DENSO ROBOT

WITH RC7J CONTROLLER

**-F SERIES

OPTIONS MANUAL

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 **-F series robot system together with the RC7J 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 RC7J controller

How the documentation set is organized

The documentation set consists of the following books. If you are unfamiliar with this robot and option(s), please read all books and understand them fully before operating your robot and option(s).

GENERAL INFORMATION ABOUT ROBOT

Provides the packing list of the robot and outlines of the robot system, robot unit, and robot controller.

INSTALLATION & MAINTENANCE GUIDE

Provides instructions for installing the robot components and customizing your robot, and maintenance & inspection procedures.

BEGINNER'S GUIDE

Introduces you to the DENSO robot. Taking an equipment setup example, this book guides you through running your robot with the teach pendant, making a program in WINCAPSII, and running your robot automatically.

SETTING-UP MANUAL

Describes how to set-up or teach your robot with the teach pendant, operating panel, or mini-pendant.

WINCAPSII GUIDE

Provides instructions on how to use the teaching system WINCAPSII which runs on the PC connected to the robot controller for developing and managing programs.

PROGRAMMER'S MANUAL (I), (II)

Describes the PAC programming language, program development, and command specifications in PAC.

RC7J CONTROLLER INTERFACE MANUAL

Describes the RC5 controller, interfacing with external devices, system- and user-input/output signals, and I/O circuits.

ERROR CODE TABLES

List error codes that will appear on the teach pendant, operating panel, or PC screen if an error occurs in the robot series or WINCAPSII. These tables provide detailed description and recovery ways.

OPTIONS MANUAL - this book -

Describes the specifications, installation, and use of optional devices.

How this book is organized

This book is just one part of the robot documentation set. This book consists of chapters 1 through 12.

PART 1 OPTIONAL OPERATION DEVICES

Describes optional operation devices designed for operating your robot.

Chapter 1 Teach Pendant

Chapter 2 Mini-Pendant

Chapter 3 PC Teaching System "WINCAPSII"

PART 2 I/O OPTION BOARD FOR RC7J

Describes I/O option board that can be installed to the RC7J controller. If you place an order for our robot system together with the board, it will be built in the RC7J controller at the factory and then the robot system will be delivered.

Chapter 4 I/O Option Board Overview

Chapter 5 System I/O Signals in Standard Mode

Chapter 6 System I/O Signals in Compatible Mode

Chapter 7 DeviceNet Slave Board

Chapter 8 DeviceNet Master Board

Chapter 9 DeviceNet Master and Slave Board

Chapter 10 CC-Link Remote Device Board

Chapter 11 Parallel I/O Board

Chapter 12 Mounting I/O Option Boards

Contents

PART 1 OPTIONAL OPERATION DEVICES

Chapter1 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

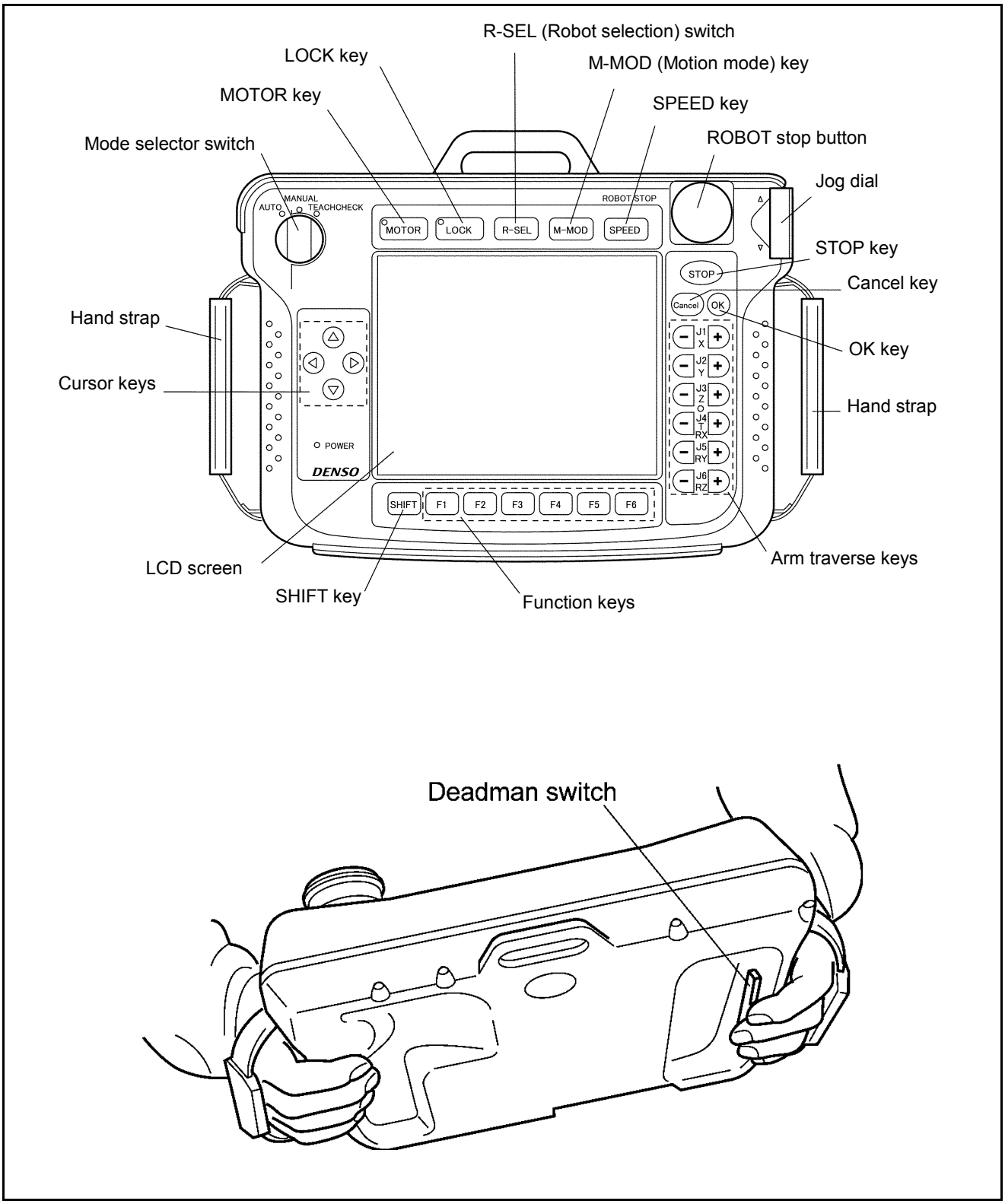
This function turns power to the motor ON/OFF, executes CAL, starts and stops automatic operation, and performs manual operation.

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

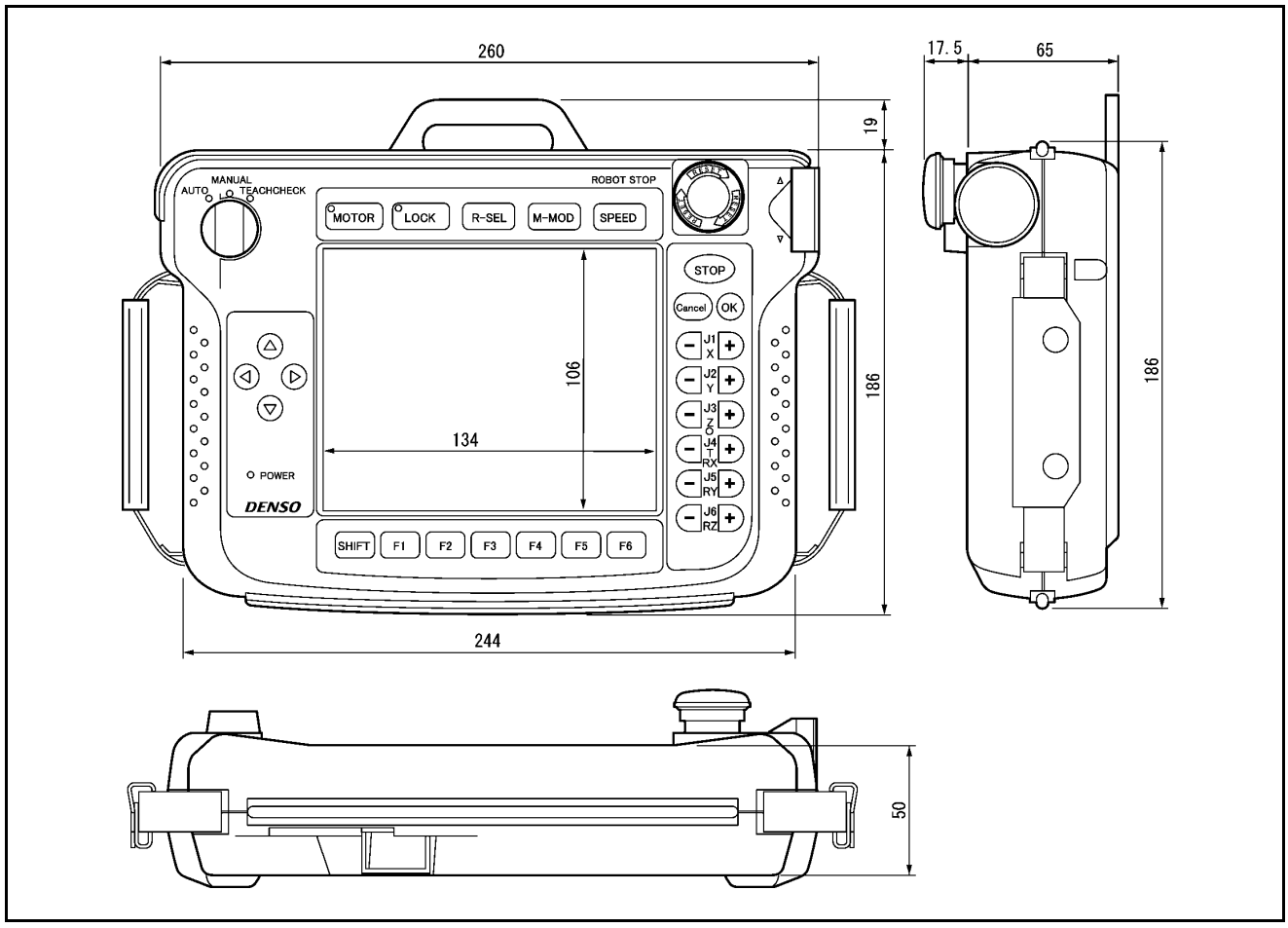
The table below lists the teach pendant specifications.

Teach Pendant Specifications

Item		Specifications
Model		TP-RC7-1
Display		Liquid crystal display with backlight, 640 × 480 pixels
Power source		24 VDC (supplied from robot controller)
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
Installation conditions		Temperature: 0 to 40°C Humidity: 90% RH or less (Dew condensation shall not be allowed.)
Outside dimensions (W x H x D)		260 × 186 × 60 mm (excluding projections)
Weight		1.2 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.



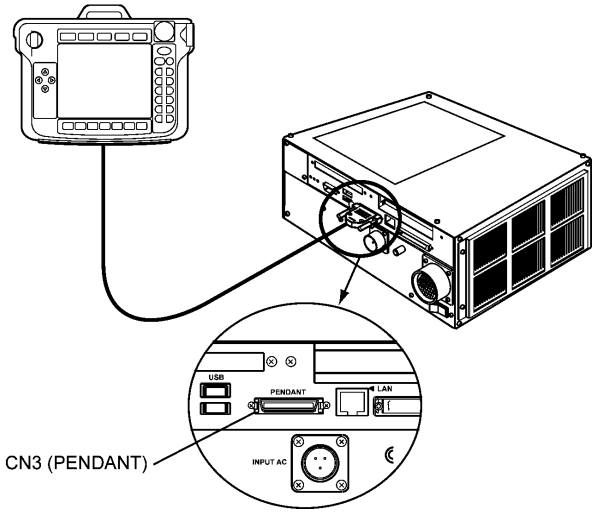
Outer Dimensions of the Teach Pendant

1.3.3 Connecting the Teach Pendant

Connect the teach pendant to the connector (CN3) of the robot controller.

Cautions at connecting the teach pendant cable to the controller:

(1) Turn the controller power OFF, when connecting the teach pendant to the controller.
(2) Turn the controller power OFF, when disconnecting the teach pendant from the controller.
(3) When and after connecting the cable to the controller, pay attention not to stress on to the connector ("CN3" in the figure below). The stress on to the connector may occur communication error.
(4) When removing the cable from the controller, unlock the connecter and disconnect 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

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 RC7J CONTROLLER INTERFACE MANUAL, Subsections 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.

Chapter2 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 WINCAPSII or WINCAPSII 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

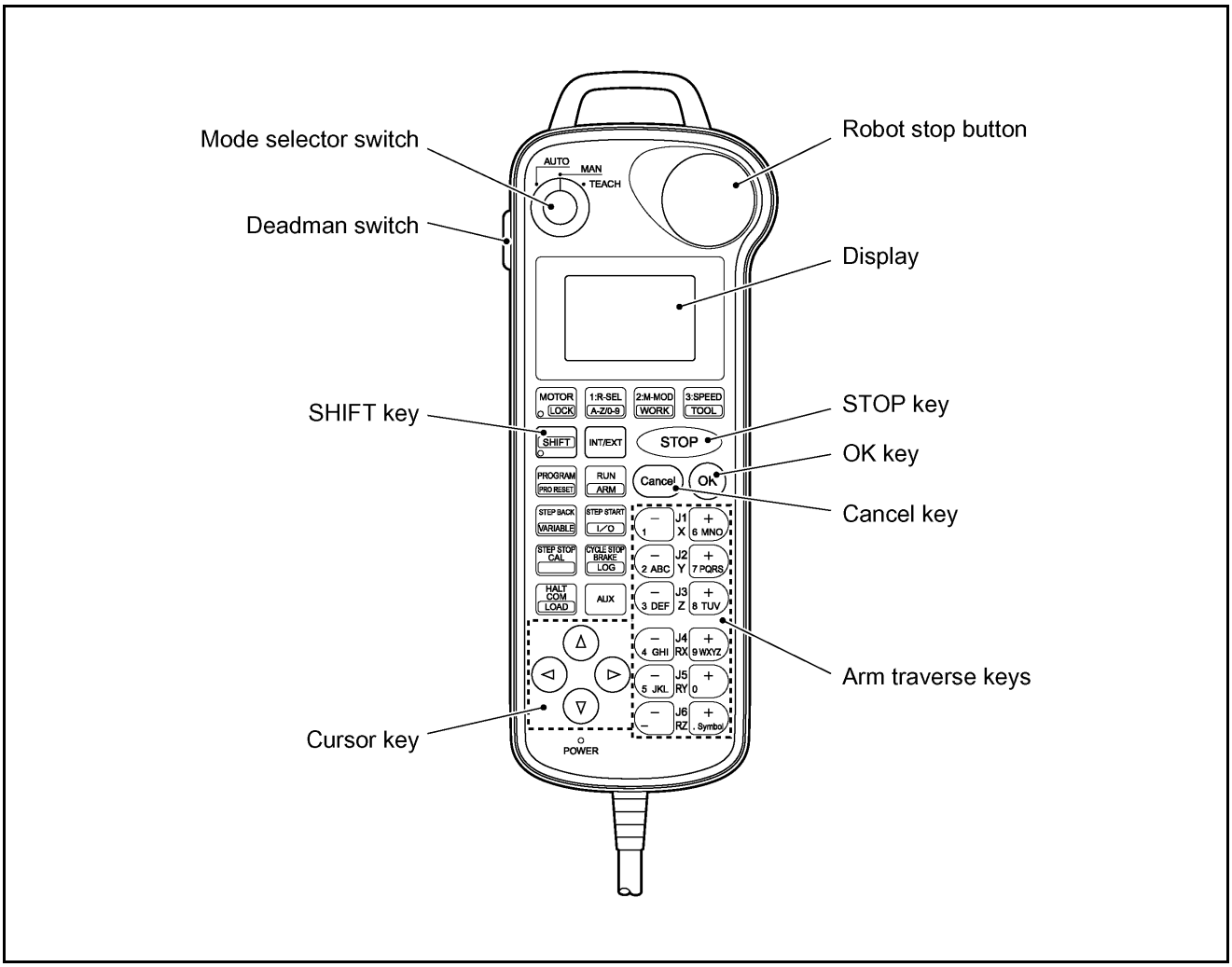
This function turns power to the motor ON/OFF, executes CAL, starts and stops automatic operation, and performs manual operation.

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

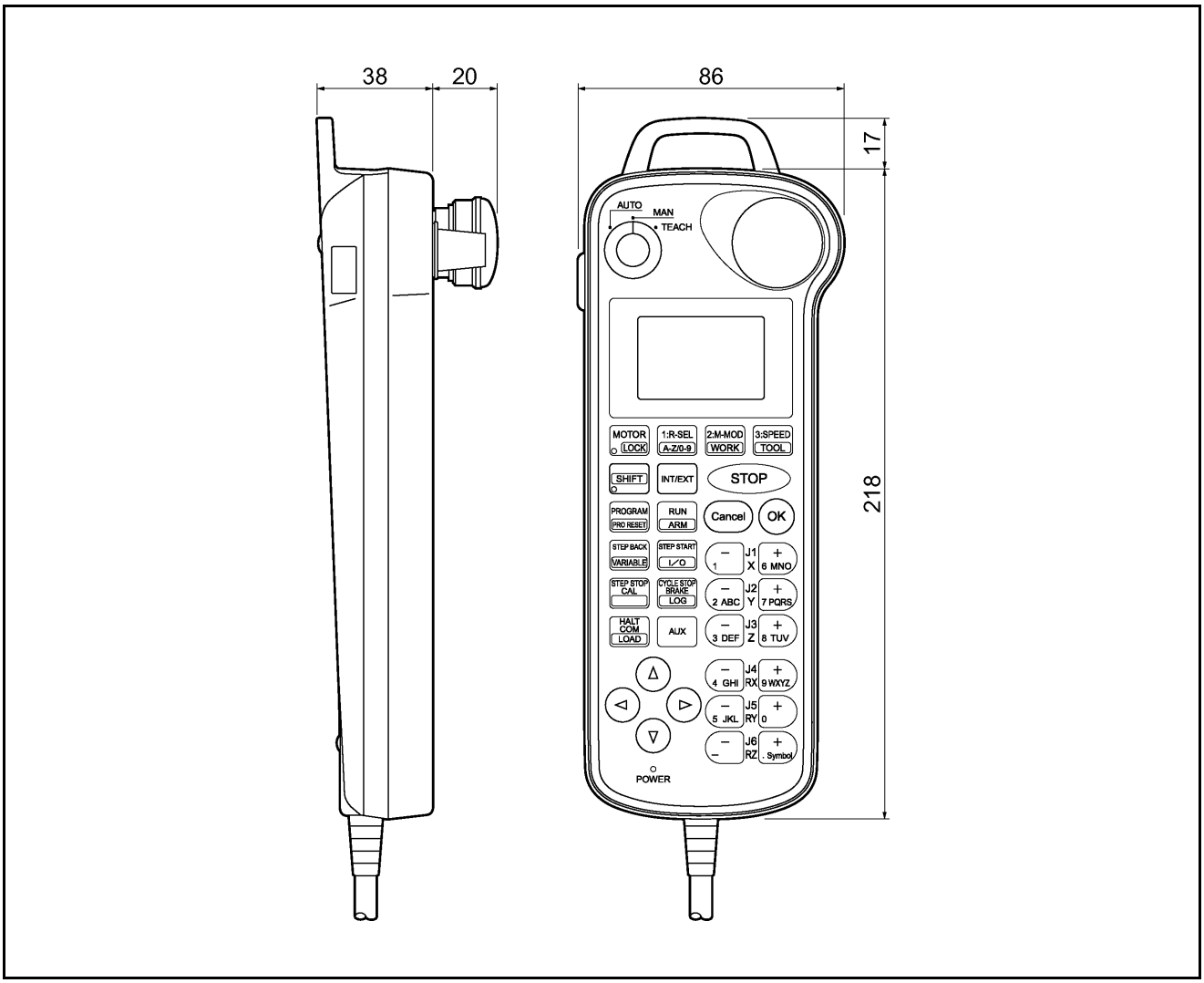
The table below lists the mini-pendant specifications.

Mini-Pendant Specifications

Item	Specifications
Model	MP7E3P4K (with 4 m cable) MP7E3P8K (with 8 m cable) MP7E3P12K (with 12 m cable)
Display	Liquid crystal display, 128 × 64 pixels
Power source	24 VDC (supplied from robot controller)
Operation	33 membrane switches, robot stop button, mode selector switch, deadman switch
Installation conditions	Temperature: 0 to 40°C Humidity: 90% RH or less (Dew condensation shall not be allowed.)
Outside dimensions (W) x (H) x (D)	86 x 218 × 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	WINCAPSII 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.



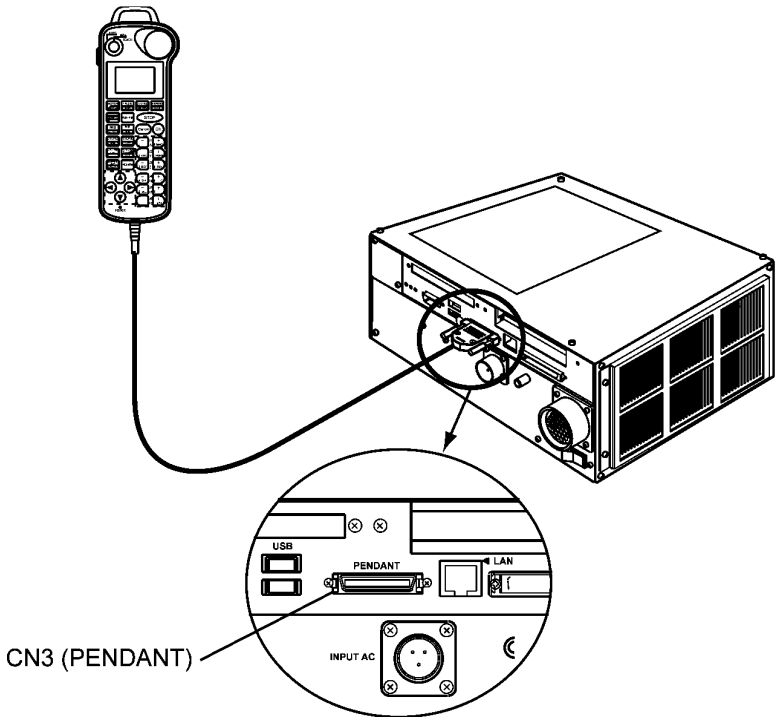
Outer Dimensions of the Mini-Pendant

2.3.3 Connecting the Mini-Pendant

Connect the mini-pendant to the connector (CN3) of the robot controller.

Cautions at connecting the teach pendant cable to the controller:

(1) Turn the controller power OFF, when connecting the mini-pendant to the controller.
(2) Turn the controller power OFF, when disconnecting the mini-pendant from the controller.
(3) When and after connecting the cable to the controller, pay attention not to stress on to the connector ("CN3" in the figure below). The stress on to the connector may occur communication error.
(4) When removing the cable from the controller, unlock the connecter and disconnect it.



2.4 Specifications of WINCAPSII Light

WINCAPSII Light that comes with the mini-pendant is PC teaching system software. It is a functionally limited version of WINCAPSII.

Except that WINCAPSII Light is limited to the following functions, it is the same as WINCAPSII. Refer to WINCAPSII given in the next chapter.

Entering and editing robot programs

In WINCAPSII 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

WINCAPSII 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

WINCAPSII 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

WINCAPSII 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.

Chapter3
PC Teaching System Software, "WINCAPSII"

The PC teaching system facilitates the creation and editing of robot programs. Use this system to improve creation and/or robot management programs. For further information about how to use this teaching system, refer to the WINCAPSII GUIDE.

3.1 Functions in WINCAPSII

WINCAPSII has the following functions:

Entering and editing robot programs

In WINCAPSII, 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

WINCAPSII 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

WINCAPSII 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, WINCAPSII may print out programs, CALSET data, log data, and other data.

Simulating the robot motion

WINCAPSII 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

The PC teaching system software requires the operating environment listed below.

Operating Environment for the PC Teaching System Software

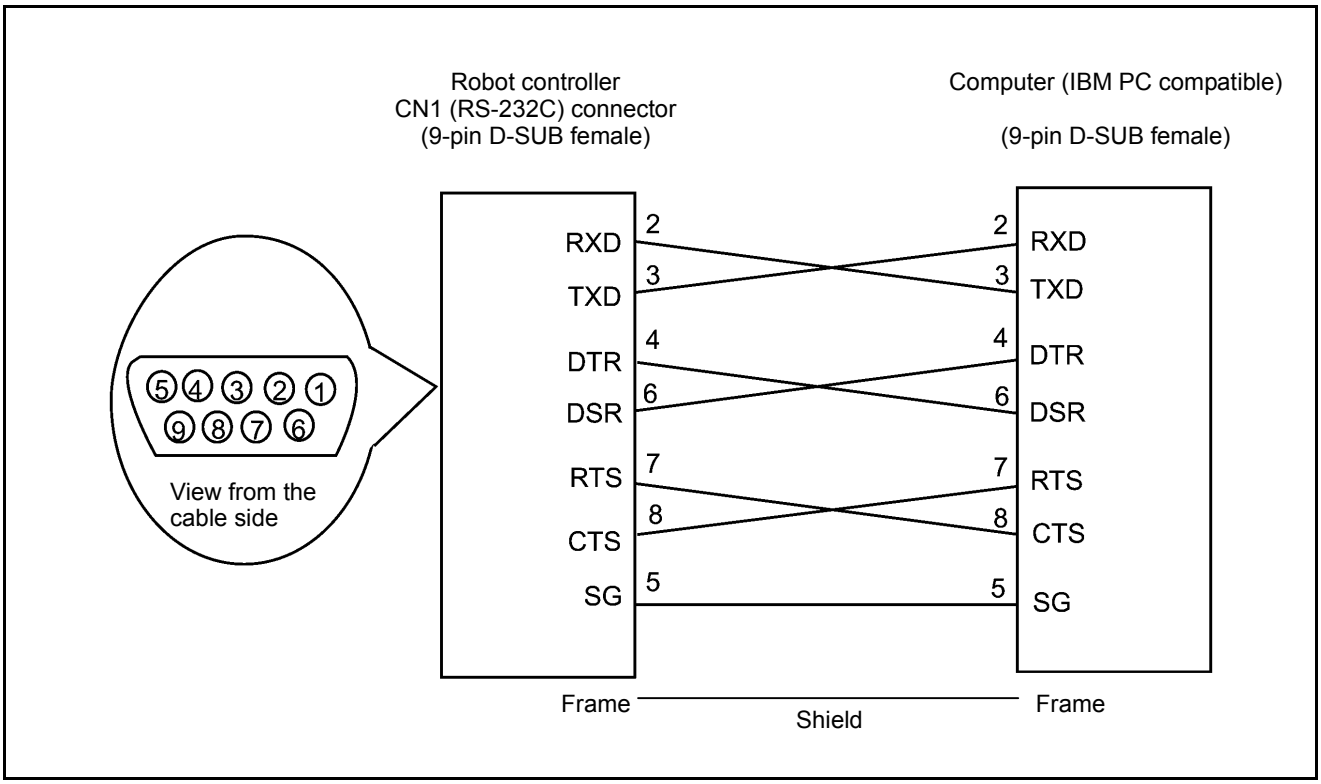
CPU	Pentium or higher capacity
OS	Windows 95 or upper version (See Note 1.)
Memory	32 MB or more (64 MB recommended)
Hard disk	A free area of 80 MB or more is required at installation.
Monitor resolution	640 × 480 or higher

Note 1 WINCAPSII cannot run properly on earlier versions of Windows 95.

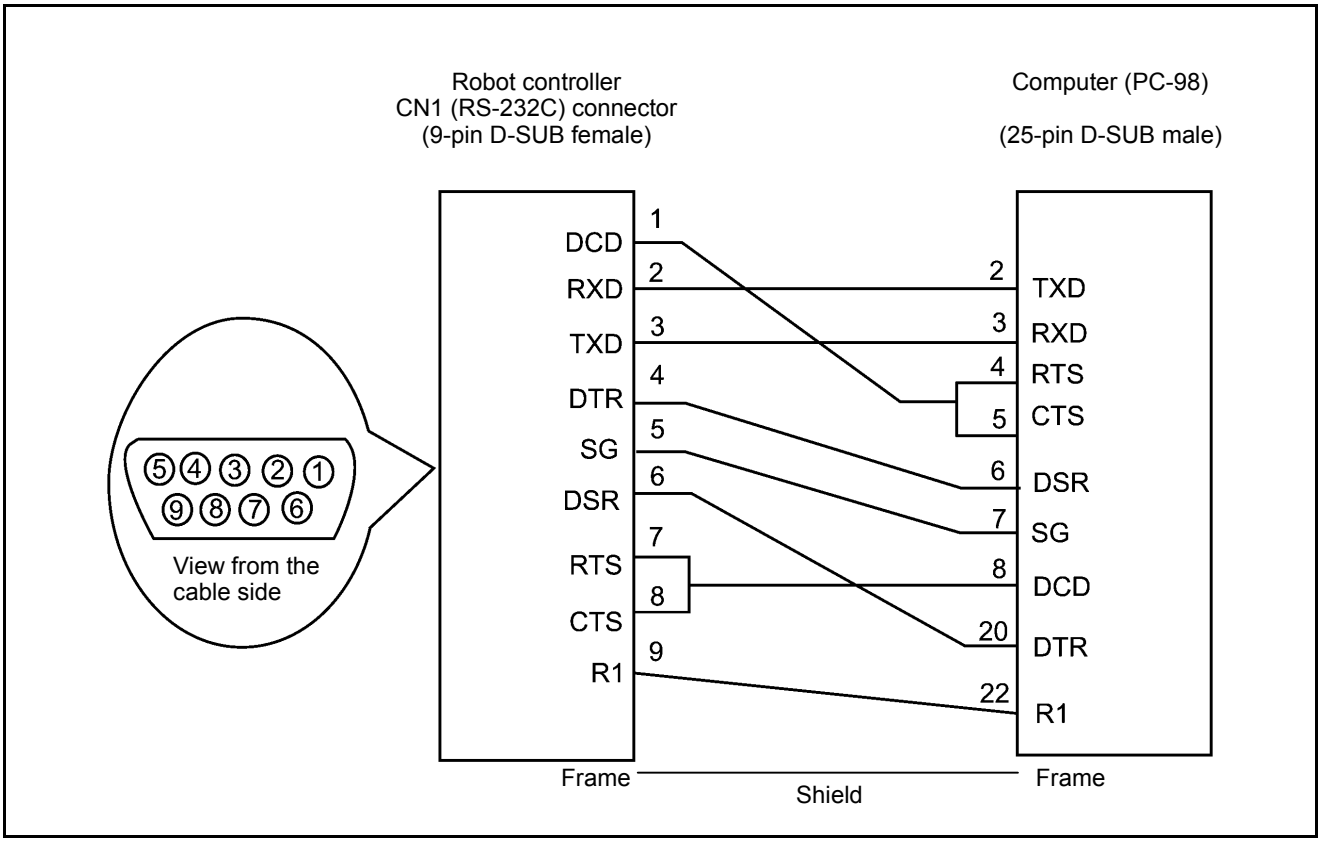
The version of Windows 95 can be checked with [Control Panel – System – Information]. If A, B or C is not displayed (no symbol) at the end of the version information (4.00, 95B), update your Windows 95 with the Windows 95 Service Pack 1 that is available from the Microsoft's web site.

3.3 Communications Cable

To enable the computer and the robot controller to communicate with each other, they must be connected with a communications cable. Use the appropriate RS-232C for cross cable wiring, as shown below.



RS-232C Communication Cable Wiring Diagram (IBM PC compatible)



RS-232C Communications Cable Wiring Diagram (PC-98)

PART 2 I/O Option Board for RC7J

Chapter4 I/O Option Board Overview

When using the RC7J controller, use an I/O option board if the I/O capacity of the Mini I/O (CN5) is insufficient, or if the robot needs to be controlled by the field network. The types of I/O option board and the maximum number of expandable user I/Os are as follows.

Types of I/O option board

I/O option board	Part number of I/O option board for purchase	
	Part number for I/O board only	Part number for shipping the board attached to the controller
DeviceNet slave board	410010-2440	410010-2230
DeviceNet master board	410010-2450	410010-2400
DeviceNet master and slave board	410010-2460	410010-2410
CC-Link remote device board	410010-2540	410010-2530
Parallel I/O board (NPN type)	410010-2580	410010-2570
Parallel I/O board (PNP type)	410010-2430	410010-2420

Maximum number of user I/Os of option boards

Allocation	Without I/O option board		DeviceNet						CC-Link remote device board (Note 5)		Parallel I/O board (Note 6)	
			Slave board (Note 2)		Master board (Note 3)		Master and slave board (Note 4)					
	Input	Output	Input	Output	Input	Output	Input	Output	Input	Output	Input	Output
Mini I/O dedicated	8	8	—	—	—	—	—	—	—	—	8+40	8+48
Compatible	—	—	16+232	15+224	—	—	16+232+1024	15+224+1024	16+88	15+80	16+19	15+16
Standard	—	—	16+216	15+224	—	—	16+216+1024	15+224+1024	16+72	15+80	16+6	15+16
Compatible (RC5-compliant) (Note 1)	—	—	16+232	15+224	—	—	16+232+1024	15+224+1024	16+88	15+80	16+19	15+16
Standard (RC5-compliant) (Note 1)	—	—	16+216	15+224	—	—	16+216+1024	15+224+1024	16+72	15+80	16+6	15+16
For all-purpose	—	—	—	—	16+1024	15+1024	16+256+1024	15+256+1024	—	—	—	—

Note 1: Includes hand I/Os.

Note 2: The total user I/O capacity of the Mini I/O and DeviceNet slave board.

Note 3: The total user I/O capacity of the Mini I/O and DeviceNet master board.

Note 4: The total user I/O capacity of the Mini I/O, DeviceNet slave board, and DeviceNet master board.

Note 5: The total user I/O capacity of the Mini I/O and CC-Link remote device board.

Note 6: The total I/O capacity of the Mini I/O and parallel I/O board.

4.1 I/O Port Map and Allocation

When an I/O option 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 option board is used, I/O port numbers beyond 511 are added.

I/O port number	Area contents	
0 : 15	Mini I/O input	Option board not used
16 : 31	Mini I/O output	
32 : 127	Unused	
128 : 511	Internal I/O	
512 : 767	DeviceNet slave board input or CC-Link remote device board input or ProfiBus slave board input	Option board used
768 : 1023	DeviceNet slave board output or CC-Link remote device board output or ProfiBus slave board output	
1024 : 2047	DeviceNet master board input	
2048 : 3071	DeviceNet master board output	
3072 : 3583	Unused	
3584 : 3623	Expanded parallel board input	
3624 : 3839	Unused	
3840 : 3887	Expanded parallel board output	

4.2 Mini I/O Functions

The function of terminals with a Mini I/O port number (terminal Nos. 11 – 26 and 45 – 60) changes when an I/O option board is used. The function of other terminals, however, (Automatic Operation Enabling and Emergency Stop Input, etc.) does not change.

There are three types of function allocation.
Choose one allocation for use.

4.2.1 User Signals for All Ports (Excluding CPU Normal)

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

Mini I/O Functions (1): User signals for all ports

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

4.2.2 User Signals for All Ports (RC5-compliant) (Except CPU Normal)

Terminal Nos. 11 – 18 are for user input, Nos 19 – 26 are for hand input, Nos. 46 – 53 are for hand output, and Nos. 54 – 60 are for user output. The port No. corresponding to the respective terminals also changes. Hand input and hand output have the same functions as user input and user output. I.e. Only the names are different.

Mini I/O Functions (2): User signals for all ports (RC5-compliant)

Terminal No.	Name	Port No.	Wire color	Terminal No.	Name	Port No.	Wire color
11	User input	21	Green	45	CPU Normal	16	White
12	User input	22	Blue	46	Hand output	64	White
13	User input	23	Violet	47	Hand output	65	White
14	User input	24	Gray	48	Hand output	66	White
15	User input	25	Pink	49	Hand output	67	White
16	User input	26	Black	50	Hand output	68	Gray
17	User input	27	Black	51	Hand output	69	Violet
18	User input	28	Brown	52	Hand output	70	Violet
19	Hand input	48	Red	53	Hand output	71	Violet
20	Hand input	49	Orange	54	User output	104	Violet
21	Hand input	50	Yellow	55	User output	105	Violet
22	Hand input	51	Green	56	User output	106	Violet
23	Hand input	52	Blue	57	User output	107	Violet
24	Hand input	53	Gray	58	User output	108	Violet
25	Hand input	54	Pink	59	User output	109	Violet
26	Hand input	55	Brown	60	User output	110	Gray

4.2.3 Mini I/O Dedicated

The allocation is the same as when an I/O option board is not used.

Refer to “4.1.2 Mini I/O CN5: User-/System-I/O Connector” and “5.1.2 Mini I/O CN5: User-/System-I/O Connector.”

4.3 System I/O Signal Allocation Types

Allocation types for system I/O signals are added when an I/O option board is used. One allocation needs to be chosen for use from the following allocation types.

System I/O signal allocation types

System allocation	General description	Remarks
Standard	Directs program activation, etc. with a combination of bits (I/O command). This allocation has the greatest number of functions.	Same as the standard mode on the RC5. Unable to allocate to CN5.
Compatible	Functions, such as program activation, are specified by each bit. Operations are directed by the bit being set.	Same as the compatible mode on the RC5. Unable to allocate to CN5.
Mini I/O dedicated (Note)	Operations are directed by a combination of bits. However, the functions are limited to some extent compared to the standard allocation.	This allocation type is for cases where an I/O option board is not used. Can only be allocated to CN5.
Note: Refer to “Chapter 3 System I/O Signals” for I/O system allocation details.		

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 option board to be used. Refer to the sections relating to the relevant I/O option board for selectable allocations. Refer also to the section for the respective I/O option boards for details regarding the port number of each I/O option board.

Setting of I/O allocation

Allocation	General description
Mini I/O dedicated	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.
Compatible	”Compatible” system allocation is allocated to the I/O option board area. Only the user signal (excluding CPU Normal) is allocated to all ports of the Mini I/O area.
Standard	”Standard” system allocation is allocated to the I/O option board area. Only the user signal (excluding CPU Normal) is allocated to all ports of the Mini I/O area.
Compatible (RC5-compliant)	”Compatible” of system allocation is allocated to the I/O option board area. Only the user signal (RC5-compliant and excluding CPU Normal) is allocated to all ports of the Mini I/O area.
Standard (RC5-compliant)	”Standard” system allocation is allocated to the I/O option board area. Only the user signal (RC5-compliant and excluding CPU Normal) is allocated to all ports of the Mini I/O area.
All-purpose	Only the user signal is allocated to the I/O option board area. Only the user signal (excluding CPU Normal) is allocated to all ports of the Mini I/O area.

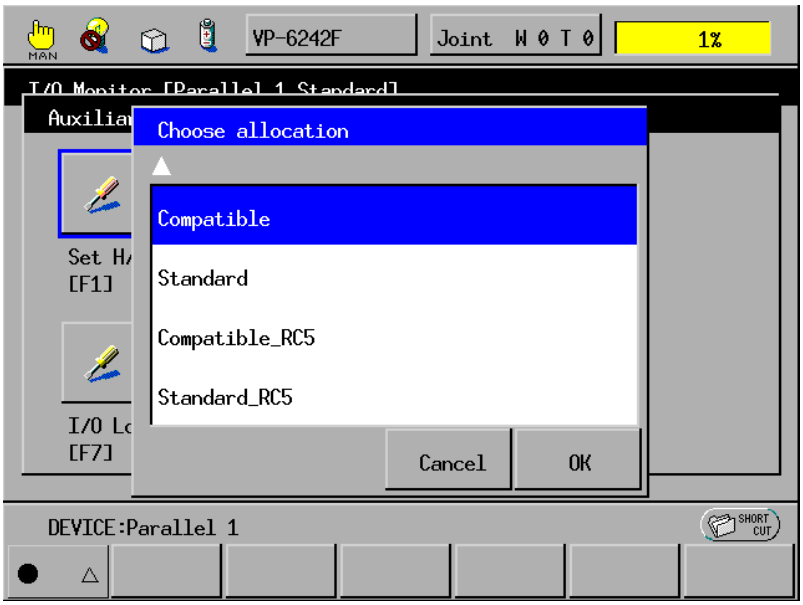
4.5 Method for Setting I/O Allocation

■ Method for setting from teaching pendant

Access: [F4 I/O] - [F6 Aux.] - [F2 AlocMode]

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

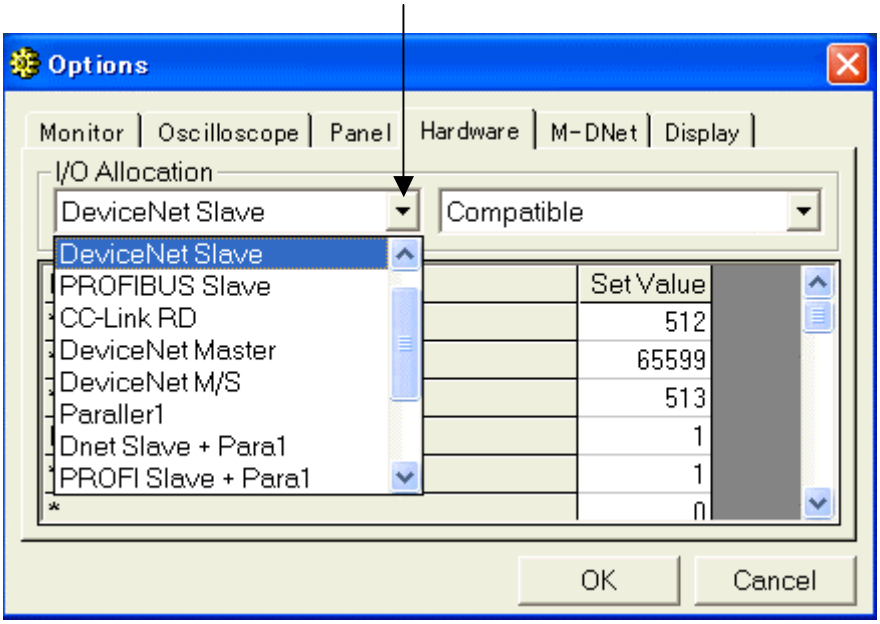
After completing the above operations, use the cursor keys or jog dial to select one of the allocations and then press OK. Restart the robot controller to make the new settings take effect.



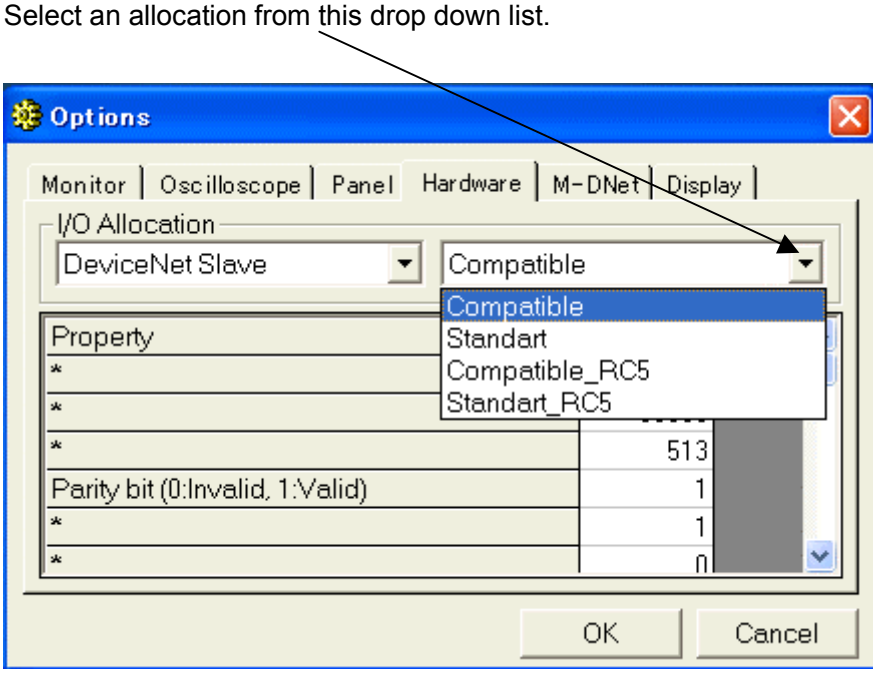
■ Method for setting from teaching pendant

(1) Select the SETTING command from the Tools menu of DIO manager and then click on the Hardware tab.

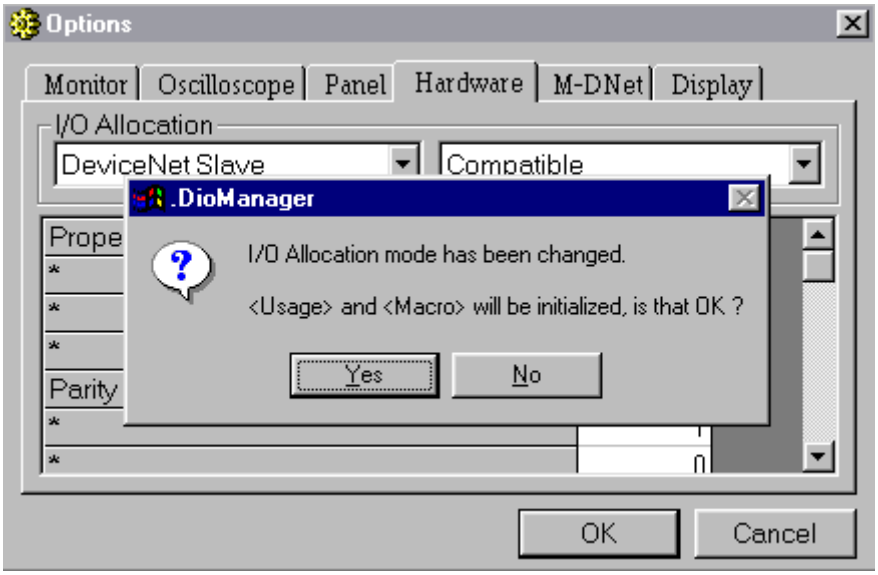
(2) In WINCAPS☐, first select the I/O option board and then select the allocation. Select an I/O option board from the drop down list.



Select an allocation from this drop down list.

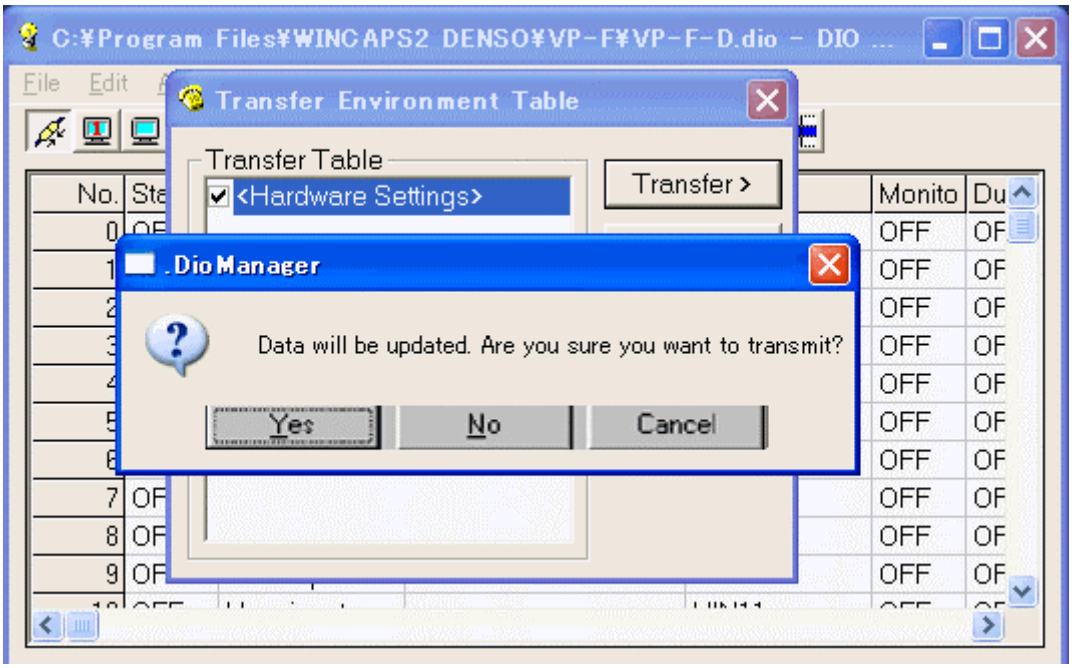


(3) The following message will appear when OK is pressed. Press Yes if there is no problem with <Usage> and <Macro> are initialized. Otherwise, press No. The allocation will change when either Yes or No is pressed.



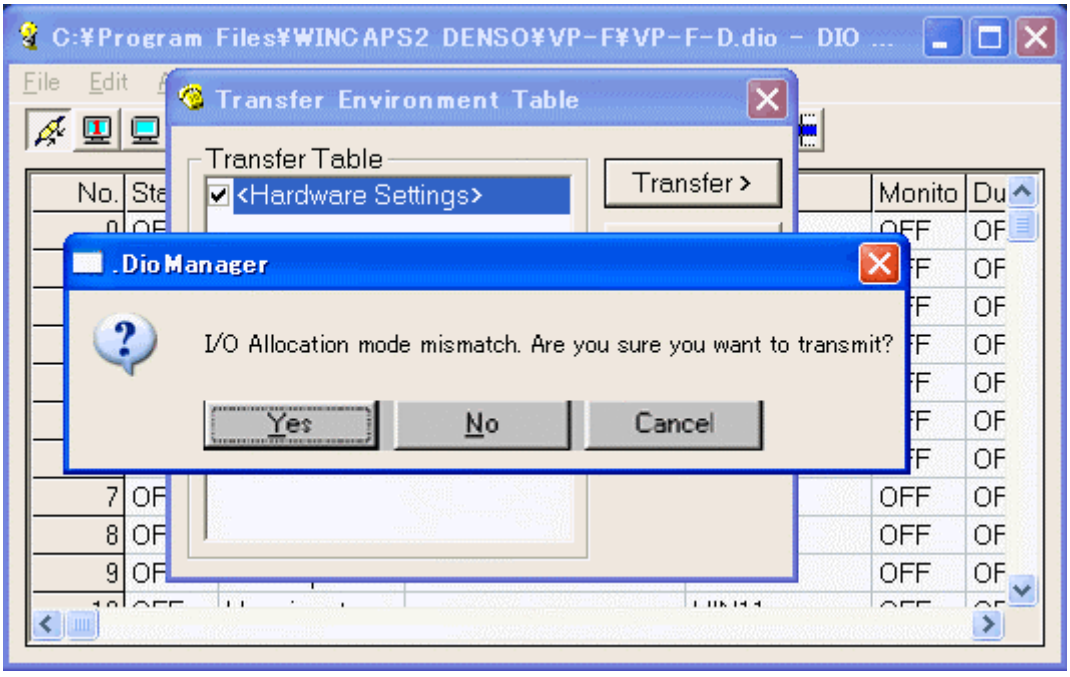
(4) After transferring the hardware setting to the controller, restart the controller to make the new setting take effect. Enable communication with the controller by pressing Connect in the Action menu of DIO manager. Press Transfer in the File menu. When the Transfer Environment Table appears, check Hardware Settings and press Transfer.

Press Yes when the following system message appears.



(5)When the following system message appears, press Yes.

Restart the robot controller to make the new settings take effect.



NOTE: Do not transfer the settings to the controller by selecting an I/O option board that is not mounted on the controller. “220F: I/O device changed” will be displayed after the settings have be transferred and the robot controller is restarted.

Chapter5
System I/O Signals in Standard Mode

5.1 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 “5.5 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 failure	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, Subsection 3.4.6 "SS (Safe Start) Function."
Emergency stop	Emergency stop	Outputs from a contact exclusively designed for an emergency stop circuitry.

5.2 Usage of System Output Signals (Standard Mode)

The usage of each system output signal in standard mode is described below:

5.2.1 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.

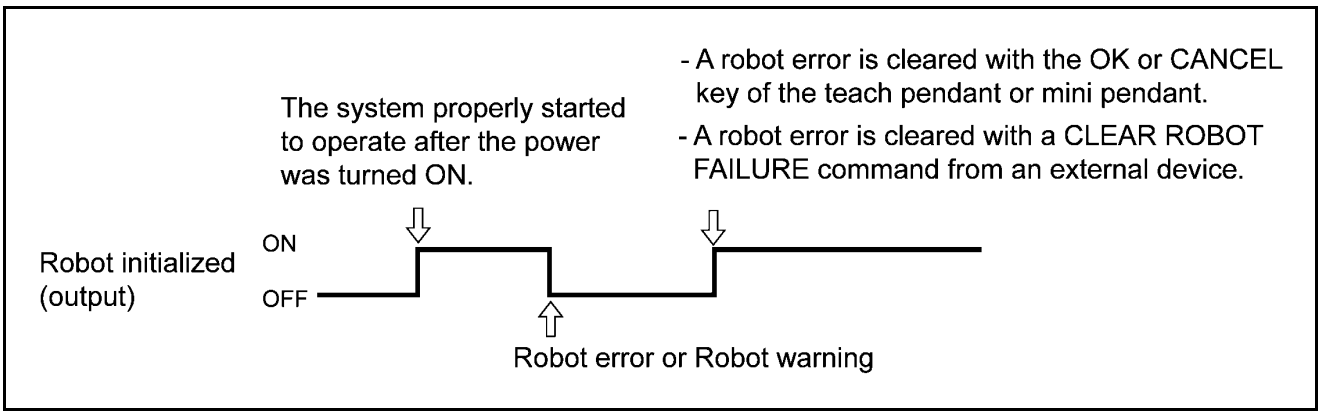
(3) ON conditions

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 failure is cleared by the CANCEL key of the teach pendant, mini-pendant or by a CLEAR ROBOT FAILURE command, after the power is turned OFF.

(4) OFF condition

The signal will be turned OFF when a robot failure or robot warning signal is turned ON.



Robot Initialization Complete Output

5.2.2 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.

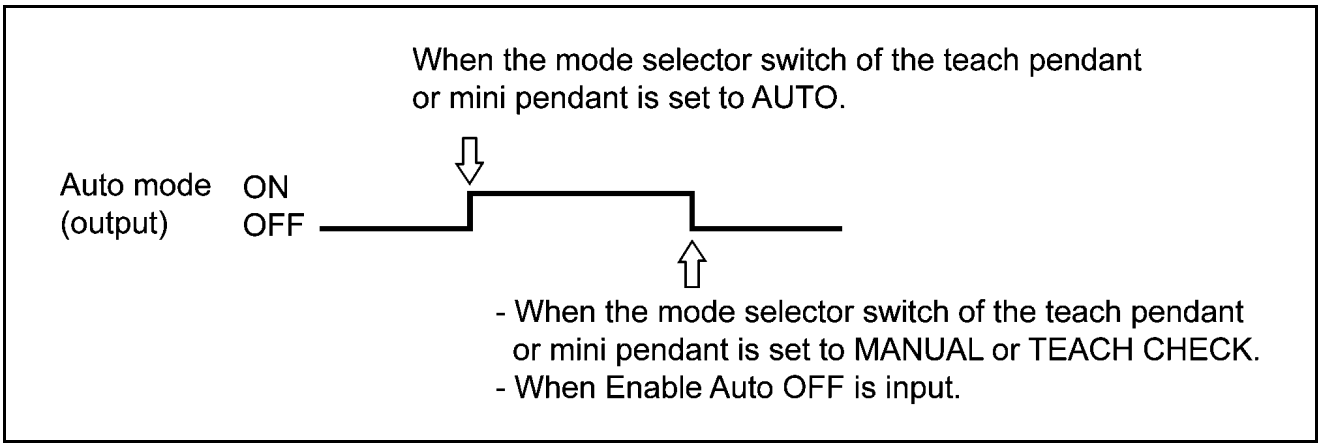
(4) OFF conditions

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, Subsection 1.3.4.)

Caution: The signal will not be turned OFF with INSTANTANEOUS STOP, STEP STOP or CYCLE STOP commands.



Auto mode Output

5.2.3 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

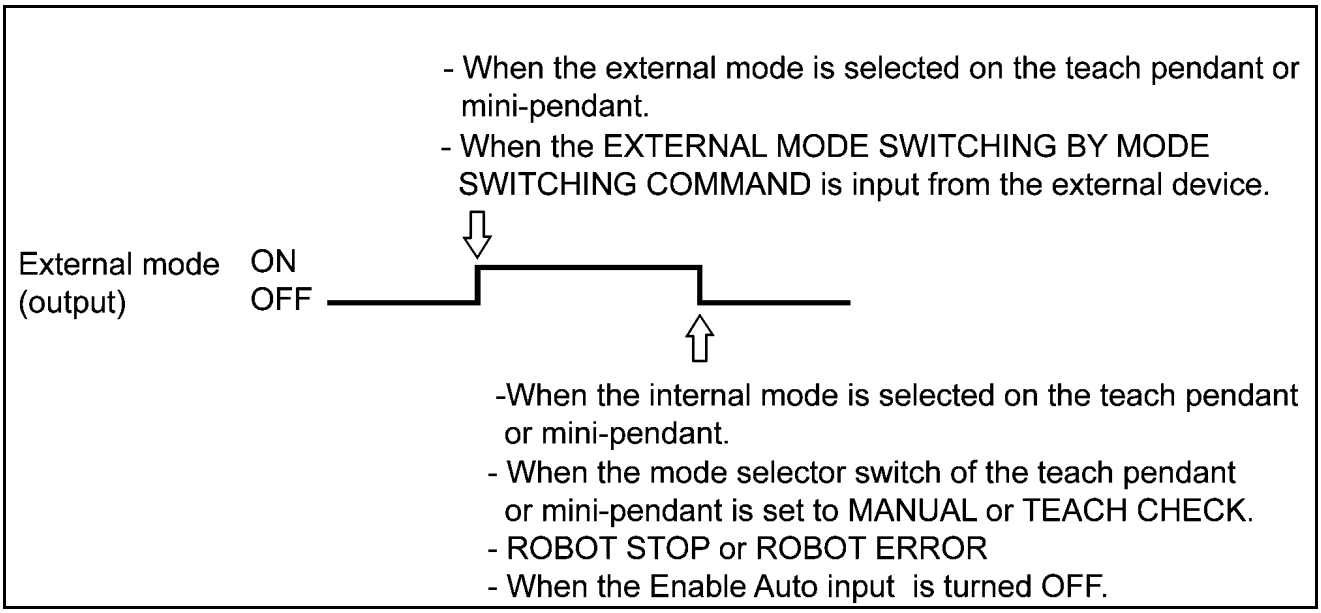
① The signal will be turned ON under the following conditions.
The external mode is selected on the teach pendant.
② The EXTERNAL MODE SWITCHING BY MODE SWITCHING COMMAND is input from the external device.

(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 FAILURE 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

5.2.4 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.

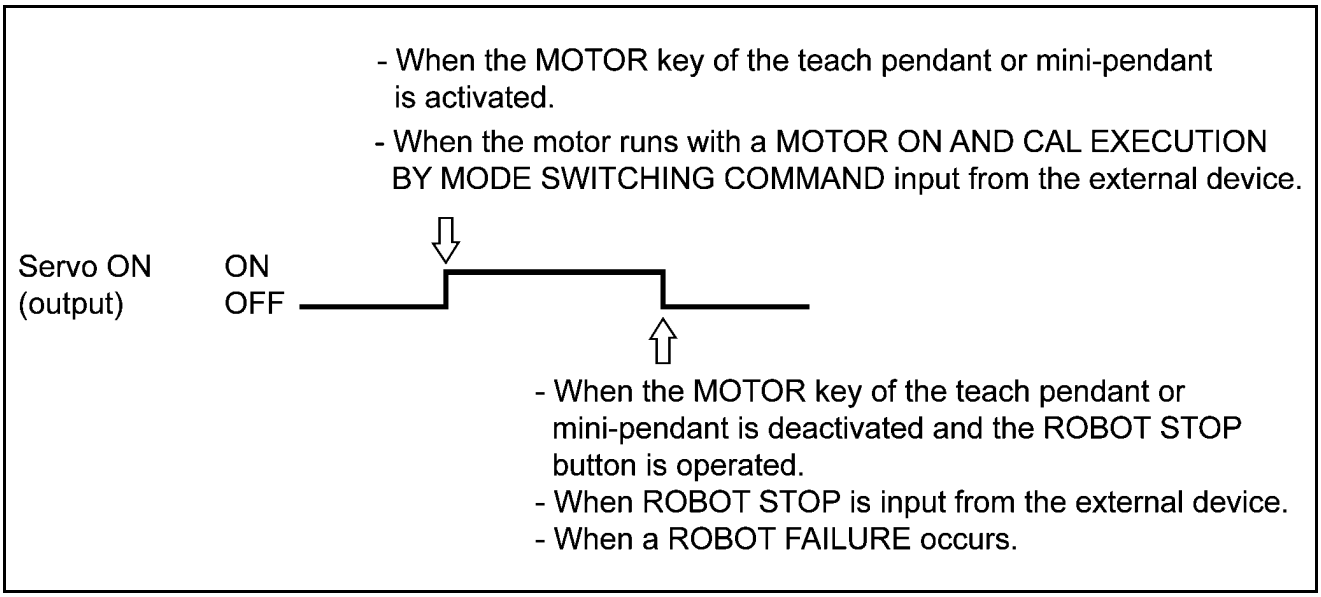
(4) OFF conditions

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 FAILURE is outputted. If errors 0 × 6071 to 607B, 0 × 6671 to 667B, 0 × 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

5.2.5 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.

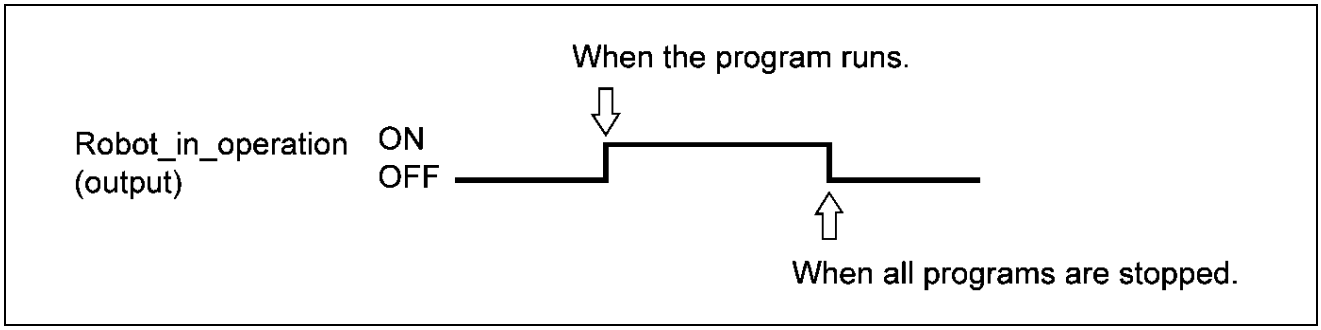
(3) ON conditions

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

5.2.6 Robot Failure (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 FAILURE signal.

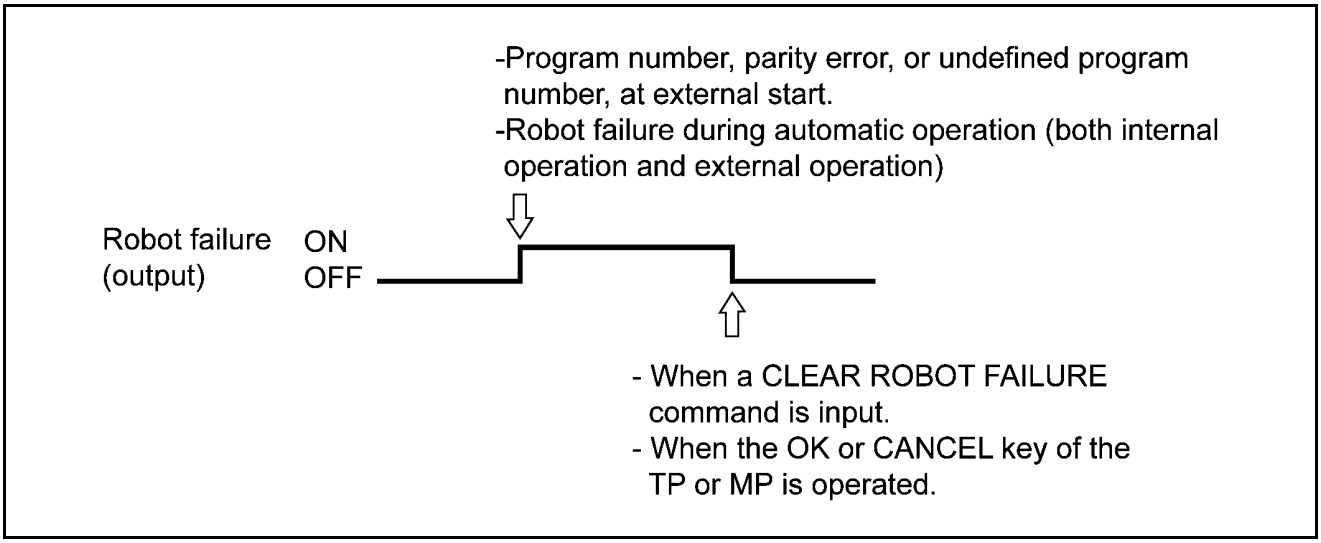
(3) ON conditions

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 a CLEAR ROBOT FAILURE command 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 Failure Output

5.2.7 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.

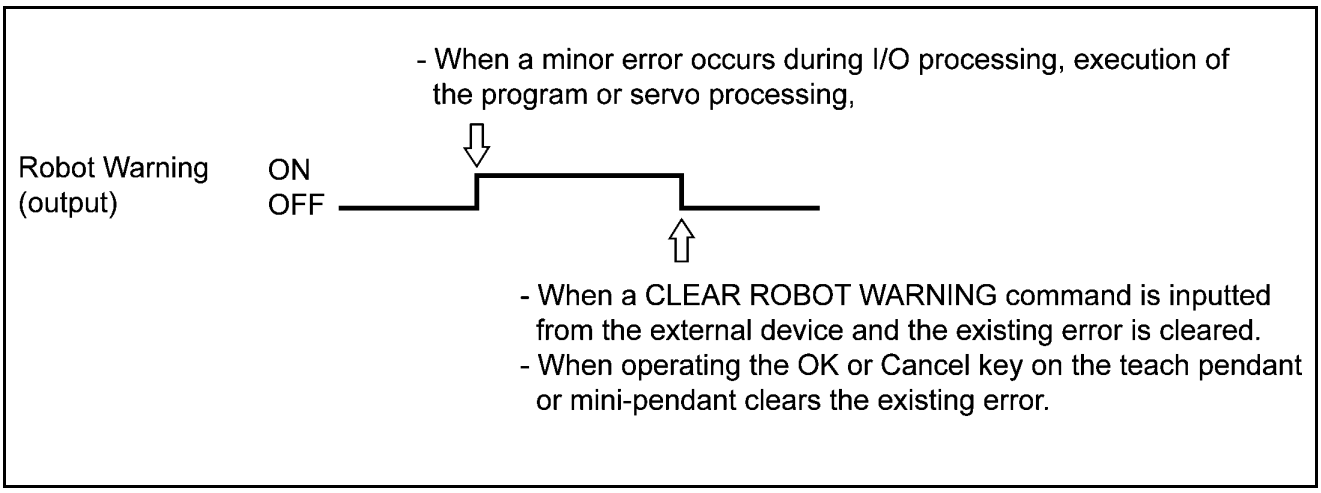
(3) ON condition

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

5.2.8 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.

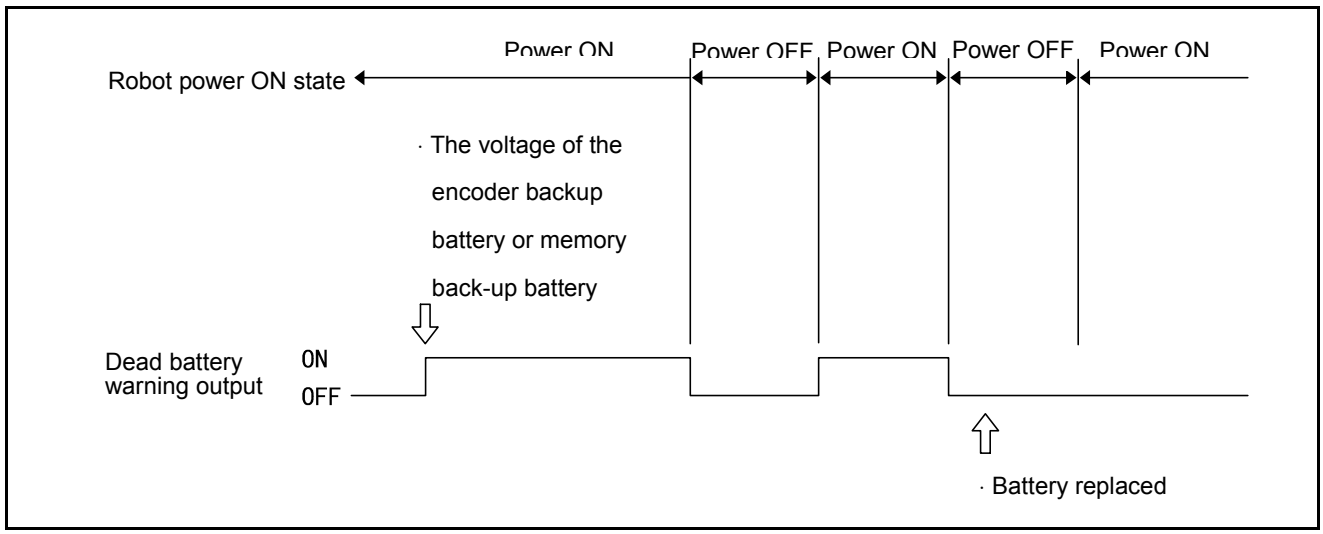
(3) ON condition

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

5.2.9 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."

5.2.10 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.

5.3 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 “5.5 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

5.4 Usage of System Input Signals (Standard Mode)

The usage of each system input signal in standard mode is described below.

5.4.1 Step Stop (All Tasks) (Input)

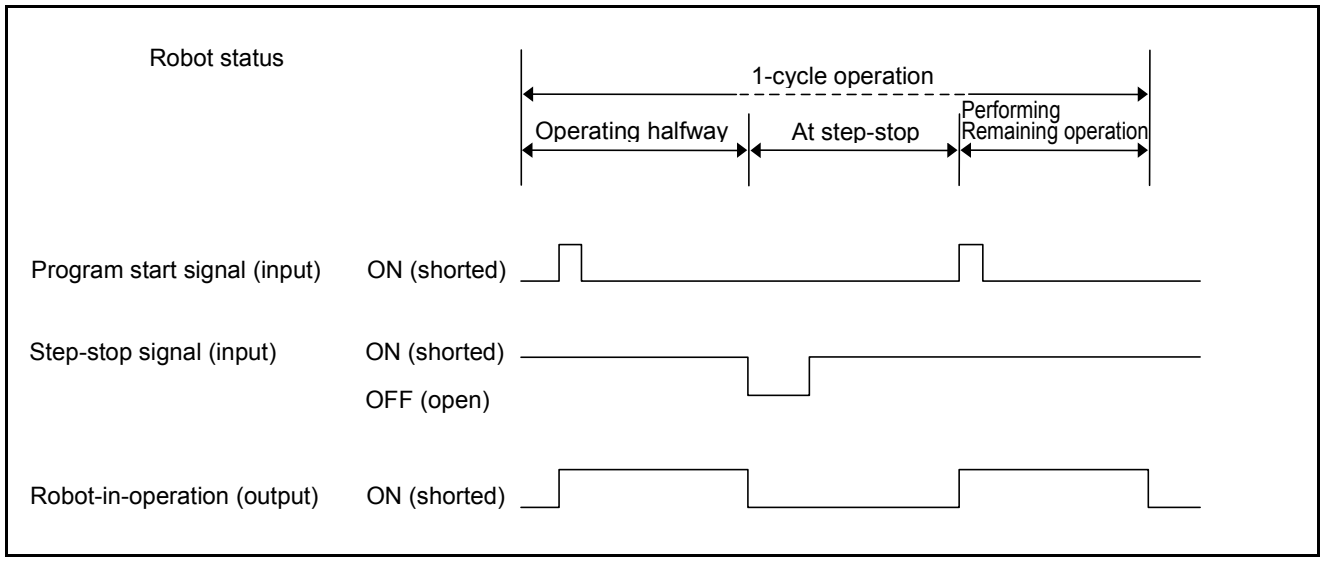
(1) Function

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 Subsection 5.5.3.2 "Program Operation Command (0001)".



Step Stop Signal

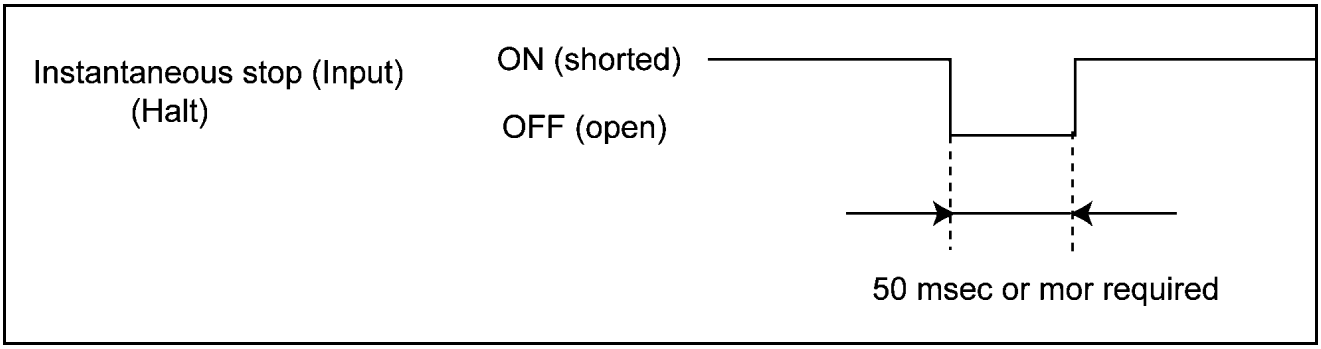
5.4.2 Instantaneous Stop (All Tasks) (Input)

(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 Subsection 5.5.3.2 "Program Operation Command (0001)".
③ The minimum required pulse width is 50 milliseconds (msec.) or more.



Minimum Instantaneous Stop Pulse Width

5.4.3 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.

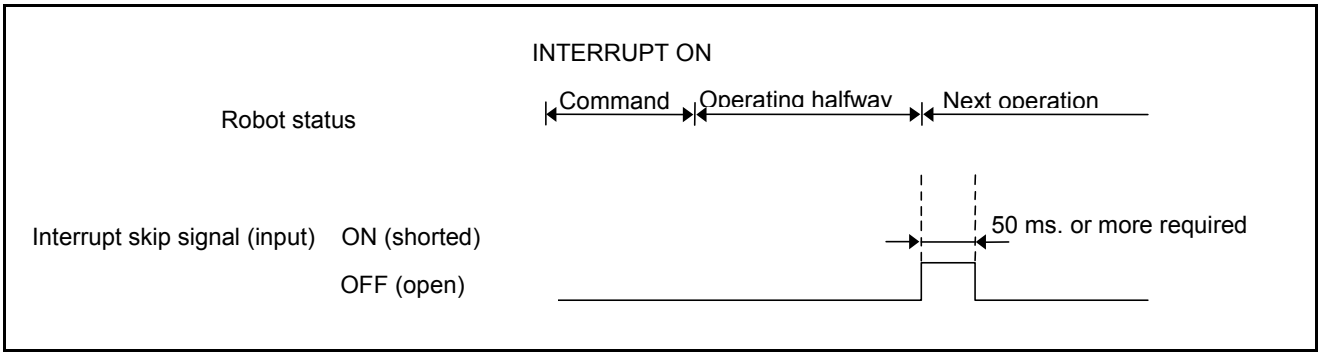
Caution: For further information about the INTERRUPT ON and OFF commands, see the PROGRAMMER'S MANUAL (I), Chapter 12, "12.3 INTERRUPT ON/OFF (Statement)."
For further information about the robot operation command, see the PROGRAMMER'S MANUAL (I), Chapter 12, "Robot Control Statements."

(2) Usage

See the PROGRAMMER'S MANUAL (I), Chapter 12, "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

5.5 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.

5.5.1 General Information about Commands

The table below shows the I/O commands functions.

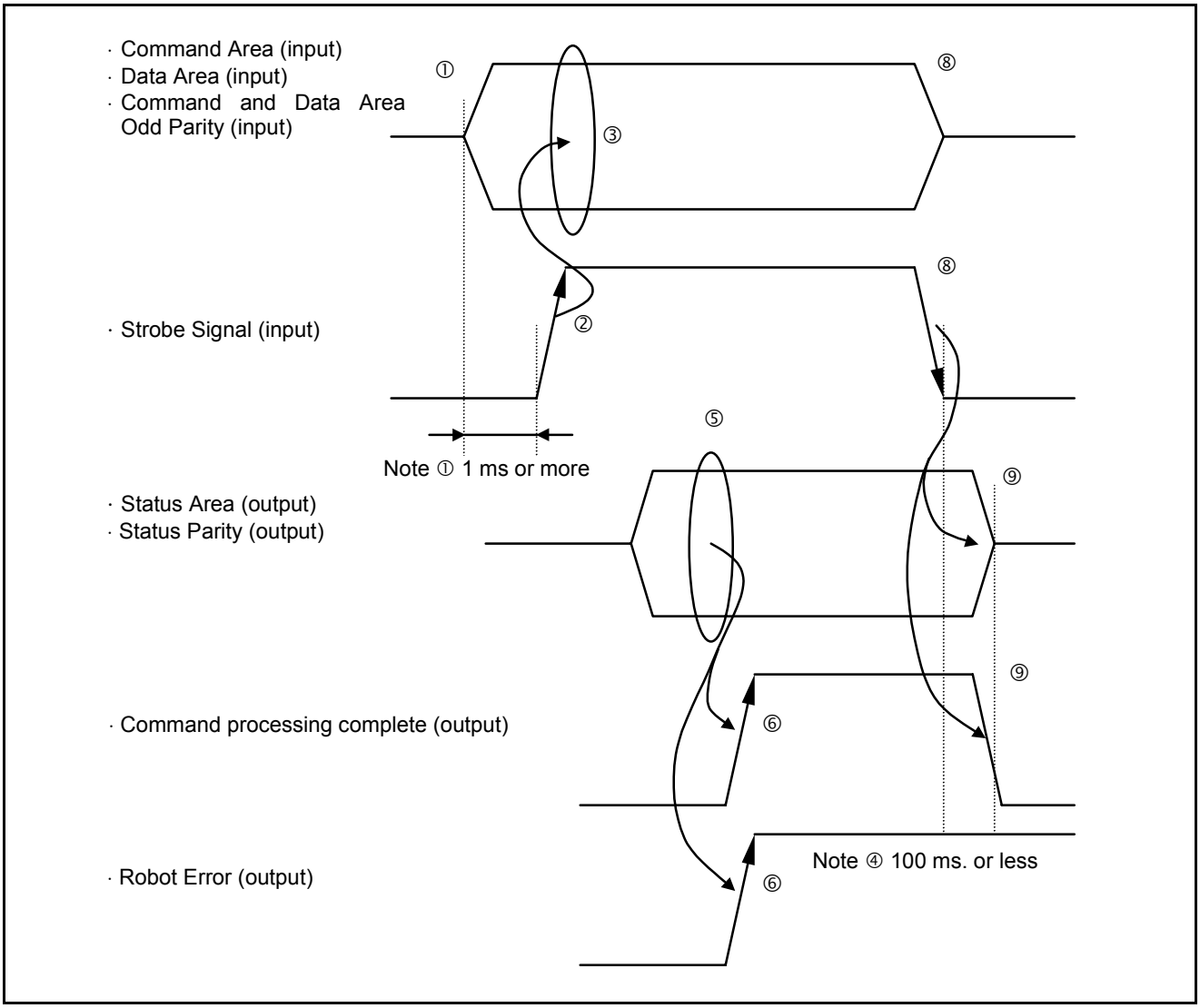
I/O Command Functions

Command	Description of function
Program operation	· 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).
Speed setting	· Sets the external speed. · Sets the external acceleration. · Sets the external deceleration.
Error number read	· Outputs the error number to the system I/O area.
Type I variable write	· Reads a value from the system I/O area and substitutes it for a Type I variable.
Type I variable read	· Outputs a Type I variable to the system I/O area.
Mode switching	· Switches the robot operation mode.
Clear robot failure	· Clears a robot failure from the external device.
Internal I/O write	· Sets the state of internal inputs and outputs.
Internal I/O read	· Outputs the state of internal inputs and outputs to the system I/O area.

5.5.2 Processing I/O Commands

5.5.2.1 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 failure 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 failure signal, which is outputted due to a command processing error, remains ON until a CLEAR ROBOT FAILURE command 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.

5.5.2.2 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 failure 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.

5.5.3 I/O Commands Details

5.5.3.1 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 Program operation	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 External speed and acceleration setting	00000001 Speed setting 00000010 Acceleration setting 00000100 Deceleration setting	Set speed value Set acceleration value Set deceleration value	— — —
0100 Error read	—	—	Error number
0101 Type I variable write	Type I variable number	Set variable value (lower 16 bits)	—
0110 Type I variable read	Type I variable number	—	Variable value (lower 16 bits)
0111 Mode switching	00000001 Motor ON, CAL execution 00000010 External speed 100 10000000 External mode switching 10000011 Execution of all above (Motor ON→CAL→SP100→External)	—	—
1000 Clear robot failure	—	—	—
1001 I/O write	Set I/O value	First internal I/O port address	—
1010 I/O read	—	First internal I/O port address	I/O

(Note) In execution of Continue Start command, program numbers will be ignored.

5.5.3.2 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 in 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 PR032767 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 top

This command immediately stops the program of the program number specified in data area 2. PRO0 to PR032767 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.

5.5.3.3 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 speed^2/100 (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.

5.5.3.4 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

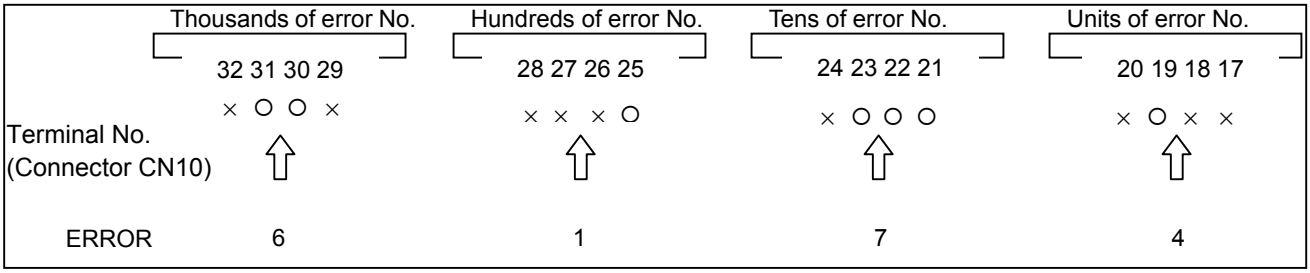
Command area (4 bits, input)
0100
Data area 1 (8 bits, input)
Nothing will be input.
Data area 2 (16 bits, input)
Nothing will be input.
Status area (16 bits, output)
The existing error code will be output.

(3) Hexadecimal codes

Refer to the figure given below.

××××	→ 0	×O×O	→ 5	O×O×	→ A		
×××O	→ 1	×OO×	→ 6	O×OO	→ B		
××O×	→ 2	×OOO	→ 7	OO××	→ C		
××OO	→ 3	O×××	→ 8	OO×O	→ D		
×O××	→ 4	O××O	→ 8	OOO×	→ E	O···ON	
				OOOO	→ F	×····OFF	

The following figure shows an example of error number output when ERROR6174 (overload error with the fourth axis) occurs.



Example of Error Number Output

(4) Description

If a command is executed when a robot failure or the robot warning signal is output, the error number, which caused the robot failure 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 failure or robot warning signal, 0 will be outputted.

5.5.3.5 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.

5.5.3.6 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.

5.5.3.7 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.

5.5.3.8 Clear Robot Failure (1000)

(1) Function

This command clears a robot failure 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 failure 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.

5.5.3.9 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.

5.5.3.10 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

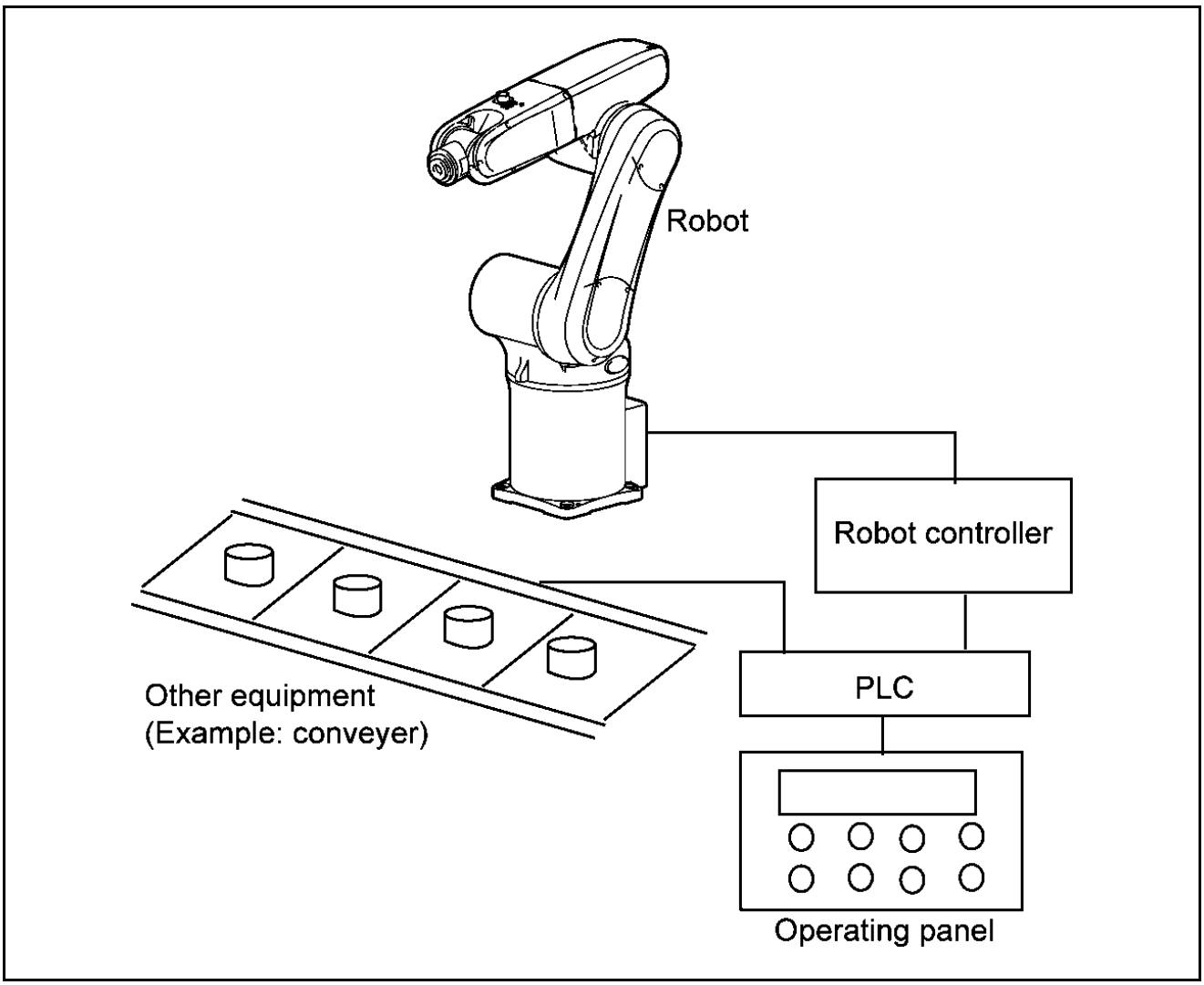
This command outputs to the lower 8 bits of the status area the status of the 8-bit internal I/O area starting from the number specified in data area 2. Zero will be output to the upper 8 bits.

5.6 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.
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 ③.

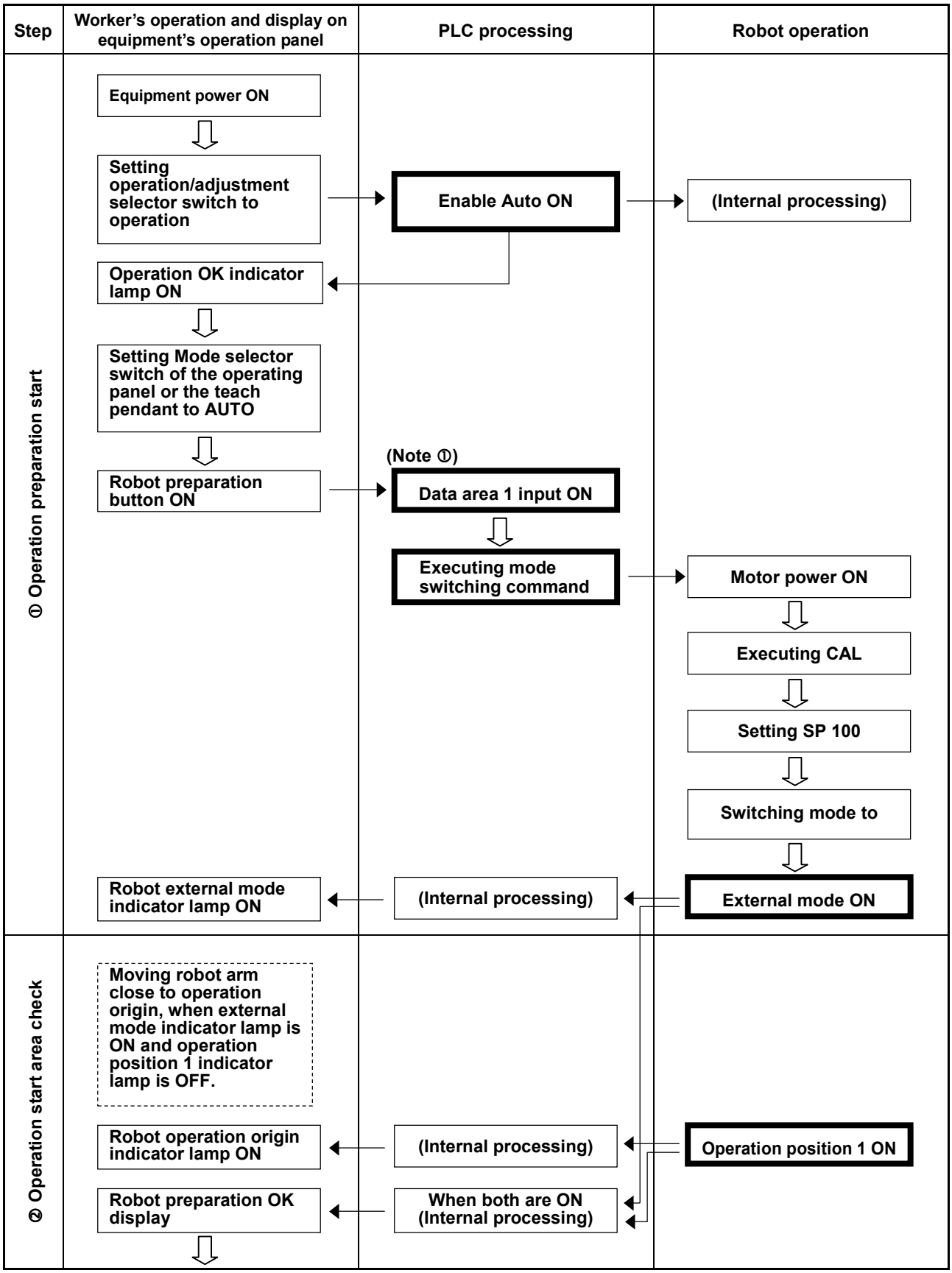
① Operation preparation start
After setting the MOTOR ON, CAL EXECUTION, EXTERNAL SPEED 100 and EXTERNAL MODE SWITCHING bits, execute the mode switching command to bring the robot into external automatic operation mode. This operation will be completed when the EXTERNAL MODE output signal is turned ON.

② Automatic operation
Start the program by which the robot starts from the operation origin, performs operations, and returns to the operation origin.

③ 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

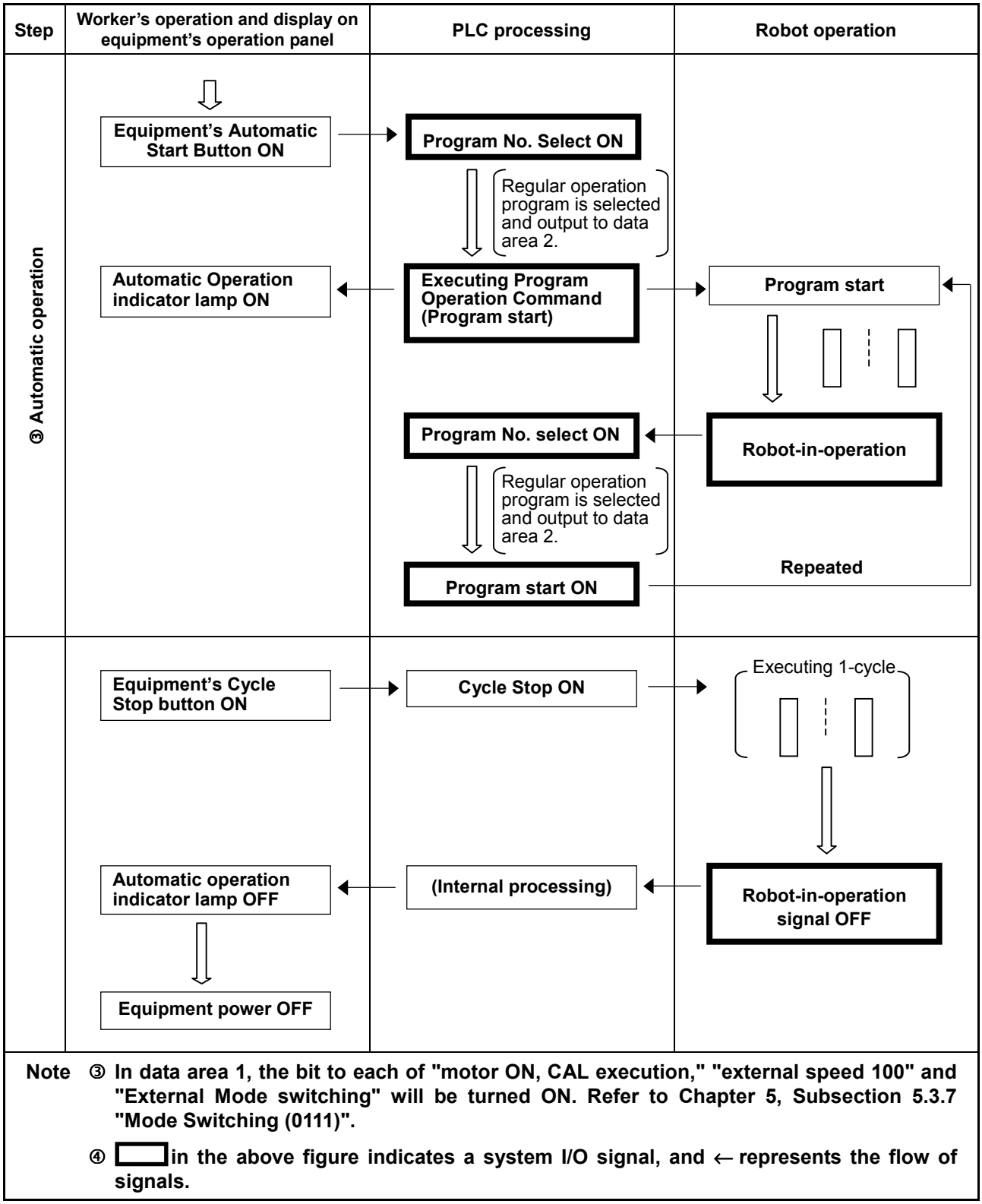
The following pages show the relationship between the system I/O signals for start and stop, worker's operation, display on the equipment operation panel, PLC proceeding, and robot motion.



Start and Stop Procedure and System I/O Signals-1

(Continued on following page)

(Continued from preceding page)



Note ③ **In data area 1, the bit to each of "motor ON, CAL execution," "external speed 100" and "External Mode switching" will be turned ON. Refer to Chapter 5, Subsection 5.3.7 "Mode Switching (0111)".**

④ **in the above figure indicates a system I/O signal, and ← represents the flow of signals.**

Start and Stop Procedure and System I/O Signals-2

Chapter6
System I/O Signals in Compatible Mode

6.1 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 failure	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, Subsection 3.4.6 "SS (Safe Start) Function."

6.2 Usage of System Output Signals in the Compatible Mode

The usage of each system output signal in the compatible mode is described below.

6.2.1 Robot Power ON Complete

(1) Function

The signal outputs to the external device that OPERATION PREPARATION START is possible.

(2) Usage

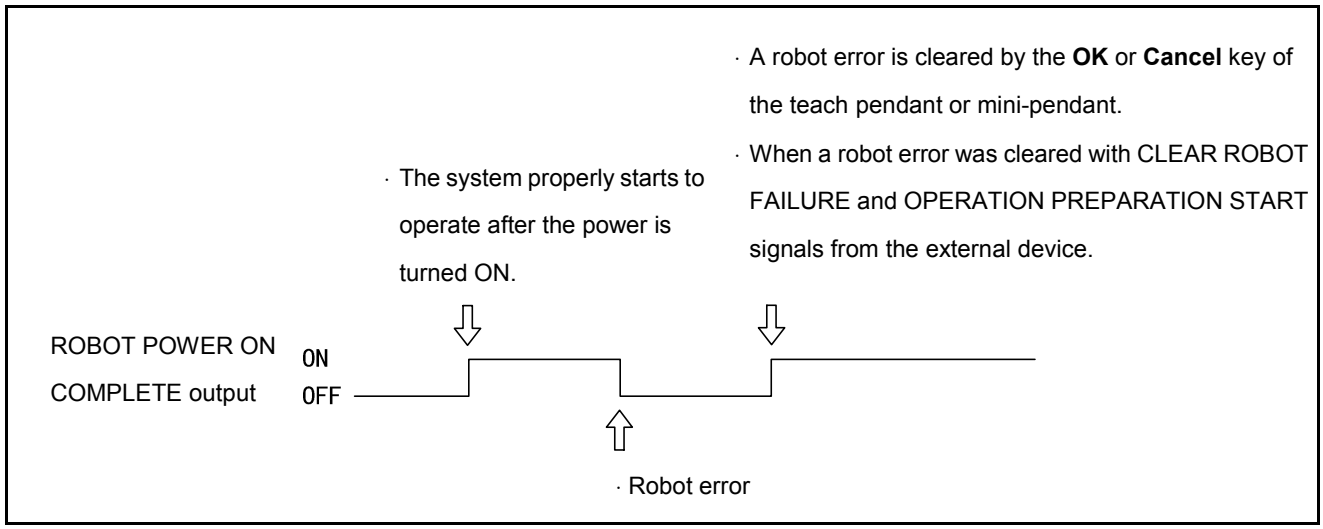
OPERATION PREPARATION START will be executed after this signal and the auto mode signal are turned ON after the power was turned ON.

(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 failure is cleared by the **OK** or **Cancel** key of the teach pendant or mini-pendant by CLEAR ROBOT FAILURE and OPERATION PREPARATION START signals, after the power was turned OFF.

(4) OFF conditions

The signal will be turned OFF when a robot failure or robot warning signal is turned ON.



Robot Power ON Complete Output

6.2.2 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.

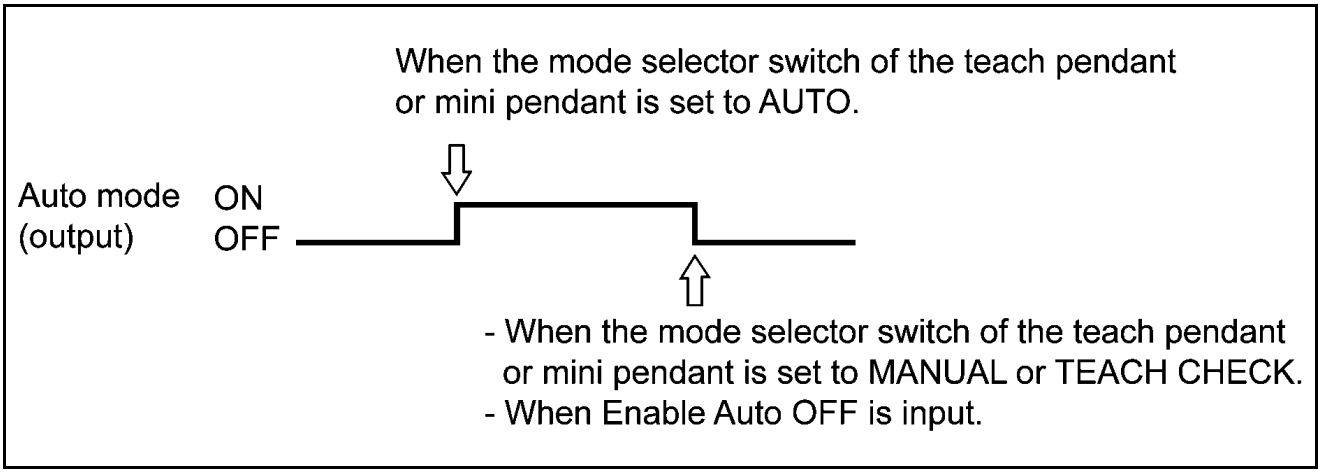
(4) OFF conditions

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, Subsection 1.3.3.)

Caution: The signal will not be turned OFF with INSTANTANEOUS STOP, STEP STOP or CYCLE STOP.



Auto Mode Output

6.2.3 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.

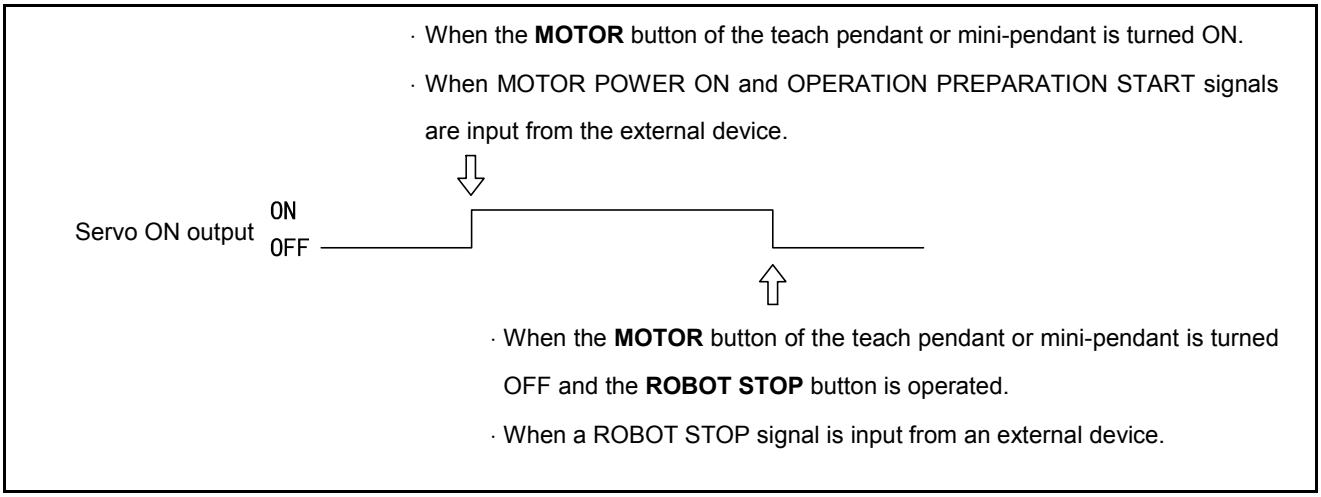
(4) OFF conditions

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 FAILURE 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

6.2.4 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.

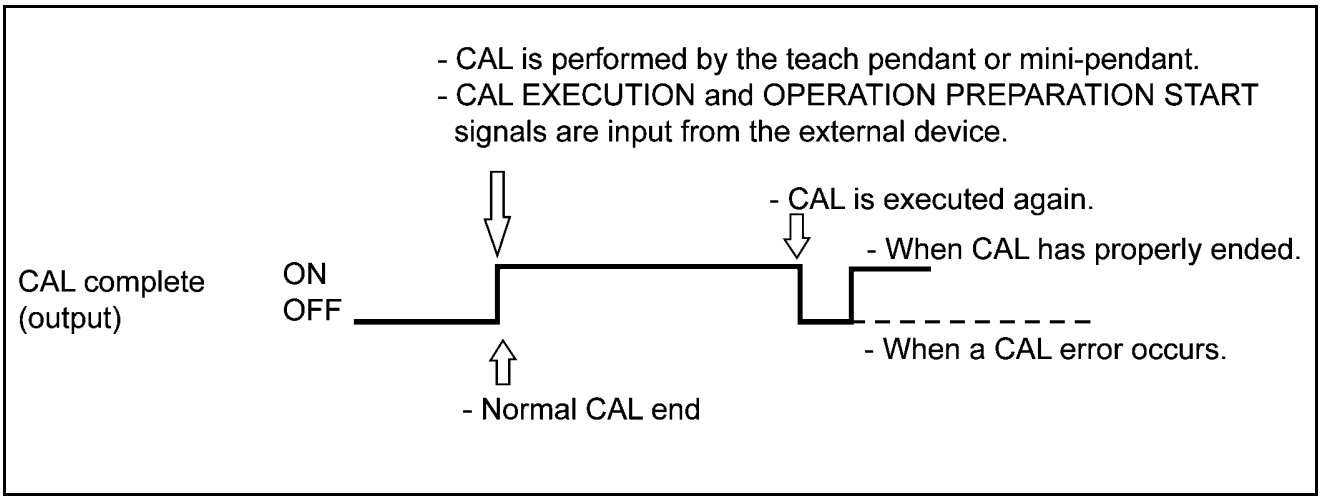
(3) ON conditions

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

6.2.5 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.

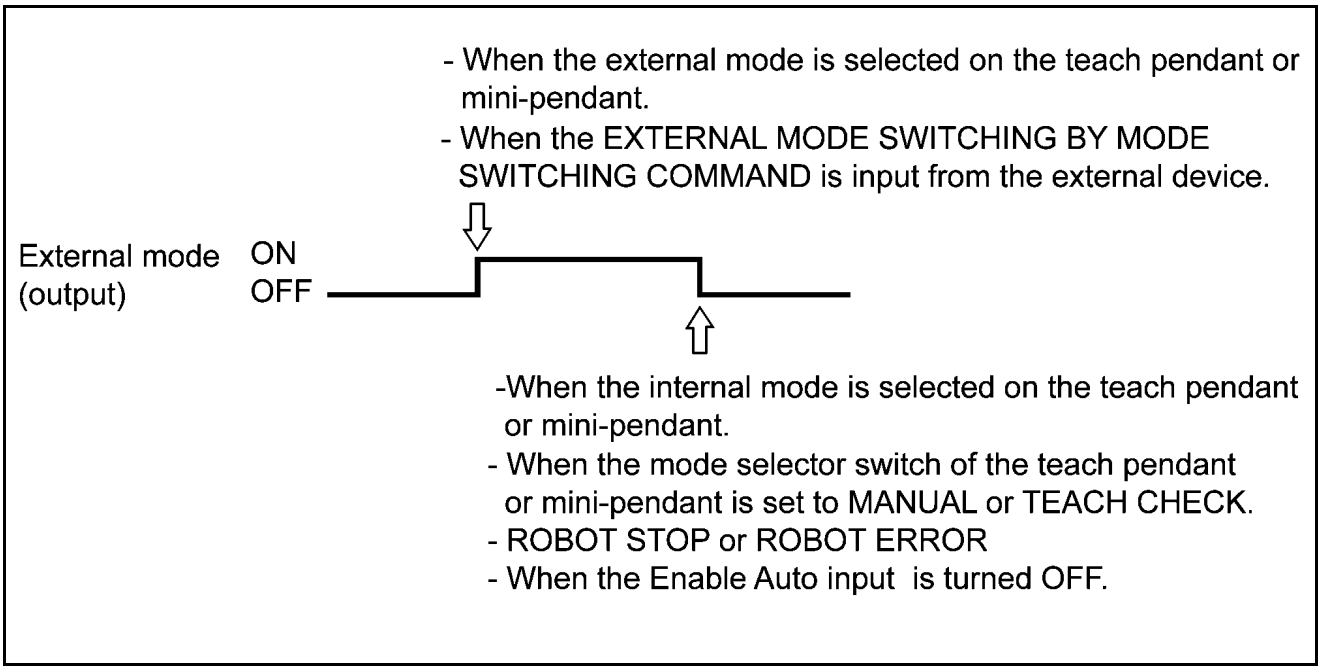
② When EXTERNAL/INTERNAL is input on the teach pendant, mini-pendant and external mode is selected.

③ When ROBOT STOP is input.

④ When ROBOT FAILURE 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

6.2.6 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

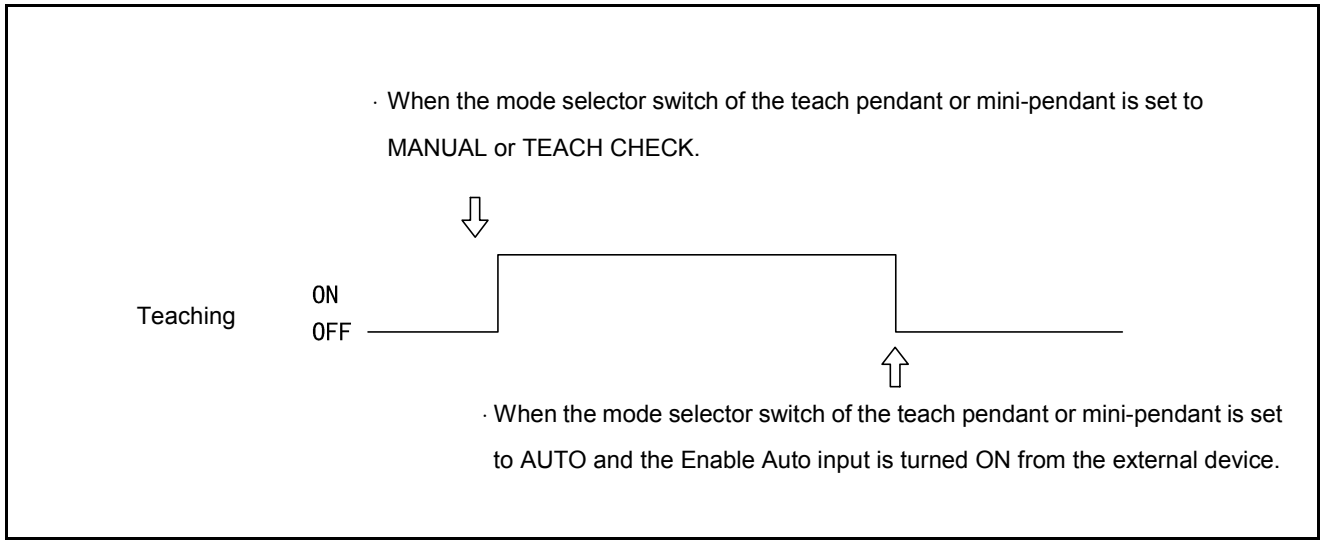
This signal is used to inform an external operating panel that the robot is teaching when they are installed separately from each other.

(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

6.2.7 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

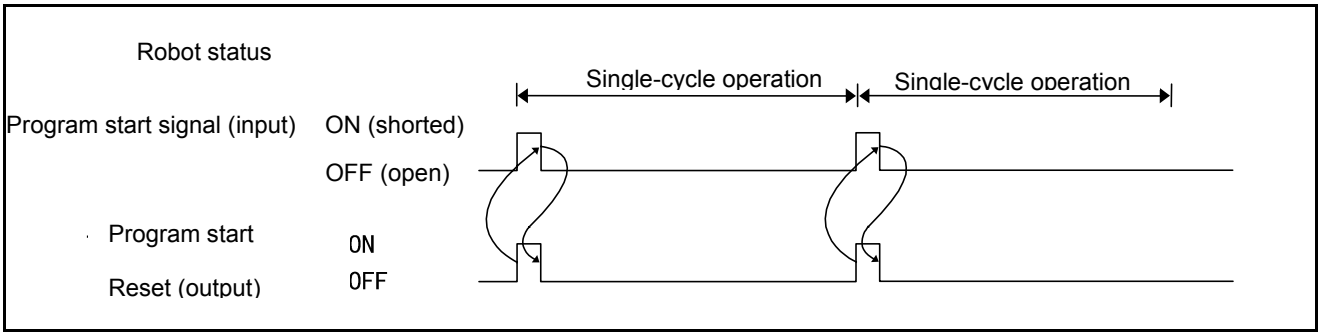
① The signal is used to prompt the external device to receive information that the robot program has started to run, and to process subsequent sequence programs.
② The signal is used as a condition to turn OFF the PROGRAM START signal sent from the external device to the robot.

(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

6.2.8 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.

6.2.9 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

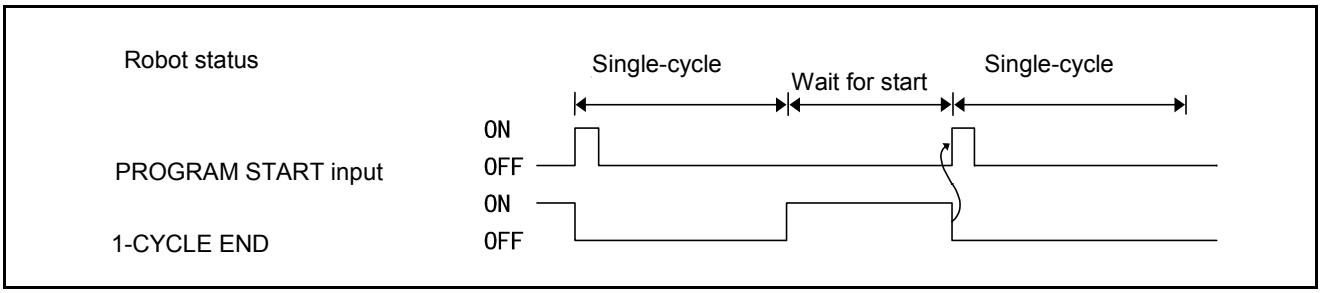
The signal is used to operate another equipment in synchronization with a single-cycle end of the program.

(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

6.2.10 Robot Failure (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 failure indicator lamp of an external operating panel.
② The signal is used to help the PLC clear an error in response to a ROBOT FAILURE signal.

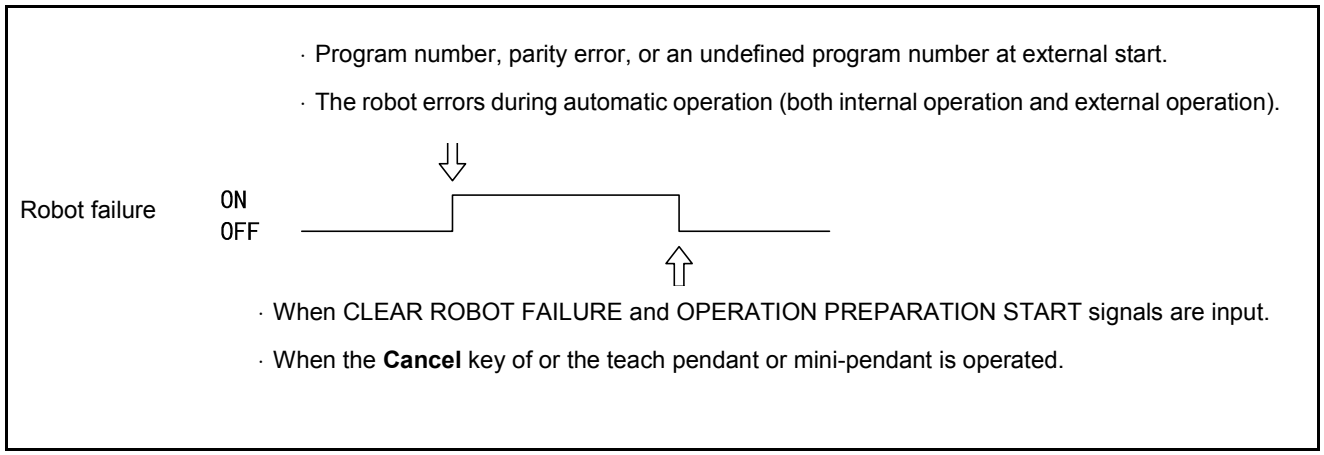
(3) ON conditions

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 a CLEAR ROBOT FAILURE command 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 Failure Output

6.2.11 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

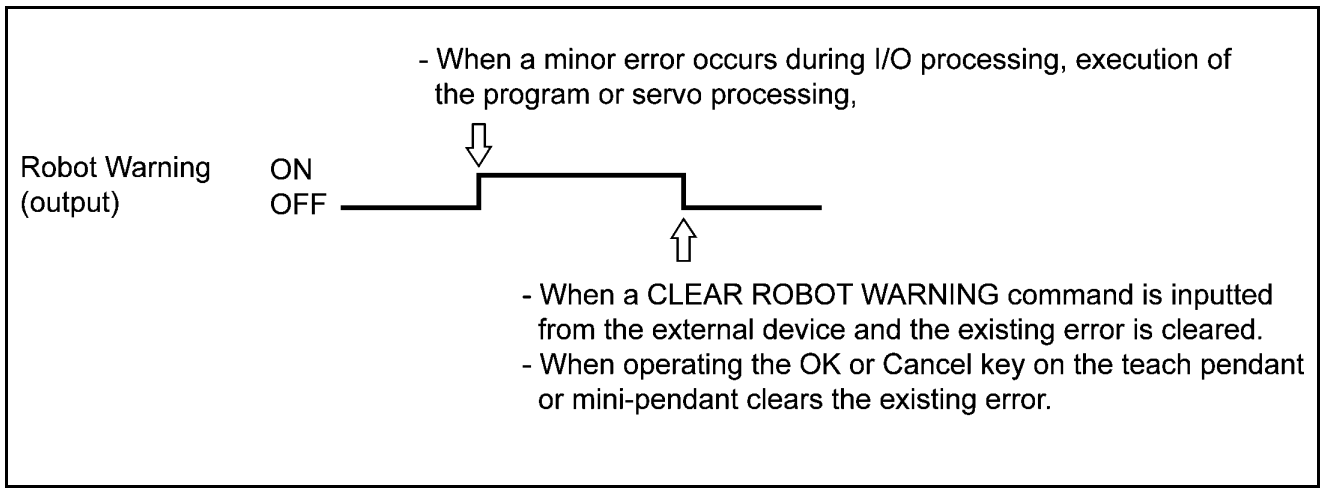
① The signal is used to light the robot warning indicator lamp of an external operating panel.
② The signal is used to help the PLC clear an error in response to a ROBOT WARNING signal.

(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 FAILURE 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

6.2.12 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).

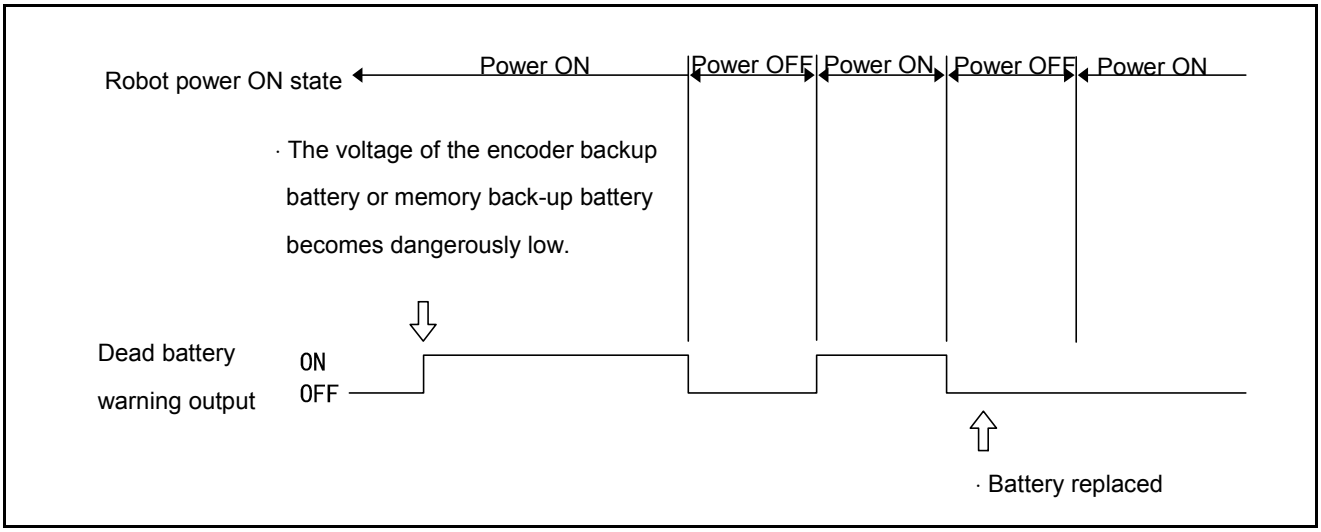
(3) ON conditions

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

6.2.13 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 FAILURE 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).

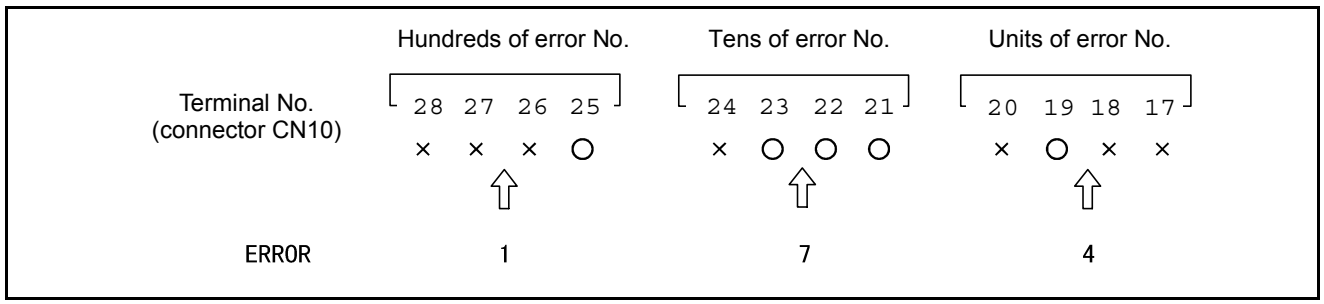
(5) Hexadecimal codes

See the following figure.

××××	→ 0	×O×O	→ 5	O×O×	→ A		
×××O	→ 1	×OO×	→ 6	O×OO	→ B		
××O×	→ 2	×OOO	→ 7	OO××	→ C		
××OO	→ 3	O×××	→ 8	OO×O	→ D		
×O××	→ 4	O××O	→ 9	OOO×	→ E	O···ON	
				OOOO	→ F	×····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

6.2.14 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."

6.2.15 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.

6.3 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	Motor power ON + operation preparation start	Turns ON the power to the motor.
	CAL execution + operation preparation start	Executes calibration.
	SP100 + operation preparation start	Sets the speed to 100%.
	Switch Ext Mode + operation preparation start	Switches the mode to external mode.
	Program reset + operation preparation start	Initializes all programs on halt. Starting a program after initialization will execute the program from the beginning.
	Program No. select + program start	Executes a specified program.
Program execution	Program reset + program No. select + program start	Cancels the current program and starts executing a specified program from the beginning.
Stop	Step stop	Step-stops all programs by opening signals.
	Instantaneous stop	Instantaneously stops all programs by opening signals.
Error clear	Clear robot failure + operation preparation start	Clears an error.
Program interrupt	Interrupt skip	Interrupts the execution of the current step and starts the next step.
Continue start	Continue start + program start	Executes continue start.

Caution: Two or more signal names listed in the signal name field indicate that they should be used in combination.

6.4 Usage of System Input Signals in Compatible Mode

The usage of each system input signal in compatible mode is described below:

6.4.1 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 FAILURE, 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.

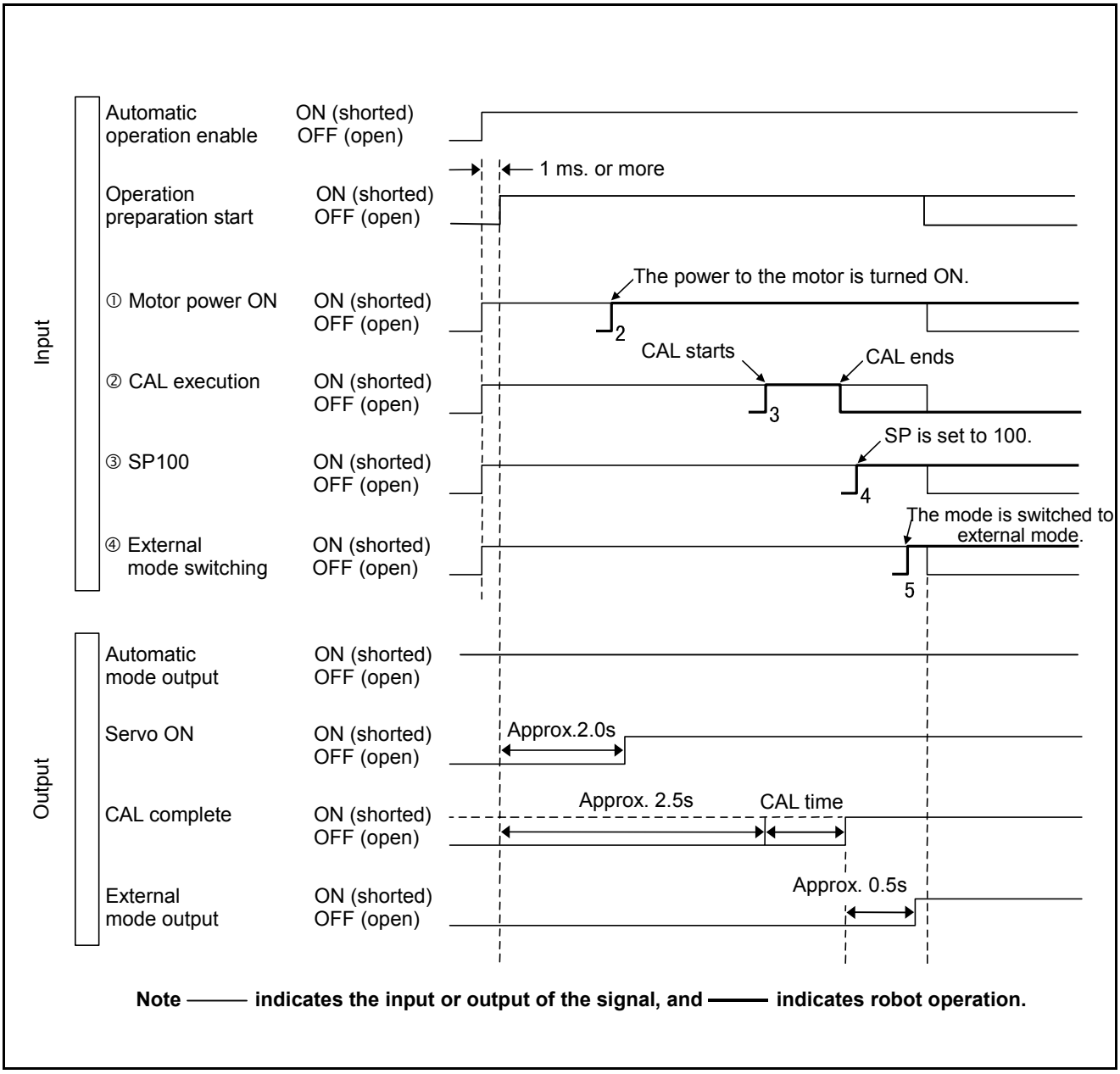
④ Switch Ext Mode (input)
- Terminal number: No.23 of connector CN8
- By turning ON (short) the operation preparation start signal with this signal turned ON (shorted), the mode will be set to the external mode. However, this signal cannot be used when the power to the motor is turned OFF and CAL is 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

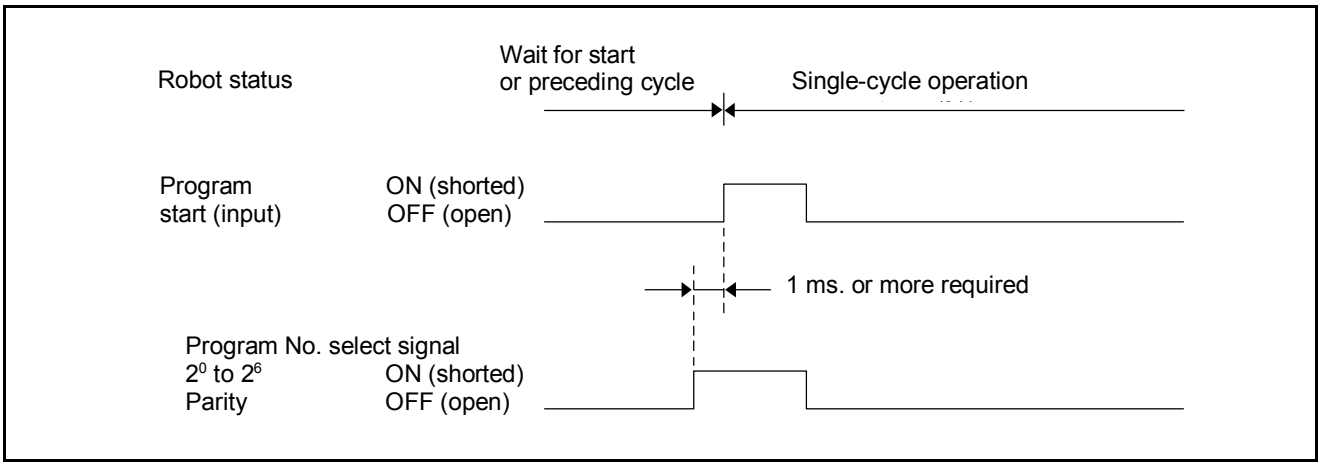
6.4.2 Program No. Select (Input)

(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, and the mode will be switched to the Auto mode.



Program No. Select Signal

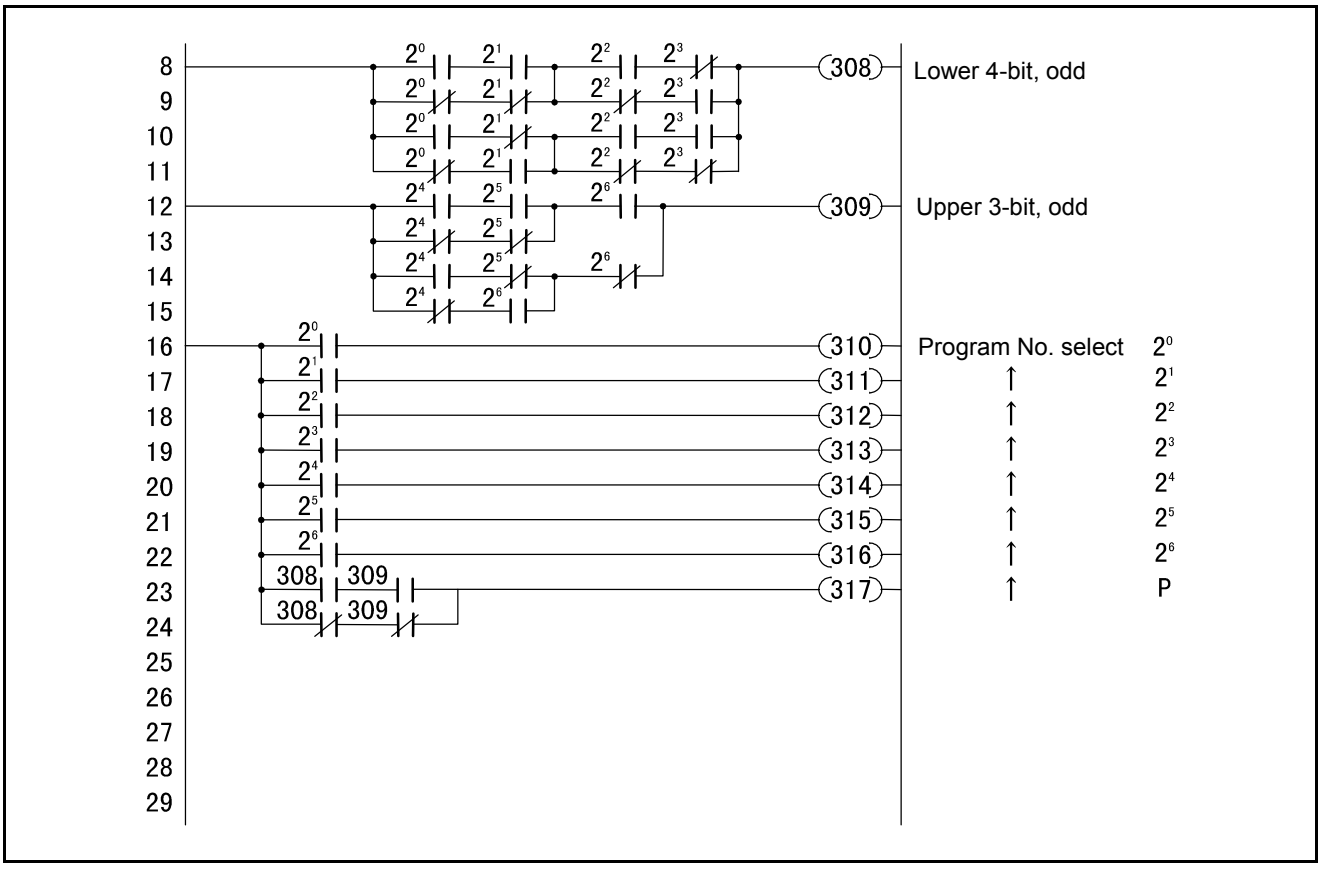
⑥ Input 1 or 0 as the parity bit so that the total of 1's existing in the eight bits of 2^0 to 2^6 and the parity bit will be odd.
Example: When the program number is 15, the bit status of 2^0 to 2^6 is (001111), and the total number of 1s is four, an even number. Set 1 as the parity bit to make the 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

6.4.3 Program Start (Input)

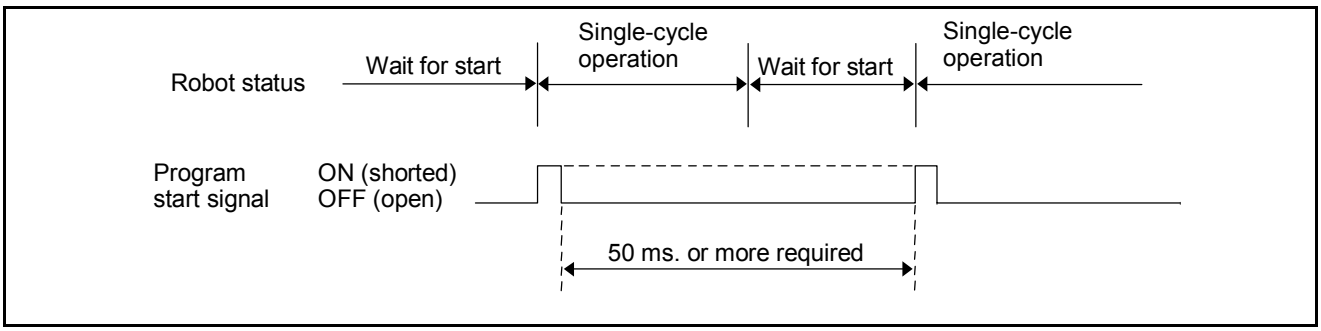
(1) Function

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.)

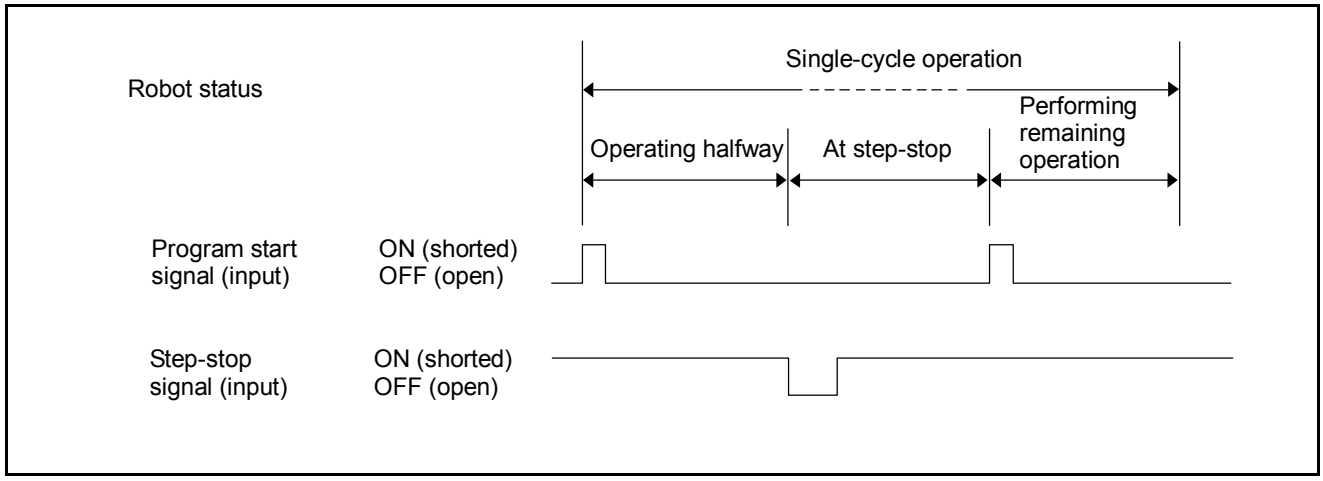
① If the program start signal is input (switched from OFF to ON) when the robot has not yet completed the program or is at rest after it has completed a cycle of the program, the program No. select signal will be read, the program will execute a cycle, and the robot will come to a stop.



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.

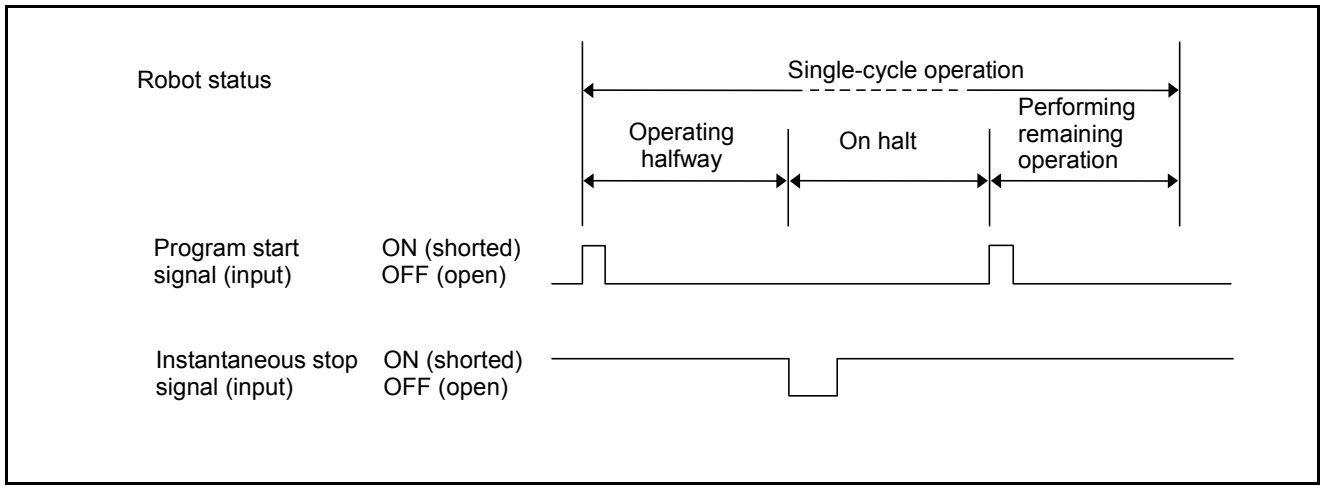
② When the status of the program start signal is switched from OFF to ON with the program step-stopped, the program will resume from the step following the suspended step and stop at the cycle end.



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 Subsection 6.4.5 "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.



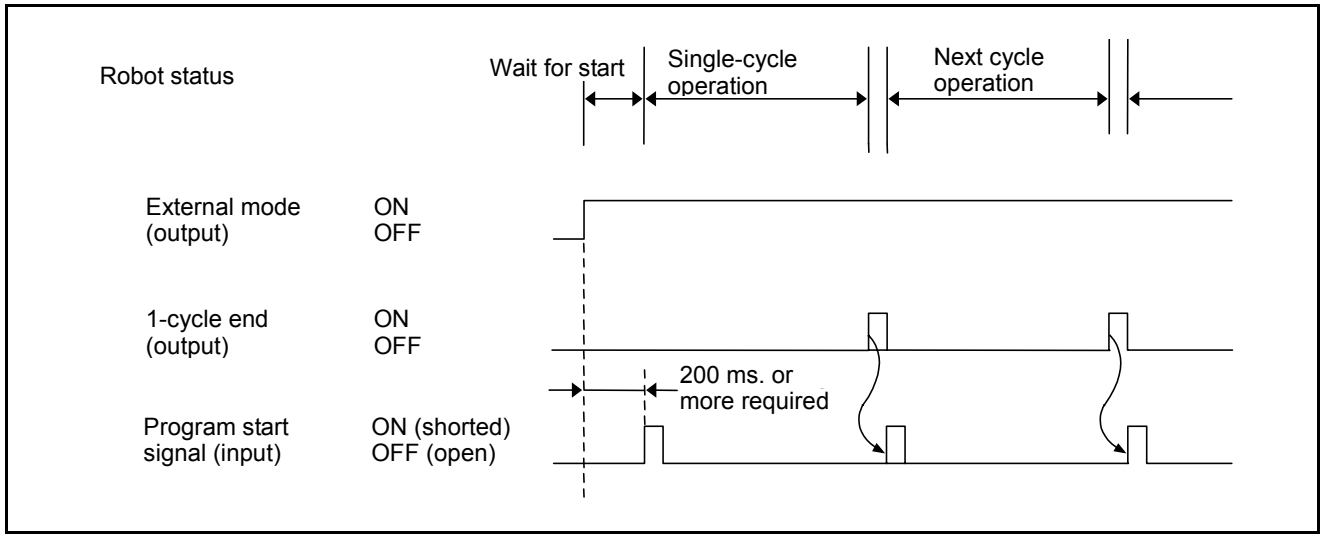
Program Start Operation-3

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 Subsection 6.4.5 "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).

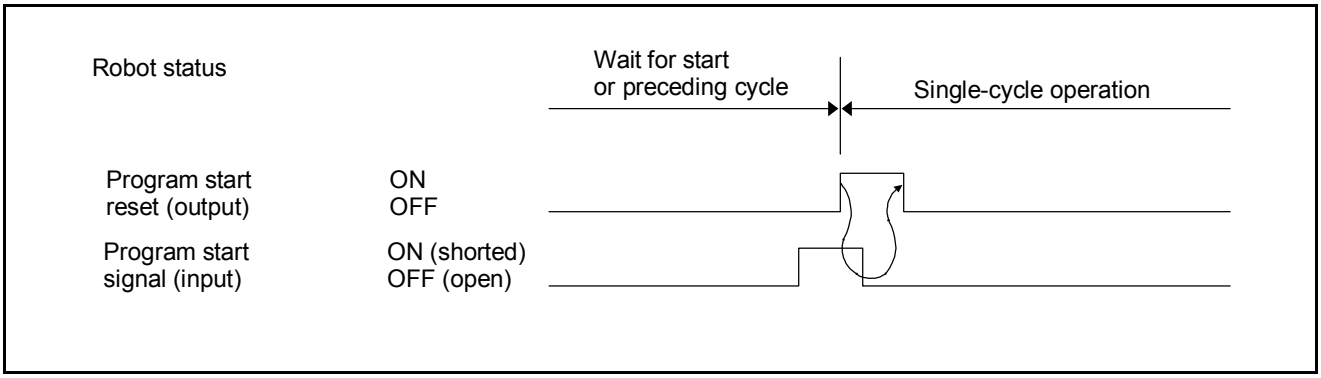


Example of Program Start Signal Rise Timing

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.

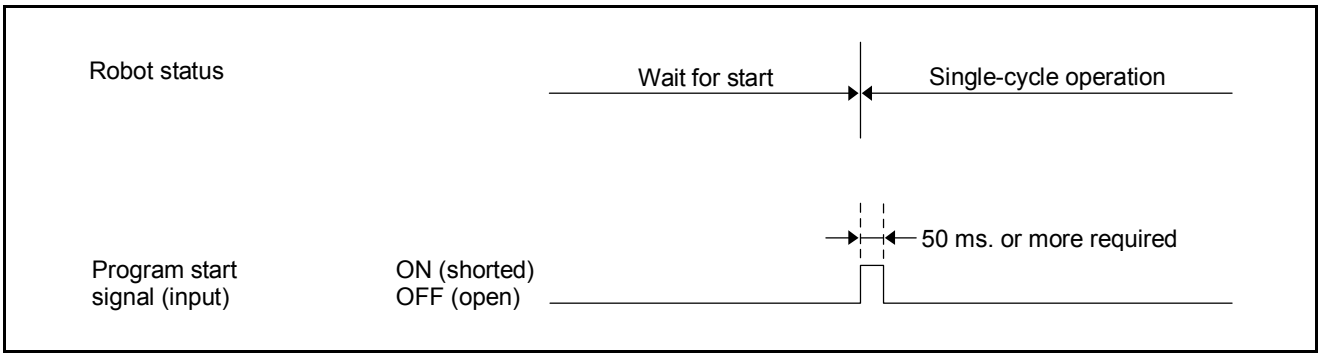
② Example of program start signal fall (OFF) timing

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).



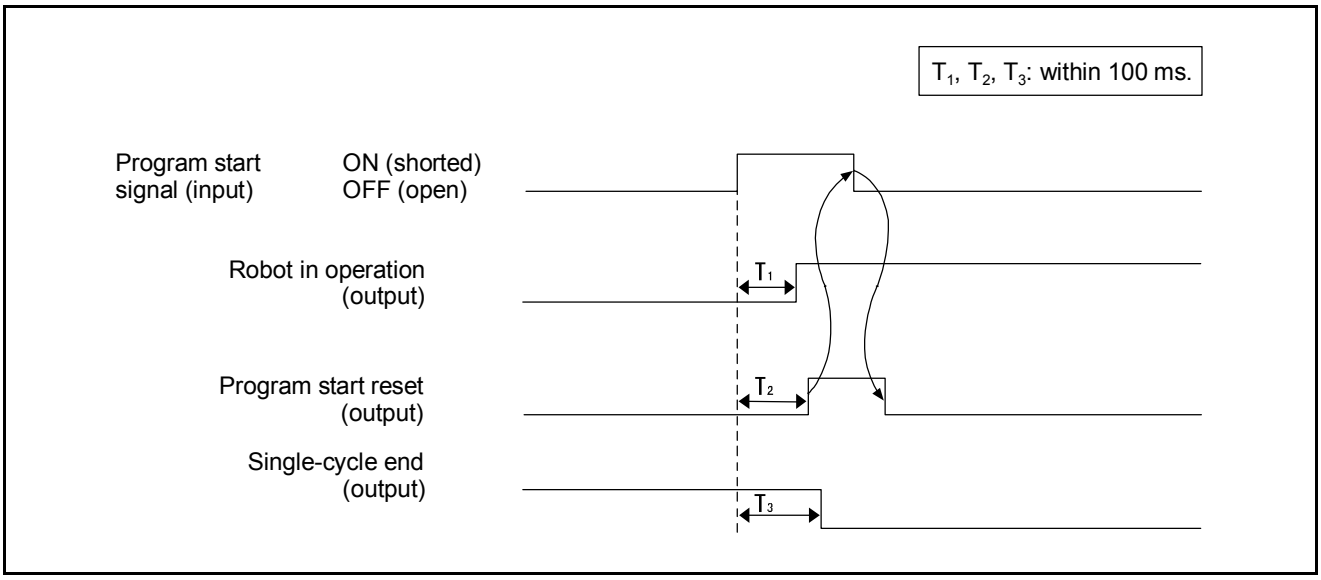
Example of Program Start Signal Fall Timing-1

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

6.4.4 Program Reset (Input)

(1) Function

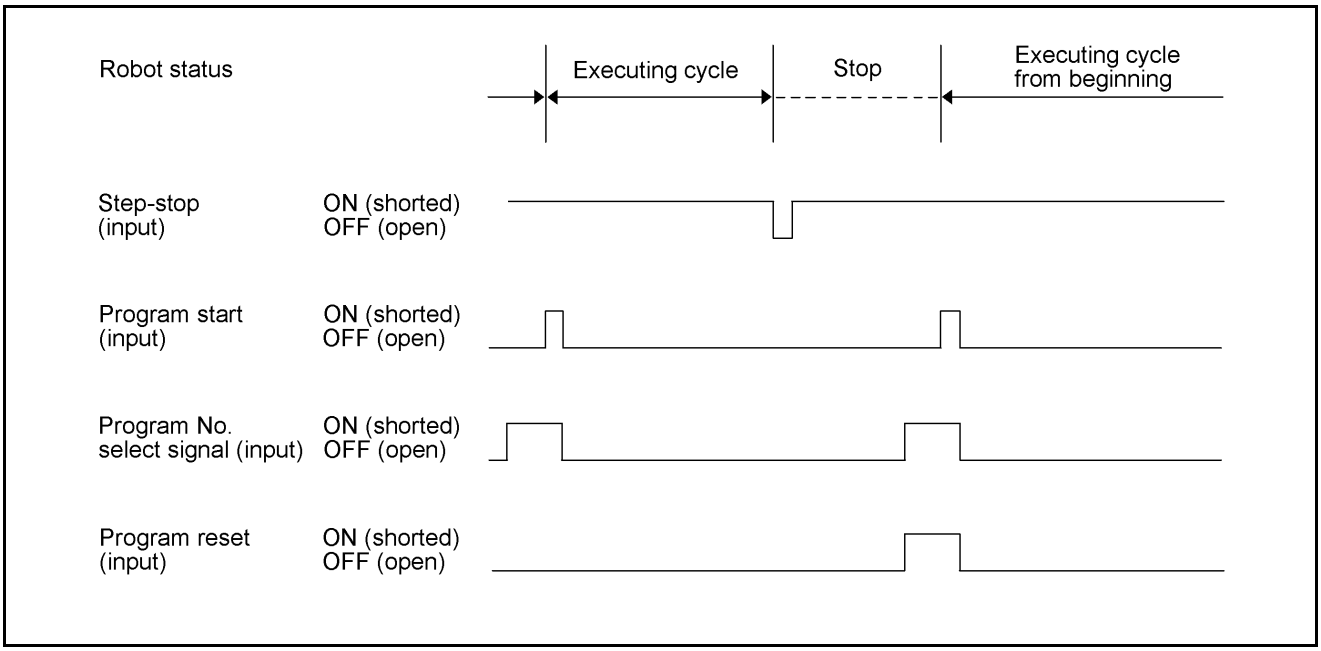
By turning ON (short) this signal, any program can be forcibly executed from the beginning in a step-stopped state and a suspended state.

Caution: Generally, a step-stopped or suspended program resumes from where it stopped.

(2) Input conditions and operation

When issued with the Program Start

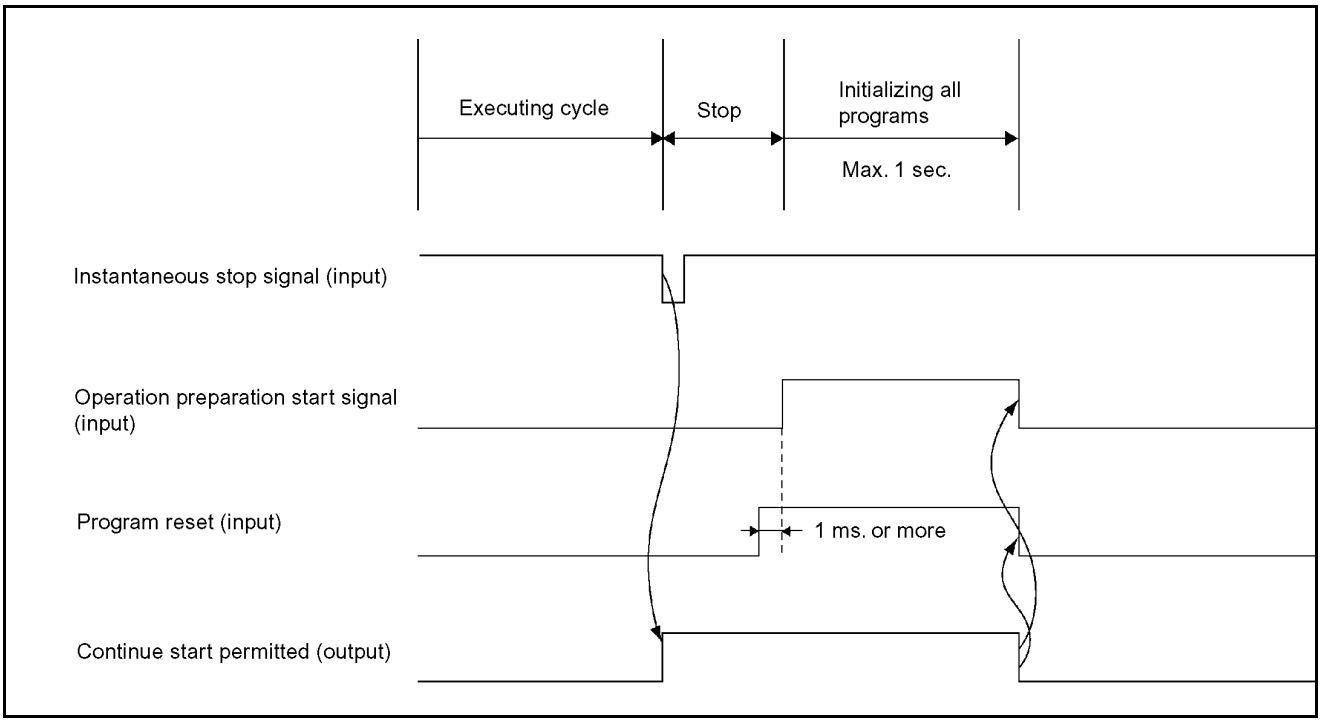
① The figure below shows the input conditions and an operation timing chart.
② Use the program reset signal together with a program No. select signal, and input it before the program start signal (1 msec. or more).
③ Turn OFF the program reset signal after the robot starts to operate (after a program 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

6.4.5 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.

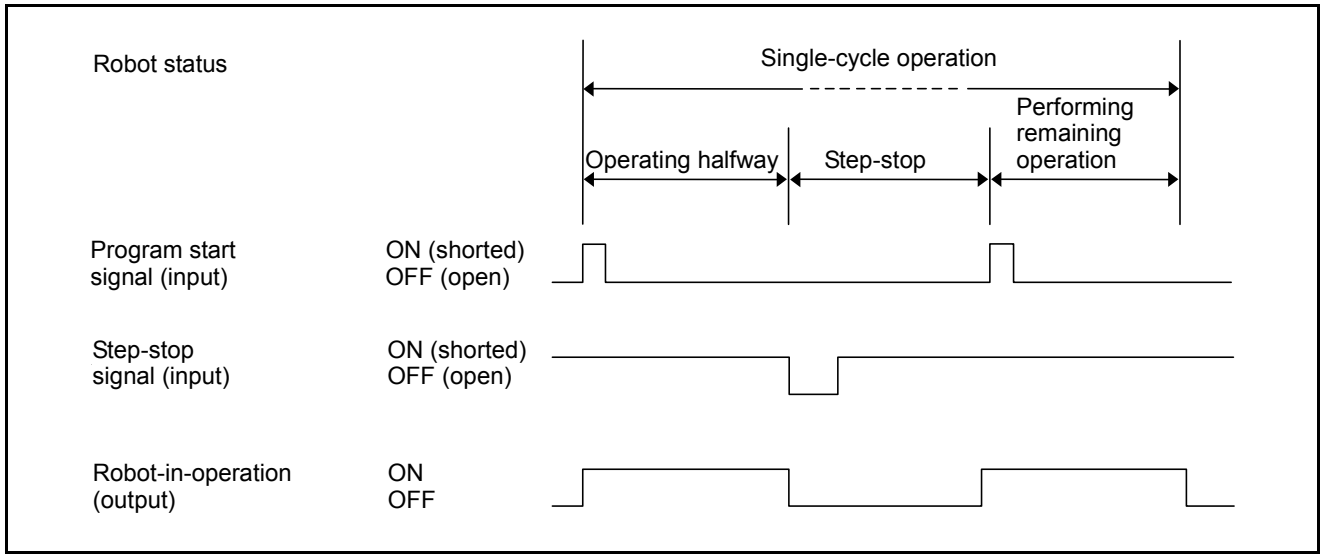
(2) Input conditions and operation

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 Subsection 4.4.4 "Program Start (Input)".



Step Stop Signal

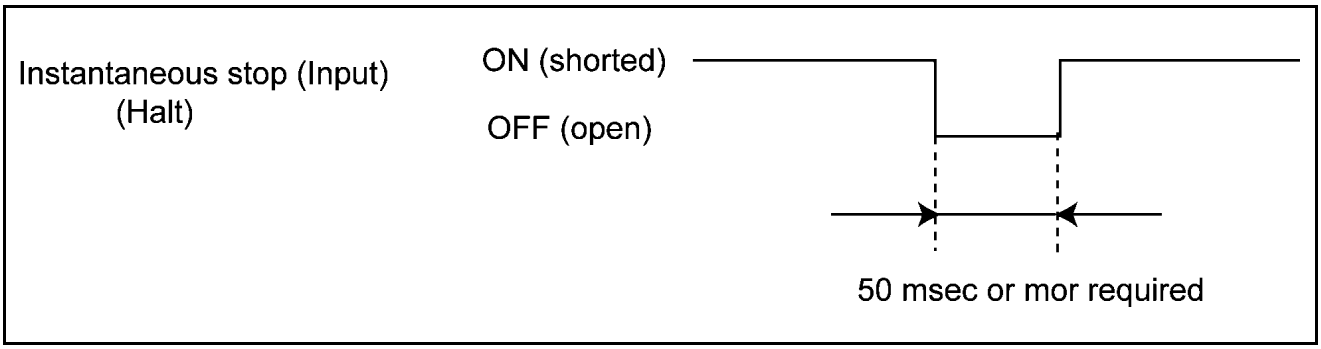
6.4.6 Instantaneous Stop (All Tasks) (Input)

(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 Subsection 4.4.4 "Program Start (Input)".
④ The minimum required pulse width is 50 msec. or more.



Minimum Instantaneous Stop Pulse Width

6.4.7 Clear Robot Failure (Input)

(1) Function

The robot can recover from a stopped state, resulting from a robot failure by turning ON (shorted) the operation preparation start signal with this signal ON (shorted).

(2) Usage

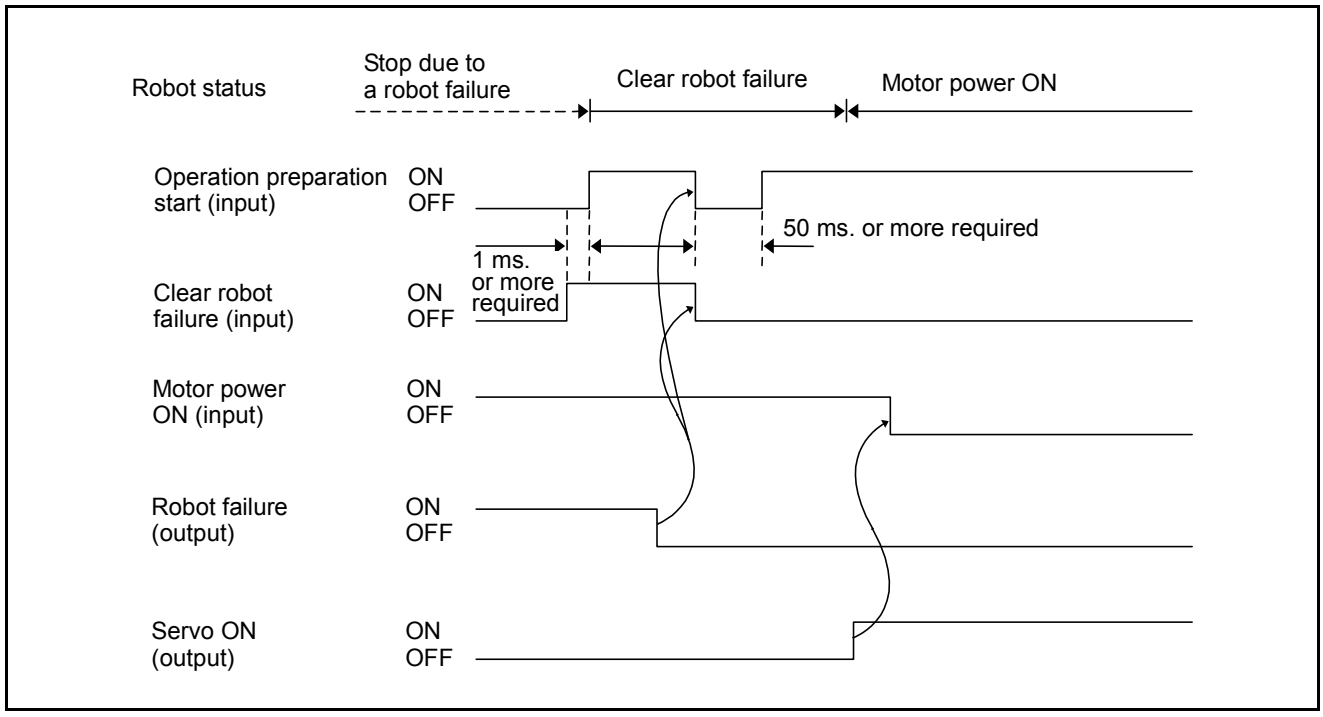
The signal is used to clear an error that brought the robot to a stop.

(3) Input conditions and operation

① When a robot failure 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 failure 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 failure is cleared, turn OFF (open) the Clear robot failure signal after turning OFF the Robot failure signal (output) as shown below.

③ Input the Clear robot failure signal before (1 msec. or more) the operation preparation start signal.



Input Conditions and Operation of Clear Robot Failure Signal

6.4.8 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)."

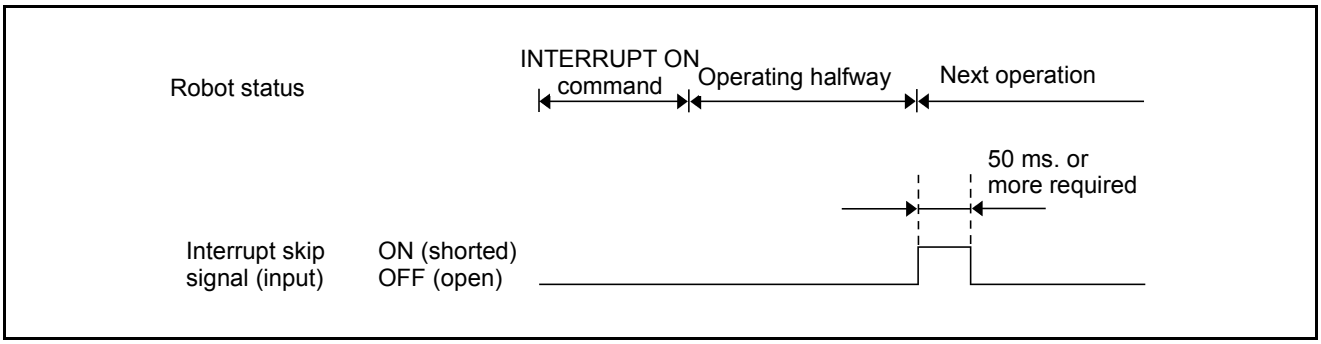
For further information about robot motion commands, refer to the PROGRAMMER'S MANUAL (I), Chapter 12, "Robot Control Statements."

(2) Usage

Refer to the PROGRAMMER'S MANUAL (I), Chapter 12 "12.3 INTERRUPT ON/OFF."

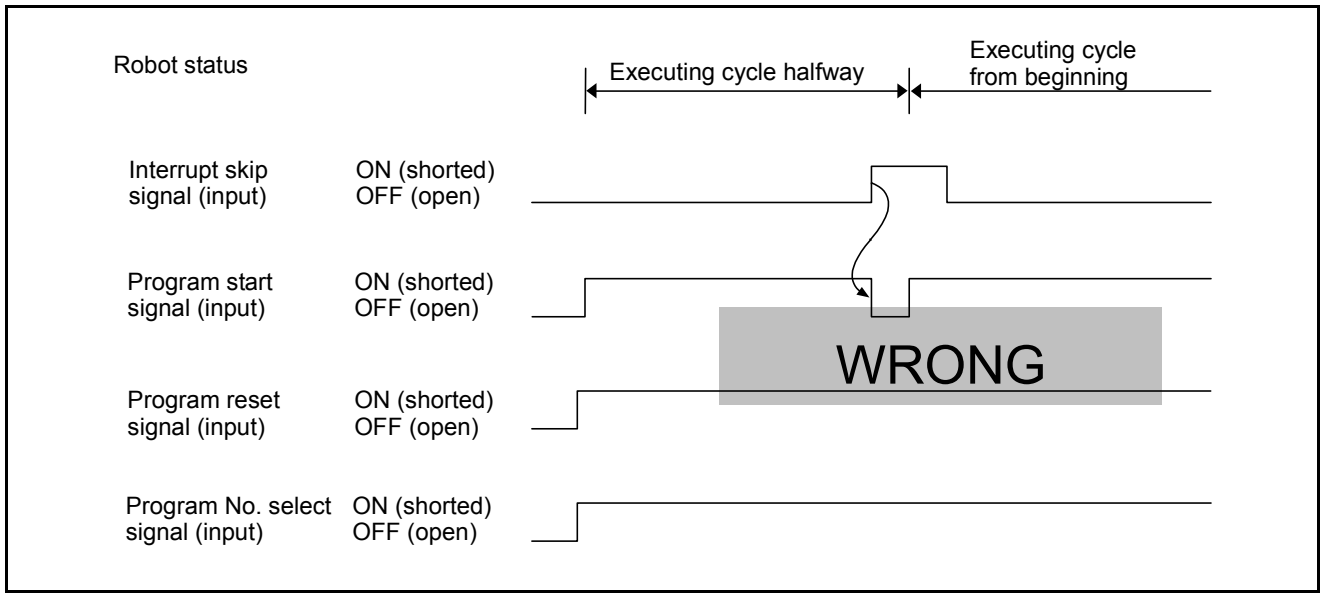
(3) Input conditions and operation

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

6.4.9 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

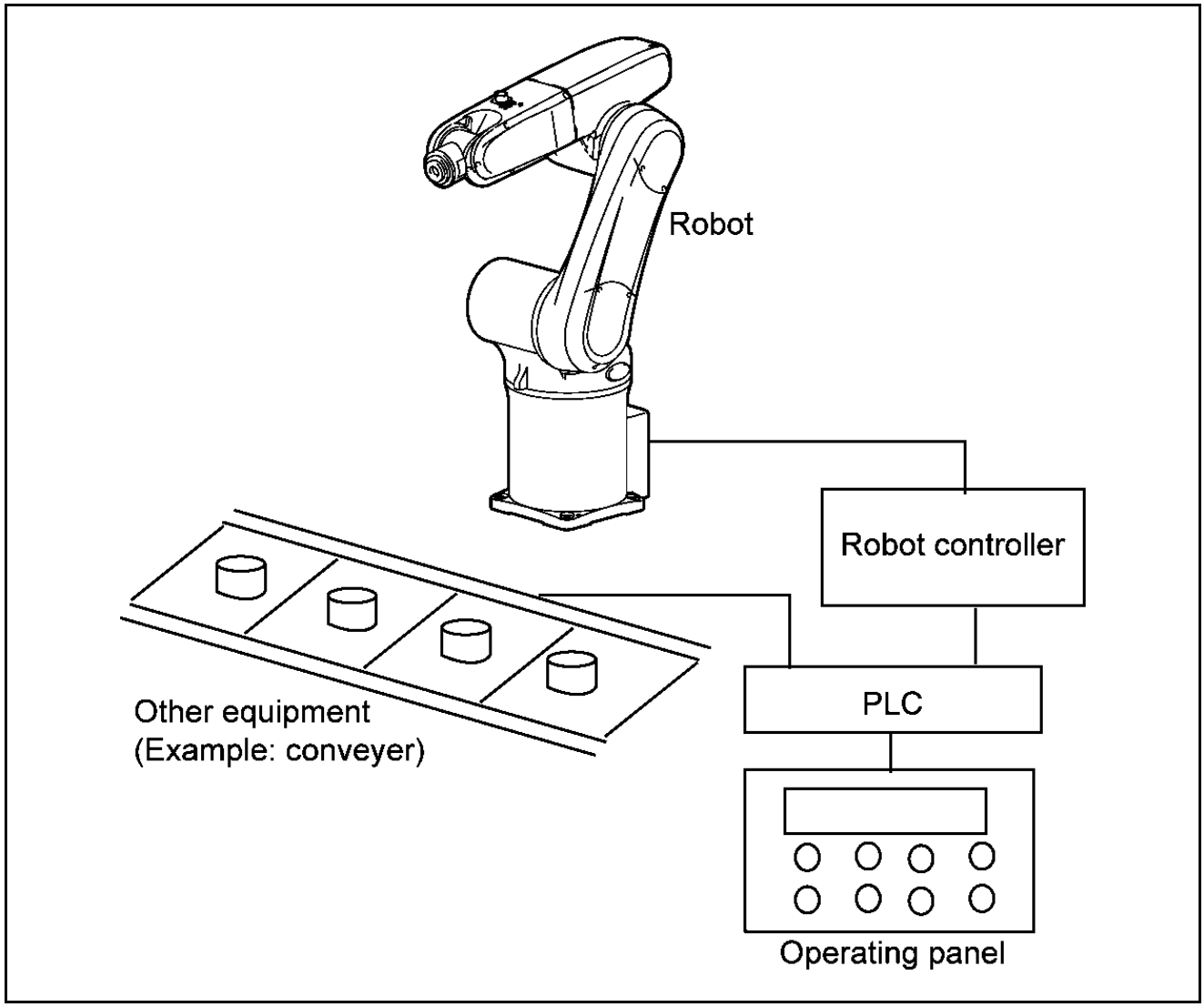
This signal is executable only in external mode. If this signal is on, program numbers will be ignored at execution of Program start and the current program being on halt will be resumed. If Continue Start Permitted signal is not ON, the controller will issue ERROR27A8.

6.5 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.
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 ③.

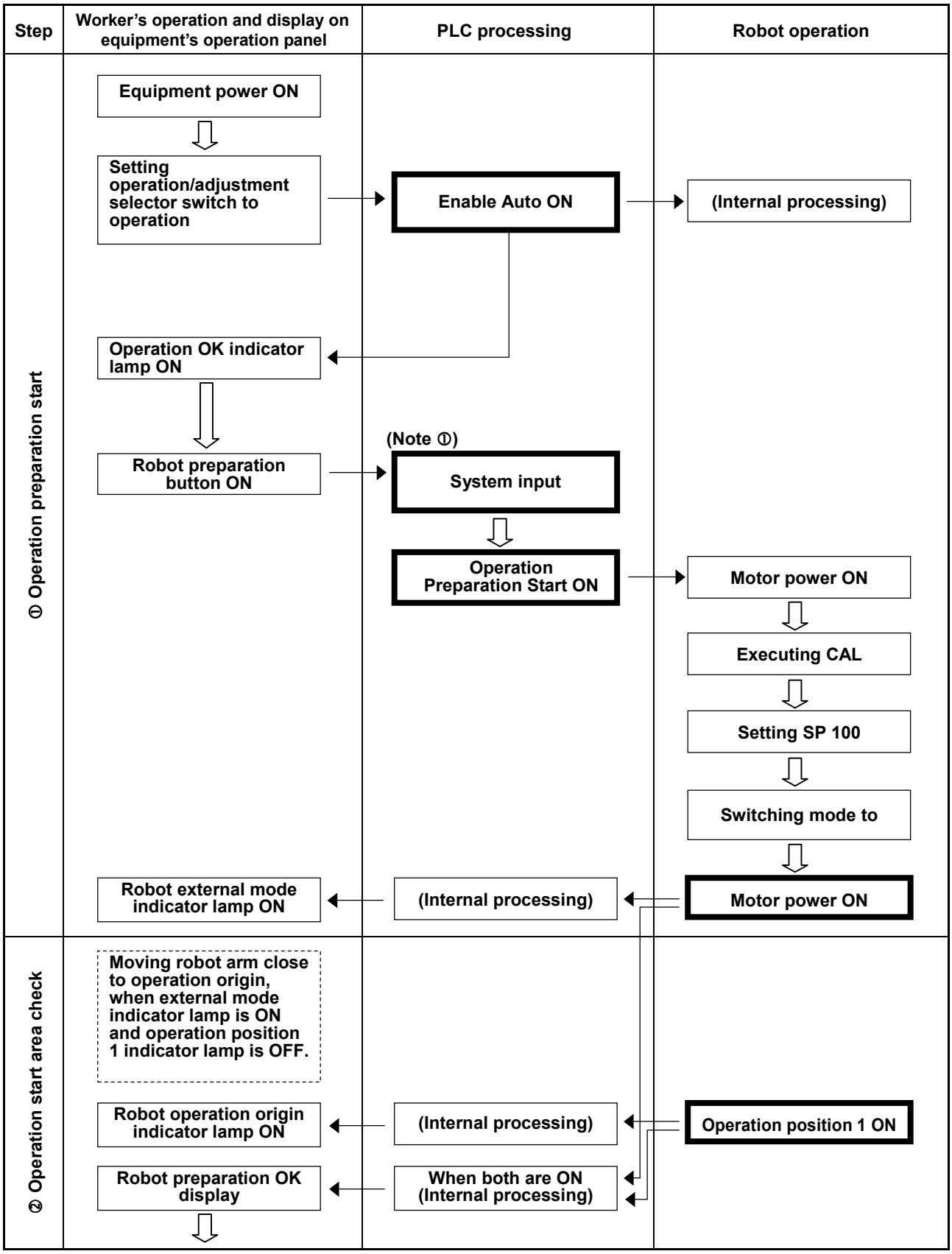
① Operation preparation start
Setting the MOTOR POWER ON, CAL EXECUTION, SP100 and SWITCH EXT MODE bits, brings the robot into the External Auto mode. This operation will be completed when the EXTERNAL MODE output signal is turned ON.

② Automatic operation
Start the program by which the robot starts from the operation origin, performs operations, and returns to the operation origin.

③ 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

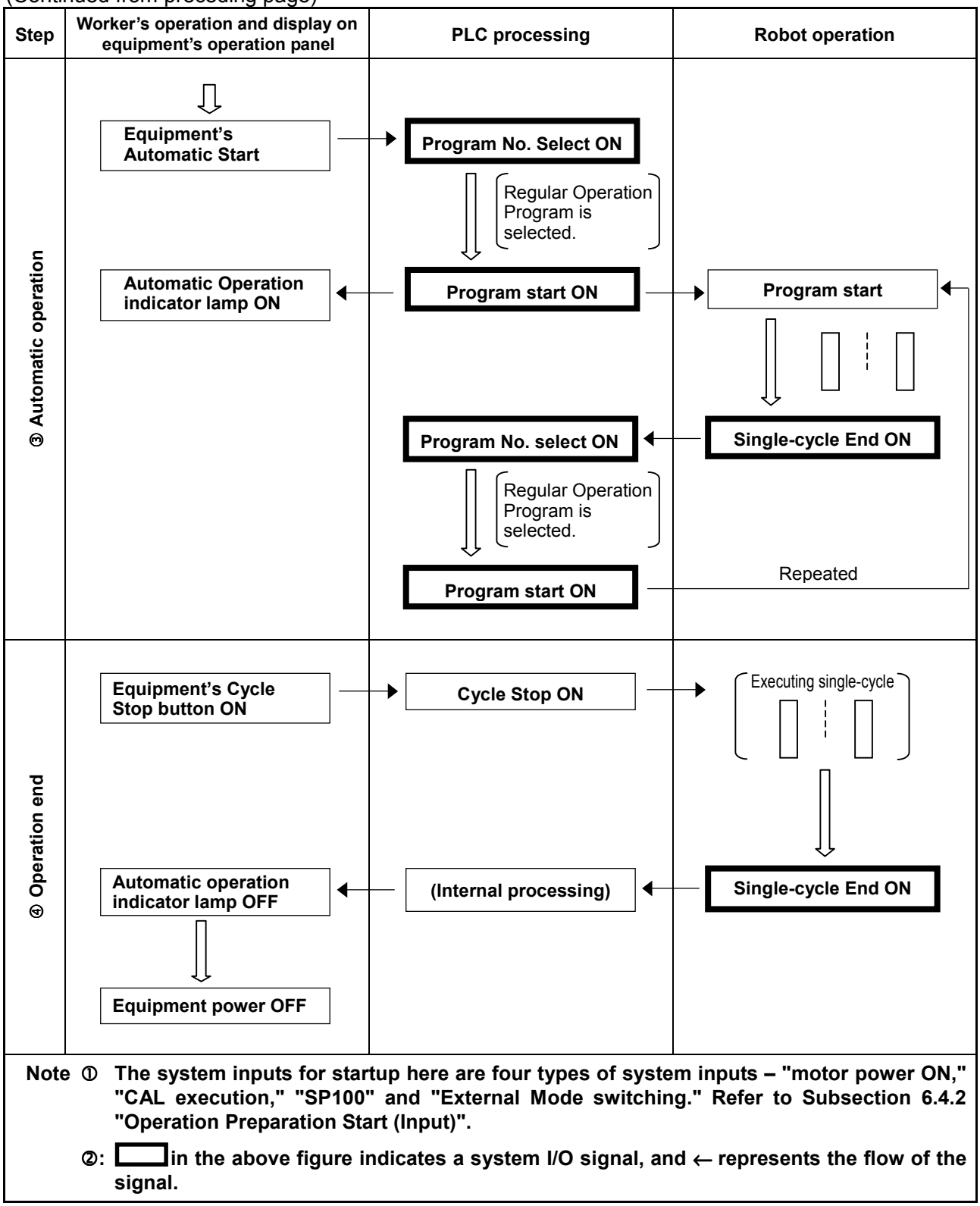
The following pages show the relationship between the system I/O signals for start and stop, worker's operation, display on the equipment operation panel, PLC proceeding, and robot motion.



Start and Stop Procedure and System I/O Signals-1

(Continued on the next page)

(Continued from preceding page)



Note ① The system inputs for startup here are four types of system inputs – "motor power ON," "CAL execution," "SP100" and "External Mode switching." Refer to Subsection 6.4.2 "Operation Preparation Start (Input)".

②: ▭ in the above figure indicates a system I/O signal, and ← represents the flow of the signal.

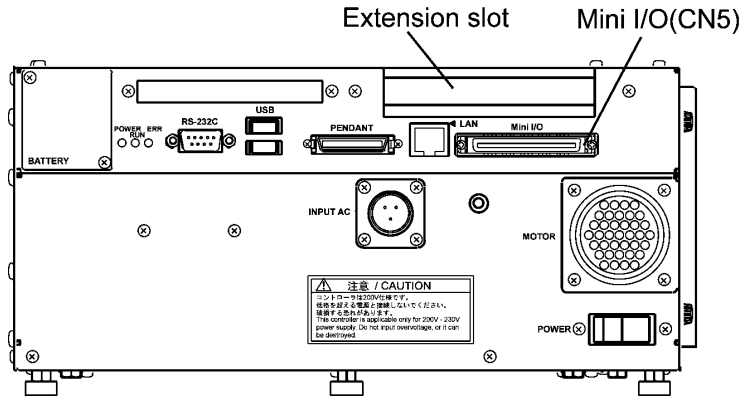
Start and Stop Procedure and System I/O Signals-2

Chapter7 DeviceNet Slave Board

7.1 Overview

If the robot controller has a built-in DeviceNet slave board, it can communicate with external devices according to the DeviceNet-compliant protocol.

As a slave unit for serial communications 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.
The DeviceNet slave board is installed into the extension slot of the controller.



Note: The CN5 (Mini I/O connector set is provided as an accessory for the controller with DeviceNet slave or DeviceNet slave board.
When using the Mini I/O, utilize this connector set after referring to "RC7J Controller Interface Manual."

Extension slot for RC7J controller

7.1.1 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.

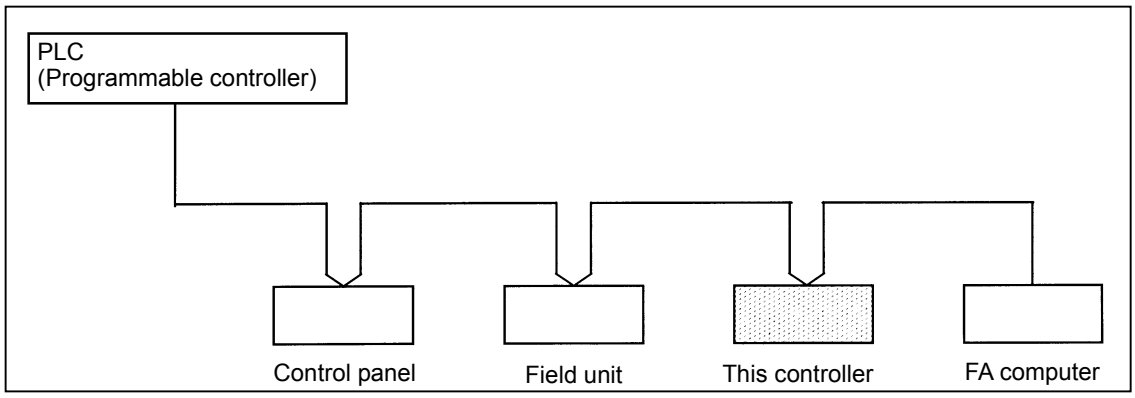
(4) Sufficient number of I/Os

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 steps.

	Number of I/Os	
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

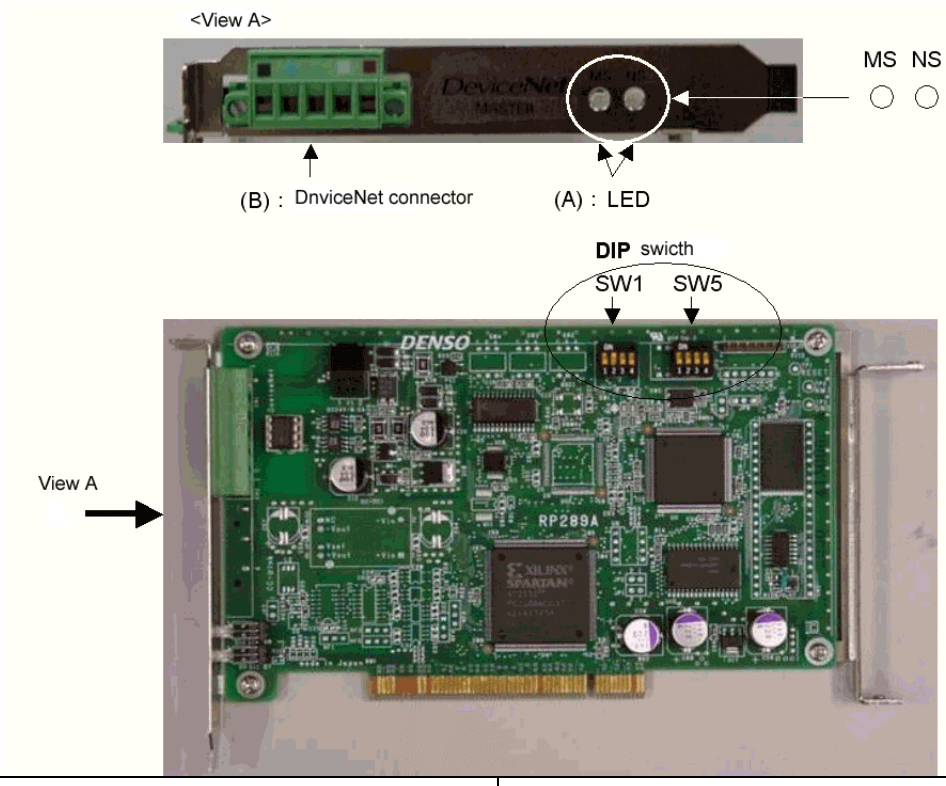
7.1.2 Typical Network

The figure below illustrates a typical network.

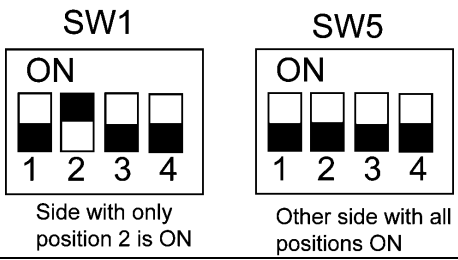


7.2 Product Specifications

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



DIP switches



Note : DO NOT adjust the DIP switches.
In the event that the DIP switches are adjusted, reset the switches to the positions shown on the left while the controller is turned off.

DeviceNet slave board

7.2.1 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	• The unit works normally.
	Red		Fatal error	• Hardware failure.
	–		No power supplied	• 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. • Node address double-assigned. • "Bus off" detected.
			Recoverable communications error	Example: I/O time out
	–		Network power supply failure	• 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.

1:V- (Black)
2:CAN_L (Blue)
3:Drain (Shield)
4:CAN_H (White)
5:V+ (Red)

Devivenet 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]

Select the “DeviceNet.Node address” on the “I/O Hardware settings” window, and set the node address.

Note: When restarting the robot controller, new settings will be effective.

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]

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 restarting the robot controller, new settings will be effective.

7.2.4 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

<table>
<tr><td>Item</td><td colspan="4">Specifications</td></tr>
<tr><td>Communications protocol</td><td colspan="4">DeviceNet-compliant</td></tr>
<tr><td>Connection supported</td><td colspan="4">Master/slave connection : Polling I/O function
Compliant with DeviceNet communications rules</td></tr>
<tr><td>Connection type (Note 1)</td><td colspan="4">Multi-drop type with possible combination of T-branch
(to trunk and branch lines)</td></tr>
<tr><td>Bit rate</td><td colspan="4">500, 250, 125 kbps</td></tr>
<tr><td>Communications media</td><td colspan="4">Special cable consisting of 5 wires
(2 for signals, 2 for power supply and 1 as a shield wire)</td></tr>
<tr><td rowspan="4">Communications cable length</td><td>Bit rate</td><td>Max. network length</td><td>Branch length</td><td>Total branch length</td></tr>
<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>
<tr><td>Power supply for communication</td><td colspan="4">External supply of 24 VDC ±10%</td></tr>
<tr><td>Internal power consumption</td><td colspan="4">Communication power source: 65 mA max.</td></tr>
<tr><td>Max. number of connectable nodes</td><td colspan="4">64 nodes (including configurator (converter) if connected)</td></tr>
<tr><td>Number of I/Os</td><td colspan="4">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.</td></tr>
<tr><td>Error check</td><td colspan="4">CRC</td></tr>
<tr><td colspan="5">(Note 1) Terminator resistors are needed at both ends of the trunk line. (121Ω)
(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.</td></tr>
</table>

7.3 I/O Allocation Settings

When using the DeviceNet slave board, the I/O allocation setting is chosen from the items below.

Setting of I/O allocation (DeviceNet slave board)

Allocation	General description
Standard	”Standard” system allocation is allocated to the DeviceNet slave board area. Only the user signal (excluding CPU Normal) is allocated to all ports of the Mini I/O area.
Compatible	”Compatible” system allocation is allocated to the DeviceNet slave board area. Only the user signal (excluding CPU Normal) is allocated to all ports of the Mini I/O area.
Standard (RC5-compliant)	”Standard” system allocation is allocated to the DeviceNet slave board area. Only the user signal (RC5-compliant and excluding CPU Normal) is allocated to all ports of the Mini I/O area.
Compatible (RC5-compliant)	”Compatible” of system allocation is allocated to the DeviceNet slave board area. Only the user signal (RC5-compliant and excluding CPU Normal) is allocated to all ports of the Mini I/O area.
Note 1: Refer to “4.2 Function of Mini I/O” for the allocation to the Mini I/O area. **Note 2:** The port numbers of DeviceNet slave board are 512 to 767 for input ports and 768 to 1023 for outputs port.	

7.3.1 Standard Assignment Mode

(1) Input Data

No.	Content	No.	Content	No.	Content	No.	Content
512	Step stop (all tasks)	520	Bit 0 in data area 1	528	Bit 0 in data area 2	536	Bit 8 in data area 2
513	–	521	Bit 1 in data area 1	529	Bit 1 in data area 2	537	Bit 9 in data area 2
514	Halt (all tasks)	522	Bit 2 in data area 1	530	Bit 2 in data area 2	538	Bit 10 in data area 2
515	Strobe signal	523	Bit 3 in data area 1	531	Bit 3 in data area 2	539	Bit 11 in data area 2
516	Skip interrupt	524	Bit 4 in data area 1	532	Bit 4 in data area 2	540	Bit 12 in data area 2
517	–	525	Bit 5 in data area 1	533	Bit 5 in data area 2	541	Bit 13 in data area 2
518	–	526	Bit 6 in data area 1	534	Bit 6 in data area 2	542	Bit 14 in data area 2
519	Command data odd parity	527	Bit 7 in data area 1	535	Bit 7 in data area 2	543	Bit 15 in data area 2

No.	Content	No.	Content			No.	Content
544	Bit 0 in command area	552	INPUT 552			760	INPUT 760
545	Bit 1 in command area	553	INPUT 553			761	INPUT 761
546	Bit 2 in command area	554	INPUT 554			762	INPUT 762
547	Bit 3 in command area	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

No.	Content	No.	Content	No.	Content	No.	Content
768		776	Robot warning	784	Bit 0 in status area	792	Bit 8 in status area
769	Robot running	777	Continue start permitted	785	Bit 1 in data area	793	Bit 9 in status area
770	Robot alarm	778	Reserved	786	Bit 2 in status area	794	Bit 10 in status area
771	Servo ON	779	Reserved	787	Bit 3 in status area	795	Bit 11 in status area
772	Robot initialization finished	780	Reserved	788	Bit 4 in status area	796	Bit 12 in status area
773	Auto mode	781	Reserved	789	Bit 5 in status area	797	Bit 13 in status area
774	External mode	782	Command process finished	790	Bit 6 in status area	798	Bit 14 in status area
775	Battery warning	783	Status area odd parity	791	Bit 7 in status area	799	Bit 15 in status area

No.	Content	No.	Content			No.	Content
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.

7.3.2 Compatible Assignment Mode

(1) Input Data

No.	Content	No.	Content	No.	Content	No.	Content
512	Step stop (all tasks)	520	Program selection bit	528	Motor power ON	536	INPUT 536
513	Continue start	521	Bit 1 for program selection	529	CAL execution	537	INPUT 537
514	Halt (all tasks)	522	Bit 2 for program selection	530	–	538	INPUT 538
515	Operation ready start	523	Bit 3 for program selection	531	SP100	539	INPUT 539
516	Skip interrupt	524	Bit 4 for program selection	532	Switching to external mode	540	INPUT 540
517	Program start	525	Bit 5 for program selection	533	Program reset	541	INPUT 541
518	–	526	Bit 6 for program selection	534	Robot alarm	542	INPUT 542
519	–	527	Program selection parity	535	–	543	INPUT 543

No.	Content	No.	Content			No.	Content
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

No.	Content	No.	Content	No.	Content	No.	Content
768	–	776	Robot power ON finished	784	Error code, unit, 2^0	792	Error code, hundreds, 2^0
769	Robot running	777	Servo ON	785	Error code, unit, 2^1	793	Error code, hundreds, 2^1
770	Robot alarm	778	CAL finished	786	Error code, unit, 2^2	794	Error code, hundreds, 2^2
771	Auto mode	779	Teaching	787	Error code, unit, 2^3	795	Error code, hundreds, 2^3
772	External mode	780	Single cycle end	788	Error code, tens, 2^1	796	–
773	Program start reset	781	Battery warning	789	Error code, tens, 2^2	797	–
774	–	782	Robot warning	790	Error code, tens, 2^3	798	–
775	–	783	Continue start permitted	791	Error code, tens, 2^4	799	–

No.	Content	No.	Content			No.	Content
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

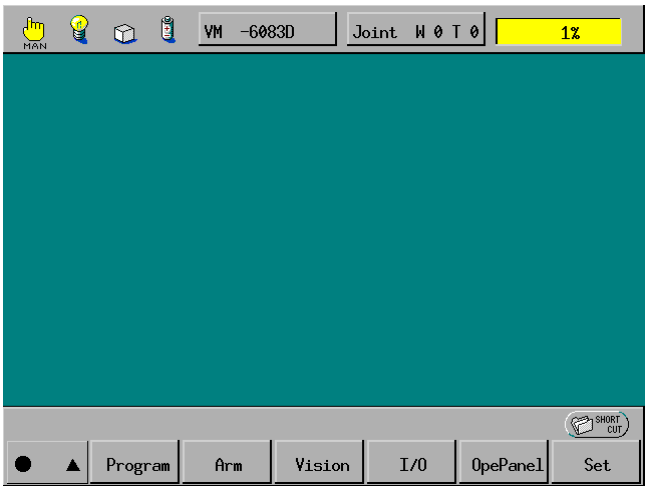
Note 1: Numerals in the No. column denote the I/O port numbers of the controller.
Note 2: The output data is handled in bytes (8 points). The default is 56 points. Up to 256 points can be used.

7.4 Parameter Entry Procedure

7.4.1 Entering the Number of Input/Output Slots

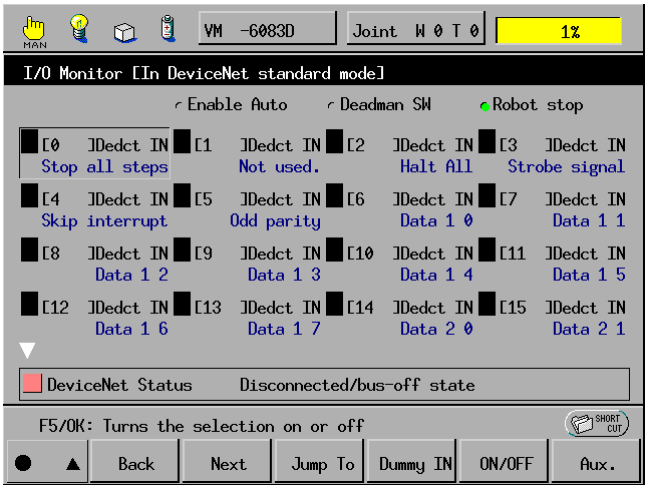
This controller allows you to increase or decrease the number of input/output slots in bytes. The number of input slots can be set in the range from 5 (default: 8) to 32 (max.), and the number of output slots in the range from 4 (default: 7) to 32 (max.). The setting procedure is given below:

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



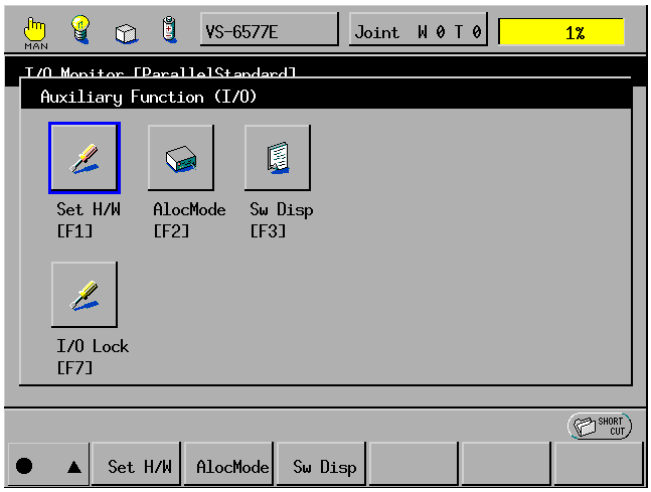
F4

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



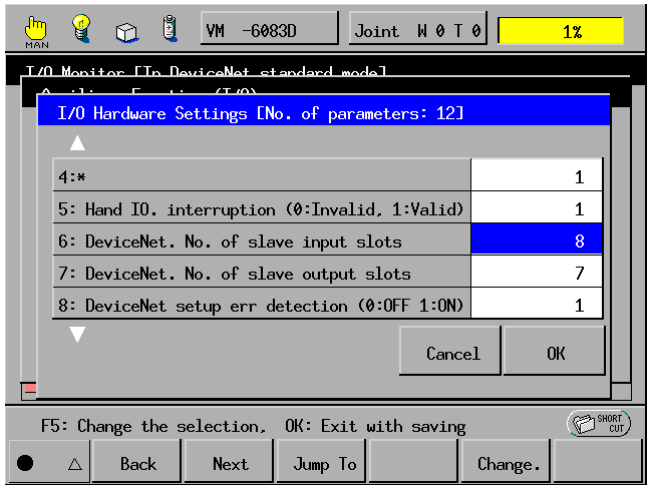
F6

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



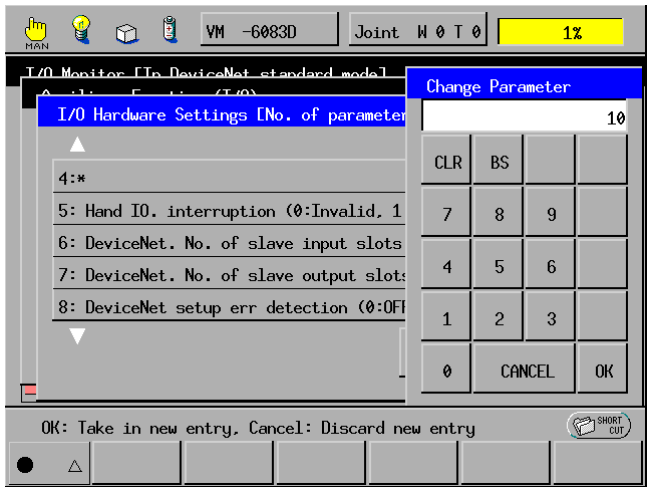
F1

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

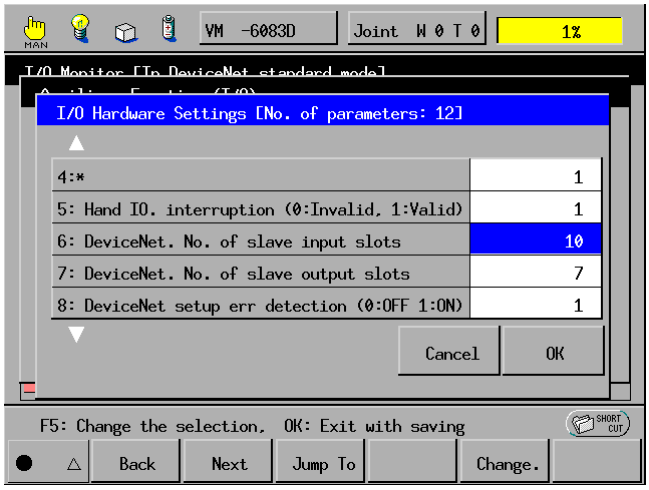


F5

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

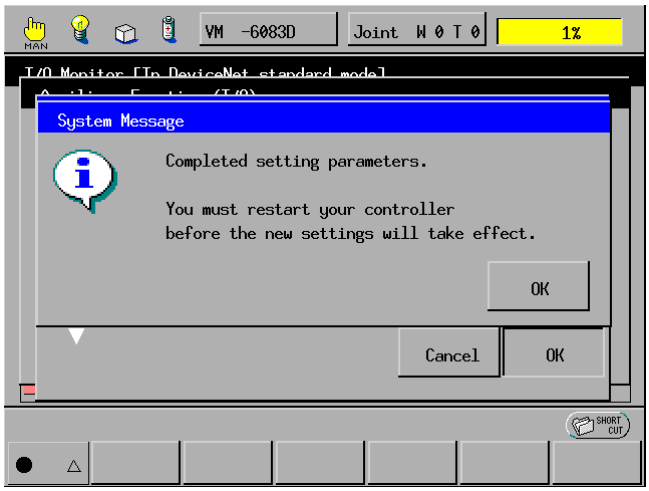


Step 6 Check that the number has been correctly changed (from 8 to 10 in this example) and press OK.



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.



7.4.2 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

7.4.3 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 DnetStat]

Search the “Master software version” on the “DeviceNet State” window.

7.4.4 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.

7.5 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.

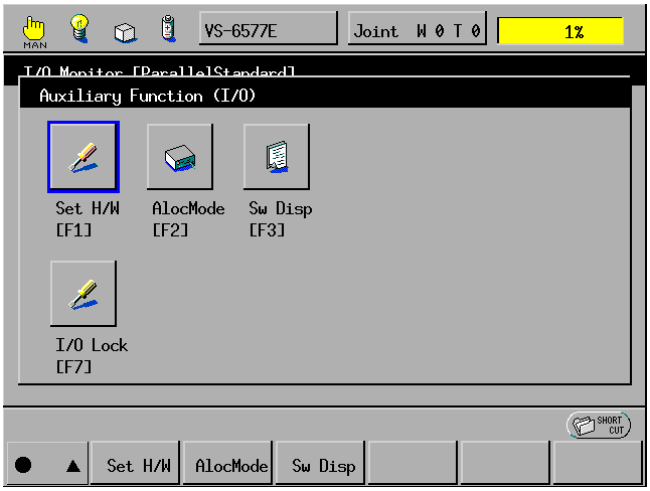
To check program operations using dummy I/Os for setting up facilities where no connection to the network has been established, set this parameter to "1" (First Time). Doing so will not display errors once detected, allowing you to check program operations.

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

■ Changing the FieldNetwork ErrDisplay parameter

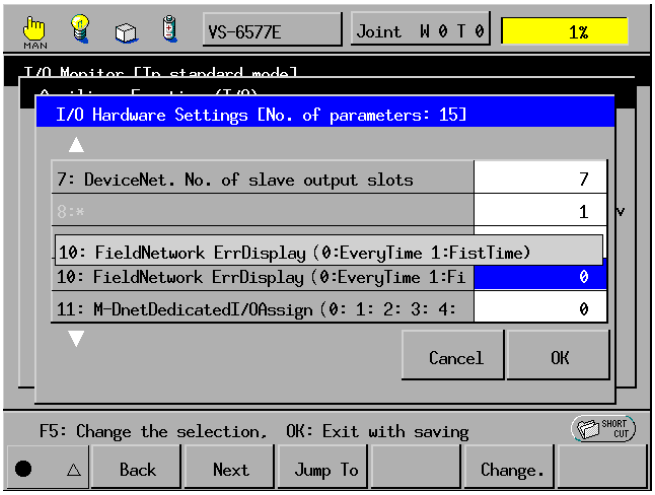
Access: [F4 I/O]—[F6 Aux.]—[F1 Set H/W]

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



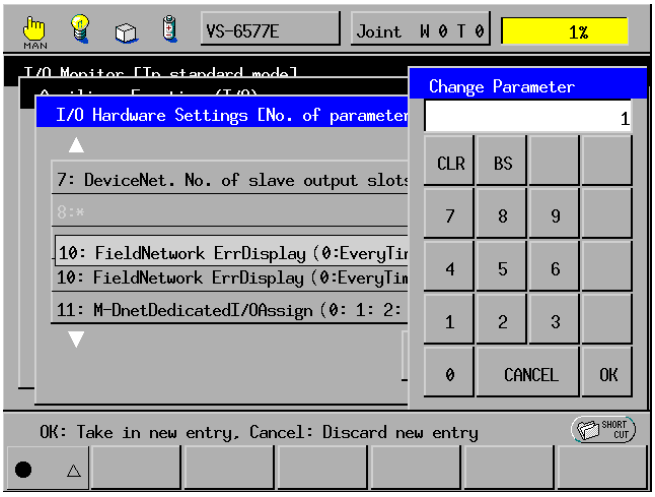
F1

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

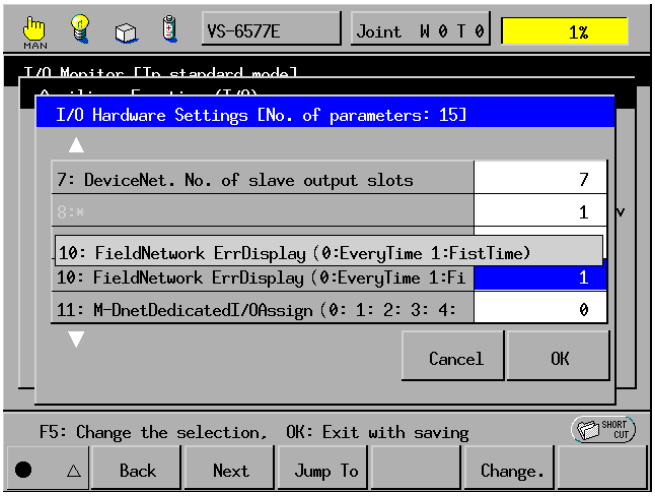


F5

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.

7.6 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.

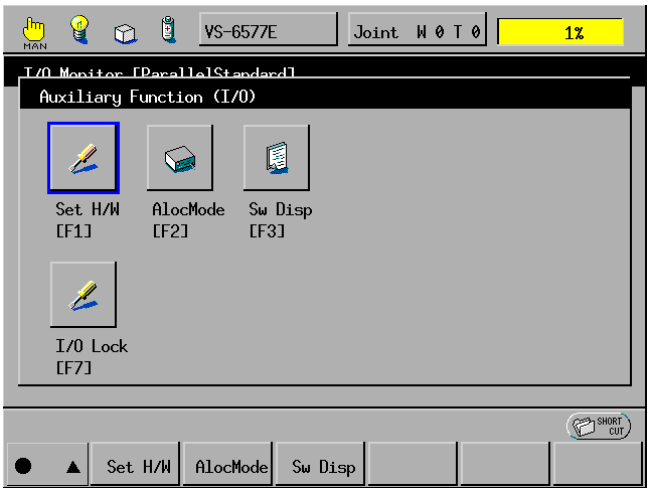
If a network error occurs when the controller is turned on, then it will be detected 8 seconds later.

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

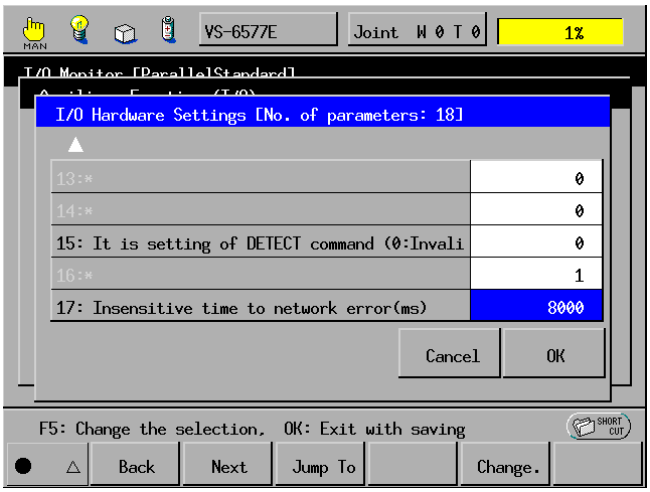
Access: [F4 I/O]—[F6 Aux.]—[F1 Set H/W]

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



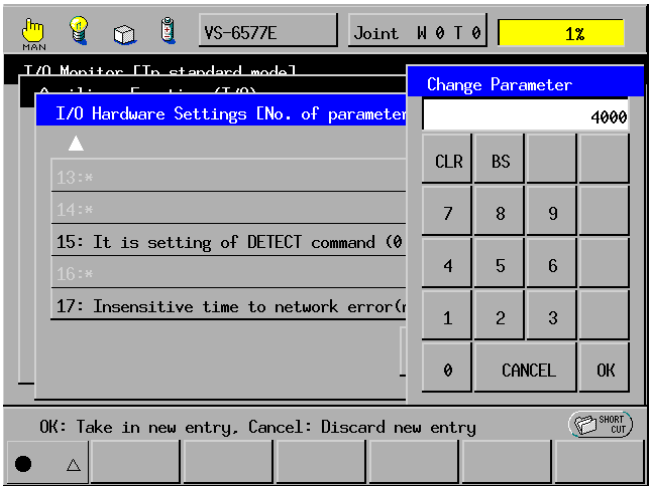
F1

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

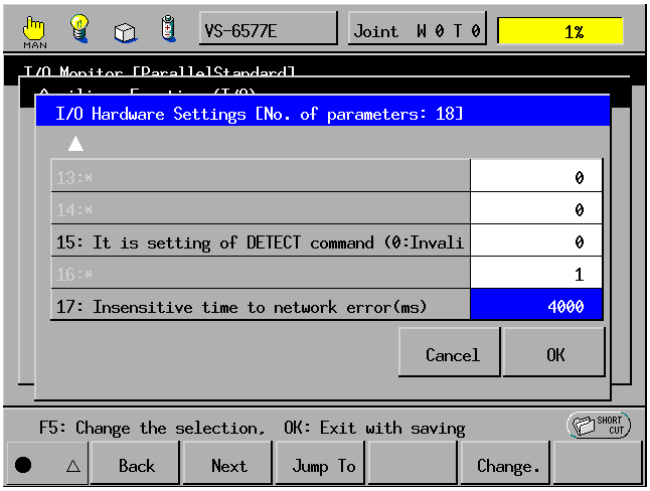


F5

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.

7.7 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) • 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) • 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) • 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 • 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

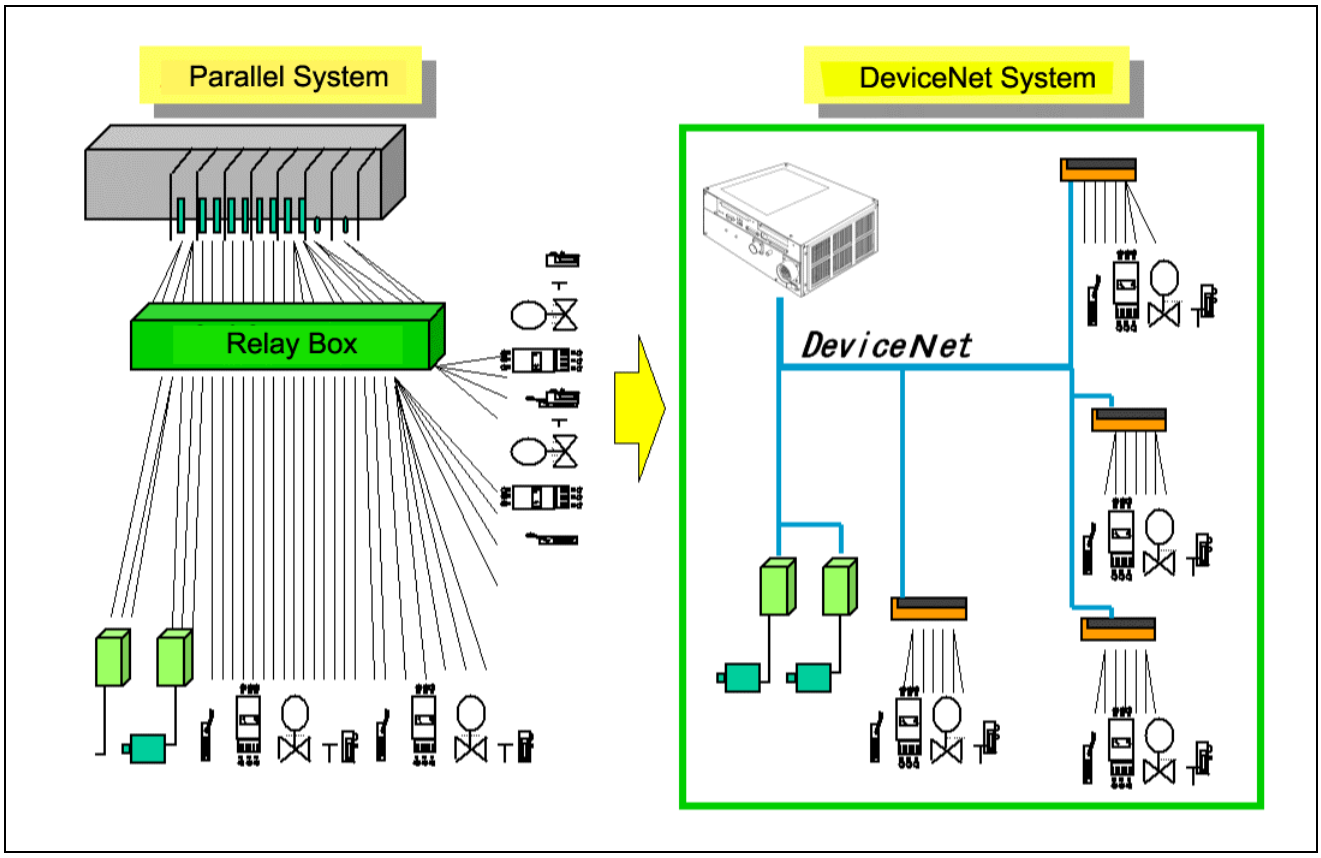
EDS File (Electronic Data Sheet)

```
$ 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;
```

Chapter8 DeviceNet Master Board

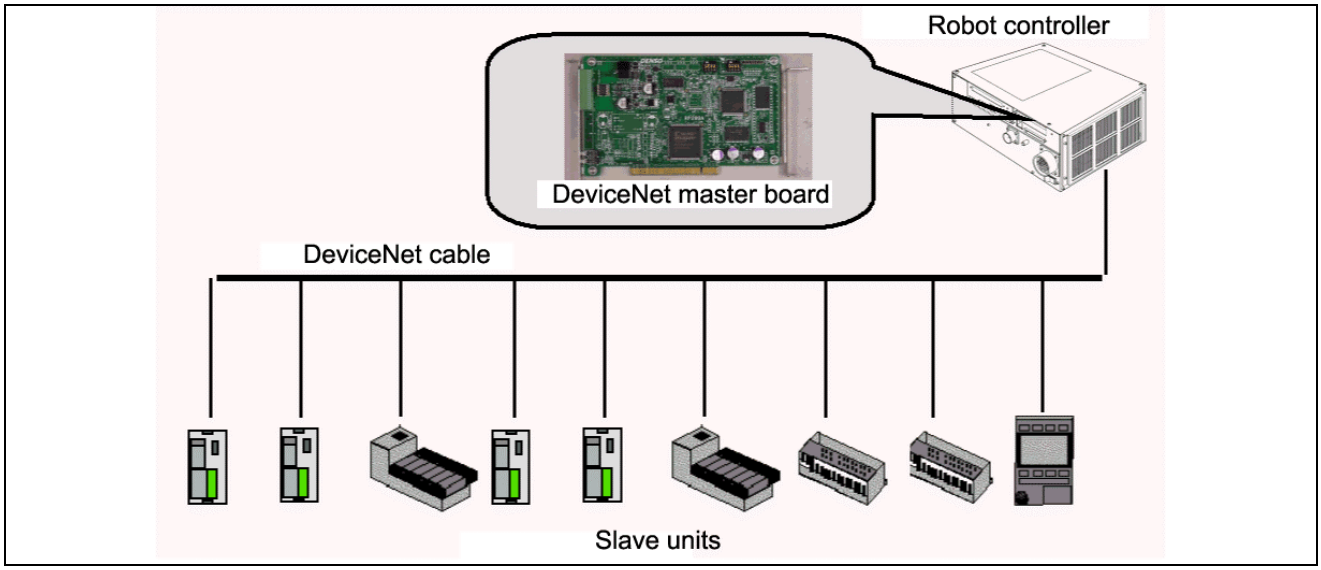
8.1 Overview

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 construction.

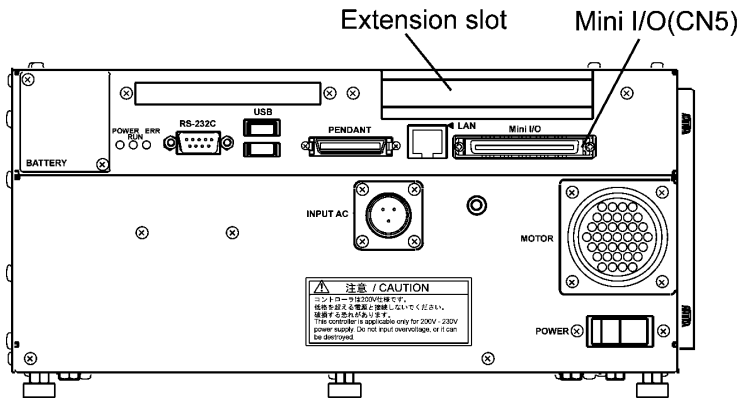


DeviceNet System

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.



The DeviceNet master board is installed into the extension slot of the controller.



Note: The CN5 (Mini I/O connector set is provided as an accessory for the controller with DeviceNet master or DeviceNet master board.
When using the Mini I/O, utilize this connector set after referring to "RC7J Controller Interface Manual."

Extension slot for RC7J controller

8.1.1 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

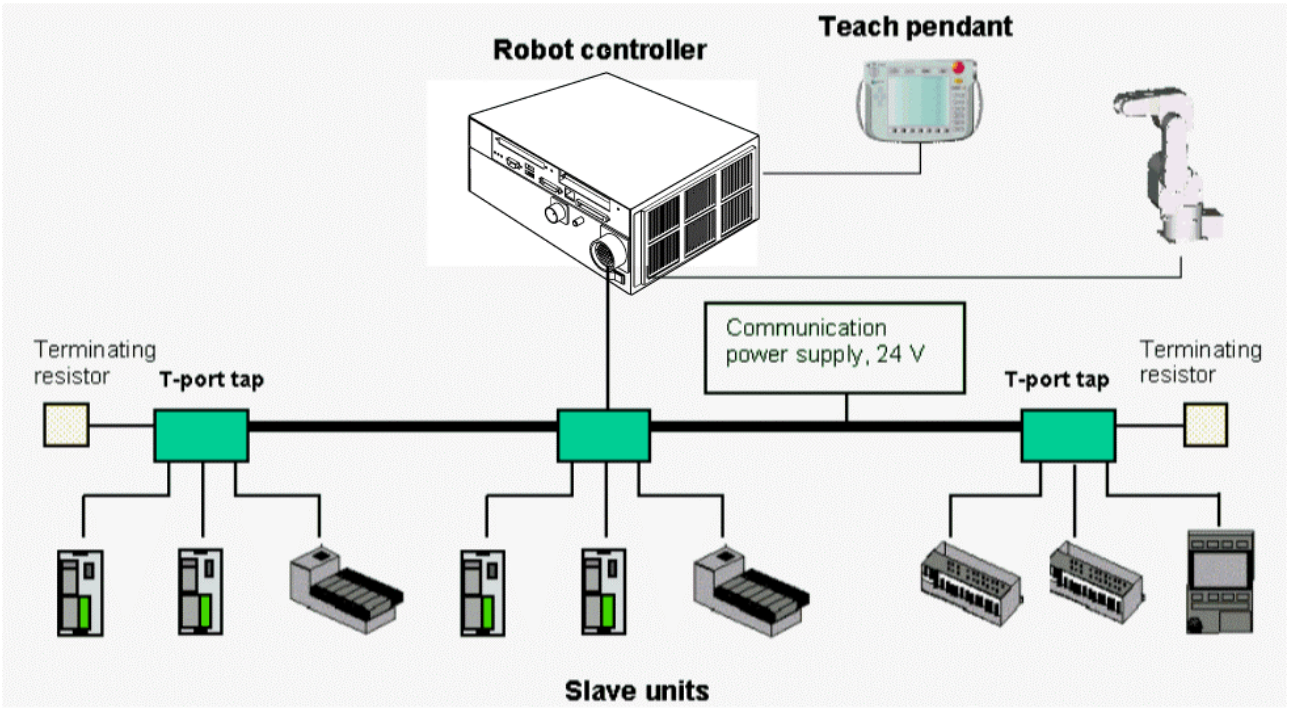
The 5-core special cable and detachable connector of the DeviceNet master board make it easy to install wiring between nodes (communications units) and disassembly/restructure the network. This will sharply reduce cost in wiring and maintenance, as well as making replacement of units easy at the time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

8.1.2 System Configuration Sample



8.1.3 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.

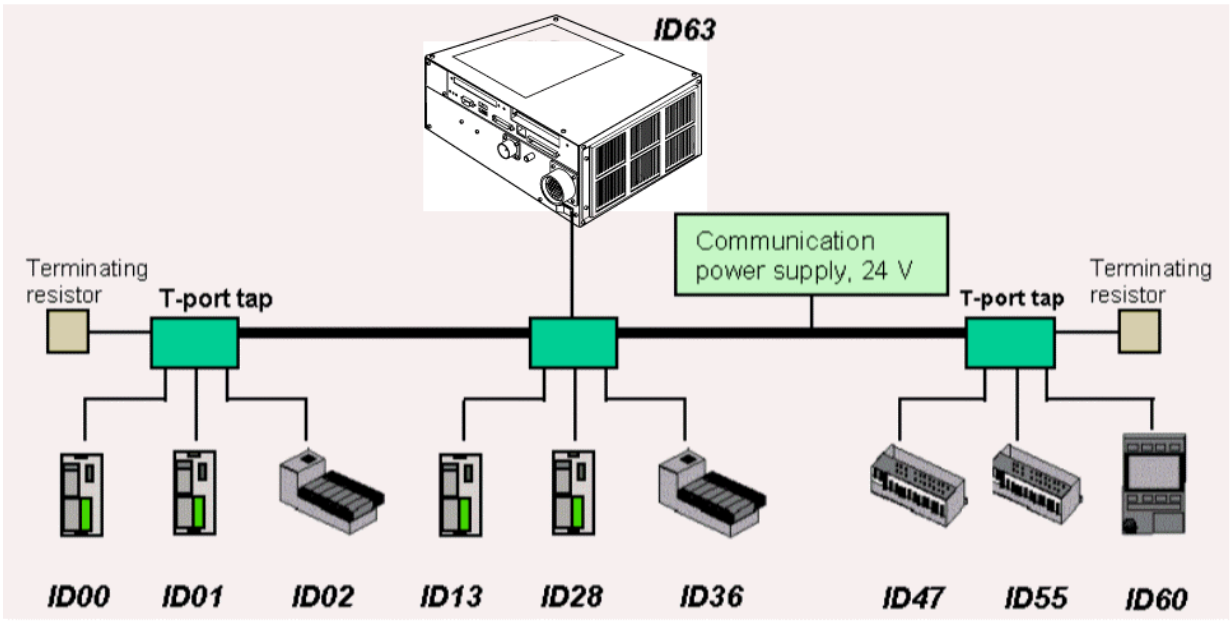
(More details about wiring and system configuration are described in Subsection 9.2.2 and in Section 9.4, respectively.)

(2) Set the communications speed for master and slave devices. DeviceNet allows selection of 125, 250, or 500 Kbps. The factory default is 500 Kbps.

(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.

(Take care not to double-assign a same address on 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.

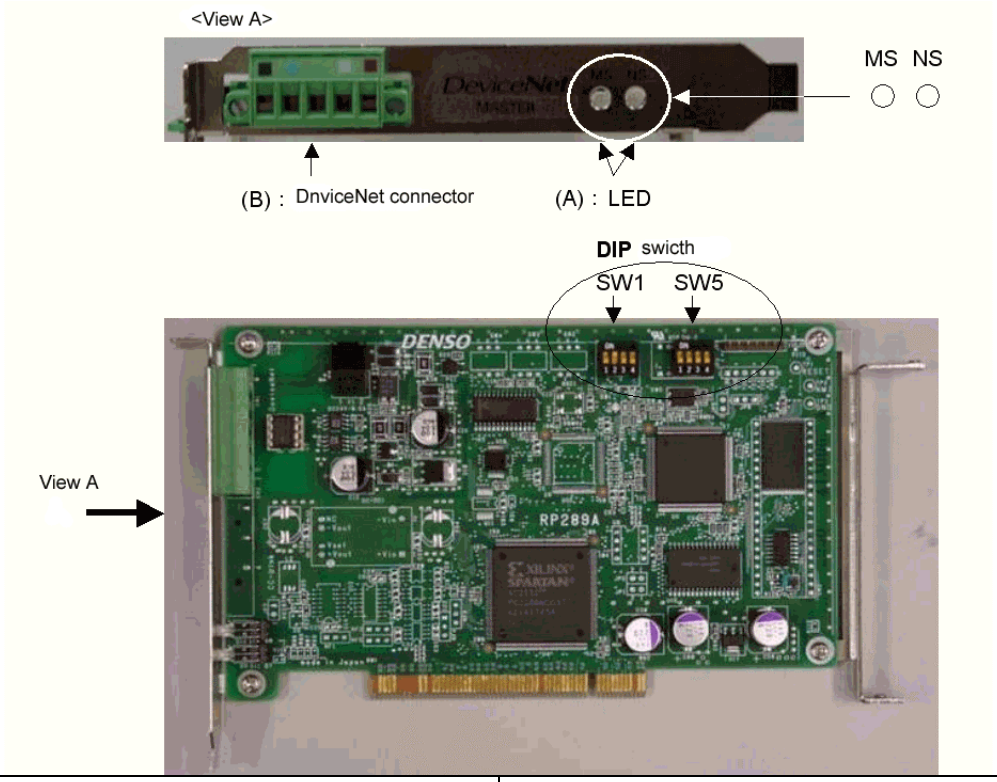
For the procedure on how to create a scanlist, refer to Subsection 9.4.2.

(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.

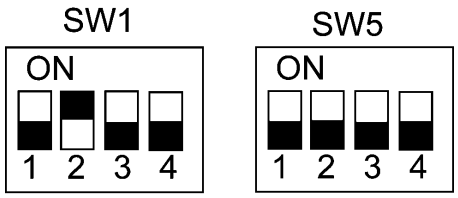
(For details about I/O addresses, refer to Section 9.3.)

8.2 Product Specifications

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



DIP switches



Side with only position 2 is ON

Other side with all positions ON

Note : DO NOT adjust the DIP switches.
In the event that the DIP switches are adjusted, reset the switches to the positions shown on the left while the controller is turned off.

DeviceNet 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	• The unit works normally.
	Red		Fatal error	• Hardware failure.
	–		No power supplied	• 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. • Node address double-assigned. • "Bus off" detected.
			Recoverable communications error	Example: I/O time out
	–		Network power supply failure	• The online status cannot be established, e.g. because a CAN send timeout error has occurred.
: 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.

1:V- (Black)
2:CAN_L (Blue)
3:Drain (Shield)
4:CAN_H (White)
5:V+ (Red)

Devivenet 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 Setting the Node Address

Set the node address using the teach pendant.

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

Select the “DeviceNet.Node address” on the “I/O Hardware settings” window, and set the node address.

Note: When restarting the robot controller, new settings will be effective.

8.2.3 Setting the Bit Rate

Set the bit rate using the teach pendant.

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

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 restarting the robot controller, new settings will be effective.

8.2.4 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 ±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☐)

(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.

8.3 I/O Allocation Settings

When using the DeviceNet master board, the I/O allocation setting is chosen from the items below.

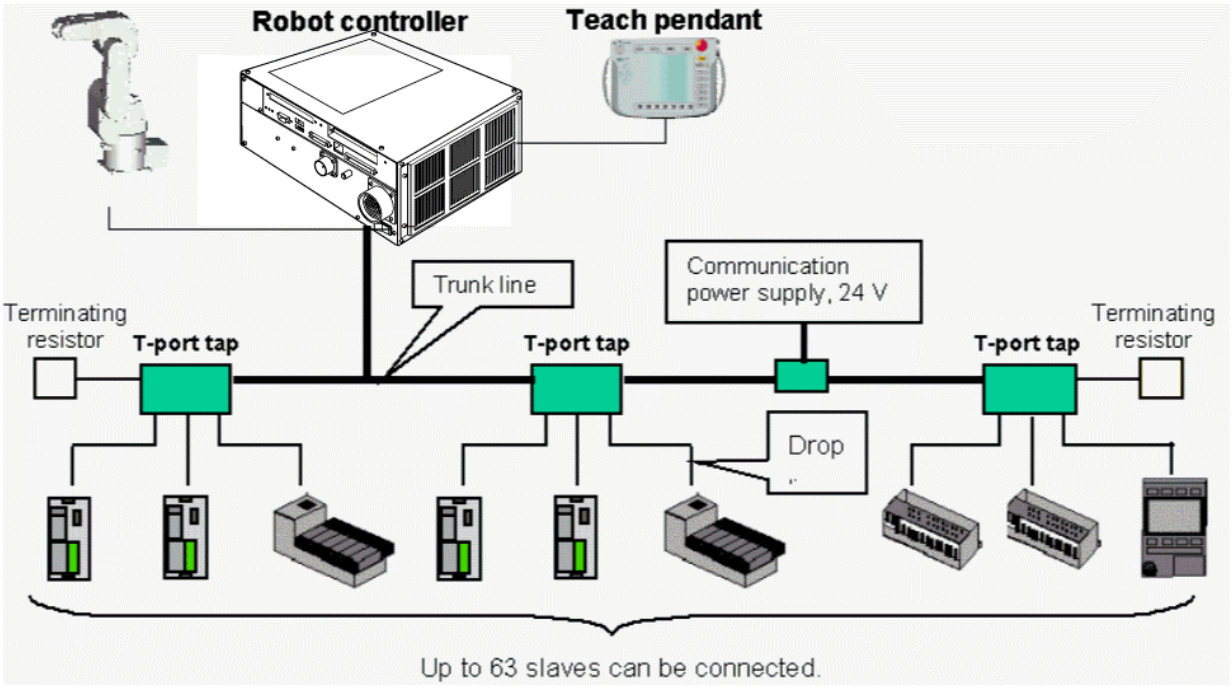
Setting of I/O allocation (DeviceNet slave board)

Allocation	General description
All-purpose	Only the user signal is allocated to the DeviceNet master board area. Only the user signal (excluding CPU Normal) is allocated to all ports of the Mini I/O area.

Note 1: Refer to "4.2 Function of Mini I/O" for the allocation to the Mini I/O area.
Note 2: 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.

8.4 Building Up a DeviceNet Network

8.4.1 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

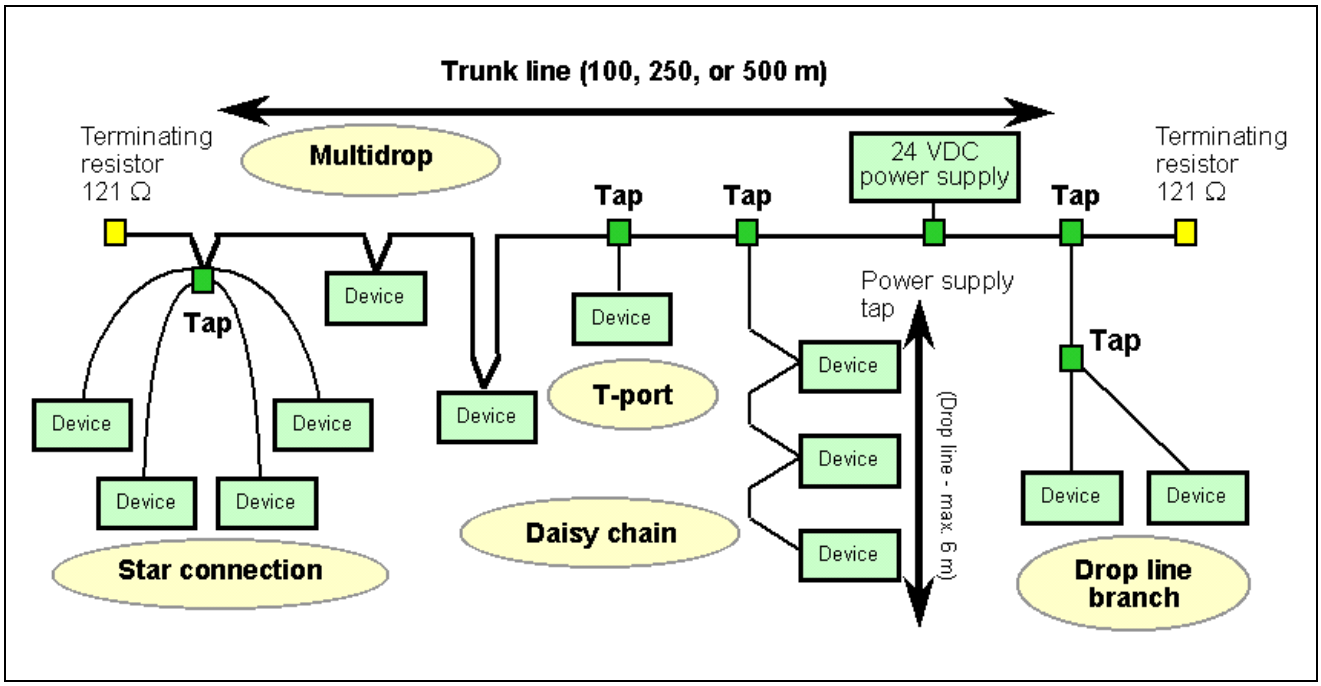
Never connect a terminating resistor to a node. This may result in a failure.

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 (thick) + 5 × L (thin) ≤ 500 m
250 Kbps	L (thick) + 2.5 × L (thin) ≤ 250 m
500 Kbps	L (thick) + L (thin) ≤ 100 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

8.4.2 Creating a Scanlist

What is “scanlist”?

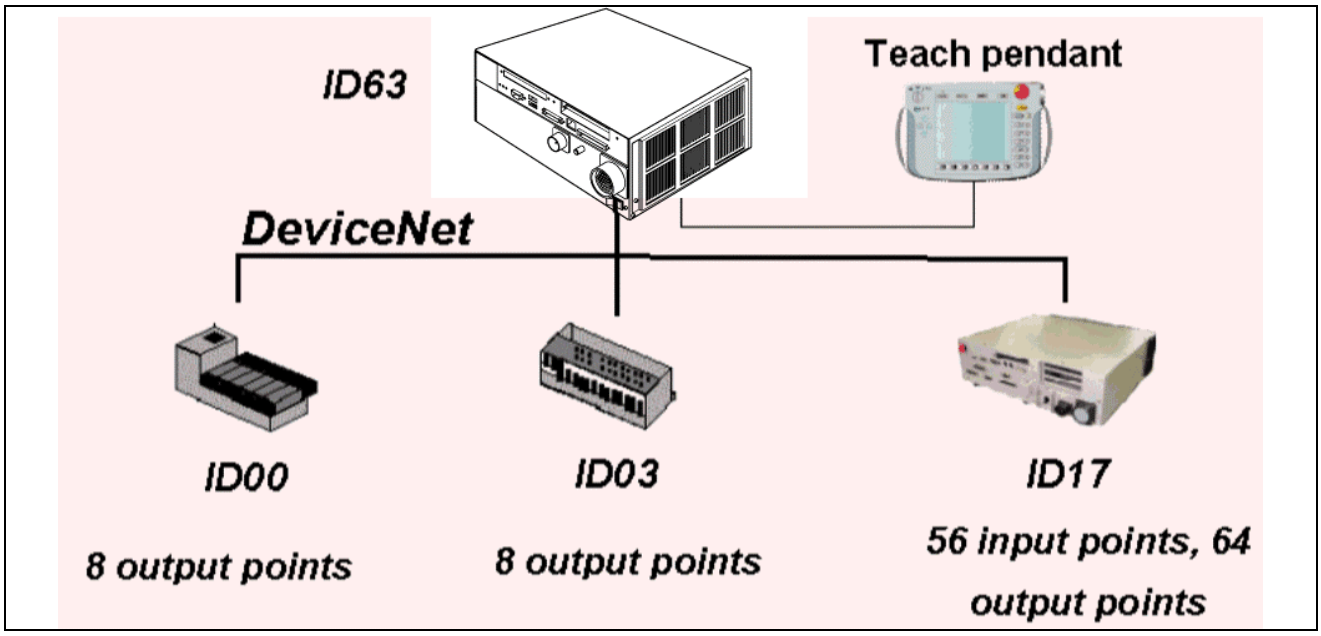
A scanlist is a parameter list that allows a DeviceNet master to identify slaves that are under its control during communication. Network communications are not possible without a scanlist.

The scanlist contains the following information:

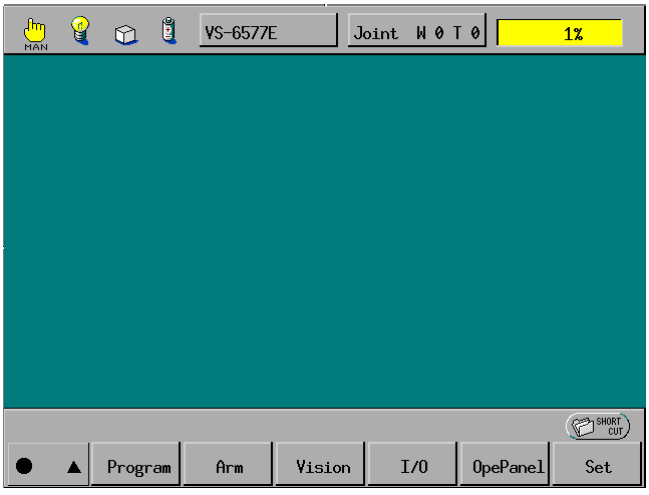
- Slave I/O allocation information (which slaves have how many input points, and which node addresses they occupy)
- The communication parameter information (remote I/O communications status, communication cycle time setting)

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.

Scanlist creation procedure

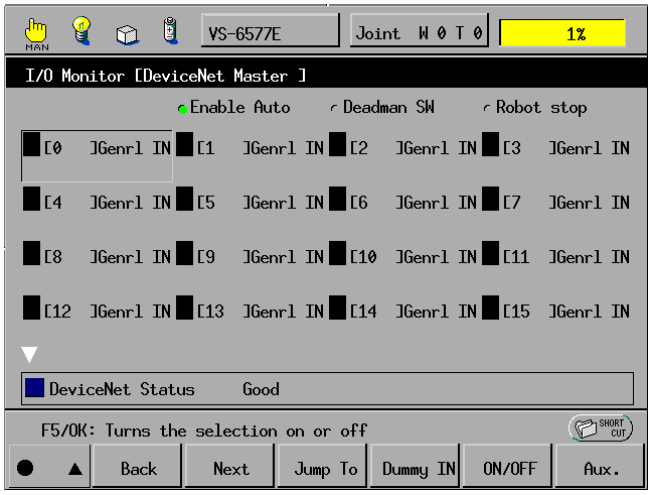


Step 1 On the top screen of the teach pendant, press [F4 I/O].



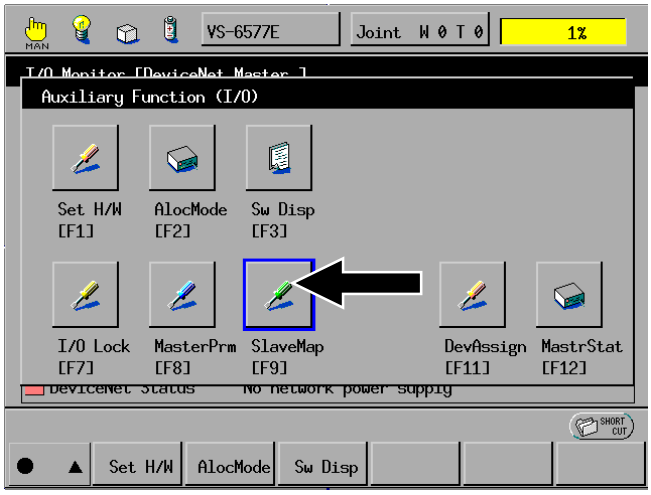
F4

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



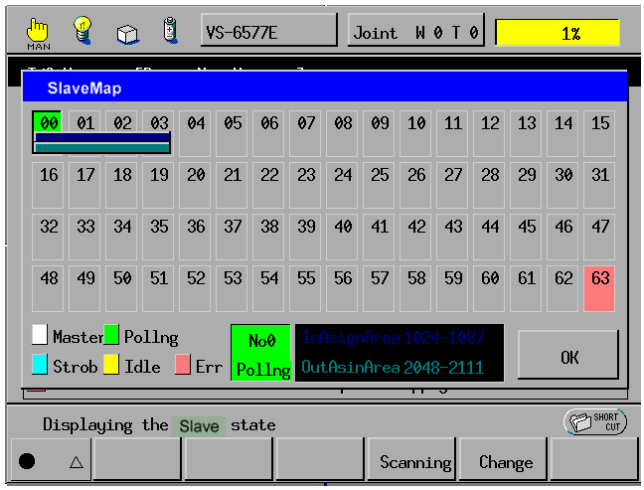
F6

Step 3 Press [F9 SlaveMap].



Step 4

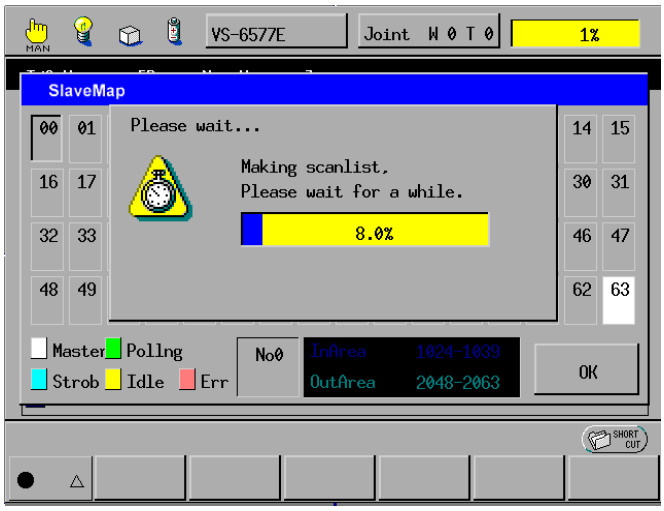
The latest scanlist will appear.
Press [F4 Scanning] on this screen.
(The default of the slave map is the fixed I/O allocation screen.)



F4

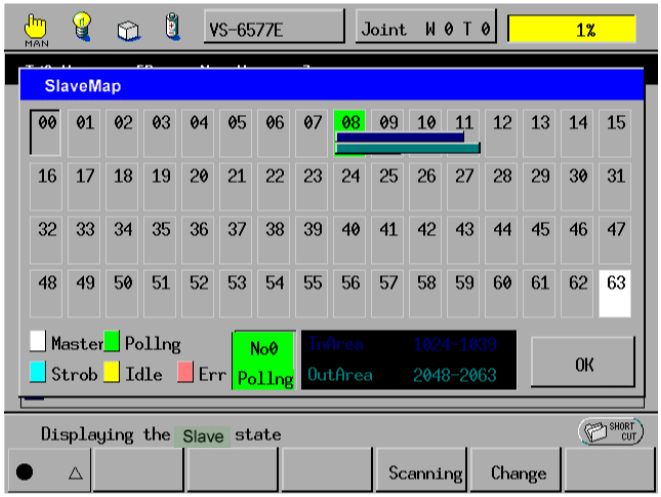
Step 5

Wait for a while when the network is being scanned.



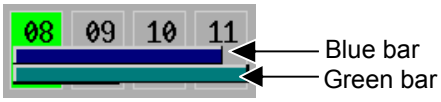
Step 6

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 × 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 blocks × 16 = 56 points
Outputs = 4.0 blocks × 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.

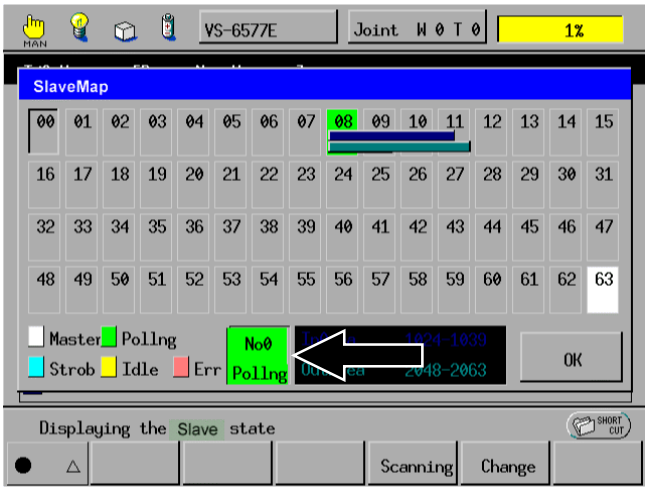
By default, the information for node 0 is displayed.

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

Displaying and changing node (slave) setting information

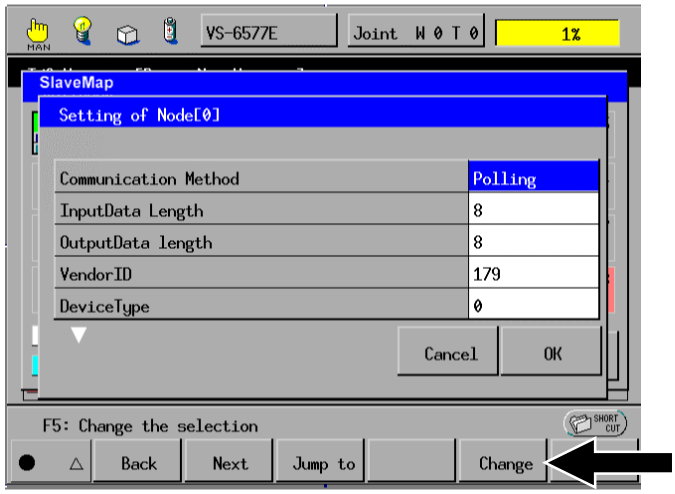
Step 1

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



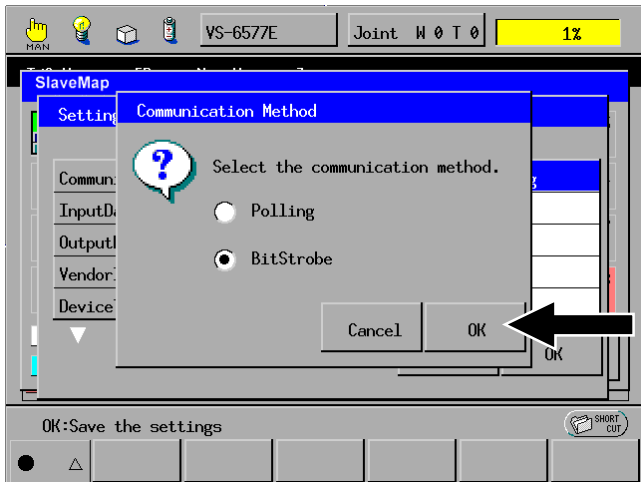
Step 2

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.



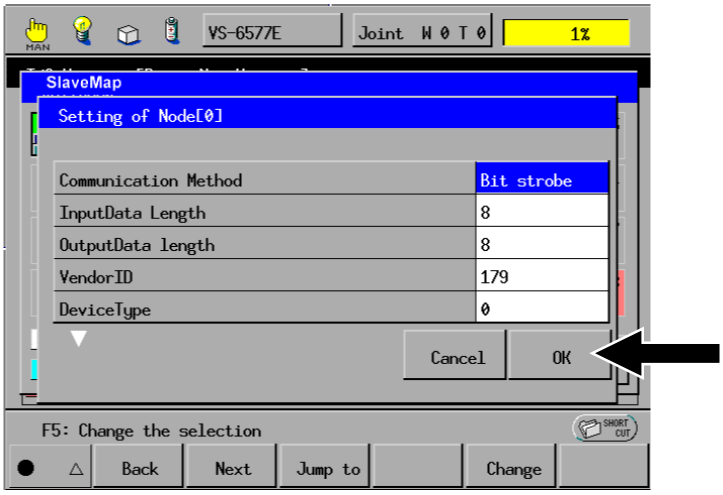
Step 3

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.

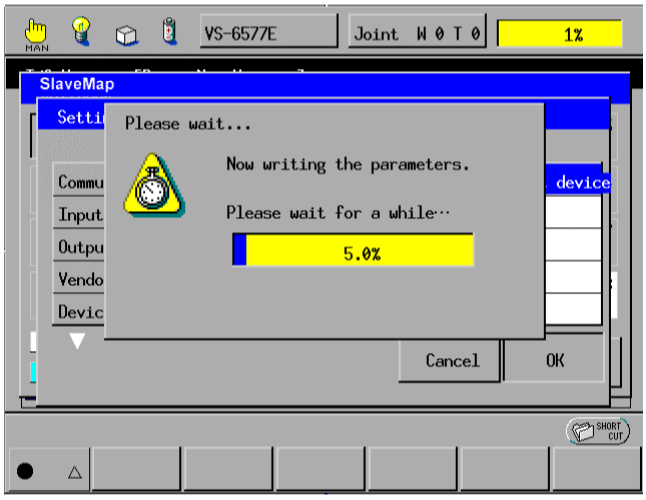


Step 4

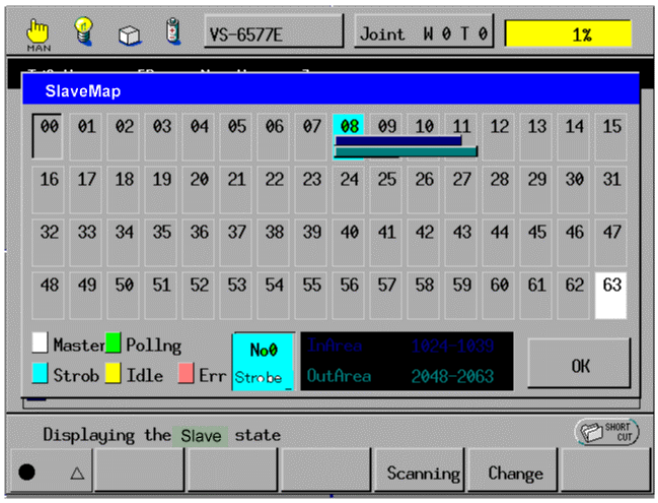
If the displayed communication method is OK, press [OK].



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



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



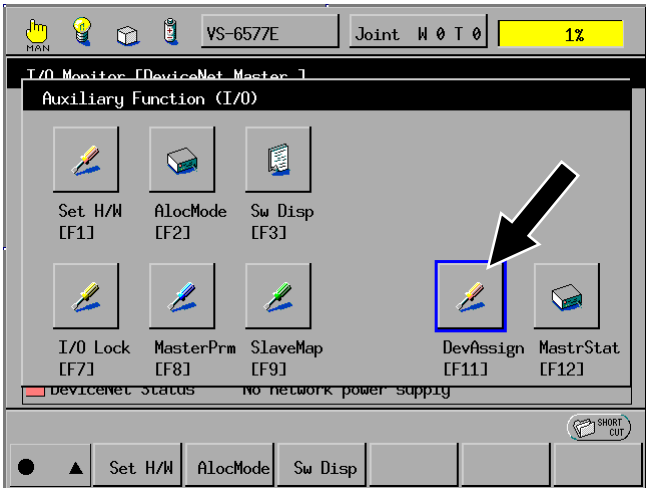
NOTE: You may change the I/O data length also on this screen but you need to make the same setting change for slaves at the same time, which makes the setting difficult. If you change the slave parameters, therefore, you are recommended to scan the network again.

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.

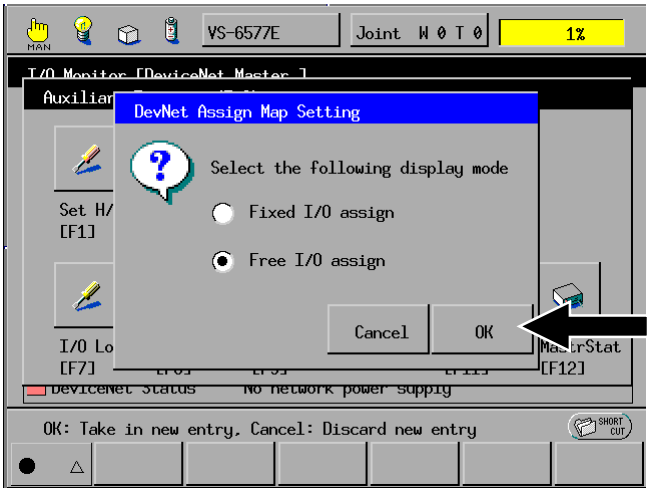
Step 1

Press [F11 DevAssign] on the Auxiliary Function (I/O) screen.



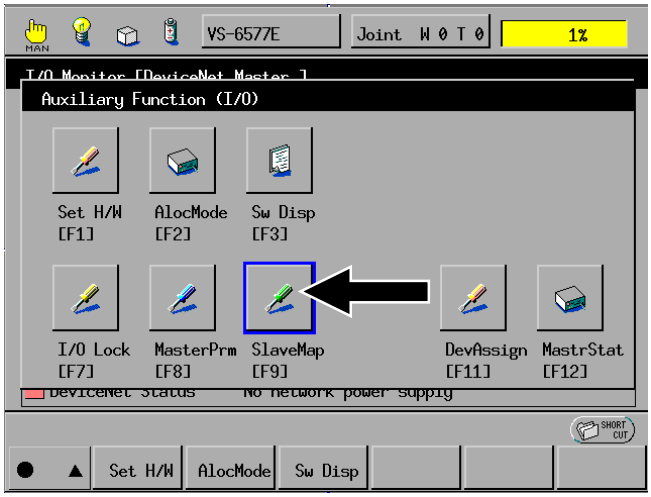
Step 2

Change the setting from “Fixed I/O assign” to “Free I/O assign” and press [OK].

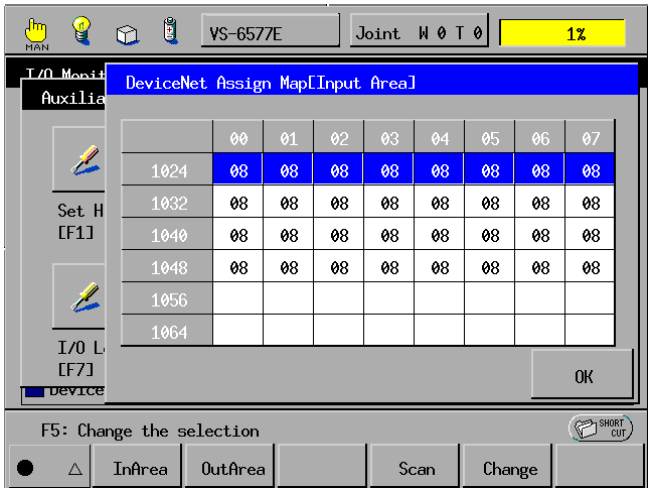


Step 3 In accordance with the change of the allocation mode, the DeviceNet master scans the network and changes the I/O allocation.

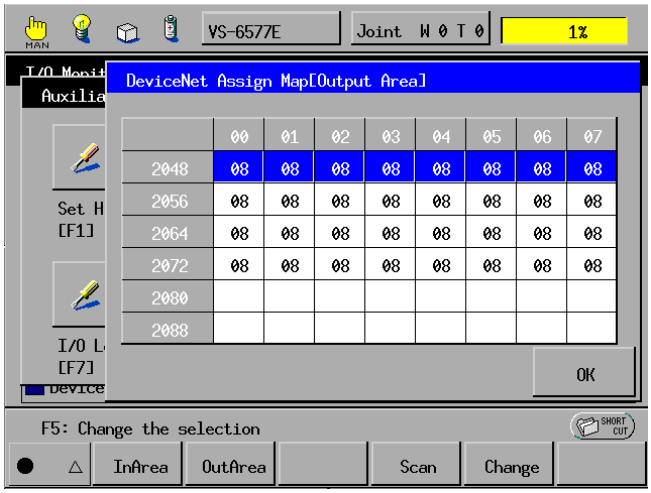
Step 4 When the following screen appears, the scan is completed. Press [F9 SlaveMap] and confirm the new setting.



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

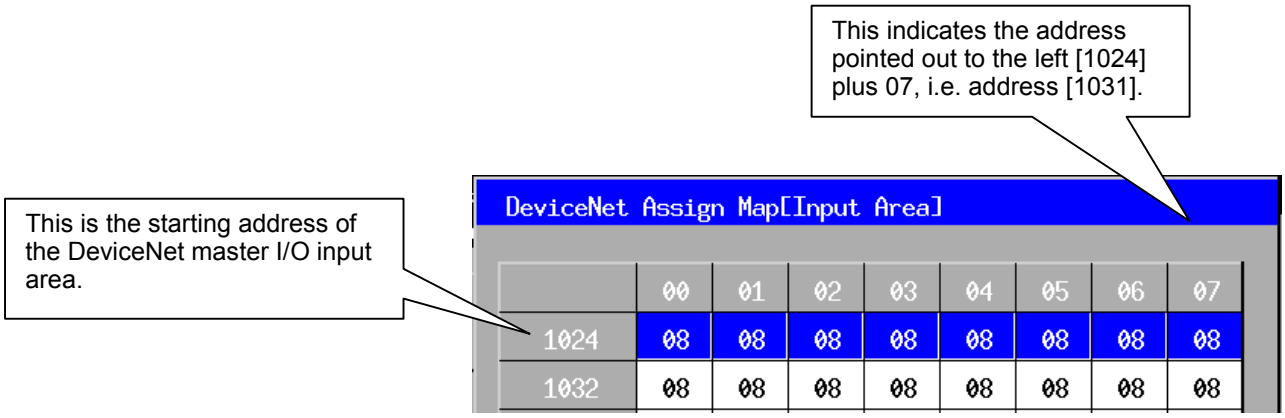


Step 6 Press [F2 OutArea] to display the output area.



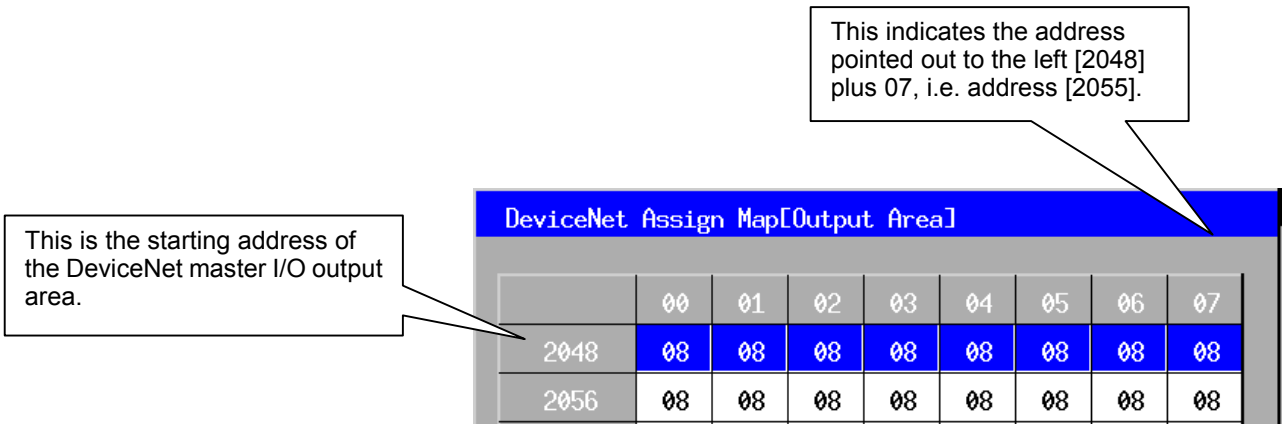
Explanation about screen

Input area display screen



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

Output area display screen



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.

8.4.3 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.

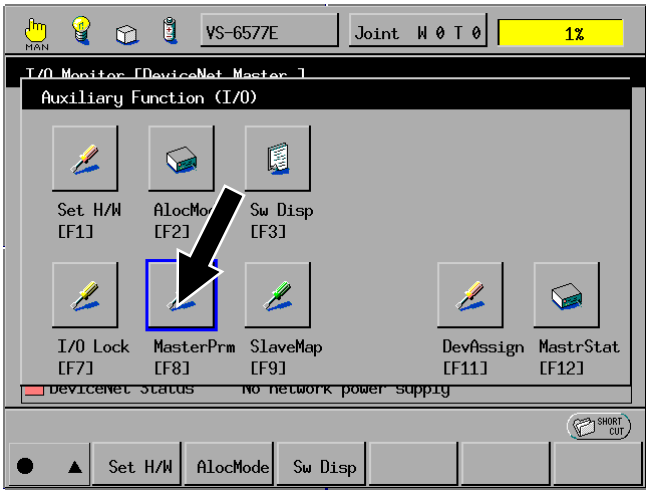
The relationship is: Detection time = EPR value × 4 (ms)

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

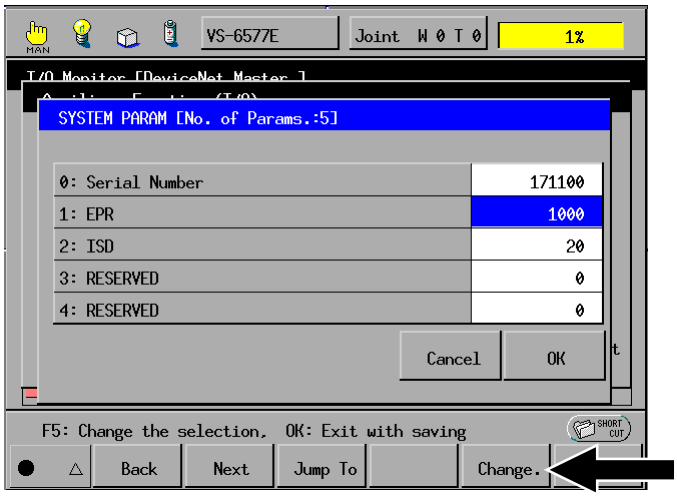
What is “ISD” (Inter Scan Delay)?

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

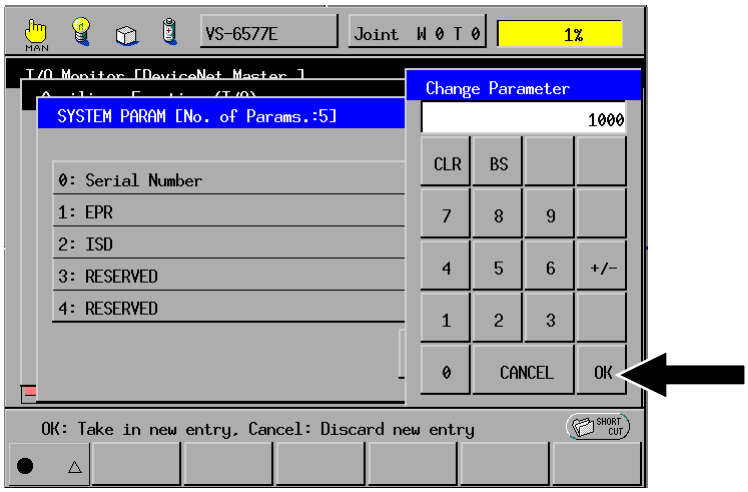
Step 1 On the Auxiliary Function (I/O) screen, press [F8 MasterPrm].



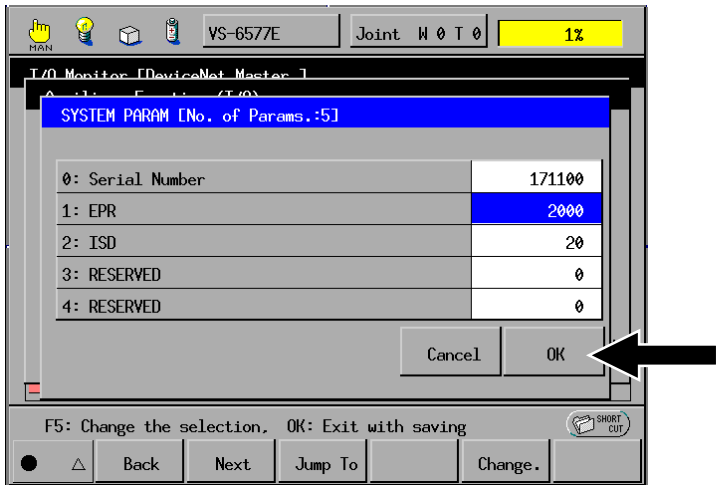
Step 2 As an example, assume that the EPR should be changed.



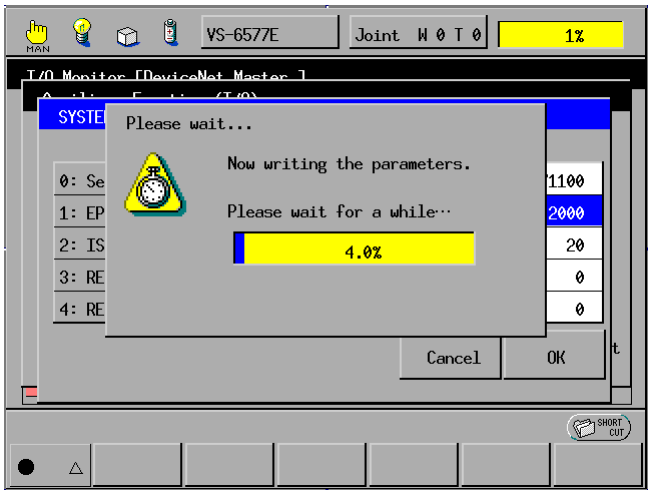
Step 3 On the SYSTEM PARAM screen, enter a new value and press [OK].



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

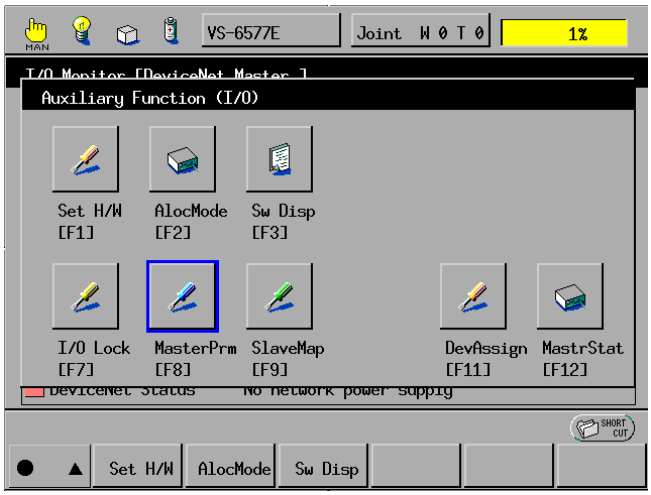


Step 5 The data will be written to the memory of the DeviceNet master.



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.

8.4.4 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 DnetStat]

Search the “Master software version” on the “DeviceNet State” window.

8.4.5 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.

8.5 Field Network Error Indication

The field network error indication parameter can be used with a DeviceNet master board. Refer to “7.5 Field Network Error Indication.”

8.6 Network Error Detector Suppression

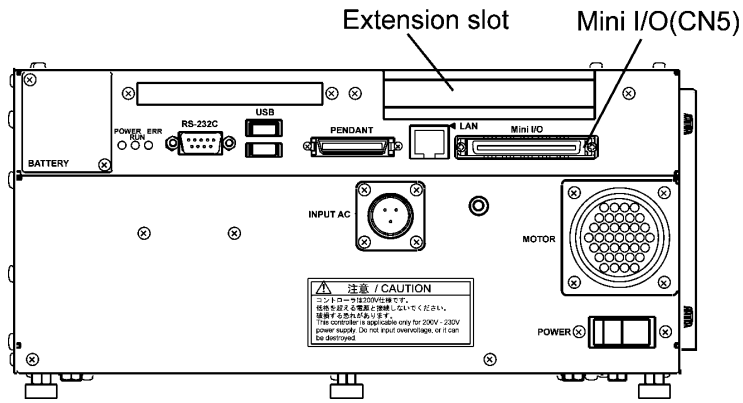
The network error detection wait-time parameter can be used with a DeviceNet master board. Refer to “7.6 Network Error Detector Suppression.”

Chapter9 DeviceNet Master and Slave Board

9.1 Overview

If the robot controller has a built-in DeviceNet master and slave board, it can communicate with external devices according to the DeviceNet-compliant protocol.

As a slave unit for serial communications 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.
The DeviceNet master and slave board is installed into the extension slot of the controller.



Note: The CN5 (Mini I/O connector set is provided as an accessory for the controller with DeviceNet master-and-slave or DeviceNet master-and-slave board.
When using the Mini I/O, utilize this connector set after referring to "RC7J Controller Interface Manual."

Extension slot for RC7J controller

9.1.1 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

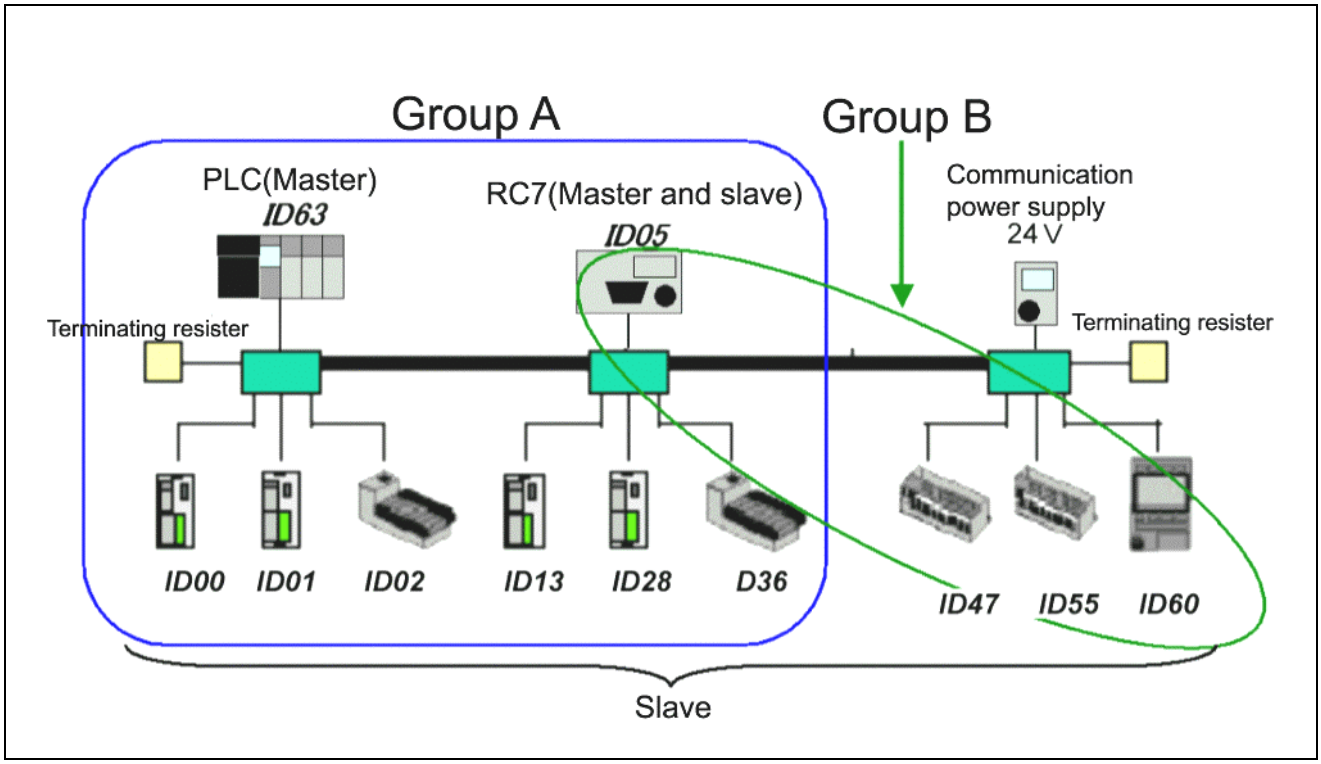
The 5-core special cable and detachable connector of the DeviceNet slave board make it easy to install wiring between nodes (communications units) and disassembly/restructure the network. This will sharply reduce cost in wiring and maintenance, as well as making replacement of units easy at the time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

9.1.2 System Configuration Sample



System Configuration Sample (DeviceNet master and slave)

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.

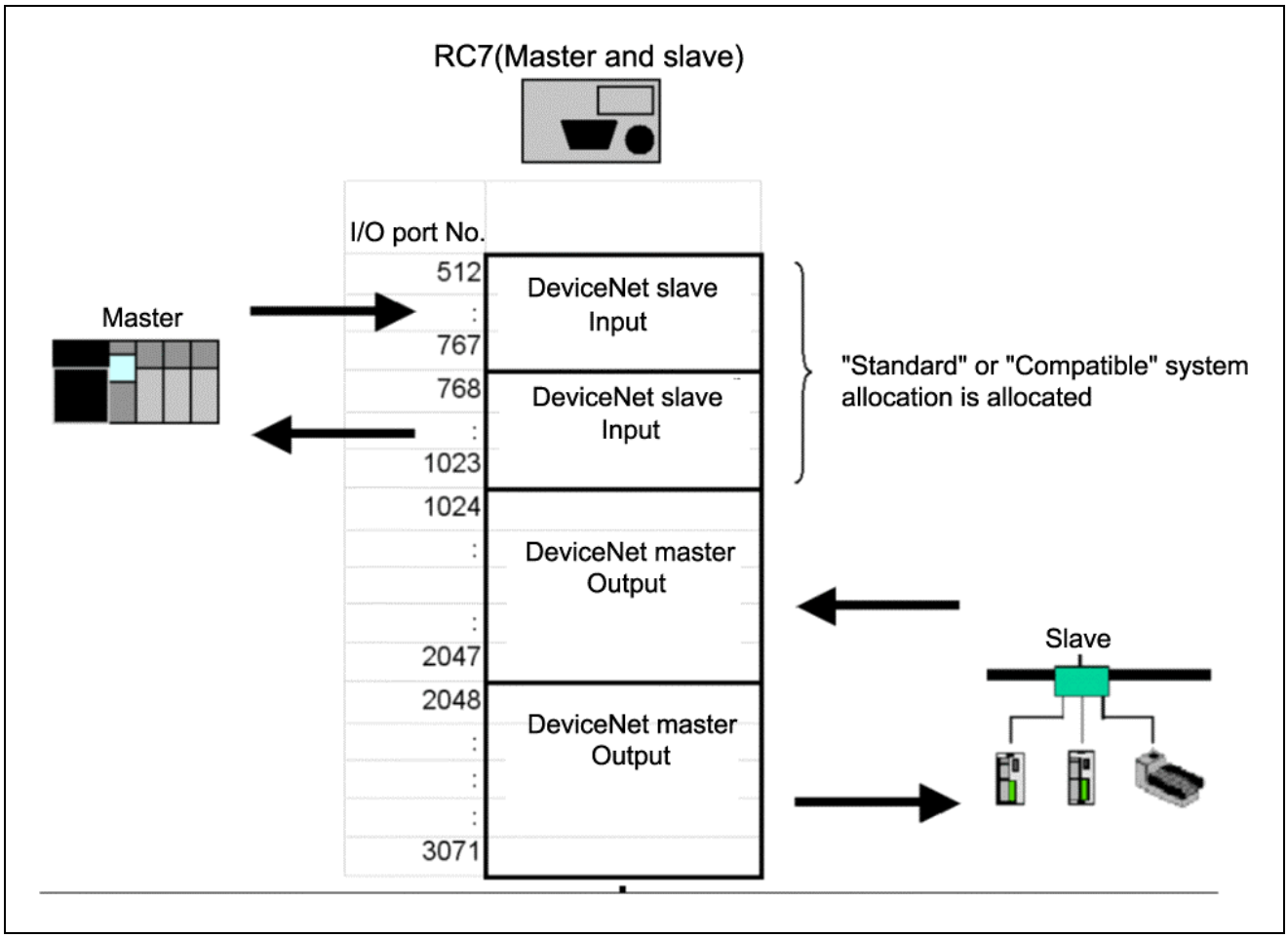
Serial communication system in Group A:
[PLC (Master): ID63] communicates with ID00, ID01, ID05, ID28 and ID36.

Serial communication system in Group B:
[RC7 (Master and slave): ID05] communicates with ID47, ID55 and ID.

9.1.3 Master Area and Slave Area

When the RC7 master-and-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.

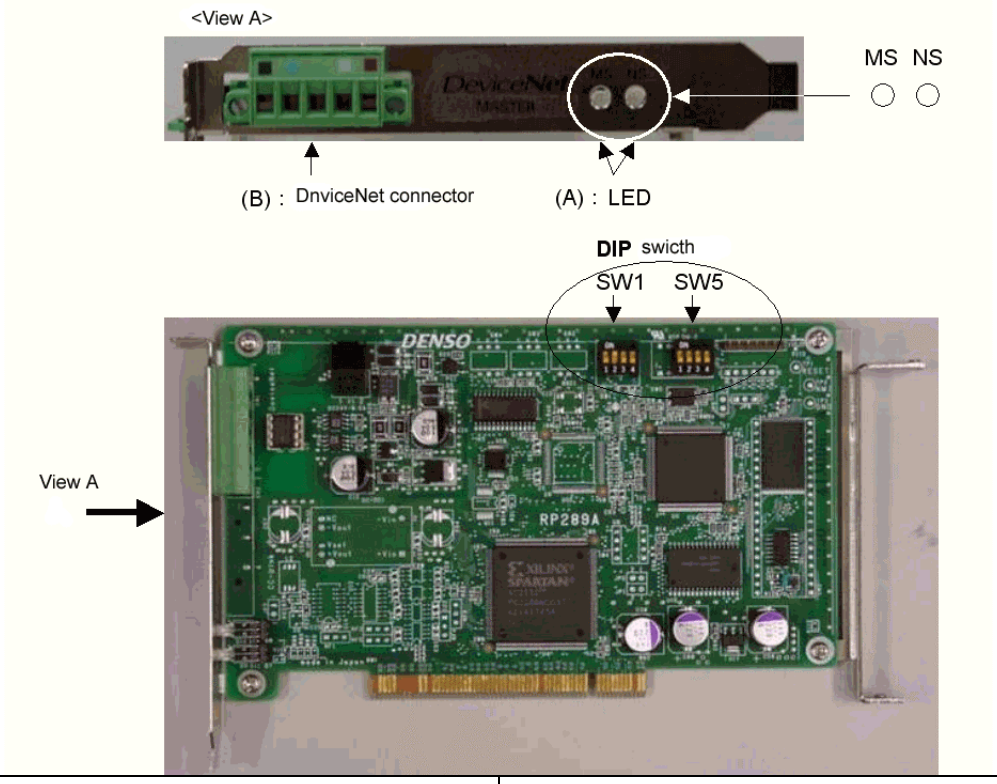
“Standard” or “ Compatible” system I/O signals are allocated to the 512 to 1023 area. As the system signals of I/O allocation is the same with the DeviceNet slave board, refer to “7.3.1 Standard Assignment Mode” and “7.3.2 Compatible Assignment Mode”.



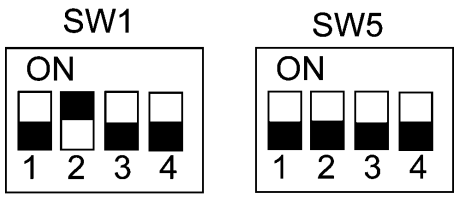
Master Area and Slave Area

9.2 Product Specifications

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



DIP switches



Note : DO NOT adjust the DIP switches.
In the event that the DIP switches are adjusted, reset the switches to the positions shown on the left while the controller is turned off.

DeviceNet master and slave board

9.2.1 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	• The unit works normally.
	Red		Fatal error	• Hardware failure.
	–		No power supplied	• 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. • Node address double-assigned. • "Bus off" detected.
			Recoverable communications error	Example: I/O time out
	–		Network power supply failure	• The online status cannot be established, e.g. because a CAN send timeout error has occurred.
: 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.

1:V- (Black)
2:CAN_L (Blue)
3:Drain (Shield)
4:CAN_H (White)
5:V+ (Red)

Devivenet 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

9.2.2 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

<table>
<tr><td>Item</td><td colspan="4">Specifications</td></tr>
<tr><td>Communications protocol</td><td colspan="4">DeviceNet–compliant</td></tr>
<tr><td>Connection supported</td><td colspan="4">Connection supported in Master
- Polling I/O function
- Bit strobe function
Connection supported in Slave
- Polling I/O function

Compliant with DeviceNet communication rules</td></tr>
<tr><td>Connection type (Note 1)</td><td colspan="4">Multi-drop type with possible combination of T-branch
(to trunk and branch lines)</td></tr>
<tr><td>Bit rate</td><td colspan="4">500, 250, 125 kbps</td></tr>
<tr><td>Communications media</td><td colspan="4">Special cable consisting of 5 wires
(2 for signals, 2 for power supply, and 1 as a shield wire)</td></tr>
<tr><td rowspan="4">Communications cable length</td><td>Bit rate</td><td>Max. network length</td><td>Branch length</td><td>Total branch length</td></tr>
<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>
<tr><td>Power supply for communication</td><td colspan="4">External supply of 24 VDC ±10%</td></tr>
<tr><td>Internal power consumption</td><td colspan="4">Communication power source: 65 mA max.</td></tr>
<tr><td>Max. number of connectable nodes</td><td colspan="4">64</td></tr>
<tr><td>Number of I/Os</td><td colspan="4">Master area
- Input 1024 points
- Output 1024 points
Slave area
- Input 256 points
- Output 256 points</td></tr>
<tr><td>Error check</td><td colspan="4">CRC</td></tr>
<tr><td colspan="5">(Note 1) Terminator resistors are needed at both ends of the trunk cable. (121☐)
(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.</td></tr>
</table>

9.2.3 I/O Allocation Settings

When using the DeviceNet master and slave board, the I/O allocation setting is chosen from the items below.

Setting of I/O allocation

Allocation	General description
Compatible	”Compatible” system allocation is allocated to the DeviceNet master and slave board area. Only the user signal (excluding CPU Normal) is allocated to all ports of the Mini I/O area.
Standard	”Standard” system allocation is allocated to the DeviceNet master and slave board area. Only the user signal (excluding CPU Normal) is allocated to all ports of the Mini I/O area.
Compatible (RC5-compliant)	”Compatible” of system allocation is allocated to the DeviceNet master and slave board area. Only the user signal (RC5-compliant and excluding CPU Normal) is allocated to all ports of the Mini I/O area.
Standard (RC5-compliant)	”Standard” system allocation is allocated to the DeviceNet master and slave board area. Only the user signal (RC5-compliant and excluding CPU Normal) is allocated to all ports of the Mini I/O area.
All-purpose	Only the user signal is allocated to the DeviceNet master and slave board area. Only the user signal (excluding CPU Normal) is allocated to all ports of the Mini I/O area.
Note 1: Refer to “4.2 Function of Mini I/O” for the allocation to the Mini I/O area. **Note 2:** 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.	

9.2.4 Setting the Node Address

Set the node address using the teach pendant.

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

Select the “DeviceNet.Node address” on the “I/O Hardware settings” window, and set the node address.

Note: When restarting the robot controller, new settings will be effective.

9.2.5 Setting the Bit Rate

Set the bit rate using the teach pendant.

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

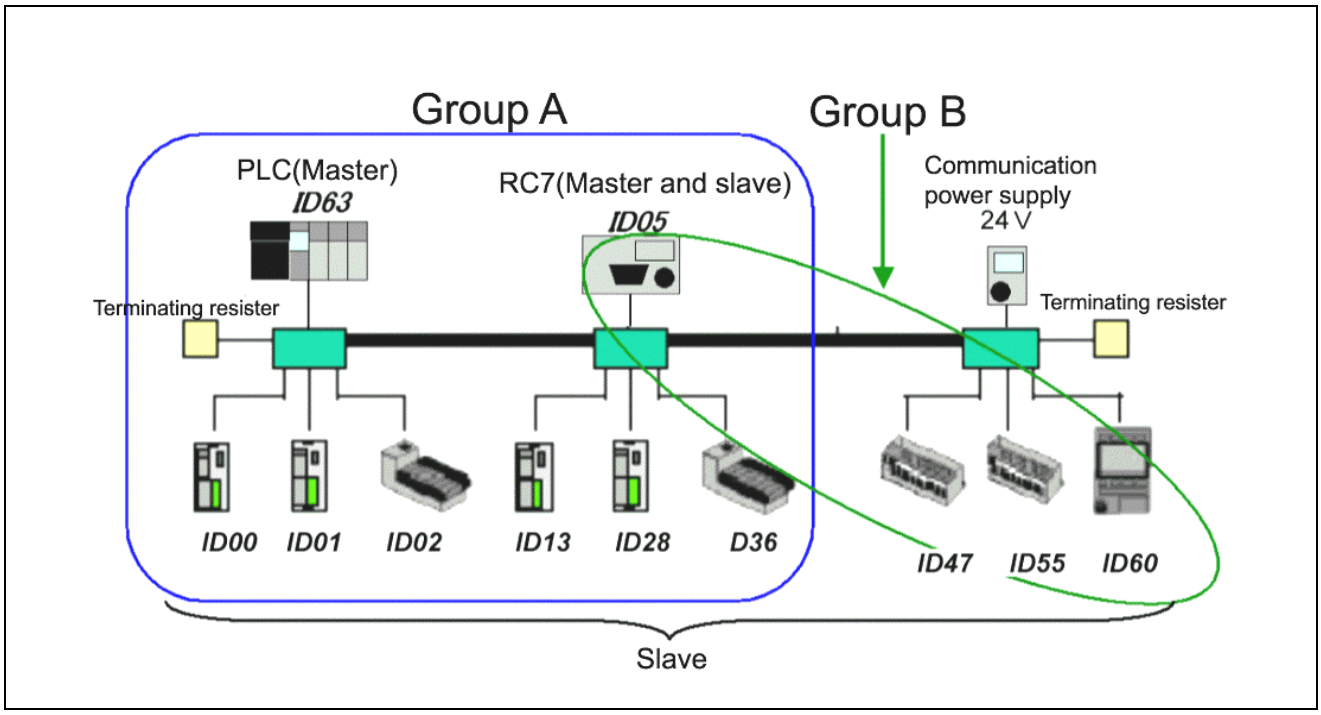
Select the “DeviceNet.Bit Rate (0:125KB, 1:250KB, 2:500KB)” on the “I/O Hardware settings” window, and set the bit rate.

Note: When restarting the robot controller, new settings will be effective.

9.2.6 Entering the Number of Input/Output Slots

Refer to “7.4.1 Entering the Number of Input/Output Slots”.

9.3 System Configuration Sample



System Configuration Sample (DeviceNet master and slave)

9.3.1 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 Subsection 9.2.2.

(2) Connect the terminating resister.

(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 Subsection 8.4.2. 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.

9.3.2 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 Subsection 9.2.2.

(2) Connect the terminating resister.

(3) Connect the communication power supply and then turn on the power of each device.

(4) Configure the Gropup 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 Subsection 8.4.2. 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.

9.4 Field Network Error Indication

The field network error indication parameter can be used with a DeviceNet master board. Refer to “7.5 Field Network Error Indication.”

9.5 Network Error Detector Suppression

The network error detection wait-time parameter can be used with a DeviceNet master board. Refer to “7.6 Network Error Detector Suppression.”

Chapter10 CC-Link Remote Device Board

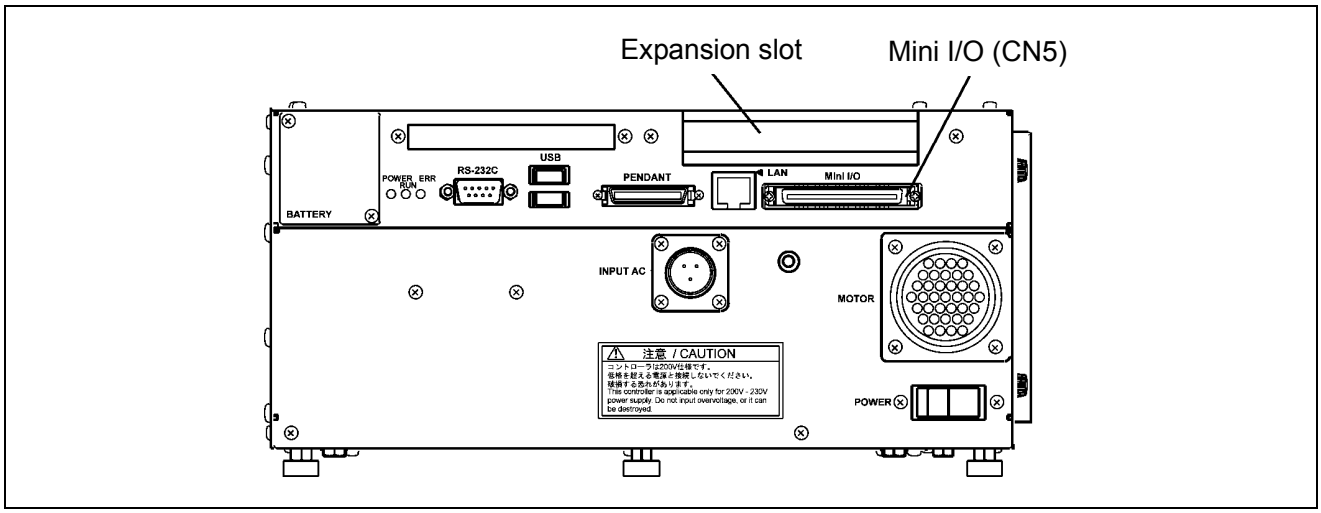
10.1 Overview

If the robot controller has a built-in CC-Link remote device board, it may easily exchange I/O data with various types of CC-Link-compliant field devices.

In this case, the robot controller becomes a remote device for serial communications compliant with the open network CC-Link.

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

A CC-Link remote device board is incorporated in the expansion slot of the robot controller. (See “Chapter 12 Mounting I/O Option Boards”.)

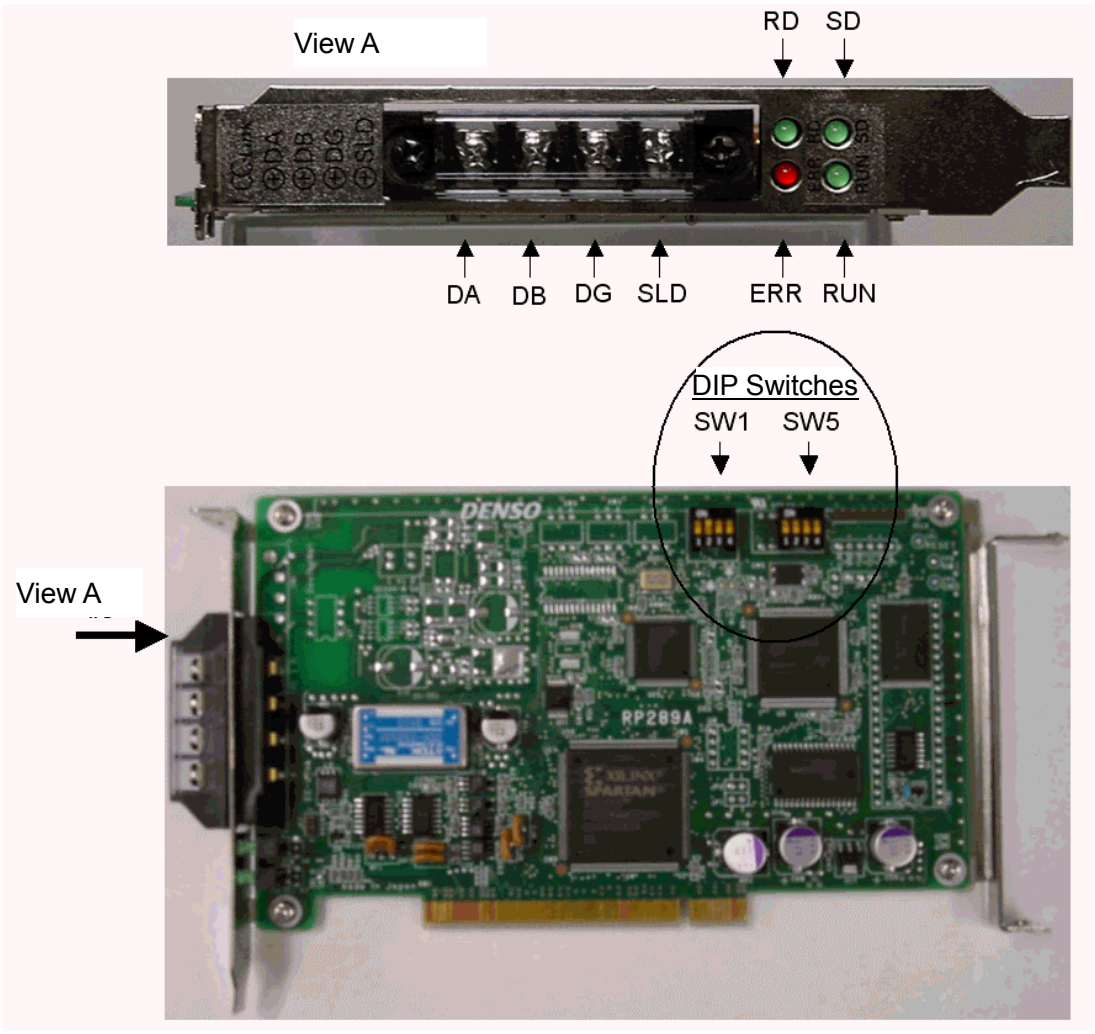


NOTE: CN5 (INPUT) is provided as an accessory for controllers with CC-Link or a CC-Link remote device board. When using Mini I/O, utilize this accessory connector set after referring to “RC7J Controller Interface Manual.”

10.2 Product Specifications

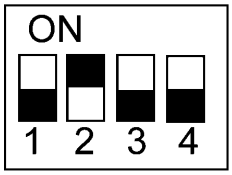
10.2.1 CC-Link Remote Device Board Part Names

CC-Link remote device board part names are shown below.



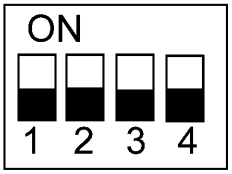
DIP switches

SW1



Side with only position 2 is ON

SW5



Other side with all positions ON

Note 1: DO NOT adjust the DIP switches.
In the event that the DIP switches are adjusted, reset the switches to the positions shown on the left while the controller is turned off.

Note 2: Be sure to attach the clear plastic
CC-Link connector cover after completing wiring.

CC-Link remote device board

10.2.2 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.

: ON : Flashing : OFF

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)
●	●	◐	○	• The link is not activated. • The mobile unit settings of the master are wrong.
●	●	◐	●	- (Impossible operational state)
●	●	●	○	• 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.

10.2.3 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

10.2.4 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

<table>
<tr><td>Item</td><td colspan="6">Specifications</td></tr>
<tr><td>Communication protocol</td><td colspan="6">CC-Link-compliant</td></tr>
<tr><td>CC-Link version</td><td colspan="6">Ver.1.10-compliant</td></tr>
<tr><td>Communication method</td><td colspan="6">Polling scheme</td></tr>
<tr><td>Synchro system</td><td colspan="6">Frame synchronization</td></tr>
<tr><td>Encoding method</td><td colspan="6">NRZ1</td></tr>
<tr><td>Transmission line method</td><td colspan="6">RS485 bus</td></tr>
<tr><td>Transmission format</td><td colspan="6">HDLC-compliant</td></tr>
<tr><td>Remote station number</td><td colspan="6">1 – 63 (64 cannot be set for this board.)</td></tr>
<tr><td>Error control method</td><td colspan="6">CRC ($X^{16} + X^{12} + X^5 + 1$)</td></tr>
<tr><td>RAS function</td><td colspan="6">Communication defect detection (CRC error, abort error)</td></tr>
<tr><td>Connection cable</td><td colspan="6">Three–pin shielded twisted pair cable</td></tr>
<tr><td rowspan="2">Total extension length
Ver. 1. 10 compliant CC-Link dedicated cable (With end resistance of 100Ω)</td><td>Baud rate (bps)</td><td>10M</td><td>5M</td><td>2.5M</td><td>625K</td><td>156K</td></tr>
<tr><td>Total extension length (m)</td><td>100</td><td>160</td><td>400</td><td>900</td><td>1200</td></tr>
<tr><td>Number of occupied stations</td><td colspan="6">2 – 4 stations</td></tr>
<tr><td>Number of I/O bits</td><td colspan="6">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

Note: Only remote input/output (RX, RY) is used with this board.
A remote resistor (RWr, RWw) is not used.</td></tr>
<tr><td>Mobile unit type</td><td colspan="6">Remote device</td></tr>
<tr><td colspan="7">Note: Refer to the operations manual of the CC-Link remote device board for details of CC-Link specifications.</td></tr>
</table>

10.3 Selectable Allocation

The allocations that can be selected while the CC-Link remote device board is in use are as follows.

Allocation	General description
Compatible	Compatible system allocation is allocated to the CC-Link remote device board area. Only the user signal (excluding Normal CPU) is allocated to all ports of the Mini I/O area.
Standard	Standard system allocation is allocated to the CC-Link remote device board area. Only the user signal (excluding Normal CPU) is allocated to all ports of the Mini I/O area.
Compatible (RC5-compliant)	Compatible system allocation is allocated to the CC-Link remote device board area. Only the user signal (RC5-compliant and excluding Normal CPU) is allocated to all ports of the Mini I/O area.
Standard (RC5-compliant)	Standard system allocation is allocated to the CC-Link remote device board area. Only the user signal (RC5-compliant and excluding Normal CPU) is allocated to all ports of the Mini I/O area.

Refer to the function of “4.2 Mini I/O” for the allocation to the Mini I/O area.

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

10.3.1 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	User input (INPUT m) (Note 2)	RY(n+2)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 name	Remote input (Note 1)
768	-	RXn0
769	Robot running	RXn1
770	Robot failure	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
:		:
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 failure (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.

(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	Unused	RY(n+5)0
:		:
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 failure	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	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 failure (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.

(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	Unused	RY(n+7)0
:		:
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 failure	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	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 failure (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.

10.3.2 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 failure	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 failure	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 code, unit, 2^0	RX(n+1)0
785	Error code, unit, 2^1	RX(n+1)1
786	Error code, unit, 2^2	RX(n+1)2
787	Error code, unit, 2^3	RX(n+1)3
788	Error code, tens, 2^0	RX(n+1)4
789	Error code, tens, 2^1	RX(n+1)5
790	Error code, tens, 2^2	RX(n+1)6
791	Error code, tens, 2^3	RX(n+1)7
792	Error code, hundreds, 2^0	RX(n+1)8
793	Error code, hundreds, 2^1	RX(n+1)9
794	Error code, hundreds, 2^2	RX(n+1)A
795	Error code, hundreds, 2^3	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 failure (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.

(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 failure	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 failure	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 code, unit, 2^0	RX(n+1)0
785	Error code, unit, 2^1	RX(n+1)1
786	Error code, unit, 2^2	RX(n+1)2
787	Error code, unit, 2^3	RX(n+1)3
788	Error code, tens, 2^0	RX(n+1)4
789	Error code, tens, 2^1	RX(n+1)5
790	Error code, tens, 2^2	RX(n+1)6
791	Error code, tens, 2^3	RX(n+1)7
792	Error code, hundreds, 2^0	RX(n+1)8
793	Error code, hundreds, 2^1	RX(n+1)9
794	Error code, hundreds, 2^2	RX(n+1)A
795	Error code, hundreds, 2^3	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 failure (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.

(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 failure	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 failure	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 code, unit, 2^0	RX(n+1)0
785	Error code, unit, 2^1	RX(n+1)1
786	Error code, unit, 2^2	RX(n+1)2
787	Error code, unit, 2^3	RX(n+1)3
788	Error code, tens, 2^0	RX(n+1)4
789	Error code, tens, 2^1	RX(n+1)5
790	Error code, tens, 2^2	RX(n+1)6
791	Error code, tens, 2^3	RX(n+1)7
792	Error code, hundreds, 2^0	RX(n+1)8
793	Error code, hundreds, 2^1	RX(n+1)9
794	Error code, hundreds, 2^2	RX(n+1)A
795	Error code, hundreds, 2^3	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 failure (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.

10.4 Field Network Error Indication Parameter

The field network error indication parameter can be used with a CC-Link remote device. Refer to “7.5 Field Network Error Indication.”

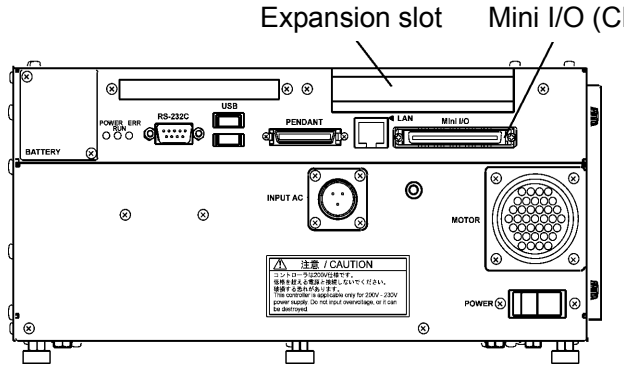
10.5 Network Error Detection Wait-time Parameter

The network error detection wait-time parameter can be used with a CC-Link remote device. Refer to “7.6 Network Error Detector Suppression.”

Chapter11 Parallel I/O Board

11.1 Overview

When the robot controller has a built-in parallel I/O board, 40 points for input and 48 points for output can be used in addition to the 16 points for input and output respectively available on Mini I/O.
(See “Chapter 12 Mounting I/O Option Boards”.)
Parallel I/O board is incorporated in the expansion slot of the robot controller.

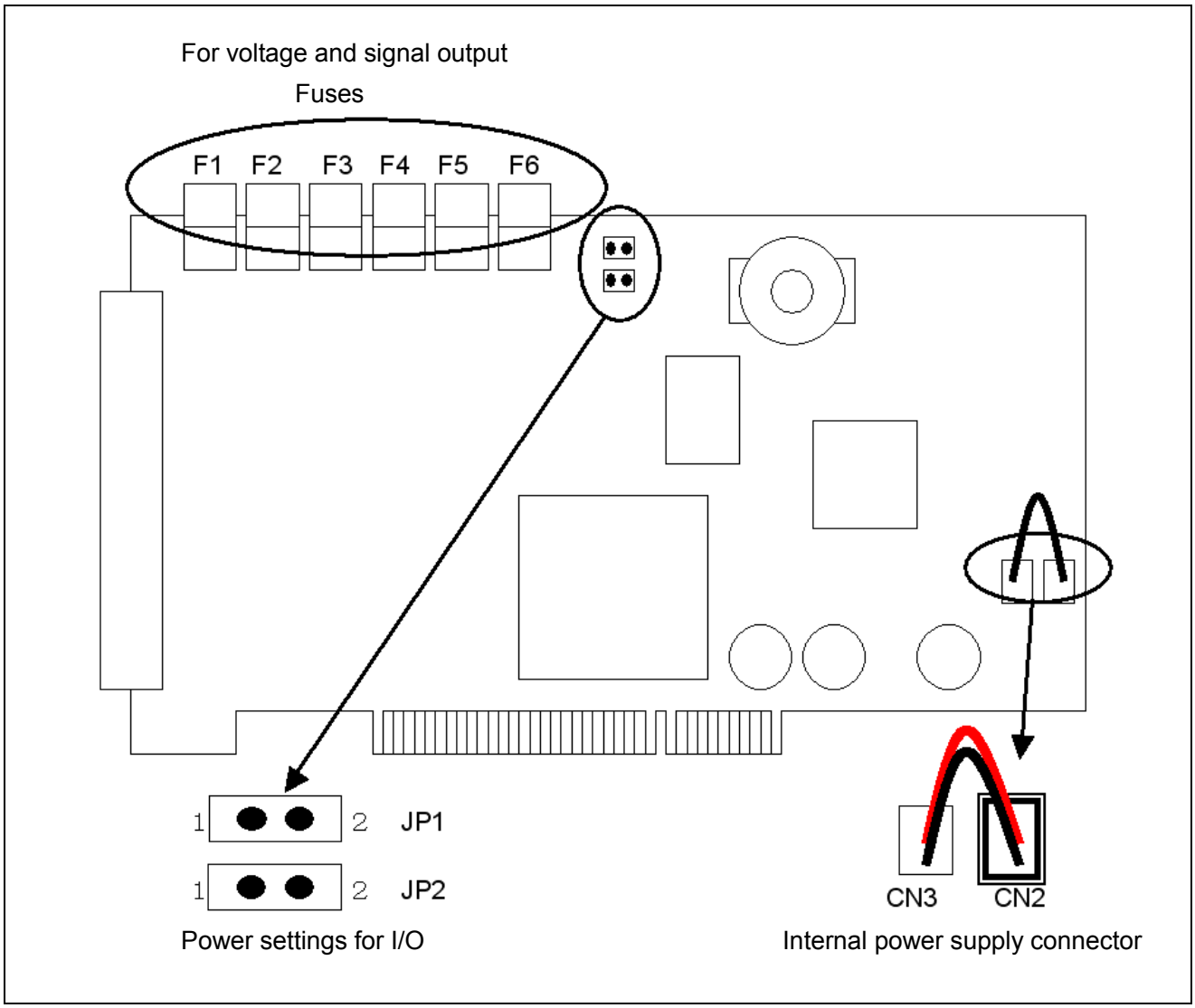


Note: The CN5 (Mini I/O connector set is provided as an accessory for the controller with parallel I/O board or the parallel I/O board. When using the Mini I/O, utilize this connector set after referring to “RC7J Controller Interface Manual.”

11.2 Product Specifications

11.2.1 Parallel I/O Board Part Names

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

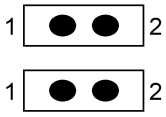
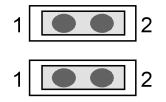
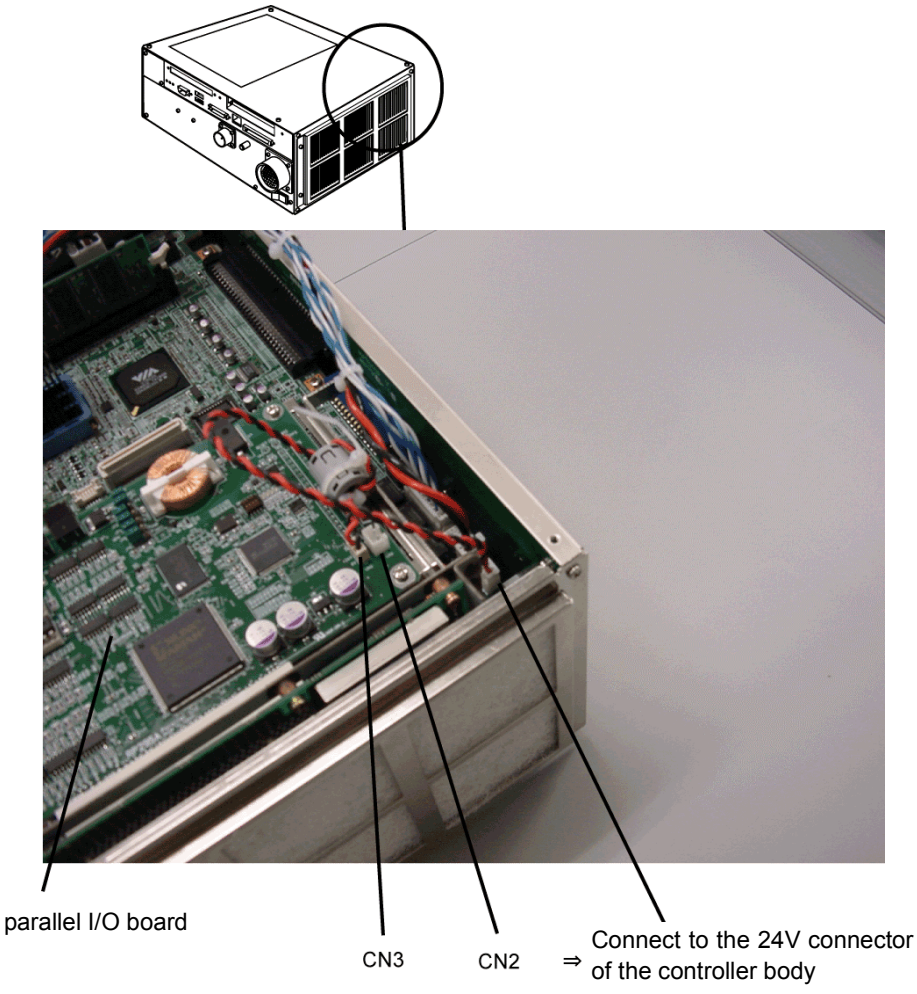


11.2.2 Part Functions and Board Settings

■ 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)	Create a short circuit between 1-2 of JP1, and 1-2 of JP2 using a short connector. Among the wires connected to the internal power connector (CN2 and CN3) of the parallel board, disconnect the wire connected to CN2 and connect it to the 24V connector of the controller body. 

Note 1: Check that the power is turned OFF before setting.

Note 2: A setting other than those noted above may damage the parallel I/O board.

■ Fuses

Details of fuse F1 to F6 are as follows.

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 port 3840 – 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 port 3856 – 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 port 3872 – 3887)	Output port short-circuit (I/O port 3872 – 3887) IC5 or IC6 transistor short-circuit failure, etc.

11.2.3 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 – 2570 (Parallel I/O NPN with the controller attached)	410010 – 2580 (Parallel I/O NPN supply product)
PNP type	410010 – 2420 (Parallel I/O NPN with the controller attached)	410010 – 2430 (Parallel I/O PNP supply product)

(2) Product 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.

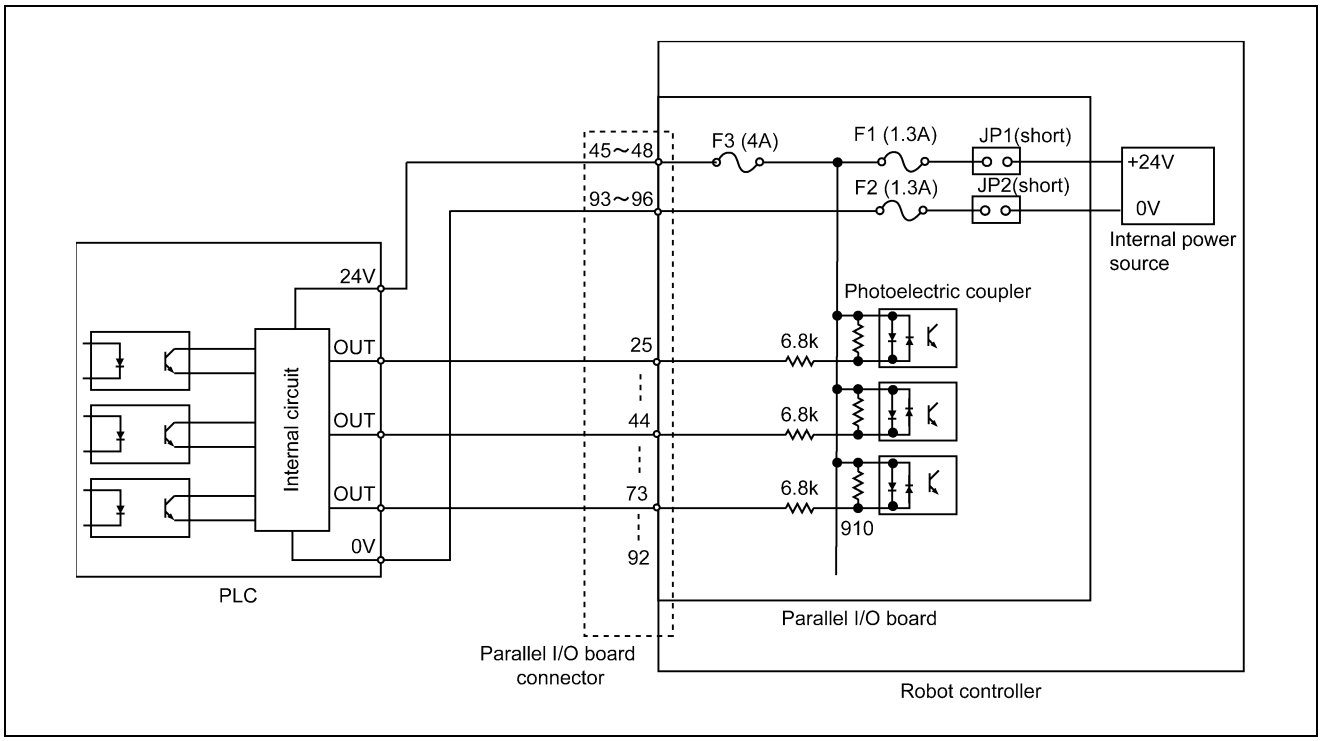
Note: (1) Either an external power supply type or built-in power type output card is available for the PLC.
However, an external power supply type requires an additional power source (24V) to be installed.
Power capacity is 15W or more.

(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.

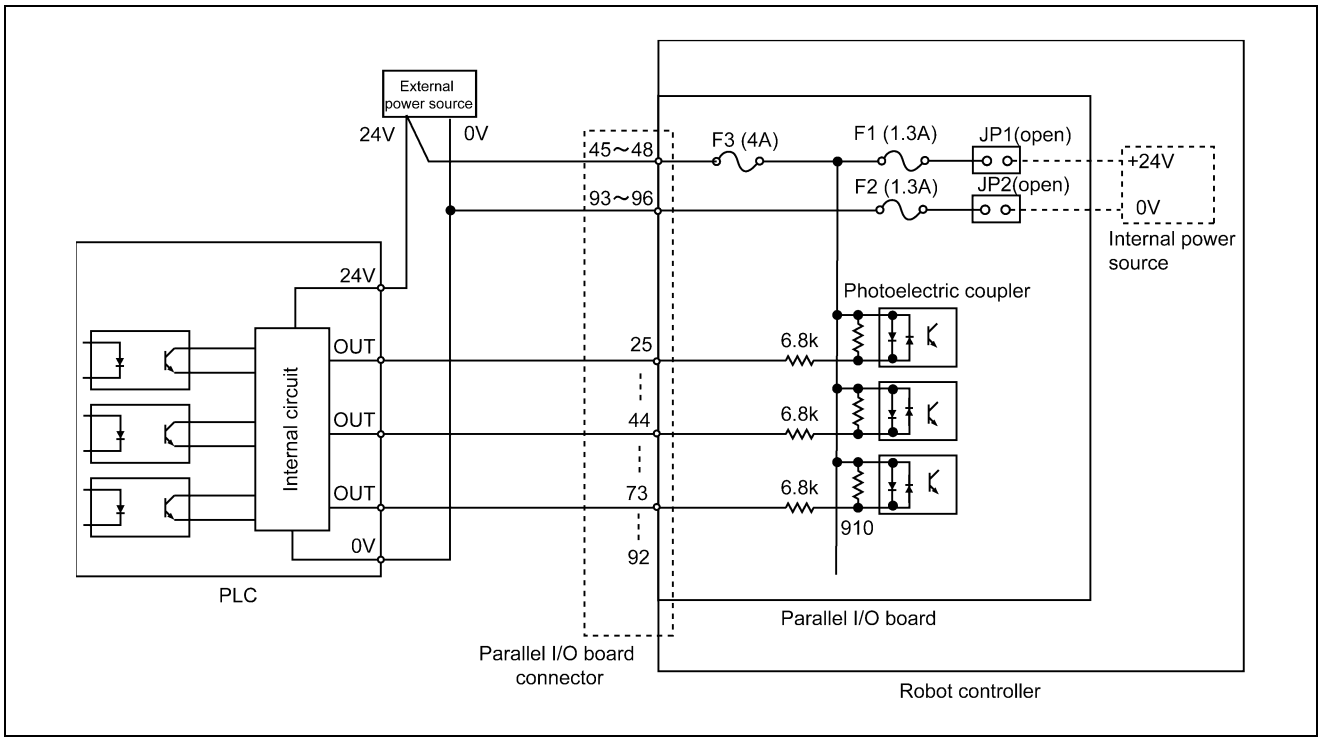
(3) A proximity switch or a relay contact may also be connected directly to the input terminal of the parallel I/O board. In such a case, use the power input to pins 45 to 48 and 93 to 96. A two-wire photoelectric switch or proximity switch can be connected if its leakage current is 0.8 mA or less.

(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

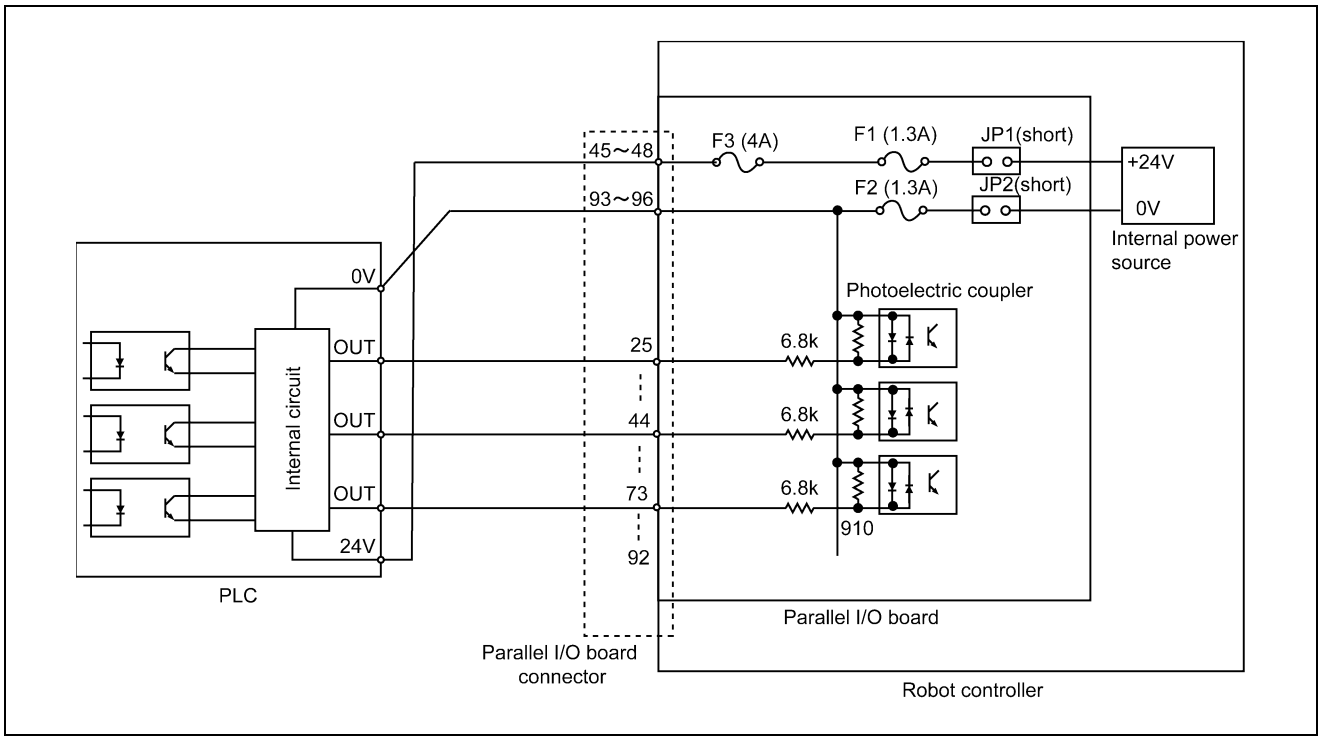


Input circuit when the internal power source is used (NPN).

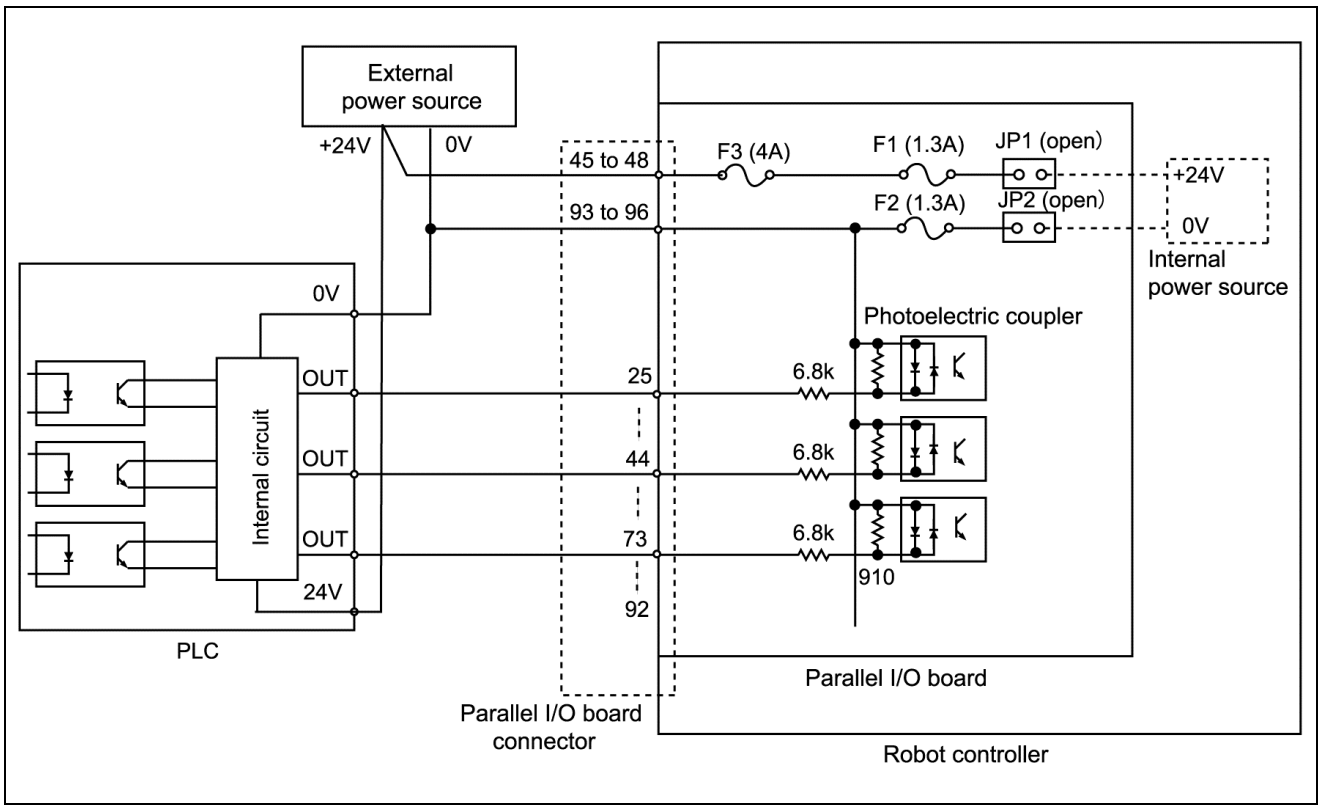


Input circuit when an external power source is used (NPN).

■ 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.**

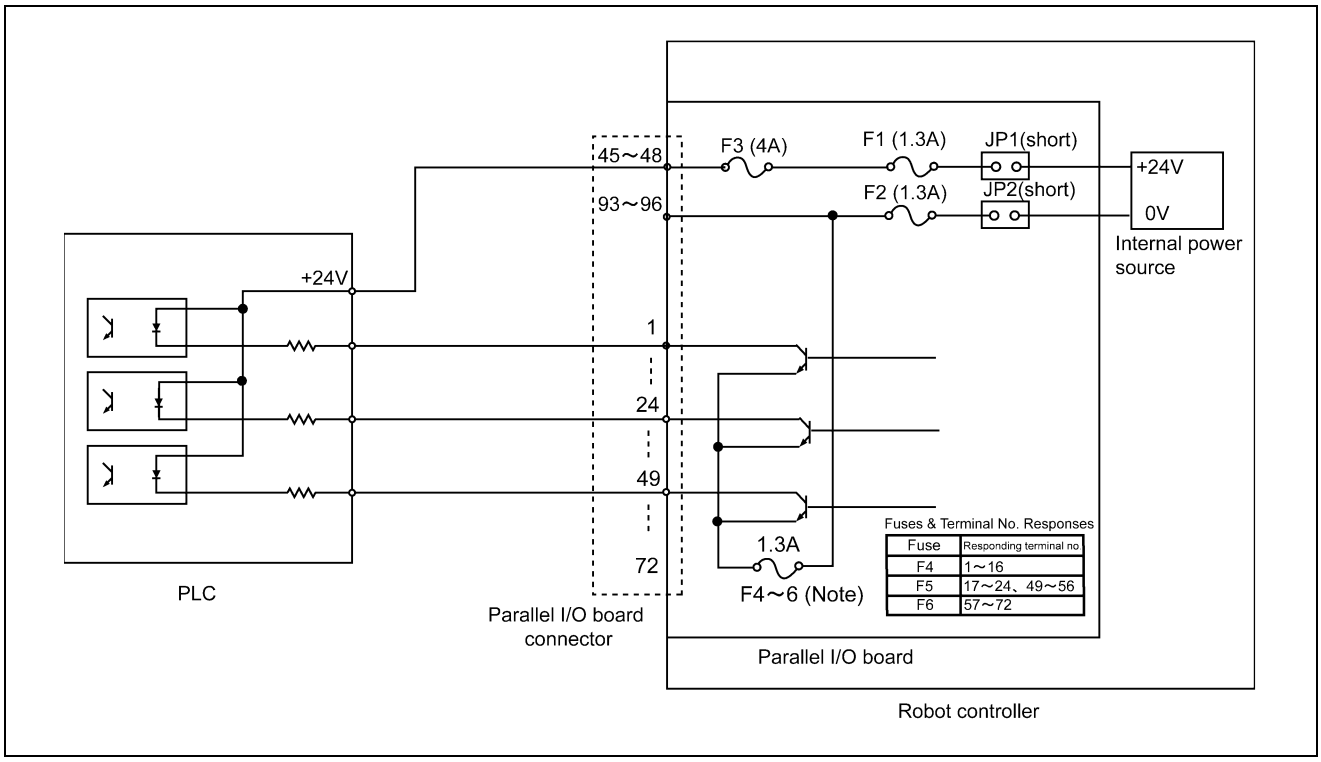
(4) When connecting a lamp, set the rating voltage of the lamp to 1.5W or less so that dark current flows. Since the initial resistance of a lamp is small, rush current that flows when the lamp lights up may damage the output circuit. To reduce the risk of damage from rush current, select a level of 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.**

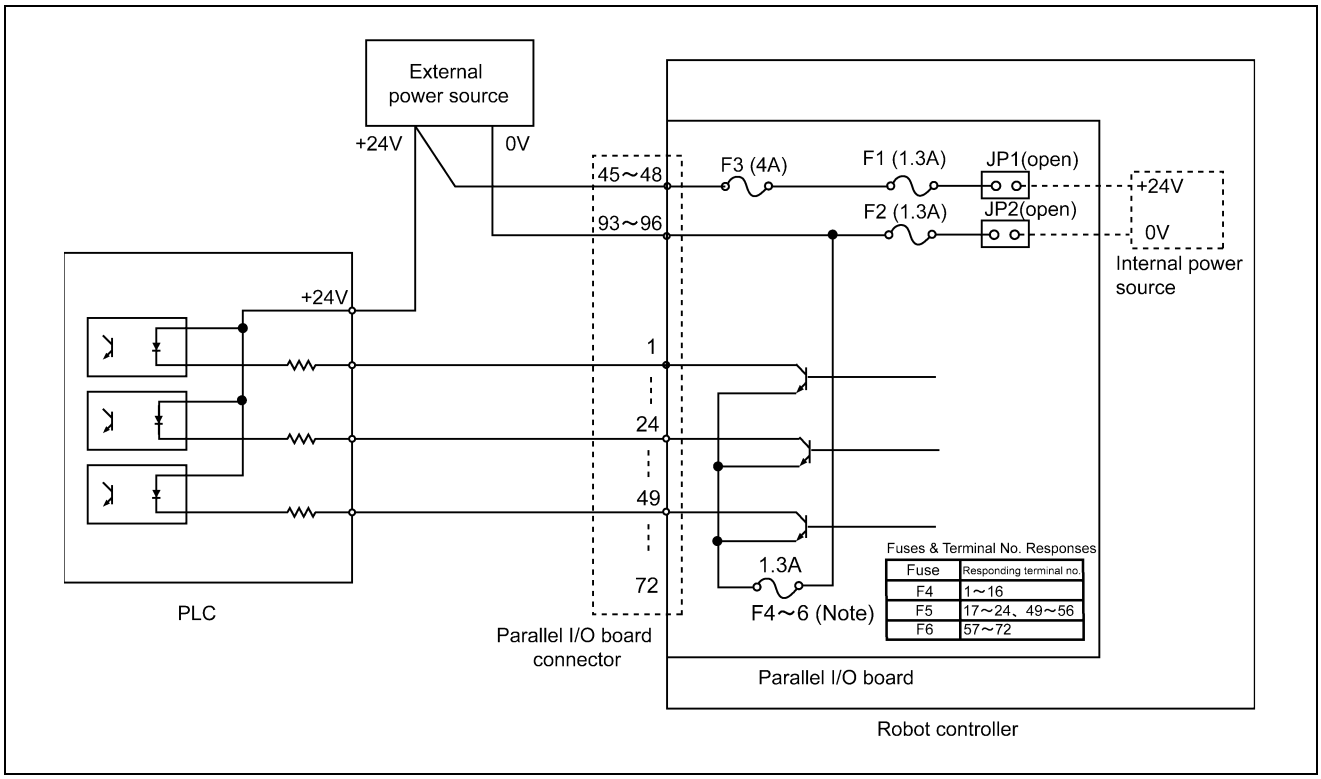
(6) Use a multi-core shielding cable for the purpose of protecting the devices from external noise.

(7) +24V output internal power source of the robot controller must not be grounded.
- **Doing so may damage the controller.**

■ NPN-type I/O

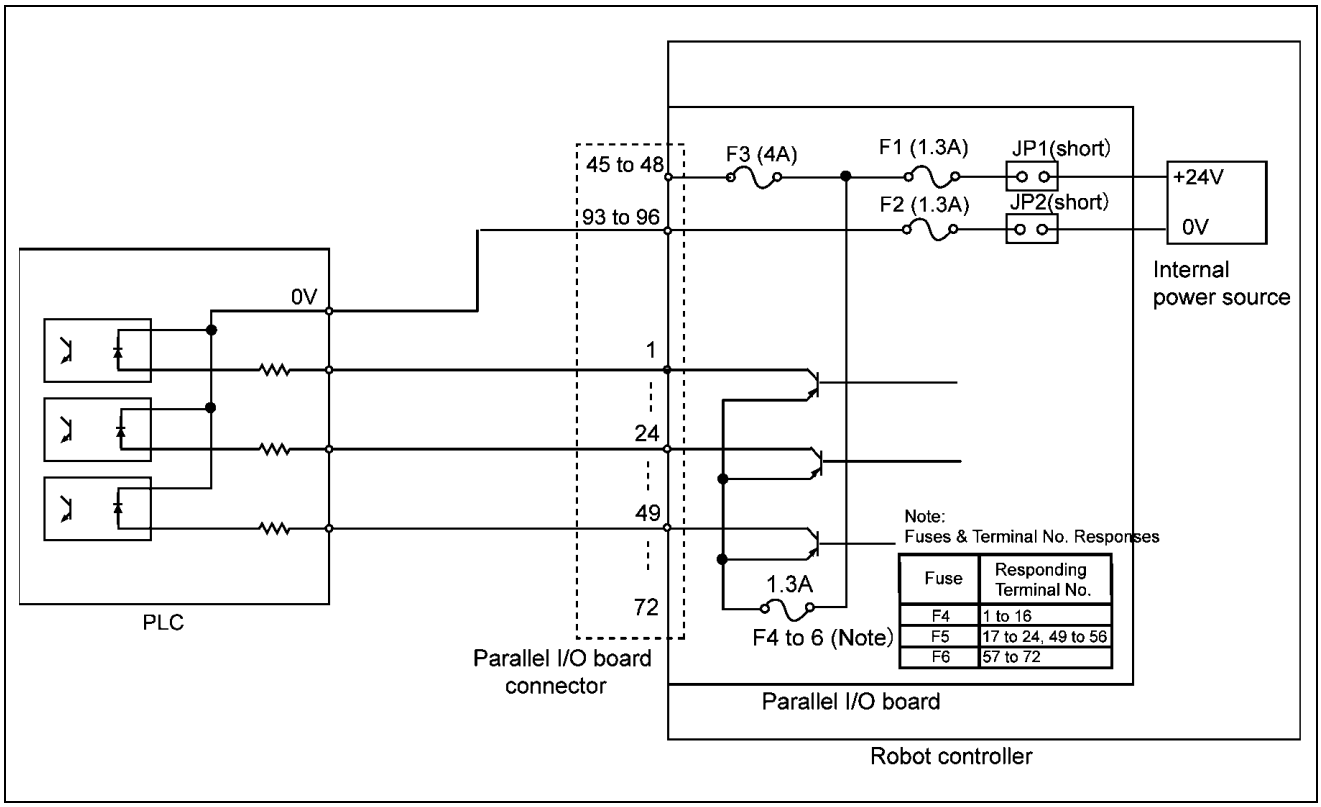


Output circuit when the internal power source is used (NPN).

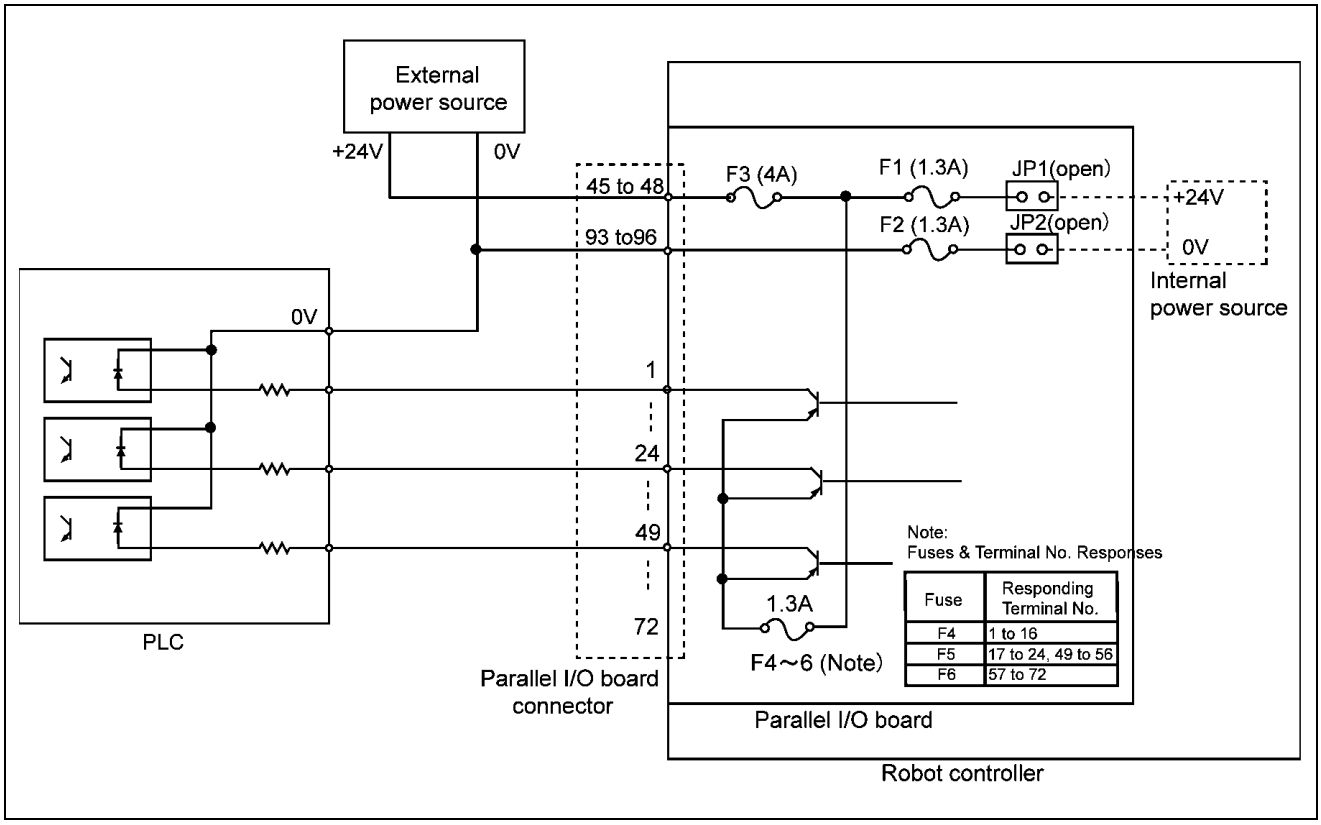


Output circuit when an external power source is used (NPN).

■ PNP-type I/O



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



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

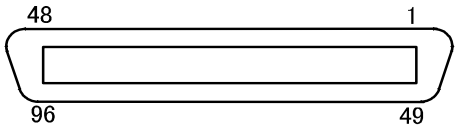
11.3 Allocation of I/O data

The allocations that can be selected while the CC-Link remote device board is in use are as follows.

Allocation	General description
Mini I/O dedicated	Mini I/O system allocation is allocated to the Mini I/O area. Only the user signal is allocated to the parallel I/O board.
Compatible	Compatible system allocation is allocated to the parallel I/O board area. Only the user signal (excluding Normal CPU) is allocated to all ports of the Mini I/O area.
Standard	Standard system allocation is allocated to the parallel I/O board area. Only the user signal (excluding Normal CPU) is allocated to all ports of the Mini I/O area.
Compatible (RC5-compliant)	Compatible system allocation is allocated to the parallel I/O board area. Only the user signal (RC5-compliant and excluding Normal CPU) is allocated to all ports of the Mini I/O area.
Standard (RC5-compliant)	Standard system allocation is allocated to the parallel I/O board area. Only the user signal (RC5-compliant and excluding Normal CPU) is allocated to all ports of the Mini I/O area.

Refer to “4.2 Function of Mini I/O” for the allocation to the Mini I/O area.
The port numbers of parallel I/O board are 3584 to 3623 for input ports and 3840 to 3887 for outputs port.
Refer to “Chapter 5 System I/O Signals in Standard Mode” and Chapter 6 System I/O Signals in Compatible Mode.”

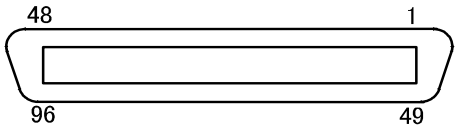
11.3.1 For Mini I/O dedicated



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		

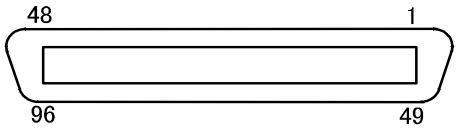
11.3.2 System I/O signals in compatible and compatible (RC5-compliant) modes



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 failure	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	User input	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		

11.3.3 System I/O Signals in standard and standard (RC5-compliant) modes



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 failure	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		

11.3.4 Option

■ Parallel I/O cable

The following “parallel I/O cables” are provided as an optional connecting cables for the parallel I/O board.

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

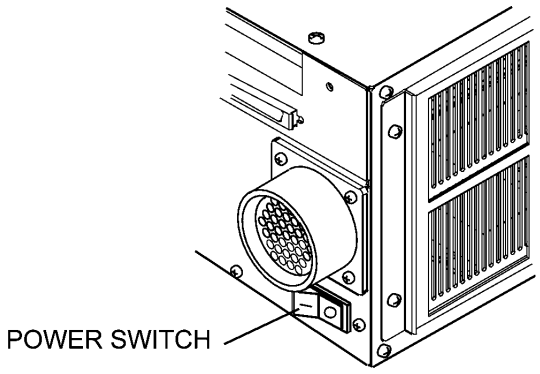
Chapter12 Mounting I/O Option Boards

This section describes how to mount the I/O option boards (DeviceNet slave board, CC-Link remote devise board and so on).

NOTE: In the illustrations below, the typical controller model is drawn.

Step 1

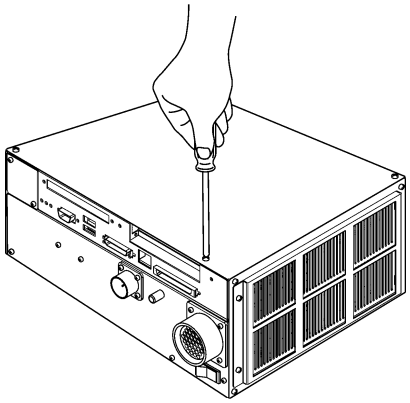
Turn the controller power OFF.



Step 2

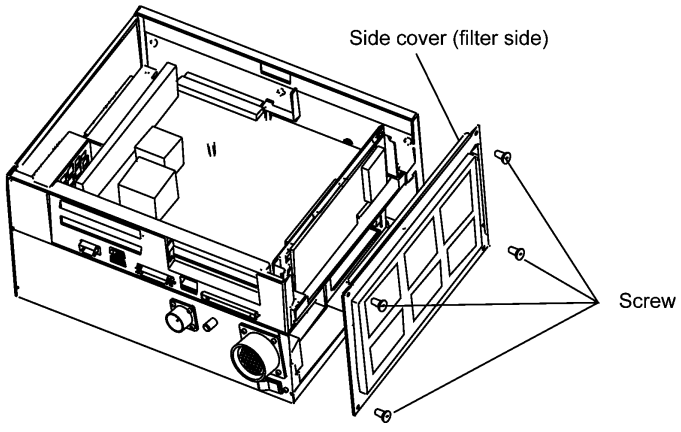
Remove the upper cover from the controller by unscrewing four screws.

⚠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.



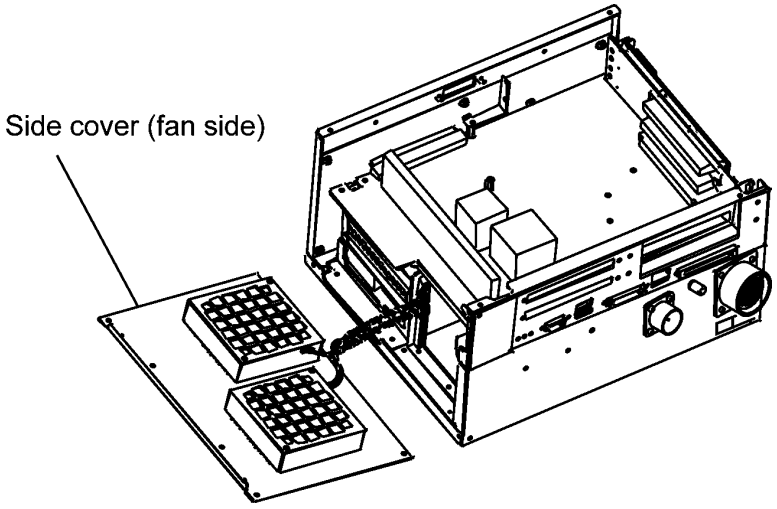
Step 3

Remove the side cover (filter side) from the controller by unscrewing four screws.

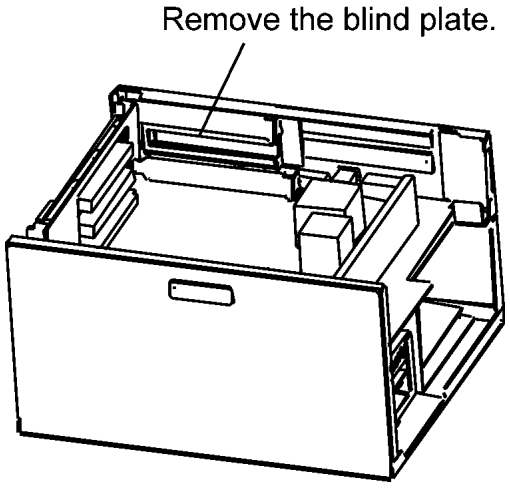


Step 4 Remove the side cover (radiating fan side) from the controller by unscrewing four screws.

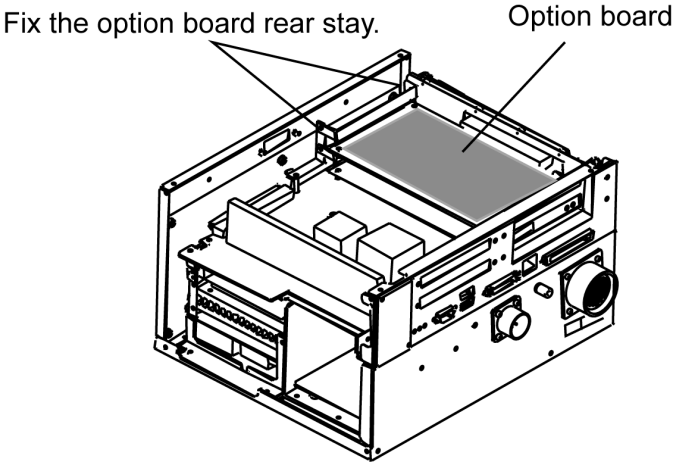
Caution: Do not damage the wiring for the fan when removing the side cover.



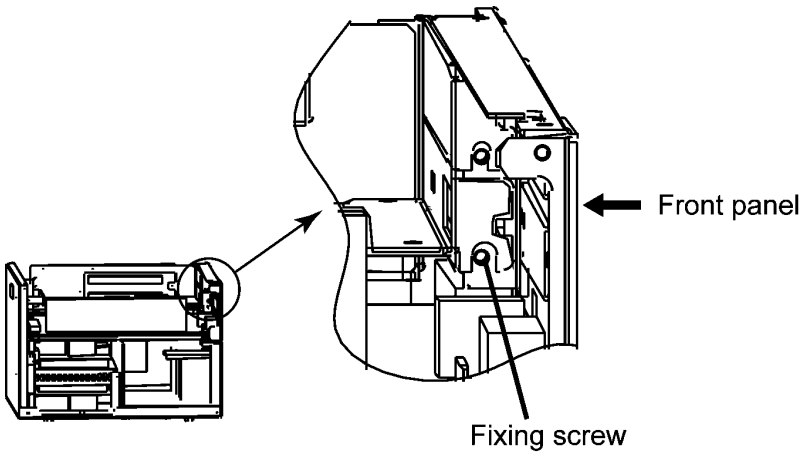
Step 5 Remove the blind cover plate for the extension slot by unscrewing a screw.



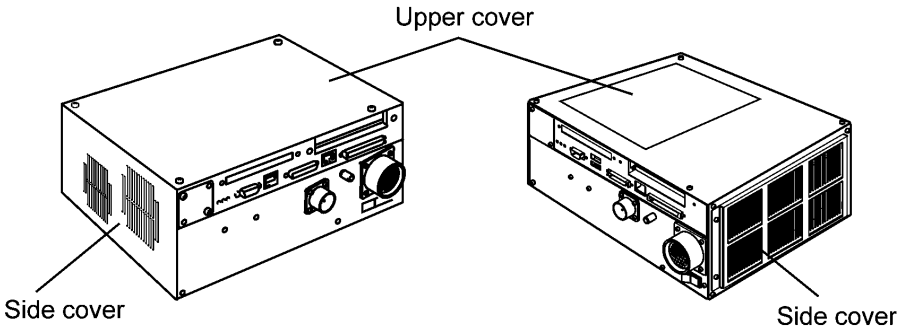
Step 6 Insert the option board into the extension slot and connect to the slot connector. And fix the option board rear stay using two screws.



Step 7 Fix the option board to the front panel using a screw.



Step 8 Reinstall the upper cover and side covers to the controller.



The mounting of the option 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 “4.5 Method for Setting I/O Allocation” and then restart the controller.

Index

**-F SERIES
WITH RC7J CONTROLLER

OPTIONS MANUAL

First Edition November 2004

DENSO WAVE INCORPORATED
Factory Automation Division

12F30C

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.