

DeviceNet

Operation Manual, First Edition

**ACON
PCON
SCON-CA**

IAI America, Inc.

Please Read Before Use

Thank you for purchasing our product.

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

Before using the product, be sure to read this manual and fully understand the contents explained herein to ensure safe use of the product.

The CD/DVD that comes with the product contains operation manuals for IAI products.

When using the product, refer to the necessary portions of the applicable operation manual by printing them out or displaying them on a PC.

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

[Important]

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



Caution: The following functions are described in the separate operation manual.

	Title of operation manual/Overview	Control number
1	DeviceNet Operation Manual Refer to this operation manual if you are using an XSEL, TT, ASEL, PSEL, SSEL, SCON-C, RCS-C E-Con controller(s).	ME0124

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Safety Guide

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

Safety Precautions for Our Products

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

No.	Operation Description	Description
1	Model Selection	<ul style="list-style-type: none">• This product has not been planned and designed for the application where high level of safety is required, so the guarantee of the protection of human life is impossible. Accordingly, do not use it in any of the following applications.<ol style="list-style-type: none">1) Medical equipment used to maintain, control or otherwise affect human life or physical health.2) Mechanisms and machinery designed for the purpose of moving or transporting people (For vehicle, railway facility or air navigation facility)3) Important safety parts of machinery (Safety device, etc.)• Do not use it in any of the following environments.<ol style="list-style-type: none">1) Location where there is any inflammable gas, inflammable object or explosive2) Place with potential exposure to radiation3) Location with the ambient temperature or relative humidity exceeding the specification range4) Location where radiant heat is added from direct sunlight or other large heat source5) Location where condensation occurs due to abrupt temperature changes6) Location where there is any corrosive gas (sulfuric acid or hydrochloric acid)7) Location exposed to significant amount of dust, salt or iron powder8) Location subject to direct vibration or impact• Do not use the product outside the specifications. Failure to do so may considerably shorten

No.	Operation Description	Description
2	Transportation	<ul style="list-style-type: none"> When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. Consider well so that it is not bumped against anything or dropped during the transportation. Transport it using an appropriate transportation measure. Do not step or sit on the package. Do not put any heavy thing that can deform the package, on it. When using a crane capable of 1t or more of weight, have an operator who has qualifications for crane operation and sling work. When using a crane or equivalent equipments, make sure not to hang a load that weighs more than the equipment's capability limit. Use a hook that is suitable for the load. Consider the safety factor of the hook in such factors as shear strength. Do not get on the load that is hung on a crane. Do not leave a load hung up with a crane. Do not stand under the load that is hung up with a crane.
3	Storage and Preservation	<ul style="list-style-type: none"> The storage and preservation environment conforms to the installation environment. However, especially give consideration to the prevention of condensation.
4	Installation and Start	<p>(1) Installation of Robot Main Body and Controller, etc.</p> <ul style="list-style-type: none"> Make sure to securely hold and fix the product (including the work part). A fall, drop or abnormal motion of the product may cause a damage or injury. Do not get on or put anything on the product. Failure to do so may cause an accidental fall, injury or damage to the product due to a drop of anything, malfunction of the product, performance degradation, or shortening of its life. When using the product in any of the places specified below, provide a sufficient shield. <ul style="list-style-type: none"> 1) Location where electric noise is generated 2) Location where high electrical or magnetic field is present 3) Location with the mains or power lines passing nearby 4) Location where the product may come in contact with water, oil or chemical droplets <p>(2) Cable Wiring</p> <ul style="list-style-type: none"> Use our company's genuine cables for connecting between the actuator and controller, and for the teaching tool. Do not scratch on the cable. Do not bend it forcibly. Do not pull it. Do not coil it around. Do not insert it. Do not put any heavy thing on it. Failure to do so may cause a fire, electric shock or malfunction due to leakage or continuity error. Perform the wiring for the product, after turning OFF the power to the unit, so that there is no wiring error. When the direct current power (+24V) is connected, take the great care of the directions of positive and negative poles. If the connection direction is not correct, it might cause a fire, product breakdown or malfunction. Connect the cable connector securely so that there is no disconnection or looseness. Failure to do so may cause a fire, electric shock or malfunction of the product. Never cut and/or reconnect the cables supplied with the product for the purpose of extending or shortening the cable length. Failure to do so may cause the product to malfunction or cause fire.





No.	Operation Description	Description
4	Installation and Start	<p>(3) Grounding</p> <ul style="list-style-type: none"> ● Make sure to perform the grounding of type D (Former Type 3) for the controller. The grounding operation should be performed to prevent an electric shock or electrostatic charge, enhance the noise-resistance ability and control the unnecessary electromagnetic radiation. <p>(4) Safety Measures</p> <ul style="list-style-type: none"> ● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● When the product is under operation or in the ready mode, take the safety measures (such as the installation of safety and protection fence) so that nobody can enter the area within the robot's movable range. When the robot under operation is touched, it may result in death or serious injury. ● Make sure to install the emergency stop circuit so that the unit can be stopped immediately in an emergency during the unit operation. ● Take the safety measure not to start up the unit only with the power turning ON. Failure to do so may start up the machine suddenly and cause an injury or damage to the product. ● Take the safety measure not to start up the machine only with the emergency stop cancellation or recovery after the power failure. Failure to do so may result in an electric shock or injury due to unexpected power input. ● When the installation or adjustment operation is to be performed, give clear warnings such as "Under Operation; Do not turn ON the power!" etc. Sudden power input may cause an electric shock or injury. ● Take the measure so that the work part is not dropped in power failure or emergency stop. ● Wear protection gloves, goggle or safety shoes, as necessary, to secure safety. ● Do not insert a finger or object in the openings in the product. Failure to do so may cause an injury, electric shock, damage to the product or fire. ● When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity.

No.	Operation Description	Description
5	Teaching	<ul style="list-style-type: none"> • When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. • Perform the teaching operation from outside the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the “Stipulations for the Operation” and make sure that all the workers acknowledge and understand them well. • When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency. • When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly. • Place a sign “Under Operation” at the position easy to see. • When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity. <p>* Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.</p>
6	Trial Operation	<ul style="list-style-type: none"> • When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. • After the teaching or programming operation, perform the check operation one step by one step and then shift to the automatic operation. • When the check operation is to be performed inside the safety protection fence, perform the check operation using the previously specified work procedure like the teaching operation. • Make sure to perform the programmed operation check at the safety speed. Failure to do so may result in an accident due to unexpected motion caused by a program error, etc. • Do not touch the terminal block or any of the various setting switches in the power ON mode. Failure to do so may result in an electric shock or malfunction.
7	Automatic Operation	<ul style="list-style-type: none"> • Before the automatic operation is started up, make sure that there is nobody inside the safety protection fence. • Before the automatic operation is started up, make sure that all the related peripheral machines are ready for the automatic operation and there is no error indication. • Make sure to perform the startup operation for the automatic operation, out of the safety protection fence. • In the case that there is any abnormal heating, smoke, offensive smell, or abnormal noise in the product, immediately stop the machine and turn OFF the power switch. Failure to do so may result in a fire or damage to the product. • When a power failure occurs, turn OFF the power switch. Failure to do so may cause an injury or damage to the product, due to a sudden motion of the product in the recovery operation from the power failure.

No.	Operation Description	Description
8	Maintenance and Inspection	<ul style="list-style-type: none"> • When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. • Perform the work out of the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the "Stipulations for the Operation" and make sure that all the workers acknowledge and understand them well. • When the work is to be performed inside the safety protection fence, basically turn OFF the power switch. • When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency. • When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly. • Place a sign "Under Operation" at the position easy to see. • For the grease for the guide or ball screw, use appropriate grease according to the Operation Manual for each model. • Do not perform the dielectric strength test. Failure to do so may result in a damage to the product. • When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity. <p>* Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.</p>
9	Modification and Dismantle	<ul style="list-style-type: none"> • Do not modify, disassemble, assemble or use of maintenance parts not specified based at your own discretion.
10	Disposal	<ul style="list-style-type: none"> • When the product becomes no longer usable or necessary, dispose of it properly as an industrial waste. • Do not put the product in a fire when disposing of it. The product may burst or generate toxic gases.

Alert Indication

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

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

1. Overview

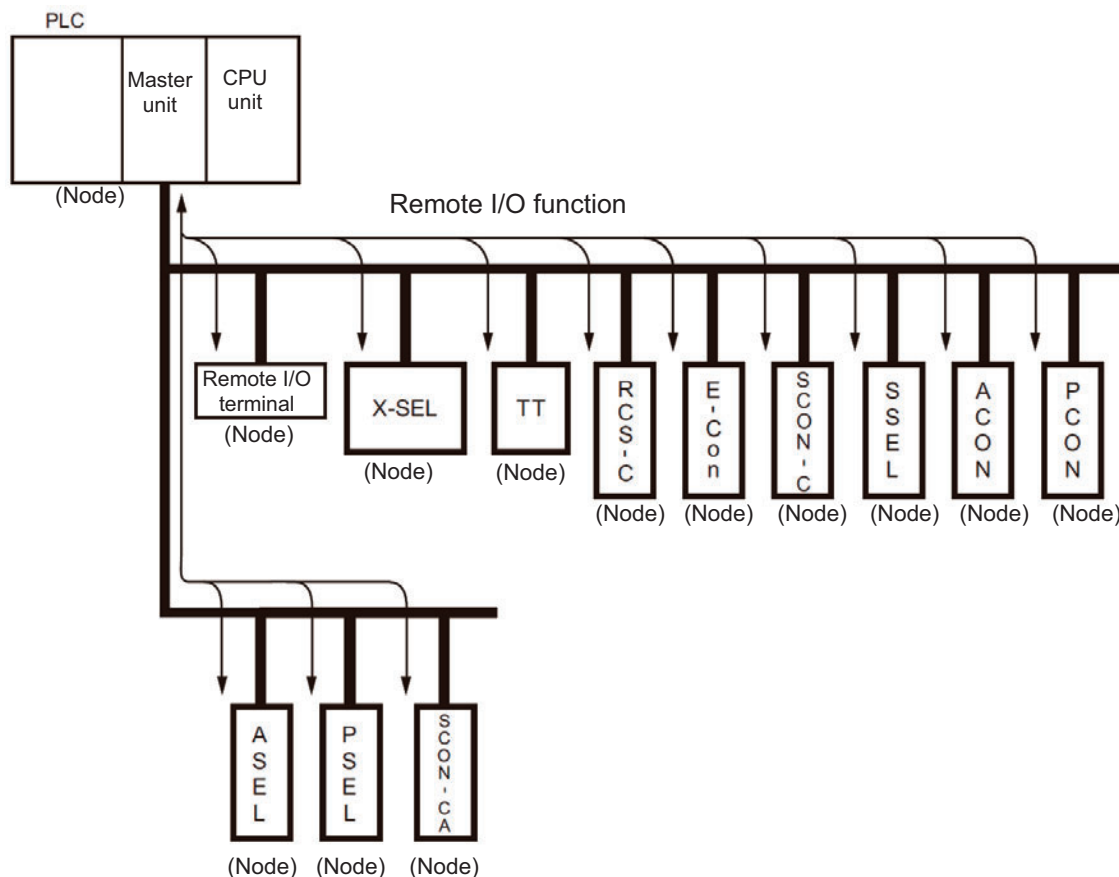
The open field network DeviceNet is a multi-bit, multi-vendor network for communication of both control and data signals of the machine/line control level.

A wire-saving system can be built by connecting IAI's X-SEL, TT, RCS-C, E-Con, SCON-C, ASEL, PSEL, SSEL, SCON-C, ACON, PCON and SCON-CA controllers (hereinafter collectively and individually referred to as "Each Controller") to a DeviceNet network.

Each controller is treated as a slave station in DeviceNet and can be used to exchange I/O data. This Operation Manual covers the ACON, PCON and SCON-CA series.

- * For details on DeviceNet, refer to the operation manual for the programmable controller (hereinafter referred to as "PLC") in which the master unit is installed.
This operation manual should be used in conjunction with the operation manual for each controller.
You should also assume that any usage not specifically permitted in this operation manual is prohibited.

System configuration example



2. ACON, PCON

2.1 Operation Modes and Functions

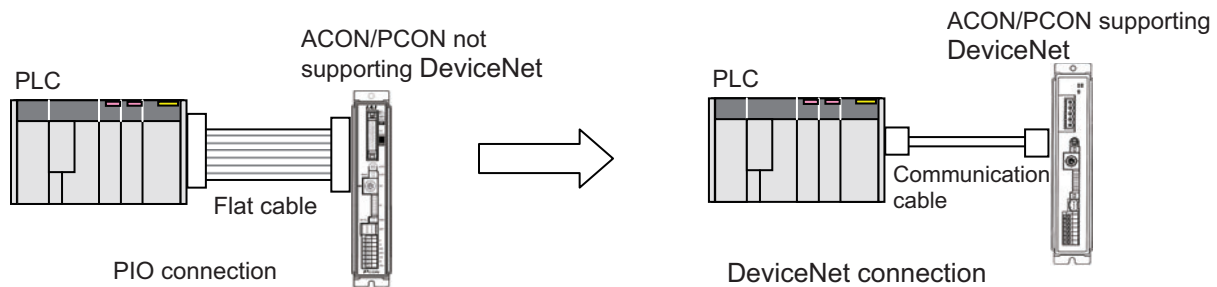
ACON and PCON controllers supporting DeviceNet can be operated in a desired operation mode selected from the following five modes.

Operation Modes and Key Functions

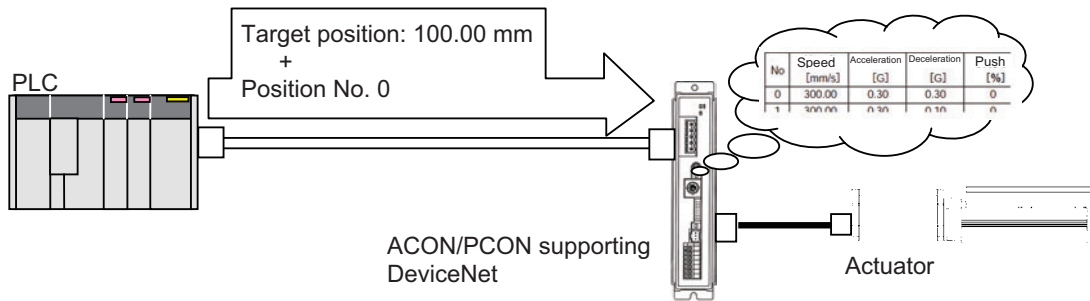
Key function	Remote I/O mode	Position/simple direct mode	Half direct mode	Full direct mode	Remote I/O mode 2
Number of occupied bytes	1CH	4CH	8CH	16CH	CH
Operation by position data specification	x	○ (*1)	○	○	x
Direct speed/acceleration specification	x	x	○	○	x
Push-motion operation	○	○	○	○	○
Current position read	x	○	○	○	○
Current speed read	x	x	○	○	x
Operation by position number specification	○	○	x	x	○
Completed position number read	○	○	x	x	○
Maximum position table size	512	768	Not used	Not used	512

(*1) The actuator is operated by specifying all position data, other than positions, using position numbers.

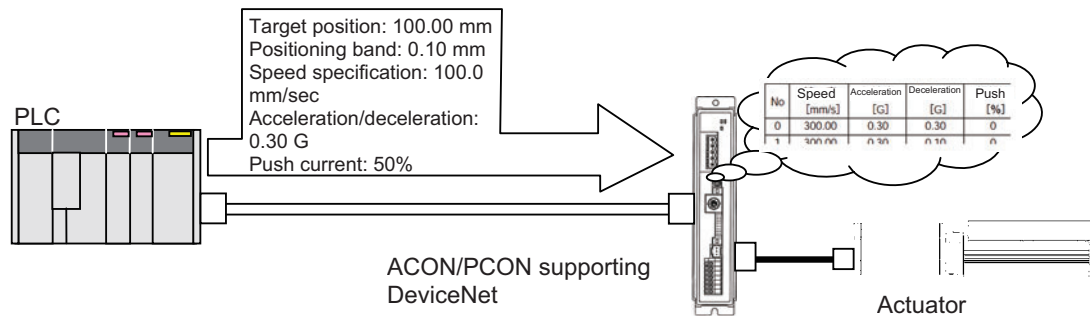
[1] Remote I/O mode: In this mode, the actuator is operated by PIOs (24-V I/Os) via DeviceNet communication.
Number of occupied bytes: 1CH



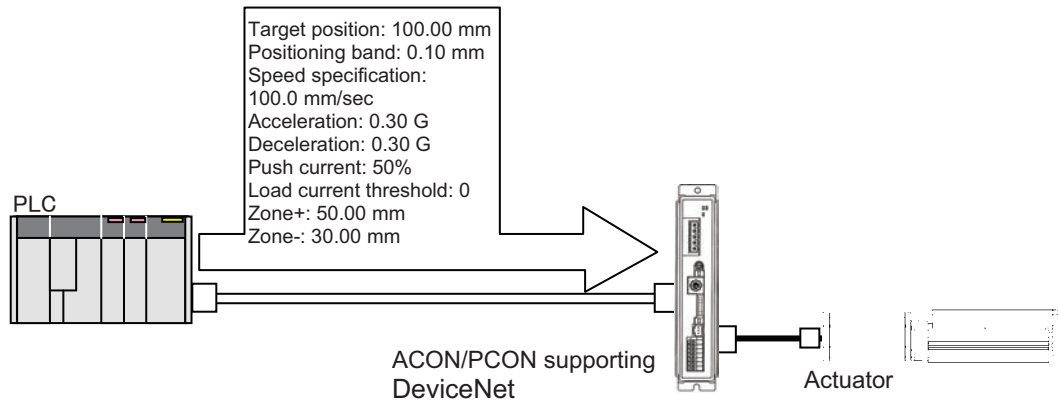
- [2] Position/simple direct mode: In this mode, the actuator is operated by specifying position numbers. You can select whether to specify the target position directly as a value, or use a value registered in the position data table, by switching a control signal. For the speed, acceleration/deceleration, positioning band, etc., values preregistered in the position data table are used. Up to 768 position data points can be set.
Number of occupied bytes: 4CH



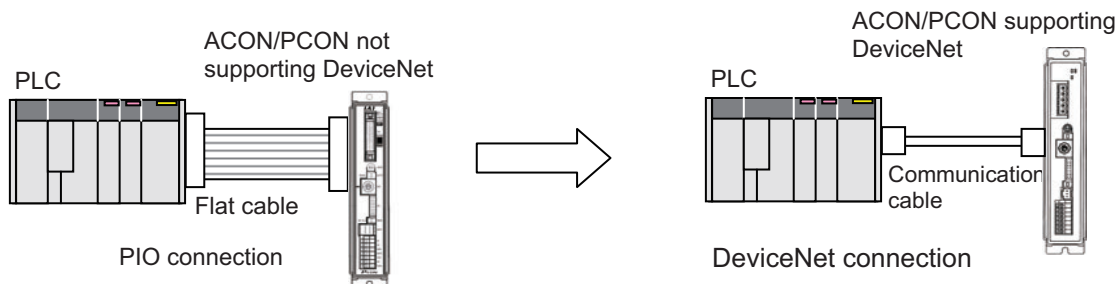
- [3] Half direct mode: In this mode, the actuator is operated by specifying the speed, acceleration/deceleration and push current, in addition to the target position, directly as values.
Number of occupied bytes: 8CH



- [4] Full direct mode: In this mode, the actuator is operated by specifying all values relating to position control (target position, speed, acceleration/deceleration, etc.) directly as values.
Number of occupied bytes: 16CH



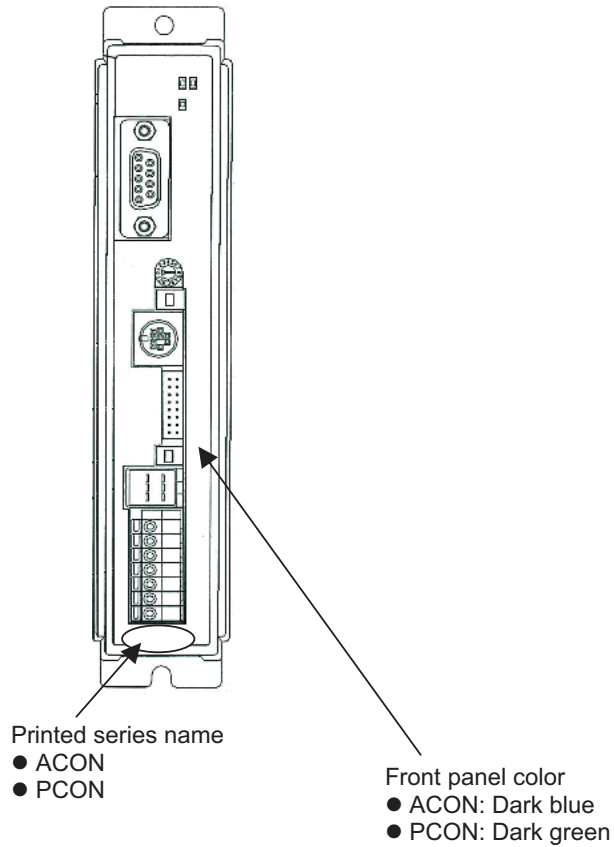
- [5] Remote I/O mode 2: In this mode, the actuator is operated by PIOs (24-V I/Os) via DeviceNet communication.
The current-position and command-current read functions are available in addition to the functions provided in mode [1].
Number of occupied bytes: 6CH



2.2 Model Numbers

The model numbers of ACON and PCON controller supporting DeviceNet are indicated as follows, respectively:

- ACON-C/CG-□-DV-□
- PCON-C/CG-□-DV-□



2.3 Interface Specifications

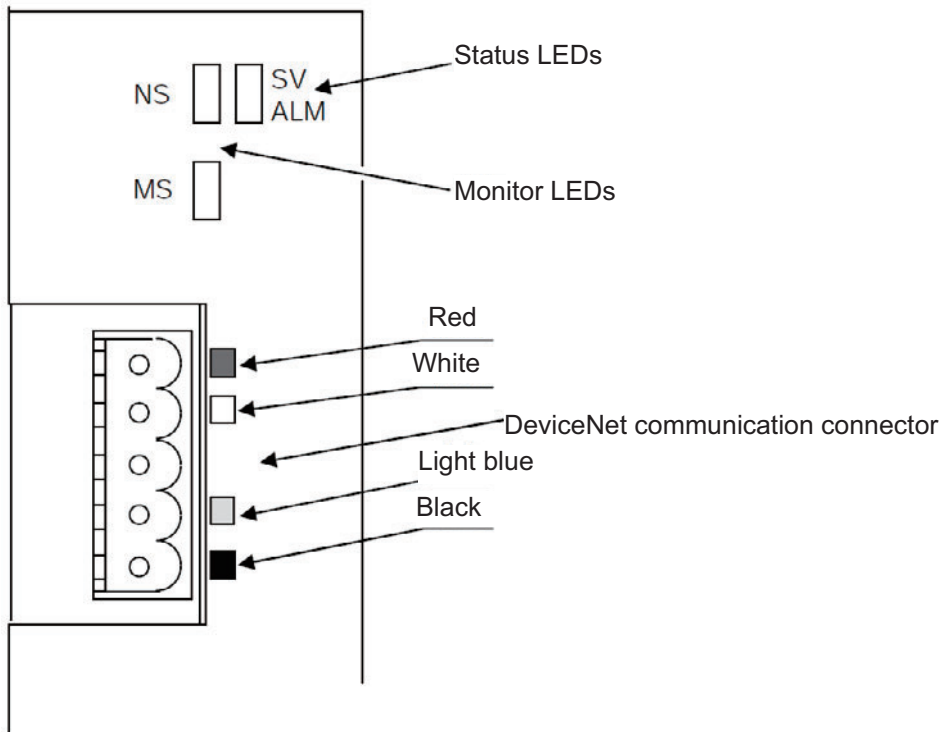
Item	Specification			
Communication protocol	DeviceNet 2.0			
	Group 2 only server			
	Network-powered isolation node			
Communication specification	Master-slave connection		Bit strobe	
			Polling	
Baud rate	Automatically set to the same value as the band rate set in the master			
Communication cable length	Baud rate	Maximum network length	Maximum branch line length	Total branch line length
	500 kbps	100 m	6 m	39 m
	250 kbps	250 m		78 m
	125 kbps	500 m		156 m
	Note) When a large-size DeviceNet cable is used.			
Communication power supply	24 VDC (supplied from DeviceNet)			
Consumption current of communication power supply	60 mA			
Number of occupied nodes	1 node			
Connector	MSTBA2.5/5-G-5.08AU M (*1) by Phoenix Contact			

(*1) The cable-end connector is a standard accessory.
SMSTB2.5/5-ST-5.08AU by Phoenix Contact

2.4 DeviceNet Interface

2.4.1 Name of Each Part

The name of each part relating to DeviceNet is shown.



2.4.2 Monitor LED Indicators

The two LEDs, MS and NS, provided on the front panel of the controller are used to check the node (controller) condition and network condition.

The LEDs illuminate in two colors (orange and green), and you can monitor the conditions listed in the table below based on the illumination status and color of each LED.

MS (Module Status) LED: Condition of the node (controller)

NS (Network Status) LED: Condition of the network

LED	Color	Illumination status	Description (meaning)
MS	Green	Steady light	The board is operating normally.
		Blinking	A hardware error occurred. The error may be reset by reconnecting the power.
	Orange	Steady light	A hardware error occurred. The board must be replaced.
		Blinking	A user setting error, configuration error or other minor error is present. These errors can be reset by setting the applicable item again, etc.
	-	Off	DeviceNet is initializing or the power is not supplied.
NS	Green	Steady light	Network connection has been established and the board is communicating normally.
		Blinking	The board is online, but network connection is not yet established. Communication is stopped. (The network is normal.)
	Orange	Steady light	Node address duplication or bus-off state was detected. Communication is not possible.
		Blinking	A communication error occurred (communication time-out occurred).
	-	Off	The board is not online. DeviceNet power is not supplied.

Self test is performed when the power is turned on.

During the test, the monitor LEDs cycle in the following sequence:

- [1] NS turns off.
- [2] MS illuminates in steady green (approx. 0.25 second).
- [3] MS illuminates in steady orange (approx. 0.25 second).
- [4] MS illuminates in steady green.
- [5] NS illuminates in steady green (approx. 0.25 second).
- [6] NS illuminates in steady orange (approx. 0.25 second).
- [7] NS turns off.

When the self test is finished and the board starts communicating normally, both the MS and NS LEDs change to steady green.

2.5 Selecting (Setting) the Operation Mode

The operation mode is set using a parameter.

Set the mode selector switch on the front panel of the controller to the MANU position, and set parameter No. 84, "FMODE: Fieldbus operation mode" using the RC PC software (V6.00.05.00 or later). (Refer to 2.10, "DeviceNet Parameters.")

Set value	Operation mode	Number of occupied stations
0 (Factory setting)	Remote I/O mode	1CH
1	Position/simple direct mode	4CH
2	Half direct mode	8CH
3	Full direct mode	16CH
4	Remote I/O mode 2	6CH

* If any other value is entered, an excessive input error will occur.

2.6 Setting the Node Address

The node address is set using a parameter.

Set parameter No. 85, "NADDR: Fieldbus node address" using the RC PC software. (Refer to 2.10, "DeviceNet Parameters.")

Allowable setting range: 0 to 63 (The parameter has been set to "63" at the factory.)

(Note) Exercise caution to avoid node address duplication.

The nodes (controllers) are assigned in the order of their node address in the remote I/O address areas of the PLC. (This is when the mount assignment mode is selected. A different rule applies when a configurator is used.)

For details, refer to the operation manuals of the master unit and PLC installed in the master unit.

(Note) The baud rate is automatically set to the same value as the baud rate set in the master. Accordingly, you need not set the baud rate.

(Note) After you have set the parameter, reconnect the controller power and return the mode selector switch on the front panel of the controller to the AUTO position. If the switch remains in the MANU position, operation by the PLC cannot be performed.

2.7 Communicating with the Master Station

2.7.1 Operation Modes and Corresponding PLC I/O Areas

The channel assignments in each mode are shown below.

- PLC output → SCON-CA input (* n indicates the node address of each axis.)

PLC output area (channel)	ACON,PCON DI and input data register							
	Remote I/O mode	Position/simple direct mode	Half direct mode	Full direct mode	Remote I/O mode 2			
	Number of occupied channels: 1CH	Number of occupied channels: 4CH	Number of occupied channels: 8CH	Number of occupied channels: 16CH	Number of occupied channels: 6CH			
n	Port number 0 to 15	Target position	Target position	Target position	Port number 0 to 15			
n+1		Specified position number	Positioning band	Positioning band	Occupied area			
n+2						Control signal	Speed	Speed specification
n+3								
n+4								
n+5		Acceleration/ deceleration	Zone boundary+					
n+6		Push-motion current-limiting value						
n+7		Control signal						
n+8			Zone boundary-	Occupied area				
n+9					Acceleration			
n+10					Deceleration			
n+11					Push-motion current-limiting value			
n+12					ACON	Load current threshold		
					PCON	Load current threshold		
n+13					Control signal 1			
n+14					Control signal 2			
n+15								

(Note) The areas denoted by “occupied area” are occupied according to the operation mode setting. These areas cannot be used for any other purpose. Also exercise caution to avoid node address duplication.

- ACON or PCON output → PLC input side (* n indicates the node address of each axis.)

PLC input area (channel)	ACON or PCON DO and output data register				
	Remote I/O mode	Position/simple direct mode	Half direct mode	Full direct mode	Remote I/O mode 2
	Number of occupied channels: 1CH	Number of occupied channels: 4CH	Number of occupied channels: 8CH	Number of occupied channels: 16CH	Number of occupied channels: 6CH
n	Port number 0 to 15	Current position	Current position	Current position	Port number 0 to 15
n+1		Completed position number (simple alarm ID) Status signal	Command current	Command current	Occupied area
n+2					Current position
n+3					
n+4		Current speed	Command current	Command current	Current position
n+5					
n+6					
n+7					
n+8		Alarm code Status signal	Alarm code	Alarm code	Command current
n+9					
n+10					
n+11					
n+12		Occupied area	Occupied area	Occupied area	Occupied area
n+13					
n+14					
n+15					
				Status signal	

(Note) The areas denoted by “occupied area” are occupied according to the operation mode setting. These areas cannot be used for any other purpose. Also exercise caution to avoid node address duplication.

2.7.2 Remote I/O Mode (Number of Occupied Channel: 1)

In this mode, the actuator is operated by specifying position numbers, just like you do when PIOs (24-V I/Os) are used.

Set position data using the RC PC software or teaching pendant.

The number of available positions is determined by the setting of parameter No. 25, "PIO pattern."

The I/O specifications for each PIO pattern are shown below. (For details, refer to the operation manual for the controller.)

Value set in parameter No. 25	Operation mode	I/O specification
0	Positioning mode	64 positioning points and two zone output points are available.
1	Teaching mode	64 positioning points and one zone output point is available. Positioning operation and jog operation are supported. The current position can be written to a specified position.
2	256-point mode	256 positioning points and one zone output point is available.
3	512-point mode	512 positioning points are available. There are no zone outputs.
4	Solenoid mode 1	7 positioning points and two zone output points are available. A direct operation command can be issued for each position number. A position complete signal is output for each position number.
5	Solenoid mode 2	3 positioning points and two zone output points are available. The actuator is operated by specifying forward, backward and intermediate position commands. A position complete signal is output separately for the front end, rear end and intermediate position.

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

ROBO Cylinder function	PIO patterns					
	0: Positioning mode	1: Teaching mode	2: 256-point mode	3: 512-point mode	4: Solenoid mode 1	5: Solenoid mode 2
Home-return operation	○	○	○	○	○	X
Positioning operation	○	○	○	○	○	○
Speed and acceleration/deceleration setting	○	○	○	○	○	○
Pitch feed (inching)	○	○	○	○	○	○
Push-motion operation	○	○	○	○	○	X
Speed change during movement	○	○	○	○	○	○
Operation at different acceleration and deceleration	○	○	○	○	○	○
Pause	○	○	○	○	○	○ (*1)
Zone signal output	○	○	○	X	○	○
PIO pattern selection (set by a parameter)	○	○	○	○	○	○

○: Supported / X: Not supported

(*1) This function is supported when parameter No. 27, "Move command type" is set to "0."
The actuator can be paused by turning the move command OFF.

(1) PLC channel configuration (* n indicates the node address of each axis.)

Parameter No. 84	ACON or PCON DI (port number)	PLC output channel	ACON or PCON DO (port number)	PLC input channel
0	0~15	n+0	0~15	n+0

(Note) Exercise caution to avoid node address duplication.

(2) I/O signal assignments for each axis

The I/O signals of each axis consist of one input word (channel) and one output word (channel) in the I/O areas.

- Each channel is controlled by ON/OFF bit signals.

PLC output

Channel (* n indicates the node address of each axis.)

	1 word (channel) = 16 bits															
n+0	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Controller input port number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

PLC input

Channel (* n indicates the node address of each axis.)

	1 word (channel) = 16 bits															
n+0	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Controller output port number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

(3) I/O signal assignments

The signals assigned to the controller's I/O ports vary depending on the setting of parameter No. 25.
(For details, refer to the operation manual for the controller.)

ACON

		Setting of Parameter No. 25					
		Positioning mode		Teaching mode		256-point mode	
		0		1		2	
Category	Port No.	Signal name	Symbol	Signal name	Symbol	Signal name	Symbol
PLC output → ACON input	0	Command position number	PC1	Command position number	PC1	Command position number	PC1
	1		PC2		PC2		PC2
	2		PC4		PC4		PC4
	3		PC8		PC8		PC8
	4		PC16		PC16		PC16
	5		PC32		PC32		PC32
	6	Not available.	-	Teaching mode command	MODE	Not available.	PC64
	7		-	Jog/inch switching	JISL		PC128
	8		-	+Jog	JOG+		-
	9	Forced brake release	BKRL	-Jog	JOG-	Forced brake release	BKRL
	10	Operation mode	RMOD	Operation mode	RMOD	Operation mode	RMOD
	11	Home return	HOME	Home return	HOME	Home return	HOME
	12	Pause	*STP	Pause	*STP	Pause	*STP
	13	Positioning start	CSTR	Positioning start/position-data read command	CSTR/PWRT	Positioning start	CSTR
	14	Reset	RES	Reset	RES	Reset	RES
	15	Servo ON command	SON	Servo ON command	SON	Servo ON command	SON
ACON output → PLC input	0	Completed position number	PM1	Completed position number	PM1	Completed position number	PM1
	1		PM2		PM2		PM2
	2		PM4		PM4		PM4
	3		PM8		PM8		PM8
	4		PM16		PM16		PM16
	5		PM32		PM32		PM32
	6	Moving signal	MOVE	Moving signal	MOVE	Not available.	PM64
	7	Zone 1	ZONE1	Teaching mode signal	MODES		PM128
	8	Position zone	PZONE	Position zone	PZONE		PZONE
	9	Operation mode status	RMDS	Operation mode status	RMDS	Operation mode status	RMDS
	10	Home return complete	HEND	Home return complete	HEND	Home return complete	HEND
	11	Position complete signal	PEND	Position complete signal/position-data read complete	PEND/WEND	Position complete signal	PEND
	12	Ready	SV	Ready	SV	Ready	SV
	13	Emergency stop	*EMGS	Emergency stop	*EMGS	Emergency stop	*EMGS
	14	Alarm	*ALM	Alarm	*ALM	Alarm	*ALM
	15	Not available.	-	Not available.	-	Not available.	-

The signals indicated by * are ON in a normal state.

The signals denoted by "Not available" are not controlled (their ON/OFF status is indeterminable).

ACON

		Setting of Parameter No. 25					
		512-point mode		Solenoid mode 1		Solenoid mode 2	
		3		4		5	
Category	Port No.	Signal name	Symbol	Signal name	Symbol	Signal name	Symbol
PLC output → ACON input	0	Command position number	PC1	Start position 0	ST0	Start position 0	ST0
	1		PC2	Start position 1	ST1	Start position 1	ST1
	2		PC4	Start position 2	ST2	Start position 2	ST2
	3		PC8	Start position 3	ST3	Not available.	-
	4		PC16	Start position 4	ST4		-
	5		PC32	Start position 5	ST5		-
	6		PC64	Start position 6	ST6		-
	7		PC128	Not available.	-		-
	8		PC256		-		-
	9	Forced brake release	BKRL	Forced brake release	BKRT	Forced brake release	BKRL
	10	Operation mode	RMOD	Operation mode	RMOD	Operation mode	RMOD
	11	Home return	HOME	Home return	HOME	Not available.	-
	12	Pause	*STP	Pause	*STP		-
	13	Positioning start	CSTR	Not available.	-		-
	14	Reset	RES	Reset	RES	Reset	RES
	15	Servo ON command	SON	Servo ON command	SON	Servo ON command	SON
ACON output → PLC input	0	Completed position number	PM1	Position 0 complete	PE0	Rear end move command 0	LS0
	1		PM2	Position 1 complete	PE1	Rear end move command 1	LS1
	2		PM4	Position 2 complete	PE2	Rear end move command 2	LS2
	3		PM8	Position 3 complete	PE3	Not available.	-
	4		PM16	Position 4 complete	PE4		-
	5		PM32	Position 5 complete	PE5		-
	6		PM64	Position 6 complete	PE6		-
	7		PM128	Zone 1	ZONE1	Zone 1	ZONE1
	8		PM256	Position zone	PZONE	Position zone	PZONE
	9	Operation mode status	RMDS	Operation mode status	RMDS	Operation mode status	RMDS
	10	Home return complete	HEND	Home return complete	HEND	Home return complete	HEND
	11	Position complete signal	PEND	Position complete signal	PEND	Position complete signal	-
	12	Ready	SV	Ready	SV	Ready	SV
	13	Emergency stop	*EMGS	Emergency stop	*EMGS	Emergency stop	*EMGS
	14	Alarm	*ALM	Alarm	*ALM	Alarm	*ALM
	15	Not available.	-	Not available.	-	Not available.	-

The signals indicated by * are ON in a normal state.

The signals denoted by "Not available" are not controlled (their ON/OFF status is indeterminable).

PCON

		Setting of Parameter No. 25					
		Positioning mode (standard)		Teaching mode (teaching type)		256-point mode (256-point type)	
		0		1		2	
Category	Port No.	Signal name	Symbol	Signal name	Symbol	Signal name	Symbol
PLC output → PCON input	0	Command position number	PC1	Command position number	PC1	Command position number	PC1
	1		PC2		PC2		PC2
	2		PC4		PC4		PC4
	3		PC8		PC8		PC8
	4		PC16		PC16		PC16
	5		PC32		PC32		PC32
	6	Not available.	-	Teaching mode command (operation mode)	MODE	Not available.	PC64
	7		-	Jog/inch switching	JISL		PC128
	8		-	+Jog	JOG+		-
	9	Forced brake release	BKRL	-Jog	JOG-	Forced brake release	BKRL
	10	Operation mode	RMOD	Operation mode	RMOD	Operation mode	RMOD
	11	Home return	HOME	Home return	HOME	Home return	HOME
	12	Pause	*STP	Pause	*STP	Pause	*STP
	13	Positioning start	CSTR	Positioning start/position-data read command	CSTR/PWRT	Positioning start	CSTR
	14	Reset	RES	Reset	RES	Reset	RES
	15	Servo ON command	SON	Servo ON command	SON	Servo ON command	SON
PCON output → PLC input	0	Completed position number	PM1	Completed position number	PM1	Completed position number	PM1
	1		PM2		PM2		PM2
	2		PM4		PM4		PM4
	3		PM8		PM8		PM8
	4		PM16		PM16		PM16
	5		PM32		PM32		PM32
	6	Moving signal	MOVE	Moving signal	MOVE	Completed position number	PM64
	7	Zone 1	ZONE1	Teaching mode signal	MODES		PM128
	8	Position zone	PZONE	Position zone	PZONE		PZONE
	9	Operation mode status	RMDS	Operation mode status	RMDS	Operation mode status	RMDS
	10	Home return complete	HEND	Home return complete	HEND	Home return complete	HEND
	11	Position complete signal	PEND	Position complete signal/position-data read complete	PEND/WEND	Position complete signal	PEND
	12	Ready	SV	Ready	SV	Ready	SV
	13	Emergency stop	*EMGS	Emergency stop	*EMGS	Emergency stop	*EMGS
	14	Alarm	*ALM	Alarm	*ALM	Alarm	*ALM
	15	Load output judgment/torque level	LOAD/TRQS	Not available.	-	Load output judgment/torque level	LOAD/TRQS

The signals indicated by * are ON in a normal state.

The signals denoted by "Not available" are not controlled (their ON/OFF status is indeterminable).

PCON

		Setting of Parameter No. 25					
		512-point mode		Solenoid mode 1		Solenoid mode 2	
		3		4		5	
Category	Port No.	Signal name	Symbol	Signal name	Symbol	Signal name	Symbol
PLC output → PCON input	0	Command position number	PC1	Start position 0	ST0	Start position 0	ST0
	1		PC2	Start position 1	ST1	Start position 1	ST1
	2		PC4	Start position 2	ST2	Start position 2	ST2
	3		PC8	Start position 3	ST3	Not available.	-
	4		PC16	Start position 4	ST4		-
	5		PC32	Start position 5	ST5		-
	6		PC64	Start position 6	ST6		-
	7		PC128	Not available.	-		-
	8		PC256		-		-
	9	Forced brake release	BKRL	Forced brake release	BKRT	Forced brake release	BKRL
	10	Operation mode	RMOD	Operation mode	RMOD	Operation mode	RMOD
	11	Home return	HOME	Home return	HOME	Not available.	-
	12	Pause	*STP	Pause	*STP		-
	13	Positioning start	CSTR	Not available.	-		-
	14	Reset	RES	Reset	RES	Reset	RES
	15	Servo ON command	SON	Servo ON command	SON	Servo ON command	SON
PCON output → PLC input	0	Completed position number	PM1	Position 0 complete	PE0	Rear end move command 0	LS0
	1		PM2	Position 1 complete	PE1	Rear end move command 1	LS1
	2		PM4	Position 2 complete	PE2	Rear end move command 2	LS2
	3		PM8	Position 3 complete	PE3	Not available.	-
	4		PM16	Position 4 complete	PE4		-
	5		PM32	Position 5 complete	PE5		-
	6		PM64	Position 6 complete	PE6		-
	7		PM128	Zone 1	ZONE1	Zone 1	ZONE1
	8		PM256	Position zone	PZONE	Position zone	PZONE
	9	Operation mode status	RMDS	Operation mode status	RMDS	Operation mode status	RMDS
	10	Home return complete	HEND	Home return complete	HEND	Home return complete	HEND
	11	Position complete signal	PEND	Position complete signal	PEND	Position complete signal	-
	12	Ready	SV	Ready	SV	Ready	SV
	13	Emergency stop	*EMGS	Emergency stop	*EMGS	Emergency stop	*EMGS
	14	Alarm	*ALM	Alarm	*ALM	Alarm	*ALM
	15	Load output judgment/torque level	LOAD/TRQS	Load output judgment/torque level	LOAD/TRQS	Not available.	-

The signals indicated by * are ON in a normal state.

The signals denoted by "Not available" are not controlled (their ON/OFF status is indeterminable).

2.7.3 Position/Simple Direct Mode (Number of Occupied Channels: 4)

In this mode, the actuator is operated by specifying position numbers. You can switch the control signal (PMOD) to select whether to specify the target position directly and numerically or by using a value registered in the position data table.

Data other than the target position, such as speed, acceleration/deceleration and positioning band, are set using values in the position table stored in the controller. Set position data by referring to the operation manual for the controller.

Up to 768 sets of positioning data can be specified.

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

ROBO Cylinder function	○: Direct control △: Indirect control X: Invalid	Remarks
Home-return operation	○	
Positioning operation	○	
Speed and acceleration/deceleration setting	△	These items must be set in the position data table.
Pitch feed (inching)	△	
Push-motion operation	△	
Speed change during movement	△	
Operation at different acceleration and deceleration	△	
Pause	○	
Zone signal output	△	Zones are set using parameters.
PIO pattern selection	X	

(1) PLC channel configuration (* n indicates the node address of each axis.)

Parameter No. 84	ACON or PCON input register	PLC output channel	ACON or PCON output register	PLC input channel
1	Target position	n+0	Current position	n+0
		n+1		n+1
	Specified position number	n+2	Completed position number (simple alarm code)	n+2
	Control signal	n+3	Status signal	n+3

(Note) Exercise caution to avoid node address duplication.

(2) I/O signal assignments for each axis

The I/O signals of each axis consist of four input words (channels) and four output words (channels) in the I/O areas.

- Control signals and status signals are ON/OFF bit signals.
- The target position and current position are 2-word (32-bit) binary data. Although values from -999999 to +999999 (unit: 0.01 mm) can be handled by the PLC for these items, set position data within the soft stroke range (0 to the effective stroke) of the applicable actuator.
- The specified position number and completed position number are 1-word (16-bit) binary data. Although values from 0 to 767 can be handled by the PLC for these items, use the PC software or teaching pendant to specify position numbers associated with predefined operating conditions.

PLC output

Channel (* n indicates the node address of each axis.)

		1 word (channel) = 16 bits															
n+0		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (lower word)																	

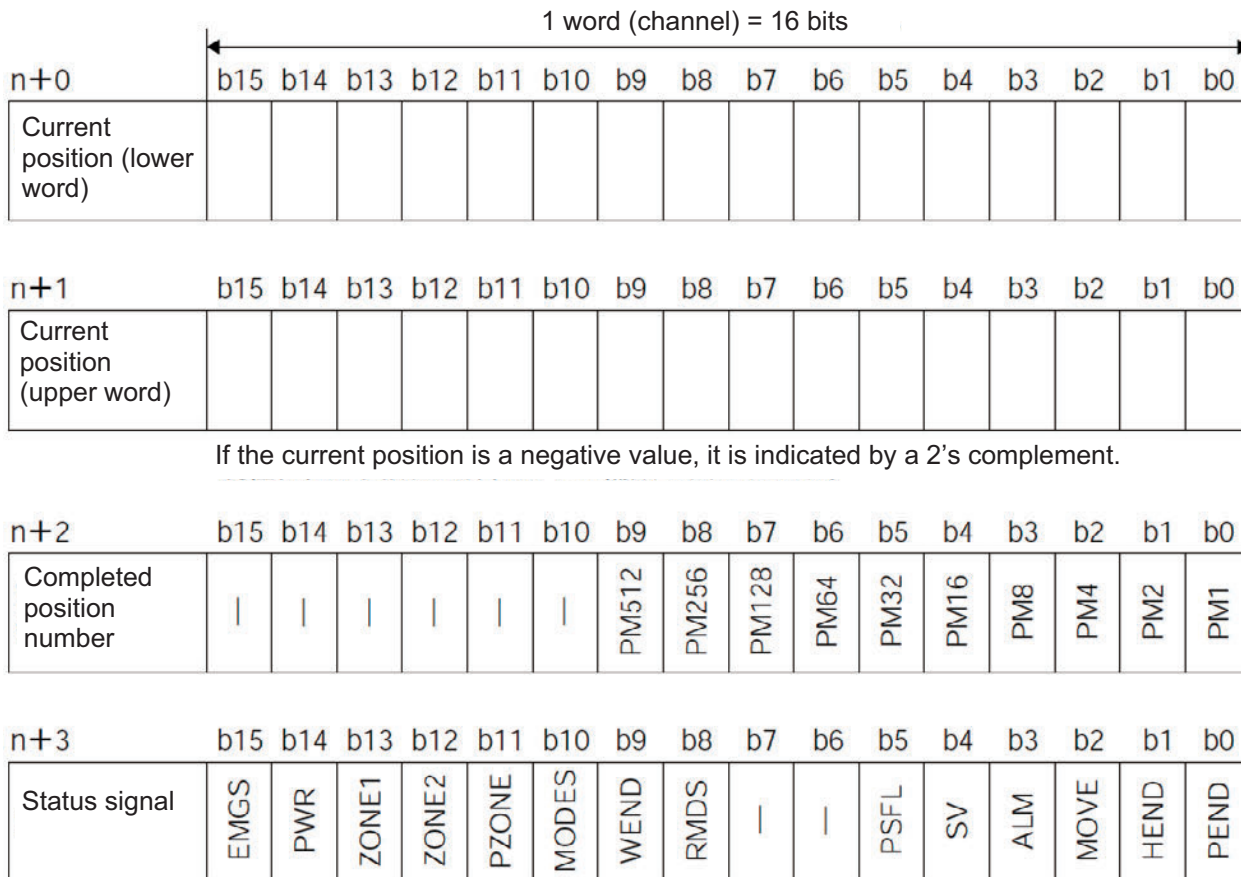
n+1		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (upper word)																	

If the target position is a negative value, it is indicated by a 2's complement.

n+2		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Specified position number								PC512	PC256	PC128	PC64	PC32	PC16	PC8	PC4	PC2	PC1

n+3		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Control signal		BKRL	RMOD	—	—	PMOD	MODE	PWRT	JOG+	JOG-	JVEL	JISL	SON	RES	STP	HOME	CSTR

PLC input
Channel (* n indicates the node address of each axis.)



(3) I/O signal assignments

(* In the table, ON indicates that the applicable bit is "1," while OFF indicates that the bit is "0.")

Signal type		Bits	Symbol	Description	Details
PLC output	Target position	32-bit data	-	32-bit signed integer. Specify the target position as a position in the absolute coordinate system. The setting unit is 0.01 mm and the allowable specification range is -999999 to 999999. (Example) To set “+25.40 mm,” specify “2540.” If the entered value exceeds the range between the soft limits (0.2 mm inside the limits) set by the parameters, the movement will be limited to the soft limit (0.2 mm inside the limit). * If target positions are entered as hexadecimals, enter negative values using 2’s complements.	2.9 (1)
	Specified position number	16-bit data	PC1 ~ PC512	16-bit integer. To operate the actuator, you must set position data associated with predefined operating conditions using the PC software or teaching pendant. Use one of these registers to specify the position number for which the desired data has been input. The allowable specification range is 0 to 767. If the specified value is outside the above range or corresponds to a position not yet set, an alarm will occur when the start signal is turned ON.	2.9 (1)
	Control signal	b15	BKRL	Forced brake release: The brake is released when this signal turns ON.	2.7.7 (18)
		b14	RMOD	Operation mode: The AUTO mode is selected when this signal is OFF, and the MANU mode is selected when the signal is ON.	2.7.7 (19)
		b13	-	Not available.	-
		b12			
		b11	PMOD	Position/simple-direct switching: The position mode is selected when this signal is OFF, and the simple direct mode is selected when the signal is ON.	2.7.7 (20)
		b10	MODE	Teaching mode command: The normal mode is selected when this signal is OFF, and the teaching mode is selected when the signal is ON.	2.7.7 (16)
		b9	PWRT	Position-data read command: Position data is read when this signal is ON.	2.7.7 (17)
		b8	JOG+	+Jog: The actuator moves in the direction opposite home when this signal is ON.	2.7.7 (13)
		b7	JOG-	-Jog: The actuator moves in the direction of home when this signal is ON.	2.7.7 (13)
		b6	JVEL	Jog-speed/inch-distance switching: The values set in parameter No. 26, “Jog speed” and parameter No. 48, “Inch distance” are used when this signal is OFF, and the values set in parameter No. 47, “Jog speed 2” and parameter No. 49, “Inch distance 2” are used when the signal is ON.	2.7.7 (14)
		b5	JISL	Jog/inch switching: Jog operation is performed when this signal is OFF, and inch operation is performed when the signal is ON.	2.7.7 (15)
		b4	SON	Servo ON command: The servo turns ON when this signal turns ON.	2.7.7 (5)
		b3	RES	Reset: A reset is performed when this signal turns ON.	2.7.7 (4)
		b2	STP	Pause: A pause command is issued when this signal turns ON.	2.7.7 (11)
		b1	HOME	Home return: A home-return command is issued when this signal turns ON.	2.7.7 (6)
		b0	CSTR	Positioning start: A move command is issued when this signal turns ON.	2.7.7 (7)

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

Signal type	Bits	Symbol	Description	Details
PLC input	Current position	32 bits	- 32-bit signed integer indicating the current position. The setting unit is 0.01 mm. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm * If current positions are read as hexadecimal, negative values are indicated by 2's complements.	2.9 (1)
	Completed position number (simple alarm code)	16 bits	PM 1 ~ PM512 16-bit integer. When the actuator has moved to the target position and entered the positioning band, the position number corresponding to the completed position is output. “0” is output when no position movement has been performed yet or while the actuator is moving. If an alarm occurs (the status signal ALM turns ON), a corresponding simple alarm code (refer to the operation manual for the controller) will be output.	2.9 (1)
	Status signal	b15	EMGS Emergency stop: An emergency stop is actuated when this signal turns ON.	2.7.7 (2)
		b14	PWR Controller ready: This signal turns ON when the controller becomes ready.	2.7.7 (1)
		b13	ZONE2 Zone 2: This signal turns ON when the current position is inside the specified zone.	2.7.7 (12)
		b12	ZONE1 Zone 1: This signal turns ON when the current position is inside the specified zone.	2.7.7 (12)
		b11	PZONE Position zone: This signal turns ON when the current position is inside the specified position zone.	2.7.7 (12)
		b10	MODES Teaching mode signal: This signal is ON while the teaching mode is selected.	2.7.7 (16)
		b9	WEND Position data read complete: This signal turns ON when reading is complete.	2.7.7 (17)
		b8	RMDS Operation mode status: This signal is OFF when the current mode is AUTO, or ON when the current mode is MANU.	2.7.7 (19)
		b7	-	-
		b6		
		b5	PSFL Load missed in push motion: This signal turns ON when the actuator missed the load in push-motion operation.	2.7.7 (23)
		b4	SV Ready: This signal turns ON when the servo turns ON.	2.7.7 (5)
		b3	ALM Alarm: This signal turns ON when an alarm occurs.	2.7.7 (3)
		b2	MOVE Moving signal: This signal remains ON while the actuator is moving.	2.7.7 (9)
		b1	HEND Home return complete: This signal turns ON when home return is completed.	2.7.7 (6)
		b0	PEND Position complete signal: This signal turns ON when positioning is completed.	2.7.7 (10)

2.7.4 Half Direct Mode (Number of Occupied Channels: 8)

In this mode, the target position, positioning band, speed, acceleration/deceleration and push-motion current are specified directly and numerically from the PLC.

Set each value in the I/O areas. To use the zone function, set appropriate values in parameter Nos. 1, 2, 23 and 24.

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

ROBO Cylinder function	○: Direct control △: Indirect control X: Invalid	Remarks
Home-return operation	○	
Positioning operation	○	
Speed and acceleration/deceleration setting	○	
Pitch feed (inching)	○	
Push-motion operation	○	
Speed change during movement	○	
Operation at different acceleration and deceleration	X	
Pause	○	
Zone signal output	△	Parameters must be set
PIO pattern selection	X	

(1) PLC channel configuration (* n indicates the node address of each axis.)

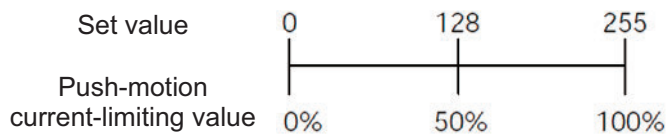
Parameter No. 84	ACON or PCON input register	PLC output channel	ACON or PCON output register	PLC input channel
2	Target position	n+0	Current position	n+0
		n+1		n+1
	Positioning band	n+2	Command current	n+2
		n+3		n+3
	Speed	n+4	Current speed	n+4
	Acceleration/ deceleration	n+5		n+5
	Push-motion current-limiting value	n+6	Alarm code	n+6
	Control signal	n+7	Status signal	n+7

(Note) Exercise caution to avoid node address duplication.

(2) I/O signal assignments for each axis

The I/O signals of each axis consist of eight input words (channels) and eight output words (channels) in the I/O areas.

- Control signals and status signals are ON/OFF bit signals.
- The target position and current position are 2-word (32-bit) binary data. Although values from -999999 to +999999 (unit: 0.01 mm) can be handled by the PLC for these items, set position data within the soft stroke range (0 to the effective stroke) of the applicable actuator.
- Specify the positioning band. The positioning band is a 2-word (32-bit) binary data. For the positioning band, the PLC can handle values from 1 to +999999 (unit: 0.01 mm).
- The specified speed is a 1-word (16-bit) binary data. For the specified speed, the PLC can handle values from 0 to +65535 (unit: 1.0 mm/sec). Take note, however, that the set value should not exceed the maximum speed supported by the applicable actuator.
- The acceleration/deceleration is a 1-word (16-bit) binary data. For the acceleration/deceleration, the PLC can handle values from 1 to 300 (unit: 0.01 G). Take note, however, that the set value should not exceed the maximum acceleration or maximum deceleration supported by the applicable actuator.
- The push-motion current-limiting value is a 1-word (16-bit) binary data. For the push-motion current-limiting value, the PLC can handle values from 0 (0%) to 255 (100%). Take note, however, that the setting should be inside the allowable specification range of push-motion current-limiting values supported by the applicable actuator (refer to the catalog or operation manual for the actuator).



- The command current is a 2-word (32-bit) binary data (unit: 1 mA).
- The current speed is a 2-word (32-bit) binary data (unit: 0.01 mm/sec).
- The alarm code is a 1-word (16-bit) binary data.

PLC output

Channel (* n indicates the node address of each axis.)

1 word (channel) = 16 bits

n+0	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (lower word)																

n+1	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (upper word)																

If the target position is a negative value, it is indicated by a 2's complement.

n+2	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Positioning band (lower word)	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1

n+3	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Positioning band (upper word)	—	—	—	—	—	—	—	—	—	—	—	—	524,288	262,144	131,072	65,536

n+4	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Speed	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1

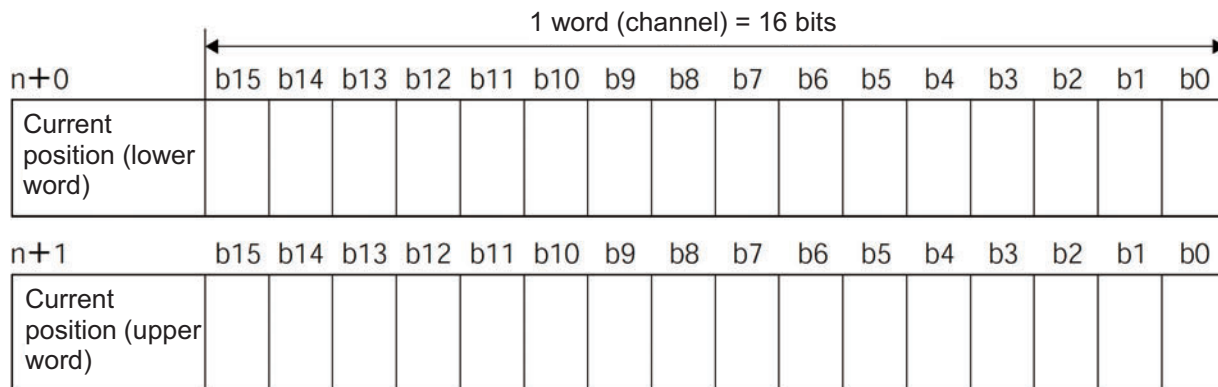
n+5	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Acceleration/ deceleration	—	—	—	—	—	—	—	256	128	64	32	16	8	4	2	1

n+6	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Push-motion current-limiting value	—	—	—	—	—	—	—	—	128	64	32	16	8	4	2	1

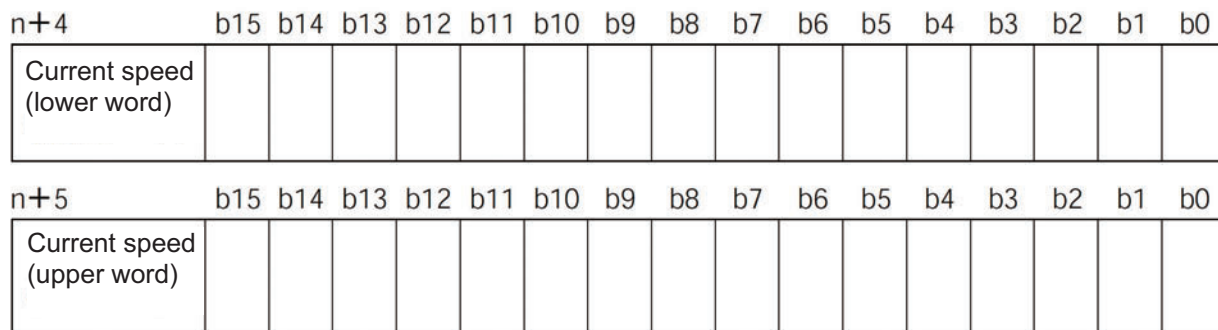
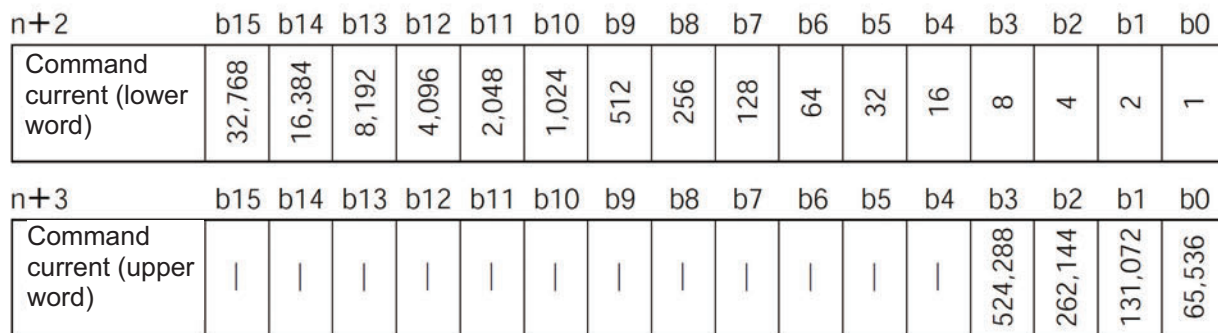
n+7	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Control signal	BKRL	RMOD	DIR	PUSH	—	—	—	JOG+	JOG-	JVEL	JISL	SON	RES	STP	HOME	DSTR

PLC input

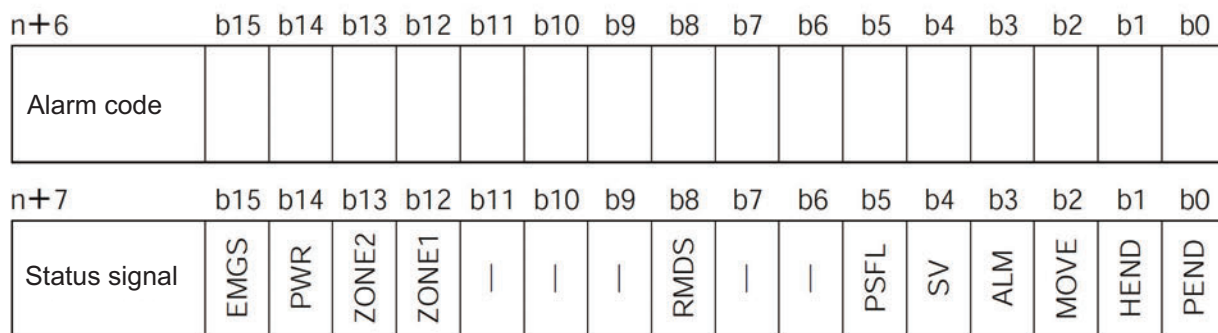
Channel (* n indicates the node address of each axis.)



If the current position is a negative value, it is indicated by a 2's complement.



If the current speed is a negative value, it is indicated by a 2's complement.



(3) I/O signal assignments

(* In the table, ON indicates that the applicable bit is "1," while OFF indicates that the bit is "0.")

Signal type	Bits	Symbol	Description	Details
PLC output	Target position	32-bit data	- 32-bit signed integer. Specify the target position as a position in the absolute coordinate system. The setting unit is 0.01 mm and the allowable specification range is -999999 to 999999. (Example) To set "+25.41 mm," specify "2541." If the entered value exceeds the range between the soft limits (0.2 mm inside the limits) set by the parameters, the movement will be limited to the soft limit (0.2 mm inside the limit). * If target positions are entered as hexadecimals, enter negative values using 2's complements.	2.9 (2)
	Positioning band	32-bit data	- 32-bit integer. The setting unit is 0.01 mm and the allowable specification range is 1 to 999999. (Example) To set "+25.40 mm," specify "2540." This register has one of two meanings depending on the operation type. [1] In positioning operation, this register defines the permissible range from the target position in which positioning will be deemed to have completed. [2] In push-motion operation, this register defines the push-motion band. Whether to perform normal operation or push-motion operation is set using the control signal PUSH.	2.9 (2)
	Speed	16-bit data	- 16-bit integer. Specify the speed at which to move the actuator. The setting unit is 1.0 mm/sec and the allowable specification range is 0 to 65535. (Example) To set "254.0 mm/sec," specify "254." If a move command is issued by specifying a value exceeding the maximum speed, an alarm will occur.	2.9 (2)
	Acceleration/deceleration	16-bit data	- 16-bit integer. Specify the acceleration/deceleration at which to move the actuator (the acceleration and deceleration will be the same value). The setting unit is 0.01 G and the allowable specification range is 1 to 300. (Example) To set "0.30 G," specify "30." If a move command is issued by specifying "0" or any value exceeding the maximum acceleration or deceleration, an alarm will occur.	2.9 (2)

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

Signal type	Bits	Symbol	Description	Details
PLC output	Push-motion current-limiting value	16-bit data	- 16-bit integer. Specify the current-limiting value to be used during push-motion operation. The allowable specification range is 0 (0%) to 255 (100%). The actual allowable specification range varies from one actuator to another. (Refer to the catalog or operation manual for each actuator.) If a move command is issued by specifying a value exceeding the maximum push-motion current, an alarm will occur.	2.9 (2)
	Control signal	b15	BKRL Forced brake release: The brake is released when this signal turns ON.	2.7.7 (18)
		b14	RMOD Operation mode: The AUTO mode is selected when this signal is OFF, and the MANU mode is selected when the signal is ON.	2.7.7 (19)
		b13	DIR Push direction specification: When this signal is OFF, push-motion operation is performed in the direction of the position determined by subtracting the positioning band from the target position. When the signal is ON, push-motion operation is performed in the direction of the position determined by adding the positioning band to the target position.	2.7.7 (22)
		b12	PUSH Push-motion specification: Positioning operation is performed when this signal is OFF, and push-motion operation is performed when the signal is ON.	2.7.7 (21)
		b11	-	-
		b10		
		b9		
		b8	JOG+ +Jog: The actuator moves in the direction opposite home when this signal is ON.	2.7.7 (13)
		b7	JOG- -Jog: The actuator moves in the direction of home when this signal is ON.	2.7.7 (13)
		b6	JVEL Jog-speed/inch-distance switching: The values set in parameter No. 26, “Jog speed” and parameter No. 48, “Inch distance” are used when this signal is OFF, and the values set in parameter No. 47, “Jog speed 2” and parameter No. 49, “Inch distance 2” are used when the signal is ON.	2.7.7 (14)
		b5	JISL Jog/inch switching: Jog operation is performed when this signal is OFF, and inch operation is performed when the signal is ON.	2.7.7 (15)
		b4	SON Servo ON command: The servo turns ON when this signal turns ON.	2.7.7 (5)
		b3	RES Reset: A reset is performed when this signal turns ON.	2.7.7 (4)
		b2	STP Pause: A pause command is issued when this signal turns ON.	2.7.7 (11)
		b1	HOME Home return: A home-return command is issued when this signal turns ON.	2.7.7 (6)
		b0	DSTR Positioning start: A move command is issued when this signal turns ON.	2.7.7 (8)

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

Signal type		Bits	Symbol	Description	Details
PLC input	Current position	32-bit data	-	32-bit signed integer indicating the current position. The setting unit is 0.01 mm. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm * If current positions are read as hexadecimal, negative values are indicated by 2's complements.	2.9 (2)
	Command current	32-bit data	-	32-bit integer. The electrical current presently specified by a command is indicated. The setting unit is mA. (Example) Reading: 000003FFH = 1023 (decimal) = 1023 mA	2.9 (2)
	Current speed	32-bit data	-	32-bit signed integer. Indicate the current speed. Positive value: The actuator is moving in the direction opposite home. Negative value: The actuator is moving in the direction of home. 32-bit integer. The current speed is indicated. The setting unit is 0.01 mm/sec. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm/sec * If this data is read as a hexadecimal, a negative value is indicated as a 2's complement.	2.9 (2)
	Alarm code	16-bit data	-	16-bit integer. If an alarm occurred, a corresponding alarm code is output. If no alarm is present, "0H" is set. For details on alarms, refer to the operation manual for the controller.	2.9 (2)
	Status signal	b15	EMGS	Emergency stop: An emergency stop is actuated when this signal turns ON.	2.7.7 (2)
		b14	PWR	Controller ready: This signal turns ON when the controller becomes ready.	2.7.7 (1)
		b13	ZONE2	Zone 2: This signal turns ON when the current position is inside the specified zone.	2.7.7 (12)
		b12	ZONE1	Zone 1: This signal turns ON when the current position is inside the specified zone.	2.7.7 (12)
		b11	-	Not available.	-
		b10			
		b9			
		b8	RMDS	Operation mode status: This signal is OFF when the current mode is AUTO, or ON when the current mode is MANU.	2.7.7 (19)
		b7	-	Not available.	-
		b6			
		b5	PSFL	Load missed in push motion: This signal turns ON when the actuator missed the load in push-motion operation.	2.7.7 (23)
		b4	SV	Ready: This signal turns ON when the servo turns ON.	2.7.7 (5)
b3		ALM	Alarm: This signal turns ON when an alarm occurs.	2.7.7 (3)	
b2		MOVE	Moving signal: This signal remains ON while the actuator is moving.	2.7.7 (9)	
b1		HEND	Home return complete: This signal turns ON when home return is completed.	2.7.7 (6)	
b0	PEND	Position complete signal: This signal turns ON when positioning is completed.	2.7.7 (10)		

2.7.5 Full Direct Mode (Number of Occupied Channels: 16)

In this mode, the actuator is operated by specifying all values relating to positioning control (target position, speed, etc.) directly from the PLC.

Set each value in the I/O area.

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

ROBO Cylinder function	O: Direct control X: Invalid
Home-return operation	O
Positioning operation	O
Speed and acceleration/deceleration setting	O
Pitch feed (inching)	O
Push-motion operation	O
Speed change during movement	O
Operation at different acceleration and deceleration	O
Pause	O
Zone signal output	O
PIO pattern selection	X

(1) PLC channel configuration (* n indicates the node address of each axis.)

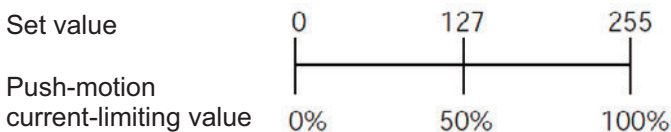
Parameter No. 84	ACON or PCON input register		PLC output channel	ACON or PCON output register	PLC input channel
3	Target position		n+0	Current position	n+0
			n+1		n+1
	Positioning band		n+2	Command current	n+2
			n+3		n+3
	Speed		n+4	Current speed	n+4
			n+5		n+5
	Zone boundary+		n+6	Alarm code	n+6
			n+7		n+7
	Zone boundary-		n+8	Occupied area	n+8
			n+9		n+9
	Acceleration		n+10		n+10
	Deceleration		n+11		n+11
	Push-motion current-limiting value		n+12		n+12
	ACON	Occupied area	n+13		n+13
	PCON	Load current threshold			
Control signal 1		n+14	n+14		
Control signal 2		n+15	Status signal	n+15	

(Note) The areas denoted by “occupied area” cannot be used for any other purpose. Also exercise caution to avoid node address duplication.

(2) I/O signal assignments for each axis

The I/O signals of each axis consist of sixteen input words (channels) and sixteen output words (channels) in the I/O areas.

- Control signals 1 and 2 and status signals are ON/OFF bit signals.
- The target position and current position are 2-word (32-bit) binary data. Although values from -999999 to +999999 (unit: 0.01 mm) can be handled by the PLC for these items, set position data within the soft stroke range (0 to the effective stroke) of the applicable actuator.
- Specify the positioning band. The positioning band is a 2-word (32-bit) binary data. For the positioning band, the PLC can handle values from 1 to +999999 (unit: 0.01 mm).
- The specified speed is a 2-word (32-bit) binary data. For the specified speed, the PLC can handle values from 0 to +999999 (unit: 0.01 mm/sec). Take note, however, that the set value should not exceed the maximum speed supported by the applicable actuator.
- The acceleration/deceleration is a 1-word (16-bit) binary data. For the acceleration/deceleration, the PLC can handle values from 1 to 300 (unit: 0.01 G). Take note, however, that the set value should not exceed the maximum acceleration or maximum deceleration supported by the applicable actuator.
- The push-motion current-limiting value is a 1-word (16-bit) binary data. For the push-motion current-limiting value, the PLC can handle values from 0 (0%) to 255 (100%). Take note, however, that the setting should be inside the allowable specification range of push-motion current-limiting values supported by the applicable actuator (refer to the catalog or operation manual for the actuator).



- Set the load current threshold. The load current threshold is a 1-word (16-bit) binary data. For the load current threshold, the PLC can handle values from 0 (0%) to 255 (100%). (Refer to the graph of push-motion current-limiting value (above graph).)
- The zone boundary+ and zone boundary- are 2-word (32-bit) binary data. For the zone boundary+ and zone boundary-, the PLC can handle values from -999999 to +999999 (unit: 0.01 mm). Take note, however, that the value of zone boundary- must be smaller than the value of zone boundary+.
- The command current is a 2-word (32-bit) binary data (unit: 1 mA).
- The current speed is a 2-word (32-bit) binary data (unit: 0.01 mm/sec).
- The alarm code is a 1-word (16-bit) binary data.

PLC output

Channel (* n indicates the node address of each axis.)

1 word (channel) = 16 bits

n+0	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (lower word)																
n+1	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (upper word)																

If the target position is a negative value, it is indicated by a 2's complement.

n+2	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Positioning band (lower word)	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1
n+3	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Positioning band (upper word)													524,288	262,144	131,072	65,536
n+4	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Speed (lower word)	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1
n+5	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Speed (upper word)													524,288	262,144	131,072	65,536
n+6	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Zone boundary+ (lower word)																
n+7	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Zone boundary+ (upper word)																

If the zone boundary is a negative value, it is indicated by a 2's complement.

Channel (* n indicates the node address of each axis.)

1 word (channel) = 16 bits

n+8	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Zone boundary- (lower word)																

n+9	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Zone boundary- (upper word)																

If the zone boundary is a negative value, it is indicated by a 2's complement.

n+10	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Acceleration								256	128	64	32	16	8	4	2	1

n+11	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Deceleration								256	128	64	32	16	8	4	2	1

n+12	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Push-motion current-limiting value									128	64	32	16	8	4	2	1

n+13	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Load current threshold (*3)									128	64	32	16	8	4	2	1

n+14	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Control signal 1						(※1)			(※2)			INC	DIR	PUSH		

n+15	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Control signal 2	BKRL	RMOD						JOG+	JOG-	JVEL	JISL	SON	RES	STP	HOME	DSTR

(*1) Signal assignment for b10 of n+14

	Symbol	
Controller	ACON	PCON
b10	-	SMOD

(*2) Signal assignments for b7 and b6 of n+14

	Symbol	
Controller	ACON	PCON
b7	MOD1	-
b6	MOD0	-

(*3) This is a dedicated function for PCON controllers. It is not available with ACON controllers.

PLC input

Channel (* n indicates the node address of each axis.)

1 word (channel) = 16 bits

n+0	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (lower word)																

n+1	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (upper word)																

If the current position is a negative value, it is indicated by a 2's complement.

n+2	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Command current (lower word)	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1

n+3	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Command current (upper word)													524,288	262,144	131,072	65,536

n+4	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current speed (lower word)																

n+5	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current speed (upper word)																

If the current speed is a negative value, it is indicated by a 2's complement.

n+6	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Alarm code																

n+7~n+14	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Not available.																

n+15	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Status signal	EMGS	PWR	ZONE2	ZONE1	PZONE	(※1)		RMDS	GHMS	PUSH	PSFL	SV	ALM	MOVE	HEND	PEND

(*1) Signal assignments for b10 and b9 of n+15

Controller	Symbol	
	ACON	PCON
b10	-	LOAD
b9	-	TRQS

(3) I/O signal assignments

(* In the table, ON indicates that the applicable bit is "1," while OFF indicates that the bit is "0.")

Address		Bits	Symbol	Function	Details
PLC output	Target position	32-bit data	-	<p>32-bit signed integer. Specify the target position as a position in the absolute coordinate system. The setting unit is 0.01 mm and the allowable specification range is -999999 to 999999. (Example) To set "+25.41 mm," specify "2541." If the entered value exceeds the range between the soft limits (0.2 mm inside the limits) set by the parameters, the movement will be limited to the soft limit (0.2 mm inside the limit). * If target positions are entered as hexadecimals, enter negative values using 2's complements.</p>	2.9 (3)
	Positioning band	32-bit data	-	<p>32-bit integer. The setting unit is 0.01 mm and the allowable specification range is 1 to 999999. (Example) To set "+25.40 mm," specify "2540." This register has one of two meanings depending on the operation type. [1] In positioning operation, this register defines the permissible range from the target position in which positioning will be deemed to have completed. [2] In push-motion operation, this register defines the push-motion band. Whether to perform normal operation or push-motion operation is set using the control signal PUSH.</p>	2.9 (3)
	Speed	32-bit data	-	<p>32-bit integer. Specify the speed at which to move the actuator. The setting unit is 1.0 mm/sec and the allowable specification range is 0 to 999999. (Example) To set "25.41 mm/sec," specify "2541." If a move command is issued by specifying a value exceeding the maximum speed, an alarm will occur.</p>	2.9 (3)
	Zone boundary+ /zone boundary-	32-bit data	-	<p>32-bit signed integer. After completion of home return, an effective zone signal can be output separately from the zone boundaries specified by parameters. The status signal PZONE turns ON when the current position is inside these +/- boundaries. (Example) To set "+25.40 mm," specify "2540." The setting unit is 0.01 mm and the specification range is -999999 to 999999. Enter a value that satisfies the relationship of "Zone boundary+ > Zone boundary-." If this function is not used, enter the same value for both the positive and negative boundaries. * If the boundaries are entered as hexadecimals, enter negative values using 2's complements.</p>	2.9 (3)

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

Address		Bits	Symbol	Function	Details											
PLC output	Acceleration	16-bit data	-	16-bit integer. Specify the acceleration and deceleration at which to move the actuator.	2.9 (3)											
	Deceleration	16-bit data	-	The setting unit is 0.01 G and the allowable specification range is 1 to 300. (Example) To set “0.30 G,” specify “30.” If a move command is issued by specifying “0” or any value exceeding the maximum acceleration or deceleration, an alarm will occur.												
	Push-motion current-limiting value	16-bit data	-	16-bit integer. Specify the current-limiting value to be used during push-motion operation. The allowable specification range is 0 (0%) to 255 (100%). The actual allowable specification range varies from one actuator to another. (Refer to the catalog or operation manual for each actuator.) If a move command is issued by specifying a value exceeding the maximum push-motion current, an alarm will occur.	2.9 (3)											
	Load current threshold	16-bit data	-	16-bit integer. If you want the controller to determine whether or not the load current has exceeded the set value, specify the current threshold using this register. The allowable specification range is 0 (0%) to 255 (100%). If threshold judgment is not required, enter “0.”	2.9 (3)											
	Control signal 1	b15	-	-	Not available.	-										
		b14														
		b13														
		b12														
		b11														
		b10	PCON	ACON	-	Not available.	-									
			PCON	SMOD	Stopping control mode: When this signal is ON, servo control is performed during stopping.	2.7.7 (28)										
		b9	-	-	Not available.	-										
		b8														
		b7	ACON	MOD1	Acceleration/deceleration mode:			2.7.7 (29)								
<table><tr><td>MOD1</td><td>MOD0</td><td>Function</td></tr><tr><td>OFF</td><td>OFF</td><td>Trapezoid pattern</td></tr><tr><td>OFF</td><td>ON</td><td>S-motion</td></tr><tr><td>ON</td><td>OFF</td><td>Primary delay filter</td></tr></table>					MOD1	MOD0	Function		OFF	OFF	Trapezoid pattern	OFF	ON	S-motion	ON	OFF
MOD1	MOD0	Function														
OFF	OFF	Trapezoid pattern														
OFF	ON	S-motion														
ON	OFF	Primary delay filter														
b6	MOD0															
b7	PCON	-	-	Not available.	-											
b6																
b5																
b4	-	-	-	Not available.	-											
b3	INC	Incremental specification: Absolute position commands are issued when this signal is OFF, and incremental position commands are issued when the signal is ON.	2.7.7 (24)													

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

Address		Bits	Symbol	Function	Details
PLC output	Control signal 1	b2	DIR	Push direction specification: When this signal is OFF, push-motion operation is performed in the direction of the position determined by subtracting the positioning band from the target position. When the signal is ON, push-motion operation is performed in the direction of the position determined by adding the positioning band to the target position.	2.7.7 (22)
		b1	PUSH	Push-motion specification: Positioning operation is performed when this signal is OFF, and push-motion operation is performed when the signal is ON.	2.7.7 (21)
		b0	-	Not available.	-
	Control signal 2	b15	BKRL	Forced brake release: The brake is released when this signal turns ON.	2.7.7 (18)
		b14	RMOD	Operation mode: The AUTO mode is selected when this signal is OFF, and the MANU mode is selected when the signal is ON.	2.7.7 (19)
		b13	-	Not available.	-
		b12			
		b11			
		b10			
		b9			
		b8	JOG+	+Jog: The actuator moves in the direction opposite home when this signal is ON.	2.7.7 (13)
		b7	JOG-	-Jog: The actuator moves in the direction of home when this signal is ON.	2.7.7 (13)
		b6	JVEL	Jog-speed/inch-distance switching: The values set in parameter No. 26, “Jog speed” and parameter No. 48, “Inch distance” are used when this signal is OFF, and the values set in parameter No. 47, “Jog speed 2” and parameter No. 49, “Inch distance 2” are used when the signal is ON.	2.7.7 (14)
		b5	JISL	Jog/inch switching: Jog operation is performed when this signal is OFF, and inch operation is performed when the signal is ON.	2.7.7 (15)
		b4	SON	Servo ON command: The servo turns ON when this signal turns ON.	2.7.7 (5)
		b3	RES	Reset: A reset is performed when this signal turns ON.	2.7.7 (4)
		b2	STP	Pause: A pause command is issued when this signal turns ON.	2.7.7 (11)
		b1	HOME	Home return: A home-return command is issued when this signal turns ON.	2.7.7 (6)
		b0	DSTR	Positioning start: A move command is issued when this signal turns ON.	2.7.7 (8)

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

Signal type	Bits	Symbol	Description	Details
Current position	32-bit data	-	32-bit signed integer indicating the current position. The setting unit is 0.01 mm. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm * If current positions are read as hexadecimal, negative values are indicated by 2's complements.	2.9 (3)
	32-bit data	-	32-bit integer. The electrical current presently specified by a command is indicated. The setting unit is mA. (Example) Reading: 000003FFH = 1023 (decimal) = 1023 mA	2.9 (3)
	32-bit data	-	32-bit integer. The current speed is indicated. The setting unit is 0.01 mm/sec. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm/sec	2.9 (3)
	16-bit data	-	16-bit integer. If an alarm occurred, a corresponding alarm code is output. If no alarm is present, “0” is set. For details on alarms, refer to the operation manual for the controller.	2.9 (3)
Status signal	b15	EMGS	Emergency stop: An emergency stop is actuated when this signal turns ON.	2.7.7 (2)
	b14	PWR	Controller ready: This signal turns ON when the controller becomes ready.	2.7.7 (1)
	b13	ZONE2	Zone 2: This signal turns ON when the current position is inside the specified zone.	2.7.7 (12)
	b12	ZONE1	Zone 1: This signal turns ON when the current position is inside the specified zone.	2.7.7 (12)
	b11	PZONE	Position zone: This signal turns on when the current position is inside the position zone.	2.7.7 (12)
	b10	ACON	-	Not available (ON/OFF status is indeterminable).
		PCON	LOAD	Load output judgment: When this signal is ON, the specified load has been reached. When the signal is OFF, the load has not been reached yet. (For details, refer to the operation manual for the controller.)
	b9	ACON	-	Not available (ON/OFF status is indeterminable).
		PCON	TRQS	Torque level: When this signal is ON, the specified torque has been reached. When the signal is OFF, the torque has not been reached yet. (For details, refer to the operation manual for the controller.)
	b8	RMDS	Operation mode status: This signal is OFF when the current mode is AUTO, or ON when the mode is MANU.	2.7.7 (19)
	b7	GHMS	Home return in progress: This signal remains ON while home return is in progress.	2.7.7 (6)
	b6	PUSHS	Push motion in progress: This signal remains ON while push-motion operation is in progress.	2.7.7 (25)
	b5	PSFL	Load missed in push motion: This signal turns ON when the actuator missed the load in push-motion operation.	2.7.7 (23)
	b4	SV	Ready: This signal turns ON when the servo turns ON.	2.7.7 (5)
	b3	ALM	Alarm: This signal turns ON when an alarm occurs.	2.7.7 (3)
	b2	MOVE	Moving signal: This signal remains ON while the actuator is moving.	2.7.7 (9)
	b1	HEND	Home return complete: This signal turns ON when home return is completed.	2.7.7 (6)
	b0	PEND	Position complete signal: This signal turns ON when positioning is completed.	2.7.7 (10)

2.7.6 Remote I/O Mode 2 (Number of Occupied Channels: 6)

In this mode, the actuator is operated by specifying position numbers, just like you do when PIOs (24-V I/Os) are used.

Set position data using the RC PC software or teaching pendant.

The number of available positions is determined by the setting of parameter No. 25, "PIO pattern."

This mode is the same as the remote I/O mode, but the current-position read function and command-current read function are also available.

The features of each PIO pattern are shown below. (For details, refer to the operation manual for the controller.)

Value set in parameter No. 25	Operation mode	I/O specification
0	Positioning mode	64 positioning points and two zone output points are available.
1	Teaching mode	64 positioning points and one zone output point is available. Positioning operation and jog operation are supported. The current position can be written to a specified position.
2	256-point mode	256 positioning points and one zone output point is available.
3	512-point mode	512 positioning points are available. There are no zone outputs.
4	Solenoid mode 1	7 positioning points and two zone output points are available. A direct operation command can be issued for each position number. A position complete signal is output for each position number.
5	Solenoid mode 2	3 positioning points and two zone output points are available. The actuator is operated by specifying forward, backward and intermediate position commands. A position complete signal is output separately for the front end, rear end and intermediate position.

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

ROBO Cylinder function	PIO patterns					
	0: Positioning mode	1: Teaching mode	2: 256-point mode	3: 512-point mode	4: Solenoid mode 1	5: Solenoid mode 2
Home-return operation	○	○	○	○	○	X
Positioning operation	○	○	○	○	○	○
Speed and acceleration/deceleration setting	○	○	○	○	○	○
Pitch feed (inching)	○	○	○	○	○	○
Push-motion operation	○	○	○	○	○	X
Speed change during movement	○	○	○	○	○	○
Operation at different acceleration and deceleration	○	○	○	○	○	○
Pause	○	○	○	○	○	○ (*1)
Zone signal output	○	○	○	X	○	○
PIO pattern selection (set by a parameter)	○	○	○	○	○	○

○: Supported / X: Not supported

(*1) This function is supported when parameter No. 27, "Move command type" is set to "0."
The actuator can be paused by turning the move command OFF.

(1) PLC channel configuration (* n indicates the node address of each axis.)

Parameter No. 84	ACON or PCON DI and input register	PLC output channel	ACON or PCON DO and output register	PLC input channel
4	Port number 0 to 15	n+0	Current position	n+0
	Occupied area	n+1	Occupied area	n+1
		n+2	Current position	n+2
		n+3		n+3
		n+4	Command current	n+4
		n+5		n+5

(Note) The areas denoted by “occupied area” cannot be used for any other purpose. Also exercise caution to avoid node address duplication.

(2) I/O signal assignments for each axis

The I/O signals of each axis consist of six input words (channels) and six output words (channels) in the I/O areas.

- The channels controlled by port number are controlled using ON/OFF bit signals.
- The current position is a 2-word (32-bit) binary data (unit: 0.01 mm).
- The command current is a 2-word (32-bit) binary data (unit: 1 mA).

PLC output (* n indicates the node address of each axis.)

Channel

n+0	1 word (channel) = 16 bits															
	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Controller input port number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

PLC input (* n indicates the node address of each axis.)

Channel

		1 word (channel) = 16 bits															
n+0		F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Controller output port number		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
n+1		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Not available.																	
n+2		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (lower word)																	
n+3		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (upper word)																	
If the current position is a negative value, it is indicated by a 2's complement.																	
n+4		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Command current (lower word)		32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1
n+5		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Command current (upper word)														524,288	262,144	131,072	65,536

(3) I/O signal assignments

For the signal assignments corresponding to each PIO pattern, refer to the I/O signal assignments for the remote I/O mode explained in 2.7.2 (3).

Signal assignments under the command-current read function and current-position read function are shown below.

Signal type		Bits	Symbol	Description	Details
PLC input	Current position	32-bit data	-	32-bit signed integer indicating the current position. The setting unit is 0.01 mm. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm * If current positions are read as hexadecimals, negative values are indicated by 2's complements.	-
	Command current	32-bit data	-	32-bit integer. Indicate the value of electrical current specified by the current command. The setting unit is 1 mA. (Example) Reading: 000003FFH = 1023 (decimal) = 1023 mA	-

2.7.7 I/O Signal Controls and Functions

* ON indicates that the applicable bit signal is “1,” while OFF indicates that the bit signal is “0.”

How the I/O signals used in the position/simple direct mode, half direct mode and full direct mode are controlled, as well as the functions provided by these signals, are explained below. For the I/O signals used in the remote I/O mode and remote I/O mode 2, refer to the operation manual for the controller.

(1) Controller ready (PWR) [PLC input signal]

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

■ Function

The PWR signal turns ON when the controller has been initialized successfully and become ready to perform control following the power on, regardless of the alarm status, servo status or any other condition.

Even when an alarm is present, the PWR signal turns ON as long as the controller is ready.

(2) Emergency stop (EMGS) [PLC input signal]

This signal turns ON when the controller has entered the emergency stop mode.

■ Function

The EMGS signal turns ON when the controller has entered the emergency stop mode (motor drive power has been cut off). The signal will turn OFF once the emergency stop is cancelled.

(3) Alarm (ALM) [PLC input signal]

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

■ Function

The ALM signal turns ON when the controller's protective circuit (function) has actuated following an error detection.

When the cause of the alarm is removed and the reset (RES) signal is turned ON, the ALM signal will turn OFF if the applicable alarm is an operation-reset alarm. (To reset cold-start alarms, the power must be reconnected.)

When an alarm is detected, the status indicator LED (refer to 2.4, “DeviceNet Interface”) on the front panel of the controller will illuminate in red.

(4) Reset (RES) [PLC output signal]

This signal has two functions. One is to reset controller alarms, and the other is to cancel the remaining travel while the actuator is paused.

■ Function

[1] Turning the RES signal from OFF to ON after removing the cause of the present alarm will reset the alarm (ALM) signal. (To reset cold-start alarms, the power must be reconnected.)

[2] Turning the RES signal from OFF to ON while the actuator is paused will cancel the remaining travel.

- (5) Servo ON command (SON) [PLC output signal]
Ready (SV) [PLC input signal]

When the SON signal is turned ON, the servo will turn on.

When the servo turns on, the status indicator LED (refer to 2.4, "DeviceNet Interface") on the front panel of the controller will illuminate in green.

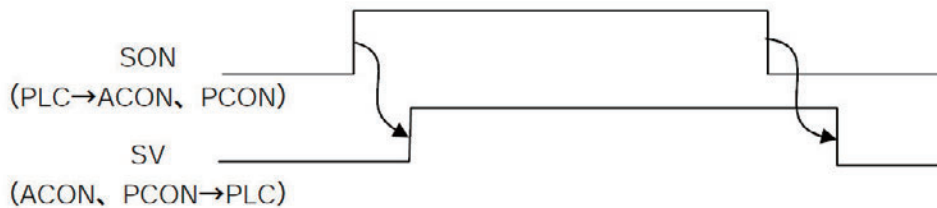
The SV signal is synchronized with this LED.

■ Function

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

While the SV signal is ON, the controller servo remains on and the actuator can be operated.

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



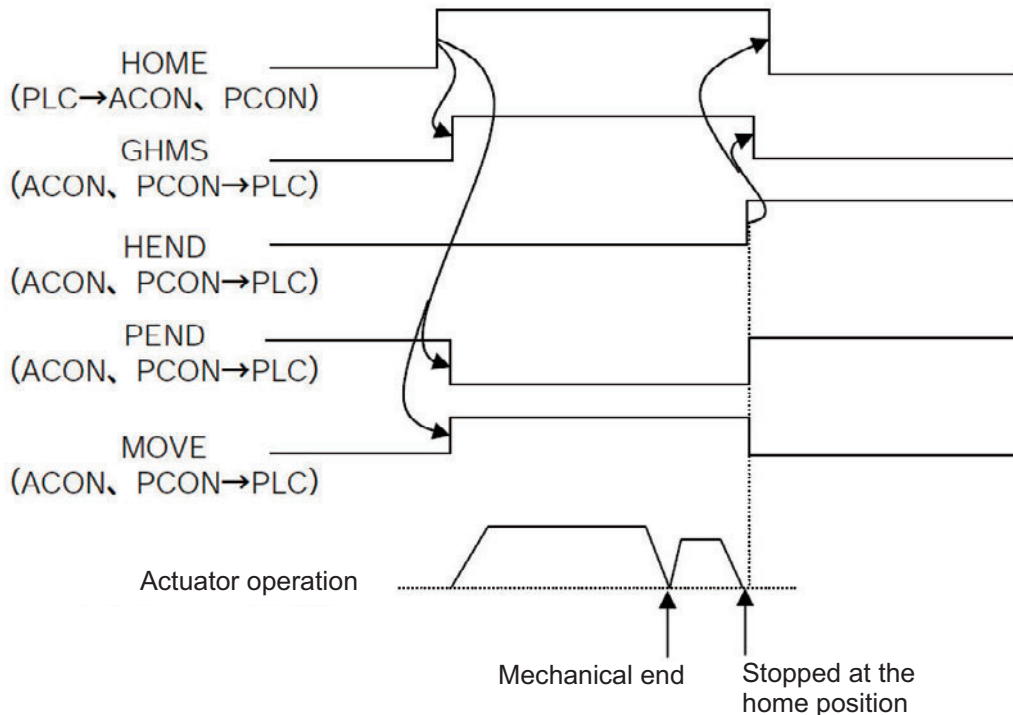
- (6) Home return (HOME) [PLC output signal]
 Home return complete (HEND) [PLC input signal]
 Home return in progress (GHMS) [PLC input signal]

When the HOME signal is turned ON, the HOME command will be processed at the leading (ON) edge of the signal and home-return operation will be performed automatically. The GHMS signal turns ON while the home return is in progress.

Once the home return has completed, the HEND signal turns ON and the GHMS signal turns OFF.

Program the controller so that the HOME signal will turn OFF after the HEND signal turns ON. Once it is turned ON, the HEND signal will not turn OFF until the power is turned off or a HOME signal is input again.

After a home return has been performed once, another home return can be performed by turning ON the HOME signal.



Caution: In the remote I/O mode, remote I/O mode 2 or position/simple direct mode, issuing a positioning command to a given position following the power on, without performing a home return first, will cause the actuator to automatically return home and then perform the positioning. Take note that this applies only to the first positioning command following the power on.

Exercise caution that in the half direct mode or full direct mode, issuing a positioning command to a given position following the power on, without performing a home return first, will generate an alarm ("Error Code 83: Alarm home ABS (absolute position move command when home return is not yet completed)" (operation-reset alarm)).

(7) Positioning start (CSTR): Used in the position/simple direct mode [PLC output signal]

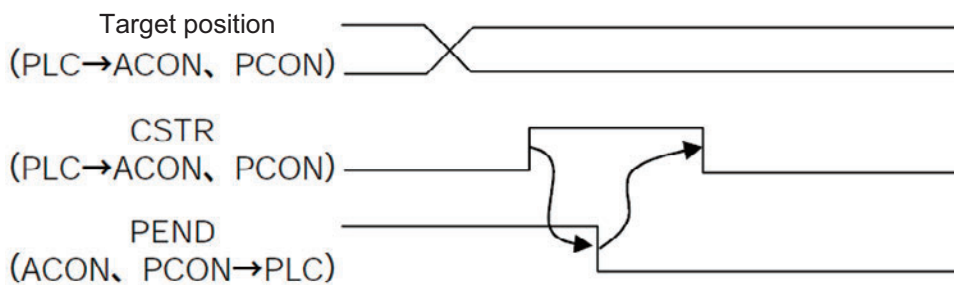
The CSTR command is processed at the leading (ON) edge of the signal, upon which the actuator will move to the position set by the target position corresponding to the specified position number or by the target position channel of the PLC.

Whether to use the target position corresponding to the specified position number or the target position channel of the PLC is determined by control signal b11 (position/simple-direct switching (PMOD) signal).

- PMOD = OFF: Use the target position data corresponding to the specified position number
- PMOD = ON: Use the value set to the target position channel of the PLC.

If this command is issued when no home-return operation has been performed yet after the power on (= while the HEND signal is OFF), the actuator will automatically return home and then move to the target position.

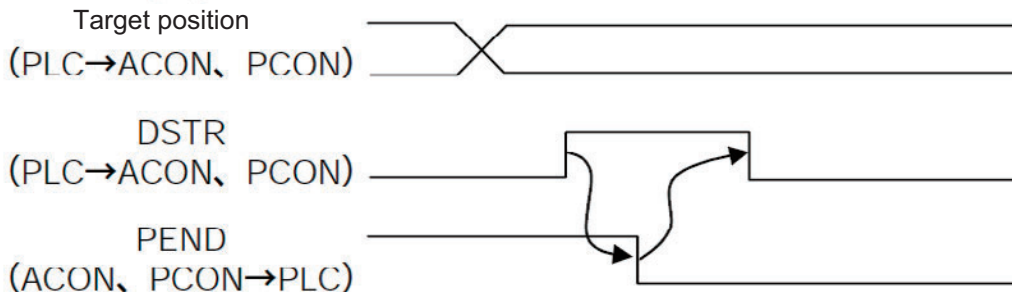
Program the controller so that the CSTR signal will be turned OFF after the position complete (PEND) signal turns OFF.



(8) Positioning command (DSTR): Used in the half direct mode and full direct mode [PLC output signal]

The DSTR command is processed at the leading (ON) edge of the signal, upon which the actuator will move to the target position input to the target position channel of the PLC. If this command is issued when no home-return operation has been performed yet after the power on (= while the HEND signal is OFF), an alarm (operation-reset alarm) will occur.

Program the controller so that this signal will be turned OFF after the position complete (PEND) signal turns OFF.



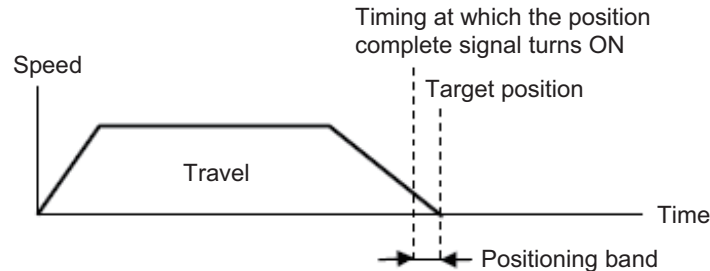
(9) Moving signal (MOVE) [PLC input signal]

This signal turns ON while the actuator slider or rod is moving (also while home-return operation, push-motion operation or jog operation is in progress).

The MOVE signal turns OFF upon completion of positioning, home-return or push-motion operation or while the actuator is paused.

(10) Position complete signal (PEND) [PLC input signal]

This signal turns ON after the actuator has moved to the target position and entered the positioning band or completed the push-motion operation.



When the servo turns on, positioning is performed based on the current position set as the target position. Accordingly, the PEND signal turns ON and will turn OFF when a positioning operation is started thereafter with the home return (HOME) signal, positioning start (CSTR) signal or positioning command (DSTR) signal.

Caution: If the servo turns off or an emergency stop is actuated while the actuator is stopped at the target position, the PEND signal will turn OFF. When the servo subsequently turns on, the PEND signal will turn ON if the current position is inside the positioning band. Also take note that the PEND signal will not turn ON if the CSTR or DSTR signal remains ON.

(11) Pause (STP) [PLC output signal]

When this signal is turned ON, the moving axis will decelerate to a stop. If the signal is turned OFF thereafter, the axis movement will resume.

The acceleration used immediately after resumption of operation, and deceleration used when the actuator stops, conform to the acceleration/deceleration value corresponding to the position number set by the specified position number channel in the position/simple direct mode, or to the value of the acceleration/deceleration channel in the half direct mode.

In the full direct mode, the acceleration and deceleration conform to the values of the acceleration channel and deceleration channel.

- (12) Zone 1 (ZONE1) [PLC input signal]
 Zone 2 (ZONE2) [PLC input signal]
 Position zone (PZONE) [PLC input signal]

Each signal turns ON when the current position of the actuator is inside the specified zone, and turns OFF when the current position is outside the zone.

[1] Zone 1, zone 2

Each zone is set by user parameters.

The ZONE1 signal is set by parameter No. 1, "Zone boundary 1+" and No. 2, "Zone boundary 1-."

The ZONE2 signal is set by parameter No. 23, "Zone boundary 2+" and No. 24, "Zone boundary 2-."

The ZONE1 and ZONE2 signals become effective following a completion of home return, after which they will remain effective even while the servo is turned off.

[2] Position zone

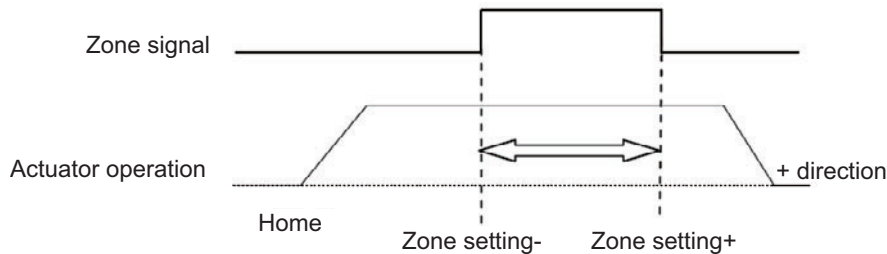
Each zone is set in the position table or using the zone boundary channels.

In the position/simple direct mode, the PZONE signal is set in the position table.

In the full direct mode, the PZONE signal is set using the zone boundary channels.

(*) The PZONE signal is not available in the half direct mode.

The PZONE signal becomes effective when a move command is issued following a completion of home return, after which it will remain effective even while the servo is turned off.



- (13) +Jog (JOG+) [PLC output signal]
 -Jog (JOG-) [PLC output signal]

These signals are used as starting commands for jog operation or inch operation.

If a + command is issued, the actuator will operate in the direction opposite home. When a – command is issued, the actuator will operate in the direction of home.

[1] Jog operation

Jog operation can be performed when the jog/inch switching (JISL) signal is OFF.

The actuator will operate in the direction opposite home while the JOG+ is ON, and decelerate to a stop once the signal turns OFF.

The actuator will operate in the direction of home while the JOG- is ON, and decelerate to a stop once the signal turns OFF.

The specific operation follows the values set in the following parameters:

- The speed conforms to the value of the parameter set by the jog-speed/inch-distance switching (JVEL) signal.
 If the JVEL signal is OFF, the actuator operates according to parameter No. 26, "PIO jog speed."
 If the JVEL signal is ON, the actuator operates according to parameter No. 47, "PIO jog speed 2."
- The acceleration/deceleration conforms to the rated acceleration/deceleration (the specific value varies depending on the actuator).
- If both the JOG+ and JOG- signals turn ON, the actuator will decelerate to a stop.

[2] Inch operation

Inch operation can be performed when the JISL signal is ON.

The actuator moves by the inch distance every time this signal turns ON.

The actuator will operate in the direction opposite home when the JOG+ is ON, or in the direction of home when the JOG- is ON.

The specific operation follows the values set in the following parameters:

- The speed conforms to the value of the parameter specified by the JVEL signal.
 If the JVEL signal is OFF, the actuator operates according to parameter No. 26, "PIO jog speed."
 If the JVEL signal is ON, the actuator operates according to parameter No. 47, "PIO jog speed 2."
- The travel conforms to the value of the parameter specified by the JVEL signal.
 If the JVEL signal is OFF, the actuator operates according to parameter No. 48, "PIO inch distance."
 If the JVEL signal is ON, the actuator operates according to parameter No. 49, "PIO inch distance 2."
- The acceleration/deceleration conforms to the rated acceleration/deceleration (the specific value varies depending on the actuator).

While performing a normal operation, the actuator will continue with the normal operation even after the +jog or -jog signal is turned ON (the jog signal will be ignored).

While the actuator is paused, turning ON the +jog or -jog signal will not cause the actuator to operate.

(Note) Since the software stroke limits are invalid before a home return is completed, the actuator may collide with the mechanical end. Exercise caution.

(14) Jog-speed/inch-distance switching (JVEL) [PLC output signal]

This signal is used to switch between the jog speed parameter when jog operation is selected, and the inch distance parameter when inch operation is selected.

JVEL signal	Jog operation: JISL = OFF	Inch operation: JISL = ON
OFF	Parameter No. 26, "Jog speed"	Parameter No. 26, "Jog speed" Parameter No. 48, "Inch distance"
ON	Parameter No. 47, "Jog speed 2"	Parameter No. 47, "Jog speed 2" Parameter No. 49, "Inch distance 2"

(15) Jog/inch switching (JISL) [PLC output signal]

This signal is used to switch between jog operation and inch operation.

JISL = OFF: Jog operation

JISL = ON: Inch operation

If the JISL signal turns ON (inch) while the actuator is moving by jogging, the actuator will decelerate to a stop and then switch to the inch function.

If the JISL signal turns ON (jog) while the actuator is moving by inching, the actuator will complete the movement and then switch to the jog function.

The table below summarizes the relationship of the ON/OFF statuses of the JISL signal and jog-speed/inch-distance switching (JVEL) signal.

		Jog operation	Inch operation
JISL		OFF	ON
JVEL=OFF	Speed	Parameter No. 26, "Jog speed"	Parameter No. 26, "Jog speed"
	Travel	-	Parameter No. 48, "Inch distance"
	Acceleration/ deceleration	Rated value (The specific value varies depending on the actuator.)	Rated value (The specific value varies depending on the actuator.)
JVEL=ON	Speed	Parameter No. 47, "Jog speed 2"	Parameter No. 47, "Jog speed 2"
	Travel	-	Parameter No. 49, "Inch distance 2"
	Acceleration/ deceleration	Rated value (The specific value varies depending on the actuator.)	Rated value (The specific value varies depending on the actuator.)
Operation		When the JOG+/JOG- signal is ON	Upon detection of the leading (ON) edge of the JOG+/JOG- signal

- (16) Teaching command (MODE) [PLC output signal]
Teaching mode signal (MODES) [PLC input signal]

When the MODE signal is turned ON, the actuator mode will switch from normal operation to teaching.
Upon switching to the teaching mode, the controller of each axis will turn the MODES signal ON.
Program the PLC so that teaching operation will be performed after the MODES signal turns ON.

(Note) For the actuator mode to switch from normal operation to teaching, the following conditions must be satisfied:

- The actuator (motor) is stopped.
- The +jog (JOG+) signal and -jog (JOG-) signal are turned OFF.
- The position-data read command (PWRT) signal and positioning start (CSTR) signal are turned OFF.

(Note) The actuator will not return to the normal operation mode unless the PWRT signal is OFF.

- (17) Position-data read command (PWRT) [PLC output signal]
Position-data read complete (WEND) [PLC input signal]

The PWRT signal is effective when the teaching mode (MODES) signal is ON.

Turn the PWRT signal ON (*1), and the data of the current position will be written to the "Position" field under the position number set to the specified position number channel of the PLC. (*2)

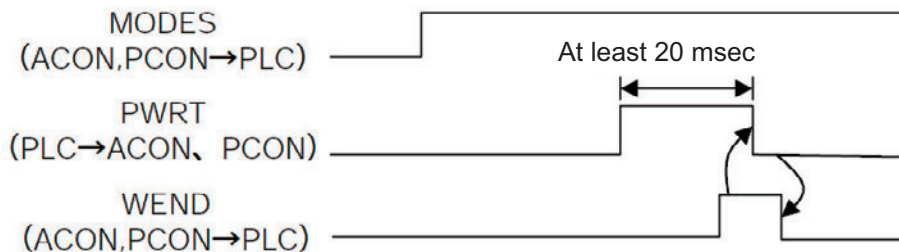
The WEND signal will turn ON once reading is complete.

Program the host PLC so that the PWRT signal will be turned OFF after the WEND signal turns ON.

If the PWRT signal is turned OFF before the WEND signal turns ON, the WEND signal will not turn ON.

When the PWRT signal is turned OFF, the WEND signal will turn OFF.

- (*1) Keep the PWRT signal ON for at least 20 msec. If the signal remains ON for less than 20 msec, the position may not be written.
(*2) If any data other than the position is not yet defined, the default value of the corresponding parameter will be written. (refer to the operation manual for the controller.)



- (18) Forced brake release (BKRL) [PLC output signal]

The brake can be forcibly released by turning this signal ON.

- (19) Operation mode (RMOD) [PLC output signal]
 Operation mode status (RMDS) [PLC input signal]

The operation mode is selected as shown below based on the RMOD signal and the MODE switch on the front panel of the controller.

Whether the current mode is AUTO or MANU can be checked using the RMDS signal.

The combinations of RMOD signal and MODE switch settings and the corresponding operation modes are shown below.

	Controller MODE switch = AUTO	Controller MODE switch = MANU
RMOD signal = OFF (AUTO mode is specified)	AUTO mode (RMDS=OFF)	MANU mode (RMDS=ON)
RMOD signal = ON (MANU mode is specified)	MANU mode (RMDS=ON)	MANU mode (RMDS=ON)

(Note) In the MANU mode, operation from the PLC cannot be performed.

- (20) Position/simple-direct switching (PMOD) [PLC output signal]

This signal is used to switch between the mode where the target position is set using a value registered in the position table stored in the controller, and the mode where a value specified by the target position channel of the PLC is used.

PMOD = OFF: Use the position table

PMOD = ON: Use the value of the target position channel

- (21) Push-motion specification (PUSH) [PLC output signal]

Push-motion operation can be performed when a move command is issued after turning this signal ON.

Normal positioning operation is performed if this signal is set to OFF.

(For the timing of setting this signal, refer to (2), "Operation in the half direct mode" under 2.9, "Operation.")

- (22) Push direction specification (DIR) [PLC output signal]

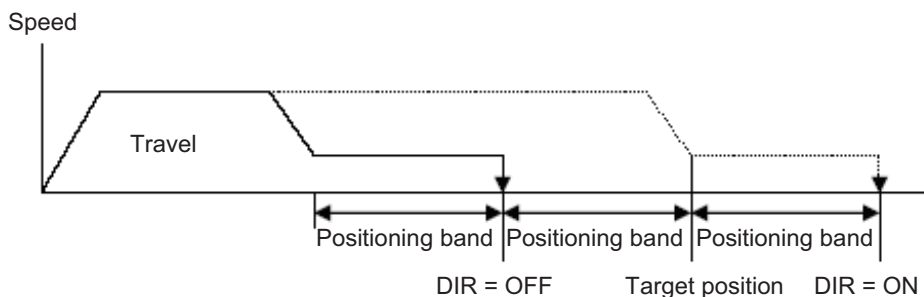
This signal specifies the direction in which the actuator pushes the load.

When the DIR signal is turned OFF, the actuator will push the load in the direction of the value determined by subtracting the positioning band from the target position.

When the DIR signal is turned ON, the actuator will push the load in the direction of the value determined by adding the positioning band to the target position.

The DIR signal is invalid during normal positioning operation.

(For the timing of setting this signal, refer to (2), "Operation in the half direct mode" under 2.9, "Operation.")



(23) Load missed in push motion (PSFL) [PLC input signal]

This signal turns ON when the actuator has not contacted the load in push-motion operation after having moved the distance set by the "Positioning band" field in the position table stored in the controller or by the positioning band channel of the PLC.

(For the timing of setting this signal, refer to (2), "Operation in the half direct mode" under 2.9, "Operation.")

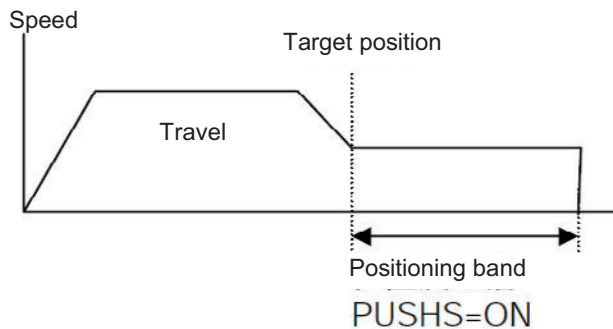
(24) Incremental specification (INC) [PLC output signal]

If a move command is issued while this signal is ON, the actuator will move from the current position by the value input to the target position channel of the PLC. (Incremental move)

If the INC signal is OFF, the actuator will move to the position corresponding to the value of the target position channel of the PLC.

(25) Push motion in progress (PUSHS) [PLC input signal]

This signal turns ON while push-motion operation is in progress.



The PUSHS signal will turn OFF once the actuator misses the load in push-motion operation, a pause command or the next move command is issued, or the servo turns off.

(For the timing of setting this signal, refer to (2), "Operation in the half direct mode" under 2.9, "Operation.")

(26) Load output judgment (LOAD) [PLC input signal] [Dedicated PCON function]

This signal is effective only during push-motion operation.

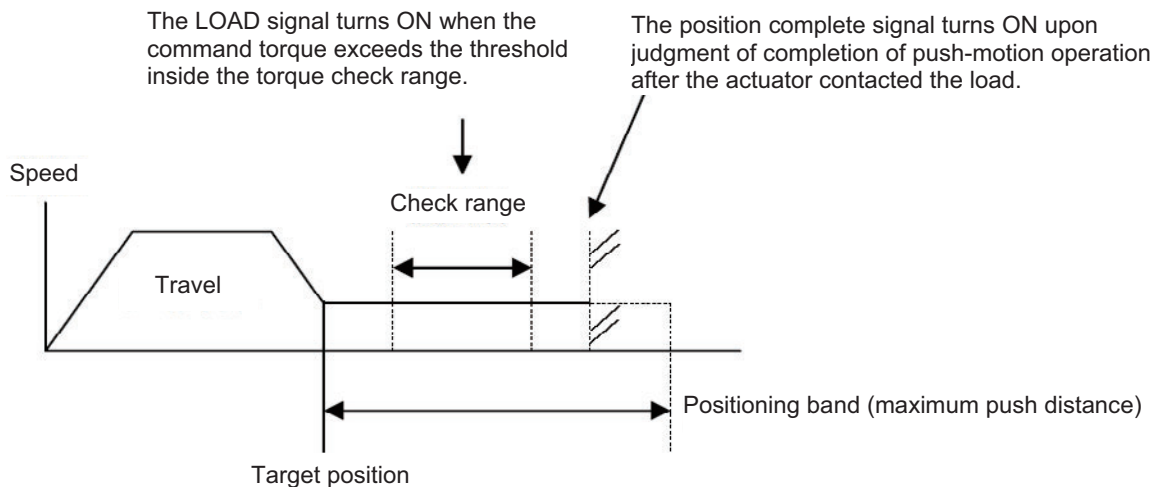
To use the LOAD signal in a press-fit application, the controller must know whether the specified load threshold has been reached during push-motion operation.

The load threshold and check range are set by the PLC, and the LOAD signal will turn ON when the command torque (motor current) exceeds the threshold inside the check range.

Under the LOAD signal, judgment is made based on whether the command torque has exceeded the threshold for the specified time cumulatively.

The processing procedure is the same as the procedure applicable to push judgment. The time of load output judgment can be changed freely using parameter No. 50, "Load output judgment time."

The status of this signal will be retained until the next move command is received.



- The push speed is set by parameter No. 34, "Push speed."
The factory setting varies with an individual actuator based on the characteristics of the actuator. Specify an appropriate speed by considering the material and shape of the load, etc.
 - Set parameter No. 50, "Load output judgment time."
 - Set parameter No. 51, "Torque check range" to "0 [Enable]."
 - The threshold check range is set by the zone boundary+ channel and zone boundary- channel of the PLC.
 - The threshold is set by the load current threshold channel of the PLC.
 - The positioning band is set by the positioning band channel of the PLC.
Set a positioning band slightly longer than the last position, by considering the mechanical variation of the load.
- For details, refer to the operation manual for the controller.

Warning:

- If the actuator contacts the load before the target position is reached, a servo error will occur. Pay extra attention to the positioning between the target position and the load.
- The actuator continues to push the load at the push current at standstill determined by the current limiting value.
Since the actuator is not stopped, exercise due caution when handling the actuator or load in this condition.

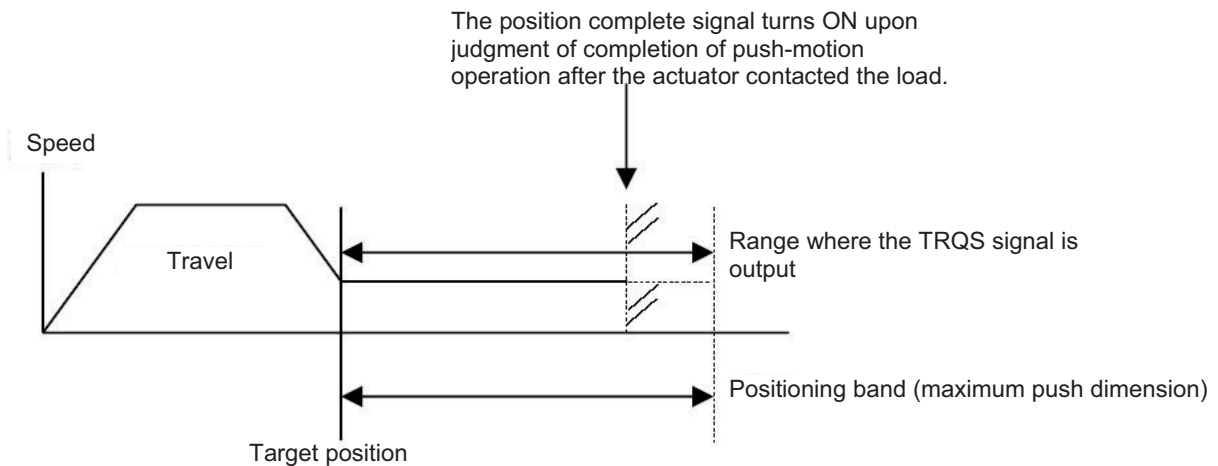
(27) Torque level (TRQS) [PLC input signal] [Dedicated PCON function]

This signal is effective only during push-motion operation.

If the motor current reaches the load threshold during push-motion operation (= while the actuator is moving within the positioning band), the TRQS signal will turn ON.

Since the level of current is monitored, the ON/OFF status of this signal will also change when the current changes.

The speed at which the actuator can push the load varies depending on the motor and lead. To set a desired speed, therefore, the applicable parameters must be adjusted.



- The push speed is set by parameter No. 34, "Push speed."
The factory setting varies with an individual actuator based on the characteristics of the actuator. Specify an appropriate speed by considering the material and shape of the load, etc.
 - Set parameter No. 50, "Load output judgment time."
 - Set parameter No. 51, "Torque check range" to "1 [Invalid]."
 - The threshold is set by the load current threshold channel of the PLC.
 - The positioning band is set by the positioning band channel of the PLC.
Set a positioning band slightly longer than the last position, by considering the mechanical variation of the load.
- For details, refer to the operation manual for the controller.

Warning:

- If the actuator contacts the load before the target position is reached, a servo error will occur. Pay extra attention to the positioning between the target position and the load.
- The actuator continues to push the load at the push current at standstill determined by the current limiting value.
Since the actuator is not stopped, exercise due caution when handling the actuator or load in this condition.

(28) Stopping control mode (SMOD) [PLC output signal] [Dedicated PCON function]

One general characteristic of pulse motors is that their holding current at standstill is greater compared to AC servo motors. Accordingly, an energy-saving mode is provided to help reduce the power consumption in a standstill state in applications where the actuator remains stationary for a long period at standby positions.

SMOD = ON: Use the full-servo control mode while standing by

SMOD = OFF: Do not use the full-servo control mode while standing by

- Full-servo control mode
The pulse motor is servo-controlled to reduce the holding current.
Although the specific level of current reduction varies depending on the actuator model, load condition, etc., the holding current generally drops to approx. 1/2 to 1/4.
The actual holding current can be checked on the current monitor screen of the PC software.
(Note) Micro-vibration or noise may generate in conditions where an external force is applied and also depending on the position at which the actuator is stopped.

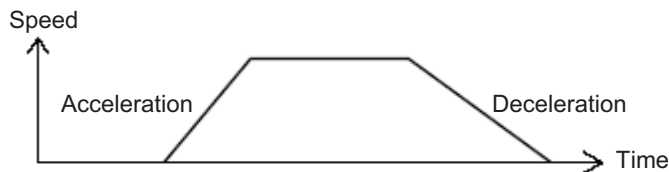
Use this mode after confirming that it will not negatively affect any part of the whole system.

(29) Acceleration/deceleration mode (MOD1, MOD0)

[PLC output signal] [Dedicated ACON function]

These signals are used to select the acceleration/deceleration pattern characteristics. Select a desired mode before issuing an actuator move command.

MOD1	MOD0	Pattern name	Remarks
OFF	OFF	Trapezoid pattern	Factory setting
OFF	ON	S-motion	
ON	OFF	Primary delay filter	
ON	ON	Not available.	

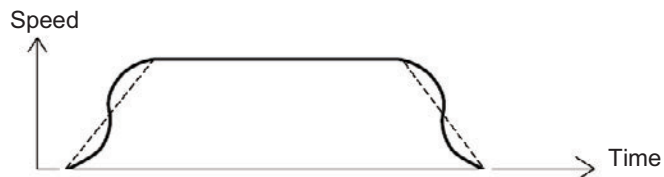
Trapezoid pattern

- * The acceleration and deceleration are set in the "Acceleration" and "Deceleration" fields of the position data table.

S-motion

The actuator accelerates along a curve that increases gradually at first and then rises rapidly in the middle.

Use this mode if you want to set a high acceleration/deceleration to meet the tact time, but also want the actuator to accelerate/decelerate gradually at start of movement and immediately before stopping.



- * The S-motion level is set by parameter No. 56, "S-motion ratio setting." The setting unit is % and the setting range is 0 to 100.

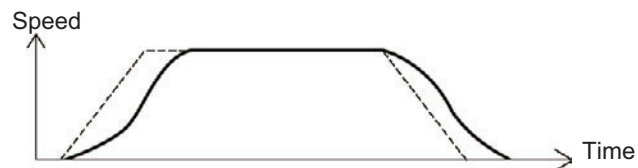
(The above graph assumes a S-motion ratio of 100 %.)

If "0" is set, the S-motion mode will become invalid.

Take note that this mode will not be reflected in jog or inch operation performed from a PC or teaching pendant.

Primary delay filter

The acceleration/deceleration curve is more gradual than that of linear acceleration/deceleration (trapezoid pattern). Use this mode if you don't want the load to receive micro-vibration during acceleration/deceleration.



- * The primary delay level is set by parameter No. 55, "Primary filter time constant for position command." The minimum input unit is 0.1 msec and the setting range is 0.0 to 100.0.
- If "0" is set, the primary delay mode will become invalid.
- Take note that this mode will not be reflected in jog or inch operation performed from a PC or teaching pendant.

2.8 I/O Signal Timings

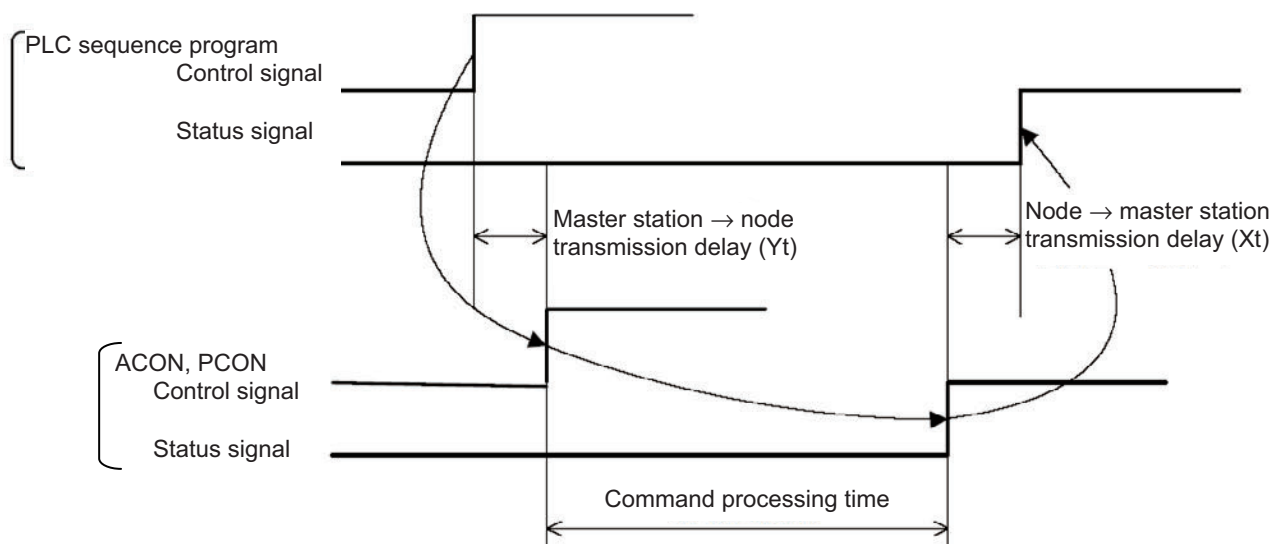
The maximum response time after a control signal is turned ON to operate the ROBO Cylinder in a PLC sequence program, until a corresponding response (status) signal is returned to the PLC, is expressed by the formula below:

Maximum response time (msec) = $Y_t + X_t + 3$ + command processing time (operation time, etc.)

Y_t : Master station → node transmission delay
 X_t : Node → master station transmission delay

} Field network transmission delay

For the master station → node transmission delay (Y_t) and node → master station transmission delay (X_t), refer to the operation manuals for the DeviceNet master unit and PLC installed in the master unit.



2.9 Operation

This section describes the timings of basic operations in the position/simple direct mode, half direct mode and full direct mode by using examples.

For the operation timings in the remote I/O mode and remote I/O mode 2, refer to the operation manual for the controller.

(In remote I/O mode 2, read the current position and current speed from the respective channels of the PLC, as deemed appropriate.)

(1) Operation in the position/simple direct mode

The actuator is operated by writing the position data to the target position channel of the PLC and specifying the speed, acceleration/deceleration, positioning band, push-motion current-limiting value, etc., using the position table.

- Example of operation (normal positioning operation)

(Preparation) Set all position data other than the target position (speed, acceleration/deceleration, positioning band, etc.) in the position table.

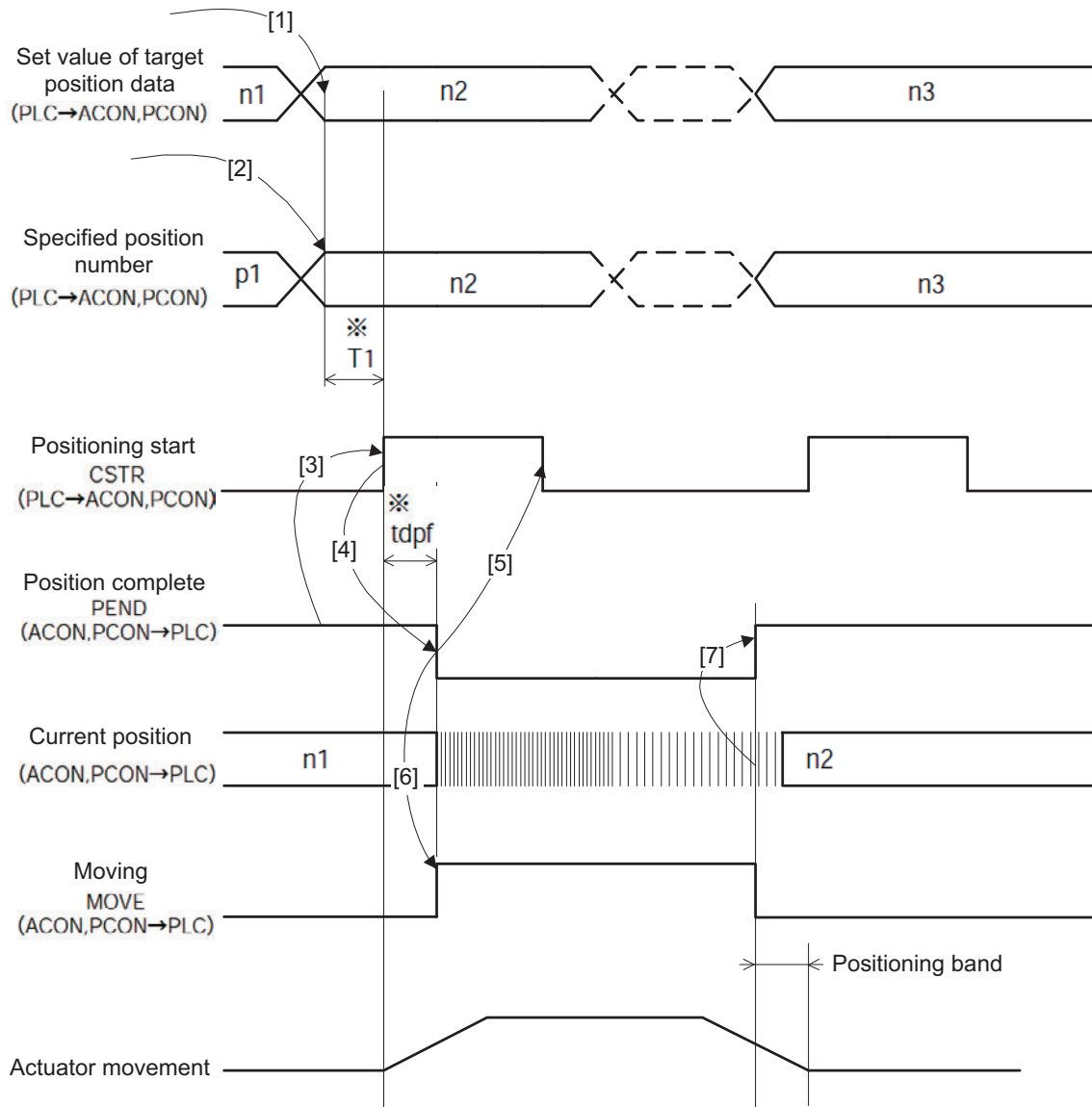
Turn the position/simple-direct switching (PMOD) signal ON.

- [1] Set the target position data to the target position channel.
- [2] Set the position number under which the position, acceleration/deceleration, etc., were set, to the specified position number channel.
- [3] Turn the positioning start (CSTR) signal ON while the position complete (PEND) signal is ON or moving (MOVE) signal is OFF.
The data set in [1] and [2] are read by the controller at the leading edge of the CSTR signal.
- [4] The PEND turns OFF upon an elapse of tpdf after the CSTR signal has turned ON.
- [5] Turn the CSTR signal OFF after confirming that the PEND signal is OFF or MOVE signal is ON. Do not change the value of the target position channel until the CSTR signal is turned OFF.
- [6] The MOVE signal turns ON simultaneously as the PEND signal turns OFF.
- [7] The current position data is constantly updated. Once the remaining travel has fallen within the positioning band set by the position data, the PEND signal turns ON if the CSTR signal is OFF, and the completed position number is output to the completed position number channel.
If the completed position number channel is to be read upon completion of positioning, therefore, wait for an appropriate period (= until the actuator moves by the remaining travel) after the PEND signal has turned ON. Also take note that the current position data may change slightly due to vibration, etc., even while the actuator is stopped.
- [8] The target position data can be changed while the actuator is moving.
To change the target position, change the target position data, wait for at least the scan time of the PLC, and then turn the CSTR signal ON.
Change the CSTR signal after an elapse of at least the scan time of the PLC.

- Example of operation (push-motion operation)

In the case of push-motion operation, the current-limiting value is set in the "Push" field of the position data table in the preparation stage.

Perform positioning to the position number under which the value was set in the "Push" field, and the actuator will perform push-motion operation.



*T1: Make sure " $T1 \geq 0 \text{ ms}$ " is satisfied by considering the scan time of the host controller.

* $Yt + Xt \leq \text{tdpf} \leq Yt + Xt + 3 \text{ (msec)}$

(2) Operation in the half direct mode

The actuator is operated by specifying the data to the target position channel, positioning band channel, specified speed channel, acceleration/deceleration channel and push-motion current-limiting value channel of the PLC.

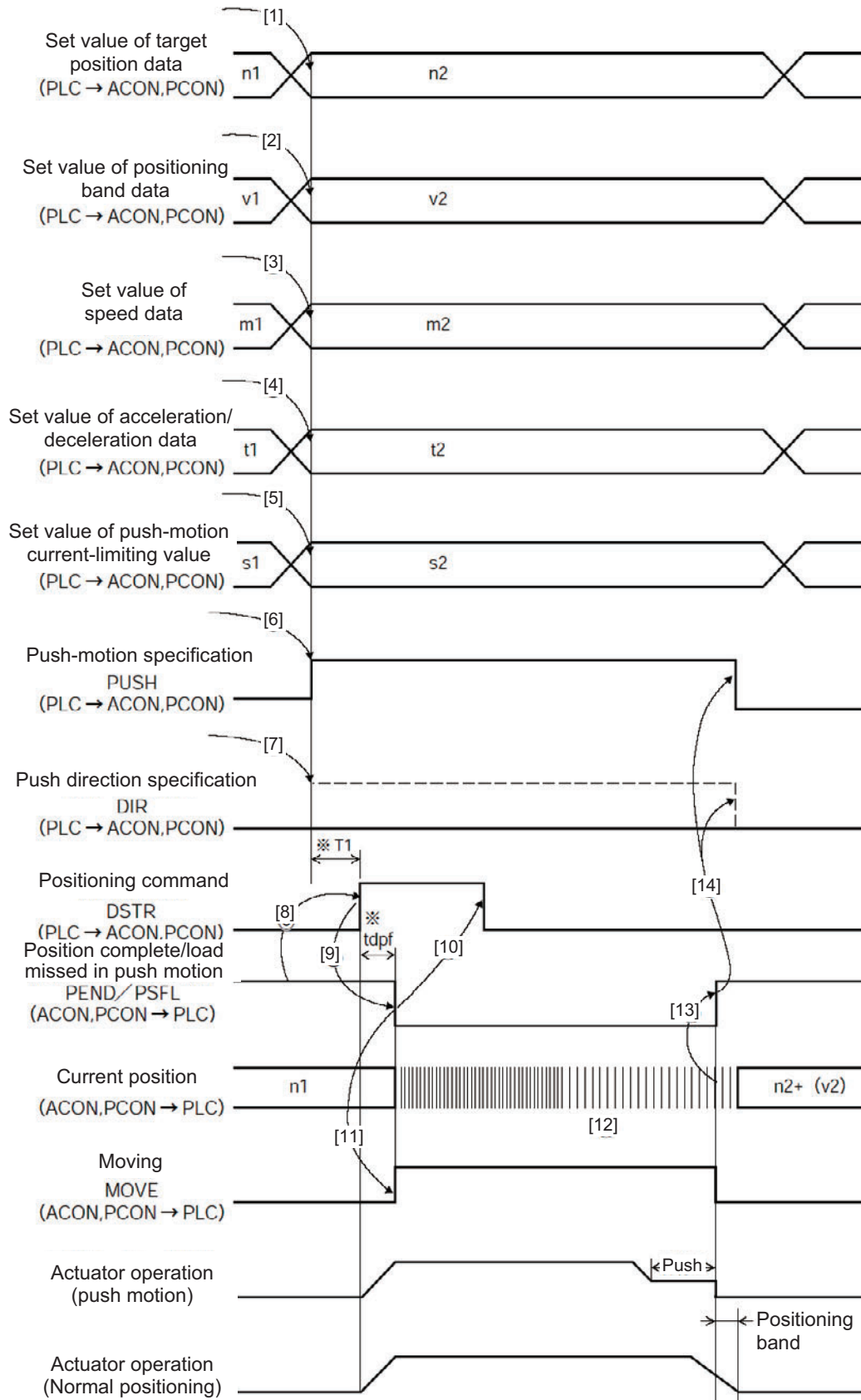
● Example of operation (push-motion operation)

- [1] Set the target position data to the target position channel.
- [2] Set the positioning band data to the positioning band channel.
- [3] Set the speed data to the speed channel.
- [4] Set the acceleration/deceleration data to the acceleration/deceleration channel.
- [5] Set the push-motion current-limiting data to the push-motion current-limiting value channel.
- [6] Turn the push direction (PUSH) signal ON.
- [7] Specify the push direction using the push direction specification (DIR) signal. (Refer to 2.7.7 (22).)
- [8] Turn the positioning command (DSTR) signal ON while the position complete (PEND) signal is ON or moving (MOVE) signal is OFF.
The data set in [1] to [5] are read by the controller at the leading edge of the DSTR signal.
- [9] The PEND turns OFF upon an elapse of tpdf after the DSTR signal has turned ON.
- [10] Turn the DSTR signal OFF after confirming that the PEND signal is OFF or MOVE signal is ON. Do not change the value of each channel until the DSTR signal is turned OFF.
- [11] The MOVE signal turns ON simultaneously as the PEND signal turns OFF.
- [12] The current position data is constantly updated.
- [13] The PEND signal turns ON when the motor current has reached the current-limiting value set in [5] while the DSTR signal is OFF. (Completion of push-motion operation)
Even when the positioning band set in [2] has been reached, the load missed in push motion (PSFL) signal does not turn ON if the motor current has yet to reach the current-limiting value set in [5]. In this case, the PEND signal does not turn ON. (The actuator missed the load in push-motion operation.)
- [14] Turn the PUSH signal OFF after the PEND or PSFL signal has turned ON.

● Example of operation (normal positioning operation)

For normal positioning operation, set the signal in [6] to OFF.

Once the remaining travel has fallen within the positioning band set by the position data, the PEND signal turns ON if the DSTR signal is OFF.



*T1: Make sure " $T1 \geq 0$ ms" is satisfied by considering the scan time of the host controller.
 *Yt + Xt \leq tdpf \leq Yt + Xt + 3 (msec)

(3) Operation in the full direct mode

The actuator is operated by specifying all conditions required for positioning to channels such as the target position channel and positioning band channel of the PLC.

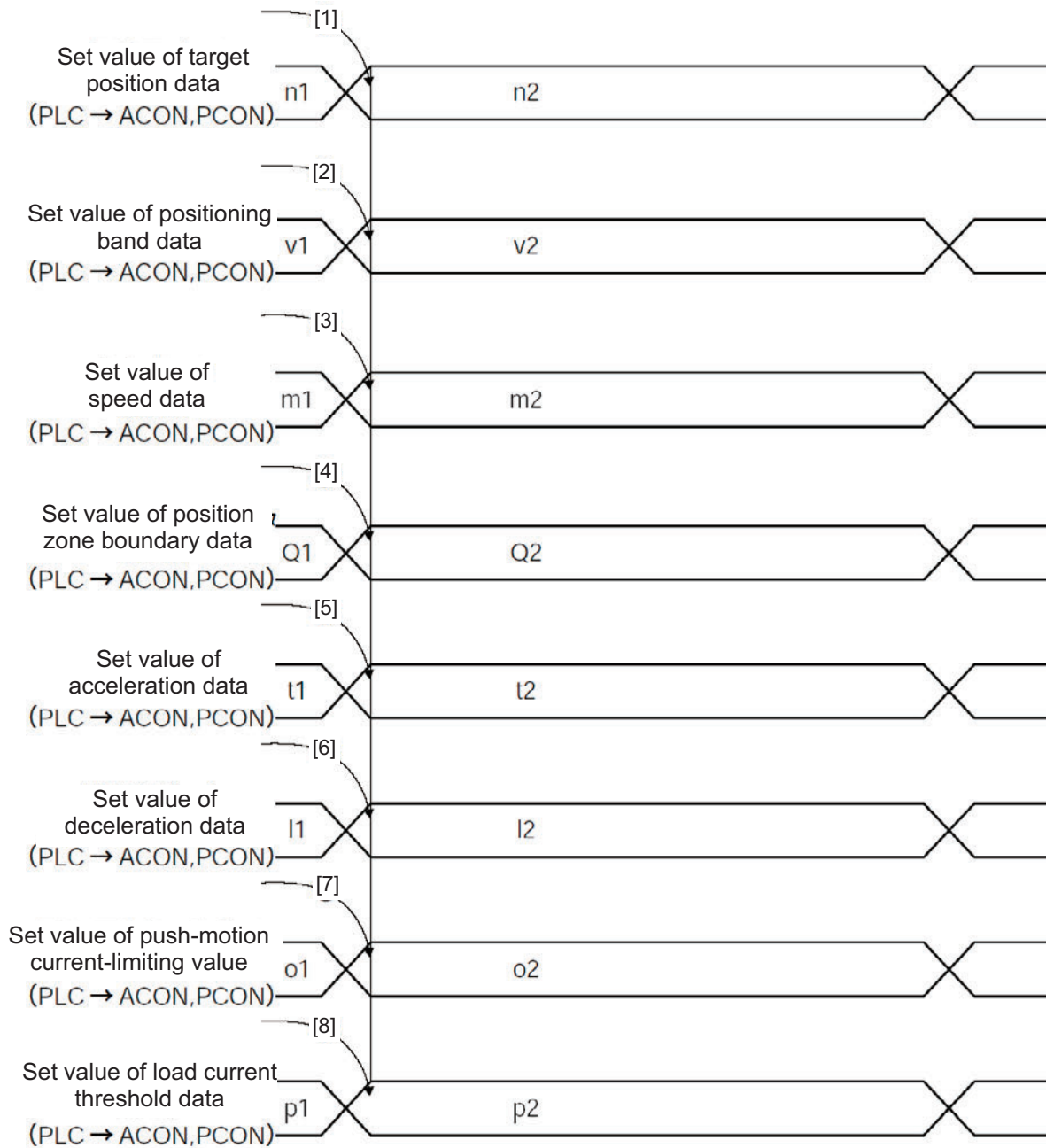
- Example of operation (push-motion operation)

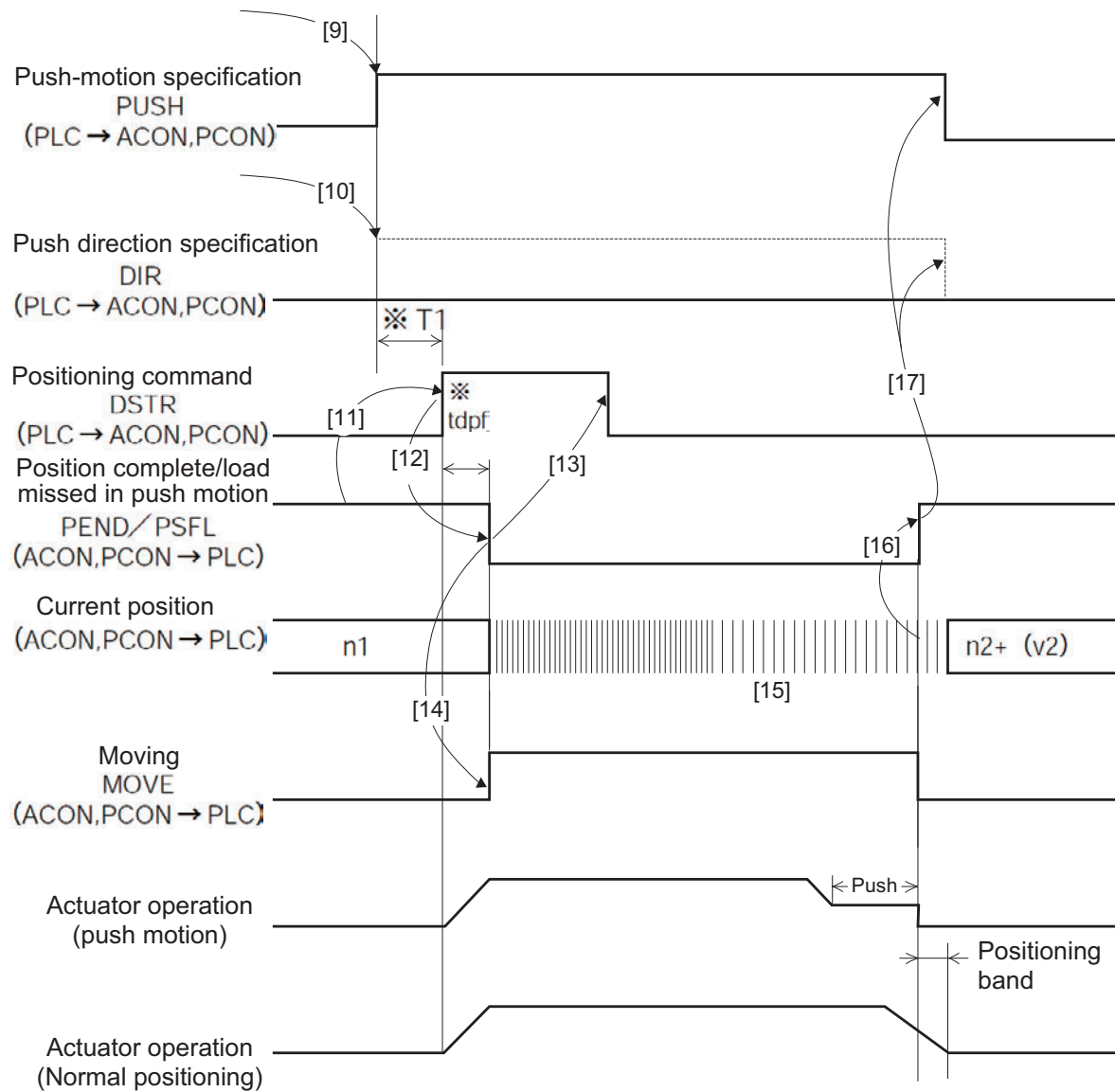
- [1] Set the target position data to the target position channel.
- [2] Set the positioning band data to the positioning band channel.
- [3] Set the speed data to the speed channel.
- [4] Set the boundary data for position zone output to the zone boundary+ channel and zone boundary- channel.
- [5] Set the acceleration data to the acceleration channel.
- [6] Set the deceleration data to the deceleration channel.
- [7] Set the push-motion current-limiting data to the push-motion current-limiting value channel.
- [8] Set the load current threshold data to the specification channel for load current threshold.
- [9] Turn the push direction (PUSH) signal ON.
- [10] Specify the push direction using the push direction specification (DIR) signal. (Refer to 2.7.7 (22).)
- [11] Turn the positioning command (DSTR) signal ON while the position complete (PEND) signal is ON or moving (MOVE) signal is OFF.
The data set in [1] to [8] are read by the controller at the leading edge of the DSTR signal.
- [12] The PEND turns OFF upon an elapse of tpdf after the DSTR signal has turned ON.
- [13] Turn the DSTR signal OFF after confirming that the PEND signal is OFF or MOVE signal is ON. Do not change the value of each channel until the DSTR signal is turned OFF.
- [14] The MOVE signal turns ON simultaneously as the PEND signal turns OFF.
- [15] The current position data is constantly updated.
- [16] The PEND signal turns ON when the motor current has reached the current-limiting value set in [7] while the DSTR signal is OFF. (Completion of push-motion operation)
Even when the positioning band set in [2] has been reached, the load missed in push motion (PSFL) signal does not turn ON if the motor current has yet to reach the current-limiting value set in [7]. In this case, the PEND signal does not turn ON. (The actuator missed the load in push-motion operation.)
- [17] Turn the PUSH signal OFF after the PEND or PSFL signal has turned ON.

- Example of operation (normal positioning operation)

For normal positioning operation, set the signal in [9] to OFF.

Once the remaining travel has fallen within the positioning band set by the position data, the PEND signal turns ON if the DSTR signal is OFF.





*T1: Make sure " $T1 \geq 0$ ms" is satisfied by considering the scan time of the host controller.

* $Yt + Xt \leq tdpf \leq Yt + Xt + 3$ (msec)

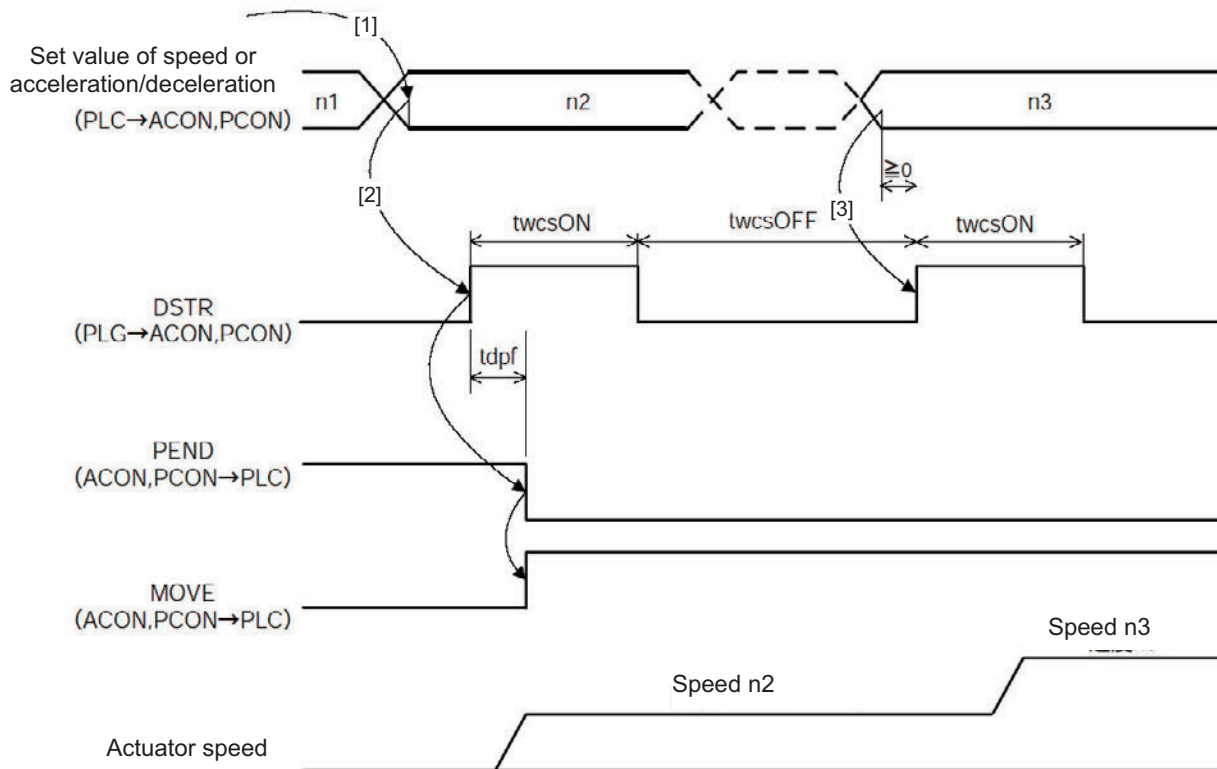
(4) Data change during movement

In the half direct mode or full direct mode, the value currently set to a given channel among the channels for target position data, acceleration/deceleration data, speed data, positioning band and push-motion current-limiting value, can be changed while the actuator is moving.

After a desired data has been changed, keep the positioning command (DSTR) signal "ON" for at least t_{dpf} .

Also make sure that after the DSTR is turned "OFF," the signal will not be turned "ON" again until at least a time corresponding to " $twcsON + twcsOFF$ " elapses.

An example of changing the speed or acceleration/deceleration is shown in the figure below.



$$twcsON \geq Yt + Xt + 3 \text{ (msec)}$$

$$twcsOFF \geq Yt + Xt + 3 \text{ (msec)}$$

$$\ast Yt + Xt \leq t_{pdf} \leq Yt + Xt + 3 \text{ (msec)}$$

⚠ Caution

1. If the speed is not set or "0" speed is set, the actuator will remain stationary and no alarm will generate.
2. If the speed is changed to "0" while the actuator is moving, the actuator will decelerate to a stop and no alarm will generate.
3. Even when the acceleration/deceleration or speed data alone is changed while the actuator is moving, the target position data must also be set.
4. Even when the target position alone is changed while the actuator is moving, the acceleration/deceleration and speed data must also be set.

2.10 DeviceNet Parameters

Parameters relating to DeviceNet are Nos. 84 to 87 and 90.

Category: C: External interface parameter

No.	Category	Symbol	Name	Factory-set default
1			For parameter Nos. 1 to 83, refer to the operation manual for the controller.	
83				
84	C	FMOD	Fieldbus operation mode	0
85	C	NADR	Fieldbus node address	63
86	C	FBRs	Field bus baud rate	0
87	C	NTYP	Network type	2
90	C	FMIO	Fieldbus I/O format	3

- Fieldbus operation mode (No. 84, FMOD)

Specify the operation mode in parameter No. 84 using a value between 0 and 4.

Value set in parameter No. 84	Mode	Number of occupied channels	Description
0 (Factory setting)	Remote I/O mode	1CH	Operation using PIOs (24-V I/Os) is performed via DeviceNet.
1	Position/simple direct mode	4CH	The actuator can be operated by specifying the target position directly and numerically or based on a value in the position data table. Other values required for operation are set in the position data table.
2	Half direct mode	8CH	The actuator is operated by specifying all data other than the target position, such as speed, acceleration/deceleration, push-motion current, directly and numerically.
3	Full direct mode	16CH	The actuator is operated by directly specifying all values relating to position control.
4	Remote I/O mode 2	6CH	The functions available in the remote I/O mode are combined with the current-position read mode and current-speed read mode.

- Fieldbus node address (No. 85, NADR)

Specify the node address of the remote station in parameter No. 85.

Setting range: 0 to 63 (The factory setting is "63.")

- Fieldbus baud rate (No. 86, FBRs)

The baud rate is automatically set to the same value as the baud rate set in the master. Accordingly, you need not set the baud rate.

- Network type (No. 87, NTYPE)

The network module type is specified in parameter No. 87. Do not change the default setting.

- Fieldbus I/O format (No. 90, FMIO)

Addresses in the PLC are assigned in units of 16 points (1 channel) based on the node address set in the controller and number of occupied channels in each operation mode.

By changing the setting of parameter No. 90, data elements can be swapped within a boundary of two words or less in units of bytes during communication using the I/O areas of the PLC.

Value set in parameter No. 90	Description
0	Data is not swapped. The data is sent directly to the PLC. (Refer to Example i.)
1	The upper byte and lower byte comprising the upper word are swapped, and the upper byte and lower byte comprising the lower word are also swapped. (Refer to Example ii.)
2	The upper word and lower word are swapped for word registers. (Refer to Example iii.)
3 (factory setting)	The upper byte and lower byte comprising the upper word are swapped, and the upper byte and lower byte comprising the lower word are also swapped. In addition, the upper word and lower word are swapped for word registers. (Refer to Example iv.)

(Example i) Set value = "0"

● indicates ON, while ○ indicates OFF.

ACON, PCON Input register	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	○	●	○	○	●	○	○	○	●	●	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hexa decimal data	1				2				3				4				A				B				C				D			

↑

PLC : Output channel	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	○	●	○	○	●	○	○	○	●	●	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hexa decimal data	1				2				3				4				A				B				C				D			

ACON, PCON Output register	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	○	●	○	○	●	○	○	○	●	●	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hexa decimal data	1				2				3				4				A				B				C				D			

↓

PLC : Input channel	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	○	●	○	○	●	○	○	○	●	●	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hexa decimal data	1				2				3				4				A				B				C				D			

(Example ii) Set value = "1"

● indicates ON, while ○ indicates OFF.

ACON, PCON Input register	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	●	●	○	●	○	○	○	○	○	○	○	○	○	○	●	●	○	○	●	●	○	●	○	○	○	○	○	○	○	○
Hexa decimal data	3				4				1				2				C				D				A				B			

PLC : Output channel	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hexa decimal data	1				2				3				4				A				B				C				D			

ACON, PCON Output register	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hexa decimal data	3				4				1				2				C				D				A				B			

PLC : Input channel	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hexa decimal data	1				2				3				4				A				B				C				D			

(Example iii) Set value = "2"

● indicates ON, while O indicates OFF.

ACON、PCON Input register	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	
ON/OFF	●	○	●	○	●	○	●	●	●	●	○	○	●	●	○	●	○	○	○	●	○	○	●	○	○	○	○	●	●	○	●	○	○
Hexa decimal data	A				B				C				D				1				2				3				4				

PLC : Output channel	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	○	●	○	○	●	○	○	○	○	●	●	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hexa decimal data	1				2				3				4				A				B				C				D			

ACON, PCON Output register	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	●	○	●	○	●	○	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hexa decimal data	A				B				C				D				1				2				3				4			

PLC : Input channel	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hexa decimal data	1				2				3				4				A				B				C				D			

(Example iv) Set value = "3"

● indicates ON, while ○ indicates OFF.

ACON, PCON Input register	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	●	●	○	○	●	●	○	●	●	○	●	○	●	○	●	○	○	○	●	○	○	●	○	○	○	○	○	○	○	○	○	
Hexa decimal data	C				D				A				B				3				4				1				2			

PLC : Output channel	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	○	●	○	○	●	○	○	○	●	●	○	●	○	○	●	○	●	○	●	○	●	●	●	●	○	○	●	●	○	●
Hexa decimal data	1				2				3				4				A				B				C				D			

ACON, PCON Output register	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	●	●	○	○	●	●	○	●	●	○	●	○	○	○	●	●	○	○	●	○	○	●	○	○	○	○	○	○	○	○	○	○
Hexa decimal data	C				D				A				B				3				4				1				2			

PLC : Input channel	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	○	●	○	○	●	○	○	○	●	●	○	●	○	○	●	○	●	○	●	○	●	●	●	●	○	○	●	●	○	●
Hexa decimal data	1				2				3				4				A				B				C				D			

2.11 Troubleshooting

- Alarm messages, causes and remedial actions

If an alarm occurs, a corresponding simple alarm code will be indicated by the completed position number (four bits of PM1 to PM8) in the remote I/O mode and remote I/O mode 2.

In the position/simple direct mode, this simple alarm code is output to the (n+2) channel.

In the half direct mode and full direct mode, this simple alarm code is output to the (n+6) channel.

[1] Check the generated alarm code using the monitor function of the PLC, etc., or connect the RC PC software or teaching pendant and check the code on the status monitor screen.

[2] Look up the applicable alarm code in the alarm list provided in the operation manual for the controller.

[3] Take appropriate actions according to the explanation given for the applicable code.

For the alarm codes listed in the table below, take the specified action.

Code	Error name	ID (*1)	RES (*2)	Cause/action
0F2	Fieldbus module error	05	X	Cause: A fieldbus module error has been detected. Action: Check the parameter.
0F3	Fieldbus module not detected	04	X	Cause: The module could not be detected. Action: Reconnect the power. If the error persists, contact IAI.

(*1) ID → Simple alarm code

(*2) RES → Whether or not the alarm can be reset = O: Alarm can be set / X: Alarm cannot be reset

2.12 CE Mark

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

3. SCON-CA

3.1 Operation Modes and Functions

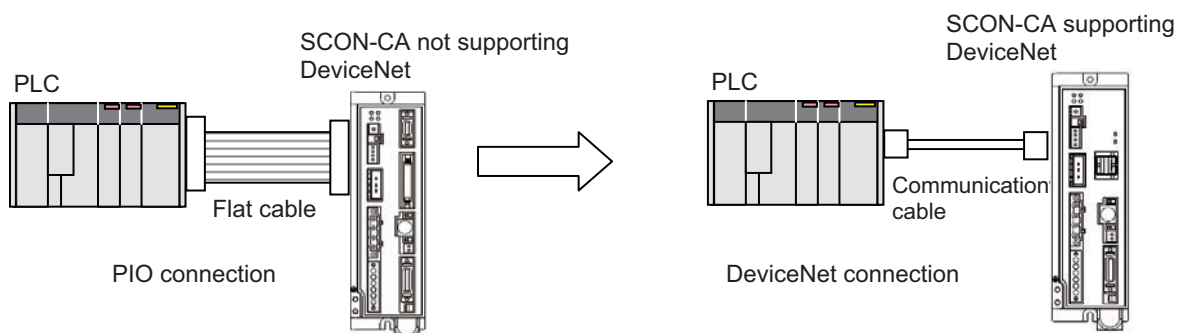
SCON-CA controllers supporting DeviceNet can be operated in a desired operation mode selected from the following nine modes.

Key function	Remote I/O mode	Position/simple direct mode	Half direct mode	Full direct mode	Remote I/O mode 2	Position/simple direct mode 2	Half direct mode 2	Remote I/O mode 3	Half direct mode 3
Number of occupied channels	1CH	4CH	8CH	16CH	6CH	4CH	8CH	6CH	8CH
Operation by position data specification	x	○(*1)	○	○	x	○(*1)	○	x	○
Direct speed/acceleration specification	x	x	○	○	x	x	○	x	○
Push-motion operation	○	○	○	○	○	○	○	○	○
Current position read	x	○	○	○	○	○	○	○	○
Current speed read	x	x	○	○	x	x	○	x	○
Operation by position number specification	○	○	x	x	○	○	x	○	x
Completed position number read	○	○	x	x	○	○	x	○	x
Maximum position table size	512	768	Not used	Not used	512	768	Not used	512	Not used
Force control	△(*2)	x	x	○	△(*2)	○	○	○	x
Vibration damping control	○	○	x	○	○	○	x	○	○
Servo gain switching	○	○	○	○	○	○	x	○	○

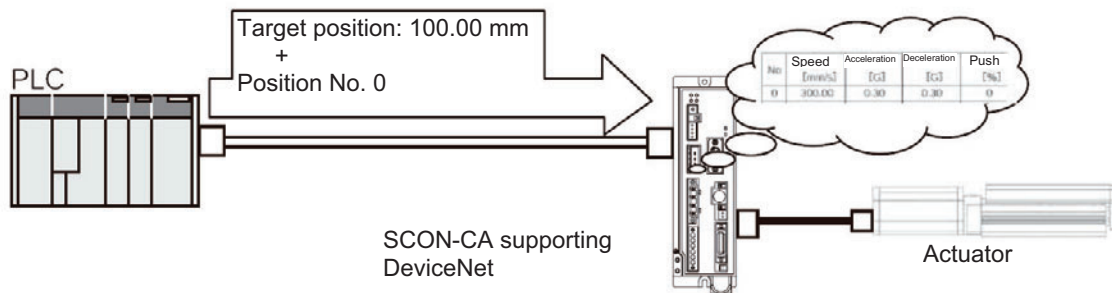
(*1) The actuator is operated by specifying all position data, other than positions, using position numbers.

(*2) These functions can be used when the PIO pattern is set to 6 or 7.

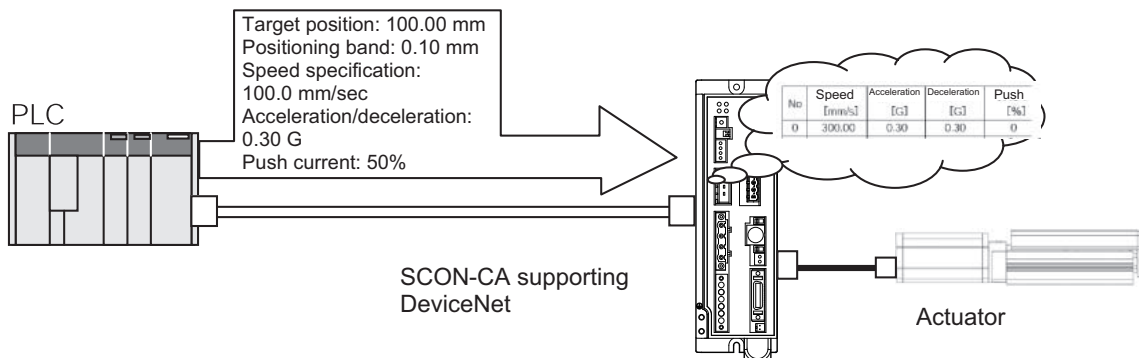
[1] Remote I/O mode: In this mode, the actuator is operated by PIOs (24-V I/Os) via DeviceNet communication.
Number of occupied channels: 1 channel



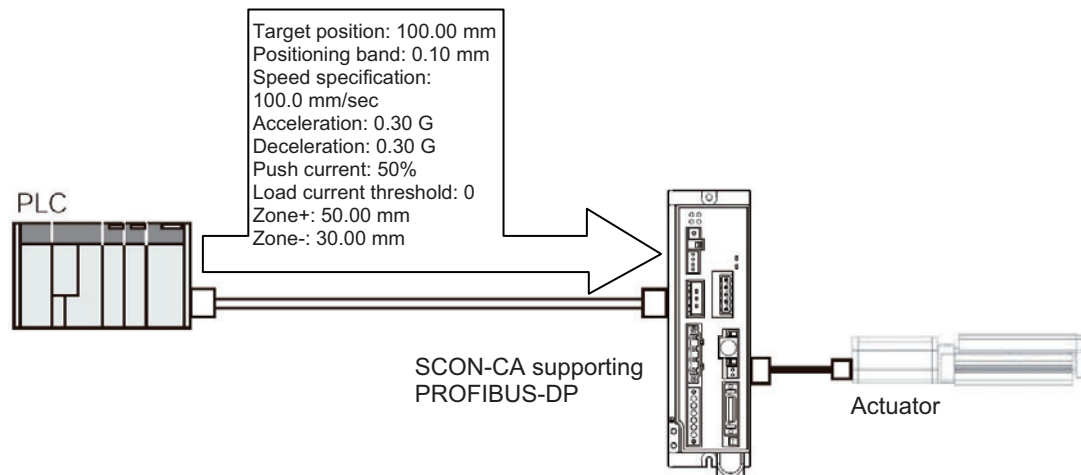
- [2] Position/simple direct mode: In this mode, the actuator is operated by specifying position numbers. You can select whether to specify the target position directly as a value, or use a value registered in the position data table, by switching a control signal. For the speed, acceleration/deceleration, positioning band, etc., values preregistered in the position data table are used. Up to 768 position data points can be set. Number of occupied channels: 4CH



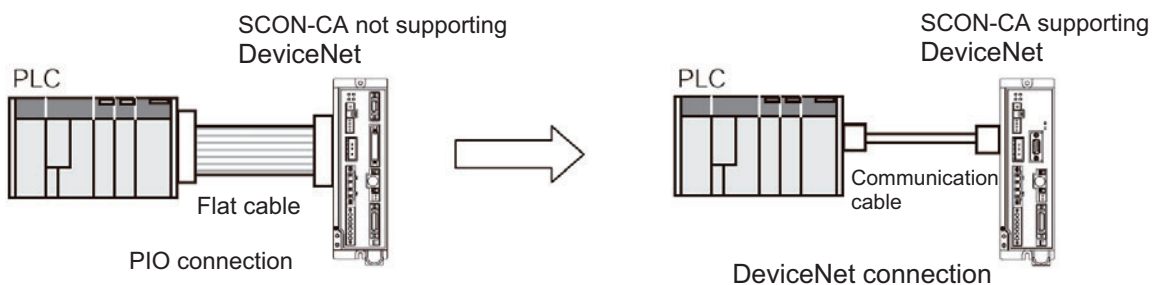
- [3] Half direct mode: In this mode, the actuator is operated by specifying the speed, acceleration/deceleration and push current, in addition to the target position, directly as values. Number of occupied channels: 8CH



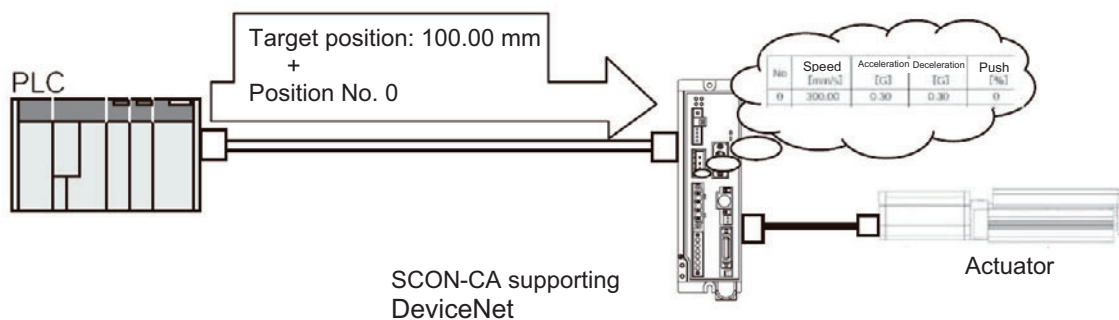
- [4] Full direct mode: In this mode, the actuator is operated by specifying all values relating to position control (target position, speed, acceleration/deceleration, etc.) directly as values.
Number of occupied channels: 16CH



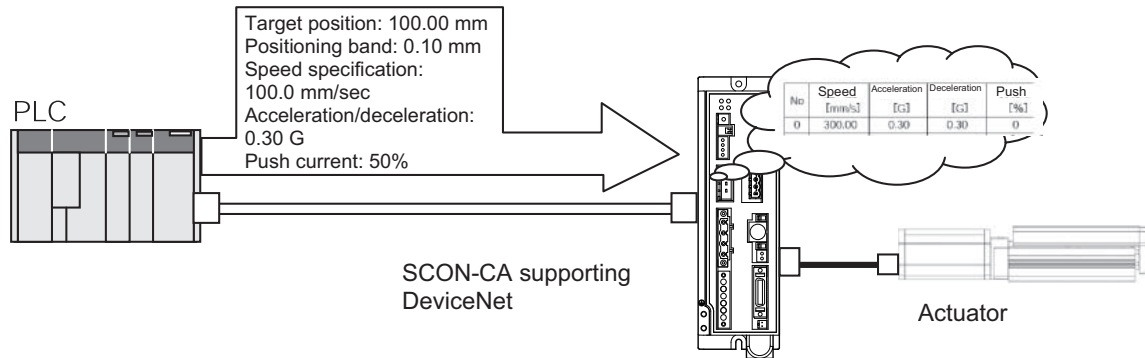
- [5] Remote I/O mode 2: In this mode, the actuator is operated by PIOs (24-V I/Os) via DeviceNet communication.
The current-position and command-current read functions are available in addition to the functions provided in mode [1].
Number of occupied channels: 6CH



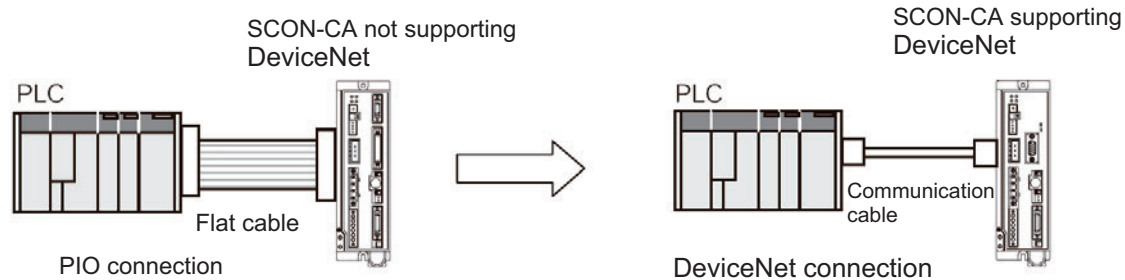
- [6] Position/simple direct mode 2: In this mode, the actuator is operated by specifying position numbers.
In this mode, the force control function is available instead of the teaching function and zone function available in mode [2].
Number of occupied channels: 4CH



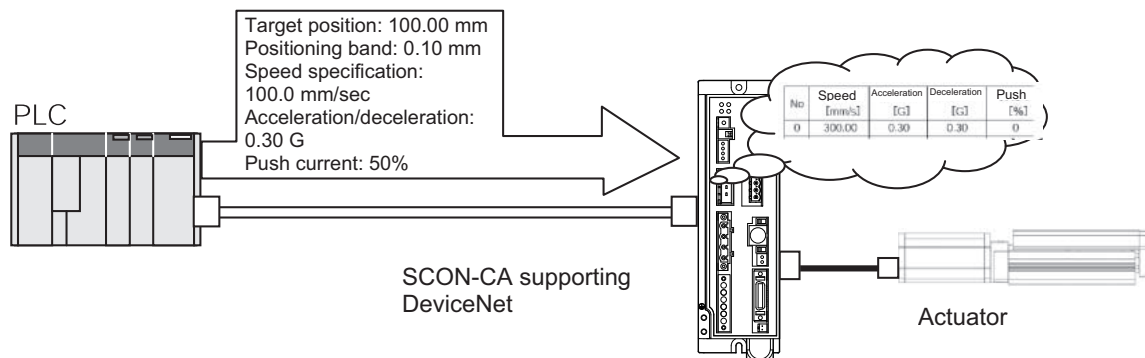
- [7] Half direct mode 2: In this mode, the actuator is operated by specifying the speed, acceleration/deceleration and push current, in addition to the target position, directly as values. Unlike in mode [3], command current cannot be read in this mode. However, load cell data can be read instead. This mode also supports force control. Number of occupied channels: 8CH



- [8] Remote I/O mode 3: In this mode, the actuator is operated by DeviceNet instead of PIO (24 V I/O). This mode provides all functions available in mode [1], plus the current position read function and load cell data read function. Number of occupied channels: 6CH



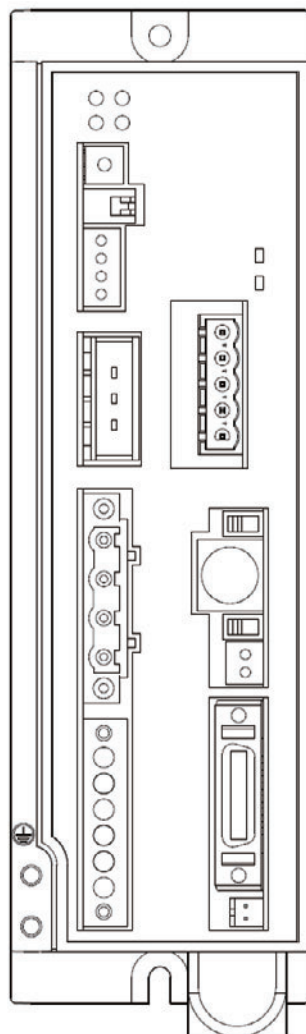
- [9] Half direct mode 3: In this mode, the actuator is operated by specifying the speed, acceleration/deceleration and push current, in addition to the target position, directly as values. In this mode, the vibration damping control function is supported instead of the jog function available in mode [3]. Number of occupied channels: 8CH



3.2 Model Numbers

The model numbers of SCON-CA controller supporting DeviceNet are indicated as follows, respectively:

- SCON-CA-□-DV-□



3.3 Interface Specifications

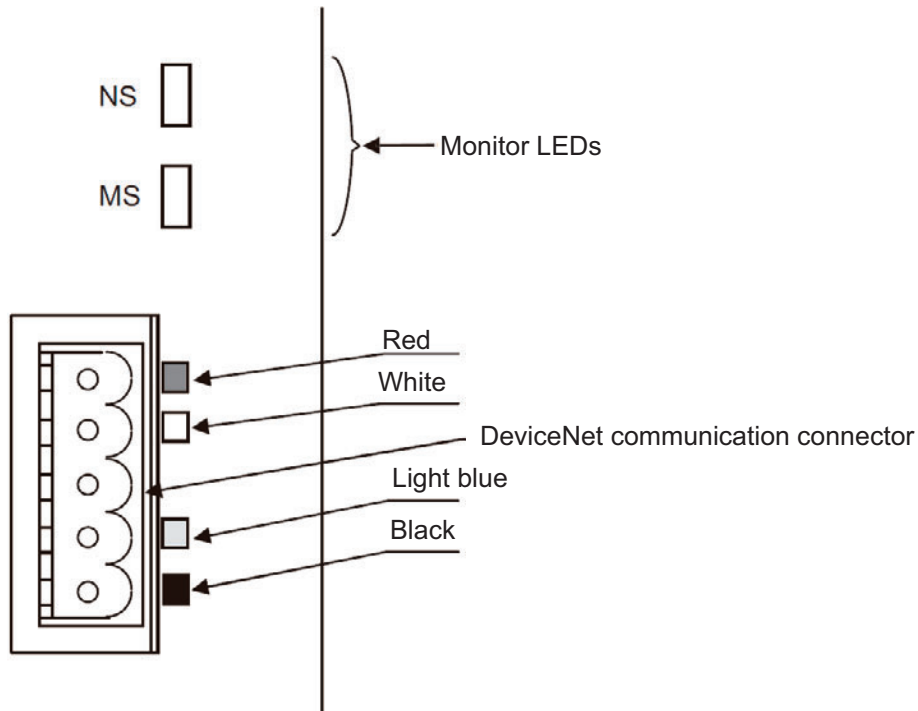
Item	Specification			
Communication protocol	DeviceNet 2.0			
	Group 2 only server			
	Network-powered isolation node			
Communication specification	Master-slave connection		Bit strobe	
			Polling	
Baud rate	Automatically set to the same value as the band rate set in the master			
Communication cable length	Baud rate	Maximum network length	Maximum branch line length	Total branch line length
	500 kbps	100 m	6 m	39 m
	250 kbps	250 m		78 m
	125 kbps	500 m		156 m
	Note) When a large-size DeviceNet cable is used.			
Communication power supply	24 VDC (supplied from DeviceNet)			
Consumption current of communication power supply	60 mA			
Number of occupied nodes	1 node			
Connector	MSTBA2.5/5-G-5.08AU M (*1) by Phoenix Contact			

(*1) The cable-end connector is a standard accessory.
SMSTB2.5/5-ST-5.08AU by Phoenix Contact

3.4 DeviceNet Interface

3.4.1 Name of Each Part

The name of each part relating to DeviceNet is shown.



3.4.2 Monitor LED Indicators

The two LEDs, MS and NS, provided on the front panel of the controller are used to check the node (controller) condition and network condition.

The LEDs illuminate in two colors (orange and green), and you can monitor the conditions listed in the table below based on the illumination status and color of each LED.

MS (Module Status) LED: Condition of the node (controller)

NS (Network Status) LED: Condition of the network

LED	Color	Illumination status	Description (meaning)
MS	Green	Steady light	The board is operating normally.
		Blinking	A hardware error occurred. The error may be reset by reconnecting the power.
	Orange	Steady light	A hardware error occurred. The board must be replaced.
		Blinking	A user setting error, configuration error or other minor error is present. These errors can be reset by setting the applicable item again, etc.
	-	Off	DeviceNet is initializing or the power is not supplied.
NS	Green	Steady light	Network connection has been established and the board is communicating normally.
		Blinking	The board is online, but network connection is not yet established. Communication is stopped. (The network is normal.)
	Orange	Steady light	Node address duplication or bus-off state was detected. Communication is not possible.
		Blinking	A communication error occurred (communication time-out occurred).
	-	Off	The board is not online. DeviceNet power is not supplied.

Self test is performed when the power is turned on.

During the test, the monitor LEDs cycle in the following sequence:

- [1] NS turns off.
- [2] MS illuminates in steady green (approx. 0.25 second).
- [3] MS illuminates in steady orange (approx. 0.25 second).
- [4] MS illuminates in steady green.
- [5] NS illuminates in steady green (approx. 0.25 second).
- [6] NS illuminates in steady orange (approx. 0.25 second).
- [7] NS turns off.

When the self test is finished and the board starts communicating normally, both the MS and NS LEDs change to steady green.

3.5 Selecting (Setting) the Operation Mode

The operation mode is set using a parameter.

Set the mode selector switch on the front panel of the controller to the MANU position, and set parameter No. 84, "FMODE: Fieldbus operation mode" using the RC PC software (V8.00.00.00 or later). (Refer to 3.10, "DeviceNet Parameters.")

Set value	Operation mode	Number of occupied stations
0 (Factory setting)	Remote I/O mode	1CH
1	Position/simple direct mode	4CH
2	Half direct mode	8CH
3	Full direct mode	16CH
4	Remote I/O mode 2	6CH
5	Position/simple direct mode 2	4CH
6	Half direct mode 2	8CH
7	Remote I/O mode 3	6CH
8	Half direct mode 3	8CH

* If any other value is entered, an excessive input error will occur.

3.6 Setting the Node Address

The node address is set using a parameter.

Set parameter No. 85, "NADR: Fieldbus node address" using the RC PC software. (Refer to 3.10, "DeviceNet Parameters.")

Allowable setting range: 0 to 63 (The parameter has been set to "63" at the factory.)

(Note) Exercise caution to avoid node address duplication.

The nodes (controllers) are assigned in the order of their node address in the remote I/O address areas of the PLC. (This is when the mount assignment mode is selected. A different rule applies when a configurator is used.)

For details, refer to the operation manuals of the master unit and PLC installed in the master unit.

(Note) The baud rate is automatically set to the same value as the baud rate set in the master. Accordingly, you need not set the baud rate.

(Note) After you have set the parameter, reconnect the controller power and return the mode selector switch on the front panel of the controller to the AUTO position. If the switch remains in the MANU position, operation by the PLC cannot be performed.

3.7 Communicating with the Master Station

3.7.1 Operation Modes and Corresponding PLC I/O Areas

The channel assignments in each mode are shown below.

- PLC output → SCON-CA input (* n indicates the node address of each axis.)

PLC output area (channel)	SCON-CA DI and input data register					
	Remote I/O mode	Position/simple direct mode	Half direct mode	Full direct mode	Remote I/O mode 2	
	Number of occupied channels: 1CH	Number of occupied channels: 4CH	Number of occupied channels: 8CH	Number of occupied channels: 16CH	Number of occupied channels: 6CH	
n	Port number 0 to 15	Target position	Target position	Target position	Port number 0 to 15	
n+1		Specified position number	Positioning band	Positioning band	Occupied area	
n+2						Control signal
n+3			Acceleration/ deceleration	Zone boundary+		
n+4		Push-motion current-limiting value				Zone boundary-
n+5			Control signal	Acceleration		
n+6		Control signal 1			Deceleration	
n+7			Control signal 2	Push-motion current-limiting value		
n+8		Load current threshold				
n+9			Control signal 1			
n+10		Control signal 2				
n+11			Control signal 1			
n+12		Control signal 2				
n+13			Control signal 1			
n+14		Control signal 2				
n+15			Control signal 1			
	Control signal 2					

(Note) The areas denoted by “occupied area” are occupied according to the operation mode setting. These areas cannot be used for any other purpose. Also exercise caution to avoid node address duplication.

- PLC output → SCON-CA input side (* n indicates the node address of each axis.)

PLC output area (channel)	SCON-CA DI and input data register			
	Position/simple direct mode 2	Half direct mode 2	Remote I/O mode 3	Half direct mode 3
	Number of occupied channels: 4CH	Number of occupied channels: 8CH	Number of occupied channels: 6CH	Number of occupied channels: 8CH
n	Target position	Target position	Port number 0 to 15	Target position
n+1			Occupied area	
n+2	Positioning band	Positioning band		
n+3				Speed
n+4	Acceleration/ deceleration			
n+5		Push-motion current-limiting value		
n+6	Control signal			
n+7				
n+8				
n+9				
n+10				
n+11				
n+12				
n+13				
n+14				
n+15				

(Note) The areas denoted by “occupied area” are occupied according to the operation mode setting. These areas cannot be used for any other purpose. Also exercise caution to avoid node address duplication.

- SCON-CA output → PLC input side (* n indicates the node address of each axis.)

PLC input area (channel)	SCON-CA DI and output data register				
	Remote I/O mode	Position/simple direct mode	Half direct mode	Full direct mode	Remote I/O mode 2
	Number of occupied channels: 1CH	Number of occupied channels: 4CH	Number of occupied channels: 8CH	Number of occupied channels: 16CH	Number of occupied channels: 6CH
n	Port number 0 to 15	Current position	Current position	Current position	Port number 0 to 15
n+1		Completed position number (simple alarm ID)	Command current	Command current	Occupied area
n+2					Current position
n+3		Status signal			
n+4		Current speed	Current speed	Current speed	Command current
n+5					
n+6					
n+7					
n+8		Alarm code	Alarm code	Alarm code	
n+9					
n+10					
n+11					
n+12		Status signal	Status signal	Status signal	
n+13					
n+14					
n+15					

(Note) The areas denoted by “occupied area” are occupied according to the operation mode setting. These areas cannot be used for any other purpose. Also exercise caution to avoid node address duplication.

- SCON-CA output → PLC input side (* n indicates the node address of each axis.)

PLC output area (channel)	SCON-CA DI and input data register			
	Position/simple direct mode 2	Half direct mode 2	Remote I/O mode 3	Half direct mode 3
	Number of occupied channels: 4CH	Number of occupied channels: 8CH	Number of occupied channels: 6CH	Number of occupied channels: 8CH
n	Current position	Current position	Port number 0 to 15	Current position
n+1			Occupied area	
n+2	Completed position number (simple alarm ID)	Force feedback data	Current position	Command current
n+3	Status signal			
n+4		Current speed	Force feedback data	Current speed
n+5		Alarm code		
n+6			Status signal	
n+7				
n+8				
n+9				
n+10				
n+11				
n+12				
n+13				
n+14				
n+15				

(Note) The areas denoted by “occupied area” are occupied according to the operation mode setting. These areas cannot be used for any other purpose. Also exercise caution to avoid node address duplication.

3.7.2 Remote I/O Mode (Number of Occupied Channel: 1)

In this mode, the actuator is operated by specifying position numbers just like when PIOs (24-V I/Os) are used. Set desired position data using the RC PC software or teaching pendant.

The number of positions to which the actuator can be operated varies according to the setting of parameter No. 25, "PIO pattern."

The I/O specification of each PIO pattern is shown below. (For details, refer to the operation manual for the controller.)

Setting of parameter No. 25	Operation mode	I/O specification
0	Positioning mode	64 positioning points, 2 zone outputs
1	Teaching mode	64 positioning points, 1 zone output Positioning and jog operations are supported. The current position can be written under a specified position number.
2	256-point mode	256 positioning points, 1 zone output
3	512-point mode	512 positioning points, no zone output
4	Solenoid valve mode 1	7 positioning points, 2 zone outputs An operation command can be specified directly for each position number. A positioning complete signal is output for each position number.
5	Solenoid valve mode 2	3 positioning points, 2 zone outputs Operation using forward, reverse and interim position commands. A positioning complete signal is output individually for forward, reverse and interim positions.
6	Force control mode 1 (a dedicated load cell is used)	32 positioning points, 1 zone output
7	Force control mode 2 (a dedicated load cell is used)	5 positioning points, 1 zone output A direct operation command can be issued for each position number. A position complete signal is output for each position number.

The key functions that are available on ROBO Cylinders controllable in this mode are shown in the table below.

ROBO Cylinder function	PIO pattern							
	0: Positioning mode	1: Teaching mode	2: 256-point mode	3: 512-point mode	4: Solenoid valve mode 1	5: Solenoid valve mode 2	6: Force control mode 1	7: Force control mode 2
Home return operation	○	○	○	○	○	X	○	○
Positioning operation	○	○	○	○	○	○	○	○
Speed & acceleration/deceleration setting	○	○	○	○	○	○	○	○
Pitch feed (inching)	○	○	○	○	○	○	○	○
Push-motion operation	○	○	○	○	○	X	○	○
Speed change during movement	○	○	○	○	○	○	○	X
Operation at different acceleration and deceleration	○	○	○	○	○	○	○	○
Pause	○	○	○	○	○	○ (*1)	○	○
Zone signal output	○	○	○	X	○	○	○	○
PIO pattern selection (set by parameter)	○	○	○	○	○	○	○	○

○: Supported, X: Not supported

(*1) This operation is supported when parameter No. 27, "Move command type" is set to "0."
The actuator can be paused by turning the move command OFF.

(1) PLC channel configuration (* n indicates the node address of each axis.)

Parameter No. 84	SCON-CA DI (port number)	PLC output channel	SCON-CA DO (port number)	PLC input channel
0	0~15	n+0	0~15	n+0

(Note) Exercise caution to avoid node address duplication.

(2) I/O signal assignments for each axis

The I/O signals of each axis consist of one input word (channel) and one output word (channel) in the I/O areas.

- Each channel is controlled by ON/OFF bit signals.

PLC output

Channel (* n indicates the node address of each axis.)

	1 word (channel) = 16 bits															
n+0	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Controller input port number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

PLC input

Channel (* n indicates the node address of each axis.)

	1 word (channel) = 16 bits															
n+0	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Controller output port number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

(3) I/O signal assignments

The signals assigned to the controller's I/O ports vary depending on the setting of parameter No. 25.
(For details, refer to the operation manual for the controller.)

		Setting of Parameter No. 25					
		Positioning mode		Teaching mode		256-point mode	
		0		1		2	
Category	Port No.	Signal name	Symbol	Signal name	Symbol	Signal name	Symbol
PLC output → SCON-CA input	0	Command position number	PC1	Command position number	PC1	Command position number	PC1
	1		PC2		PC2		PC2
	2		PC4		PC4		PC4
	3		PC8		PC8		PC8
	4		PC16		PC16		PC16
	5		PC32		PC32		PC32
	6	Not available.	-	Teaching mode command	MODE	Not available.	PC64
	7		-	Jog/inch switching	JISL		PC128
	8		-	+Jog	JOG+		-
	9	Forced brake release	BKRL	-Jog	JOG-	Forced brake release	BKRL
	10	Operation mode	RMOD	Operation mode	RMOD	Operation mode	RMOD
	11	Home return	HOME	Home return	HOME	Home return	HOME
	12	Pause	*STP	Pause	*STP	Pause	*STP
	13	Positioning start	CSTR	Positioning start/position-data read command	CSTR/PWRT	Positioning start	CSTR
	14	Reset	RES	Reset	RES	Reset	RES
	15	Servo ON command	SON	Servo ON command	SON	Servo ON command	SON
SCON-CA output → PLC input	0	Completed position number	PM1	Completed position number	PM1	Completed position number	PM1
	1		PM2		PM2		PM2
	2		PM4		PM4		PM4
	3		PM8		PM8		PM8
	4		PM16		PM16		PM16
	5		PM32		PM32		PM32
	6	Moving signal	MOVE	Moving signal	MOVE	Completed position number	PM64
	7	Zone 1	ZONE1	Teaching mode signal	MODES		PM128
	8	Position zone	PZONE	Position zone	PZONE		PZONE
	9	Operation mode status	RMDS	Operation mode status	RMDS	Operation mode status	RMDS
	10	Home return complete	HEND	Home return complete	HEND	Home return complete	HEND
	11	Position complete signal	PEND	Position complete signal/position-data read complete	PEND/WEND	Position complete signal	PEND
	12	Ready	SV	Ready	SV	Ready	SV
	13	Emergency stop	*EMGS	Emergency stop	*EMGS	Emergency stop	*EMGS
	14	Alarm	*ALM	Alarm	*ALM	Alarm	*ALM
	15	Battery alarm	*BALM	Battery alarm	*BALM	Battery alarm	*BALM

The signals indicated by * are ON in a normal state.

The signals denoted by "Not available" are not controlled (their ON/OFF status is indeterminable).

		Setting of Parameter No. 25					
		512-point mode		Solenoid mode 1		Solenoid mode 2	
		3		4		5	
Category	Port No.	Signal name	Symbol	Signal name	Symbol	Signal name	Symbol
PLC output → SCON-CA input	0	Command position number	PC1	Start position 0	ST0	Start position 0	ST0
	1		PC2	Start position 1	ST1	Start position 1	ST1
	2		PC4	Start position 2	ST2	Start position 2	ST2
	3		PC8	Start position 3	ST3	Not available.	-
	4		PC16	Start position 4	ST4		-
	5		PC32	Start position 5	ST5		-
	6		PC64	Start position 6	ST6		-
	7		PC128	Not available.	-		-
	8		PC256		-		-
	9	Forced brake release	BKRL	Forced brake release	BKRT	Forced brake release	BKRL
	10	Operation mode	RMOD	Operation mode	RMOD	Operation mode	RMOD
	11	Home return	HOME	Home return	HOME	Not available.	-
	12	Pause	*STP	Pause	*STP		-
	13	Positioning start	CSTR	Not available.	-		-
	14	Reset	RES	Reset	RES	Reset	RES
	15	Servo ON command	SON	Servo ON command	SON	Servo ON command	SON
SCON-CA output → PLC input	0	Completed position number	PM1	Position 0 complete	PE0	Rear end move command 0	LS0
	1		PM2	Position 1 complete	PE1	Rear end move command 1	LS1
	2		PM4	Position 2 complete	PE2	Rear end move command 2	LS2
	3		PM8	Position 3 complete	PE3	Not available.	-
	4		PM16	Position 4 complete	PE4		-
	5		PM32	Position 5 complete	PE5		-
	6		PM64	Position 6 complete	PE6		-
	7		PM128	Zone 1	ZONE1	Zone 1	ZONE1
	8		PM256	Position zone	PZONE	Position zone	PZONE
	9	Operation mode status	RMDS	Operation mode status	RMDS	Operation mode status	RMDS
	10	Home return complete	HEND	Home return complete	HEND	Home return complete	HEND
	11	Position complete signal	PEND	Position complete signal	PEND	Position complete signal	-
	12	Ready	SV	Ready	SV	Ready	SV
	13	Emergency stop	*EMGS	Emergency stop	*EMGS	Emergency stop	*EMGS
	14	Alarm	*ALM	Alarm	*ALM	Alarm	*ALM
	15	Battery alarm.	*BALM	Battery alarm.	*BALM	Battery alarm.	*BALM

The signals indicated by * are ON in a normal state.

The signals denoted by "Not available" are not controlled (their ON/OFF status is indeterminable).

		Setting of Parameter No. 25			
		Force control mode 1		Force control mode 2	
		6		7	
Category	Port No.	Signal name	Symbol	Signal name	Symbol
PLC output → SCON-CA input	0	Command position number	PC1	Start position 0	ST0
	1		PC2	Start position 1	ST1
	2		PC4	Start position 2	ST2
	3		PC8	Start position 3	ST3
	4		PC16	Start position 4	ST4
	5	Not available.	-	Not available	-
	6		-		-
	7		-		-
	8	Load cell calibration command	CLBR	Load cell calibration command	CLBR
	9	Forced brake release	BKRL	Forced brake release	BKRT
	10	Operation mode	RMOD	Operation mode	RMOD
	11	Home return	HOME	Home return	HOME
	12	Pause	*STP	Pause	*STP
	13	Positioning start	CSTR	Not available.	-
	14	Reset	RES	Reset	RES
SCON-CA output → PLC input	15	Servo ON command	SON	Servo ON command	SON
	0	Completed position number	PM1	Position 0 complete	PE0
	1		PM2	Position 1 complete	PE1
	2		PM4	Position 2 complete	PE2
	3		PM8	Position 3 complete	PE3
	4		PM16	Position 4 complete	PE4
	5	Torque level status	TRQS	Torque level status	TRQS
	6	Load output judgment	LOAD	Load output judgment	LOAD
	7	Load cell calibration complete	CEND	Load cell calibration complete	CEND
	8	Position zone	PZONE	Position zone	PZONE
	9	Operation mode status	RMDS	Operation mode status	RMDS
	10	Home return complete	HEND	Home return complete	HEND
	11	Position complete signal	PEND	Position complete signal	PEND
	12	Ready	SV	Ready	SV
	13	Emergency stop	*EMGS	Emergency stop	*EMGS
	14	Alarm	*ALM	Alarm	*ALM
	15	Battery alarm	*BALM	Battery alarm	*BALM

The signals indicated by * are ON in a normal state.

The signals denoted by "Not available" are not controlled (their ON/OFF status is indeterminable).

3.7.3 Position/Simple Direct Mode (Number of Occupied Channels: 4)

In this mode, the actuator is operated by specifying position numbers. You can switch the control signal (PMOD) to select whether to specify the target position directly and numerically or by using a value registered in the position data table.

Data other than the target position, such as speed, acceleration/deceleration and positioning band, are set using values in the position table stored in the controller. Set position data by referring to the operation manual for the controller.

Up to 768 sets of positioning data can be specified.

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

Actuator function	○: Direct control △: Indirect control X: Invalid	Remarks
Home-return operation	○	
Positioning operation	○	
Speed and acceleration/deceleration setting	△	These items must be set in the position data table.
Pitch feed (inching)	△	
Push-motion operation	△	
Speed change during movement	△	
Operation at different acceleration and deceleration	△	
Pause	○	
Zone signal output	△	Zones are set using position data or parameters.
PIO pattern selection	X	

(1) PLC channel configuration (* n indicates the node address of each axis.)

Parameter No. 84	SCON-CA input register	PLC output channel	SCON-CA output register	PLC input channel
1	Target position	n+0	Current position	n+0
		n+1		n+1
	Specified position number	n+2	Completed position number (simple alarm code)	n+2
	Control signal	n+3	Status signal	n+3

(Note) Exercise caution to avoid node address duplication.

(2) I/O signal assignments for each axis

The I/O signals of each axis consist of four input words (channels) and four output words (channels) in the I/O areas.

- Control signals and status signals are ON/OFF bit signals.
- The target position and current position are 2-word (32-bit) binary data. Although values from -999999 to +999999 (unit: 0.01 mm) can be handled by the PLC for these items, set position data within the soft stroke range (0 to the effective stroke) of the applicable actuator.
- The specified position number and completed position number are 1-word (16-bit) binary data. Although values from 0 to 767 can be handled by the PLC for these items, use the PC software or teaching pendant to specify position numbers associated with predefined operating conditions.

PLC output

Channel (* n indicates the node address of each axis.)

		1 word (channel) = 16 bits															
n+0		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (lower word)																	

n+1		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (upper word)																	

If the target position is a negative value, it is indicated by a 2's complement.

n+2		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Specified position number								PM512	PM256	PM128	PM64	PM32	PM16	PM8	PM4	PM2	PM1

n+3		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Control signal		EMGS	PWR	ZONE1	ZONE2	PZONE	MODES	WEND	RMDS	BALM	—	PSFL	SV	ALM	MOVE	HEND	PEND

PLC input

Channel (* n indicates the node address of each axis.)

1 word (channel) = 16 bits

n+0	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (lower word)																

n+1	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (upper word)																

If the current position is a negative value, it is indicated by a 2's complement.

n+2	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Completed position number							PM512	PM256	PM128	PM64	PM32	PM16	PM8	PM4	PM2	PM1

n+3	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Status signal	EMGS	PWR	ZONE1	ZONE2	PZONE	MODES	WEND	RMDS	BALM	—	PSFL	SV	ALM	MOVE	HEND	PEND

(3) I/O signal assignments

(* In the table, ON indicates that the applicable bit is "1," while OFF indicates that the bit is "0.")

Signal type	Bits	Symbol	Description	Details
PLC output	Target position	32-bit data	- 32-bit signed integer. Specify the target position as a position in the absolute coordinate system. The setting unit is 0.01 mm and the allowable specification range is -999999 to 999999. (Example) To set "+25.40 mm," specify "2540." If the entered value exceeds the range between the soft limits (0.2 mm inside the limits) set by the parameters, the movement will be limited to the soft limit (0.2 mm inside the limit). * If target positions are entered as hexadecimals, enter negative values using 2's complements.	3.9 (1)
	Specified position number	16-bit data	PC1 ~ PC512 16-bit integer. To operate the actuator, you must set position data associated with predefined operating conditions using the PC software or teaching pendant. Use one of these registers to specify the position number for which the desired data has been input. The allowable specification range is 0 to 767. If the specified value is outside the above range or corresponds to a position not yet set, an alarm will occur when the start signal is turned ON.	3.9 (1)
	Control signal	b15	BKRL Forced brake release: The brake is released when this signal turns ON.	3.7.11 (18)
		b14	RMOD Operation mode: The AUTO mode is selected when this signal is OFF, and the MANU mode is selected when the signal is ON.	3.7.11 (19)
		b13 b12	- Not available.	-
		b11	PMOD Position/simple-direct switching: The position mode is selected when this signal is OFF, and the simple direct mode is selected when the signal is ON.	3.7.11 (20)
		b10	MODE Teaching mode command: The normal mode is selected when this signal is OFF, and the teaching mode is selected when the signal is ON.	3.7.11 (16)
		b9	PWRT Position-data read command: Position data is read when this signal is ON.	3.7.11 (17)
		b8	JOG+ +Jog: The actuator moves in the direction opposite home when this signal is ON.	3.7.11 (13)
		b7	JOG- -Jog: The actuator moves in the direction of home when this signal is ON.	3.7.11 (13)
		b6	JVEL Jog-speed/inch-distance switching: The values set in parameter No. 26, "Jog speed" and parameter No. 48, "Inch distance" are used when this signal is OFF, and the values set in parameter No. 47, "Jog speed 2" and parameter No. 49, "Inch distance 2" are used when the signal is ON.	3.7.11 (14)
		b5	JISL Jog/inch switching: Jog operation is performed when this signal is OFF, and inch operation is performed when the signal is ON.	3.7.11 (15)
		b4	SON Servo ON command: The servo turns ON when this signal turns ON.	3.7.11 (5)
		b3	RES Reset: A reset is performed when this signal turns ON.	3.7.11 (4)
		b2	STP Pause: A pause command is issued when this signal turns ON.	3.7.11 (11)
		b1	HOME Home return: A home-return command is issued when this signal turns ON.	3.7.11 (6)
		b0	CSTR Positioning start: A move command is issued when this signal turns ON.	3.7.11 (7)

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

Signal type		Bits	Symbol	Description	Details
PLC input	Current position	32 bits	-	32-bit signed integer indicating the current position. The setting unit is 0.01 mm. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm * If current positions are read as hexadecimal, negative values are indicated by 2's complements.	3.9 (1)
	Completed position number (simple alarm code)	16 bits	PM 1 ~ PM512	16-bit integer. When the actuator has moved to the target position and entered the positioning band, the position number corresponding to the completed position is output. “0” is output when no position movement has been performed yet or while the actuator is moving. If an alarm occurs (the status signal ALM turns ON), a corresponding simple alarm code (refer to the operation manual for the controller) will be output.	3.9 (1)
	Status signal	b15	EMGS	Emergency stop: An emergency stop is actuated when this signal turns ON.	3.7.11 (2)
		b14	PWR	Controller ready: This signal turns ON when the controller becomes ready.	3.7.11 (1)
		b13	ZONE2	Zone 2: This signal turns ON when the current position is inside the specified zone.	3.7.11 (12)
		b12	ZONE1	Zone 1: This signal turns ON when the current position is inside the specified zone.	3.7.11 (12)
		b11	PZONE	Position zone: This signal turns ON when the current position is inside the specified position zone.	3.7.11 (12)
		b10	MODES	Teaching mode signal: This signal is ON while the teaching mode is selected.	3.7.11 (16)
		b9	WEND	Position data read complete: This signal turns ON when reading is complete.	3.7.11 (17)
		b8	RMDS	Operation mode status: This signal is OFF when the current mode is AUTO, or ON when the current mode is MANU.	3.7.11 (19)
		b7	BALM	Absolute battery voltage low alarm: This signal turns ON when the battery voltage drops.	3.7.11 (28)
		b6	-	Not available.	
		b5	PSFL	Load missed in push motion: This signal turns ON when the actuator missed the load in push-motion operation.	3.7.11 (23)
		b4	SV	Ready: This signal turns ON when the servo turns ON.	3.7.11 (5)
		b3	ALM	Alarm: This signal turns ON when an alarm occurs.	3.7.11 (3)
		b2	MOVE	Moving signal: This signal remains ON while the actuator is moving.	3.7.11 (9)
b1	HEND	Home return complete: This signal turns ON when home return is completed.	3.7.11 (6)		
b0	PEND	Position complete signal: This signal turns ON when positioning is completed.	3.7.11 (10)		

3.7.4 Half Direct Mode (Number of Occupied Channels: 8)

In this mode, the target position, positioning band, speed, acceleration/deceleration and push-motion current are specified directly and numerically from the PLC.

Set each value in the I/O areas. To use the zone function, set appropriate values in parameter Nos. 1, 2, 23 and 24.

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

Actuator function	○: Direct control △: Indirect control X: Invalid	Remarks
Home-return operation	○	
Positioning operation	○	
Speed and acceleration/deceleration setting	○	
Pitch feed (inching)	○	
Push-motion operation	○	
Speed change during movement	○	
Operation at different acceleration and deceleration	X	
Pause	○	
Zone signal output	△	Parameters must be set
PIO pattern selection	X	

(1) PLC channel configuration (* n indicates the node address of each axis.)

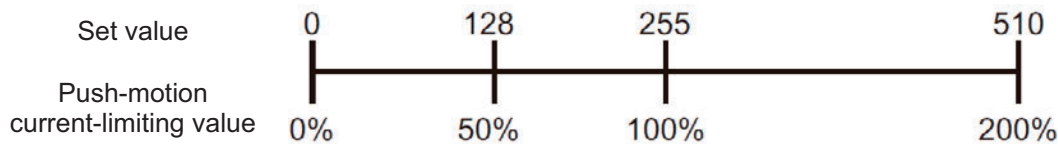
Parameter No. 84	SCON-CA input register	PLC output channel	SCON-CA output register	PLC input channel
2	Target position	n+0	Current position	n+0
		n+1		n+1
	Positioning band	n+2	Command current	n+2
		n+3		n+3
	Speed	n+4	Current speed	n+4
	Acceleration/ deceleration	n+5		n+5
	Push-motion current-limiting value	n+6	Alarm code	n+6
	Control signal	n+7	Status signal	n+7

(Note) Exercise caution to avoid node address duplication.

(2) I/O signal assignments for each axis

The I/O signals of each axis consist of eight input words (channels) and eight output words (channels) in the I/O areas.

- Control signals and status signals are ON/OFF bit signals.
- The target position and current position are 2-word (32-bit) binary data. Although values from -999999 to +999999 (unit: 0.01 mm) can be handled by the PLC for these items, set position data within the soft stroke range (0 to the effective stroke) of the applicable actuator.
- Specify the positioning band. The positioning band is a 2-word (32-bit) binary data. For the positioning band, the PLC can handle values from 1 to +999999 (unit: 0.01 mm).
- The specified speed is a 1-word (16-bit) binary data. For the specified speed, the PLC can handle values from 0 to +65535 (unit: 1.0 mm/sec). Take note, however, that the set value should not exceed the maximum speed supported by the applicable actuator.
- The acceleration/deceleration is a 1-word (16-bit) binary data. For the acceleration/deceleration, the PLC can handle values from 1 to 300 (unit: 0.01 G). Take note, however, that the set value should not exceed the maximum acceleration or maximum deceleration supported by the applicable actuator.
- The push-motion current-limiting value is a 1-word (16-bit) binary data. For the push-motion current-limiting value, the PLC can handle values from 0 (0%) to 510 (200%). Take note, however, that the setting should be inside the allowable specification range of push-motion current-limiting values supported by the applicable actuator (refer to the catalog or operation manual for the actuator).



- The command current is a 2-word (32-bit) binary data (unit: 1 mA).
- The current speed is a 2-word (32-bit) binary data (unit: 0.01 mm/sec).
- The alarm code is a 1-word (16-bit) binary data.

PLC output

Channel (* n indicates the node address of each axis.)

1 word (channel) = 16 bits																
n+0	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (lower word)																
n+1	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (upper word)																
If the target position is a negative value, it is indicated by a 2's complement.																
n+2	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Positioning band (lower word)	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1
n+3	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Positioning band (upper word)													524,288	262,144	131,072	65,536
n+4	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Speed	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1
n+5	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Acceleration/ deceleration								256	128	64	32	16	8	4	2	1
n+6	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Push-motion current-limiting value								256	128	64	32	16	8	4	2	1
n+7	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Control signal	BKRL	RMOD	DIR	PUSH	GSL1	GSL0	—	JOG+	JOG—	JVEL	JISL	SON	RES	STP	HOME	DSTR

PLC input
Channel (* n indicates the node address of each axis.)

1 word (channel) = 16 bits

n+0	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (lower word)																

n+1	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (upper word)																

If the current position is a negative value, it is indicated by a 2's complement.

n+2	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Command current (lower word)	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1

n+3	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Command current (upper word)													524,288	262,144	131,072	65,536

n+4	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current speed (lower word)																

n+5	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current speed (upper word)																

If the current speed is a negative value, it is indicated by a 2's complement.

n+6	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Alarm code																

n+7	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Status signal	EMGS	PWR	ZONE2	ZONE1	—	—	—	RMDS	BALM	—	PSFL	SV	ALM	MOVE	HEND	PEND

(3) I/O signal assignments

(* In the table, ON indicates that the applicable bit is "1," while OFF indicates that the bit is "0.")

Signal type	Bits	Symbol	Description	Details
PLC output	Target position	32-bit data	- 32-bit signed integer. Specify the target position as a position in the absolute coordinate system. The setting unit is 0.01 mm and the allowable specification range is -999999 to 999999. (Example) To set "+25.41 mm," specify "2541." If the entered value exceeds the range between the soft limits (0.2 mm inside the limits) set by the parameters, the movement will be limited to the soft limit (0.2 mm inside the limit). * If target positions are entered as hexadecimals, enter negative values using 2's complements.	3.9 (2)
	Positioning band	32-bit data	- 32-bit integer. The setting unit is 0.01 mm and the allowable specification range is 1 to 999999. (Example) To set "+25.40 mm," specify "2540." This register has one of two meanings depending on the operation type. [1] In positioning operation, this register defines the permissible range from the target position in which positioning will be deemed to have completed. [2] In push-motion operation, this register defines the push-motion band. Whether to perform normal operation or push-motion operation is set using the control signal PUSH.	3.9 (2)
	Speed	16-bit data	- 16-bit integer. Specify the speed at which to move the actuator. The setting unit is 1.0 mm/sec and the allowable specification range is 0 to 65535. (Example) To set "254.0 mm/sec," specify "254." If a move command is issued by specifying a value exceeding the maximum speed, an alarm will occur.	3.9 (2)
	Acceleration/deceleration	16-bit data	- 16-bit integer. Specify the acceleration/deceleration at which to move the actuator (the acceleration and deceleration will be the same value). The setting unit is 0.01 G and the allowable specification range is 1 to 300. (Example) To set "0.30 G," specify "30." If a move command is issued by specifying "0" or any value exceeding the maximum acceleration or deceleration, an alarm will occur.	3.9 (2)

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

Signal type		Bits	Symbol	Description			Details	
PLC output	Push-motion current-limiting value	16-bit data	-	16-bit integer. Specify the current-limiting value to be used during push-motion operation. The allowable specification range is 0 (0%) to 255 (100%). The actual allowable specification range varies from one actuator to another. (Refer to the catalog or operation manual for each actuator.) If a move command is issued by specifying a value exceeding the maximum push-motion current, an alarm will occur.			3.9 (2)	
	Control signal	b15	BKRL	Forced brake release: The brake is released when this signal turns ON.			3.7.11 (18)	
		b14	RMOD	Operation mode: The AUTO mode is selected when this signal is OFF, and the MANU mode is selected when the signal is ON.			3.7.11 (19)	
		b13	DIR	Push direction specification: When this signal is OFF, push-motion operation is performed in the direction of the position determined by subtracting the positioning band from the target position. When the signal is ON, push-motion operation is performed in the direction of the position determined by adding the positioning band to the target position.			3.7.11 (22)	
		b12	PUSH	Push-motion specification: Positioning operation is performed when this signal is OFF, and push-motion operation is performed when the signal is ON.			3.7.11 (21)	
		b11	GSL1	Servo gain parameter set selection 1	Select the servo gain parameter set to be used.			3.7.11 (33)
					GSL1	GSL0	Function	
					OFF	OFF	Select parameter set 0.	
					OFF	ON	Select parameter set 1.	
		b10	GSL0	Servo gain parameter set selection 0	ON	OFF	Select parameter set 2.	
					ON	ON	Select parameter set 3.	
		b9	-	Not available.			-	
		b8	JOG+	+Jog: The actuator moves in the direction opposite home when this signal is ON.			3.7.11 (13)	
		b7	JOG-	-Jog: The actuator moves in the direction of home when this signal is ON.			3.7.11 (13)	
		b6	JVER	Jog-speed/inch-distance switching: The values set in parameter No. 26, "Jog speed" and parameter No. 48, "Inch distance" are used when this signal is OFF, and the values set in parameter No. 47, "Jog speed 2" and parameter No. 49, "Inch distance 2" are used when the signal is ON.			3.7.11 (14)	
		b5	JISL	Jog/inch switching: Jog operation is performed when this signal is OFF, and inch operation is performed when the signal is ON.			3.7.11 (15)	
b4	SON	Servo ON command: The servo turns ON when this signal turns ON.			3.7.11 (5)			
b3	RES	Reset: A reset is performed when this signal turns ON.			3.7.11 (4)			
b2	STP	Pause: A pause command is issued when this signal turns ON.			3.7.11 (11)			
b1	HOME	Home return: A home-return command is issued when this signal turns ON.			3.7.11 (6)			
b0	DSTR	Positioning start: A move command is issued when this signal turns ON.			3.7.11 (8)			

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

Signal type		Bits	Symbol	Description	Details
PLC input	Current position	32-bit data	-	32-bit signed integer indicating the current position. The setting unit is 0.01 mm. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm * If current positions are read as hexadecimals, negative values are indicated by 2's complements.	3.9 (2)
	Command current	32-bit data	-	32-bit integer. The electrical current presently specified by a command is indicated. The setting unit is mA. (Example) Reading: 000003FFH = 1023 (decimal) = 1023 mA	3.9 (2)
	Current speed	32-bit data	-	32-bit signed integer. Indicate the current speed. Positive value: The actuator is moving in the direction opposite home. Negative value: The actuator is moving in the direction of home. 32-bit integer. The current speed is indicated. The setting unit is 0.01 mm/sec. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm/sec * If this data is read as a hexadecimal, a negative value is indicated as a 2's complement.	3.9 (2)
	Alarm code	16-bit data	-	16-bit integer. If an alarm occurred, a corresponding alarm code is output. If no alarm is present, "0H" is set. For details on alarms, refer to the operation manual for the controller.	3.9 (2)
	Status signal	b15	EMGS	Emergency stop: An emergency stop is actuated when this signal turns ON.	3.7.11 (2)
		b14	PWR	Controller ready: This signal turns ON when the controller becomes ready.	3.7.11 (1)
		b13	ZONE2	Zone 2: This signal turns ON when the current position is inside the specified zone.	3.7.11 (12)
		b12	ZONE1	Zone 1: This signal turns ON when the current position is inside the specified zone.	3.7.11 (12)
		b11	-	Not available.	-
		b10			
		b9			
		b8	RMDS	Operation mode status: This signal is OFF when the current mode is AUTO, or ON when the current mode is MANU.	3.7.11 (19)
		b7	BALM	Absolute battery voltage low alarm: This signal turns ON when the battery voltage drops.	
		b6	-	Not available.	-
		b5	PSFL	Load missed in push motion: This signal turns ON when the actuator missed the load in push-motion operation.	3.7.11 (23)
		b4	SV	Ready: This signal turns ON when the servo turns ON.	3.7.11 (5)
b3		ALM	Alarm: This signal turns ON when an alarm occurs.	3.7.11 (3)	
b2		MOVE	Moving signal: This signal remains ON while the actuator is moving.	3.7.11 (9)	
b1		HEND	Home return complete: This signal turns ON when home return is completed.	3.7.11 (6)	
b0	PEND	Position complete signal: This signal turns ON when positioning is completed.	3.7.11 (10)		

3.7.5 Full Direct Mode (Number of Occupied Channels: 16)

In this mode, the actuator is operated by specifying all values relating to positioning control (target position, speed, etc.) directly from the PLC.

Set each value in the I/O area.

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

Actuator function	O: Direct control X: Invalid
Home-return operation	O
Positioning operation	O
Speed and acceleration/deceleration setting	O
Pitch feed (inching)	O
Push-motion operation	O
Speed change during movement	O
Operation at different acceleration and deceleration	O
Pause	O
Zone signal output	O
PIO pattern selection	X

(1) PLC channel configuration (* n indicates the node address of each axis.)

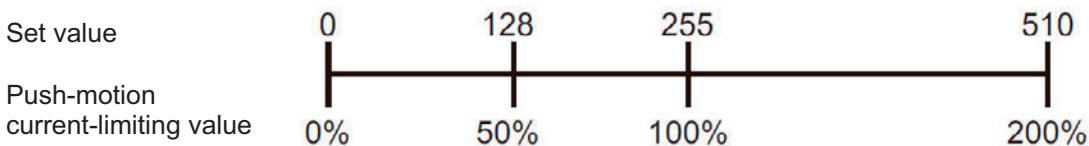
Parameter No. 84	SCON-CA input register	PLC output channel	SCON-CA output register	PLC input channel
3	Target position	n+0	Current position	n+0
		n+1		n+1
	Positioning band	n+2	Command current	n+2
		n+3		n+3
	Speed	n+4	Current speed	n+4
		n+5		n+5
	Zone boundary+	n+6	Alarm code	n+6
		n+7	Occupied area	n+7
	Zone boundary-	n+8	Force feedback data	n+8
		n+9		n+9
	Acceleration	n+10	Occupied area	n+10
	Deceleration	n+11		n+11
	Push-motion current-limiting value	n+12		n+12
	Load current threshold	n+13		n+13
	Control signal 1	n+14	Status signal 1	n+14
	Control signal 2	n+15	Status signal 2	n+15

(Note) The areas denoted by “occupied area” cannot be used for any other purpose. Also exercise caution to avoid node address duplication.

(2) I/O signal assignments for each axis

The I/O signals of each axis consist of sixteen input words (channels) and sixteen output words (channels) in the I/O areas.

- Control signals 1 and 2 and status signals are ON/OFF bit signals.
- The target position and current position are 2-word (32-bit) binary data. Although values from -999999 to +999999 (unit: 0.01 mm) can be handled by the PLC for these items, set position data within the soft stroke range (0 to the effective stroke) of the applicable actuator.
- Specify the positioning band. The positioning band is a 2-word (32-bit) binary data. For the positioning band, the PLC can handle values from 1 to +999999 (unit: 0.01 mm).
- The specified speed is a 2-word (32-bit) binary data. For the specified speed, the PLC can handle values from 0 to +999999 (unit: 0.01 mm/sec). Take note, however, that the set value should not exceed the maximum speed supported by the applicable actuator.
- The acceleration/deceleration is a 1-word (16-bit) binary data. For the acceleration/deceleration, the PLC can handle values from 1 to 300 (unit: 0.01 G). Take note, however, that the set value should not exceed the maximum acceleration or maximum deceleration supported by the applicable actuator.
- The push-motion current-limiting value is a 1-word (16-bit) binary data. For the push-motion current-limiting value, the PLC can handle values from 0 (0%) to 510 (200%). Take note, however, that the setting should be inside the allowable specification range of push-motion current-limiting values supported by the applicable actuator (refer to the catalog or operation manual for the actuator).



- Set the load current threshold. The load current threshold is a 1-word (16-bit) binary data. For the load current threshold, the PLC can handle values from 0 (0%) to 510 (200%). (Refer to the graph of push-motion current-limiting value (above graph).)
- The zone boundary+ and zone boundary- are 2-word (32-bit) binary data. For the zone boundary+ and zone boundary-, the PLC can handle values from -999999 to +999999 (unit: 0.01 mm). Take note, however, that the value of zone boundary- must be smaller than the value of zone boundary+.
- The command current is a 2-word (32-bit) binary data (unit: 1 mA).
- The current speed is a 2-word (32-bit) binary data (unit: 0.01 mm/sec).
- The alarm code is a 1-word (16-bit) binary data.
- The force feedback data is 2-word (32-bit) binary data (unit: 0.01 N).

PLC output
Channel (* n indicates the node address of each axis.)

1 word (channel) = 16 bits

n+0	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (lower word)																

n+1	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (upper word)																

If the target position is a negative value, it is indicated by a 2's complement.

n+2	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Positioning band (lower word)	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1

n+3	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Positioning band (upper word)													524,288	262,144	131,072	65,536

n+4	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Speed (lower word)	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1

n+5	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Speed (upper word)													524,288	262,144	131,072	65,536

n+6	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Zone boundary+ (lower word)																

n+7	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Zone boundary+ (upper word)																

If the zone boundary is a negative value, it is indicated by a 2's complement.

Channel (* n indicates the node address of each axis.)

1 word (channel) = 16 bits

n+8	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Zone boundary- (lower word)																

n+9	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Zone boundary- (upper word)																

If the zone boundary is a negative value, it is indicated by a 2's complement.

n+10	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Acceleration								256	128	64	32	16	8	4	2	1

n+11	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Deceleration								256	128	64	32	16	8	4	2	1

n+12	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Push-motion current-limiting value								256	128	64	32	16	8	4	2	1

n+13	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Load current threshold								256	128	64	32	16	8	4	2	1

n+14	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Control signal 1			NTC1	NTC0			ASO1	ASO0	MOD1	MOD0	GSL1	GSL0	INC	DIR	PUSH	

n+15	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Control signal 2	BKRL	RMOD					CLBR	JOG+	JOG-	JVEL	JISL	SON	RES	STP	HOME	DSTR

PLC input

Channel (* n indicates the node address of each axis.)

1 word (channel) = 16 bits

n+0	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (lower word)																

n+1	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (upper word)																

If the current position is a negative value, it is indicated by a 2's complement.

n+2	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Command current (lower word)	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1

n+3	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Command current (upper word)													524,288	262,144	131,072	65,536

n+4	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current speed (lower word)																

n+5	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current speed (upper word)																

If the current speed is a negative value, it is indicated by a 2's complement.

n+6	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Alarm code																

n + 7	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Not available.																

n + 8	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Force feedback data (lower word)																

n + 9	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Force feedback data (upper word)																

If the current force feedback data is a negative value, it is indicate by a 2's complement.

n + 10~n + 13	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Not available.																

n + 14	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Status signal 1															CEND	BALM

n + 15	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Status signal 2	EMGS	PWR	ZONE2	ZONE1	PZONE	LOAD	TRQS	RMDS	GHMS	PUSHS	PSFL	SV	ALM	MOVE	HEND	PEND

(3) I/O signal assignments

(* In the table, ON indicates that the applicable bit is "1," while OFF indicates that the bit is "0.")

Address		Bits	Symbol	Function	Details
PLC output	Target position	32-bit data	-	32-bit signed integer. Specify the target position as a position in the absolute coordinate system. The setting unit is 0.01 mm and the allowable specification range is -999999 to 999999. (Example) To set “+25.41 mm,” specify “2541.” If the entered value exceeds the range between the soft limits (0.2 mm inside the limits) set by the parameters, the movement will be limited to the soft limit (0.2 mm inside the limit). * If target positions are entered as hexadecimals, enter negative values using 2’s complements.	3.9 (3)
	Positioning band	32-bit data	-	32-bit integer. The setting unit is 0.01 mm and the allowable specification range is 1 to 999999. (Example) To set “+25.40 mm,” specify “2540.” This register has one of two meanings depending on the operation type. [1] In positioning operation, this register defines the permissible range from the target position in which positioning will be deemed to have completed. [2] In push-motion operation, this register defines the push-motion band. Whether to perform normal operation or push-motion operation is set using the control signal PUSH.	3.9 (3)
	Speed	32-bit data	-	32-bit integer. Specify the speed at which to move the actuator. The setting unit is 1.0 mm/sec and the allowable specification range is 0 to 999999. (Example) To set “25.41 mm/sec,” specify “2541.” If a move command is issued by specifying a value exceeding the maximum speed, an alarm will occur.	3.9 (3)
	Zone boundary+ /zone boundary-	32-bit data	-	32-bit signed integer. After completion of home return, an effective zone signal can be output separately from the zone boundaries specified by parameters. The status signal PZONE turns ON when the current position is inside these +/- boundaries. (Example) To set “+25.40 mm,” specify “2540.” The setting unit is 0.01 mm and the specification range is -999999 to 999999. Enter a value that satisfies the relationship of “Zone boundary+ > Zone boundary-.” If this function is not used, enter the same value for both the positive and negative boundaries. * If the boundaries are entered as hexadecimals, enter negative values using 2’s complements.	3.9 (3)

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

		Address	Bits	Symbol	Function	Details		
PLC output	Acceleration	16-bit data	-	16-bit integer. Specify the acceleration and deceleration at which to move the actuator.		3.9 (3)		
	Deceleration	16-bit data	-	The setting unit is 0.01 G and the allowable specification range is 1 to 300. (Example) To set “0.30 G,” specify “30.” If a move command is issued by specifying “0” or any value exceeding the maximum acceleration or deceleration, an alarm will occur.				
	Push-motion current-limiting value	16-bit data	-	16-bit integer. Specify the current-limiting value to be used during push-motion operation. The allowable specification range is 0 (0%) to 510 (200%). The actual allowable specification range varies from one actuator to another. (Refer to the catalog or operation manual for each actuator.) If a move command is issued by specifying a value exceeding the maximum push-motion current, an alarm will occur.		3.9 (3)		
	Load current threshold	16-bit data	-	16-bit integer. If you want the controller to determine whether or not the load current has exceeded the set value, specify the current threshold using this register. The allowable specification range is 0 (0%) to 255 (100%). If threshold judgment is not required, enter “0.”		3.9 (3)		
	Control signal 1	b15	-	-	Not available.		-	
		b14						
		b13	NTC1	Vibration damping control mode selection 1	Select the servo gain parameter set to be used.		3.7.11 (33)	
		b12	NTC0	Vibration damping control mode selection 0				
					NTC1	NTC0		Function
					OFF	OFF		Do not use vibration damping control.
					OFF	ON		Select parameter set 1.
		ON	OFF	Select parameter set 2.				
ON	ON	Select parameter set 3.						
b11	-	-	Not available.		-			
b10								
b9	ASO1	Stop mode 1	Select the stop mode to be applied while on standby.		3.7.11 (31)			
b8	ASO0	Stop mode 0						
			ASO1	ASO0		Function		
			OFF	OFF		Invalid (the servo is always on).		
			OFF	ON		The servo turns off after the time set in parameter No. 36.		
ON	OFF	The servo turns off after the time set in parameter No. 37.						
ON	ON	The servo turns off after the time set in parameter No. 38.						

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

Address		Bits	Symbol	Function			Details	
PLC output	Control signal 1	b7	MOD1	Acceleration/deceleration mode:			3.7.11	
		b6	MOD0	Trapezoid pattern when both signals are OFF, S-motion when MOD1 is OFF and MOD0 is ON, or primary delay filter when MOD1 is ON and MOD0 is OFF.			3.7.11 (14)	
		b5	GSL1	Servo gain parameter set selection 1	Select the servo gain parameter set to be used.			3.7.11 (33)
		b4	GSL0	Servo gain parameter set selection 0	GSL1	GSL0	Function	
					OFF	OFF	Select parameter set 0.	
					OFF	ON	Select parameter set 1.	
					ON	OFF	Select parameter set 2.	
		ON	ON	Select parameter set 3.				
		b3	INC	Incremental specification: Absolute position command when the signal is OFF, or incremental position command when the signal is ON.			3.7.11 (24)	
	b2	DIR	Push direction specification: When the signal is OFF, the direction of the position obtained by subtracting the positioning band from the target position is used. When the signal is ON, the direction of the position obtained by adding the positioning band to the target position is used.			3.7.11 (22)		
	b1	PUSH	Push specification: Positioning operation when the signal is OFF, or push-motion operation when the signal is ON.			3.7.11 (21)		
	b0	-	Not available.			-		
	Control signal 2	b15	BKRL	Forced brake release: The brake is released when this signal turns ON.			3.7.11 (18)	
		b14	RMOD	Operation mode: The AUTO mode is selected when this signal is OFF, and the MANU mode is selected when the signal is ON.			3.7.11 (19)	
		b13	-	Not available.			-	
		b12						
		b11						
		b10						
		b9	CLBR	Load cell calibration command: Calibration is performed when this signal turns ON.			3.7.11 (32)	
		b8	JOG+	+Jog: The actuator moves in the direction opposite home when this signal is ON.			3.7.11 (13)	
		b7	JOG-	-Jog: The actuator moves in the direction of home when this signal is ON.			3.7.11 (13)	
		b6	JVEL	Jog-speed/inch-distance switching: The values set in parameter No. 26, "Jog speed" and parameter No. 48, "Inch distance" are used when this signal is OFF, and the values set in parameter No. 47, "Jog speed 2" and parameter No. 49, "Inch distance 2" are used when the signal is ON.			3.7.11 (14)	
		b5	JISL	Jog/inch switching: Jog operation is performed when this signal is OFF, and inch operation is performed when the signal is ON.			3.7.11 (15)	
		b4	SON	Servo ON command: The servo turns ON when this signal turns ON.			3.7.11 (5)	
		b3	RES	Reset: A reset is performed when this signal turns ON.			3.7.11 (4)	
b2		STP	Pause: A pause command is issued when this signal turns ON.			3.7.11 (11)		
b1		HOME	Home return: A home-return command is issued when this signal turns ON.			3.7.11 (6)		
b0		DSTR	Positioning start: A move command is issued when this signal turns ON.			3.7.11 (8)		

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

Signal type	Bits	Symbol	Description	Details
PLC input	Current position	32-bit data	- 32-bit signed integer indicating the current position. The setting unit is 0.01 mm. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm * If current positions are read as hexadecimal, negative values are indicated by 2's complements.	3.9 (3)
	Command current	32-bit data	- 32-bit integer. The electrical current presently specified by a command is indicated. The setting unit is mA. (Example) Reading: 000003FFH = 1023 (decimal) = 1023 mA	3.9 (3)
	Current speed	32-bit data	- 32-bit integer. The current speed is indicated. The setting unit is 0.01 mm/sec. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm/sec	3.9 (3)
	Alarm code	16-bit data	- 16-bit integer. If an alarm occurred, a corresponding alarm code is output. If no alarm is present, “0” is set. For details on alarms, refer to the operation manual for the controller.	3.9 (3)
	Force feedback data	32-bit data	- 32-bit signed integer The current measurement on the load cell is indicated. The unit is 0.01 N. * If readings are expressed in hexadecimal, a negative value is indicated by a two's complement.	3.9 (3)
	Status signal 1	b15	-	Not available.
		b14	-	
		b13	-	
		b12	-	
		b11	-	
		b10	-	
		b9	-	
		b8	-	
		b7	-	
		b6	-	
		b5	-	
		b4	-	
		b3	-	
		b2	-	
		b1	Home return complete: This signal turns ON when home return is completed.	3.7.11 (32)
		b0	Position complete signal: This signal turns ON when positioning is completed.	3.7.11 (28)

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

Signal type	Bits	Symbol	Description	Details
PLC input	b15	EMGS	Emergency stop: An emergency stop is being executed when the signal is ON.	3.7.11 (2)
	b14	PWR	Controller ready: The signal turns ON when the controller becomes ready.	3.7.11 (1)
	b13	ZONE2	Zone 2: The signal is ON when the current position is inside the specified zone.	3.7.11 (12)
	b12	ZONE1	Zone 1: The signal is ON when the current position is inside the specified zone.	3.7.11 (12)
	b11	PZONE	Position zone: The signal is ON when the current position is inside the specified position zone.	3.7.11 (12)
	b10	MODES	Teaching mode signal: The signal is ON when the teaching mode is selected.	3.7.11 (26)
	b9	WEND	Position data read complete: The signal turns ON when the position data read is complete.	3.7.11 (27)
	b8	RMDS	Operation mode: The signal is OFF when the current mode AUTO, or ON when the current mode is MANU.	3.7.11 (19)
	b7	BALM	Absolute battery voltage low warning: This signal turns ON when the voltage drops.	3.7.11 (6)
	b6	-	Not available	3.7.11 (25)
	b5	PSFL	Missed load during push-motion operation: The signal turns ON when the actuator missed the load during push-motion operation.	3.7.11 (23)
	b4	SV	Ready: The signal is ON when the servo is ON.	3.7.11 (5)
	b3	ALM	Alarm: The signal turns ON when an alarm occurs.	3.7.11 (3)
	b2	MOVE	Moving signal: The signal is ON while the actuator is moving.	3.7.11 (9)
	b1	HEND	Home return complete: The signal turns ON when the home return is completed.	3.7.11 (6)
	b0	PEND	Positioning complete signal: The signal turns ON when the positioning is completed.	3.7.11 (10)

3.7.6 Remote I/O Mode 2 (Number of Occupied Channels: 6)

In this mode, the actuator is operated by specifying position numbers, just like you do when PIOs (24-V I/Os) are used.

Set position data using the RC PC software or teaching pendant.

The number of available positions is determined by the setting of parameter No. 25, "PIO pattern."

This mode is the same as the remote I/O mode, but the current-position read function and command-current read function are also available.

The features of each PIO pattern are shown below. (For details, refer to the operation manual for the controller.)

Value set in parameter No. 25	Operation mode	I/O specification
0	Positioning mode	64 positioning points and two zone output points are available.
1	Teaching mode	64 positioning points and one zone output point is available. Positioning operation and jog operation are supported. The current position can be written to a specified position.
2	256-point mode	256 positioning points and one zone output point is available.
3	512-point mode	512 positioning points are available. There are no zone outputs.
4	Solenoid mode 1	7 positioning points and two zone output points are available. A direct operation command can be issued for each position number. A position complete signal is output for each position number.
5	Solenoid mode 2	3 positioning points and two zone output points are available. The actuator is operated by specifying forward, backward and intermediate position commands. A position complete signal is output separately for the front end, rear end and intermediate position.
6	Force control mode 1 (a dedicated load cell is used)	32 positioning points, 1 zone output
7	Force control mode 2 (a dedicated load cell is used)	5 positioning points, 1 zone output A direct operation command can be issued for each position number. A position complete signal is output for each position number.

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

Actuator function	PIO pattern							
	0: Positioning mode	1: Teaching mode	2: 256-point mode	3: 512-point mode	4: Solenoid valve mode 1	5: Solenoid valve mode 2	6: Force control mode 1	7: Force control mode 2
Home return operation	○	○	○	○	○	X	○	○
Positioning operation	○	○	○	○	○	○	○	○
Speed & acceleration/ deceleration setting	○	○	○	○	○	○	○	○
Pitch feed (inching)	○	○	○	○	○	○	○	○
Push-motion operation	○	○	○	○	○	X	○	○
Speed change during movement	○	○	○	○	X	○	○	X
Operation at different acceleration and deceleration	○	○	○	○	○	○	○	○
Pause	○	○	○	○	○	○ (*1)	○	○
Zone signal output	○	○	○	X	○	○	○	○
PIO pattern selection (set by parameter)	○	○	○	○	○	○	○	○

○: Supported / X: Not supported

(*1) This function is supported when parameter No. 27, "Move command type" is set to "0."

The actuator can be paused by turning the move command OFF.

(1) PLC channel configuration (* n indicates the node address of each axis.)

Parameter No. 84	SCON-CA DI and input register	PLC output channel	SCON-CA DO and output register	PLC input channel
4	Port number 0 to 15	n+0	Port number 0 to 15	n+0
	Occupied area	n+1	Occupied area	n+1
		n+2	Current position	n+2
		n+3		n+3
		n+4	Command current	n+4
		n+5		n+5

(Note) The areas denoted by “occupied area” cannot be used for any other purpose. Also exercise caution to avoid node address duplication.

(2) I/O signal assignments for each axis

The I/O signals of each axis consist of six input words (channels) and six output words (channels) in the I/O areas.

- The channels controlled by port number are controlled using ON/OFF bit signals.
- The current position is a 2-word (32-bit) binary data (unit: 0.01 mm).
- The command current is a 2-word (32-bit) binary data (unit: 1 mA).

PLC output (* n indicates the node address of each axis.)

Channel

n+0	1 word (channel) = 16 bits															
	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Controller input port number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

PLC input (* n indicates the node address of each axis.)

Channel

1 word (channel) = 16 bits																
n+0	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Controller output port number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

n+1	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Not available.																

n+2	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (lower word)																

n+3	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (upper word)																

If the current position is a negative value, it is indicated by a 2's complement.

n+4	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Command current (lower word)	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1

n+5	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Command current (upper word)													524,288	262,144	131,072	65,536

(3) I/O signal assignments

For the signal assignments corresponding to each PIO pattern, refer to the I/O signal assignments for the remote I/O mode explained in 3.7.2 (3).

Signal assignments under the command-current read function and current-position read function are shown below.

Signal type		Bits	Symbol	Description	Details
PLC input	Current position	32-bit data	-	32-bit signed integer indicating the current position. The setting unit is 0.01 mm. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm * If current positions are read as hexadecimal, negative values are indicated by 2's complements.	-
	Command current	32-bit data	-	32-bit integer. Indicate the value of electrical current specified by the current command. The setting unit is 1 mA. (Example) Reading: 000003FFH = 1023 (decimal) = 1023 mA	-

3.7.7 Position/Simple Direct Mode 2 (Number of Occupied Channels: 4)

In this mode, the actuator is operated by means of force control (push-motion operation based on feedback of load cell values) and also by specifying position numbers. You can directly specify the target position as a numerical value by switching the control signal (PMOD signal), or use a pre-registered value in the position data. Data other than the target position, such as speed, acceleration/deceleration and positioning band, are set using values in the position table stored in the controller. Set position data by referring to the operation manual for the controller.

Up to 768 sets of positioning data can be specified.

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

Actuator function	○: Direct control △: Indirect control X: Invalid	Remarks
Home-return operation	○	
Positioning operation	○	
Speed and acceleration/deceleration setting	△	These items must be set in the position data table.
Pitch feed (inching)	△	
Push-motion operation	△	
Speed change during movement	△	
Operation at different acceleration and deceleration	△	
Pause	○	
Zone signal output	△	Zones are set using position data or parameters.
PIO pattern selection	X	

(1) PLC channel configuration (* n indicates the node address of each axis.)

Parameter No. 84	SCON-CA input register	PLC output channel	SCON-CA output register	PLC input channel
5	Target position	n+0	Current position	n+0
		n+1		n+1
	Specified position number	n+2	Completed position number (simple alarm code)	n+2
	Control signal	n+3	Status signal	n+3

(Note) Exercise caution to avoid node address duplication.

(2) I/O signal assignments for each axis

The I/O signals of each axis consist of four input words (channels) and four output words (channels) in the I/O areas.

- Control signals and status signals are ON/OFF bit signals.
- The target position and current position are 2-word (32-bit) binary data. Although values from -999999 to +999999 (unit: 0.01 mm) can be handled by the PLC for these items, set position data within the soft stroke range (0 to the effective stroke) of the applicable actuator.
- The specified position number and completed position number are 1-word (16-bit) binary data. Although values from 0 to 767 can be handled by the PLC for these items, use the PC software or teaching pendant to specify position numbers associated with predefined operating conditions.

PLC output

Channel (* n indicates the node address of each axis.)

		1 word (channel) = 16 bits															
n+0		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (lower word)																	

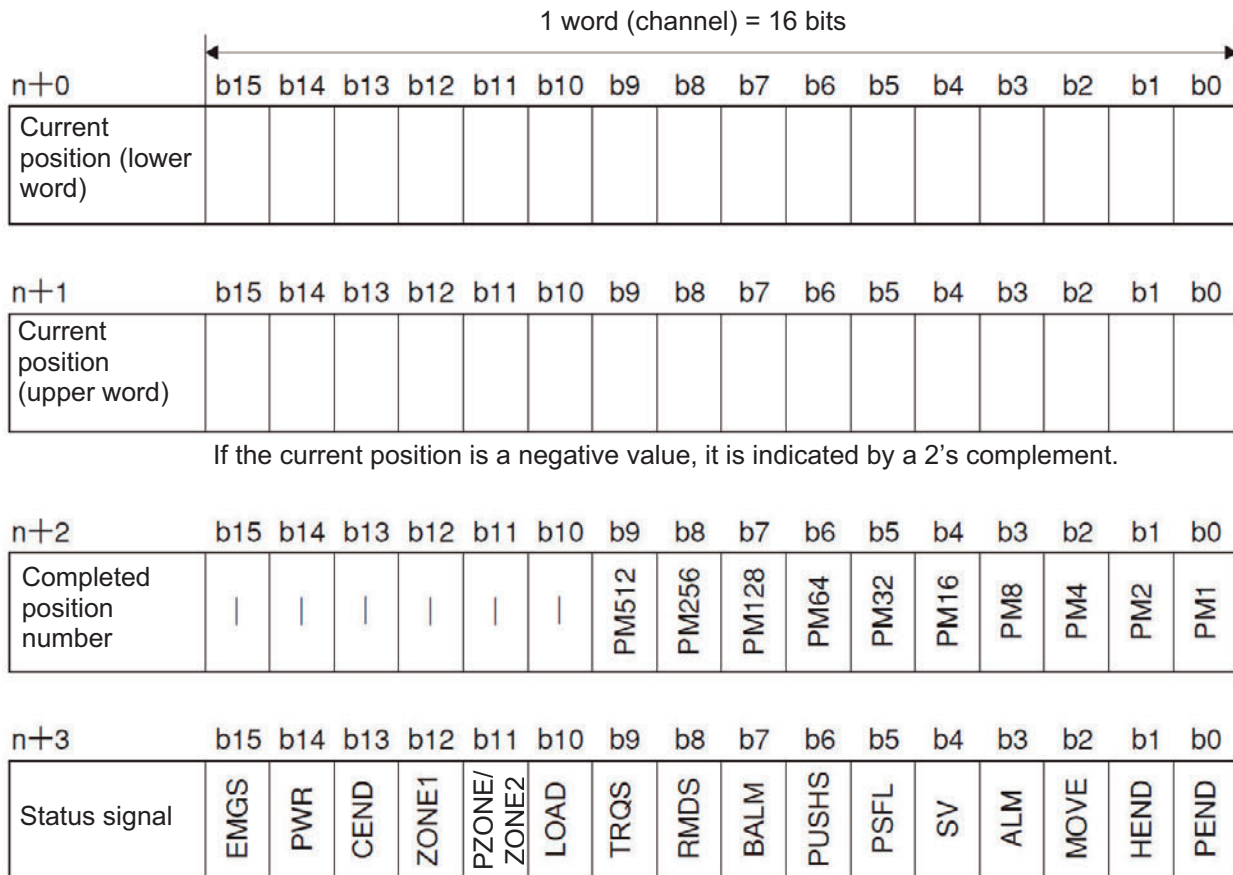
n+1		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (upper word)																	

If the target position is a negative value, it is indicated by a 2's complement.

n+2		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Specified position number								PC512	PC256	PC128	PC64	PC32	PC16	PC8	PC4	PC2	PC1

n+3		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Control signal		BKRL	RMOD			PMOD		CLBR	JOG+	JOG-	JVEL	JISL	SON	RES	STP	HOME	CSTR

PLC input
Channel (* n indicates the node address of each axis.)



(3) I/O signal assignments

(* In the table, ON indicates that the applicable bit is "1," while OFF indicates that the bit is "0.")

Signal type		Bits	Symbol	Description	Details
PLC output	Target position	32-bit data	-	32-bit signed integer. Specify the target position as a position in the absolute coordinate system. The setting unit is 0.01 mm and the allowable specification range is -999999 to 999999. (Example) To set "+25.40 mm," specify "2540." If the entered value exceeds the range between the soft limits (0.2 mm inside the limits) set by the parameters, the movement will be limited to the soft limit (0.2 mm inside the limit). * If target positions are entered as hexadecimals, enter negative values using 2's complements.	3.9 (1)
	Specified position number	16-bit data	PC1 ~ PC512	16-bit integer. To operate the actuator, you must set position data associated with predefined operating conditions using the PC software or teaching pendant. Use one of these registers to specify the position number for which the desired data has been input. The allowable specification range is 0 to 767. If the specified value is outside the above range or corresponds to a position not yet set, an alarm will occur when the start signal is turned ON.	3.9 (1)
	Control signal	b15	BKRL	Forced brake release: The brake is released when this signal turns ON.	3.7.11 (18)
		b14	RMOD	Operation mode: The AUTO mode is selected when this signal is OFF, and the MANU mode is selected when the signal is ON.	3.7.11 (19)
		b13	-	Not available.	-
		b12			
		b11	-	Position/simple-direct switching: The position mode is selected when this signal is OFF, and the simple direct mode is selected when the signal is ON.	3.7.11 (20)
		b10	-	Not available.	-
		b9	CLBR	Load cell calibration command: Calibration is performed when this signal turns ON.	3.7.11 (32)
		b8	JOG+	+Jog: The actuator moves in the direction opposite home when this signal is ON.	3.7.11 (13)
		b7	JOG-	-Jog: The actuator moves in the direction of home when this signal is ON.	3.7.11 (13)
		b6	JVEL	Jog-speed/inch-distance switching: The values set in parameter No. 26, "Jog speed" and parameter No. 48, "Inch distance" are used when this signal is OFF, and the values set in parameter No. 47, "Jog speed 2" and parameter No. 49, "Inch distance 2" are used when the signal is ON.	3.7.11 (14)
		b5	JISL	Jog/inch switching: Jog operation is performed when this signal is OFF, and inch operation is performed when the signal is ON.	3.7.11 (15)
		b4	SON	Servo ON command: The servo turns ON when this signal turns ON.	3.7.11 (5)
		b3	RES	Reset: A reset is performed when this signal turns ON.	3.7.11 (4)
		b2	STP	Pause: A pause command is issued when this signal turns ON.	3.7.11 (11)
		b1	HOME	Home return: A home-return command is issued when this signal turns ON.	3.7.11 (6)
		b0	CSTR	Positioning start: A move command is issued when this signal turns ON.	3.7.11 (7)

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

Signal type	Bits	Symbol	Description	Details
PLC input	Current position	32 bits	- 32-bit signed integer indicating the current position. The setting unit is 0.01 mm. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm * If current positions are read as hexadecimals, negative values are indicated by 2's complements.	3.9 (1)
	Completed position number (simple alarm code)	16 bits	PM 1 ~ PM512 16-bit integer. When the actuator has moved to the target position and entered the positioning band, the position number corresponding to the completed position is output. “0” is output when no position movement has been performed yet or while the actuator is moving. If an alarm occurs (the status signal ALM turns ON), a corresponding simple alarm code (refer to the operation manual for the controller) will be output.	3.9 (1)
	Status signal	b15	EMGS Emergency stop: An emergency stop is actuated when this signal turns ON.	3.7.11 (2)
		b14	PWR Controller ready: This signal turns ON when the controller becomes ready.	3.7.11 (1)
		b13	ZONE2 Zone 2: This signal turns ON when the current position is inside the specified zone.	3.7.11 (12)
		b12	ZONE1 Zone 1: This signal turns ON when the current position is inside the specified zone.	3.7.11 (12)
		b11	PZONE/ ZONE2 PZONE and ZONE2 can be switched in Parameter No.149. No.149 = 0 Position zone : This signal turns ON when the current position is inside the specified position zone. No.149 = 1 Zone2 : This signal turns ON when the current position is inside the specified zone.	3.7.11 (12)
		b10	LOAD Load output judgment: This signal turns ON when the specified load is reached. If the signal is OFF, it means the specified load is not yet reached. (For details, refer to the operation manual for your controller.)	3.7.11 (26)
		b9	TRQS Torque level: This signal turns ON when the specified torque is reached. If the signal is OFF, it means the specified torque is not yet reached. (For details, refer to the operation manual for your controller.)	3.7.11 (27)
		b8	RMDS Operation mode status: This signal is OFF when the current mode is AUTO, or ON when the current mode is MANU.	3.7.11 (19)
		b7	BALM Absolute battery voltage low alarm: This signal turns ON when the battery voltage drops.	3.7.11 (28)
		b6	PUSHS Push-motion operation in progress: This signal remains ON while the actuator is performing push-motion operation.	3.7.11 (23)
		b5	PSFL Load missed in push motion: This signal turns ON when the actuator missed the load in push-motion operation.	3.7.11 (23)
		b4	SV Ready: This signal turns ON when the servo turns ON.	3.7.11 (5)
		b3	ALM Alarm: This signal turns ON when an alarm occurs.	3.7.11 (3)
		b2	MOVE Moving signal: This signal remains ON while the actuator is moving.	3.7.11 (9)
		b1	HEND Home return complete: This signal turns ON when home return is completed.	3.7.11 (6)
		b0	PEND Position complete signal: This signal turns ON when positioning is completed.	3.7.11 (10)

3.7.8 Half Direct Mode (Number of Occupied Channels: 8)

In this mode, the actuator is operated by means of force control (push-motion operation based on feedback of load cell values) and also by specifying the target position, in-position band, speed, acceleration/deceleration and push current directly from the PLC as numerical values.

Set each value in the I/O areas. To use the zone function, set appropriate values in parameter Nos. 1, 2, 23 and 24.

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

Actuator function	○: Direct control △: Indirect control X: Invalid	Remarks
Home-return operation	○	
Positioning operation	○	
Speed and acceleration/deceleration setting	○	
Pitch feed (inching)	○	
Push-motion operation	○	
Speed change during movement	○	
Operation at different acceleration and deceleration	X	
Pause	○	
Zone signal output	△	Parameters must be set
PIO pattern selection	X	

(1) PLC channel configuration (* n indicates the node address of each axis.)

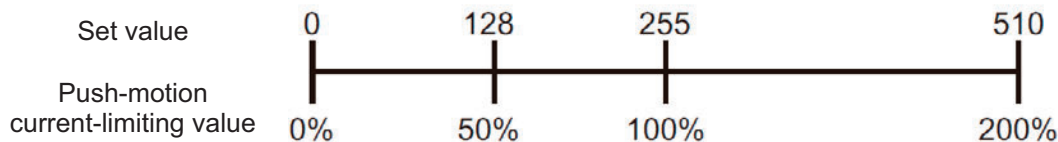
Parameter No. 84	SCON-CA input register	PLC output channel	SCON-CA output register	PLC input channel
6	Target position	n+0	Current position	n+0
		n+1		n+1
	Positioning band	n+2	Force feedback data	n+2
		n+3		n+3
	Speed	n+4	Current speed	n+4
	Acceleration/ deceleration	n+5		n+5
	Push-motion current-limiting value	n+6	Alarm code	n+6
	Control signal	n+7	Status signal	n+7

(Note) Exercise caution to avoid node address duplication.

(2) I/O signal assignments for each axis

The I/O signals of each axis consist of eight input words (channels) and eight output words (channels) in the I/O areas.

- Control signals and status signals are ON/OFF bit signals.
- The target position and current position are 2-word (32-bit) binary data. Although values from -999999 to +999999 (unit: 0.01 mm) can be handled by the PLC for these items, set position data within the soft stroke range (0 to the effective stroke) of the applicable actuator.
- Specify the positioning band. The positioning band is a 2-word (32-bit) binary data. For the positioning band, the PLC can handle values from 1 to +999999 (unit: 0.01 mm).
- The specified speed is a 1-word (16-bit) binary data. For the specified speed, the PLC can handle values from 0 to +65535 (unit: 1.0 mm/sec). Take note, however, that the set value should not exceed the maximum speed supported by the applicable actuator.
- The acceleration/deceleration is a 1-word (16-bit) binary data. For the acceleration/deceleration, the PLC can handle values from 1 to 300 (unit: 0.01 G). Take note, however, that the set value should not exceed the maximum acceleration or maximum deceleration supported by the applicable actuator.
- The push-motion current-limiting value is a 1-word (16-bit) binary data. For the push-motion current-limiting value, the PLC can handle values from 0 (0%) to 510 (200%). Take note, however, that the setting should be inside the allowable specification range of push-motion current-limiting values supported by the applicable actuator (refer to the catalog or operation manual for the actuator).



- The force feedback data is 2-word (32-bit) binary data (unit: 0.01 N).
- The current speed is a 2-word (32-bit) binary data (unit: 0.01 mm/sec).
- The alarm code is a 1-word (16-bit) binary data.

PLC output

Channel (* n indicates the node address of each axis.)

		1 word (channel) = 16 bits															
n+0		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (lower word)																	
n+1		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (upper word)																	

If the target position is a negative value, it is indicated by a 2's complement.

n+2		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Positioning band (lower word)		32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1
n+3		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Positioning band (upper word)		—	—	—	—	—	—	—	—	—	—	—	—	524,288	262,144	131,072	65,536
n+4		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Speed		32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1
n+5		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Acceleration/ deceleration		—	—	—	—	—	—	—	256	128	64	32	16	8	4	2	1
n+6		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Push-motion current-limiting value		—	—	—	—	—	—	—	256	128	64	32	16	8	4	2	1
n+7		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Control signal		BKRL	RMOD	DIR	PUSH	—	—	CLBR	JOG+	JOG—	JVEL	JISL	SON	RES	STP	HOME	DSTR

PLC input

Channel (* n indicates the node address of each axis.)

1 word (channel) = 16 bits

n+0	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (lower word)																

n+1	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (upper word)																

If the current position is a negative value, it is indicated by a 2's complement.

n+2	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Force feedback data (lower word)																

n+3	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Force feedback data (upper word)																

If the force feedback data is a negative value, it is indicated by a 2's complement.

n+4	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current speed (lower word)																

n+5	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current speed (upper word)																

If the current speed is a negative value, it is indicated by a 2's complement.

n+6	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Alarm code																

n+7	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Status signal	EMGS	PWR	ZONE2	ZONE1	—	—	CEND	RMDS	BALM	PUSHS	PSFL	SV	ALM	MOVE	HEND	PEND

(3) I/O signal assignments

(* In the table, ON indicates that the applicable bit is "1," while OFF indicates that the bit is "0.")

Signal type		Bits	Symbol	Description	Details
PLC output	Target position	32-bit data	-	32-bit signed integer. Specify the target position as a position in the absolute coordinate system. The setting unit is 0.01 mm and the allowable specification range is -999999 to 999999. (Example) To set "+25.41 mm," specify "2541." If the entered value exceeds the range between the soft limits (0.2 mm inside the limits) set by the parameters, the movement will be limited to the soft limit (0.2 mm inside the limit). * If target positions are entered as hexadecimals, enter negative values using 2's complements.	3.9 (2)
	Positioning band	32-bit data	-	32-bit integer. The setting unit is 0.01 mm and the allowable specification range is 1 to 999999. (Example) To set "+25.40 mm," specify "2540." This register has one of two meanings depending on the operation type. [1] In positioning operation, this register defines the permissible range from the target position in which positioning will be deemed to have completed. [2] In push-motion operation, this register defines the push-motion band. Whether to perform normal operation or push-motion operation is set using the control signal PUSH.	3.9 (2)
	Speed	16-bit data	-	16-bit integer. Specify the speed at which to move the actuator. The setting unit is 1.0 mm/sec and the allowable specification range is 0 to 65535. (Example) To set "254.0 mm/sec," specify "254." If a move command is issued by specifying a value exceeding the maximum speed, an alarm will occur.	3.9 (2)
	Acceleration/ deceleration	16-bit data	-	16-bit integer. Specify the acceleration/deceleration at which to move the actuator (the acceleration and deceleration will be the same value). The setting unit is 0.01 G and the allowable specification range is 1 to 300. (Example) To set "0.30 G," specify "30." If a move command is issued by specifying "0" or any value exceeding the maximum acceleration or deceleration, an alarm will occur.	3.9 (2)

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

Signal type	Bits	Symbol	Description	Details
PLC output	Push-motion current-limiting value	16-bit data	- 16-bit integer. Specify the current-limiting value to be used during push-motion operation. The allowable specification range is 0 (0%) to 255 (100%). The actual allowable specification range varies from one actuator to another. (Refer to the catalog or operation manual for each actuator.) If a move command is issued by specifying a value exceeding the maximum push-motion current, an alarm will occur.	3.9 (2)
	Control signal	b15	BKRL Forced brake release: The brake is released when this signal turns ON.	3.7.11 (18)
		b14	RMOD Operation mode: The AUTO mode is selected when this signal is OFF, and the MANU mode is selected when the signal is ON.	3.7.11 (19)
		b13	DIR Push direction specification: When this signal is OFF, push-motion operation is performed in the direction of the position determined by subtracting the positioning band from the target position. When the signal is ON, push-motion operation is performed in the direction of the position determined by adding the positioning band to the target position.	3.7.11 (22)
		b12	PUSH Push-motion specification: Positioning operation is performed when this signal is OFF, and push-motion operation is performed when the signal is ON.	3.7.11 (21)
		b11	-	-
		b10		
		b9	CLBR Load cell calibration command: Calibration is performed when this signal turns ON.	3.7.11 (32)
		b8	JOG+ +Jog: The actuator moves in the direction opposite home when this signal is ON.	3.7.11 (13)
		b7	JOG- -Jog: The actuator moves in the direction of home when this signal is ON.	3.7.11 (13)
		b6	JVEL Jog-speed/inch-distance switching: The values set in parameter No. 26, “Jog speed” and parameter No. 48, “Inch distance” are used when this signal is OFF, and the values set in parameter No. 47, “Jog speed 2” and parameter No. 49, “Inch distance 2” are used when the signal is ON.	3.7.11 (14)
		b5	JISL Jog/inch switching: Jog operation is performed when this signal is OFF, and inch operation is performed when the signal is ON.	3.7.11 (15)
		b4	SON Servo ON command: The servo turns ON when this signal turns ON.	3.7.11 (5)
		b3	RES Reset: A reset is performed when this signal turns ON.	3.7.11 (4)
		b2	STP Pause: A pause command is issued when this signal turns ON.	3.7.11 (11)
		b1	HOME Home return: A home-return command is issued when this signal turns ON.	3.7.11 (6)
		b0	DSTR Positioning start: A move command is issued when this signal turns ON.	3.7.11 (8)

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the bit is “0.”)

Signal type		Bits	Symbol	Description	Details
PLC input	Current position	32-bit data	-	32-bit signed integer indicating the current position. The setting unit is 0.01 mm. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm * If current positions are read as hexadecimal, negative values are indicated by 2's complements.	3.9 (2)
	Command current	32-bit data	-	32-bit signed integer The current measurement on the load cell is indicated. The unit is 0.01 N. * If readings are expressed in hexadecimal, a negative value is indicated by a 2's complement.	3.9 (2)
	Current speed	32-bit data	-	32-bit signed integer. Indicate the current speed. Positive value: The actuator is moving in the direction opposite home. Negative value: The actuator is moving in the direction of home. 32-bit integer. The current speed is indicated. The setting unit is 0.01 mm/sec. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm/sec * If this data is read as a hexadecimal, a negative value is indicated as a 2's complement.	3.9 (2)
	Alarm code	16-bit data	-	16-bit integer. If an alarm occurred, a corresponding alarm code is output. If no alarm is present, "0H" is set. For details on alarms, refer to the operation manual for the controller.	3.9 (2)
	Status signal	b15	EMGS	Emergency stop: An emergency stop is actuated when this signal turns ON.	3.7.11 (2)
		b14	PWR	Controller ready: This signal turns ON when the controller becomes ready.	3.7.11 (1)
		b13	ZONE2	Zone 2: This signal turns ON when the current position is inside the specified zone.	3.7.11 (12)
		b12	ZONE1	Zone 1: This signal turns ON when the current position is inside the specified zone.	3.7.11 (12)
		b11	-	Not available.	-
		b10			
		b9	CEND	Load cell calibration complete: This signal turns ON when the calibration is complete.	3.7.11 (32)
		b8	RMDS	Operation mode status: This signal is OFF when the current mode is AUTO, or ON when the current mode is MANU.	3.7.11 (19)
		b7	BALM	Absolute battery voltage low alarm: This signal turns ON when the battery voltage drops.	3.7.11 (28)
		b6	PUSHS	Push-motion operation in progress: This signal remains ON while the actuator is performing push-motion operation	3.7.11 (25)
		b5	PSFL	Load missed in push motion: This signal turns ON when the actuator missed the load in push-motion operation.	3.7.11 (23)
		b4	SV	Ready: This signal turns ON when the servo turns ON.	3.7.11 (5)
		b3	ALM	Alarm: This signal turns ON when an alarm occurs.	3.7.11 (3)
		b2	MOVE	Moving signal: This signal remains ON while the actuator is moving.	3.7.11 (9)
		b1	HEND	Home return complete: This signal turns ON when home return is completed.	3.7.11 (6)
b0	PEND	Position complete signal: This signal turns ON when positioning is completed.	3.7.11 (10)		

3.7.9 Remote I/O Mode 3 (Number of Occupied Channels: 6)

In this mode, the actuator is operated by means of force control (push-motion operation based on feedback of load cell values) and also by specifying position numbers in the same manner you would using PIOs (24-V I/Os). Set position data using the RC PC software or other teaching tool.

The number of available positions is determined by the setting of parameter No. 25, "PIO pattern."

In this mode, all functions in the remote I/O mode are available, plus additional functions to read the current position and force feedback data.

The features of each PIO pattern are shown below. (For details, refer to the operation manual for the controller.)

Value set in parameter No. 25	Operation mode	I/O specification
0	Positioning mode	64 positioning points and two zone output points are available.
1	Teaching mode	64 positioning points and one zone output point is available. Positioning operation and jog operation are supported. The current position can be written to a specified position.
2	256-point mode	256 positioning points and one zone output point is available.
3	512-point mode	512 positioning points are available. There are no zone outputs.
4	Solenoid mode 1	7 positioning points and two zone output points are available. A direct operation command can be issued for each position number. A position complete signal is output for each position number.
5	Solenoid mode 2	3 positioning points and two zone output points are available. The actuator is operated by specifying forward, backward and intermediate position commands. A position complete signal is output separately for the front end, rear end and intermediate position.
6	Force control mode 1 (a dedicated load cell is used)	32 positioning points, 1 zone output
7	Force control mode 2 (a dedicated load cell is used)	5 positioning points, 1 zone output A direct operation command can be issued for each position number. A position complete signal is output for each position number.

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

ROBO Cylinder function	PIO pattern							
	0: Positioning mode	1: Teaching mode	2: 256-point mode	3: 512-point mode	4: Solenoid valve mode 1	5: Solenoid valve mode 2	6: Force control mode 1	7: Force control mode 2
Home return operation	○	○	○	○	○	X	○	○
Positioning operation	○	○	○	○	○	○	○	○
Speed & acceleration/ deceleration setting	○	○	○	○	○	○	○	○
Pitch feed (inching)	○	○	○	○	○	○	○	○
Push-motion operation	○	○	○	○	○	X	○	○
Speed change during movement	○	○	○	○	X	○	○	X
Operation at different acceleration and deceleration	○	○	○	○	○	○	○	○
Pause	○	○	○	○	○	○ (*1)	○	○
Zone signal output	○	○	○	X	○	○	○	○
PIO pattern selection (set by parameter)	○	○	○	○	○	○	○	○

○: Supported / X: Not supported

(*1) This function is supported when parameter No. 27, "Move command type" is set to "0."

The actuator can be paused by turning the move command OFF.

(1) PLC channel configuration (* n indicates the node address of each axis.)

Parameter No. 84	SCON-CA DI and input register	PLC output channel	SCON-CA DO and output register	PLC input channel
7	Port number 0 to 15	n+0	Port number 0 to 15	n+0
	Occupied area	n+1	Occupied area	n+1
		n+2	Current position	n+2
		n+3		n+3
		n+4		n+4
		n+5	Force feedback data	n+5

(Note) The areas denoted by “occupied area” cannot be used for any other purpose. Also exercise caution to avoid node address duplication.

(2) I/O signal assignments for each axis

The I/O signals of each axis consist of six input words (channels) and six output words (channels) in the I/O areas.

- The channels controlled by port number are controlled using ON/OFF bit signals.
- The current position is a 2-word (32-bit) binary data (unit: 0.01 mm).
- The force feedback data is a 2-word (32-bit) binary data (unit: 0.01N).

PLC output (* n indicates the node address of each axis.)

Channel

	1 word (channel) = 16 bits															
n+0	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Controller input port number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

PLC input (* n indicates the node address of each axis.)

Channel

1 word (channel) = 16 bits

n+0	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Controller output port number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

n+1	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Not available.																

n+2	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (lower word)																

n+3	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (upper word)																

If the current position is a negative value, it is indicated by a 2's complement.

n+4	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Force feedback data (lower word)																

n+5	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Force feedback data (upper word)																

If the force feedback data is a negative value, it is indicated by a 2's complement.

(3) I/O signal assignments

For the signal assignments corresponding to each PIO pattern, refer to the I/O signal assignments for the remote I/O mode explained in 3.7.2 (3).

Signal assignments under the command-current read function and current-position read function are shown below.

Signal type		Bits	Symbol	Description	Details
PLC input	Current position	32-bit data	-	32-bit signed integer indicating the current position. The setting unit is 0.01 mm. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm * If current positions are read as hexadecimal, negative values are indicated by 2's complements.	-
	Force feedback data	32-bit data	-	32-bit integer. Indicate the measured value of the current load cell. The setting unit is 1 mA. * If current positions are read as hexadecimal, negative values are indicated by 2's complements.	-

3.7.10 Half Direct Mode 3 (Number of Occupied Channels: 8)

In this operation mode, the jog function available in the half numerical value mode is unavailable, but the vibration damping control parameter set can be changed.

Set each value in the I/O areas. To use the zone function, set appropriate values in parameter Nos. 1, 2, 23 and 24.

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

ROBO Cylinder function	○: Direct control △: Indirect control X: Invalid	Remarks
Home-return operation	○	
Positioning operation	○	
Speed and acceleration/deceleration setting	○	
Pitch feed (inching)	○	
Push-motion operation	○	
Speed change during movement	○	
Operation at different acceleration and deceleration	X	
Pause	○	
Zone signal output	△	Parameters must be set
PIO pattern selection	X	

(1) PLC channel configuration (* n indicates the node address of each axis.)

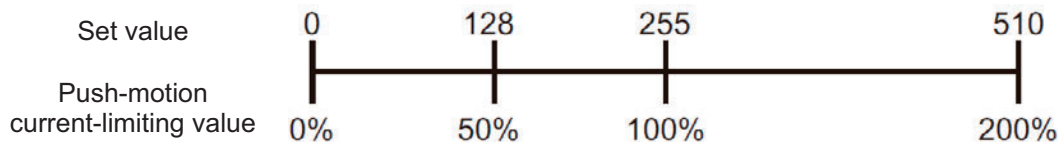
Parameter No. 84	SCON-CA input register	PLC output channel	SCON-CA output register	PLC input channel
8	Target position	n+0	Current position	n+0
		n+1		n+1
	Positioning band	n+2	Command current	n+2
		n+3		n+3
	Speed	n+4	Current speed	n+4
	Acceleration/ deceleration	n+5		n+5
	Push-motion current-limiting value	n+6	Alarm code	n+6
	Control signal	n+7	Status signal	n+7

(Note) Exercise caution to avoid node address duplication.

(2) I/O signal assignments for each axis

The I/O signals of each axis consist of eight input words (channels) and eight output words (channels) in the I/O areas.

- Control signals and status signals are ON/OFF bit signals.
- The target position and current position are 2-word (32-bit) binary data. Although values from -999999 to +999999 (unit: 0.01 mm) can be handled by the PLC for these items, set position data within the soft stroke range (0 to the effective stroke) of the applicable actuator.
- Specify the positioning band. The positioning band is a 2-word (32-bit) binary data. For the positioning band, the PLC can handle values from 1 to +999999 (unit: 0.01 mm).
- The specified speed is a 1-word (16-bit) binary data. For the specified speed, the PLC can handle values from 0 to +65535 (unit: 1.0 mm/sec). Take note, however, that the set value should not exceed the maximum speed supported by the applicable actuator.
- The acceleration/deceleration is a 1-word (16-bit) binary data. For the acceleration/deceleration, the PLC can handle values from 1 to 300 (unit: 0.01 G). Take note, however, that the set value should not exceed the maximum acceleration or maximum deceleration supported by the applicable actuator.
- The push-motion current-limiting value is a 1-word (16-bit) binary data. For the push-motion current-limiting value, the PLC can handle values from 0 (0%) to 510 (200%). Take note, however, that the setting should be inside the allowable specification range of push-motion current-limiting values supported by the applicable actuator (refer to the catalog or operation manual for the actuator).



- The command current is a 2-word (32-bit) binary data (unit: 1 mA).
- The current speed is a 2-word (32-bit) binary data (unit: 0.01 mm/sec).
- The alarm code is a 1-word (16-bit) binary data.

PLC output

Channel (* n indicates the node address of each axis.)

1 word (channel) = 16 bits																
n+0	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (lower word)																
n+1	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Target position (upper word)																

If the target position is a negative value, it is indicated by a 2's complement.

n+2	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Positioning band (lower word)	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1
n+3	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Positioning band (upper word)	—	—	—	—	—	—	—	—	—	—	—	—	524,288	262,144	131,072	65,536
n+4	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Speed	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1
n+5	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Acceleration/ deceleration	—	—	—	—	—	—	—	256	128	64	32	16	8	4	2	1
n+6	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Push-motion current-limiting value	—	—	—	—	—	—	—	256	128	64	32	16	8	4	2	1
n+7	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Control signal	BKRL	RMOD	DIR	PUSH	GSL1	GSL0	NTC1	NTC0	MOD1	MOD0	—	SON	RES	STP	HOME	DSTR

PLC input
Channel (* n indicates the node address of each axis.)

		1 word (channel) = 16 bits															
n+0		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (lower word)																	
n+1		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current position (upper word)																	

If the current position is a negative value, it is indicated by a 2's complement.

n+2		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Command current (lower word)		32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1
n+3		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Command current (upper word)														524,288	262,144	131,072	65,536
n+4		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current speed (lower word)																	
n+5		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Current speed (upper word)																	

If the current speed is a negative value, it is indicated by a 2's complement.

n+6		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Alarm code																	
n+7		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Status signal		EMGS	PWR	ZONE2	ZONE1				RMDS	BALM		PSFL	SV	ALM	MOVE	HEND	PEND

(3) I/O signal assignments

(* In the table, ON indicates that the applicable bit is "1," while OFF indicates that the bit is "0.")

Signal type	Bits	Symbol	Description	Details
PLC output	Target position	32-bit data	- 32-bit signed integer. Specify the target position as a position in the absolute coordinate system. The setting unit is 0.01 mm and the allowable specification range is -999999 to 999999. (Example) To set "+25.41 mm," specify "2541." If the entered value exceeds the range between the soft limits (0.2 mm inside the limits) set by the parameters, the movement will be limited to the soft limit (0.2 mm inside the limit). * If target positions are entered as hexadecimals, enter negative values using 2's complements.	3.9 (2)
	Positioning band	32-bit data	- 32-bit integer. The setting unit is 0.01 mm and the allowable specification range is 1 to 999999. (Example) To set "+25.40 mm," specify "2540." This register has one of two meanings depending on the operation type. [1] In positioning operation, this register defines the permissible range from the target position in which positioning will be deemed to have completed. [2] In push-motion operation, this register defines the push-motion band. Whether to perform normal operation or push-motion operation is set using the control signal PUSH.	3.9 (2)
	Speed	16-bit data	- 16-bit integer. Specify the speed at which to move the actuator. The setting unit is 1.0 mm/sec and the allowable specification range is 0 to 65535. (Example) To set "254.0 mm/sec," specify "254." If a move command is issued by specifying a value exceeding the maximum speed, an alarm will occur.	3.9 (2)
	Acceleration/ deceleration	16-bit data	- 16-bit integer. Specify the acceleration/deceleration at which to move the actuator (the acceleration and deceleration will be the same value). The setting unit is 0.01 G and the allowable specification range is 1 to 300. (Example) To set "0.30 G," specify "30." If a move command is issued by specifying "0" or any value exceeding the maximum acceleration or deceleration, an alarm will occur.	3.9 (2)

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the applicable bit is “0.”)

Signal type	Bit	Symbol	Description	Details
Push-current limiting value	16-bit data	-	16-bit integer. Specify the current-limiting value during push-motion operation. The specified range is 0 (0%) to 255 (100%). The actual specifiable range varies with each actuator. (Refer to the catalog or operation manual for each actuator.) If a move command is issued by specifying a value exceeding the maximum push current value, an alarm will occur.	3.9 (2)
Control signal	b15	BKRL	Forced brake release: The brake is released when the signal turns ON.	3.7.11 (18)
	b14	RMOD	Operation mode: AUTO mode when the signal is OFF, or MANU mode when the signal is ON.	3.7.11 (19)
	b13	DIR	Push direction specification: When the signal is OFF, the direction of the position obtained by subtracting the positioning band from the target position is used. When the signal is ON, the direction of the position obtained by adding the positioning band to the target position is used.	3.7.11 (22)
	b12	PUSH	Push specification: Positioning operation when the signal is OFF, or push-motion operation when the signal is ON.	3.7.11 (21)
	b11	GSL1	Servo gain parameter set selection 1	3.7.11 (33)
	b10	GSL0	Servo gain parameter set selection 0	
	b9	NTC1	Vibration damping control mode selection 1	
	b8	NTC0S	Vibration damping control mode selection 0	
	b7	MOD1	Acceleration/deceleration mode:	3.7.11 (30)
	b6	MOD0	Trapezoid pattern when both signals are OFF, S-motion when MOD1 is OFF and MOD0 is ON, or primary delay filter when MOD1 is ON and MOD0 is OFF.	
	b5	-	Not available	
	b4	SON	Servo ON command: The servo is ON when the signal is ON.	
	b3	RES	Reset: A reset is performed when the signal turns ON.	3.7.11 (4)
	b2	STP	Pause: A pause command is issued when the signal turns ON.	3.7.11 (11)
	b1	HOME	Home return: A home return command is issued when the signal turns ON.	3.7.11 (6)
	b0	DSTR	Positioning start command: A move command is issued when the signal turns ON.	3.7.11 (8)

(* In the table, ON indicates that the applicable bit is “1,” while OFF indicates that the applicable bit is “0.”)

Signal type		Bit	Symbol	Description	Details
PLC input	Current position	32-bit data	-	32-bit signed integer indicating the current position. The unit is 0.01 mm. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm * If this data is read as a hexadecimal, a negative value is indicated by a 2's complement.	3.9 (2)
	Command current	32-bit data	-	32-bit integer. The value of electrical current specified by the present command is indicated. The unit is mA. (Example) Reading: 000003FFH = 1023 (decimal) = 1023 mA	3.9 (2)
	Current speed	32-bit data	-	32-bit signed integer. The current speed is indicated. Positive value: The actuator is moving in the direction opposite home. Negative value: The actuator is moving in the direction of home. The unit is 0.01 mm/sec. (Example) Reading: 000003FFH = 1023 (decimal) = 10.23 mm/sec * If this data is read as a hexadecimal value, a negative value is indicated by a 2's complement.	3.9 (2)
	Alarm code	16-bit data	-	16-bit integer. If an alarm occurs, an alarm code will be output. 0H is output when no alarm is present. For details on alarms, refer to the operation manual for the controller.	3.9 (2)
	Status signal	b15	EMGS	Emergency stop: An emergency stop is being executed when the signal is ON.	3.7.11 (2)
		b14	PWR	Controller ready: The signal turns ON when the controller becomes ready.	3.7.11 (1)
		b13	ZONE2	Zone 2: The signal is ON when the current position is inside the specified zone.	3.7.11 (12)
		b12	ZONE1	Zone 1: The signal is ON when the current position is inside the specified zone.	3.7.11 (12)
		b11	-	Not available	-
		b10			
		b9			
		b8	RMDS	Operation mode: The signal is OFF when the current mode AUTO, or ON when the current mode is MANU.	3.7.11 (19)
		b7	BALM	Absolute battery voltage low warning: This signal turns ON when the voltage drops.	3.7.11 (28)
		b6	-	Not available	-
		b5	PSFL	Missed load during push-motion operation: The signal turns ON when the actuator missed the load during push-motion operation.	3.7.11 (23)
		b4	SV	Ready: The signal is ON when the servo is ON.	3.7.11 (5)
		b3	ALM	Alarm: The signal turns ON when an alarm occurs.	3.7.11 (3)
		b2	MOVE	Moving signal: The signal is ON while the actuator is moving.	3.7.11 (9)
		b1	HEND	Home return complete: The signal turns ON when the home return is completed.	3.7.11 (6)
		b0	PEND	Positioning complete signal: The signal turns ON when the positioning is completed.	3.7.11 (10)

3.7.11 I/O Signal Controls and Functions

* ON indicates that the applicable bit signal is “1,” while OFF indicates that the bit signal is “0.”

How the I/O signals used in the position/simple direct mode 1, 2, half direct mode 1 to 3 and full direct mode are controlled, as well as the functions provided by these signals, are explained below. For the I/O signals used in the remote I/O mode 1 to 3, refer to the operation manual for the controller.

(1) Controller ready (PWR) [PLC input signal]

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

■ Function

The PWR signal turns ON when the controller has been initialized successfully and become ready to perform control following the power on, regardless of the alarm status, servo status or any other condition.

Even when an alarm is present, the PWR signal turns ON as long as the controller is ready.

(2) Emergency stop (EMGS) [PLC input signal]

This signal turns ON when the controller has entered the emergency stop mode.

■ Function

The EMGS signal turns ON when the controller has entered the emergency stop mode (motor drive power has been cut off). The signal will turn OFF once the emergency stop is cancelled.

(3) Alarm (ALM) [PLC input signal]

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

■ Function

The ALM signal turns ON when the controller's protective circuit (function) has actuated following an error detection.

When the cause of the alarm is removed and the reset (RES) signal is turned ON, the ALM signal will turn OFF if the applicable alarm is an operation-reset alarm. (To reset cold-start alarms, the power must be reconnected.)

When an alarm is detected, the status indicator LED (refer to 3.4, “DeviceNet Interface”) on the front panel of the controller will illuminate in red.

(4) Reset (RES) [PLC output signal]

This signal has two functions. One is to reset controller alarms, and the other is to cancel the remaining travel while the actuator is paused.

■ Function

[1] Turning the RES signal from OFF to ON after removing the cause of the present alarm will reset the alarm (ALM) signal. (To reset cold-start alarms, the power must be reconnected.)

[2] Turning the RES signal from OFF to ON while the actuator is paused will cancel the remaining travel.

- (5) Servo ON command (SON) [PLC output signal]
Ready (SV) [PLC input signal]

When the SON signal is turned ON, the servo will turn on.

When the servo turns on, the status indicator LED (refer to 3.4, "DeviceNet Interface") on the front panel of the controller will illuminate in green.

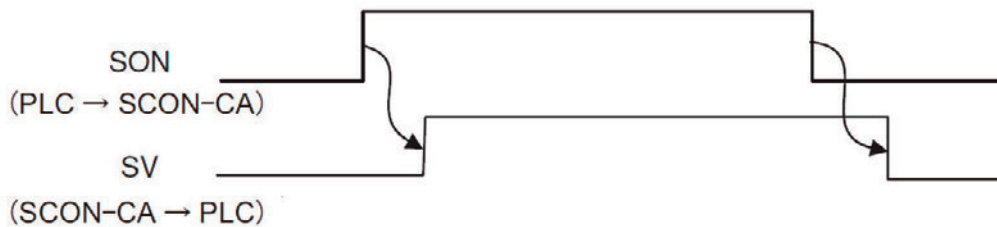
The SV signal is synchronized with this LED.

■ Function

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

While the SV signal is ON, the controller servo remains on and the actuator can be operated.

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



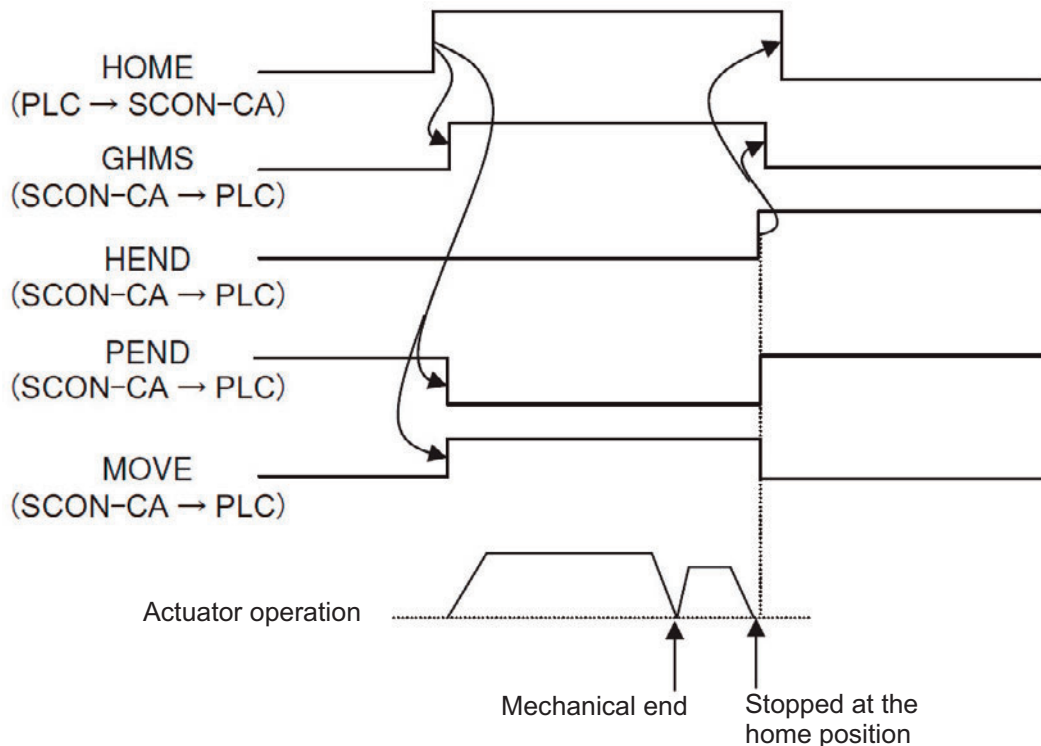
- (6) Home return (HOME) [PLC output signal]
 Home return complete (HEND) [PLC input signal]
 Home return in progress (GHMS) [PLC input signal]

When the HOME signal is turned ON, the HOME command will be processed at the leading (ON) edge of the signal and home-return operation will be performed automatically. The GHMS signal turns ON while the home return is in progress.

Once the home return has completed, the HEND signal turns ON and the GHMS signal turns OFF.

Program the controller so that the HOME signal will turn OFF after the HEND signal turns ON. Once it is turned ON, the HEND signal will not turn OFF until the power is turned off or a HOME signal is input again.

After a home return has been performed once, another home return can be performed by turning ON the HOME signal.



Caution: In the remote I/O mode, 1 to 3 or position/simple direct mode 1, 2, issuing a positioning command to a given position following the power on, without performing a home return first, will cause the actuator to automatically return home and then perform the positioning. Take note that this applies only to the first positioning command following the power on. Exercise caution that in the half direct mode or full direct mode 1 to 3, issuing a positioning command to a given position following the power on, without performing a home return first, will generate an alarm ("Error Code 83: Alarm home ABS (absolute position move command when home return is not yet completed)" (operation-reset alarm)).

(7) Positioning start (CSTR): Used in the position/simple direct mode 1,2 [PLC output signal]

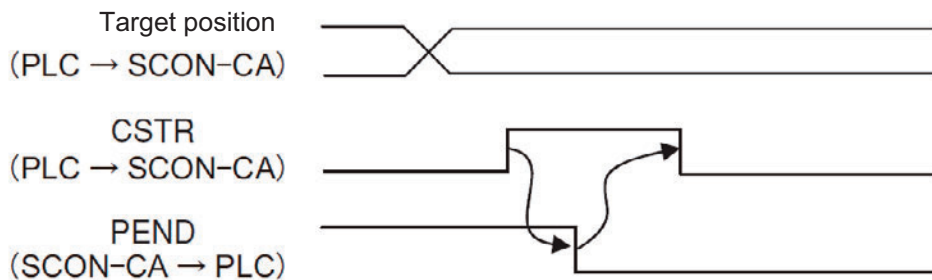
The CSTR command is processed at the leading (ON) edge of the signal, upon which the actuator will move to the position set by the target position corresponding to the specified position number or by the target position channel of the PLC.

Whether to use the target position corresponding to the specified position number or the target position channel of the PLC is determined by control signal b11 (position/simple-direct switching (PMOD) signal).

- PMOD = OFF: Use the target position data corresponding to the specified position number
- PMOD = ON: Use the value set to the target position channel of the PLC.

If this command is issued when no home-return operation has been performed yet after the power on (= while the HEND signal is OFF), the actuator will automatically return home and then move to the target position.

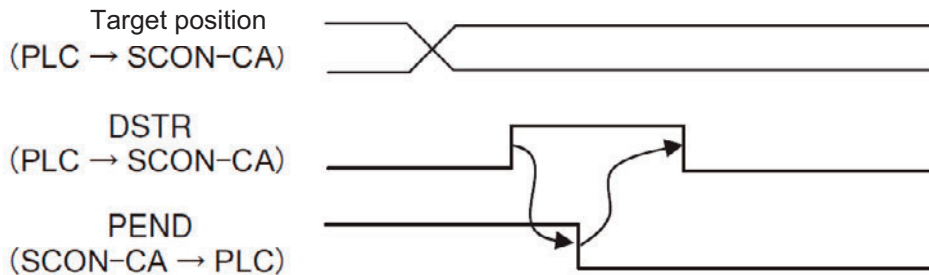
Program the controller so that the CSTR signal will be turned OFF after the position complete (PEND) signal turns OFF.



(8) Positioning command (DSTR): Used in the half direct mode and full direct mode 1 to 3 [PLC output signal]

The DSTR command is processed at the leading (ON) edge of the signal, upon which the actuator will move to the target position input to the target position channel of the PLC. If this command is issued when no home-return operation has been performed yet after the power on (= while the HEND signal is OFF), an alarm (operation-reset alarm) will occur.

Program the controller so that this signal will be turned OFF after the position complete (PEND) signal turns OFF.



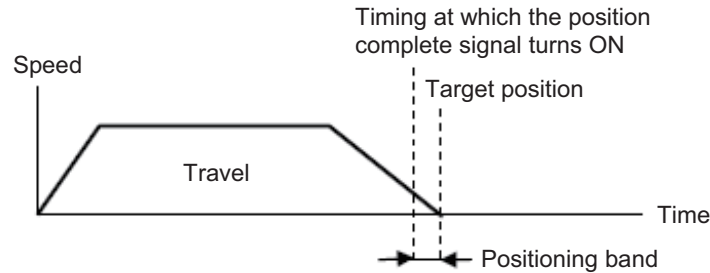
(9) Moving signal (MOVE) [PLC input signal]

This signal turns ON while the actuator slider or rod is moving (also while home-return operation, push-motion operation or jog operation is in progress).

The MOVE signal turns OFF upon completion of positioning, home-return or push-motion operation or while the actuator is paused.

(10) Position complete signal (PEND) [PLC input signal]

This signal turns ON after the actuator has moved to the target position and entered the positioning band or completed the push-motion operation.



When the servo turns on, positioning is performed based on the current position set as the target position. Accordingly, the PEND signal turns ON and will turn OFF when a positioning operation is started thereafter with the home return (HOME) signal, positioning start (CSTR) signal or positioning command (DSTR) signal.

Caution: If the servo turns off or an emergency stop is actuated while the actuator is stopped at the target position, the PEND signal will turn OFF. When the servo subsequently turns on, the PEND signal will turn ON if the current position is inside the positioning band. Also take note that the PEND signal will not turn ON if the CSTR or DSTR signal remains ON.

(11) Pause (STP) [PLC output signal]

When this signal is turned ON, the moving axis will decelerate to a stop. If the signal is turned OFF thereafter, the axis movement will resume.

The acceleration used immediately after resumption of operation, and deceleration used when the actuator stops, conform to the acceleration/deceleration value corresponding to the position number set by the specified position number channel in the position/simple direct mode 1, 2, or to the value of the acceleration/deceleration channel in the half direct mode 1 to 3.

In the full direct mode, the acceleration and deceleration conform to the values of the acceleration channel and deceleration channel.

- (12) Zone 1 (ZONE1) [PLC input signal]
 Zone 2 (ZONE2) [PLC input signal]
 Position zone (PZONE) [PLC input signal]

Each signal turns ON when the current position of the actuator is inside the specified zone, and turns OFF when the current position is outside the zone.

[1] Zone 1, zone 2

Each zone is set by user parameters.

The ZONE1 signal is set by parameter No. 1, "Zone boundary 1+" and No. 2, "Zone boundary 1-."

The ZONE2 signal is set by parameter No. 23, "Zone boundary 2+" and No. 24, "Zone boundary 2-."

The ZONE1 and ZONE2 signals become effective following a completion of home return, after which they will remain effective even while the servo is turned off.

[2] Position zone

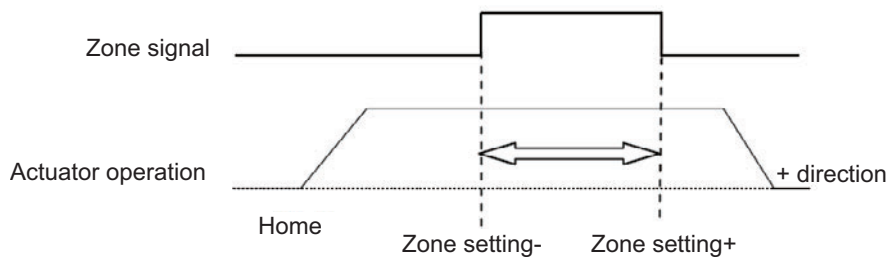
Each zone is set in the position table or using the zone boundary channels.

In the position/simple direct mode, the PZONE signal is set in the position table.

In the full direct mode, the PZONE signal is set using the zone boundary channels.

(*) The PZONE signal is not available in the half direct mode.

The PZONE signal becomes effective when a move command is issued following a completion of home return, after which it will remain effective even while the servo is turned off.



- (13) +Jog (JOG+) [PLC output signal]
 -Jog (JOG-) [PLC output signal]

These signals are used as starting commands for jog operation or inch operation.

If a + command is issued, the actuator will operate in the direction opposite home. When a – command is issued, the actuator will operate in the direction of home.

[1] Jog operation

Jog operation can be performed when the jog/inch switching (JISL) signal is OFF.

The actuator will operate in the direction opposite home while the JOG+ is ON, and decelerate to a stop once the signal turns OFF.

The actuator will operate in the direction of home while the JOG- is ON, and decelerate to a stop once the signal turns OFF.

The specific operation follows the values set in the following parameters:

- The speed conforms to the value of the parameter set by the jog-speed/inch-distance switching (JVEL) signal.
 If the JVEL signal is OFF, the actuator operates according to parameter No. 26, "PIO jog speed."
 If the JVEL signal is ON, the actuator operates according to parameter No. 47, "PIO jog speed 2."
- The acceleration/deceleration conforms to the rated acceleration/deceleration (the specific value varies depending on the actuator).
- If both the JOG+ and JOG- signals turn ON, the actuator will decelerate to a stop.

[2] Inch operation

Inch operation can be performed when the JISL signal is ON.

The actuator moves by the inch distance every time this signal turns ON.

The actuator will operate in the direction opposite home when the JOG+ is ON, or in the direction of home when the JOG- is ON.

The specific operation follows the values set in the following parameters:

- The speed conforms to the value of the parameter specified by the JVEL signal.
 If the JVEL signal is OFF, the actuator operates according to parameter No. 26, "PIO jog speed."
 If the JVEL signal is ON, the actuator operates according to parameter No. 47, "PIO jog speed 2."
- The travel conforms to the value of the parameter specified by the JVEL signal.
 If the JVEL signal is OFF, the actuator operates according to parameter No. 48, "PIO inch distance."
 If the JVEL signal is ON, the actuator operates according to parameter No. 49, "PIO inch distance 2."
- The acceleration/deceleration conforms to the rated acceleration/deceleration (the specific value varies depending on the actuator).

While performing a normal operation, the actuator will continue with the normal operation even after the +jog or -jog signal is turned ON (the jog signal will be ignored).

While the actuator is paused, turning ON the +jog or -jog signal will not cause the actuator to operate.

(Note) Since the software stroke limits are invalid before a home return is completed, the actuator may collide with the mechanical end. Exercise caution.

(14) Jog-speed/inch-distance switching (JVEL) [PLC output signal]

This signal is used to switch between the jog speed parameter when jog operation is selected, and the inch distance parameter when inch operation is selected.

JVEL signal	Jog operation: JISL = OFF	Inch operation: JISL = ON
OFF	Parameter No. 26, "Jog speed"	Parameter No. 26, "Jog speed" Parameter No. 48, "Inch distance"
ON	Parameter No. 47, "Jog speed 2"	Parameter No. 47, "Jog speed 2" Parameter No. 49, "Inch distance 2"

(15) Jog/inch switching (JISL) [PLC output signal]

This signal is used to switch between jog operation and inch operation.

JISL = OFF: Jog operation

JISL = ON: Inch operation

If the JISL signal turns ON (inch) while the actuator is moving by jogging, the actuator will decelerate to a stop and then switch to the inch function.

If the JISL signal turns ON (jog) while the actuator is moving by inching, the actuator will complete the movement and then switch to the jog function.

The table below summarizes the relationship of the ON/OFF statuses of the JISL signal and jog-speed/inch-distance switching (JVEL) signal.

		Jog operation	Inch operation
JISL		OFF	ON
JVEL=OFF	Speed	Parameter No. 26, "Jog speed"	Parameter No. 26, "Jog speed"
	Travel	-	Parameter No. 48, "Inch distance"
	Acceleration/ deceleration	Rated value (The specific value varies depending on the actuator.)	Rated value (The specific value varies depending on the actuator.)
JVEL=ON	Speed	Parameter No. 47, "Jog speed 2"	Parameter No. 47, "Jog speed 2"
	Travel	-	Parameter No. 49, "Inch distance 2"
	Acceleration/ deceleration	Rated value (The specific value varies depending on the actuator.)	Rated value (The specific value varies depending on the actuator.)
Operation		When the JOG+/JOG- signal is ON	Upon detection of the leading (ON) edge of the JOG+/JOG- signal

- (16) Teaching command (MODE) [PLC output signal]
 Teaching mode signal (MODES) [PLC input signal]

When the MODE signal is turned ON, the actuator mode will switch from normal operation to teaching.
 Upon switching to the teaching mode, the controller of each axis will turn the MODES signal ON.
 Program the PLC so that teaching operation will be performed after the MODES signal turns ON.

(Note) For the actuator mode to switch from normal operation to teaching, the following conditions must be satisfied:

- The actuator (motor) is stopped.
- The +jog (JOG+) signal and -jog (JOG-) signal are turned OFF.
- The position-data read command (PWRT) signal and positioning start (CSTR) signal are turned OFF.

(Note) The actuator will not return to the normal operation mode unless the PWRT signal is OFF.

- (17) Position-data read command (PWRT) [PLC output signal]
 Position-data read complete (WEND) [PLC input signal]

The PWRT signal is effective when the teaching mode (MODES) signal is ON.

Turn the PWRT signal ON (*1), and the data of the current position will be written to the "Position" field under the position number set to the specified position number channel of the PLC. (*2)

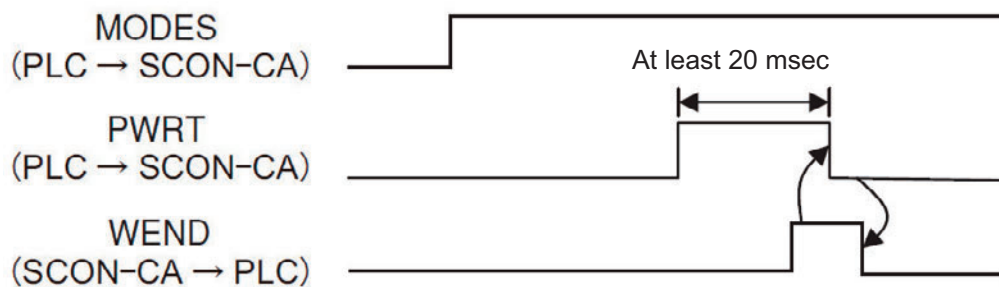
The WEND signal will turn ON once reading is complete.

Program the host PLC so that the PWRT signal will be turned OFF after the WEND signal turns ON.

If the PWRT signal is turned OFF before the WEND signal turns ON, the WEND signal will not turn ON.

When the PWRT signal is turned OFF, the WEND signal will turn OFF.

- (*1) Keep the PWRT signal ON for at least 20 msec. If the signal remains ON for less than 20 msec, the position may not be written.
 (2) If any data other than the position is not yet defined, the default value of the corresponding parameter will be written. (refer to the operation manual for the controller.)



- (18) Forced brake release (BKRL) [PLC output signal]

The brake can be forcibly released by turning this signal ON.

- (19) Operation mode (RMOD) [PLC output signal]
 Operation mode status (RMDS) [PLC input signal]

The operation mode is selected as shown below based on the RMOD signal and the MODE switch on the front panel of the controller.

Whether the current mode is AUTO or MANU can be checked using the RMDS signal.

The combinations of RMOD signal and MODE switch settings and the corresponding operation modes are shown below.

	Controller MODE switch = AUTO	Controller MODE switch = MANU
RMOD signal = OFF (AUTO mode is specified)	AUTO mode (RMDS=OFF)	MANU mode (RMDS=ON)
RMOD signal = ON (MANU mode is specified)	MANU mode (RMDS=ON)	MANU mode (RMDS=ON)

(Note) In the MANU mode, operation from the PLC cannot be performed.

- (20) Position/simple-direct switching (PMOD) [PLC output signal]

This signal is used to switch between the mode where the target position is set using a value registered in the position table stored in the controller, and the mode where a value specified by the target position channel of the PLC is used.

PMOD = OFF: Use the position table

PMOD = ON: Use the value of the target position channel

- (21) Push-motion specification (PUSH) [PLC output signal]

Push-motion operation can be performed when a move command is issued after turning this signal ON.

Normal positioning operation is performed if this signal is set to OFF.

(For the timing of setting this signal, refer to (2), "Operation in the half direct mode" under 3.9, "Operation.")

- (22) Push direction specification (DIR) [PLC output signal]

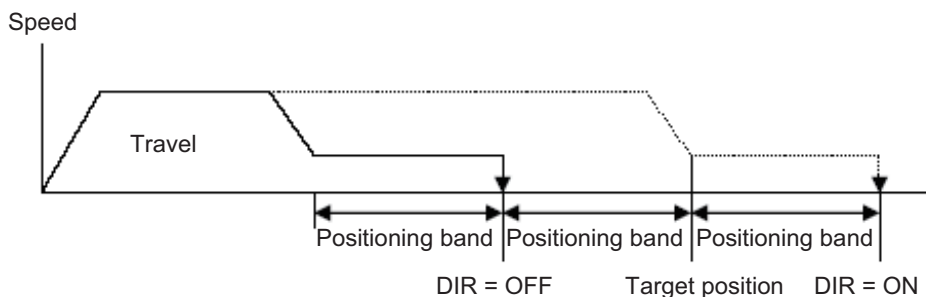
This signal specifies the direction in which the actuator pushes the load.

When the DIR signal is turned OFF, the actuator will push the load in the direction of the value determined by subtracting the positioning band from the target position.

When the DIR signal is turned ON, the actuator will push the load in the direction of the value determined by adding the positioning band to the target position.

The DIR signal is invalid during normal positioning operation.

(For the timing of setting this signal, refer to (2), "Operation in the half direct mode" under 3.9, "Operation.")



(23) Load missed in push motion (PSFL) [PLC input signal]

This signal turns ON when the actuator has not contacted the load in push-motion operation after having moved the distance set by the "Positioning band" field in the position table stored in the controller or by the positioning band channel of the PLC.

(For the timing of setting this signal, refer to (2), "Operation in the half direct mode" under 3.9, "Operation.")

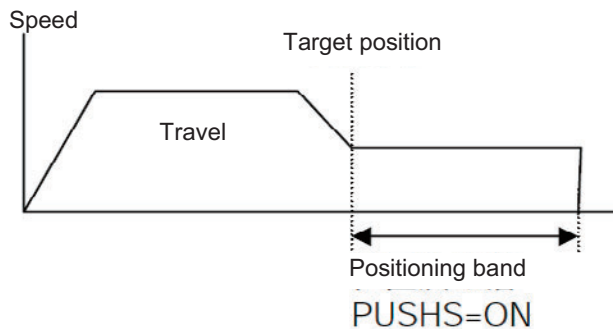
(24) Incremental specification (INC) [PLC output signal]

If a move command is issued while this signal is ON, the actuator will move from the current position by the value input to the target position channel of the PLC. (Incremental move)

If the INC signal is OFF, the actuator will move to the position corresponding to the value of the target position channel of the PLC.

(25) Push motion in progress (PUSHS) [PLC input signal]

This signal turns ON while push-motion operation is in progress.



The PUSHS signal will turn OFF once the actuator misses the load in push-motion operation, a pause command or the next move command is issued, or the servo turns off.

(For the timing of setting this signal, refer to (2), "Operation in the half direct mode" under 3.9, "Operation.")

(26) Load output judgment (LOAD) [PLC input signal]

This signal is effective only during push-motion operation.

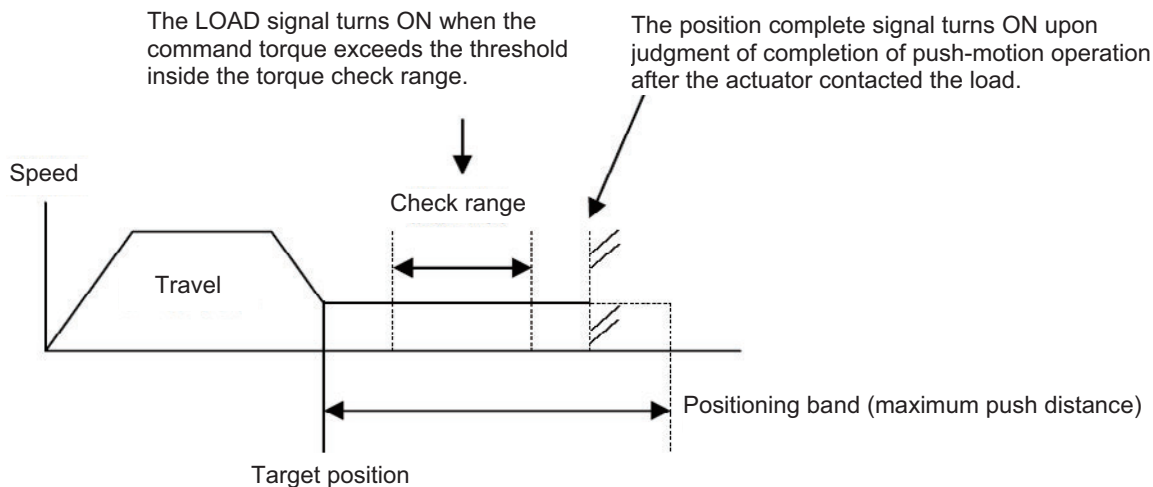
To use the LOAD signal in a press-fit application, the controller must know whether the specified load threshold has been reached during push-motion operation.

The load threshold and check range are set by the PLC, and the LOAD signal will turn ON when the command torque (motor current) exceeds the threshold inside the check range.

Under the LOAD signal, judgment is made based on whether the command torque has exceeded the threshold for the specified time cumulatively.

The processing procedure is the same as the procedure applicable to push judgment. The time of load output judgment can be changed freely using parameter No. 50, "Load output judgment time."

The status of this signal will be retained until the next move command is received.



- The push speed is set by parameter No. 34, "Push speed."
The factory setting varies with an individual actuator based on the characteristics of the actuator. Specify an appropriate speed by considering the material and shape of the load, etc.
 - Set parameter No. 50, "Load output judgment time."
 - The threshold check range is set by the zone boundary+ channel and zone boundary- channel of the PLC.
 - The threshold is set by the load current threshold channel of the PLC.
 - The positioning band is set by the positioning band channel of the PLC.
Set a positioning band slightly longer than the last position, by considering the mechanical variation of the load.
- For details, refer to the operation manual for the controller.

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

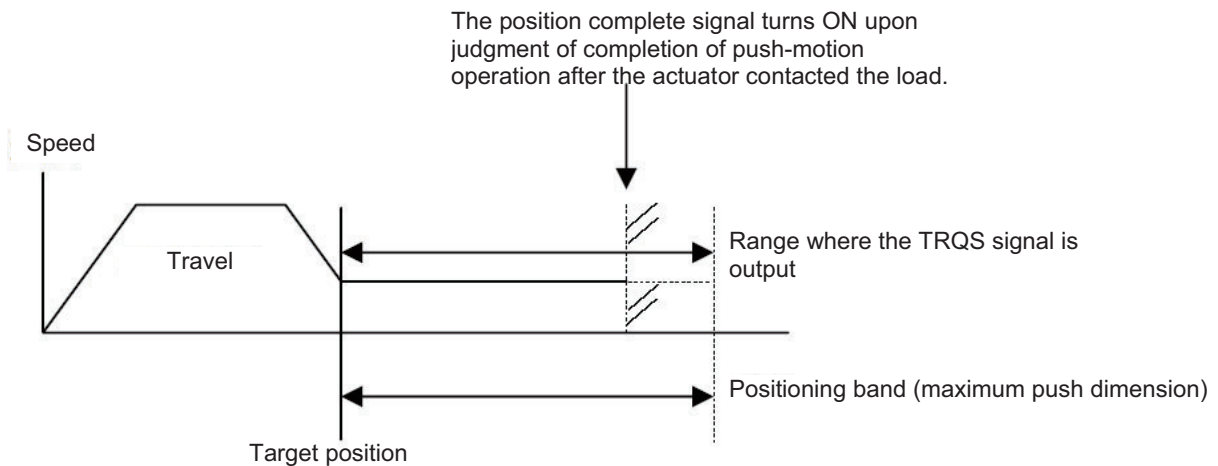
(27) Torque level (TRQS) [PLC input signal]

This signal is effective only during push-motion operation.


If the motor current reaches the load threshold during push-motion operation (= while the actuator is moving within the positioning band), the TRQS signal will turn ON.

Since the level of current is monitored, the ON/OFF status of this signal will also change when the current changes.

The speed at which the actuator can push the load varies depending on the motor and lead. To set a desired speed, therefore, the applicable parameters must be adjusted.



- The push speed is set by parameter No. 34, "Push speed."
The factory setting varies with an individual actuator based on the characteristics of the actuator. Specify an appropriate speed by considering the material and shape of the load, etc.
 - Set parameter No. 50, "Load output judgment time."
 - The threshold is set by the load current threshold channel of the PLC.
 - The positioning band is set by the positioning band channel of the PLC.
Set a positioning band slightly longer than the last position, by considering the mechanical variation of the load.
- For details, refer to the operation manual for the controller.

 **Warning:** The actuator continues to push the load at the push current at standstill determined by the current limiting value.
Since the actuator is not stopped, exercise due caution when handling the actuator or load in this condition.

(28) Absolute Battery Voltage Low Warning (BALM) PLC Input Signal

With an absolute system, this signal is OFF when the absolute battery voltage is normal. It remains OFF with an incremental system.

This BALM signal turns ON when the absolute battery voltage drops to 3.1 V. If the controller is operated continuously and the voltage drops further to 2.5 V, the controller can no longer retain position information. (If you are using an absolute system and this signal turns ON, replace the battery at the earliest opportunity.)

(29) Vibration Damping Control Mode Selection 0, 1 (NTC0, NTC1) PLC Output Signals

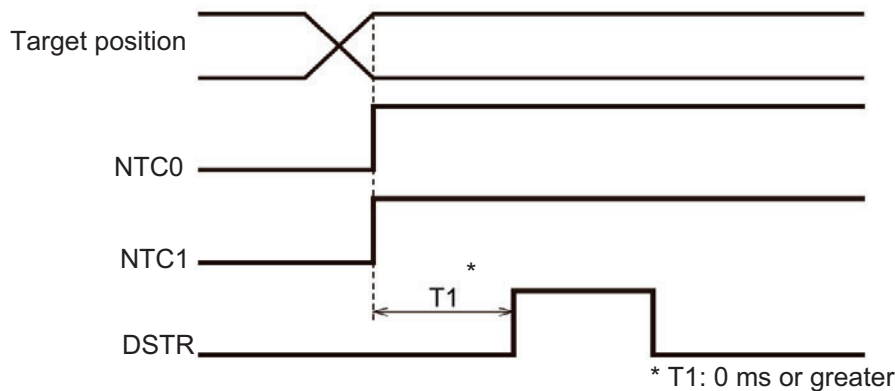
The vibration damping control function suppresses the load vibration induced by IAI's actuator. Measure the vibration frequency and set it in a parameter. In another parameter, select and set an appropriate option based on a combination of these signals.

For details, refer to the operation manual for your controller.

NTC1	NTC0	Function	Remarks
OFF	OFF	Do not use vibration damping control.	Factory setting
OFF	ON	Select parameter set 1	
ON	OFF	Select parameter set 2	
ON	ON	Select parameter set 3	

Input timing

An input timing chart of NTC0/NTC1 signals is shown below.

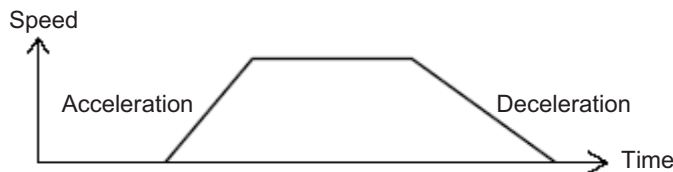


Caution: Since the statuses of NTC0/NTC1 signals are loaded when a movement command (DSTR) is recognized, nothing happens when the NTC0/NTC1 signals are turned ON/OFF while the actuator is moving.

(30) Acceleration/deceleration mode (MOD1, MOD0) [PLC output signal]

These signals are used to select the acceleration/deceleration pattern characteristics. Select a desired mode before issuing an actuator move command.

MOD1	MOD0	Pattern name	Remarks
OFF	OFF	Trapezoid pattern	Factory setting
OFF	ON	S-motion	
ON	OFF	Primary delay filter	
ON	ON	Not available.	

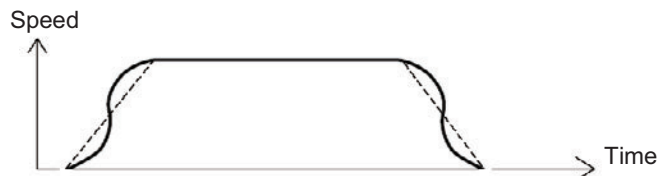
Trapezoid pattern

- * The acceleration and deceleration are set in the "Acceleration" and "Deceleration" fields of the position data table.

S-motion

The actuator accelerates along a curve that increases gradually at first and then rises rapidly in the middle.

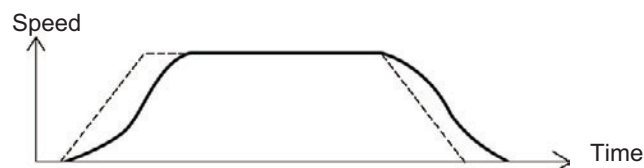
Use this mode if you want to set a high acceleration/deceleration to meet the tact time, but also want the actuator to accelerate/decelerate gradually at start of movement and immediately before stopping.



- * The S-motion level is set by parameter No. 56, "S-motion ratio setting." The setting unit is % and the setting range is 0 to 100.
(The above graph assumes a S-motion ratio of 100 %.)
If "0" is set, the S-motion mode will become invalid.
Take note that this mode will not be reflected in jog or inch operation performed from a PC or teaching pendant.

Primary delay filter

The acceleration/deceleration curve is more gradual than that of linear acceleration/deceleration (trapezoid pattern). Use this mode if you don't want the load to receive micro-vibration during acceleration/deceleration.



- * The primary delay level is set by parameter No. 55, "Primary filter time constant for position command." The minimum input unit is 0.1 msec and the setting range is 0.0 to 100.0.
If "0" is set, the primary delay mode will become invalid.
Take note that this mode will not be reflected in jog or inch operation performed from a PC or teaching pendant.

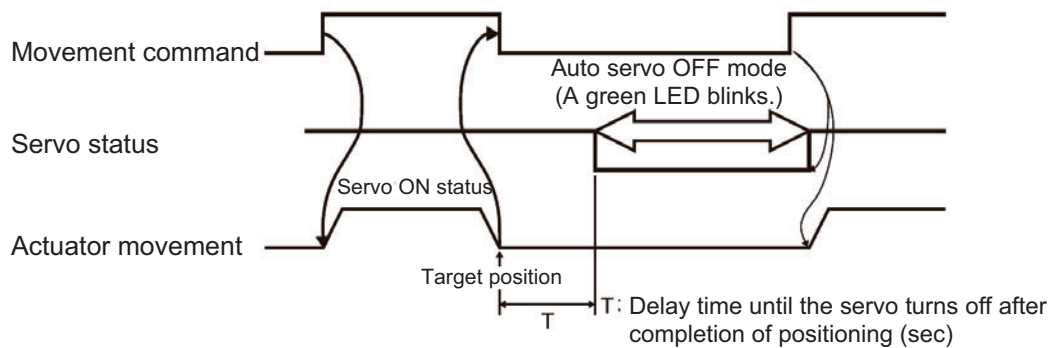
(31) Standstill Mode Selection (ASO0, ASO1) PLC Output Signals

Select the stop mode to be applied while the actuator is standing by to move to the next position after completing a positioning.

If the actuator remains standstill for a long time, the servo is turned off automatically to lower the power consumption.

For details, refer to the operation manual for your controller.

ASO1	ASO0	Standstill mode	Remarks
OFF	OFF	Disabled	(Factory setting)
OFF	ON	Auto servo OFF mode T in the chart below corresponds to the setting of parameter No. 36.	
ON	OFF	Auto servo OFF mode T in the chart below corresponds to the setting of parameter No. 37.	
ON	ON	Auto servo OFF mode T in the chart below corresponds to the setting of parameter No. 38.	

(32) Load Cell Calibration Command (CLBR) PLC Output Signal

Load Cell Calibration Complete (CEND) PLC Input Signal

The factory setting for the load cell is 0 N when no load is applied. If you want to use the loaded condition as the reference (0 N), perform the following calibration. Also perform this calibration in other conditions as necessary (such as during readjustment, inspection, etc.).

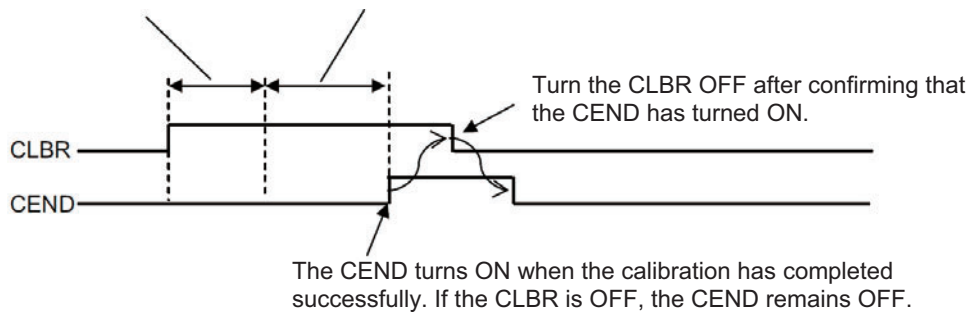
- [1] Stop the operation. (Calibration cannot be performed while any axis is operating, pushing a work part or paused, in which case an attempt to perform calibration will generate a 0E1 (load cell calibration error) alarm.
- [2] Turn ON the load cell calibration signal (CLBR) and keep it ON for at least 20 ms.
- [3] Once the calibration is complete, the calibration complete signal (CEND) turns ON. Thereafter, turn OFF the CLBR signal.

If the calibration was not successful, a 0E1 (load cell calibration error) alarm generates.

Caution: Normal operation commands are not accepted while the CLBR signal is ON.

Signal input is recognized continuously for 20 ms^{*1}

Calibration time^{*2}



*1 If the CLBR is turned OFF during this period, the signal is not recognized and therefore calibration is not performed.

*2 If the CLBR is turned OFF during this period, an alarm generates.

(33) Servo Gain Parameter Set Selection (GSL0, GSL1) PLC Output Signals

The actuator can be operated by selecting, for each position movement, any one of the following four pre-defined sets of servo gain parameters (six different parameters).

For details, refer to the operation manual for your controller.

GSL1	GSL0	Function	Remarks
OFF	OFF	Select parameter set 0	Factory setting
OFF	ON	Select parameter set 1	
ON	OFF	Select parameter set 2	
ON	ON	Select parameter set 3	

3.8 I/O Signal Timings

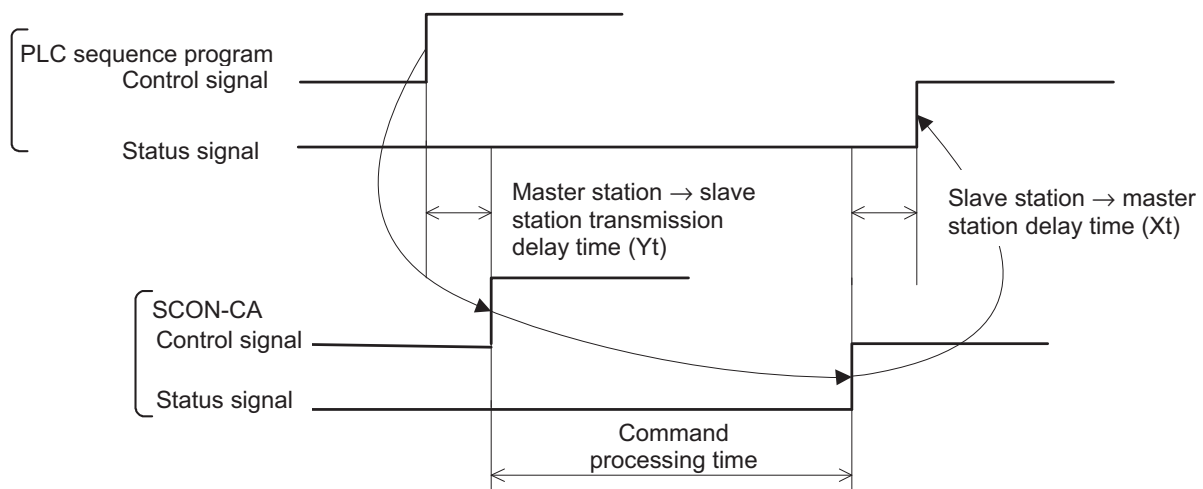
The maximum response time after a given control signal is turned ON to operate the ROBO Cylinder using the PLC's sequence program, until a response (status) signal is turned, is expressed by the formula below:

Maximum response time (msec) = $Y_t + X_t + 2$ + Command processing time (operation time, etc.)

Y_t : Master station → slave station transmission delay time
 X_t : Slave station → master station delay time

} Field network transmission delay time

For the master station → slave station transmission delay time (Y_t) and slave station → master station delay time (X_t), refer to the operation manuals for the PROFIBUS-DP master unit and the PLC in which the master unit is installed.



3.9 Operation

Next, timings in the position/simple direct mode 1, 2, half direct mode 1 to 3 and full direct mode are explained using examples of basic operations.

For the remote I/O mode 1 to 3, refer to the operation manual for the controller.

(In remote I/O mode 2 or 3, read the current position, command current or force feedback data from each applicable byte on the PLC side as deemed necessary.)

(1) Operation in the position/simple direct mode 1, 2

Operate the actuator by writing the position data to the PLC's target position, while specifying the speed, acceleration/deceleration, positioning band, push-current limiting value, etc., in the position table.

- Example of operation (normal positioning operation)

(Preparation) Set all position data other than the target position (speed, acceleration/deceleration, positioning band, etc.) in the position table.

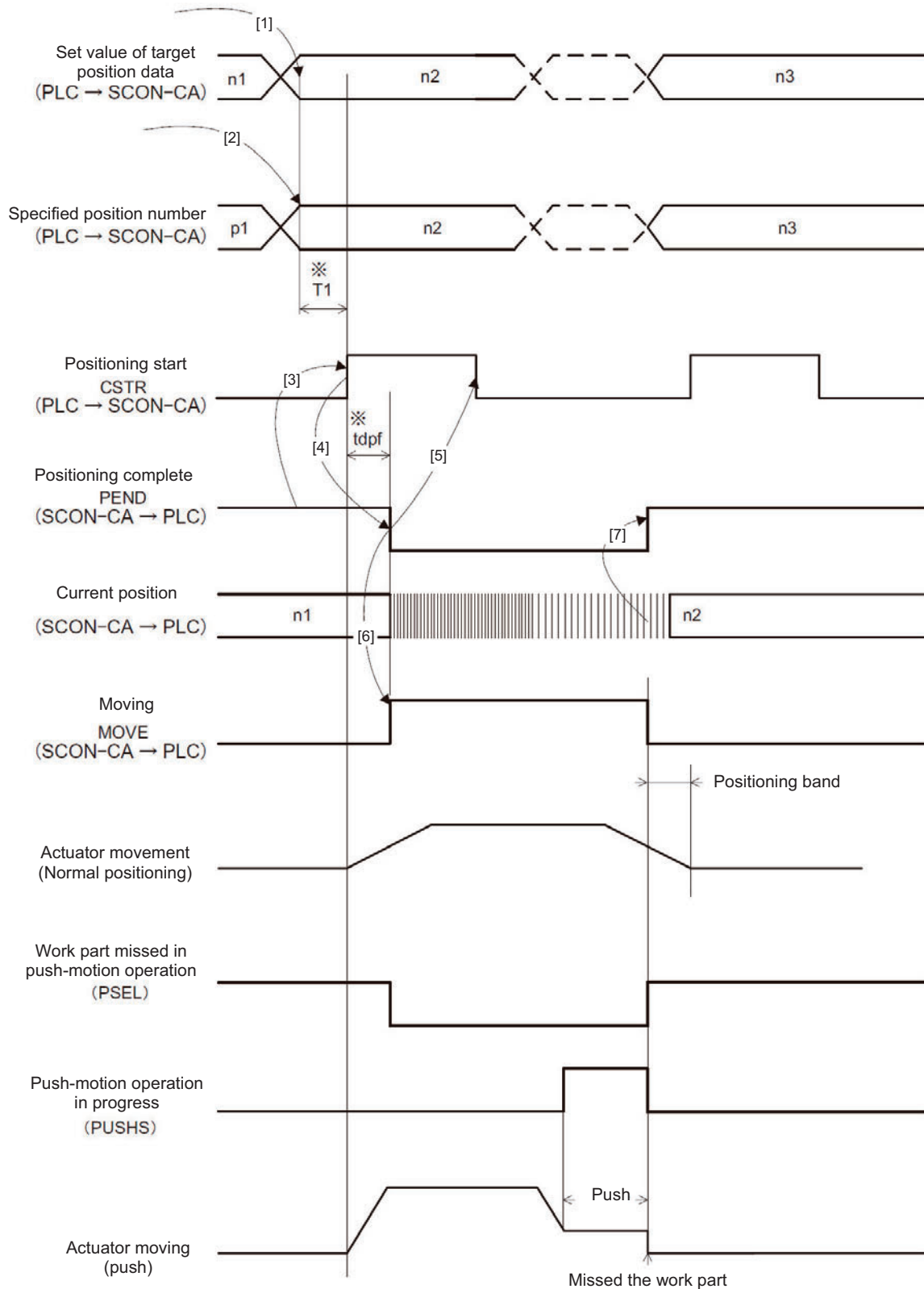
Turn the position/simple direct switching (PMOD) signal ON.

- [1] Set the target position data for the target positions (*) corresponding to output addresses n and n+1.
- [2] Set the position number for which the speed, acceleration/deceleration, etc., have been set for the specified position number corresponding to output address n+2 (*).
- [3] Turn the positioning start (CSTR) signal ON while the positioning complete (PEND) signal is ON or moving signal (MOVE) is OFF.
The data set in [1] and [2] are read by the controller at the leading edge of the CSTR signal.
- [4] The CSTR signal turns ON and PEND turns ON thereafter.
- [5] Turn the CSTR signal OFF after confirming that the PEND signal has turned OFF or MOVE signal has turned ON. Do not change the target value (*) until the CSTR signal is turned OFF.
- [6] The MOVE signal turns ON simultaneously as the PEND signal turns OFF.
- [7] The current position data (*) in input addresses n and n+1 are constantly updated. When the remaining travel falls within the positioning band set by the position data table, the PEND signal turns ON if the CSTR signal is OFF, upon which the completed position number is output to the completed position number (*) corresponding to input address n+2.
Accordingly, wait until the PEND signal turns ON and an appropriate time (time to move the remaining travel) elapses before reading the completed position number (*) following the completion of positioning.
The current position data may vary slightly due to vibration, etc., even when the actuator is at standstill.
- [8] The target position data can be changed while the actuator is moving.
To change the target position, change the target position data, wait until at least the PLC's scan time elapses, and then turn the CSTR signal ON.
Change the value of the CSTR signal after an elapse of at least the PLC's scan time.

- Example of operation (push-motion operation)

In push-motion operation, a current-limiting value is set in the Push field of the position data table in the "preparation" stage.

When positioning is started by specifying the position number for which the above value has been set in the Push field, push-motion operation is performed.



*T1: Make sure "T1 ≥ 0 ms" is satisfied by considering the scan time of the host controller.
 *Yt + Xt ≤ tdpf ≤ Yt + Xt + 3 (msec)

(2) Operation in the half direct mode 1 to 3

Operate the actuator by specifying data for the PLC's target position, positioning band, specified speed, acceleration/deceleration and push-current limiting specification.

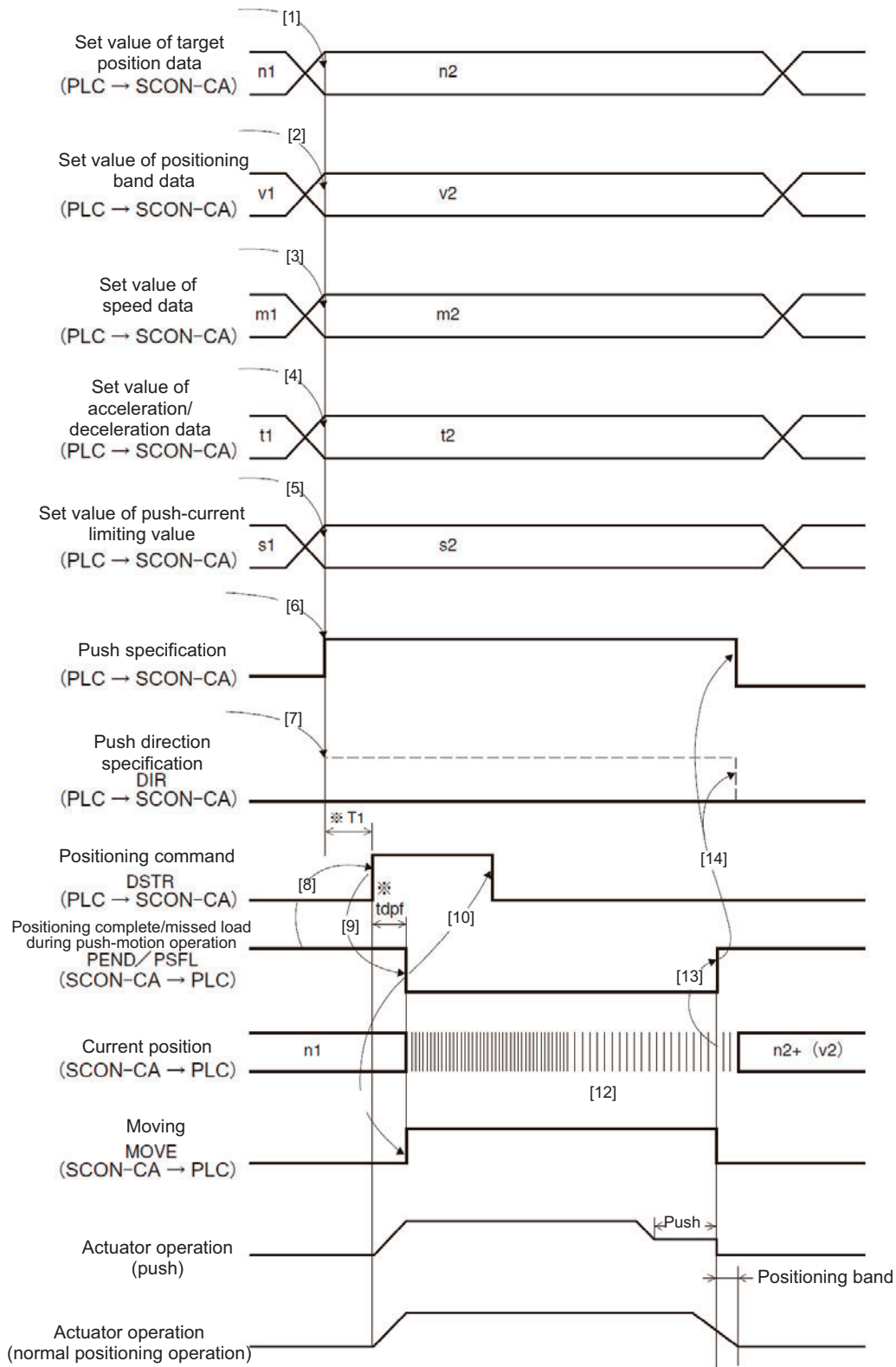
● Example of operation (push-motion operation)

- [1] Set the target position data for the target positions (*) corresponding to output addresses n and n+1.
- [2] Set the positioning band data for the positioning bands (*) corresponding to output addresses n+2 and n+3.
- [3] Set the speed data for the speed (*) corresponding to output address n+4.
- [4] Set the acceleration/deceleration data for the acceleration/deceleration (*) corresponding to output address n+5.
- [5] Set the push-current limiting data for the push-current limiting value (*) corresponding to output address n+6.
- [6] Turn the push specification (PUSH) signal ON.
- [7] Specify the push direction using the push direction specification (DIR) signal. (Refer to (22) of 3.7.11.)
- [8] Turn the positioning command (DSTR) signal ON while the positioning complete (PEND) signal is ON or moving signal (MOVE) is OFF.
The data set in [1] to [5] are read by the controller at the leading edge of the DSTR signal.
- [9] The DSTR signal turns ON and PEND turns ON tpdf thereafter.
- [10] Turn the DSTR signal OFF after confirming that the PEND signal has turned OFF or MOVE signal has turned ON. Do not change the values set in [1] to [5] until the DSTR signal is turned OFF.
- [11] The MOVE signal turns ON simultaneously as the PEND signal turns OFF.
- [12] The current position data (*) in input addresses n and n+1 are constantly updated.
- [13] The PEND signal turns ON when the motor current reaches the current-limiting value set in [5] while the DSTR signal is OFF. (Push-motion operation is completed.)
If the motor current does not reach the current-limiting value set in [5] after the positioning band set in [2] has been reached, the missed load in push-motion operation (PSFL) signal turns ON. In this case, the PEND signal will not turn ON. (The actuator has missed the load during push-motion operation.)
- [14] Turn the PUSH signal OFF after the PEND signal or PSFL signal has turned ON.

● Example of operation (normal positioning operation)

In normal positioning operation, the signal in [6] is set to OFF.

When the remaining travel falls within the positioning band set by the position data table, the PEND signal turns ON as long as the DSTR signal is OFF.



*T1: Make sure " $T1 \geq 0$ ms" is satisfied by considering the scan time of the host controller.

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

(3) Operation in the full direct mode

Operate the actuator by specifying from the PLC all conditions required for positioning, such as the PLC's target position and positioning band.

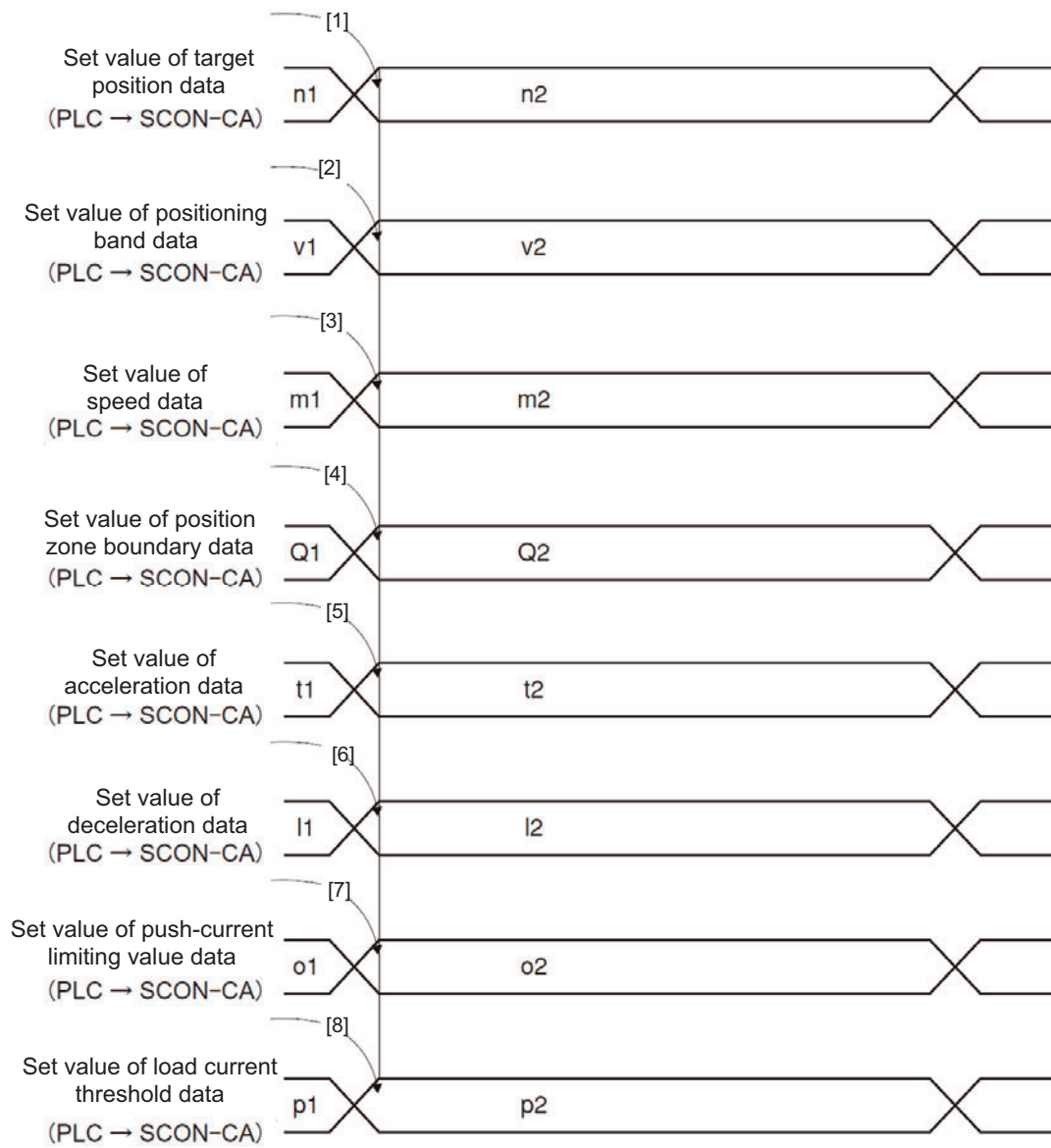
- Example of operation (push-motion operation)

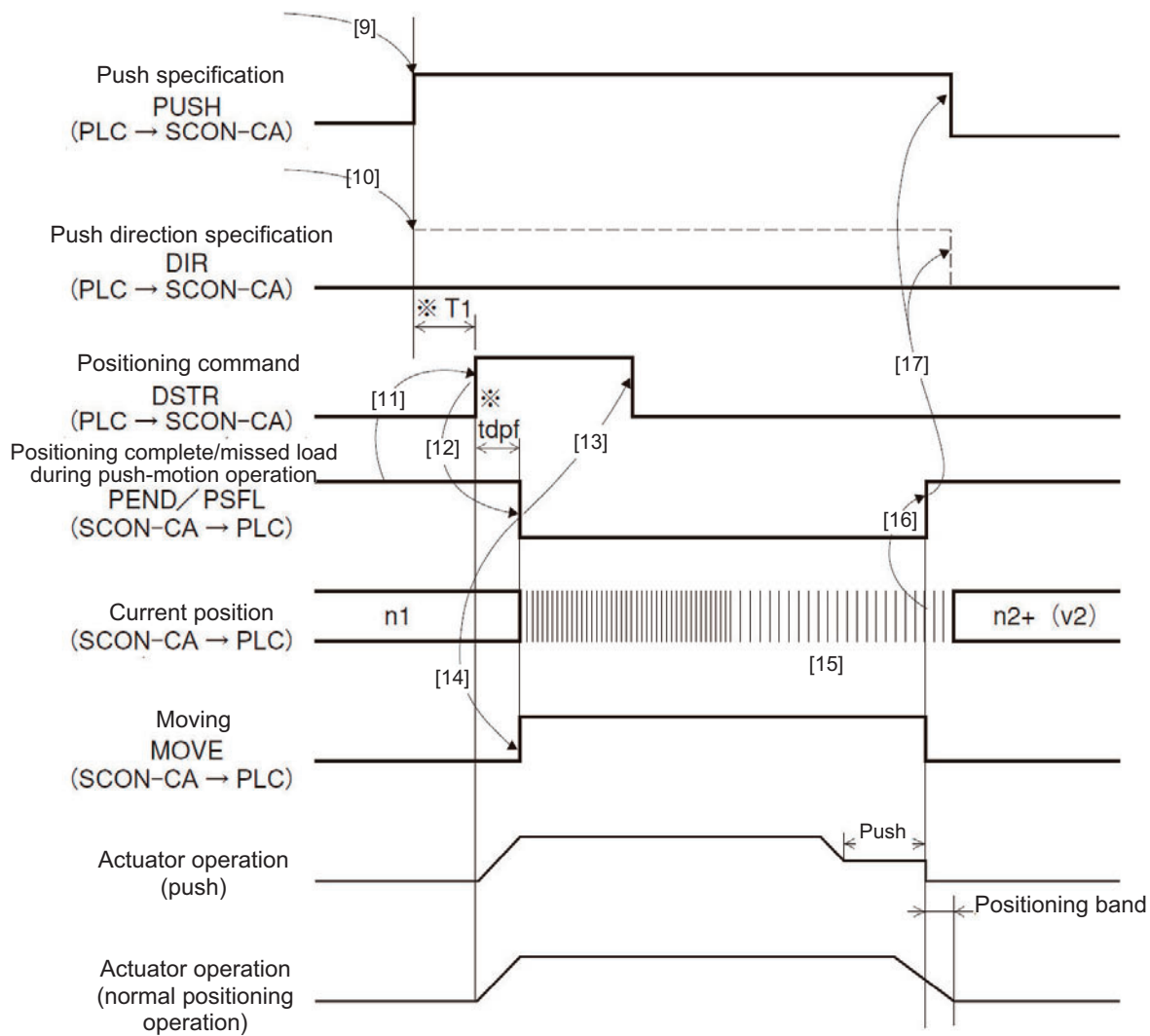
- [1] Set the target position data for the target positions (*) corresponding to output addresses n and n+1.
- [2] Set the positioning band data for the positioning bands (*) corresponding to output addresses n+2 and n+3.
- [3] Set speed data for the speeds (*) corresponding to output addresses n+4 and n+5.
- [4] Set the position-zone output boundary data for the zone boundary+ and zone boundary- (*) corresponding to output addresses n+6 to n+9.
- [5] Set the acceleration data for the acceleration (*) corresponding to output address n+10.
- [6] Set the deceleration data for the deceleration (*) corresponding to output address n+11.
- [7] Set the push-current limiting value data for the push-current limiting value (*) corresponding to output address n+12.
- [8] Set the load current threshold data for the load current threshold (*) corresponding to output address n+13.
- [9] Turn the push specification (PUSH) signal ON.
- [10] Specify the push direction using the push direction specification (DIR) signal. (Refer to (22) of 3.7.11.)
- [11] Turn the positioning command (DSTR) signal ON while the positioning complete (PEND) signal is ON or moving signal (MOVE) is OFF.
The data set in [1] to [8] are read by the controller at the leading edge of the DSTR signal.
- [12] The DSTR signal turns ON and PEND turns ON thereafter.
- [13] Turn the DSTR signal OFF after confirming that the PEND signal has turned OFF or MOVE signal has turned ON. Do not change the values set in [1] to [8] until the DSTR signal is turned OFF.
- [14] The MOVE signal turns ON simultaneously as the PEND signal turns OFF.
- [15] The current position data (*) in input addresses n and n+1 are constantly updated.
- [16] The PEND signal turns ON when the motor current reaches the current-limiting value set in [7] while the DSTR signal is OFF. (Push-motion operation is completed.)
If the motor current does not reach the current-limiting value set in [7] after the positioning band set in [2] has been reached, the missed load in push-motion operation (PSFL) signal turns ON. In this case, the PEND signal will not turn ON. (The actuator has missed the load during push-motion operation.)
- [17] Turn the PUSH signal OFF after the PEND signal or PSFL signal has turned ON.

- Example of operation (normal positioning operation)

In normal positioning operation, the signal in [9] is set to OFF.

When the remaining travel falls within the positioning band set by the position data table, the PEND signal turns ON as long as the DSTR signal is OFF.





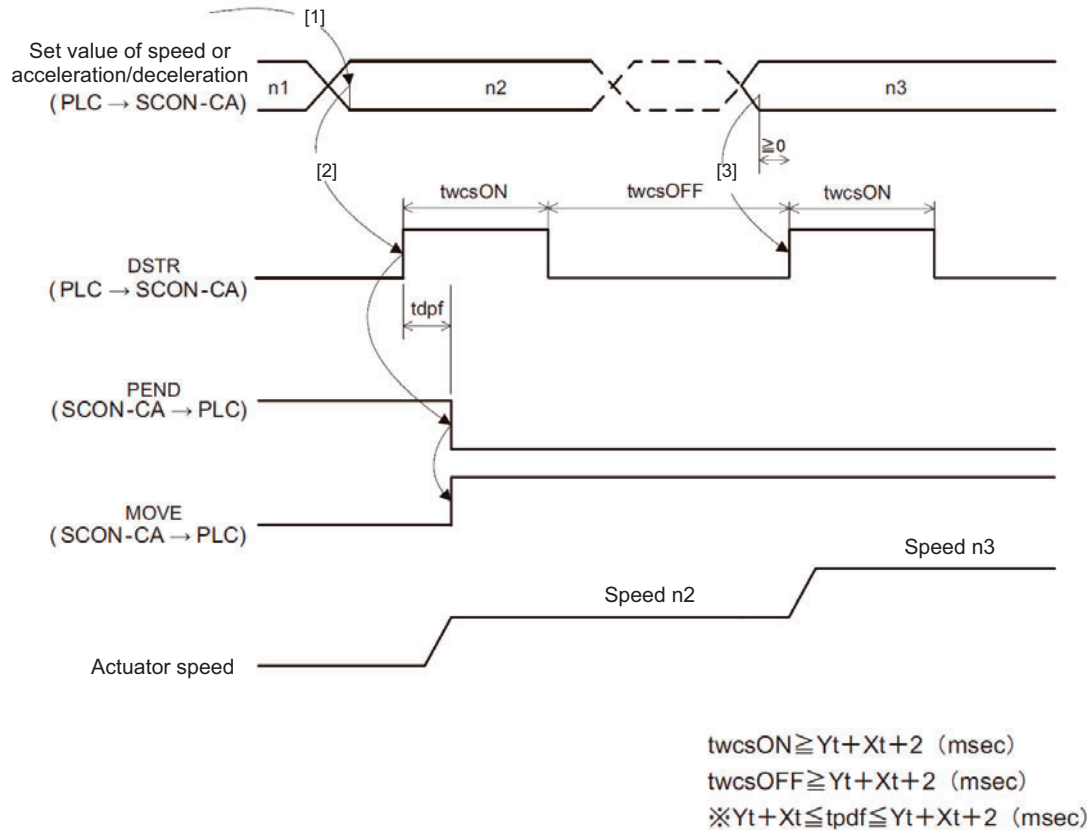
*T1: Make sure "T1 ≥ 0 ms" is satisfied by considering the scan time of the host controller.

*Yt + Xt ≤ tdpf ≤ Yt + Xt + 2 (msec)

(4) Data change during movement

In the half direct mode 1 to 3 and full direct mode, the values of target position data, acceleration/deceleration data, speed data, positioning band and push-current limiting value set by the PLC can be changed while the actuator is moving. After a desired data has been changed, turn the positioning command (DSTR) signal "ON" for tdpf or longer.

After the DSTR is turned "OFF," wait for at least "twcsON + twcsOFF" before DSTR is turned "ON" again. An example of changing the speed or acceleration/deceleration is given below.



Caution:

1. If the speed is not yet set or set to "0," the actuator will remain standstill and no alarm will generate.
2. If the speed is changed to "0" while the actuator is moving, the actuator will decelerate to a stop and no alarm will generate.
3. Even when the acceleration/deceleration or speed data alone is changed while the actuator is moving, the target position data must also be set.
4. Even when the target position alone is changed while the actuator is moving, the acceleration/deceleration and speed data must also be set.

3.10 DeviceNet Parameters

The parameters relating to DeviceNet are parameter Nos. 84 to 87 and 90.

Category: C: External interface parameter

No.	Category	Symbol	Name	Factory default
1			For parameter Nos. 1 to 83, refer to the operation manual for the controller.	
2				
83				
84	C	FMOD	Fieldbus operation mode	0
85	C	NADR	Fieldbus node address	63
86	C	FBRS	Fieldbus baud rate	0
87	C	NYTP	Network type	2
90	C	FMIO	Fieldbus I/O format	3

- Fieldbus operation mode (No. 84 FMOD)

Specify a desired operation mode in parameter No. 84 using a value between 0 and 4.

Set value of parameter No. 84	Mode name	Number of occupied bytes	Description
0 (factory setting)	Remote I/O mode	1CH	The actuator is operated by PIOs (24-V I/Os) via PROFIBUS-DP.
1	Position/simple direct mode	4CH	The target position can be specified directly as a value or using a value in the position data table. Other values required for operation are set in the position data table.
2	Half direct mode	8CH	Operate the actuator by specifying the speed, acceleration/deceleration and push-current value, in addition to the target position, directly using values.
3	Full direct mode	16CH	Operate the actuator by specifying all values relating to position control directly using values.
4	Remote I/O mode 2	6CH	The current-position and current-speed read functions are added to the functions available in the remote I/O mode.
5	Position/simple direct mode 2	4CH	Set this value to implement force control in the position/simple direct numerical mode.
6	Half direct mode 2	8CH	Set this value to implement force control in the half direct numerical mode.
7	Remote I/O mode 3	6CH	Set this value to implement force control in the remote I/O mode 2.
8	Half direct mode 3	8CH	Set this value to switch servo gains or vibration damping control parameters in the half direct numerical mode.

- Fieldbus node address (No. 85 NADR)

Specify the slave number of the remote station in parameter No. 85.

Setting range: 0 to 125 (The factory setting is 1.)

- Fieldbus baud rate (No. 86 FBRS)

The baud rate is automatically set according to the corresponding setting on the master side and thus need not be set.

- Network type (No. 87 NTYP)

Specify the network module in parameter No. 87. Do not change the default value.

- Fieldbus I/O format (No. 90 FMIO)

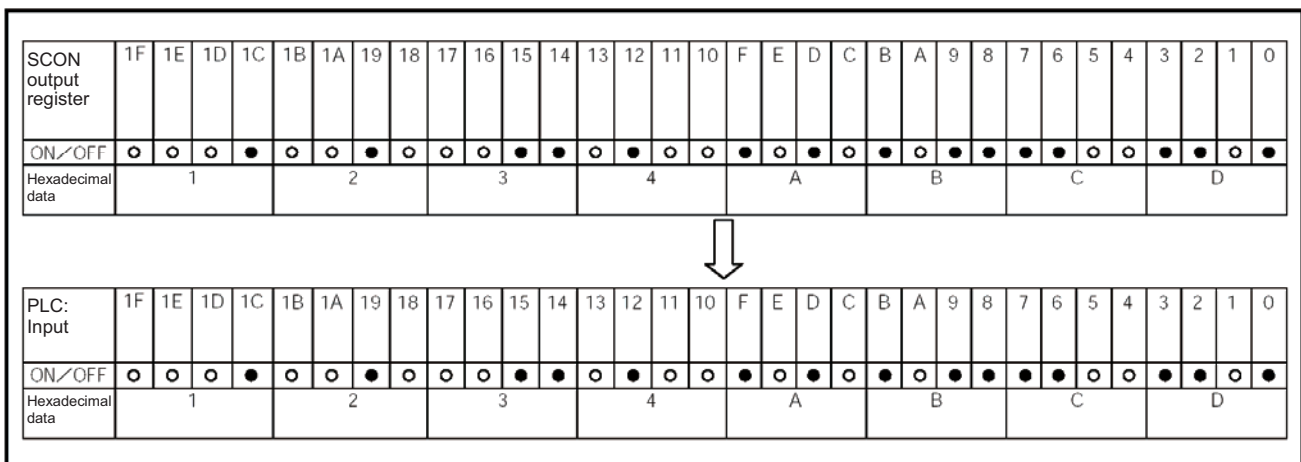
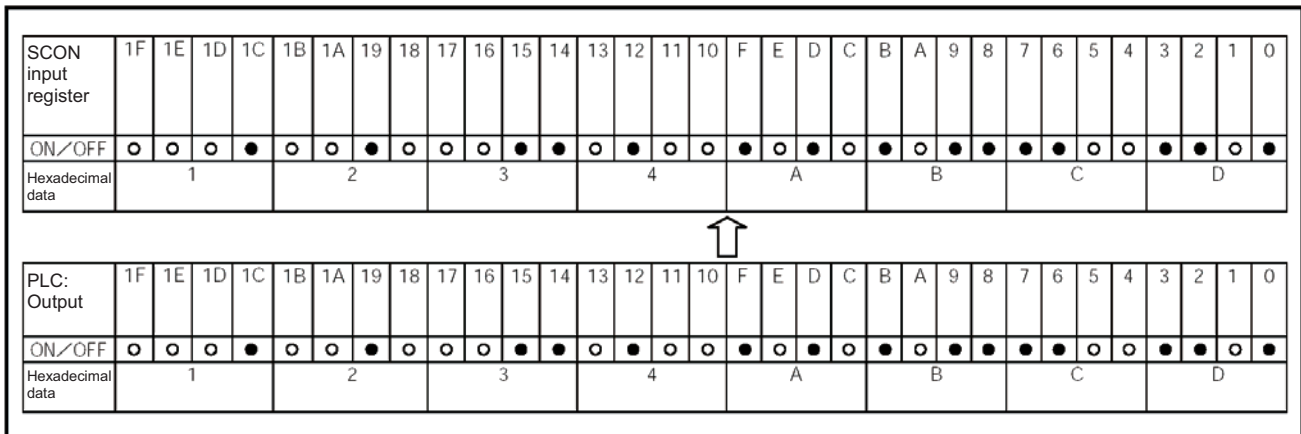
PLC addresses are assigned in units of 16 points (units of words) based on the I/O addresses set to the controller and number of occupied addresses in each mode.

By changing the setting of parameter No. 90, data of up to 2 words can be swapped in units of bytes before transmission within the range of communication with the PLC's I/O addresses.

Set value of parameter No. 90	Description
0	Data is not swapped and sent as is to the PLC. (Refer to Example i.)
1	The upper byte and lower byte of the upper word are swapped, while the upper byte and lower byte of the lower word are also swapped. (Refer to Example ii.)
2	In the case of a word register, the upper word and lower word are swapped. (Refer to Example iii.)
3 (factory setting)	The upper byte and lower byte of the upper word are swapped, while the upper byte and lower byte of the lower word are also swapped. In the case of a word register, the upper word and lower word are also swapped. (Refer to Example iv.)

(Example i) Set value = "0"

● indicates ON, while ○ indicates OFF.



(Example ii) Set value = "1"

● indicates ON, while ○ indicates OFF.

SCON input register	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hexadecimal data	3				4				1				2				C				D				A				B			

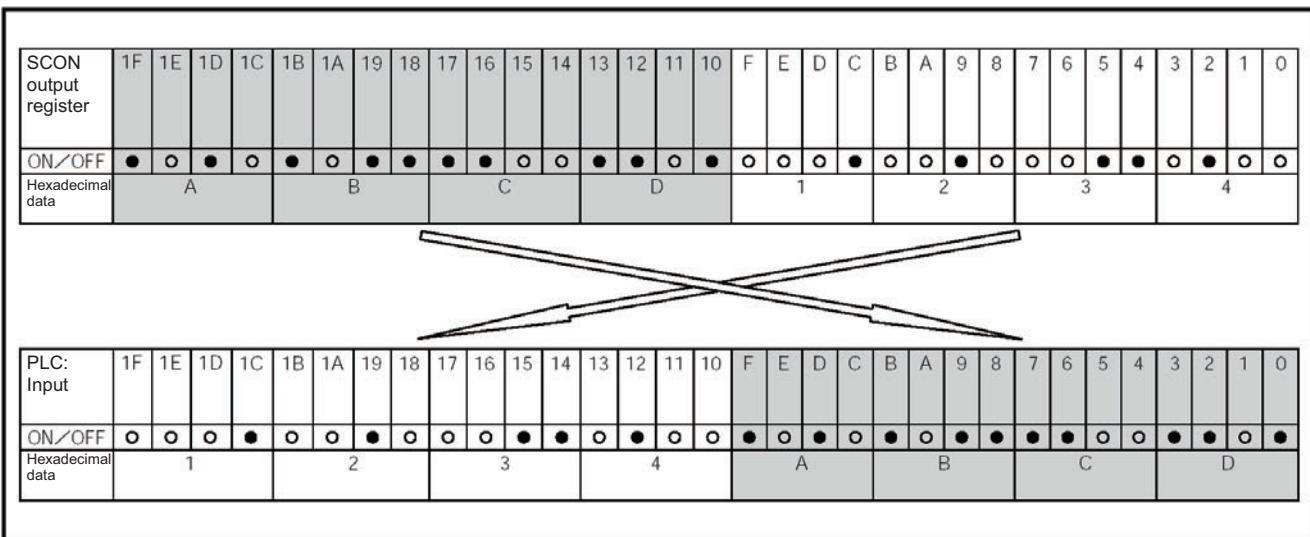
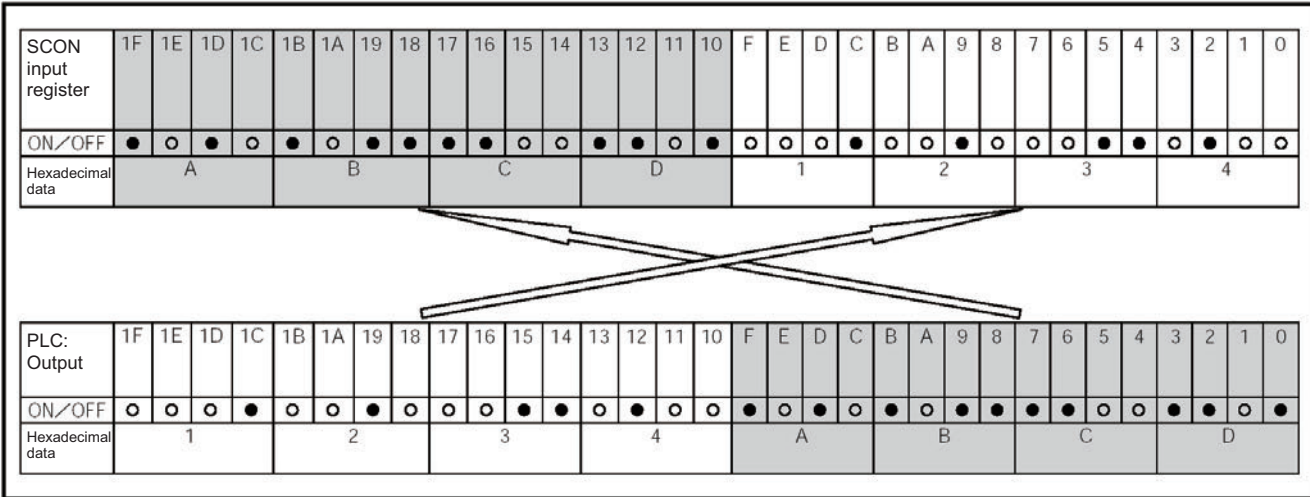
PLC: Output	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hexadecimal data	1				2				3				4				A				B				C				D			

SCON output register	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hexadecimal data	3				4				1				2				C				D				A				B			

PLC: Input	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ON/OFF	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hexadecimal data	1				2				3				4				A				B				C				D			

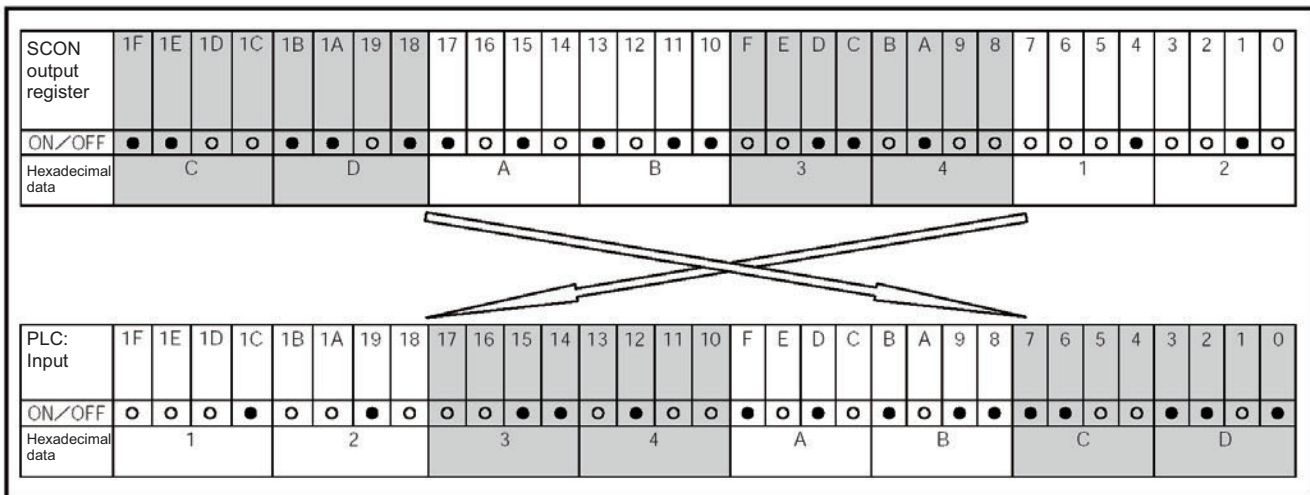
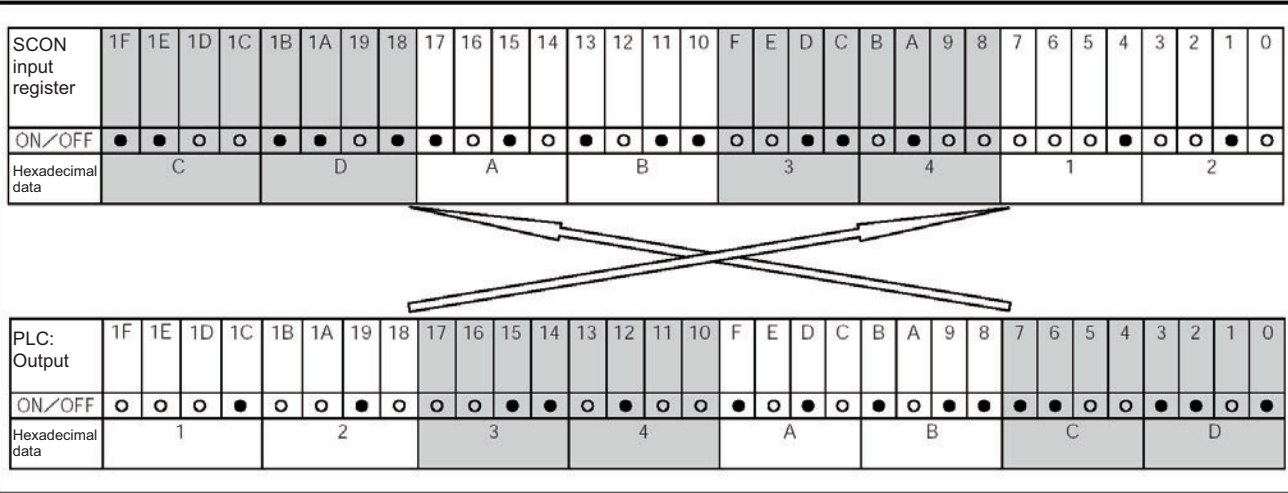
(Example iii) Set value = "2"

● indicates ON, while ○ indicates OFF.



(Example iv) Set value = "3"

● indicates ON, while ○ indicates OFF.



3.11 Troubleshooting

- Alarm messages, causes and remedial actions

If an alarm occurs, a corresponding simple alarm code will be indicated by the completed position number (four bits of PM1 to PM8) in the remote I/O mode and remote I/O mode 1 to 3.

In the position/simple direct mode 1, 2, this simple alarm code is output to the (n+2) channel.

In the half direct mode 1 to 3 and full direct mode, this simple alarm code is output to the (n+6) channel.

[1] Check the generated alarm code using the monitor function of the PLC, etc., or connect the RC PC software or teaching pendant and check the code on the status monitor screen.

[2] Look up the applicable alarm code in the alarm list provided in the operation manual for the controller.

[3] Take appropriate actions according to the explanation given for the applicable code.

For the alarm codes listed in the table below, take the specified action.

Code	Error name	ID (*1)	RES (*2)	Cause/action
0F2	Fieldbus module error	05	X	Cause: A fieldbus module error has been detected. Action: Check the parameter.
0F3	Fieldbus module not detected	04	X	Cause: The module could not be detected. Action: Reconnect the power. If the error persists, contact IAI.

(*1) ID → Simple alarm code

(*2) RES → Whether or not the alarm can be reset = O: Alarm can be set / X: Alarm cannot be reset

4. Troubleshooting

If you encountered a problem concerning DeviceNet, check the operating condition using the table below and remove the cause of the problem. The monitor LEDs, MS and NS, illuminate in two colors (red and green), and you can check the condition of DeviceNet based on the illumination status and color of each LED.

If an error occurred, MS or NS should change to steady or blinking red. If you spot a steady or blinking red light, check (reconfigure) the connections of the power supply and communication cable, DIP switch settings, parameter settings, etc., and then reconnect the power.

○: Steady light, ●: Blinking, ⊙: Off

Monitor LEDs				Condition	Remedial action
MS		NS			
Grn	Red	Grn	Red		
○	-	○	-	Operating normally	
○	-	●	●	Waiting for completion of node address duplication check by the master.	<ul style="list-style-type: none">• Confirm that the baud rate of the master is the same as the baud rates of all slaves. If not, correct the applicable settings and then restart the system.• Confirm that the connectors are connected correctly.• Confirm that the communication power (24 VDC) is supplied.• Confirm that the master is operating correctly.• Confirm that the communication cable is not broken.
○	-	⊙	-	Waiting for connection to be established with the master.	<ul style="list-style-type: none">• Confirm that the master is operating correctly.• Confirm that the applicable slave is registered in the master scan list.
-	○	●	●	A hardware error occurred.	<ul style="list-style-type: none">• Contact IAI. (The DeviceNet board may have to be replaced.)
-	⊙	●	●	Incorrect DIP switch setting.	<ul style="list-style-type: none">• Confirm that the baud rate of the slave is the same as the baud rate of the master.• Confirm that the configuration is correct.• After correcting the applicable settings, restart the system.
○	-	-	○	Detected a node address duplication or bus-off state (communication was stopped due to frequent data errors).	<ul style="list-style-type: none">• Correct the node address, and then restart the system.• Confirm that the baud rate of the slave is the same as the baud rate of the master.• Confirm that the communication cable length is appropriate.• Check the communication cable for wire breakage or loose or disconnected connector.• Confirm that the terminal resistors are installed correctly.• Confirm that no noise sources are located nearby, that the communication cable is not wired in parallel with any power line, and that the system is not otherwise affected by noise.• After correcting the applicable settings, restart the system.
○	-	-	⊙	A communication time out occurred.	<ul style="list-style-type: none">• Confirm that the baud rate of the slave is the same as the baud rate of the master.• Confirm that the communication cable length is appropriate.• Check the communication cable for wire breakage or loose or disconnected connector.• Confirm that the terminal resistors are installed correctly.• Confirm that no noise sources are located nearby, that the communication cable is not wired in parallel with any power line, and that the system is not otherwise affected by noise.• After correcting the applicable settings, restart the system.
NS switches repeatedly between steady green and blinking green. Or, NS switches repeatedly between blinking red and blinking green.				A communication error occurred.	<ul style="list-style-type: none">• Confirm that the applicable slave is registered in the master scan list.• Confirm that any of the I/O area is not used by other slave.• Confirm that the I/O area does not exceed the area permitted for use by the master unit (in the case of fixed assignment).

5. Change History

Revision Date	Description of Revision
November 2011	First edition Contents changed in Safety Guide Caution notes added for when working with two or more persons ACON and PCON picked up from existing Operation Manual and SCON-CA added to rearrange new Operation Manual



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