

DENSO ROBOT
RC7M CONTROLLER

OPTIONS MANUAL

Copyright © DENSO WAVE INCORPORATED, 2005-2011

All rights reserved. No part of this publication may be reproduced in any form or by any means without permission in writing from the publisher.

Specifications are subject to change without prior notice.

All products and company names mentioned are trademarks or registered trademarks of their respective holders.

Preface

Thank you for purchasing optional devices designed for DENSO robots.

This manual covers the specifications, installation, and use of optional devices to be configured in the **G series robot system together with the RC7M controller.

Before use, read this manual carefully to safely get the maximum benefit from your robot and options in your assembling operations.

Options covered by this manual

Optional devices designed for robot systems configured with RC7M controller

How this book is organized

This book is just one part of the robot documentation set. It consists of chapters 1 through 17.

PART 1 OPTIONAL OPERATION DEVICES

Describes optional operation devices designed for operating your robot.

- Chapter 1 Teach Pendant
- Chapter 2 Mini-Pendant
- Chapter 3 Programming Support Tool "WINCAPSIII"

PART 2 I/O EXTENSION BOARDS FOR RC7M

Describes I/O extension boards that can be mounted on the RC7M robot controller.

- Chapter 4 Overview of I/O Extension Boards
- Chapter 5 Parallel I/O Board
- Chapter 6 DeviceNet Slave Board
- Chapter 7 DeviceNet Master Board
- Chapter 8 DeviceNet Master/Slave Board
- Chapter 9 CC-Link Board
- Chapter 10 PROFIBUS-DP Slave Board (Commercial board recommended)
- Chapter 11 RS-232C Extension Board (Commercial board recommended)
- Chapter 12 S-Link V Master Board (Commercial board recommended)
- Chapter 13 EtherNet/IP Adapter Board
- Chapter 14 Mounting I/O Extension Boards

PART 3 SYSTEM I/O SIGNALS FOR I/O EXTENSION BOARDS

Describes the system I/O signals to be used for I/O extension boards.

- Chapter 15 System I/O Signals in Standard Mode
- Chapter 16 System I/O Signals in Compatible Mode

PART 4 SPECIFICATIONS OF OTHER OPTIONS

Provides the specifications of other options available.

- Chapter 17 Controller Protective Box
- Chapter 18 μ Vision Board (Version 2.41 or later)

Contents

PART 1 OPTIONAL OPERATION DEVICES	1
Chapter 1 Teach Pendant	1
1.1 Teach Pendant Functions	1
1.2 Names of Teach Pendant Components	2
1.3 Teach Pendant Specifications	3
1.3.1 Specifications	3
1.3.2 Outer Dimensions	4
1.3.3 Connecting the Teach Pendant	5
1.3.4 Pendantless State	5
1.3.5 Replacing the Teach Pendant Cable	6
1.4 Pendant Extension Cable	8
Chapter 2 Mini-Pendant	9
2.1 Mini-Pendant Functions	9
2.2 Names of Mini-Pendant Components	10
2.3 Mini-Pendant Specifications	11
2.3.1 Specifications	11
2.3.2 Outer Dimensions	12
2.3.3 Connecting the Mini-Pendant	13
2.4 Specifications of WINCAPSIIL Light	14
2.5 Pendant Extension Cable	14
Chapter 3 Programming Support Tool "WINCAPSIIL"	15
3.1 Functions in WINCAPSIIL	15
3.2 Operating Environment Required	16
PART 2 I/O EXTENSION BOARDS FOR RC7M	17
Chapter 4 Overview of I/O Extension Boards	17
4.1 I/O Extension Boards Available	17
4.2 Combination of I/O Extension Boards and Allocation Mode	19
4.3 I/O Port Map and Allocation	20
4.4 I/O Allocation Settings	21
4.5 Mini I/O Functions (with I/O extension board mounted)	21
4.5.1 Mini I/O Dedicated	21
4.5.2 Other Allocation (Standard, Compatible and All User I/O)	22
4.6 Method for Setting I/O Allocation	23
4.7 I/O Conversion Box	26
4.7.1 I/O Conversion Box and Accessories	26
4.7.2 Allocation Mode Available with the I/O Conversion Box	27
4.7.3 I/O Port Map and Allocation	28
4.7.4 Types of Input/Output Signals and Usage	28
Chapter 5 Parallel I/O Board	29
5.1 Overview	29
5.2 Product Specifications	30
5.2.1 Parallel I/O Board Part Names	30

5.2.2	Part Functions and Board Settings	31
5.2.3	General Specifications	32
5.3	Allocation of I/O data	39
5.3.1	Mini I/O Dedicated or All User I/O Allocation	40
5.3.2	Standard Mode	41
5.3.3	Compatible Mode	42
5.3.4	Option	43
Chapter 6 DeviceNet Slave Board		44
6.1	Overview	44
6.1.1	Configuration and Mounting Position	44
6.1.2	Features	45
6.1.3	Typical Network	45
6.2	Product Specifications	46
6.2.1	Names and Functions of Slave Board Components	47
6.2.2	Setting the Node Address	48
6.2.3	Setting the Bit Rate	48
6.2.4	General Specifications	49
6.2.5	EDS File	50
6.3	I/O Allocation Settings	50
6.3.1	Standard Assignment Mode	50
6.3.2	Compatible Assignment Mode	52
6.4	Parameter Entry Procedure	53
6.4.1	Entering the Number of Input/Output Slots	53
6.4.2	Quick Reference Table for the Number of Input/Output Slots	56
6.4.3	Researching the Firmware Version	57
6.4.4	Function of Resetting "BusOff"	57
6.5	Field Network Error Indication	58
6.6	Network Error Detector Suppression	60
6.7	Error Code Table	63
Chapter 7 DeviceNet Master Board		66
7.1	Overview	66
7.1.1	Configuration and Mounting Position	67
7.1.2	Features	68
7.1.3	System Configuration Sample	68
7.1.4	System Construction Procedure	69
7.2	Product Specifications	70
7.2.1	Functions of Master Board Components	71
7.2.2	Setting the Node Address	72
7.2.3	Setting the Bit Rate	72
7.2.4	General Specifications	73
7.3	I/O Allocation Settings	73
7.4	Building Up a DeviceNet Network	74
7.4.1	Network Configuration Sample and Configurators	74
7.4.2	Creating a Scanlist	77
7.4.3	Changing Master Parameters	88
7.4.4	Researching the Firmware Version	91
7.4.5	Function of Resetting "BusOff"	91
7.5	Field Network Error Indication	91
7.6	Network Error Detector Suppression	91

Chapter 8 DeviceNet Master/Slave Board	92
8.1 Overview	92
8.1.1 Configuration and Mounting Position.....	92
8.1.2 Features.....	93
8.1.3 System Configuration Sample	93
8.1.4 Master Area and Slave Area.....	94
8.2 Product Specifications	95
8.2.1 Functions of Master Board Components.....	96
8.2.2 General Specifications	97
8.2.3 EDS File.....	98
8.2.4 I/O Allocation Settings.....	98
8.2.5 Setting the Node Address.....	98
8.2.6 Setting the Bit Rate	98
8.2.7 Entering the Number of Input/Output Slots	98
8.3 System Configuration Sample	99
8.3.1 System Configuration Sample 1	99
8.3.2 System Configuration Sample 2	100
8.4 Field Network Error Indication	100
8.5 Network Error Detector Suppression.....	100
Chapter 9 CC-Link Board	101
9.1 Overview	101
9.1.1 Configuration and Mounting Position.....	101
9.2 Product Specifications	102
9.2.1 CC-Link Board Part Names	102
9.2.2 Component Functions and Board Setting	103
9.2.3 Parameter Setting Method.....	103
9.2.4 General Specifications	104
9.3 Selectable Allocation	105
9.3.1 Standard Mode Allocation	106
9.3.2 Compatible Mode Allocation	109
9.4 Field Network Error Indication Parameter	112
9.5 Network Error Detection Wait-time Parameter	112
9.6 Remote Resistors (RWw and RWr)	112
9.6.1 Operating Environment.....	112
9.6.2 Programming Remote Resistors RWw and RWr	113
9.6.3 Monitoring and Modifying I/O Variables Used as Word Data via the Teach Pendant	117
9.6.4 Monitoring and Modifying I/O Data (units of 1 bit) via the Teach Pendant	122
9.6.5 Monitoring and Modifying I/O Variables Used as Word Data via WINCAPS III	124
9.6.6 Monitoring and Modifying I/O Data (units of 1 bit) via WINCAPS III	126
9.6.7 Monitoring and Modifying Variable Values via the Mini-pendant.....	130
Chapter 10 PROFIBUS-DP Slave Board (Commercial board recommended)	132
10.1 Overview	132
10.2 Requirements for Use of PROFIBUS-DP Slave Board	132
10.3 Front Panel and its Function.....	133
10.4 Specifications	134
10.5 Assignment when using the PROFIBUS-DP slave board.....	134
10.6 Parameter Entry Procedure.....	135
10.6.1 Entering the Node Address and Number of I/Os with the Teach Pendant.....	135
10.6.2 Configuring the Robot Controller from the PC with the PROFIBUS Configurator	137

Chapter 11 RS-232C Extension Board (Commercial board recommended)	138
11.1 Requirements for Use of RS-232C Extension Board	138
11.2 RS-232C Extended Serial Ports and Line Number Assignment	139
11.3 Communications Configuration of RS-232C Extension Board	140
11.4 Coding Sample for Transmission Error Recovery	141
11.5 Limited Warranty	141
Chapter 12 S-Link V Master Board (Commercial board recommended)	142
12.1 Overview	142
12.2 Requirements for Use of S-Link V Master Board	144
12.3 Part Names and Functions	146
12.4 Specifications	150
12.5 S-Link V System Configuration	151
12.5.1 Configuring the System	151
12.5.2 Errors and Actions (Error Code Table)	164
12.6 I/O Assignment for Use of S-Link V Master Board	164
Chapter 13 EtherNet/IP Adapter Board	165
13.1 Overview	165
13.1.1 Operating Environment	165
13.1.2 Extension Board	165
13.1.3 Limited Warranty	165
13.2 Specifications	165
13.2.1 General Specifications	165
13.2.2 Front Panel and its Functions	166
13.2.3 Combination of other Extension Boards	166
13.2.4 I/O Port Map	166
13.2.5 Mounting the EtherNet/IP Adapter Board	167
13.2.6 Adding Functions to the Robot Controller	167
13.3 Setting for the EtherNet/IP	167
13.3.1 Setting the Robot Controller	167
13.3.2 EDS File	168
13.4 Allocation	168
13.4.1 Standard Allocation	169
13.4.2 Compatible Allocation	171
13.5 Quick Reference Table for Input/Output Sizes	173
Chapter 14 Mounting I/O Extension Boards.....	174
PART 3 SYSTEM I/O SIGNALS FOR EXTENSION BOARDS.....	177
Chapter 15 System I/O Signals in Standard Mode	177
15.1 Types and Functions of System Output Signals (Standard Mode).....	177
15.2 Usage of System Output Signals (Standard Mode)	178
15.2.1 Robot Initialization Complete (Output)	178
15.2.2 Auto Mode (Output)	179
15.2.3 External Mode (Output).....	180
15.2.4 Servo ON (Output).....	181
15.2.5 Robot-in-operation (Output)	182
15.2.6 Robot Error (Output).....	183
15.2.7 Robot Warning (Output)	184
15.2.8 Dead Battery Warning (Output)	185
15.2.9 Continue Start Permitted (Output)	186

15.2.10	SS mode (Output)	186
15.3	Types and Functions of System Input Signals (Standard Mode)	187
15.4	Usage of System Input Signals (Standard Mode)	188
15.4.1	Step Stop (All Tasks) (Input)	188
15.4.2	Instantaneous Stop (All Tasks) (Input).....	189
15.4.3	Interrupt Skip (Input)	190
15.5	Command Execution I/O Signals Dedicated to Standard Mode	191
15.5.1	General Information about Commands	191
15.5.2	Processing I/O Commands.....	192
15.5.3	I/O Commands Details.....	197
15.6	Example of Using System I/O Signals in Standard Mode.....	208
Chapter 16 System I/O Signals in Compatible Mode		212
16.1	Types and Functions of System Output Signals (Compatible Mode)	212
16.2	Usage of System Output Signals in the Compatible Mode.....	213
16.2.1	Robot Power ON Complete	213
16.2.2	Auto Mode (Output)	214
16.2.3	Servo ON (Output).....	215
16.2.4	CAL Complete (Output)	216
16.2.5	External Mode (Output).....	217
16.2.6	Teaching (Output)	218
16.2.7	Program Start Reset (Output).....	219
16.2.8	Robot-in-operation (Output)	220
16.2.9	Single-Cycle End (Output).....	221
16.2.10	Robot Error (Output).....	222
16.2.11	Robot Warning (Output)	223
16.2.12	Dead Battery Warning (Output)	224
16.2.13	Error No. (Output)	225
16.2.14	Continue Start Permitted (Output)	226
16.2.15	SS mode (Output)	226
16.3	Types and Functions of System Input Signals (Compatible Mode).....	227
16.4	Usage of System Input Signals in Compatible Mode	228
16.4.1	Operation Preparation Start (Input).....	228
16.4.2	Program No. Select (Input)	230
16.4.3	Program Start (Input)	232
16.4.4	Program Reset (Input).....	237
16.4.5	Step Stop (All Tasks) (Input)	239
16.4.6	Instantaneous Stop (All Tasks) (Input).....	240
16.4.7	Clear Robot Error (Input).....	241
16.4.8	Interrupt Skip (Input)	242
16.4.9	Continue Start (Input)	243
16.5	Example of Using System I/O Signals in Compatible Mode.....	244
PART 4 SPECIFICATIONS OF OTHER OPTIONS		248
Chapter 17 Controller Protective Box		248
17.1	Configuration.....	248
17.2	Component Names and External Dimensions	248
17.3	Specifications	249
17.4	Usage.....	249
17.4.1	Installation Environment.....	249
17.4.2	Placing the Robot Controller in the Protective Box.....	250

17.4.3 Cabling to the Robot Controller.....	251
17.5 Notes.....	252
Chapter 18 μVision Board (Version 2.41 or later)	253
18.1 μ Vision Board and Mounting Position	253
18.2 μ Vision Board Specifications	254
18.3 Names and Functions of Connectors	255
18.4 Block Diagram and Internal Configuration of μ Vision Board.....	256
18.5 Peripheral Devices (Camera).....	257
18.6 Peripheral Devices (Monitor)	258

PART 1 **OPTIONAL OPERATION DEVICES**

Chapter 1 Teach Pendant

The teach pendant is an entry/operation device for creating programs and teaching. The teach pendant can perform all operations except automatic external operation.

1.1 Teach Pendant Functions

For instructions on how to operate the teach pendant, refer to the SETTING-UP MANUAL.

Programming and teaching

This function allows you:

- to enter commands and store the robot arm position. You may specify a program and enter program steps one by one,
- to modify, delete, or copy those commands and robot arm positions, and
- to check edited programs in running them in Teach check mode.

Operating the robot

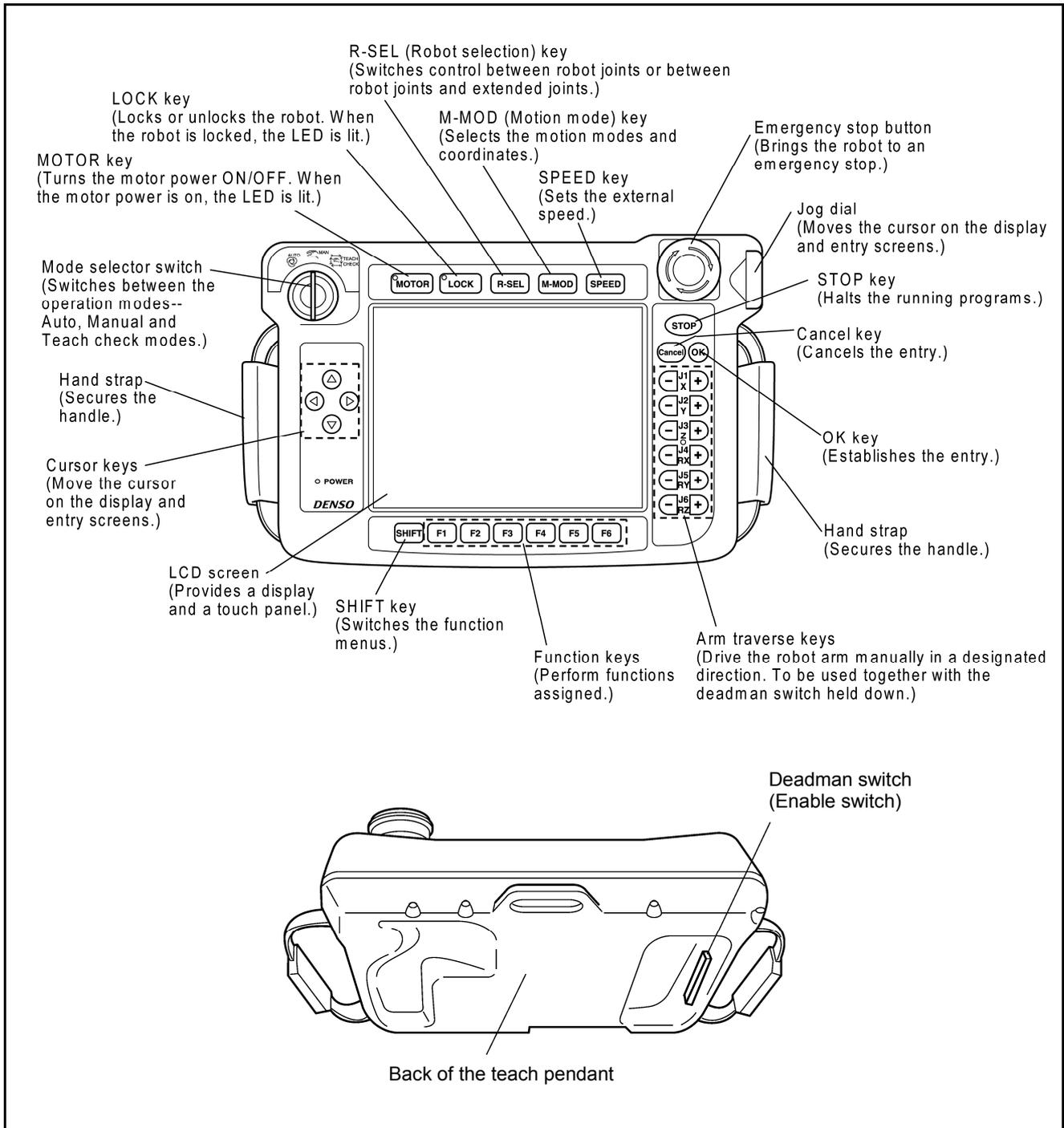
This function controls motor power ON/OFF, starts/stops automatic operation, and enables manual operation.

Displaying

This function displays the contents of programs, the progress of running programs, ongoing step number, current robot position or error messages.

1.2 Names of Teach Pendant Components

The figure below shows the names of the teach pendant components.



Names of Teach Pendant Components

1.3 Teach Pendant Specifications

1.3.1 Specifications

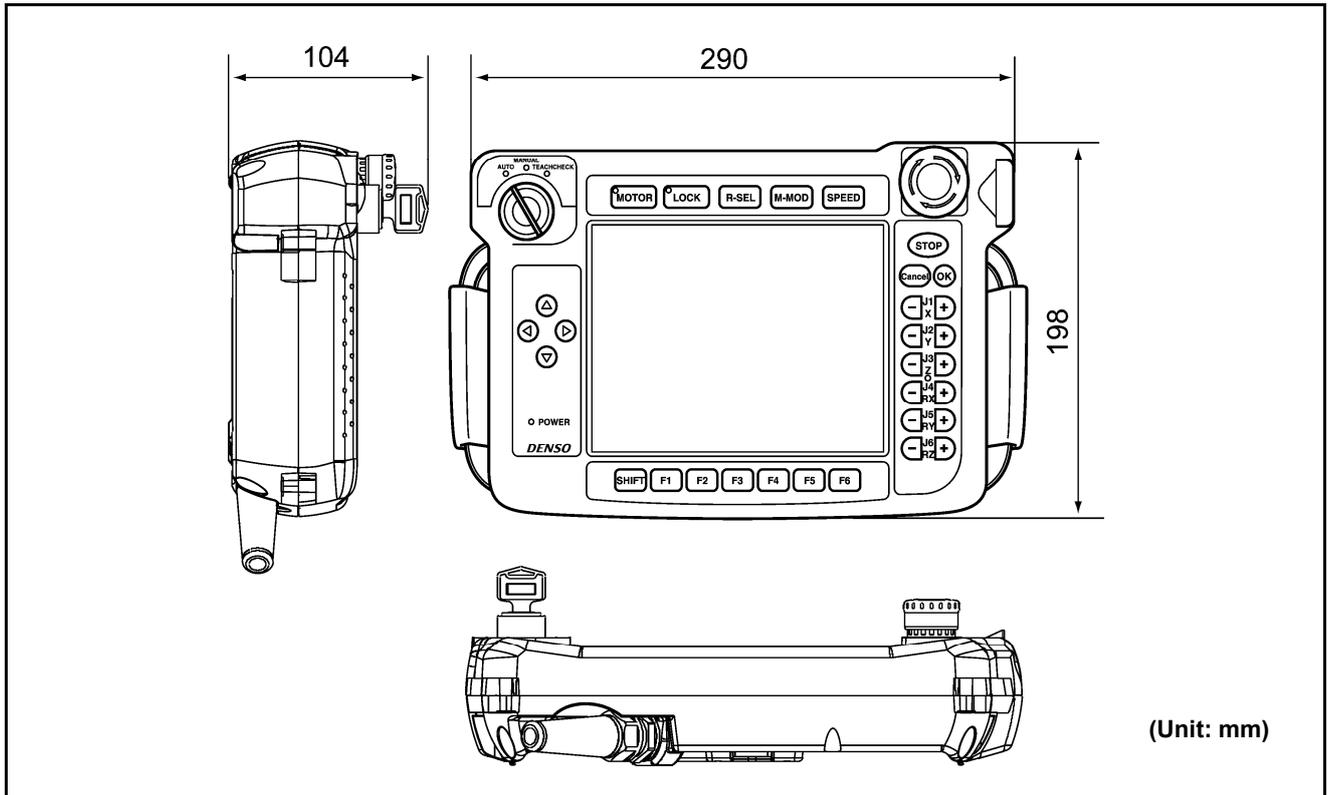
The table below lists the teach pendant specifications.

Teach Pendant Specifications

Item		Specifications
Model		TP-RC7M-1
Power source		24 VDC (supplied from robot controller)
Display	LCD	Liquid crystal display with backlight 7.5-inch TFT color LCD, 640 × 480 pixels
	LED	3 LEDs (POWER, MOTOR and LOCK)
Operation	Switches & keys	Robot stop button, deadman switch, jog dial, MOTOR power on/off key, AUTO/MANUAL selector switch, function keys, arm traverse keys, LOCK key, R-SEL (robot selection) key, M-MOD (motion mode) key, SPEED key, cursor keys, STOP key, OK key, Cancel key
	Touch-panel	Liquid crystal display with touch-panel function
Emergency stop button		Four B contacts, 4 circuit outputs (Forced disjunction type)
Deadman switch (Enable switch)		3-position type (OFF-ON-OFF), 2 circuit outputs
Mode selector switch		3-position (AUTO, MANUAL and TEACHCHECK), keylock switch Note: Switchable only with the key inserted.
Installation conditions		Temperature: 0 to 40°C Humidity: 90% RH or less (Dew condensation not allowed)
Degree of protection		IP65
Outside dimensions (W x H x D)		260 × 186 × 60 mm (excluding projections)
Weight		1.3 kg or less
Cable length		4 m, 8 m, or 12 m
Caution (1)		Do not drop the teach pendant and do not impact against the teach pendant.
(2)		Touch the teach pendant with your fingers only, never with the tip of a pen or any pointed object. Otherwise, the LCD may be broken.

1.3.2 Outer Dimensions

The figure below shows the outer dimensions of the teach pendant.



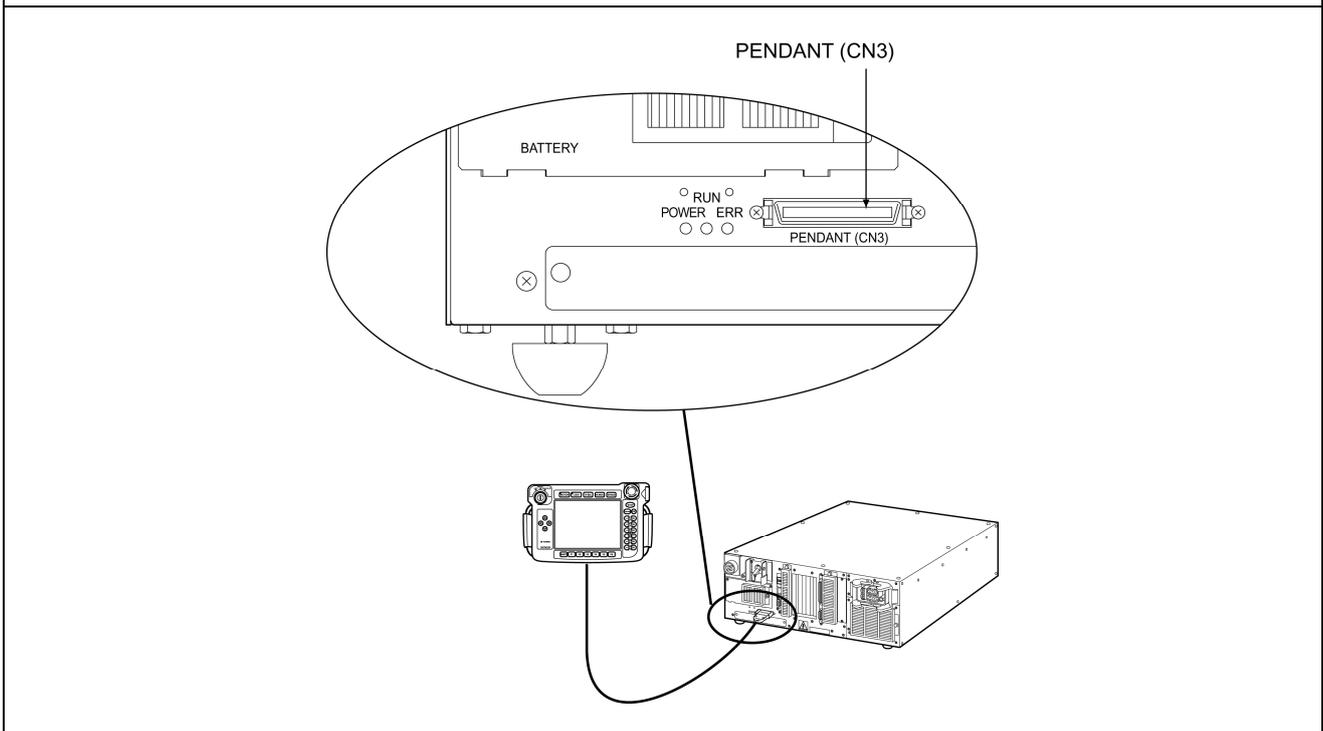
Outer Dimensions of the Teach Pendant

1.3.3 Connecting the Teach Pendant

The robot controller leaves the factory in the pendantless state (described in Section 1.3.4). Connect the teach pendant to the PENDANT connector (CN3) on the robot controller.

Cautions in connecting the pendant cable to the controller:

- (1) After connecting the pendant cable, do not apply pressure on the connector in either direction. Such pressure may cause a communications error.
- (2) When disconnecting the cable, unlock the connector and pull out the cable straight without twisting it.



1.3.4 Pendantless State

What is Pendantless State?

The state without having connected the teach pendant and the mini-pendant to the robot controller is called a pendantless state.

Pendantless State Precautions

NOTE: The UL-Listed robot system cannot be operated in the pendantless state.

Since no teach pendant is connected in the Pendantless state, the robot cannot enter the manual operation mode or the teach check mode.

The robot is therefore in the Auto mode whenever the Enable Auto input is free. The external mode cannot be switched, and the program cannot start to run. When operating the robot in the Pendantless state perform the following steps:

- (1) Set the robot not to start to operate when the Enable Auto input is free.
- (2) Enable Auto input free state and automatic mode output. Refer to the RC7M CONTROLLER INTERFACE MANUAL, Section 3.2.2 "Auto Mode (Output)."

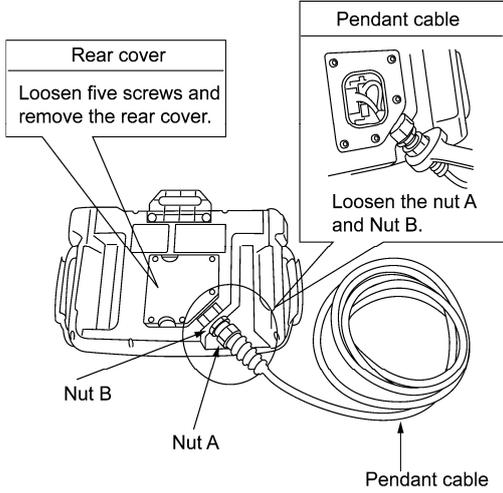
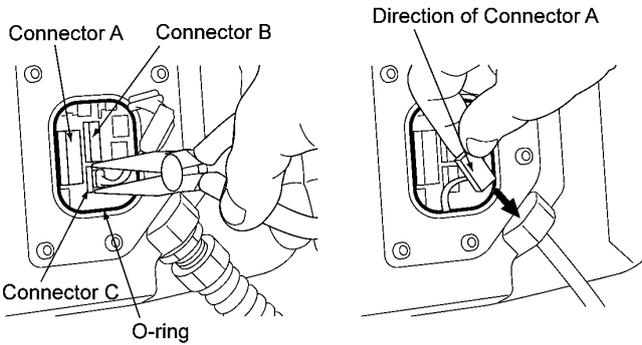
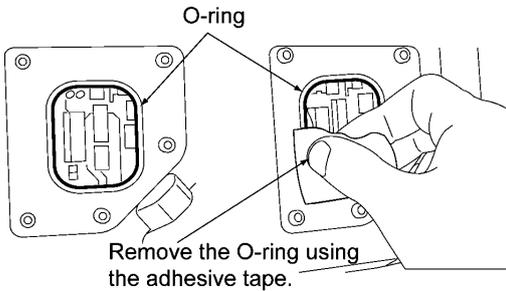
Set the equipment to make an emergency stop in an AND state.

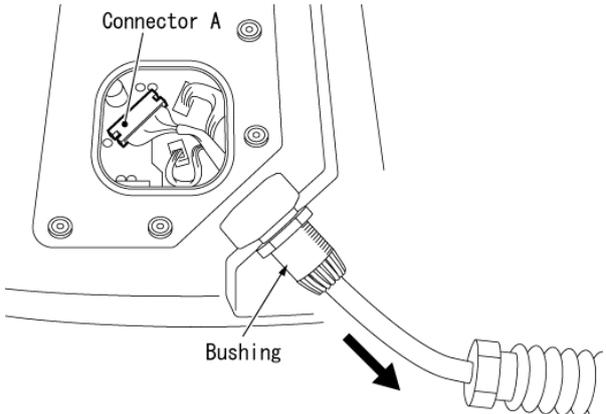
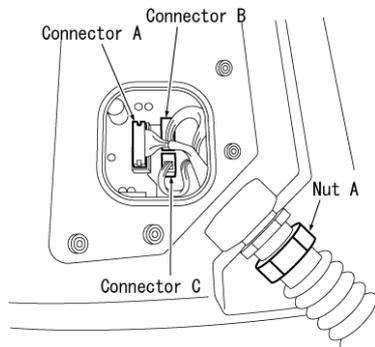
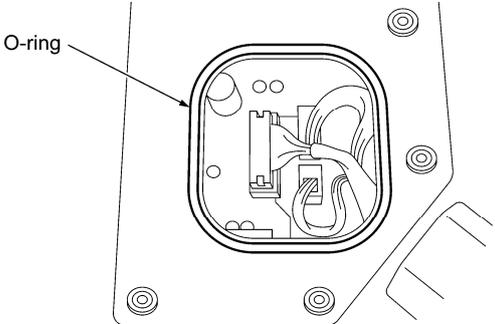
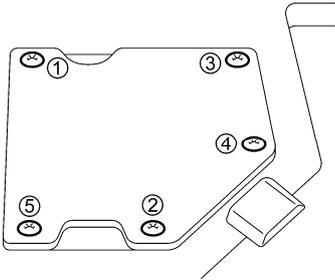
Add (1) and (2) above to the external sequence circuit.

1.3.5 Replacing the Teach Pendant Cable

The teach pendant is waterproof type (IP65). Replace the cable carefully according to the procedure below. Any careless work could deteriorate the waterproof property.

Note: When replacing the teach pendant cable, be sure to also replace the O-ring with a new one that comes with the new cable for sealing the rear cover.

Procedure	Illustration
<p>(1) Loosen five screws and remove the rear cover from the teach pendant.</p> <p>(2) Loosen nut A fixing the cable.</p> <p>(3) Loosen nut B.</p>	
<p>(4) Disconnect three connectors A, B, and C of the teach pendant cable using longnose pliers, <u>taking care not to damage the wiring, connectors and the groove provided for an O-ring.</u></p> <p>(5) Pull out the cable from the teach pendant, <u>with connector A directed as shown at right.</u></p>	
<p>(6) Remove the O-ring from the teach pendant, <u>using a piece of adhesive tape not to damage the groove provided for an O-ring.</u></p>	
<p>(7) Insert the new teach pendant cable into the teach pendant and then tighten nut B.</p>	<p>< Tightening torque > Nut B: 1.69 to 1.85 Nm</p>

Procedure	Illustration
<p>(8) Pull the cable in the direction of the arrow so that the banding band that is attached to the cable touches the bushing. Ensure that the banding band does not come out of the bushing.</p>	
<p>(9) Tighten nut A. Connect three connectors A, B and C of the teach pendant cable.</p>	<p>< Tightening torque > Nut A: 1.69 to 1.85 Nm</p> 
<p>(10) Fit the new O-ring into the groove, <u>taking care not to twist the O-ring.</u></p>	
<p>(11) Mount the rear cover, <u>taking care not to pinch the O-ring.</u> Then tighten five screws <u>in the order of ① to ⑤</u> as shown at right.</p>	<p>< Tightening torque > Screws for rear cover: 0.54 to 0.66 Nm</p> 

1.4 Pendant Extension Cable

The pendant extension cable for the teach pendant or mini-pendant is available as an option. The drawing below shows the external appearance of the extension cable.

Note: The total length of the original and extension cables should be 12 m or shorter. Do not use more than one extension cable with the teach pendant or mini-pendant.

Pendant Extension Cable

Part name	Part number	Length
Pendant extension cable	410141-3711	L=4m
	410141-3721	L=8m

(Unit: mm)

(To pendant)

(To controller)

Chapter 2 Mini-Pendant

The mini-pendant is an entry/operation device for operating the robot manually, starting programs, and teaching. It has no programming function.

Using the mini-pendant together with WINCAPSIII or WINCAPSIII Light enables efficient programming and teaching.

2.1 Mini-Pendant Functions

For instructions on how to operate the mini-pendant, refer to the SETTING-UP MANUAL.

Teaching

This function allows you to store the robot arm position (limited to editing of P variables and J variables). You can check edited programs in running them step by step.

Operating the robot

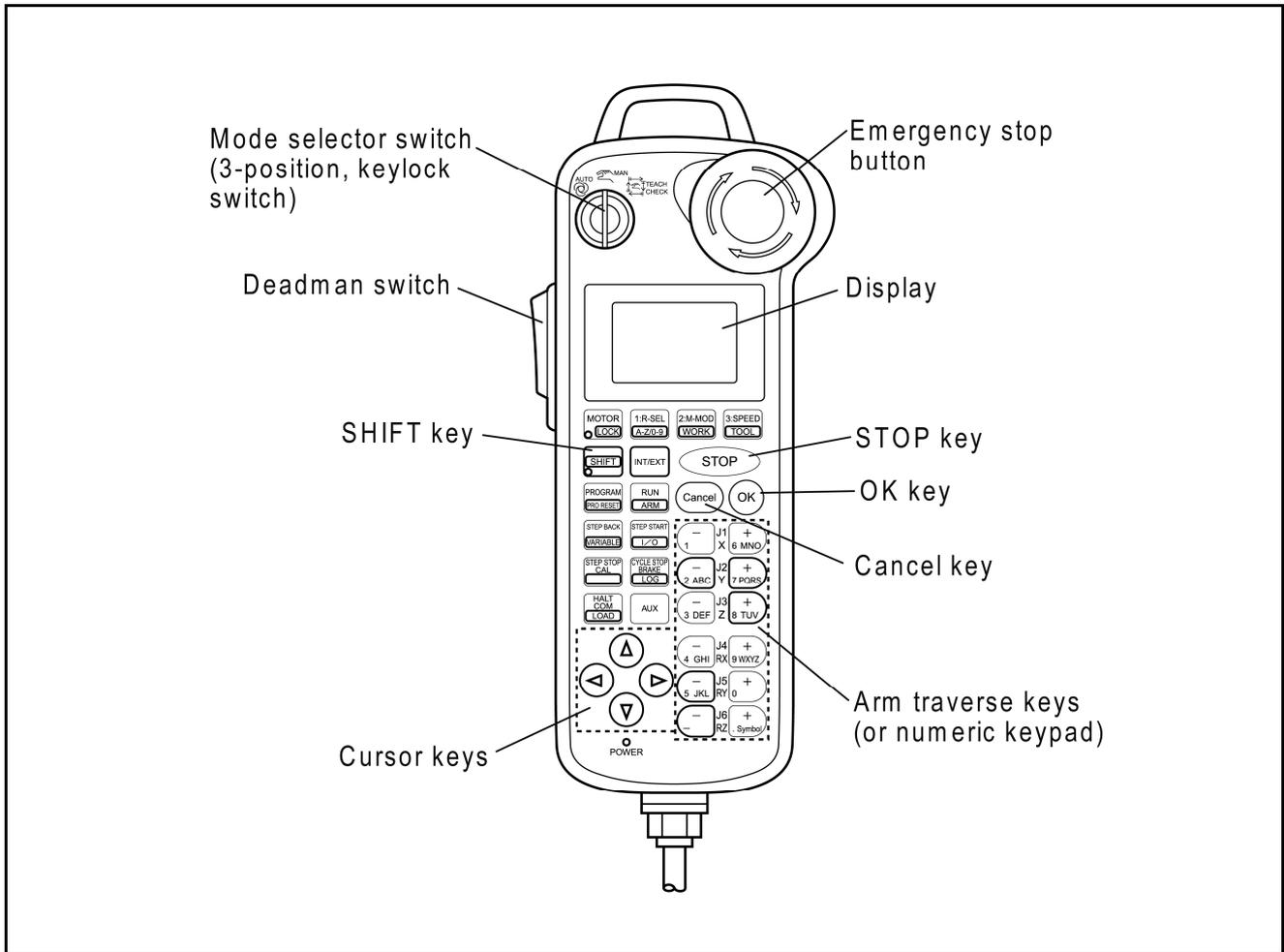
This function controls motor power ON/OFF, starts/stops automatic operation, and enables StepStart/StepBack and manual operation.

Displaying

This function displays the current robot arm position, running program number, ongoing step number or error codes.

2.2 Names of Mini-Pendant Components

The figure below shows the names of the mini-pendant components.



Names of Mini-Pendant Components

2.3 Mini-Pendant Specifications

2.3.1 Specifications

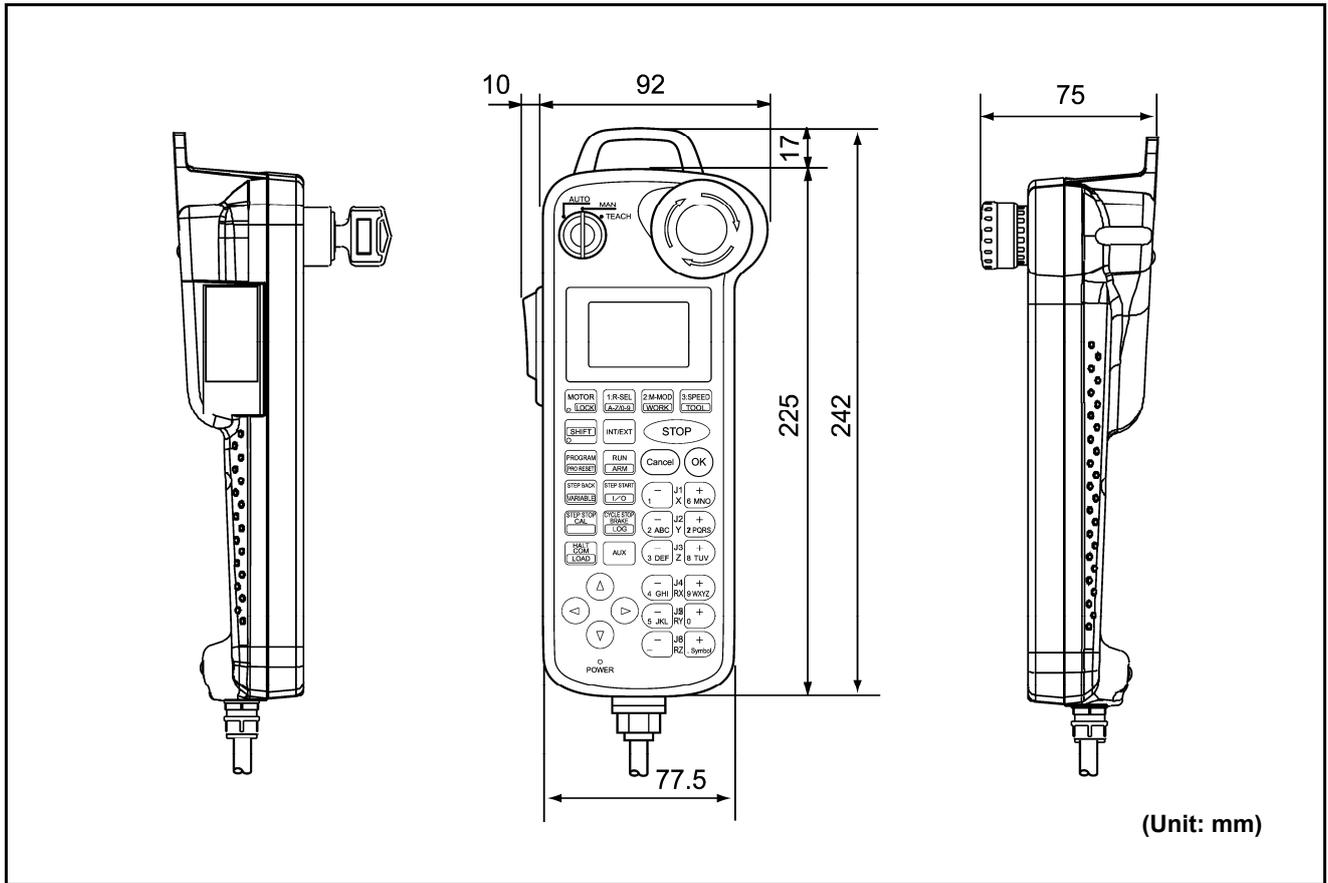
The table below lists the mini-pendant specifications.

Mini-Pendant Specifications

Item		Specifications
Model		MP7E3P4K (with 4 m cable) MP7E3P8K (with 8 m cable) MP7E3P12K (with 12 m cable)
Power source		24 VDC (supplied from robot controller)
Display	LCD	Liquid crystal display, 128 × 64 pixels
	LED	3 LEDs (POWER, MOTOR and LOCK)
Operation		33 membrane switches, robot stop button, mode selector switch, deadman switch
Emergency stop button		Four B contacts, 4 circuit outputs (Forced disjunction type)
Deadman switch (Enable switch)		3-position switch (OFF-ON-OFF), 2 circuit outputs
Mode selector switch		3-position switch (AUTO, MANUAL and TEACHCHECK) with lock key Note: Switchable only with the lock key inserted.
Installation conditions		Temperature: 0 to 40°C Humidity: 90% RH or less (Dew condensation shall not be allowed.)
Degree of protection		IP65
Outside dimensions (W) x (H) x (D)		86 x 218 x 38 mm (excluding projections such as switches)
Weight		Approx. 0.3 kg (excluding cables. See Note below.)
Cable length		4 m, 8 m, or 12 m
Accessory		WINCAPSIII Light
Note: Cable weight Approx. 0.2 kg (4 m), 0.4 kg (8 m), 0.6 kg (12 m)		

2.3.2 Outer Dimensions

The figure below shows the outer dimensions of the mini-pendant.



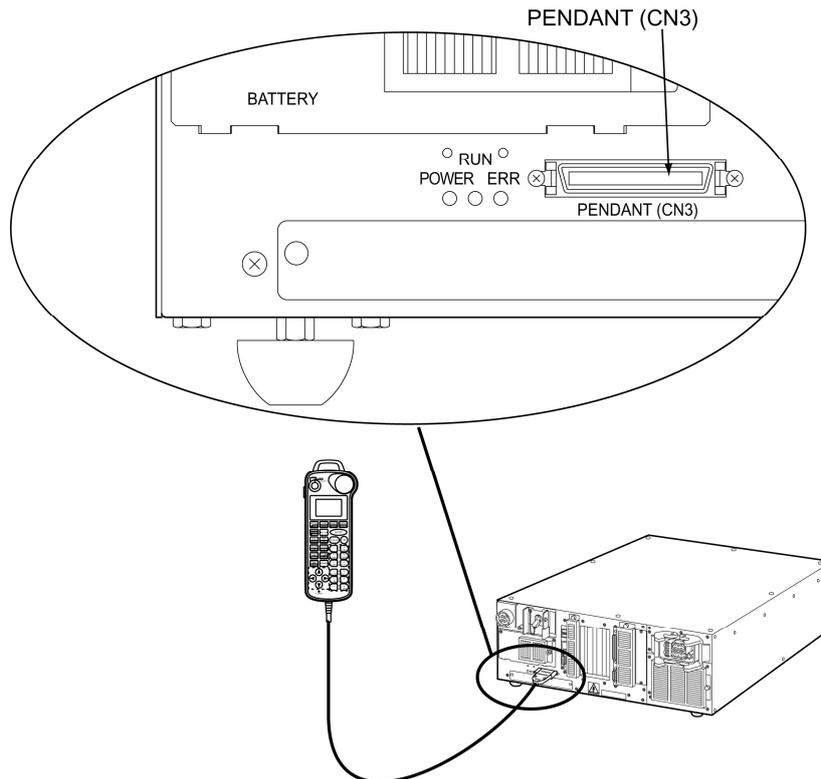
Outer Dimensions of the Mini-Pendant

2.3.3 Connecting the Mini-Pendant

The robot controller leaves the factory in the pendantless state (described in Section 1.3.4). Connect the mini-pendant to the PENDANT connector (CN3) on the robot controller.

Cautions in connecting the pendant cable to the controller:

- (1) After connecting the pendant cable, do not apply pressure on the connector in either direction. Such pressure may cause a communications error.
- (2) When disconnecting the cable, unlock the connector and pull out the cable straight without twisting it.



2.4 Specifications of WINCAPSIII Light

WINCAPSIII Light that comes with the mini-pendant is a programming support tool. It is a functionally limited version of WINCAPSIII.

Except that WINCAPSIII Light is limited to the following functions, it is equivalent to WINCAPSIII. Refer to the next chapter "WINCAPSIII."

Entering and editing robot programs

In WINCAPSIII Light, you may enter or edit robot programs. You may also develop new programs by making use of existing programs.

Reading/writing programs and data

WINCAPSIII Light may read programs, variables, coordinate values, CALSET data, log data, and other data from the robot controller and display them on the PC screen or can write them to the robot controller.

NOTE: To use this function, the robot controller and the PC must be connected with each other using a communications cable.

Saving programs and data

WINCAPSIII Light may store programs, CALSET data, log data, and other data onto the hard disk or floppy disks. It may also read out those stored data and re-edit or write them to the robot controller.

Getting a snapshot

WINCAPSIII Light may get a snapshot containing robot motion data from the robot controller and display the robot motion at one particular point in time on the PC screen, enabling you to check it.

2.5 Pendant Extension Cable

The pendant extension cable for the teach pendant or mini-pendant is available as an option. For details, refer to Section 1.4.

Chapter 3

Programming Support Tool "WINCAPSIII"

WINCAPSIII facilitates the creation and editing of robot programs. Use WINCAPSIII to improve creation and management of robot programs. For further information about how to use WINCAPSIII, refer to the WINCAPSIII GUIDE.

3.1 Functions in WINCAPSIII

WINCAPSIII has the following functions:

Entering and editing robot programs

In WINCAPSIII, you may enter or edit robot programs. You may also develop new programs by making use of programs supplied as a library or with existing programs.

Reading/writing programs and data

WINCAPSIII may read programs, variables, coordinate values, CALSET data, log data, and other data from the robot controller and display them on the PC screen or can write them to the robot controller.

NOTE: To use this function, the robot controller and the PC must be connected with each other using a communications cable.

Saving programs and data

WINCAPSIII may store programs, CALSET data, log data, and other data onto the hard disk or floppy disks. It may also read out those stored data and re-edit or write them to the robot controller.

Printing programs and data

If you connect a printer to the PC, WINCAPSIII may print out programs, CALSET data, log data, and other data.

Simulating the robot motion

WINCAPSIII may simulate the robot motion in animation on the PC screen.

NOTE: To use this function, the robot controller and the PC must be connected with each other using an interface cable.

During automatic operation or manual operation using the teach pendant, the simulated image moves corresponding to the actual robot motion.

3.2 Operating Environment Required

WINCAPSIII requires the operating environment listed below.

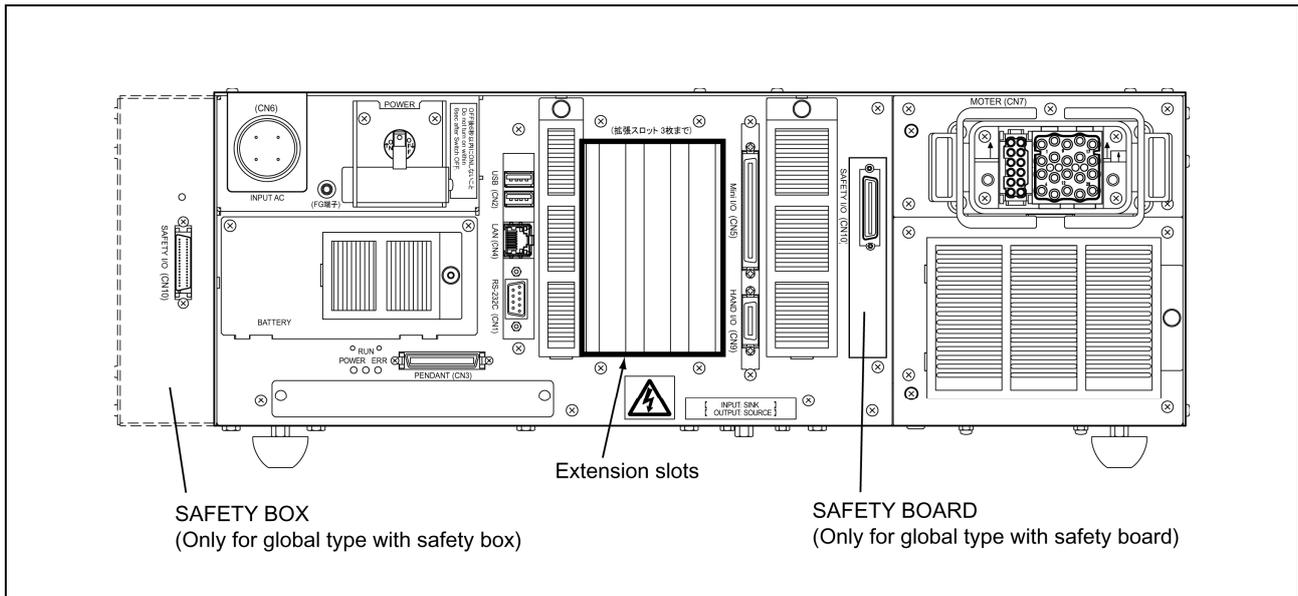
Operating Environment for the WINCAPSIII

CPU	Pentium 4
OS	Windows XP/Vista
Memory	512 megabytes or more free
Hard disk	500 megabytes or more free
Other requirements	GPU recommended for the use of 3D data

PART 2 I/O EXTENSION BOARDS FOR RC7M

Chapter 4 Overview of I/O Extension Boards

If you need I/O signal lines more than the ones provided on the Mini I/O port (CN5) or if you want to control the robot in any of the various field networks, add up to two I/O extension boards to the extension slots (there are three slots) in the controller as shown below.



4.1 I/O Extension Boards Available

The robot controller is available with I/O extension boards optionally provided by Denso Wave and recommended commercial ones as listed below.

Note: For the repeat system in the RC5 controller, an optional "I/O conversion box" is convenient to use. Refer to Section 4.7, "I/O Conversion Box."

(1) Denso Wave I/O Extension Boards (option)

	Board name	Part number	
		Board built in the controller	Board as a spare part
Place an order with Denso Wave.	Parallel I/O board (NPN type)	410010-3320	410010-3340
	Parallel I/O board (PNP type)	410010-3330	410010-3350
	DeviceNet slave board	410010-3370	410010-3400
	DeviceNet master board	410010-3380	410010-3410
	DeviceNet master/slave board	410010-3390	410010-3480
	CC-Link board	410010-3430	410010-3440
	Conveyor tracking board (Note 1)	410010-3460	410010-3470
	μ Vision board (Note 2)	410010-4150	410010-4160

(Note 1) Instructions on how to handle the conveyor tracking board are given in the supplement (410002-6500) separately issued.

(Note 2) Instructions on how to handle the μ Vision board are given in PART 4 "SPECIFICATIONS OF OTHER OPTIONS."

(2) Commercial I/O Extension Boards (recommended)

	Board name	Manufacturer (Model)	Part number of license certificate for permitting the configuration software to run	
			Permitted at the factory	To be permitted by the user
Prepare on the user's responsibility.	PROFIBUS-DP slave board	Hilscher GmbH (CIF50-DPSIDENSO)	410006-0300	410006-0310
	S-LINK V board	SUNX (SL-VPCI)	410006-0280	410006-0290
	RS-232C extension board	CONTEC (COM-2P (PCI) H)	410006-0260	410006-0270
	Ethernet/IP adapter board	Hilscher GmbH (CIFX50-REIDENSO)	410006-0800	410006-0810

4.2 Combination of I/O Extension Boards and Allocation Mode

Up to two I/O extension boards can be mounted on the controller. There are no restrictions on the choice of extension slots or the mounting order.

The table below lists the permitted combination of I/O extension boards and selectable allocation mode.

Combination of I/O Extension Boards and Selectable Allocation Mode

No.	I/O extension boards (Max. 2 boards per controller)			Allocation modes			
	Extension 1	Extension 2	Extension 3	Mini I/O dedicated	Allocated to Extension 1		All user I/O
					Compatible	Standard	
0	-	-	-	√			
1	-	S-Link V board	-	√			√
2	-	DeviceNet master board	-				√
3	-	DeviceNet master board	Parallel I/O board				√
4	-	DeviceNet master board	S-Link V board				√
5	Parallel I/O board	-	-	√	√	√	
6	Parallel I/O board	Parallel I/O board	-	√	√	√	
7	Parallel I/O board	S-Link V board	-	√	√	√	√
8	DeviceNet slave board	-	-		√	√	
9	DeviceNet slave board	Parallel I/O board	-		√	√	
10	DeviceNet slave board	S-Link V board	-		√	√	√
11	DeviceNet master/slave board	-	-		√	√	√
12	DeviceNet master/slave board	Parallel I/O board	-		√	√	√
13	DeviceNet master/slave board	S-Link V board	-		√	√	√
14	CC-Link board	-	-		√	√	
15	CC-Link board	Parallel I/O board	-		√	√	
16	CC-Link board	DeviceNet master board	-		√	√	√
17	CC-Link board	S-Link V board	-		√	√	√
18	PROFIBUS-DP slave board	-	-		√	√	
19	PROFIBUS-DP slave board	Parallel I/O board	-		√	√	
20	PROFIBUS-DP slave board	DeviceNet master board	-		√	√	√
21	PROFIBUS-DP slave board	S-Link V board	-		√	√	√
22	Ethernet/IP adapter board	-	-		√	√	
23	Ethernet/IP adapter board	Parallel I/O board	-		√	√	
24	Ethernet/IP adapter board	DeviceNet master board	-		√	√	√
25	Ethernet/IP adapter board	S-Link V board	-		√	√	√

Note 1: Only one mode can be selected from among check-marked modes in the "Application modes" column.

Note 2: Up to two I/O extension boards can be mounted on the controller. There are no restrictions on the choice of extension slots or the mounting order.

Note 3: When two parallel I/O boards are mounted, the controller recognizes the board inserted in the left-hand extension slot as Extension 1. The allocation I/O port numbers on Extension 1 and 2 boards differ with each other.

4.3 I/O Port Map and Allocation

When an I/O extension board is not used, I/O port numbers (the number specified when I/O is processed with PAC program or I/O command) go up to 511. However, when an I/O extension board is used, I/O port numbers beyond 511 are added.

I/O Port Mapping and Allocation

I/O port number	Allocation	
0 to 15	Mini I/O input	Standard area (Note)
16 to 30	Mini I/O output	
32 to 47	Not used.	
48 to 55	Input by hand	
56 to 63	Not used.	
64 to 71	Output by hand	
72 to 127	Not used.	
128 to 511	Internal I/O	
512 to 767	DeviceNet slave board input CC-Link input PROFIBUS-DP slave input Ethernet/IP adapter input	
768 to 1023	DeviceNet slave board output CC-Link output PROFIBUS-DP slave output Ethernet/IP adapter output	
1024 to 2047	DeviceNet master board input	
2048 to 3071	DeviceNet master board output	
3072 to 3327	S-Link V input	
3328 to 3583	S-Link V output	
3584 to 3623	(1st)Parallel I/O board input	
3624 to 3663	(2nd)Parallel I/O board input	
3664 to 3839	Not used.	
3840 to 3887	(1st)Parallel I/O board output	
3888 to 3935	(2nd)Parallel I/O board output	
3936 to 4095	Not used.	
4096 to 4351	CC-Link remote register R _{Ww} input	
4352 to 4607	Not used.	
4608 to 4863	CC-Link remote register R _{Wr} output	
4096 to 7871	Ethernet/IP adapter input	
7872 to 11647	Ethernet/IP adapter output	

4.4 I/O Allocation Settings

The I/O allocation setting is chosen from the items below. In actual use, the selectable allocations are limited according to the I/O extension board to be used. Refer to the sections relating to the relevant I/O extension board for selectable allocations. Refer also to the section for the respective I/O extension boards for details regarding the port number of each I/O extension board.

Type of I/O Allocation

Allocation	General description
Standard	Directs program activation, etc. with a combination of bits (I/O command.) This allocation has the greatest number of functions. "Standard" system allocation is allocated to the I/O extension board area. Only the user signal (excluding CPU Normal) is allocated to all ports of the Mini I/O area.
Compatible	Functions, such as program activation, are specified by each bit. Operations are directed by the bit being set. "Compatible" system allocation is allocated to the I/O extension board area. Only the user signal (excluding CPU Normal) is allocated to all ports of the Mini I/O area.
All user I/O	Only the user signal is allocated to the I/O extension board area. Only the user signal (excluding CPU Normal) is allocated to all ports of the Mini I/O area.
Mini I/O dedicated	Combination of bits commands operations. Some functions are deleted from the ones provided in Standard allocation. Mini I/O system allocation is allocated to the Mini I/O area. When an I/O option board is attached, only the user signal is allocated to the I/O option board area.

4.5 Mini I/O Functions (with I/O extension board mounted)

The function of terminals with a Mini I/O port number (terminal Nos. 11 – 26 and 45 – 60) changes when an I/O extension board is used.

4.5.1 Mini I/O Dedicated

The allocation is the same as when an I/O extension board is not used.
Refer to the RC7M Controller Interface Manual for details.

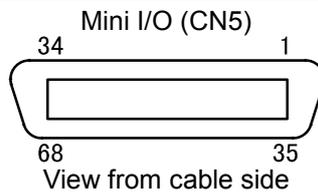
4.5.2 Other Allocation (Standard, Compatible and All User I/O)

Terminal Nos. 11 to 26 are for user input and Nos. 46 to 60 are for user output.

(Except terminal number 45 and CPU normal)

Mini I/O (CN5) Functions (I/O Allocation: Standard, Compatible and All User I/O)

Terminal No.	Name	Port No.	Wire color	Terminal No.	Name	Port No.	Wire color
11	User input	0	Green	45	CPU Normal	16	White
12	User input	1	Blue	46	User output	17	White
13	User input	2	Violet	47	User output	18	White
14	User input	3	Gray	48	User output	19	White
15	User input	4	Pink	49	User output	20	White
16	User input	5	Black	50	User output	21	Gray
17	User input	6	Black	51	User output	22	Violet
18	User input	7	Brown	52	User output	23	Violet
19	User input	8	Red	53	User output	24	Violet
20	User input	9	Orange	54	User output	25	Violet
21	User input	10	Yellow	55	User output	26	Violet
22	User input	11	Green	56	User output	27	Violet
23	User input	12	Blue	57	User output	28	Violet
24	User input	13	Gray	58	User output	29	Violet
25	User input	14	Pink	59	User output	30	Violet
26	User input	15	Brown	60	User output	31	Gray



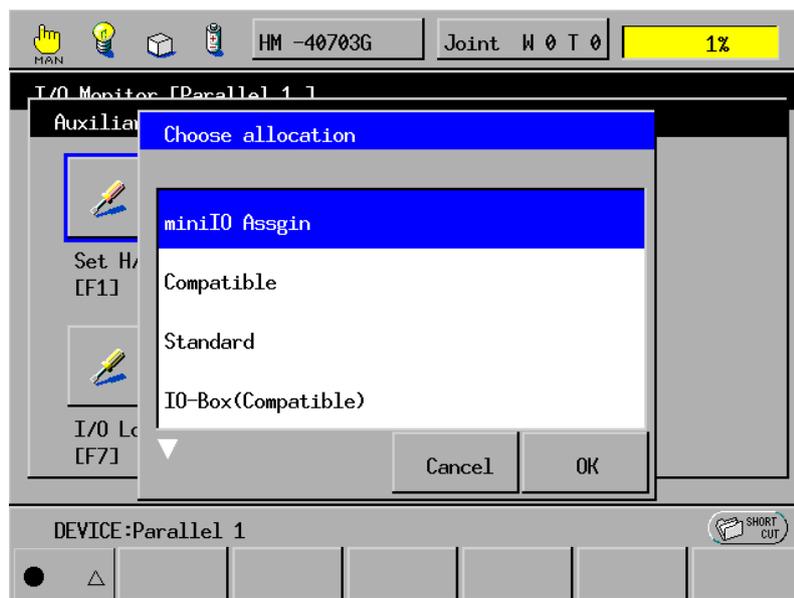
4.6 Method for Setting I/O Allocation

■ Method for setting from teaching pendant

Access: [F4 I/O]—[F6 Aux.]—[F2 AllocMode]

Mount the floppy disk drive into the robot controller according to the following procedure:

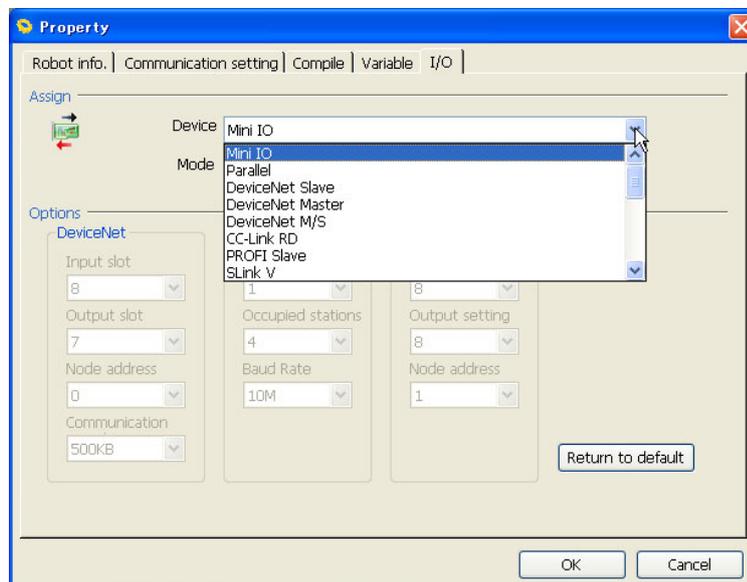
After completing the above operations, use the cursor keys or jog dial to select one of the allocations and then press OK. Restart the robot controller to make the new settings take effect.



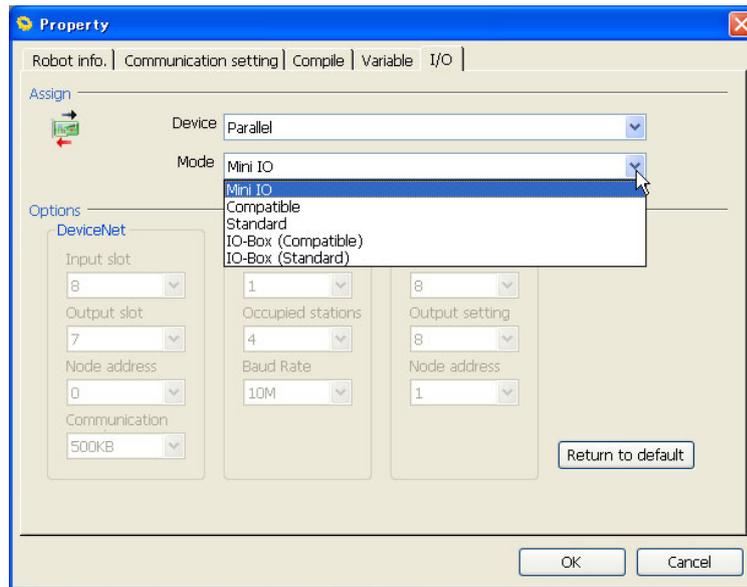
■ Method for setting from WINCAPSIII

- (1) Choose Project | Property to display the Property window. Choose the I/O tab.
- (2) In the Assign area, pull down the Device menu and select the desired I/O extension board.

Note: Do not select an I/O extension board not mounted. Doing so and transferring assignment data to the controller results in an error when the controller is restarted after reception of the data.

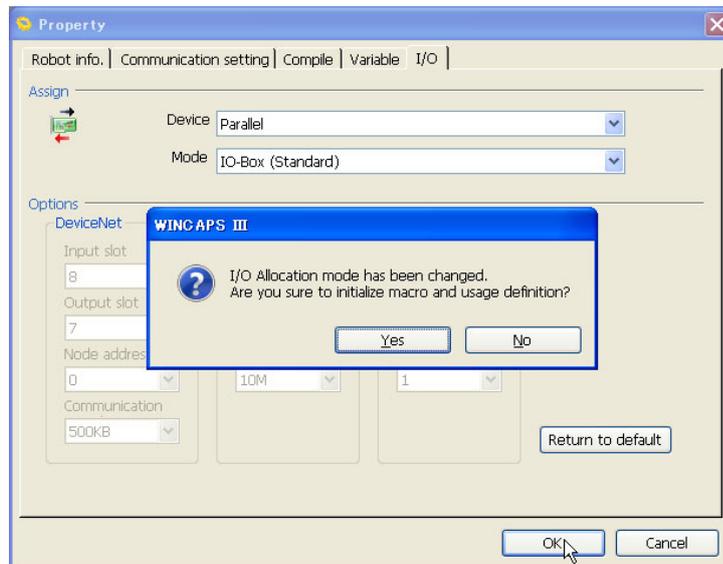


(3) Pull down the Mode menu and select the desired assignment.

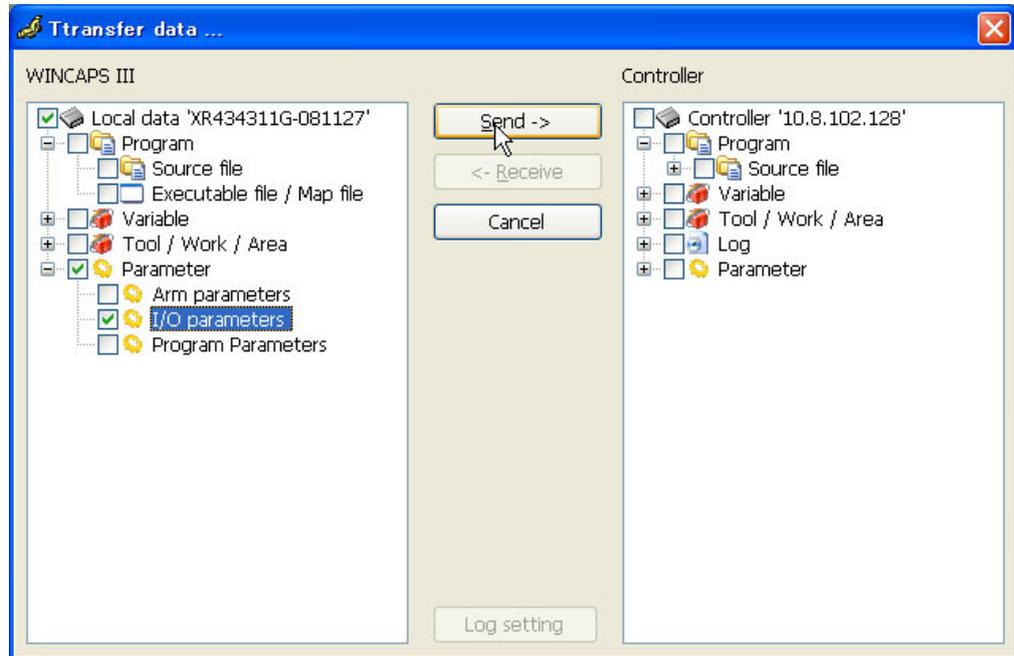


(4) In the window above, press OK, and the following message appears.

In the dialog box below, press Yes if there is no problem with initialization of macro and usage definition; press No if there is a problem. Pressing either one changes the allocation.

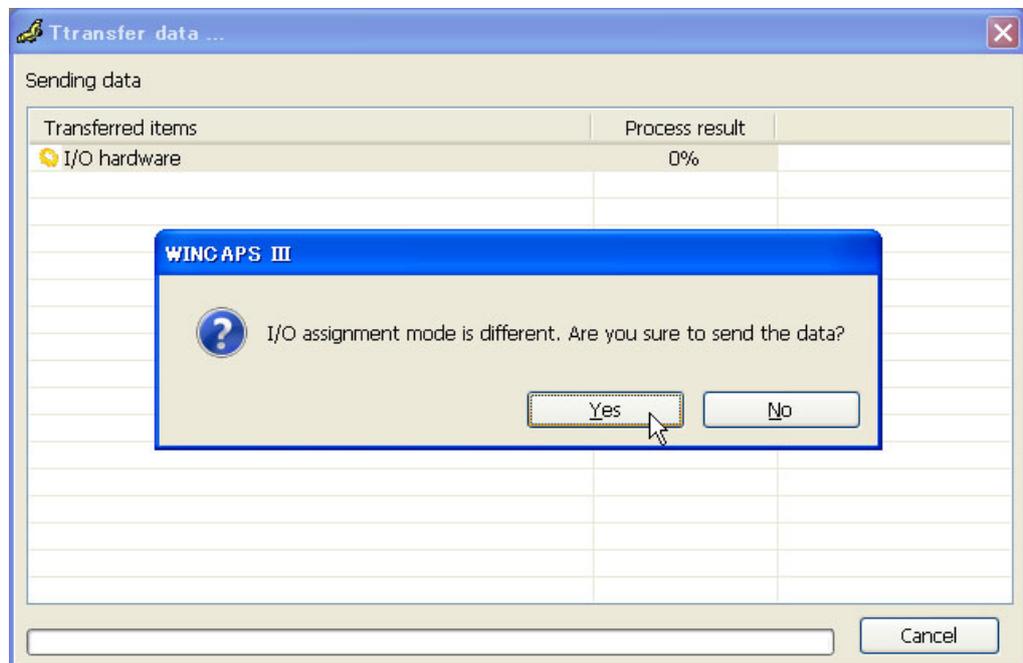


- (5) Choose Connect | Transfer data to display the bidirectional transfer dialog box. Select I/O parameters in WINCAPSIII and press Send to transfer I/O assignment from WINCAPSIII to the robot controller.



- (6) As shown below, the two confirmation messages (for data updating and I/O assignment mode) appear. Press Yes in both dialog boxes to transfer data to the controller.

The data transferred takes effect when the controller is restarted.



4.7 I/O Conversion Box

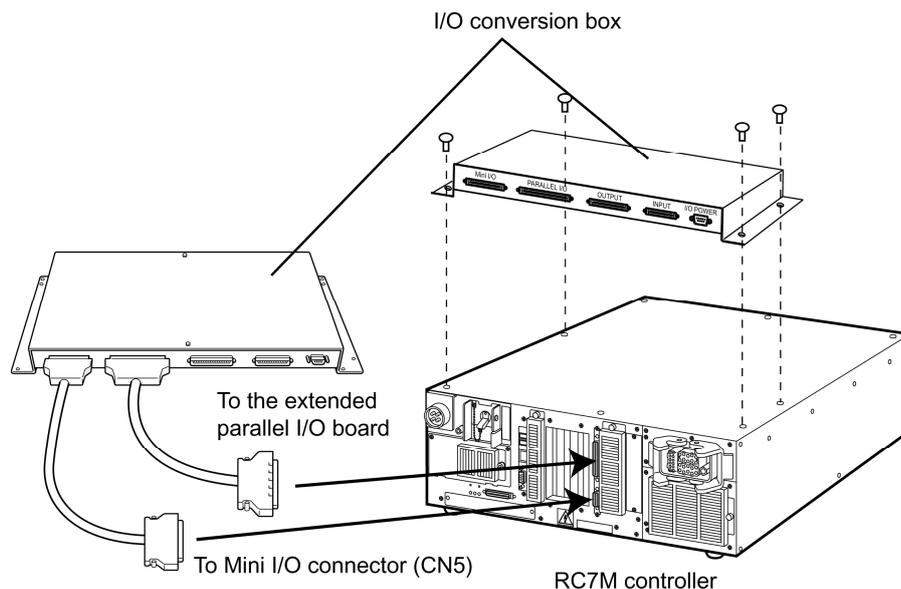
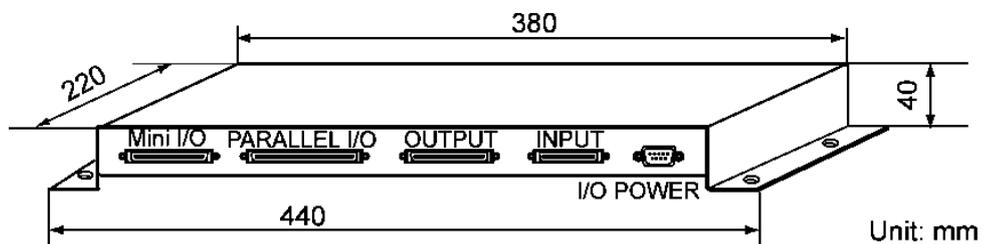
Mounting an optional parallel I/O board on the RC7M controller and connecting the I/O conversion box allows the signals fed to the INPUT connector (CN8), OUTPUT connector (CN10) and I/O POWER connector (CN7) on the RC5 controller to be used as is in the RC7M controller.

4.7.1 I/O Conversion Box and Accessories

The table below lists the I/O conversion box and its accessories.

Component	Remarks
I/O conversion box	Mount this conversion box on the top of the controller, secure it with four screws at the front panel side, and connect it to the controller with two cables--mini I/O connection cable and parallel I/O connection cable, which come with this box.
Mini I/O connection cable	Interfacing between the Mini I/O connector on the I/O conversion box and the Mini I/O (CN5) connector on the controller.
Parallel I/O connection cable	Interfacing between the PARALLEL I/O connector on the I/O conversion box and the connector on the optional parallel I/O board added.
4 screws (M3 x 6)	To be used for securing the I/O conversion box to the controller.

Mount the I/O conversion box on the top of the RC7M controller as shown below.



External Dimensions of I/O Conversion Box (Above top) and Mounting/Connecting (Above bottom)

4.7.2 Allocation Mode Available with the I/O Conversion Box

Using the I/O conversion box requires mounting an optional parallel I/O board that covers the short of signal lines on the standard mini I/O port for compatibility with the RC5 controller.

The table below lists the permitted combination of I/O extension boards and selectable allocation mode.

Combination of I/O Extension Boards and Selectable Allocation Mode, with I/O Conversion Box

No.	I/O extension boards		Allocation mode		
	1st	2nd	I/O-Box (Compatible)	I/O-Box (Standard)	I/O-Box (All user I/O)
1	Parallel I/O board	—	√	√	
2	Parallel I/O board	Parallel I/O board	√	√	
3	Parallel I/O board	DeviceNet slave board	√	√	
4	Parallel I/O board	DeviceNet master board			√
5	Parallel I/O board	DeviceNet master/slave board	√	√	√
6	Parallel I/O board	CC-Link board	√	√	
7	Parallel I/O board	PROFIBUS-DP slave board	√	√	
8	Parallel I/O board	S-LINK V board	√	√	√
9	Parallel I/O board	Ethernet/IP adapter board	√	√	

4.7.3 I/O Port Map and Allocation

Using the I/O conversion box allocates the area of the 1st parallel I/O board mounted to I/O port #0 to #127, so the standard area allocation is changed as listed below.

I/O Port Map and Allocation

I/O port number	Allocation	
0 to 45	Parallel input	Standard area
46 to 47	Not used.	
48 to 55	Input by hand	
56 to 63	Not used.	
64 to 71	Output by hand	
72 to 127	Parallel output	
128 to 511	Internal I/O	
512 to 767	DeviceNet slave board input CC-Link input PROFIBUS-DP slave input Ethernet/IP adapter input	
768 to 1023	DeviceNet slave board output CC-Link output PROFIBUS-DP slave output Ethernet/IP adapter output	
1024 to 2047	DeviceNet master board input	
2048 to 3071	DeviceNet master board output	
3072 to 3327	S-Link V input	
3328 to 3583	S-Link V output	
3584 to 3623	(1st) Parallel I/O board input	
3624 to 3663	(2nd) Parallel I/O board input	
3664 to 3839	Not used.	
3840 to 3887	(1st) Parallel I/O board output	
3888 to 3935	(2nd) Parallel I/O board output	
3936 to 4095	Not used.	
4096 to 4351	CC-Link remote register R _W w input	
4352 to 4607	Not used.	
4608 to 4863	CC-Link remote register R _W r output	
4096 to 7871	Ethernet/IP adapter input	
7872 to 11647	Ethernet/IP adapter output	

4.7.4 Types of Input/Output Signals and Usage

For the I/O signals and the usage when the I/O conversion box is connected, refer to the RC5 CONTROLLER INTERFACE MANUAL except Section 4.6 "Selectable I/O Mode."

The RC5 CONTROLLER INTERFACE MANUAL is contained in the manual pack CD, Supplement, Additional information.

Chapter 5 Parallel I/O Board

5.1 Overview

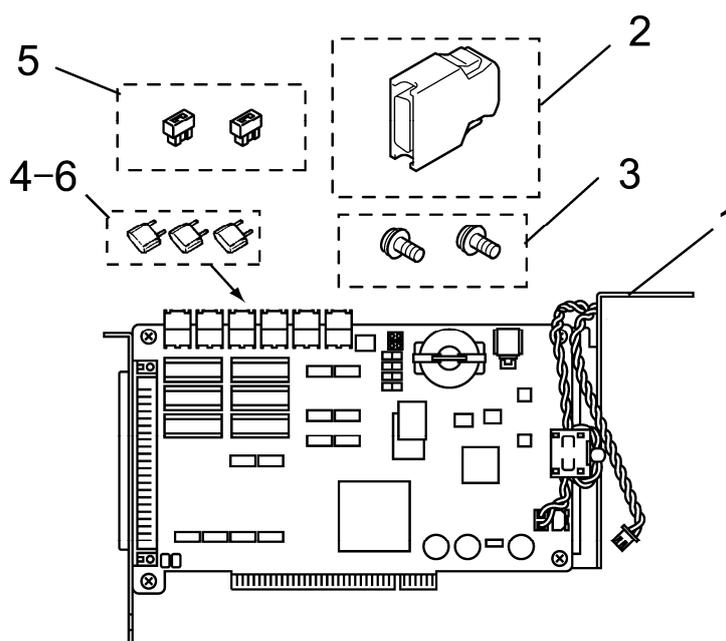
Mounting a single (or two) parallel I/O board(s) on the robot controller allows 40 (or 80) points for input and 48 (or 96) points for output, in addition to the Mini I/O's 16 points each for input and output.

The parallel I/O board can be incorporated into any of the extension slots provided in the robot controller.

The parallel I/O board is configured as shown below.

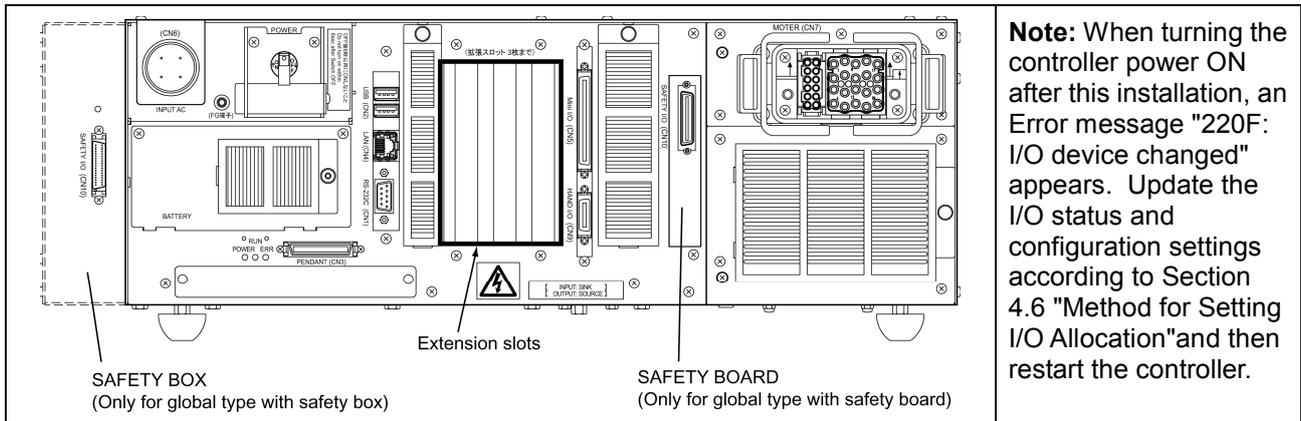
Configuration of Parallel I/O Board

No.	Components	Part Number	Remarks
1	Parallel I/O board (including Nos. 2 through 5)	410010-3320	NPN type, integrated in the controller
		410010-3330	PNP type, integrated in the controller
		410010-3340	NPN type, shipped alone
		410010-3350	PNP type, shipped alone
2	Mini I/O connector kit	410159-0190	For wiring to Mini I/O (CN5) This kit consists of : - Connector (PCR-E68FS) - Connector cover (PCS-E68LPA-1E) (Both of these are manufactured by HONDA TSUSHIN KOGYO CO., LTD.)
3	Screw with washer (2 pieces)	410815-0750	For securing the board (M3x6) (When the board is integrated at the factory, these screws are used in the controller.)
4	Fuse (4A)	410054-0250	F3 fuse (LM40) that comes with the PNP type only
5	Fuse (1.3A) (3 pieces)	410054-0230	For F1, F2, F4, F5, and F6 fuses (LM13)
6	Short socket (2 pieces)	410874-0370	See Section 5.2.2 "I/O power supply settings."



The parallel I/O board can be incorporated into any of the extension slots provided in the robot controller. (Refer to Chapter 14 "Mounting I/O Extension Boards".)

Note: Two parallel I/O boards mounted are counted from the left side (when viewed from the front panel side); that is, the left-hand board is 1st board.



Note: When turning the controller power ON after this installation, an Error message "220F: I/O device changed" appears. Update the I/O status and configuration according to Section 4.6 "Method for Setting I/O Allocation" and then restart the controller.

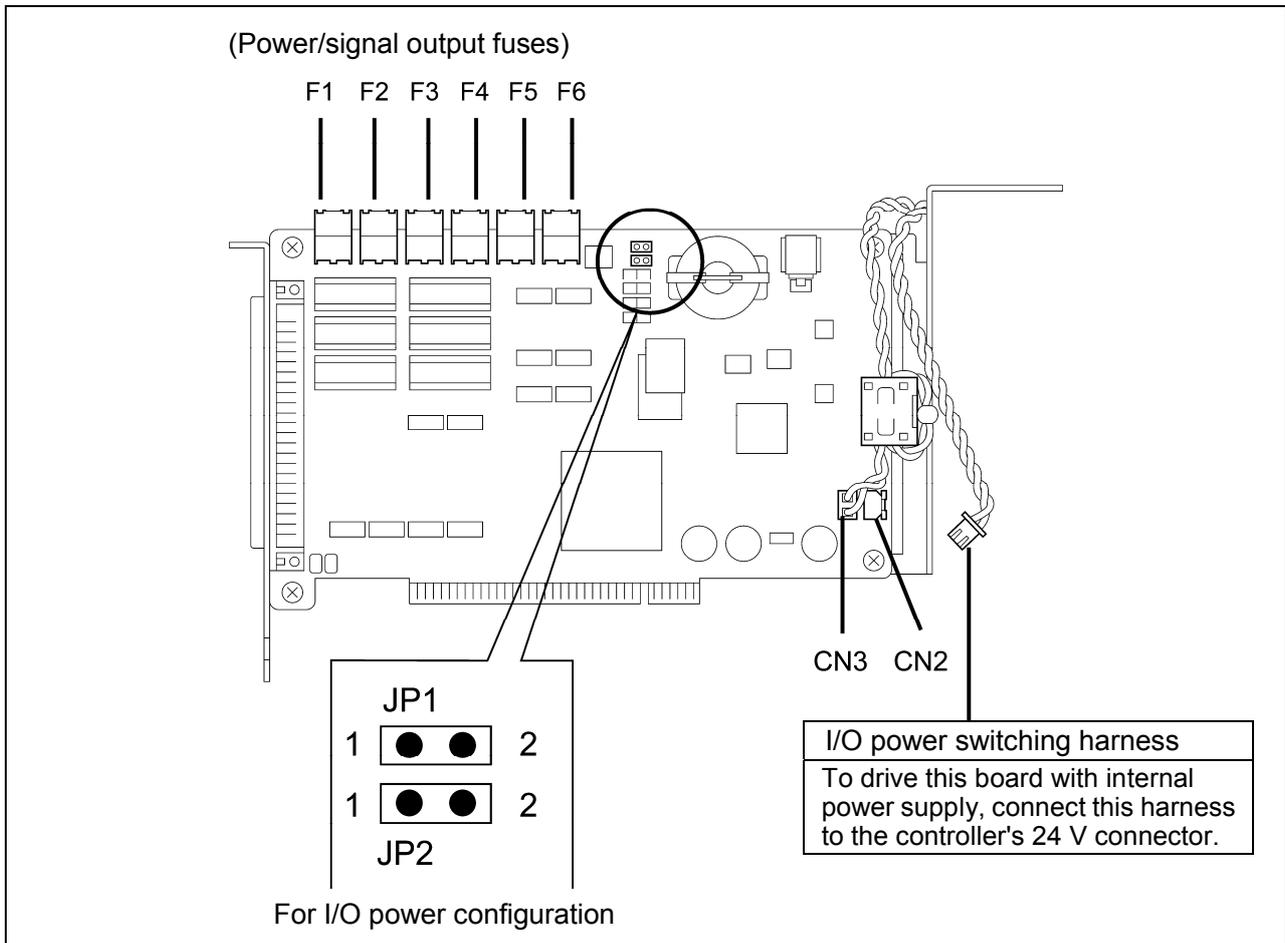
Extension Slots in RC7M Controller

5.2 Product Specifications

5.2.1 Parallel I/O Board Part Names

Section names of the parallel I/O board are as follows.

Note: F3 fuse is not mounted on the NPN type.



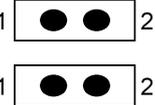
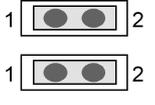
Parts on the Parallel I/O Board

5.2.2 Part Functions and Board Settings

■ I/O power supply settings

Either an external power supply or the internal power supply can be set as the parallel I/O board's I/O power supply (+24V DC). An external power supply is the factory default setting.

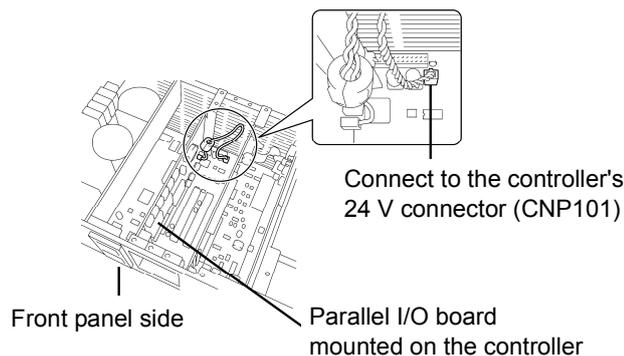
I/O power supply setting method

I/O power supply settings	P1 and JP2 settings	Setting method
External power supply	 JP1, JP2 (Open)	Use the board under the factory default settings (both JP1 and JP2 are open).
Internal power supply	 JP1, JP2 (Short-circuit)	Short-circuit pin 1 to 2 on each of JP1 and JP2 using a short socket.

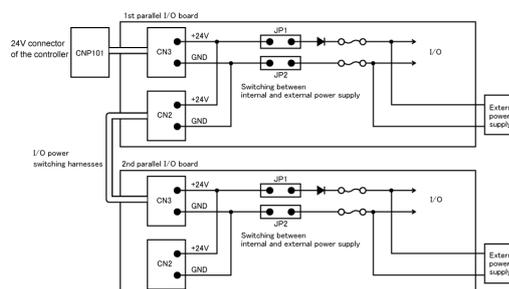
(Note) Check that the controller's power is turned OFF before setting.

<Connecting internal power supply cables when mounting add-on parallel I/O boards>

- (1) Disconnect the I/O power switching harness from CN2 on the parallel I/O board and connect it to 24 V connector (CNP101) on the controller's printed circuit board.



- (2) When mounting two parallel I/O boards, connect the I/O power switching harness of the 2nd board to CN2 on the 1st board.



■ Fuses

The specifications of fuses F1 to F6 are listed below.

Name	Capacity	Type (Manufacturer)	Function	Cause of fuse disconnection
F1	1.3A	LM13 (Daito Communication Apparatus)	For internal power supply	Output port or power supply short circuit, etc. when the internal power supply is used.
F2	1.3A	LM13 (Daito Communication Apparatus)		
F3	4A	LM40 (Daito Communication Apparatus)	For 24V power supply	Application of excess power, reverse connection of power supply, output port short circuit, etc.
F4	1.3A	LM13 (Daito Communication Apparatus)	For signal output (I/O ports 3840 to 3855)	Output port short circuit (I/O port 3840 – 3855) IC1 or IC2 transistor short-circuit failure, etc.
F5	1.3A	LM13 (Daito Communication Apparatus)	For signal output (I/O ports 3856 to 3871)	Output port short circuit (I/O port 3856 – 3871) IC3 or IC4 transistor short-circuit failure, etc.
F6	1.3A	LM13 (Daito Communication Apparatus)	For signal output (I/O ports 3872 to 3887)	Output port short-circuit (I/O port 3872 – 3887) IC5 or IC6 transistor short-circuit failure, etc.

5.2.3 General Specifications

(1) Products

Signal I/O type	Product Number (for shipping after assembling with the controller)	Product Number (for shipping alone)
NPN type	410010–3320 (Parallel I/O NPN with the controller attached)	410010–3340 (Parallel I/O NPN supply product)
PNP type	410010–3330 (Parallel I/O PNP with the controller attached)	410010–3350 (Parallel I/O PNP supply product)

(2) Product Specifications

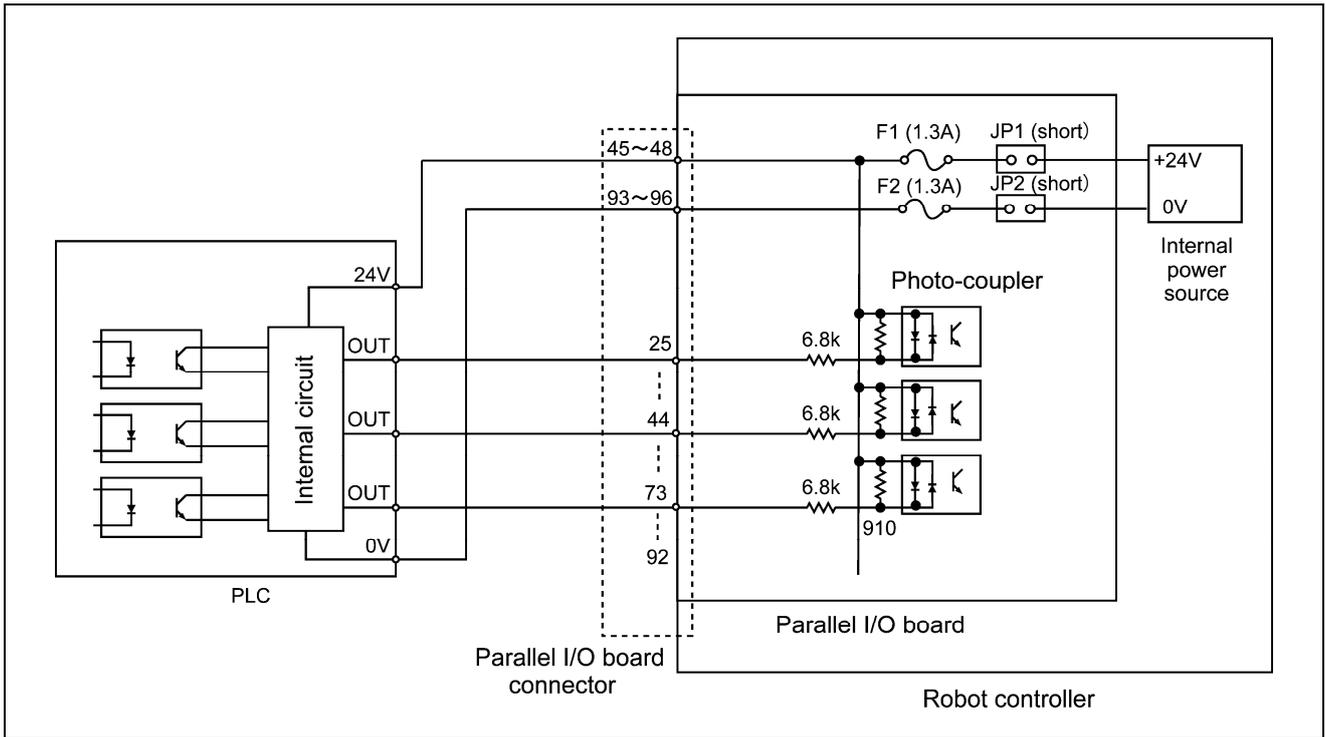
Item	Specifications
Number of input points	40 points
Number of output points	48 points
Input current	3.8 mA/1 bit max.
Output current	70 mA/1 bit max.
Leakage current	0.8 mA
External supply voltage	±24V±10% (External power mode)
Power supply voltage	±5V±5% (supplied from the controller)
Signal I/O	NPN or PNP
Operating temperature	0 to 40°C
Operating humidity	90% RH or less (No condensation)

(3) User-Input and System-Input Circuits

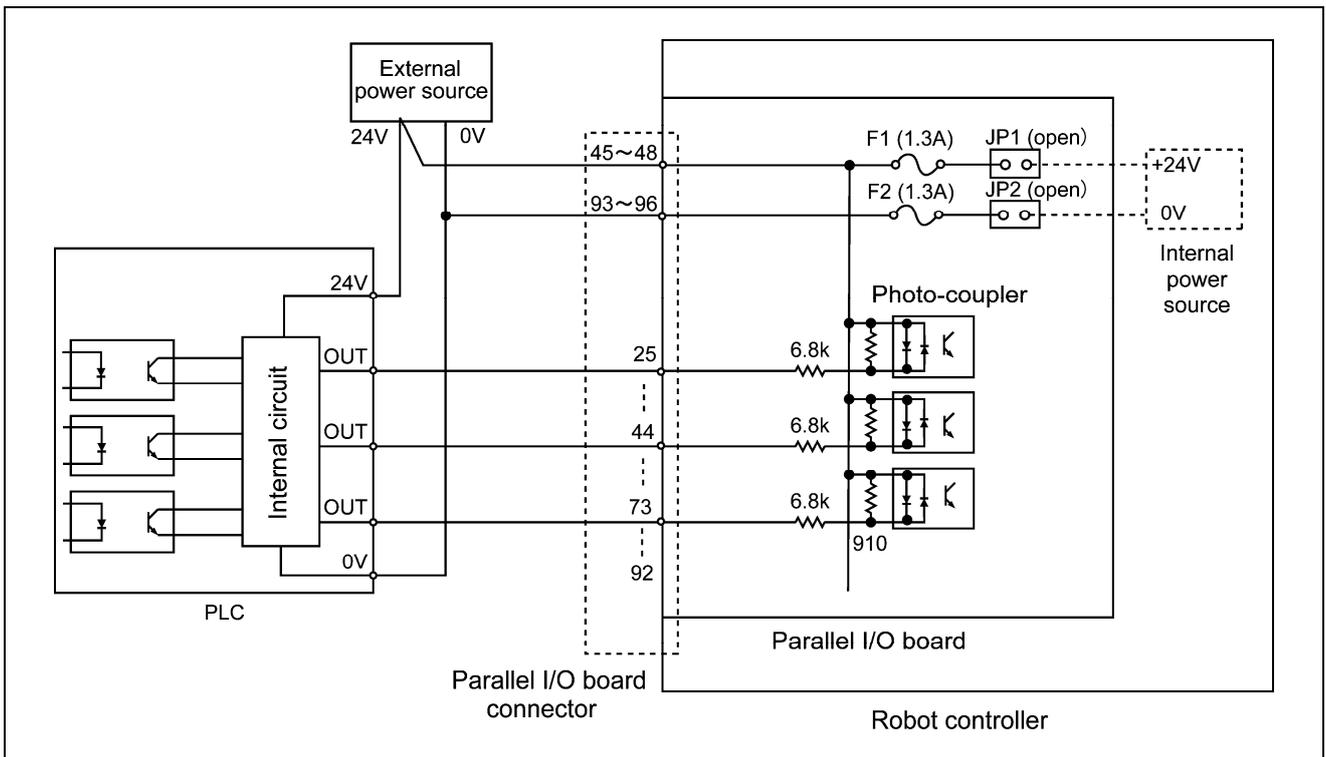
The following two pages show examples of the user-input and system-input circuit configurations and connections of the parallel I/O board. The maximum allowable capacity of the parallel board's internal power source is 1.3A. Use the internal source within this allowable range.

- Note:
- (1) Either an external power supply type or built-in power type output card is available for the PLC.
However, an external power supply type requires an additional power source (24V) to be installed.
Power capacity is 15W or more.
 - (2) When controlling two or more robots with a single PLC using the internal power source of the robot controller, a PLC output card should be set for each robot.
 - (3) A proximity switch or a relay contact may also be connected directly to the input terminal of the parallel I/O board. In such a case, use the power input to pins 45 to 48 and 93 to 96. A two-wire photoelectric switch or proximity switch can be connected if its leakage current is 0.8 mA or less.
 - (4) Use a multi-wire shielding cable for the purpose of protecting the devices from external noise. Ground it to the robot controller.

■ NPN-type I/O

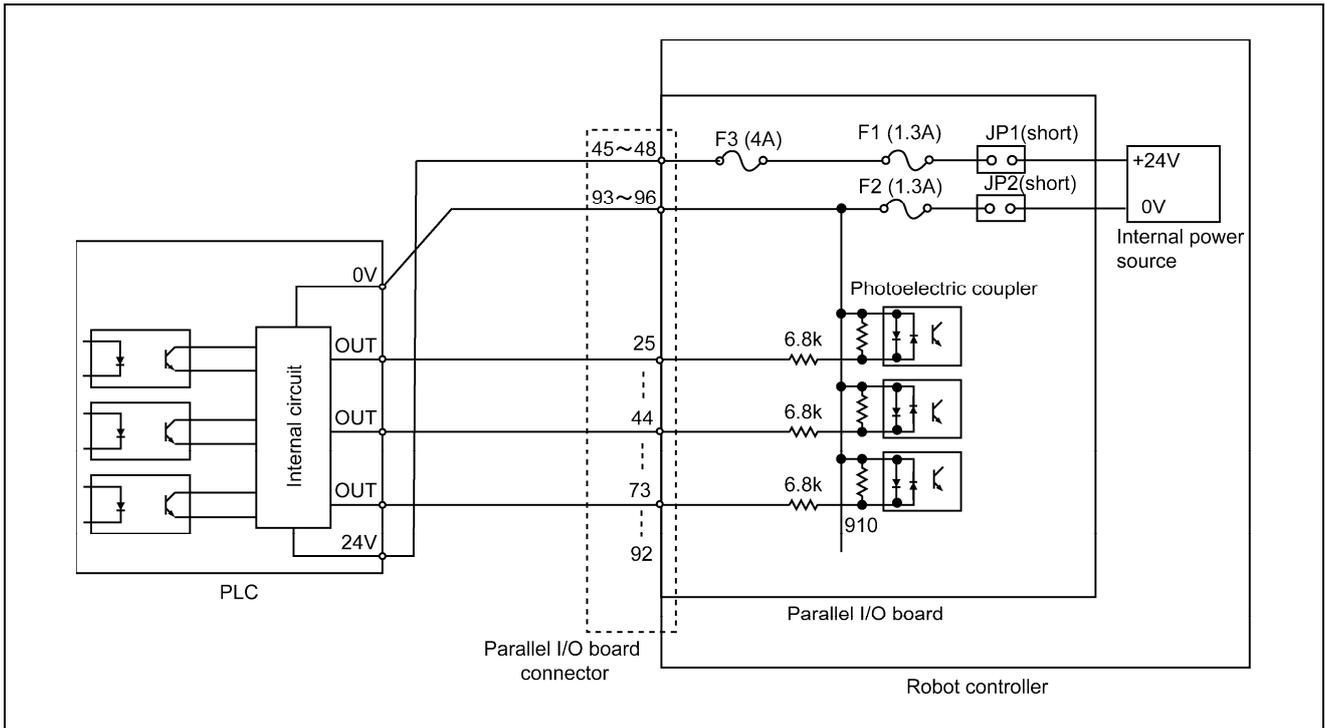


Input circuit when the internal power source is used (NPN)

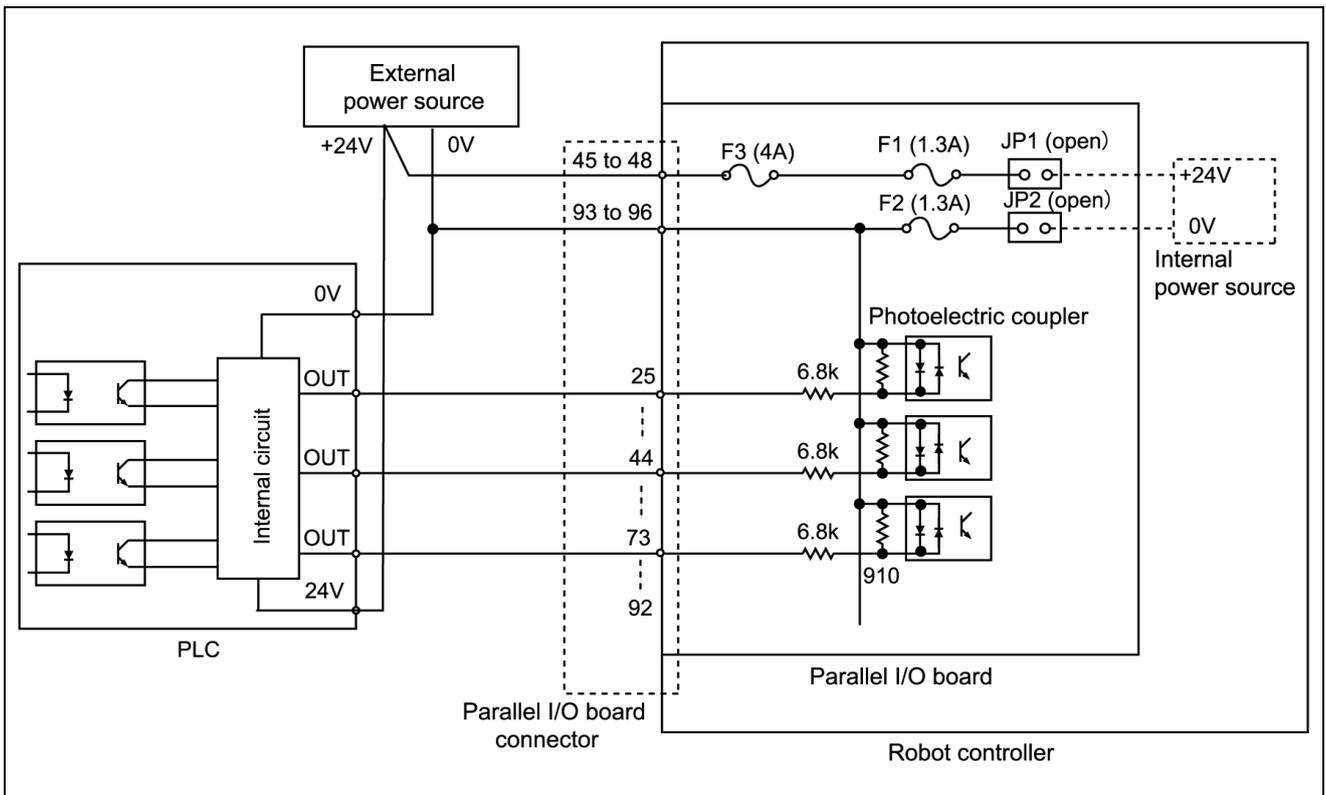


Input circuit when an external power source is used (NPN)

■ PNP-type I/O



Input circuit when the internal power source is used (PNP)



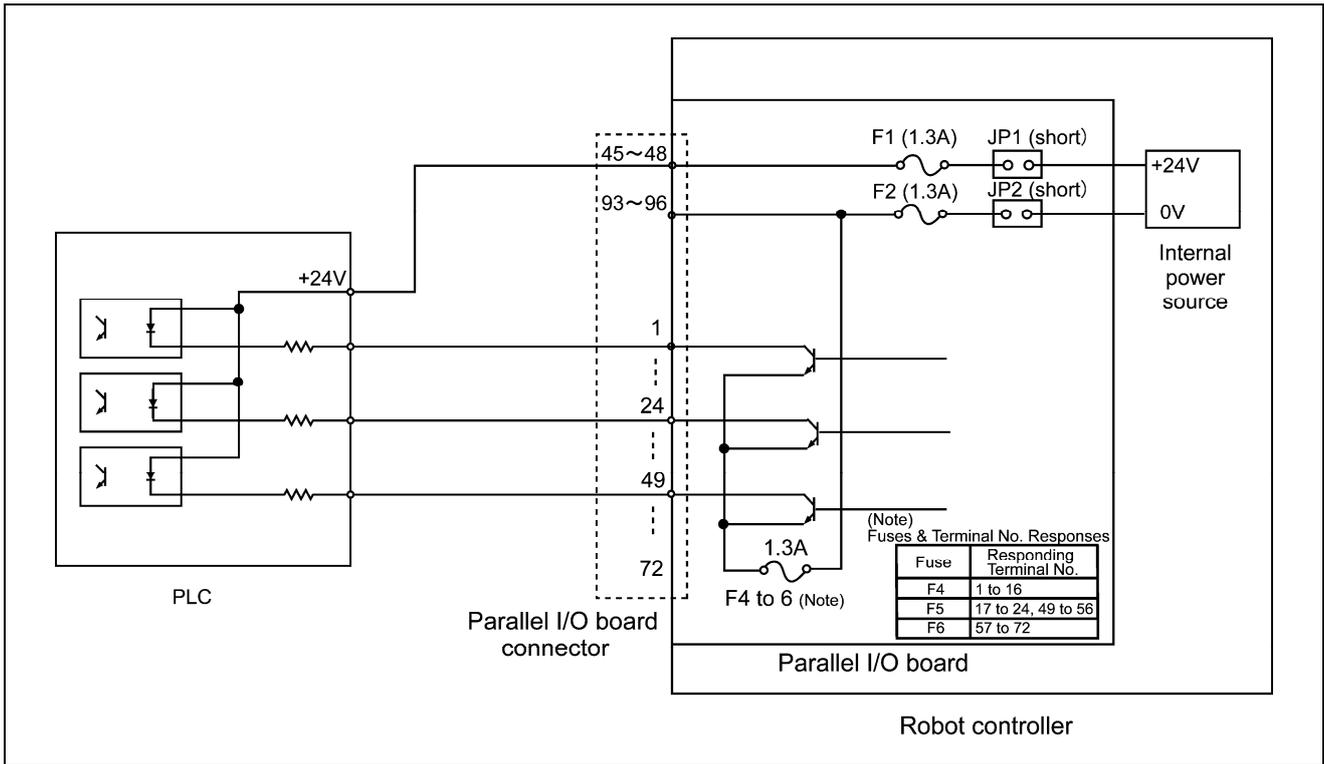
Input circuit when an external power source is used (PNP)

(4) User-Output and System-Output Circuits

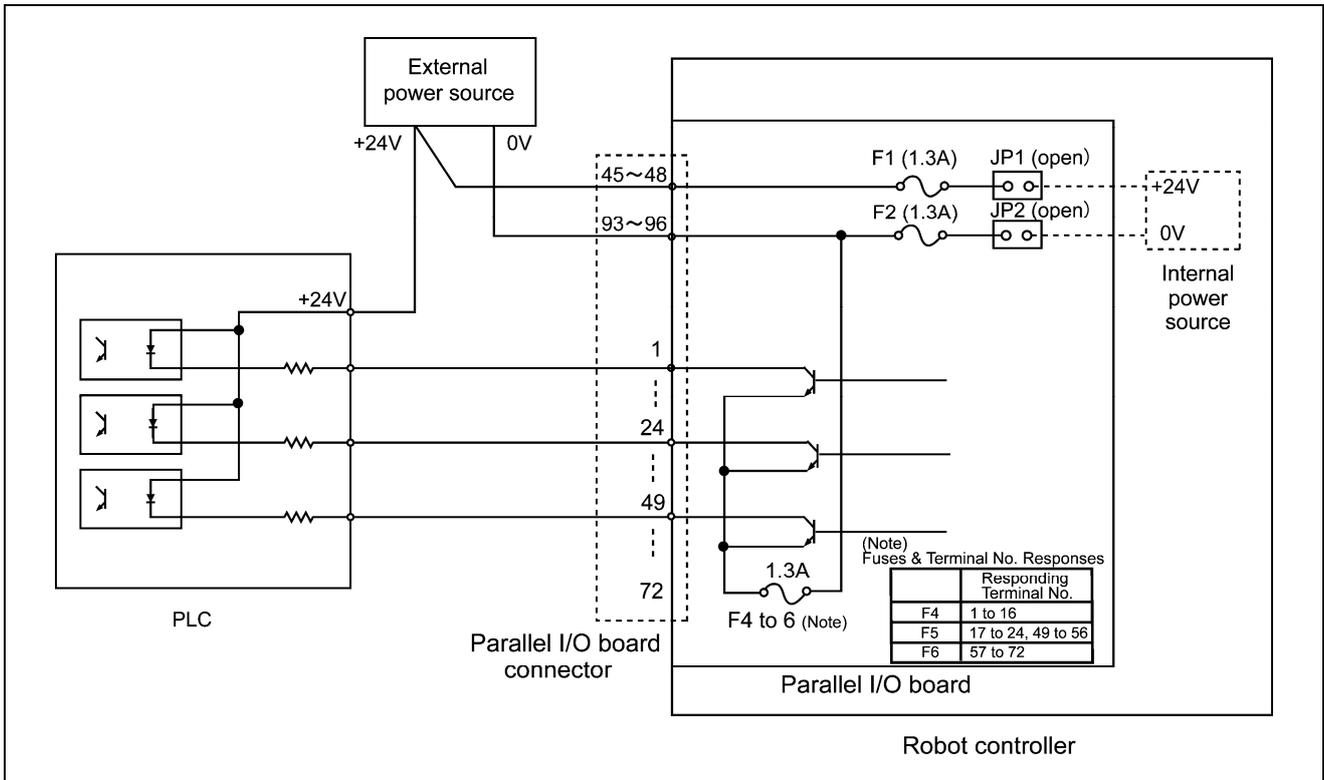
The following two pages show examples of the user-output and system-output circuit configurations and connections of the parallel I/O board.

- Note: (1) The user-output and system-output circuits are open collector output circuits.
- (2) Keep the current consumption of a device to be connected, such as a PLC or a relay coil, below the allowable current level.
- **The maximum allowable sink current is 70 mA. (NPN type)**
 - **The maximum allowable source current is 70 mA. (PNP type)**
- (3) Select an induction load that has a built-in diode (for absorbing inverse electromotive force), such as a relay coil. To use an induction load without a built-in diode, add a diode equivalent to the 1S1888 (Toshiba) in close vicinity to the coil.
- **When externally attaching a diode, connect it with the correct polarity. Incorrect polarity may damage the output circuit.**
- (4) When connecting a lamp, set the rating voltage of the lamp to 1.5W or less so that dark current flows. Since the initial resistance of a lamp is small, rush current that flows when the lamp lights up may damage the output circuit. To reduce the risk of damage from rush current, select a level of resistance so that dark current of a third of the rating current flows when the lamp is off.
- (5) When using the internal power source, prepare a PLC input circuit unit that does not contain a power source.
- **Keep the total current capacity of the internal power source below 1.3A.**
- (6) Use a multi-core shielding cable for the purpose of protecting the devices from external noise.
- (7) +24V output internal power source of the robot controller must not be grounded.
- **Doing so may damage the controller.**

■ NPN-type I/O



Output circuit when the internal power source is used (NPN).



Output circuit when an external power source is used (NPN).

5.3 Allocation of I/O data

For available allocations, see "Combination of I/O Extension Boards and Allocation Mode."

Notes in allocation of I/O data

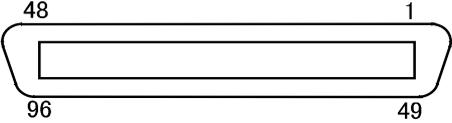
- (1) Port numbers on the parallel I/O board are 3584 to 3623 for input and 3840 to 3887 for output.
- (2) When two parallel I/O boards are mounted, port numbers on the 2nd board are 3624 to 3663 for input and 3888 to 3935 for output. The area is assigned all user signals. The connector pin assignment is the same as for the 1st board except the port numbers. (Refer to Section 5.3.1.)
- (3) For the system I/O signals, refer to Chapter 15 "System I/O Signals in Standard Mode" and Chapter 16 "System I/O Signals in Compatible Mode."

5.3.1 Mini I/O Dedicated or All User I/O Allocation

View from the cable side

Terminal No.	Signal name	Port No.	Direction	Terminal No.	Signal name	Port No.	Direction
1	User output	3840	out	49	User output	3864	out
2		3841	out	50		3865	out
3		3842	out	51		3866	out
4		3843	out	52		3867	out
5		3844	out	53		3868	out
6		3845	out	54		3869	out
7		3846	out	55		3870	out
8		3847	out	56		3871	out
9		3848	out	57		3872	out
10		3849	out	58		3873	out
11		3850	out	59		3874	out
12		3851	out	60		3875	out
13		3852	out	61		3876	out
14		3853	out	62		3877	out
15		3854	out	63		3878	out
16		3855	out	64		3879	out
17		3856	out	65		3880	out
18		3857	out	66		3881	out
19		3858	out	67		3882	out
20		3859	out	68		3883	out
21		3860	out	69		3884	out
22		3861	out	70		3885	out
23		3862	out	71		3886	out
24		3863	out	72		3887	out
25	User input	3584	in	73	User input	3604	in
26		3585	in	74		3605	in
27		3586	in	75		3606	in
28		3587	in	76		3607	in
29		3588	in	77		3608	in
30		3589	in	78		3609	in
31		3590	in	79		3610	in
32		3591	in	80		3611	in
33		3592	in	81		3612	in
34		3593	in	82		3613	in
35		3594	in	83		3614	in
36		3595	in	84		3615	in
37		3596	in	85		3616	in
38		3597	in	86		3617	in
39		3598	in	87		3618	in
40		3599	in	88		3619	in
41		3600	in	89		3620	in
42		3601	in	90		3621	in
43		3602	in	91		3622	in
44		3603	in	92		3623	in
45	Power +24V DC			93	Power 0V		
46	Power +24V DC			94	Power 0V		
47	Power +24V DC			95	Power 0V		
48	Power +24V DC			96	Power 0V		

5.3.2 Standard Mode

							
View from the cable side							
Terminal No.	Signal name	Port No.	Direction	Terminal No.	Signal name	Port No.	Direction
1	--	3840	out	49	Status 08	3864	out
2	Robot running	3841	out	50	Status 09	3865	out
3	Robot error	3842	out	51	Status 10	3866	out
4	Servo ON	3843	out	52	Status 11	3867	out
5	Robot initialization completed	3844	out	53	Status 12	3868	out
6	Auto mode	3845	out	54	Status 13	3869	out
7	External mode	3846	out	55	Status 14	3870	out
8	Battery warning	3847	out	56	Status 15	3871	out
9	Robot warning	3848	out	57	User output	3872	out
10	Continue permitted	3849	out	58		3873	out
11	SS mode	3850	out	59		3874	out
12	--	3851	out	60		3875	out
13	--	3852	out	61		3876	out
14	--	3853	out	62		3877	out
15	Command processing completed	3854	out	63		3878	out
16	Status parity	3855	out	64		3879	out
17	Status 00	3856	out	65		3880	out
18	Status 01	3857	out	66		3881	out
19	Status 02	3858	out	67		3882	out
20	Status 03	3859	out	68		3883	out
21	Status 04	3860	out	69		3884	out
22	Status 05	3861	out	70		3885	out
23	Status 06	3862	out	71	3886	out	
24	Status 07	3863	out	72	3887	out	
25	All step stop	3584	in	73	Bit 6 in data area 2	3604	in
26	--	3585	in	74	Bit 7 in data area 2	3605	in
27	All halt	3586	in	75	Bit 8 in data area 2	3606	in
28	Strobe signal	3587	in	76	Bit 9 in data area 2	3607	in
29	Skip interrupt	3588	in	77	Bit 10 in data area 2	3608	in
30	Odd parity	3589	in	78	Bit 11 in data area 2	3609	in
31	Bit 0 in data area 1	3590	in	79	Bit 12 in data area 2	3610	in
32	Bit 1 in data area 1	3591	in	80	Bit 13 in data area 2	3611	in
33	Bit 2 in data area 1	3592	in	81	Bit 14 in data area 2	3612	in
34	Bit 3 in data area 1	3593	in	82	Bit 15 in data area 2	3613	in
35	Bit 4 in data area 1	3594	in	83	Bit 0 in command area	3614	in
36	Bit 5 in data area 1	3595	in	84	Bit 1 in command area	3615	in
37	Bit 6 in data area 1	3596	in	85	Bit 2 in command area	3616	in
38	Bit 7 in data area 1	3597	in	86	Bit 3 in command area	3617	in
39	Bit 0 in data area 2	3598	in	87	User input	3618	in
40	Bit 1 in data area 2	3599	in	88		3619	in
41	Bit 2 in data area 2	3600	in	89		3620	in
42	Bit 3 in data area 2	3601	in	90		3621	in
43	Bit 4 in data area 2	3602	in	91		3622	in
44	Bit 5 in data area 2	3603	in	92		3623	in
45	Power +24V DC			93	Power 0V		
46	Power +24V DC			94	Power 0V		
47	Power +24V DC			95	Power 0V		
48	Power +24V DC			96	Power 0V		

5.3.3 Compatible Mode

View from the cable side

Terminal No.	Signal name	Port No.	Direction	Terminal No.	Signal name	Port No.	Direction
1	--	3840	out	49	Error hundreds bit 0	3864	out
2	Robot running	3841	out	50	Error hundreds bit 1	3865	out
3	Robot error	3842	out	51	Error hundreds bit 2	3866	out
4	Auto mode	3843	out	52	Error hundreds bit 3	3867	out
5	External mode	3844	out	53	SS mode	3868	out
6	Start reset	3845	out	54	--	3869	out
7	--	3846	out	55	--	3870	out
8	--	3847	out	56	--	3871	out
9	Robot power-on completed	3848	out	57	User output	3872	out
10	Servo ON	3849	out	58		3873	out
11	CAL completed	3850	out	59		3874	out
12	Teaching being operated	3851	out	60		3875	out
13	1 cycle completed	3852	out	61		3876	out
14	Battery warning	3853	out	62		3877	out
15	Robot warning	3854	out	63		3878	out
16	Continue permitted	3855	out	64		3879	out
17	Error units bit 0	3856	out	65		3880	out
18	Error units bit 1	3857	out	66		3881	out
19	Error units bit 2	3858	out	67		3882	out
20	Error units bit 3	3859	out	68		3883	out
21	Error tens bit 0	3860	out	69		3884	out
22	Error tens bit 1	3861	out	70		3885	out
23	Error tens bit 2	3862	out	71	3886	out	
24	Error tens bit 3	3863	out	72	3887	out	
25	All step stop	3584	in	73	Failure clear	3604	in
26	Continued start	3585	in	74		3605	in
27	All halt	3586	in	75		3606	in
28	Operation preparation start	3587	in	76		3607	in
29	Skip interrupt	3588	in	77		3608	in
30	Program start	3589	in	78		3609	in
31	Program select 0	3590	in	79		3610	in
32	Program select 1	3591	in	80		3611	in
33	Program select 2	3592	in	81		3612	in
34	Program select 3	3593	in	82		3613	in
35	Program select 4	3594	in	83		3614	in
36	Program select 5	3595	in	84	3615	in	
37	Program select 6	3596	in	85	3616	in	
38	Program odd parity	3597	in	86	3617	in	
39	Motor ON	3598	in	87	3618	in	
40	CAL execution	3599	in	88	3619	in	
41	--	3600	in	89	3620	in	
42	SP100	3601	in	90	3621	in	
43	External mode	3602	in	91	3622	in	
44	Program reset	3603	in	92	3623	in	
45	Power +24V DC			93	Power 0V		
46	Power +24V DC			94	Power 0V		
47	Power +24V DC			95	Power 0V		
48	Power +24V DC			96	Power 0V		

5.3.4 Option

■ Parallel I/O cable

The following parallel I/O cables are optionally provided for connecting parallel I/O boards.

Name	Product Number
Parallel I/O cable (8 m)	410141-3050
Parallel I/O cable (15 m)	410141-3060

Refer to the following list of pin No., pair No., and wire color for wiring.

Pair No.	Pin No.	Wire color	Pair No.	Pin No.	Wire color	Pair No.	Pin No.	Wire color	Pair No.	Pin No.	Wire color	Pair No.	Pin No.	Wire color
1	1	Black	11	11	Black	21	21	Brown	31	31	Orange	41	41	Black
	49	Pink		59	White		69	Gray		79	Violet		89	Green
2	2	Brown	12	12	Brown	22	22	Red	32	32	Yellow	42	42	Brown
	50	Pink		60	White		70	Gray		80	Violet		90	Green
3	3	Red	13	13	Red	23	23	Orange	33	33	Green	43	43	Red
	51	Pink		61	White		71	Gray		81	Violet		91	Green
4	4	Orange	14	14	Orange	24	24	Yellow	34	34	Blue	44	44	Orange
	52	Pink		62	White		72	Gray		82	Violet		92	Green
5	5	Yellow	15	15	Yellow	25	25	Green	35	35	Black	45	45	Yellow
	53	Pink		63	White		73	Gray		83	Blue		93	Green
6	6	Green	16	16	Green	26	26	Blue	36	36	Brown	46	46	Black
	54	Pink		64	White		74	Gray		84	Blue		94	Yellow
7	7	Blue	17	17	Blue	27	27	Violet	37	37	Red	47	47	Brown
	55	Pink		65	White		75	Gray		85	Blue		95	Yellow
8	8	Violet	18	18	Violet	28	28	Black	38	38	Orange	48	48	Red
	56	Pink		66	White		76	Violet		86	Blue		96	Yellow
9	9	Gray	19	19	Gray	29	29	Brown	39	39	Yellow	49	-	Orange
	57	Pink		67	White		77	Violet		87	Blue		-	Yellow
10	10	White	20	20	Black	30	30	Red	40	40	Green	50	-	Black
	58	Pink		68	Gray		78	Violet		88	Blue		-	Orange

<Parallel I/O cable connector types (reference)>

Parts	Manufacturer	Model	Remarks
Connector	Honda Tsushin	PCR-E96FA	Welded type
		PCR-E96FS	Soldered type
Connector cover	Honda Tsushin	PCS-E96LKPA	

Chapter 6 DeviceNet Slave Board

6.1 Overview

Mounting a DeviceNet slave board in the robot controller enables the controller to communicate with external devices according to the DeviceNet-compliant protocol.

As a slave unit for serial communication which is compliant with the open network DeviceNet, the robot controller may easily exchange I/O data with a variety of DeviceNet-compliant control devices of many manufacturers.

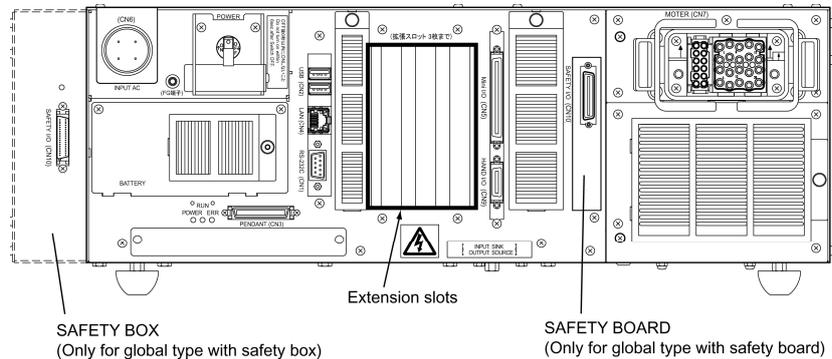
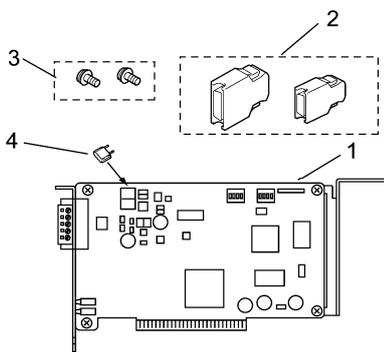
6.1.1 Configuration and Mounting Position

The DeviceNet slave board is configured as shown below.

The DeviceNet slave board can be mounted into any of the extension slots provided in the controller. (Refer to Chapter 14 "Mounting I/O Extension Boards.")

Configuration of DeviceNet Slave Board and Mounting Position

No.	Components	Part Number	Remarks
1	DeviceNet slave board (including Nos. 2 through 4)	410010-3370	Integrated in the controller
		410010-3400	Shipped alone
2	Mini I/O connector kit	410159-0190	For wiring to Mini I/O (CN5) This kit consists of : - Connector (PCR-E68FS) - Connector cover (PCS-E68LPA-1E) (Both of these are manufactured by HONDA TSUSHIN KOGYO CO., LTD.)
	HAND I/O connector kit		410159-0260
3	Screw with washer (2 pieces)	410815-0750	For securing the board (M3x6) (When the board is integrated at the factory, these screws are used in the controller.)
4	Fuse (0.5A)	410054-0260	F1 fuse (LM05)



Note: When turning the controller power ON after this installation, an Error message "220F: I/O device changed" appears. Update the I/O status and configuration settings according to Section 4.6 "Method for Setting I/O Allocation" and then restart the controller.

6.1.2 Features

(1) DeviceNet-compliant

The DeviceNet is an internationally open network developed by Allen-Bradley and is designed to allow control devices (e.g., sensors and actuators) to communicate with each other.

(2) Can be networked with control devices of various manufacturers

The robot controller equipped with DeviceNet slave board can be networked with DeviceNet-compliant control devices of various domestic and foreign manufacturers since the communications specifications are open.

(3) Easy wiring and maintenance

The 5-core special cable and detachable connector of the DeviceNet slave board make it easy to install wiring between nodes (communications units) and disassembly/restructure the network. This will sharply reduce cost in wiring and maintenance, as well as making replacement of units easy at the time of failure.

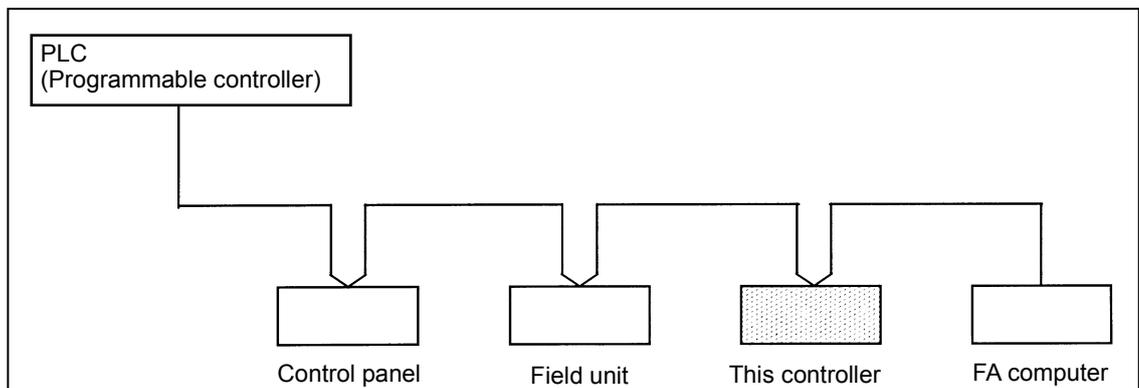
(4) Sufficient number of I/Os

The controller is capable of handling a large quantity of I/O data as listed below. Further, increase or decrease of the number of user-input I/Os is possible in units of 8 points.

Number of I/Os in DeviceNet Area		
Transmission	Standard assignment mode	0 to 224
	Compatible assignment mode	0 to 224
Reception	Standard assignment mode	0 to 216
	Compatible assignment mode	16 to 232

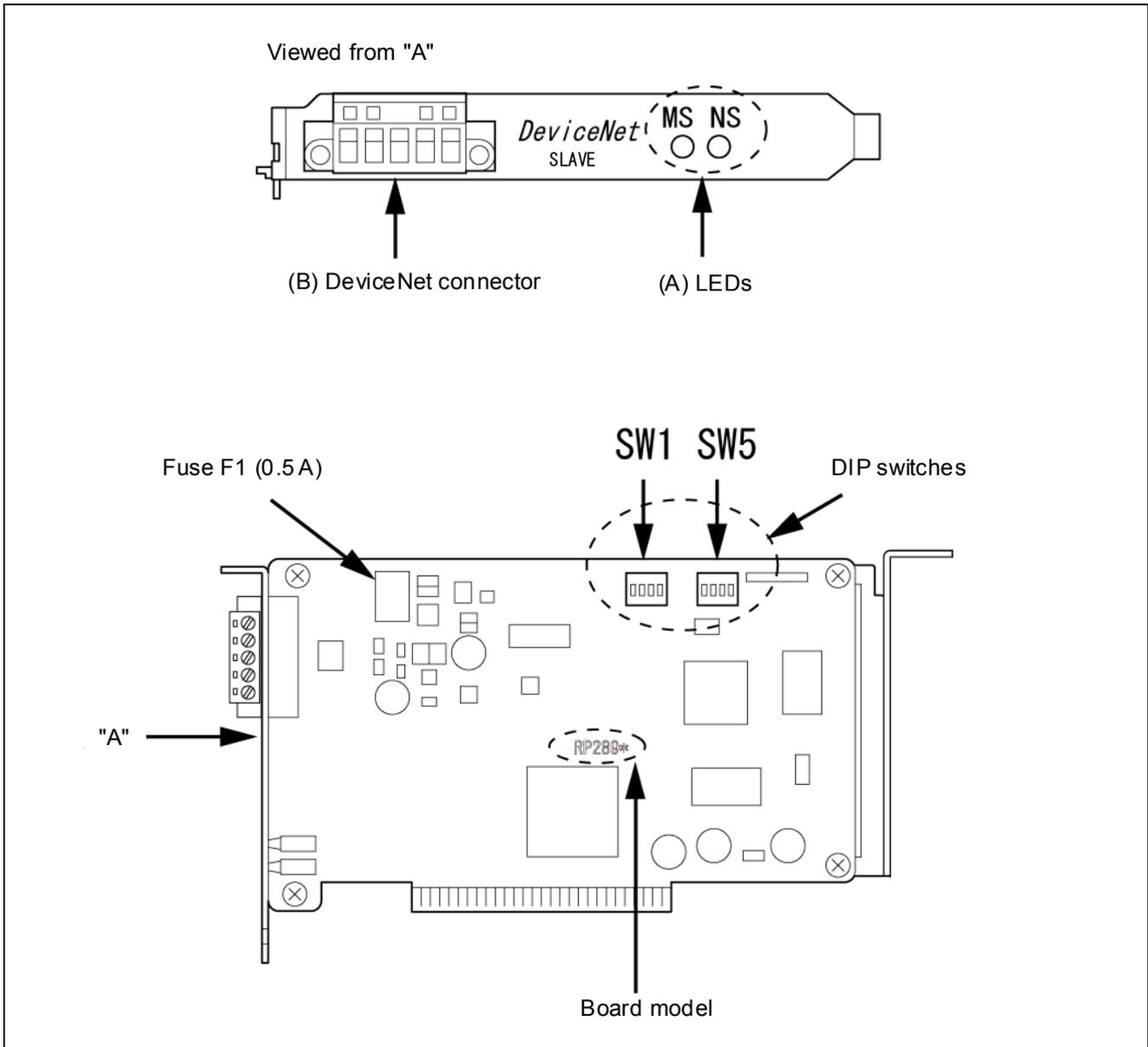
6.1.3 Typical Network

The figure below illustrates a typical network.



6.2 Product Specifications

The figure below shows the location of the LEDs, DIP switches, and DeviceNet connector on the DeviceNet slave board.



DIP Switches

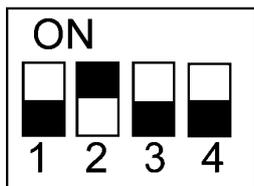
Configuration 1

Board model (with version): RP289D or earlier

Configuration 2

Board model (with version): RP289E or later

SW1



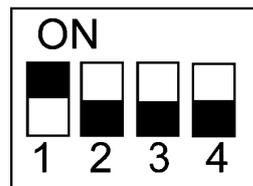
(Only selector 2 placed at the ON position)

SW5



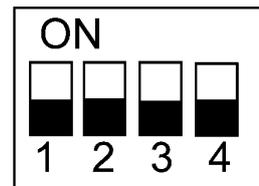
(All selectors placed at the OFF position)

SW1



(Only selector 1 placed at the ON position)

SW5



(All selectors placed at the OFF position)

Note: Never disturb the DIP switches.

If any change is made to their configurations, revert them to the defaults (Configuration 1 or 2 depending upon the board model and version) shown above with the controller power being off.

DeviceNet Slave Board

6.2.1 Names and Functions of Slave Board Components

(A) Status indicator LEDs

The status indicators MS and NS ("A" in the figure given on the previous page) can light or flash in green or red. Each of the ON, flashing, and OFF states of those indicators shows the module or network status as listed below.

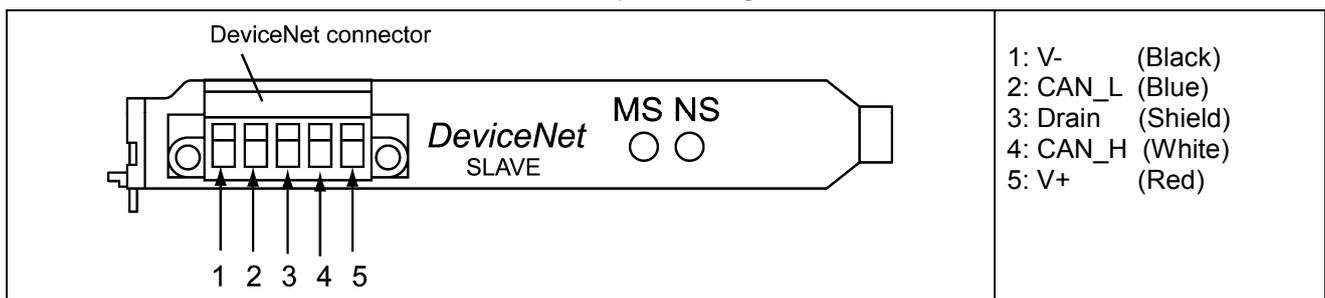
The flashing interval is once per second (0.5 second of ON and 0.5 second of OFF).

LED name	Color	State	Definition	Explanation
MS (Module Status)	Green		Normal state	<ul style="list-style-type: none"> The unit works normally.
	Red		Fatal error	<ul style="list-style-type: none"> Hardware failure.
	–		No power supplied	<ul style="list-style-type: none"> No power is supplied to the DeviceNet module. (Controller power: OFF)
NS (Network Status)	Green		Communications link established	The network is working normally. (The line is connected.)
			Communications link not established	The network is working normally, but the line is not connected yet.
	Red		Fatal communications error	The unit detects any error disabling communication on the network. <ul style="list-style-type: none"> Node address double-assigned. "Bus off" detected.
			Recoverable communications error	Example: I/O time out
	–		Network power supply failure	<ul style="list-style-type: none"> Not connected to the master unit.
 : ON  : Flashing  : OFF				

(B) DeviceNet connector

The robot controller uses an open screw connector whose pin arrangement is shown below.

NOTE: When the controller power (including the network power) is on, do not disconnect/connect the communication connector or touch its pins. Doing so will result in a failure.



DeviceNet Connector

It is recommended that either of the following crimp terminals be used for the communications cable.

No.	Crimp terminal	Tools required
(1)	AI series (Phoenix Contact)	ZA3 (Phoenix Contact)
(2)	TC series (Nichifu) For thin cables: TME TC-0.5 For thick cables: TME TC-2-11 (for power supply) TME TC-1.25-11 (for communication)	NH-32

6.2.2 Setting the Node Address

Set the node address using the teach pendant.

Access: [Top screen]—[F4 I/O]—[F6 Aux.]—[F1 Set H/W]

- (1) Select the "DeviceNet. Node address" on the "I/O Hardware Settings" window, and specify the node address.

Note: When using the [F3 Jump To], type 33.

- (2) Restart the robot controller to make the new settings go into effect.

6.2.3 Setting the Bit Rate

Set the bit rate using the teach pendant.

Access: [Top screen]—[F4 I/O]—[F6 Aux.]—[F1 Set H/W]

- (1) Select the "DeviceNet. Bit Rate (0:125KB, 1:250KB, 2:500KB)" on the "I/O Hardware settings" window, and set the bit rate.

Note: When using the [F3 Jump To], type 34.

- (2) Restart the robot controller to make the new settings go into effect.

6.2.4 General Specifications

The following tables list the controller environmental and communication specifications.

(1) Environmental requirements

Item	Specifications
Operating temperature	0 to 40°C
Operating humidity	90% RH or less (without condensation)

(2) DeviceNet communications specifications

Item	Specifications			
Communications protocol	DeviceNet-compliant			
Connection supported	Master/slave connection : Polling I/O function Compliant with DeviceNet communications rules			
Connection type (Note 1)	Multi-drop type with possible combination of T-branch (to trunk and branch lines)			
Bit rate	500, 250, 125 kbps			
Communications media	Special cable consisting of 5 wires (2 for signals, 2 for power supply and 1 as a shield wire)			
Communications cable length	Bit rate	Max. network length	Branch length	Total branch length
	500 kbps	100 m or less (Note 2)	6 m or less	39 m or less
	250 kbps	250 m or less (Note 2)	6 m or less	78 m or less
	125 kbps	500 m or less (Note 2)	6 m or less	156 m or less
Power supply for communication	External supply of 24 VDC \pm 10%			
Internal power consumption	Communication power source: 65 mA max.			
Max. number of connectable nodes	64 nodes (including configurator (converter) if connected)			
Number of I/Os	Standard assignment mode: 40 points for system input 32 points for system output 0 points to 216 for user input 0 to 224 points for user output The number of I/Os can be set in unit of 8 points. Compatible assignment mode: 24 points for system input 32 points for system output 16 to 232 points for user input 0 to 224 points for user output The number of I/Os can be set in unit of 8 points.			
Error check	CRC			
(Note 1) Terminator resistors are needed at both ends of the trunk line. (121 Ω) (Note 2) These values may apply when a special thick cable is used as a trunk line. If a special fine cable is used, the max. network length is 100 m or less. (Note 3) The polling period for system input signal is 8 ms. The 8 ms or less input signal may not be detected.				

6.2.5 EDS File

The EDS file for the DeviceNet slave board is stored in the WINCAPSIII installation disk (version 3.00 or later) that comes with the robot controller. Use this file when registering the slave with the DeviceNet master.

File path: \Unsupported\Eds\DeviceNet\RC7slave.eds

The content of the EDS file is also shown in "Appendix table: EDS file."

6.3 I/O Allocation Settings

For available allocations, see "Combination of I/O Extension Boards and Allocation Mode."

Note: The port numbers of DeviceNet slave board are 512 to 767 for input ports and 768 to 1023 for outputs port.

6.3.1 Standard Assignment Mode

(1) Input Data

Port No.	Signal name	Port No.	Signal name	Port No.	Signal name	Port No.	Signal name
512	Step Stop (All tasks)	520	Data area 1, bit 0	528	Data area 2, bit 0	536	Data area 2, bit 8
513	–	521	Data area 1, bit 1	529	Data area 2, bit 1	537	Data area 2, bit 9
514	Halt (All tasks)	522	Data area 1, bit 2	530	Data area 2, bit 2	538	Data area 2, bit 10
515	Strobe Signal	523	Data area 1, bit 3	531	Data area 2, bit 3	539	Data area 2, bit 11
516	Interruption Skip	524	Data area 1, bit 4	532	Data area 2, bit 4	540	Data area 2, bit 12
517	–	525	Data area 1, bit 5	533	Data area 2, bit 5	541	Data area 2, bit 13
518	–	526	Data area 1, bit 6	534	Data area 2, bit 6	542	Data area 2, bit 14
519	Command data area odd parity	527	Data area 1, bit 7	535	Data area 2, bit 7	543	Data area 2, bit 15

Port No.	Signal name	Port No.	Signal name			Port No.	Signal name
544	Command area, bit 0	552	INPUT 552			760	INPUT 760
545	Command area, bit 1	553	INPUT 553			761	INPUT 761
546	Command area, bit 2	554	INPUT 554			762	INPUT 762
547	Command area, bit 3	555	INPUT 555			763	INPUT 763
548	–	556	INPUT 556			764	INPUT 764
549	–	557	INPUT 557			765	INPUT 765
550	–	558	INPUT 558			766	INPUT 766
551	–	559	INPUT 559			767	INPUT 767

Note 1: Numerals in the No. column denote the I/O port numbers of the controller.

Note 2: The input data is handled in bytes (8 points). The default is 64 points. Up to 256 points can be used.

(2) Output Data

Port No.	Signal name	Port No.	Signal name	Port No.	Signal name	Port No.	Signal name
768	–	776	Robot Warning	784	Status area, bit 0	792	Status area, bit 8
769	Robot Running	777	Continue Start Permission	785	Status area, bit 1	793	Status area, bit 9
770	Robot Error	778	SS Mode	786	Status area, bit 2	794	Status area, bit 10
771	Servo ON	779	–	787	Status area, bit 3	795	Status area, bit 11
772	Robot Initialized	780	–	788	Status area, bit 4	796	Status area, bit 12
773	Auto Mode	781	–	789	Status area, bit 5	797	Status area, bit 13
774	External Mode	782	Command Processing Completed	790	Status area, bit 6	798	Status area, bit 14
775	Battery Warning	783	Status area, odd parity	791	Status area, bit 7	799	Status area, bit 15

Port No.	Signal name	Port No.	Signal name			Port No.	Signal name
800	OUTPUT 800	808	OUTPUT 808			1016	OUTPUT 1016
801	OUTPUT 801	809	OUTPUT 809			1017	OUTPUT 1017
802	OUTPUT 802	810	OUTPUT 810			1018	OUTPUT 1018
803	OUTPUT 803	811	OUTPUT 811			1019	OUTPUT 1019
804	OUTPUT 804	812	OUTPUT 812			1020	OUTPUT 1020
805	OUTPUT 805	813	OUTPUT 813			1021	OUTPUT 1021
806	OUTPUT 806	814	OUTPUT 814			1022	OUTPUT 1022
807	OUTPUT 807	815	OUTPUT 815			1023	OUTPUT 1023

Note 1: Numerals in the No. column denote the I/O port numbers of the controller.

Note 2: The output data is handled in bytes (8 points). The default is 56 points. Up to 256 points can be used.

6.3.2 Compatible Assignment Mode

(1) Input Data

Port No.	Signal name	Port No.	Signal name	Port No.	Signal name	Port No.	Signal name
512	Step Stop (All tasks)	520	Program No. selection bit 0	528	Motor Power ON	536	INPUT 536
513	Continue Start	521	Program No. selection bit 1	529	CAL Execution	537	INPUT 537
514	Halt (All tasks)	522	Program No. selection bit 2	530	–	538	INPUT 538
515	Operation Preparation Start	523	Program No. selection bit 3	531	SP100	539	INPUT 539
516	Interruption Skip	524	Program No. selection bit 4	532	External Mode Change	540	INPUT 540
517	Program Start	525	Program No. selection bit 5	533	Program Reset	541	INPUT 541
518	–	526	Program No. selection bit 6	534	Clear Robot Error	542	INPUT 542
519	–	527	Program No. selection parity bit	535	–	543	INPUT 543

Port No.	Signal name	Port No.	Signal name			Port No.	Signal name
544	INPUT 544	552	INPUT 552			760	INPUT 760
545	INPUT 545	553	INPUT 553			761	INPUT 761
546	INPUT 546	554	INPUT 554			762	INPUT 762
547	INPUT 547	555	INPUT 555			763	INPUT 763
548	INPUT 548	556	INPUT 556			764	INPUT 764
549	INPUT 549	557	INPUT 557			765	INPUT 765
550	INPUT 550	558	INPUT 558			766	INPUT 766
551	INPUT 551	559	INPUT 559			767	INPUT 767

Note 1: Numerals in the No. column denote the I/O port numbers of the controller.

Note 2: The input data is handled in bytes (8 points). The default value is 64 points. Up to 256 points can be used.

(2) Output Data

Port No.	Signal name	Port No.	Signal name	Port No.	Signal name	Port No.	Signal name
768	–	776	Robot Power ON Completed	784	Error in the units place, bit 0	792	Error in the hundreds place, bit 0
769	Robot Running	777	Servo ON	785	Error in the units place, bit 1	793	Error in the hundreds place, bit 1
770	Robot Error	778	CAL Completed	786	Error in the units place, bit 2	794	Error in the hundreds place, bit 2
771	Auto Mode	779	Teaching ON	787	Error in the units place, bit 3	795	Error in the hundreds place, bit 3
772	External Mode	780	1 Cycle End	788	Error in the tens place, bit 0	796	–
773	Program Start Reset	781	Battery Warning	789	Error in the tens place, bit 1	797	–
774	–	782	Robot Warning	790	Error in the tens place, bit 2	798	–
775	–	783	Continue Start Permission	791	Error in the tens place, bit 3	799	–

Port No.	Signal name	Port No.	Signal name			Port No.	Signal name
800	OUTPUT 800	808	OUTPUT 808			1016	OUTPUT 1016
801	OUTPUT 801	809	OUTPUT 809			1017	OUTPUT 1017
802	OUTPUT 802	810	OUTPUT 810			1018	OUTPUT 1018
803	OUTPUT 803	811	OUTPUT 811			1019	OUTPUT 1019
804	OUTPUT 804	812	OUTPUT 812			1020	OUTPUT 1020
805	OUTPUT 805	813	OUTPUT 813			1021	OUTPUT 1021
806	OUTPUT 806	814	OUTPUT 814			1022	OUTPUT 1022
807	OUTPUT 807	815	OUTPUT 815			1023	OUTPUT 1023

Note 1: Numerals in the No. column denote the I/O port numbers of the controller.

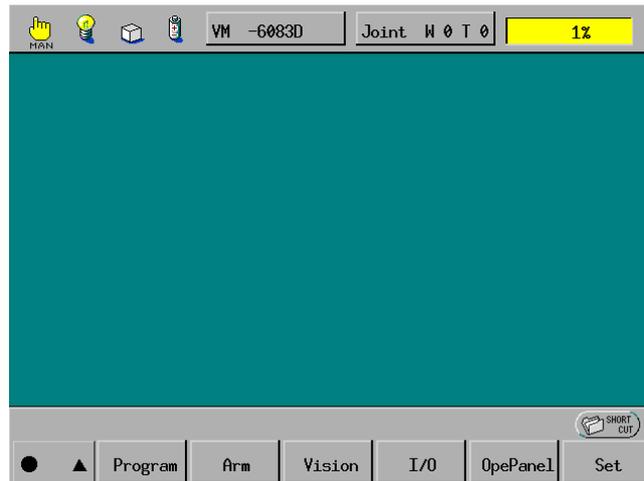
Note 2: The output data is handled in bytes (8 points). The default is 56 points. Up to 256 points can be used.

6.4 Parameter Entry Procedure

6.4.1 Entering the Number of Input/Output Slots

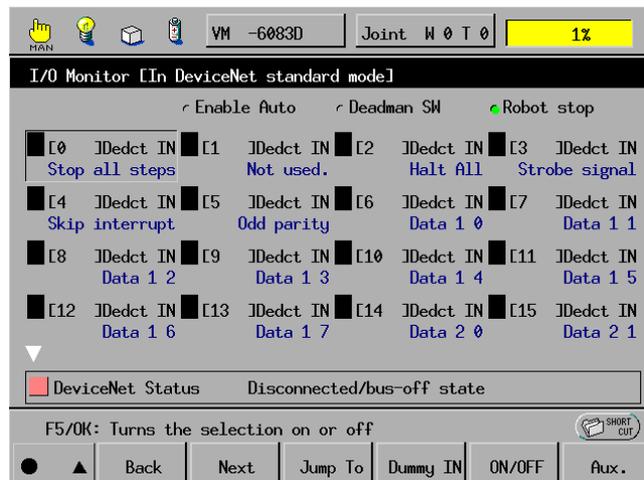
This controller allows you to increase or decrease the number of input/output slots in bytes. The number of input slots can be set in the range from 5 (default: 8) to 32 (max.), and the number of output slots in the range from 4 (default: 7) to 32 (max.). The setting procedure is given below.

Step 1 Press [F4 I/O] on the following screen.



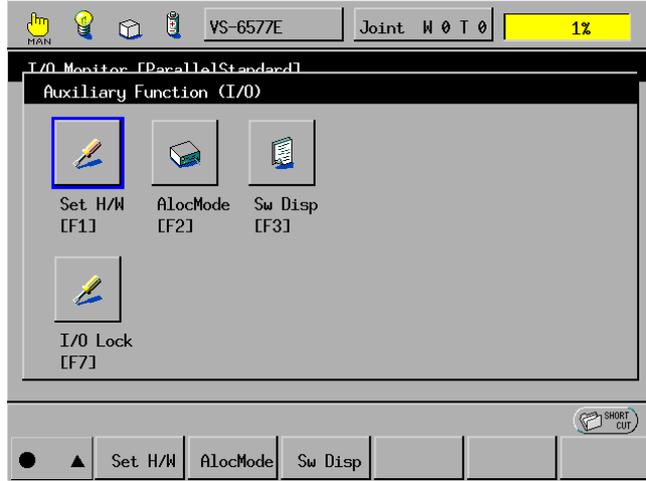
F4

Step 2 Press [F6 Aux.] on the following screen.



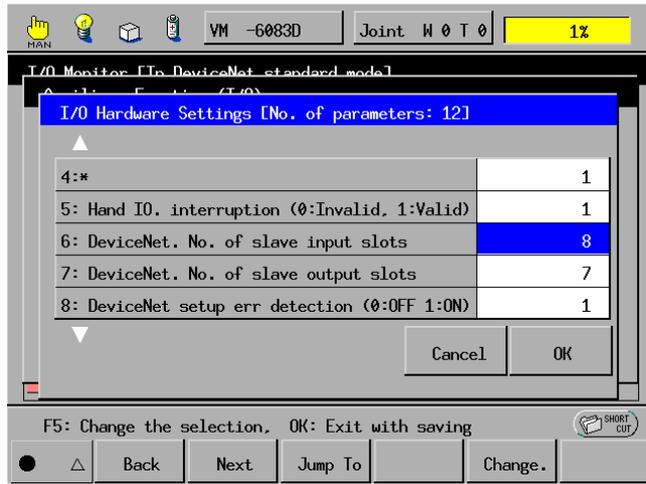
F6

Step 3 Press [F1 Set H/W] on the following screen.



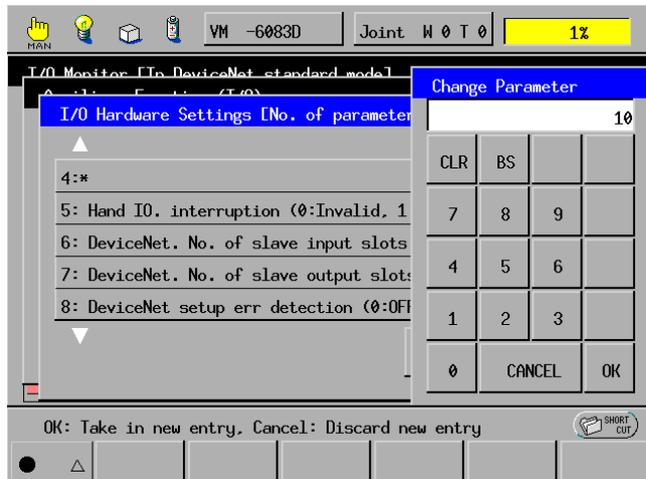
F1

Step 4 Select the box for changing the number of DeviceNet input/output slots and then press [F5 Change].

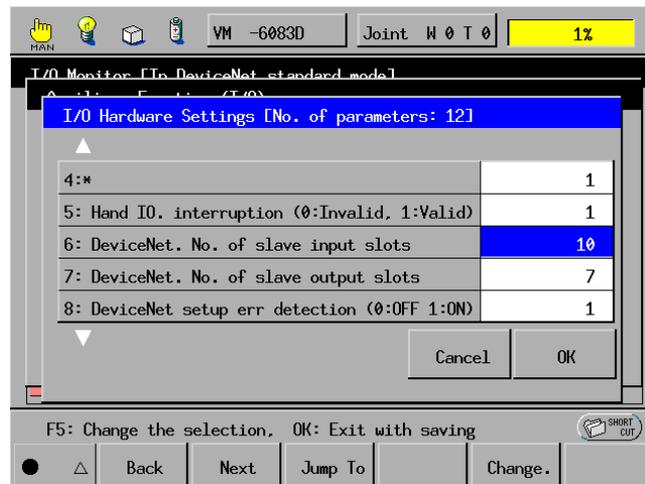


F5

Step 5 Enter a required number of slots on the following screen and press OK. The quick reference table given in the next section [2] will be helpful for you to determine the number of input/output slots.



Step 6 Check that the number has been correctly changed (from 8 to 10 in this example) and press OK.



Step 7 Turn the controller power OFF and then turn it back ON according to the message on the following screen.

NOTE: The internal data that you have changed will not go into effect until you turn the controller power off and on.



6.4.2 Quick Reference Table for the Number of Input/Output Slots

The table below lists the correspondence between the number of input/output slots in DeviceNet and the number of user input/output points.

DeviceNet No. of input slots	Max. number of user input points		DeviceNet No. of output slots	Max. number of user output points	
	In standard assignment mode	In compatible assignment mode		In standard assignment mode	In compatible assignment mode
5	0	16	4	0	0
6	8	24	5	8	8
7	16	32	6	16	16
8	24	40	7	24	24
9	32	48	8	32	32
10	40	56	9	40	40
11	48	64	10	48	48
12	56	72	11	56	56
13	64	80	12	64	64
14	72	88	13	72	72
15	80	96	14	80	80
16	88	104	15	88	88
17	96	112	16	96	96
18	104	120	17	104	104
19	112	128	18	112	112
20	120	136	19	120	120
21	128	144	20	128	128
22	136	152	21	136	136
23	144	160	22	144	144
24	152	168	23	152	152
25	160	176	24	160	160
26	168	184	25	168	168
27	176	192	26	176	176
28	184	200	27	184	184
29	192	208	28	192	192
30	200	216	29	200	200
31	208	224	30	208	208
32	216	232	31	216	216
			32	224	224

6.4.3 Researching the Firmware Version

You can research the firmware version of the DeviceNet board using the teach pendant.

Access: [Top screen]—[F4 I/O] -> [F6 Aux.] -> [F12 FieldBus] -> [F1 Dnet] -> [F1 Status]

Search the "Master software version" on the "DeviceNet State" window.

6.4.4 Function of Resetting "BusOff"

When DeviceNet communication error causes a "Busoff" state, it cannot be recovery even if the error is correct. In this case, use the function of resetting "BusOff" according to following procedures. Even if resetting the "BusOff" of the controller, it cannot be recovery when another node is "BusOff".

Resetting "BusOff" procedures:

- (1) Turn the controller power ON again.
- (2) Turn the network power ON again.
- (3) Use the function of resetting "BusOff" as follows.

Access: [Top screen]—[F4 I/O]—[F7 BUSOFrst]

When pressing [F7 BUSOFrst];

When DeviceNet is not "BusOff" state, "Not Busoff now." appears.

When DeviceNet is "BusOff" state, press [OK] ,and "BusOff"-reset will be executed.

6.5 Field Network Error Indication

This parameter allows you to choose whether a network error will display "every time" it occurs or at the "first time."

This parameter is set to "0" (EveryTime) by default for safe operation of the facilities. Every time an I/O operation is carried out, an error will display if any.

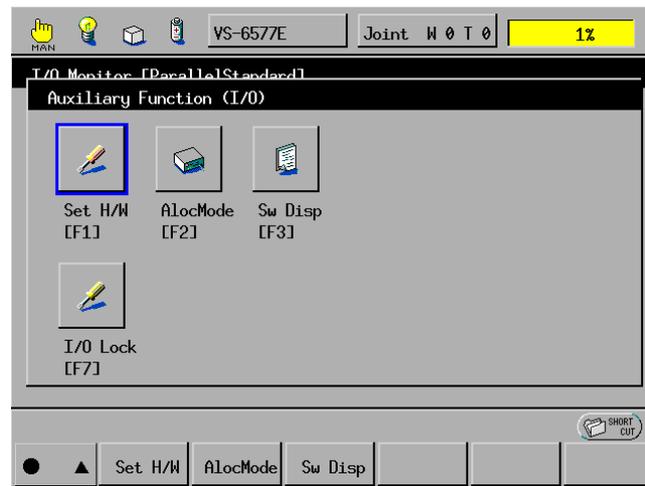
To check program operations using dummy I/Os for setting up facilities where no connection to the network has been established, set this parameter to "1" (First Time). Doing so will not display errors once detected, allowing you to check program operations.

NOTE: After completion of setting-up, be sure to set this parameter back to "0."

■ Changing the FieldNetwork ErrDisplay parameter

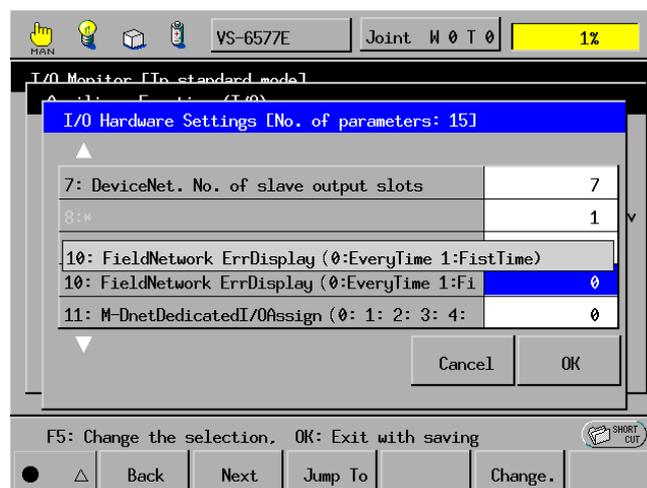
Access: [F4 I/O]—[F6 Aux.]—[F1 Set H/W]

Step 1 Press [F1 Set H/W] in the Auxiliary Function (I/O) window.



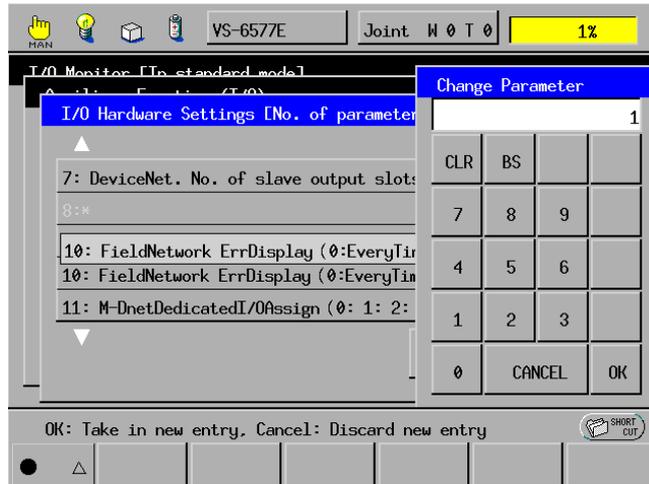
F1

Step 2 Select "10: FieldNetwork ErrDisplay" and press [F5 Change.].

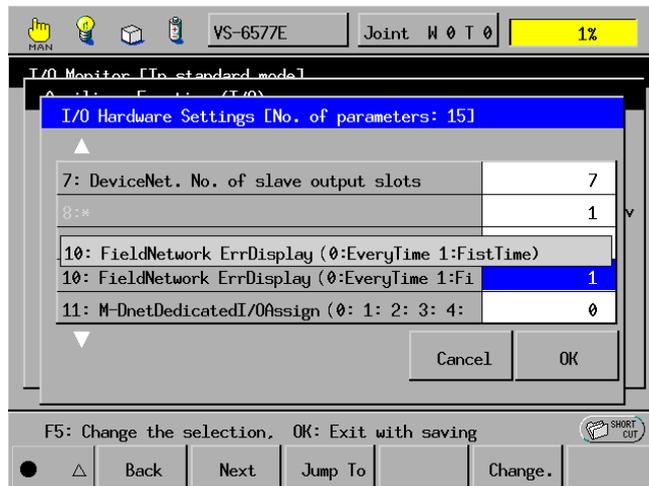


F5

Step 3 Enter "1" in this example and press [OK].



Step 4 Check the newly entered value and press [OK].



Step 5 Following the system message, switch the controller power off and then on.



NOTE: If this message appears, you must switch the controller off.

6.6 Network Error Detector Suppression

If facilities are powered up, the network components will immediately start to establish connections between the master and slaves.

If connected as a slave, the robot controller will start to establish connection with the master (PLC). The time required for the establishment will differ depending upon manufacturers of masters.

If it takes long time to establish connection after the controller is turned on, then the controller system may interpret it as a network error. To prevent such a network error from occurring, it supports the network error detector suppression that suppresses the detector for the specified time after the controller is turned on.

You may set the suppression time length (from 0 to 65535 ms) to the "17: Insensitive time to network error (ms)" parameter in the I/O Hardware Settings window (Access: [F4 I/O]—[F6 Aux.]—[F1 Set H/W]).

The initial value of the parameter is 8000, meaning that no network error will be detected for 8 seconds after completion of controller initialization.

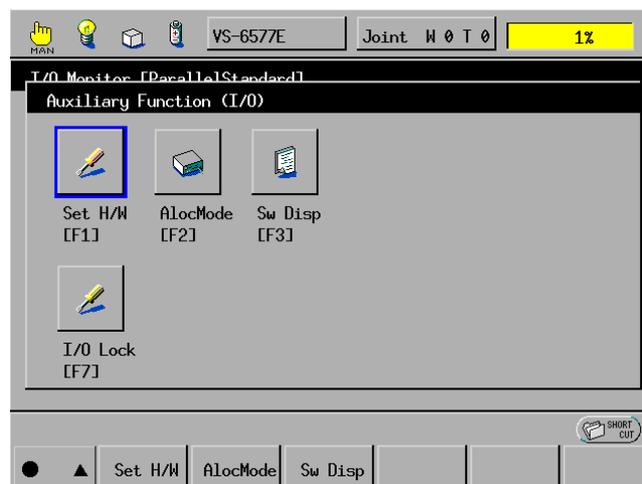
If a network error occurs when the controller is turned on, then it will be detected 8 seconds later.

This parameter takes effect only immediately after the controller is turned on. After that, it does not influence network error detection so that any network error will be detected the moment it occurs.

■ Changing the Network ErrDetection Suppression Time parameter

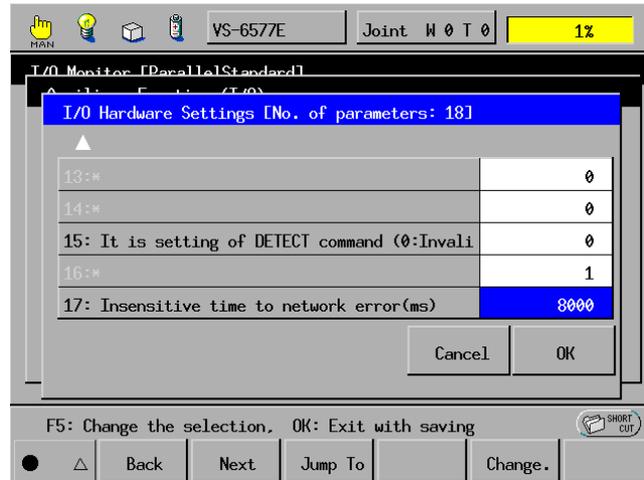
Access: [F4 I/O]—[F6 Aux.]—[F1 Set H/W]

Step 1 Press [F1 Set H/W] in the Auxiliary Function (I/O) window.



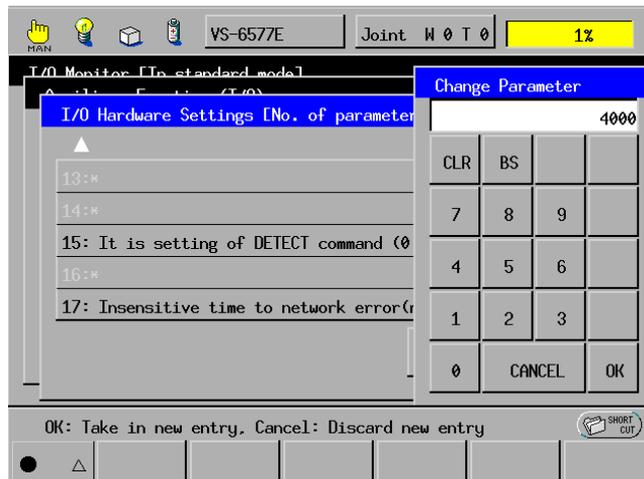
F1

Step 2 Select "17: Insensitive time to network error" and press [F5 Change.].

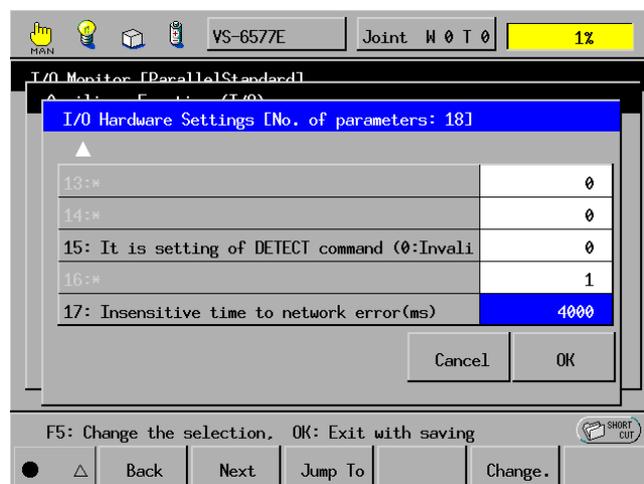


F5

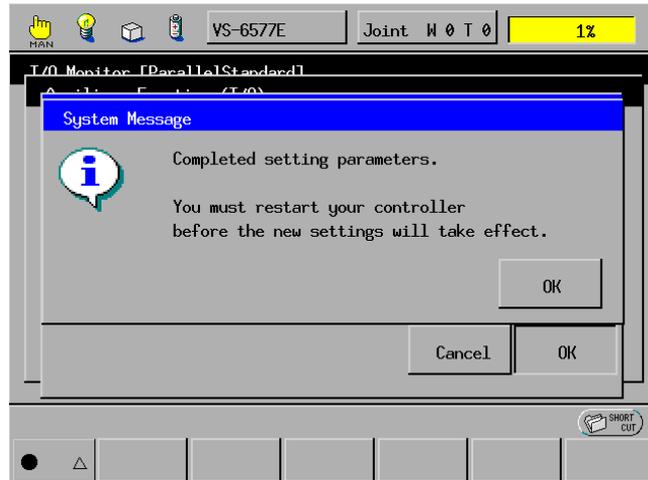
Step 3 Enter "4000" in this example and press [OK].



Step 4 Check the newly entered value and press [OK].



Step 5 Following the system message, switch the controller power off and then on.



NOTE: If this message appears, you must switch the controller off.

6.7 Error Code Table

Here, only the error codes relative to DeviceNet communication errors are described in the table below. For other error codes, refer to the ERROR CODE TABLES, "2 Controller Error Code Table."

DeviceNet Error Code Table

Error code	What has happened:	What to do:	LEDs	
			MS	NS
1201	Preparing for communications (link not established) <ul style="list-style-type: none"> The DeviceNet module is working normally, but has not established link with the master device. 	Establish the link from the master device. If the network connection can be established even after this error that occurred during a power-on sequence, then increase the wait time for network error detection.	 G	 G or  G
1203	Preparing for communications (communications idling) <ul style="list-style-type: none"> The DeviceNet module is working normally, but cannot receive data except empty data from the master device. 	Check the contents of I/O data that the master device sends. If the network connection can be established even after this error that occurred during a power-on sequence, then increase the wait time for network error detection.	 G	 G
1204	Preparing for communications (I/O timeout) <ul style="list-style-type: none"> The DeviceNet module is working normally, but cannot receive data from the master device within the specified time. 	Check that the DeviceNet cable is not broken or its connector is firmly plugged in. Check the DeviceNet cable length and that a terminator resistor is attached to each end of the trunk line. If the network connection can be established even after this error that occurred during a power-on sequence, then increase the wait time for network error detection.	 G	 R
1205	Robot access failure in DPRAM <ul style="list-style-type: none"> The robot cannot access the DPRAM on the DeviceNet board. 	Turn the controller power off and then on, and do the same operation again.	-	-

 : ON

 : Flashing

 : OFF

- : Indefinite

Error code	What has happened:	What to do:	LEDs	
			MS	NS
1246	MACID overlaps • The node address of this node is used by another node.	Change the node address of either node.	-	 R
1247	BusOff condition is detected • Network entered communication disabled state.	Power the controller off and on for restart.	-	 R
1248	No network power supply • No DeviceNet network power is supplied.	Confirm the network power supply line.	 G	●
1249	CAN transmission timeout • Transmission to the CAN chip failed on the DeviceNet master.	Locate and solve the problem occurring on the network. This error can happen when there is no other node in the network and the network is powered on.	 G	●
124A	DeviceNet RAM failure • The DeviceNet's communications software detected a hardware error of RAM.	Power the controller off and on for restart.	 R	●
124D	DeviceNet board access failure in DPRAM • The DeviceNet's communications software cannot access DPRAM.	Power the controller off and on for restart.	 R	●
1219	Parameter information area error • A data error has occurred in the parameter information area on the DeviceNet board.	Power the controller off and on for restart.	 R	●
121A	Robot control area error • A data error has occurred in the Robot Controller's control area on the DeviceNet board.	Power the controller off and on for restart.	 R	●

 : ON

 : Flashing

● : OFF

- : Indefinite

EDS File (Electronic Data Sheet)

```
$ Denso Wave PCI (Master&Slave) Electronic Data Sheet
$
$ *1)
$ Poll Input1 size <- Robot Controller
$ Poll Output1 size <- Robot Controller
$
```

\$ File Description Section

[File]

```
DescText = "Robot Controller PCI EDS File";
CreateDate = 01-23-2004;
CreateTime = 9:00:00;
ModDate = 01-23-2004;
ModTime = 9:00:00;
Revision = 1.1;
```

\$ Device Description Section

[Device]

```
VendCode = 171;          $ Vendor Code
VendName = "DENSO WAVE Inc."; $ Vendor Name
ProdType = 12;          $ Product Type
ProdTypeStr = "Communication Adapter"; $ Product Type String
ProdCode = 20;          $ Product Code
MajRev = 3;             $ Major Rev
MinRev = 1;             $ Minor Rev
ProdName = "PCI Master Slave";
```

\$ I/O Characteristics Section

[IO_Info]

```
Default = 0x0001;      $ Poll Only
PollInfo = 0x0001,    $ Poll Only
1,          $ Default Input = Input1
1;         $ Default Output = Output1
```

\$Input Connections

```
Input1 =          $Input(Producing)
32,          $ *1) By the controller
0,          $ All bits are significant
0x0001,      $ Poll Only Connection
"Input Data", $ Name
6,          $ Path Length
"20 04 24 65 30 03", $ Assembly Object Instance 101
"Robot Input Data"; $ Help
```

\$Output Connections

```
Output1 =          $Output(Consuming)
32,          $ *1) By the controller
0,          $ All bits are significant
0x0001,      $ Poll Only Connection
"Output Data", $ Name
6,          $ Path Length
"20 04 24 64 30 03", $ Assembly Object Instance 100
"Robot Output Data"; $ Help
```

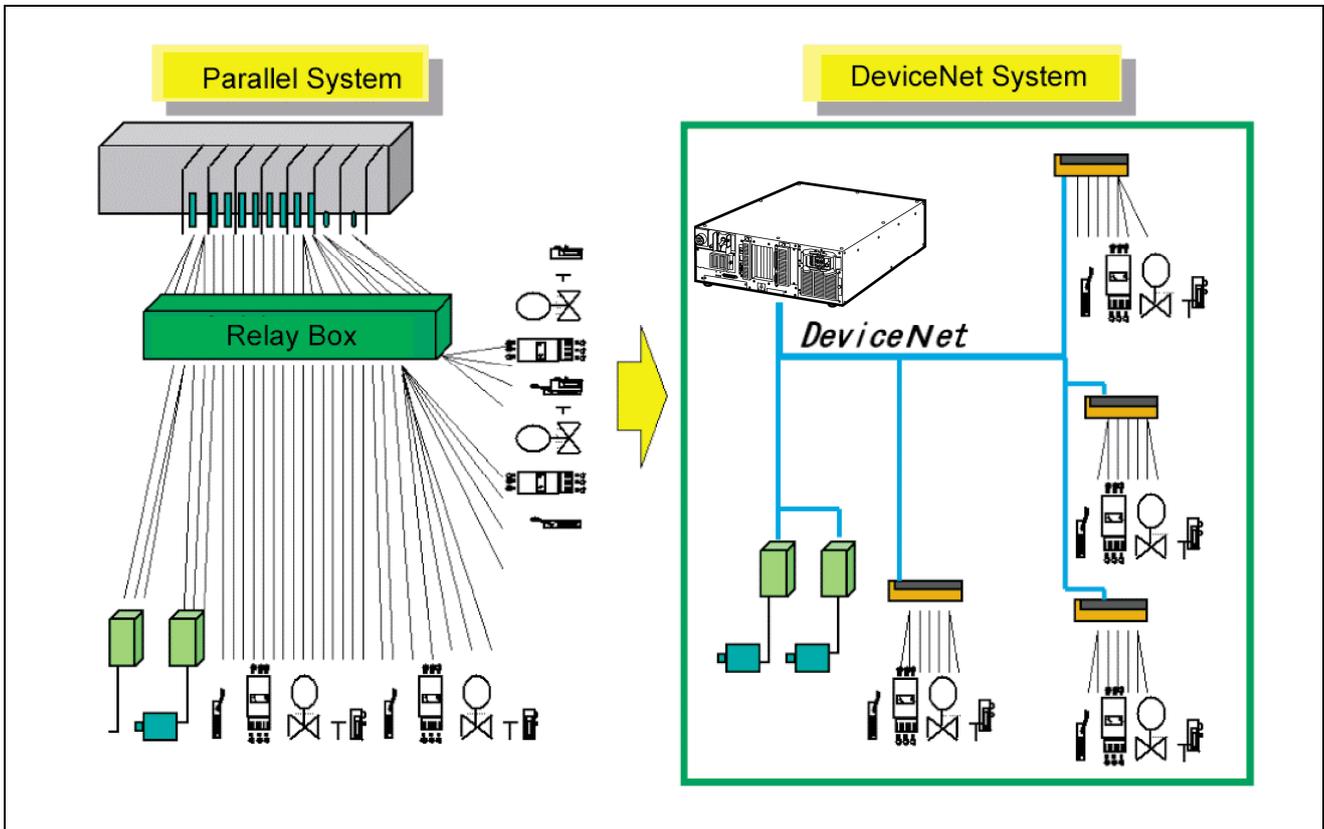
[ParamClass]

```
MaxInst = 0;
Descriptor = 0x00;
CfgAssembly = 0;
```

Chapter 7 DeviceNet Master Board

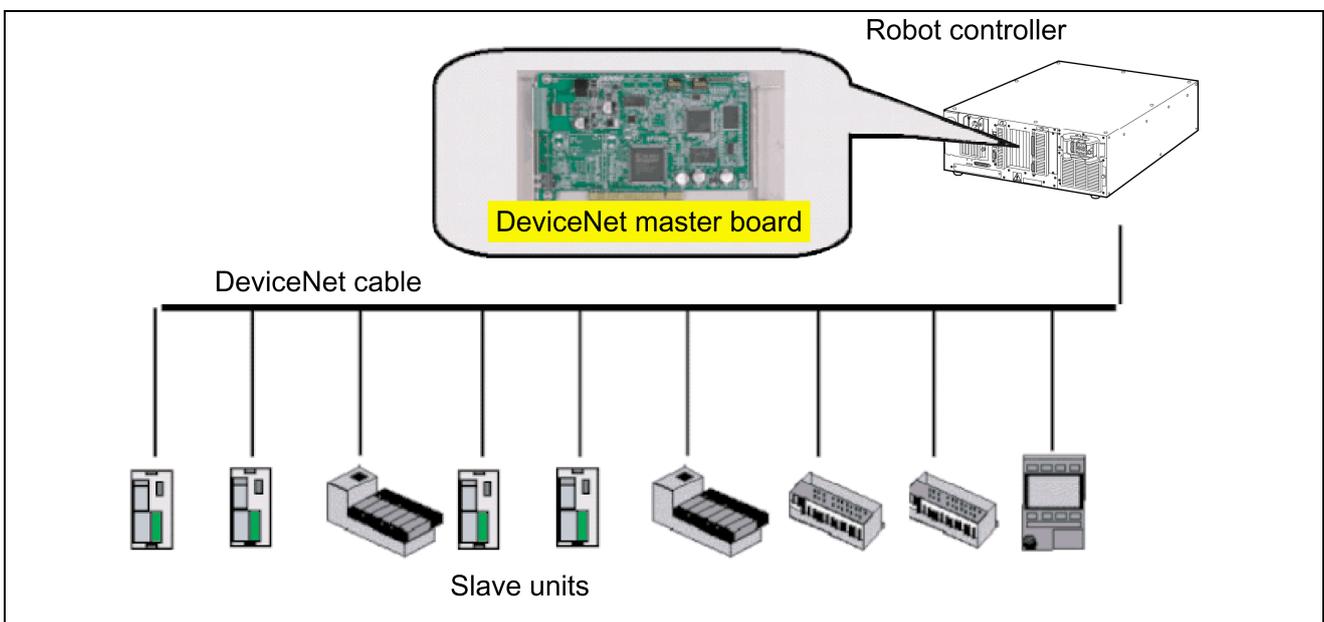
7.1 Overview

DeviceNet is a serial communication system that makes it easy to interconnect control devices such as PLCs, computers, sensors, and actuators. DeviceNet sharply cuts cost in wiring and allows connection of DeviceNet-compliant devices of various manufacturers, enabling cost-effective and convenient system configuration.



DeviceNet System

If the robot controller has a built-in DeviceNet master board and connects with slave units via DeviceNet cables, it can configure a DeviceNet system.



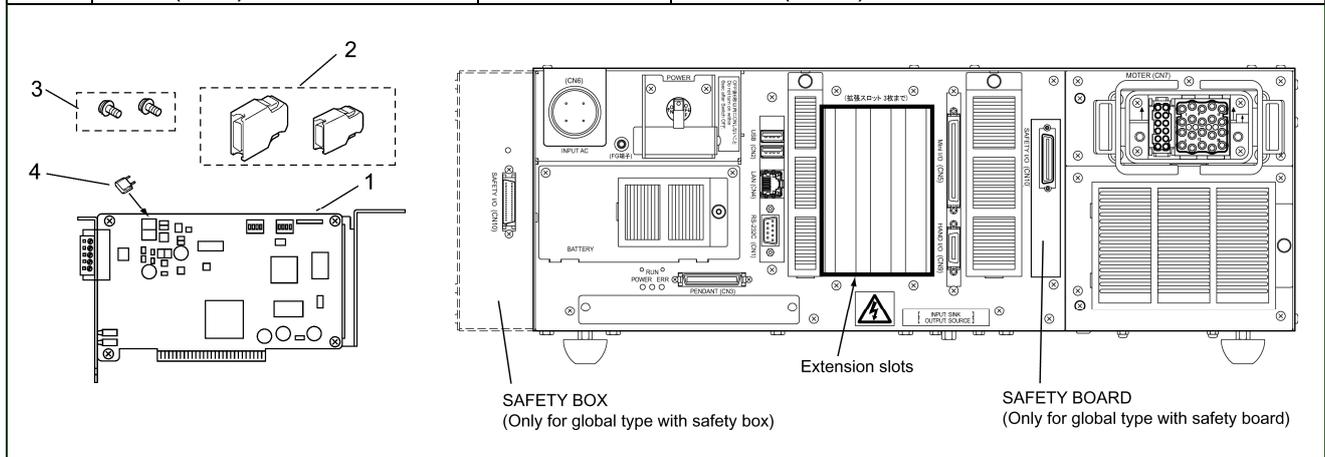
7.1.1 Configuration and Mounting Position

The DeviceNet master board is configured as shown below.

The DeviceNet master board can be mounted into any of the extension slots provided in the controller. (Refer to Chapter 14 "Mounting I/O Extension Boards.")

Configuration of DeviceNet Master Board and Mounting Position

No.	Components	Part Number	Remarks
1	DeviceNet master board (including Nos. 2 through 4)	410010-3380	Integrated in the controller
		410010-3410	Shipped alone
2	Mini I/O connector kit	410159-0190	For wiring to Mini I/O (CN5) This kit consists of : - Connector (PCR-E68FS) - Connector cover (PCS-E68LPA-1E) (Both of these are manufactured by HONDA TSUSHIN KOGYO CO., LTD.)
	HAND I/O connector kit		For wiring to HAND I/O (CN9) This kit consists of: - Connector (PCR-E20FS+) - Connector cover (PCS-E20LA) (Both of these are manufactured by HONDA TSUSHIN KOGYO CO., LTD.)
3	Screw with washer (2 pieces)	410815-0750	For securing the board (M3x6) (When the board is integrated at the factory, these screws are used in the controller.)
4	Fuse (0.5A)	410054-0260	F1 fuse (LM05)



Note: When turning the controller power ON after this installation, an Error message "220F: I/O device changed" appears. Update the I/O status and configuration settings according to Section 4.6 "Method for Setting I/O Allocation" and then restart the controller.

7.1.2 Features

(1) DeviceNet-compliant

The DeviceNet is an internationally open network developed by Allen-Bradley and is designed to allow control devices (e.g., sensors and actuators) to communicate with each other.

(2) Can be networked with control devices of various manufacturers

The robot controller equipped with DeviceNet master board can be networked with DeviceNet-compliant control devices of various domestic and foreign manufacturers since the communications specifications are open.

(3) Easy wiring and maintenance

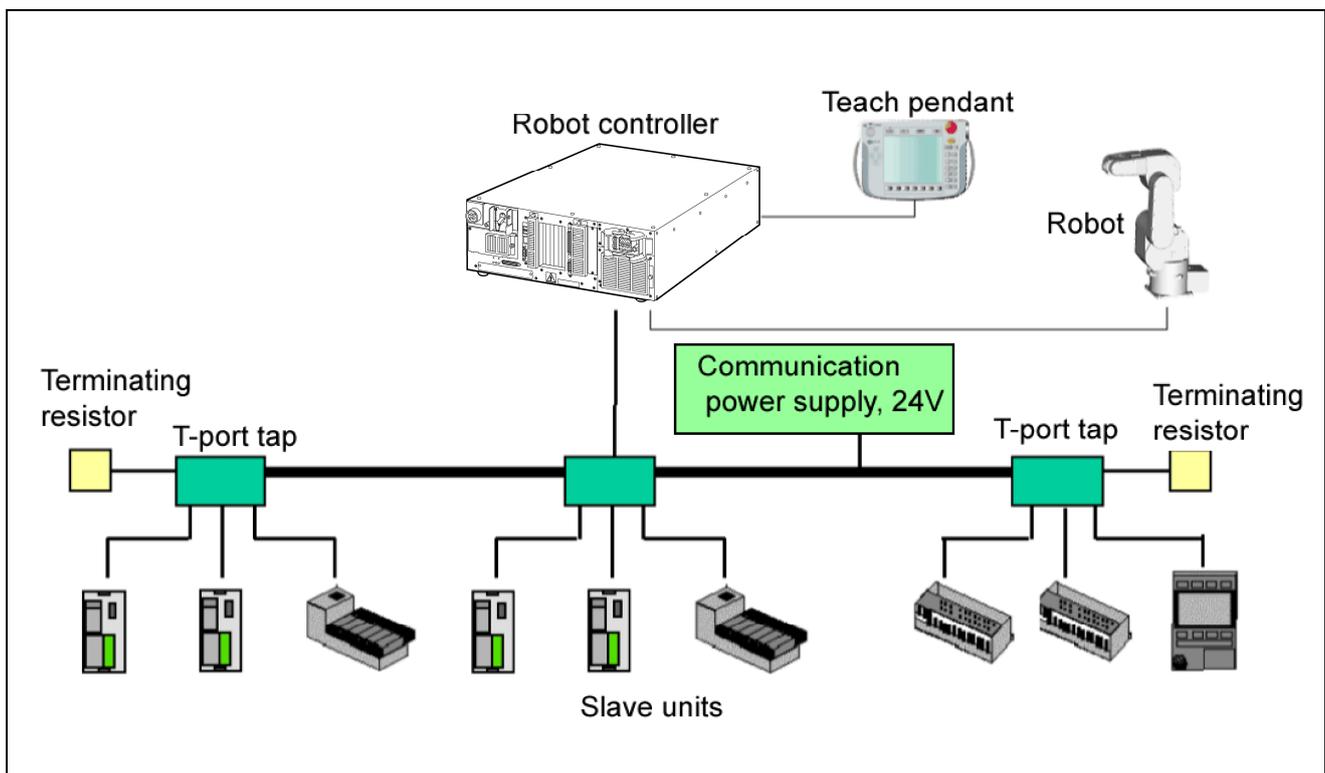
The 5-core special cable and detachable connector of the DeviceNet master board make it easy to install wiring between nodes (communications units) and disassembly/restructure the network. This will sharply reduce cost in wiring and maintenance, as well as making replacement of units easy at the time of failure.

(4) Sufficient number of I/Os

This controller is capable of handling a large volume of transmitted and received data, with up to 1024 input contacts and 1024 output contacts.

With the teach pendant, you may scan the network without using a dedicated configurator so as to easily rearrange connected slave units.

7.1.3 System Configuration Sample



7.1.4 System Construction Procedure

- (1) First, connect the master and slave devices with each other by using DeviceNet cables, referring to the system configuration sample. It is essential to connect terminating resistors. The power supply for communications should not be turned on at this stage.

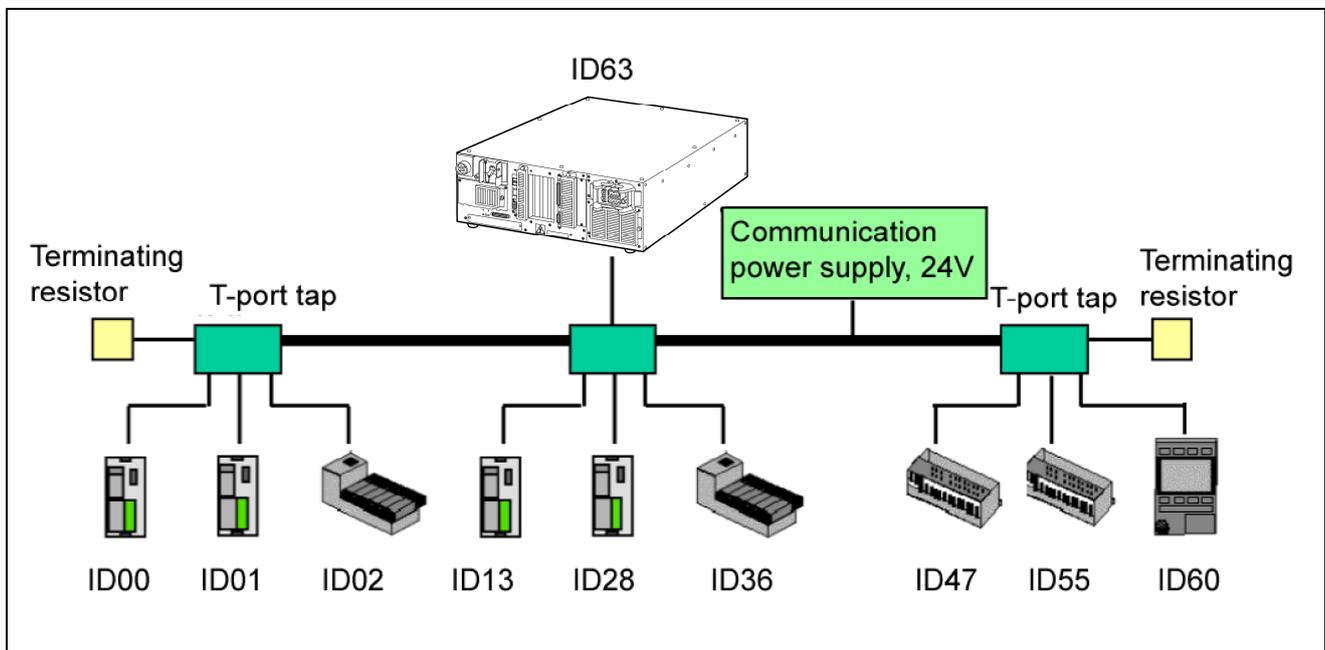
(More details about wiring and system configuration are described in Section 7.2.2 and Section 7.4, respectively.)

- (2) Set the communications speed for master and slave devices. DeviceNet allows selection of 125, 250, or 500 Kbps. For the setting procedure, refer to Section 7.2.3.

Note: Wrong speed setting will make communications impossible.

- (3) Set the addresses of the master and slave devices. In DeviceNet, as shown below, a total of 64 master and slave devices can be connected, and each device must be assigned any of ID addresses ranging from 0 to 63. For the node address setting procedure, refer to "Setting the Node Address".

Note: Take care not to double-assign a same address in the same network.



- (4) After setting up the communications speeds and addresses, connect the communication power supply and then turn on the power of each device. This completes the hardware settings.
- (5) Register the information about the connected slave devices to the master device. This registration information is called "scanlist." According to the scanlist, the master device may control those slave devices.

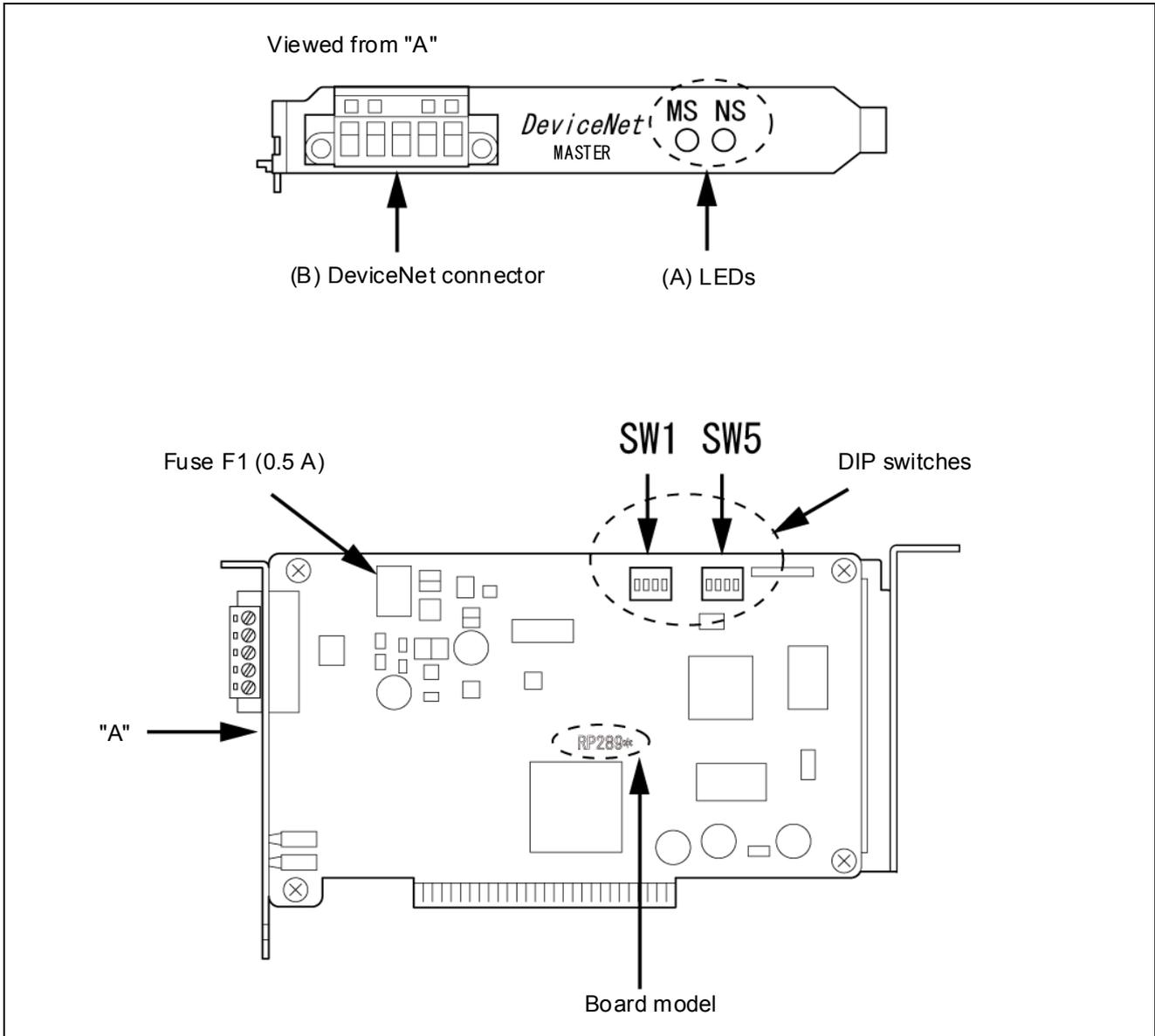
For the procedure on how to create a scanlist, refer to Section 7.4.2.

- (6) The creation of the scanlist will automatically determine I/O addresses for the connected slave devices. Accordingly, the I/O communication between the master and slave devices becomes possible. The input and output areas of the master device from/to slave devices are IO [1024] to [2047] and IO [2048] to [3071], respectively.

(For details about I/O addresses, refer to Section 7.3.)

7.2 Product Specifications

The figure below shows the location of the LEDs, DIP switches, and DeviceNet connector on the DeviceNet master board.



DIP Switches

Configuration 1
Board model (with version): RP289D or earlier

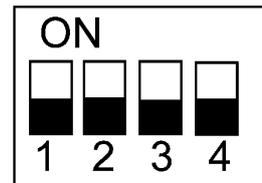
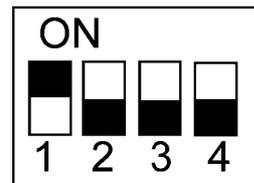
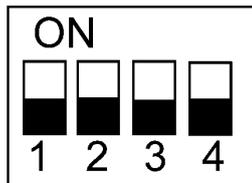
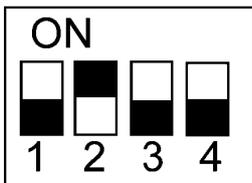
Configuration 2
Board model (with version): RP289E or later

SW1

SW5

SW1

SW5



(Only selector 2 placed at the ON position)

(All selectors placed at the OFF position)

(Only selector 1 placed at the ON position)

(All selectors placed at the OFF position)

Note: Never disturb the DIP switches.

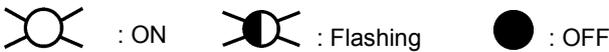
If any change is made to their configurations, revert them to the defaults (Configuration 1 or 2 depending upon the board model and version) shown above with the controller power being off.

7.2.1 Functions of Master Board Components

(A) Status indicator LEDs

The status indicators MS and NS ("A" in the figure given on the previous page) can light or flash in green or red. Each of the ON, flashing, and OFF states of those indicators shows the module or network status as listed below.

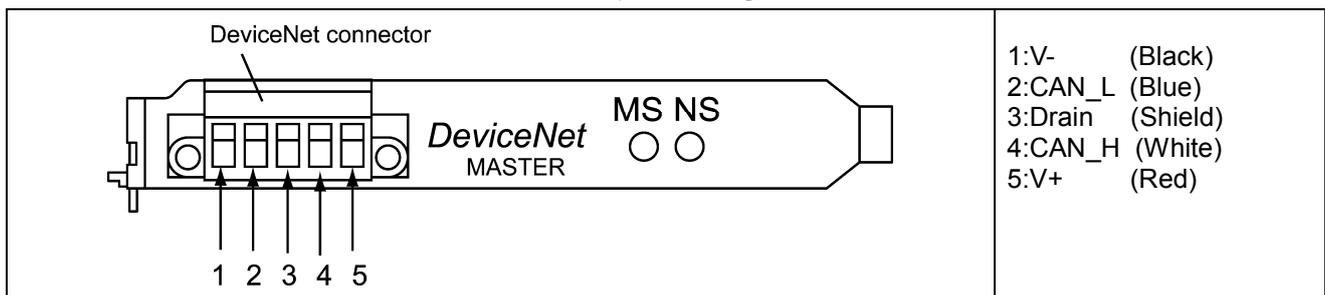
The flashing interval is once per second (0.5 second of ON and 0.5 second of OFF).

LED name	Color	State	Definition	Explanation
MS (Module Status)	Green		Normal state	<ul style="list-style-type: none"> The unit works normally.
	Red		Fatal error	<ul style="list-style-type: none"> Hardware failure.
	–		No power supplied	<ul style="list-style-type: none"> No power is supplied to the DeviceNet module. (Controller power: OFF)
NS (Network Status)	Green		Communications link established	The network is working normally. (The line is connected.)
			Communications link not established	The network is working normally, but the line is not connected yet.
	Red		Fatal communications error	The unit detects any error disabling communication on the network. <ul style="list-style-type: none"> Node address double-assigned. "Bus off" detected.
			Recoverable communications error	Example: I/O time out
	–		Network power supply failure	<ul style="list-style-type: none"> The online status cannot be established, e.g. because a CAN send timeout error has occurred.
				

(B) DeviceNet connector

The robot controller uses an open screw connector whose pin arrangement is shown below.

NOTE: When the controller power (including the network power) is on, do not disconnect/connect the communication connector or touch its pins. Doing so will result in a failure.



DeviceNet Connector

It is recommended that either of the following crimp terminals be used for the communications cable.

No.	Crimp terminal	Tools required
(1)	AI series (Phoenix Contact)	ZA3 (Phoenix Contact)
(2)	TC series (Nichifu) For thin cables: TME TC-0.5 For thick cables: TME TC-2-11 (for power supply) TME TC-1.25-11 (for communication)	NH-32

7.2.2 Setting the Node Address

Set the node address using the teach pendant.

Access: [Top screen]—[F4 I/O]—[F6 Aux.]—[F1 Set H/W]

- (1) Select the "DeviceNet. Node address" on the "I/O Hardware Settings" window, and specify the node address.

Note: When using the [F3 Jump To], type 33.

- (2) Restart the robot controller to make the new settings go into effect.

7.2.3 Setting the Bit Rate

Set the bit rate using the teach pendant.

Access: [Top screen]—[F4 I/O]—[F6 Aux.]—[F1 Set H/W]

- (1) Select the "DeviceNet. Bit Rate (0:125KB, 1:250KB, 2:500KB)" on the "I/O Hardware settings" window, and set the bit rate.

Note: When using the [F3 Jump To], type 34.

- (2) Restart the robot controller to make the new settings go into effect.

7.2.4 General Specifications

(1) Environmental requirements

Item	Specifications
Operating temperature	0 to 40°C
Operating humidity	90% RH or less (without condensation)

(2) DeviceNet communications specifications

Item	Specifications			
Communications protocol	DeviceNet-compliant			
Connection supported	- Polling I/O function - Bit strobe function Compliant with DeviceNet communication rules			
Connection type (Note 1)	Multi-drop type with possible combination of T-branch (to trunk and branch lines)			
Bit rate	500, 250, 125 kbps (selectable by switch)			
Communications media	Special cable consisting of 5 wires (2 for signals, 2 for power supply, and 1 as a shield wire)			
Communications cable length	Bit rate	Max. network length	Branch length	Total branch length
	500 kbps	100 m or less (Note 2)	6 m or less	39 m or less
	250 kbps	250 m or less (Note 2)	6 m or less	78 m or less
	125 kbps	500 m or less (Note 2)	6 m or less	156 m or less
Power supply for communication	External supply of 24 VDC $\pm 10\%$			
Internal power consumption	Communication power source: 65 mA max.			
Max. number of connectable nodes	64			
Number of I/Os	- Input 1024 points - Output 1024 points			
Error check	CRC			
(Note 1) Terminator resistors are needed at both ends of the trunk cable. (121 Ω)				
(Note 2) These values may apply when a special thick cable is used as a trunk line. If a special fine cable is used, the max. network length is 100 m or less.				
(Note 3) The polling period for system input signal is 8 ms. The 8 ms or less input signal may not be detected.				

7.3 I/O Allocation Settings

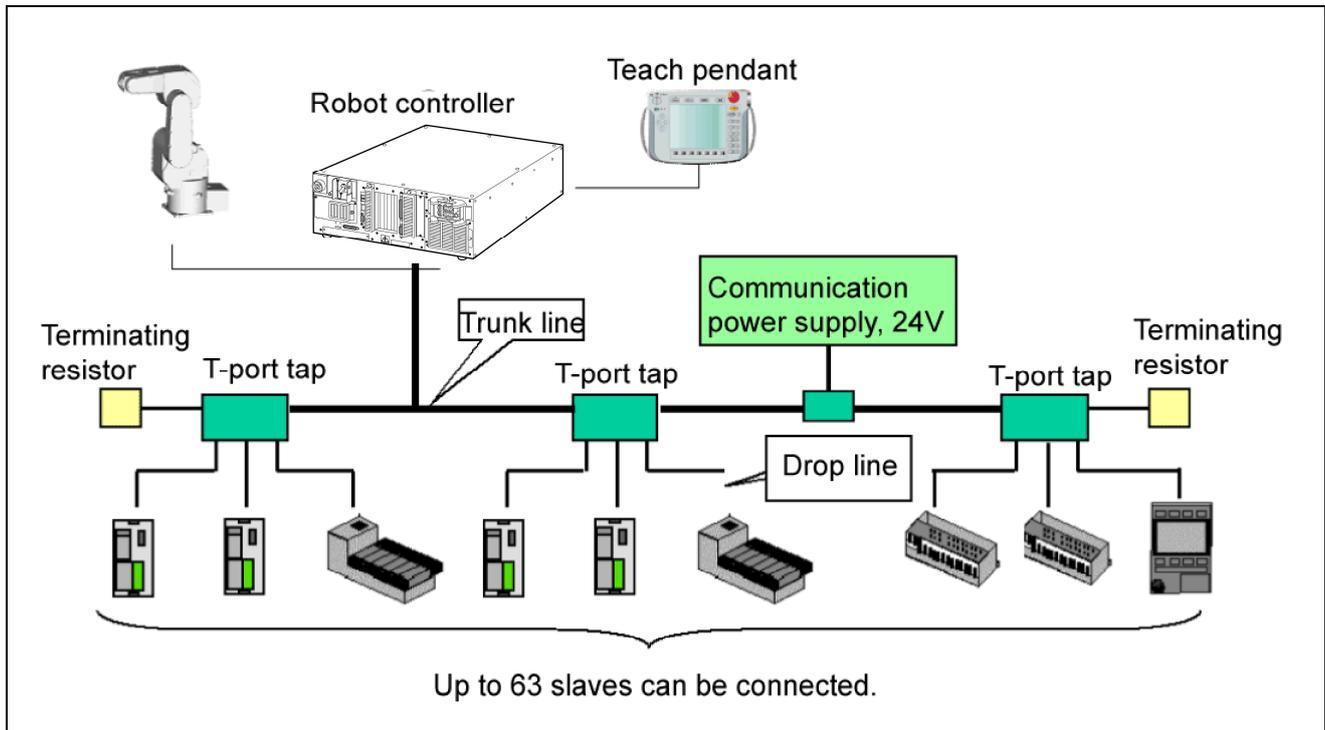
For available allocations, see "Combination of I/O Extension Boards and Allocation Mode."

Refer to Section 4.5 "Mini I/O Functions" for the allocation to the Mini I/O area.

The port numbers of DeviceNet master board are 1024 to 2047 for input ports and 2048 to 3071 for outputs port. The port numbers from 512 to 1023 are unusable.

7.4 Building Up a DeviceNet Network

7.4.1 Network Configuration Sample and Configurators



Nodes

A DeviceNet network has two kinds of nodes: slaves to which external I/Os are connected, and a master that controls these slaves. Note that their addresses are just network settings, so the master and slaves can be freely arranged on physical sites.

Trunk lines and drop lines

The trunk line is a cable whose both ends are terminated with resistors.

A drop line is a cable that branches off the trunk line.

The trunk line and drop lines can be constructed using DeviceNet thick cables, DeviceNet thin cables, or both.

Thick cables are used for long-distance trunk lines, strong trunk lines, and drop lines.

Thin cables are used for trunk lines and drop lines, and for easy termination processing.

Terminating resistors

Terminating resistors must be connected at both ends of the trunk line in a DeviceNet system. The specifications of the terminating resistors are listed below.

- 121 Ω
- Metal film resistor with resistance error of less than 1%
- 1/4 W

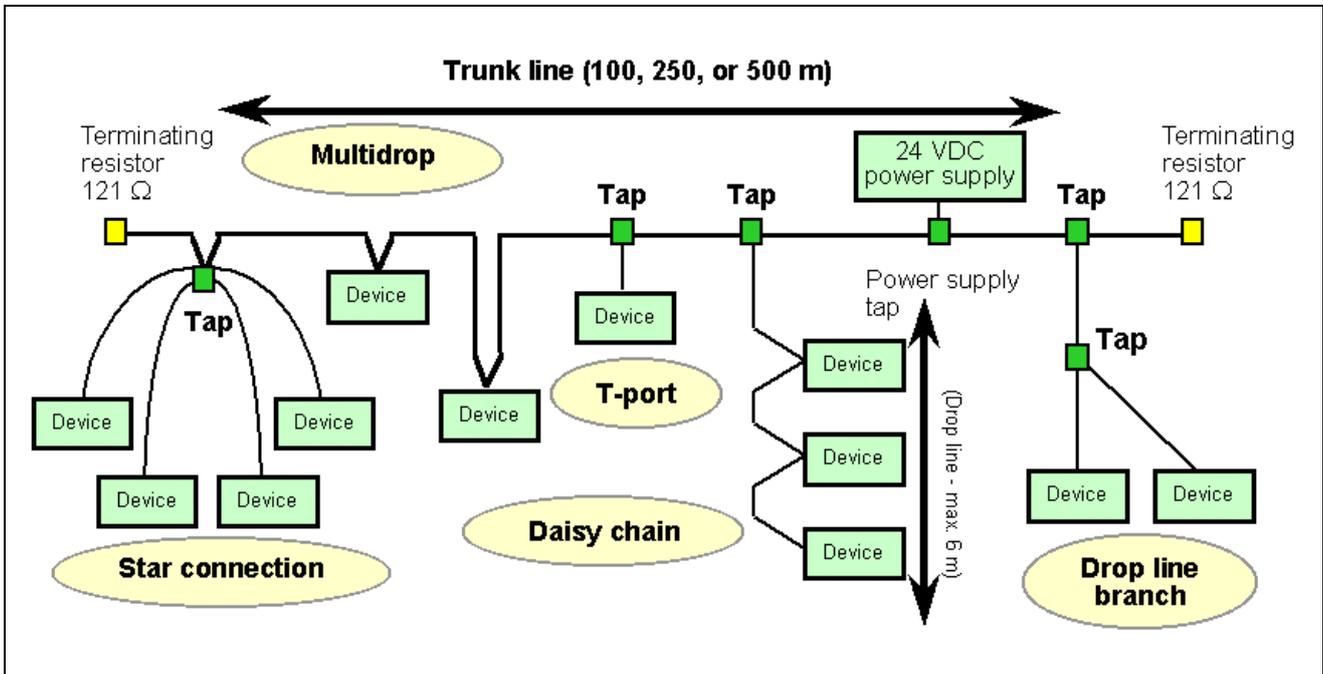
Never connect a terminating resistor to a node. This may result in a failure.

Communication power supply

To operate a DeviceNet network, a communication power must be supplied to each node through DeviceNet cables. The communication power supply, internal circuit power supply, and I/O power supply should be supplied separately.

Connection style

As shown below, a variety of connection styles are available for DeviceNet. They include multidrop, star connection, T-ports, daisy chain, and drop line branching.



Trunk line length

The permissible total length of a trunk line used in a DeviceNet network will differ depending upon the data transmission speed and the type of cables used (thick cable or thin cable).

Communications speed	Maximum cable length when only thick cables are used	Maximum cable length when only thin cables are used
125 Kbps	500 m	100 m
250 Kbps	250 m	
500 Kbps	100 m	

A DeviceNet network may be constructed with thick and thin cables together. In such a case, the permissible total lengths of thin and thick cables can be obtained according to the calculation formulae below.

Communications speed	Maximum network length
125 Kbps	$L(\text{thick}) + 5 \times L(\text{thin}) \leq 500 \text{ m}$
250 Kbps	$L(\text{thick}) + 2.5 \times L(\text{thin}) \leq 250 \text{ m}$
500 Kbps	$L(\text{thick}) + L(\text{thin}) \leq 100 \text{ m}$

“L (thick)” indicates the length of thick cables.
“L (thin)” indicates the length of

Drop line length

The drop line length is cable distance between the trunk line tap and the farthest node on the drop line. The permissible overall length of drop lines throughout the network ("total length") depends on the communications speed, and must be within the lengths listed in the table below.

Communications speed	Drop line length	
	Maximum length	Overall length
125 Kbps	6 m	156 m
250 Kbps		78 m
500 Kbps		39 m

7.4.2 Creating a Scanlist

What is "scanlist"?

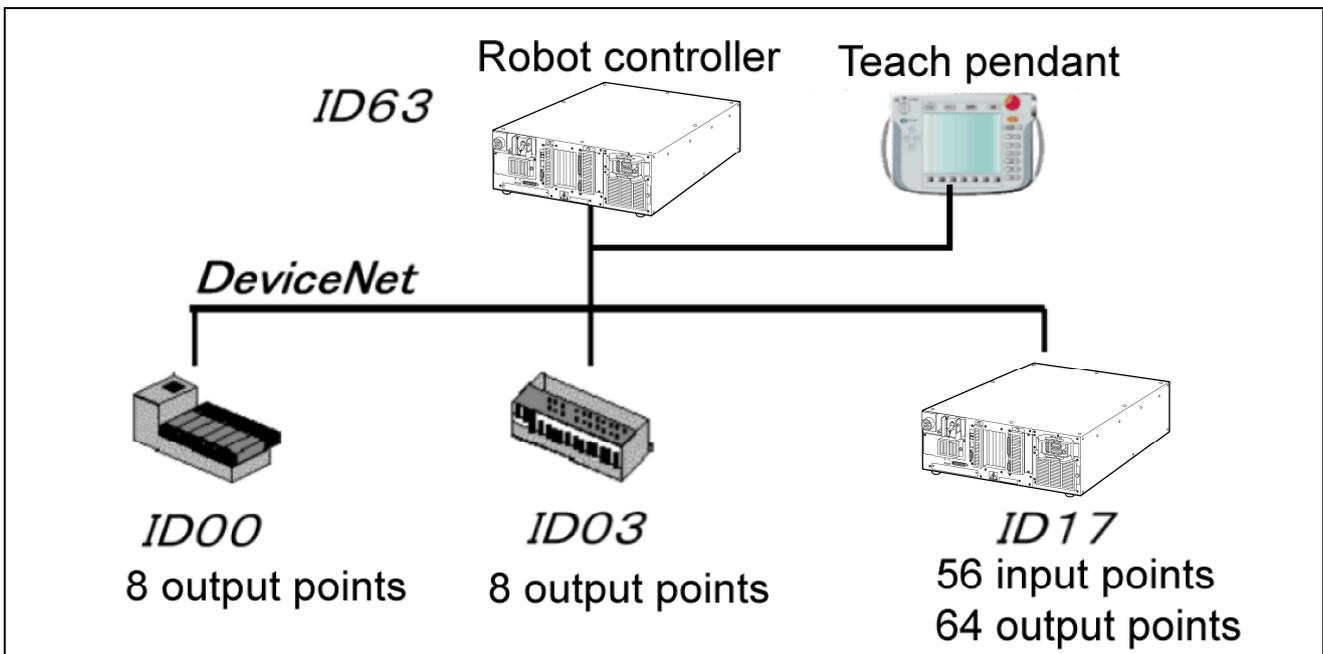
A scanlist is a parameter list that allows a DeviceNet master to identify slaves that are under its control during communication. Network communications are not possible without a scanlist.

The scanlist contains the following information:

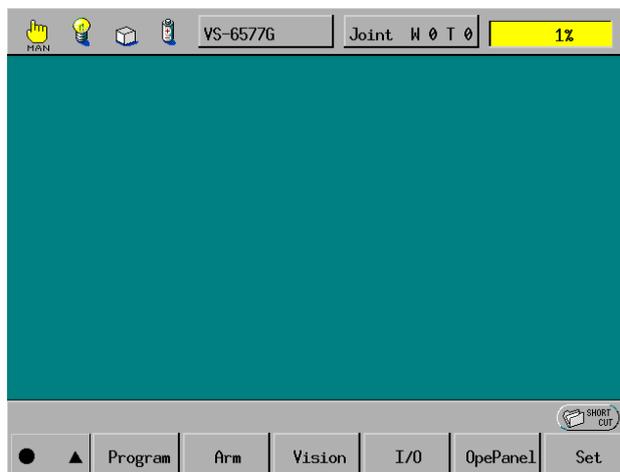
- Slave I/O allocation information (which slaves have how many input points, and which node addresses they occupy)
- The communication parameter information (remote I/O communications status, communication cycle time setting)

When creating a scanlist with the robot controller, you may choose either of the fixed I/O allocation mode (default) and free I/O allocation mode.

(1) Scanlist creation procedure

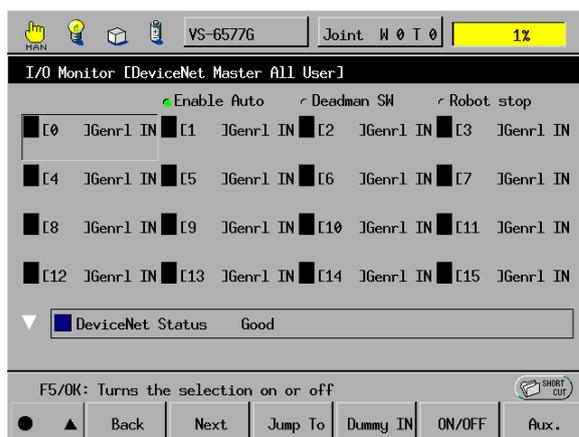


Step 1 On the top screen of the teach pendant, press [F4 I/O].



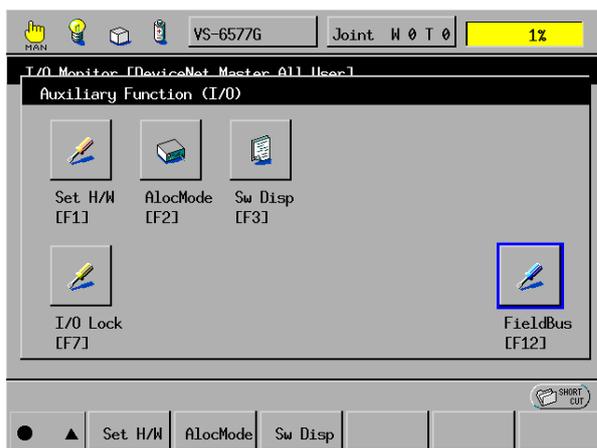
F4

Step 2 On the following screen, press [F6 Aux.].

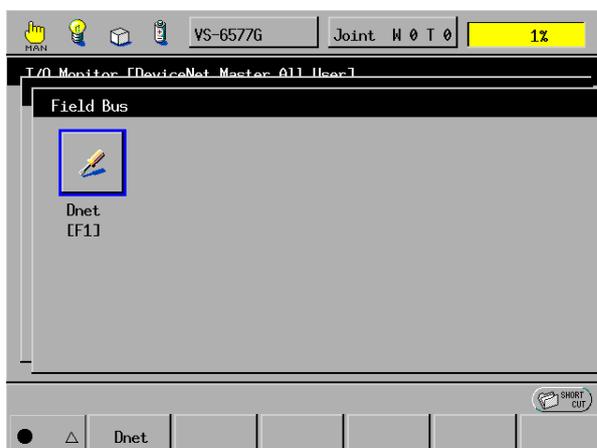


F6

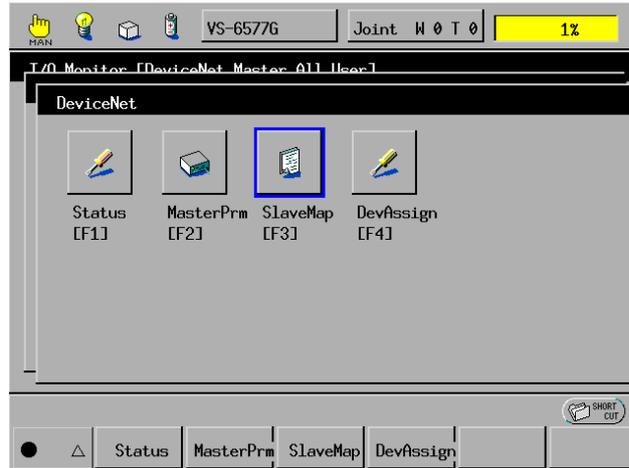
Step 3 Press [F12 FieldBus].



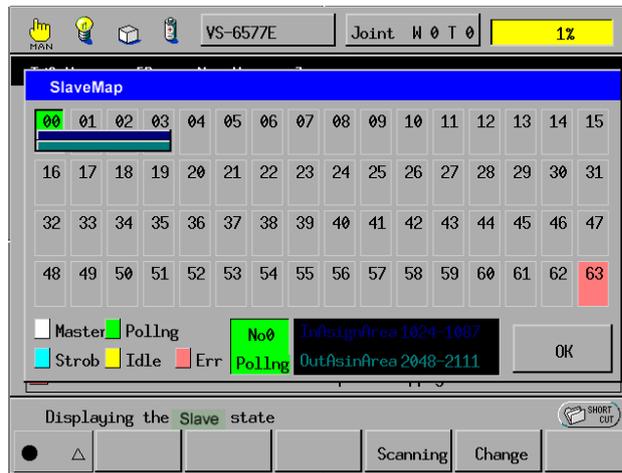
Step 4 Press [F1 Dnet].



Step 5 Press [F3 SlaveMap].

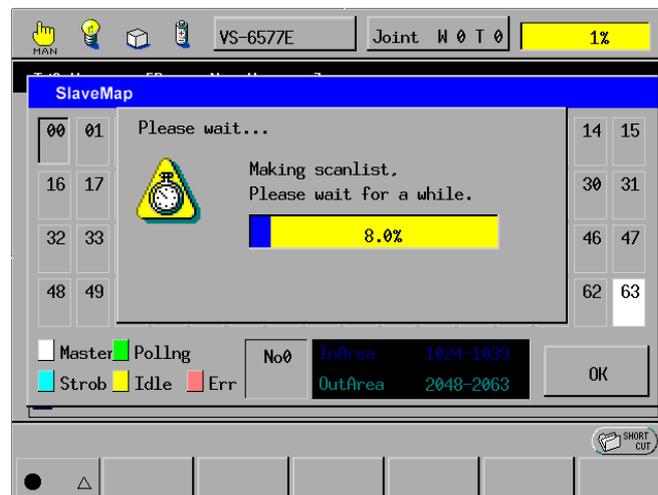


Step 6 The latest scanlist will appear.
Press [F4 Scanning] on this screen.
(The default of the slave map is the fixed I/O allocation screen.)

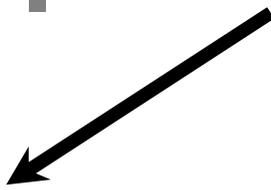
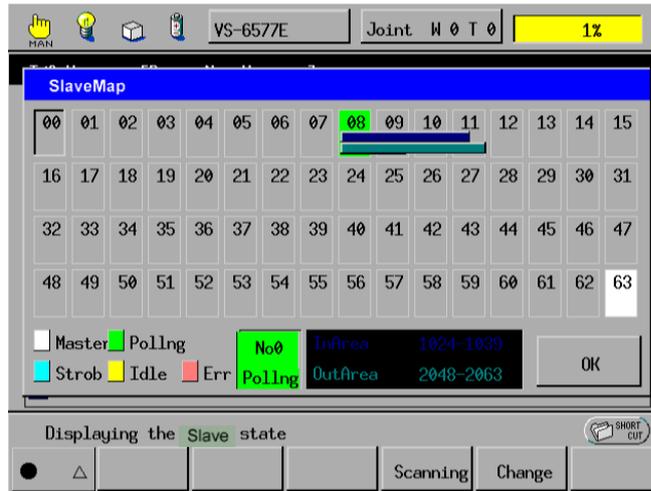


F4

Step 7 Wait for a while when the network is being scanned.

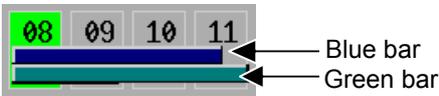


Step 8 The current scanning results will display.



Screen explanation

In the fixed I/O allocation, each block has 16 input points and 16 output points. The whole screen area represents $16 \times 24 = 1024$ I/O points.



In the figure shown at left, the blue bar indicates the number of input points at node 8 and the green bar, the number of output points.

This slave has the following numbers of points:
 Inputs = $3.5 \text{ blocks} \times 16 = 56$ points
 Outputs = $4.0 \text{ blocks} \times 16 = 64$ points

Since the number of I/O points increases in 8-point increments, the bar indications increase or decrease in 0.5-block units.



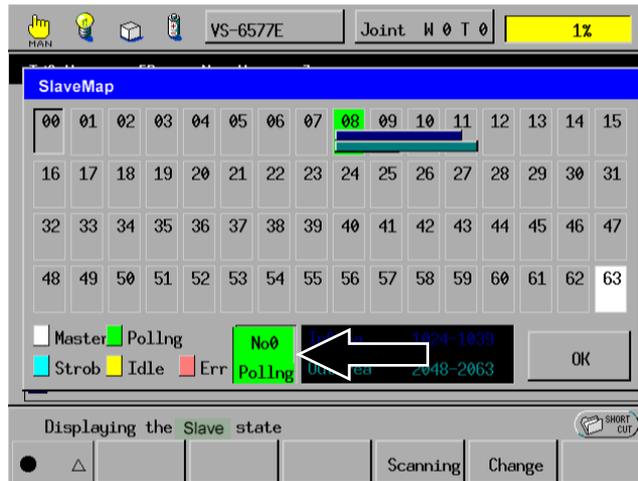
The left display shows the I/O number of the selected node.

By default, the information for node 0 is displayed.

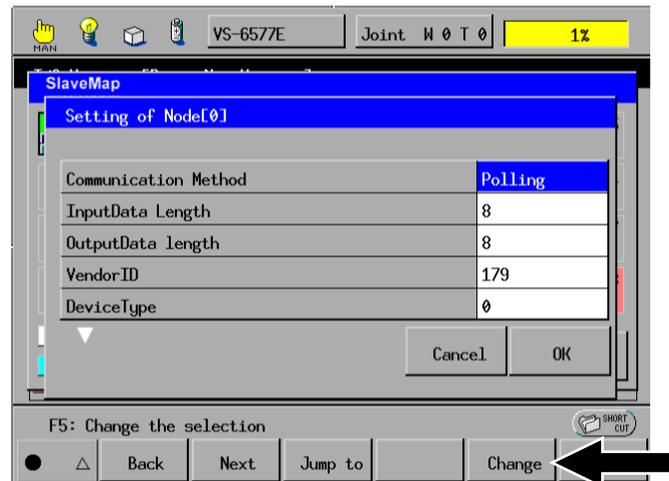
To change the node, press the node number whose information you want to display.

(2) Displaying and changing node (slave) setting information

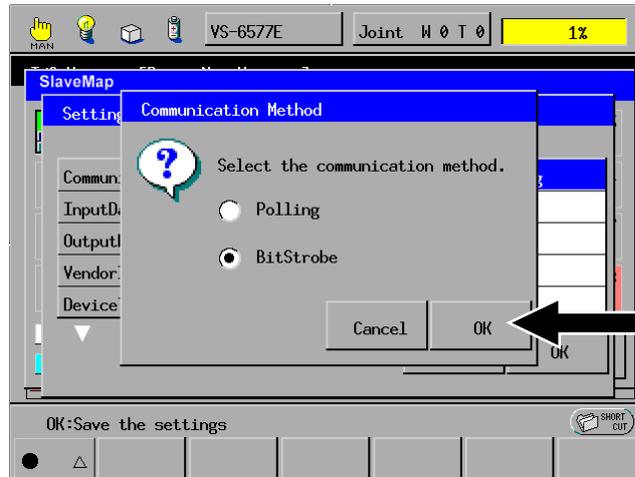
Step 1 To display or change node information, press the relevant node number on the screen below.



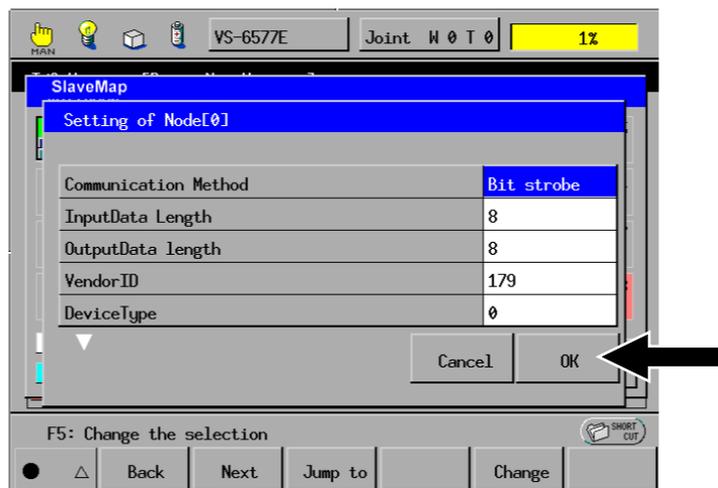
Step 2 On the screen below, only the communication method and I/O data length can be changed: the other parameters are displayed but cannot be changed.



Step 3 As an example, let's change node 0 to the bit strobe mode here. Note that when the communication method is changed, an error will occur if the specified slave lacks the chosen communication function.



Step 4 If the displayed communication method is OK, press [OK].



Step 5 The DeviceNet master changes the interface with the slave.



Step 6 Node 0 has been changed to the bit strobe mode.

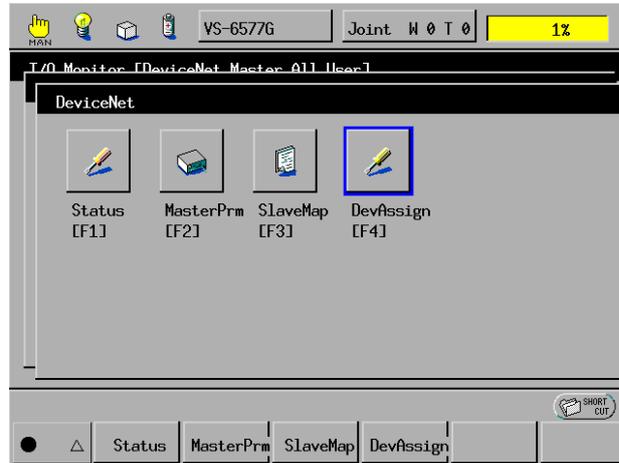


NOTE: You may change the I/O data length also on this screen but you need to make the same setting change for slaves at the same time, which makes the setting difficult. If you change the slave parameters, therefore, you are recommended to scan the network again.

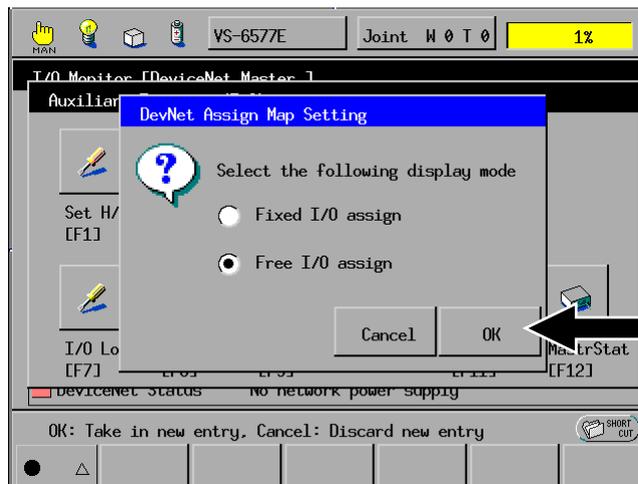
(3) Changing the I/O allocation mode

The procedure for switching from the fixed I/O allocation mode to the free I/O allocation mode is explained here.

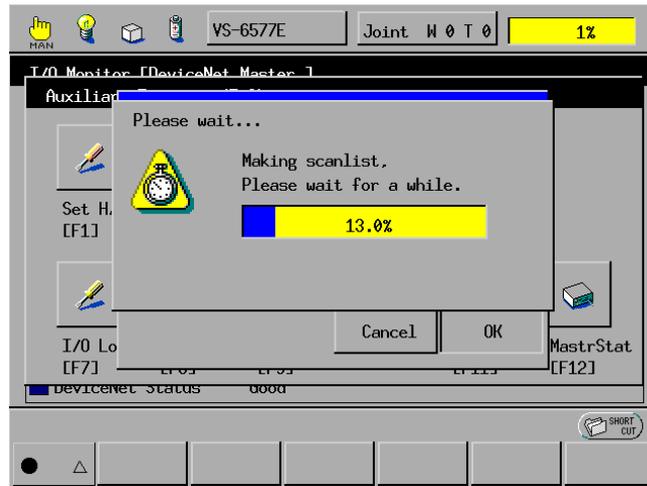
Step 1 Press [F4 DevAssign] on the Auxiliary Function (I/O) screen.



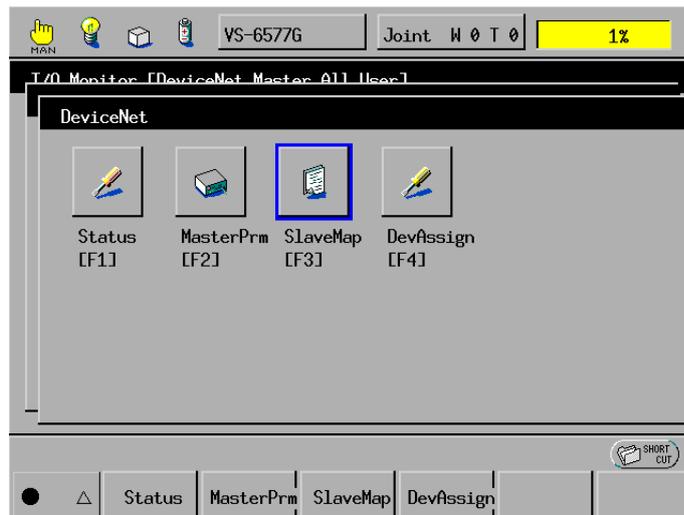
Step 2 Change the setting from "Fixed I/O assign" to "Free I/O assign" and press [OK].



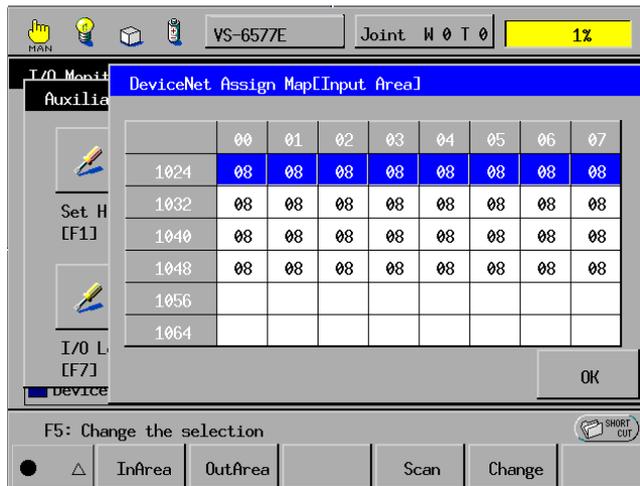
Step 3 In accordance with the change of the allocation mode, the DeviceNet master scans the network and changes the I/O allocation.



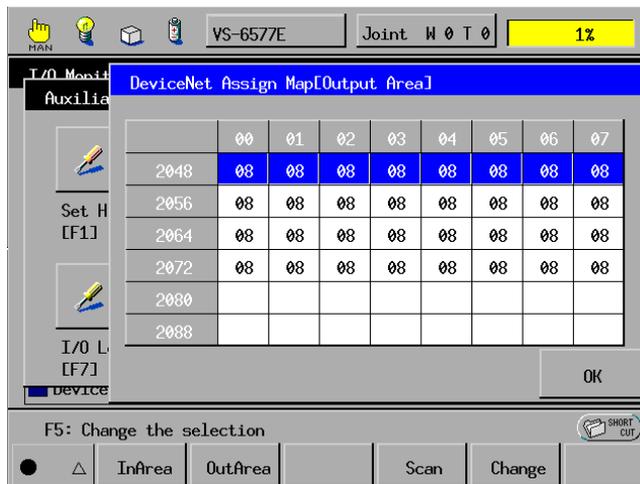
Step 4 When the following screen appears, the scan is completed. Press [F3 SlaveMap] and confirm the new setting.



Step 5 The input area in the free I/O allocation mode will display.



Step 6 Press [F2 OutArea] to display the output area.



Explanation about screen

Input area display screen

This is the starting address of the DeviceNet master I/O input area.

DeviceNet Assign Map[Input Area]								
	00	01	02	03	04	05	06	07
1024	08	08	08	08	08	08	08	08
1032	08	08	08	08	08	08	08	08

This indicates the address pointed out to the left [1024] plus 07, i.e. address [1031].

The display above indicates that slave ID4 is allocated to input areas 1024 to 1039.

Output area display screen

This is the starting address of the DeviceNet master I/O output area.

DeviceNet Assign Map[Output Area]								
	00	01	02	03	04	05	06	07
2048	08	08	08	08	08	08	08	08
2056	08	08	08	08	08	08	08	08

This indicates the address pointed out to the left [2048] plus 07, i.e. address [2055].

The display above indicates that the following allocations have been made:

Output areas 2048 to 2055: Output to slave ID0

Output areas 2056 to 2063: Output to slave ID3

Output areas 2064 to 2071: Output to slave ID4

[Scan] and [Change] keys



The functions of these keys are equivalent to the fixed allocation mode.

[Scan] recreates the scanlist.

[Change] changes the slave settings.

7.4.3 Changing Master Parameters

Usually there is no need to change these parameters. This is because the DeviceNet master automatically detects the network status and writes the typical parameters.

Only when you need to change the EPR or ISD, change these parameters. For example, you need to decrease the EPR value in order to shorten the disconnection detection time.

To make master parameters revert to the original after change, enter "0."

Do not change serial numbers.

What is "EPR" (Expected Packet Rate)?

This value is the basis for judging a "timeout" when the slaves communicate with the master (polling or bit strobe). If there is no access from the master during the set time, then the slave times out and an error status is established. For the master, this value is the setting for the disconnection detection time.

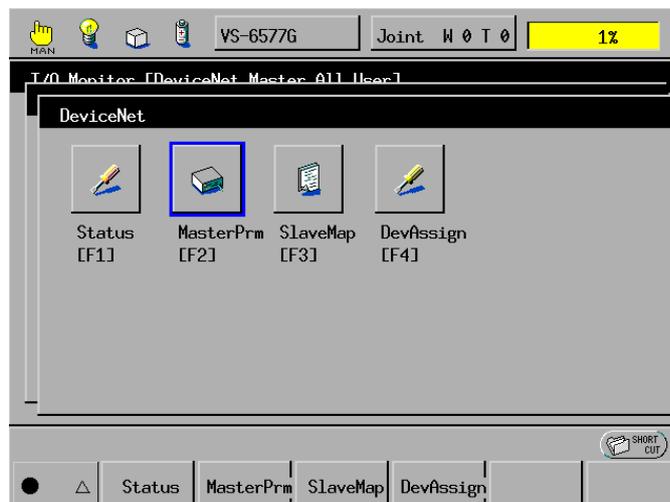
The relationship is: Detection time = EPR value × 4 (ms)

Note that if a too small value is entered, the "No response from slave" error will occur even in normal status.

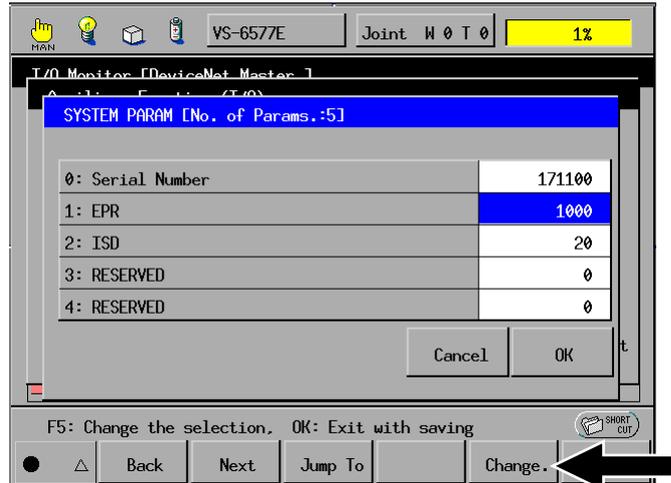
What is "ISD" (Inter Scan Delay)?

This is the interval between the scan cycles in which the master scans the slave devices.

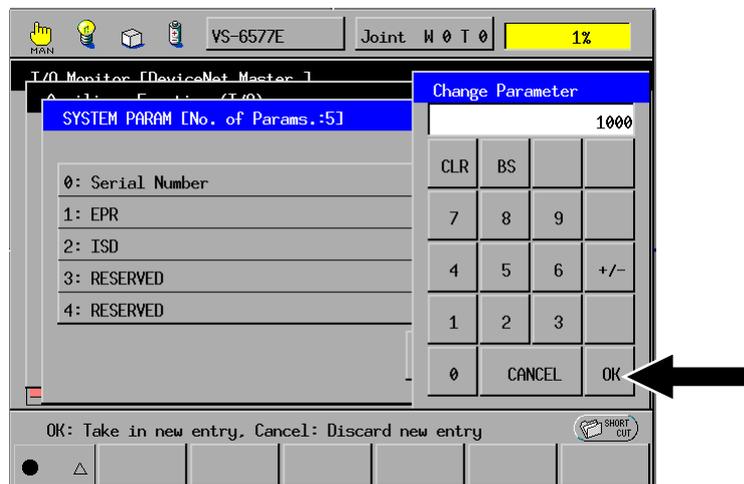
Step 1 On the Auxiliary Function (I/O) screen, press [F2 MasterPrm].



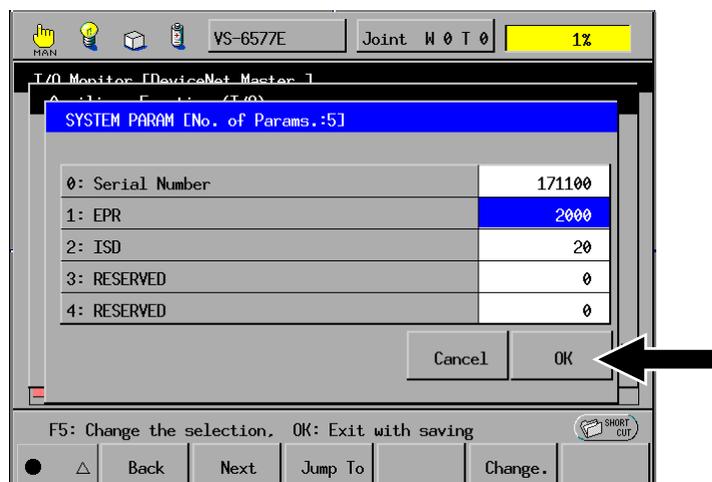
Step 2 As an example, assume that the EPR should be changed.



Step 3 On the SYSTEM PARAM screen, enter a new value and press [OK].



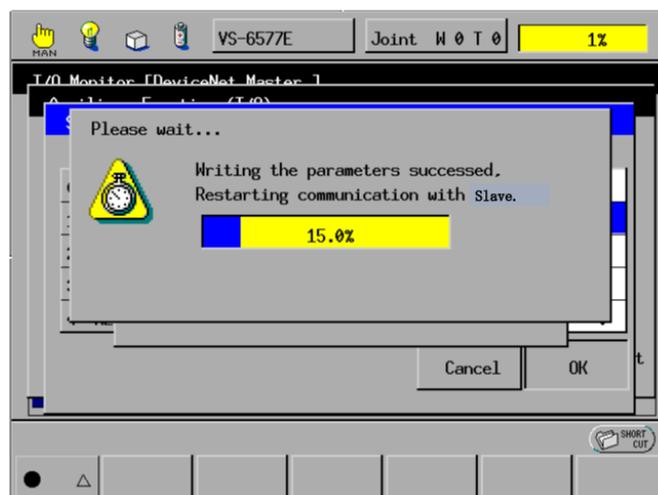
Step 4 In this example, enter "2000" here. Check the entered value. If it is normal, press [OK].



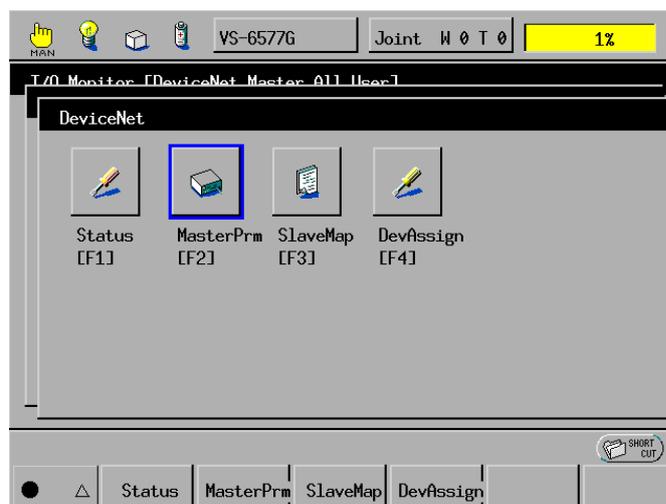
Step 5 The data will be written to the memory of the DeviceNet master.



Step 6 Based on the new values, the network is being constructed.



Step 7 After parameter writing is normally completed, the following screen will display.



NOTE: You may change the ISC value in the same procedure.

7.4.4 Researching the Firmware Version

You can research the firmware version of the DeviceNet board using the teach pendant.

Access: [Top screen]—[F4 I/O] -> [F6 Aux.] -> [F12 FieldBus] -> [F1 Dnet] -> [F1 Status]

Search the "Master software version" on the "DeviceNet State" window.

7.4.5 Function of Resetting "BusOff"

When DeviceNet communication error causes a "Busoff" state, it cannot be recovery even if the error is correct. In this case, use the function of resetting "BusOff" according to following procedures. Even if resetting the " BusOff" of the controller, it cannot be recovery when another node is "BusOff".

Resetting "BusOff" procedures:

- (4) Turn the controller power ON again.
- (5) Turn the network power ON again.
- (6) Use the function of resetting "BusOff" as follows.

Access: [Top screen]—[F4 I/O]—[F7 BUSOFrst]

When pressing [F7 BUSOFrst];

When DeviceNet is not "BusOff" state, "Not Busoff now." appears.

When DeviceNet is "BusOff" state, press [OK] ,and "BusOff"-reset will be executed.

7.5 Field Network Error Indication

The field network error indication parameter can be used with a DeviceNet master board. Refer to Section 6.5 "Field Network Error Indication."

7.6 Network Error Detector Suppression

The network error detection wait-time parameter can be used with a DeviceNet master board. Refer to Section 6.6 "Network Error Detector Suppression."

Chapter 8 DeviceNet Master/Slave Board

8.1 Overview

Mounting a DeviceNet master/slave board in the robot controller enables the controller to communicate with external devices according to the DeviceNet-compliant protocol.

This board allows the controller to work as a slave or master unit for serial communication which is compliant with the open network DeviceNet.

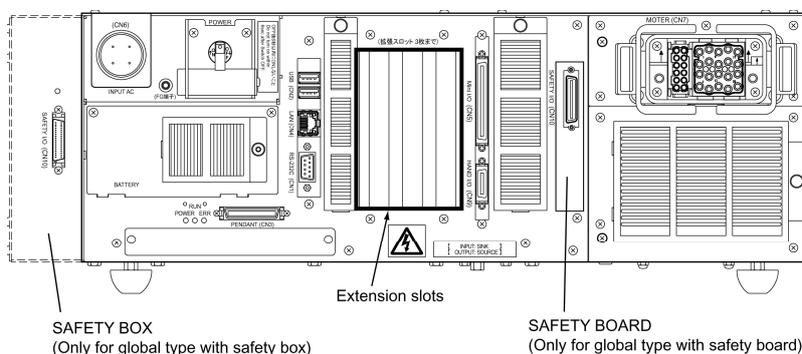
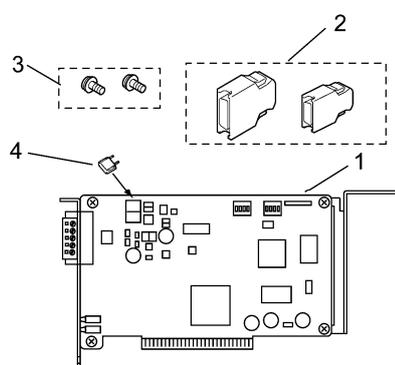
8.1.1 Configuration and Mounting Position

The DeviceNet master/slave board is configured as shown below.

This board can be mounted into any of the extension slots provided in the controller. (Refer to Chapter 14 "Mounting I/O Extension Boards.")

Configuration of DeviceNet Master/Slave Board and Mounting Position

No.	Components	Part Number	Remarks
1	DeviceNet master/slave board (including Nos. 2 through 4)	410010-3390	Integrated in the controller
		410010-3480	Shipped alone
2	Mini I/O connector kit	410159-0190	For wiring to Mini I/O (CN5) This kit consists of : - Connector (PCR-E68FS) - Connector cover (PCS-E68LPA-1E) (Both of these are manufactured by HONDA TSUSHIN KOGYO CO., LTD.)
	HAND I/O connector kit	410159-0260	For wiring to HAND I/O (CN9) This kit consists of : - Connector (PCR-E20FS+) - Connector cover (PCS-E20LA) (Both of these are manufactured by HONDA TSUSHIN KOGYO CO., LTD.)
3	Screw with washer (2 pieces)	410815-0750	For securing the board (M3x6) (When the board is integrated at the factory, these screws are used in the controller.)
4	Fuse (0.5A)	410054-0260	F1 fuse (LM05)



Note: When turning the controller power ON after this installation, an Error message "220F: I/O device changed" appears. Update the I/O status and configuration settings according to Section 4.6 "Method for Setting I/O Allocation" and then restart the controller.

8.1.2 Features

(1) DeviceNet-compliant

The DeviceNet is an internationally open network developed by Allen-Bradley and is designed to allow control devices (e.g., sensors and actuators) to communicate with each other.

(2) Can be networked with control devices of various manufacturers

The robot controller equipped with DeviceNet slave board can be networked with DeviceNet-compliant control devices of various domestic and foreign manufacturers since the communications specifications are open.

(3) Easy wiring and maintenance

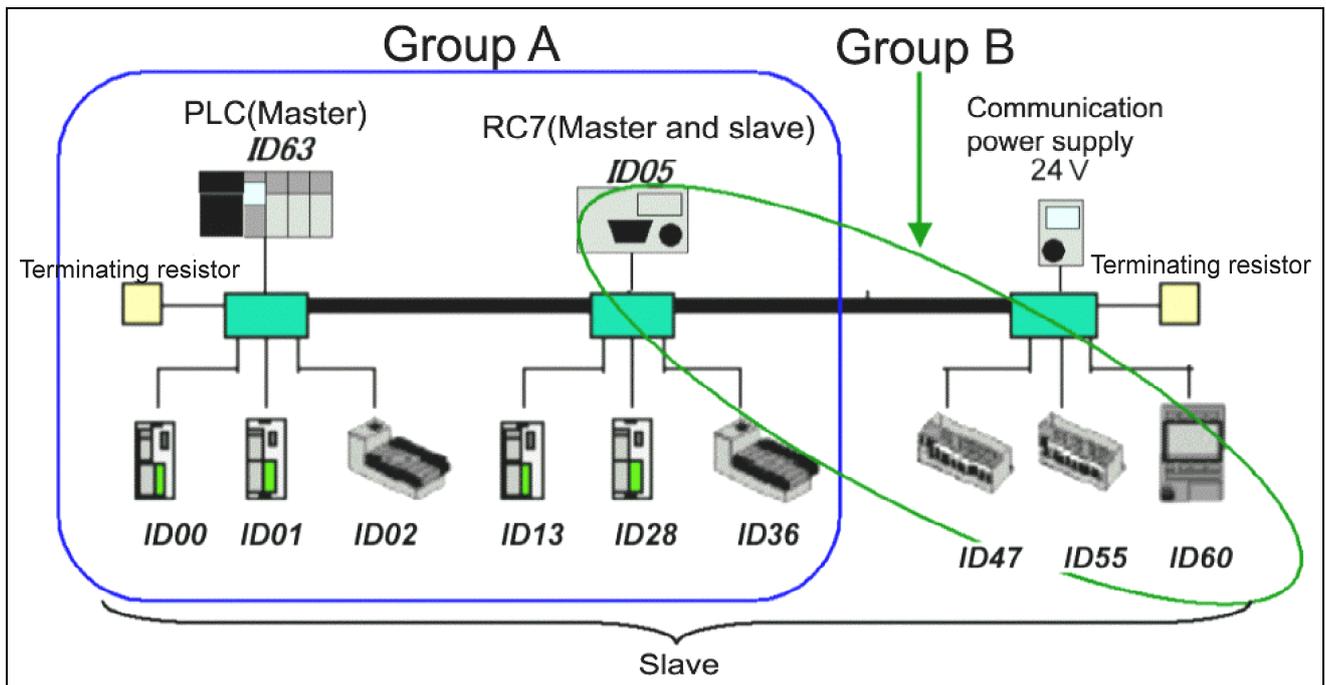
The 5-core special cable and detachable connector of the DeviceNet slave board make it easy to install wiring between nodes (communications units) and disassembly/restructure the network. This will sharply reduce cost in wiring and maintenance, as well as making replacement of units easy at the time of failure.

(4) Sufficient number of I/Os

This controller is capable of handling a large volume of transmitted and received data, with up to 1024 input contacts and 1024 output contacts in the master area and with up to 256 input contacts and 256 output contacts in the slave area.

With the teach pendant, you may scan the network without using a dedicated configurator so as to easily rearrange connected slave units.

8.1.3 System Configuration Sample



System Configuration Sample (with DeviceNet master/slave board)

The figure above shows a sample of DeviceNet master and slave system. RC7 communicates with PLC (Master) in Group A and also with slaves in Group B. But RC7 does not communicate with slaves in Group A.

Serial communication system in Group A: [PLC (Master): ID63] communicates with ID00, ID01, ID02, ID05, ID13, ID28 and ID36.

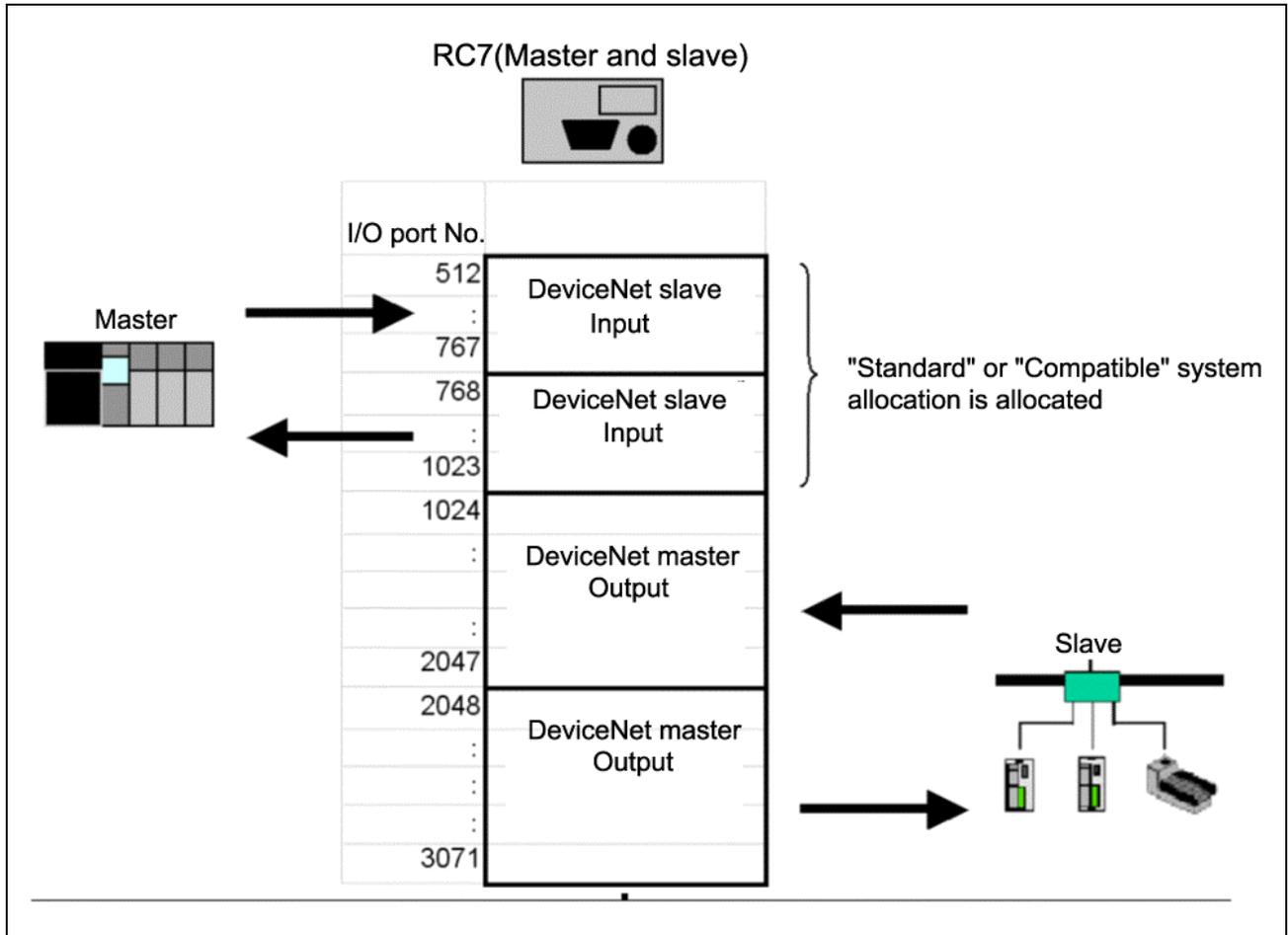
Serial communication system in Group B:

[RC7 (Master/slave): ID05] communicates with ID47, ID55 and ID60.

8.1.4 Master Area and Slave Area

When the RC7 master/slave board is used, "I/O port numbers 512 to 1023" are area for communicated with the master, and "1024 to 3071" are area for communicated with the slaves.

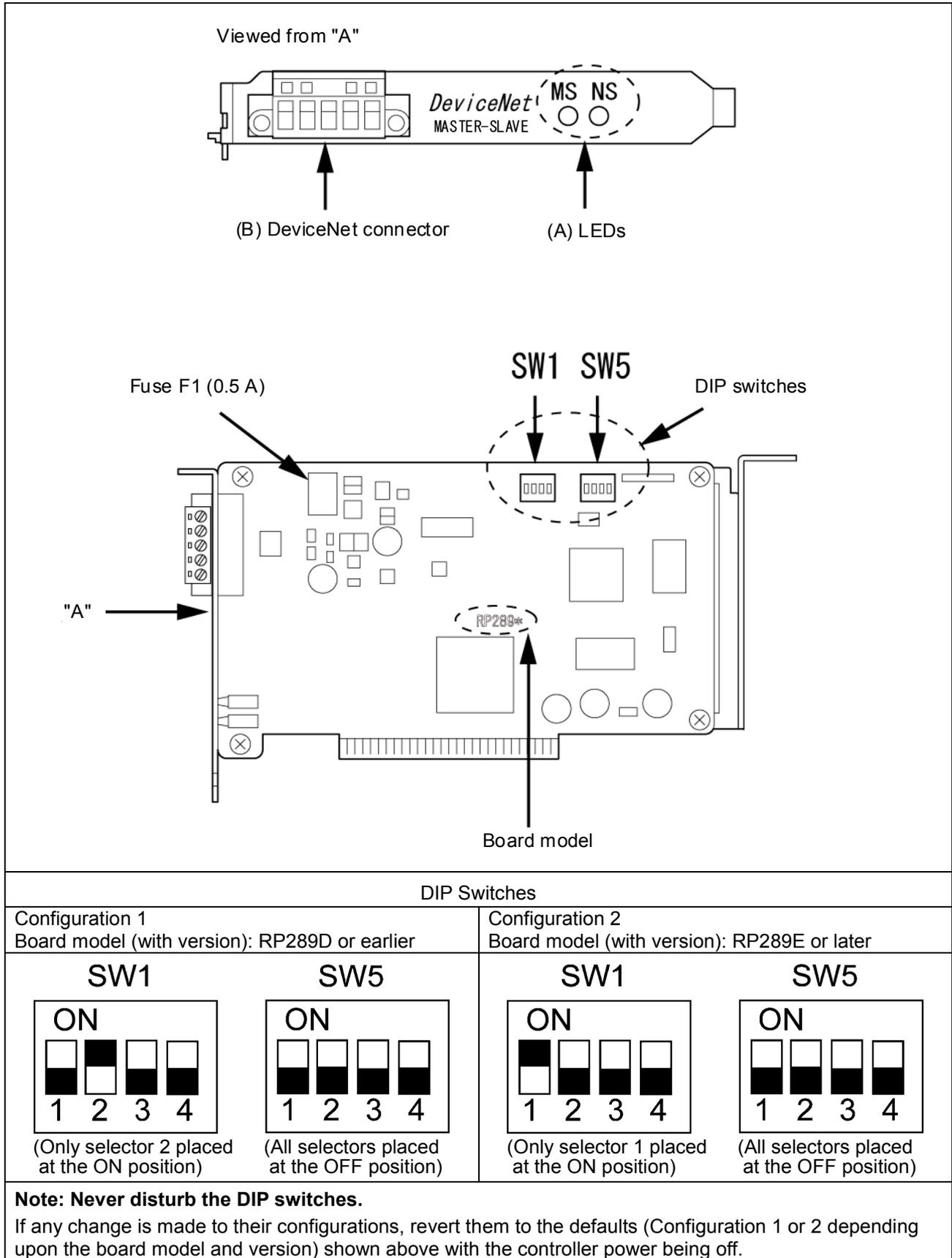
"Standard" or "Compatible" system I/O signals are allocated to the 512 to 1023 area. As the system signals of I/O allocation is the same with the DeviceNet slave board, refer to Section 6.3.1 "Standard Assignment Mode" and Section 6.3.2 "Compatible Assignment Mode."



Master Area and Slave Area

8.2 Product Specifications

The figure below shows the location of the LEDs, DIP switches, and DeviceNet connector on the DeviceNet master/slave board.



DeviceNet Master/Slave Board

8.2.1 Functions of Master Board Components

(A) Status indicator LEDs

The status indicators MS and NS ("A" in the figure given on the previous page) can light or flash in green or red. Each of the ON, flashing, and OFF states of those indicators shows the module or network status as listed below.

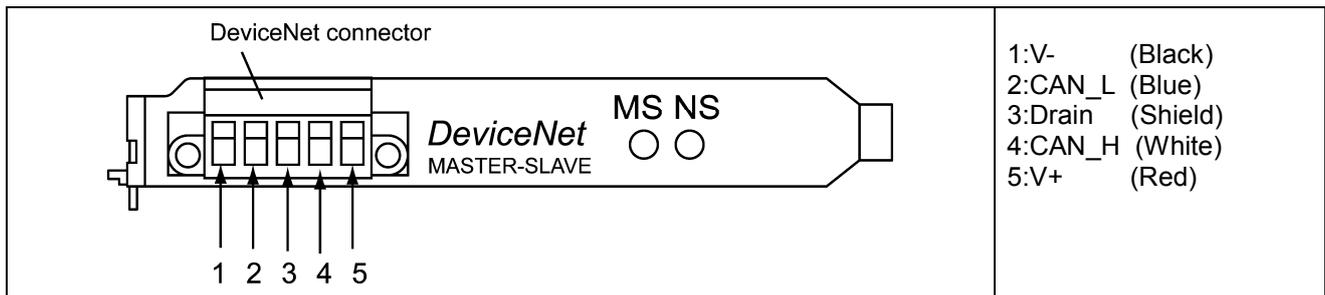
The flashing interval is once per second (0.5 second of ON and 0.5 second of OFF).

LED name	Color	State	Definition	Explanation
MS (Module Status)	Green		Normal state	<ul style="list-style-type: none"> The unit works normally.
	Red		Fatal error	<ul style="list-style-type: none"> Hardware failure.
	–		No power supplied	<ul style="list-style-type: none"> No power is supplied to the DeviceNet module. (Controller power: OFF)
NS (Network Status)	Green		Communications link established	The network is working normally. (The line is connected.)
			Communications link not established	The network is working normally, but the line is not connected yet.
	Red		Fatal communications error	The unit detects any error disabling communication on the network. <ul style="list-style-type: none"> Node address double-assigned. "Bus off" detected.
			Recoverable communications error	Example: I/O time out
	–		Network power supply failure	<ul style="list-style-type: none"> The online status cannot be established, e.g. because a CAN send timeout error has occurred.

(B) DeviceNet connector

The robot controller uses an open screw connector whose pin arrangement is shown below.

NOTE: When the controller power (including the network power) is on, do not disconnect/connect the communication connector or touch its pins. Doing so will result in a failure.



DeviceNet Connector

It is recommended that either of the following crimp terminals be used for the communications cable.

No.	Crimp terminal	Tools required
(1)	AI series (Phoenix Contact)	ZA3 (Phoenix Contact)
(2)	TC series (Nichifu) For thin cables: TME TC-0.5 For thick cables: TME TC-2-11 (for power supply) TME TC-1.25-11 (for communication)	NH-32

8.2.2 General Specifications

(1) Environmental requirements

Item	Specifications
Operating temperature	0 to 40°C
Operating humidity	90% RH or less (without condensation)

(2) DeviceNet communications specifications

Item	Specifications																
Communications protocol	DeviceNet-compliant																
Connection supported	Connection supported in Master - Polling I/O function - Bit strobe function Connection supported in Slave - Polling I/O function Compliant with DeviceNet communication rules																
Connection type (Note 1)	Multi-drop type with possible combination of T-branch (to trunk and branch lines)																
Bit rate	500, 250, 125 kbps																
Communications media	Special cable consisting of 5 wires (2 for signals, 2 for power supply, and 1 as a shield wire)																
Communications cable length	<table border="1"> <thead> <tr> <th>Bit rate</th> <th>Max. network length</th> <th>Branch length</th> <th>Total branch length</th> </tr> </thead> <tbody> <tr> <td>500 kbps</td> <td>100 m or less (Note 2)</td> <td>6 m or less</td> <td>39 m or less</td> </tr> <tr> <td>250 kbps</td> <td>250 m or less (Note 2)</td> <td>6 m or less</td> <td>78 m or less</td> </tr> <tr> <td>125 kbps</td> <td>500 m or less (Note 2)</td> <td>6 m or less</td> <td>156 m or less</td> </tr> </tbody> </table>	Bit rate	Max. network length	Branch length	Total branch length	500 kbps	100 m or less (Note 2)	6 m or less	39 m or less	250 kbps	250 m or less (Note 2)	6 m or less	78 m or less	125 kbps	500 m or less (Note 2)	6 m or less	156 m or less
	Bit rate	Max. network length	Branch length	Total branch length													
	500 kbps	100 m or less (Note 2)	6 m or less	39 m or less													
	250 kbps	250 m or less (Note 2)	6 m or less	78 m or less													
125 kbps	500 m or less (Note 2)	6 m or less	156 m or less														
Power supply for communication	External supply of 24 VDC \pm 10%																
Internal power consumption	Communication power source: 65 mA max.																
Max. number of connectable nodes	64																
Number of I/Os	Master area - Input 1024 points - Output 1024 points Slave area - Input 256 points - Output 256 points																
Error check	CRC																
<p>(Note 1) Terminator resistors are needed at both ends of the trunk cable. (121 Ω)</p> <p>(Note 2) These values may apply when a special thick cable is used as a trunk line. If a special fine cable is used, the max. network length is 100 m or less.</p> <p>(Note 3) The polling period for system input signal is 8 ms. The 8 ms or less input signal may not be detected.</p>																	

8.2.3 EDS File

The EDS file for the DeviceNet slave board is stored in the WINCAPSIII installation disk (version 3.00 or later) that comes with the robot controller. Use this file when registering the slave with the DeviceNet master.

File path: \Unsupported\Eds\DeviceNet\RC7slave.eds

The content of the EDS file is also shown in "Appendix table: EDS file."

8.2.4 I/O Allocation Settings

For available allocations, see "Combination of I/O Extension Boards and Allocation Mode."

The port numbers of DeviceNet master are 1024 to 2047 for input ports and 2048 to 3071 for outputs port. The port numbers from 512 to 1023 are unusable.

8.2.5 Setting the Node Address

Set the node address using the teach pendant.

Access: [Top screen]—[F4 I/O]—[F6 Aux.]—[F1 Set H/W]

- (1) Select the "DeviceNet. Node address" on the "I/O Hardware Settings" window, and specify the node address.

Note: When using the [F3 Jump To], type 33.

- (2) Restart the robot controller to make the new settings go into effect.

8.2.6 Setting the Bit Rate

Set the bit rate using the teach pendant.

Access: [Top screen]—[F4 I/O]—[F6 Aux.]—[F1 Set H/W]

- (1) Select the "DeviceNet. Bit Rate (0:125KB, 1:250KB, 2:500KB)" on the "I/O Hardware settings" window, and set the bit rate.

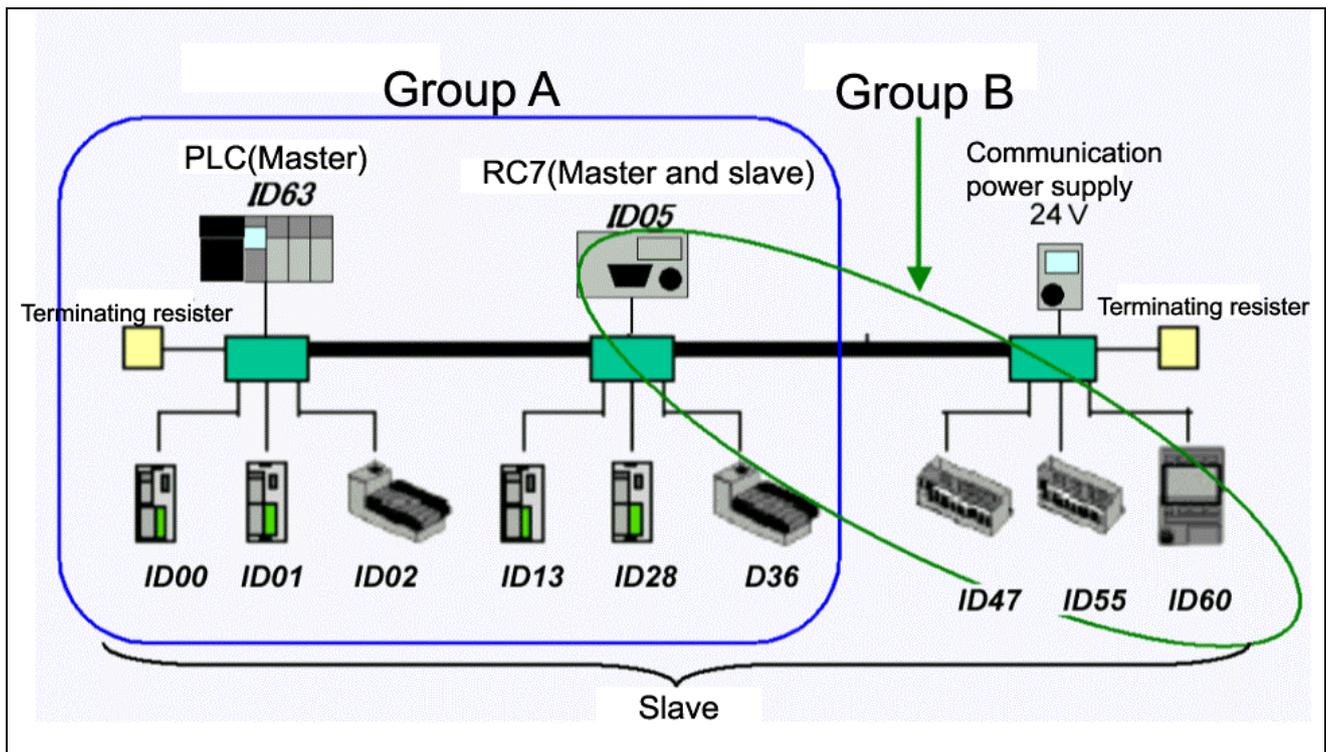
Note: When using the [F3 Jump To], type 34.

- (2) Restart the robot controller to make the new settings go into effect.

8.2.7 Entering the Number of Input/Output Slots

Refer to Section 6.4.1 "Entering the Number of Input/Output Slots."

8.3 System Configuration Sample



System Configuration Sample (DeviceNet master/slave)

8.3.1 System Configuration Sample 1

- (1) Connect the RC7 to the slaves in only Group B. Do not yet turn the communication power and nodes power ON.
Note: For the connections, refer to Section 8.2.2.
- (2) Connect the terminating resistor.
- (3) Set the node address and bit rate.
Note: Wrong settings will communications impossible.
- (4) Connect the communication power supply and then turn on the power of each device.
- (5) Create a scanlist for the RC7.
Note: Register the information about the connected slave devices to the master device. This registration information is called "scanlist." According to the scanlist, the master device may control those slave devices. For the procedure on how to create a scanlist, refer to Section 7.4.2. The creation of the scanlist will automatically determine I/O addresses for the connected slave devices. Accordingly, the I/O communication between the master and slave devices becomes possible. The input and output areas of the master device from/to slave devices are IO [1024] to [2047] and IO [2048] to [3071], respectively.
- (6) Turn the communication power and nodes power OFF.
- (7) Connect all devices to the network.
- (8) Set the node address and bit rate for the added nodes.
Note: Wrong settings will communications impossible.
- (9) Turn the communication power and nodes power ON.
- (10) Create a scanlist for the PLC.

8.3.2 System Configuration Sample 2

- (1) Connect all devices to the network according to the system configuration sample. Do not yet turn the communication power and nodes power ON.
Note: For the connections, refer to Section 8.2.2.
- (2) Connect the terminating resistor.
- (3) Connect the communication power supply and then turn on the power of each device.
- (4) Configure the Group A by using the PLC (Master) configurator. Establish the network by sending the configuration data to the PLC master.
- (5) Create a scanlist for the RC7.

Note: Register the information about the connected slave devices to the master device. This registration information is called "scanlist." According to the scanlist, the master device may control those slave devices. For the procedure on how to create a scanlist, refer to Section 7.4.2. The creation of the scanlist will automatically determine I/O addresses for the connected slave devices. Accordingly, the I/O communication between the master and slave devices becomes possible. The input and output areas of the master device from/to slave devices are IO [1024] to [2047] and IO [2048] to [3071], respectively.

8.4 Field Network Error Indication

The field network error indication parameter can be used with a DeviceNet master board. Refer to Section 6.5 "Field Network Error Indication."

8.5 Network Error Detector Suppression

The network error detection wait-time parameter can be used with a DeviceNet master board. Refer to Section 6.6 "Network Error Detector Suppression."

Chapter 9 CC-Link Board

9.1 Overview

Mounting a CC-Link board in the robot controller enables the controller to communicate with various CC-Link-compliant field devices of many manufacturers.

As a remote device for serial communications compliant with the open network CC-Link, the controller can easily exchange I/O data.

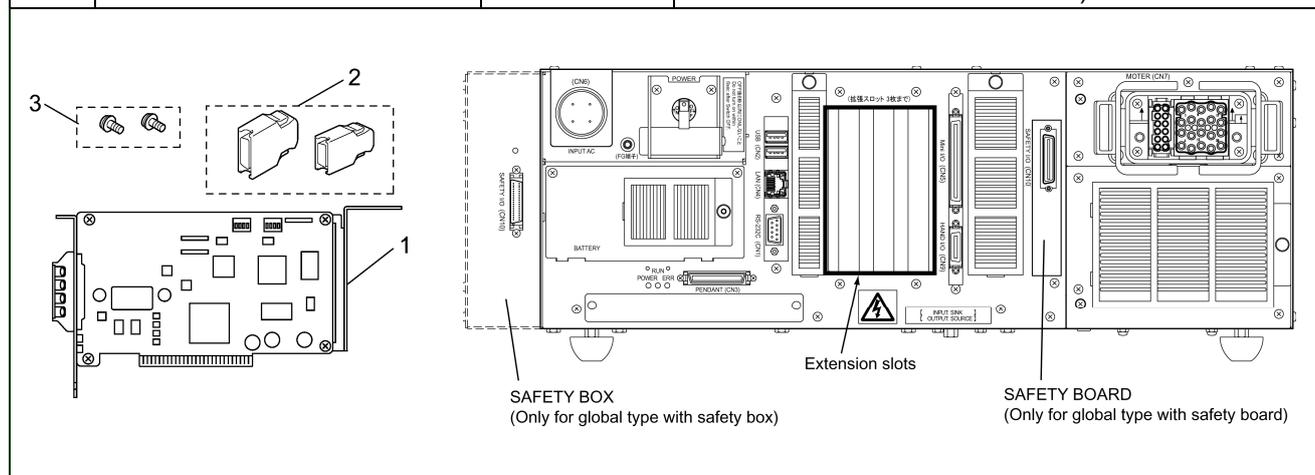
9.1.1 Configuration and Mounting Position

The CC-Link board is configured as shown below.

This board can be mounted in any of the expansion slots provided in the robot controller. (Refer to Chapter 14 "Mounting I/O Extension Boards.")

Configuration of CC-Link Board and Mounting Position

No.	Components	Part Number	Remarks
1	CC-Link board (including Nos. 2 and 3)	410010-3430	Integrated in the controller
		410010-3440	Shipped alone
2	Mini I/O connector kit	410159-0190	For wiring to Mini I/O (CN5) This kit consists of : - Connector (PCR-E68FS) - Connector cover (PCS-E68LPA-1E) (Both of these are manufactured by HONDA TSUSHIN KOGYO CO., LTD.)
	HAND I/O connector kit	410159-0260	For wiring to HAND I/O (CN9) This kit consists of : - Connector (PCR-E20FS+) - Connector cover (PCS-E20LA) (Both of these are manufactured by HONDA TSUSHIN KOGYO CO., LTD.)
3	Screw with washer (2 pieces)	410815-0750	For securing the board (M3x6) (When the board is integrated at the factory, these screws are used in the controller.)

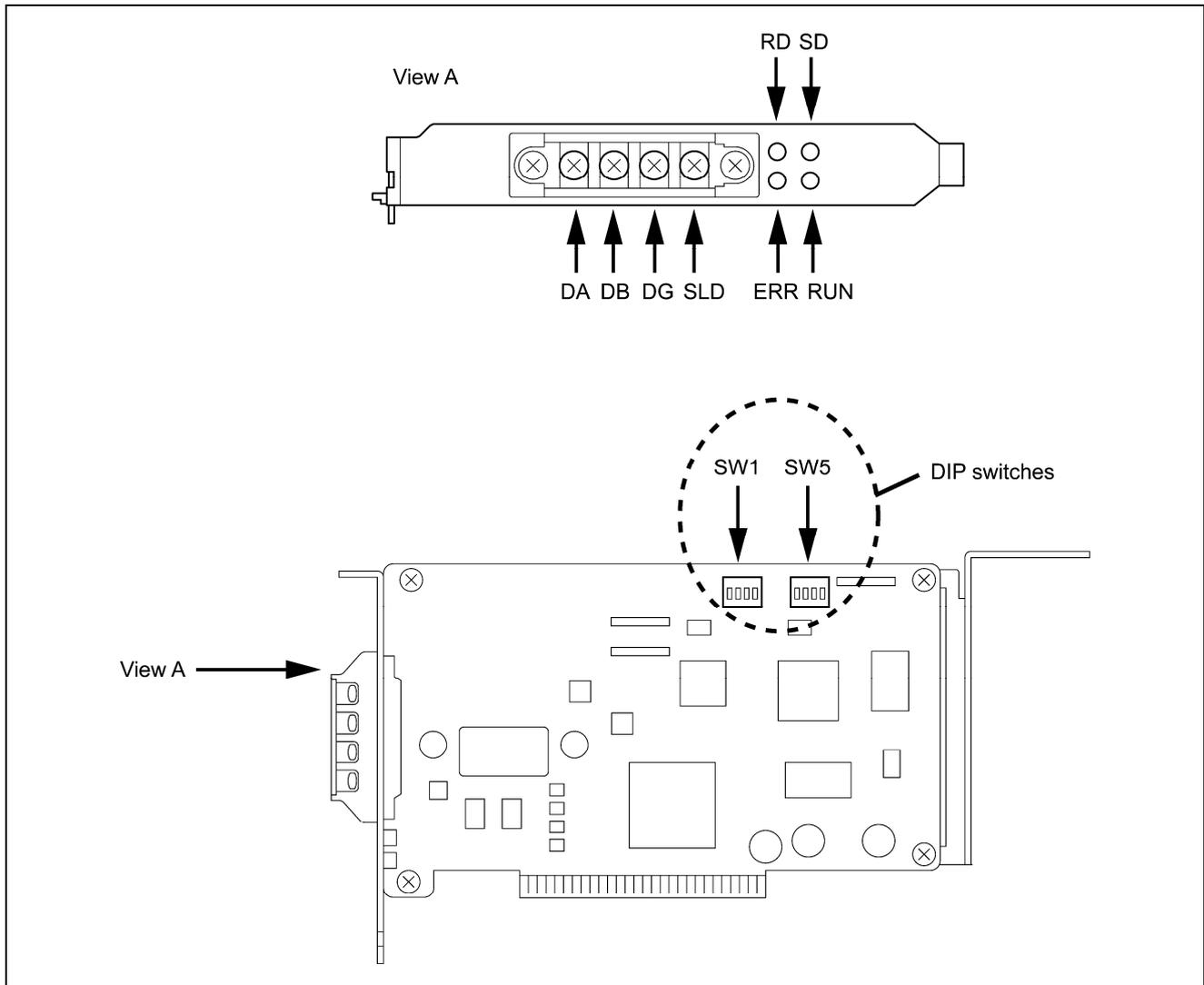


Note: When turning the controller power ON after this installation, an Error message "220F: I/O device changed" appears. Update the I/O status and configuration settings according to Section 4.6 "Method for Setting I/O Allocation" and then restart the controller.

9.2 Product Specifications

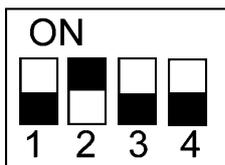
9.2.1 CC-Link Board Part Names

CC-Link board part names are shown below.



DIP switches

SW1



Only selector 2 placed at the ON position

SW5



All selectors placed at the OFF position

Note: DO NOT disturb the DIP switches.

If these switches are set to any configurations other than the ones specified at the left, correct them to the configurations shown at left with the controller power being off.

Note: After wiring, be sure to attach the clear plastic cover to the CC-Link connector.

CC-Link Board

9.2.2 Component Functions and Board Setting

(1) Meaning of LED indications

The operational state can be checked from the state of the four LEDs (RUN, ERR, SD, and RD) shown below.

State of LED				Operation
RUN	ERR	SD	RD	
				Normal communication, but a CRC error occurs occasionally due to noise.
	0.4s 			The baud rate setting or station number has changed from the time of reset release.
				- (Impossible operational state)
				Unable to respond because the receive data causes a CRC error.
				- (Impossible operational state)
				Normal communication
				- (Impossible operational state)
				No data is received at the station.
				- (Impossible operational state)
				Polling response is effective, but refresh receiving is causing a CRC error.
				- (Impossible operational state)
				Data received at the station is causing CRC error.
				- (Impossible operational state)
				<ul style="list-style-type: none"> •The link is not activated. •The mobile unit settings of the master are wrong.
				- (Impossible operational state)
				<ul style="list-style-type: none"> •No data to the station, or unable to receive data at the station due to noise. •The baud rate setting is wrong.
				Unable to receive data due to breaking, etc. Power is off, or H/W is being set.
				Irregular baud rate setting or station number.

Note: The robot controller does not perform CC-Link communication unless the sequencer enters a RUN state. If a message informing of a CC-Link communication error is indicated on the teaching pendant even when the LED indicates normal communication, set the sequencer to a RUN state to cancel the communication error.

9.2.3 Parameter Setting Method

■ Access (teaching pendant)

[Top screen] → [F4 I/O] → [F6 Aux.] → [F1 Set H/W]

Baud rate, station number, and the number of occupied stations need to be set for CC-Link.

Set the following items in the I/O Hardware Settings window, .

- 43:CC_Link baud rate (bps) (0:156K 1:625K 2:2.5M 3:5M 4:10M)
- 44:CC_Link Station Number
- 45:Number of CC-Link occupied stations

9.2.4 General Specifications

(1) Environment Specifications

Item	Specifications
Operating temperature	0 to 40°C
Operating humidity	90% RH or less (No condensation)

(2) CC-Link Communication Specifications

Item	Specifications					
Communication protocol	CC-Link-compliant					
CC-Link version	Ver. 1.10-compliant					
Communication method	Polling scheme					
Synchronous system	Frame synchronization					
Encoding method	NRZ1					
Transmission line method	RS-485 bus					
Transmission format	HDLC-compliant					
Remote station number	1 – 63 (64 cannot be set for this board.)					
Error control method	CRC ($X^{16} + X^{12} + X^5 + 1$)					
RAS function	Communication defect detection (CRC error, abort error)					
Connection cable	Three-pin shielded twisted pair cable					
Total extension length Ver. 1. 10 compliant CC-Link dedicated cable (With end resistance of 100Ω)	Baud rate (bps)	10M	5M	2.5M	625K	156K
	Total extension length (m)	100	160	400	900	1200
Number of occupied stations	2 – 4 stations					
Number of I/O bits	48 – 128 points Standard mode allocation: System input - 40 points (Fixed) System output - 32 points (Fixed) User input - 8 to 72 points (Settable by units of 32 points) User output - 16 to 80 points (Settable by units of 32 points) System input - 16 points System output - 16 points Compatible mode allocation: System input - 24 points (Fixed) System output - 32 points (Fixed) User input - 24 to 88 points (Settable by units of 32 points) User output - 16 to 80 points (Settable by units of 32 points) System input - 16 points System output - 16 points					
Number of I/O Words	8 to 16 words (Remote register RWw and RWr areas) Standard, Compatible, and All User I/O mode allocations: User input - 128 to 256 points (Can be set in units of 64 points) User output - 128 to 256 points (Can be set in units of 64 points) For remote registers RWw and RWr, refer to the "Remote Resistors (RWw and RWr)"					
Mobile unit type	Remote device					
Note: The polling period for system input signal is 8 ms. The 8 ms or less input signal may not be detected.						

9.3 Selectable Allocation

For available allocations, see "Combination of I/O Extension Boards and Allocation Mode."

The port numbers of the CC-Link board are 512 to 639 for input ports and 768 to 895 for output ports.

9.3.1 Standard Mode Allocation

(1) In standard mode with two occupied stations

Input data (Master → Remote device)		
I/O port number	Signal name	Remote output. (Note 1)
512	Step stop (all tasks)	RYn0
513	Reserved	RYn1
514	Halt (all tasks)	RYn2
515	Strobe signal	RYn3
516	Skip interrupt	RYn4
517	-	RYn5
518	-	RYn6
519	Command and data odd parity	RYn7
520	Bit 0 in data area 1	RYn8
521	Bit 1 in data area 1	RYn9
522	Bit 2 in data area 1	RYnA
523	Bit 3 in data area 1	RYnB
524	Bit 4 in data area 1	RYnC
525	Bit 5 in data area 1	RYnD
526	Bit 6 in data area 1	RYnE
527	Bit 7 in data area 1	RYnF
528	Bit 0 in data area 2	RY(n+1)0
529	Bit 1 in data area 2	RY(n+1)1
530	Bit 2 in data area 2	RY(n+1)2
531	Bit 3 in data area 2	RY(n+1)3
532	Bit 4 in data area 2	RY(n+1)4
533	Bit 5 in data area 2	RY(n+1)5
534	Bit 6 in data area 2	RY(n+1)6
535	Bit 7 in data area 2	RY(n+1)7
536	Bit 8 in data area 2	RY(n+1)8
537	Bit 9 in data area 2	RY(n+1)9
538	Bit 10 in data area 2	RY(n+1)A
539	Bit 11 in data area 2	RY(n+1)B
540	Bit 12 in data area 2	RY(n+1)C
541	Bit 13 in data area 2	RY(n+1)D
542	Bit 14 in data area 2	RY(n+1)E
543	Bit 15 in data area 2	RY(n+1)F
544	Bit 0 in command area	RY(n+2)0
545	Bit 1 in command area	RY(n+2)1
546	Bit 2 in command area	RY(n+2)2
547	Bit 3 in command area	RY(n+2)3
548	Reserved	RY(n+2)4
549	Reserved	RY(n+2)5
550	Reserved	RY(n+2)6
551	Reserved	RY(n+2)7
552		RY(n+2)8
:	User input (INPUT m) (Note 2)	:
559		RY(n+2)F
560	Unused	RY(n+3)0
:		:
575		RY(n+3)F

Output data (Remote device → Master)		
I/O port number	Signal name	Remote input (Note 1)
768	-	RXn0
769	Robot running	RXn1
770	Robot error	RXn2
771	Servo ON	RXn3
772	Robot initialization completed	RXn4
773	Auto mode	RXn5
774	External mode	RXn6
775	Battery warning	RXn7
776	Robot warning	RXn8
777	Continued start permitted	RXn9
778	SS mode output	RXnA
779	Reserved	RXnB
780	Reserved	RXnC
781	Reserved	RXnD
782	Command processing completed	RXnE
783	Status area odd parity	RXnF
784	Bit 0 in status area	RX(n+1)0
785	Bit 1 in status area	RX(n+1)1
786	Bit 2 in status area	RX(n+1)2
787	Bit 3 in status area	RX(n+1)3
788	Bit 4 in status area	RX(n+1)4
789	Bit 5 in status area	RX(n+1)5
790	Bit 6 in status area	RX(n+1)6
791	Bit 7 in status area	RX(n+1)7
792	Bit 8 in status area	RX(n+1)8
793	Bit 9 in status area	RX(n+1)9
794	Bit 10 in status area	RX(n+1)A
795	Bit 11 in status area	RX(n+1)B
796	Bit 12 in status area	RX(n+1)C
797	Bit 13 in status area	RX(n+1)D
798	Bit 14 in status area	RX(n+1)E
799	Bit 15 in status area	RX(n+1)F
800		RX(n+2)0
:	User output (OUTPUT m) (Note 2)	:
815		RX(n+2)F
816	Unused	RX(n+3)0
:		:
825		RX(n+3)9
826	Error status flag (Note 3)	RX(n+3)A
827	Remote station ready (Note 4)	RX(n+3)B
828		RX(n+3)C
:	Unused	:
831		RX(n+3)F

Note 1: n denotes (station number - 1) × 2 (hexadecimal notation).

Note 2: m denotes I/O port number.

Note 3: Output timing is the same as that of robot error (I/O port number 770 (RXn2)) and robot warning (I/O port number 776 (RXn8)).

Note 4: Output timing is the same as that of robot initialization completed (I/O port number 772 (RXn4)).

Note 5: indicates system area, which cannot be used for user I/O.

Additional note: For remote registers RWw and RWr, refer to the "Remote Resistors (RWw and RWr)"

(2) In standard mode with three occupied stations

Input data (Master → Remote device)		
I/O port number	Signal name	Remote output (Note 1)
512	Step stop (all tasks)	RYn0
513	Reserved	RYn1
514	Halt (all tasks)	RYn2
515	Strobe signal	RYn3
516	Skip interrupt	RYn4
517	-	RYn5
518	-	RYn6
519	Command and data odd parity	RYn7
520	Bit 0 in data area 1	RYn8
521	Bit 1 in data area 1	RYn9
522	Bit 2 in data area 1	RYnA
523	Bit 3 in data area 1	RYnB
524	Bit 4 in data area 1	RYnC
525	Bit 5 in data area 1	RYnD
526	Bit 6 in data area 1	RYnE
527	Bit 7 in data area 1	RYnF
528	Bit 0 in data area 2	RY(n+1)0
529	Bit 1 in data area 2	RY(n+1)1
530	Bit 2 in data area 2	RY(n+1)2
531	Bit 3 in data area 2	RY(n+1)3
532	Bit 4 in data area 2	RY(n+1)4
533	Bit 5 in data area 2	RY(n+1)5
534	Bit 6 in data area 2	RY(n+1)6
535	Bit 7 in data area 2	RY(n+1)7
536	Bit 8 in data area 2	RY(n+1)8
537	Bit 9 in data area 2	RY(n+1)9
538	Bit 10 in data area 2	RY(n+1)A
539	Bit 11 in data area 2	RY(n+1)B
540	Bit 12 in data area 2	RY(n+1)C
541	Bit 13 in data area 2	RY(n+1)D
542	Bit 14 in data area 2	RY(n+1)E
543	Bit 15 in data area 2	RY(n+1)F
544	Bit 0 in command area	RY(n+2)0
545	Bit 1 in command area	RY(n+2)1
546	Bit 2 in command area	RY(n+2)2
547	Bit 3 in command area	RY(n+2)3
548	Reserved	RY(n+2)4
549	Reserved	RY(n+2)5
550	Reserved	RY(n+2)6
551	Reserved	RY(n+2)7
552	User input (INPUT m) (Note 2)	RY(n+2)8
:		:
591		RY(n+4)F
592		RY(n+5)0
:	Unused	:
607		RY(n+5)F

Output data (Remote device → Master)		
I/O port number	Signal number	Remote output (Note 1)
768	-	RXn0
769	Robot running	RXn1
770	Robot error	RXn2
771	Servo begin ON	RXn3
772	Robot initialization completed	RXn4
773	Auto mode	RXn5
774	External mode	RXn6
775	Battery warning	RXn7
776	Robot warning	RXn8
777	Continued start permitted	RXn9
778	SS mode output	RxnA
779	Reserved	RXnB
780	Reserved	RXnC
781	Reserved	RXnD
782	Command processing completed	RxnE
783	Status area odd parity	RXnF
784	Bit 0 in status area	RX(n+1)0
785	Bit 1 in status area	RX(n+1)1
786	Bit 2 in status area	RX(n+1)2
787	Bit 3 in status area	RX(n+1)3
788	Bit 4 in status area	RX(n+1)4
789	Bit 5 in status area	RX(n+1)5
790	Bit 6 in status area	RX(n+1)6
791	Bit 7 in status area	RX(n+1)7
792	Bit 8 in status area	RX(n+1)8
793	Bit 9 in status area	RX(n+1)9
794	Bit 10 in status area	RX(n+1)A
795	Bit 11 in status area	RX(n+1)B
796	Bit 12 in status area	RX(n+1)C
797	Bit 13 in status area	RX(n+1)D
798	Bit 14 in status area	RX(n+1)E
799	Bit 15 in status area	RX(n+1)F
800	User output (OUTPUT m) (Note 2)	RX(n+2)0
:		:
847		RX(n+4)F
848		Unused
:	:	
857	Error status flag (Note 3) Remote station ready (Note 4)	RX(n+5)9
858		RX(n+5)A
859	RX(n+5)B	
860	Unused	RX(n+5)C
:		:
863		RX(n+5)F

Note 1: n denotes (station number - 1) × 2 (hexadecimal notation).

Note 2: m denotes I/O port number.

Note 3: Output timing is the same as that of robot error (I/O port number 770 (RXn2)) and robot warning (I/O port number 776 (RXn8)).

Note 4: Output timing is the same as that of robot initialization completed (I/O port number 772 (RXn4)).

Note 5: indicates system area, which cannot be used for user I/O.

Additional note: For remote registers RWw and RWr, refer to the "Remote Resistors (RWw and RWr)"

(3) In standard mode with four occupied stations

Input data (Master → Remote device)		
I/O port number	Signal name	Remote output. (Note 1)
512	Step stop (all tasks)	RYn0
513	Reserved	RYn1
514	Halt (all tasks)	RYn2
515	Strobe signal	RYn3
516	Skip interrupt	RYn4
517	-	RYn5
518	-	RYn6
519	Command and data odd parity	RYn7
520	Bit 0 in data area 1	RYn8
521	Bit 1 in data area 1	RYn9
522	Bit 2 in data area 1	RYnA
523	Bit 3 in data area 1	RYnB
524	Bit 4 in data area 1	RYnC
525	Bit 5 in data area 1	RYnD
526	Bit 6 in data area 1	RYnE
527	Bit 7 in data area 1	RYnF
528	Bit 0 in data area 2	RY(n+1)0
529	Bit 1 in data area 2	RY(n+1)1
530	Bit 2 in data area 2	RY(n+1)2
531	Bit 3 in data area 2	RY(n+1)3
532	Bit 4 in data area 2	RY(n+1)4
533	Bit 5 in data area 2	RY(n+1)5
534	Bit 6 in data area 2	RY(n+1)6
535	Bit 7 in data area 2	RY(n+1)7
536	Bit 8 in data area 2	RY(n+1)8
537	Bit 9 in data area 2	RY(n+1)9
538	Bit 10 in data area 2	RY(n+1)A
539	Bit 11 in data area 2	RY(n+1)B
540	Bit 12 in data area 2	RY(n+1)C
541	Bit 13 in data area 2	RY(n+1)D
542	Bit 14 in data area 2	RY(n+1)E
543	Bit 15 in data area 2	RY(n+1)F
544	Bit 0 in command area	RY(n+2)0
545	Bit 1 in command area	RY(n+2)1
546	Bit 2 in command area	RY(n+2)2
547	Bit 3 in command area	RY(n+2)3
548	Reserved	RY(n+2)4
549	Reserved	RY(n+2)5
550	Reserved	RY(n+2)6
551	Reserved	RY(n+2)7
552	User input (INPUT m) (Note 2)	RY(n+2)8
:		:
623		RY(n+6)F
624		RY(n+7)0
:	Unused	:
639		RY(n+7)F

Output data (Remote device → Master)		
I/O port number	Signal name	Remote input (Note 1)
768	-	RXn0
769	Robot running	RXn1
770	Robot error	RXn2
771	Servo ON	RXn3
772	Robot initialization completed	RXn4
773	Auto mode	RXn5
774	External mode	RXn6
775	Battery warning	RXn7
776	Robot warning	RXn8
777	Continued start permitted	RXn9
778	SS mode output	RxnA
779	Reserved	RXnB
780	Reserved	RXnC
781	Reserved	RXnD
782	Command processing completed	RxnE
783	Status area odd parity	RXnF
784	Bit 0 in status area	RX(n+1)0
785	Bit 1 in status area	RX(n+1)1
786	Bit 2 in status area	RX(n+1)2
787	Bit 3 in status area	RX(n+1)3
788	Bit 4 in status area	RX(n+1)4
789	Bit 5 in status area	RX(n+1)5
790	Bit 6 in status area	RX(n+1)6
791	Bit 7 in status area	RX(n+1)7
792	Bit 8 in status area	RX(n+1)8
793	Bit 9 in status area	RX(n+1)9
794	Bit 10 in status area	RX(n+1)A
795	Bit 11 in status area	RX(n+1)B
796	Bit 12 in status area	RX(n+1)C
797	Bit 13 in status area	RX(n+1)D
798	Bit 14 in status area	RX(n+1)E
799	Bit 15 in status area	RX(n+1)F
800	User output (OUTPUT m) (Note 2)	RX(n+2)0
:		:
879		RX(n+6)F
880		Unused
:	:	
889	Error status flag (Note 3)	RX(n+7)9
890		RX(n+7)A
891	Remote station ready (Note 4)	RX(n+7)B
892	Unused	RX(n+7)C
:		:
895		RX(n+7)F

Note 1: n denotes (station number - 1) × 2 (hexadecimal notation).

Note 2: m denotes I/O port number.

Note 3: Output timing is the same as that of robot error (I/O port number 770 (RXn2)) and robot warning (I/O port number 776 (RXn8)).

Note 4: Output timing is the same as that of robot initialization completed (I/O port number 772 (RXn4)).

Note 5: indicates system area, which cannot be used for user I/O.

Additional note: For remote registers RWw and RWr, refer to the "Remote Resistors (RWw and RWr)"

9.3.2 Compatible Mode Allocation

(1) In the compatible mode with two occupied stations

Input data (Master → Remote device)		
I/O port number	Signal number	Remote output. (Note 1)
512	Step stop	RYn0
513	Continue start	RYn1
514	Halt	RYn2
515	Operation preparation start	RYn3
516	Skip interrupt	RYn4
517	Program start	RYn5
518	Reserved	RYn6
519	Reserved	RYn7
520	Bit 0 for program No. select	RYn8
521	Bit 1 for program No. select	RYn9
522	Bit 2 for program No. select	RYnA
523	Bit 3 for program No. select	RYnB
524	Bit 4 for program No. select	RYnC
525	Bit 5 for program No. select	RYnD
526	Bit 6 for program No. select	RYnE
527	Program No. select parity bit	RYnF
528	Motor power ON	RY(n+1)0
529	CAL execution	RY(n+1)1
530	Reserved	RY(n+1)2
531	SP100	RY(n+1)3
532	Switching to external mode	RY(n+1)4
533	Program reset	RY(n+1)5
534	Clear robot error	RY(n+1)6
535	Reserved	RY(n+1)7
536	User input (INPUT m) (Note 2)	RY(n+1)8
:		:
559		RY(n+2)F
560	Unused	RY(n+3)0
:		:
575		RY(n+3)F

Output data (Remote device → Master)		
I/O port number	Signal number	Remote input (Note 1)
768	-	RXn0
769	Robot running	RXn1
770	Robot error	RXn2
771	Auto mode	RXn3
772	External mode	RXn4
773	Program start reset	RXn5
774	Unused	RXn6
775	Unused	RXn7
776	Robot power-on completed	RXn8
777	Servo ON	RXn9
778	CAL completed	RXnA
779	Teaching being operated	RXnB
780	1 cycle completed	RXnC
781	Battery warning	RXnD
782	Robot warning	RXnE
783	Continued start permitted	RXnF
784	Error in the units place, bit 0	RX(n+1)0
785	Error in the units place, bit 1	RX(n+1)1
786	Error in the units place, bit 2	RX(n+1)2
787	Error in the units place, bit 3	RX(n+1)3
788	Error in the tens place, bit 0	RX(n+1)4
789	Error in the tens place, bit 1	RX(n+1)5
790	Error in the tens place, bit 2	RX(n+1)6
791	Error in the tens place, bit 3	RX(n+1)7
792	Error in the hundreds place, bit 0	RX(n+1)8
793	Error in the hundreds place, bit 1	RX(n+1)9
794	Error in the hundreds place, bit 2	RX(n+1)A
795	Error in the hundreds place, bit 3	RX(n+1)B
796	SS mode output	RX(n+1)C
797	Unused	RX(n+1)D
798	Unused	RX(n+1)E
799	Unused	RX(n+1)F
800	User output (OUTPUT m) (Note 2)	RX(n+2)0
:		:
815		RX(n+2)F
816	Unused	RX(n+3)0
:		:
825		RX(n+3)9
826	Error status flag (Note 3)	RX(n+3)A
827	Remote station ready (Note 4)	RX(n+3)B
828	Unused	RX(n+3)C
:		:
831		RX(n+3)F

Note 1: n denotes (station number - 1) × 2 (hexadecimal notation).

Note 2: m denotes I/O port number.

Note 3: Output timing is the same as that of robot error (I/O port number 770 (RXn2)) and robot warning (I/O port number 782 (RXnE)).

Note 4: Output timing is the same as that of robot power-on completed (I/O port number 776 (RXn8)).

Note 5: indicates system area, which cannot be used for user I/O.

Additional note: For remote registers RWw and RWr, refer to the "Remote Resistors (RWw and RWr)"

(2) In compatible mode with three occupied stations

Input data (Master → Remote device)		
I/O port number	Signal number	Remote output. (Note 1)
512	Step stop	RYn0
513	Continue start	RYn1
514	Halt	RYn2
515	Operation preparation start	RYn3
516	Skip interrupt	RYn4
517	Program start	RYn5
518	Reserved	RYn6
519	Reserved	RYn7
520	Bit 0 for program No. select	RYn8
521	Bit 1 for program No. select	RYn9
522	Bit 2 for program No. select	RYnA
523	Bit 3 for program No. select	RYnB
524	Bit 4 for program No. select	RYnC
525	Bit 5 for program No. select	RYnD
526	Bit 6 for program No. select	RYnE
527	Program No. select parity bit	RYnF
528	Motor power ON	RY(n+1)0
529	CAL execution	RY(n+1)1
530	Reserved	RY(n+1)2
531	SP100	RY(n+1)3
532	Switching to external mode	RY(n+1)4
533	Program reset	RY(n+1)5
534	Clear robot error	RY(n+1)6
535	Reserved	RY(n+1)7
536	User input (INPUT m) (Note 2)	RY(n+1)8
:		:
591		RY(n+4)F
592	Unused	RY(n+5)0
:		:
607		RY(n+5)F

Output data (Remote device → Master)		
I/O port number	Signal number	Remote input. (Note 1)
768	-	RXn0
769	Robot running	RXn1
770	Robot error	RXn2
771	Auto mode	RXn3
772	External mode	RXn4
773	Program start reset	RXn5
774	Unused	RXn6
775	Unused	RXn7
776	Robot power-on completed	RXn8
777	Servo ON	RXn9
778	CAL completed	RxnA
779	Teaching being operated	RXnB
780	1 cycle completed	RXnC
781	Battery warning	RXnD
782	Robot warning	RxnE
783	Continued start permitted	RXnF
784	Error in the units place, bit 0	RX(n+1)0
785	Error in the units place, bit 1	RX(n+1)1
786	Error in the units place, bit 2	RX(n+1)2
787	Error in the units place, bit 3	RX(n+1)3
788	Error in the tens place, bit 0	RX(n+1)4
789	Error in the tens place, bit 1	RX(n+1)5
790	Error in the tens place, bit 2	RX(n+1)6
791	Error in the tens place, bit 3	RX(n+1)7
792	Error in the hundreds place, bit 0	RX(n+1)8
793	Error in the hundreds place, bit 1	RX(n+1)9
794	Error in the hundreds place, bit 2	RX(n+1)A
795	Error in the hundreds place, bit 3	RX(n+1)B
796	SS mode output	RX(n+1)C
797	Unused	RX(n+1)D
798	Unused	RX(n+1)E
799	Unused	RX(n+1)F
800	User output (OUTPUT m) (Note 2)	RX(n+2)0
:		:
847		RX(n+4)F
848	Unused	RX(n+5)0
:		:
857		RX(n+5)9
858	Error status flag (Note 3)	RX(n+5)A
859	Remote station ready (Note 4)	RX(n+5)B
860	Unused	RX(n+5)C
:		:
863		RX(n+5)F

Note 1: n denotes (station number - 1) × 2 (hexadecimal notation).

Note 2: m denotes I/O port number.

Note 3: Output timing is the same as that of robot error (I/O port number 770 (RXn2)) and robot warning (I/O port number 782 (RXnE)).

Note 4: Output timing is the same as that of robot power-on completed (I/O port number 776 (RXn8)).

Note 5: indicates system area, which cannot be used for user I/O.

Additional note: For remote registers RWw and RWr, refer to the "Remote Resistors (RWw and RWr)"

(3) In compatible mode with 4 occupied stations

Input data (Master → Remote device)		
I/O port number	Signal number	Remote output. (Note 1)
512	Step stop	RYn0
513	Continue start	RYn1
514	Halt	RYn2
515	Operation preparation start	RYn3
516	Skip interrupt	RYn4
517	Program start	RYn5
518	Reserved	RYn6
519	Reserved	RYn7
520	Bit 0 for program No. select	RYn8
521	Bit 1 for program No. select	RYn9
522	Bit 2 for program No. select	RYnA
523	Bit 3 for program No. select	RYnB
524	Bit 4 for program No. select	RYnC
525	Bit 5 for program No. select	RYnD
526	Bit 6 for program No. select	RYnE
527	Program number select parity bit	RYnF
528	Motor power ON	RY(n+1)0
529	CAL execution	RY(n+1)1
530	Reserved	RY(n+1)2
531	SP100	RY(n+1)3
532	Switching to external mode	RY(n+1)4
533	Program reset	RY(n+1)5
534	Clear robot error	RY(n+1)6
535	Reserved	RY(n+1)7
536	User input (INPUT m) (Note 2)	RY(n+1)8
:		:
623		RY(n+6)F
624	Unused	RY(n+7)0
:		:
639		RY(n+7)F

Output data (Remote device → Master)		
I/O port number	Signal number	Remote input. (Note 1)
768	-	RXn0
769	Robot running	RXn1
770	Robot error	RXn2
771	Auto mode	RXn3
772	External mode	RXn4
773	Program start reset	RXn5
774	Unused	RXn6
775	Unused	RXn7
776	Robot power-on completed	RXn8
777	Servo ON	RXn9
778	CAL completed	RxnA
779	Teaching being operated	RXnB
780	1 cycle completed	RXnC
781	Battery warning	RXnD
782	Robot warning	RxnE
783	Continued start permitted	RXnF
784	Error in the units place, bit 0	RX(n+1)0
785	Error in the units place, bit 1	RX(n+1)1
786	Error in the units place, bit 2	RX(n+1)2
787	Error in the units place, bit 3	RX(n+1)3
788	Error in the tens place, bit 0	RX(n+1)4
789	Error in the tens place, bit 1	RX(n+1)5
790	Error in the tens place, bit 2	RX(n+1)6
791	Error in the tens place, bit 3	RX(n+1)7
792	Error in the hundreds place, bit 0	RX(n+1)8
793	Error in the hundreds place, bit 1	RX(n+1)9
794	Error in the hundreds place, bit 2	RX(n+1)A
795	Error in the hundreds place, bit 3	RX(n+1)B
796	SS mode output	RX(n+1)C
797	Unused	RX(n+1)D
798	Unused	RX(n+1)E
799	Unused	RX(n+1)F
800	User output (OUTPUT m) (Note 2)	RX(n+2)0
:		:
879		RX(n+6)F
880	Unused	RX(n+7)0
:		:
889		RX(n+7)9
890	Error status flag (Note 3)	RX(n+7)A
891	Remote station ready (Note 4)	RX(n+7)B
892	Unused	RX(n+7)C
:		:
895		RX(n+7)F

Note 1: n denotes (station number - 1) × 2 (hexadecimal notation).

Note 2: m denotes I/O port number.

Note 3: Output timing is the same as that of robot error (I/O port number 770 (RXn2)) and robot warning (I/O port number 782 (RXnE)).

Note 4: Output timing is the same as that of robot power-on completed (I/O port number 776 (RXn8)).

Note 5: indicates system area, which cannot be used for user I/O.

Additional note: For remote registers RWw and RWr, refer to the "Remote Resistors (RWw and RWr)"

9.4 Field Network Error Indication Parameter

The field network error indication parameter can be used with a CC-Link board. Refer to Section 6.5 "Field Network Error Indication."

9.5 Network Error Detection Wait-time Parameter

The network error detection wait-time parameter can be used with a CC-Link board. Refer to Section 6.6 "Network Error Detector Suppression."

9.6 Remote Resistors (RWw and RWr)

Combining the robot controller (software Ver. 3.0 or later) with CC-Link board (firmware Ver. 2.4 or later) enables the use of CC-Link remote resistors RWw and RWr. Remote resistors RWw and RWr are capable of processing the ON/OFF state of 16 consecutive I/O points as 16 bits of word data. Four words are allocated per station; therefore a total of 16 words (256 points) are allocated to four stations. Up to 16 words (256 points) each are added to CC-Link input/output points in comparison with conventional ones.

9.6.1 Operating Environment

The following operating environments are required in order to use remote resistors RWw and RWr.

Robot controller software version	Ver.3.0 or later
CC-Link board firmware version	Ver.2.4 or later

- When using WINCAPSIII

WINCAPSIII software version	Ver.3.0 or later
-----------------------------	------------------

Check each software version as indicated below.

9.6.1.1 Robot Controller Software Version

The software version of the robot controller is indicated in the main software ver. column of the "controller setting table" on the controller. It also can be checked on the version screen of the teach pendant.

From the top screen of the teach pendant, press [F6 Set]—[F6Maint.]—[F2 Version]

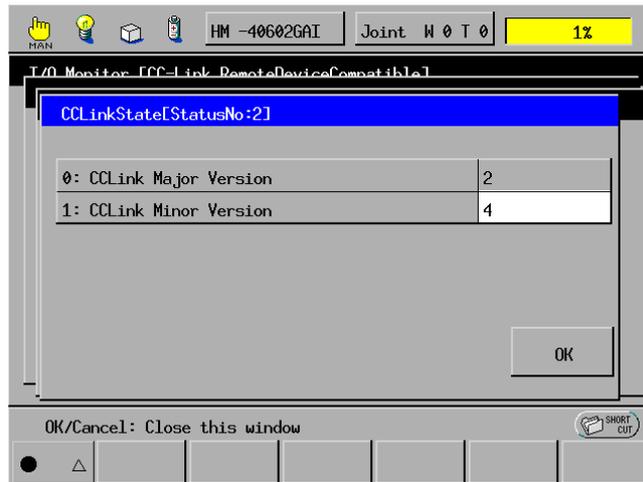
9.6.1.2 CC-Link Board Firmware Version

To check the firmware version of the CC-Link board, execute the following operation.

Path: From the top screen,

[F4 I/O]—[F6 Aux.]—[F12 FieldBus]—[F2 CCLink]—[F1 Status]

How to read this screen: Read figures from CCLink Major Version to CCLink Minor Version and add a dot between those two figures. The screen below shows that the version is 2.4.



9.6.1.3 WINCAPS III Software Version

To check the version of WINCAPS III, select "Version" from "Help" menu.

9.6.2 Programming Remote Resistors RWw and RWr

When accessing the remote resistors RWw and RWr (I/O port number from 4096 to 4863) via the program, conventional I/O port commands can be used. In addition to these commands, I/O variables used as word data (the data in units of 16 bits) also can be used.

By using I/O variables used as word data, remote resistors RWw and RWr can be handled as I/O variables without defining them with the DEFIO command beforehand.

I/O variables used as word data are called "WDIN" for input and "WDOOUT" for output. In the program, the reserved words "WDIN" and "WDOOUT" are used for accessing.

For a correspondence table between I/O variables used as word data and I/O port numbers, see "Correspondence Table between I/O Variables Used as Word Data and I/O Ports".

Note: Commands for conventional I/O port are DEFIO, IN, OUT, SET, RESET, WAIT etc. For details, refer to the PROGRAMMER'S MANUAL I.

9.6.2.1 Reserved Words Used as Word Data

WDIN

Function	Reads word data (data in units of 16 bits)
Syntax	WDIN[nn] or WDINnn (1) nn indicates word data number. Mathematical expressions and/or user defined macro names also can be used. (2) "[]" in the above statement does not mean it is omissible and it must be defined.
Description	Reads 16 points of I/O port number data that corresponds to the designated word data number. For a correspondence table between word data numbers and I/O port numbers, see "Correspondence Table between I/O Variables Used as Word Data and I/O Ports". The numeric value ranges from -32768 to 32767, and it is the same range as word type I/O variables declared with DEFIO command. "IN" command can be omitted. For example, (1) and (2) below execute the same process. (1) IN I[1] = WDIN[0] 'Store the value of WDIN[0] in I[1]. (2) I[1] = WDIN[0] 'Store the value of WDIN[0] in I[1]. WDIN can also be used for substitute or conditional expressions.
Related Terms	WDOUT, IN, WAIT, OUT, SET, RESET.

Example

```
DEFIO iowInValue = WORD, 4096
                                'Defines the data from IO4096 as WORD.
DEFIO iowOutValue = WORD, 4608
                                'Defines the data from IO4608 as WORD.
#DEFINE BASE_NUM 5
                                'Allocates 5 to the BASE_NUM.

I[0] = WDOOUT[0] + WDIN[0]      'Adds values of WDOOUT0 and WDIN0, and stores the
                                'result in I[0].
I[0] = iowOutValue + iowInValue
                                'Executes the same process as the previous line.

IF WDIN[0] = 32767 THEN
    SET WDOOUT[0]                'Changes all bits of WDOOUT[0] to ON.
    OUT WDOOUT[1] = &h5555        'Sets &h5555 (hexadecimal number) to WDOOUT[1].
    WAIT WDIN[BASE_NUM + I[1]] = 12767
                                'Waits until the value of WDIN[BASE_NUM plus I[1]]
                                'becomes 12767.
ENDIF
IF WDIN0 = -32768 THEN
                                'If the value of WDIN[0] is -32768, it becomes
                                'true.
    RESET WDOOUT0                'Changes all bits of WDOOUT[0] to OFF.
    OUT WDOOUT1 = -1             'Sets -1 to WDOOUT[1].
    WAIT WDIN[2] AND &HFFFF = &HAAAA
                                'Waits until the value of WDIN[2] becomes &HAAAA.
ENDIF
```

WDOUT

Function Outputs word data (the data in units of 16 bits)

Syntax WDOUT[nn] or WDOUTnn

- (1) nn indicates the word data number.
Mathematical expressions and/or user defined macro names also can be used.
- (2) "[]" in the above statement does not mean it is omissible and it must be defined.

Description Outputs word data to the I/O port number that corresponds to the designated word data number. It can also read the status. For a correspondence table between the word data number and I/O port number, see "Correspondence Table between I/O Variables Used as Word Data and I/O Ports".
The numeric value ranges from -32768 to 32767, and it is the same range as word type I/O variables declared with DEFIO command.
Carrying out SET/RESET changes all 16 bits of designated word data to ON/OFF.

Related Terms WDIN, WAIT, OUT, SET, RESET

Example

```
DEFIO iowInValue = WORD, 4096
                                'Defines the data from IO4096 as WORD.
DEFIO iowOutValue = WORD, 4608
                                'Defines the data from IO4608 as WORD.
#DEFINE BASE_NUM 5             'Allocates 5 to the BASE_NUM.

I[0] = WDOUT[0] + WDIN[0]      'Adds values of WDOUT0 and WDIN0, and stores the
                                'result in I[0].
I[0] = iowOutValue + iowInValue
                                'Executes the same process as the previous line.

IF WDIN[0] = 32767 THEN        'If the value of WDIN[0] is 32767, it becomes true.
    SET WDOUT[0]                'Changes all bits of WDOUT[0] to ON.
    OUT WDOUT[1] = &h5555        'Sets &h5555 (hexadecimal number) to WDOUT[1].
    WAIT WDIN[BASE_NUM + I[1]] = 12767
                                'Waits until the value of WDIN[BASE_NUM plus I[1]]
                                'becomes 12767.
ENDIF

IF WDIN0 = -32768 THEN        'If the value of WDIN[0] is -32768, it becomes
                                'true.
    RESET WDOUT0                'Changes all bits of WDOUT[0] to OFF.
    OUT WDOUT1 = -1             'Sets -1 to WDOUT[1].
    WAIT WDIN[2] AND &HFFFF = &HAAAA
                                'Waits until the value of WDIN[2] becomes &HAAAA.
ENDIF
```

9.6.2.2 Correspondence Table between I/O Variables Used as Word Data and I/O Ports

The table below is a correspondence table between I/O variables used as word data and I/O ports.

Input data RWw (Master → Remote device)		Output data RWr (Remote device → Master)				
I/O port No.	Word data	I/O port No.	Word data			
4096 to 4111	WDIN0	4608 to 4623	WDOUT0	Occupied 2 stations	Occupied 3 stations	Occupied 4 stations
4112 to 4127	WDIN1	4624 to 4639	WDOUT1			
4128 to 4143	WDIN2	4640 to 4655	WDOUT2			
4144 to 4159	WDIN3	4656 to 4671	WDOUT3			
4160 to 4175	WDIN4	4672 to 4687	WDOUT4			
4176 to 4191	WDIN5	4688 to 4703	WDOUT5			
4192 to 4207	WDIN6	4704 to 4719	WDOUT6			
4208 to 4223	WDIN7	4720 to 4735	WDOUT7			
4224 to 4239	WDIN8	4736 to 4751	WDOUT8			
4240 to 4255	WDIN9	4752 to 4767	WDOUT9			
4256 to 4271	WDIN10	4768 to 4783	WDOUT10			
4272 to 4287	WDIN11	4784 to 4799	WDOUT11			
4288 to 4303	WDIN12	4800 to 4815	WDOUT12			
4304 to 4319	WDIN13	4816 to 4831	WDOUT13			
4320 to 4335	WDIN14	4832 to 4847	WDOUT14			
4336 to 4351	WDIN15	4848 to 4863	WDOUT15			

When the controller occupies 2, 3 or 4 stations, up to 8, 12, or 16 words, respectively can be used.

The highest I/O port number becomes the sign bit. Taking WDIN0 as an example, I/O port number 4111 becomes the sign bit.

9.6.2.3 Precautions when Programming with WDIN and WDOUT

When using WDIN or WDOUT, be sure to observe the following.

- (1) When "Disable General Out" or "Disable All" is selected in the I/O lock setting (path: [F4 I/O]—[F6 Aux.]—[I/O LOCK]), even if you change the value with OUT, SET or RESET, the change is not reflected in CC-Link master.
- (2) WDIN and WDOUT are reserved words. These words cannot be used as, for example, variable names for local variables.
- (3) When comparing values, if the values to be compared are binary notation or hexadecimal notation, mask 16 bits of values that are read with WDIN or WDOUT. The example below compares WDIN[2] with &HAAAA (hexadecimal notation). Before comparing, mask WDIN[2] with &HFFFF.

```
WAIT WDIN[2] AND &HFFFF = &HAAAA
                                'Waits until the value of WDIN[2] becomes &HAAAA.
```

When you need to perform a comparison positively, carry out mask processing.

9.6.3 Monitoring and Modifying I/O Variables Used as Word Data via the Teach Pendant

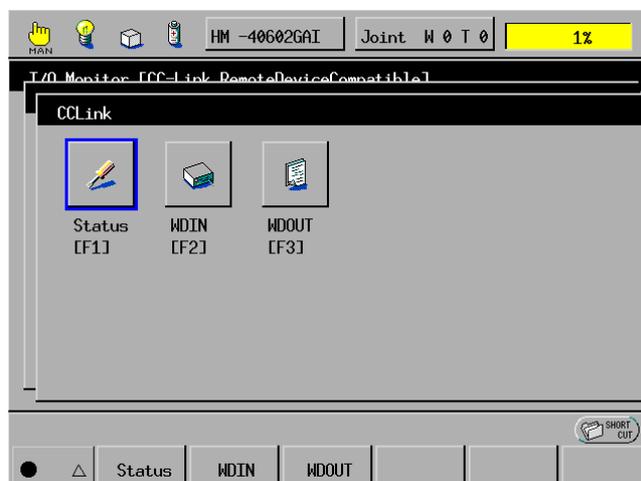
There is a variable list screen for I/O variables used as word data. You can monitor and modify variable values on that screen. "Quick reference function" and "Registered variable reference function" can also be used to monitor or modify variable values used in the program.

9.6.3.1 Monitoring and Modifying Variable Values on the WDIN and WDOUT Variable List Screens

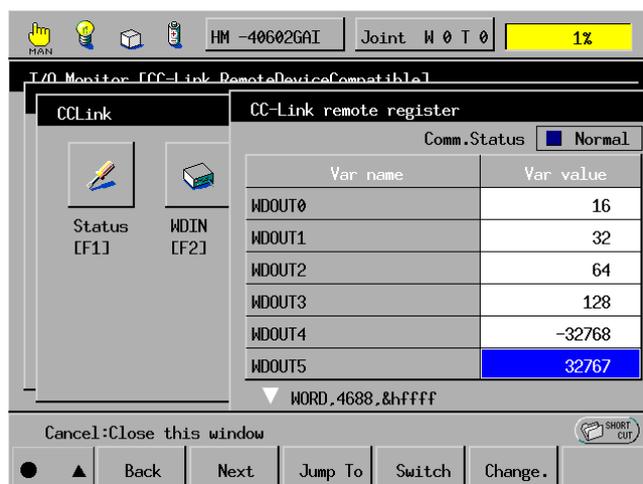
Variable values can be monitored and modified on the WDIN and WDOUT variable list screens by operating the teach pendant as follows.

Path: From the top screen—[F4 I/O]—[F6 Aux.]—[F12 FieldBus]—[F2 CCLink]

- (1) [CCLink] window displays. Press either [F2 WDIN] or [F3 WDOUT].



(2) When pressing [F3 WDOUT], the following window displays.



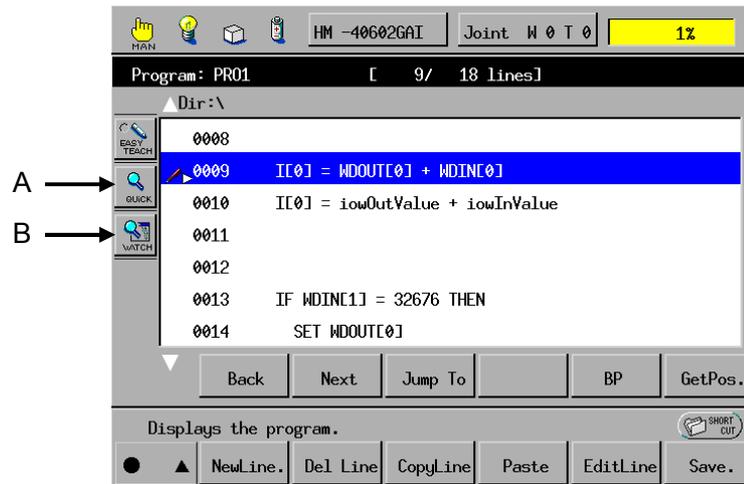
Available function keys	
[F1 Back]	Displays the previous page.
[F2 Next]	Displays the next page.
[F3 Jump To]	Displays the "Jump To Variable Number" window. Type a word data number with the numerical keys and press [OK]. Doing so displays the target WDOUT position.
[F4 Switch]	Displays the value of variable in hexadecimal notation.
[F5 Change.]	Displays the "Change" window. Enter a value you want to assign with the numerical keys and then press OK while holding down the deadman switch. Doing so changes the selected WDOUT value.
[F12 Register]	Selected WDOUT is registered in the registered variable reference function. You can see the registered variables with the registered variable reference function. For details, refer to the "Monitoring and Modifying Variable Values with Quick Reference and Registered Variable Reference Functions."

For WDIN, available function keys are same as WDOUT. When you change variables with [F5 Change.], you need to configure the dummy I/O setting for all I/O corresponding to WDIN. Dummy I/O setting can be configured via the teach pendant or WINCAPS III. For details, see "Modifying" in "Monitoring and Modifying I/O Data (units of 1 bit) via the Teach Pendant" and "Monitoring and Modifying I/O Data (units of 1 bit) via WINCAPS III".

9.6.3.2 Monitoring and Modifying Variable Values with Quick Reference and Registered Variable Reference Functions

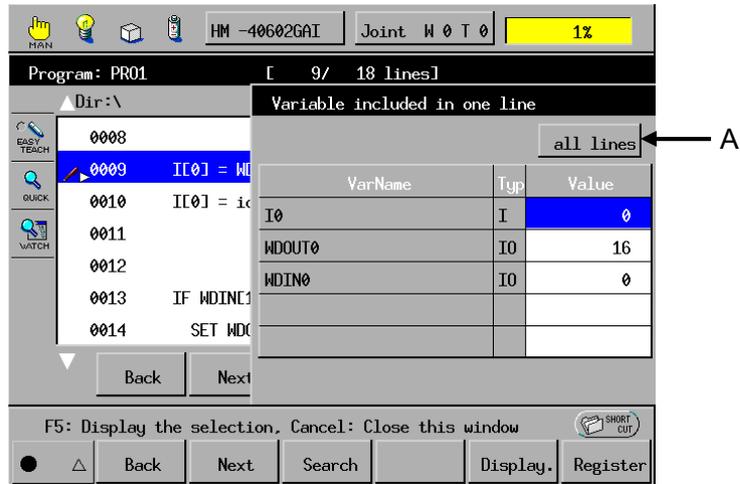
The operation of the teach pendant below allows variable values to be monitored and modified using the quick reference or registered variable reference functions for WDIN and WDOU.

Path: From the top screen—[F1 Program]



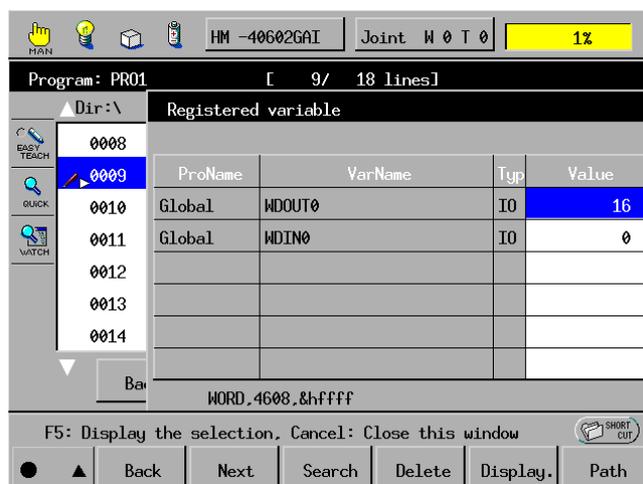
A	QUICK reference button
B	WATCH button

- (1) Press [Quick reference] button, to display the "Variables included in one line" window (see below) where variables involved in the currently highlighted line are displayed.



Available function keys	
[F1 Back]	Displays the previous page.
[F2 Next]	Displays the next page.
[F3 Search]	Searches a variable name from variable list.
[F5 Display]	Displays the selected variables. Changes can be made to values, etc. When you modify variable values of WDIN or WDOUT, press OK while holding down the deadman switch.
[F6 Register]	After registering, the registered variable can be displayed by the registered variable reference function.
A: Display switcher button	You can switch the display between "Variables included in one line" and "Variables included in all lines". While the "Variables included in one line" window displays not only local variables but also global variables, the "Variables included in all lines" window cannot display global variables. Since WDIN and WDOUT are global variables, the "Variables included in all lines" window cannot show them.

- (2) Pressing the WATCH button displays the variable list registered by the quick reference function etc.



Available function keys	
[F1 Back]	Displays the previous page.
[F2 Next]	Displays the next page.
[F3 Search]	Searches a variable name from variable list.
[F4 Delete]	Deletes the selected variable from the list of the registered variable reference function.
[F5 Display]	Displays the selected variable. Changes can be made to values, etc. When you modify variable values of WDIN or WDOUT, press OK while holding down the deadman switch.
[F6 Path]	Displays the folder path of the program where the selected variable is defined. Since WDIN and WDOUT are global variables, "Global" is displayed in the program name column (ProName).
[F10 Del All]	Deletes the entire registered variable list in the registered variable reference function.

9.6.4 Monitoring and Modifying I/O Data (units of 1 bit) via the Teach Pendant

The following procedures allow variable values to be monitored and modified in 1 bit units.

Path: From the top screen—[F4 I/O]

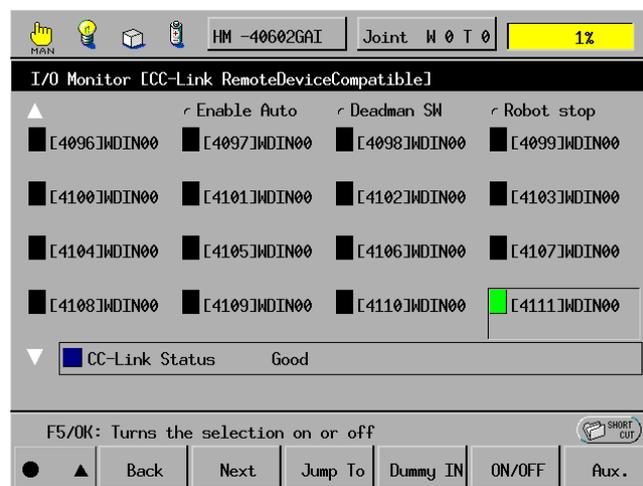
Move the cursor to the I/O port number where remote resistors RWw and RWr are allocated.

[F3 Jump to] is useful since you can jump to the desired I/O port number.

The example window below shows the 16 bits of data starting from the I/O port number 4096.

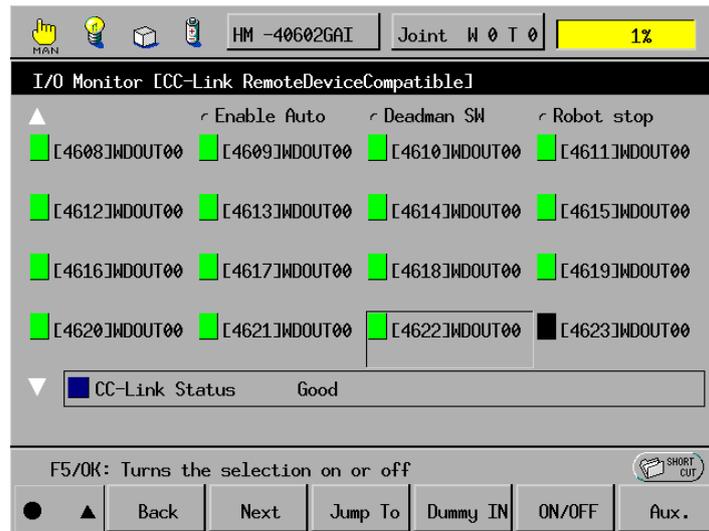
This data is equivalent to WDIN0. The most significant bits for WDIN and WDOU are sign bits.

Therefore, the window below indicates that WDIN0 is -32768 (two's complement number representation).



Available function keys	
[F1 Back]	Displays the previous page.
[F2 Next]	Displays the next page.
[F3 Jump To]	Displays the "Jump to I/O No." window. Type an I/O port address you want to see with the numerical keys and press OK. Doing so displays the target input or output signal.
[F4 Dummy IN]	Allows the selected system-input port to accept a dummy input. That input port is marked with "!" and the dummy I/O icon is displayed in the status bar of the top of the screen. This command is used when testing programs. The deadman switch must be held down, while configuring the setting.
[F5 ON/OFF]	Displays the system message "Are you sure you want to turn the I/O xxxx ON (or OFF)?" Pressing the OK button while holding down the deadman switch turns the selected input port ON (or OFF).
[F6 Aux.]	Displays various Aux. menus.
[F10 ClrDummy]	Clears the dummy input setting.

The window below shows 16 bits of port numbers starting from 4608. This data is equivalent to WDOU0. The following window indicates that WDOU is 32767.



9.6.5 Monitoring and Modifying I/O Variables Used as Word Data via WINCAPS III

You can monitor the I/O variables used as word data being used in the program, by using the chip help or the quick watch on the program view. After registering in the watch information, variable values can be monitored and modified on the “Watch” window. You can also check the changes in value in the variable log while executing the program.

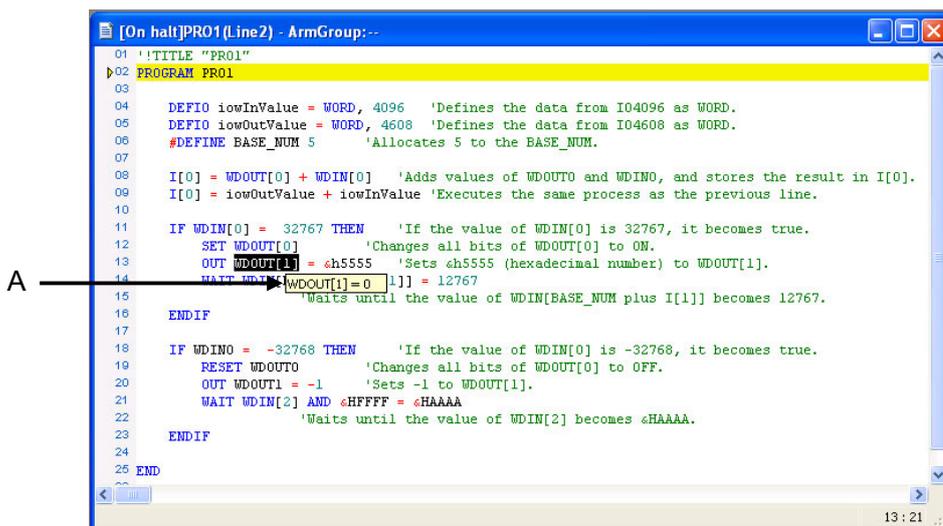
Since WDIN and WDOOUT are global variables, the “Local Variable” window cannot show them.

- (1) Switch to the monitoring function or debugging function.

To switch to the monitoring function, select the “Monitor Communication”/“Online (Monitor)” from the “Connect” menu.

To switch to the debug function, select the “Monitor Communication”/“Online (Debug)” from the “Connect” menu.

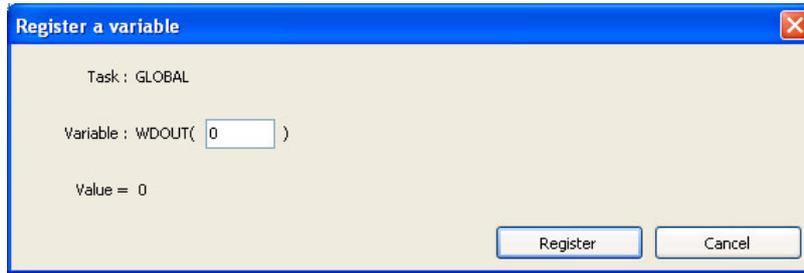
- (2) Double click the arbitrary program from the “Project window” or “Program list” window and then select the arbitrary variables (WDOOUT[1] is selected on the screen below). Pointing the cursor to the selected variable displays the chip help.



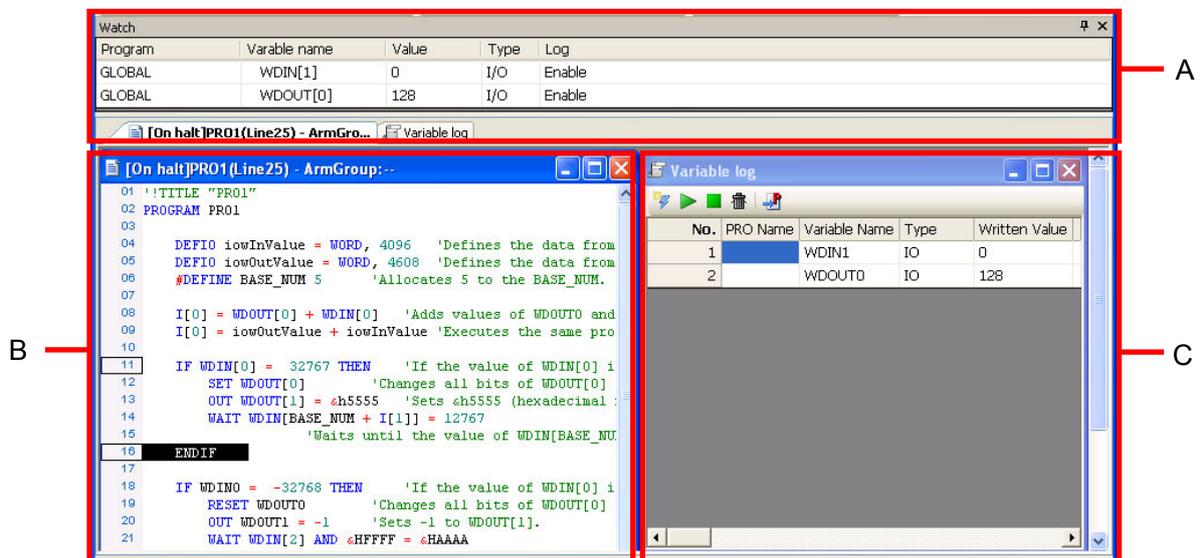
```
01 'TITLE "PRO1"
02 PROGRAM PRO1
03
04 DEFIO iowInValue = WORD, 4096 'Defines the data from I04096 as WORD.
05 DEFIO iowOutValue = WORD, 4608 'Defines the data from I04608 as WORD.
06 #DEFINE BASE_NUM 5 'Allocates 5 to the BASE_NUM.
07
08 I[0] = WDOOUT[0] + WDIN[0] 'Adds values of WDOOUT0 and WDIN0, and stores the result in I[0].
09 I[0] = iowOutValue + iowInValue 'Executes the same process as the previous line.
10
11 IF WDIN[0] = 32767 THEN 'If the value of WDIN[0] is 32767, it becomes true.
12 SET WDOOUT[0] 'Changes all bits of WDOOUT[0] to ON.
13 OUT WDOOUT[1] = &h5555 'Sets &h5555 (hexadecimal number) to WDOOUT[1].
14 WAIT WDIN[0] AND WDOOUT[1] = 12767 'Waits until the value of WDIN[BASE_NUM plus I[1]] becomes 12767.
15
16 ENDIF
17
18 IF WDIN[0] = -32768 THEN 'If the value of WDIN[0] is -32768, it becomes true.
19 RESET WDOOUT0 'Changes all bits of WDOOUT[0] to OFF.
20 OUT WDOOUT[1] = -1 'Sets -1 to WDOOUT[1].
21 WAIT WDIN[2] AND &HFFFF = &HAAAA 'Waits until the value of WDIN[2] becomes &HAAAA.
22
23 ENDIF
24
25 END
```

A	Chip help
---	-----------

- (3) Select the arbitrary variable (WDOUT[1] is selected on the screen below). Click the right mouse button and select "Show quick watch". The "Quick watch" dialog displays.



- (4) Register the arbitrary variables in the watch (on the screen below, WDOUT[1] and WDOUT[0] are registered) and set the variable log start line and stop line in the arbitrary lines (13th and 18th lines are set on the screen below). Run the program and record the variable log.



A	"Watch" window
B	Program view
C	"Variable log" window

9.6.6 Monitoring and Modifying I/O Data (units of 1 bit) via WINCAPS III

You can monitor and modify I/O data values in units of one bit on "I/O" window.

9.6.6.1 Monitoring

Monitoring can be performed as follows.

- (1) Switch to the monitoring or debugging functions.

To switch to the monitoring function, select the "Monitor Communication" / "Online (Monitor)" from the "Connect" menu.

To switch to the debugging function, select the "Monitor Communication" / "Online (Debug)" from the "Connect" menu.

- (2) Select the "I/O" from the "Display" menu. "I/O" window displays.

The window below shows 16 bits of WDIN0. The most significant bits for WDIN and WDOUT are sign bits.

No.	State	Type	Usage	Macro	Dummy	Smart
4096	●	User input	Remote register input	WDIN00B0	<input type="checkbox"/>	<input type="checkbox"/>
4097	●	User input	Remote register input	WDIN00B1	<input type="checkbox"/>	<input type="checkbox"/>
4098	●	User input	Remote register input	WDIN00B2	<input type="checkbox"/>	<input type="checkbox"/>
4099	●	User input	Remote register input	WDIN00B3	<input type="checkbox"/>	<input type="checkbox"/>
4100	●	User input	Remote register input	WDIN00B4	<input type="checkbox"/>	<input type="checkbox"/>
4101	●	User input	Remote register input	WDIN00B5	<input type="checkbox"/>	<input type="checkbox"/>
4102	●	User input	Remote register input	WDIN00B6	<input type="checkbox"/>	<input type="checkbox"/>
4103	●	User input	Remote register input	WDIN00B7	<input type="checkbox"/>	<input type="checkbox"/>
4104	●	User input	Remote register input	WDIN00B8	<input type="checkbox"/>	<input type="checkbox"/>
4105	●	User input	Remote register input	WDIN00B9	<input type="checkbox"/>	<input type="checkbox"/>
4106	●	User input	Remote register input	WDIN00B10	<input type="checkbox"/>	<input type="checkbox"/>
4107	●	User input	Remote register input	WDIN00B11	<input type="checkbox"/>	<input type="checkbox"/>
4108	●	User input	Remote register input	WDIN00B12	<input type="checkbox"/>	<input type="checkbox"/>
4109	●	User input	Remote register input	WDIN00B13	<input type="checkbox"/>	<input type="checkbox"/>
4110	●	User input	Remote register input	WDIN00B14	<input type="checkbox"/>	<input type="checkbox"/>
4111	●	User input	Remote register input	WDIN00B15	<input type="checkbox"/>	<input type="checkbox"/>

A	Number input box
---	------------------

- (3) Move the cursor to the I/O port number where remote resistors RWw and RWr are allocated. The "JumpTo" button is useful because it allows you to jump to the desired I/O port number by designating the I/O port number. Enter the desired I/O port number in the number input box to jump to the desired I/O port number.

9.6.6.2 Modifying

To modify the value of input signal, configure the dummy I/O setting. By pretending to change I/O status, dummy I/O can debug the program before completing the equipments. The following types can configure the dummy I/O setting.

- User input
- Hand input
- System input (Available only in online(debug) mode)

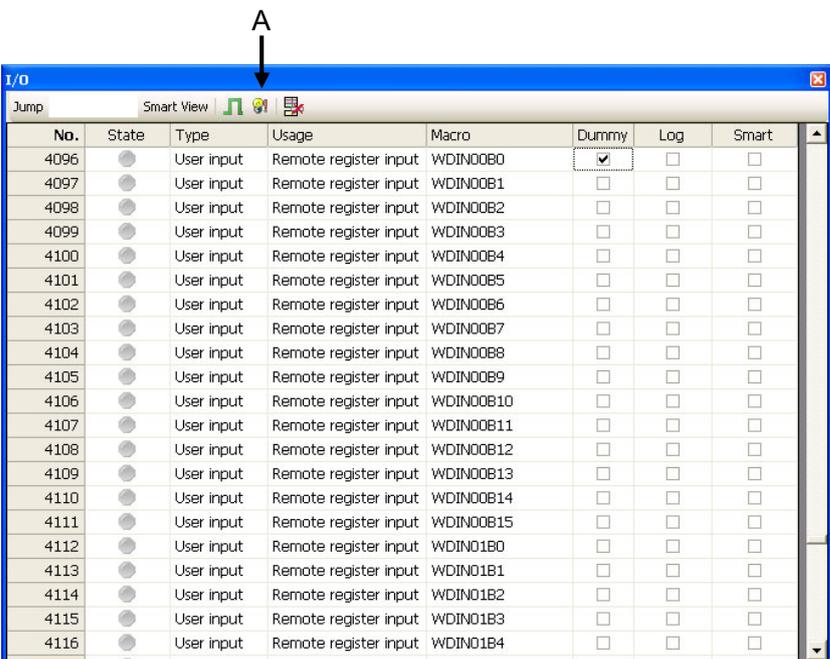
(1) Switch to the monitoring or debugging functions.

To switch to the monitoring function, choose “Monitor Communication” / ”Online (Monitor)” from “Connect” menu.

To switch to the debugging function, choose “Monitor Communication” / ”Online (Debug)” from “Connect” menu.

(2) Choose “I/O” from “Display” menu. ”I/O” window displays.

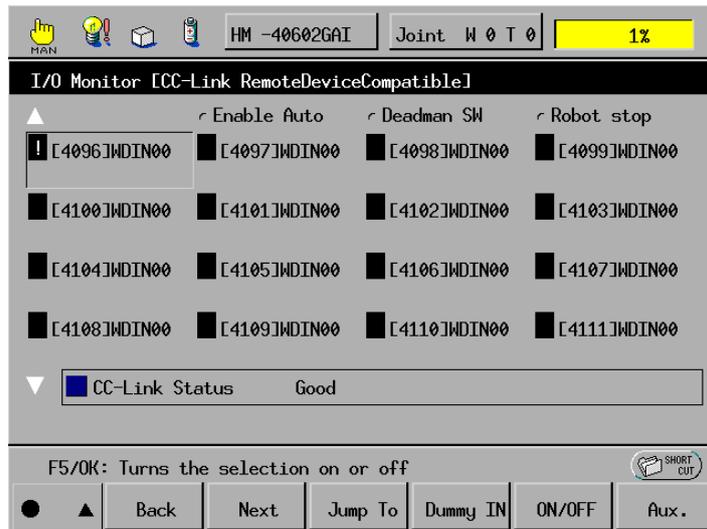
(3) Click the checkbox of the arbitrary I/O number in the Dummy column, and then the check mark is entered. (No. 4096 is checked on the screen below)
 Note that if you check the space outside the checkbox, the check mark is not entered.



No.	State	Type	Usage	Macro	Dummy	Log	Smart
4096	●	User input	Remote register input	WDIN00B0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4097	●	User input	Remote register input	WDIN00B1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4098	●	User input	Remote register input	WDIN00B2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4099	●	User input	Remote register input	WDIN00B3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4100	●	User input	Remote register input	WDIN00B4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4101	●	User input	Remote register input	WDIN00B5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4102	●	User input	Remote register input	WDIN00B6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4103	●	User input	Remote register input	WDIN00B7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4104	●	User input	Remote register input	WDIN00B8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4105	●	User input	Remote register input	WDIN00B9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4106	●	User input	Remote register input	WDIN00B10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4107	●	User input	Remote register input	WDIN00B11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4108	●	User input	Remote register input	WDIN00B12	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4109	●	User input	Remote register input	WDIN00B13	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4110	●	User input	Remote register input	WDIN00B14	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4111	●	User input	Remote register input	WDIN00B15	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4112	●	User input	Remote register input	WDIN01B0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4113	●	User input	Remote register input	WDIN01B1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4114	●	User input	Remote register input	WDIN01B2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4115	●	User input	Remote register input	WDIN01B3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4116	●	User input	Remote register input	WDIN01B4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A “Dummy IN” button

- (4) Click the “Dummy IN” button. The setting in the Dummy column is then reflected in the controller.

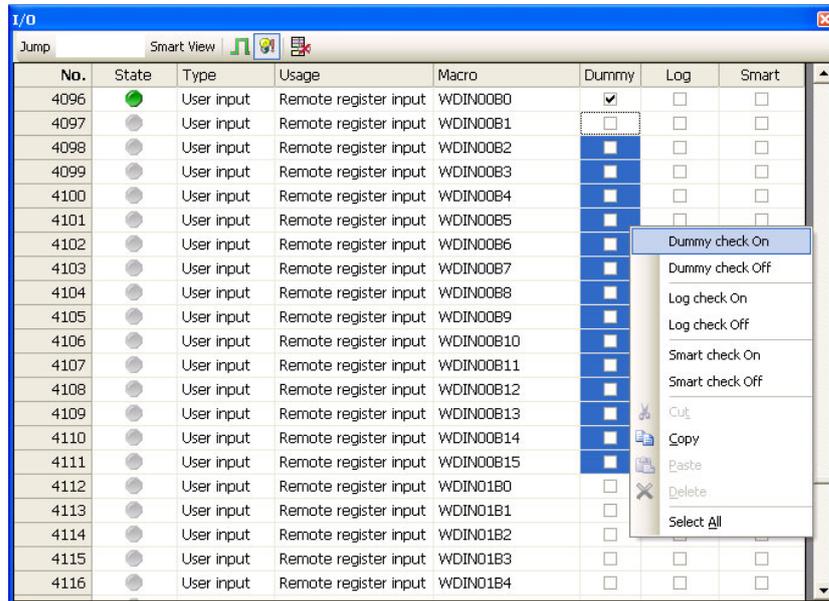


- (5) If you click the I/O port number in the State column where the dummy I/O setting is configured (No.4096 is selected on the screen below), the light lights green and changes the status to ON. Click it again to change the status to OFF.

The screenshot shows the 'I/O' configuration window with a table of input points. The table has columns for No., State, Type, Usage, Macro, Dummy, Log, and Smart. The 'State' column shows a green circle for No. 4096 and grey circles for others. The 'Dummy' column has a checked box for No. 4096 and unchecked boxes for others.

No.	State	Type	Usage	Macro	Dummy	Log	Smart
4096	●	User input	Remote register input	WDIN00B0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4097	●	User input	Remote register input	WDIN00B1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4098	●	User input	Remote register input	WDIN00B2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4099	●	User input	Remote register input	WDIN00B3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4100	●	User input	Remote register input	WDIN00B4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4101	●	User input	Remote register input	WDIN00B5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4102	●	User input	Remote register input	WDIN00B6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4103	●	User input	Remote register input	WDIN00B7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4104	●	User input	Remote register input	WDIN00B8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4105	●	User input	Remote register input	WDIN00B9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4106	●	User input	Remote register input	WDIN00B10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4107	●	User input	Remote register input	WDIN00B11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4108	●	User input	Remote register input	WDIN00B12	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4109	●	User input	Remote register input	WDIN00B13	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4110	●	User input	Remote register input	WDIN00B14	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4111	●	User input	Remote register input	WDIN00B15	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4112	●	User input	Remote register input	WDIN01B0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4113	●	User input	Remote register input	WDIN01B1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4114	●	User input	Remote register input	WDIN01B2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4115	●	User input	Remote register input	WDIN01B3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4116	●	User input	Remote register input	WDIN01B4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- (6) When configuring the dummy I/O setting for two or more I/O port numbers, point the cursor to the space outside the checkbox in the Dummy column and drag to choose the setting range. (From No. 4097 to 4111 are chosen on the screen below.) Then point the cursor on the setting range and click the right mouse button to choose the “Dummy check On.”



9.6.7 Monitoring and Modifying Variable Values via the Mini-pendant

You can monitor and modify I/O data in units of 1 bit via the mini-pendant.

- Key : [I/O] key [SHIFT] + [STEP START]
- Operation

The following are I/O port names allocated to remote resistors RWw and RWr.

I/O port and Symbol

I/O port	Symbol
CC-Link Remote resistor input area (RWw)	WI
CC-Link Remote resistor output area (RWr)	WO

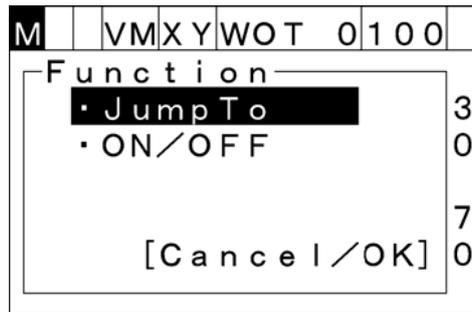
- (1) Press [I/O] to call up the I/O signal truth table as shown below.
The window below displays low 8 bits of WDIN0.
The most significant bits for WDIN and WDOUT are sign bits.

M	V	M	X	Y	W	O	T	0	1	0	0
4 0 9 6	4 0 9 7	4 0 9 8	4 0 9 9	WI	0	WI	0	WI	0	WI	0
4 1 0 0	4 1 0 1	4 1 0 2	4 1 0 3	WI	0	WI	0	WI	0	WI	0
[Standrd]											

- (2) To change the truth status assigned to I/O lines, choose the line with the up, down, left, and right cursor keys. It is useful to use the "JumpTo" function at this time. For the "JumpTo" function, see "JumpTo".

M	V	M	X	Y	W	O	T	0	1	0	0
4 6 0 8	4 6 0 9	4 6 1 0	4 6 1 1	WO	0	WO	0	WO	0	WO	0
4 6 1 2	4 6 1 3	4 6 1 4	4 6 1 5	WO	0	WO	0	WO	0	WO	0
[Standrd]											

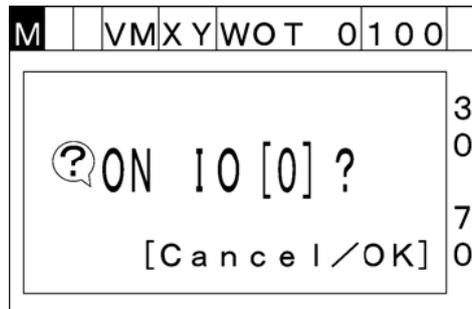
- (3) Press [OK] call up the "Function" screen that handles I/O signals. To return to the I/O signal truth table, press [CANCEL].



- (4) Choose one of handles with the up and down cursor keys, then press [OK].

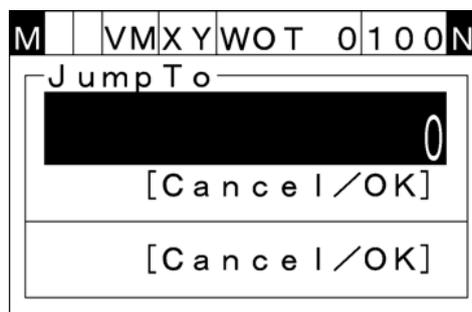
1. ON/OFF

If you choose "ON/OFF" with the up and down cursor keys and press [OK] with the deadman switch held down, then the following screen displays where you can reverse the truth assignment of the line. To discard the new setting and return to the I/O signal truth table, press [CANCEL].



2. JumpTo

If you choose "JumpTo" with the up and down cursor keys, the JumpTo screen displays. Enter an I/O line number you want to jump to, into the highlighted line and then press [OK]. To discard the new setting and return to the I/O signal truth table, press [CANCEL].



On the I/O signal truth table, the display can be changed for each screen using the up, down, right, and left cursor keys with the [SHIFT] key held down.

Chapter 10 PROFIBUS-DP Slave Board (Commercial board recommended)

10.1 Overview

Mounting a PROFIBUS-DP slave board in the robot controller enables the controller to communicate with external devices according to the PROFIBUS-DP-compliant communications protocol.

As a slave unit, the robot controller can exchange I/O data with PROFIBUS-DP-compliant field devices of different manufacturers.

For details about PROFIBUS, refer to the PROFIBUS website as shown below.

PROFIBUS International: <http://www.profibus.com/>

10.2 Requirements for Use of PROFIBUS-DP Slave Board

A recommended commercial PROFIBUS-DP slave board should be used for the RC7M robot controller. To configure the board in your robot system, you need to purchase the board, obtain the license for permitting the PROFIBUS-DP slave configuration software to run, enter the user ID of the configuration software, and mount the board in the controller as detailed below.

- (1) Purchasing a PROFIBUS-DP slave board on the user's responsibility

Purchase the PROFIBUS-DP slave board listed below for the use of the RC7M robot controller.

Board model	CIF50-DPS\DENSO
Manufacturer	Hilscher GmbH

- (2) Obtaining the license for permitting the PROFIBUS-DP slave configuration software to run

At the time of purchase of your robot system or if you inform Denso Wave of the serial number of your robot, you can purchase the PROFIBUS-DP slave configuration software. Denso Wave issues the license that permits the configuration software to run in your controller.

- (3) Entering the user ID indicated on the PROFIBUS-DP slave configuration software license

Use the teach pendant and call up the Input ID Number screen with the following procedure.

From the top screen of the teach pendant, press [F6 Set]—[F7 Options.]—[F8 Function Extension]—[F5 Input ID].

Enter the user ID indicated in the upper right-hand corner of the license certificate.

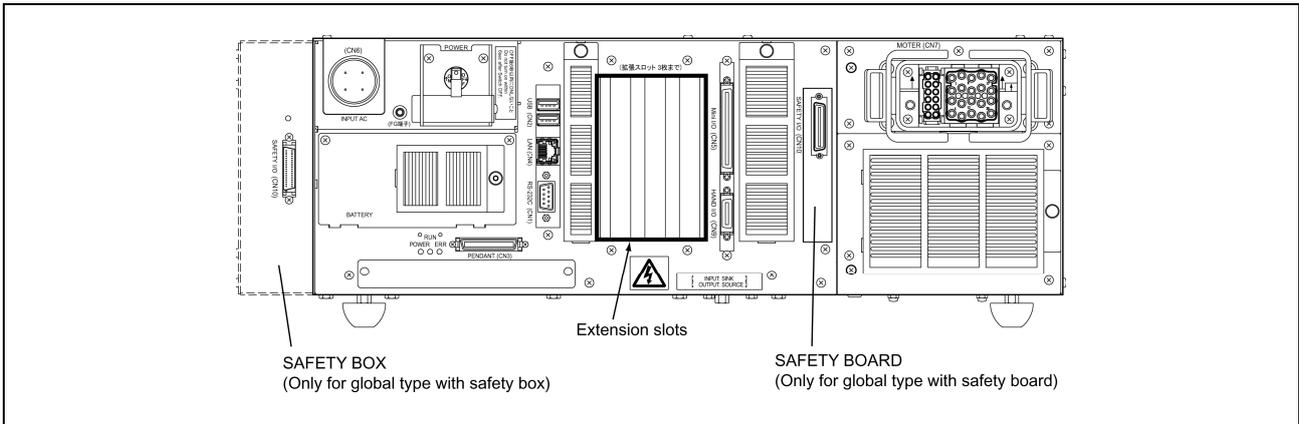
(For details, see the SETTING-UP MANUAL, Chapter 5, Section 5.7, "Enabling extension functions" in the manual pack CD that comes with your robot.)

Note: Placing an order for our robot system together with the permission for the configuration software delivers the system with the robot controller ready to run the configuration software.

(4) Mounting the PROFIBUS-DP slave board

Mount the PROFIBUS-DP slave board in any of the extension slots provided in the robot controller.

(Refer to Chapter 14 "Mounting I/O Extension Boards".)



Note: When turning the controller power ON after this installation, an Error message "220F: I/O device changed" appears. Update the I/O status and configuration settings according to Section 4.6 "Method for Setting I/O Allocation" and then restart the controller.

Extension Slots in RC7M Controller

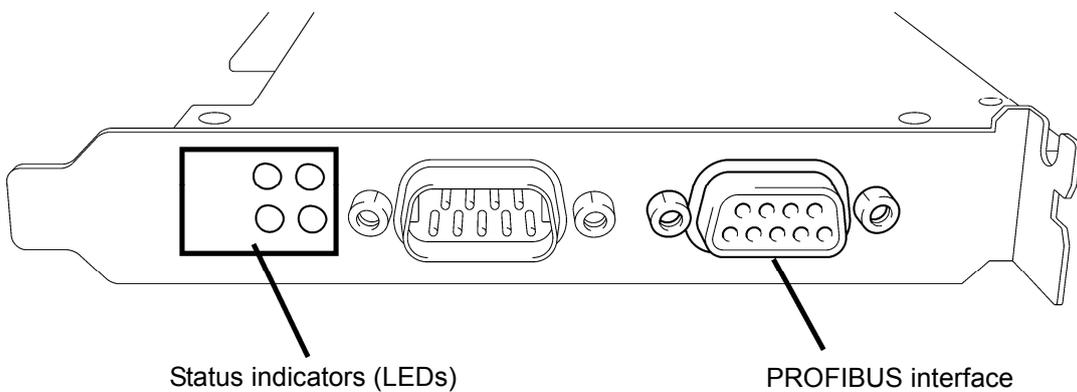
(5) Limited Warranty

- a) DENSO WAVE provides the user with the PROFIBUS-DP slave configuration software built in the controller for configuring the board for use with the controller. It does not give you any warranty or technical support for the extension board itself.
- b) No fixing brackets come with this board. DENSO WAVE does not give you any warranty against problems that could arise due to vibration or impact. Before using this board, make sure that no communications error occurs due to vibration or impact.

10.3 Front Panel and its Function

The front panel of the PROFIBUS-DP slave board has the following components.

Name		Description
Status indicators (LEDs)	ERR	Lights in red when an error occurs in the PROFIBUS-DP slave board.
	STA	Lights in yellow when the communications link is established.
PROFIBUS interface		RS-485 connector (9-pin D-Sub, female)



Note 1: For details about components on the PROFIBUS-DP slave board, see the user's manual that comes with the board.
 Note 2: The Diagnostic-Interface, RDY LED and RUN LED are not used in this controller.

10.4 Specifications

Item	Specifications					
Communications protocol	PROFIBUS-DP-compliant					
Transmission speed	9.6K, 19.2K, 93.75K, 187.5K, 500K, 1.5M, 3M, 6M, and 12M bps, with automatic recognition					
Interface connector	9-pin, D-sub connector					
Communications media	RS-485 interface cable (Type A recommended)					
Communications distance (when Type A interface cable is used)	Transmission speed (bps)	9.6 K to 93.75 K	187.5 K	500 K	1.5 M	3 M to 12 M
	Distance/segment	1200 m	1000 m	400 m	200 m	100 m
PROFIBUS address	1 to 125					
Max. number of stations	126 (when the repeater is used)					
Number of I/Os	Standard assignment: 40 points for system input 32 points for system output 24 (default) to 216 points for user input 32 (default) to 224 points for user output Compatible assignment: 24 points for system input 32 points for system output 40 (default) to 232 points for user input 32 (default) to 224 points for user output					
Board type	CIF50-DPSIDENSO					
Note: The polling period for system input signal is 8 ms. The 8 ms or less input signal may not be detected.						

10.5 Assignment when using the PROFIBUS-DP slave board

For available allocations, see "Combination of I/O Extension Boards and Allocation Mode."

The I/O data assignment is the same as that for the DeviceNet slave board. For the assignment, refer to Chapter 6 "DeviceNet Slave Board."

10.6 Parameter Entry Procedure

10.6.1 Entering the Node Address and Number of I/Os with the Teach Pendant

You may choose the number of I/Os for the robot controller from the tables given below.

Note: These I/Os are viewed from the robot controller. They are opposite of the I/Os displayed on the teach pendant, as listed below

Points for User Input

Points for input	Max. number of points in standard assignment mode	Max. number of points in compatible assignment mode	Display on the teach pendant
64 points (8 bytes)	24 points (3 bytes)	40 points (5 bytes)	8-byte Output con
96 points (12 bytes)	56 points (7 bytes)	72 points (9 bytes)	12-byte Output con
128 points (16 bytes)	88 points (11 bytes)	104 points (13 bytes)	16-byte Output con
160 points (20 bytes)	120 points (15 bytes)	136 points (17 bytes)	20-byte Output con
256 points (32 bytes)	216 points (27 bytes)	232 points (29 bytes)	32-byte Output con

Points for User Output

Points for output	Max. number of points in standard or compatible assignment mode	Display on the teach pendant
64 points (8 bytes)	32 points (4 bytes)	8-byte Input con
96 points (12 bytes)	64 points (8 bytes)	12-byte Input con
128 points (16 bytes)	96 points (12 bytes)	16-byte Input con
160 points (20 bytes)	128 points (16 bytes)	20-byte Input con
256 points (32 bytes)	224 points (28 bytes)	32-byte Input con

Operating Procedure for Setting Node Address and I/O Module

Step 1 Display the PROFIBUS window.

Access: [F4 I/O.]—[F6 Aux.]—[F12 FieldBus] —[F3 PROFIBUS]



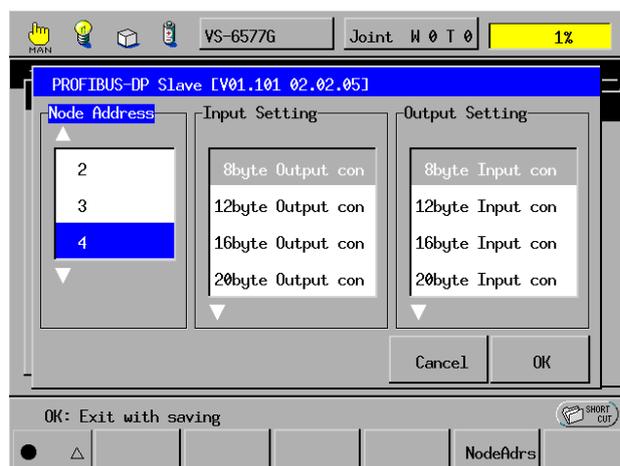
The PROFIBUS-DP Slave window will appear as shown below.

Step 2 Choose the Note Address, Input Setting, or Output Setting field that you want to set by using the right- and left-arrow cursor keys or directly touching the target item field.

Make the desired setting for each item by using the up- and down-arrow cursor keys or directly touching the target setting field.

Pressing [F5 NodeAdrs] will show the numeric keypad where you may enter the desired numeral.

After completion of setting, press [OK]. If you press [Cancel], the newly entered values will be discarded.



F5

Step 3 On the screen shown in Step 2, press [OK]. The system message window will appear as shown below.

Turn the controller power off and on. Then the new settings will take effect.



10.6.2 Configuring the Robot Controller from the PC with the PROFIBUS Configurator

Configure the robot controller (node address and I/O module) by using the PROFIBUS configurator (GSD file) stored in the CD-ROM that comes with the PROFIBUS slave board.

CD-ROM:\EDS\PROFIBUS\GSD\Hil_049F.gsd

I/Os expressed in the PROFIBUS configurator are viewed from the master device. Therefore, they are opposite of those viewed from the robot controller and are the same as viewed from the teach pendant, as listed in Section 10.6.1.

When configuring the robot controller on the PC with the PROFIBUS configurator, set the same module as one selected on the teach pendant screen. Slot 0 should be equal to "n byte Output con", and Slot 1, "n byte Input con."

Note 1: The robot controller may use a coherent type of module only. The GSD file contains both programs for coherent and incoherent types, so be sure to choose the program exclusive to the coherent type. (The program name contains a "con" string.)

Note 2: Some master device programs use special functions when exchanging data with a coherent type of module. For details, refer to the instructions manuals prepared for master devices.

Chapter 11 RS-232C Extension Board (Commercial board recommended)

Mounting an RS-232C extension board in the robot controller enables the controller to support three RS-232C serial data transmission lines (One standard line plus two add-on lines).

11.1 Requirements for Use of RS-232C Extension Board

A recommended commercial RS-232C extension board should be used for the RC7M robot controller. To configure the board in your robot system, you need to purchase the board, obtain the license for permitting the RS-232C configuration software to run, enter the user ID of the configuration software, and mount the board in the controller as detailed below.

- (1) Purchasing an RS-232C extension board on the user's responsibility

Purchase the RS-232C extension board listed below for the use of the RC7M robot controller.

Board model	COM-2P (PCI) H (Insulation type)
Manufacturer	CONTEC

- (2) Obtaining the license for permitting the RS-232C configuration software to run

At the time of purchase of your robot system or if you inform Denso Wave of the serial number of your robot, you can purchase the RS-232C configuration software. Denso Wave issues the license that permits the configuration software to run in your controller.

- (3) Entering the user ID indicated on the RS-232C configuration software license

Use the teach pendant and call up the Input ID Number screen with the following procedure.

From the top screen of the teach pendant, press [F6 Set]—[F7 Options.]—[F8 Function Extnsion]—[F5 Input ID].

Enter the user ID indicated in the upper right-hand corner of the license certificate.

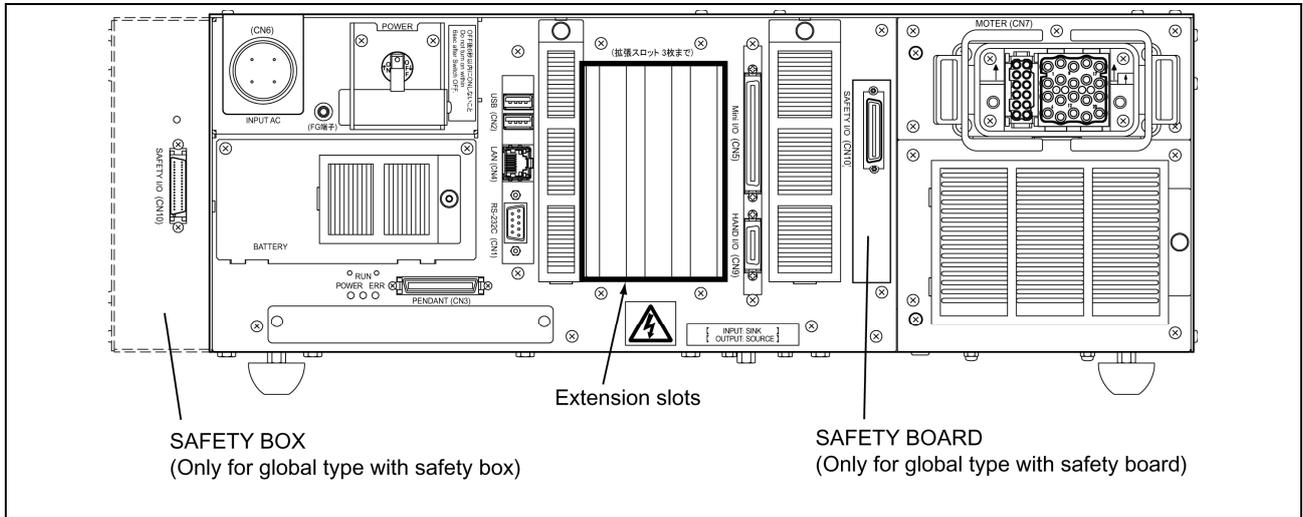
(For details, see the SETTING-UP MANUAL, Chapter 5, Section 5.7, "Enabling extension functions" in the manual pack CD that comes with your robot.)

Note: Placing an order for our robot system together with the permission for the configuration software delivers the system with the robot controller ready to run the configuration software.

(4) Mounting the RS-232C extension board

Mount the RS-232C extension board in any of the extension slots provided in the robot controller.

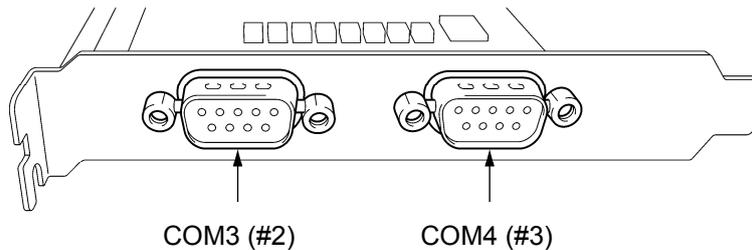
(Refer to Chapter 14 "Mounting I/O Extension Boards".)



Extension Slots in RC7M Controller

11.2 RS-232C Extended Serial Ports and Line Number Assignment

The RS-232C extension board features two COM ports--COM3 and COM4. Two serial data transmission lines #2 and #3 are assigned to COM3 and COM4, respectively.



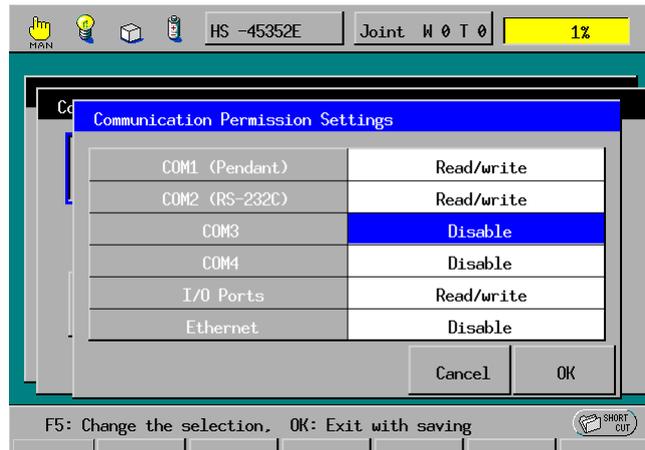
11.3 Communications Configuration of RS-232C Extension Board

Follow the procedure described below to configure communications feature of COM3 and COM4 on the RS-232C extension board.

- Setting the communication permission

Access: [F6 Set]—[F5 Set Com.]—[F1 Permit.]

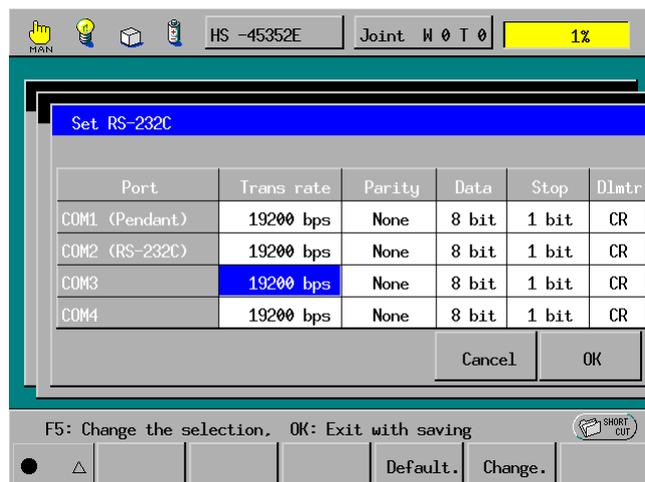
Caution: COM3 and COM4 do not support data transfer with WINCAPSI. Keep both of those ports "Disable" (default).



- Setting the transmission rate for RS-232C serial interface ports

Access: [F6 Set]—[F5 Set Com.]—[F2 Serial IF]

Select each of the COM3 and COM4 and then press [F5 Change.] to the transmission rate, parity (None, Odd or Even) and other values.



Caution: Communications failure may occur due to electric noises or other interference. You may need to use the `com_state` command for setting retry capabilities as shown in the coding sample below.

11.4 Coding Sample for Transmission Error Recovery

```
'!TITLE "<Title>"
PROGRAM sample
.
.
.
DEFPOS lp1(10)      'Local position variable.
DEFINT li1         'Local integer variable.
'
.
.
li1 = 0            'Initialize li1.
.
.
.
WHILE li1 < 10     'Repeat pre-decision.
.
.
.
INPUT #2,lp1(li1)  'Get data on line #2 into
                  'li1(li1).
com_state #2,I280  'Get communication status into I280.
IF I280 < 0 THEN   'If an error occurs, the value is -1.
PRINT #2,"R"      'Output retry instruction.
ELSE
PRINT #2,"A"      'Output "normal receive".
li1 = li1 + 1
END IF
.
.
.
.
WEND              'Repeat 10 times.
End
```

In the coding sample above,
It is assumed that "R" is a retry command that requires the external equipment to make
retry operation and "A" is an acknowledge command for normal data reception.

11.5 Limited Warranty

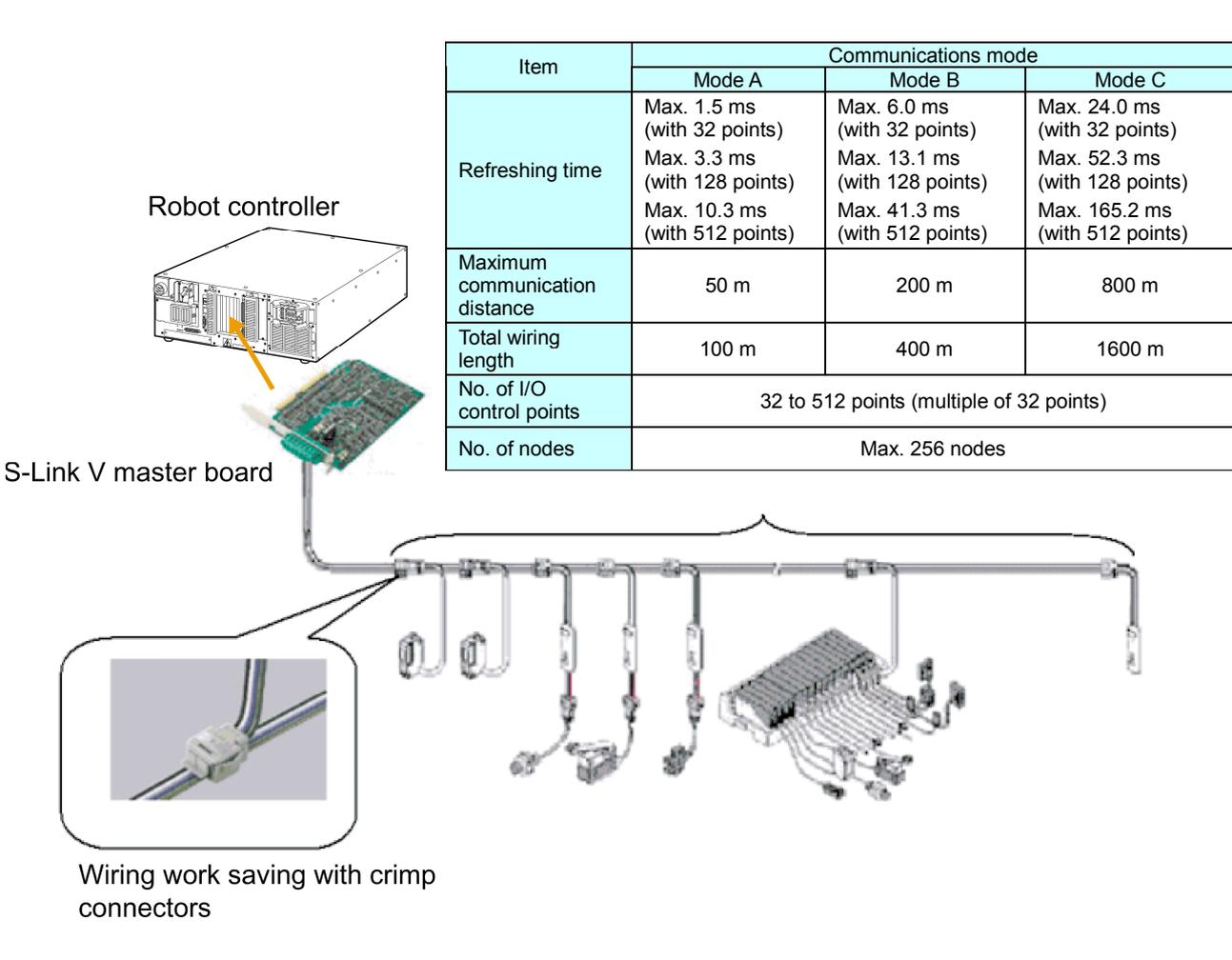
- (a) DENSO WAVE provides the user with the communications function built in the controller for using the RS-232C extension board. It does not give you any warranty or technical support for the extension board itself.
- (b) No fixing brackets come with this board. DENSO WAVE does not give you any warranty against problems that could arise due to vibration or impact. Before using this board, make sure that no communications error occurs due to vibration or impact.

Chapter 12

S-Link V Master Board (Commercial board recommended)

12.1 Overview

Mounting an S-Link V master board can configure the "S-Link V wire-saving system."



The diagram illustrates the S-Link V wire-saving system. It shows a robot controller connected to an S-Link V master board. The master board is connected to a bus system that uses crimp connectors to connect multiple nodes. A callout shows a close-up of a crimp connector on a wire.

Item	Communications mode		
	Mode A	Mode B	Mode C
Refreshing time	Max. 1.5 ms (with 32 points)	Max. 6.0 ms (with 32 points)	Max. 24.0 ms (with 32 points)
	Max. 3.3 ms (with 128 points)	Max. 13.1 ms (with 128 points)	Max. 52.3 ms (with 128 points)
	Max. 10.3 ms (with 512 points)	Max. 41.3 ms (with 512 points)	Max. 165.2 ms (with 512 points)
Maximum communication distance	50 m	200 m	800 m
Total wiring length	100 m	400 m	1600 m
No. of I/O control points	32 to 512 points (multiple of 32 points)		
No. of nodes	Max. 256 nodes		

Wiring work saving with crimp connectors

(1) Wire saving including power supply cables

The S-LINK V system offers wire saving not only for I/O devices but also for power supplies, greatly decreasing the amount of wiring in facilities.

(2) Decentralized installation, channel-based (Max. 256 nodes)

To save wiring of conveyor sensors scattered over a factory, for example, the S-Link V master board can use I/O units capable of handling signals on a channel basis, facilitating free installation in facilities.

(3) Easy wiring and maintenance

Four-core flat cables and crimp connectors save wiring works. No cable stripping, terminal crimping, screw tightening, or wiring through cable ducts is required. This greatly reduces wiring works, lead time, and workers' stress.

(4) Cost reduction by decreasing the number of parts

No extra cables, relay terminal boards or other wiring materials are required while they are required by the conventional wiring-saving systems. In addition, the use of crimp connectors makes the addition/modification of sensors and units easy, preventing faulty wiring and reducing the total wiring cost.

(5) Communication modes switchable between three levels

The communication modes in the entire system can be switched just by operating the robot controller.

Switching between communication modes A, B, and C eliminates the consideration and modification of the controller or I/O units which have been required with the communications speed and system scale.

Selecting the communication mode matching the communications speed and distance covers even the environmental requirements.

12.2 Requirements for Use of S-Link V Master Board

A recommended commercial S-Link V master board should be used for the RC7M robot controller. To configure the board in your robot system, you need to purchase the board, obtain the license for permitting the S-Link V master configuration software to run, enter the user ID of the configuration software, and mount the board in the controller as detailed below.

- (1) Purchasing a S-Link V master board on the user's responsibility

Purchase the S-Link V master board listed below for the use of the RC7M robot controller.

Model	S-Link V control board
Manufacturer	SUNX

- (2) Obtaining the license for permitting the S-Link V master configuration software to run

At the time of purchase of your robot system or if you inform Denso Wave of the serial number of your robot, you can purchase the S-Link V master configuration software. Denso Wave issues the license that permits the configuration software to run in your controller.

- (3) Entering the user ID indicated on the S-Link V master configuration software license

Use the teach pendant and call up the Input ID Number screen with the following procedure.

From the top screen of the teach pendant, press [F6 Set]—[F7 Options.]—[F8 Function Extension]—[F5 Input ID].

Enter the user ID indicated in the upper right-hand corner of the license certificate.

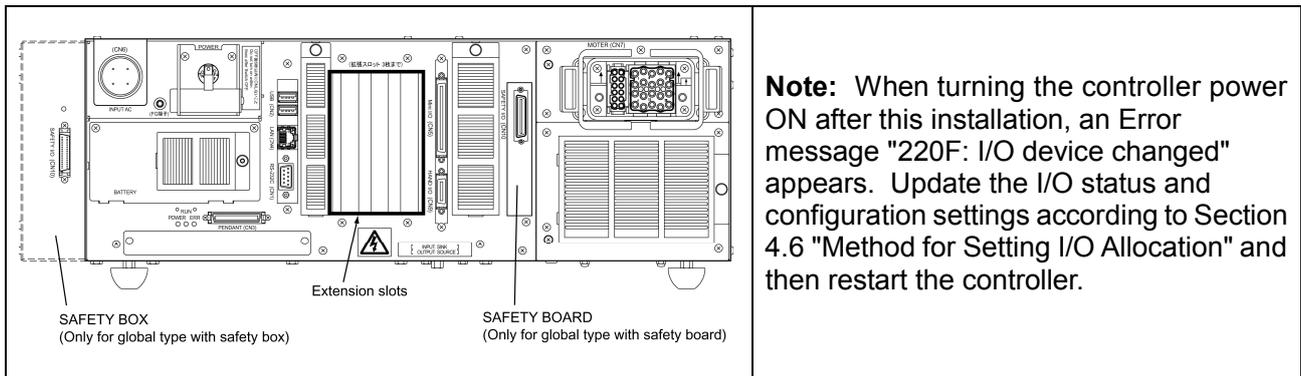
(For details, see the SETTING-UP MANUAL, Chapter 5, Section 5.7, "Enabling extension functions" in the manual pack CD that comes with your robot.)

Note: Placing an order for our robot system together with the permission for the configuration software delivers the system with the robot controller ready to run the configuration software.

(4) Mounting the S-Link V master board

Mount the S-Link V master board in any of the extension slots provided in the robot controller.

(Refer to Chapter 14 "Mounting I/O Extension Boards".)



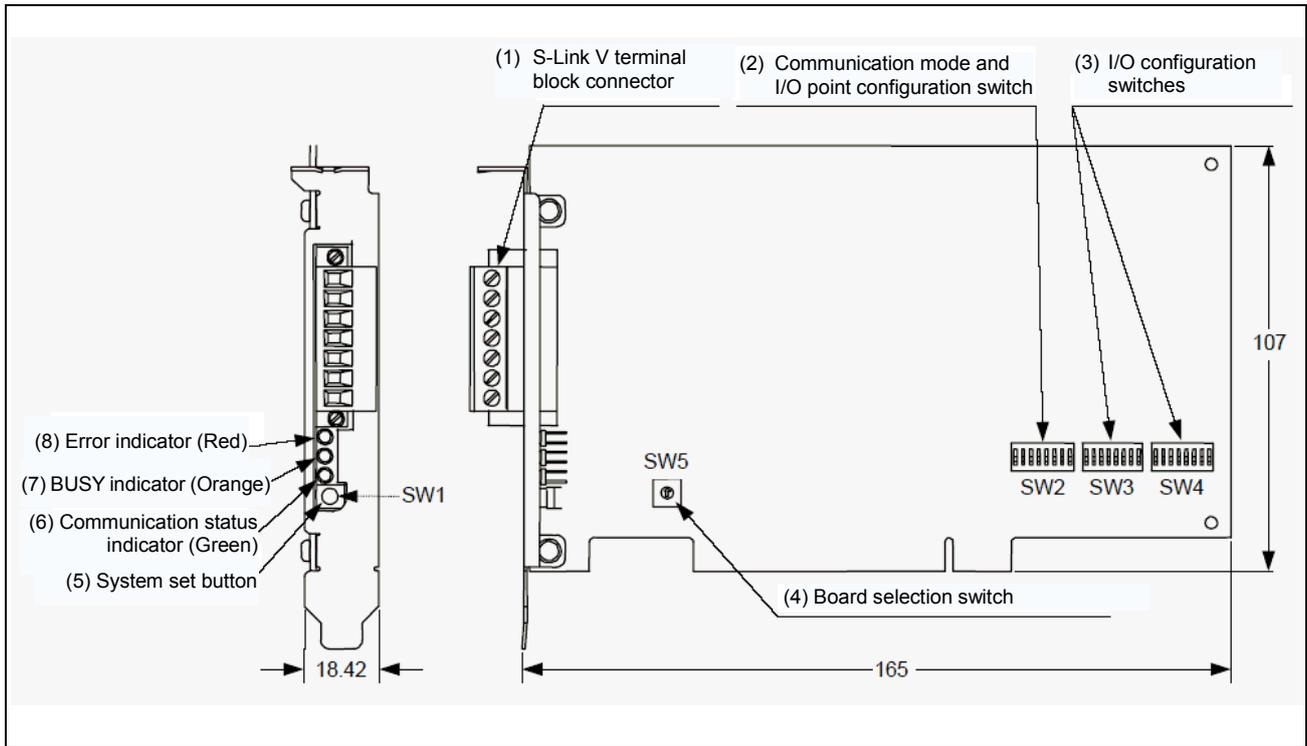
Extension Slots in RC7M Controller

(5) Limited Warranty

- a) DENSO WAVE provides the user with the communications function built in the controller for using the S-Link V master board. It does not give you any warranty or technical support for the board itself.
- b) No fixing brackets come with this board. DENSO WAVE does not give you any warranty against problems that could arise due to vibration or impact. Before using this board, make sure that no communications error occurs due to vibration or impact.

12.3 Part Names and Functions

The figure below shows the external views of the S-Link V master board and its terminal block connector.



(1) S-Link V terminal block connector

(Viewed from wiring side)

No.	Terminal name	Remarks
7	F.G.	Frame ground
6	+24 V	External power supply
5	0 V	
4	+24 V	Brown
3	0 V	Blue
2	D	White
1	G	Black

Tightening torque for screws: 0.5 to 0.6 N·m

Applicable terminal block connector: MSTB 2.5/7-STF-5.08 (with flange)
(Manufactured by Phoenix Contact)

External Views of the S-Link V Master Board and Terminal Block Connector

(2) Communication mode and I/O point configuration switch (SW2)

The combination of SW2-1 and SW2-2 (selectors 1 and 2 on SW2) specifies the communications mode--Mode A, B or C. The combination of SW2-5 through SW2-8 specifies the number of I/O control points.

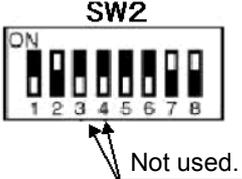
The specified settings will be read in when the controller is powered ON. Changing the switch settings when the controller is in operation does not go into effect.

Note: The RESET command issued from the S-Link V system cannot change the SW2 settings.

Communication Mode Configuration Switch			I/O Point Configuration Switch				
Communication mode	SW2-1	SW2-2	I/O control points	SW2-5	SW2-6	SW2-7	SW2-8
Mode A	OFF	OFF	32 points	OFF	OFF	OFF	OFF
Mode B	OFF	ON	64 points	OFF	OFF	OFF	ON
Mode C	ON	OFF	96 points	OFF	OFF	ON	OFF
(Mode A)	ON	ON	128 points	OFF	OFF	ON	ON
			160 points	OFF	ON	OFF	OFF
			192 points	OFF	ON	OFF	ON
			224 points	OFF	ON	ON	OFF
			256 points	OFF	ON	ON	ON
			288 points	ON	OFF	OFF	OFF
			320 points	ON	OFF	OFF	ON
			352 points	ON	OFF	ON	OFF
			384 points	ON	OFF	ON	ON
			416 points	ON	ON	OFF	OFF
			448 points	ON	ON	OFF	ON
			480 points	ON	ON	ON	OFF
			512 points	ON	ON	ON	ON

Communication Mode Configuration Switch		
Communication mode	SW2-1	SW2-2
Mode A	OFF	OFF
Mode B	OFF	ON
Mode C	ON	OFF
(Mode A)	ON	ON

(Ex.) Communication mode: Mode B
I/O control points: 128 points



Communication Mode and I/O Point Configuration Switch (SW2)

(3) I/O configuration switches (SW3 and SW4)

SW3 and SW4 specify I/O settings, 32 points per selector.

Be sure to set all selectors on both SW3 and SW4 to the ON positions since the system automatically assigns the I/O control points, fifty-fifty to input and output, according to the SW2 settings.

The specified settings will be read in when the controller is powered ON.

(Example 1) If I/O control points = 512 points

Input: 0 to 255 (256 points)

Output: 256 to 511 (256 points)

(Example 2) If I/O control points = 128 points

Input: 0 to 63 (64 points)

Output: 64 to 127 (64 points)

	Selector No.	Address	ON	OFF
SW3	1	0 to 31	Input	Output
	2	32 to 63		
	3	64 to 95		
	4	96 to 127		
	5	128 to 159		
	6	160 to 191		
	7	192 to 223		
	8	224 to 255		
SW4	1	256 to 287	Input	Output
	2	288 to 319		
	3	320 to 351		
	4	352 to 383		
	5	384 to 415		
	6	416 to 447		
	7	448 to 479		
	8	480 to 511		

I/O Configuration Switches

SW3

SW4

Be sure to set all selectors on both SW3 and SW4 to the ON positions since the system automatically assigns the I/O control points, fifty-fifty to input and output, according to the SW2 settings.

These selectors are set to the ON positions by factory default.

I/O Configuration Switches (SW3 and SW4)

(4) Board selection switch

(5) System reset button (SW1)

Pressing the system reset button (SW1) reads in the current status of the unit connection. The system refers to the status read for checking Error 3, 4, and 5.

Note 1: When Error 3 has occurred, pressing SW1 releases the error state. If the cause of the error is not removed, however, the system no longer checks the error address. It interprets that address as no unit connected.

Note 2: When Error 4 has occurred, pressing SW1 releases the error state and reads in the current status of the unit connection including the address where Error 4 has occurred.

(6) Communication status indicator (green)

This indicator blinks when the S-Link V master board is communicating with its I/O units. It is off when the board is not communicating.

The blinking cycle differs depending upon the communication mode selected--Fast blinking in Mode A and slow blinking in Mode C.

(7) BUSY indicator (orange)

This indicator lights at the startup of the system; that is, during the time after the power is turned on until the start of I/O refreshing.

It also lights during the setting up of the system which is triggered by pressing the system set button or by software from the PC. After completion of the system setting up, the indicator goes off.

(8) Error indicator (red)

This indicator lights if an error occurs in the S-Link V system line and it blinks when the cause of the error is removed.

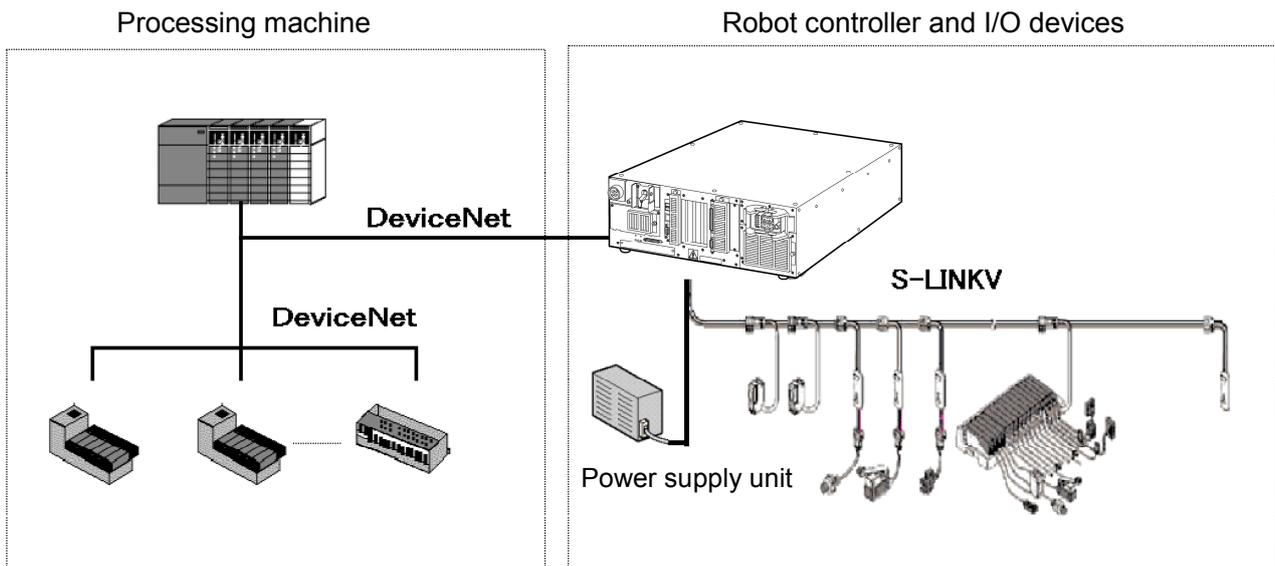
Clearing the error number by software or performing a system set turns this indicator off.

Note: This indicator cannot distinguish among Errors 0 through 6.

12.4 Specifications

Name	S-Link V control board for PCI bus	
Model	SL-VPCI	
Source voltage	S-LINK V system: +24 VDC -5 to +10%	
	PCI bus: +5 VDC ±5%	
Power consumption	24 VDC: 85 mA or less	
	+24 VDC (S-Link V I/O units for load drive): Maximum supply current 7A	
	+5 VDC: 315 mA or less	
Communications speed	Mode A: 110 kbps, Mode B: 27.5 kbps, Mode C: 6.9 kbps	
Connection mode	T connection or Multidrop connection	
Maximum communications distance	Mode A: 50 m, Mode B: 200 m, Mode C: 800 m	
Total wiring length	Mode A: Max. 100 m, Mode B: Max. 400 m, Mode C: Max. 1,600 m	
Communications cable	4-wire flat cable (0.5 mm ²) or 4-wire VCTF cable (not shielded) with conductor sectional area from 0.3 to 2.0 mm ²	
No. of I/O points	Max. 512 points (In units of 32 points by DIP switches, In units of 16 points by software)	
Nodes	Max. 256 nodes	
Indicator lamps	Communication	Green LED (Blinks during communication)
	BUSY	Orange LED (Lights at the startup and system resetting. Off during communication)
	Error	Red LED (Lights when an error has occurred. Blinks after removal of error cause. Off during normal operation)
Compliant bus	PCI bus	
Assignment	Plug and play	
Ambient temperature	In operation: 0 to 55°C (no dew condensation), In storage: -20 to 70°C	
Ambient humidity	In operation: 20 to 85% RH, In storage: 20 to 85% RH	
Noise resistance	Power line: 500 Vp, Period: 10 ms, Pulse duration: 1 μs Common: 1,000 Vp, Period: 10 ms, Pulse duration: 1 μs (Resulted with noise simulator)	
Voltage resistance	1,000 VAC for one minute (Between external terminal and grounding)	
Insulation resistance	20 MΩ or above, measured by 500 VDC Megger (External terminal to grounding)	
Vibration resistance	Frequency: 10 to 150 Hz, Multiamplitude: 0.75 mm In the three directions of X, Y, and Z for 2 hours each	
Shock resistance	Resistance: 98 m/s ² (Approx. 10G) in the three directions of X, Y and Z axis, three times each	
Grounding	Bracket: Floating, S-Link V System: C-connection	
Interrupt control	Error or input change triggers an interrupt (Enable/Disable selectable)	

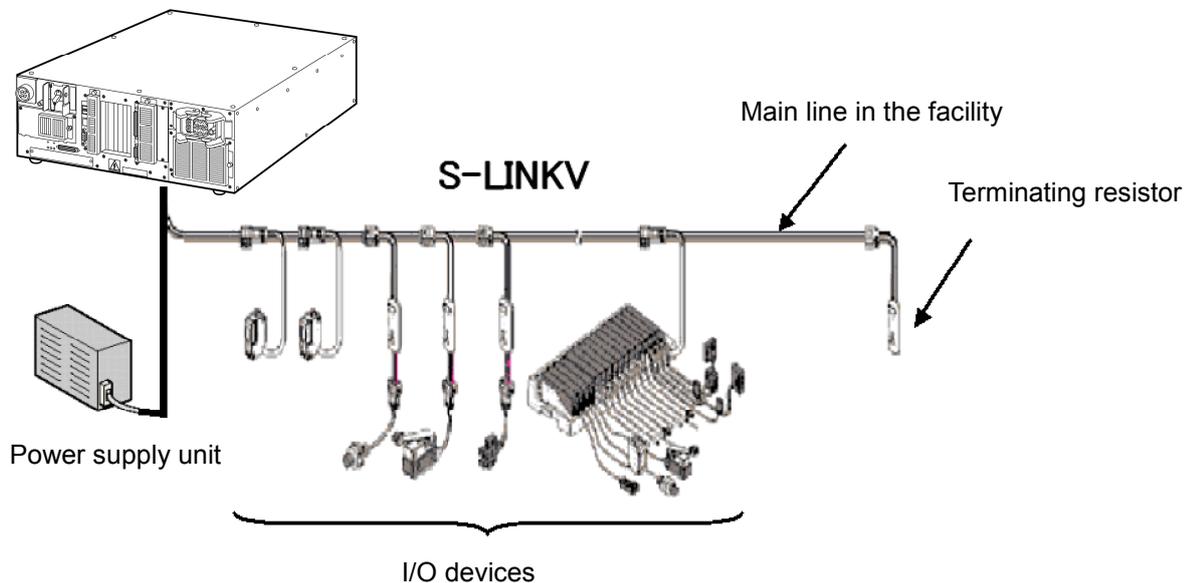
12.5 S-Link V System Configuration



12.5.1 Configuring the System

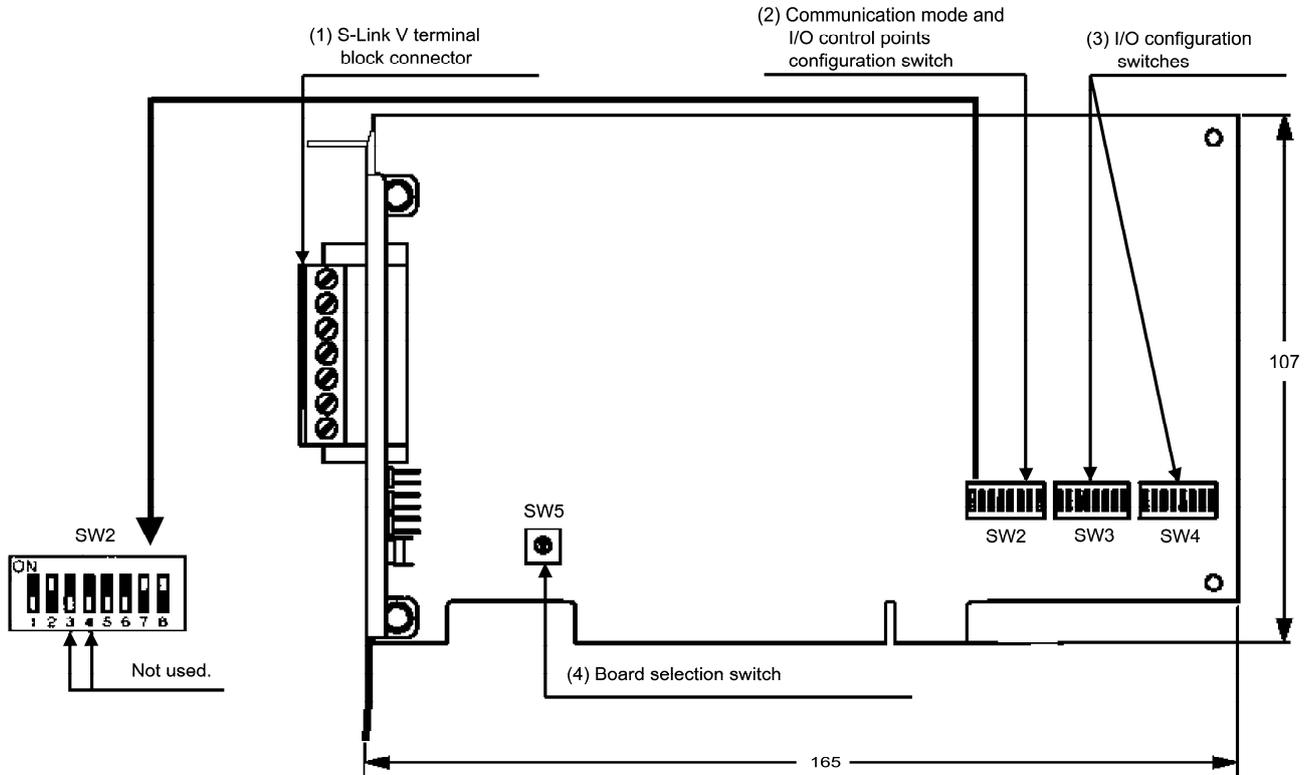
This section gives procedures for configuring the S-Link V system sample shown above. (The DeviceNet related description is omitted.)

(1) Wiring hardware components



(2) Configuring the S-LINK V master board

Use SW2 (see Section 12.3 (2)) to specify the communications mode and the number of I/O control points after making sure that both the controller power and network power are turned OFF.

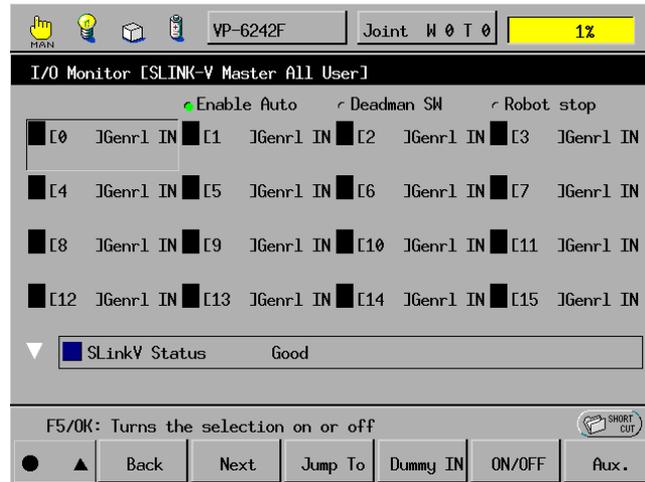


(3) Setting up the S-LINK V master I/O area

The S-Link V master allows you to monitor the I/O settings, controller I/O addresses, and S-Link V addresses of individual blocks in the control area.

Access: Top screen of teach pendant—[F4 I/O]—[F6 Aux.]—[F4 S-LinkV]

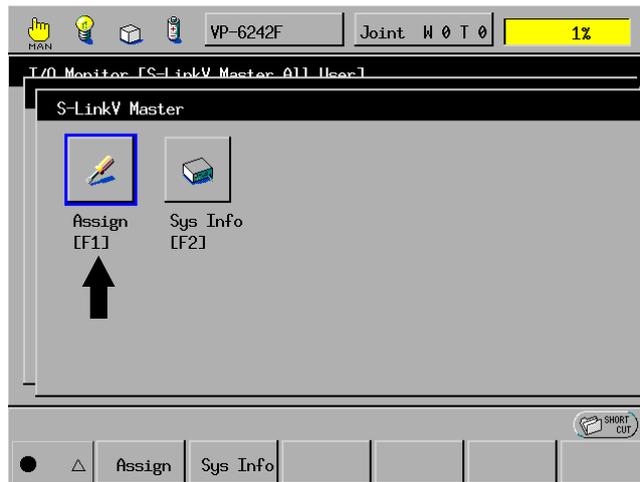
- Step 1** On the top screen, press [F4 I/O] to call up the I/O Monitor window as shown below. On this window, press [F6 Aux.].



- Step 2** Press [F4 S-LinkV].

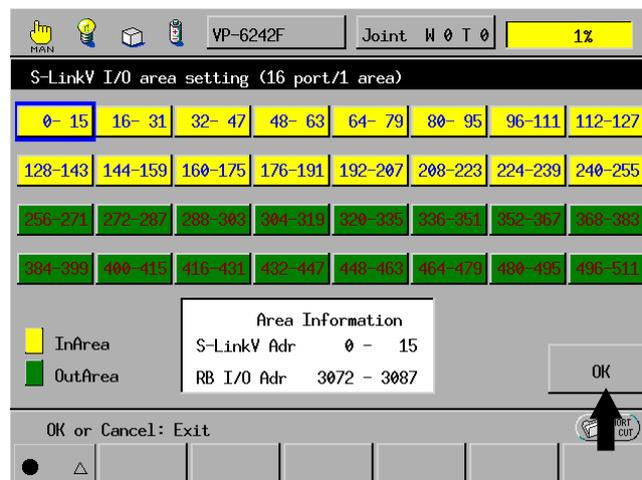


Step 3 Press [F1 Assign].



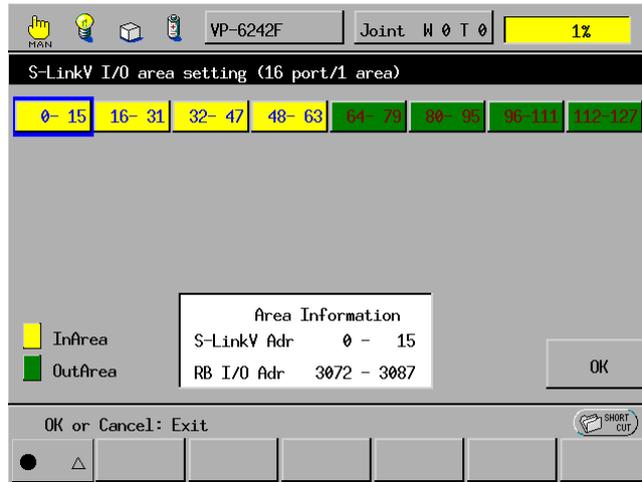
Step 4 The screen below displays 512 control points that can be confirmed in units of 16 points.

To monitor the I/O setting, press the target I/O block, and its details appear in the Area Information area at the bottom center of the screen.



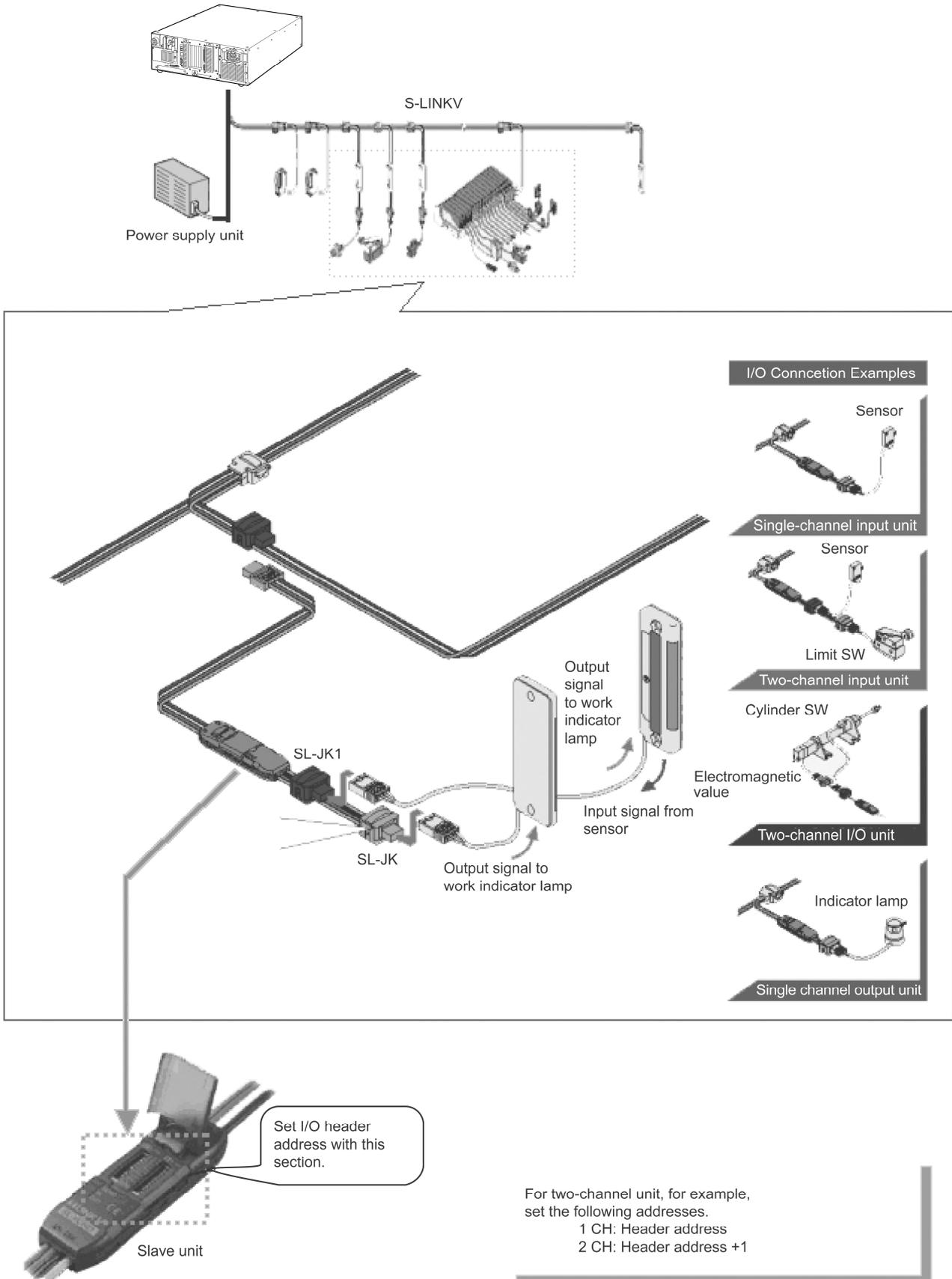
Press [OK].

The screen below shows 128 control points.



(4) Configuring S-Link V slave units

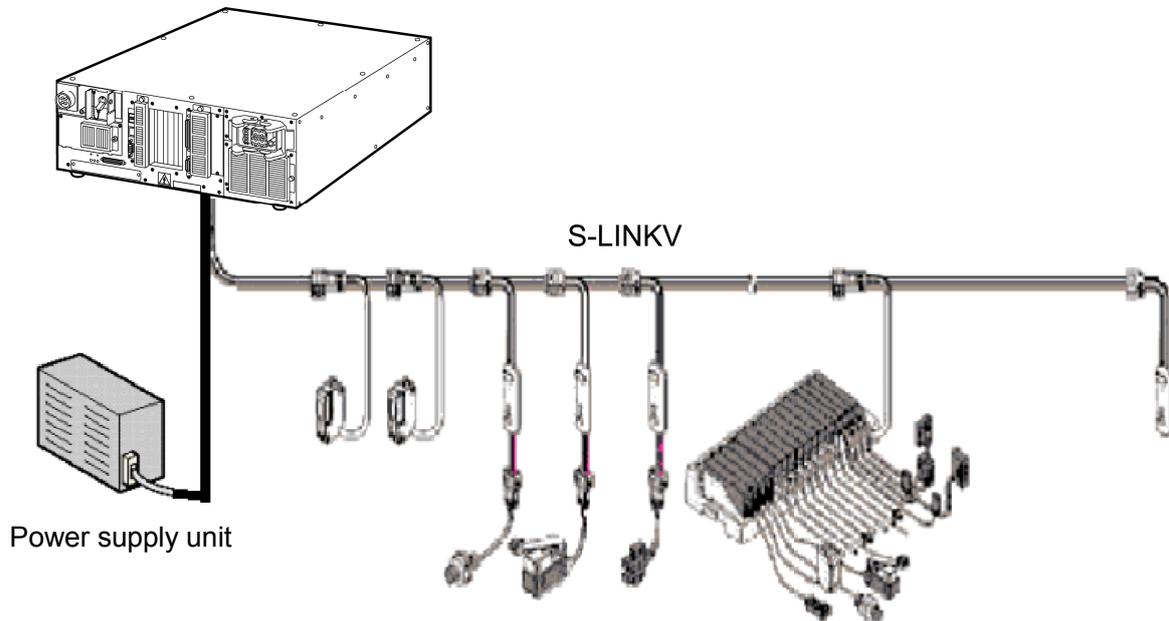
Configure S-Link V slave units by setting the I/O header address (within the range from 0 to 511) on each unit with its DIP switch.



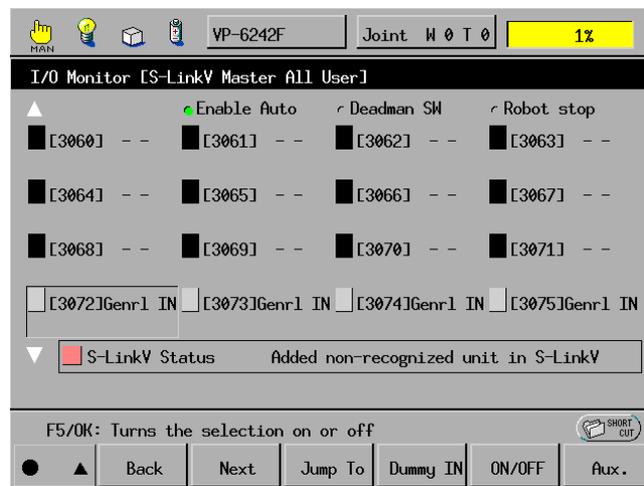
Configuring the S-Link V Slave Units

(5) Configuring the S-Link V master network

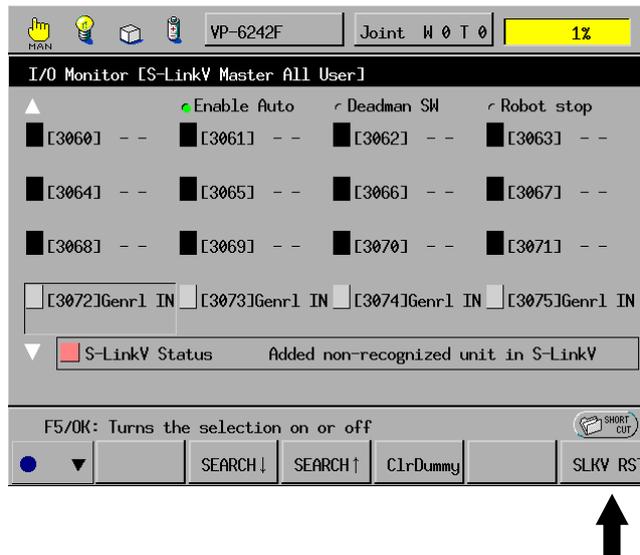
Let the S-Link V master scan the slave units currently connected and configure the communications network, using the procedure given below.



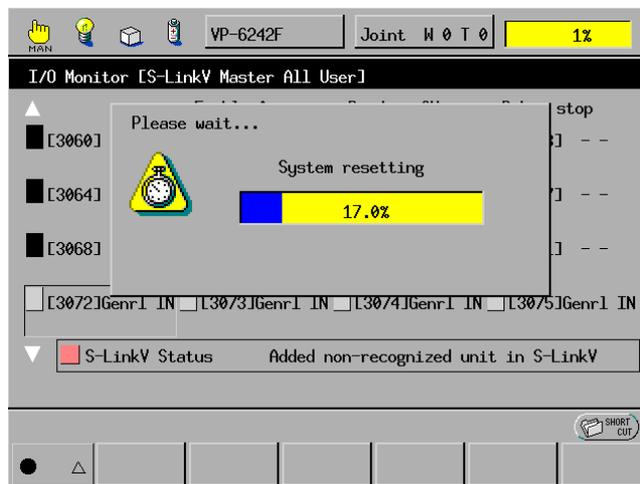
Step 1 Connecting a new slave unit displays the message below.
Press [Shift].



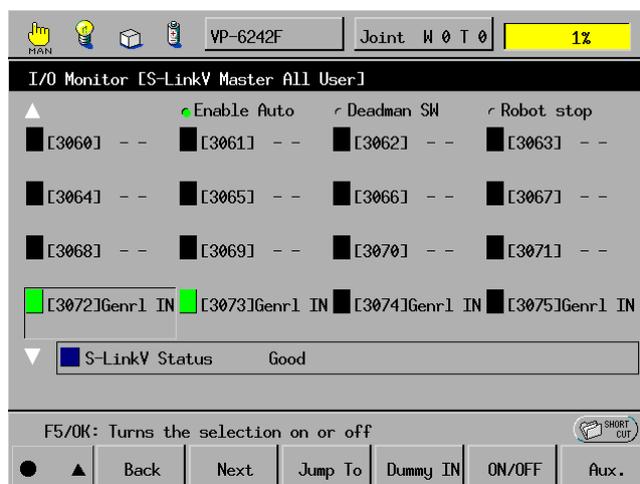
Step 2 Press [SLKV RST.].



Step 3 Wait for the S-Link V master to scan the system.



Step 4 Wait for the "S-LinkV Status Good" message to appear, indicating the normal end of scanning.



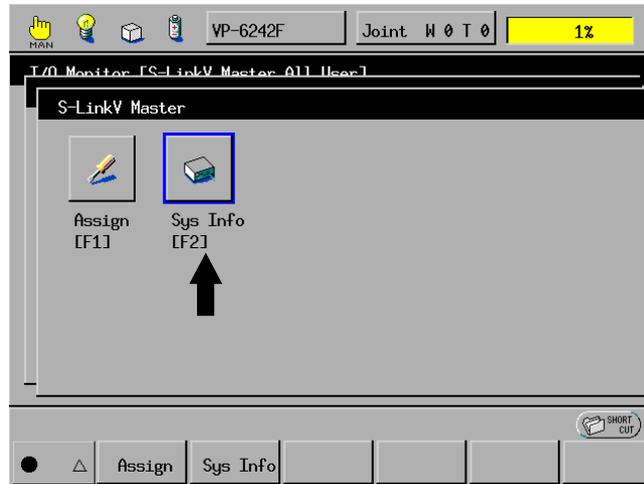
The system configuration is successfully completed.

(6) Monitoring the S-Link V system information

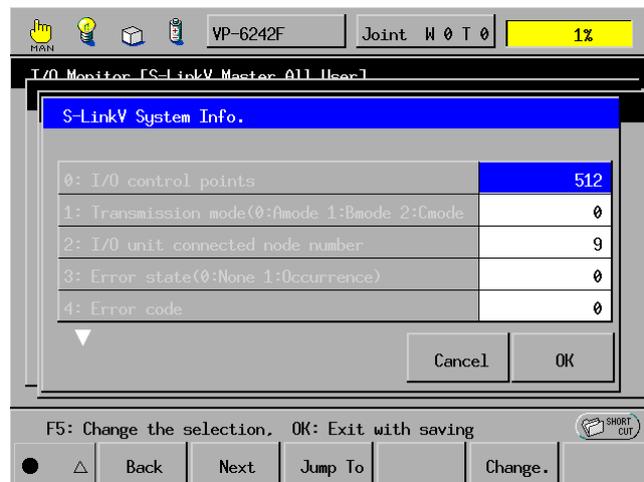
The procedure given below displays the management info, current bank info and register info of the S-Link V master.

Unavailable parameters appear dimmed. Do not change even available parameters, but only monitor them.

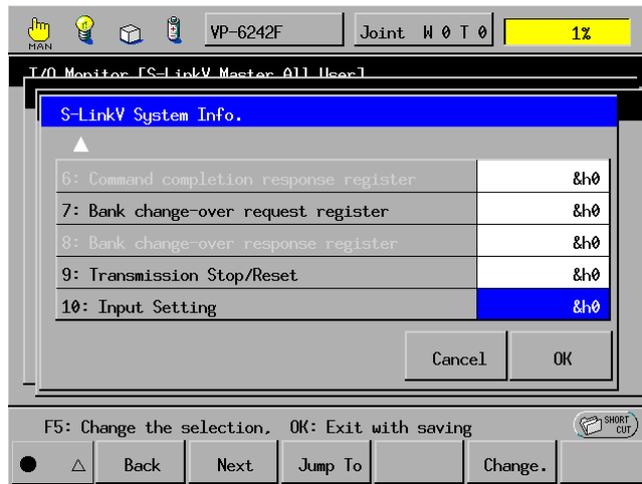
Step 1 On the following screen, press [Sys Info F2].



Step 2 Wait for the heading five lines of status information to appear.

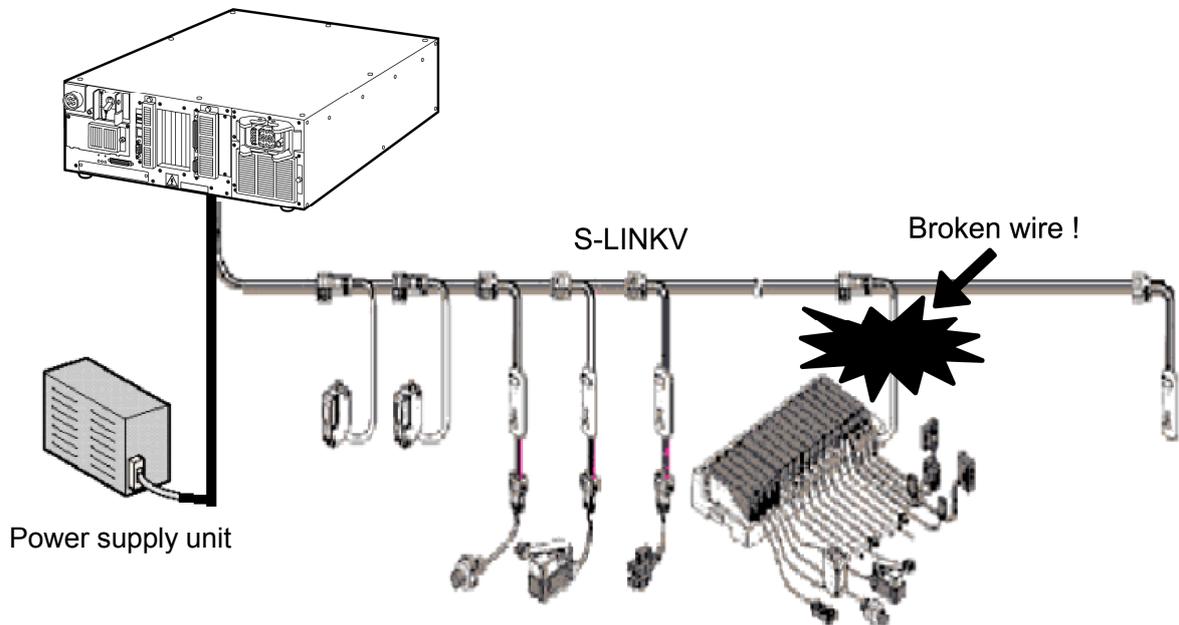


Step 3 Press [Next] to display the subsequent lines of status information.

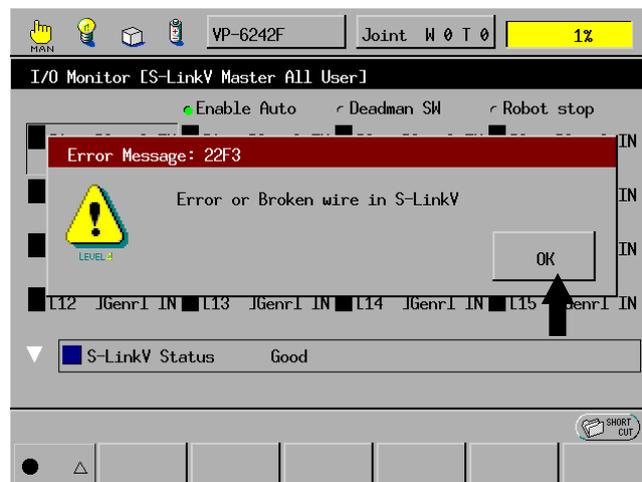


(7) Searching for slave units causing communications errors in the S-Link V system

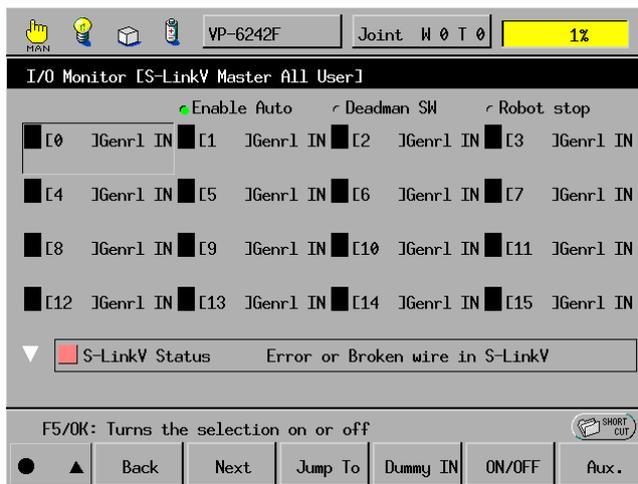
The S-Link V system can search slave units that have caused communications errors. This section gives the search procedure.



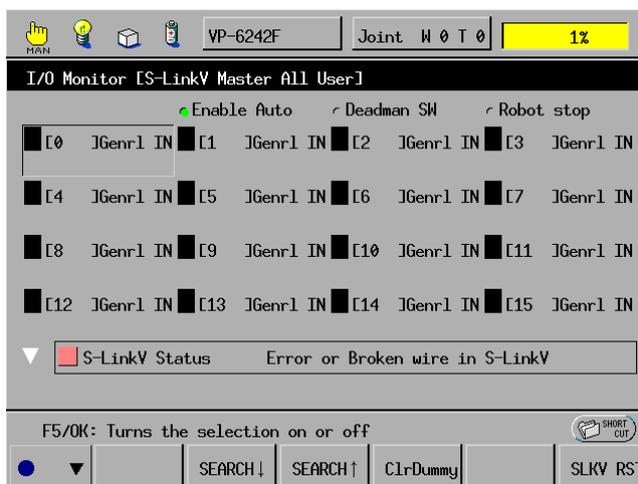
Step 1 Check the error message on the teach pendant and press [OK].



Step 2 Switch back to the I/O Monitor window and press [Shift].

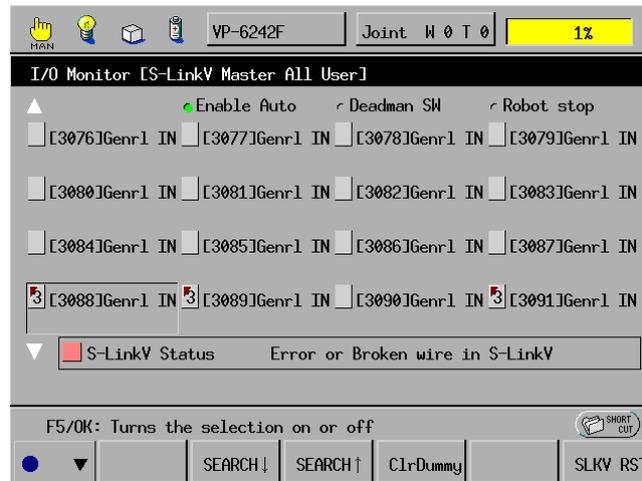


Step 3 Press [SEARCH↓] and [SEARCH↑] to search for abnormal slave units. Press [SEARCH↓] here since the S-Link V area begins with 3072.



Step 4 The screen below indicates that the abnormal slave unit causing Error 3 belongs to [3072] Genrl IN (or address 0 of S-LinkV).

Check the corresponding slave unit and fix the error.



12.5.2 Errors and Actions (Error Code Table)

The table below lists S-Link V communications error codes only. For other error codes, refer to the robot ERROR CODE TABLES.

Error code	Error	Action
22F0	System error in S-Link V board	Restart the robot controller. If the error recurs, the board may be damaged.
22F1	Short circuit between +24 and D on S-Link V board	Check the communications line.
22F2	Short circuit between D and G on S-Link V board	Check the communications line.
22F3	Error or broken wire in S-Link V unit	Check the communications line.
22F4	Unrecognized unit added to S-Link V	Perform the system resetting.
22F5	Short circuit in output units or power shutdown in I/O units in S-Link V	Check the slave unit.
22F6	S-Link V system not properly reset	Perform the system resetting with the pendant.
22F7	I/O configuration error in S-Link V	Set all selectors on the I/O point configuration switch (SW2) to INPUT.
22F8	Reserved by system.	
22F9	Reserved by system.	
22FA	Reserved by system.	
22FB	Reserved by system.	
22FC	Reserved by system.	
22FD	Reserved by system.	
22FE	Reserved by system.	
22FF	Reserved by system.	

12.6 I/O Assignment for Use of S-Link V Master Board

Using an S-Link V master board restricts I/O assignment. For the details, refer to "Combination of I/O Extension Boards and Allocation Mode."

Note 1: All areas on the S-Link V master board are used for general signals.

Note 2: Port numbers on the S-Link V master board are 3072 to 3327 for input, and 3328 to 3583 for output.

Note 3: The I/O point configuration switch (SW2) changes the I/O points allowable for each I/O port, but does not change the heading addresses (Input: 3072, Output: 3328) on each port.

Chapter 13 EtherNet/IP Adapter Board

13.1 Overview

Mounting an EtherNet/IP Adapter board in the robot controller enables the controller to communicate with external devices according to the EtherNet/IP-compliant protocol. The robot controller may easily exchange I/O data with EtherNet/IP-compliant Network devices.

13.1.1 Operating Environment

EtherNet/IP Adapter board can be used in the robot controller with software Ver. 3.0 or later. You need the configuration software license for function extension. When you purchase the license, you need the serial number of your robot controller.

13.1.2 Extension Board

The board indicated below needs to be prepared by the user.

Board Type	CIFX 50-RE\DENSO
Manufacturer	Hilscher GmbH

No fixing brackets come with this board. Before using this board, make sure that no communications error occurs due to vibration or impact.

13.1.3 Limited Warranty

DENSO WAVE provides the user with communications software built in the robot controller. It does not give you any warranty or technical support for the extension board itself.

13.2 Specifications

For the specifications of EtherNet/IP Adapter board unit, refer to the instructions manual.

13.2.1 General Specifications

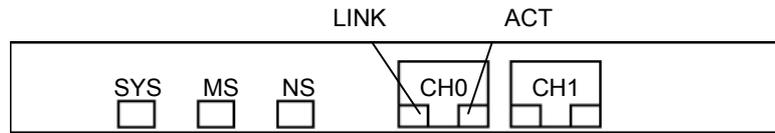
Item	Specifications			
Board Type	CIFX 50-RE\DENSO			
Communications protocol	EtherNet/IP-compliant			
Transmission speed	10M, 100M (bits/s)			
Interface connector	RJ-45 connector			
Communications media	Category 5 or above, twisted pair cable			
Number of I/Os	Standard allocation	Compatible allocation	All-user allocation	
	System input	40 points	24 points	0 points
	System output	32 points	32 points	0 points
	User input	24 to 3992 points (Note 2)	40 to 4008 points (Note 2)	4032 points (Note 2)
User output	32 to 4000 points (Note 2)	32 to 4000 points (Note 2)	4032 points (Note 2)	

Note 1: Polling period for system input signal is 8ms. The 8ms or less input signal may not be detected.

Note 2: When the software is lower than Ver.3.2, deduct 3776 points from the maximum value.

13.2.2 Front Panel and its Functions

The following figure and table describe each part of the EtherNet/IP Adapter board's (interface's) front panel.



The front panel of the EtherNet/IP Adapter

Classification	Name	Description
Status indicators (LEDs)	SYS	Lights when EtherNet/IP board is activated.
	MS	Lights during EtherNet/IP board is in motion.
	NS	Lights when the connection is established.
	LINK	Lights when the Ethernet is connected to other Ethernet devices.
	ACT	Blinks when transmits/receives Ethernet frame.
EtherNet/IP Interface	CH0	RJ45 connector (female)
	CH1	Use either CH0 or CH1.

13.2.3 Combination of other Extension Boards

EtherNet/IP Adapter board also can be used in combination with other extension boards.

Selectable allocation mode differs depend on the combination of the extension boards.

For available allocations, see "Combination of I/O Extension Boards and Allocation Mode."

13.2.4 I/O Port Map

I/O port numbers allocated to EtherNet/IP Adapter range from 512 to 767 and 4096 to 7871 for input and from 768 to 1023 and 7872 to 11647 for output. (For software lower than Ver.3.2, these range from 512 to 767 for input and from 768 to 1023 for output.)

I/O port number	Allocation	Area
0 to 15	Mini I/O input	Standard area
16 to 31	Mini I/O output	
32 to 47	Not used	
48 to 55	Hand input	
56 to 63	Not used	
64 to 71	Hand output	
72 to 127	Not used	
128 to 511	Internal I/O	
512 to 767	EtherNet/IP Adapter input	Extension board area
768 to 1023	EtherNet/IP Adapter output	
4096 to 7871	Ethernet/IP adapter input	
7872 to 11647	Ethernet/IP adapter output	

13.2.5 Mounting the EtherNet/IP Adapter Board

Mount the EtherNet/IP Adapter board in any of the extension slots provided in the robot controller. For installation, refer to "Mounting I/O Extension Boards"

The extension board will be recognized when it is installed in any of the three extension slots. When it is used in combination with the other extension boards, the board mounted in the far left will be recognized as the first board.

13.2.6 Adding Functions to the Robot Controller

In order to use EtherNet/IP functions, you need to add functions to the robot controller. To add functions, register the configuration software license number with the controller.

If purchasing our controller together with the EtherNet/IP configuration software license, the functions are already added in the controller at the factory.

You can add functions through the teach pendant or WINCAPS.

The Teach Pendant

From the top screen of the teach pendant, press [F6 Set]—[F7 Option.]—[F8 Function Extension]

WINCAPS

Establish the online status(Monitor) →[Tool]—[Controller extension]

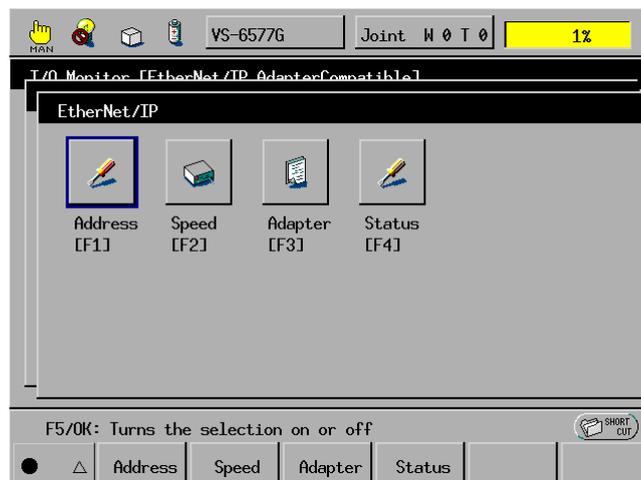
13.3 Setting for the EtherNet/IP

Set up the EtherNet/IP scanner equipment and also the robot controller.

13.3.1 Setting the Robot Controller

According to the EtherNet/IP scanner equipment and environment, set as follows:

From the top screen—[F4 I/O]—[F6 Aux.]—[F12 FieldBus]—[F5 RT-Ether]—[F1 EtherIP]



Address

When setting the IP address for EtherNet/IP, choose either getting the IP address automatically from DHCP or designating it. When designating the IP address, set the IP address, subnet mask, and gateways.

Speed

Select the speed according to the network communication configuration.

Option	Description
Auto Negotiation	The transmission rate is automatically configured according to the connected devices. (Factory default setting)
100M Full Duplex	100Mbps Full Duplex
100M Half Duplex	100Mbps Half Duplex
10M Full Duplex	10Mbps Full Duplex
10M Half Duplex	10Mbps Half Duplex

Adapter

Input/Output sizes

Input sizes can be set in the range from 5 to 504 (32 if the software version is lower than Ver.3.2), and output sizes in the range from 4 to 504 (32 if the software version is lower than Ver.3.2). This controller allows you to increase or decrease input/output sizes in bytes.

For input/output sizes and the maximum number of user input/output points, see Appendix "Quick Reference Table for Input/Output Sizes."

Insensitive time to network error (ms)

Set the insensitive time to network error. The value has been set at 12000 at the factory.

Status

You can check the firmware version, type, IP address and MAC address etc. of the EtherNet/IP Adapter board.

13.3.2 EDS File

EDS file for EtherNet/IP Adapter board is stored in WINCAPSIII CD-ROM that comes with the robot controller. Use this file when you register with EtherNet/IP scanner.

The path: \unsupported\eds\EtherNetIP\denso_RC7_eia_V1.1.eds

Additionally, you can download from the DENSO ROBOT MEMBER SITE on our homepage.

HP : <http://www.densorobot.com>

When input or output size is 33 bytes or more, use the file in the WINCAPS III install disk Ver.3.2 or above, or the file downloaded from the DENSO ROBOT MEMBER SITE on our homepage.

13.4 Allocation

Allocation setting is chosen from the items below.

For available allocations, see "Combination of I/O Extension Boards and Allocation Mode."

13.4.1 Standard Allocation

Input Data (Standard)

Port No.	Signal name
512	Step Stop (All tasks)
513	—
514	Halt (All tasks)
515	Strobe Signal
516	Interruption Skip
517	—
518	—
519	Command data area odd parity
520	Data area 1, bit 0
521	Data area 1, bit 1
522	Data area 1, bit 2
523	Data area 1, bit 3
524	Data area 1, bit 4
525	Data area 1, bit 5
526	Data area 1, bit 6
527	Data area 1, bit 7
528	Data area 2, bit 0
529	Data area 2, bit 1
530	Data area 2, bit 2
531	Data area 2, bit 3
532	Data area 2, bit 4
533	Data area 2, bit 5
534	Data area 2, bit 6
535	Data area 2, bit 7
536	Data area 2, bit 8
537	Data area 2, bit 9
538	Data area 2, bit 10
539	Data area 2, bit 11
540	Data area 2, bit 12
541	Data area 2, bit 13
542	Data area 2, bit 14
543	Data area 2, bit 15

Port No.	Signal name
544	Command area, bit 0
545	Command area, bit 1
546	Command area, bit 2
547	Command area, bit 3
548	—
549	—
550	—
551	—
552	INPUT 552
553	INPUT 553
554	INPUT 554
555	INPUT 555
556	INPUT 556
557	INPUT 557
558	INPUT 558
559	INPUT 559
760	INPUT 760
761	INPUT 761
762	INPUT 762
763	INPUT 763
764	INPUT 764
765	INPUT 765
766	INPUT 766
767	INPUT 767
4096	INPUT 4096
4097	INPUT 4097
7870	INPUT 7870
7871	INPUT 7871

Note: For software lower than Ver.3.2, signals are allocated up to I/O port No. 767.

Output Data (Standard)

Port No.	Signal name
768	—
769	Robot Running
770	Robot Error
771	Servo ON
772	Robot Initialized
773	Auto Mode
774	External Mode
775	Battery Warning
776	Robot Warning
777	Continue Start Permission
778	SS Mode
779	—
780	—
781	—
782	Command Processing Completed
783	Status area, odd parity
784	Status area, bit 0
785	Status area, bit 1
786	Status area, bit 2
787	Status area, bit 3
788	Status area, bit 4
789	Status area, bit 5
790	Status area, bit 6
791	Status area, bit 7
792	Status area, bit 8
793	Status area, bit 9
794	Status area, bit 10
795	Status area, bit 11
796	Status area, bit 12
797	Status area, bit 13
798	Status area, bit 14
799	Status area, bit 15

Port No.	Signal name
800	OUTPUT 800
801	OUTPUT 801
802	OUTPUT 802
803	OUTPUT 803
804	OUTPUT 804
805	OUTPUT 805
806	OUTPUT 806
807	OUTPUT 807
808	OUTPUT 808
809	OUTPUT 809
810	OUTPUT 810
811	OUTPUT 811
812	OUTPUT 812
813	OUTPUT 813
814	OUTPUT 814
815	OUTPUT 815
1016	OUTPUT 1016
1017	OUTPUT 1017
1018	OUTPUT 1018
1019	OUTPUT 1019
1020	OUTPUT 1020
1021	OUTPUT 1021
1022	OUTPUT 1022
1023	OUTPUT 1023
7872	OUTPUT 7872
7873	OUTPUT 7873
11646	OUTPUT 11646
11647	OUTPUT 11647

Note: For software lower than Ver.3.2, signals are allocated up to I/O port No. 1023.

13.4.2 Compatible Allocation

Input

Port No.	Signal name
512	Step Stop (All tasks)
513	Continue Start
514	Halt (All tasks)
515	Operation Preparation Start
516	Interruption Skip
517	Program Start
518	—
519	—
520	Program No. selection bit 0
521	Program No. selection bit 1
522	Program No. selection bit 2
523	Program No. selection bit 3
524	Program No. selection bit 4
525	Program No. selection bit 5
526	Program No. selection bit 6
527	Program No. selection parity bit
528	Motor Power ON
529	CAL Execution
530	—
531	SP100
532	External Mode Change
533	Program Reset
534	Clear Robot Error
535	—
536	INPUT 536
537	INPUT 537
538	INPUT 538
539	INPUT 539
540	INPUT 540
541	INPUT 541
542	INPUT 542
543	INPUT 543
544	INPUT 544

Port No.	Signal name
545	INPUT 545
546	INPUT 546
547	INPUT 547
548	INPUT 548
549	INPUT 549
550	INPUT 550
551	INPUT 551
552	INPUT 552
553	INPUT 553
554	INPUT 554
555	INPUT 555
556	INPUT 556
557	INPUT 557
558	INPUT 558
559	INPUT 559
760	INPUT 760
761	INPUT 761
762	INPUT 762
763	INPUT 763
764	INPUT 764
765	INPUT 765
766	INPUT 766
767	INPUT 767
4096	INPUT 4096
4097	INPUT 4097
7870	INPUT 7870
7871	INPUT 7871

Note: For software lower than Ver.3.2, signals are allocated up to I/O port No. 767.

Output

Port No.	Signal name
768	—
769	Robot Running
770	Robot Error
771	Auto Mode
772	External Mode
773	Program Start Reset
774	—
775	—
776	Robot Power ON Completed
777	Servo ON
778	CAL Completed
779	Teaching ON
780	1 Cycle End
781	Battery Warning
782	Robot Warning
783	Continue Start Permission
784	Error in the units place, bit 0
785	Error in the units place, bit 1
786	Error in the units place, bit 2
787	Error in the units place, bit 3
788	Error in the tens place, bit 0
789	Error in the tens place, bit 1
790	Error in the tens place, bit 2
791	Error in the tens place, bit 3
792	Error in the hundreds place, bit 0
793	Error in the hundreds place, bit 1
794	Error in the hundreds place, bit 2
795	Error in the hundreds place, bit 3
796	—
797	—
798	—
799	—

Port No.	Signal name
800	OUTPUT 800
801	OUTPUT 801
802	OUTPUT 802
803	OUTPUT 803
804	OUTPUT 804
805	OUTPUT 805
806	OUTPUT 806
807	OUTPUT 807
808	OUTPUT 808
809	OUTPUT 809
810	OUTPUT 810
811	OUTPUT 811
812	OUTPUT 812
813	OUTPUT 813
814	OUTPUT 814
815	OUTPUT 815
1016	OUTPUT 1016
1017	OUTPUT 1017
1018	OUTPUT 1018
1019	OUTPUT 1019
1020	OUTPUT 1020
1021	OUTPUT 1021
1022	OUTPUT 1022
1023	OUTPUT 1023
7872	OUTPUT 7872
7873	OUTPUT 7873
11646	OUTPUT 11646
11647	OUTPUT 11647

Note: For software lower than Ver.3.2, signals are allocated up to I/O port No. 1023.

13.5 Quick Reference Table for Input/Output Sizes

The table below lists the input/output sizes in EtherNet/IP and the maximum number of user input/output points.

The table below was determined with the following formula.

When both the input size and output size exceed 32, calculate the maximum general points with the formula below.

Maximum number of general input points

Standard allocation: $\text{Input size} \times 8 - 40$

Compatible allocation: $\text{Input size} \times 8 - 24$

Maximum number of general output points

Standard allocation: $\text{Output size} \times 8 - 32$

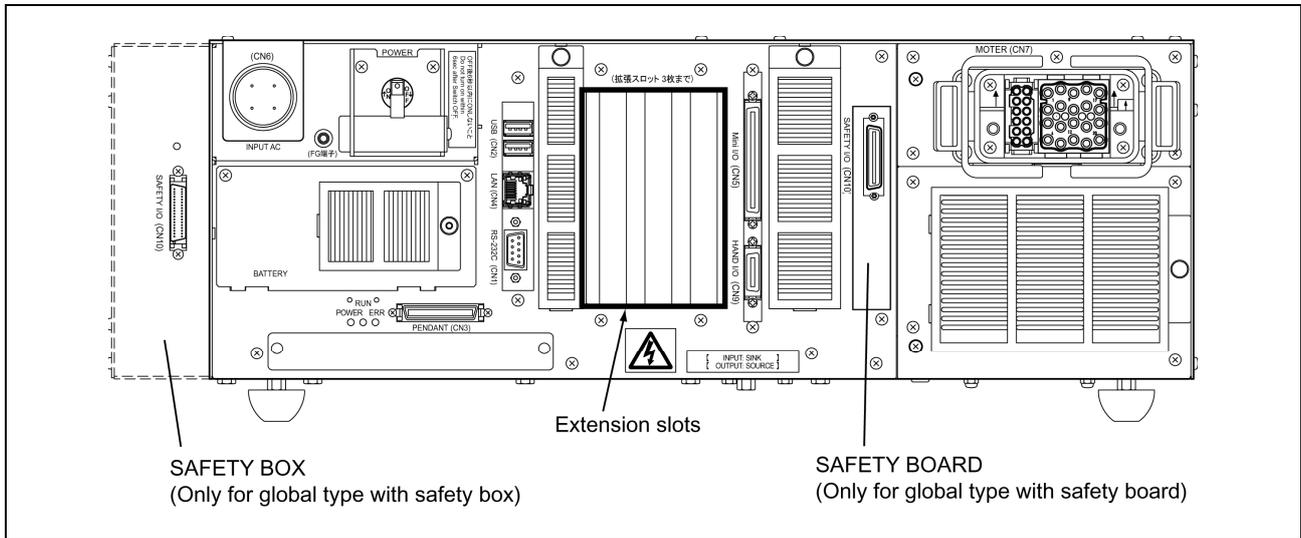
Compatible allocation: $\text{Output size} \times 8 - 32$

EtherNet/IP Input size	Max. number of user input points	
	Standard allocation	Compatible allocation
5	0	16
6	8	24
7	16	32
8	24	40
9	32	48
10	40	56
11	48	64
12	56	72
13	64	80
14	72	88
15	80	96
16	88	104
17	96	112
18	104	120
19	112	128
20	120	136
21	128	144
22	136	152
23	144	160
24	152	168
25	160	176
26	168	184
27	176	192
28	184	200
29	192	208
30	200	216
31	208	224
32	216	232

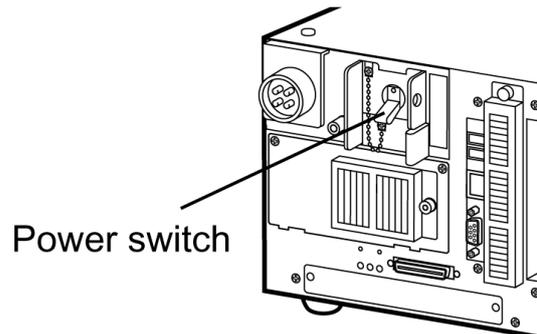
EtherNet/IP Output size	Max.number of user output points	
	Standard allocation	Compatible allocation
4	0	0
5	8	8
6	16	16
7	24	24
8	32	32
9	40	40
10	48	48
11	56	56
12	64	64
13	72	72
14	80	80
15	88	88
16	96	96
17	104	104
18	112	112
19	120	120
20	128	128
21	136	136
22	144	144
23	152	152
24	160	160
25	168	168
26	176	176
27	184	184
28	192	192
29	200	200
30	208	208
31	216	216
32	224	224

Chapter 14 Mounting I/O Extension Boards

This section describes how to mount I/O extension boards such as DeviceNet slave board and CC-Link board.

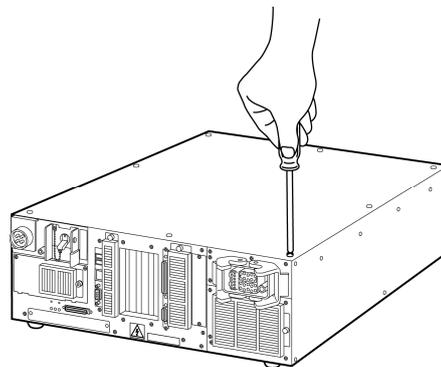


Step 1 Turn the controller power OFF.

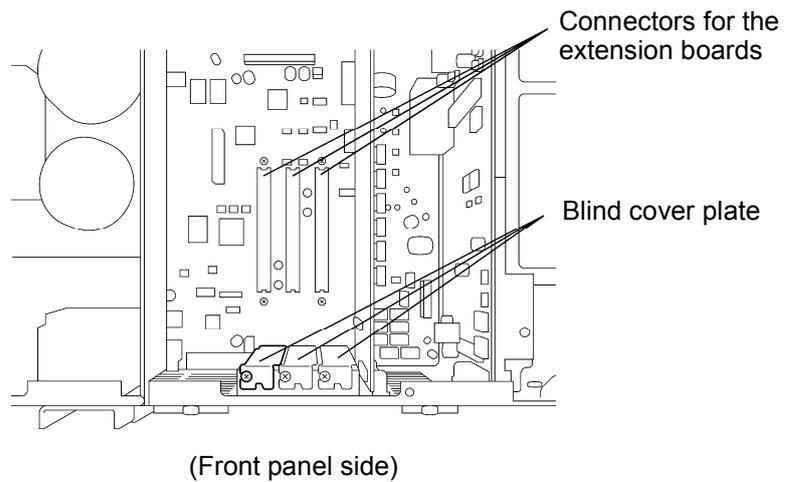


Step 2 Remove the upper cover from the controller by unscrewing four screws.

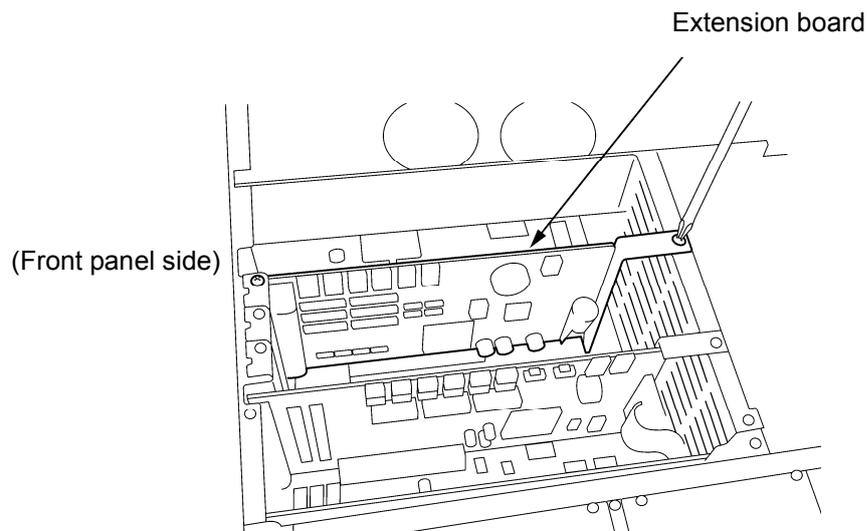
Warning Do not touch the inside of controller before turning off the power switch and waiting 3 minutes or more, or you can easily receive an electric shock.



- Step 3** Use the extension slots starting from the left one (viewed from the front panel side). Loosen the screw on the blind cover plate for the target extension slot and remove the plate.



- Step 4** Fully insert the extension board into the target connector, then secure the extension board stay with two screws.
(The illustration given below shows a mounting example of a parallel I/O board.)



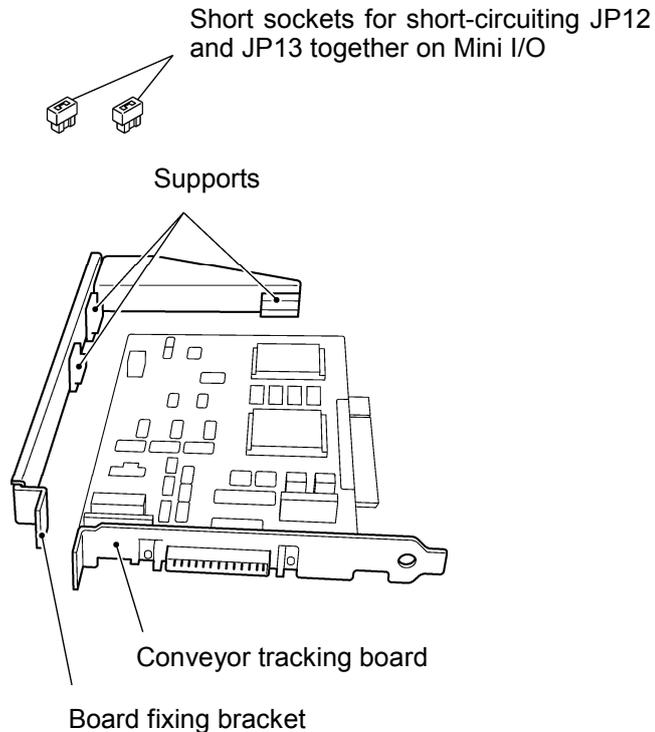
To mount the conveyor tracking board, follow Step 5 and use the board fixing bracket (that comes with the board).

Step 5 For the conveyor tracking board

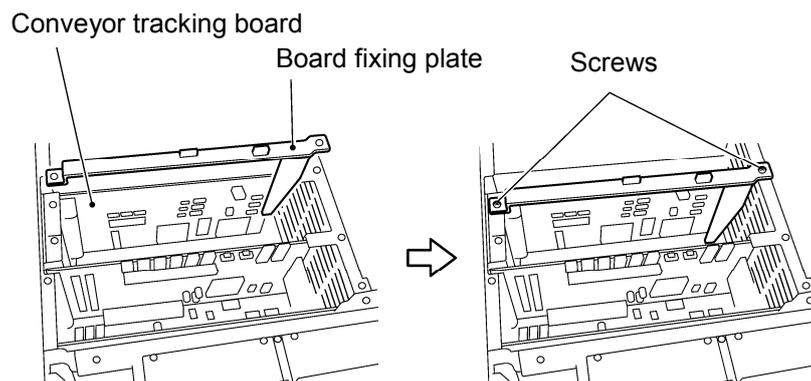
(Required for the conveyor tracking board only)

The conveyor tracking board comes with a board fixing bracket and two short sockets.

NOTE: Using the short sockets enables the board to use the Mini I/O's 24 V internal power supply on the RC7M controller. For the instruction on how to use it, refer to the Conveyor Tracking Board User's Manual, Section 1.4.2 (3) "DC-DC converter wiring diagram."



- (1) Fully insert the conveyor tracking board into the target connector.
- (2) Clamp the board with the three supports provided on the fixing bracket, then secure the bracket with two screws.



Step 6 Set the controller's upper cover back into place.

The mounting of the extension boards is now finished.

Note: When turning the controller power ON after this installation, an Error message "220F: I/O device changed" appears. Update the I/O status and configuration settings according to Section 4.6 "Method for Setting I/O Allocation" and then restart the controller.

PART 3 SYSTEM I/O SIGNALS FOR EXTENSION BOARDS

Chapter 15 System I/O Signals in Standard Mode

15.1 Types and Functions of System Output Signals (Standard Mode)

The table below lists the system output signals used in standard mode.

Types and Functions of System Output Signals to be Used in Standard Mode

Application	Signal name	Function
Start-up	Robot initialization complete	Outputs when preparations for operation are ready to start.
	Auto mode	Outputs when the robot is in Auto mode.
	External mode	Outputs when the robot is in external mode.
	Servo ON	Outputs when the power to the motor is turned ON.
Program execution	Robot-in-operation	Outputs when the robot is in operation (the program is being executed).
Refer to "Command Execution I/O Signals."	Command Processing Complete	Outputs to the external device that I/O command processing is completed.
	Status area (16 bits)	Outputs the result of I/O command processing to the external device.
	Status area odd parity	Bit for parity check in status area
Error/Warning	Robot error	Outputs when a serious error, such as a servo error and a program error, occurs.
	Robot warning	Outputs when a slight error occurs.
	Dead battery warning	Outputs when the voltage of the encoder back-up battery or memory back-up battery dangerously low.
Continue start	Continue start permitted	Outputs when Continue Start is enabled.
Safe start function	SS mode	Outputs when the robot is in SS mode. Refer to the SETTING-UP MANUAL, Chapter 3, Section 3.4.6 "SS (Safe Start) Function."
Emergency stop	Emergency stop	Outputs from a contact exclusively designed for an emergency stop circuitry.

15.2 Usage of System Output Signals (Standard Mode)

The usage of each system output signal in standard mode is described below:

15.2.1 Robot Initialization Complete (Output)

(1) Function

The signal outputs to the external device that a MODE SWITCHING COMMAND is ready to execute from the device.

(2) Usage

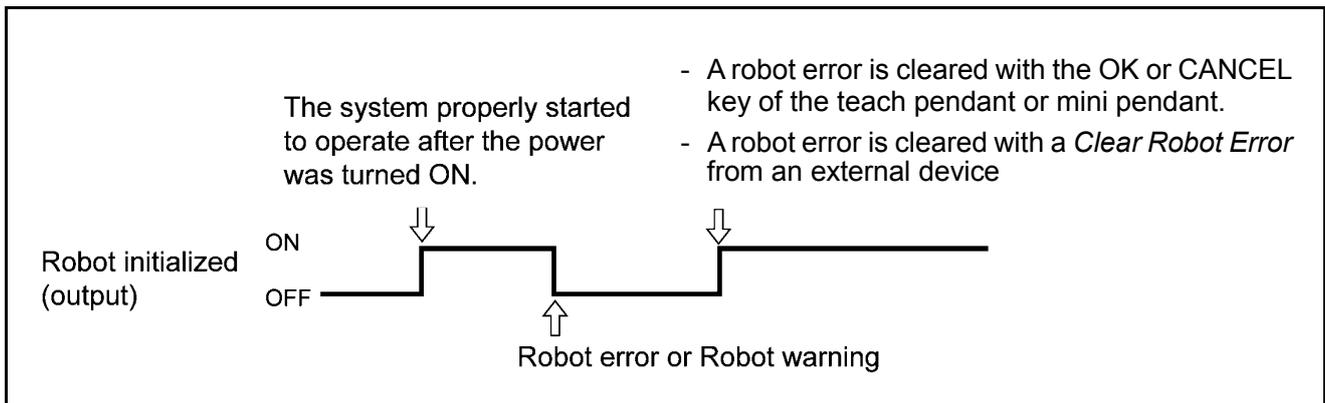
The "mode switching command" will be executed as soon as this signal and the auto mode signal are turned ON, after the power is turned ON.

(3) ON conditions

- ① The signal will be turned ON when the system program for the Robot Controller normally starts, after the power, is turned ON and the mode switching command is ready to execute.
- ② The signal will be turned ON when a robot error is cleared by the CANCEL key of the teach pendant, mini-pendant or by *Clear Robot Error*, after the power is turned OFF.

(4) OFF condition

The signal will be turned OFF when a robot error or robot warning signal is turned ON.



Robot Initialization Complete Output

15.2.2 Auto Mode (Output)

(1) Function

The signal outputs to the external device that the robot is in auto mode.

(2) Usage

Starting the program from the external device requires an EXTERNAL MODE SWITCHING BY MODE SWITCHING COMMAND input and a PROGRAM START BY PROGRAM OPERATION COMMAND input. The signal is used to monitor the auto mode output signal and determine whether to execute the command.

(3) ON condition

The signal will be output when the robot enters auto mode by setting the mode selector switch of the teach pendant or mini-pendant to AUTO.

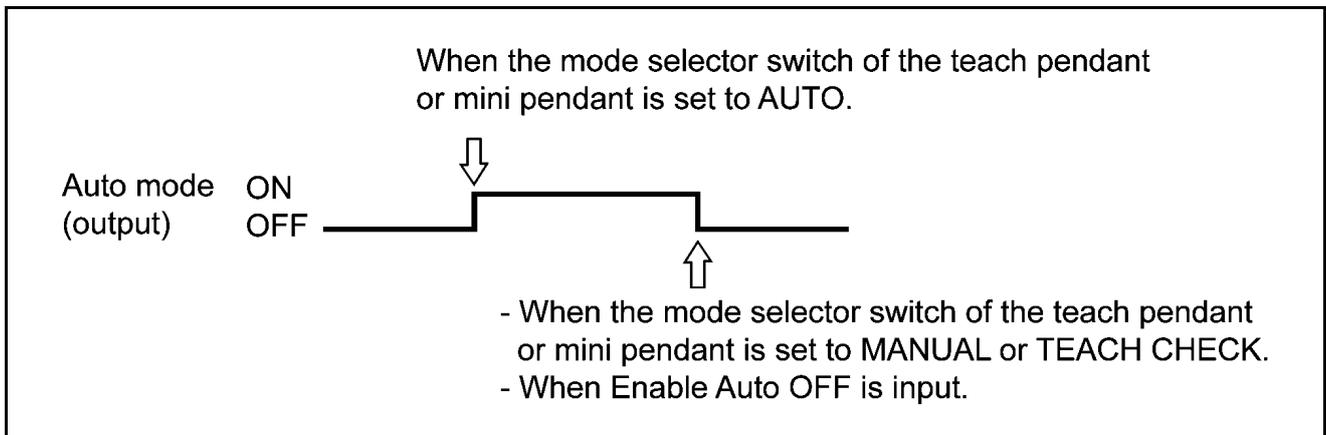
(4) OFF conditions

The signal will be turned OFF under the following conditions.

- ① The mode selector switch of the teach pendant or mini-pendant is set to MANUAL or TEACH CHECK.
- ② The Enable Auto OFF is input.

(Note: The signal will not be turned OFF in the pendantless state described in the OPTIONS MANUAL, Chapter 1, Section 1.3.4.)

Caution: The signal will not be turned OFF with INSTANTANEOUS STOP, STEP STOP or CYCLE STOP commands.



Auto mode Output

15.2.3 External Mode (Output)

(1) Function

The signal outputs to the external device that the robot is in external mode.

(2) Usage

Starting the program from the external device requires an EXTERNAL MODE SWITCHING BY MODE SWITCHING COMMAND input and a PROGRAM START BY PROGRAM OPERATION COMMAND input. The signal is used to confirm that the robot is in external mode.

(3) ON conditions

- ① The signal will be turned ON under the following conditions.
The external mode is selected on the teach pendant.
- ② The EXTERNAL MODE SWITCHING BY MODE SWITCHING COMMAND is input from the external device.

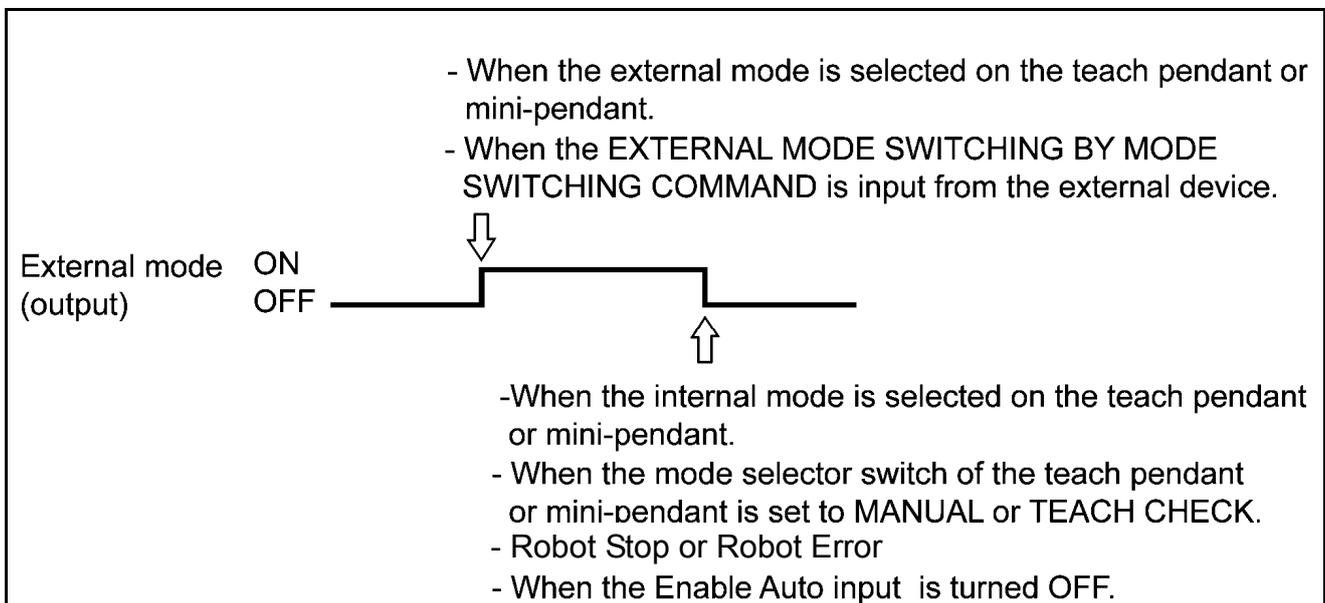
(4) OFF conditions

The signal will be turned ON under the following conditions.

- ① When internal mode is selected on the teach pendant or mini-pendant.
- ② When the mode selector switch of the teach pendant or mini-pendant is set to MANUAL or TEACH CHECK in external mode.
- ③ When *Robot Stop* is input.
- ④ When *Robot Error* is outputted.

Caution: The signal will not be turned OFF with INSTANTANEOUS STOP, STEP STOP or CYCLE STOP.

- ⑤ When an Enable Auto input is turned OFF.



External Mode Output

15.2.4 Servo ON (Output)

(1) Function

The signal outputs to the external device that the power to the motor of the robot is turned ON.

(2) Usage

Starting the program requires the power to the motor to be turned ON. This signal is used to light the motor power ON indicator lamp on an external operating panel.

(3) ON conditions

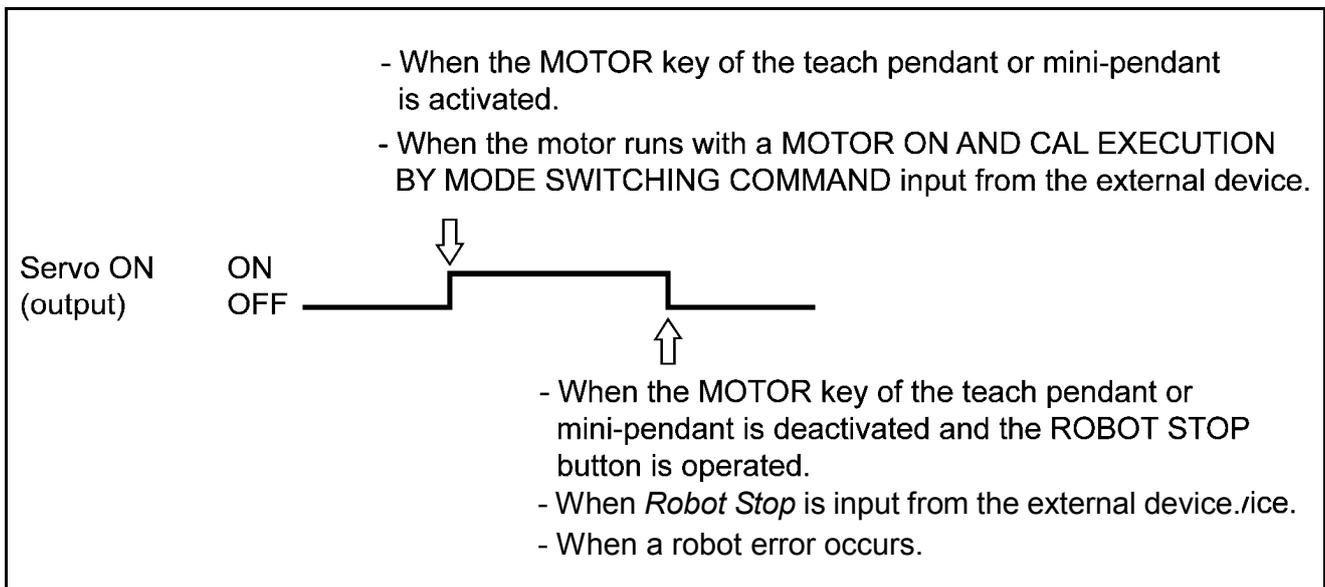
The signal will be turned ON when the power to the motor is turned ON.

- ① When the MOTOR key of the teach pendant or mini-pendant is activated;
or
- ② When the motor runs with a MOTOR ON AND CAL EXECUTION BY MODE SWITCHING COMMAND input from the external device.

(4) OFF conditions

The signal will be turned OFF when the power to the motor is turned OFF.

- ① When the MOTOR key of the teach pendant or mini-pendant is deactivated and the ROBOT STOP button is operated;
- ② When *Robot Stop* is input from the external device; or
- ③ When a *Robot Error* is outputted. If errors 0×6071 to $607B$, 0×6671 to $667B$, $0 \times 607F$ occur, the servo will be turned OFF in automatic or external mode but will not be turned OFF in the manual or the teach check mode.



Servo ON Output

15.2.5 Robot-in-operation (Output)

(1) Function

This signal outputs to the external device that the robot is in operation.

(2) Usage

The signal is used to light the robot operating indicator lamp of an external operating panel.

Since the signal is turned OFF with STOP ALL PROGRAMS, outputs to the external device that all programs are stopped.

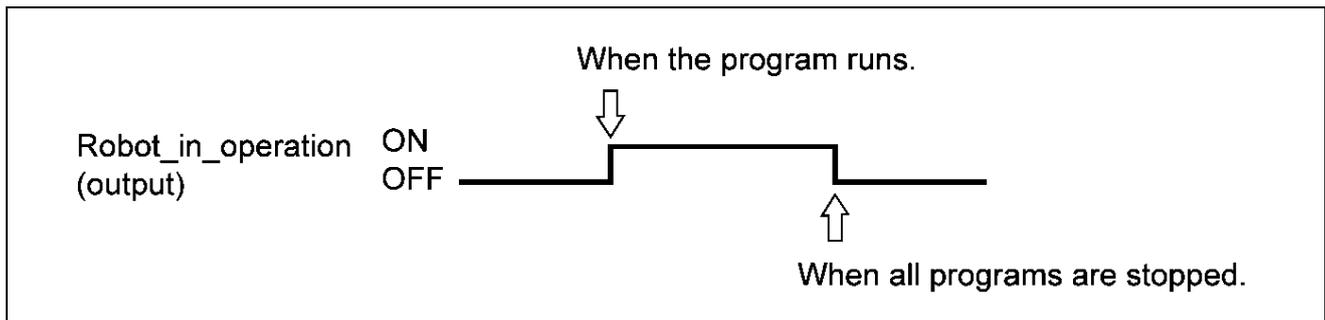
(3) ON conditions

The signal will be turned ON during execution of the program and also while in the WAIT STATE with a condition branch or timer command.

(4) OFF conditions

The signal will be turned OFF with STOP ALL PROGRAMS.

Caution: STOP ALL PROGRAMS means the operation of the ROBOT STOP or STOP button of the operating panel or teach pendant and INSTANTANEOUS STOP (ALL TASKS), STEP STOP (ALL TASKS) and ROBOT STOP inputs.



Robot-in-operation Output

15.2.6 Robot Error (Output)

(1) Function

The signal outputs to the external device that a problem (such as a servo error or a program error) occurs with the robot.

(2) Usage

- ① The signal is used to light the robot external operating panel error indicator lamp of an.
- ② The signal is used to help the PLC clear an error in response to a *Robot Error* signal.

(3) ON conditions

As shown below, the signal will be turned ON under the following conditions.

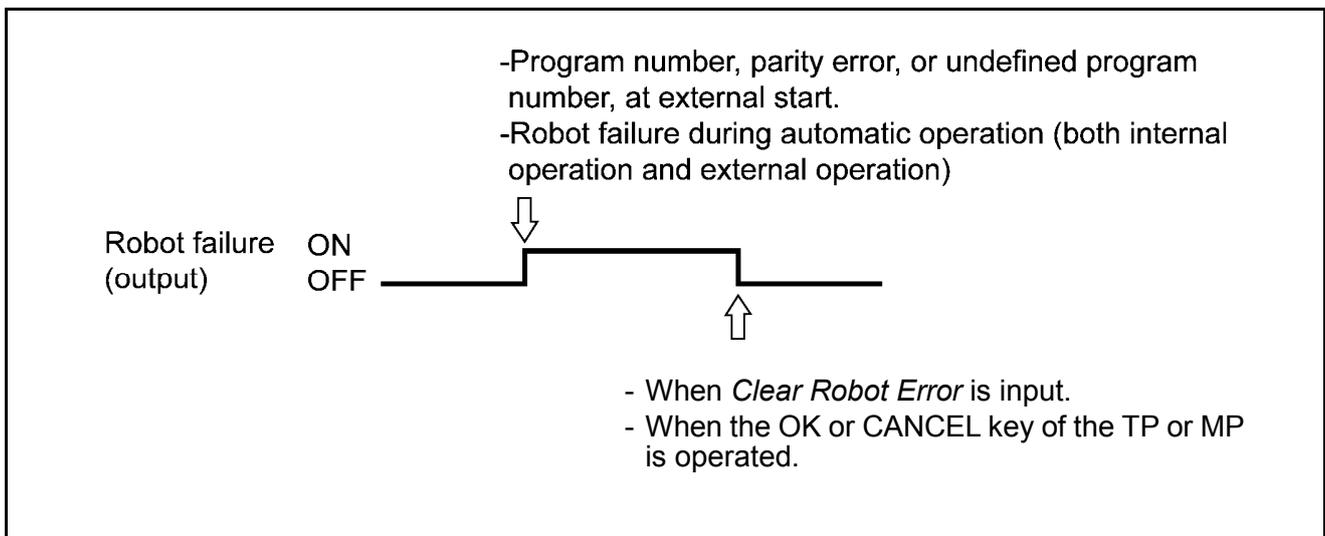
- ① When an error, such as a servo error, a program error or program undefined, occurs at the start of the program and during execution of the program.
- ② When an error occurs during execution of the program in internal operation by the teach pendant or the mini-pendant or in external operation by the PLC.

Caution: The signal will not be outputted when an error, such as a program input error occurs in manual operation, except when a servo error occurs in manual operation. For further information, see the "ERROR CODE TABLES."

(4) OFF conditions

As shown below, the signal will be turned OFF under the following conditions.

- ① When *Clear Robot Error* is inputted and the existing error is cleared.
- ② When the existing error is cleared by operating the **OK** or **Cancel** key on the teach pendant or the mini-pendant.



Robot Error Output

15.2.7 Robot Warning (Output)

(1) Function

The signal outputs to the external device that a minor error occurs with an I/O command or during servo processing.

Caution: The signal will not be outputted if a minor error, such as a program selection error occurs by the operation of the teach pendant or mini-pendant.

(2) Usage

- The signal is used to light the robot warning indicator lamp of the external operating panel.
- The signal is used to help the PLC clear an error in response to a ROBOT WARNING signal.

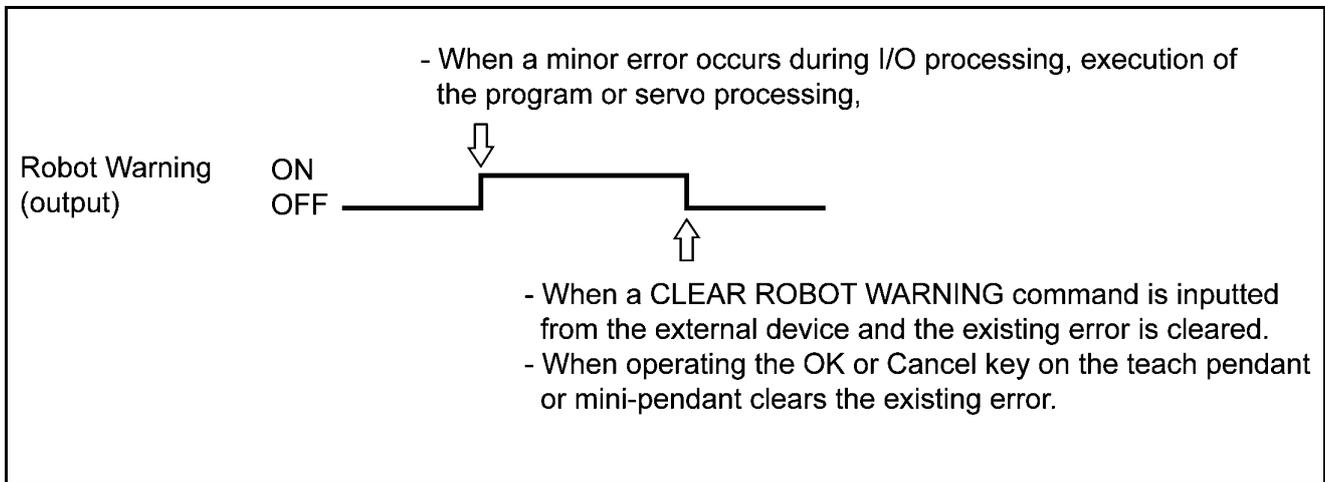
(3) ON condition

As shown below, the signal will be turned ON if a minor error occurs during I/O processing, execution of the program or servo processing, irrespective of the operation mode.

(4) OFF conditions

As shown below, the robot-warning signal will be turned OFF under the following conditions.

- When a CLEAR ROBOT WARNING command is inputted from the external device and the existing error is cleared.
- When operating the **OK** or **Cancel** key on the teach pendant or the mini-pendant clears the existing error.



Robot Warning Output

15.2.8 Dead Battery Warning (Output)

(1) Function

The signal will be output when the voltage of the encoder back-up battery or memory back-up battery becomes lower than acceptable.

(2) Usage

The signal is used to check the timing battery replacement. For example, the battery voltage becomes lower than acceptable.

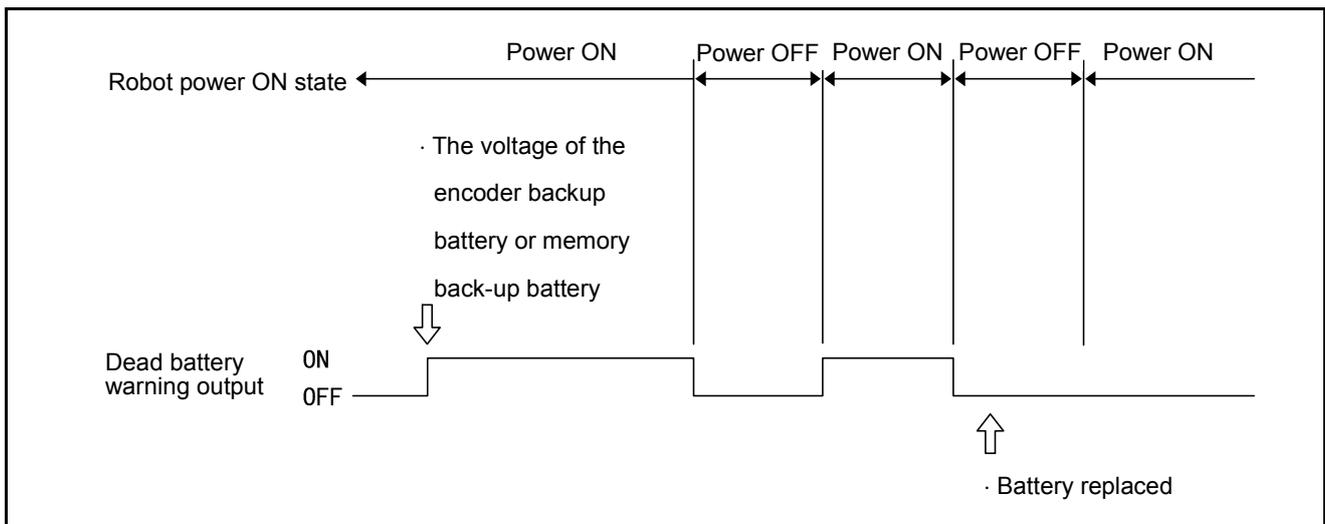
(3) ON condition

The signal will be turned ON when the voltage of the encoder back-up battery or memory back-up battery becomes lower than acceptable.

Caution: The teach pendant or mini-pendant shows any of ERROR64A1 to 64A6 when the encoder back-up battery voltage is low. Meanwhile, each pendant shows ERROR6103 when the memory back-up battery voltage is low.

(4) OFF condition

The signal will be turned OFF when the power is turned ON after the dead battery was replaced.



Dead Battery Warning Output

15.2.9 Continue Start Permitted (Output)

(1) Function

The controller will output this signal when the continue start is permitted.

(2) Usage

Use this signal when you want to know whether the continue start is permitted.

(3) ON condition

This signal comes on when the continue start is permitted. For details, refer to the SETTING-UP MANUAL.

(4) OFF condition

This signal goes off by carrying out the "Task Status Change Operation."

15.2.10 SS mode (Output)

(1) Function

The controller will output this signal during the SS mode.

This mode is effective when the slow mode is selected.

(2) Usage

This signal is used to warn workers that the robot is in the SS mode by beeping or lighting the lamp.

(3) ON condition

This signal comes on when the SS mode is selected.

(4) OFF condition

The signal goes off when the TS time passes so as to cancel SS mode. This function is effective when the slow mode is selected.

Note: If the TS time passes, this signal goes off even when the robot is operation in the slow mode. After this signal goes off, the robot runs at the original speed.

15.3 Types and Functions of System Input Signals (Standard Mode)

The table below lists the system input signals to be used in standard mode:

Types and Functions of System Input Signals to be Used in Standard Mode

Application	Signal Name	Function
Stop	Instantaneous stop (all tasks)	Immediately stops all programs being executed with canceling signals.
	Step stop (all tasks)	Step-stops all programs being executed with canceling signals.
Program interrupt	Interrupt skip	Interrupts the execution of the current step and starts executing the next step.
Refer to "Command Execution I/O Signals".	Command area (4 bits)	Specifies the commands to be executed by the Robot Controller.
	Data area 1 (8 bits)	First data for data area if commands require them.
	Data area 2 (16 bits)	Second data for data area if commands require them.
	Command and data area odd parity	Bit for parity check in command and data area

15.4 Usage of System Input Signals (Standard Mode)

The usage of each system input signal in standard mode is described below.

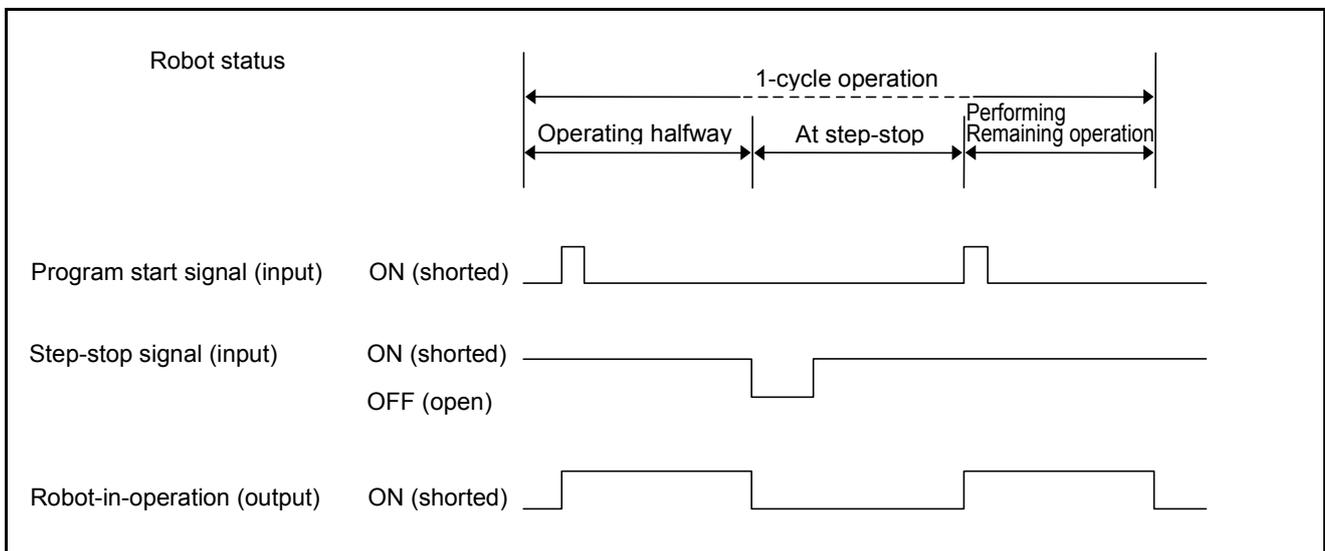
15.4.1 Step Stop (All Tasks) (Input)

(1) Function

Input this signal to step-stop the program being executed from the external device. All tasks will be step-stopped.

(2) Input conditions and operation

- ① If the state of this signal is changed from ON (shorted) to OFF (open), the robot will stop all tasks as soon as the ongoing step is completed, and the Robot-in-operation signal will be turned OFF. However, auto mode or external mode will remain valid, and the suspended program will be resumed by inputting a program operation command (start). See the figure given below.
- ② For resuming the program after a step stop, see Section 15.5.3.2 "Program Operation Command (0001)".



Step Stop Signal

15.4.2 Instantaneous Stop (All Tasks) (Input)

(1) Function

Input this signal (Halt) to instantaneously stop the running programs from an external device. All tasks will stop.

(2) Input conditions and operation

- ① If the state of this signal is turned from ON (shorted) to OFF (open), the robot will immediately stop in the middle of the ongoing step, and the Robot-in-operation signal will be turned OFF. However, auto mode or external mode will remain valid, and the suspended programs will be resumed by inputting Program start signal.
- ② For resuming the program after an instantaneous stop, see Section 15.5.3.2 "Program Operation Command (0001)".
- ③ The minimum required pulse width is 50 milliseconds (msec.) or more.



Minimum Instantaneous Stop Pulse Width

15.4.3 Interrupt Skip (Input)

(1) Function

If this signal is turned ON (shorted) during execution of the robot operation command, within the range between INTERRUPT ON and INTERRUPT OFF in the program, the correct step operation will immediately stop and the next step will start.

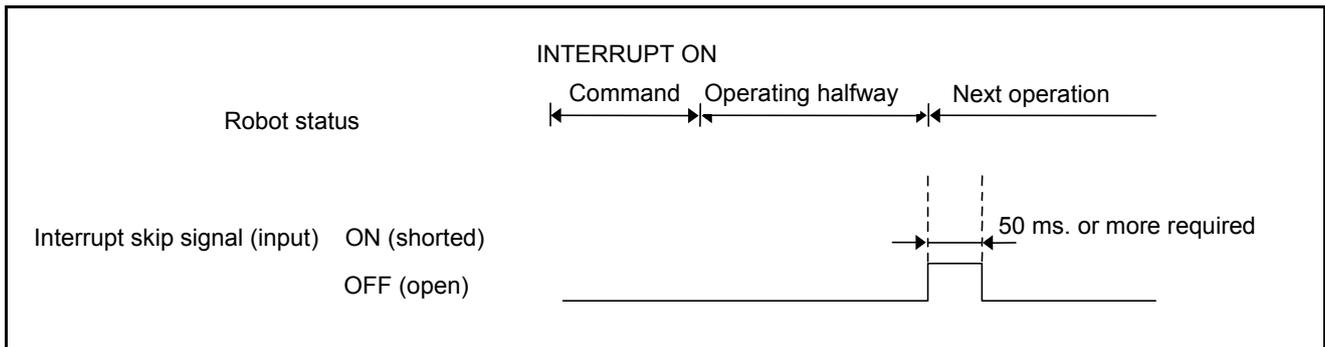
Caution: For further information about the INTERRUPT ON and OFF commands, see the PROGRAMMER'S MANUAL (I), Chapter 12, "12.3 INTERRUPT ON/OFF (Statement)."
For further information about the robot operation command, see the PROGRAMMER'S MANUAL (I), Chapter 12, "Robot Control Statements."

(2) Usage

See the PROGRAMMER'S MANUAL (I), Chapter 12, Section 12.3 "INTERRUPT ON/OFF."

(3) Input conditions and operation

If this signal is turned ON (shorted), the robot will immediately stop the current operation and start executing the next step.



Input Conditions and Operation of Interrupt Skip

15.5 Command Execution I/O Signals Dedicated to Standard Mode

In standard mode the I/O commands can be executed using command execution I/O signals. I/O commands execute the following.

- Operate (start and stop) a program for each task.
- Refer to or change variables from the external device.
- Refer to or change inputs and outputs from the external device.

15.5.1 General Information about Commands

The table below shows the I/O commands functions.

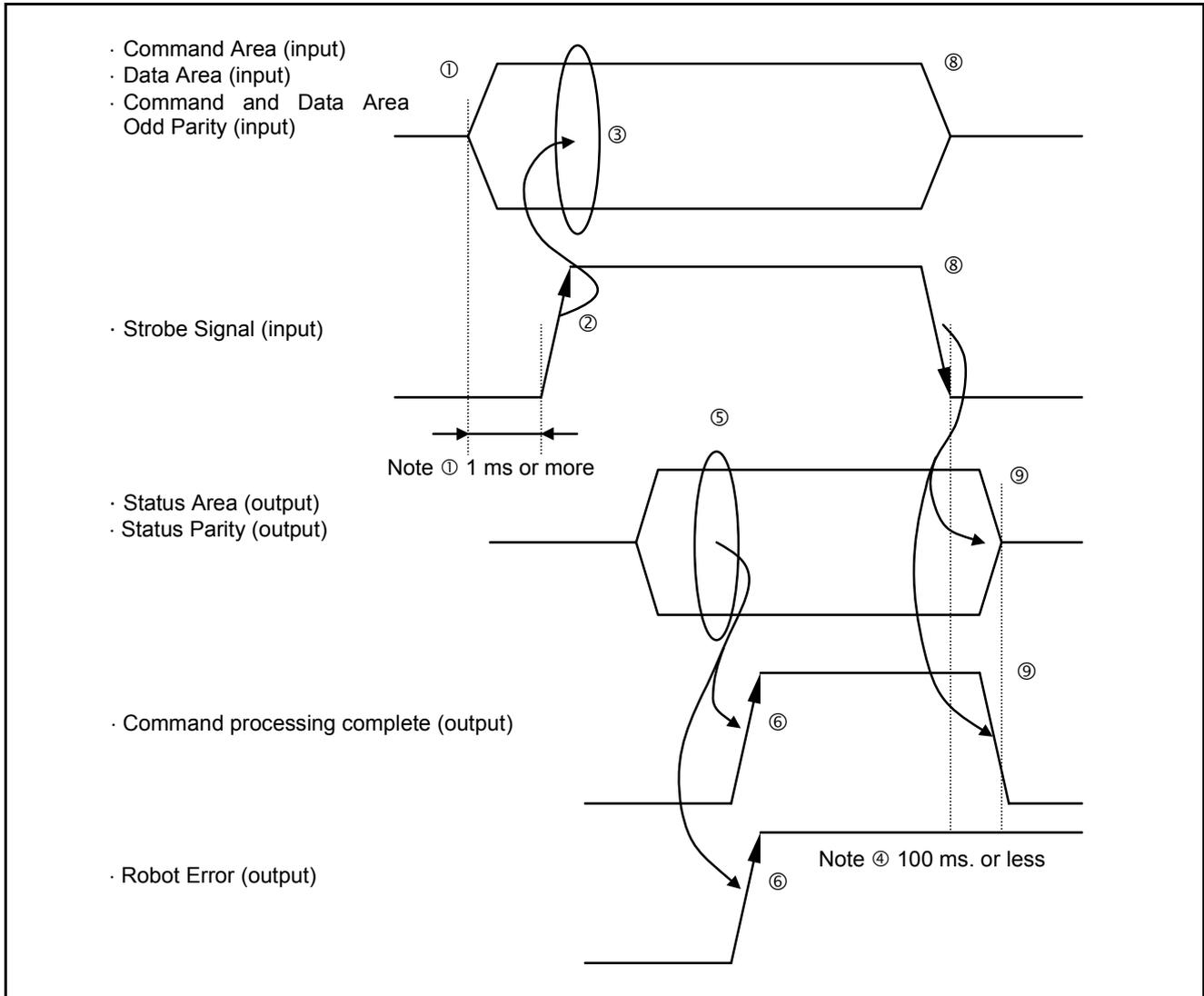
I/O Command Functions

Command	Description of function
<i>Program Operation</i>	<ul style="list-style-type: none"> · Starts the program cycle (specified program). · Step-stops the program (specified program/all programs). · Immediately stops the program (specified program/all programs). · Resets the program (specified program/all programs).
<i>Speed Setting</i>	<ul style="list-style-type: none"> · Sets the external speed. · Sets the external acceleration. · Sets the external deceleration.
<i>Error Number Read</i>	<ul style="list-style-type: none"> · Outputs the error number to the system I/O area.
<i>Type I Variable Write</i>	<ul style="list-style-type: none"> · Reads a value from the system I/O area and substitutes it for a Type I variable.
<i>Type I Variable Read</i>	<ul style="list-style-type: none"> · Outputs a Type I variable to the system I/O area.
<i>Mode Switching</i>	<ul style="list-style-type: none"> · Switches the robot operation mode.
<i>Clear Robot Error</i>	<ul style="list-style-type: none"> · Clears a robot error from the external device.
<i>Internal I/O Write</i>	<ul style="list-style-type: none"> · Sets the state of internal inputs and outputs.
<i>Internal I/O Read</i>	<ul style="list-style-type: none"> · Outputs the state of internal inputs and outputs to the system I/O area.

15.5.2 Processing I/O Commands

15.5.2.1 General Information about Processing

I/O commands to be executed are processed as shown below.



Outline of I/O Command Processing

- ① Set a command area, a data area (if necessary) and command and data area odd parity for the command execution I/O signal from the external device to the Robot Controller.
- ② After the setting is completed, turn ON the strobe signal.

Caution: ① The data to be set in ① must be defined more at least 1 msec. before the strobe signal is turned ON.
 ② Perform command input with a strobe signal after the system output signal *Robot Initialization Complete* is output.

- ③ The controller reads the command area, the data area and the command and data area odd parity as the strobe signal is input.
- ④ The controller starts processing based on the command it read.
- ⑤ If the command is one that outputs a status, the controller sets the status area and status parity.
- ⑥ After command processing has been completed and a status area has been set, the controller turns ON the command processing complete signal.
 If an error occurs in the while processing, a *Robot Error* signal will be outputted together with the command processing complete signal.
- ⑦ The PLC waits until the command processing complete signal is input, and receives the status of the status area, if necessary. In this case, confirmation that no error exists with the robot.
- ⑧ After the PLC has read the status, it turns OFF the command and data areas and the strobe signal.
- ⑨ As soon as the strobe signal is turned OFF, the controller turns OFF the status area and the command processing complete signal.
 The *Robot Error* signal, which is outputted due to a command processing error, remains ON until *Clear Robot Error* is executed.

Caution: ③ The maximum time taken until the status area and the command processing complete signal are turned OFF, after the strobe signal is turned OFF in ⑧, is 100 msec.
 ④ If the strobe signal is turned OFF before the command processing complete signal is turned ON in ⑥, the command processing complete signal and the status area will be output and then turned OFF within 100 msec.

15.5.2.2 Using Each Signal Line

[1] Command and Data Areas

This section describes the usage of the command area (4 bits, input), data area 1 (8 bits, input), data area 2 (16 bits, input) and command and data area odd parity (input).

(1) Function

Specifies the commands to be executed by the Robot Controller.
Sets the command area at all times, and data areas 1 and 2, if necessary.

(2) Input conditions and operation

- ① Set the command area whenever I/O commands are to be executed.
Set data for data areas 1 and 2 if commands require them.
- ② "Shorted" represents the bit value = 1.
"Open" represents the bit value = 0.
"Parity bit " is odd parity.
- ③ Input the command area, data areas 1 and 2, and command and data area odd parity before the strobe signal (1 msec. or more). Retain the status until the command processing complete signal is output.
- ④ Input 1 or 0 as the parity bit so that the total of 1s existing in the command area, data areas 1 and 2 and the command and data area odd parity will be odd
The data areas count even commands, which do not require any data area, in a check sum calculation.
- ⑤ Checksum can be set valid or invalid using a parameter. When checksum is invalid, no checksum check will be performed.

[2] Strobe Signal (Input)

(1) Function

This signal informs the Robot Controller that the command area, data areas 1 and 2, and the command and data area odd parity bit have been set. Additionally it directs the start of command processing.

Caution: Perform command input with a strobe signal after the system output signal ROBOT INITIALIZATION COMPLETE is output.

(2) Input conditions and operation

- ① By turning ON this input in automatic or external mode, the Robot Controller reads the command area, data areas 1 and 2, and the command and data area odd parity bit starts processing.
- ② Retain the status until a command processing complete signal is output and the necessary status data is read. If the strobe signal is turned OFF before a command processing complete signal is output, the status area will not be output.
- ③ By turning OFF this input after the status is read, the command processing complete output, the status area and the status parity will be turned OFF.

[3] Command Processing Complete (Output)

(1) Function

The signal outputs to the external device that I/O command processing is completed.

(2) Usage

The signal is used to confirm that I/O command processing is complete, or as a timing signal for obtaining the result of I/O command processing.

(3) ON conditions

- ① The signal will be turned ON upon completion of processing the I/O command given and determination of outputting the status area.
- ② If an error occurs as a result of executing an I/O command, the result will not be output to the status area, but the robot error signal and the command processing complete signal will be turned simultaneously ON.

(4) OFF conditions

- ① The signal will be turned OFF when the strobe signal is turned OFF.
- ② If the strobe signal is turned OFF, before command processing is completed, the command processing complete signal will be output and then turned OFF within 100 msec.

[4] Status Area

This section describes the usage of the status area (16 bits, output) and of status area odd parity (output).

(1) Function

The signal outputs the result of I/O command processing to the external device.

(2) Usage

The signal is used to execute an I/O command and obtain the result of the PLC.

(3) ON conditions

- ① When processing of the I/O given is completed, the status corresponding to the command will be set.
- ② "ON" represents the bit value = 1.
"OFF" represents the bit value = 0.
"Parity bit" is odd parity.
- ③ Input 1 or 0 as the parity bit so that the total of 1s existing in the command area and status area parity will be odd.
The status area counts even commands, which do not require any data area, in a parity calculation.

(4) OFF conditions

- ① The signal will be turned OFF when the strobe signal is turned OFF.
- ② If the strobe signal is turned OFF, before command processing is completed, the status signal will be output and then turned OFF within 100 msec.

15.5.3 I/O Commands Details

15.5.3.1 List of I/O Commands

The table below lists I/O commands.

List of I/O Commands

Command area	Data area 1	Data area 2	Status area
0001 <i>Program Operation</i>	00000001 Program reset start 00000010 Program start 00000100 Continue start 00010000 Step stop 00100000 Instantaneous stop 01000000 Reset	Program number Program number (Note) Program number Program number Program number	— — — — — —
0010 <i>External Speed and Acceleration Setting</i>	00000001 Speed setting 00000010 Acceleration setting 00000100 Deceleration setting	Set speed value Set acceleration value Set deceleration value	— — —
0100 <i>Error Read</i>	—	—	Error number
0101 <i>Type I Variable Write</i>	Type I variable number	Set variable value (lower 16 bits)	—
0110 <i>Type I Variable Read</i>	Type I variable number	—	Variable value (lower 16 bits)
0111 <i>Mode Switching</i>	00000001 Motor ON, CAL execution 00000010 External speed 100 10000000 External mode switching 10000011 Execution of all above (Motor ON→CAL→SP100→External)	—	—
1000 <i>Clear Robot Error</i>	—	—	—
1001 <i>I/O Write</i>	Set I/O value	First internal I/O port address	—
1010 <i>I/O Read</i>	—	First internal I/O port address	I/O

(Note) In execution of Continue Start command, program numbers will be ignored.

15.5.3.2 Program Operation Command (0001)

(1) Function

This command controls the operating state of the program specified in data area 2 based on the setting of data area 1.

(2) Format

Command area (4 bits, input)
0001

Data area 1 (8 bits, input)
00000001: Program reset start
00000010: Program start
00000100: Continue start
00010000: Step stop
00100000: Instantaneous stop
01000000: Reset

An error (ERROR2032) will occur if data is other than the above is set.

Data area 2 (16 bits, input)

Program number: Program number to start

When the number given in data area 2 is nn, the operating state of PR0nn will be controlled as given in data area 1. If the program number is negative in the case of a step stop, instantaneous stop or reset command, all programs will stop or be reset. If the program number is negative with a program reset start or program start command, ERROR73E4 will result.

Status area (16 bits, output)
Nothing will be output.

(3) Description

① Program reset start

This command is executable only in external mode. If executed in other mode an error will occur.

This command initializes and starts the program of the program number specified in data area 2. PRO0 to PRO32767 can be started.

If the program number specified in data area 2 is negative, an error (ERROR73E4) will occur.

Either of the following operations takes place according to the operating status of the program:

- If the specified program is terminated (stopped), step-stopped or immediately stopped, it will start from the beginning.
- If the specified program is running, an error (ERROR21F5) will be displayed, and the program will stop.

② Program start

This command is executable only in external mode. An error (ERROR2032) will occur in other modes.

This command starts the program of the program number specified in data area 2. PRO0 to PRO32767 can be started.

If the program number specified in data area 2 is negative, an error (ERROR73E4) will occur.

One of the following operations takes place according to the operating status of the program.

- If the specified program is terminated (stopped), it will start from the beginning.
- If the specified program is step-stopped, it will resume from the step following the suspended step.
- If the specified program is immediately stopped, it will resume from the step following the suspended step. When the program is instantaneously stopped while in execution of an operation command, it will resume from the operation still undone.
- If the specified program is running, an error (ERROR21F5) will be displayed, and the program will stop.

③ Continue start

This command is executable only in external mode when the Continue Start Permitted signal is on. The data area will be ignored.

④ Step stop

This command step-stops the program of the program number specified in data area 2. PRO0 to PRO32767 can be step-stopped.

If the program number specified in data area 2 is negative, all programs being executed will step-stop.

Either of the following operations takes place according to the operating status of the program.

- If the specified program is terminated (stopped), step-stopped or immediately stopped, nothing will happen.
- If the specified program is running, it will step-stop. If started after a step stop, the stopped program will resume from the step following the suspended step.

⑤ Instantaneous stop

This command immediately stops the program of the program number specified in data area 2. PRO0 to PRO32767 can be stopped immediately.

If the program number specified in data area 2 is negative, all programs being executed will step-stop.

Either of the following operations takes place according to the operating status of the program:

- If the specified program is terminated (stopped), step-stopped or immediately stopped, nothing will happen.
- If the specified program is running, it will immediately stop. If started after an instantaneous stop, the stopped program will resume from the suspended step. If the program is immediately stopped in the middle of execution of an operation command, it will resume, starting from the last uncompleted operation.

⑥ Reset

This command immediately stops and also initializes the program of the program number specified in data area 2. PRO0 to PR032767 can be stopped.

This command cannot be used together with the program start command.

To start a step-stopped or cycle-stopped program from the beginning, use the program reset start command.

If the program number specified in data area 2 is negative, all programs being executed will be reset.

One of the following operations takes place according to the operating status of the program.

- When the specified program is terminated (stopped), nothing will happen.
- When the specified program is step-stopped or immediately stopped, it will be initialized. The initialized program will resume from the beginning.
- When the specified program is running, it will immediately stop and also be initialized. If started after an instantaneous stop, the stopped program will resume from the beginning.

15.5.3.3 External Speed and Acceleration Setting (0010)

(1) Function

This command sets the external speed, acceleration and deceleration values selected in data area 1 to the values specified in data area 2.

This command is executable only in external mode. An error will occur in other modes.

(2) Format

Command area (4 bits, input)

0010

Data area 1 (8 bits, input)

00000001: Speed setting

00000010: Acceleration setting

00000100: Deceleration setting

An error (ERROR2032) will occur if data other than the above is set.

Data area 2 (16 bits, input)

Set values: Speed, acceleration and deceleration to be set

Enter any of the external speed, acceleration and deceleration values specified in data area 1.

The values must be between 1 and 100. If they are out of this range, an error (ERROR2003) will occur.

Status area (16 bits, output)

Nothing will be output.

(3) Description

① Speed setting

The external speed is set to the value specified in data area 2. The value must be between 1 and 100. An error (ERROR2003) will occur if the value is out of this range.

The external acceleration and deceleration will be set simultaneously as shown below by setting the external speed:

External acceleration and external deceleration = External speed²/100
(minimum value: 1)

② Acceleration setting

The external acceleration is set to the value specified in data area 2. The value must be between 1 and 100. An error (ERROR2003) will occur if the value is out of this range.

③ Deceleration setting

The external deceleration is set to the value specified in data area 2. The value must be between 1 and 100. An error (ERROR2003) will occur if the value is out of this range.

15.5.3.4 Error Read (0100)

(1) Function

This command outputs the existing error number to the status area.
This command is output to the status area only when the strobe signal remains ON.

Caution: This command will not be output if a minor error occurs, such as a program selection error, caused by the operation of the teach pendant or the mini-pendant.

(2) Format

Command area (4 bits, input)
0100
Data area 1 (8 bits, input)
Nothing will be input.
Data area 2 (16 bits, input)
Nothing will be input.
Status area (16 bits, output)
The existing error code will be output.

(3) Hexadecimal codes

Refer to the figure given below.

xxxx → 0	xOxO → 5	OxOx → A	
xxxO → 1	xOOx → 6	OxOO → B	
xxOx → 2	xOOO → 7	OOxx → C	
xxOO → 3	Oxxx → 8	OOxO → D	
xOxx → 4	OxxO → 8	OOOx → E	O...ON
		OOOO → F	x...OFF

The following figure shows an example of error number output when ERROR6174 (overload error with the fourth axis) occurs.

	Thousands of error No.				Hundreds of error No.				Tens of error No.				Units of error No.			
	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
Terminal No. (Connector CN10)	x	O	O	x	x	x	x	O	x	O	O	O	x	O	x	x
	↑				↑				↑				↑			
ERROR	6				1				7				4			

Example of Error Number Output

(4) Description

If a command is executed when a robot error or the robot warning signal is output, the error number, which caused the robot error or robot warning signal to be output, will be output to the status area.

If no error exists after an error has been cleared, 0 will be output to the status area. Also, when there is an error that does not output any robot error or robot warning signal, 0 will be outputted.

15.5.3.5 Type I Variable Write (0101)

(1) Function

This command substitutes the value specified in data area 2 for the Type I (integer type) global variable of the number specified in data area 1.

(2) Format

Command area (4 bits, input)
0101

Data area 1 (8 bits, input)

The number of the Type I variable for which a value will be substituted. Any number between I[0] and I[255] can be specified. When the input data in data area 1 is nn, the value specified in data area 2 will be substituted for the Type I variable I [nn].

Data area 2 (16 bits, input)

The value to be substituted for the Type I variable specified in data area 1. Any value between -32768 and 32767 can be set.

Status area (16 bits, output)

Nothing will be output.

(3) Description

The value specified in data area 2 is substituted for the Type I variable specified in data area 1.

Although the type I variable has a storage area of 32 bits, the 16-bit data in data area 2 will be substituted for the lower 16 bits. Zero will be substituted for the upper 16 bits of the Type I variable.

15.5.3.6 Type I Variable Read (0110)

(1) Function

This command outputs to the status area the value of the Type I (integer type) global variable of the number specified in data area 1.

(2) Format

Command area (4 bits, input)
0110

Data area 1 (8 bits, input)

The number of the Type I variable for which a value will be substituted. Any number between I [0] and I [255] can be specified. When the input data in data area 1 is nn, the value specified in data area 2 will be substituted for the Type I variable I [nn].

Data area 2 (16 bits, input)
Nothing will be input.

Status area (16 bits, output)

The lower 16 bit value of the Type I variable specified in data area 1 will be output.

(3) Description

The value of the Type I variable specified in data area 1 is output to the status area.

Although the Type I variable has a storage area of 32 bits, the lower 16 bits will be output to the status area.

Therefore, any value between -32768 and 32767 can be output properly. However, if the value is out of this range, only the lower 16 bits of the data will be output.

15.5.3.7 Mode Switching (0111)

(1) Function

This command switches the robot mode from the external device to prepare the robot for operation.

This command is executable only in auto mode. An error will occur in other modes. Before executing this command, select auto mode on the operating panel or the teach pendant.

(2) Format

Command area (4 bits, input)

0111

Data area 1 (8 bits, input)

Bit 0 (00000001): Motor ON, CAL execution

Bit 1 (00000010): External speed 100

Bit 7 (10000000): External mode switching

These bits can be set together to execute commands. When two or more bits are set, commands will be executed one after another.

For example, when bits 0, 1 and 7 are set, motor ON, CAL execution, external speed 100 and external mode will be executed in this order.

If bits other than the above are set, an error will result.

Data area 2 (16 bits, input)

Nothing will be input.

Status area (16 bits, output)

Nothing will be output.

(3) Description

This command is used for equipment using the robot to switch the operation mode of the robot to external mode from the external device

The processing operations to be executed are specified by the bits set in data area 1 and will be executed from bit 0 to bit 7.

① Motor ON, CAL execution (bit 0)

When this bit is set, the power to the Robot Controller motor will be turned ON and CAL will be executed. If CAL is executed once after the power is turned ON, no processing will take place.

② External speed 100 (bit 1)

When this bit is set, the external speed, external acceleration and external deceleration of the Robot Controller will be set to 100.

③ External mode switching (bit 7)

When this bit is set, the mode of the Robot Controller will be switched from automatic to external.

15.5.3.8 Clear Robot Error (1000)

(1) Function

This command clears a robot error that has been caused.

(2) Format

Command area (4 bits, input)
1000

Data area 1 (8 bits, input)
Nothing will be input.

Data area 2 (16 bits, input)
Nothing will be input.

Status area (16 bits, output)
Nothing will be output.

(3) Description

If a robot error occurs, this command clears it. When there is no failure, no processing will take place

When an error is displayed, the same processing as when the **OK** or **Cancel** key of the operating panel or the teach pendant is operated will be performed.

15.5.3.9 I/O Write (1001)

(1) Function

This command substitutes the status specified in data area 1 for the 8-bit internal I/O area starting from the number specified in data area 2.

(2) Format

Command area (4 bits, input)
1001

Data area 1 (8 bits, input)
The status to be set will be specified in the internal I/O area starting from the number specified in data area 2.

Data area 2 (16 bits, input)
This is first number of the internal I/O (8-bit) area for which the status will be substituted. The number can be set between 128 and 504. If the number is out of this range, an error (ERROR2034) will occur.

Status area (16 bits, output)
Nothing will be output.

(3) Description

This command substitutes the status specified in data area 1 for the 8-bit internal I/O area starting from the number specified in data area 2.

15.5.3.10 I/O Read (1010)

(1) Function

This command outputs to the lower 8 bits of the status area the status of the 8-bit internal I/O area starting from the number specified in data area 2.

(2) Format

Command area (4 bits, input)
1010

Data area 1 (8 bits, input)
Nothing will be input.

Data area 2 (16 bits, input)
This is the first number of the internal I/O (8-bit) area whose status will be output. The number can be set between 128 and 504. If the number is out of this range, an error (ERROR2034) will occur.

Status area (16 bits, output)
The status of the 8-bit internal I/O area starting from the number specified in data area 2 will be output to the lower 8 bits of this area.

(3) Description

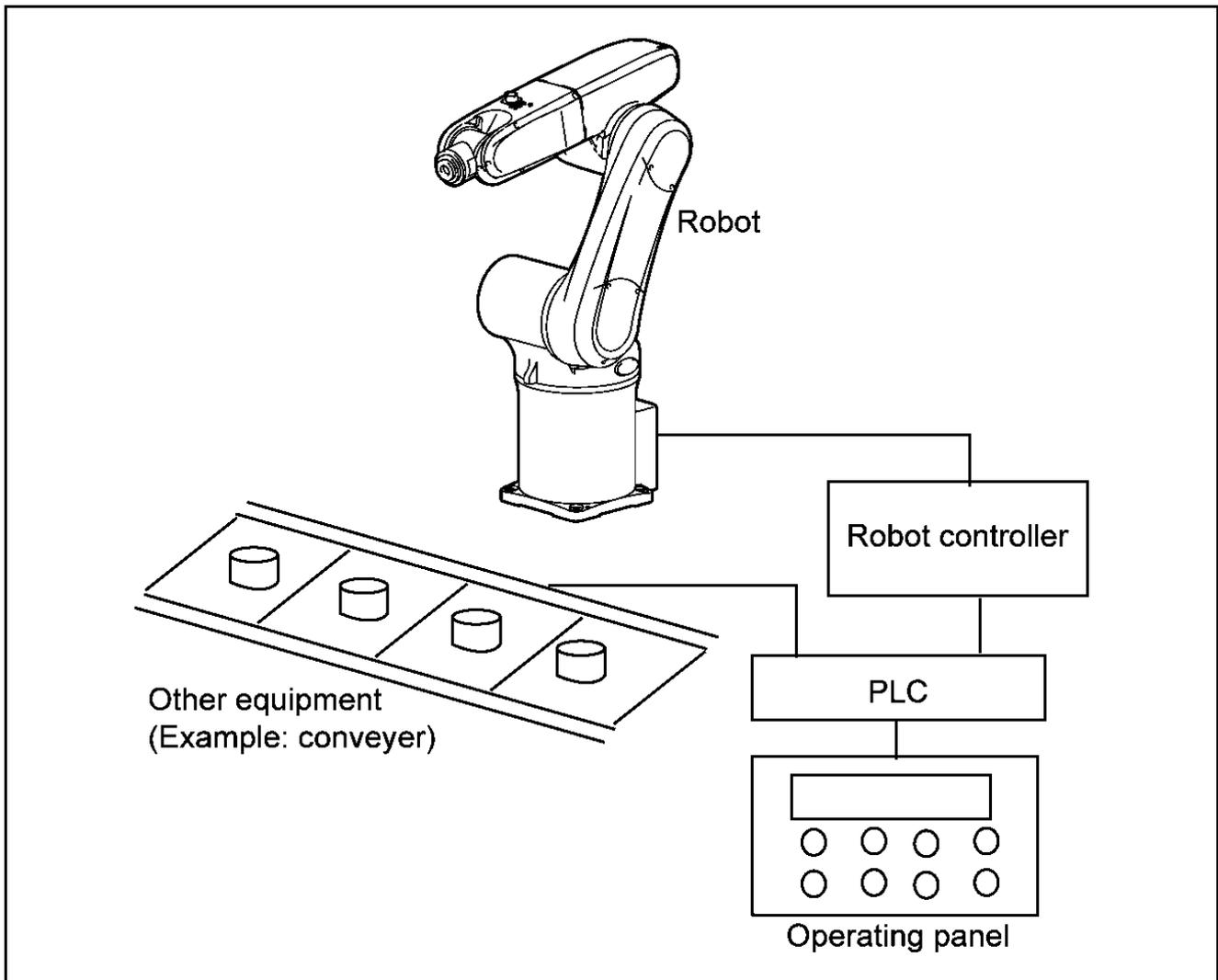
This command outputs to the lower 8 bits of the status area the status of the 8-bit internal I/O area starting from the number specified in data area 2. Zero will be output to the upper 8 bits.

15.6 Example of Using System I/O Signals in Standard Mode

This section illustrates an example of starting and stopping the robot using system I/O signals.

(1) Equipment setup example

This example shown below assumes an equipment setup which allows you to run the robot by operating an external equipment's operation panel connected via the PLC to the robot controller. It is assumed that the operation panel has a display, lamps and switches listed on the next page.



Example of Equipment Setup Using a Robot

Function Example of Equipment Operating Panel

Classification	Part	Application
Display	Display	Displays messages, such as ROBOT PREPARATION OK.
Lamp	① Automatic operation indicator lamp	· Lights during automatic operation. · Turned OFF when the robot is not in automatic operation.
	② Robot external mode indicator lamp	· Lights when the robot is in external mode. · Turned OFF when the robot is not in external mode.
	③ Operation OK indicator lamp	· Lights when the Enable Auto signal (CN5) is ON. · Turned OFF when the Enable Auto signal (CN5) is OFF.
	④ Robot home position indicator	· Lights when the robot is in the home position for working. · Turned OFF when the robot is out of the home position for working. (By programming with a user-output)
Switch	① Robot preparation button	Starts the preparation of the robot.
	② Automatic start button	Starts the operation of the equipment.
	③ Cycle stop button	Stops the equipment after a cycle of operations is completed.
	④ Operation/Adjustment selector switch	Automatic operation of the robot possible when OPERATION is selected. Manual operation or teach check of the robot possible when ADJUSTMENT is selected.
Caution: Actual equipment requires emergency stop, interlock and other functions; however, described here are the necessary functions.		

(2) Outline of procedure

Described below is the outline of the procedure when using the equipment taken as an example shown on the previous page.

Follow steps ① to ④.

① Operation preparation start

After setting the MOTOR ON, CAL EXECUTION, EXTERNAL SPEED 100 and EXTERNAL MODE SWITCHING bits, execute the mode switching command to bring the robot into external automatic operation mode. This operation will be completed when the EXTERNAL MODE output signal is turned ON.

② Operation start area check

When the robot arm is in the home position for working, the robot home position indicator lights and "ROBOT PREPARATION OK" displays.

③ Automatic operation

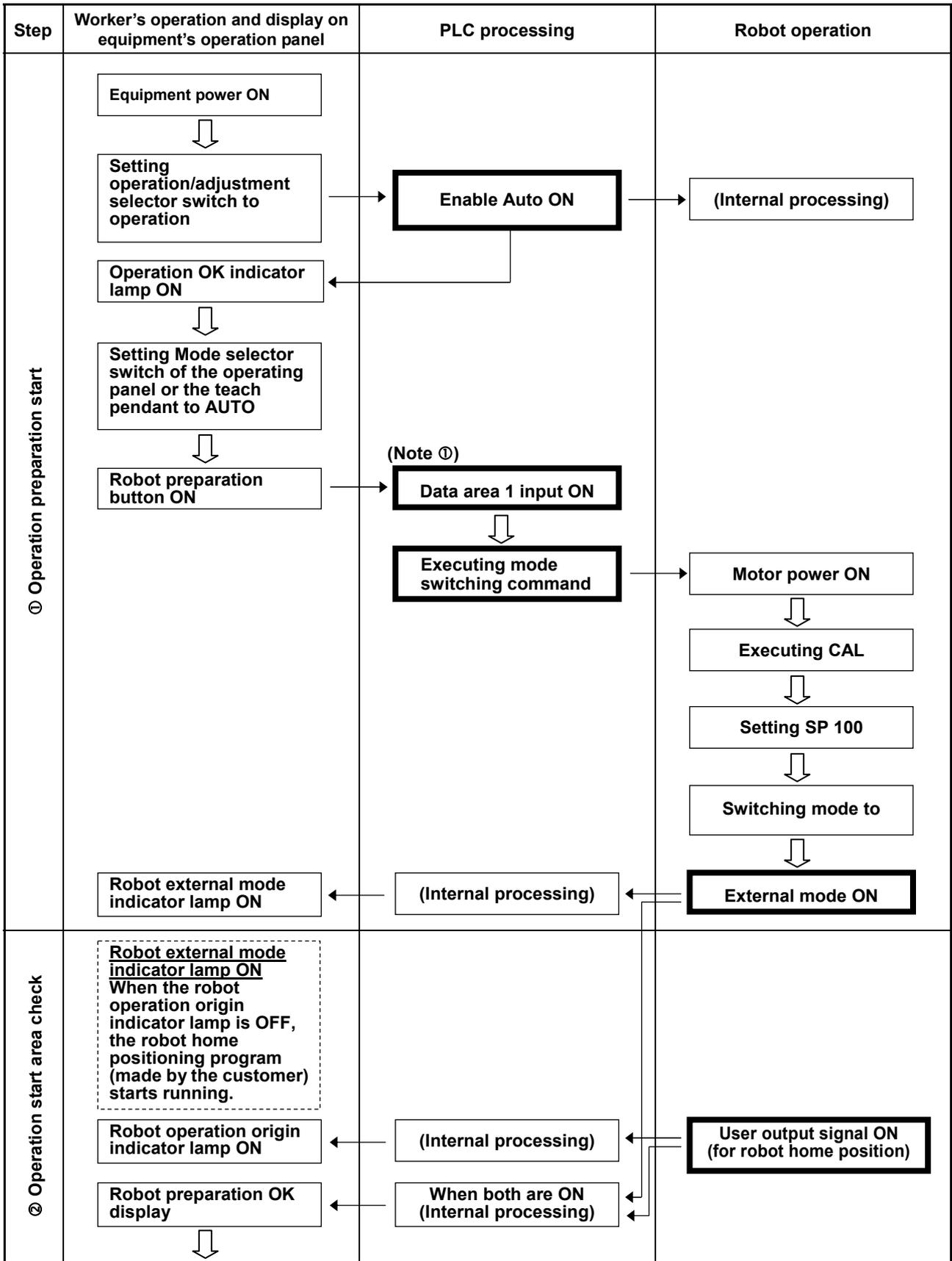
Start the program by which the robot starts from the operation origin, performs operations, and returns to the operation origin.

④ Operation end

Terminate the day's operations with a cycle stop, and turn OFF the power.

(3) Start and stop procedure, and system I/O signals

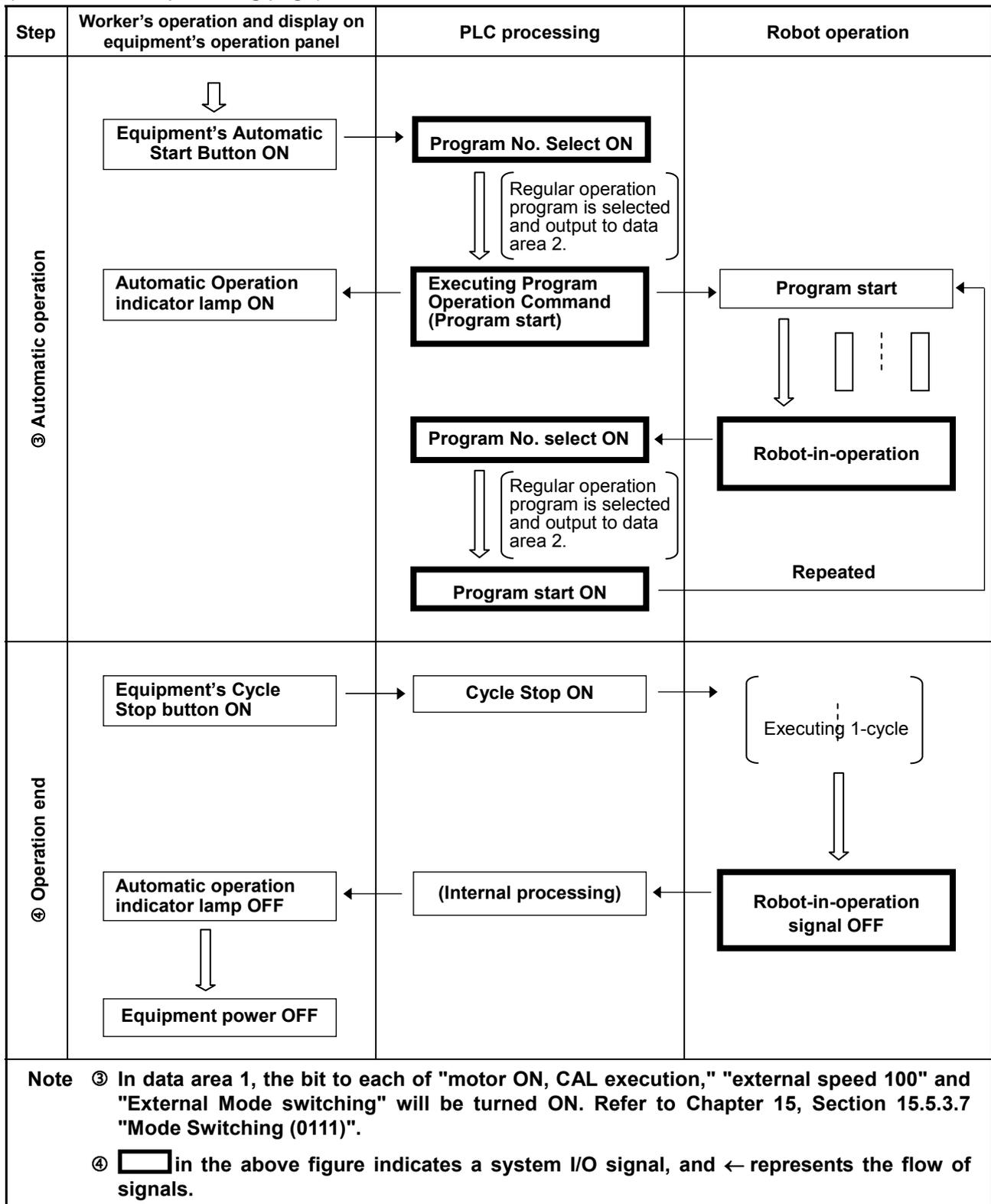
The following pages show the relationship between the system I/O signals for start and stop, worker's operation, display on the equipment operation panel, PLC proceeding, and robot motion.



Start and Stop Procedure and System I/O Signals-1

(Continued on following page)

(Continued from preceding page)



Start and Stop Procedure and System I/O Signals-2

Chapter 16

System I/O Signals in Compatible Mode

16.1 Types and Functions of System Output Signals (Compatible Mode)

The table below lists the system output signals used in the compatible mode.

Types and Functions of System Output Signals to be Used in Compatible Mode

Application	Signal name	Function
Start-up	Robot power ON complete	Outputs when preparations for operation are ready to start.
	Auto mode	Outputs when the robot is in auto mode.
	Servo ON	Outputs when the power to the motor is turned ON.
	CAL complete	Outputs when calibration is completed.
	External mode	Outputs when the robot is in external mode.
Program pre-execution check	Teaching	Outputs when the robot is in manual or teach check mode.
Program execution	Program start reset	Outputs when execution of the program starts in response to the program start signal received.
	Robot-in-operation	Outputs when the robot is in operation (the program is being executed).
	Continue start permitted	Outputs when the continue start is permitted.
Program end	Single cycle end	Outputs when the program completes a cycle.
Error/warning	Robot error	Outputs when a failure (such as a servo failure and program error) occurs in the robot.
	Robot warning	Outputs when a slight error occurs.
	Dead battery warning	Outputs when the voltage of the encoder backup battery or memory backup battery lowers.
	Error No.	An error number will be outputted in BCD code if an error occurs.
Continue start	Continue start permitted	Outputs when Continue Start is enabled.
Safe start function	SS mode	Outputs when the robot is in SS mode. Refer to the SETTING-UP MANUAL, Chapter 3, Section 3.4.6 "SS (Safe Start) Function."

16.2 Usage of System Output Signals in the Compatible Mode

The usage of each system output signal in the compatible mode is described below.

16.2.1 Robot Power ON Complete

(1) Function

The signal outputs to the external device that *Operation Preparation Start* is possible.

(2) Usage

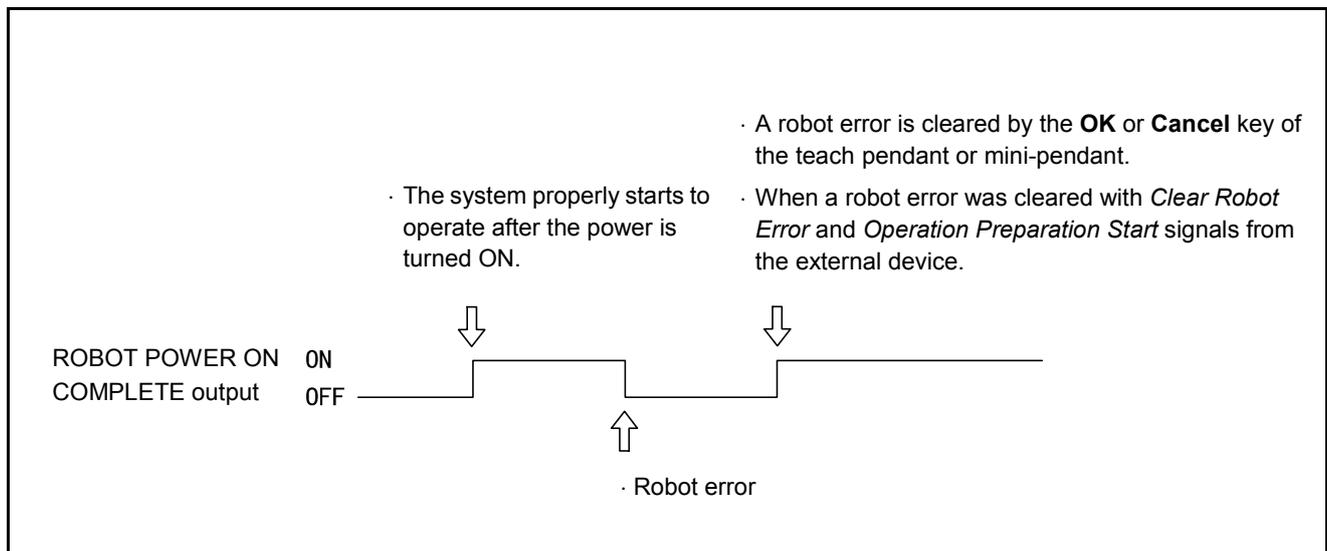
Operation Preparation Start will be executed after this signal and the auto mode signal are turned ON after the power was turned ON.

(3) ON conditions

- ① The signal will be turned ON when the Robot Controller system program properly starts. Preparations for operation can be started after the power was turned ON.
- ② The signal will be turned ON when the robot error is cleared by the **OK** or **Cancel** key of the teach pendant or mini-pendant by *Clear Robot Error* and *Operation Preparation Start* signals, after the power was turned OFF.

(4) OFF conditions

The signal will be turned OFF when a robot error or robot warning signal is turned ON.



Robot Power ON Complete Output

16.2.2 Auto Mode (Output)

(1) Function

The signal outputs to the external device that the robot is in the auto mode.

(2) Usage

Starting the program from the external device requires an SWITCH EXT MODE input, a PROGRAM NO. SELECT input and a PROGRAM START input. The signal is used to confirm that the robot is in the auto mode.

(3) ON conditions

The signal will be output when the robot enters the auto mode under the following conditions.

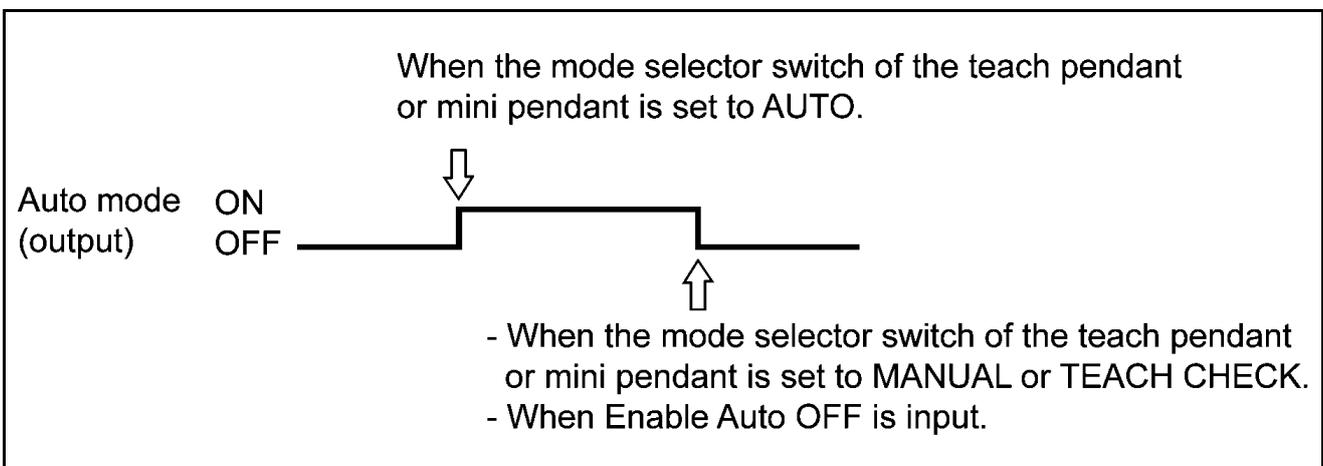
- ① The mode selector switch of the teach pendant or mini-pendant is set to AUTO.

(4) OFF conditions

The signal will be turned OFF under the following conditions.

- ① When the mode selector switch of the teach pendant or mini-pendant is set to MANUAL or TEACH CHECK.
 - ② When Enable Auto OFF is input.
- (Caution: The signal will not be turned OFF in the pendantless state described in the OPTIONS MANUAL, Chapter 1, Section 1.3.3.)

Caution: The signal will not be turned OFF with INSTANTANEOUS STOP, STEP STOP or CYCLE STOP.



Auto Mode Output

16.2.3 Servo ON (Output)

(1) Function

The signal outputs to the external device that the power to the robot motor is turned ON.

(2) Usage

Executing CAL from the external device or starting the program requires the power to the motor to be turned ON. This signal is used to confirm that the power to the motor is turned ON and to light the motor power ON indicator lamp on an external operating panel.

(3) ON conditions

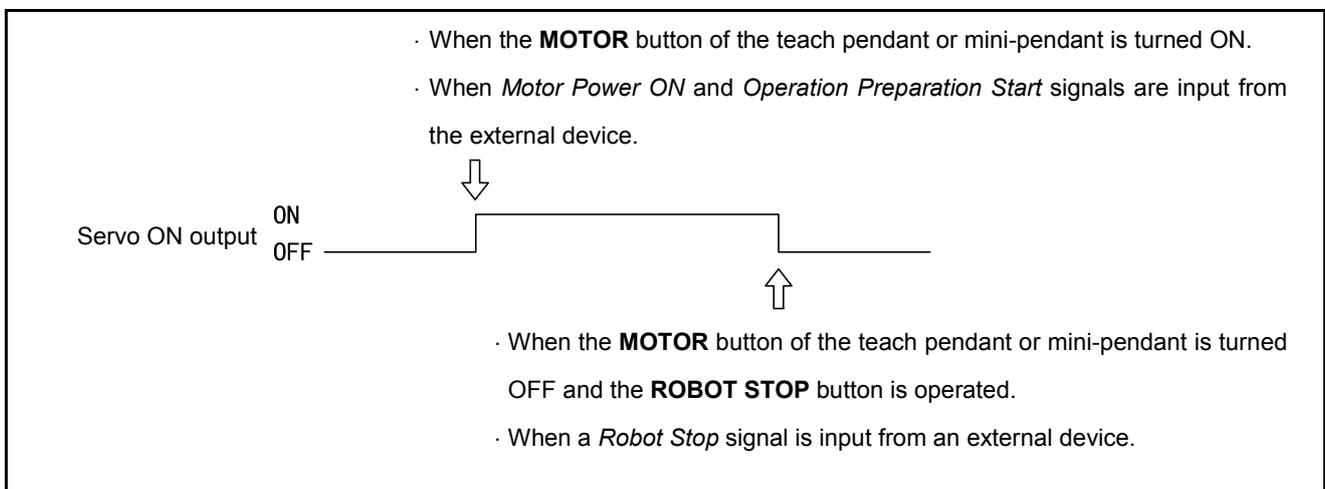
The signal will be turned ON when the power to the motor is turned ON under the following conditions.

- ① The **MOTOR** switch on the teach pendant or mini-pendant is activated.
- ② *Motor Power ON + Operation Preparation Start* signals are input from the external device.

(4) OFF conditions

The signal will be turned OFF when the power to the motor is turned OFF under the following conditions.

- ① The **MOTOR** switch of the teach pendant or mini-pendant is deactivated and the **ROBOT STOP** button is operated.
- ② *Robot Stop* is input from the external device.
- ③ *Robot Error* is outputted. If any of errors 0 × 6071 to 607B, 0 × 6671 to 667B, 0 × 607F occurs, the servo ON signal will be turned OFF in External Auto mode but will not be turned OFF in manual or teach check mode.



Servo ON Output

16.2.4 CAL Complete (Output)

(1) Function

The signal outputs to the external device that CAL is completed.

(2) Usage

This signal is used to determine whether to execute CAL.

Once CAL is completed, it does not need to be executed again as long as the power to the Robot Controller is turned ON.

(3) ON conditions

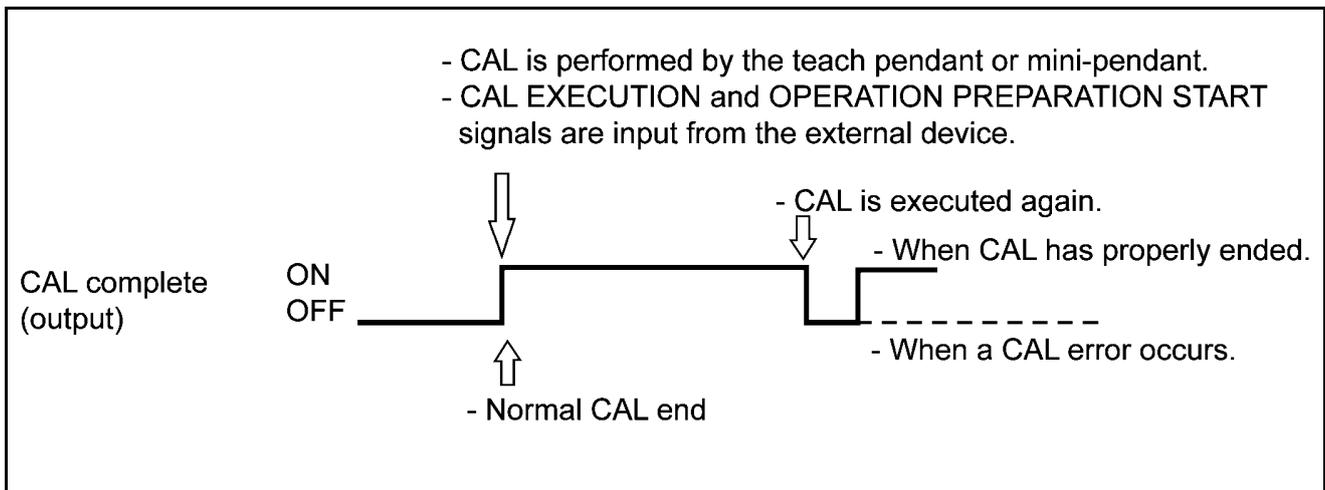
The signal will be turned ON upon proper completion of CAL under the following conditions.

- ① When CAL is performed by the teach pendant or mini-pendant.
- ② When CAL EXECUTION and OPERATION PREPARATION START signals are input from the external device.

(4) OFF conditions

The signal will be turned OFF when CAL is not properly completed as shown below.

It will remain OFF until CAL is performed again and properly completed.



CAL Complete Output

16.2.5 External Mode (Output)

(1) Function

The signal outputs to the external device that the robot is in the external mode.

(2) Usage

Starting the program from the external device requires an SWITCH EXT MODE input, PROGRAM NO. SELECT input and a PROGRAM START input. The signal is used to confirm to the external device that the robot is in external mode.

(3) ON conditions

The signal will be turned ON under the following conditions.

- ① When INTERNAL/EXTERNAL is input on the teach pendant, mini-pendant and the external mode is selected.
- ② When SWITCH EXT MODE and OPERATION PREPARATION START signals are input from the external device.

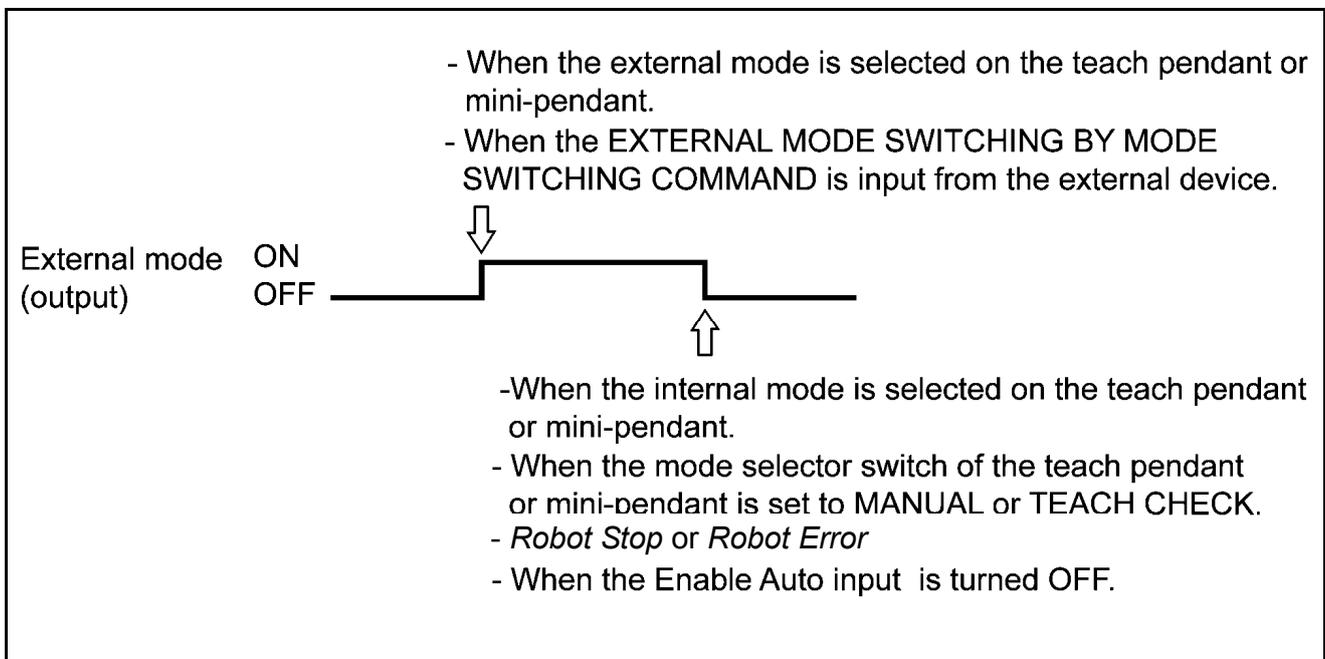
(4) OFF conditions

The signal will be turned OFF under the following conditions.

- ① When the mode selector switch of the teach pendant or mini-pendant is set to MANUAL or TEACH CHECK in external mode.
- ② When EXTERNAL/INTERNAL is input on the teach pendant, mini-pendant and external mode is selected.
- ③ When *Robot Stop* is input.
- ④ When *Robot Error* is outputted.

Caution: The signal will not be turned OFF with STEP STOP.

- ⑤ When an Enable Auto input is turned OFF.



External Mode Output

16.2.6 Teaching (Output)

(1) Function

The signal outputs to the external device that the robot is in the manual mode or teaches check mode.

(2) Usage

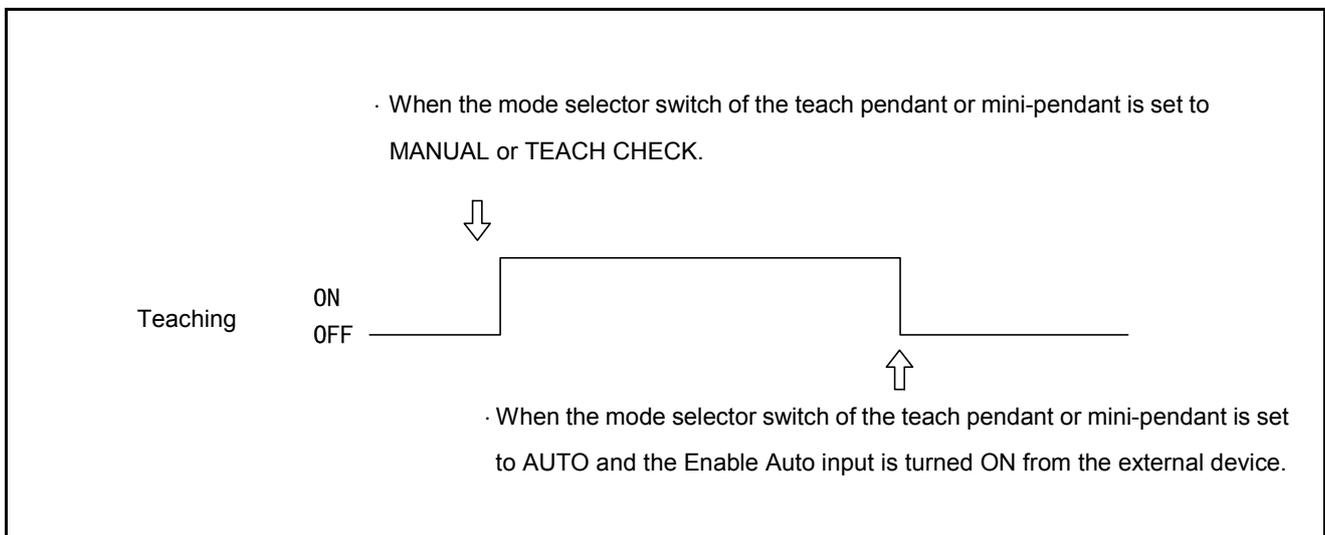
This signal is used to inform an external operating panel that the robot is teaching when they are installed separately from each other.

(3) ON conditions

The signal will be turned ON when the mode selector switch of the teach pendant or mini-pendant is set to MANUAL or TEACH CHECK, as shown below.

(4) OFF conditions

The signal will be turned OFF when the mode selector switch of the teach pendant or mini-pendant is set to AUTO and the Enable Auto input is turned ON.



Teaching Output

16.2.7 Program Start Reset (Output)

(1) Function

This signal is output to the external device when the robot receives a start signal from the external device and starts to operate.

(2) Usage

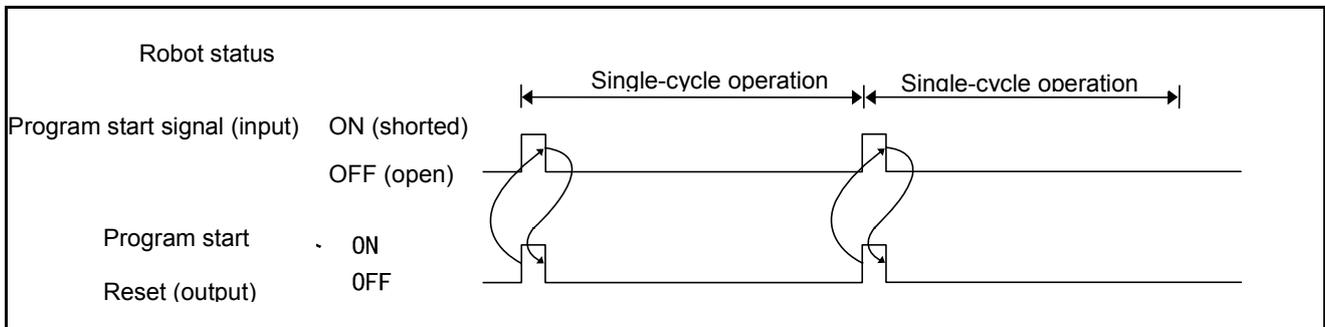
- ① The signal is used to prompt the external device to receive information that the robot program has started to run, and to process subsequent sequence programs.
- ② The signal is used as a condition to turn OFF the PROGRAM START signal sent from the external device to the robot.

(3) ON conditions

The signal will be turned ON immediately after the robot program starts to run, as shown below.

(4) OFF conditions

The signal will be turned OFF automatically when the PROGRAM START signal sent to the robot is turned OFF.



Program Start Reset Output ON Condition

16.2.8 Robot-in-operation (Output)

(1) Function

The signal outputs to the external device that the robot is in operation (executing more than one task).

(2) Usage

The signal is used to light the robot operating indicator lamp of the external operating panel.

Since the signal is turned OFF with STOP ALL PROGRAMS, it outputs to the external device that all programs are stopped.

(3) ON conditions

The signal will be turned ON while executing the program and also in the Wait State with a condition branch or timer command.

(4) OFF conditions

The program will be turned OFF with STOP ALL PROGRAMS.

Caution: STOP ALL PROGRAMS means the operation of the ROBOT STOP or STOP button of the teach pendant or the mini-pendant and INSTANTANEOUS TOP (ALL TASKS), STEP STOP (ALL TASKS) and ROBOT STOP inputs.

16.2.9 Single-Cycle End (Output)

(1) Function

The signal outputs to the external device that a single-cycle of the program is completed.

- Caution** ① The single-cycle end signal will be output upon reading **END** of the program. However, it will be output earlier than the end of the actual robot operation because the Robot Controller pre-reads the program.
- ② The single-cycle end signal will be output on the premise that only one program is executed at a time. If two or more programs are executed simultaneously (multi-tasks), the single-cycle end signal will be turned **ON** immediately after any of the programs reads an **END** command.

(2) Usage

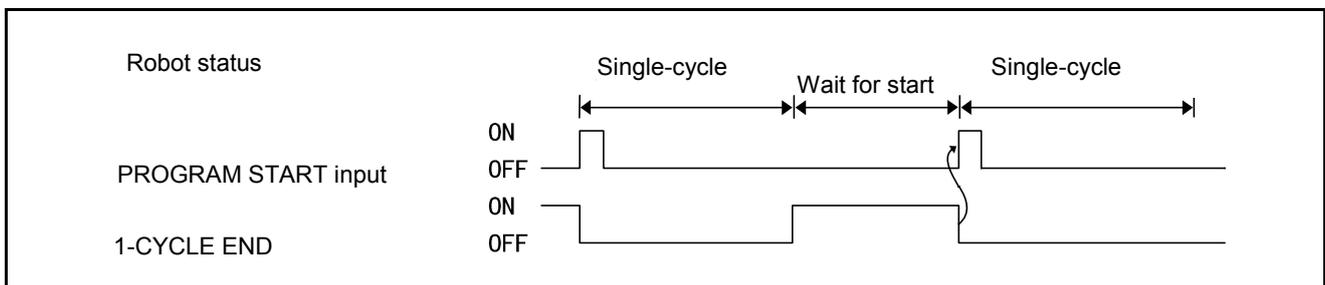
The signal is used to operate another equipment in synchronization with a single-cycle end of the program.

(3) ON conditions

The signal will be turned ON when the program is read to the end.

(4) OFF conditions

The signal will be turned OFF immediately after the program starts to run.



Single-Cycle End Output

16.2.10 Robot Error (Output)

(1) Function

The signal outputs to the external device that a problem, such as a servo error and a program error, occurs with the robot.

(2) Usage

- ① The signal is used to light the robot error indicator lamp of an external operating panel.
- ② The signal is used to help the PLC clear an error in response to a *Robot Error* signal.

(3) ON conditions

As shown below, the signal will be turned ON under the following conditions.

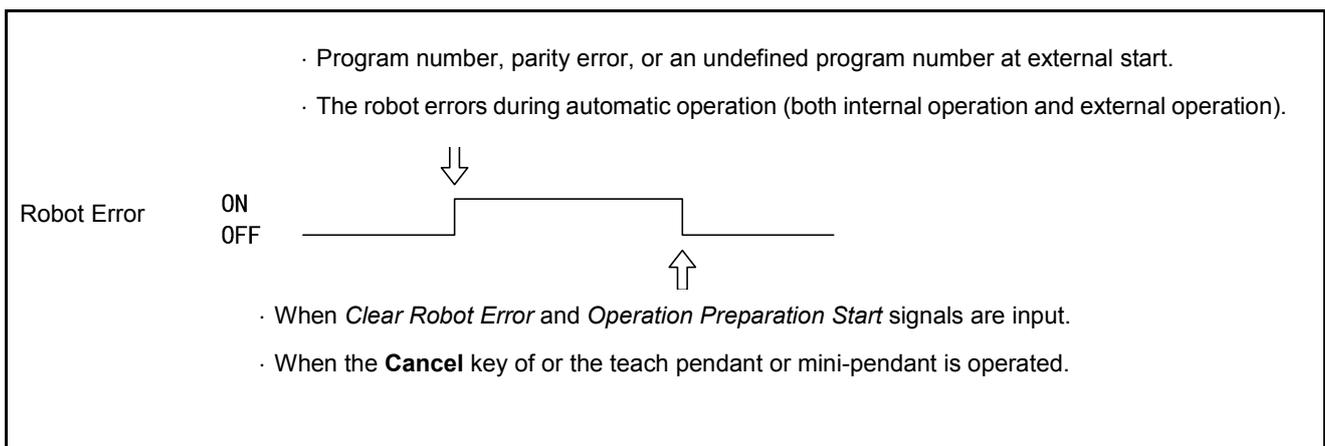
- ① When an error, such as a servo error, a program error and undefined program, occurs at the start of the program and during execution of the program.
- ② When an error occurs during execution of the program in internal operation by the teach pendant or the mini-pendant or in external operation by the PLC.
- ③ When an error, such as undefined program, occurs at the start of the program only in external operation.

Caution: The signal will not be output when an error, such as a program input error occurs in manual operation, except when a servo error occurs in manual operation. For further information, see "ERROR CODE TABLES."

(4) OFF conditions

As shown below, the signal will be turned OFF under the following conditions.

- ① When *Clear Robot Error* is input from the external device and the existing error is cleared.
- ② When the existing error is cleared by operating the **Cancel** key of the teach pendant or the mini-pendant.



Robot Error Output

16.2.11 Robot Warning (Output)

(1) Function

The signal outputs to the external device that a minor error has occurred with an I/O command or during servo processing.

Caution: The signal will not be output in case of a minor error, such as a program selection error, caused by the operation of the teach pendant or mini-pendant.

(2) Usage

- ① The signal is used to light the robot warning indicator lamp of an external operating panel.
- ② The signal is used to help the PLC clear an error in response to a *Robot Warning* signal.

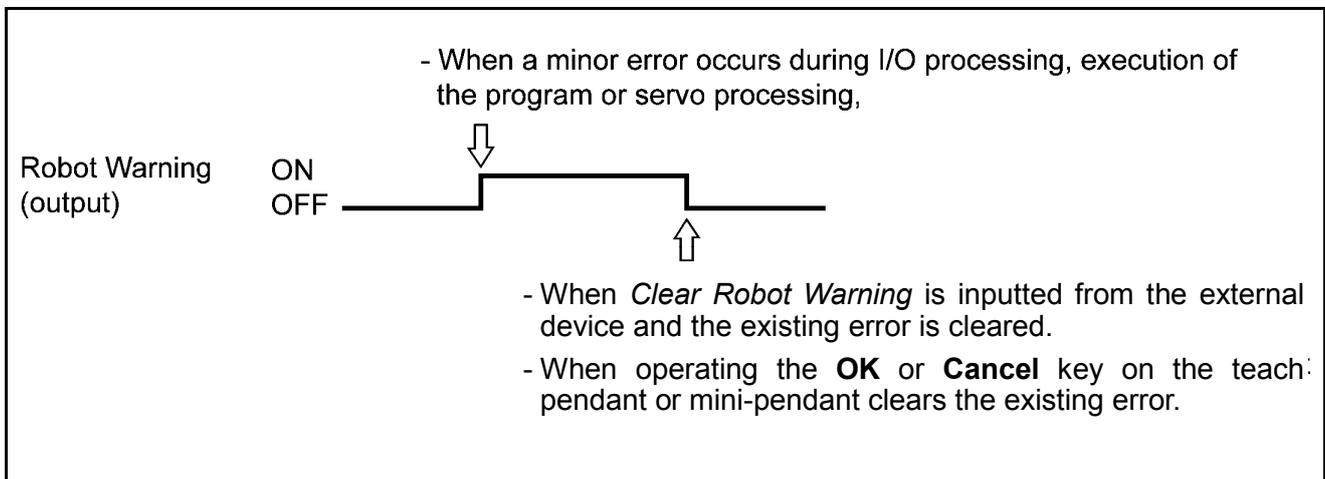
(3) ON conditions

As shown below, the signal will be turned ON when a minor error occurs during I/O processing, execution of the program or servo processing, irrespective of the operation mode.

(4) OFF conditions

As shown below, the robot-warning signal will be turned OFF under the following conditions.

- ① When *Clear Robot Error* and *Operation Preparation Start* signals are input from the external device and the existing error is cleared.
- ② When the existing error is cleared by operating the **OK** or **Cancel** key of the teach pendant or mini-pendant.



Robot Warning Output

16.2.12 Dead Battery Warning (Output)

(1) Function

The signal will be output when the voltage of the encoder back-up battery or memory back-up battery becomes dangerously low.

(2) Usage

The signal is used to check the timing of battery replacement (lowering of the battery voltage).

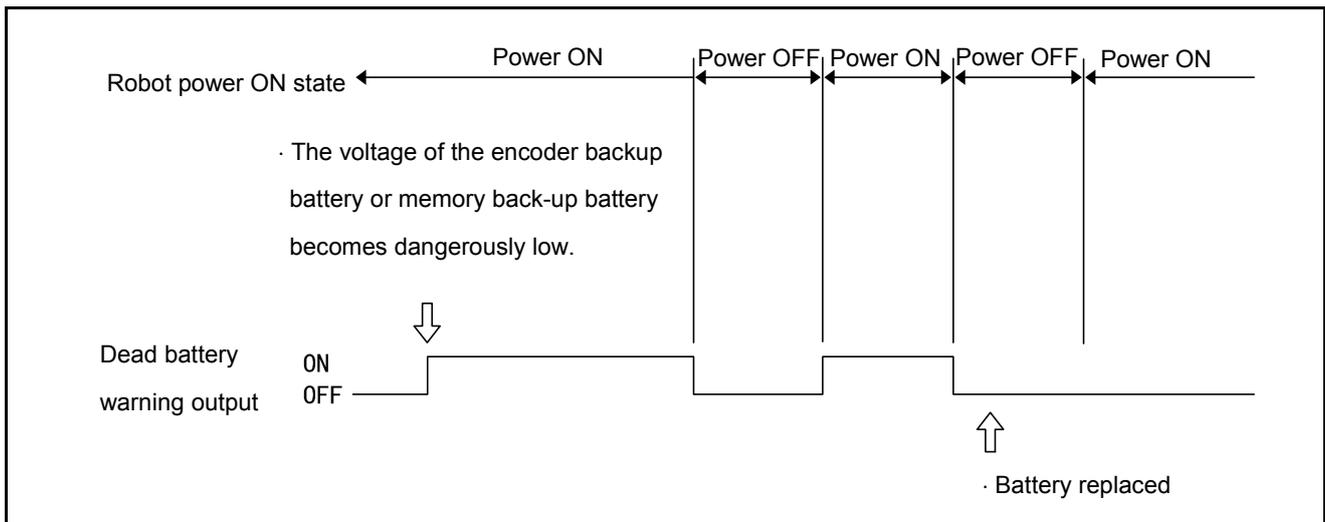
(3) ON conditions

The signal will be turned ON when the voltage of the encoder back-up battery or memory backup battery becomes dangerously low.

Caution: Any error of ERROR64A1 to 64A6 indicating the dead encoder back-up battery or ERROR6103 informing the dead memory back-up battery will be displayed on the teach pendant or mini-pendant.

(4) OFF conditions

The signal will be turned OFF when the power is turned ON after the dead battery was replaced.



Dead Battery Warning Output

16.2.13 Error No. (Output)

(1) Function

When an error occurs, the signal outputs the error number in a 3-digit (12-bit) hexadecimal code.

(2) Usage

The signal is used to display an error number on the external device.

(3) Output conditions

The signal will be output when an error occurs.

(4) Clear conditions

The signal will be cleared when *Clear Robot Error* and *Operation Preparation Start* signals are inputted or by operating the **Cancel** key of the teach pendant or mini-pendant. When this signal is cleared, all states will become OFF (0).

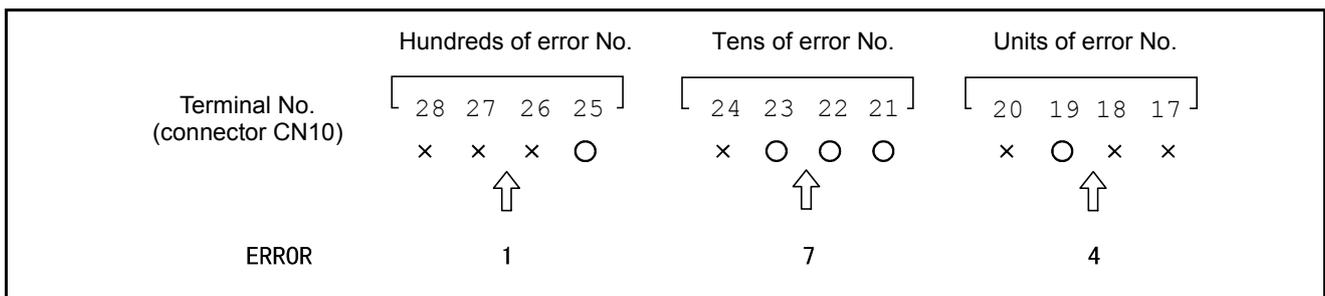
(5) Hexadecimal codes

See the following figure.

xxxx → 0	xOxO → 5	OxOx → A	
xxxO → 1	xOOx → 6	OxOO → B	
xxOx → 2	xOOO → 7	OOxx → C	
xxOO → 3	Oxxx → 8	OOxO → D	
xOxx → 4	OxxO → 9	OOOx → E	O...ON
		OOOO → F	x...OFF

Hexadecimal Codes

The figure below shows an example of error number output, when ERROR174 (overload error with the fourth axis) occurs.



Example of Error Number Output

16.2.14 Continue Start Permitted (Output)

(1) Function

The controller will output this signal when the continue start is permitted.

(2) Usage

Use this signal when you want to know whether the continue start is permitted.

(3) ON condition

This signal comes on when the continue start is permitted. For details, refer to the SETTING-UP MANUAL.

(4) OFF condition

This signal goes off by carrying out the "Task Status Change Operation."

16.2.15 SS mode (Output)

(1) Function

The controller will output this signal during the SS mode.

This mode is effective when the slow mode is selected.

(2) Usage

This signal is used to warn workers that the robot is in the SS mode by beeping or lighting the lamp.

(3) ON condition

This signal comes on when the SS mode is selected.

(4) OFF condition

The signal goes off when the TS time passes so as to cancel SS mode. This function is effective when the slow mode is selected.

Note: If the TS time passes, this signal goes off even when the robot is operation in the slow mode. After this signal goes off, the robot runs at the original speed.

16.3 Types and Functions of System Input Signals (Compatible Mode)

The table below lists the system input signals to be used in compatible mode.

Types and Functions of System Input Signals to be Used in Compatible Mode

Application	Signal name	Function
Start-up	<i>Motor Power ON</i> + <i>Operation Preparation Start</i>	Turns ON the power to the motor.
	<i>CAL Execution</i> + <i>Operation Preparation Start</i>	Executes calibration.
	<i>SP100</i> + <i>Operation Preparation Start</i>	Sets the speed to 100%.
	<i>Switch Ext Mode</i> + <i>Operation Preparation Start</i>	Switches the mode to external mode.
	<i>Program Reset</i> + <i>Operation Preparation Start</i>	Initializes all programs on halt. Starting a program after initialization will execute the program from the beginning.
	<i>Program No. Select</i> + <i>Program Start</i>	Executes a specified program.
Program execution	<i>Program Reset</i> + <i>Program No. Select</i> + <i>Program Start</i>	Cancels the current program and starts executing a specified program from the beginning.
Stop	<i>Step Stop</i>	Step-stops all programs by opening signals.
	<i>Instantaneous Stop</i>	Instantaneously stops all programs by opening signals.
Error clear	<i>Clear Robot Error</i> + <i>Operation Preparation Start</i>	Clears an error.
Program interrupt	<i>Interrupt Skip</i>	Interrupts the execution of the current step and starts the next step.
Continue start	<i>Continue Start</i> + <i>Program Start</i>	Executes continue start.

Caution: Two or more signal names listed in the signal name field indicate that they should be used in combination.

16.4 Usage of System Input Signals in Compatible Mode

The usage of each system input signal in compatible mode is described below:

16.4.1 Operation Preparation Start (Input)

(1) Function

- By turning ON (short) this signal, input signals ① to ④ described in (3), input conditions and operation will be detected and the robot will automatically start to operate. Input these signals with the system output *Robot Power ON Complete* turned ON.
- By turning ON (short) *Clear Robot Error*, an error that has occurred will be cleared.

(2) Input conditions and operation

Before inputting an operation preparation start signal, turn ON (short) inputs ① to ④ below:

① Motor power ON (input)

- Terminal number: No.19 of connector CN8
- By turning ON (short) the operation preparation start signal with this signal turned ON (shorted), the power to the motor will be turned ON. However, this signal can be used only in the Auto mode.

② CAL execution (input)

- Terminal number: No.20 of connector CN8
- By turning ON (short) the operation preparation start signal with this signal turned ON (shorted), calibration takes place. However, this signal cannot be used when the power to the motor is turned OFF (① not executed).

③ SP100 (input)

- Terminal number: No.22 of connector CN8
- By turning ON (short) the operation preparation start signal with this signal turned ON (shorted), SP100% will be set.

④ Switch Ext Mode (input)

- Terminal number: No.23 of connector CN8
- By turning ON (short) the operation preparation start signal with this signal turned ON (shorted), the mode will be set to the external mode. However, this signal cannot be used when the power to the motor is turned OFF and CAL is not completed.

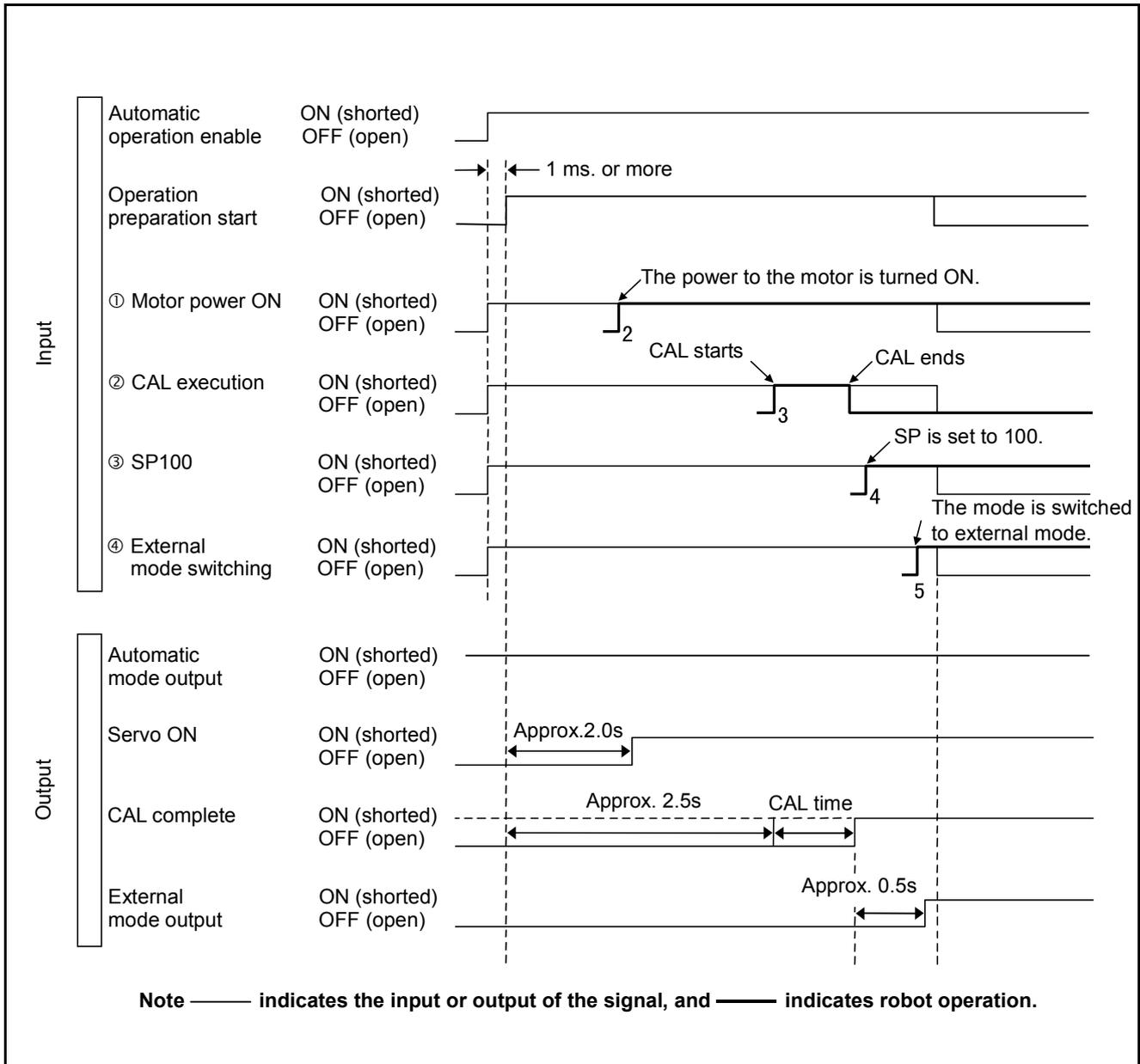
⑤ Program reset (input)

- Terminal number: No.24 of connector CN8
- By turning ON (short) the operation preparation start signal with this signal turned ON (shorted), all programs will be initialized.

NOTE: By turning ON (short) the operation preparation start signal with all inputs ① to ⑤ turned ON (shorted), ① to ⑤ will be executed one by one. Input ② cannot be executed until input ① is completed. Inputs ① to ⑤ will also become valid when part of them are executed by the teach pendant or mini-pendant.

For the input timing of the operation preparation start signal and ① to ④, see the figure given below.

Caution: The operation preparation start signal and each input signal, except the Enable Auto signal, will be turned OFF (falling) upon turning ON of the external mode output is turned ON. Although the robot is made to execute all items at start-up, execute only necessary items at the time of recovery from suspension during operation to reduce recovery time. The required time to execute all items may be about 5 seconds depending on CAL time. The time is about 1.3 seconds without CAL. (Once CAL is completed, it does not need to be executed again as long as the power to the Robot Controller is turned ON.) Determine whether to execute CAL according to the CAL complete output.



Example of Operation Preparation Start Signal Timing Chart

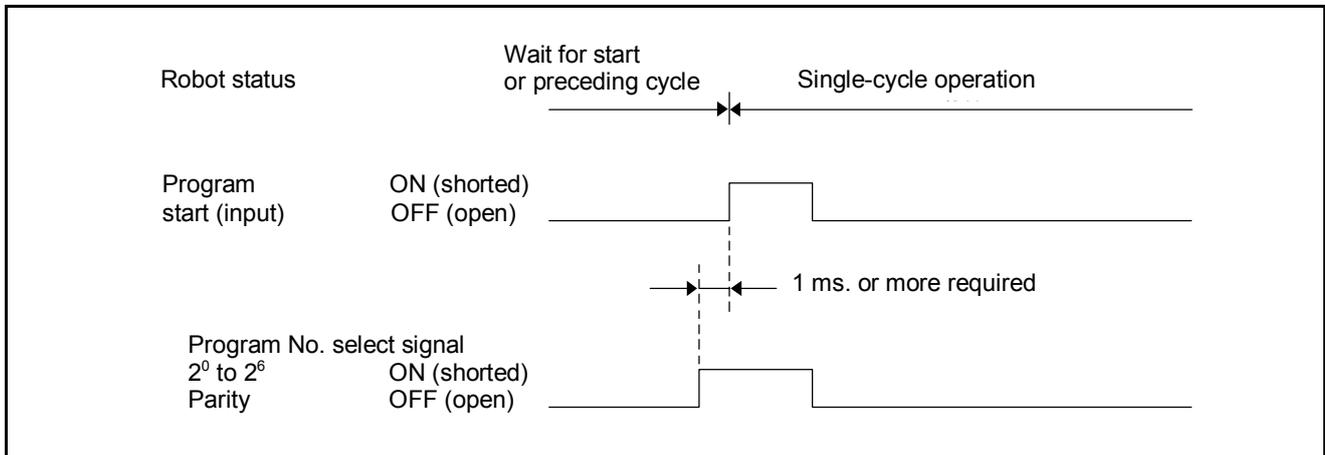
16.4.2 Program No. Select (Input)

(1) Function

The program number to be executed can be specified from the external device by inputting this signal.

(2) Input conditions and operation

- ① This signal is executable only in the external mode. In other modes, an error (ERROR21E2, 21E4, 21E6) will be displayed, and the terminal motor power will be turned OFF.
- ② As shown in the table given on the next page, the program No. select signal is made up of eight bits of 2^0 to 2^6 and the parity bit.
- ③ Input a decimal program number by converting it into binary 2^0 to 2^6 and parity bit.
- ④ "Short" represents the bit value = 1, "open" represents the bit value = 0, and the parity bit is odd parity.
- ⑤ As shown below, input the program No. select signal before the program start signal (1 msec. or more), and hold the state until the robot starts to operate. If this condition is not met, ERROR2031 or ERROR2033 will be displayed, the power to the motor will be turned OFF.



Program No. Select Signal

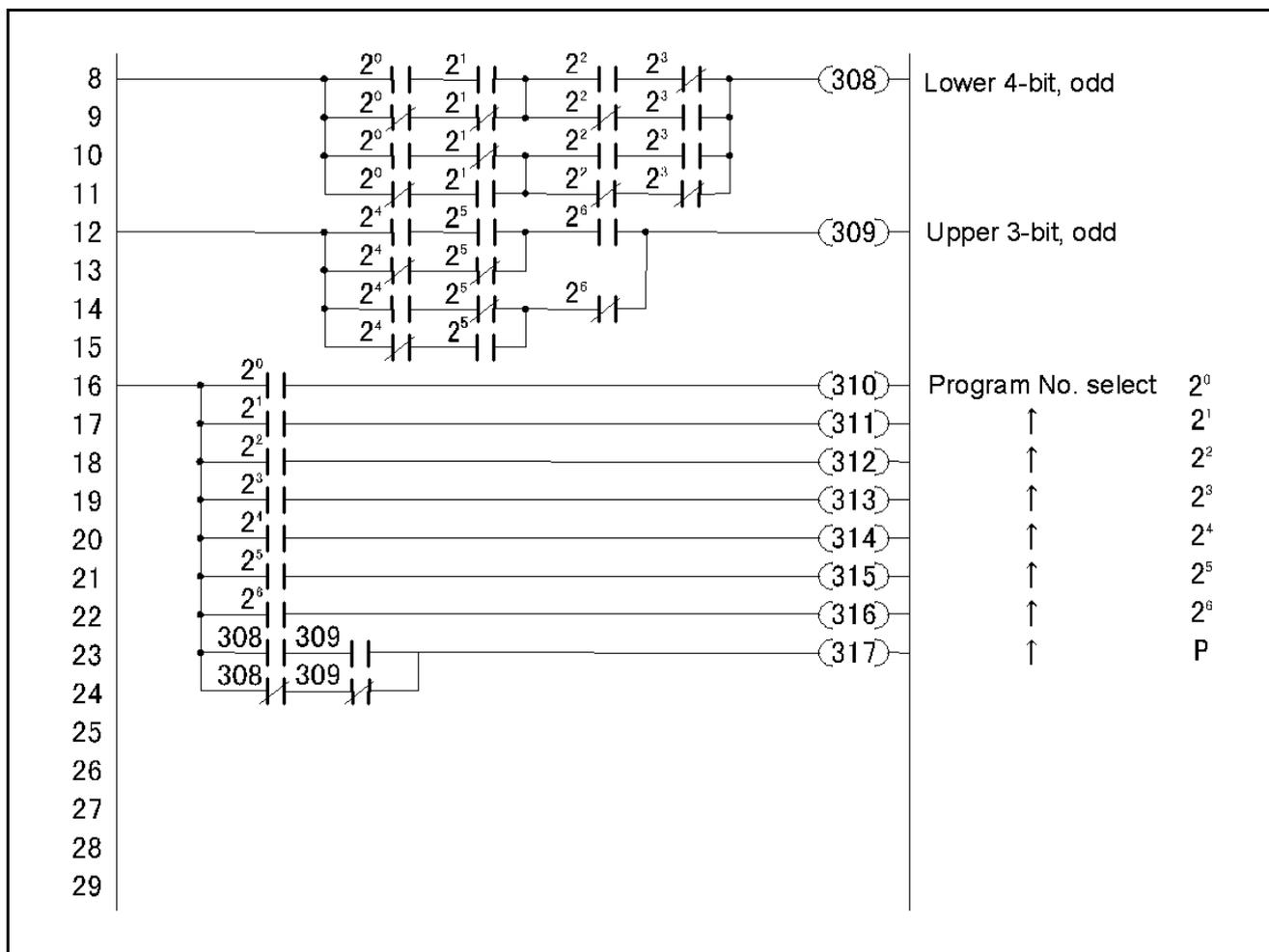
- ⑥ Input 1 or 0 as the parity bit so that the total of 1's existing in the eight bits of 2^0 to 2^6 and the parity bit will be odd.
Example: When the program number is 15, the bit status of 2^0 to 2^6 is (001111), and the total number of 1s is four, an even number. Set 1 as the parity bit to make the total number of 1s five, an odd number.

Caution ① The bit value =1 represents short, and the bit value =0 represents open.
② The program numbers executable from the external device are limited to Pro0 to Pro127.

Example of Program No. Select Signals

Input signal	Program No. (decimal)			
	1	15	26	65
$2^0 = 1$	1	1	0	1
$2^1 = 2$	0	1	1	0
$2^2 = 4$	0	1	0	0
$2^3 = 8$	0	1	1	0
$2^4 = 16$	0	0	1	0
$2^5 = 32$	0	0	0	0
$2^6 = 64$	0	0	0	1
Parity	0	1	0	1

The figure below shows an example of a program No. select signal sequence circuit considering parity.



Example of Program No. Select Signal Sequence Circuit

16.4.3 Program Start (Input)

(1) Function

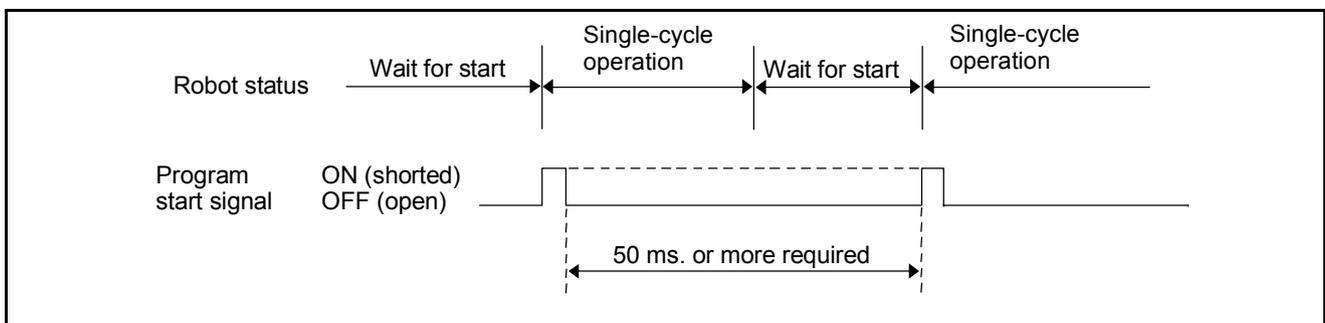
This signal starts the program specified with the program No. select signal from the external device.

(2) Input conditions and operation

By switching the status of this signal from ON (open) to ON (shorted) in external mode, operations ①, ② and ③ described below will take place. (The status of the signal must be switched from OFF to ON.)

- ① If the program start signal is input (switched from OFF to ON) when the robot has not yet completed the program or is at rest after it has completed a cycle of the program, the program No. select signal will be read, the program will execute a cycle, and the robot will come to a stop.

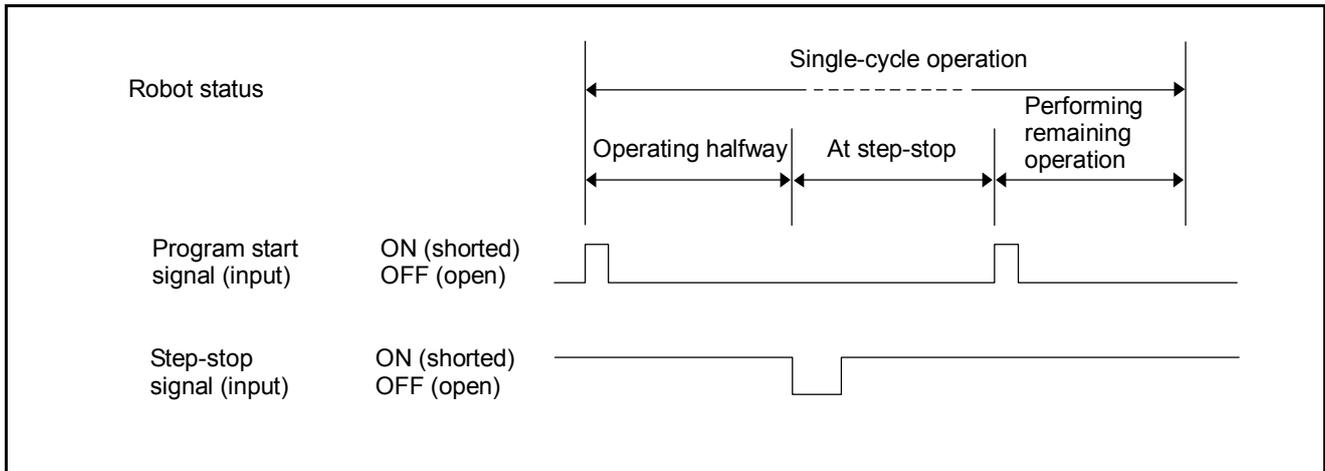
Tip: Input the program No. select signal before the program start signal (1 msec. or more), and hold the state until the robot starts to operate. If this condition is not met, ERROR2031 or ERROR2033 will be displayed, the power to the motor will be turned OFF.



Program Start Operation-1

Caution: The program start signal requires program start preparation time (50 msec. or more) before input from OFF (open) to ON (shorted).
The program start signal must remain OFF (open) during the program start preparation time. If it is turned ON (shorted) during that time, the next cycle will not start to run.
To start a new cycle, the status of the external start signal must be switched from OFF to ON before each cycle.

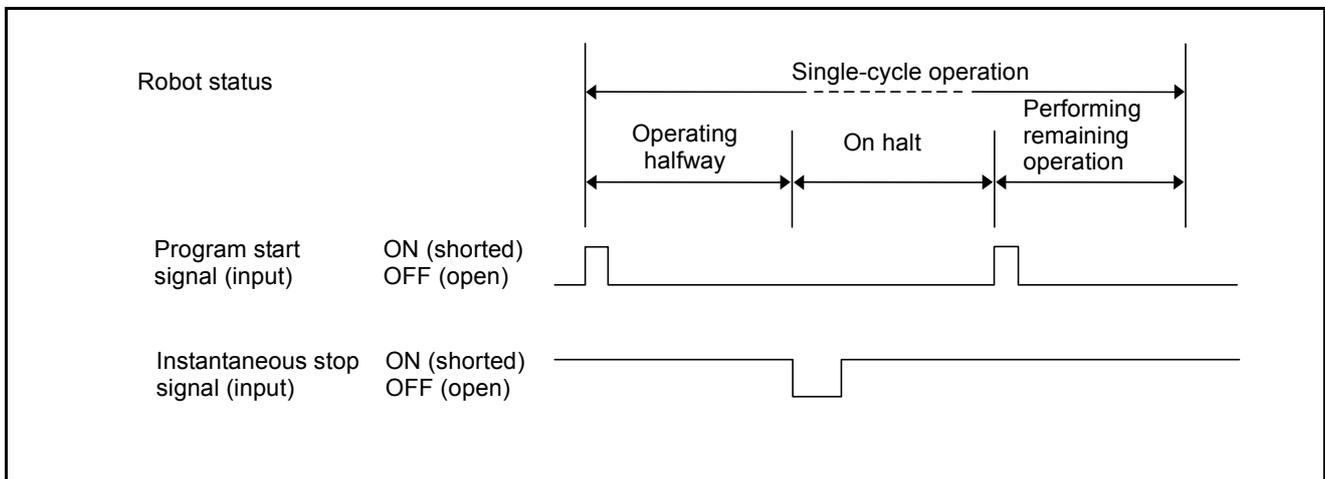
- ② When the status of the program start signal is switched from OFF to ON with the program step-stopped, the program will resume from the step following the suspended step and stop at the cycle end.



Program Start Operation-2

Caution: To cancel the execution of the remaining steps of a step-stopped program and start it from the beginning, input a program reset signal, a program No. select signal and a program start signal at the same time. For further information, refer to Section 16.4.4 "Program Reset (Input)".

- ③ When the status of the program start signal is switched from OFF to ON with the program immediately stopped, the program will resume from the suspended step and stop at the cycle end.



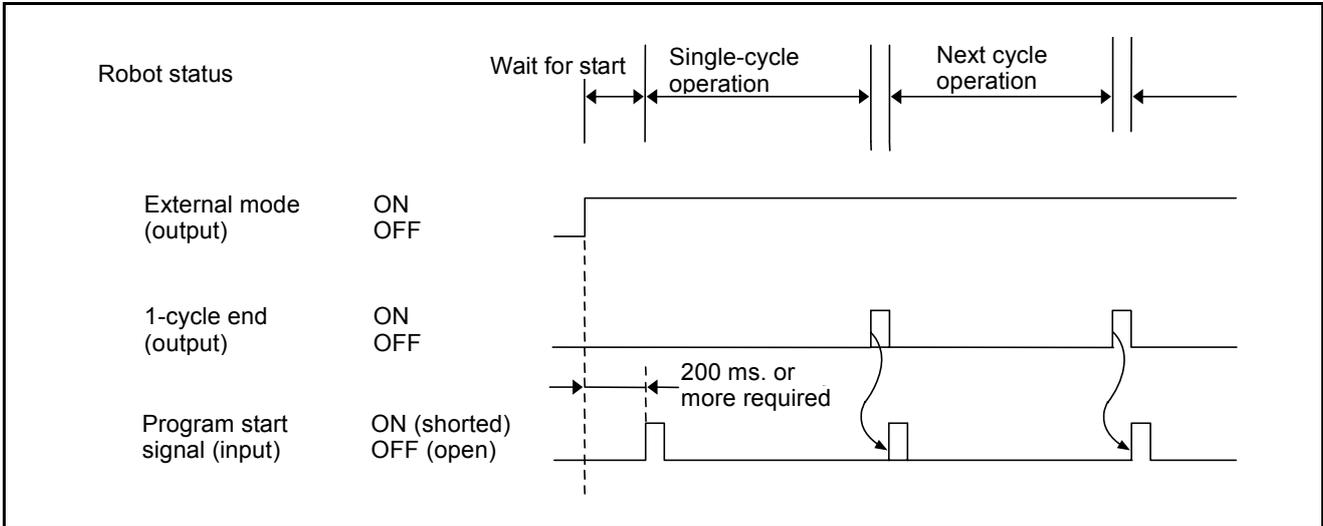
Program Start Operation-3

Caution: To cancel the execution of the remaining steps of an instantaneously stopped program and start it from the beginning, input a program reset signal, a program No. select signal and a program start signal at the same time. For further information, refer to Section 16.4.4 "Program Reset (Input)".

(3) Example of program start signal (rise) ON and (fall) OFF timing

① Example of program start signal rise (ON) timing

The figure below shows how to make the program start signal rise with robot system outputs (external mode output and single-cycle end output).

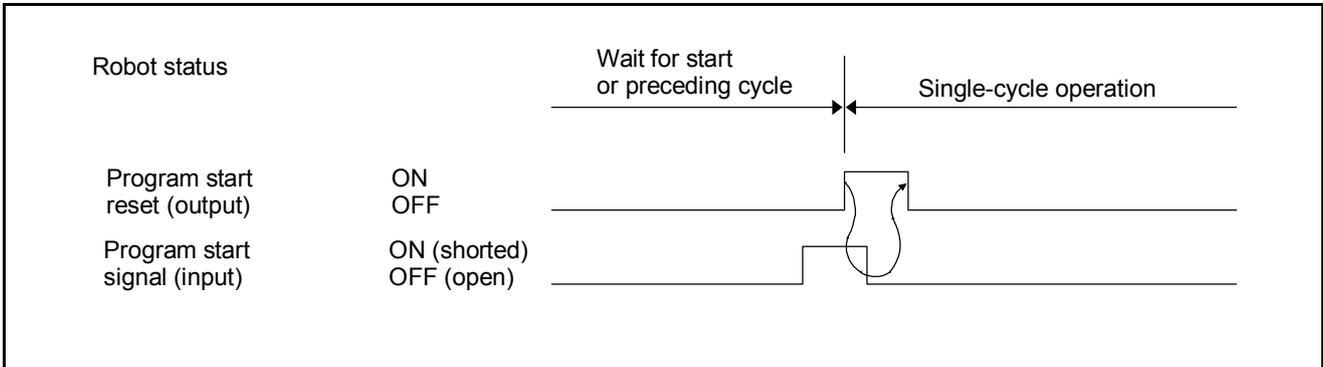


Example of Program Start Signal Rise Timing

Caution: The program start signal for the first cycle rises as soon as the external mode becomes valid and the conditions of the peripheral devices are met. The program start signal for subsequent cycles rises after output of a single-cycle end signal.

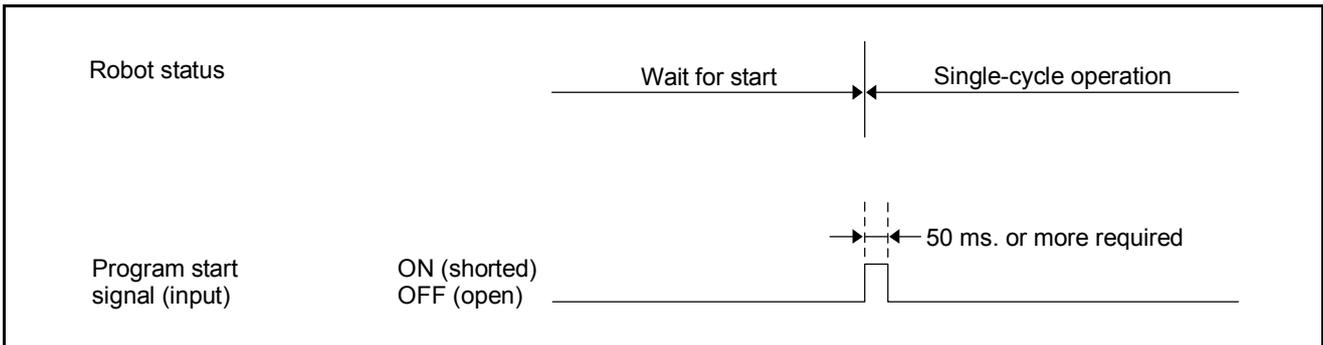
② Example of program start signal fall (OFF) timing

- a) The following figure shows how to make the program start signal fall with a robot system output (program start reset output).
 When the robot program starts to run, a program start reset signal is output. The external device receives it and makes the program start signal fall (OFF).



Example of Program Start Signal Fall Timing-1

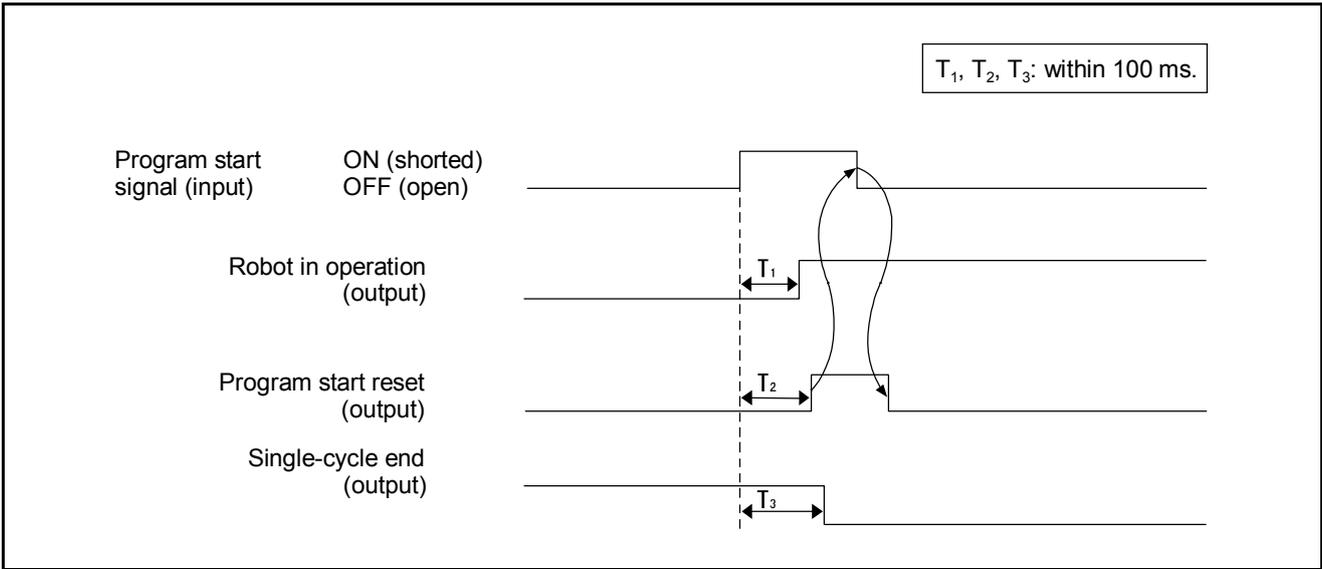
- b) The figure below shows how to make the program start signal fall with the simplified method (1 shot method using a timer).



Example of Program Start Signal Fall Timing-2

Caution ① Although the 1 shot method is easy, the timer setting for falling to raise the program start signal in the middle of the preceding cycle is difficult.
 Use this method only to raise the program start signal after the robot stops at the end of each cycle.

② The status of the robot-in-operation, program start reset and single cycle end output signals changes in sequence after the program start signal is input ($T_1 \rightarrow T_2 \rightarrow T_3$ in the figure given on the next page).
 The change of the status of these signals takes place within 100 msec. after the program start signal rises (ON). See the next page.



Program Start Signal Rise Output Signal Timing

16.4.4 Program Reset (Input)

(1) Function

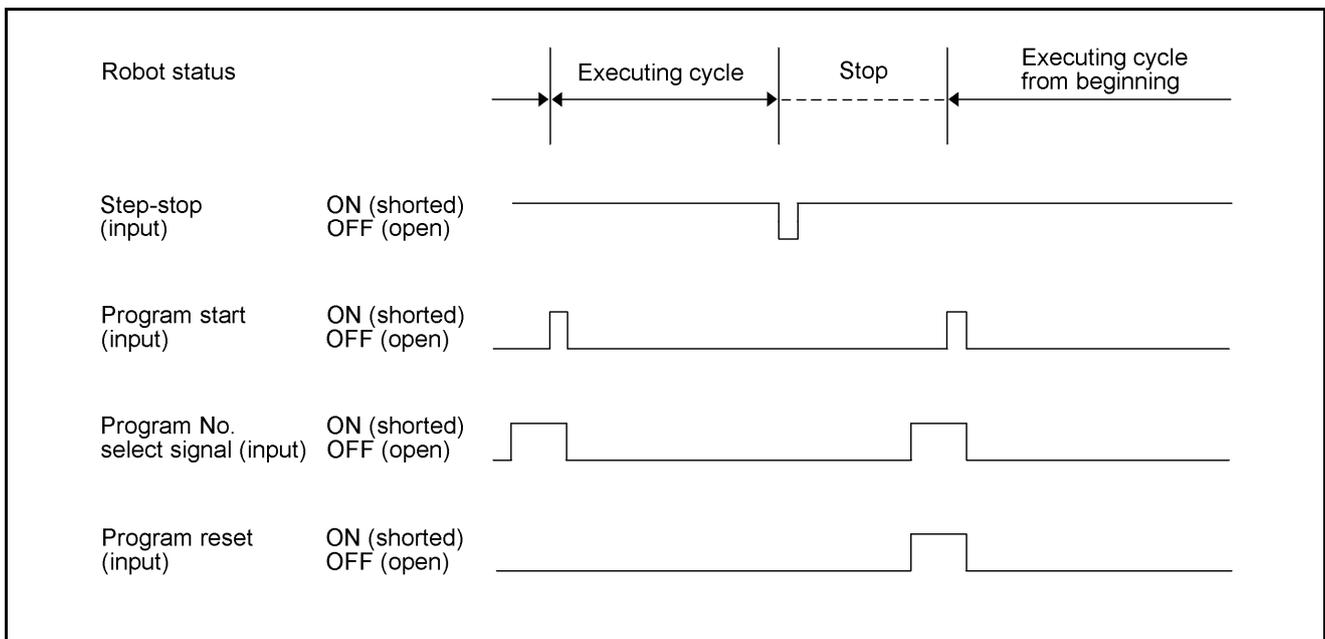
By turning ON (short) this signal, any program can be forcibly executed from the beginning in a step-stopped state and a suspended state.

Caution: Generally, a step-stopped or suspended program resumes from where it stopped.

(2) Input conditions and operation

When issued with the Program Start

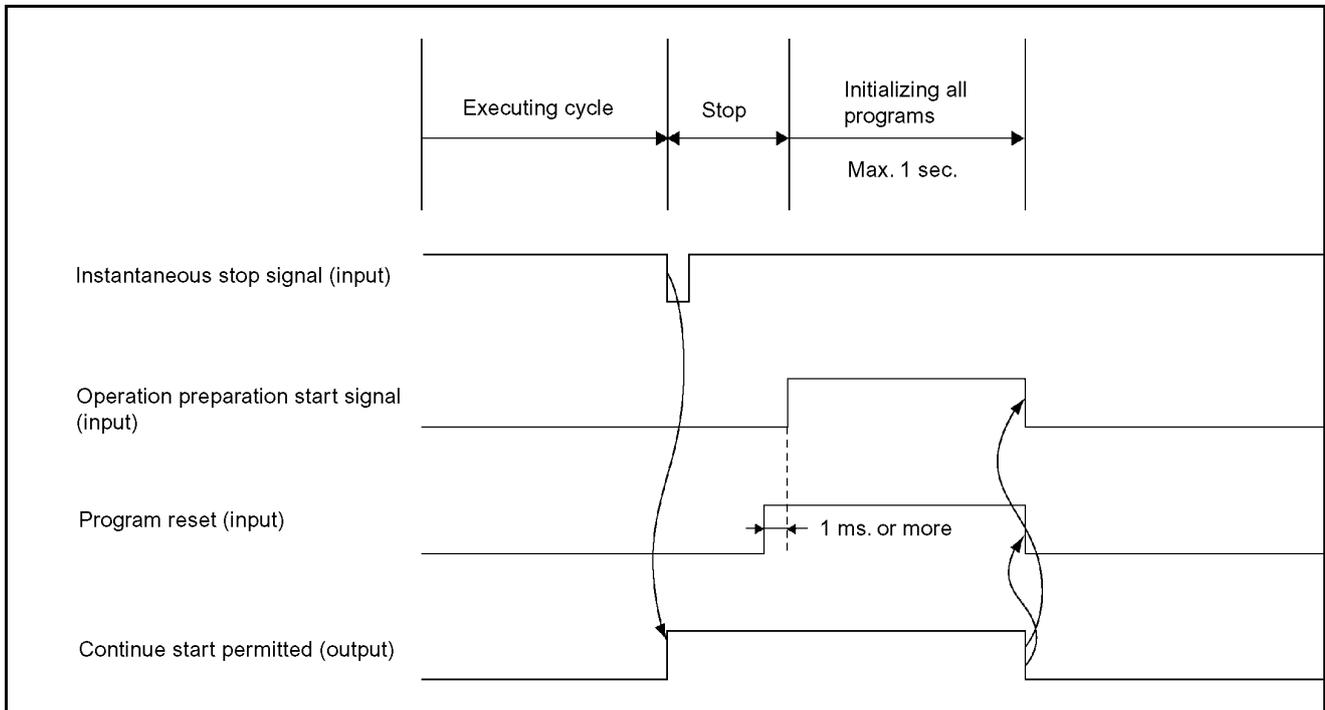
- ① The figure below shows the input conditions and an operation timing chart.
- ② Use the program reset signal together with a program No. select signal, and input it before the program start signal (1 msec. or more).
- ③ Turn OFF the program reset signal after the robot starts to operate (after a program start reset signal is output).
- ④ A program No. select signal is required to execute the same program number as the suspended one from the beginning.



Input Conditions and Operation of Program Reset Signal

When issued with the Operation Preparation Start

- ① The figure below shows the input conditions and an operation timing chart.
- ② Input Program Reset before Operation Preparation Start (1 msec. or more).
- ③ After turned ON, this signal may take a maximum of one second for initializing all programs. During the period, do not input signals to the robot.



Input Conditions and Operation of Program Reset Signal

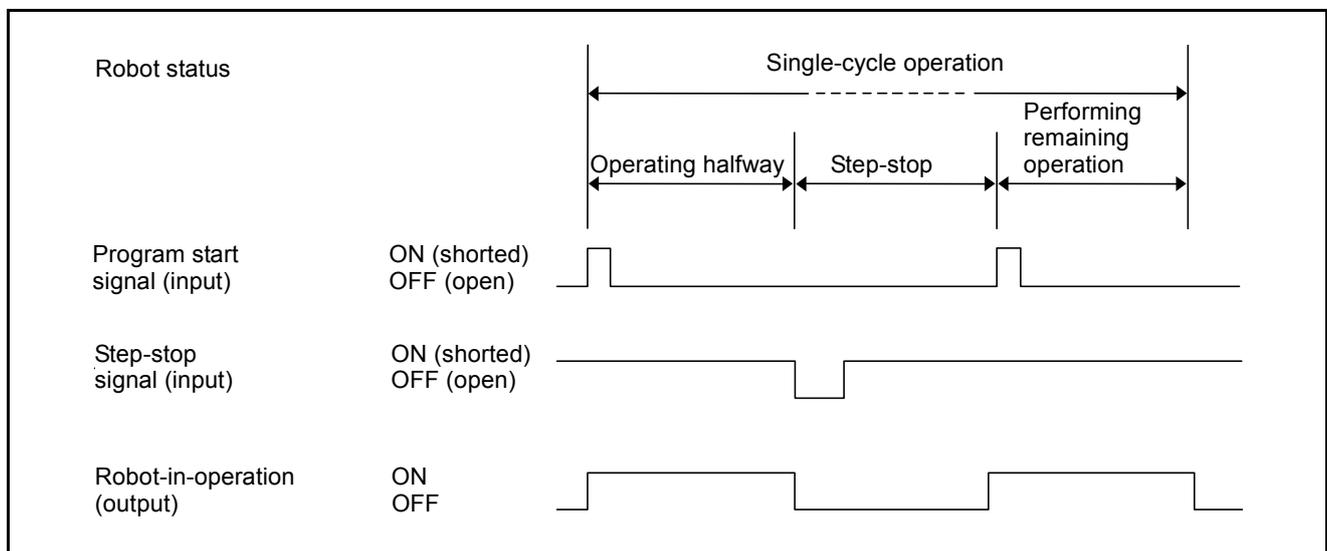
16.4.5 Step Stop (All Tasks) (Input)

(1) Function

Input this signal to step-stop the program being executed from the external device. All tasks will be step-stopped.

(2) Input conditions and operation

- ① If the status of this signal is changed from ON (shorted) to OFF (open), the robot will stop all tasks immediately after the ongoing step is completed, and the Robot-in-operation signal will be turned OFF. However, External Auto mode will remain valid, and the suspended program will be resumed by inputting a program start signal. See the figure given below.
- ② Turning OFF (open) this signal when inputting a program start signal makes the robot stop step by step.
- ③ Internal operation with the teach pendant is valid only when the status of this signal is changed from ON (shorted) to OFF (open).
- ④ For resuming the program after a step stop, refer to Section 16.4.3 "Program Start (Input)."



Step Stop Signal

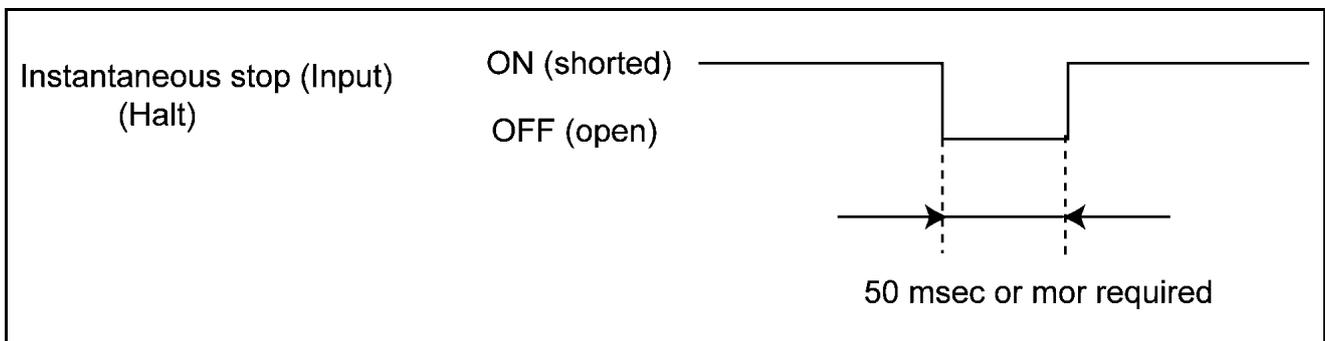
16.4.6 Instantaneous Stop (All Tasks) (Input)

(1) Function

Input this signal to instantaneously stop the program being executed from the external device. All tasks will instantaneously stop.

(2) Input conditions and operation

- ① If the status of this signal is changed from ON (shorted) to OFF (open), the robot will instantaneously stop in the middle of the ongoing step, and the Robot-in-operation signal will be turned OFF. However, Auto mode or external mode will remain valid, and the suspended program will be resumed by inputting a program start signal.
- ② Internal operation by the teach pendant is valid only when the status of this signal is changed from ON (shorted) to OFF (open).
- ③ For resuming the program after an instantaneous stop, refer to Section 16.4.3 "Program Start (Input)."
- ④ The minimum required pulse width is 50 msec. or more.



Minimum Instantaneous Stop Pulse Width

16.4.7 Clear Robot Error (Input)

(1) Function

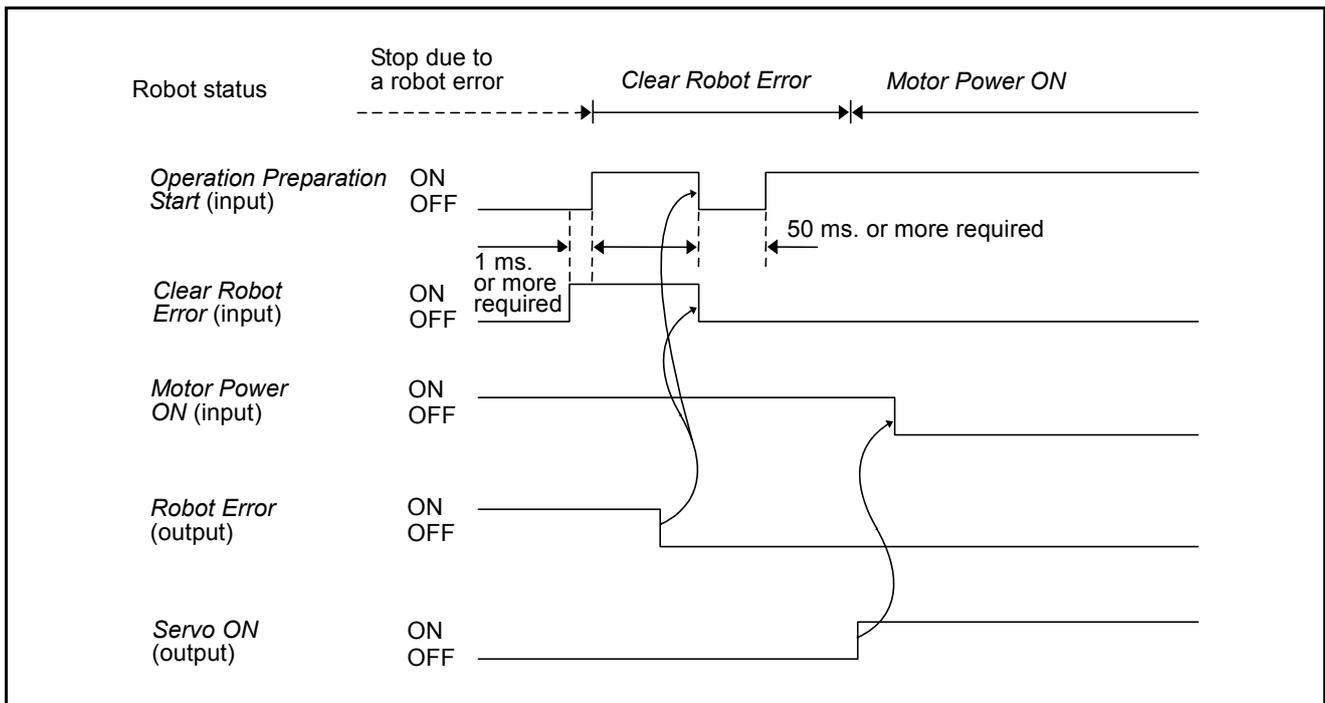
The robot can recover from a stopped state, resulting from a robot error by turning ON (shorted) the operation preparation start signal with this signal ON (shorted).

(2) Usage

The signal is used to clear an error that brought the robot to a stop.

(3) Input conditions and operation

- ① When a robot error occurs, clear the error display on the teach pendant or mini-pendant and the external output *Error Number* to ready the robot to operate.
- ② When the *Clear Robot Error* signal is turned ON (shorted), other input signals (*Motor Power ON*, *CAL Execution*, *SP100* and *Switch EXT Mode*), which are to be used in combination with the *Operation Preparation Start* signal, will be ignored.
To turn ON the power to the motor after a robot error is cleared, turn OFF (open) the *Clear Robot Error* signal after turning OFF the *Robot Error* signal (output) as shown below.
- ③ Input the *Clear Robot Error* signal before (1 msec. or more) the *Operation Preparation Start* signal.



Input Conditions and Operation of *Clear Robot Error* Signal

16.4.8 Interrupt Skip (Input)

(1) Function

If this signal is turned ON (shorted) during execution of the robot operation command within the range between INTERRUPT ON and INTERRUPT OFF in the program, the operation of the ongoing step will stop and the next step will start.

Note: For further information about the INTERRUPT ON and OFF commands, refer to the PROGRAMMER'S MANUAL (I), Chapter 12 "12.3 INTERRUPT ON/OFF (Statement)."

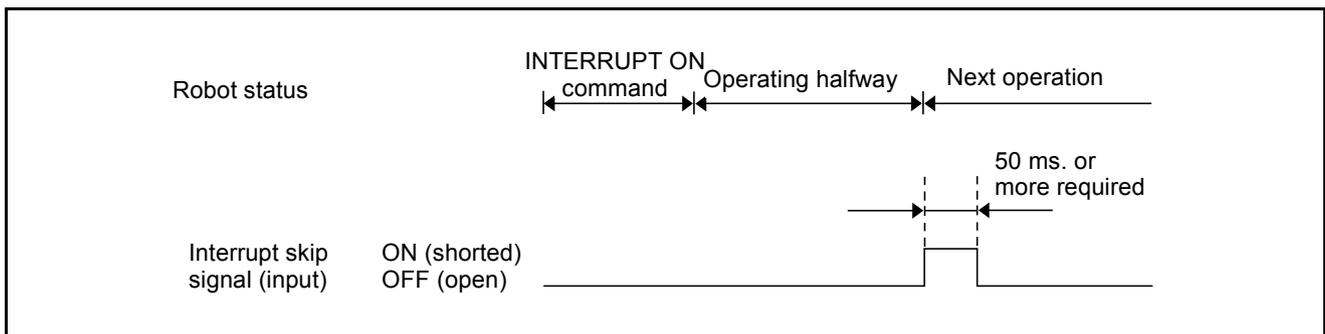
For further information about robot motion commands, refer to the PROGRAMMER'S MANUAL (I), Chapter 12, "Robot Control Statements."

(2) Usage

Refer to the PROGRAMMER'S MANUAL (I), Chapter 12 "12.3 INTERRUPT ON/OFF."

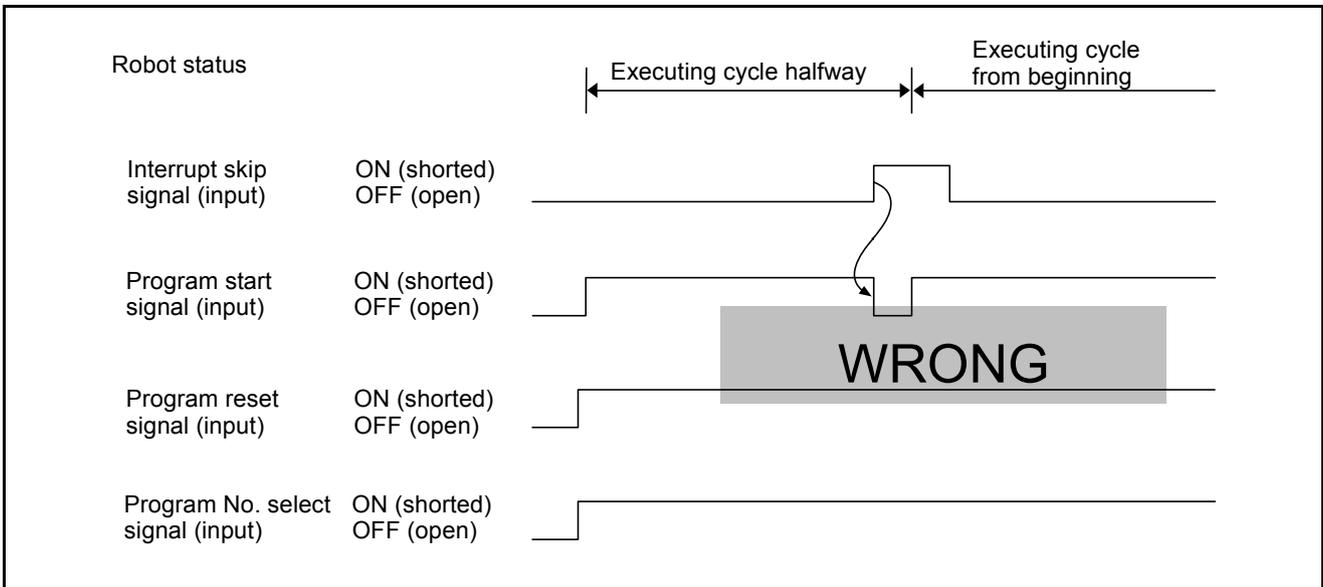
(3) Input conditions and operation

If this signal is turned ON (shorted), the robot will immediately stop the ongoing operation and start executing the next step.



Input Conditions and Operation of Interrupt Skip

⚠ Caution: When turning ON (shorted) the interrupt skip signal, at least either the program reset signal or the program start signal must be turned OFF (open).
 If the interrupt skip signal is turned ON, the robot interprets the program start signal as instantaneously turned OFF (open). Consequently, the program selected with the program No. select signal will be executed from the beginning. (See the figure given below.)



Example of Operation When an Interrupt Skip Signal is Input

16.4.9 Continue Start (Input)

(1) Function

Turning the program start signal ON when this continue start signal is ON will resume the current program being on halt.

(2) Input conditions and operation

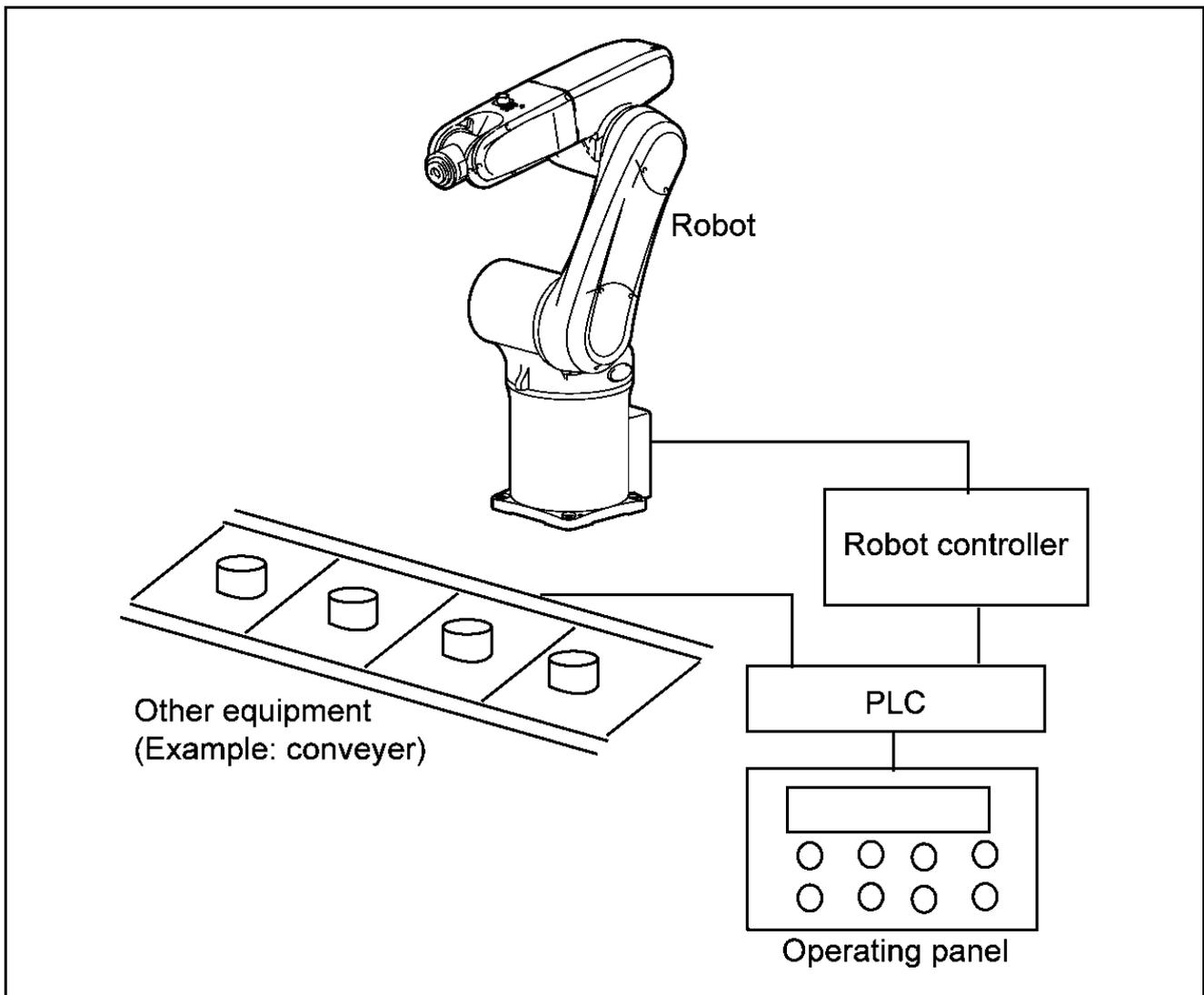
This signal is executable only in external mode. If this signal is on, program numbers will be ignored at execution of Program start and the current program being on halt will be resumed. If Continue Start Permitted signal is not ON, the controller will issue ERROR27A8.

16.5 Example of Using System I/O Signals in Compatible Mode

This section describes an example of starting and stopping the robot using system I/O signals.

(1) Equipment setup example

The example shown below assumes an equipment setup which allows you to run the robot by operating an external equipment's operation panel connected via the PLC to the robot controller. It is assumed that the operation panel has a display, lamps and switches listed on the next page.



Example of Equipment Setup Using a Robot

Function Example of Equipment Operating Panel

Classification	Part	Application
Display	Display	Displays messages, such as ROBOT PREPARATION OK.
Lamp	① Automatic operation indicator lamp	· Lights during automatic operation. · Not illuminated when the robot is not in automatic operation.
	② Robot external mode indicator lamp	· Lights when the robot is in external mode. · Turned OFF when the robot is not in external mode.
	③ Operation OK indicator lamp	· Lights when the Enable Auto signal is ON. · Turned OFF when the Enable Auto signal is OFF.
	④ Robot home position indicator	· Lights when the robot is in the home position for working. · Turned OFF when the robot is out of the home position for working. (By programming with a user-output)
Switch	① Robot operation button	Starts the robot preparation.
	② Automatic start button	Starts the operation of the equipment.
	③ Cycle stop button	Stops the equipment after a cycle of operations is completed.
	④ Operation/Adjustment selector switch	Automatic operation of the robot possible when OPERATION is selected. Manual operation or teach check of the robot possible when ADJUSTMENT is selected.
Note: Actual equipment requires emergency stop, interlock and other functions. However, described here are only necessary functions and others are omitted.		

(2) Outline of procedure

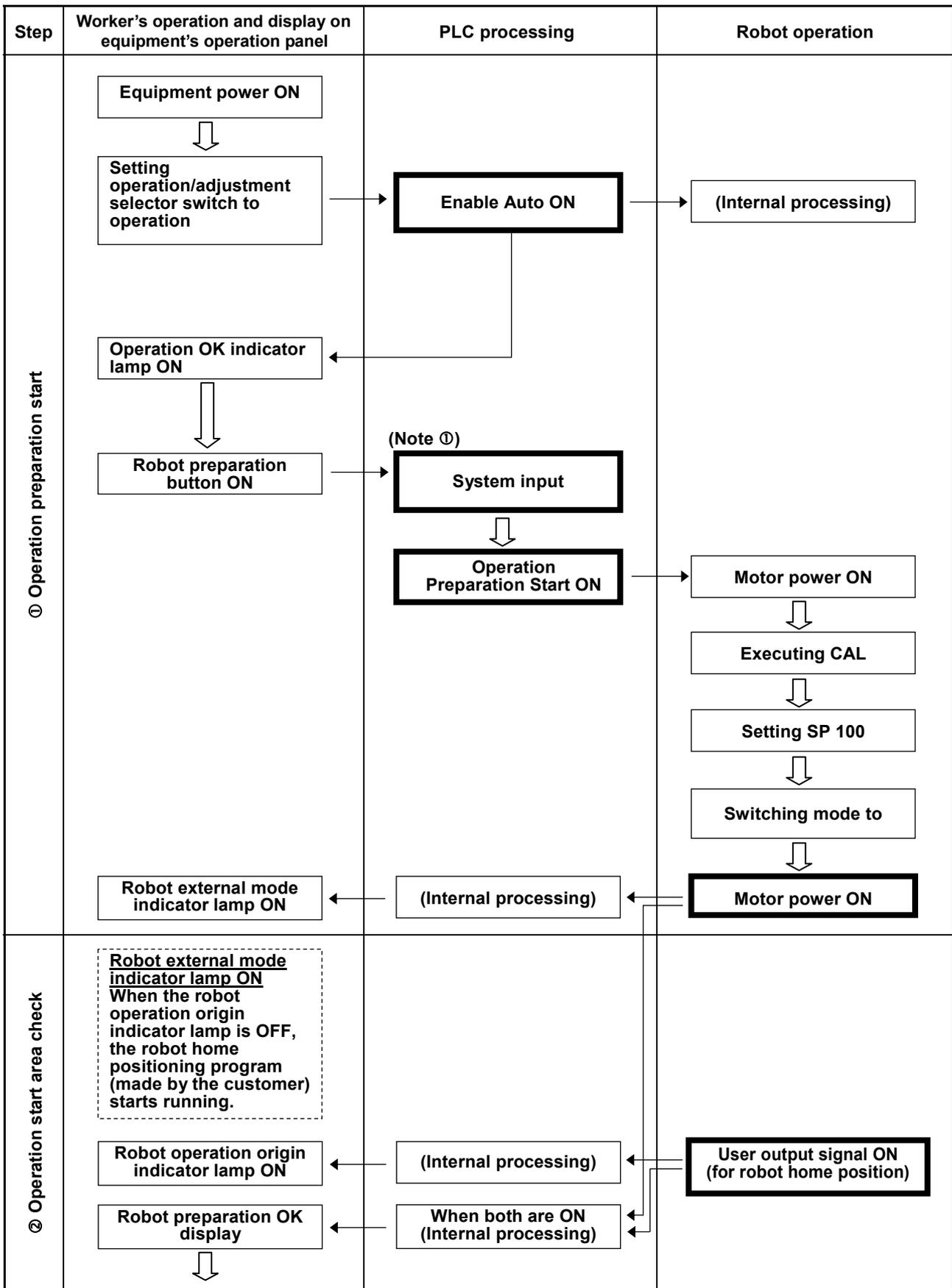
Described below is the outline of the procedure when using the equipment, as shown on the previous page.

Follow steps ① to ④.

- ① Operation preparation start
Setting the MOTOR POWER ON, CAL EXECUTION, SP100 and SWITCH EXT MODE bits, brings the robot into the External Auto mode. This operation will be completed when the EXTERNAL MODE output signal is turned ON.
- ② Operation start area check
When the robot arm is in the home position for working, the robot home position indicator lights and "ROBOT PREPARATION OK" displays.
- ③ Automatic operation
Start the program by which the robot starts from the operation origin, performs operations, and returns to the operation origin.
- ④ Operation end
Terminate the day's operations with a cycle stop, and turn OFF the power.

(3) Start and stop procedure and system I/O signals

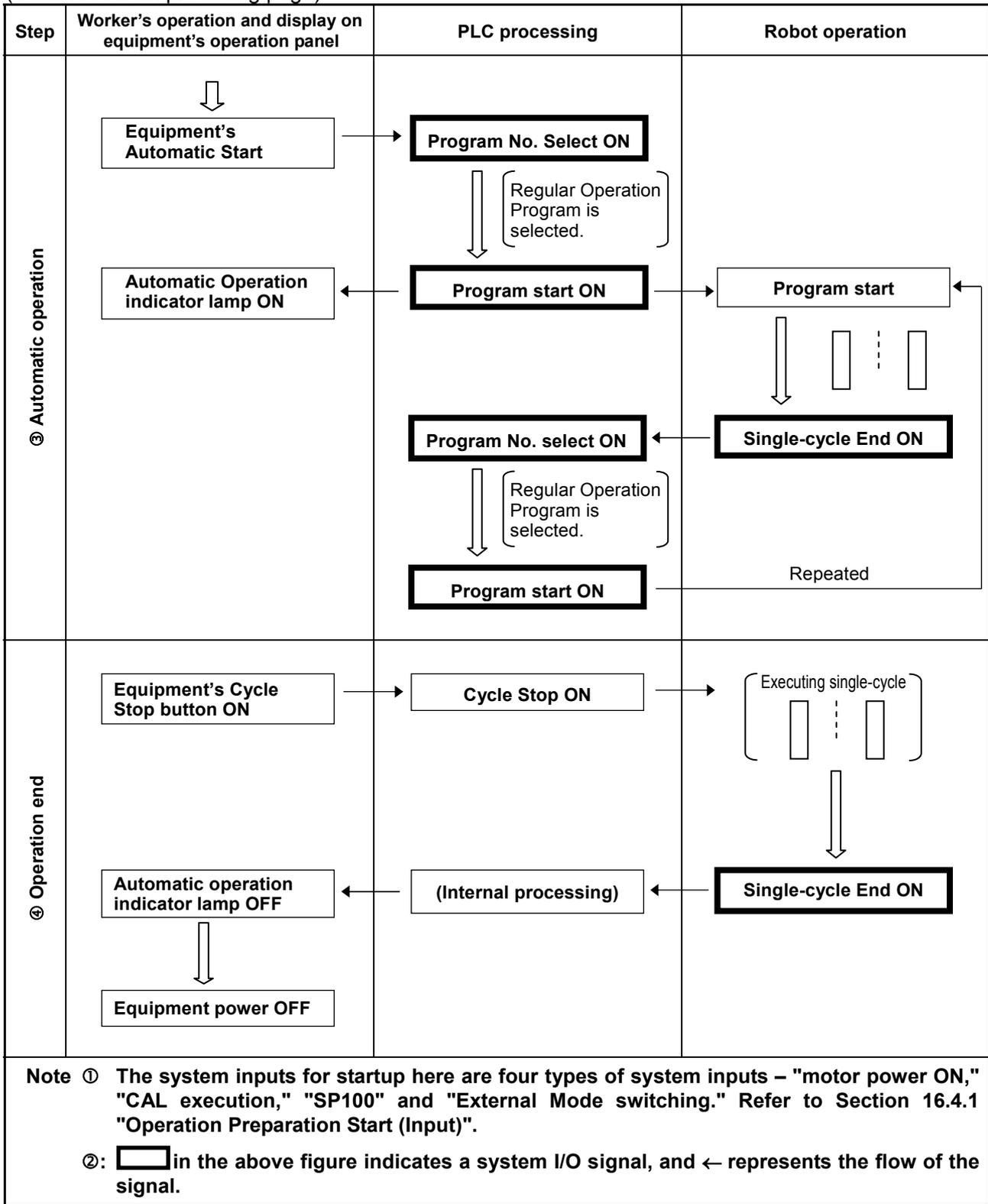
The following pages show the relationship between the system I/O signals for start and stop, worker's operation, display on the equipment operation panel, PLC proceeding, and robot motion.



Start and Stop Procedure and System I/O Signals-1

(Continued on the next page)

(Continued from preceding page)



Start and Stop Procedure and System I/O Signals-2

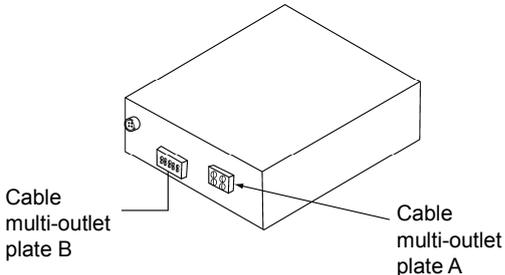
PART 4 SPECIFICATIONS OF OTHER OPTIONS

Chapter 17 Controller Protective Box

The controller protective box protects the controller from dust, dirt and oil mist existing in the factory. It is equipped with a heat exchanger for cooling the air warmed up by the controller inside the box down to the ambient temperature.

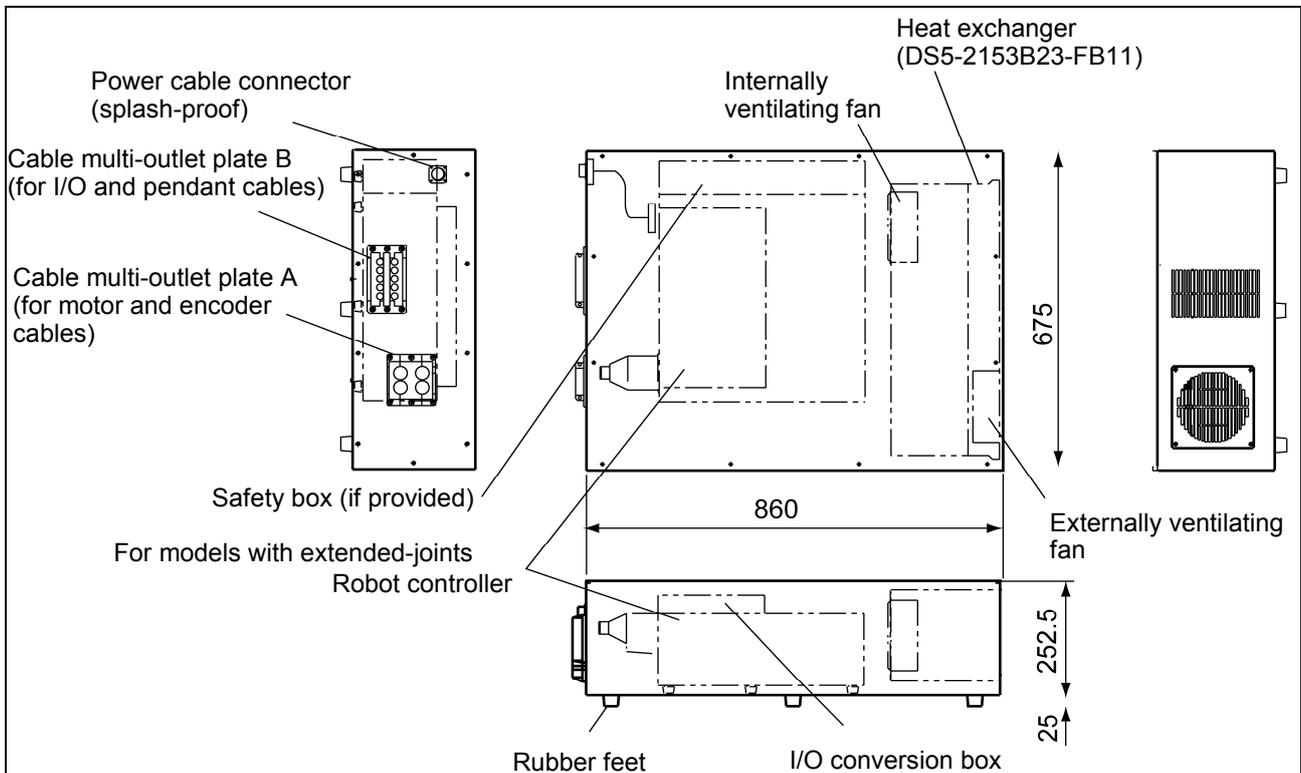
17.1 Configuration

The controller protective box and its accessories are shown below.

Protective Box		Accessories for Cable Multi-outlet Plate B	Option	
	Name printed	Applicable cable dia.	Rubber packing set for extended-joint cables Part No. 410169-2140	
	P0			
	P4	$\phi 4$ to $\phi 6$		
	P6	$\phi 6$ to $\phi 8$		
	P8	$\phi 8$ to $\phi 10$		
	P10	$\phi 10$ to $\phi 12$		

17.2 Component Names and External Dimensions

The figure below shows the names of the protective box components and the external dimensions.



Controller Protective Box (with the upper cover removed)

17.3 Specifications

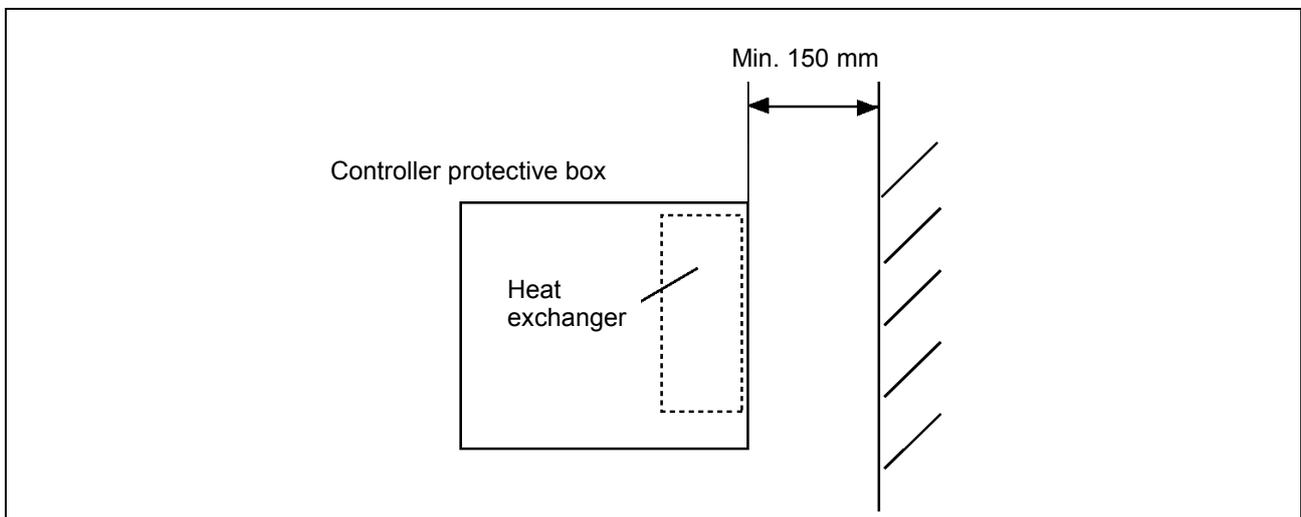
The table below lists the specifications of the controller protective box.

Item		Specifications
Protective box model		FB-11
Applicable controller		RC7M controller (The controller equipped with an I/O conversion box is also applicable.)
Power cable		410141-3570 (used for the global type) recommended Note: Using the power cable 410141-3570 provides higher sealing capability than 410141-0010 (used for the domestic, standard type).
Environmental conditions (Temperature and humidity)	In operation	0 to 40°C, RH 90% or below (dew condensation not allowed)
	In storage or during transportation	-10 to 60°C, RH 75% or below (dew condensation not allowed)
Enclosure		IP54
Weight (Mass)		Approx. 32 kg
Heat exchanger	Model	DS5-2153B23-FB11 (NIHON KAGAKU SANGYO CO., LTD)
	Fans	Internally and externally ventilating fans (US7556KX-TP manufactured by ROYAL ELECTRIC CO., LTD.)
	Cooling power	31 W/K (temperature change 1°C, calculated value)
	Power supply	Supplied from the controller power (Single-phase, 200 VAC distributed on the terminal board)
	Power consumption	80 W (60 Hz), 72 W (50 Hz)
	Rated current	0.54 A (60 Hz), 0.46 A (50 Hz)

17.4 Usage

17.4.1 Installation Environment

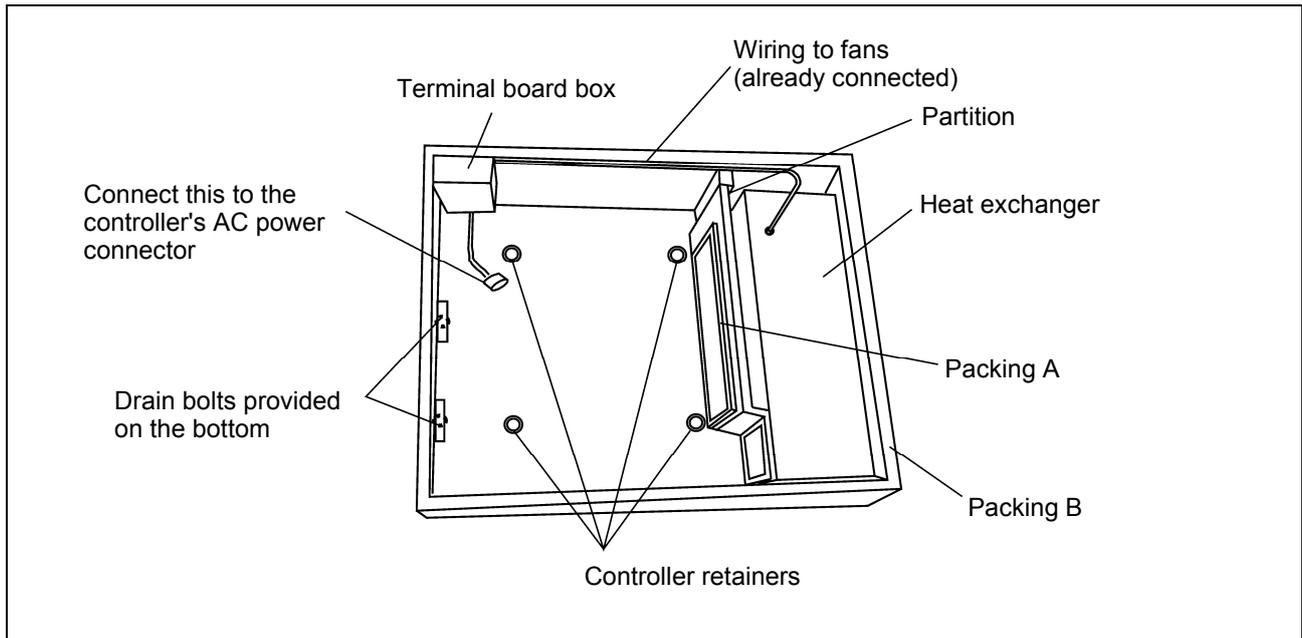
- (1) Place the protective box indoors.
- (2) Place the protective box on a horizontal plane.
- (3) Keep a space of min. 150 mm at the heat exchanger side of the protective box.



17.4.2 Placing the Robot Controller in the Protective Box

- (1) Remove the upper cover from the protective box and peel off tapes from packings A and B.
- (2) Place the robot controller in the protective box so that controller's rubber feet fit in the retainers provided in the protective box.
- (3) Connect the cable coming from the terminal board box to the power connector (CN5) on the controller.

Note: The wiring to the heat exchanger's fans has been done via a 0.5 A glass fuse with single-phase 200 VAC distributed on the terminal board. If the fan(s) is not working, check this fuse.



17.4.3 Cabling to the Robot Controller

The cables to be connected to the controller should be passed through the cable multi-outlet plates on the front panel of the protective box and then connected to the controller.

To pass the cables through the cable multi-outlet plates, remove those plates from the protective box, pass the cables through them, and then set those plates back into place.

- (1) Connect the power cable 410141-3570 (used for the global type, recommended) to the power cable connector on the protective box.
- (2) Pass the robot control cable (motor and encoder cables) through the cable multi-outlet plate A mounted on the protective box.
- (3) Replace the rubber packings currently mounted on the cable multi-outlet plate B with the ones suitable as listed below, then pass the cables through the plate B.

Rubber Packing Set (that comes with the protective box) for Cable Multi-outlet Plate B

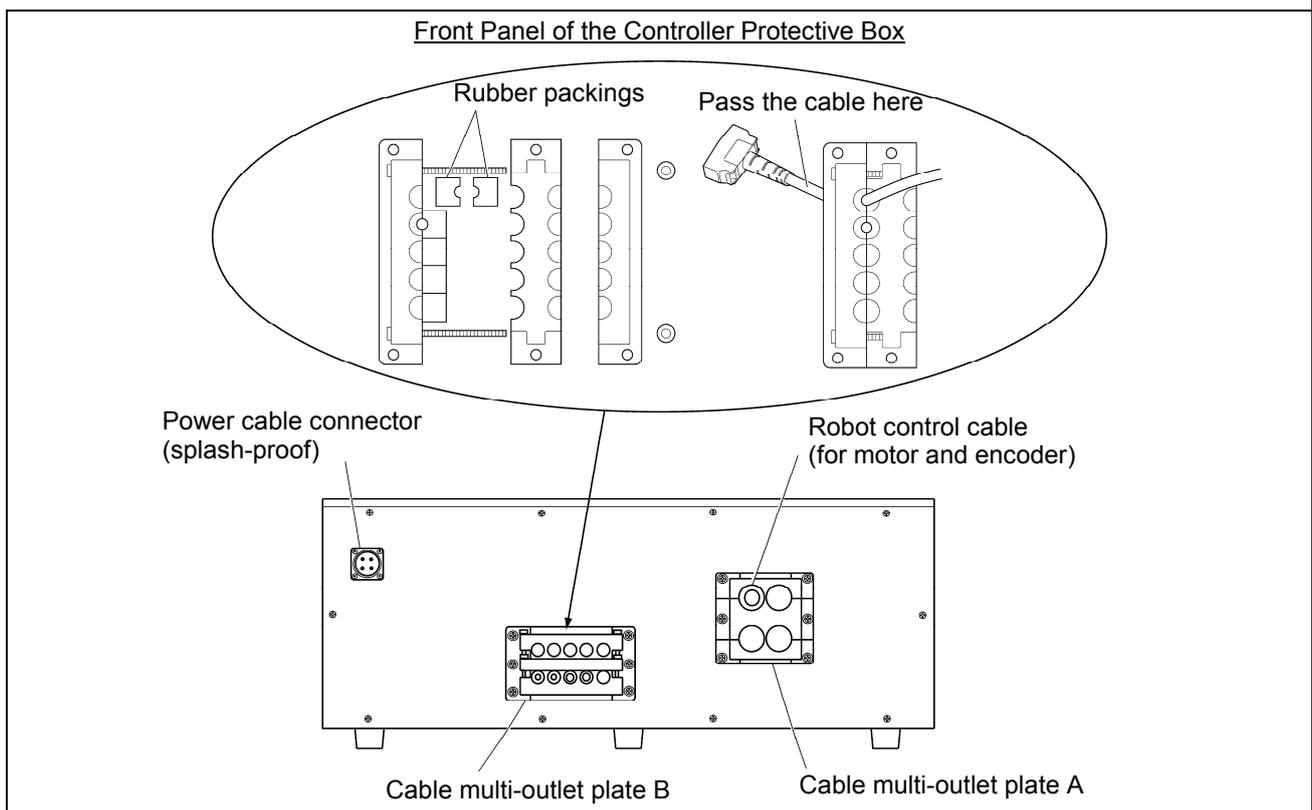
Model	Applicable cable dia.	Application	No. of sets (2 pieces per set)
EMSP0	No cable holes	To be used as a blind cover	2
EMSP4	φ4 to φ6		1
EMSP6	φ6 to φ8	Pendant cable, hand I/O cable, and safety I/O cable	1
EMSP8	φ8 to φ10	Mini I/O cable	2
EMSP10	φ10 to φ12	Extended parallel I/O cable	1

Rubber Packing Set for Extended-Joint Cables

Model	Applicable cable dia.	Application	No. of sets (2 pieces per set)
EM28P8	φ8 to φ10	Extended-joint motor cable	1
EMSP8	φ8 to φ10	Extended-joint encoder cable	1

Note 1: Replace the rubber packings currently mounted on the cable multi-outlet plate A with the ones for extended-joint motor cable (EM28P8), then pass the extended-joint motor cable through the plate A.

Note 2: Replace the rubber packings currently mounted on the cable multi-outlet plate B with the ones for extended-joint encoder cable (EMSP8), then pass the extended-joint encoder cable through the plate B.



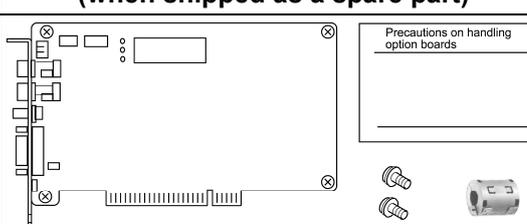
17.5 Notes

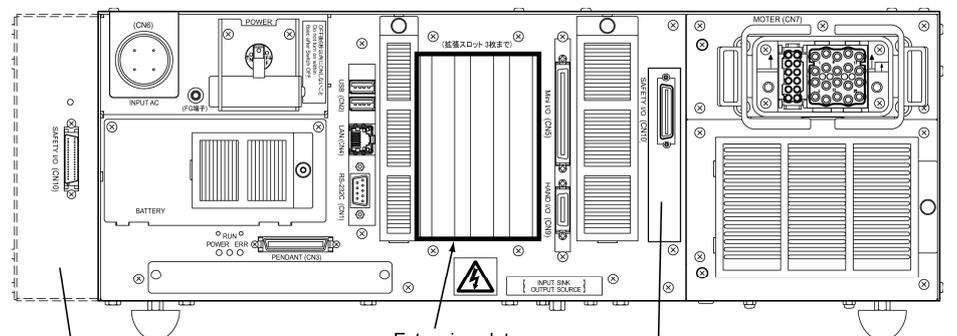
- (1) The controller protective box is a dust- and splash-proof structure equivalent to IP54. However, it has not been designed to withstand explosions, so avoid installing the protective box in any environment where:
 - there are any flammable gases or liquids,
 - there are any acidic, alkaline or other corrosive gases,
 - there are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise,
 - the ambient temperature is out of the range from 0°C to 40°C,
 - the protective box is directly exposed to rains,
 - the protective box is directly exposed to water, oil, grinding chips or shavings,
 - there are any grinding or machining chips or shavings, or
 - any machining oil not specified in this manual is in use.
Note: Yushiron Oil No. 4C (non-soluble) is specified.
- (2) When using the controller protective box in an environment where there is much oil mist, perform sealing on the mounting face and around the screws. Also periodically clean the fins to prevent oil sludge from accumulating on the fins.
- (3) If oil mist accumulates inside the controller protective box, remove the drain bolts to drain oil.
- (4) The controller protective box has no power switch, so externally turn the controller power on and off.

Chapter 18 μ Vision Board (Version 2.41 or later)

18.1 μ Vision Board and Mounting Position

The μ Vision board is shipped as a part integrated in the controller or shipped alone as a spare part. It should be mounted in any of the extension slots.

Name	Part number	Remarks	μ Vision board and its accessories (when shipped as a spare part)
μ Vision board	410010-4150	Integrated in the controller when shipped	 <p>Precautions on handling option boards</p>
	410010-4160	Shipped alone as a spare part	



SAFETY BOX
(Only for global type with safety box)

Extension slots

SAFETY BOARD
(Only for global type with safety board)

18.2 μ Vision Board Specifications

Image processing commands are already incorporated and no special operations or programming is required.

μ Vision Board Specifications

Item	Specifications
CPU	SH7750R 240 MHz
Image storage memory for processed images	512 (H) \times 480 (V) pixels, 8 bits \times 4 screens
Overlay memory for drawn images	640 (H) \times 480 (V) pixels, 2 bits \times 2 screens
Search model registration memory	Approx. 2 MB, Max. 100 models registrable (Note 1)
Image input, number of channels	RS-170 (NTSC) monochrome, 256 gradations, 2 channels
Image output	RS-170 (NTSC) monochrome, 256 gradations, 1 channel
Image processing	Binary feature extraction (area, center of gravity, main axis angle, and luminance integration), histogram, edge detection, image-to-image operation, filtering, labeling, light/dark image search, code recognition (QR code)
Processing range specification (window)	Up to 512 windows registrable (Shape: straight line, rectangle, circle, ellipse, sector)
Self-diagnosis function	Memory check, input error, processing range error, camera connection failure, etc.
Error display	Errors will be displayed on the teach pendant (option).
Power source	5 VDC, 12 V (supplied via controller PCI bus) (Note 2)
Environmental conditions (in operating)	Temperature: 0 to 40°C Humidity: 90 % RH or less (without dew condensation)

Note 1 The number of registrable models differs depending upon the model image or size.

Note 2 Since the power is internally supplied from the robot controller, no external power source is required.

18.3 Names and Functions of Connectors

The connectors on the panel of the μ Vision board and the pin assignments are shown below.

Connectors on the Panel of the μ Vision Board

Connectors on the panel of μ Vision board	Function
Camera input connector 1 (C1)	Used for connection with camera 1 (12-pin, round connector).
Camera input connector 2 (C2)	Used for connection with camera 2 (12-pin, round connector).
Monitor output connector (VO)	Used for connection with the monitor (BNC).
Serial port 1 (S1)	RS-232C port (Not used.)
Trigger connector (IO)	TTL level input/output, 1 point each (Not used.)

Note 1 Switches and short pins on the μ Vision board have been configured at the factory. Do not change the settings. Changing them results in a failure.

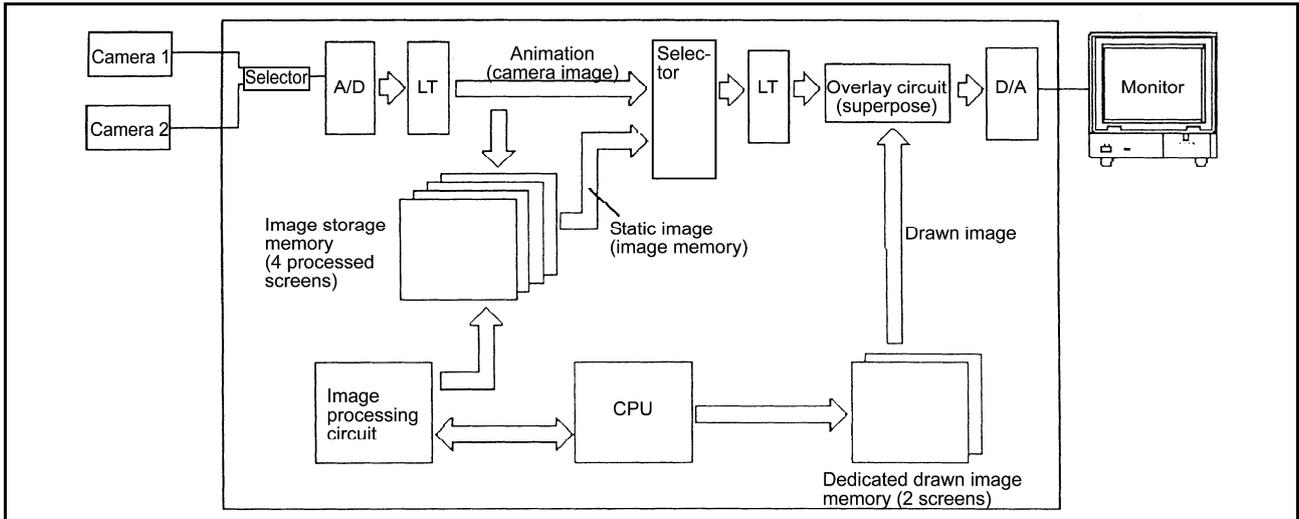
Note 2 Do not connect anything to the "Not used" connectors on the board. A failure may result.

Note 3 Serial port 1 and trigger connector on the board are unusable. Do not connect anything to them. A failure may result.

Camera Input Connector Pin Layout (Hirose Electric HR10A-10R-12S or equivalent)

Pin No.	Signal name	Remarks
1	GND	Camera power GND
2	+12V	Camera power 12V
3	GND	Camera power GND
4	VIDEO	Video signal
5	HDGND	Horizontal synchronous signal GND
6	HD	Horizontal synchronous signal
7	VD	Vertical synchronous signal
8	NC	Not connected
9	NC	Not connected
10	NC	Not connected
11	TRIG	Trigger signal (not used)
12	VDGND	Vertical synchronous signal GND

18.4 Block Diagram and Internal Configuration of mVision Board

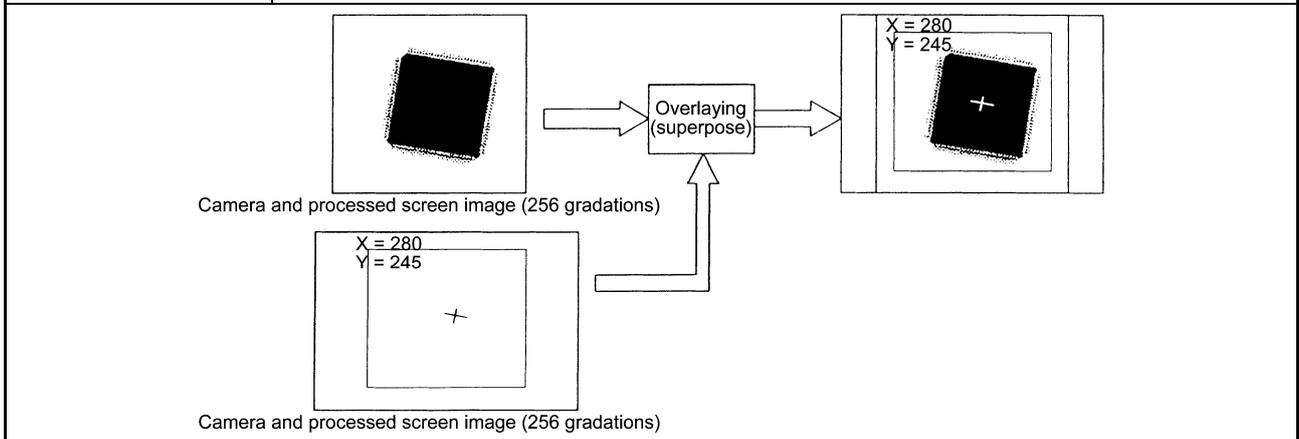


Block Diagram of μVision Board

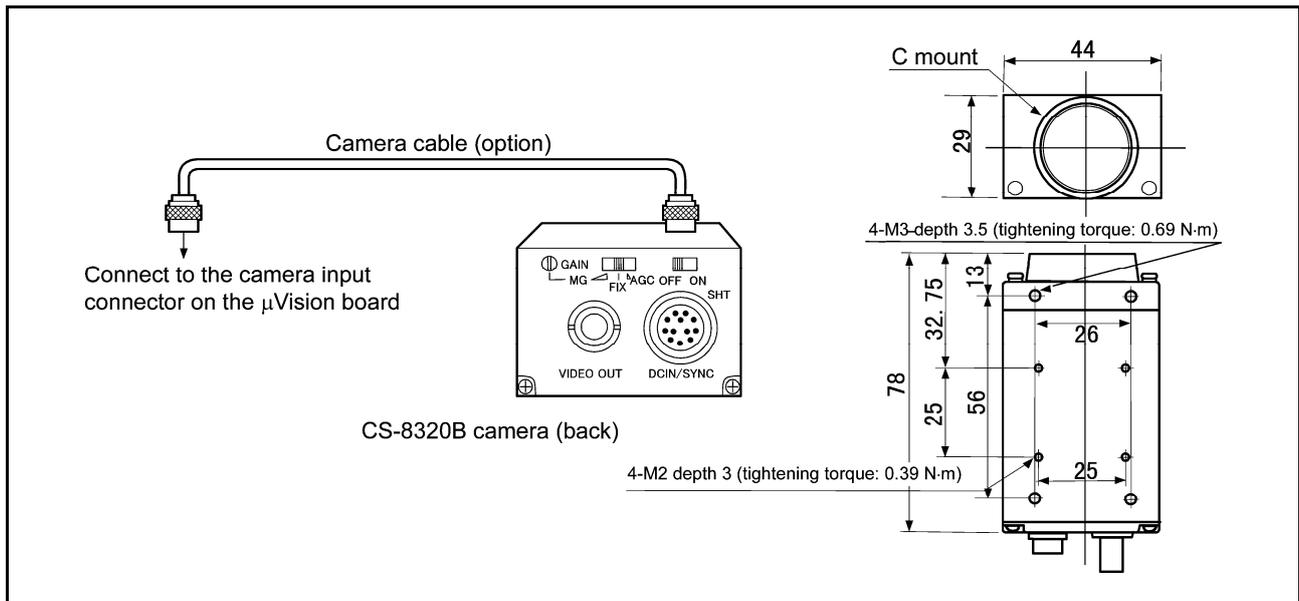
The above figure illustrates the processing flow of the μVision board as a reference. The actual circuit configuration is different from this diagram.

Configurators on the Block Diagram

Configurators	Function
Camera selector	Switches between cameras 1 and 2.
A/D	Converts analog signals into digital signals (8-bit).
Monitor selector	Selects whether to display the camera live image or static image on the monitor.
LT	Converts 8-bit data values using the appropriate table.
Overlay circuit	Overlays a drawn image, which is stored in the dedicated drawn image memory, on the camera live image or static image.
D/A	Converts digital signals into analog signals.
Image storage memory	Stores camera live images. When outputted onto the monitor screen, those images will be handled as static images. Up to four screens can be stored on this board.
Dedicated drawn image memory	Stores drawn images of characters and figures. Those images can be displayed on the monitor screen via the overlay circuit. Up to two screens can be stored on this board.
Image processing circuit	Processes images.
CPU	Manages the entire system.



18.5 Peripheral Devices (Camera)



Camera Dimensions and its Parts Names

Camera Specifications

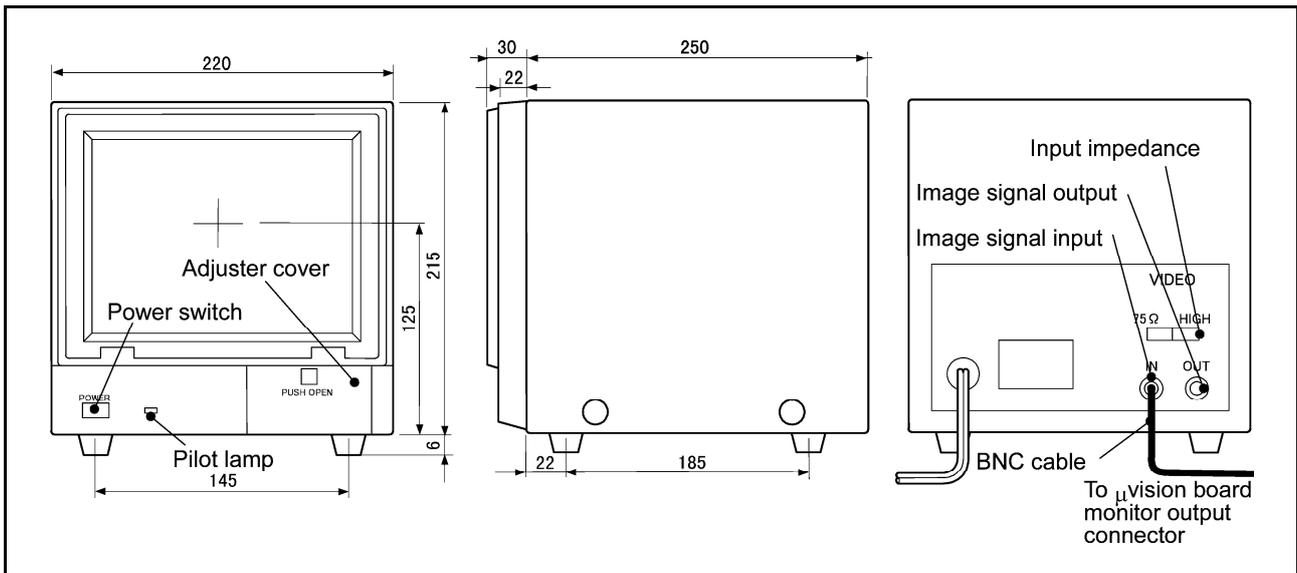
Item	Specifications
Manufacturer	Tokyo Electronic Industry Co., Ltd.
Manufacturer's model	CS8320B
Image pickup interline transfer system	CCD pixels: 768 (H) \times 493 (V)
Lens mount	C mount
Image output NTSC signal	1.0 V _{p-p} /75 Ω
Power source, Ambient temperature	Supplied from power adapter, 0 to +40°C
Weight	120 g
Vibration-proof	98 m/s, 10G (10 to 50 Hz, 30 minutes in each of X, Y and Z directions)

Cables (Option)

Cable length	Camera cable model
3 m	CPC3440-03
5 m	CPC3440-05
15 m	CPC3440-15

- Caution**
- (1) When mounting the camera to the equipment, tighten the screws securely to the specified torque as shown above.
 - (2) Do not apply a strong impact or vibration to the camera. A failure may result.
 - (3) When opening the camera top cover and changing the settings, be sure to turn the controller power off or disconnect the camera cable.
 - (4) For setting up of cameras, refer to the instruction manual that comes with the camera.

18.6 Peripheral Devices (Monitor)



Monitor Dimensions and Parts Names

Monitor Specifications

Item	Specifications
Manufacturer	Chuo Musen Co., Ltd.
Manufacturer's model	TMP-232-03
Cathode-ray tube (CRT)	9-inch, monochrome
Image input NTSC signal	0.7 Vp-p (straight polarity)
Power supply	100 VAC, 50/60 Hz
Power consumption	Approx. 30 W
Ambient temperature	0 to 40°C
Humidity	90% or less (without dew condensation)

Cables (Option)

Cable length	BNC coaxial cable type
1 m	3CV-PP (1)
3 m	3CV-PP (3)
5 m	3CV-PP (5)

Caution (1) NEVER disassemble the monitor.

(2) Be sure to set a ferrite core clamp (ZCAT1518 manufactured by TDK) that comes with the μ Vision board, to the BNC cable at the monitor output connector side.

RC7M CONTROLLER

OPTIONS MANUAL

First Edition July 2005
Twelfth Edition April 2011
Thirteenth Edition October 2011

DENSO WAVE INCORPORATED

10N **C

The purpose of this manual is to provide accurate information in the handling and operating of the robot. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will DENSO WAVE INCORPORATED be liable for any direct or indirect damages resulting from the application of the information in this manual.

