# DENSO ROBOT

**Cartesian coordinate**

## XYC-4D SERIES

# INSTALLATION & MAINTENANCE GUIDE

# Preface

Thank you for purchasing this high-speed, high-accuracy assembly robot.

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

### Robot series and/or models covered by this manual

| Series | Model |
|---|---|
| XYC-4D<br>(Cartesian coordinate) | XYC-40***D-L<br>XYC-40***D-R |

**NOTE 1:** Model names listed above apply to the models of robot systems. The model names of robot units are followed by M. If the robot system model is XYC-40***D-L, for example, the robot unit model is XYC-40***DM-L.

**NOTE 2:** Asterisks (***) in model names denote numerals meaning the strokes of the X-, Y-, and Z-axes.

**NOTE 3:** The XYC-D series may provide an extended-joint support system (capable of controlling up to two extended-joints). For details about the extended-joints support system, refer to the SUPPLEMENT (No. 410002-6090) to the robot instruction manuals.

### Important

To ensure operator safety, be sure to read the precautions and instructions given in "SAFETY PRECAUTIONS" on pages 1 through 9.

# How the XYC-4D documentation set is organized

The XYC-4D documentation set consists of the following six books. If you are unfamiliar with this robot series, please read all books and understand them fully before operating your robot.

**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.

**INSTALLATION & MAINTENANCE GUIDE - this book -**

Provides an explanation of the robot outline, instructions for installing the robot components, and maintenance & inspection procedures.

**SETTING-UP MANUAL**

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

**WINCAPSII GUIDE (that comes with WINCAPSII)**

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

**PROGRAMMER'S MANUAL**

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

**ERROR CODE TABLES**

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

# How this book is organized

This book is just one part of the XYC-4D documentation set. This book consists of SAFETY PRECAUTIONS, chapters one through six, and appendix.

**SAFETY PRECAUTIONS**

Defines safety terms and related symbols and provides precautions that should be observed. Be sure to read this section before operating your robot.

**Chapter 1 General Information about Robot**

This chapter describes the components and specifications of the robot. Read this chapter before installing and operating the robot to familiarize yourself with the robot.

**Chapter 2 Installing Robot Components**

This chapter describes the procedures and precautions for transporting the robot during installation, and for designing end-effectors.

**Chapter 3 Optional Devices**

This chapter describes the configurations and functions of the optional devices.

**Chapter 4 Customizing Your Robot**

This chapter describes how to customize your robot.

**Chapter 5 Robot Controller Interface**

This chapter describes the connections between the robot controller and other devices and precautions for connecting them.

**Chapter 6 Maintenance and Inspection**

This chapter describes the regular maintenance and inspections necessary for maintaining the performance and functions of the robot.

**Appendix**

Appendix 1 I/O Circuits and Connectors (NPN type)

# SAFETY PRECAUTIONS

Be sure to observe all of the following safety precautions.

Strict observance of these warning and caution indications are a MUST for preventing accidents, which could result in bodily injury and substantial property damage. Make sure you fully understand all definitions of these terms and related symbols given below, before you proceed to the text itself.

| | |
|---|---|
| ⚠ **WARNING** | Alerts you to those conditions, which could result in serious bodily injury or death if the instructions are not followed correctly. |
| ⚠ **CAUTION** | Alerts you to those conditions, which could result in minor bodily injury or substantial property damage if the instructions are not followed correctly. |

## Terminology and Definitions

**Maximum space:** Refers to the volume of space encompassing the maximum designed movements of all robot parts including the end-effector, workpiece and attachments. (Quoted from the RIA* Committee Draft.)

**Restricted space:** Refers to the portion of the maximum space to which a robot is restricted by limiting devices (i.e., mechanical stops). The maximum distance that the robot, end-effector, and workpiece can travel after the limiting device is actuated defines the boundaries of the restricted space of the robot. (Quoted from the RIA Committee Draft.)

**Motion space:** Refers to the portion of the restricted space to which a robot is restricted by software motion limits. The maximum distance that the robot, end-effector, and workpiece can travel after the software motion limits are set defines the boundaries of the motion space of the robot. (The "motion space" is Denso-proprietary terminology.)

**Operating space:** Refers to the portion of the restricted space (or motion space in Denso) that is actually used by the robot while performing its task program. (Quoted from the RIA Committee Draft.)

**Task program:** Refers to a set of instructions for motion and auxiliary functions that define the specific intended task of the robot system. (Quoted from the RIA Committee Draft.)

(*RIA: Robotic Industries Association)

# 1. Introduction

This section provides safety precautions to be observed during installation, teaching, inspection, adjustment, and maintenance of the robot.

# 2. Installation Precautions

## 2.1 Insuring the proper installation environment

### 2.1.1 For standard type

The standard type has not been designed to withstand explosions, dust-proof, nor is it splash-proof. Therefore, it should not be installed in any environment where:

(1) there are flammable gases or liquids,

(2) there are any shavings from metal processing or other conductive material flying about,

(3) there are any acidic, alkaline or other corrosive gases,

(4) there is cutting or grinding oil mist,

(5) it may likely be submerged in fluid,

(6) there is sulfuric cutting or grinding oil mist, or

(7) there are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise.

### 2.1.2 For dust-proof, splash-proof type

The dust-proof, splash-proof type is an IP54-equivalent dust-proof and splash-proof structure, but it has not been designed to withstand explosions.

Note that the robot controller is not a dust- or splash-proof structure. Therefore, when using the robot controller in an environment exposed to mist, put it in an optional protective box.

The dust-proof, splash-proof type should not be installed in any environment where:

(1) there are any flammable gases or liquids,

(2) there are any acidic, alkaline or other corrosive gases,

(3) there are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise,

(4) it may likely be submerged in fluid,

(5) there are any grinding or machining chips or shavings,

(6) any machining oil other than DENSO authorized oil is in use, or

Note: DENSO authorized oil: Yushiron Oil No. 4C (non-soluble)

(7) there is sulfuric cutting or grinding oil mist.

## 2.2 Service space

The robot and peripheral equipment should be installed so that sufficient service space is maintained for safe teaching, maintenance, and inspection.

**2.3 Control devices outside the robot's restricted space**

The robot controller, teach pendant, mini pendant and operating panel should be installed outside the robot's restricted space and in a place where you can observe all of the robot’s movements when operating the robot controller, teach pendant, mini pendant or operating panel.

**2.4 Positioning of gauges**

Pressure gauges, oil pressure gauges and other gauges should be installed in an easy-to-check location.

**2.5 Protection of electrical wiring and hydraulic/pneumatic piping**

If there is any possibility of the electrical wiring or hydraulic/pneumatic piping being damaged, protect them with a cover or similar item.

**2.6 Positioning of emergency stop switches**

Emergency stop switches should be provided in a position where they can be reached easily should it be necessary to stop the robot immediately.

(1) The emergency stop switches should be red.

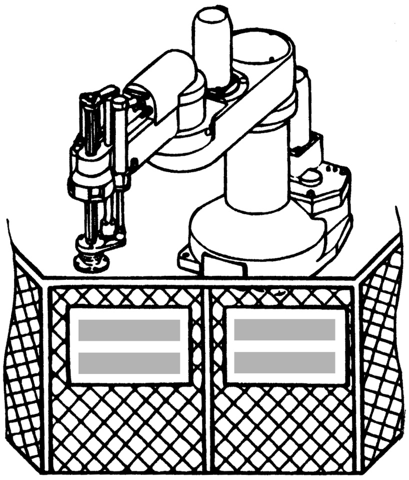
(2) Emergency stop switches should be designed so that they will not be released after pressed, automatically or mistakenly by any other person.

(3) Emergency stop switches should be separate from the power switch.

**2.7 Positioning of operating status indicators**

Operating status indicators should be positioned in such a way where workers can easily see whether the robot is on temporary halt or on an emergency or abnormal stop.

## 2.8 Setting-up the safety fence or enclosure



A safety fence or enclosure should be set up so that no one can easily enter the robot's restricted space. If it is impossible, utilize other protectors as described in Section 2.9.

(1) The fence or enclosure should be constructed so that it cannot be easily moved or removed.

(2) The fence or enclosure should be constructed so that it cannot be easily damaged or deformed through external force.

(3) Establish the exit/entrance to the fence or enclosure. Construct the fence or enclosure so that no one can easily get past it by climbing over the fence or enclosure.

(4) The fence or enclosure should be constructed to ensure that it is not possible for hands or any other parts of the body to get through it.

(5) Take any one of the following protections for the entrance/exit of the fence or enclosure:

1) Place a door, rope or chain across the entrance/exit of the fence or enclosure, and fit it with an interlock that ensures the emergency stop device operates automatically if it is opened or removed.

2) Post a warning notice at the entrance/exit of the fence or enclosure stating "In operation--Entry forbidden" or "Work in progress--Do not operate" and ensure that workers follow these instructions at all times.

When making a test run, before setting up the fence or enclosure, place an overseer in a position outside the robot's restricted space and one in which he/she can see all of the robot's movements. The overseer should prevent workers from entering the robot's restricted space and be devoted solely to that task.

## 2.9 Positioning of rope or chain

If it is not possible to set up the safety fence or enclosure described in Section 2.8, hang a rope or chain around the perimeter of the robot's restricted space to ensure that no one can enter the restricted space.

(1) Ensure the support posts cannot be moved easily.

(2) Ensure that the rope or chain's color or material can easily be discerned from the surrounds.

(3) Post a warning notice in a position where it is easy to see stating "In operation--Entry forbidden" or "Work in progress --Do not operate" and ensure that workers follow these instructions at all times.

(4) Set the exit/entrance, and follow the instructions given in Section 2.8, (3) through (5).

### 2.10 Setting the robot's motion space

The area required for the robot to work is called the robot's operating space.

If the robot’s motion space is greater than the operating space, it is recommended that you set a smaller motion space to prevent the robot from interfering or disrupting other equipment.

Refer to the "INSTALLATION & MAINTENANCE GUIDE" Chapter 4.

### 2.11 No robot modification allowed

Never modify the robot unit, robot controller, teach pendant , mini pendant or other devices.

### 2.12 Cleaning of tools

If your robot uses welding guns, paint spray nozzles, or other end-effectors requiring cleaning, it is recommended that the cleaning process be carried out automatically.

### 2.13 Lighting

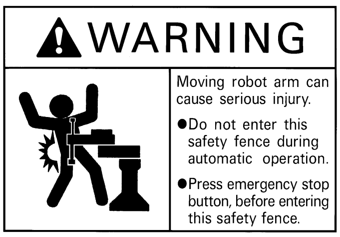
Sufficient illumination should be assured for safe robot operation.

### 2.14 Protection from objects thrown by the end-effector

If there is any risk of workers being injured in the event that the object being held by the end-effector is dropped or thrown by the end-effector, consider the size, weight, temperature and chemical nature of the object and take appropriate safeguards to ensure safety.

### 2.15 Affixing the warning label

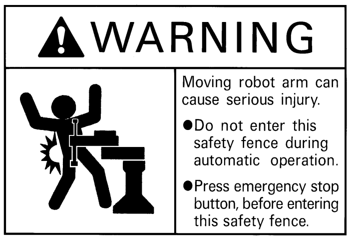
Place the warning label packaged with the robot on the exit/entrance of the safety fence or in a position where it is easy to see.



## 3. Precautions while robot is running

⚠ **Warning**

Touching the robot while it is in operation can lead to serious injury. Please ensure the following conditions are maintained and that the cautions listed from Section 3.1 onwards are followed when any work is being performed.




1) Do not enter the robot's restricted space when the robot is in operation or when the motor power is on.
2) As a precaution against malfunction, ensure that an emergency stop device is activated to cut the power to the robot motor upon entry into the robot's restricted space.
3) When it is necessary to enter the robot's restricted space to perform teaching or maintenance work while the robot is running, ensure that the steps described in Section 3.3 "Ensuring safety of workers performing jobs within the robot's restricted space” are taken.

### 3.1 Creation of working regulations and assuring worker adherence

When entering the robot’s restricted space to perform teaching or maintenance inspections, set “working regulations” for the following items and ensure workers adhere to them.

(1) Operating procedures required to run the robot.

(2) Robot speed when performing teaching.

(3) Signaling methods to be used when more than one worker is to perform work.

(4) Steps that must be taken by the worker in the event of a malfunction, according to the contents of the malfunction.

(5) The necessary steps for checking release and safety of the malfunction status, in order to restart the robot after robot movement has been stopped due to activation of the emergency stop device

(6) Apart from the above, any steps below necessary to prevent danger from unexpected robot movement or malfunction of the robot.

1) Display of the control panel (See Section 3.2 on the following page)

2) Assuring the safety of workers performing jobs within the robot's restricted space (See Section 3.3 on the following page)

3) Maintaining worker position and stance

Position and stance that enables the worker to confirm normal robot operation and to take immediate refuge if a malfunction occurs.

4) Implementation of measures for noise prevention

5) Signaling methods for workers of related equipment

6) Types of malfunctions and how to distinguish them

Please ensure “working regulations” are appropriate to the robot type, the place of installation and to the content of the work.

Be sure to consult the opinions of related workers, engineers at the equipment manufacturer and that of a labor safety consultant when creating these “working regulations”.

### 3.2 Display of operation panel

To prevent anyone other than the worker from accessing the start switch or the changeover switch by accident during operation, display something to indicate it is in operation on the operating panel, teach pendant or mini pendant. Take any other steps as appropriate, such as locking the cover.

### 3.3 Ensuring safety of workers performing jobs within the robot's restricted space

When performing jobs within the robot’s restricted space, take any of the following steps to ensure that robot operation can be stopped immediately upon a malfunction.

(1) Ensure an overseer is placed in a position outside the robot’s restricted space and one in which he/she can see all robot movements, and that he/she is devoted solely to that task.

① An emergency stop device should be activated immediately upon a malfunction.

② Do not permit anyone other than the worker engaged for that job to enter the robot’s restricted space.

(2) Ensure a worker within the robot's restricted space carries the portable emergency stop switch so he/she can press it (the robot stop button on the teach pendant or mini pendant) immediately if it should be necessary to do so.

## 3.4 Inspections before commencing work such as teaching

Before starting work such as teaching, inspect the following items, carry out any repairs immediately upon detection of a malfunction and perform any other necessary measures.

(1) Check for any damage to the sheath or cover of the external wiring or to the external devices.

(2) Check that the robot is functioning normally or not (any unusual noise or vibration during operation).

(3) Check the functioning of the emergency stop device.

(4) Check there is no leakage of air or oil from any pipes.

(5) Check there are no obstructive objects in or near the robot's restricted space.

## 3.5 Release of residual air pressure

Before disassembling or replacing pneumatic parts, first release any residual air pressure in the drive cylinder.

## 3.6 Precautions for test runs

Whenever possible, have the worker stay outside of the robot's restricted space when performing test runs.

## 3.7 Precautions for automatic operation

(1) At start-up

Before the robot is to be started up, first check the following items as well as setting the signals to be used and perform signaling practice with all related workers.

1) Check that there is no one inside the robot's restricted space.

2) Check that the teach pendant and tools are in their designated places.

3) Check that no lamps indicating a malfunction on the robot or related equipment are lit.

(2) Check that the display lamp indicating automatic operation is lit during automatic operation.

(3) Steps to be taken when a malfunction occurs

Should a malfunction occur with the robot or related equipment and it is necessary to enter the robot's restricted space to perform emergency maintenance, stop the robot's operation by activating the emergency stop device. Take any necessary steps such as placing a display on the starter switch to indicate work is in progress to prevent anyone from accessing the robot.

### 3.8 Precautions in repairs

(1) Do not perform repairs outside of the designated range.

(2) Under no circumstances should the interlock mechanism be removed.

(3) When opening the robot controller's cover for battery replacement or any other reasons, always turn the robot controller power off and disconnect the power cable.

(4) Use only spare tools authorized by DENSO.

## 4. Daily and periodical inspections

(1) Be sure to perform daily and periodical inspections. Before starting jobs, always check that there is no problem with the robot and related equipment. If any problems are found, take any necessary measures to correct them.

(2) When carrying out periodical inspections or any repairs, maintain records and keep them for at least 3 years.

## 5. Management of floppy disks

(1) Carefully handle and store the "Initial settings" floppy disks packaged with the robot, which store special data exclusively prepared for your robot.

(2) After finishing teaching or making any changes, always save the programs and data onto floppy disks.

Making back-ups will help you recover if data stored in the robot controller is lost due to the expired life of the back-up battery.

(3) Write the names of each of the floppy disks used for storing task programs to prevent incorrect disks from loading into the robot controller.

(4) Store the floppy disks where they will not be exposed to dust, humidity and magnetic field, which could corrupt the disks or data stored on them.

# CONTENTS

**Chapter 4 Customizing Your Robot**

**Chapter 5 Robot Controller Interface**



**Chapter 6 Maintenance and Inspection**

**Appendix**

# Chapter 1

# General Information about Robot

This chapter describes the components and specifications of the robot. Read this chapter before installing and operating the robot to familiarize yourself with the robot.

# 1.1 Items Contained in the Package

## 1.1.1 Standard Items

The items listed in Table 1-1 are contained in the product package.

**Table 1-1 Standard Items**

| No. | Item | Qty. |
|---|---|---|
| (1) | Robot unit | 1 |
| (2) | Robot controller | 1 |
| (3) | Power supply cable (5 m) (Note 1) | 1 |
| (4) | Air regulator | 1 |
| (5) | Robot control cable (Note 2) (Option) | 1 set |
| (6) | Manuals<br>1) BEGINNER'S GUIDE<br>2) INSTALLATION & MAINTENANCE GUIDE<br>3) SETTING-UP MANUAL<br>4) PROGRAMMER'S MANUAL<br>5) ERROR CODE TABLES<br>6) NetwRC CD (containing WINCAPSII beta version and robot documents) | 1 each |
| (7) | Spare fuse for robot controller | 3 |
| (8) | Initialization floppy disk (1.44 MB format) (Note 3) | 1 |
| (9) | Pendantless connector (Dummy connector) | 1 |
| (10) | Connector set for end-effector control signals (for CN20 and CN21) | 1 set |
| (11) | Power connector for I/O | 1 |
| (12) | Direction indicator label (Note 4) | 1 |
| (13) | Warning label (Note 5) | 1 |
| (14) | Spare output IC for robot controller | 1 |

Note 1: Not only the standard power cable but also the UL-compliant one is available. The CE-compliant one consists of a power connector only.

Note 2: Choose a robot control cable set from Table 1-2.

Note 3: Preserve the initialization floppy disk in a safe place. The disk contains arm data in WINCAPSII format. If a memory error appears on the teach pendant due to memory failure, use the disk to load the arm data to the robot controller. (Refer to Section 6.10 "Using the Initialization Floppy Disk.")

Note 4: Attach the direction indicator label in a position on the robot unit that can be easily seen after installation.

Note 5: Attach the warning label on the robot safety fence or other location where operators will notice it.

If necessary, prepare a plate for attaching the seal.

**TIP:** The XYC-4D series may provide an extended-joint support system (capable of controlling up to two extended-joints). For details about the extended-joint support system, refer to the SUPPLEMENT (No. 410002-6090) to the robot instruction manuals.

**Table 1-2 Robot Control Cable Sets (Motor cable & Encoder cable)**

| No. | Cable set | Part No. |
|---|---|---|
| 1 | Standard cable set (3 m) | 410149-0580 |
| 2 | Standard cable set (6 m) | 410149-0590 |
| 3 | Standard cable set (3 m) destined for Europe | 410149-0560 |
| 4 | Standard cable set (6 m) destined for Europe | 410149-0570 |

## 1.1.2 Optional Items

The table below lists the optional components.

**Optional Components (1)**

| Classification | No. | Item | Remarks | Part No. |
|---|---|---|---|---|
| I/O cables | 1 | I/O cable set | (8 m) (Consists of Nos.1-1 to 1-3, one each) | 410149-0330 |
| | 1-1 | Input cable | (8 m) | 410141-1630 |
| | 1-2 | Output cable | (8 m) | 410141-1650 |
| | 1-3 | Hand I/O cable | (8 m) | 410141-1740 |
| | 2 | I/O cable set (Only hand I/O cable is a high-strength type.) | (8 m) (Consists of Nos.2-1 to 2-3, one each) | 410149-0350 |
| | 2-1 | Input cable | (8 m) | 410141-1630 |
| | 2-2 | Output cable | (8 m) | 410141-1650 |
| | 2-3 | Hand I/O cable (high-strength) | (8 m) | 410141-1670 |
| | 3 | I/O cable set | (15 m) (Consists of Nos.3-1 to 3-3, one each) | 410149-0340 |
| | 3-1 | Input cable | (15 m) | 410141-1640 |
| | 3-2 | Output cable | (15 m) | 410141-1660 |
| | 3-3 | Hand I/O cable | (15 m) | 410141-1750 |
| | 4 | I/O cable set (Only the hand I/O cable is a high-strength type.) | (15 m) (Consists of Nos.4-1 to 4-3, one each) | 410149-0360 |
| | 4-1 | Input cable | (15 m) | 410141-1640 |
| | 4-2 | Output cable | (15 m) | 410141-1660 |
| | 4-3 | Hand I/O cable (high-strength) | (15 m) | 410141-1680 |
| Operation devices | 5 | Operating panel **(Note 1)** | (4 m) | 410100-0970 |
| | 6 | Operating panel **(Note 1)** | (8 m) | 410100-0980 |
| | 7 | Teach pendant **(Note 1)** | (4 m) | 410100-0940 |
| | 8 | Teach pendant **(Note 1)** | (8 m) | 410100-0950 |
| | 9 | Teach pendant **(Note 1)** | (12 m) | 410100-0960 |
| | 10 | Mini-pendant (Version 1.7 or later) (Incl. WINCAPSII Light) | (4 m) | 410109-0020 |
| | 11 | Mini-pendant (Version 1.7 or later) (Incl. WINCAPSII Light) | (8 m) | 410109-0040 |
| | 12 | Mini-pendant (Version 1.7 or later) (Incl. WINCAPSII Light) | (12 m) | 410109-0060 |
| | 13 | Pendant extension cable **(Note 2)** | (4 m) For TP/MP/OP | 410141-2390 |
| | 14 | Pendant extension cable **(Note 2)** | (8 m) For TP/MP/OP | 410141-2400 |

**Note1:** The total cable length must not be more than 12 m when the operating panel and the teach pendant are to be connected in series.

**Note2:** The total cable length must not be more than 12 m when the pendant extension cable is connected to the TP, MP or OP. Do not connect two or more pendant extension cables to the TP, MP or OP.

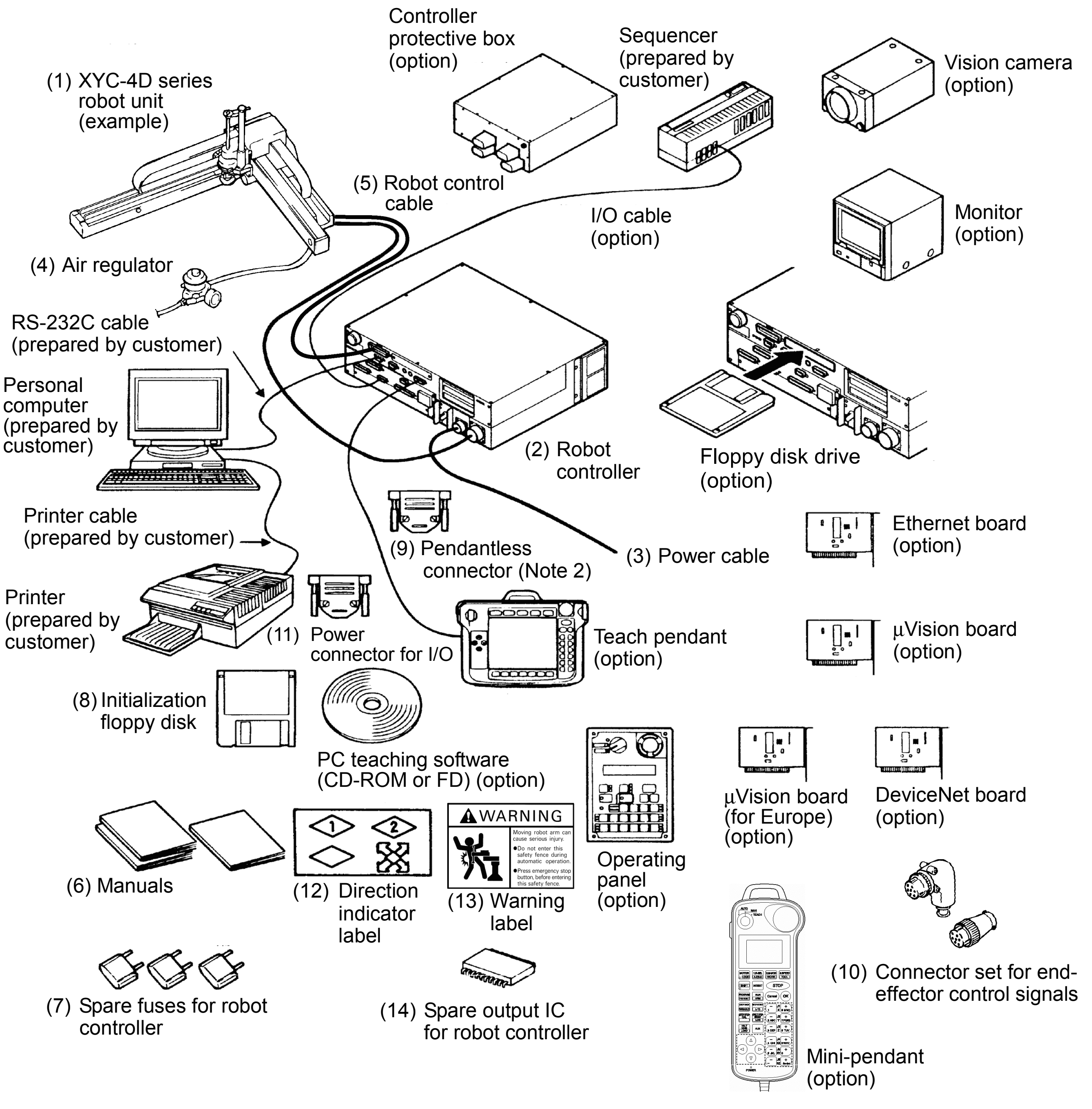
**Table 1-3 Optional Items (2)**

| Classification | No. | Item | Remarks | Part No. |
|---|---|---|---|---|
| PC teaching software | 15 | WINCAPSII | (in CD-ROM) | 410090-0860 |
| | 16 | WINCAPSII | (in floppy disk) | 410090-0870 |
| Visual equipment | 17 | µVision (built-in visual) board | (NTSC) | 410010-2070 |
| | 18 | µvision (built-in visual) board (for Europe) | (PAL) | 410010-2080 |
| | 19 | Camera | | 463980-0030 |
| | 20 | Monitor | | 463980-0021 |
| | 21 | Camera cable | (3 m) | 463981-0110 |
| | 22 | Camera cable | (5 m) | 463981-0120 |
| | 23 | Camera cable | (15 m) | 463981-0160 |
| | 24 | Monitor cable | (BNC) (1 m) | 463981-0010 |
| | 25 | Monitor cable | (BNC) (3 m) | 463981-0030 |
| | 26 | Monitor cable | (BNC) (5 m) | 463981-0050 |
| Optional boards for the robot controller | 27 | Ethernet board | | 410010-0710 |
| | 28 | Built-in floppy disk drive | (for 1.44 MB floppy disk) | 410010-0520 |
| | 29 | DeviceNet slave board | (Slave station) | 410010-0720 |
| | 30 | DeviceNet master board | (Master station) | 410010-0740 |
| | 31 | PROFIBUS slave board | (Slave station) | 410010-1190 |
| Controller-related components | 32 | Controller protection box | (FB-10) | 410181-0060 |
| | 33 | I/O connector set for RC5 | For parallel I/O | 410159-0070 |
| Manuals (Printed materials) | 35 | XYC-D INSTALLATION & MAINTENANCE GUIDE | | 410002-1500 |
| | 36 | BEGINNER'S GUIDE | | 410002-1340 |
| | 37 | SETTING-UP MANUAL | (Common to all robot series) | 410002-1320 |
| | 38 | PROGRAMMER'S MANUAL (I) | (Common to all robot series) | 410002-2050 |
| | 39 | PROGRAMMER'S MANUAL (II) | (Common to all robot series) | 410002-2060 |
| | 40 | ERROR CODE TABLES | (Common to all robot series) | 410002-1430 |
| | 41 | WINCAPS II GUIDE | (Common to all robot series) | 410002-0930 |

# 1.2 Robot Configuration

## 1.2.1 Robot Components

Figure 1-1 shows the entire configuration of the robot.




Note 1: Items (1) to (14) are the standard components listed in Table 1-1.

Note 2: The pendantless connector should be attached to the robot controller connector when no teach pendant is connected.

**Figure 1-1 XYC-4D Series Robot Components**

# 1.2.2 Robot Unit Components and Operation Modes

Figure 1-2 shows the names of the components of the robot unit. Figures 1-3 through 1-5 show the motions of the robot unit in the manual operation modes--Joint mode, X-Y mode, and Tool mode.

## ■ Names of robot unit components

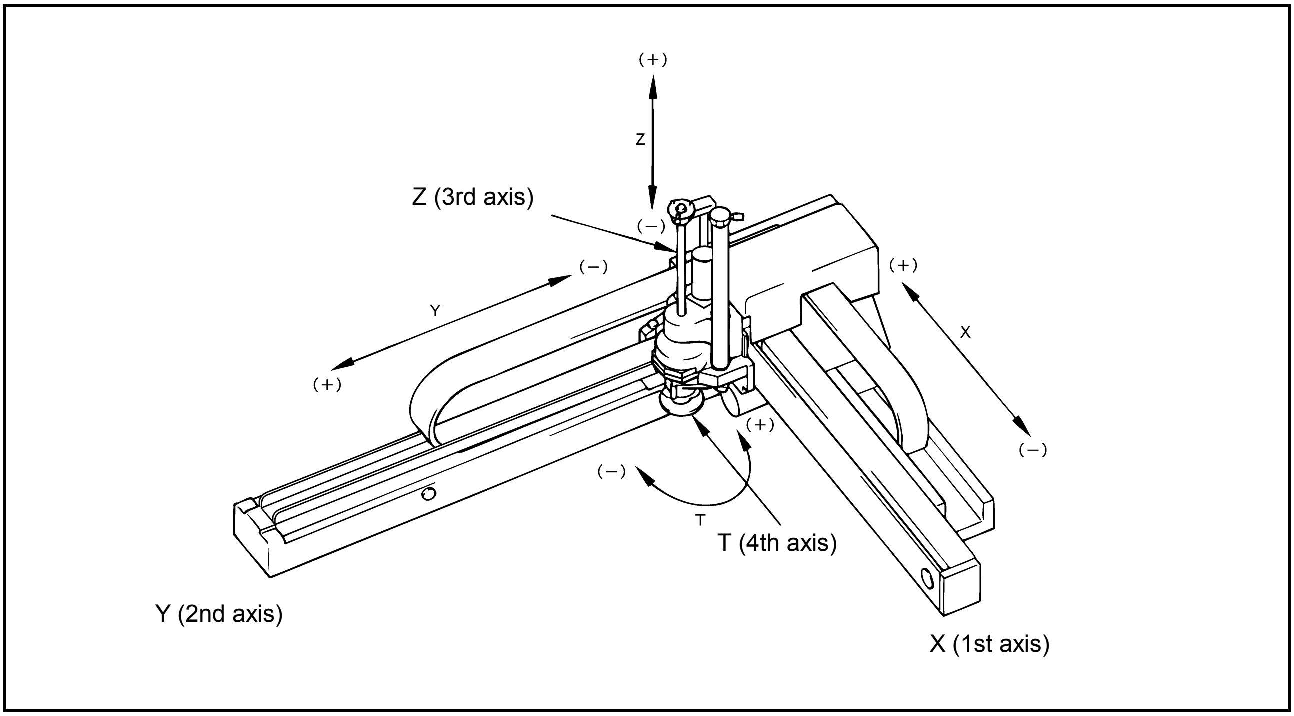



**Figure 1-2 (a) Components of the XYC-40***D-L**

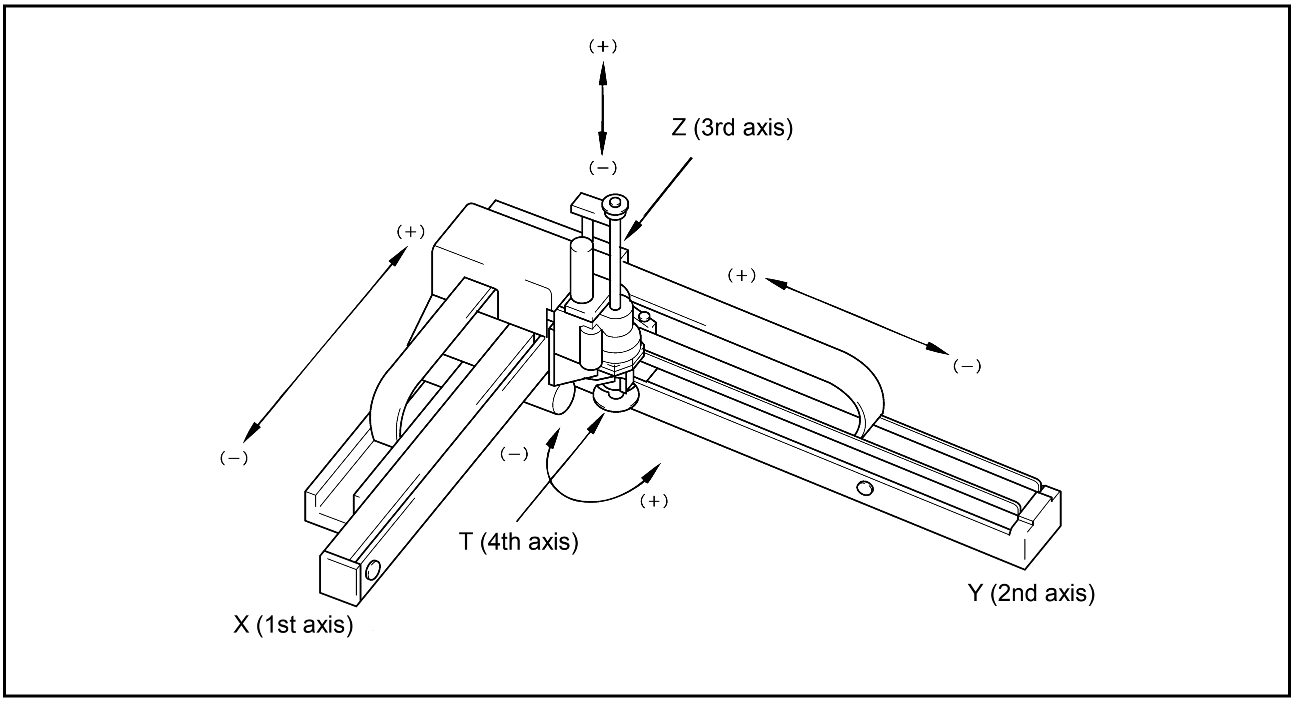



**Figure 1-2 (b) Components of the XYC-40***D-R**

## ■ Motions in manual operation modes

You may run the robot manually in three operation modes--Joint mode, X-Y mode, and Tool mode.

(1) Joint mode

As illustrated below, the Joint mode allows you to drive each of the four joints independently. In this mode, you may run the robot unit even before carrying out CAL operation. In Joint mode and X-Y mode, the XYC series will produce the same operation.

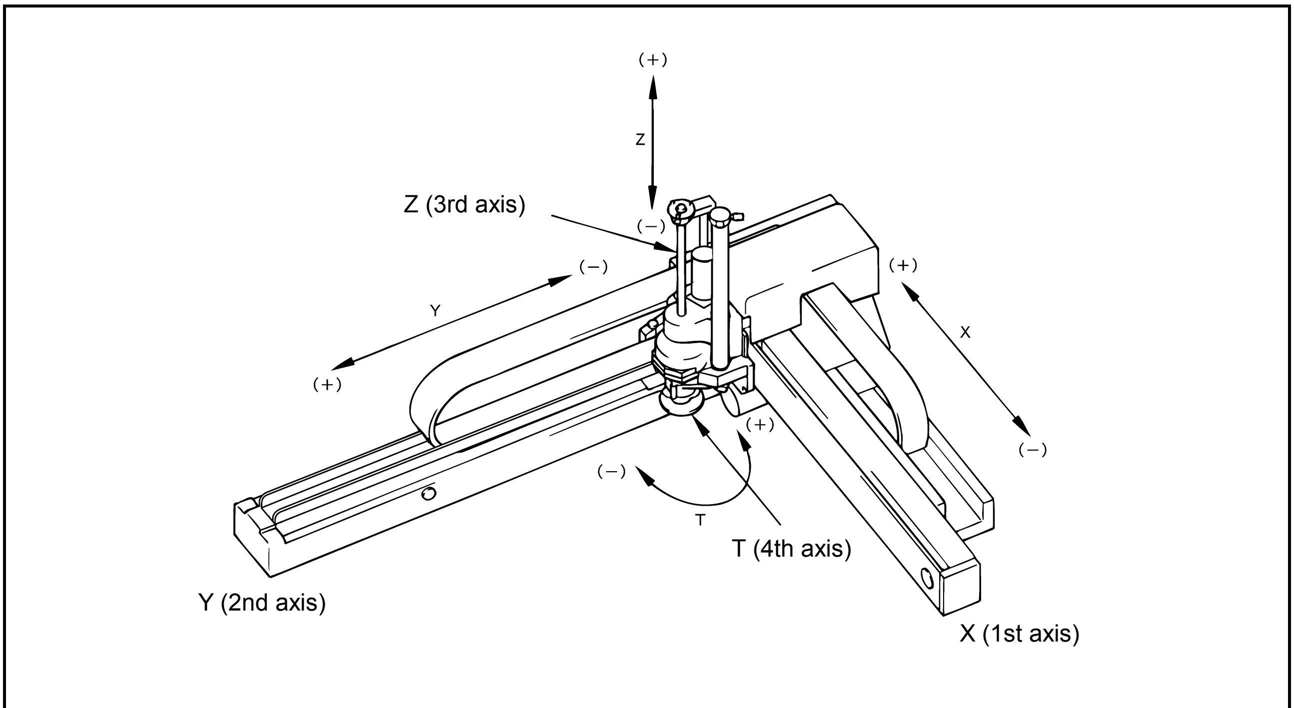



**Figure 1-3 (a) Motion of the XYC-40***D-L in Joint Mode**

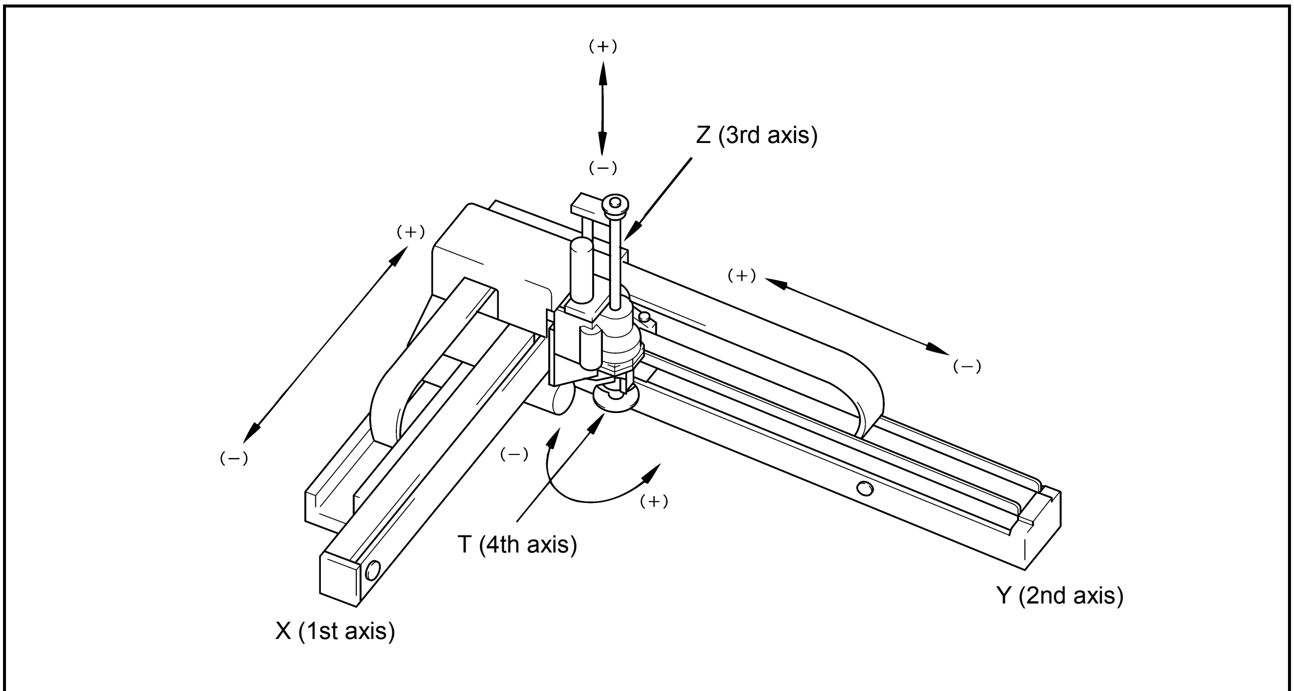



**Figure 1-3 (b) Motion of the XYC-40***D-R in Joint Mode**

(2) X-Y mode

As illustrated below, the X-Y mode allows you to drive the robot arm linearly in base coordinates (whose origin is defined at the center of the robot base). The 4th axis will keep the orientation that was held immediately before the robot was driven.

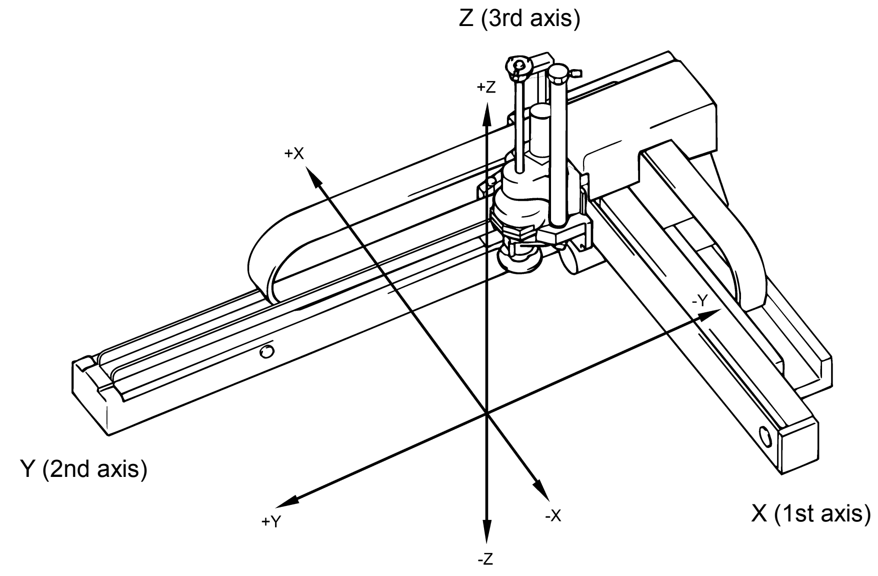



**Figure 1-4 (a) Motion of the XYC-40***D-L in X-Y Mode**

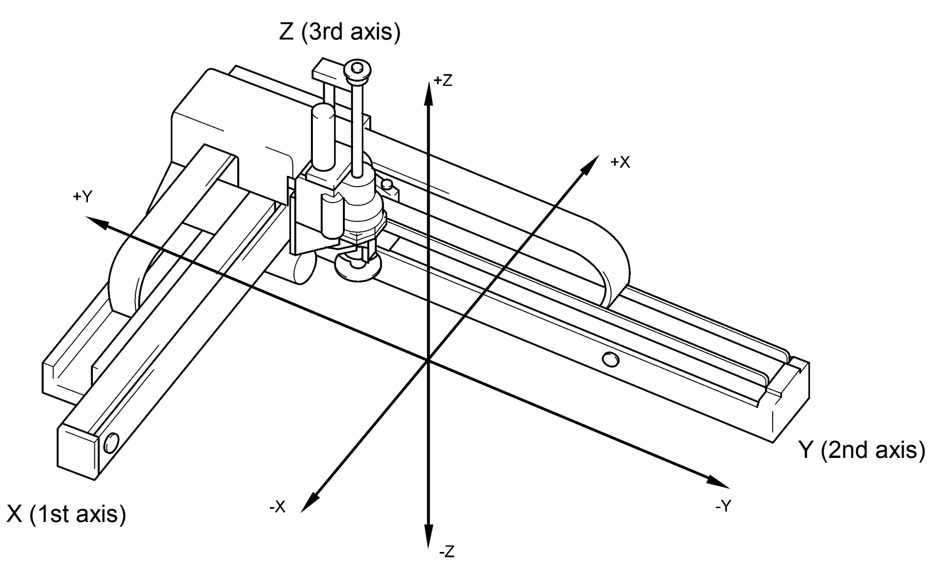



**Figure 1-4 (b) Motion of the XYC-40***D-R in X-Y Mode**

(3) Tool mode

As illustrated below, the Tool mode allows you to drive the robot arm linearly along the cartesian coordinates of the 4th axis. The 4th axis will hold its orientation.

In the figure below, the coordinates are represented by TX, TY, and TZ for distinguishing the Tool mode from X-Y mode.

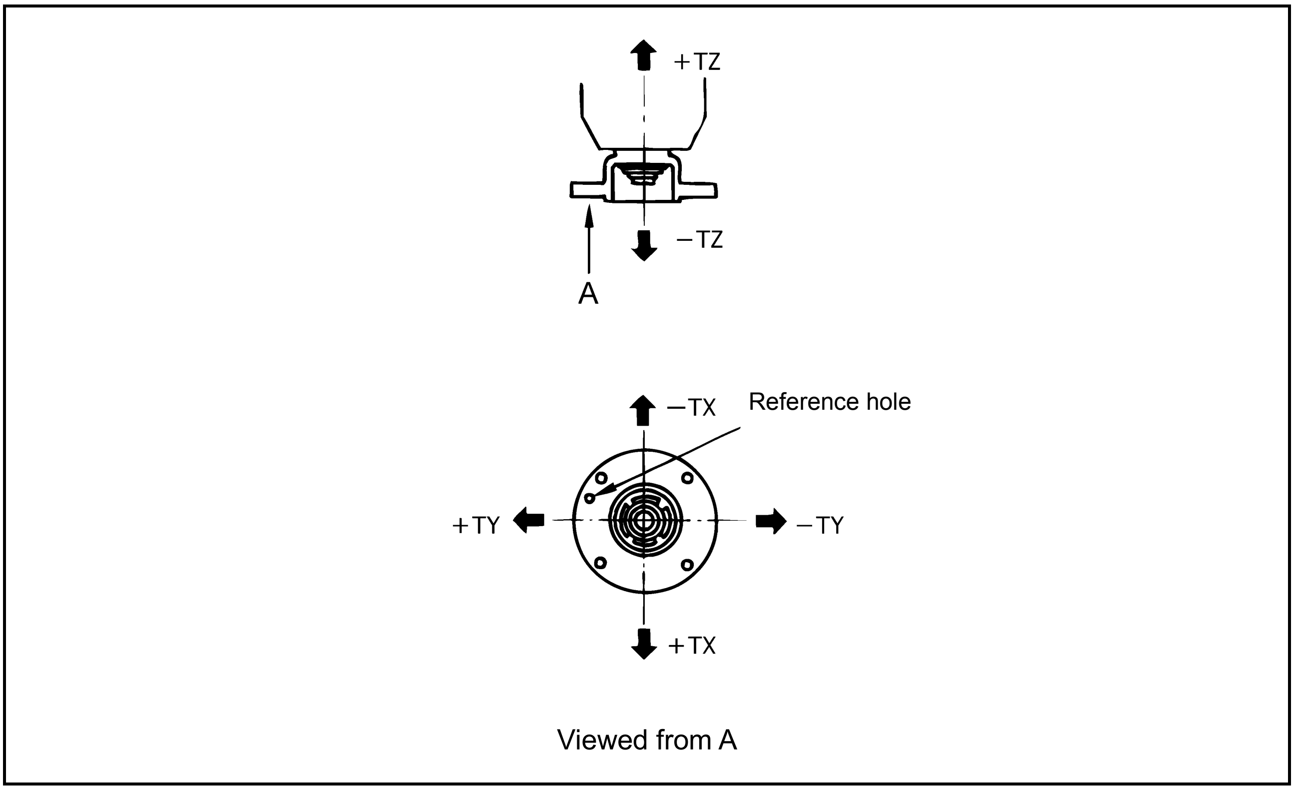



**Figure 1-5 Motion in Tool Mode**

## 1.2.3 Names of the Robot Controller Components

Figure 1-6 and Table 1-4 show the names of the robot controller components.

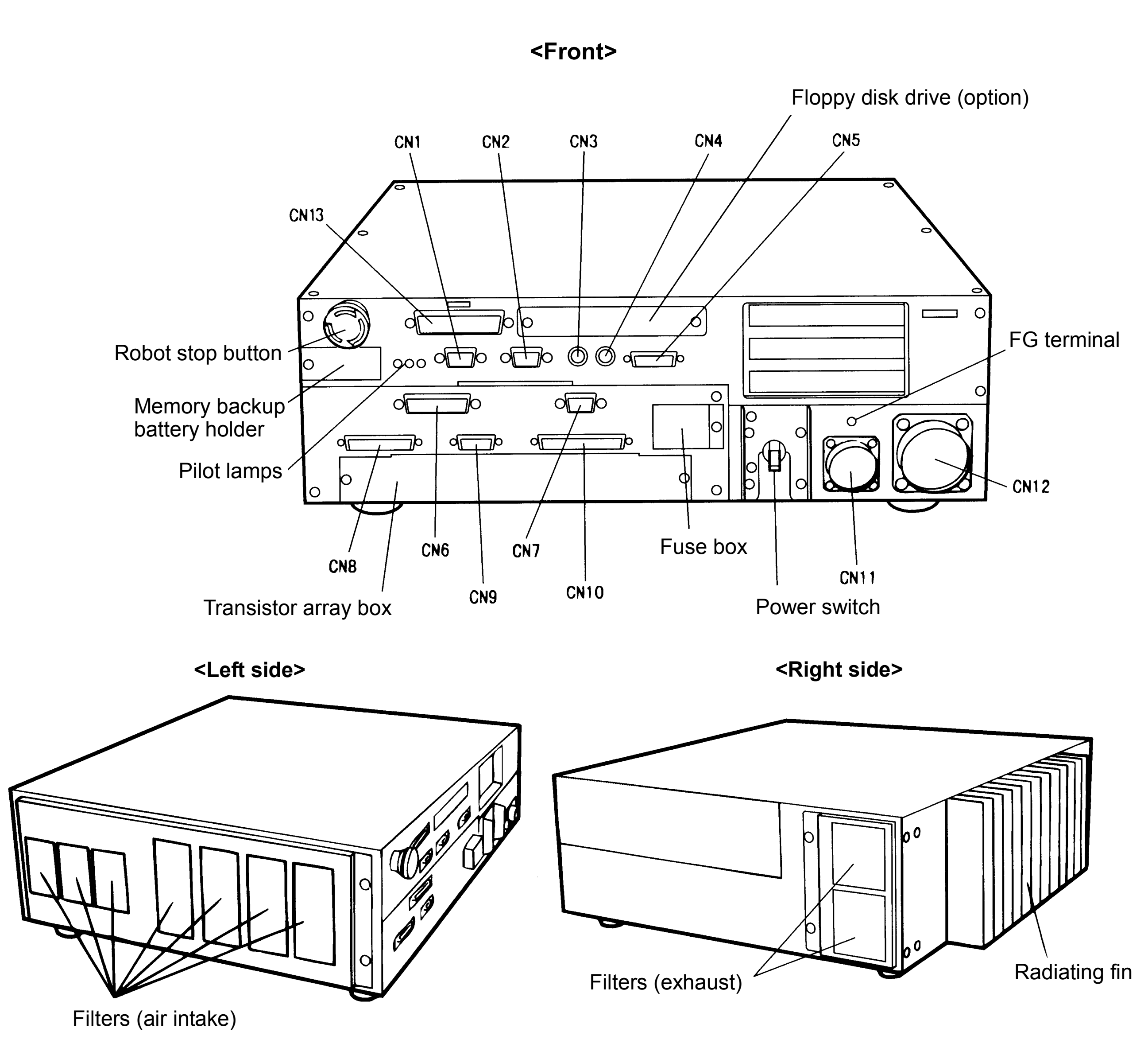



**Figure 1-6 Names of Robot Controller Components**

**Table 1-4 Connector Names**

| Connector No. | Marking | Name | Connector No. | Marking | Name |
|---|---|---|---|---|---|
| CN1 | RS232C | Serial interface connector | CN8 | INPUT | Connector for user input or system input |
| CN2 | CRT | CRT connector | CN9 | HAND I/O | Connector for end-effector I/O |
| CN3 | KEYBD | Keyboard connector | CN10 | OUTPUT | Connector for user output or system output |
| CN4 | MOUSE | Connector for PS/2 mouse | CN11 | INPUT AC | Power connector |
| CN5 | PENDANT | Connector for teach pendant | CN12 | MOTOR | Motor connector |
| CN6 | PRINTER | Printer connector (Not used) | CN13 | ENCODER | Encoder connector |
| CN7 | I/O POWER | Power connector for I/O | | | |

⚠**Caution: The robot controller connectors are of a screw-lock type or ring-lock type. Lock the connectors securely. If even one of the connectors is not locked, weak contact may result thereby causing an error.**

**Be sure to turn the robot controller OFF before connecting/disconnecting the power connector or motor connector. Otherwise, the internal circuits of the robot controller may be damaged.**

# 1.3 Robot Specifications

## [ 1 ] Robot Unit Specifications

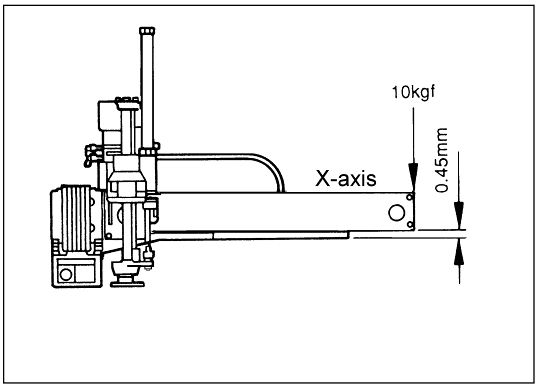
Table 1-5 lists the robot unit specifications of the XYC-4D series.

**Table 1-5 Robot Unit Specifications of the XYC-4D Series**

| Item | | Specifications |
|---|---|---|
| Model of robot system (Note 1) (Note 2) | | XYC-40∗a∗b∗cD-L (R) |
| Model of robot unit | | XYC-40∗a∗b∗cDM-L (R) |
| X-axis stroke (*a) | | (*a=) 2: 250 mm, 3: 350 mm, 4: 450 mm, 5: 550 mm |
| Y-axis stroke (*b) | | (*b=) 3: 300 mm, 4: 400 mm, 5: 500 mm, 6: 600 mm, 7: 700 mm, 9: 900 mm |
| Vertical stroke (*c) | | (*c=) 2: 200 mm, 3: 300 mm |
| Wrist rotation angle | | ±270° |
| Axis combination | | X (1st axis) +Y (2nd axis) +Z (3rd axis) +T (4th axis) |
| Maximum payload | | 10 kg |
| Composite speed | | X (1st axis) and Y (2nd axis): 1000 mm/s, Z (3rd axis): 2000 mm/s,<br>+T (4th axis): 610°/s |
| Position repeatability (Note 2) | | X (1st axis), Y (2nd axis) and Z (3rd axis): ±0.025 mm,<br>+T (4th axis): ±0.02° |
| Maximum force-fit | | 98N (one second or less) |
| Maximum allowable inertia moment around T axis | | 0.078 $kgm^2$ |
| Position detection | | Simplified absolute encoder |
| Drive motor | | AC servomotors for all axes + Gravity air balance cylinder,<br>Z axis (3rd axis) equipped with brake |
| Air source (for balance with gravity) | Operating pressure | 0.05 to 0.35 MPa |
| | Maximum allowable pressure | 0.59 MPa |
| Weight | | Approx. 66 kg (in the case of the heaviest model, XYC-40593DM-L(R)) |

Note 1: The model of robot system refers to the model of a complete set, including a robot unit and robot controller.
Note 2: Provided that the ambient temperature is constant.

### ■ Rigidity of the X axis

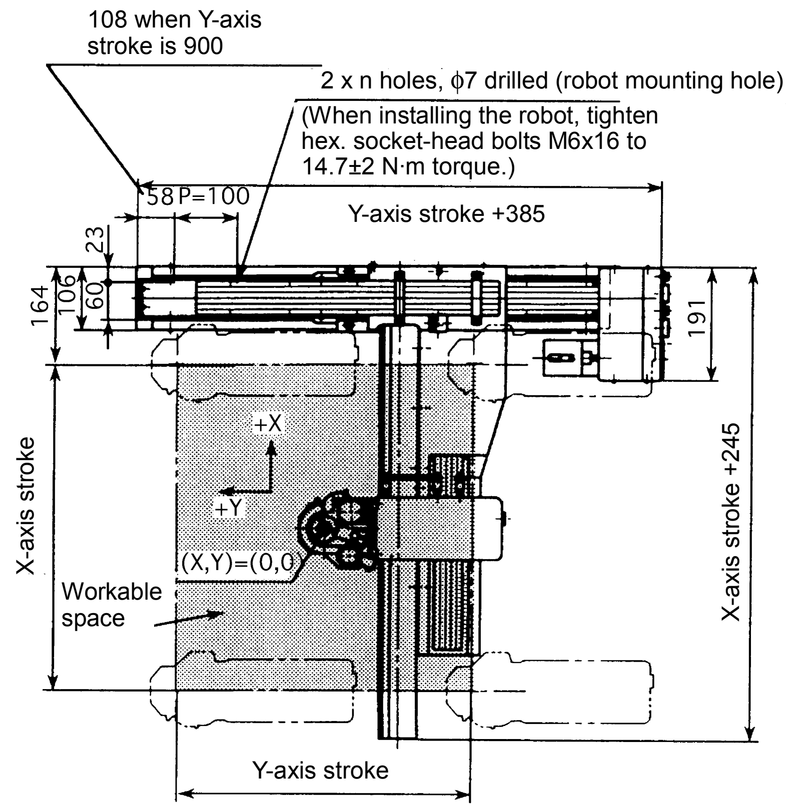



The X axis is cantilever-structured, so its rigidity is lower than that of other axes.

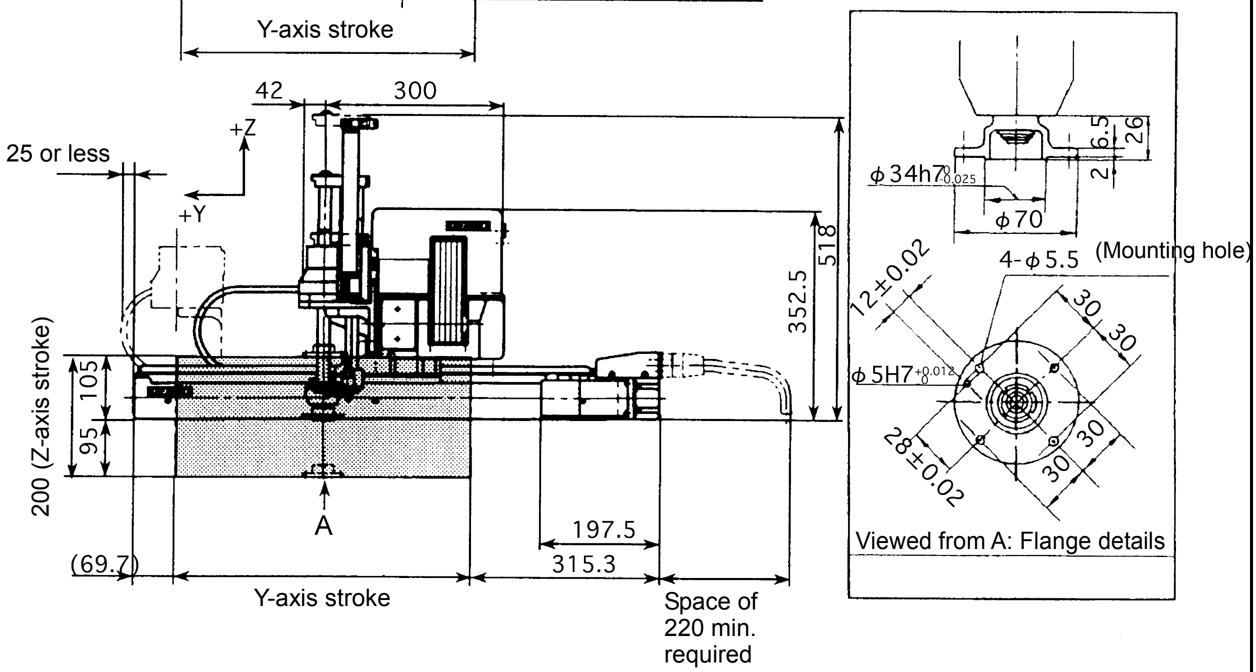
In the case of the XYC-40592DM-L(R), the deflection at the end of the X-axis frame is 0.45 mm when a load of 10 kg is applied.

## [ 2 ] Outer Dimensions and Workable Space of the Robot Unit

Figure 1-7 shows the outer dimensions and workable space of the XYC-4D series.

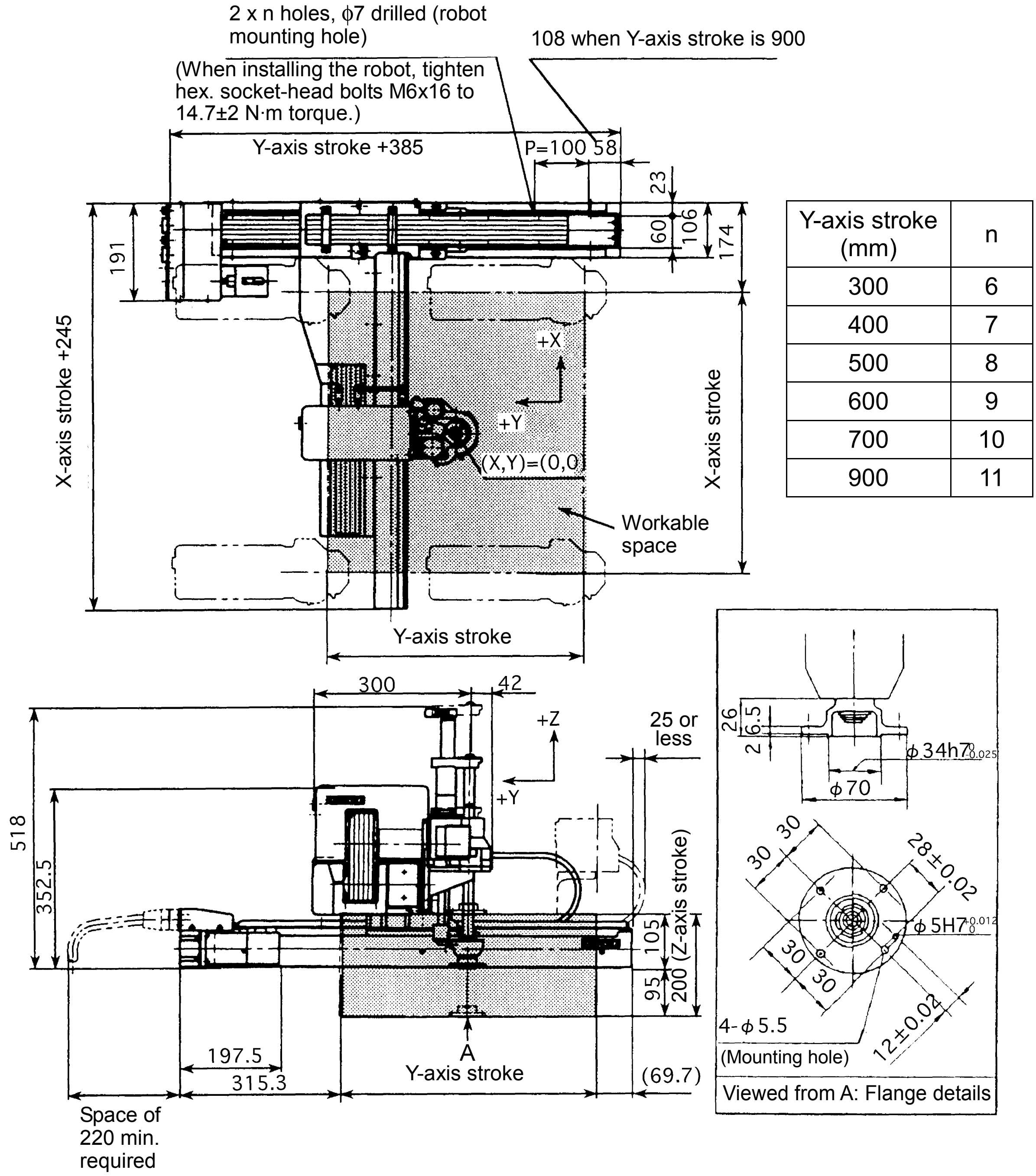



| Y-axis stroke (mm) | n |
|---|---|
| 300 | 6 |
| 400 | 7 |
| 500 | 8 |
| 600 | 9 |
| 700 | 10 |
| 900 | 11 |




Note: The origin (X, Y, Z, T = 0, 0, 0, 0) is at the center of the X- and Y-axis strokes, at the underside of the mounting base, and at the center of the robot flange shown in "Flange details" figure.

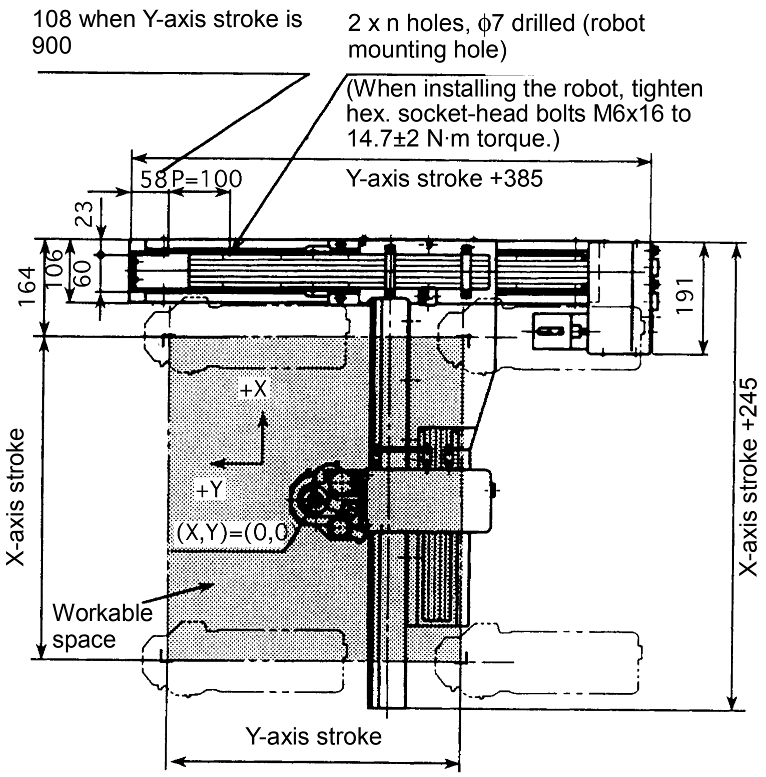
**Figure 1-7 (a) Outer Dimensions and Workable Space of the XYC-40**2D-L**



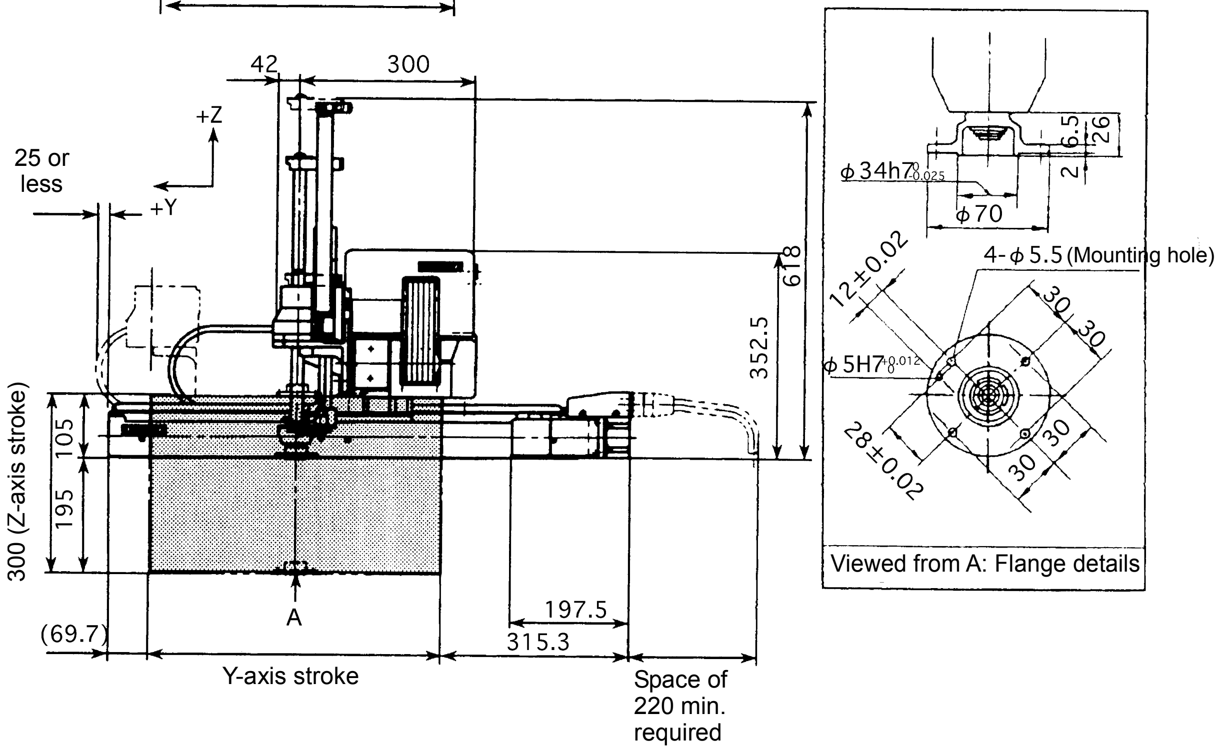

| Y-axis stroke (mm) | n |
|---|---|
| 300 | 6 |
| 400 | 7 |
| 500 | 8 |
| 600 | 9 |
| 700 | 10 |
| 900 | 11 |

Note: The origin (X, Y, Z, T = 0, 0, 0, 0) is at the center of the X- and Y-axis strokes, at the underside of the mounting base, and at the center of the robot flange shown in "Flange details" figure.

**Figure 1-7 (b) Outer Dimensions and Workable Space of the XYC-40**2D-R**

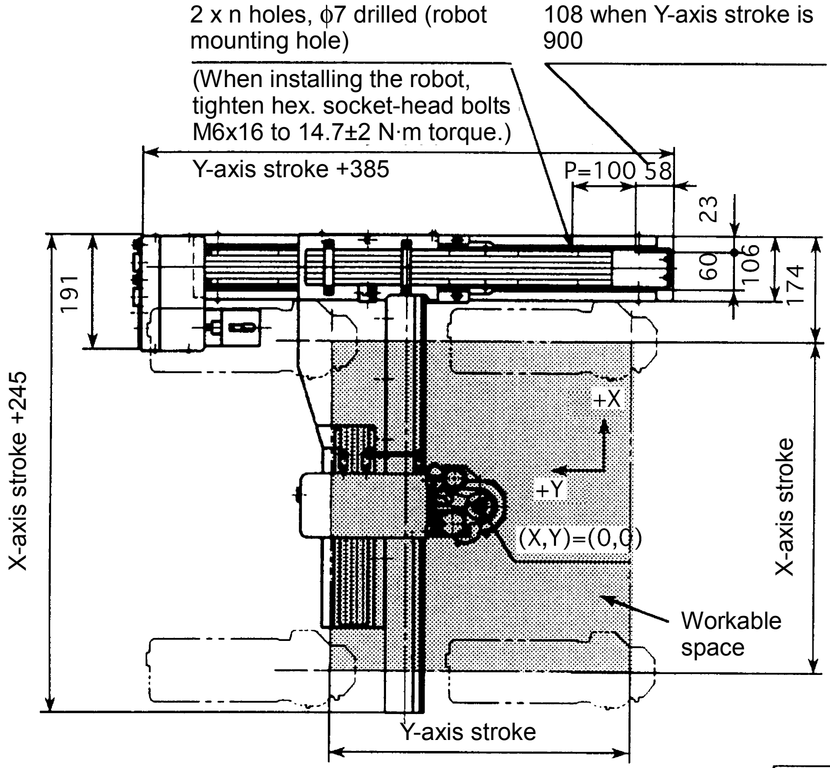



| Y-axis stroke (mm) | n |
|---|---|
| 300 | 6 |
| 400 | 7 |
| 500 | 8 |
| 600 | 9 |
| 700 | 10 |
| 900 | 11 |

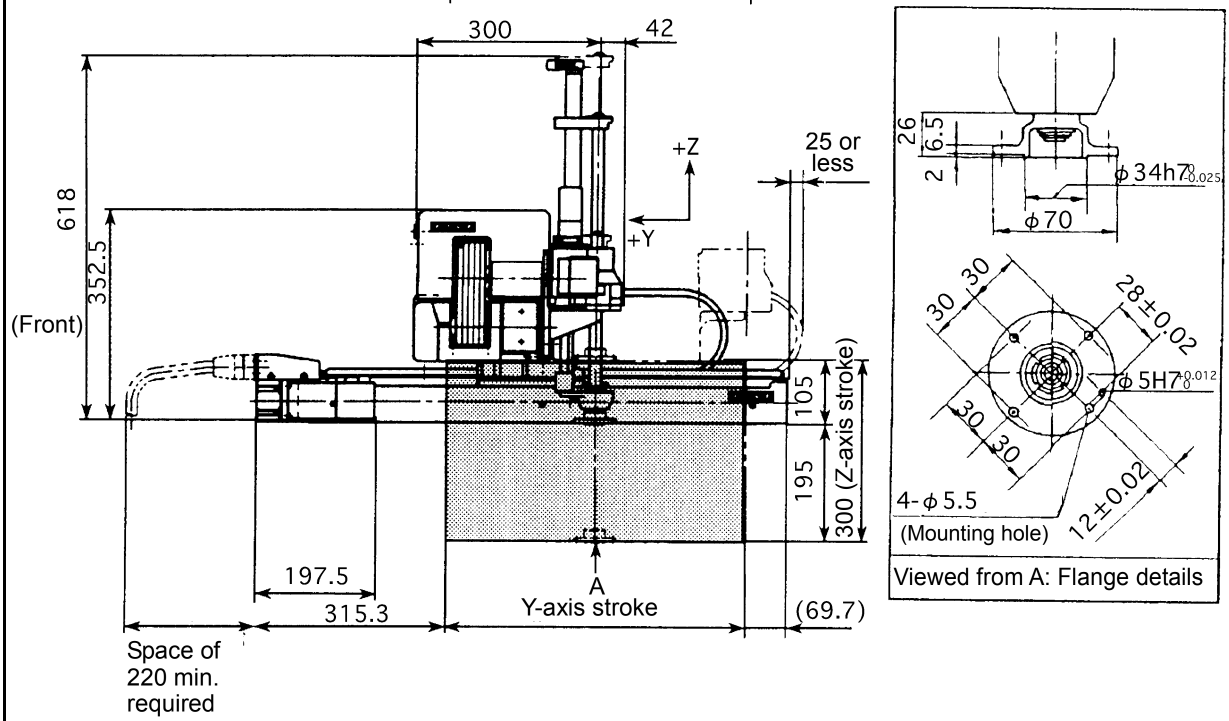



Note: The origin (X, Y, Z, T = 0, 0, 0, 0) is at the center of the X- and Y-axis strokes, at the underside of the mounting base, and at the center of the robot flange shown in "Flange details" figure.

**Figure 1-7 (c) Outer Dimensions and Workable Space of the XYC-40**3D-L**




| Y-axis stroke (mm) | n |
|---|---|
| 300 | 6 |
| 400 | 7 |
| 500 | 8 |
| 600 | 9 |
| 700 | 10 |
| 900 | 11 |




Note: The origin (X, Y, Z, T = 0, 0, 0, 0) is at the center of the X- and Y-axis strokes, at the underside of the mounting base, and at the center of the robot flange shown in "Flange details" figure.

**Figure 1-7 (d) Outer Dimensions and Workable Space of the XYC-40**3D-R**

## [ 3 ] Robot Positioning Time

Positioning time for the XYC-4D series

1. Figures 1-9 through 1-12 show the positioning times used to calculate the cycle time.
2. Positioning time means the time from the start of robot operation to the arrival at the target positioning point.
3. After the robot moves to and passes the target positioning point, vibration will be dampened and the robot positioned at the target positioning point as shown in Figure 1-8. This vibration dampening time is not considered in the graph.

**Caution (1) The vibration dampening time depends on factors such as the weight of the end-effector. If the robot is to be used in such a way that it overshoots or if the vibration damping time is of great concern, test the robot carefully beforehand.**

**(2) If acceleration begins before residual vibration of the robot stops, an overcurrent error (code starts from ERROR6120; the first digit represents the axis number) may be displayed. In this case, take one of the following measures:**

- **Lower the deceleration of the preceding operation with a DECEL command to reduce residual vibration.**
- **Keep the robot on standby with a DELAY command until residual vibration stops.**
- **Lower acceleration with an ACCEL command.**

**(3) Operate the robot with the optimum payload setting in accordance with the end-effector weight and workpiece weight. If not, a robot failure may result.**

**(4) In the locating time graph, the Z-axis stroke of 300 mm is represented near the upper end. Near the lower end, the horizontal movement time along the J1/J2 axis increases.**

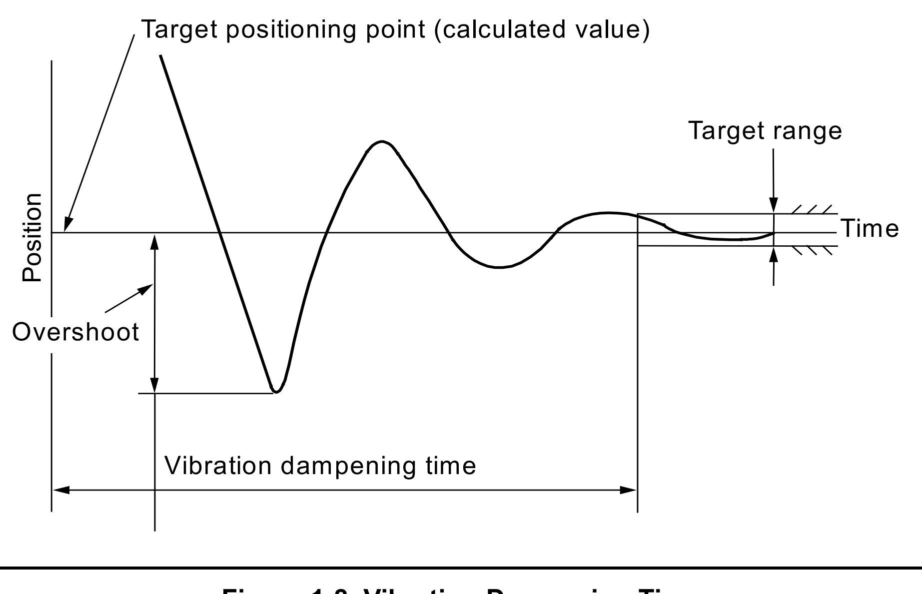



**Figure 1-8 Vibration Dampening Time**

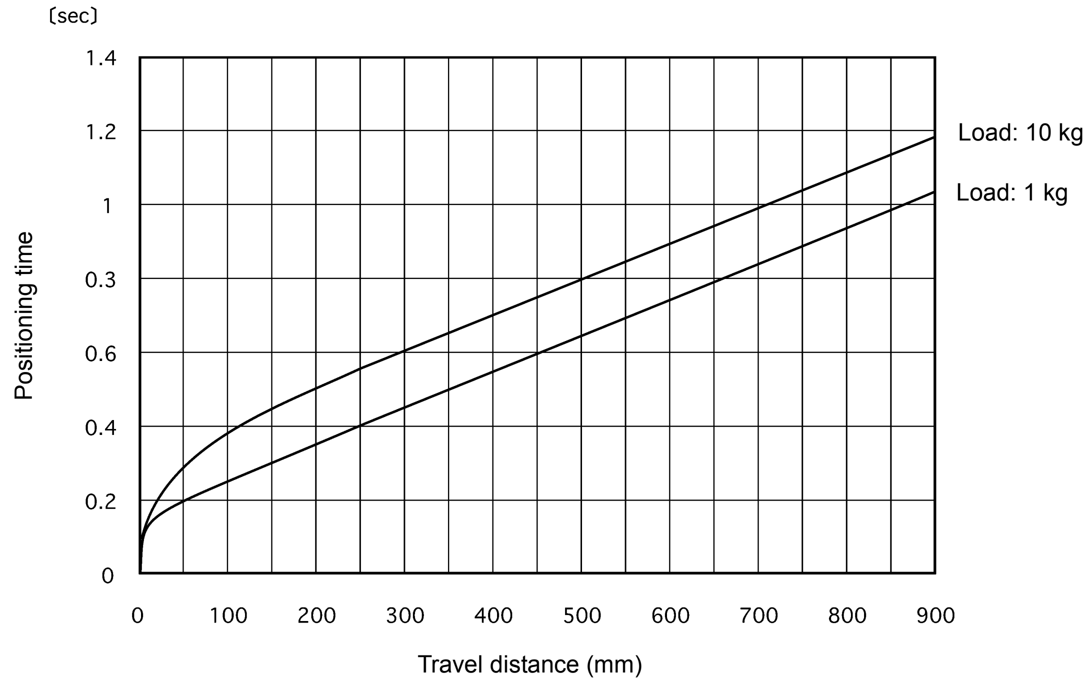



**Figure 1-9 X-/Y-axis Positioning Time**

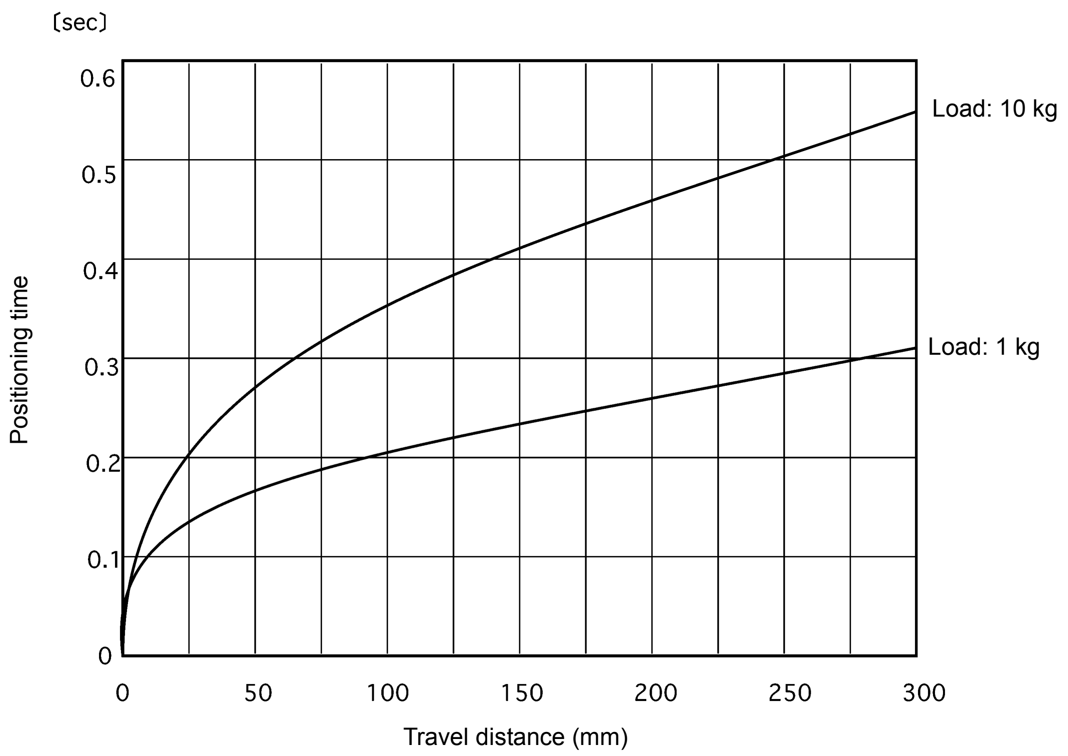
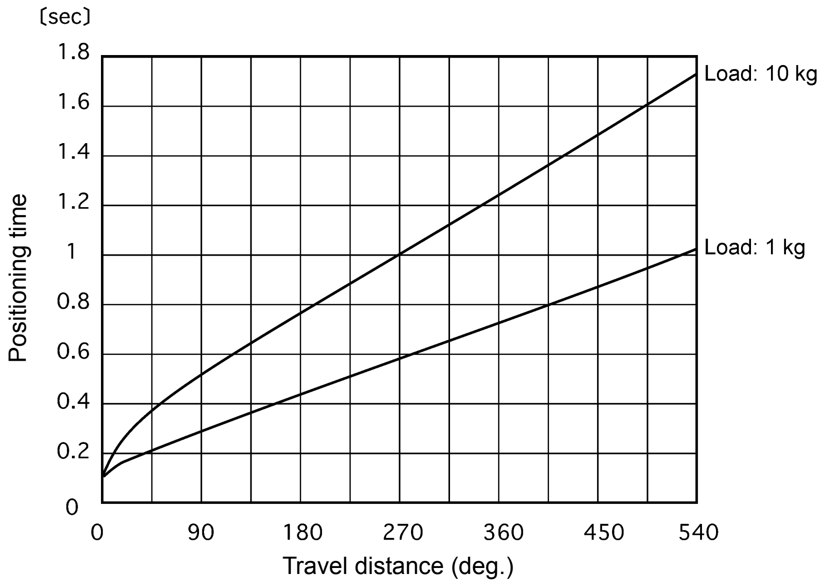



**Figure 1-10 Z-axis Positioning Time**




| Payload | Payload moment of inertia |
|---|---|
| 1 kg | 0.010kg・m$^2$ |
| 2 kg | 0.021kg・m$^2$ |
| 3 kg | 0.028kg・m$^2$ |
| 4 kg | 0.038kg・m$^2$ |
| 5 kg | 0.044kg・m$^2$ |
| 6 kg | 0.052kg・m$^2$ |
| 7 kg | 0.058kg・m$^2$ |
| 8 kg | 0.066kg・m$^2$ |
| 9 kg | 0.074kg・m$^2$ |
| 10 kg | 0.082kg・m$^2$ |

**Figure 1-11 T-axis Positioning Time**

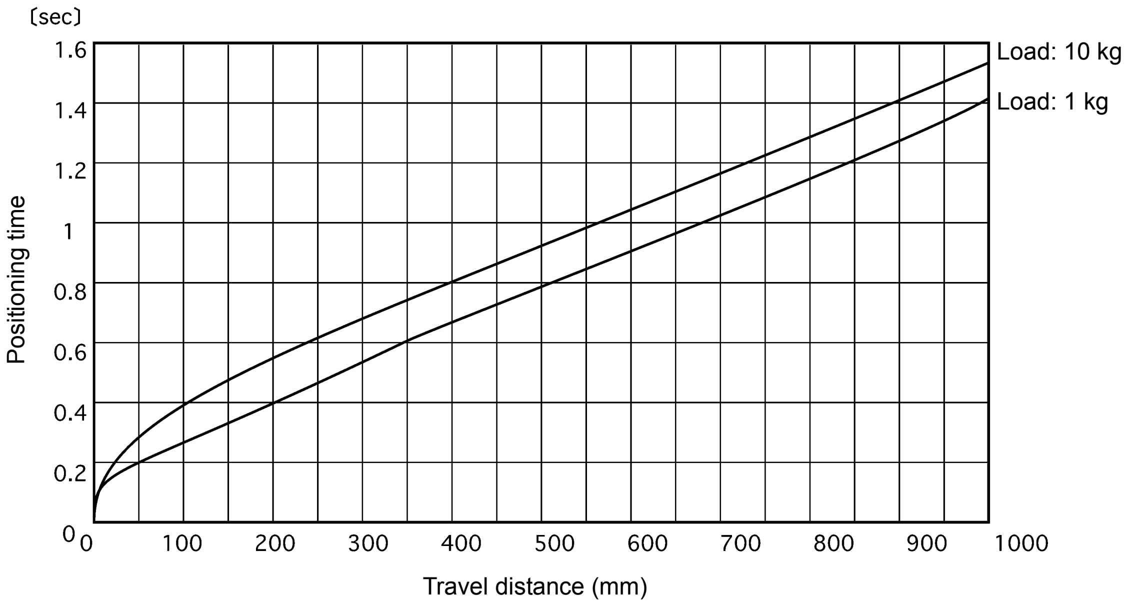
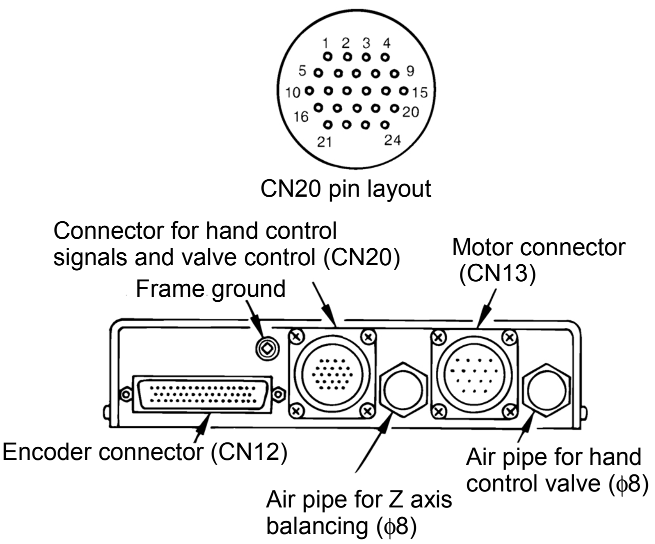



**Figure 1-12 Composite Positioning Time of All Axes (MV S motion)**

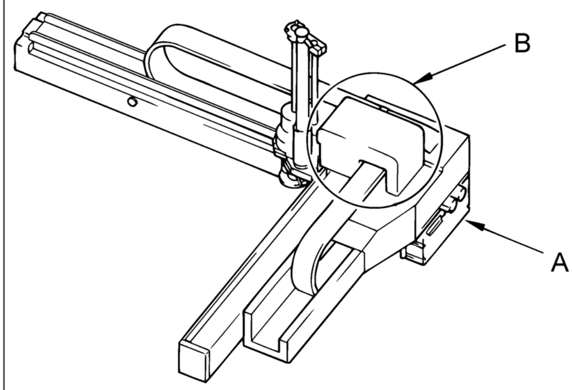
# [ 4 ] Air piping and signal wiring

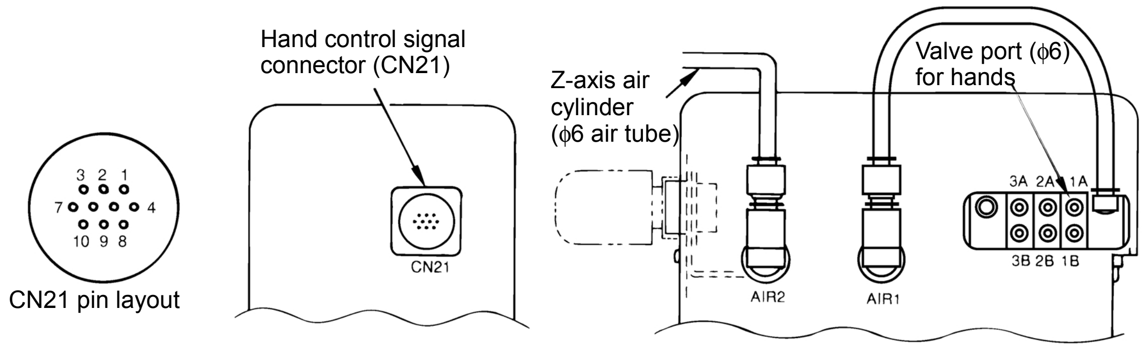
The XYC-4D series robot is equipped with 6 air pipes for air chuck, 10 signal lines, and 4 solenoid valves (incl. 3 for users) in it.

Those solenoid valves may be used by the robot controller if you connect pins 11 through 18 on CN20 with the valve output port on controller's CN4.




Viewed from A (Connector mount details)




Viewed from B (Hand control signal connector and air valve connector)

Note: For hand control signal connectors CN20 and CN21, use the connector set that comes with the robot unit.

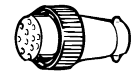
| Parts No. of connector set | Part No. | Model and name | Illustration |
|---|---|---|---|
| 410889-0030 | 410877-0170 (For CN20) | SRCN6A25-24S (Round connector) (Nippon Kohku Denshi) |  |
| | 410877-0180 (For CN21) | JMLP1610M (L-type plug connector) (Dai-ichi Electronic Industry) |  |

**Figure 1-13 Air Piping and Signal Wiring**

**Table 1-6 (a) Solenoid Valve Specifications**

| | Item | Specifications |
|---|---|---|
| Valve | Switching system | 2-position double |
| | Structural valve | Metal seal |
| | Applicable fluid | Air |
| | Operating pressure range | 0.18 to 0.7 MPa |
| | Guarantee pressure resistance | 1.5 MPa |
| | Ambient temperature and fluid temperature | -10 to +50°C (If the temperature is low, use dry air. No dew condensation allowed.) |
| | Lubrication | Not required. |
| | Effective cross section (CV value)<br>Response time | 4.5 $mm^2$ (0.25)<br>12 ms or less |
| Power source | Coil rated voltage<br>(Allowable voltage regulation)<br>Power consumption (current value) | 24 VDC<br>(±10 %)<br>1 W DC (42 mA) |

**Table 1-6 (b) CN20 Pin Layout**

| Pin No. | Name |
|---|---|
| 12 | +24V |
| 13 | Solenoid 1A (solenoid valve 1) |
| 14 | Solenoid 1B (solenoid valve 1) |
| 15 | Solenoid 2A (solenoid valve 2) |
| 16 | Solenoid 2B (solenoid valve 2) |
| 17 | Solenoid 3A (solenoid valve 3) |
| 18 | Solenoid 3B (solenoid valve 3) |

**Table 1-6 (c) Valve Symbols and Air Intake/ Exhaust States**

| Air piping joint | | Valve signal | | |
|---|---|---|---|---|
| Air intake | Exhaust | Solenoid valve | Solenoid | |
| | | | A | B |
| 1A | 1B | 1 | ON | OFF |
| 1B | 1A | 1 | OFF | ON |
| 2A | 2B | 2 | ON | OFF |
| 2B | 2A | 2 | OFF | ON |
| 3A | 3B | 3 | ON | OFF |
| 3B | 3A | 3 | OFF | ON |

**NOTE: Pins 1 to 10 on CN21 are connected with pins 1 to 10 on CN20, respectively. The maximum rated current is 1A per line.**

# 1.4 Robot Controller Specifications

## 1.4.1 Specifications and Outer Dimensions

### [ 1 ] Controller Specifications

Table 1-7 lists the specifications of the XYC-4D series robot controller.

**Table 1-7 Specifications of XYC-4D Series Robot Controller**

| Item | | Specifications |
|---|---|---|
| Applicable robot | | Cartesian coordinate |
| Model | | RC5-XYC4A |
| Control system | | PTP, CP 3-dimensional linear, 3-dimensional circular |
| No. of controllable axes | | Up to four axes simultaneously |
| Drive system | | All axes: all digital AC servo |
| Memory capacity | | 1.25 MB (equivalent to 5000 steps, equivalent to 13,000 points) |
| Language used | | DENSO robot language (conforming to SLIM) |
| Usable programs | | 255 |
| Teaching system | | 1) Remote teaching 2) Numerical input (MDI) 3) Direct teaching |
| External signals (I/O) | Input signal | 20 user open points (PLC 12, hand input 8) + 36 fixed system points |
| | Output signal | 32 user open points (PLC 24, hand output 8) + 33 fixed system points |
| External communication | | RS-232C: 1 line<br>Ethernet: 1 line (option) |
| Timer function | | 0.02 to 10 sec. (in increment of 1/60 sec.) |
| Self-diagnosis function | | Overrun, servo error, memory error, input error, etc. |
| Error display | | Error codes will be displayed on the external I/O, operating panel (option), or mini-pendant (option). Error messages will be displayed in English on the teach pendant (option). |
| Power source | | 3-phase, 200 VAC-15% to 230 VAC+10%, 50/60 Hz, 1.5 kVA<br>Single-phase, 200 VAC-10% to 230 VAC+10%, 50/60 Hz, 1.5 kVA |
| Environmental conditions (in operation) | | Temperature: 0 to 40°C<br>Humidity: 90% RH or less (no condensation allowed) |
| Degree of protection | | IP20 |
| Cables | Robot control cable | 3 m or 6 m (selective) |
| | I/O cable | 8 m, 15 m (Option) |
| | Power supply cable | 5 m |
| Weight | | Approx. 16 kg (excluding attached cables) |

⚠CAUTION
- DO NOT touch fins. Hot surface may cause severe burns.
- DO NOT insert fingers or foreign objects into openings, or bodily injury may occur.
- DO NOT touch inside of the controller before turning the power off, disconnecting cable from the controller and waiting at least 3 minutes, or you can receive electric shock.
- DO NOT connect or disconnect connectors while the robot controller is turned ON. Doing so will result in an electric shock or controller failure.

⚠ CAUTION IN INSTALLATION
- This controller does not meet dust-proof, splash-proof or explosion-proof specifications.
- Read the owner's manuals before installation.
- Do not place anything on the controller.

## [ 2 ] Outer Dimensions of the Robot Controller

Figure 1-14 shows the outer dimensions of the XYC-4D series robot controller.

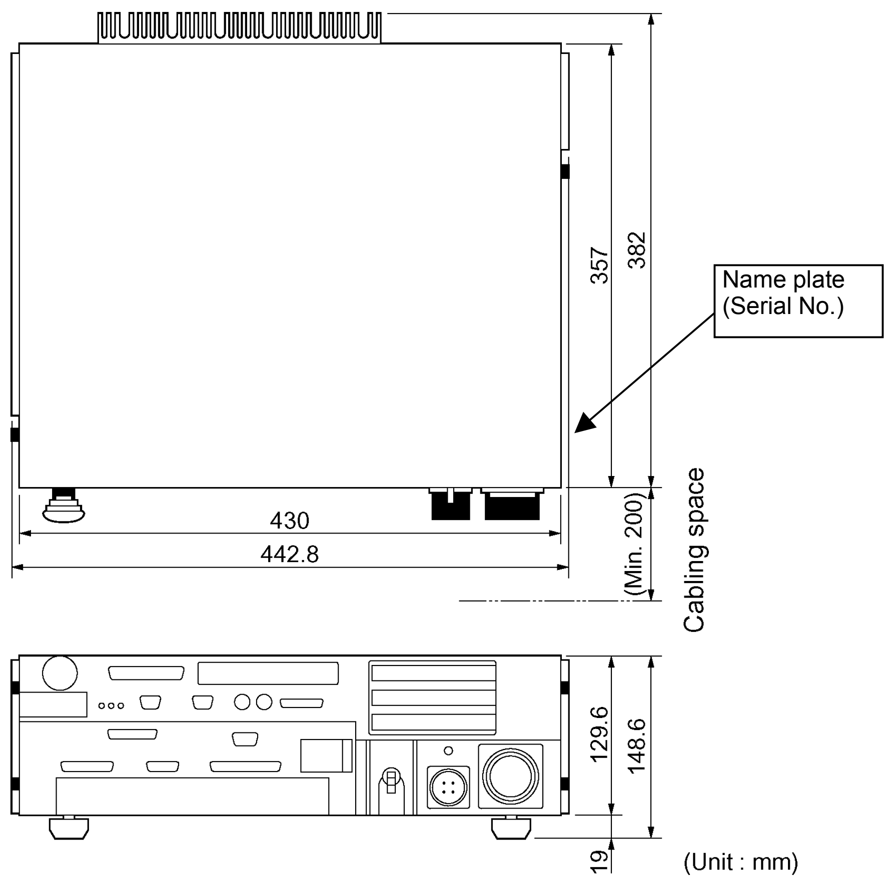



**Figure 1-14 Outer Dimensions of XYC-4D Series Robot Controller**

## 1.4.2 Controller Setting Table

The controller setting table given on the next page is attached to the controller. It shows the parameters that are set before delivery of the robot, as well as the next replacement dates of the memory backup battery and encoder backup battery.

• Parameters (① in the controller setting table)

Shows only parameters changed from typical values. Blanks indicate that the typical values are set.

For further information about parameters, see Chapter 4 “Customizing Your Robot.”

• Main system software Ver. (② in the table)

Shows the version of the main system software of the controller.

• Sub software Ver. (③ in the table)

Shows the version of the control software.

• Battery replacement date (④ in the table)

Shows the next battery replacement date.

• SER No. (⑤ in the table)

Shows the serial number of the robot.

• TYPE (⑥ in the table)

Shows the model of the robot system. Its coding system is described below.

• **Cartesian coordinate type**

XYC - 4 0 * * * D - *

- Figure
  - L: Lefty
  - R: Righty
- Z-axis stroke
  - 2: 200 mm, 3: 300 mm
- Y-axis stroke
  - 3: 300 mm, 4: 400 mm, 5: 500 mm,
  - 6: 600 mm, 7: 700 mm, 9: 900 mm
- X-axis stroke
  - 2: 250 mm, 3: 350 mm, 4: 450 mm,
  - 5: 550 mm
- Maximum payload (10 kg)
- Number of axes (4 axes)

# コントローラ設定表/THE SETPRM LIST

注記1.標準値から変更された個所のみ値を示します。空欄のものは標準値が設定されています。
　2.パラメータ値を変更した場合は、必ず下表の値の書き直し、または記入をしてください。
Note1.Only the different value from the defaults of the SETPRM are written. The blank means default.
　2.Write the new values on this list when you modify the SETPRM values.

① 1 パラメータ/PARAMETER

| パラメータ PARAMETER | | 値 VALUE |
|---|---|---|
| 正方向ソフトリミット PLIM | 1 | |
| | 2 | |
| | 3 | |
| | 4 | |
| | 5 | |
| | 6 | |
| | 7 | |
| | 8 | |
| 負方向ソフトリミット NLIM | 1 | |
| | 2 | |
| | 3 | |
| | 4 | |
| | 5 | |
| | 6 | |
| | 7 | |
| | 8 | |
| RANG | 1 | |
| | 2 | |
| | 3 | |
| | 4 | |
| | 5 | |
| | 6 | |
| | 7 | |
| | 8 | |
| I/Oモード I/O MODE | | |

| | |
|---|---|
| ② メインソフト Ver. MAIN SOFTWARE Ver. | |
| ③ サブソフト Ver. SUB SOFTWARE Ver. | |
| ④ 電池交換日 DATE OF RENEWING BAT. | |
| ⑤ SERIAL No. | |
| ⑥ TYPE | |

2 サブアッセンブリ/SUBASSEMBLY

| 名称 BOARD | 型式 BOARD TYPE | 備考 REMARK |
|---|---|---|
| メインボード MAIN BOARD | RP227 | |
| I/Oボード I/O BOARD | RP228, 229 | |
| 電源ボード POWER SUPPLY BOARD | RP214A,B | |
| ハーネスボード HARNESS BOARD | RP231 | |
| NFボード NF BOARD | RP235A | |
| コンパクトABSボード C-ABS BOARD | RP240A | |
| ブレーキリレーボード BRAKE RELAY BOARD | RP242 | |
| 回生抵抗ボード RESISTER BOARD | RP243 | |
| IPMボード (L) IPM BOARD (L) | RP232 | |
| IPMボード (M) IPM BOARD (M) | RP232 | |
| IPMボード (S) IPM BOARD (S) | RP232 | |
| IPMボード (SS) IPM BOARD (SS) | RP232 | |
| 拡張ボード1 EXTENSION BOARD 1 | | |
| 拡張ボード2 EXTENSION BOARD 2 | | |
| 拡張ボード3 EXTENSION BOARD 3 | | |
| メモリボード MEMORY BOARD | RP234 | |
| FD | | |

3 その他の変更点/OTHER MODIFICATIONS

# 1.5 Warranty

DENSO manufactures robots under strict quality control. In case of failure, we warrant the robot under the following conditions:

### Warranty Period

The warranty shall be effective for one year from the date of purchase.

### Warranty Coverage

DENSO shall repair the robot free of charge when a failure occurs and is attributable to the design, manufacture or material of the robot within the warranty period in spite of proper use.

### Items Not Covered

Failures, which arise from one of the following, shall not be covered by the warranty even if the robot is under warranty:

(1) Failures caused by improper repair, modification, transfer or handling by you or a third party;

(2) Failures caused by the use of a part or oil/fat other than those specified by DENSO;

(3) Failures caused by a fire, salt damage, earthquake, storm/flood or other acts of God;

(4) Failures caused by the use of the robot in an environment other than the environment specified by DENSO, such as dust and water ingress;

(5) Failures caused by a worn-out consumable, such as a fan filter;

(6) Failures caused by improper performance or non-performance of lubrication, maintenance or inspections stated in this owner's manual; and

(7) Damages other than the robot repair costs.

# Chapter 2

# Installing Robot Components

This chapter describes the procedures and precautions for transporting the robot during installation and for designing end-effectors.

For safe operation of the robot, read "SAFETY PRECAUTIONS, 2. Installation Precautions."

# 2.1 Preparing a Proper Environment for Installation

Before installing the robot unit and robot controller, confirm that the operating environment is in conformity with each item of the "SAFETY PRECAUTIONS, 2. Installation Precautions," and that the surrounding environment of the location where the robot is to be used meets the specifications as described below. Also, take proper measures to protect the components from vibration.

In an inappropriate environment, the robot will not operate to its full capacity or performance, components may not last long, and unexpected failure may result.

## 2.1.1 Installation Environments

The XYC-4D series robot is not explosion-proof, dust-proof or splash-proof, so it should not be installed in any environment where:

(1) there are flammable gases or liquids,

(2) there are any shavings from metal processing or other conductive material flying about,

(3) there are any acidic, alkaline or other corrosive gases,

(4) there is cutting or grinding oil mist,

(5) there is sulfuric cutting or grinding oil mist, or

(6) there are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise.

## 2.1.2 Ambient Temperature and Humidity

Keep the ambient temperature between 0°C and 40°C during operation.

Keep the ambient humidity at 90% or below to prevent dew condensation.

## 2.1.3 Vibration

Do not install the robot in an environment where it will be exposed to excessive vibration or impact.

## 2.1.4 Connecting the Robot Unit and Robot Controller

Before delivery, the robot unit and the robot controller are configured as a set. If you purchase two or more robot systems, take care not to mistake each set when connecting robot units and controllers.

| | |
|---|---|
| ⚠**Caution** | **Configured as a set, the robot unit and robot controller are given the same serial number. For the position of the serial number, see "1.3 [ 2 ] Outer Dimensions and Workable Space of the Robot Unit" and "1.4 [ 2 ] Outer Dimensions."** |

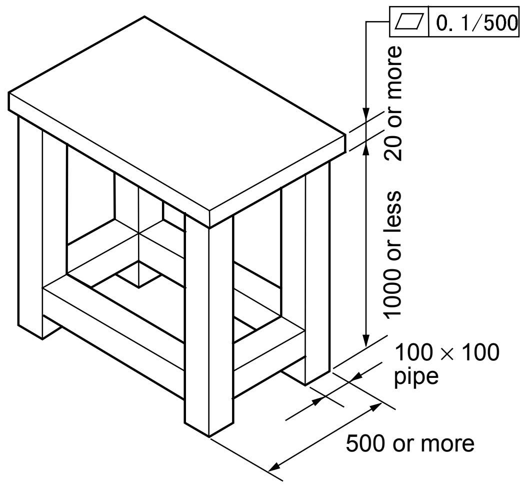
## 2.1.5 Installation Environment of the Robot Unit

Table 2-1 lists the installation requirements for the robot unit. Prepare a highly rigid mount as shown in Figure 2-1.

| | |
|---|---|
| ⚠**Caution:** | **Do not electric-weld the equipment including the robot. A large current may flow through the motor encoder or robot controller resulting in a failure. If electric welding is required, remove the robot unit and the robot controller from the equipment beforehand.** |

**Table 2-1 Installation Requirements for the Robot Unit**

| Item | Environments and Conditions |
|---|---|
| Flatness of the mount | 0.1/500 mm (See Figure 2-1.) |
| Rigidity of the mount | Use steel materials. (See Figure 2-1) |
| Installation type | Floor-mount |
| Ambient temperature | During operation : 0 to 40°C<br>During storage and transportation : -10 to 60°C |
| Humidity | During operation : 90% or less (No dew condensation allowed.)<br>During storage and transportation : 75% or less (No dew condensation allowed.) |
| Vibration | During operation : 4.9 $m/s^2$ (0.5G) or less<br>During storage and transportation : 29.4 $m/s^2$ (3G) or less |
| Safe installation environment | The robot should not be installed in an environment where:<br>• there are flammable gases or liquids,<br>• there are any shavings from metal processing or other conductive material flying about,<br>• there are any acidic, alkaline or other corrosive gases,<br>• there is cutting or grinding oil mist,<br>• there is sulfuric cutting or grinding oil mist,<br>• there are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise, or<br>• it may be directly exposed to water, oil or cutting chips. |
| Working space, etc. | • Sufficient service space must be available for inspection and disassembly.<br>• Keep wiring space (230 mm or more) behind the robot, and fasten the wiring to the mounting face or beam so that the weight of the cables will not be directly applied to the connectors. |
| Grounding conditions | Grounding resistance: 100 Ω or less |




⚠Caution (1) When the robot operates at high speed, the robot mount undergoes large reaction forces. The mount must be rigid enough so that it will not vibrate or be displaced due to reaction forces. It is also advisable to mechanically join the robot mount with heavy equipment.

(2) Some mounts may produce a resonance sound (howling). If this sound is loud, increase the rigidity of the mount or slightly modify the robot speed.

**Figure 2-1 Robot Mount Sample for Floor-mount**

# 2.2 Installing the Robot Unit

**⚠Caution: Before handling or installing the robot unit, be sure to read "SAFETY PRECAUTIONS, 2. Installation Precautions."**

## [ 1 ] Transporting the Robot Unit

The transporting jobs should be handled by at least three persons. The XYC-4D series weights approximately 66 kg (in the case of the heaviest model, XYC-40593DM).

Workers should put on helmet, safety shoes, and globes.

Follow the transporting procedure given below.

(1) Remove the motor and encoder cables from the robot unit.

(2) Press the ZT-axis against the mechanical end by moving it in the direction of the arrows as shown in Figure 2-2.

(3) Secure the ZT-axis with a rope or belt.

(4) While supporting the end of the X-axis to prevent the robot unit from overturning, remove the Y-axis mounting bolts to release the robot unit from the mount.

(5) Have at least three workers lift up the robot unit and transport it to the installation place.

The ZT-axis side of the X-axis and Y-axis is heavier, so keep the robot unit in balance for safe transport.

**⚠Caution (1) Do not hold the plastic covers by hand. They may be deformed or broken.**
**(2) Make sure that the transport path is free of obstacles.**

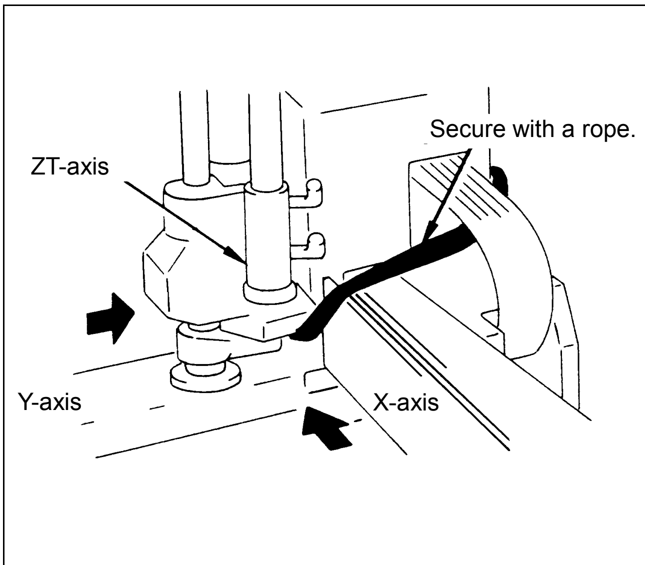



**Figure 2-2 Securing the ZT-Axis**

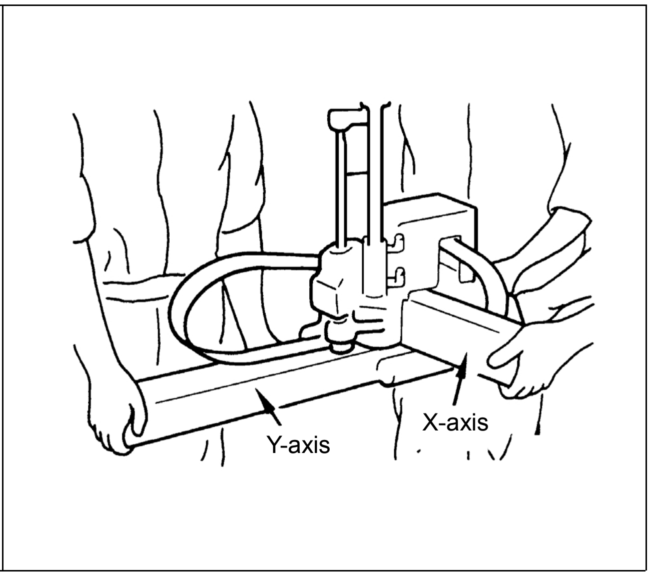



**Figure 2-3 Transporting the Robot Unit**

(6) Lift the robot unit down onto the installation point; as soon as this is done, temporarily clamp the robot unit with the four bolts previously removed.

(7) Fix the robot unit properly, referring to the procedures given in "[ 2 ] Installing the Robot Unit" on the next page.

| |
|---|
| **NOTE: After temporary bolting, connect the motor cable and encoder cable previously detached.** |

## [ 2 ] Installing the Robot Unit

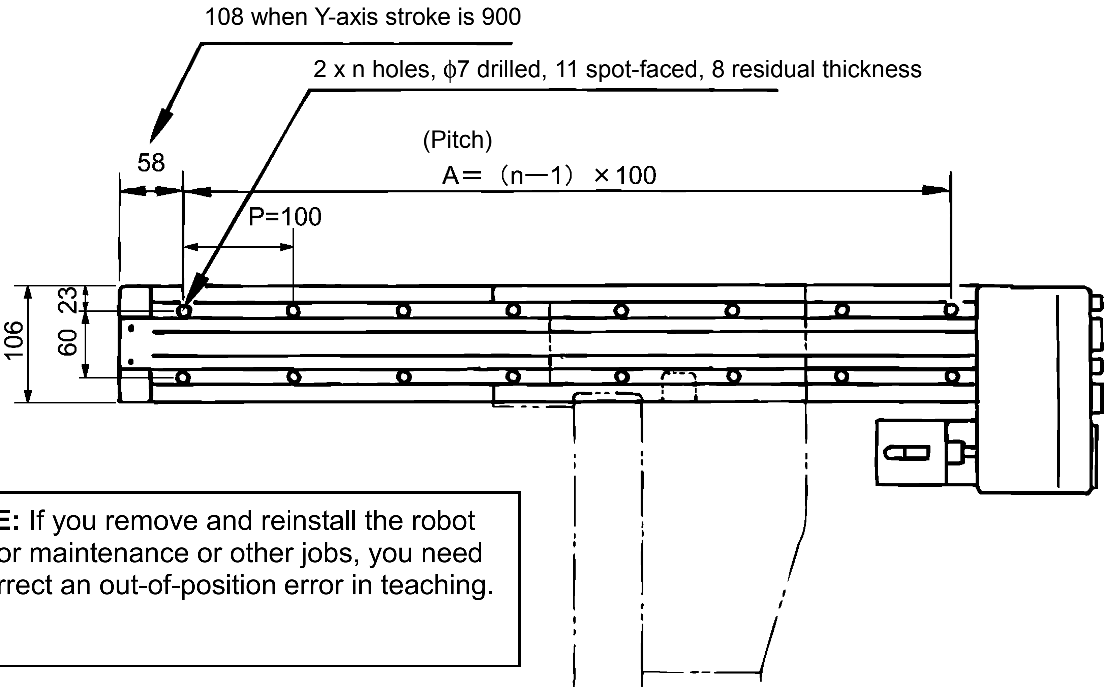
(1) Drill "2 x n" bolt holes (M6) in the robot mount where the robot unit is to be secured, according to the dimensions shown below.

(2) Put the robot unit on the robot mount, following the transport instructions given in "[ 1 ] Transporting the Robot Unit."

(3) Secure the robot unit to the mount with hex. socket-head bolts (M6x18). Tightening torque: 14.7±2 N·m

**Caution: Be sure to tighten all of "2 x n" bolts firmly. If any one of those bolts is loose, the rigidity of Y-axis frame setting will decrease, resulting in vibration of the robot servo system. When designing the robot mount, take care not to cause trouble due to improper installation. Failures which arise from improper installation shall not be covered by the warranty.**

| Y-axis stroke (mm) | A (mm) | n |
|---|---|---|
| 300 | 500 | 6 |
| 400 | 600 | 7 |
| 500 | 700 | 8 |
| 600 | 800 | 9 |
| 700 | 900 | 10 |
| 900 | 1000 | 11 |




**NOTE:** If you remove and reinstall the robot unit for maintenance or other jobs, you need to correct an out-of-position error in teaching.

**Figure 2-4 Bolt Positions for Securing the XYC-4D Series**

## [ 3 ] Grounding the Robot Unit

Ground the earth terminal of the robot unit using a wire of 5.5 mm$^2$ or more.

**NOTE:** Use a dedicated grounding wire and grounding electrode. Do not share them with any other electric power or power equipment such as a welder.

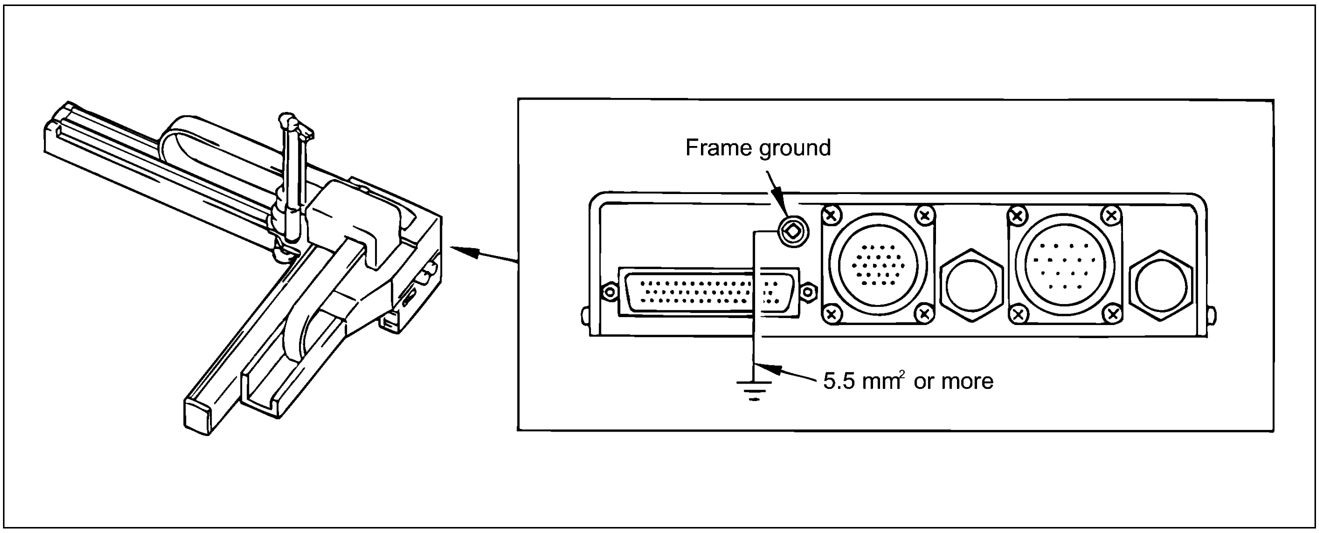



**Figure 2-5 Grounding the Robot Unit**

# 2.3 Installing the Robot Controller

Before installing the robot controller to the target position, you need to secure the robot controller to the controller mounting panel as described in Subsection 2.3.1.

The robot controller supported by the mounting panel may be either stand-alone or wall-mounted.

> ⚠**Caution:** **When using the robot controller in any environment where there is mist, put the controller in an optional robot controller protective box. The robot controller is not dust-proof, splash-proof, or explosion-proof.**

## 2.3.1 Securing the Robot Controller to the Controller Mounting Panel

(1) Figure 2-6 shows the bottom view of the robot controller. Marked with "O," the M4-nut welded holes may be used for securing the robot controller to the mounting panel.

(2) Prepare a mounting panel large enough to mount the robot controller. Secure the robot controller to the mounting panel at six nut-welded holes marked with "O" in Figure 2-6 using six M4 screws.

> ⚠**Caution**
>
> **(1) The controller mounting screws must not be more than the "thickness of the mounting panel plus 5 mm" in length. If they exceed 5 mm, the nut welded holes may be damaged.**
>
> **(2) Fix the robot controller at all of the six nut-welded holes.**

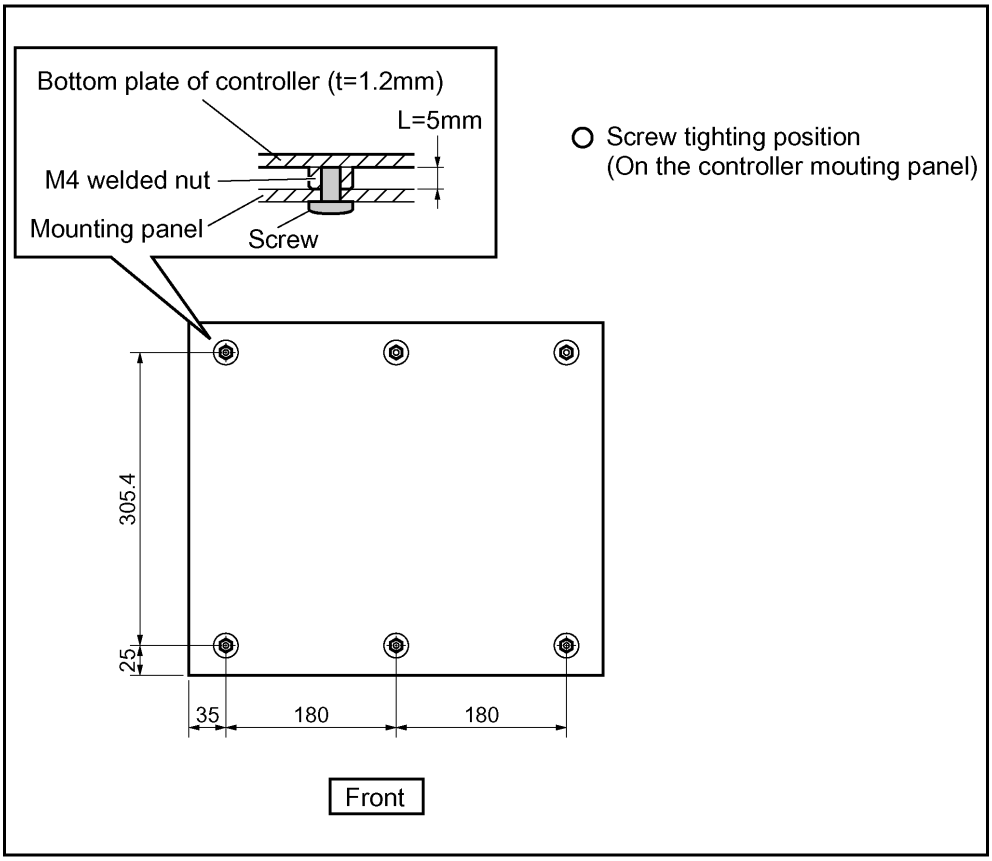



**Figure 2-6 Location of Mounting Screw Holes**
(on the bottom of the robot controller)

## 2.3.2 Installing the Robot Controller

The robot controller may be installed stand-alone or on the wall.

### [ 1 ] Stand-alone

Install the robot controller as shown in Figure 2-7.

> ⚠ **Caution: Do not place anything within 200 mm from the air inlet and air outlet on the robot controller.**

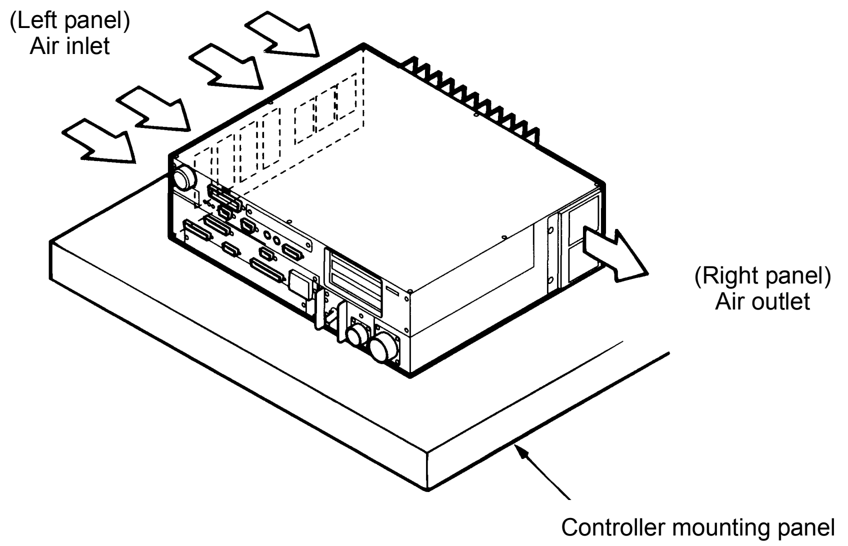



**Figure 2-7 Stand-alone Installation**

## [ 2 ]   Wall-mounted

Install the robot controller as shown in Figure 2-8.

> ⚠ **Caution: Do not place anything within 200 mm from the air inlet and air outlet on the robot controller.**

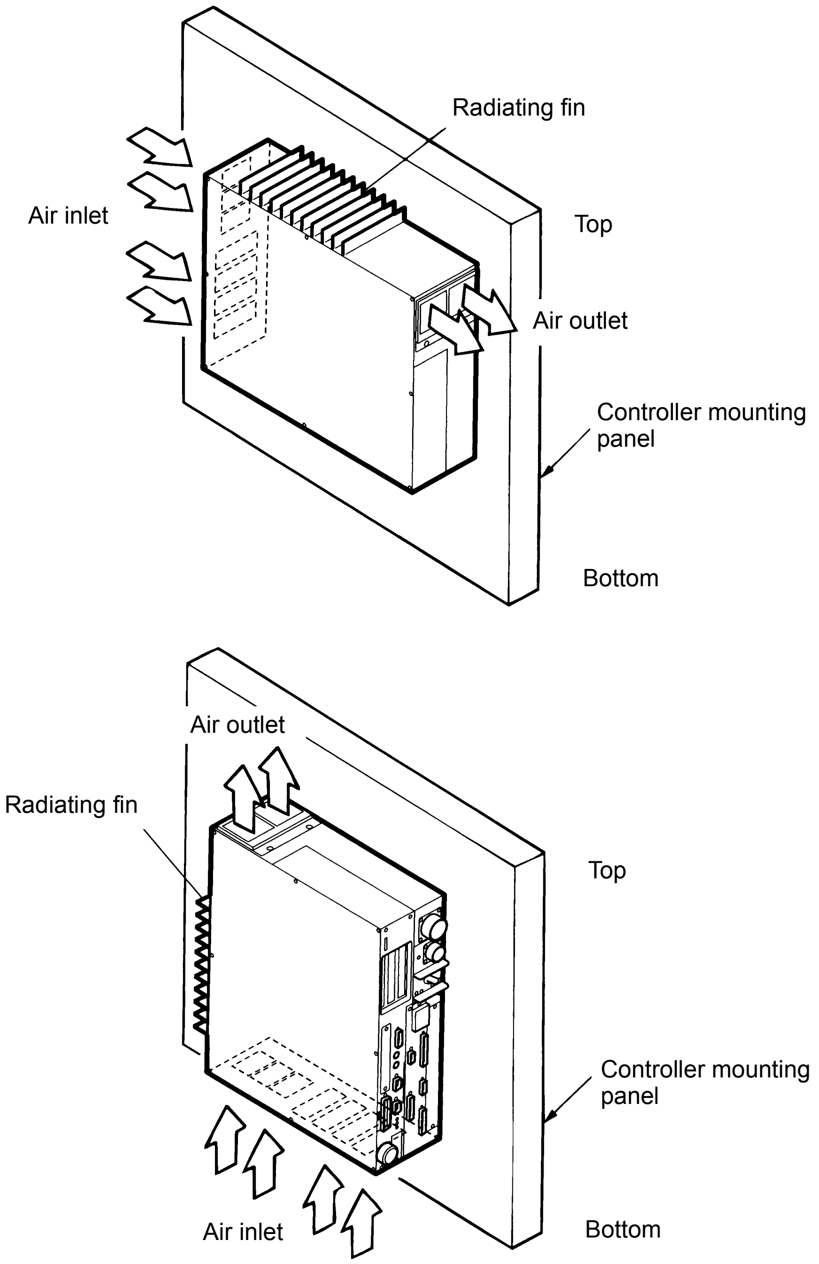



**Figure 2-8  Wall-mounted Installation**

# 2.4 Electrical Wiring and Air Piping of the Robot Unit

Make electrical wiring and air piping of the hand or tool to be attached to the arm end, referring to the example given below.

Use robot instrumentation cables (manufactured by Daikyo Denshi) or equivalent for electrical wiring.

## [ 1 ] Piping for Brake and Air Balance Cylinder

Install piping for the brake and air balance cylinder as shown in Figure 2-9. Apply air pressure within the range listed below.

| | |
|---|---|
| Air source pressure | 0.35 to 0.59 MPa |

> **Caution:** Be sure to connect the brake piping to the primary side of the air regulator.

Join air pipes to the robot unit at the connector sections shown in Figure 2-10.

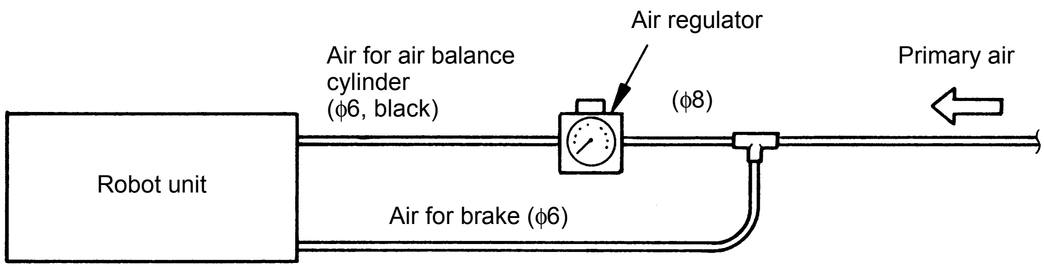



**Figure 2-9  Air Piping to the Robot Unit**

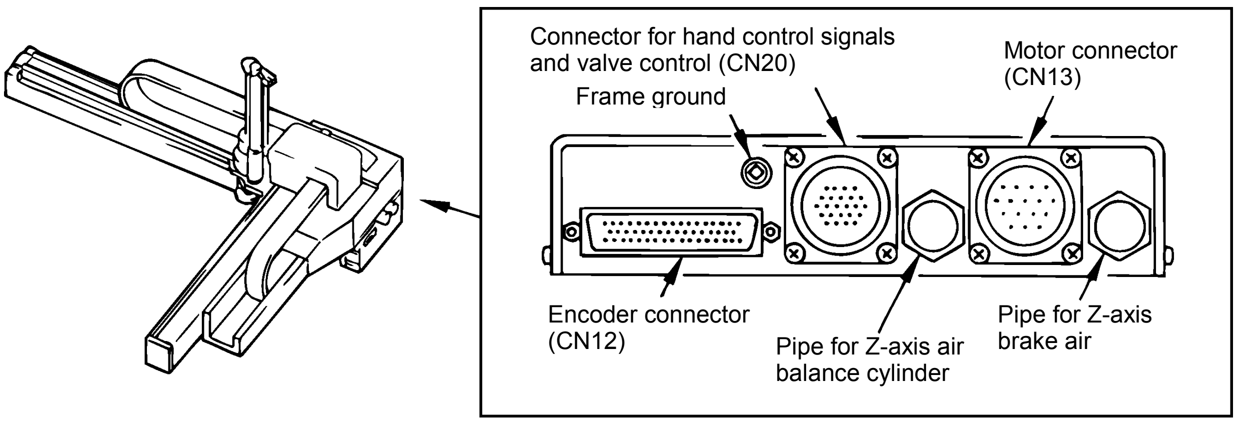



**Figure 2-10  Air Piping Section at the Robot Unit**

# [ 2 ] Making Stays for Wiring and Piping

You need to make stays for wiring and piping.

(1) Make stays. Figures 2-11 to 2-14 show the drawings of sample stays 1 to 4.

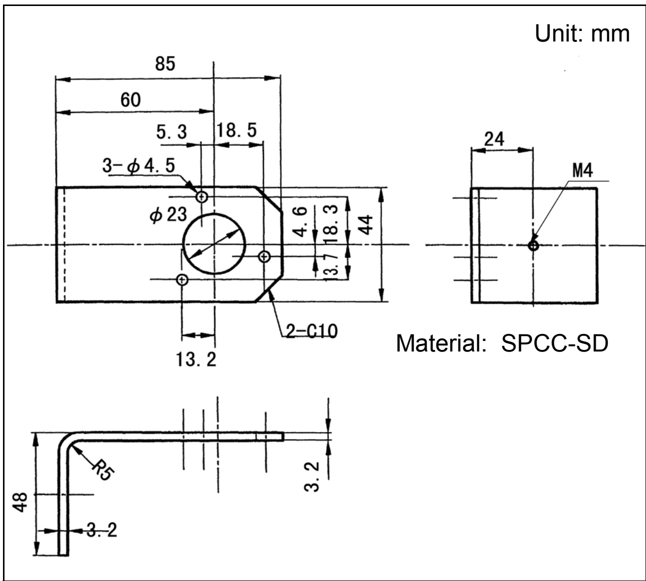



Figure 2-11 Stay 1

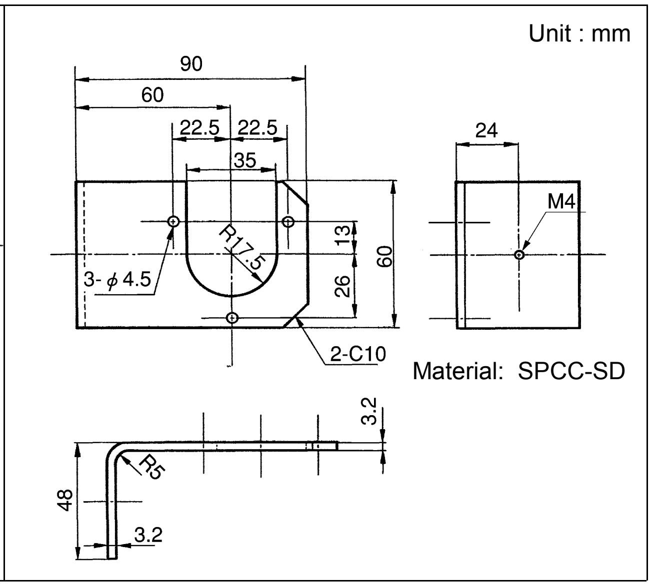
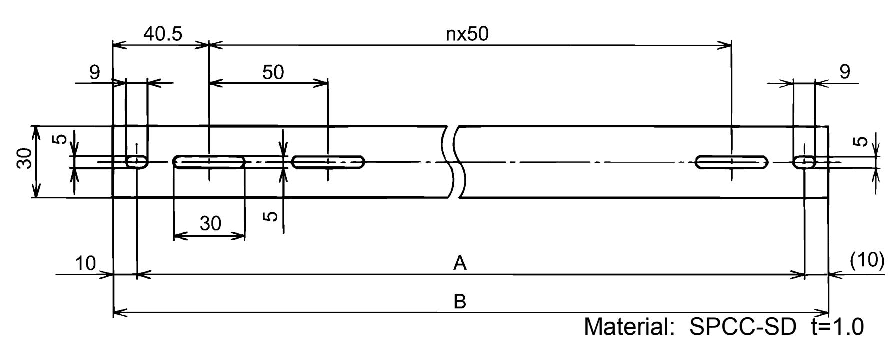



Figure 2-12 Stay 2




| Z-axis stroke | A | B | n |
|---|---|---|---|
| 200 | 311 | 331 | 5 |
| 300 | 411 | 431 | 7 |

Figure 2-13 Stay 3

(2) Secure stays 1 and 2 to the top and bottom of the vertical axis arm together with the bearing covers. (See Figure 2-14.)

(3) Install stay 3 to stays 1 and 2 with M4 screws.

(4) Carry out wiring and piping jobs.

> ⚠ **Caution: The range of the motion angle of the 4th-axis is 540°, so the length of the wiring and piping should be enough to support the wide motion range.**

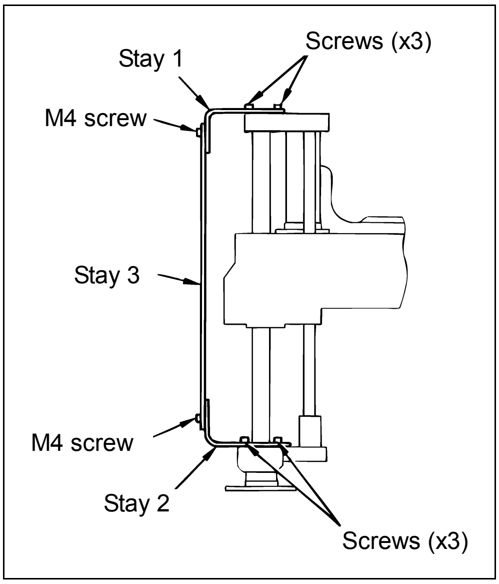


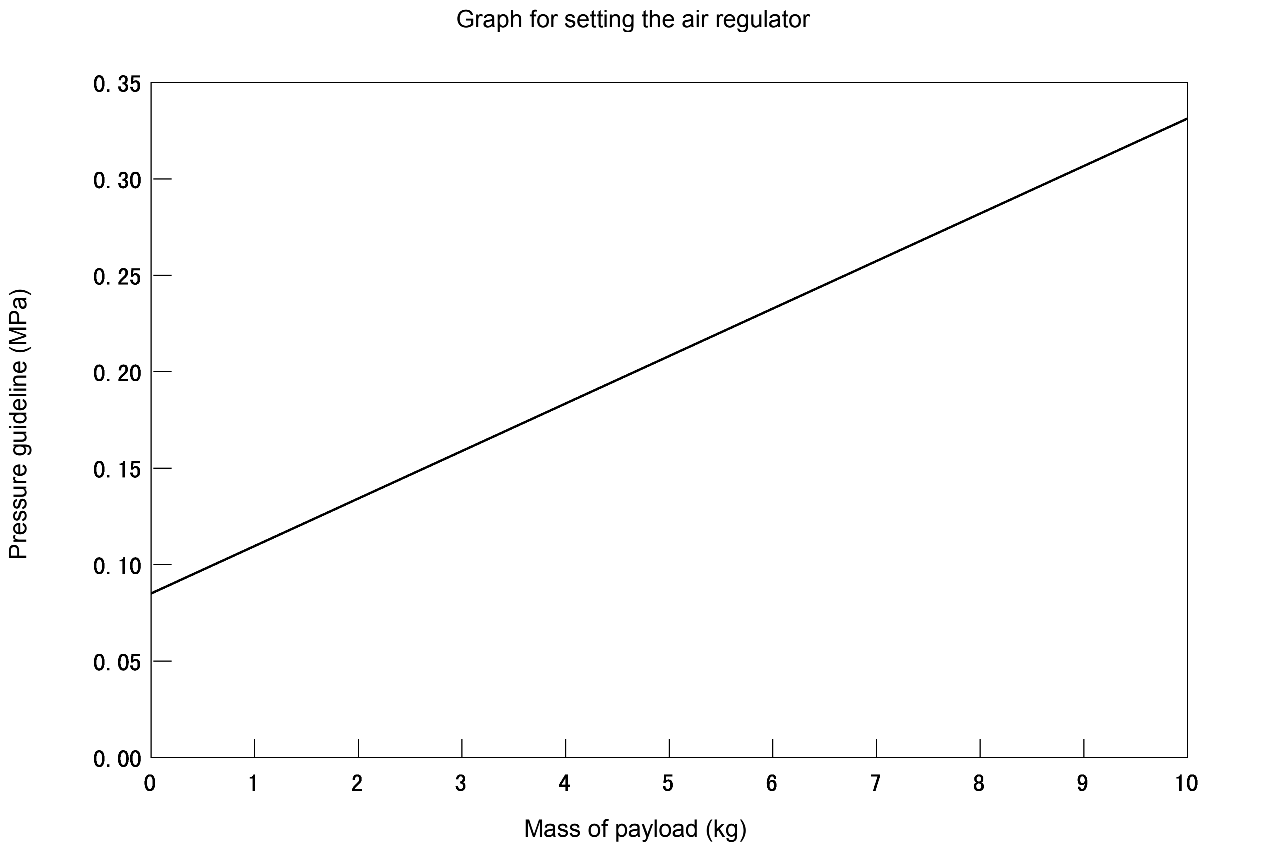

Figure 2-14 Stay 4

## [ 3 ]   Adjusting the Air Balance

Adjust the air pressure by using the air regulator so that the end-effector plus payload chucked by the end-effector will balance with gravity.

For details, refer to Graph 2-2 below and the SETTING-UP MANUAL, Section 5.3, "Adjusting the air pressure balance of the Z-axis, [F2 Arm]—[F12 Maint.]—[F4 Adj.Z.Bal]."

**Graph 2-2 Air Pressure Guideline**




**Note:** This graph shows only a guideline.

# 2.5 Engineering-design Notes for End-effectors

Design an end-effector so that it will satisfy conditions (1) through (3) described below.

⚠**Caution**: Strictly observe these engineering-design notes. Otherwise, the clamped sections of the robot unit will become loose, rattle or be out of position. In the worst case, the mechanical parts of the robot unit and the robot controller may be damaged.

## (1) Mass of an end-effector

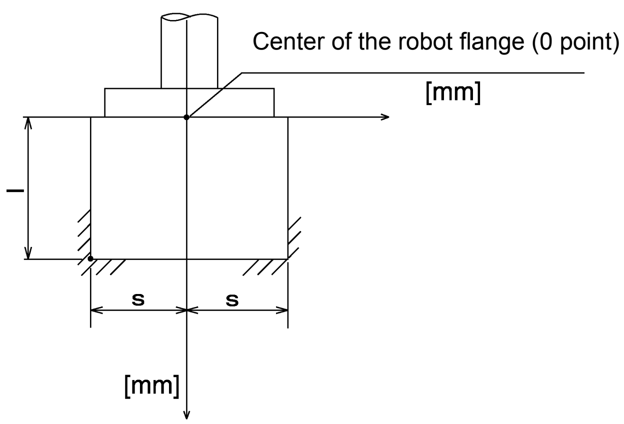
The total mass of an end-effector (including workpiece) should be less than the maximum allowable payload of the robot. Be sure to include the mass of wirings and piping used for end-effectors.

**Total mass of end-effector (incl. workpiece) ≤ Maximum allowable payload**

NOTE: The maximum allowable payload refers to a mass of payload that you have preset.

## (2) End-effector center of gravity

The center of gravity of an end-effector (including workpiece) should be within the range specified in Figure 2-15.




End-effector center of gravity

| Payload (kg) | l (mm) | S (mm) |
|---|---|---|
| 1 | 300 | 100 |
| 2 | 300 | 70 |
| 3 | 200 | 70 |
| 4 | 150 | 60 |
| 5 | 120 | 50 |
| 6 | 100 | 50 |
| 7 | 80 | 50 |
| 8 | 60 | 40 |
| 9 | 60 | 40 |
| 10 | 60 | 40 |

**Figure 2-15 Allowable Range of Center of Gravity of End-effector**

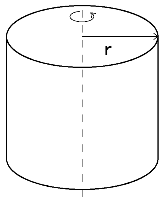
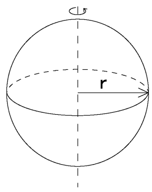
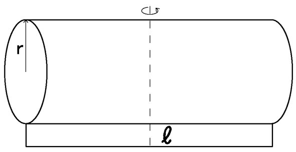
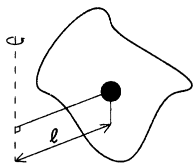
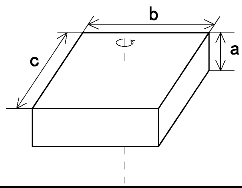
## (3) Moment of inertia around the T-axis

The moment of inertia of an end-effector (including workpiece) around the T-axis should be less than the maximum allowable moment of inertia around the T-axis of the robot.

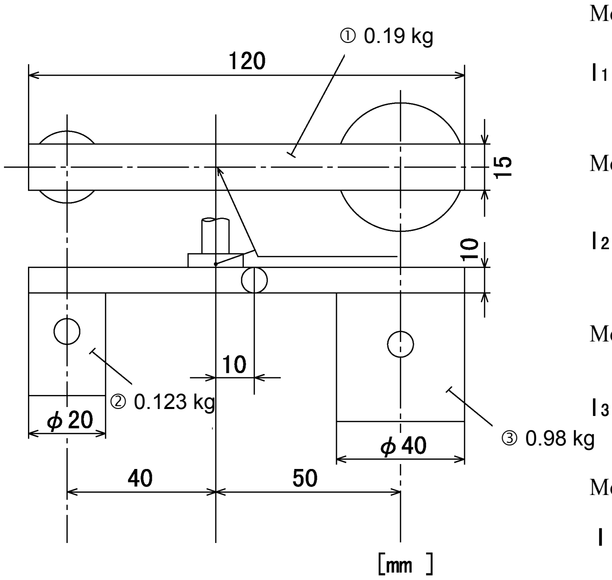
**End-effector moment of inertia (incl. workpiece) around the T-axis ≤ Maximum allowable moment of inertia**

Calculate the moment of inertia around the T-axis, referring to Table 2-3.

**Table 2-3 Moment-of-inertia Formulas**

| | |
|---|---|
| 1. Cylinder (1)<br>(Axis of rotation = Center axis)<br><br>$I = \frac{mr^2}{2}$ | 4. Sphere<br>(Axis of rotation = Center axis)<br><br>$I = \frac{2mr^2}{5}$ |
| 2. Cylinder (2)<br>(The axis of rotation passes through the center of gravity.)<br><br>$I = \frac{m}{4}\left(r^2 + \frac{\ell^2}{3}\right)$ | 5. Center of gravity not on the axis of rotation.<br>Ig: Moment of inertia around center of gravity<br><br>〔$kgm^2$〕<br>$I = I_g + m\ell^2$ |
| 3. Rectangular parallelepiped<br>(The axis of rotation passes through the center of gravity.)<br><br>$I = \frac{m}{12}(b^2 + c^2)$ | I: Moment of inertia 〔$kgm^2$〕<br>m: Mass 〔kg〕<br>r: Radius 〔m〕<br>a, b, c, $\ell$: Length 〔m〕 |

Calculation example : When calculating the moment of inertia of a complicated shape, divide it into simple parts as much as possible for easier calculations.
As shown in the figure below, divide the end-effector into three parts (①, ②, ③).




Moment of inertia around T-axis of ①: $I_1$ (from 3 and 5 in Table 2-3)

$$I_1 = \frac{0.19}{12}(0.12^2 + 0.015^2) + 0.19 \times 0.01^2 = 2.51 \times 10^{-4}$$

[$kgm^2$ ]

Moment of inertia around T-axis of ②: $I_2$ (from 1 and 5 in Table 2-3)

$$I_2 = \frac{0.123 \times 0.01^2}{2} + 0.123 \times 0.04^2 = 2.03 \times 10^{-4}$$

[$kgm^2$ ]

Moment of inertia around T-axis of ③: $I_3$ (from 1 and 5 in Table 2-3)

$$I_3 = \frac{0.98 \times 0.02^2}{2} + 0.98 \times 0.05^2 = 2.65 \times 10^{-3}$$

[$kgm^2$ ]

Moment of inertia around T-axis of entire end-effector: I

$$I = I_1 + I_2 + I_3 = 0.003 \quad [kgm^2]$$

**Figure 2-16 Calculation Example of End-effector Moment of Inertia Around T-Axis**

# Chapter 3

# Optional Devices

This chapter describes the configurations and functions of these optional devices--operating panel, teach pendant, PC teaching system "WINCAPSII," floppy disk drive, µVision board, Ethernet board, DeviceNet board, and PROFIBUS-DP board.

# 3.1 Operating Panel

The operating panel is a fixed type operation console that allows you to recover the robot from a stop due to problems caused by peripheral units, etc. The panel has minimum necessary teaching/operating functions.

To the operating panel you may connect a teach pendant which is designed for teaching and other fine operations.

The **ROBOT STOP** button and the **STOP** key on the operating panel and the teach pendant are available anytime. For other functions, you may select the operating panel or teach pendant. To switch between the operating panel and teach pendant, use the mode selector switch on the operating panel.

## 3.1.1 Operating Panel Functions

### Operating

The operating panel provides these functions--motor power ON/OFF, CAL execution, program selection, speed change, automatic operation start/stop and manual operation. For further information, see the SETTING-UP MANUAL.

### Display

The operating panel has an LCD capable of displaying 2 lines of 16 characters. It displays the current robot position, ongoing program number, error code when an error occurs, and related information in alphanumerical characters.

### Teaching

With the operating panel, you may run the robot manually and start programs. As listed below, you may also edit variables, get robot arm positions into variables in teaching, and move the robot arm by specifying a desired variable, depending upon the version of the main software. Choosing work coordinates or tool coordinates is also possible. For details, refer to the SETTING-UP MANUAL.

| Version of main software | Function | Description |
|---|---|---|
| Version 1.2 or later | Editing variables | You may edit variables by entering numerical values. |
| Version 1.4 or later | Teaching the current position | You may get the current position into P variables, J variables, and T variables. It is used for position teaching. |
| | Choosing work coordinates or tool coordinates | You may choose work coordinates or tool coordinates. |
| Version 1.6 or later | Operating the robot arm by specifying a desired variable | You may move the robot arm according to the specified variable. It is used to confirm variables you have preset in teaching. |

### Connecting the Teach Pendant

You may connect the teach pendant to the **TP** terminal at the bottom of the operating panel. Setting the mode selector switch on the operating panel to the **TP** position allows you to operate the robot from the teach pendant.

When the mode selector switch is set to the **MANUAL** or **AUTO** position, the robot is operated from the operating panel.

# 3.1.2 Names of Operating Panel Components

Figure 3-1 shows the names of the operating panel components.

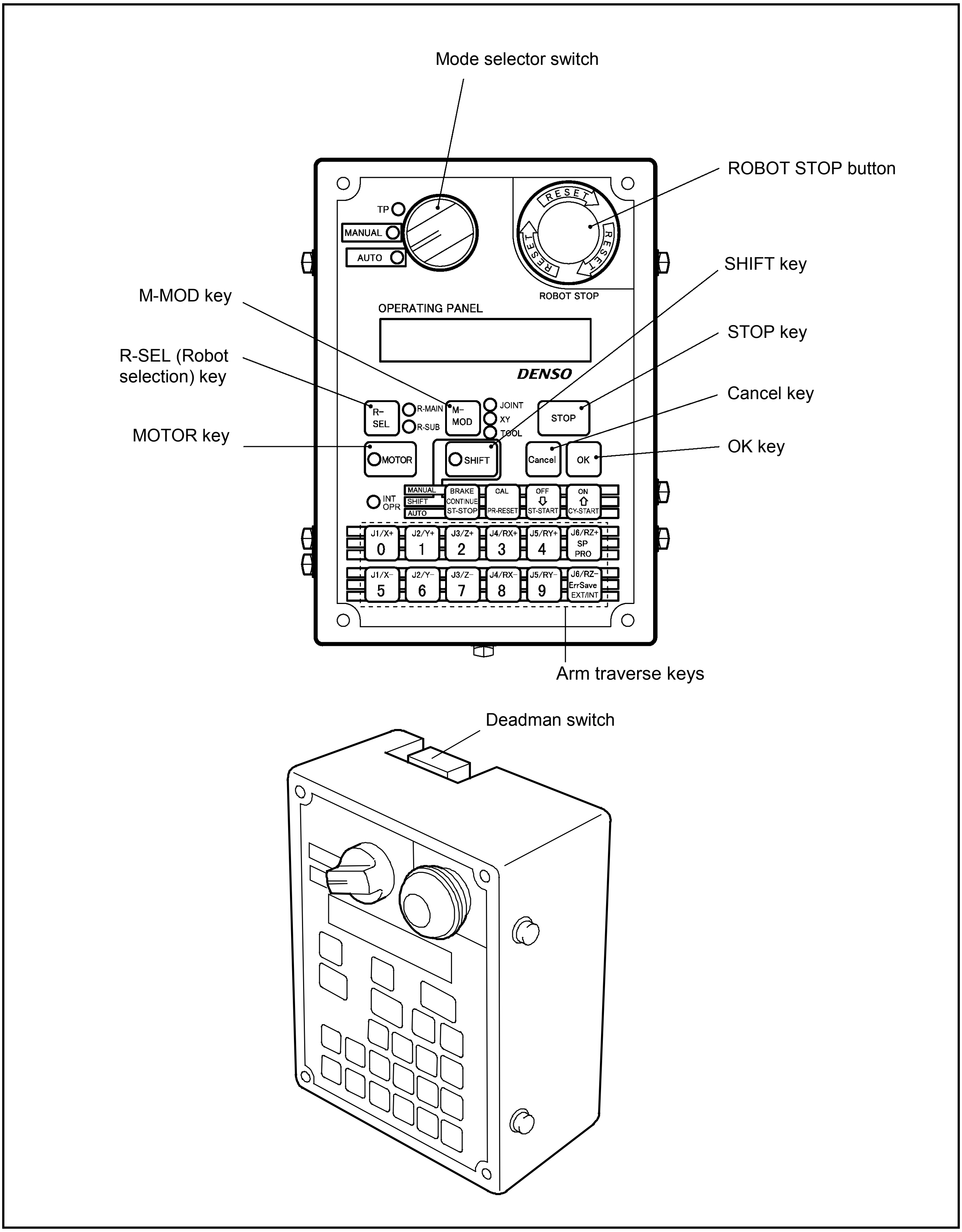



**Figure 3-1 Names of Operating Panel Components**

### 3.1.3 Operating Panel Specifications

Table 3-1 lists the operating panel specifications.

**Table 3-1 Operating Panel Specifications**

| Item | Specifications |
|---|---|
| Model | OP-RC5-1 |
| Display | Liquid crystal display with backlight, 16 characters × 2 lines |
| Power source | 24 VDC (supplied from robot controller) |
| Operation | 23 flat key switches, ROBOT STOP button, mode selector switch, deadman switch |
| Installation conditions | Temperature: 0 to 40°C<br>Humidity: 90% RH or less (Dew condensation shall not be allowed.) |
| Dimensions (H x W x D) | 140 × 100 × 40 mm (Excluding projections such as switches) |
| Weight | Approx. 0.7 kg |
| Cable length | 4 m or 8 m |
| Others | Equipped with a socket for connecting the teach pendant (See Note.) |

(Note) When no teach pendant is connected, a pendantless connector should be connected to the TP socket.

> ⚠**Caution:** **The operating panel is a fixed type operation console. Be sure to secure it to the equipment.**

# 3.1.4 Mounting and Connecting the Operating Panel

## Mounting the operating panel

The operating panel is a fixed type operation console. Mount it to the equipment, referring to Figure 3-2.

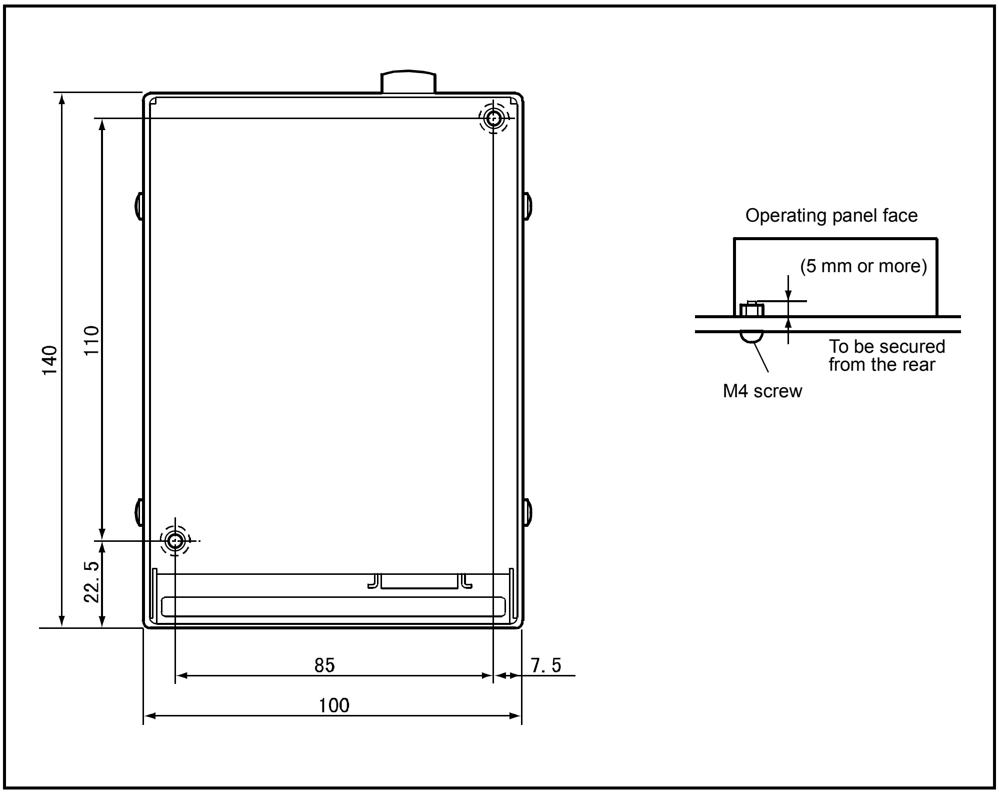
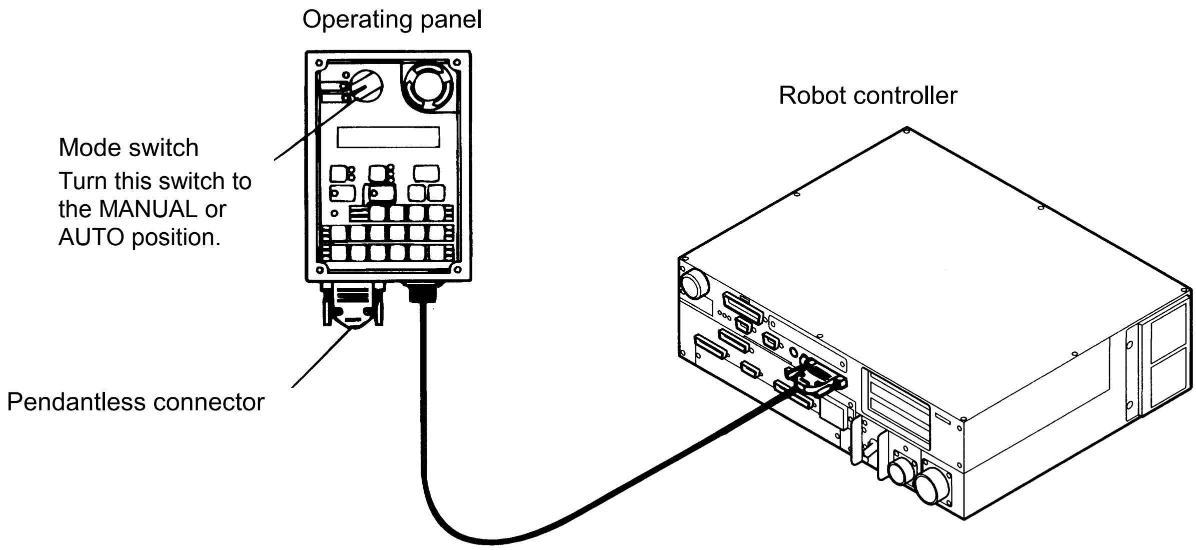



**Figure 3-2 Mounting the Operating Panel**

## Connecting the operating panel

As shown in Figure 3-3, the operating panel can be connected to the robot controller. A teach pendant can also be connected to the operating panel.

Connection type 1: Operating panel only




**NOTE:** Be sure to secure the operating panel to a safe place such as equipment.

**NOTE:** When using the operating panel without the teach pendant connected, always insert the pendantless connector into the TP socket on the operating panel.

Connection type 2: Operating panel connected with the teach pendant

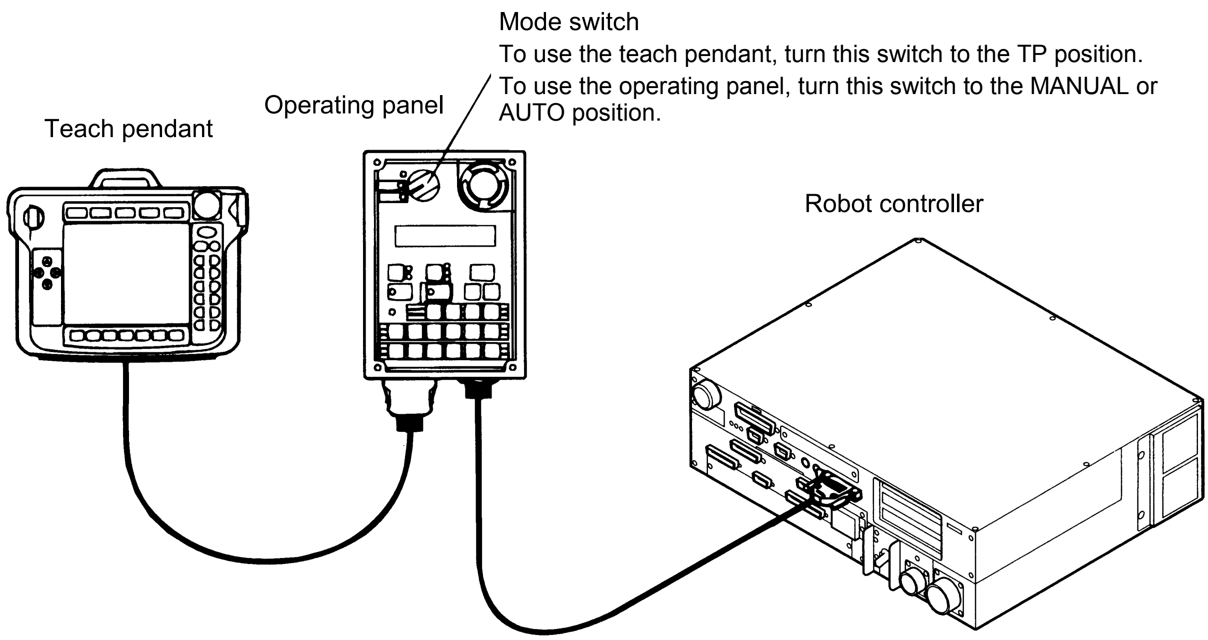



**Figure 3-3 Connecting the Operating Panel to the Robot Controller and the Teach Pendant**

# 3.2 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.

## 3.2.1 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.

# 3.2.2 Names of Teach Pendant Components

Figure 3-4 shows the names of the teach pendant components.

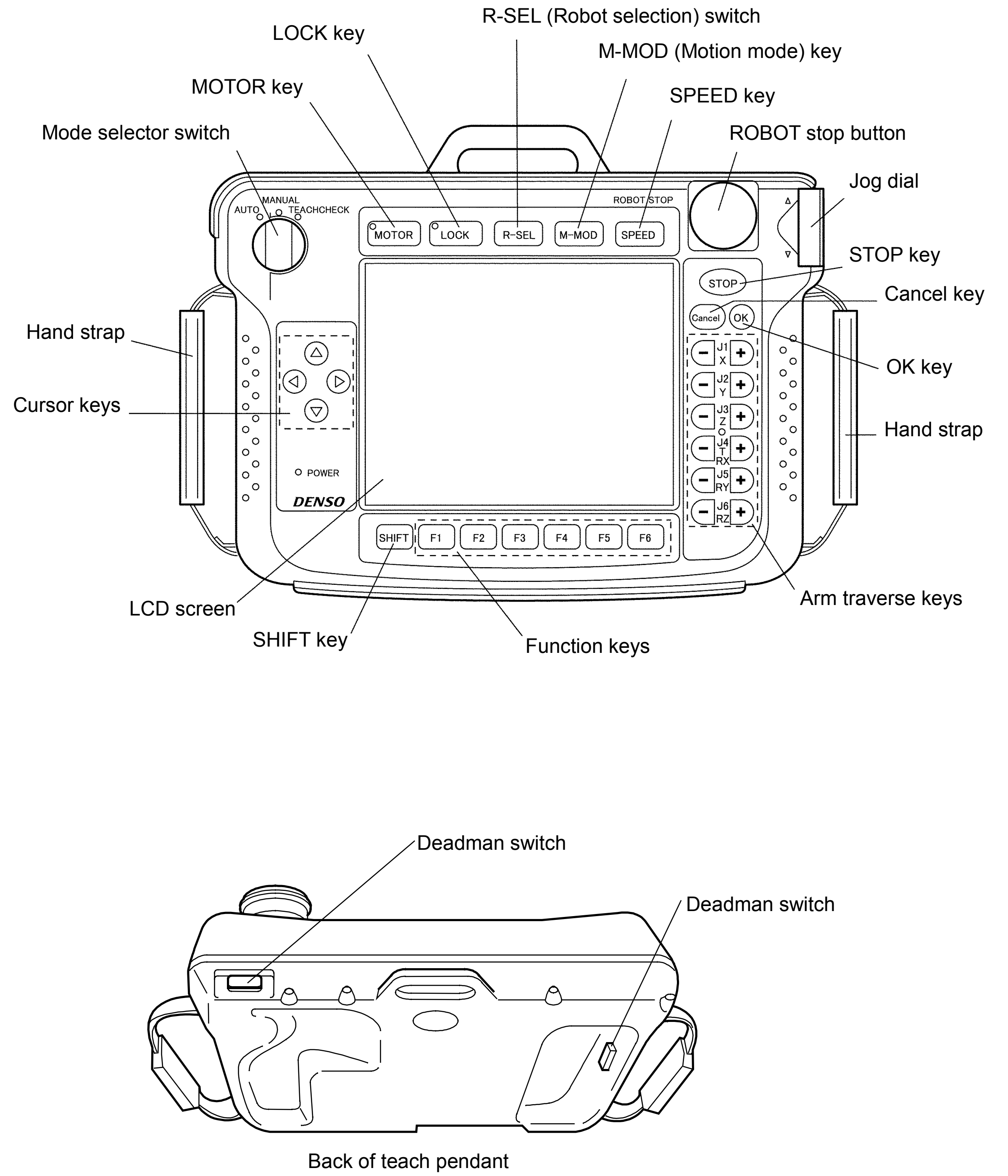



**Figure 3-4 Names of Teach Pendant Components**

## 3.2.3 Teach Pendant Specifications

### [ 1 ] Specifications

Table 3-2 lists the teach pendant specifications.

**Table 3-2 Teach Pendant Specifications**

| Item | Specifications |
|---|---|
| Model | TP-RC5-1 |
| Display | Liquid crystal display with backlight, 640 × 480 pixels |
| Power source | 24 VDC (supplied from robot controller) |
| Operation | 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 |
| Installation conditions | Temperature: 0 to 40°C<br>Humidity: 90% RH or less<br>(Dew condensation shall not be allowed.) |
| Outside dimensions (W x H x D) | 260 × 186 × 60 mm (excluding projections) |
| Weight | 1 kg |
| Cable length | 4 m, 8 m, or 12 m |

## [ 2 ] Outer Dimensions

Figure 3-5 shows the outer dimensions of the teach pendant.

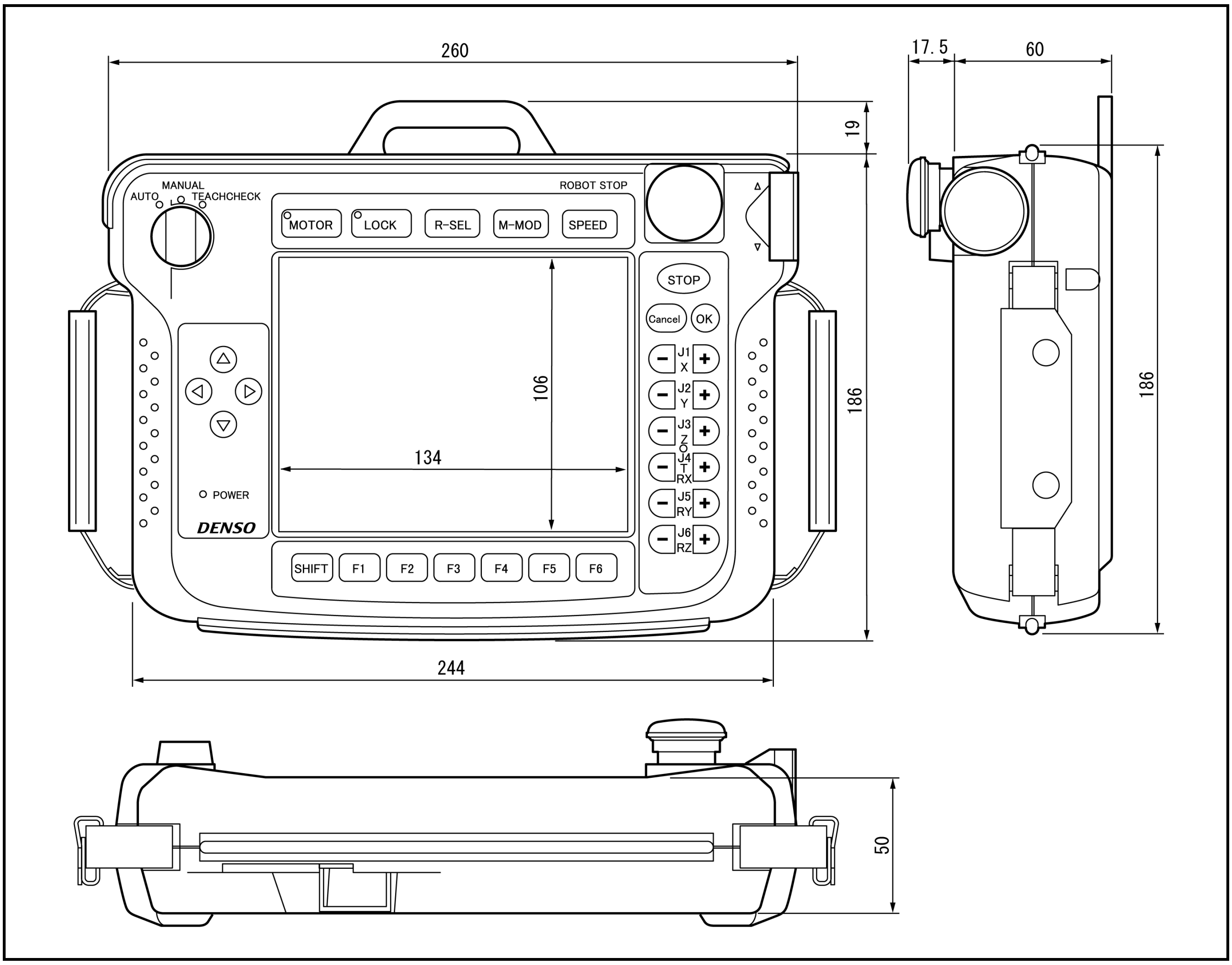



**Figure 3-5 Outer Dimensions of the Teach Pendant**

# [ 3 ] Pendantless State

### What is Pendantless State?

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

### Setting the Pendantless State

As described below, there are four ways to set the pendantless state:

(1) Turning ON the power to the robot controller without the operating panel and the teach pendant.

(2) Disconnecting the connected teach pendant.

(3) Disconnecting the connected operating panel.

(4) Disconnecting the connected operating panel and teach pendant.

**Caution: Refer to the operation procedures described in "[ 4 ] Connecting and Disconnecting Operating Panel and Teach Pendant" on the next page when connecting or disconnecting the operating panel and the teach pendant with the power to the robot controller ON.**

### 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 "5.3.2.2 Auto Mode (Output) and 5.5.2.2 Auto Mode (Output)".

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

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

## [ 4 ] Connecting and Disconnecting Operating Panel and Teach Pendant

The operating panel and the teach pendant can be connected or disconnected with the power to the robot controller ON. Connect or disconnect them according to the procedure described below.

Table 3-3 shows the state of change resulting from connecting or disconnecting the operating panel and/or the teach pendant.

Each letter in the table represents the appropriate connecting and disconnecting procedure (×: no procedure applicable).

**Table 3-3 Table Showing Change of State by Connection and Disconnection**

| Before change / After change | Pendantless mode | OP connected | TP connected | OP and TP connected |
|---|---|---|---|---|
| **Pendantless mode** | × | (A) | (B) | (A) |
| **OP connected** | (D) | × | × | (C) |
| **TP connected** | (D) | × | × | × |
| **OP and TP connected** | (D) | (D) | × | × |

**Caution: The operating panel and the teach pendant cannot be connected or disconnected while a program is being executed.**

**Table 3-4  Connection and Disconnection Procedures**

| Procedure | Steps |
|---|---|
| (A) | Step 1 Select the AUTO mode, and activate an emergency stop.<br>Step 2 Disconnect the connector from CN5 on the robot controller.<br>Step 3 Connect the connector used for pendantless operation to CN5 of the robot controller.<br>Step 4 Error 2187 occurs. Clear it from the external device. |
| (B) | Step 1 Select the AUTO mode, and activate an emergency stop.<br>Step 2 Perform disconnection. See the SETTING-UP MANUAL, Section 5.9, "Preparing the Robot Controller to Unplug the Teach Pendant."<br>Step 3 Disconnect the connector from CN5 on the robot controller within 15 seconds.<br>Step 4 Connect the connector for Pendantless operation to CN5 on the robot controller. |
| (C) | Step 1 Set the mode selector switch on the operating panel to TP.<br>Step 2 Set the mode selector switch on the teach pendant to AUTO, and activate an emergency stop.<br>Step 3 Perform disconnection. See the SETTING-UP MANUAL, Section 5.9, "Preparing the Robot Controller to Unplug the Teach Pendant."<br>Step 4 Disconnect the teach pendant from the operating panel within 15 seconds.<br>Step 5 Connect the connector used for Pendantless operation to the operating panel.<br>Step 6 Set the mode selector switch on the operating panel to MANUAL. |
| (D) | Step 1 Disconnect the connector used for pendantless operation from CN5 on the robot controller.<br>Step 2 Connect the operating panel or teach pendant to CN5 on the robot controller. |

# 3.3 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.

## 3.3.1 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, J variables and T variables). You can check edited programs in running them step by step.

### Operating the robot

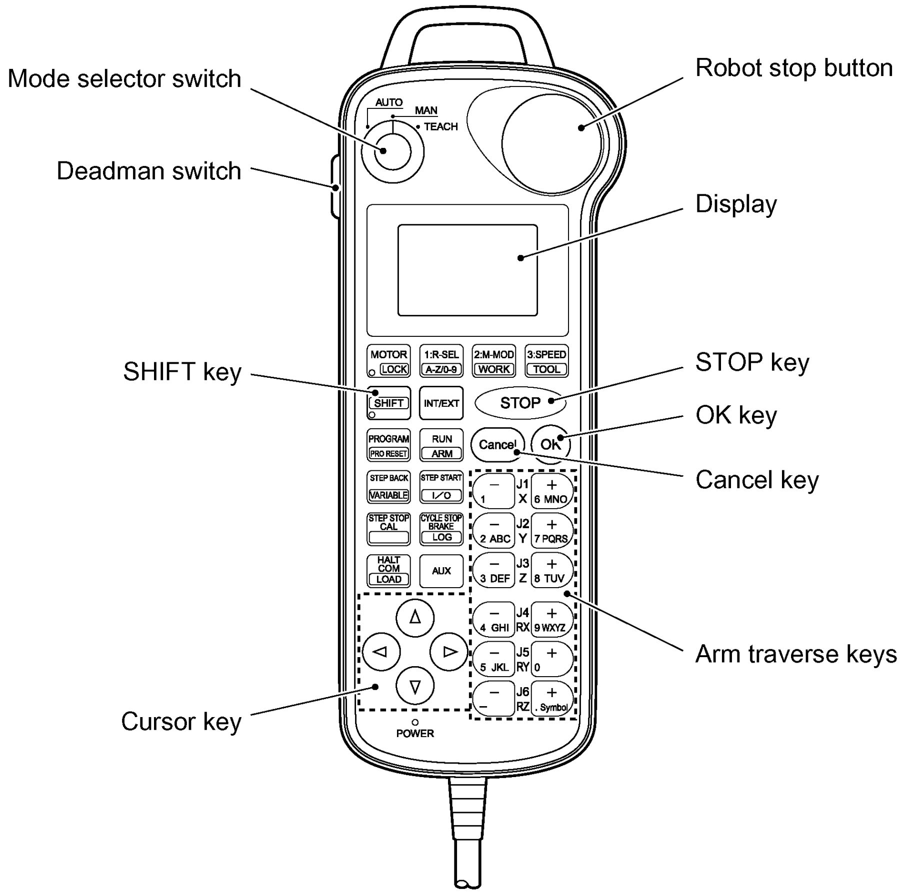
This function turns power to the motor ON/OFF, executes CAL, starts and stops automatic operation, and performs manual operation.

### Displaying

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

## 3.3.2 Names of Mini-Pendant Components

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




Names of Mini-Pendant Components

## 3.3.3 Mini-Pendant Specifications

### [ 1 ] Specifications

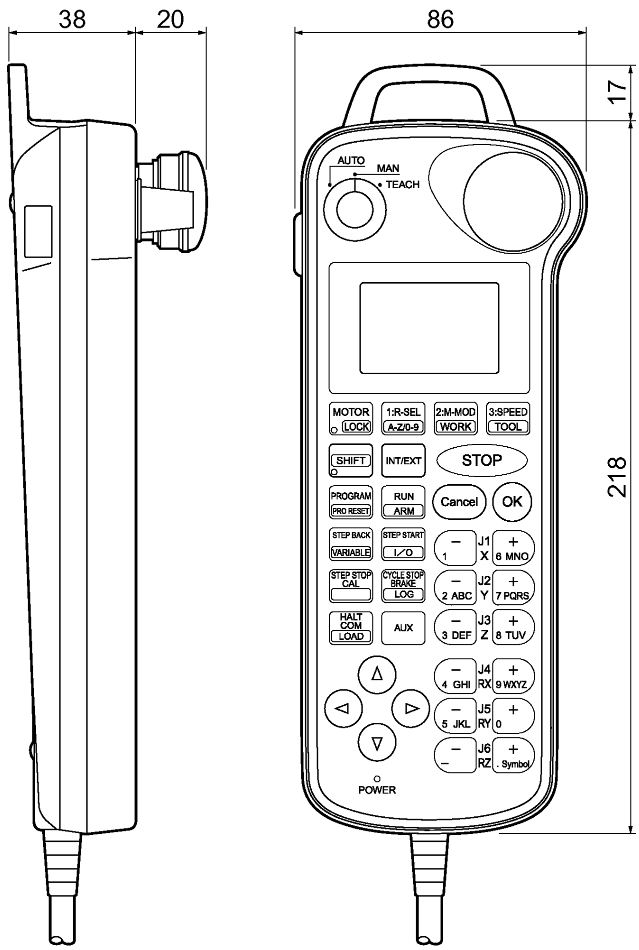
The table below lists the mini-pendant specifications.

**Mini-Pendant Specifications**

| Item | Specifications |
|---|---|
| Model | MP5J4K (with 4 m cable)<br>MP5J8K (with 8 m cable)<br>MP5J12K (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<br>Humidity: 90% RH or less<br>(Dew condensation shall not be allowed.) |
| Outside dimensions (W) x (H) x (D) | 86 x 218 × 38 mm<br>(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<br>Approx. 0.2 kg (4 m), 0.4 kg (8 m), 0.6 kg (12 m) | |

# [ 2 ]  Outer Dimensions

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




**Outer Dimensions of the Mini-Pendant**

# [ 3 ]  Connecting the Mini-Pendant

You may connect the mini-pendant to the "pendant" connector on the robot controller. When it is connected, neither the teach pendant nor operating panel can be used concurrently.

## 3.3.4 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 section.

### 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.

# 3.4 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.

## 3.4.1 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.

## 3.4.2 Operating Environment Required

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

**Table 3-5 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.**

## 3.4.3 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 in Figures 3-6 and 3-7.

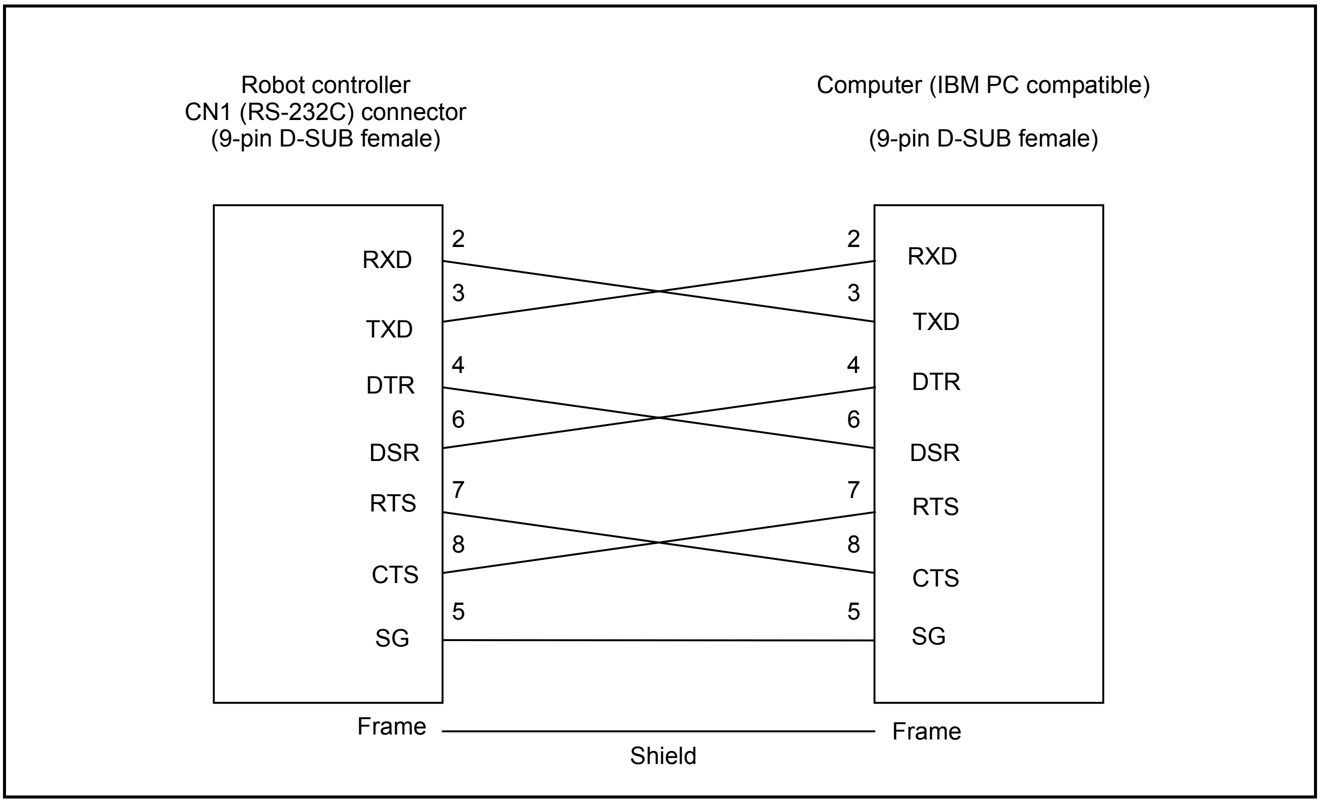



**Figure 3-6 RS-232C Communication Cable Wiring Diagram (IBM PC compatible)**

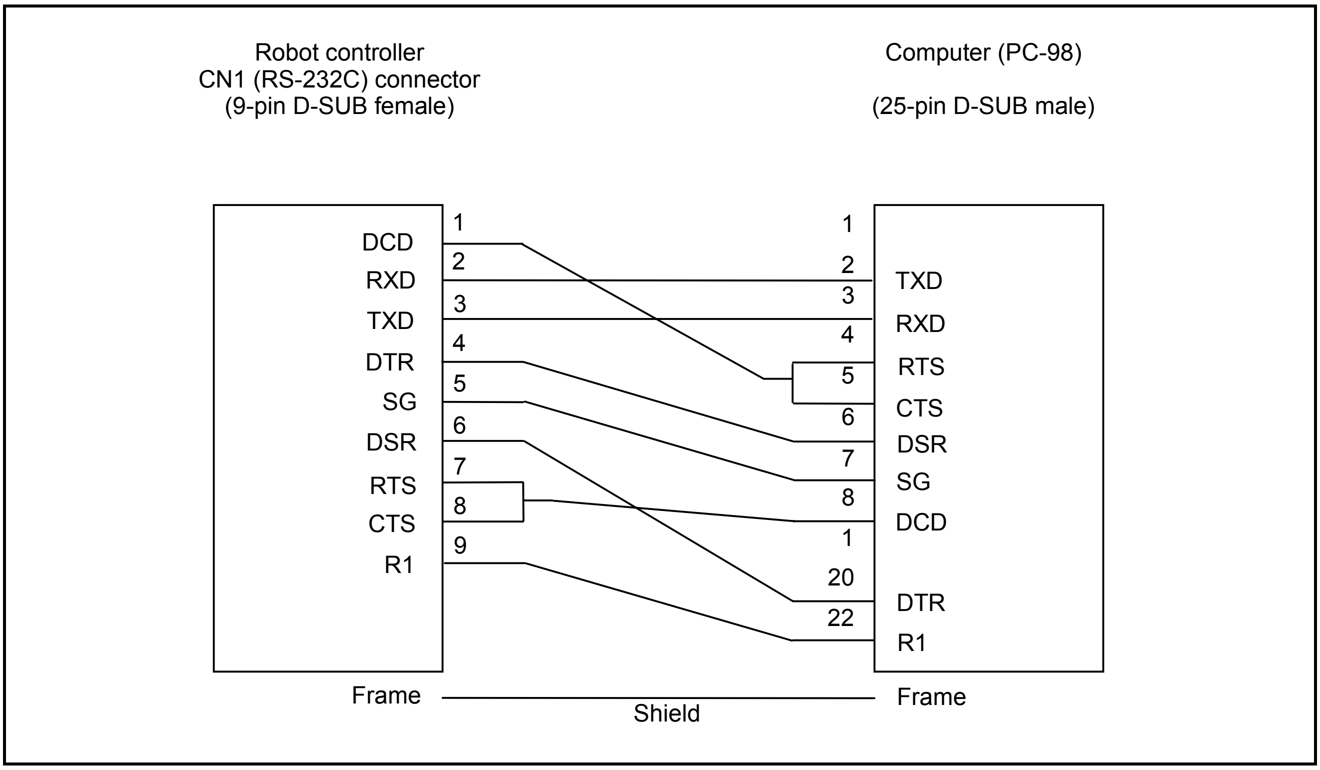



**Figure 3-7 RS-232C Communications Cable Wiring Diagram (PC-98)**

# 3.5 Floppy Disk Drive

The floppy disk drive is an optional storage device that stores or reads data such as robot programs, to/from a floppy disk. It may be built in the robot controller.

## 3.5.1 Floppy Disk Drive Functions

The floppy disk drive has the following functions:

### Formatting

This function initializes a floppy disk so that it can store data. You need to initialize a new floppy disk before use.

Floppy disks will be initialized in MS-DOS format.

### Saving

This function stores programs, CALSET data, etc. from the robot controller onto a floppy disk.

### Loading

This function reads programs, CALSET data, etc. from a floppy disk to the robot controller.

⚠**Caution** **NEVER load the CALSET data prepared for other robots. If loaded, the robot will malfunction. It is DANGEROUS.**

## 3.5.2 Floppy Disk Drive Specifications

Table 3-6 lists the specifications of the built-in floppy disk drive.

**Table 3-6 Built-in Floppy Disk Drive Specifications**

| Item | Specifications | |
|---|---|---|
| Power source | 5 VDC (supplied from the robot controller) | |
| Environmental conditions | Temperature : 5 to 40°C<br>Humidity : 20% to 80% (without dew condensation) | |
| Weight | 155 g (body alone) | |
| Applicable floppy disk | Type | 2HD, 3.5-inch floppy disk |
| | Storage capacity | 1.44 MB |

## 3.5.3 Location of the Floppy Disk Drive and its Component Names

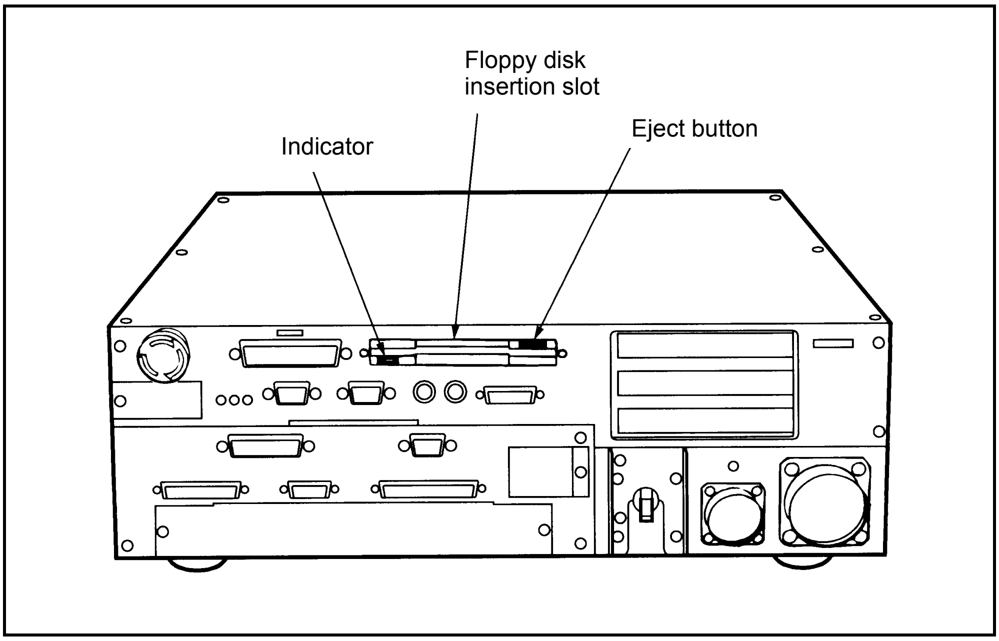



**Figure 3-8 Location of the Floppy Disk Drive and its Component Names**

| | |
|---|---|
| Floppy disk insertion slot | Insert a floppy disk through this slot. (See Figure 3-9.). |
| Eject button | Push this button to eject the floppy disk. |
| Indicator | This lamp comes ON when the floppy disk is accessed. |

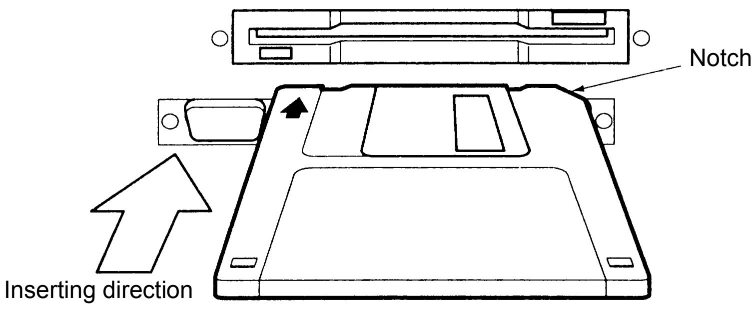


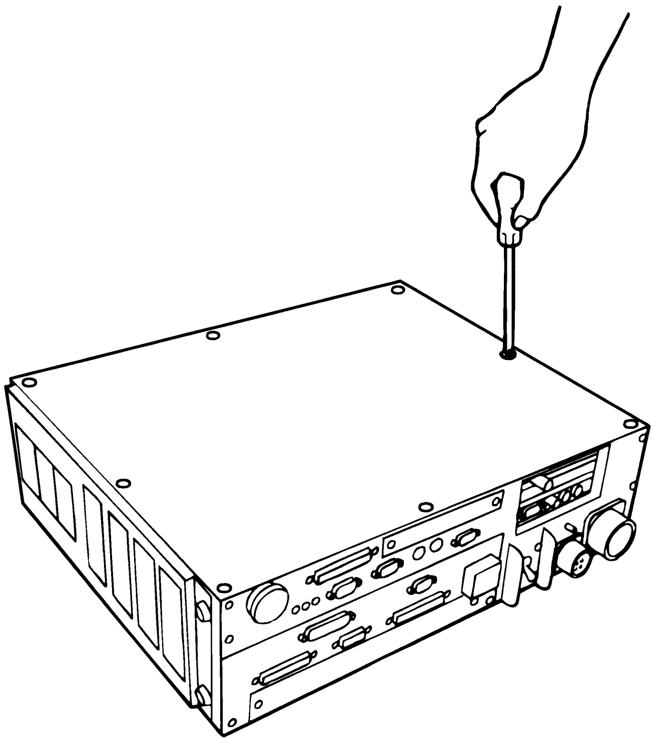

**Figure 3-9 Inserting a Floppy Disk**

| | |
|---|---|
| **Caution:** | **Do not eject the floppy disk when the indicator is lit. Doing so will damage or destroy data stored on the floppy disk.** |

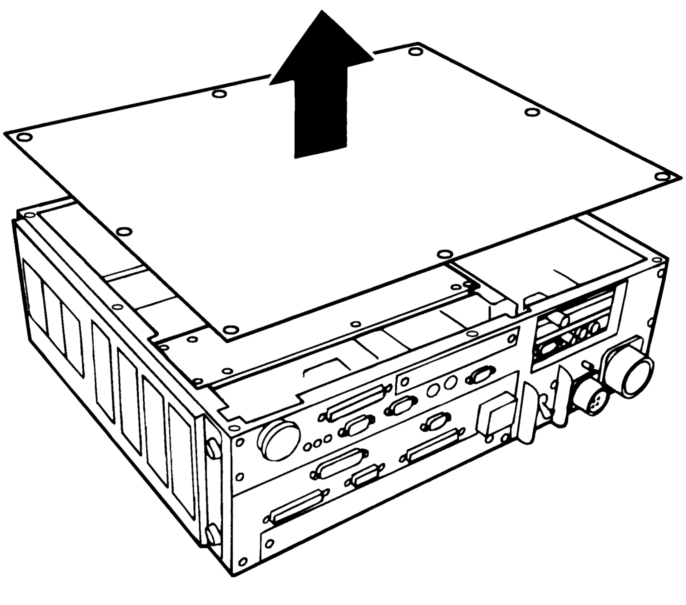
## 3.5.4 Mounting the Floppy Disk Drive

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

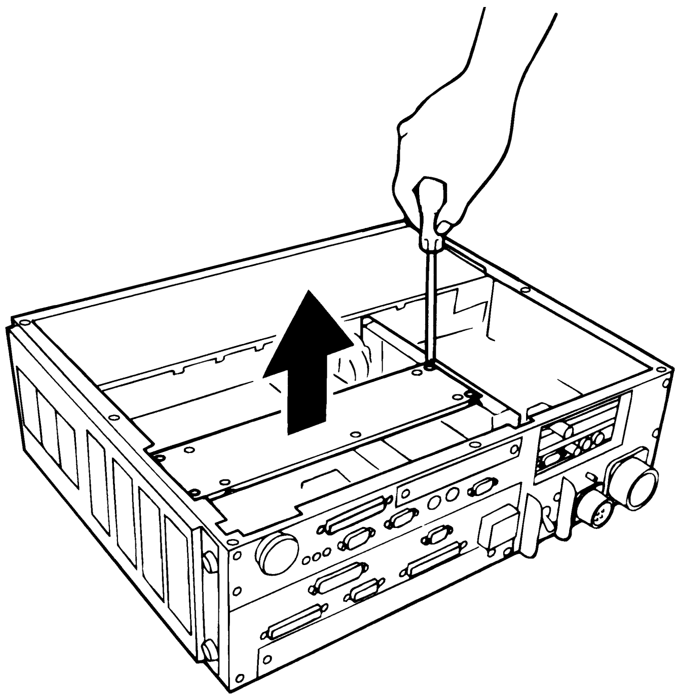
**Step 1** Remove the eight screws from the controller top cover.



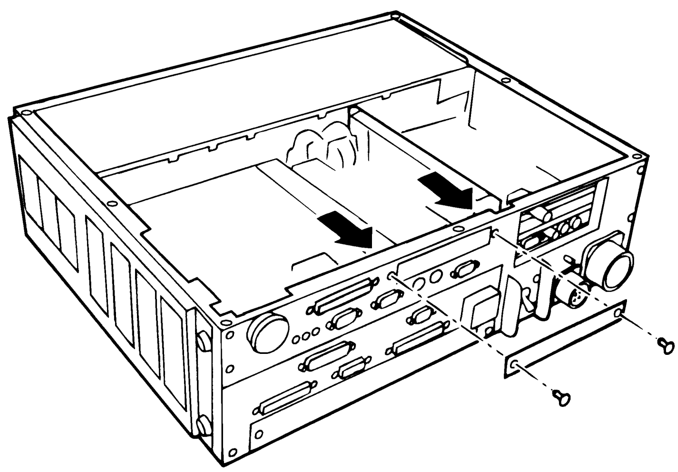
**Step 2** Lift the top cover up and off the robot controller.



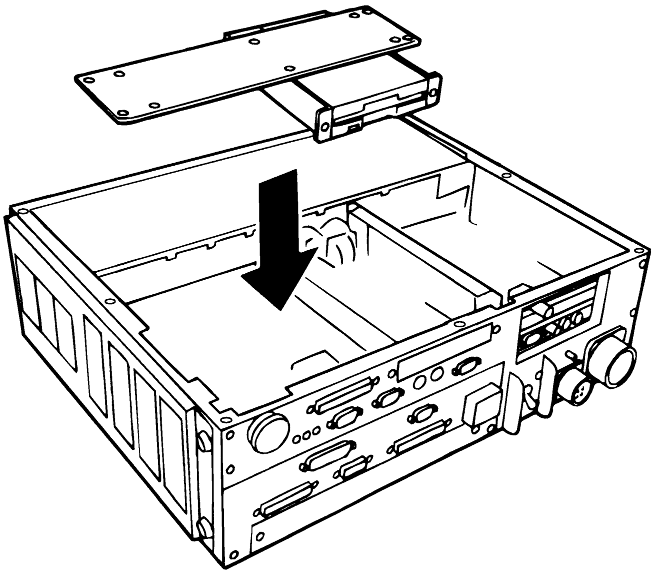
**Step 3** Remove the four screws from the upper plate and take off the upper plate.



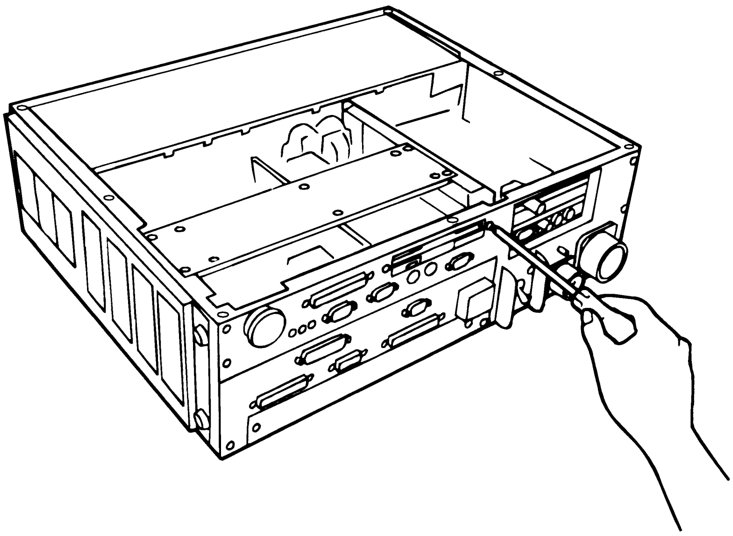
**Step 4** Push the two pins of the blind plate outwards and remove the blind plate.



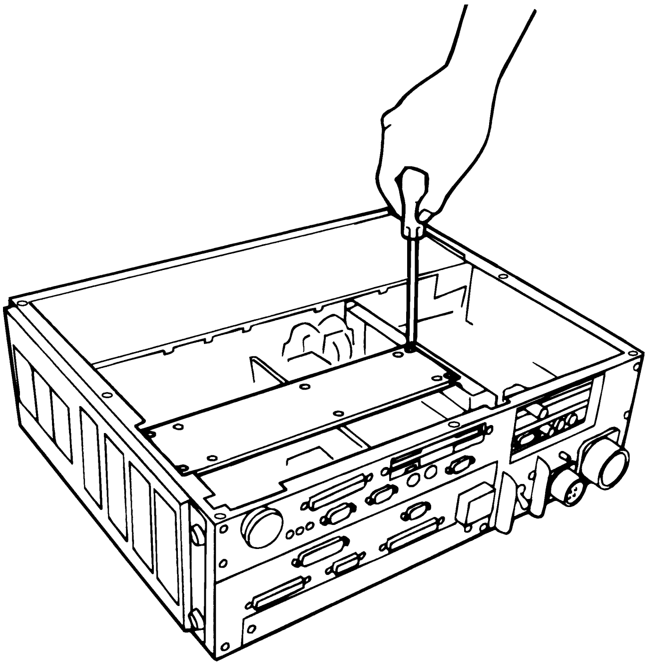
**Step 5** Mount the floppy disk drive in the appropriate position of the robot controller. The floppy disk drive is secured to a disk drive mounting plate.



**Step 6** Secure the front panel of the floppy disk drive with two screws.



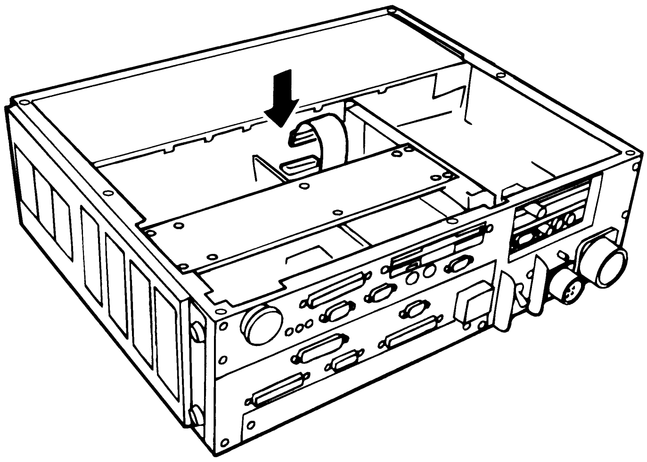
**Step 7** Secure the floppy disk drive mounting plate with four screws.



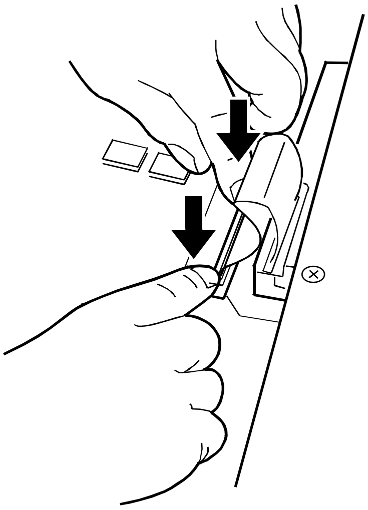
**Step 8** Connector J6 FDD 26P on the printed circuit board has a cable lock.

If the connector is locked, lift and unlock it. The lock is made of resin. Do not apply excessive force to it since the lock could easily break. Handle it with extra care.

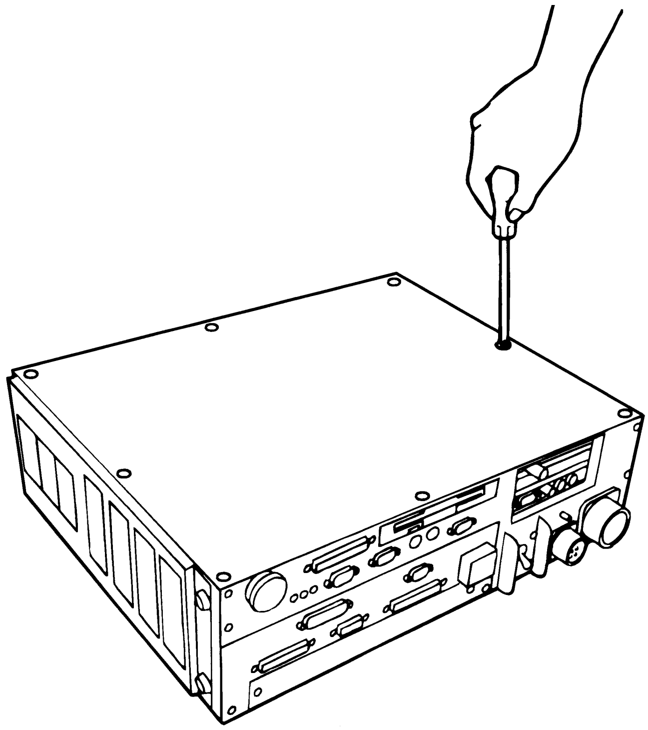
Fully insert the flat cable of the floppy disk drive into connector J6 FDD 26P on the circuit board. If the flat cable is inserted fully, the blue line marked on the connecting section will become aligned with the top edge of the connector.



**Step 9** Securely push in the connector lock.



**Step 10** Put the top cover and secure it with eight screws.



The mounting of the floppy disk drive is completed.

# 3.6 μVision Board

## 3.6.1 μVision Board Specifications

If the robot controller has a built-in μVision board, it can handle a variety of image processor functions.

Similar to other commands, image processing commands are already incorporated and no special operations or programming are required.

**Table 3-7 μVision Board Specifications**

| Item | Specifications |
|---|---|
| CPU | 32-bit CPU |
| Image storage memory for processed images (Horizontal x Vertical) | 512 × 480 pixels, 8 bits × 4 screens |
| Overlay memory for drawn images (Horizontal x Vertical) | 624 × 480 pixels, 2 bits × 2 screens |
| Search model registration memory | 1 MB (H255 × V255 × 8 models), Up to 100 models registrable **Note (1)** |
| Image input, number of channels | EIA/CCIR monochrome, 256 gradations, 2 channels |
| Image output | EIA/CCIR monochrome, 256 gradations, 1 channel |
| Image processing | Binary feature extract<br>(area, center of gravity, main axis angle, luminance integration), histogram, edge detection, image-to-image operation, filtering, labeling, light/dark image search, code recognition (QR code) |
| Processing range specification (window) | Up to 512 windows registrable<br>(shape: straight line, rectangle, circle, ellipse, sector) |
| Self-diagnosis function | Memory check, incorrect input, incorrect processing range, improper camera connection, etc. |
| Error display | Errors will be displayed on the teach pendant (option). |
| Power source | 5 VDC, 12 V (supplied from controller ISA) **Note (2)** |
| Environmental conditions (during operation) | Temperature: 0 to 40°C<br>Humidity: 90 %RH or less<br>(Dew condensation shall not be allowed.) |
| Outside dimensions (H x W x D) | 21.4 × 114 × 185 mm (excluding projections of connectors) |

**Note (1)** The number of registrable models will differ depending upon the model image and/or size.
**(2)** Since power is supplied from the inside of the robot controller, no external power source is required.

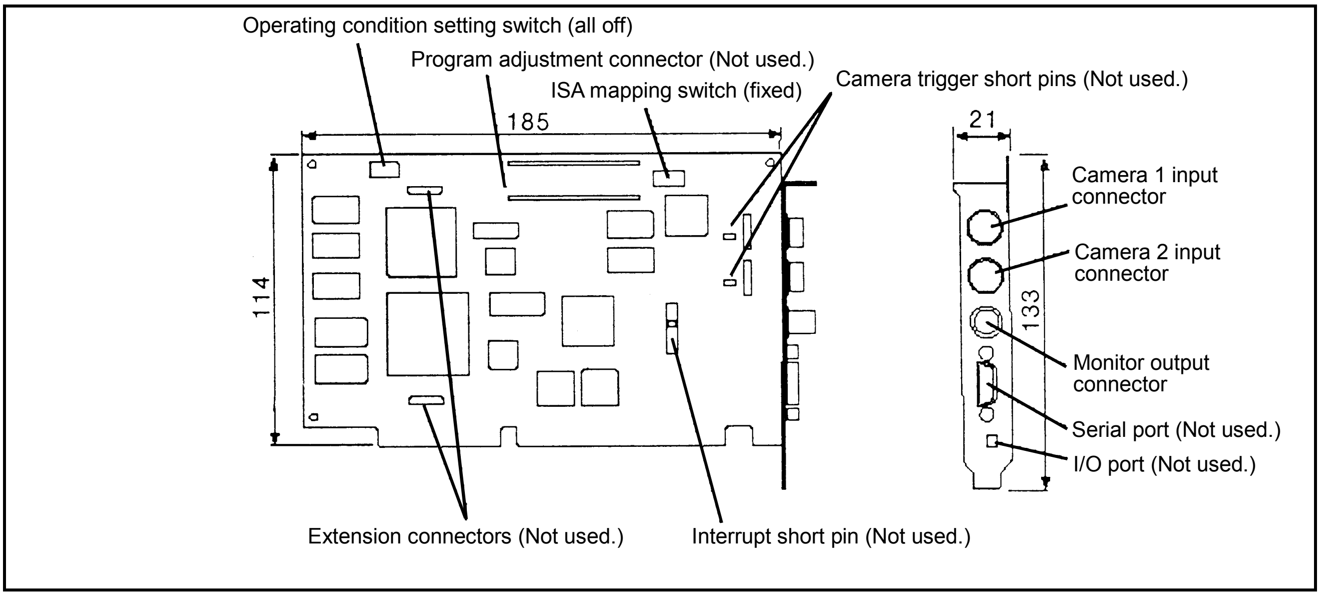



**Figure 3-10 µVision Board**

**Note (1) Switches and the short pins on the µVision board have been set at the factory. Do not change the settings. A failure may result.**

**Note (2) Do not connect anything to the unused connectors on the board. A failure may result.**

**Note (3) The serial port and the I/O port on the board are unusable. Do not connect anything to them. A failure may result.**

## [ 1 ] Location of the µVision Board and Names of Connectors

Insert a µVision board into extension slot 3 shown in Figure 3-11.

Inserting the board in a wrong slot may damage the internal circuits of the robot controller. For the installation procedure, refer to Subsection 3.11, "Mounting Extension Boards."

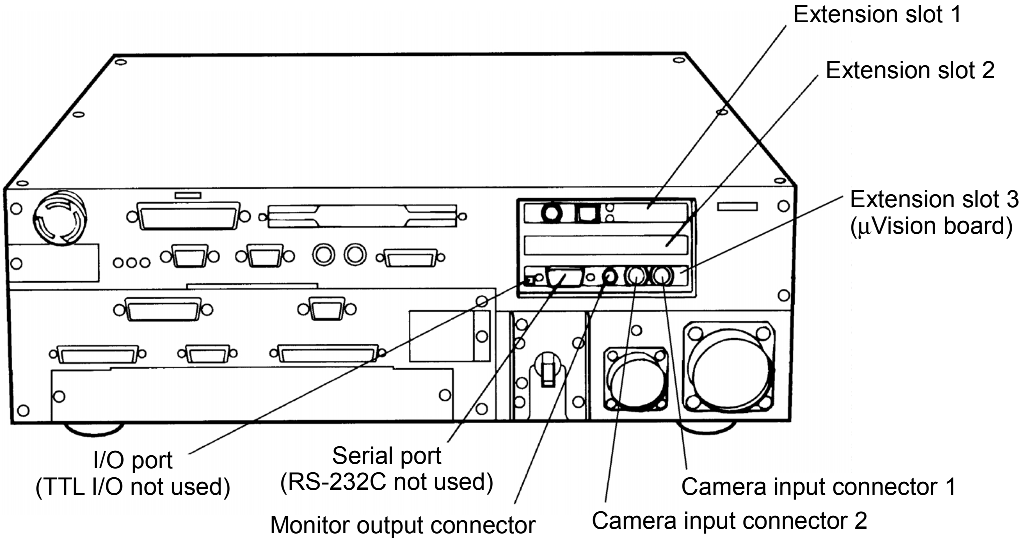



**Figure 3-11 Location of µVision Board and Names of Connectors**

| | |
|---|---|
| Camera input connector 1 | Used for connection with camera 1 (12-pin, round connector) |
| Camera input connector 2 | Used for connection with camera 2 (12-pin, round connector) |
| Monitor output connector | Used for connection with the monitor (BNC). |
| Serial port | RS-232C port (not used) |
| I/O port | TTL level input/output: 1 point each (not used) |

**Table 3-8 Camera Input Connector Pin Layout (Manufacturer: Hirose Electric HR10A-10R-12S or equivalent)**

| Pin No. | Signal name | Remarks |
|---|---|---|
| 1 | GND | Camera power GND |
| 2 | +12V | Camera power 12V |
| 3 | GND | Camera power GND |
| 4 | VIDEO | Video signal |
| 5 | HDGND | HD synchronous signal GND |
| 6 | HD | Horizontal synchronous signal |
| 7 | VD | Vertical synchronous signal |
| 8 | NC | Not connected |
| 9 | NC | Not connected |
| 10 | NC | Not connected |
| 11 | TRIG | Trigger signal (not used) |
| 12 | VDGND | VD synchronous signal GND |

# [ 2 ] Block Diagram and Internal Configuration of µVision Board

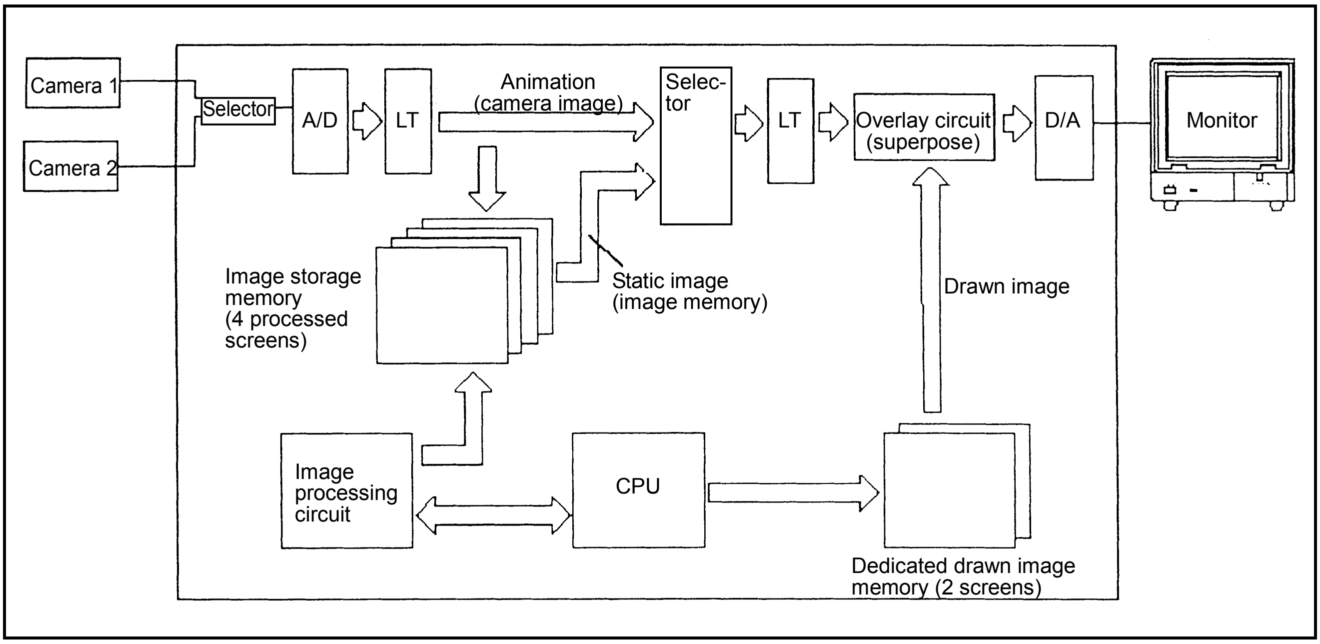



**Figure 3-12 Block Diagram of µVision Board**

Figure 3-12 illustrates the processing flow of the µVision board as a reference. The actual circuit configuration is different from this diagram.

| | |
|---|---|
| Camera selector | Switches between camera 1 and 2. |
| A/D | Converts analog signals into digital signals (8-bit). |
| Monitor selector | Selects whether to display the camera live image or static image on the monitor. |
| LT | Converts 8-bit data values using the appropriate table. |
| Overlay circuit | Overlays a drawn image, which is stored in the dedicated drawn image memory, on the camera live image or static image (see Figure 3-13, Overlay Concept). |
| D/A | Converts digital data into analog signals. |
| Image storage memory | Stores camera live images. When outputted onto the monitor screen, those images will be handled as static images. Up to four screens can be stored on this board. |
| Dedicated drawn image memory | Stores drawn images of characters and figures. Those images can be displayed on the monitor screen via the overlay circuit. Up to two screens can be stored on this board. |
| Image processing circuit | Processes images. |
| CPU | Manages the entire system. |

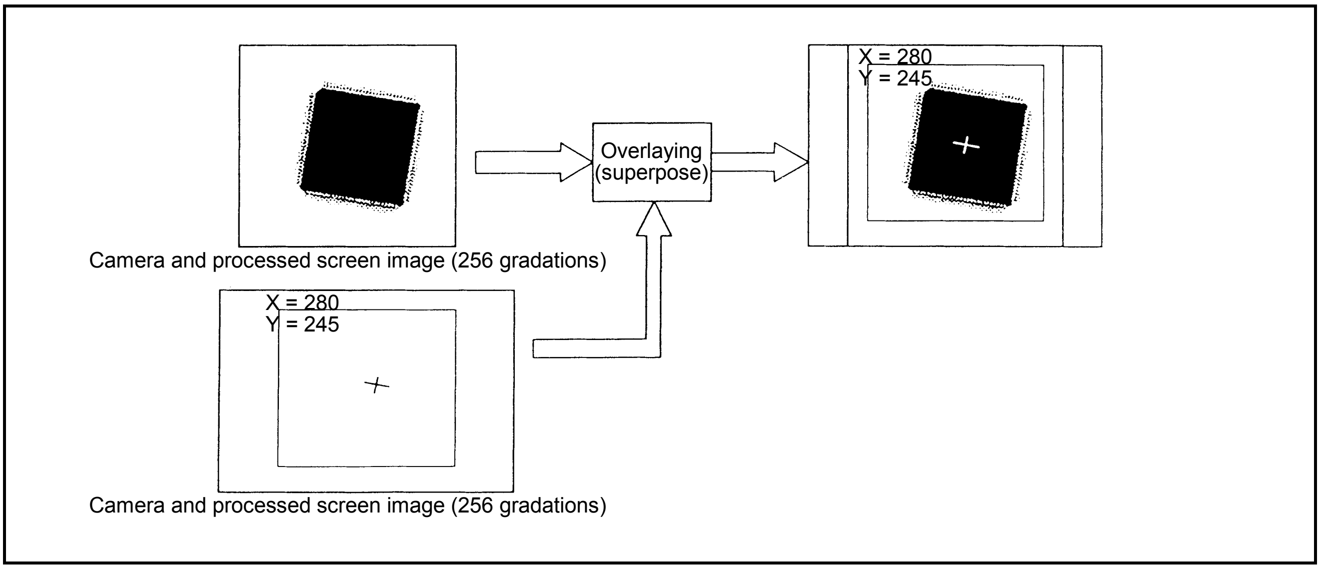



**Figure 3-13  Overlay Concept**

# 3.6.2 Peripheral Devices

## [ 1 ] General Information about the Camera

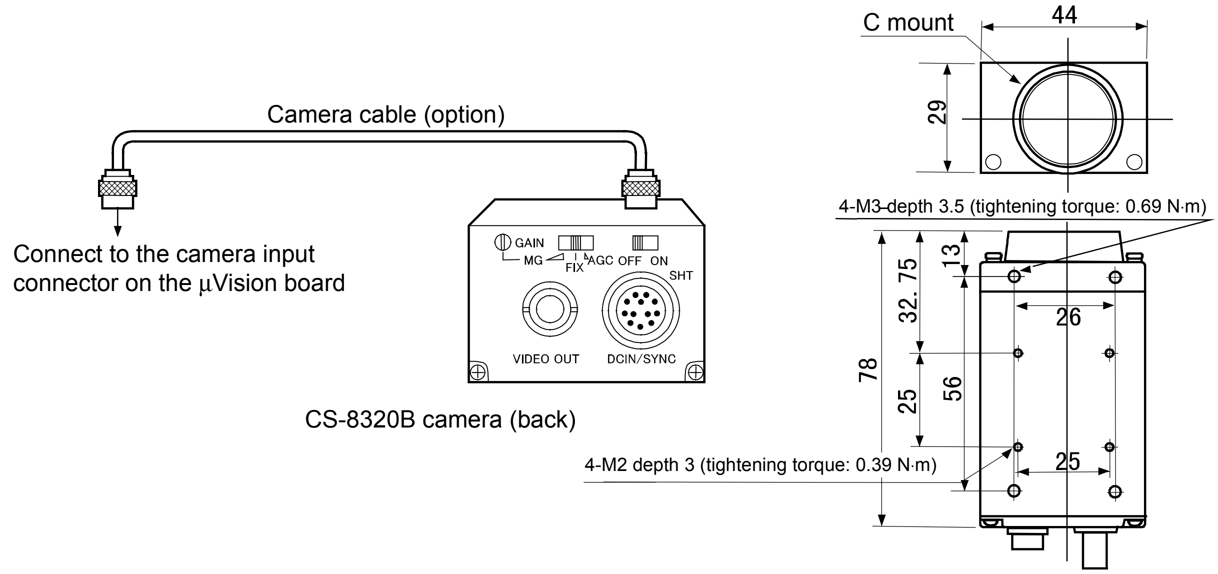



**Figure 3-14 Camera Dimensions and its Parts Names**

**Table 3-9 Camera Specifications**

| Item | Specifications |
|---|---|
| Manufacturer | Tokyo Electronic Industry Co., Ltd. |
| Manufacturer's model | CS8320B |
| Image pickup interline transfer system | CCD pixels: 768 (H) × 493 (V) |
| Lens mount | C mount |
| Image output NTSC signal | 1.0 Vp-p/75 Ω |
| Power source/Ambient temperature | Supplied from power adapter, 0 to +40°C |
| Weight | 120 g |
| Vibration-proof | 98 m/s, 10G<br>(10 to 50 Hz, 30 minutes in each of X, Y and Z directions) |

**Cables (Option)**

| Cable length | Camera cable model |
|---|---|
| 3 m | CPC3440-03 |
| 5 m | CPC3440-05 |
| 15 m | CPC3440-15 |

**Caution (1) When mounting the camera to the equipment, tighten the screws securely to the specified torque. See Figure 3-14.**

**(2) Do not apply a strong impact or vibration to the camera. A failure may result.**

**(3) When opening the camera top cover and changing the settings, be sure to turn the controller power off or disconnect the camera cable.**

**(4) For setting up cameras, refer to the instruction manual that comes with the camera.**

# [ 2 ]  General Information about the Monitor

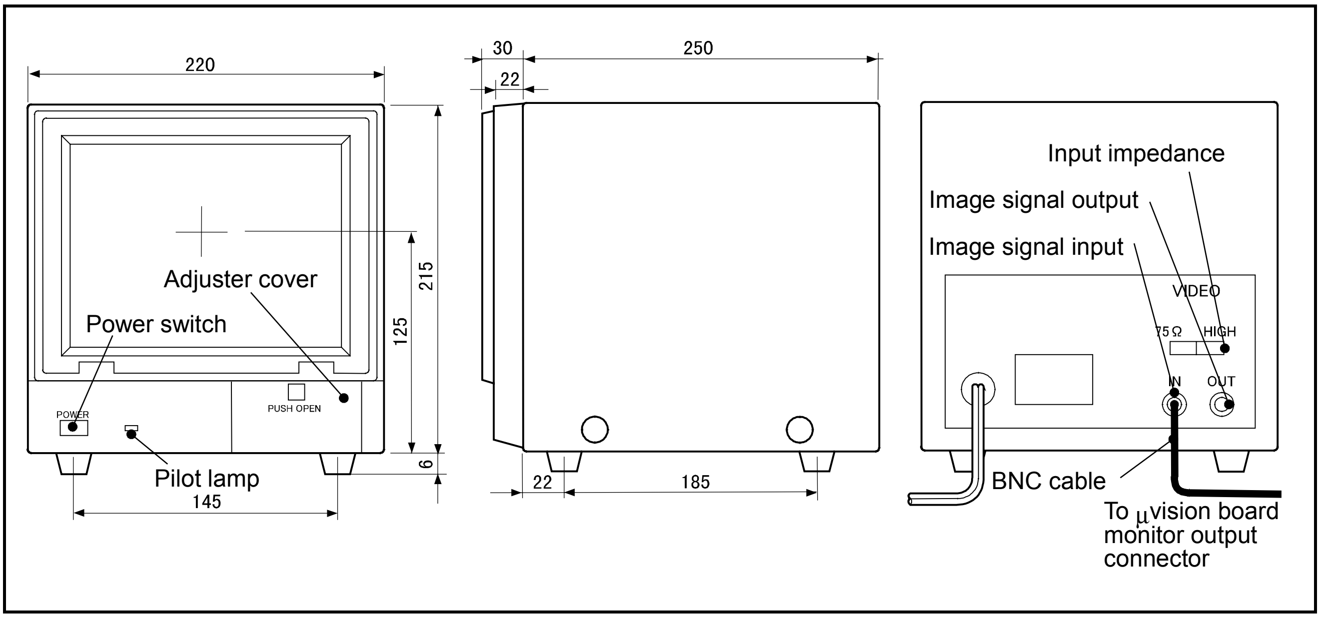



**Figure 3-15  Monitor Dimensions and its Parts Names**

**Table 3-10  Monitor Specifications**

| Item | Specifications |
|---|---|
| Manufacturer | Chuo Musen Co., Ltd. |
| Manufacturer's model | TMP-232-03 |
| Cathode-ray tube | 9-inch, monochrome |
| Image input NTSC signal | 0.7 Vp-p (straight polarity) |
| Power supply | 100 VAC, 50/60 Hz |
| Power consumption | Approx. 30 W |
| Ambient temperature | 0 to 40°C |
| Humidity | 90% or less (without dew condensation) |

**Cables (Option)**

| Cable length | BNC coaxial cable type |
|---|---|
| 1 m | 3CV-PP (1) |
| 3 m | 3CV-PP (3) |
| 5 m | 3CV-PP (5) |

**Caution (1) NEVER disassemble the monitor.**
**(2) Be sure to set a ferrite core clamp (ZCAT1518) that comes with the BNC cable, to the monitor output connector side on the μVision board.**

# 3.7 Ethernet Board

If the robot controller has a built-in Ethernet board, it can communicate with the PC teaching system according to the TCP/IP protocol.

This board is helpful for communication between a single PC teaching system and more than one robot controller. It also provides faster communication than an RS-232C cable, contributing to improved response of the PC teaching system.

## 3.7.1 Ethernet Board Position and Connector Names

Insert the Ethernet board in extension slot 1 (upper slot) or extension slot 2 (middle slot). See Figure 3-16.

Inserting the board into a wrong slot may damage the internal circuits of the robot controller. For installation procedure of the Ethernet board, refer to Subsection 3.11, "Mounting Extension Boards."

**Table 3-11 Ethernet Board Specifications**

| Item | Specifications |
|---|---|
| Standard | 10Base2, 10BaseT (IEEE 802.3) |
| Baud rate | 10 Mbits/sec. |

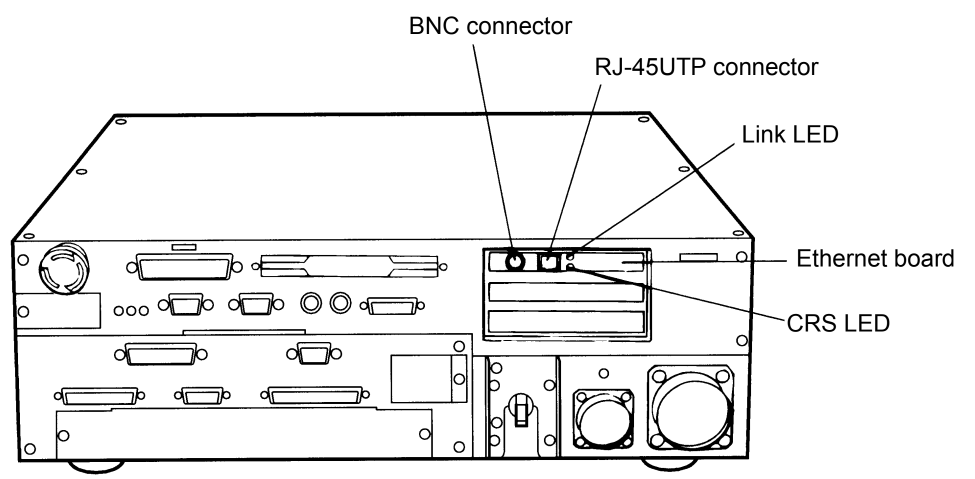



**Figure 3-16 Location of Ethernet Board and its Parts Names**

**Table 3-12 LEDs and Connectors on the Ethernet Board**

| Name | Function |
|---|---|
| Link LED | Lights if the UTP port detects a signal. |
| CRS LED | Lights if a carrier signal is detected. This LED will remain ON if no cable is connected to the UTP connector or BNC connector. |
| RJ-45 UTP connector | Used for 10BaseT connection. |
| BNC connector | Used for 10Base2 connection.<br>**Caution** (1) **When not using 10Base2, attach a BNC connector cap (that comes with the Ethernet board) to the BNC connector.**<br>(2) **When using 10Base2, cover all exposed metallic parts of connectors and the T-branch connector with insulator tape.** |

# 3.8 DeviceNet Slave Board

## 3.8.1 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.

### [ 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.

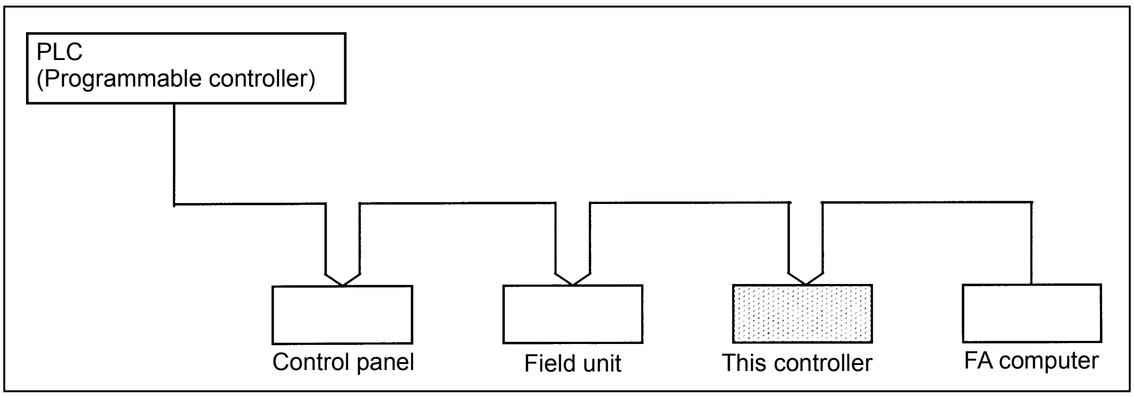
**(3) Easy wiring and maintenance**
The 5-core special cable and detachable connector of the DeviceNet slave board make it easy to install wiring between nodes (communications units) and disassembly/restructure the network. This will sharply reduce cost in wiring and maintenance, as well as making replacement 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 | 24 to 224 |
| | Compatible assignment mode | 24 to 224 |
| Reception | Standard assignment mode | 24 to 216 |
| | Compatible assignment mode | 40 to 232 |

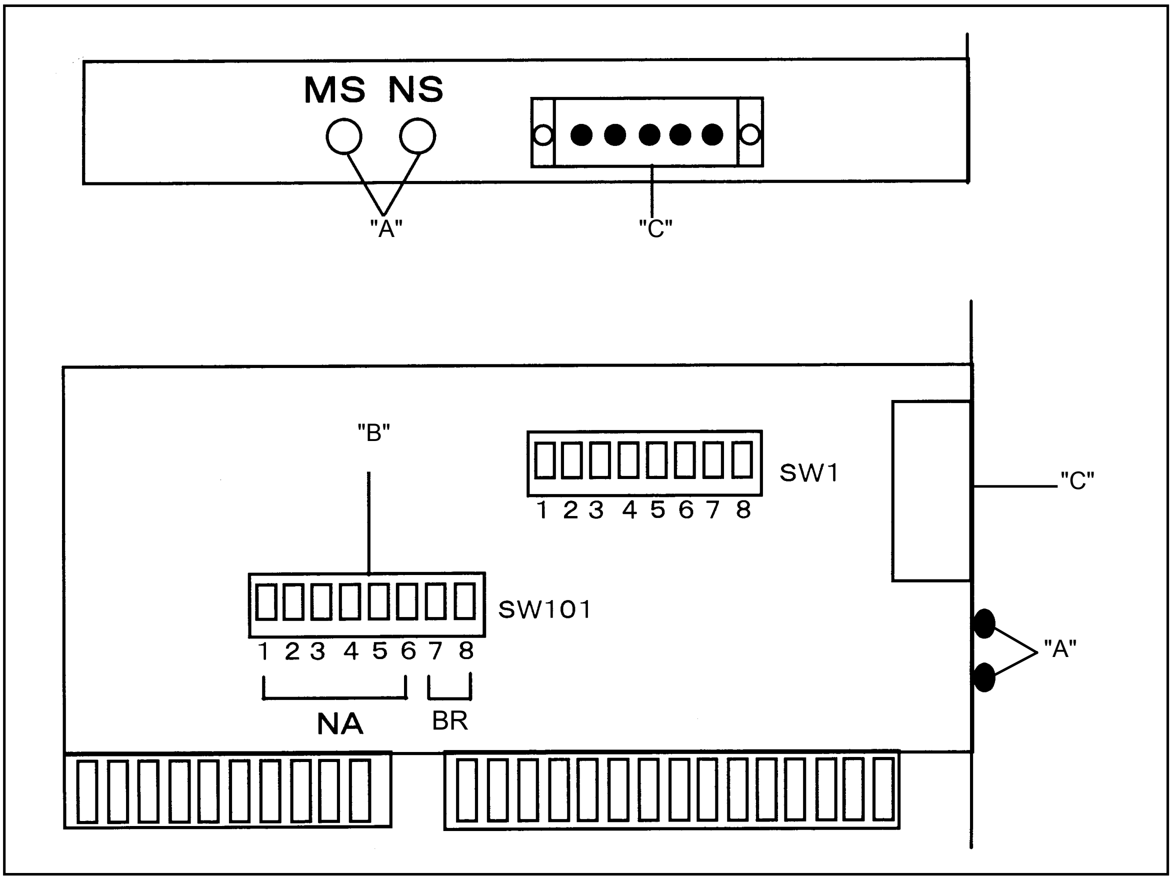
### [ 2 ] Typical Network

The figure below illustrates a typical network.



## 3.8.2 Product Specifications

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



# [ 1 ] Components and Functions

## (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.

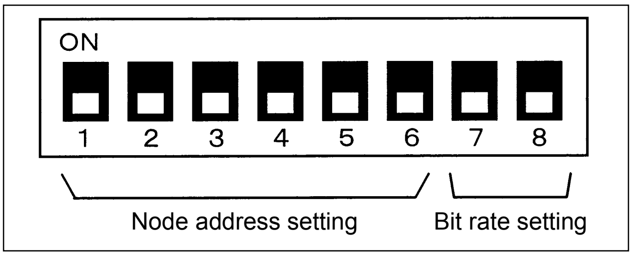
The flashing interval is once per second (0.5 second of ON and 0.5 second of OFF).

| LED name | Color | State | Definition | Explanation |
|---|---|---|---|---|
| MS (Module Status) | Green | ○ | Normal state | • The unit works normally. |
| | | ◐ | Setup not completed | • Reading the DIP switch settings. |
| | Red | ○ | Fatal error | • Hardware failure. |
| | | ◐ | Recoverable error | • Wrong DIP switch settings, etc. |
| | – | ● | No power supplied | • No power is supplied to the DeviceNet module.<br>• Resetting data.<br>• Waiting for initialization. |
| 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.<br>• Node address double-assigned.<br>• "Bus off" detected. |
| | | ◐ | Recoverable communications error | Communications error in some slaves. |
| | – | ● | Network power supply failure | • Not connected to the master unit.<br>• Communications line broken. |

○ : ON ◐ : Flashing ● : OFF

### (B) DIP switch (SW101)

Use the DIP switch for setting the node address and bit rate as shown below.




**DIP Switch Setting**

**NOTE:** Always turn off the controller power (including the network power) before setting the DIP switch.

### Setting the node address

Set the node address of the robot controller using selectors 1 through 6 of the DIP switch, referring to the table below. You may freely set any of 0 through 63 to a node address unless the address is double-assigned on the same network including the master and slaves. Double assignment will cause an address double-assignment error, disabling the network.

**Node Address Setting by the DIP Switch**

| DIP switch | | | | | | Node address | | DIP switch | | | | | | Node address |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 (32) | 2 (16) | 3 (8) | 4 (4) | 5 (2) | 6 (1) | | | 1 (32) | 2 (16) | 3 (8) | 4 (4) | 5 (2) | 6 (1) | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 32 |
| 0 | 0 | 0 | 0 | 0 | 1 | 1 | | 0 | 0 | 0 | 0 | 0 | 1 | 33 |
| 0 | 0 | 0 | 0 | 1 | 0 | 2 | | 0 | 0 | 0 | 0 | 1 | 0 | 34 |
| 0 | 0 | 0 | 0 | 1 | 1 | 3 | | 0 | 0 | 0 | 0 | 1 | 1 | 35 |
| 0 | 0 | 0 | 1 | 0 | 0 | 4 | | 0 | 0 | 0 | 1 | 0 | 0 | 36 |
| 0 | 0 | 0 | 1 | 0 | 1 | 5 | | 0 | 0 | 0 | 1 | 0 | 1 | 37 |
| 0 | 0 | 0 | 1 | 1 | 0 | 6 | | 0 | 0 | 0 | 1 | 1 | 0 | 38 |
| 0 | 0 | 0 | 1 | 1 | 1 | 7 | | 0 | 0 | 0 | 1 | 1 | 1 | 39 |
| 0 | 0 | 1 | 0 | 0 | 0 | 8 | | 0 | 0 | 1 | 0 | 0 | 0 | 40 |
| 0 | 0 | 1 | 0 | 0 | 1 | 9 | | 0 | 0 | 1 | 0 | 0 | 1 | 41 |
| 0 | 0 | 1 | 0 | 1 | 0 | 10 | | 0 | 0 | 1 | 0 | 1 | 0 | 42 |
| 0 | 0 | 1 | 0 | 1 | 1 | 11 | | 0 | 0 | 1 | 0 | 1 | 1 | 43 |
| 0 | 0 | 1 | 1 | 0 | 0 | 12 | | 0 | 0 | 1 | 1 | 0 | 0 | 44 |
| 0 | 0 | 1 | 1 | 0 | 1 | 13 | | 0 | 0 | 1 | 1 | 0 | 1 | 45 |
| 0 | 0 | 1 | 1 | 1 | 0 | 14 | | 0 | 0 | 1 | 1 | 1 | 0 | 46 |
| 0 | 0 | 1 | 1 | 1 | 1 | 15 | | 0 | 0 | 1 | 1 | 1 | 1 | 47 |
| 0 | 1 | 0 | 0 | 0 | 0 | 16 | | 0 | 1 | 0 | 0 | 0 | 0 | 48 |
| 0 | 1 | 0 | 0 | 0 | 1 | 17 | | 0 | 1 | 0 | 0 | 0 | 1 | 49 |
| 0 | 1 | 0 | 0 | 1 | 0 | 18 | | 0 | 1 | 0 | 0 | 1 | 0 | 50 |
| 0 | 1 | 0 | 0 | 1 | 1 | 19 | | 0 | 1 | 0 | 0 | 1 | 1 | 51 |
| 0 | 1 | 0 | 1 | 0 | 0 | 20 | | 0 | 1 | 0 | 1 | 0 | 0 | 52 |
| 0 | 1 | 0 | 1 | 0 | 1 | 21 | | 0 | 1 | 0 | 1 | 0 | 1 | 53 |
| 0 | 1 | 0 | 1 | 1 | 0 | 22 | | 0 | 1 | 0 | 1 | 1 | 0 | 54 |
| 0 | 1 | 0 | 1 | 1 | 1 | 23 | | 0 | 1 | 0 | 1 | 1 | 1 | 55 |
| 0 | 1 | 1 | 0 | 0 | 0 | 24 | | 0 | 1 | 1 | 0 | 0 | 0 | 56 |
| 0 | 1 | 1 | 0 | 0 | 1 | 25 | | 0 | 1 | 1 | 0 | 0 | 1 | 57 |
| 0 | 1 | 1 | 0 | 1 | 0 | 26 | | 0 | 1 | 1 | 0 | 1 | 0 | 58 |
| 0 | 1 | 1 | 0 | 1 | 1 | 27 | | 0 | 1 | 1 | 0 | 1 | 1 | 59 |
| 0 | 1 | 1 | 1 | 0 | 0 | 28 | | 0 | 1 | 1 | 1 | 0 | 0 | 60 |
| 0 | 1 | 1 | 1 | 0 | 1 | 29 | | 0 | 1 | 1 | 1 | 0 | 1 | 61 |
| 0 | 1 | 1 | 1 | 1 | 0 | 30 | | 0 | 1 | 1 | 1 | 1 | 0 | 62 |
| 0 | 1 | 1 | 1 | 1 | 1 | 31 | | 0 | 1 | 1 | 1 | 1 | 1 | 63 |

**Note 1 :** **Selector OFF and ON are expressed by 0 and 1, respectively.**
**Note 2 :** **Before shipment from the factory, "Node address" is set to 0 by default.**

### Setting the bit rate

To match the bit rate of the robot controller with that of the network, use selectors 7 and 8 of the DIP switch, referring to the table below:

**Bit Rate Setting By DIP Switch**

| Selectors on the DIP switch | | Bit rate |
|---|---|---|
| Selector 7 | Selector 8 | |
| 0 | 0 | 125 kbps |
| 0 | 1 | 250 kbps |
| 1 | 0 | 500 kbps |
| 1 | 1 | 500 kbps |

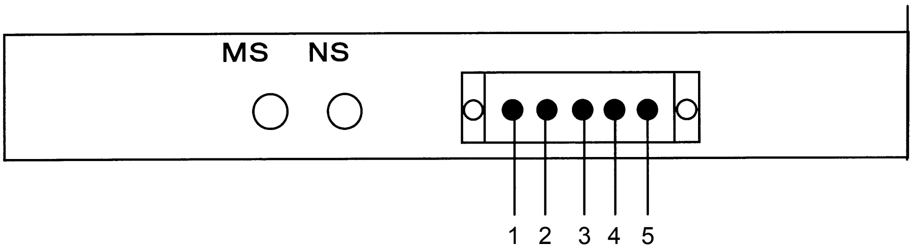
**Note 1: Selector OFF and ON are expressed by 0 and 1, respectively. (Before shipment from the factory, both of these selectors are set to 0 (=500 kbps) by default.**

**Note 2: On the same network, set the same bit rate to all nodes (master and slaves). Otherwise, slaves whose bit rate is different from that of the master cannot communicate only, but also they may cause a communications error between correctly set nodes.**

## (C) DeviceNet connector

The robot controller uses an open type 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) |

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)<br>For thin cables: TME TC-0.5<br>For thick cables: TME TC-2-11 (for power supply)<br>TME TC-1.25-11 (for communication) | NH-32 |

# [ 2 ] General Specifications

The following tables list the controller environmental and communication specifications.

### (1) Environmental requirements

| Item | Specifications |
|---|---|
| Power requirements | 5 VDC (supplied via the controller ISA bus) |
| Operating temperature | 0 to 40°C |
| Operating humidity | 90% RH or less (without condensation) |

### (2) DeviceNet communications specifications

<table>
<tr><th>Item</th><th colspan="4">Specifications</th></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<br>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<br>(to trunk and branch lines)</td></tr>
<tr><td>Bit rate</td><td colspan="4">500, 250, 125 kbps (selectable by switch)</td></tr>
<tr><td>Communications media</td><td colspan="4">Special cable consisting of 5 wires<br>(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: 30 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:<br>40 points for system input<br>32 points for system output<br>24 points to 216 for user input<br>24 to 224 points for user output<br>The number of I/Os can be set in unit of 8 points.<br>Compatible assignment mode:<br>24 points for system input<br>32 points for system output<br>40 to 232 points for user input<br>24 to 224 points for user output<br>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.<br>(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>

## 3.8.3 Assignment of Serial I/O Data

Two types of serial I/O data assignment modes are available--standard assignment mode and compatible assignment mode (which is compatible with our previous models). In each of those assignment modes, serial input/output data are assigned as shown in [ 1 ] and [ 2 ].

The controller equipped with a DeviceNet slave board transfers the system input/output data only through the DeviceNet, disabling the parallel ports. The controller, however, can handle the user input/output data using both parallel ports and DeviceNet.

Signals such as *robot stop*, *enable auto*, and *CPU normal* are transferred only through the parallel ports.

## [ 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 failure | 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.

## [ 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 failure | 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 failure | 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.

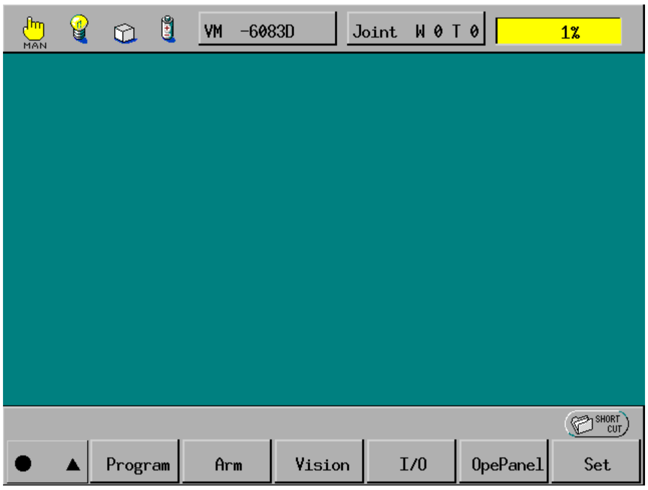
## 3.8.4 Parameter Entry Procedure

### [ 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 8 (default) to 32 (max.), and the number of output slots in the range from 7 (default) to 32 (max.). The setting procedure is given below:

**STEP 1**

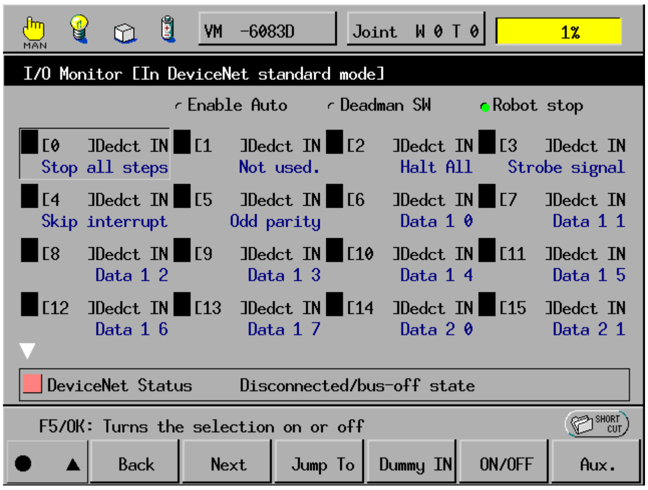
Press [F4 I/O] on the following screen.




F4

**STEP 2**

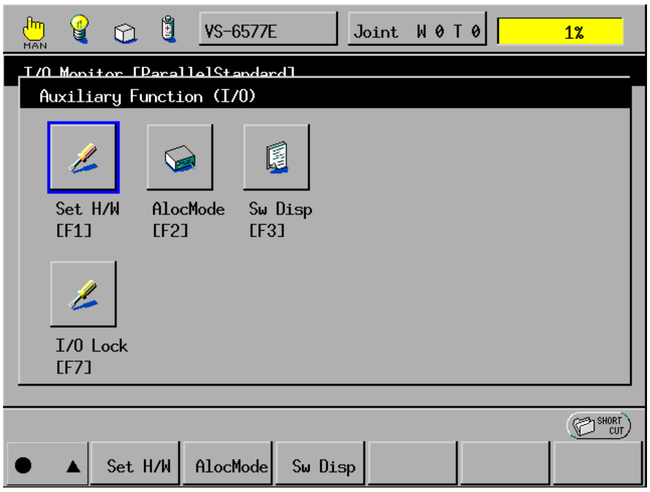
Press [F6 Aux.] on the following screen.




F6

**STEP 3**

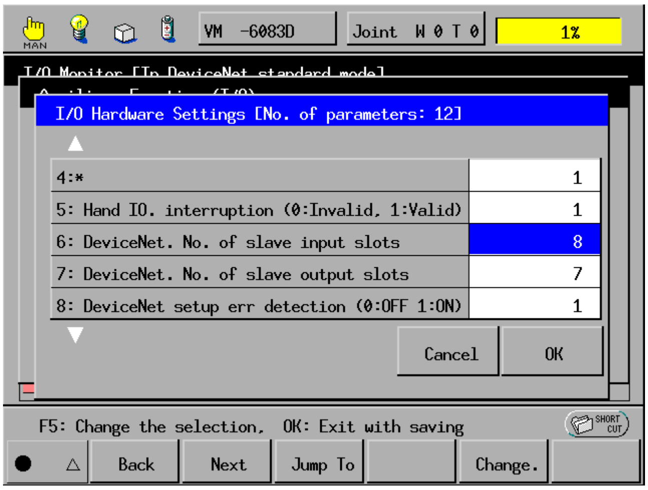
Press [F1 Set H/W] on the following screen.




F1

**STEP 4**

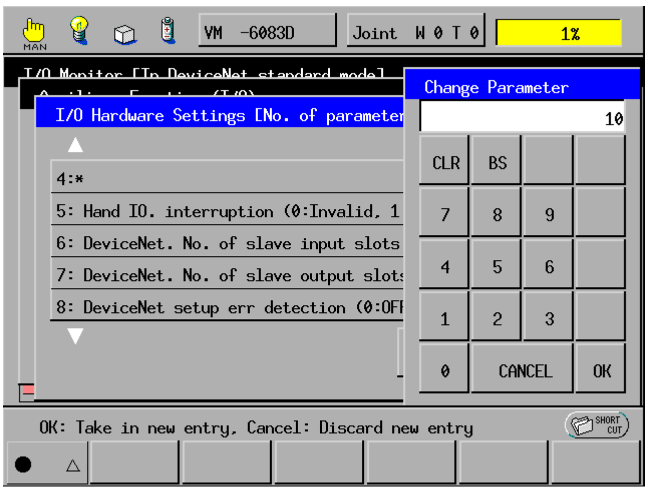
Select the box for changing the number of DeviceNet input/output slots and then press [F5 Change].




F5

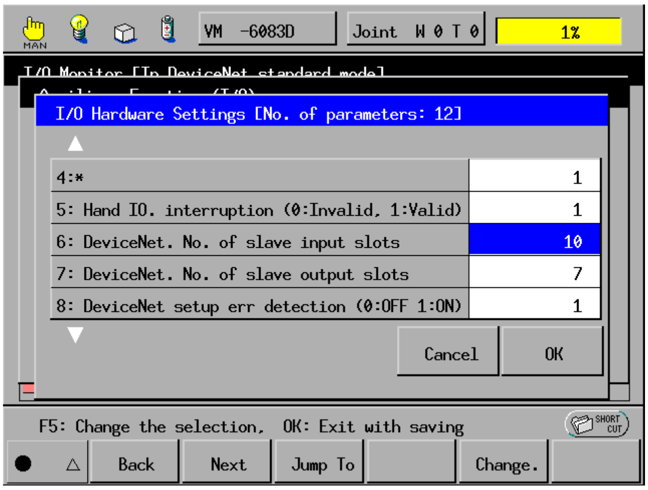
**STEP 5**

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.

## [ 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 | |
|---|---|---|
| | In standard assignment mode | In compatible assignment mode |
| 8 | 24 | 40 |
| 9 | 32 | 48 |
| 10 | 40 | 56 |
| 11 | 48 | 64 |
| 12 | 56 | 72 |
| 13 | 64 | 80 |
| 14 | 72 | 88 |
| 15 | 80 | 96 |
| 16 | 88 | 104 |
| 17 | 96 | 112 |
| 18 | 104 | 120 |
| 19 | 112 | 128 |
| 20 | 120 | 136 |
| 21 | 128 | 144 |
| 22 | 136 | 152 |
| 23 | 144 | 160 |
| 24 | 152 | 168 |
| 25 | 160 | 176 |
| 26 | 168 | 184 |
| 27 | 176 | 192 |
| 28 | 184 | 200 |
| 29 | 192 | 208 |
| 30 | 200 | 216 |
| 31 | 208 | 224 |
| 32 | 216 | 232 |

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

## 3.8.5 Field Network Error Indication (Version 1.5 or later)

In Main Software Version 1.5 or later, the "10: FieldNetwork ErrDisplay" parameter is newly added to the I/O Hardware Settings window (Access: [F4 I/O]—[F6 Aux.]—[F1 Set H/W]). This parameter allows you to choose whether a network error will display "every time" it occurs or at the "first time."

This parameter takes effect in the DeviceNet masters and slaves and the PROFIBUS slaves.

The addition of this parameter disables the "8: DeviceNet Setup ErrDisplay" in the I/O Hardware Settings window.

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.

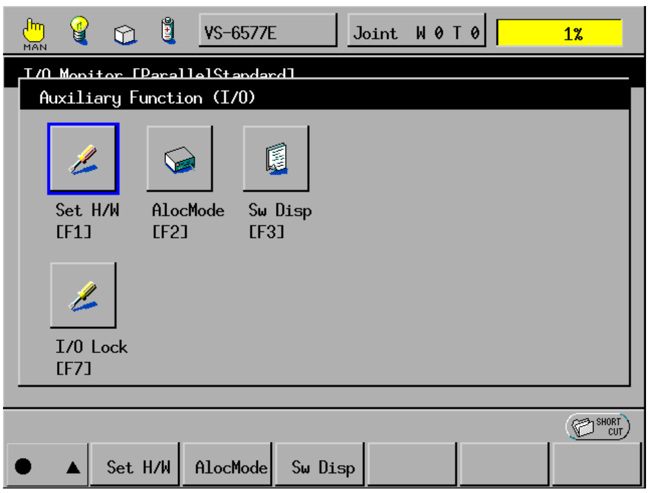
To check program operations using dummy I/Os for setting up facilities where no connection to the network has been established, set this parameter to "1" (First Time). Doing so will not display errors once detected, allowing you to check program operations.

**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]

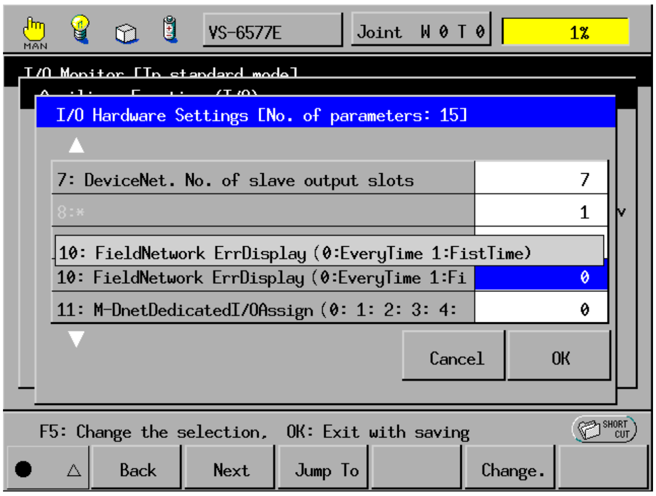
**STEP 1** Press [F1 Set H/W] in the Auxiliary Function (I/O) window.




F1

## STEP 2

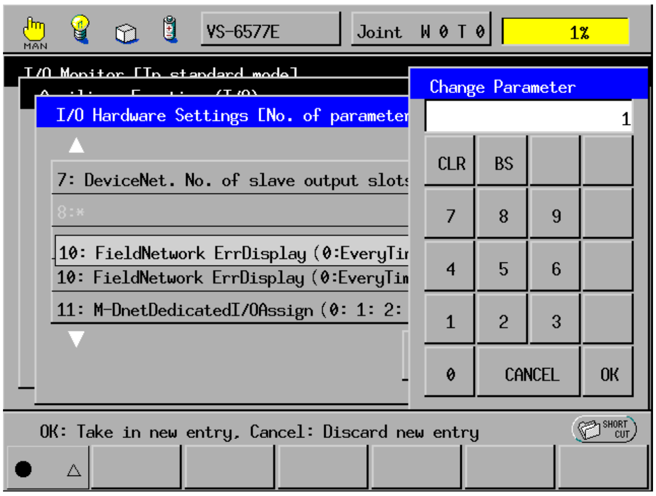
Select "10: FieldNetwork ErrDisplay" and press [F5 Change.].




F5

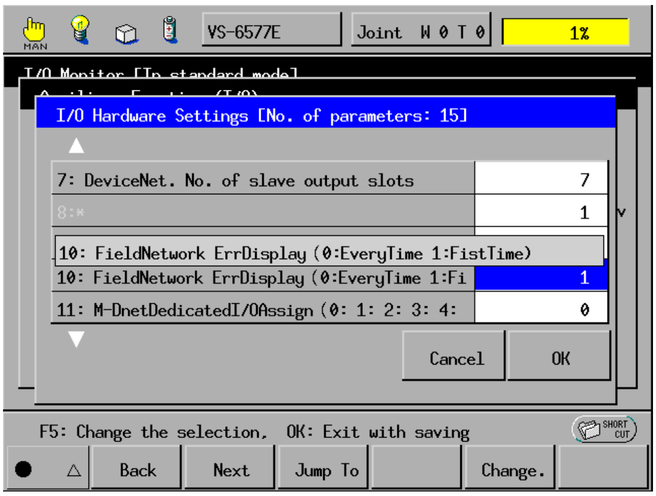
## STEP 3

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.**

## 3.8.6 Network Error Detector Suppression (Version 1.7 or later)

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.

Also if the robot controller RC5 equipped with DeviceNet master board is connected as a master with RC5 slaves, then the time required for establishing connections will vary depending upon differences between setting-up times of individual controllers.

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, Main Software Version 1.7 or later newly 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.

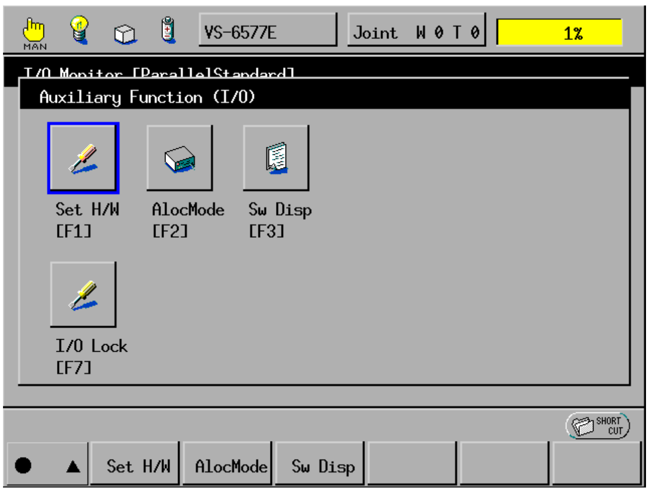
If a network error occurs when the controller is turned on, then it will be detected 8 seconds later.

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]

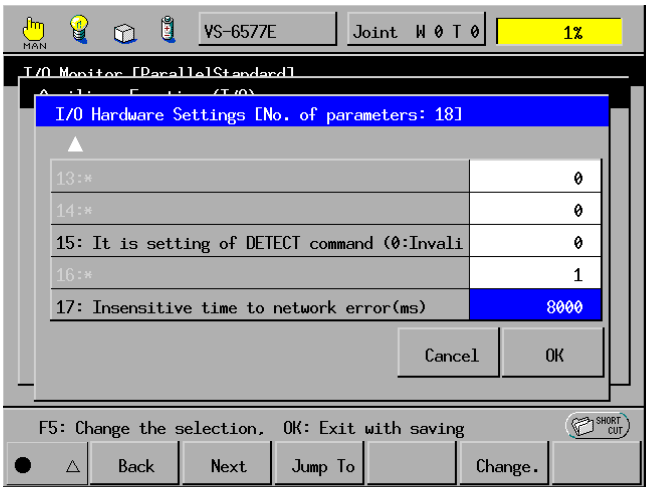
**STEP 1** Press [F1 Set H/W] in the Auxiliary Function (I/O) window.



F1

## STEP 2

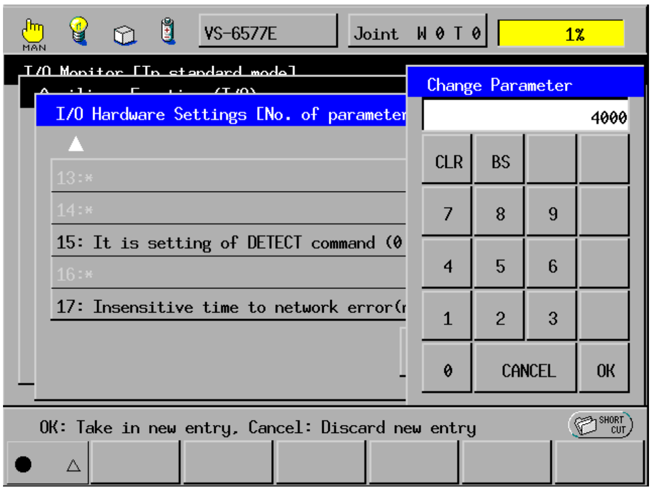
Select "17: Insensitive time to network error" and press [F5 Change.].




F5

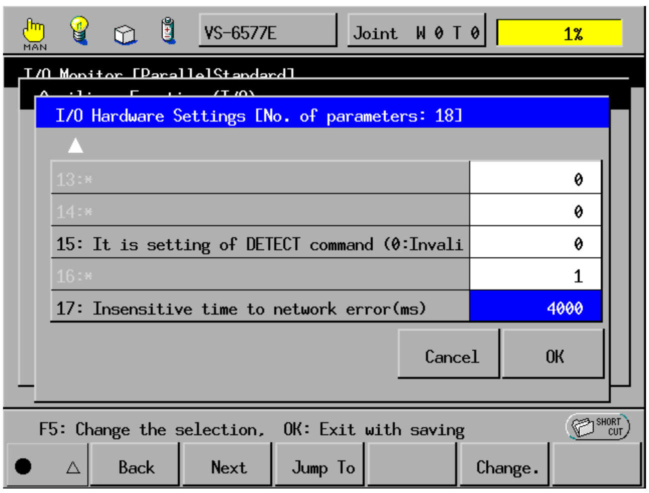
## STEP 3

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.**

## 3.8.7 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)<br>• The DeviceNet module is working normally, but has not established link with the master device. | Establish the link from the master device. | ☼ G | ◐ G |
| 1202 | Preparing for communications (link not established)<br>• The DeviceNet module is working normally and has established explicit link with the master device, but not established an I/O link. | Establish the I/O link from the master device. | ☼ G | ☼ G |
| 1203 | Preparing for communications (communications idling)<br>• 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. | ☼ G | ☼ G |
| 1204 | Preparing for communications (I/O timeout)<br>• 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.<br>Check the DeviceNet cable length and that a terminator resistor is attached to each end of the trunk line. | ☼ G | ◐ R |
| 1205 | Initial setting error in the communications processor<br>• Failed to establish the initial link with the DeviceNet communication processor. | Turn the controller power off and then on, and do the same operation again. | – | – |
| 1210 | A DeviceNet internal communications error has occurred. | Turn the controller power off and then on, and do the same operation again. | – | – |
| 1213 | The network is broken or "bus off."<br>• The DeviceNet cable is broken or not connected. | Check whether the DeviceNet cable is connected with the robot controller. If this error occurs after you change the DIP switch setting, check whether the bit rate setting made with the DIP switch matches the network's bit rate. | ☼ G | ☼ R |
| 1215 | Preparing for communications (Initial setting error)<br>• No initial settings have been received from the robot. | Check whether the bit rate setting made with the DIP switch matches the network's bit rate.. | ☼ G | ● |
| 1216 | Data length setting error<br>• DeviceNet INSLOT or OUTSLOT is not 32 or less. | Turn the controller power off and then on. Then, set correct DeviceNet INSLOT and OUTSLOT values. | ☼ R | ● |
| 1217 | Node address double-assign error<br>• The same node address is double assigned to the robot controller and any other online node. | Assign an exclusive node address to each node (including the robot controller) on the same DeviceNet. | ☼ G | ☼ R |

☼ : ON ◐ : Flashing ● : OFF – : Indefinite

| Error code | What has happened: | What to do: | LEDs | |
|---|---|---|---|---|
| | | | MS | NS |
| 1230 | Retry error in the DPRAM built in the robot controller | Turn the controller power off and then on, and do the same operation again. | – | – |
| 1232 | Reset command received<br>• The robot controller has received a reset command from the master device. | Turn the controller power off and then on, and do the same operation again. | ☼ G | ☼ G |
| 1234 | DeviceNet internal RAM error | Turn the controller power off and then on, and do the same operation again. | ☼ R | ● |
| 1235 | Reserved for System | – | ☼ R | ● |
| 1236 | DeviceNet internal DPRAM error | Turn the controller power off and then on, and do the same operation again. | ☼ R | ● |
| 1237 | DeviceNet EEPROM error | Turn the controller power off and then on, and do the same operation again. | ☼ R | ● |
| 1238 | Retry error in the DeviceNet DPRAM | Turn the controller power off and then on, and do the same operation again. | ☼ R | ● |

☼ : ON ◐ : Flashing ● : OFF – : Indefinite

**RC5 EDS File ($ DeviceNet Manager Generated Electronic Data Sheet)**

```
[File]
        DescText= "RC5 EDS File";
        CreateDate= 11-14-1997;
        CreateTime= 15:00:00;
        ModDate= 06-26-1999;
        ModTime= 10:57:07;
        Revision= 1.1;

[Device]
        VendCode        = 171;              $ Vendor Code
        ProdType        = 12;               $ Product Type
        ProdCode        = 1;                $ Product Code
        MajRev          = 1;                $ Major Rev
        MinRev          = 1;                $ Minor Rev
        VendName        = "Denso Corporation";
        ProdTypeStr     = "Communication Adapter";
        ProdName        = "RC5";
        Catalog         = "";

[IO_Info]
        Default         = 0X0001;           $ Poll Only
        PollInfo        = 0X0001,           $ Poll Only
                          1,                $ Default Input = Input1
                          1;                $ Default Output = Output1

        $Input Connections
        Input1          =
                7,                          $ From 7 to 32 Bytes, Variability
                0,                          $ All bits are significant
                0x0001, $ Poll Only Connection
                "Data",                     $ Name
                6,                          $ Path Length
                "20 07 24 02 30 04",        $ Register Object Instance 2 Attribute 4
                "Robot Output Data";        $ Help

        $Output Connections
        Output1         =
                8,                          $ From 8 to 32 Bytes, Variability
                0,                          $ All bits are significant
                0x0001, $ Poll Only Connection
                "Data",                     $ Name
                6,                          $ Path Length
                "20 07 24 01 30 04",        $ Register Object Instance 1 Attribute 4
                "Robot Input Data";         $ Help
```

# 3.9 DeviceNet Master Board

## 3.9.1 Overview

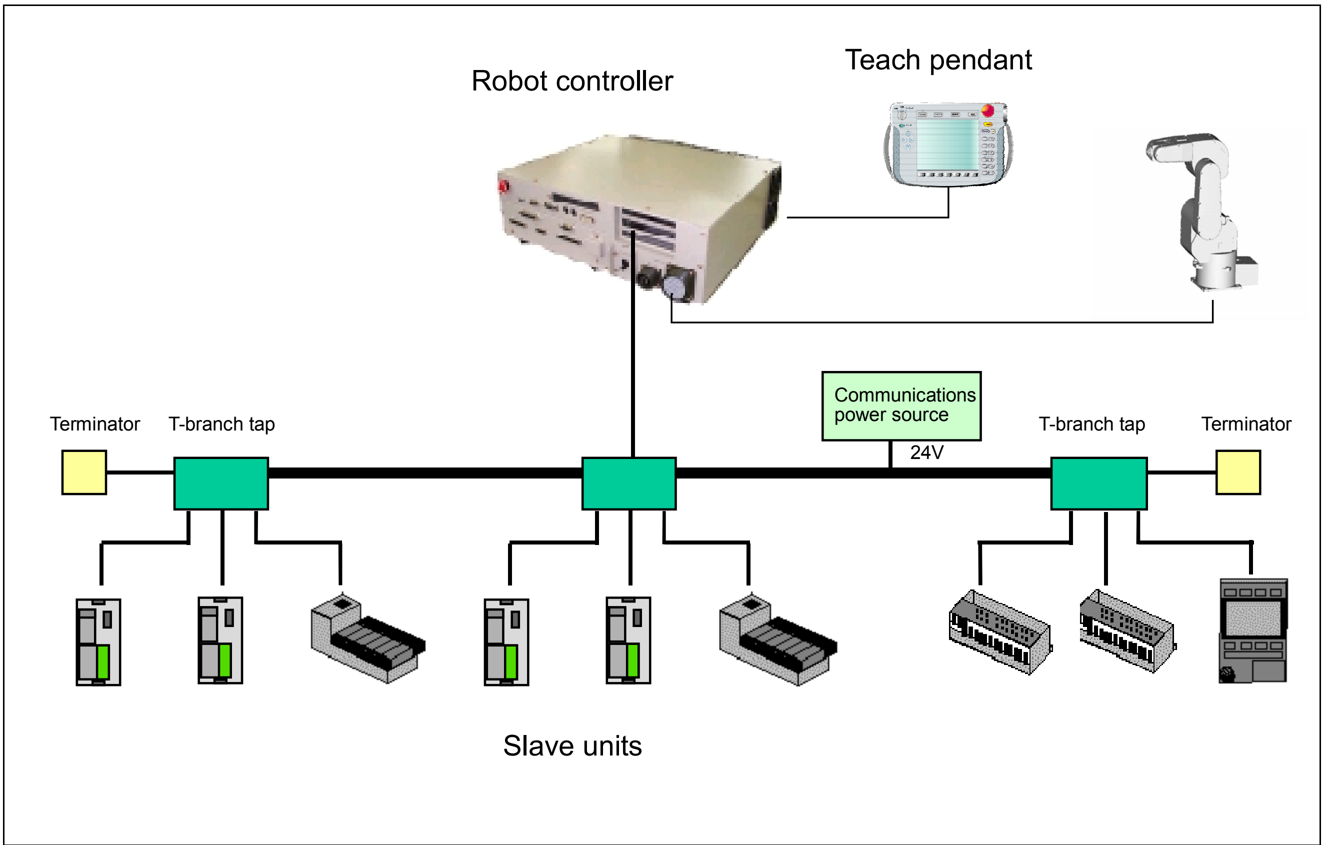
If the robot controller has a built-in DeviceNet master board, it can communicate with external devices according to the DeviceNet-compliant protocol.

The robot controller works as a master unit for serial communications which is compliant with the open network DeviceNet.

For details about the DeviceNet master board, refer to the SUPPLEMENT "DeviceNet Master Unit."

## 3.9.2 Typical Network Configuration

The figure below shows a typical network configuration.



## 3.9.3 General Specifications

### (1) Environmental requirements

| Item | Specifications |
|---|---|
| Power requirements | 5 VDC (supplied via the controller ISA bus) |
| Operating temperature | 0 to 40°C |
| Operating humidity | 90% RH or less (without condensation) |

### (2) DeviceNet communications specifications

<table>
<tr><th>Item</th><th colspan="4">Specifications</th></tr>
<tr><td>Communications protocol</td><td colspan="4">DeviceNet–compliant</td></tr>
<tr><td>Connection supported</td><td colspan="4">- Polling I/O function<br>- Bit strobe function<br>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<br>(to trunk and branch lines)</td></tr>
<tr><td>Bit rate</td><td colspan="4">500, 250, 125 kbps (selectable by switch)</td></tr>
<tr><td>Communications media</td><td colspan="4">Special cable consisting of 5 wires<br>(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>100m or less (Note 2)</td><td>6m or less</td><td>39m or less</td></tr>
<tr><td>250 kbps</td><td>250m or less (Note 2)</td><td>6m or less</td><td>78m or less</td></tr>
<tr><td>125 kbps</td><td>500m or less (Note 2)</td><td>6m or less</td><td>156m 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: 30 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">- Input 1024 points<br>- Output 1024 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.<br>(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>

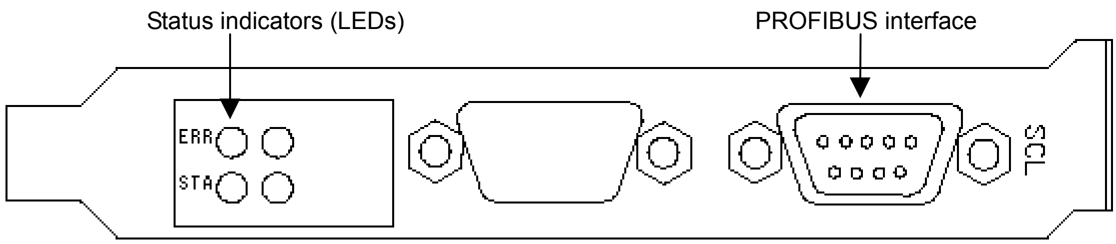
# 3.10 PROFIBUS-DP Slave Board

If the robot controller has a built-in PROFIBUS-DP slave board, it may communicate with external devices according to the PROFIBUS-DP–compliant communications protocol. The robot controller works as a slave unit, which can exchange I/O data with PROFIBUS-DP–compliant field devices of different manufacturers.

For details about the PROFIBUS-DP slave board, refer to the SUPPLEMENT "PROFIBUS-DP Slave Board."

## 3.10.1 Specifications

<table>
<tr><th>Item</th><th colspan="6">Specifications</th></tr>
<tr><td>Communications protocol</td><td colspan="6">PROFIBUS-DP–complient</td></tr>
<tr><td>Transmission speed</td><td colspan="6">9.6K, 19.2K, 93.75K, 187.5K, 500K, 1.5M, 3M, 6M, and 12M bps, with automatic recognition</td></tr>
<tr><td>Interface connector</td><td colspan="6">9-pin, D-sub connector</td></tr>
<tr><td>Communications media</td><td colspan="6">RS-485 interface cable (Type A recommended)</td></tr>
<tr><td rowspan="2">Communications distance (when Type A interface cable is used)</td><td>Transmission speed (bps)</td><td>9.6 K to 93.75 K</td><td>187.5 K</td><td>500 K</td><td>1.5 M</td><td>3 M to 12 M</td></tr>
<tr><td>Distance/segment</td><td>1200 m</td><td>1000 m</td><td>400 m</td><td>200 m</td><td>100 m</td></tr>
<tr><td>PROFIBUS address</td><td colspan="6">1 to 125</td></tr>
<tr><td>Max. number of stations</td><td colspan="6">126 (when the repeater is used)</td></tr>
<tr><td>Number of I/Os</td><td colspan="6">Standard assignment: 40 points for system input<br>32 points for system output<br>24 (default) to 216 points for user input<br>32 (default) to 224 points for user output<br><br>Compatible assignment: 24 points for system input<br>32 points for system output<br>40 (default) to 232 points for user input<br>32 (default) to 224 points for user output</td></tr>
<tr><td>Board model</td><td colspan="6">CIF30-DPS</td></tr>
</table>




<table>
<tr><th>Name</th><th colspan="2">Explanation</th></tr>
<tr><td rowspan="2">Status indicators (LEDs)</td><td>ERR</td><td>Lights when an error occurs in the PROFIBUS-DP slave board.</td></tr>
<tr><td>STA</td><td>Lights when the network is established.</td></tr>
<tr><td>PROFIBUS interface</td><td colspan="2">9-pin, D-sub connector<br>RS-485</td></tr>
</table>

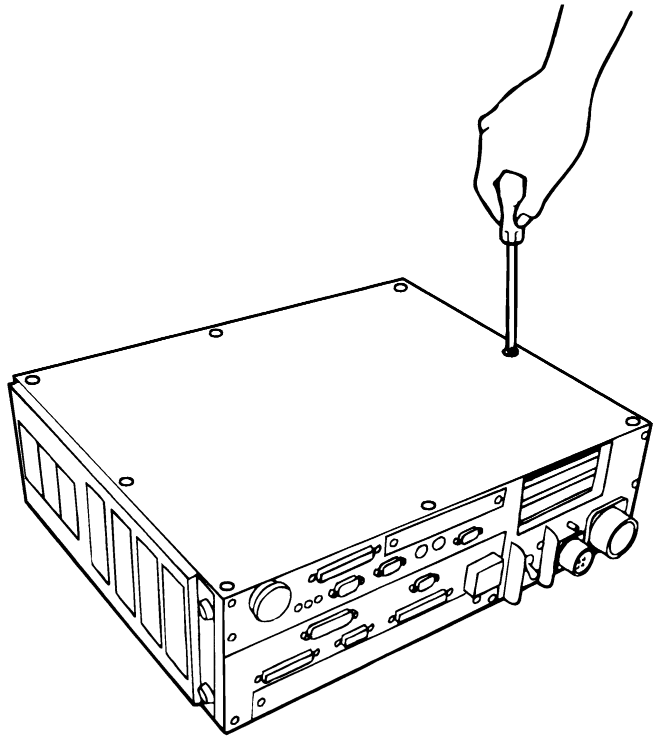
# 3.11 Mounting Extension Boards

This section describes how to mount the μVision board, Ethernet board, and DeviceNet board.

When mounting only one of these boards, skip the steps for mounting other boards.

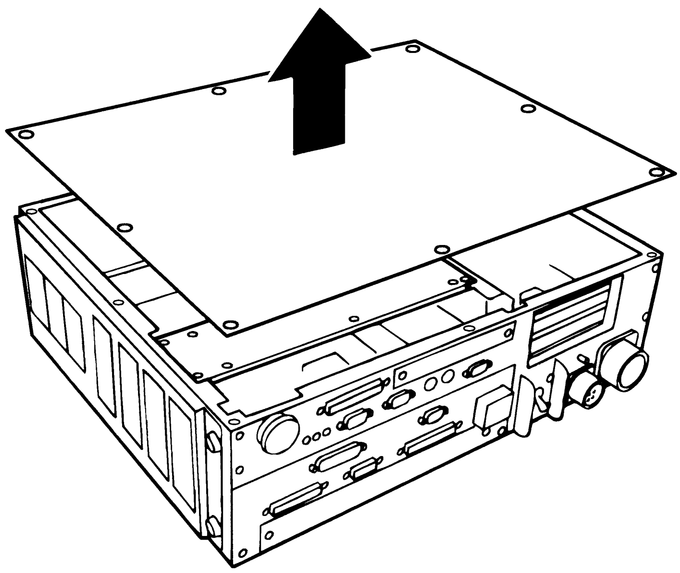
## STEP 1

Remove the eight screws from the controller top cover.



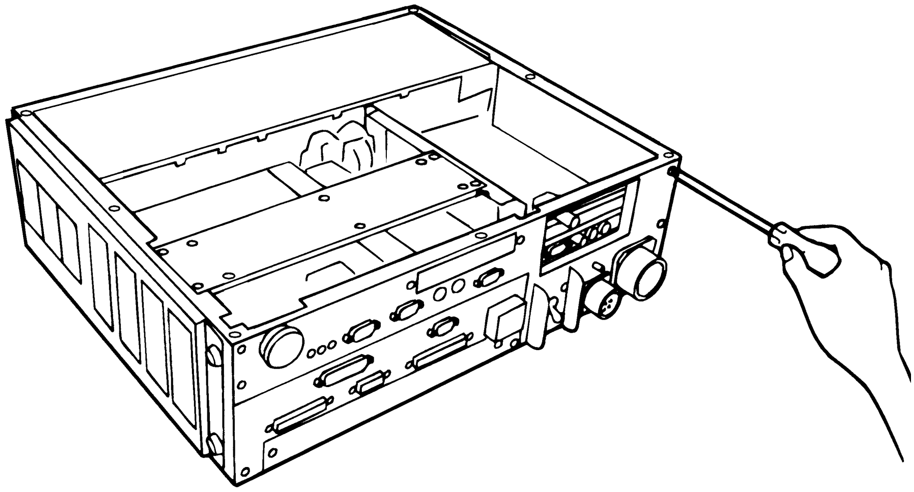
## STEP 2

Lift and remove the top cover from the robot controller.



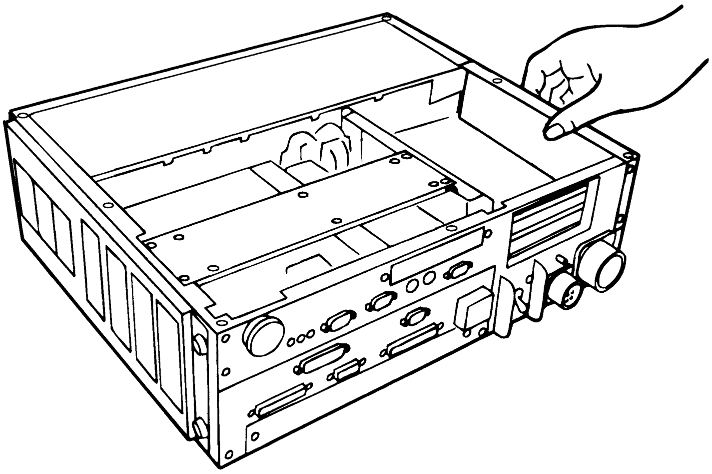
## STEP 3

Remove the two screws fastening the side plate from the front panel of the robot controller as shown below.



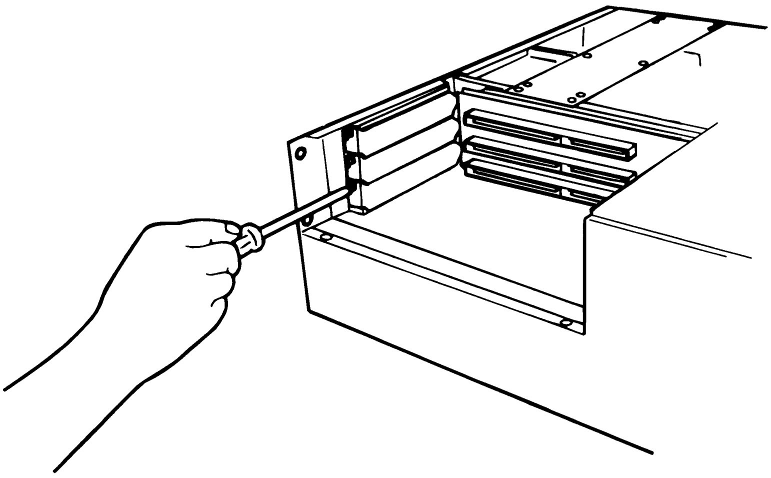
## STEP 4

Remove the side plate.



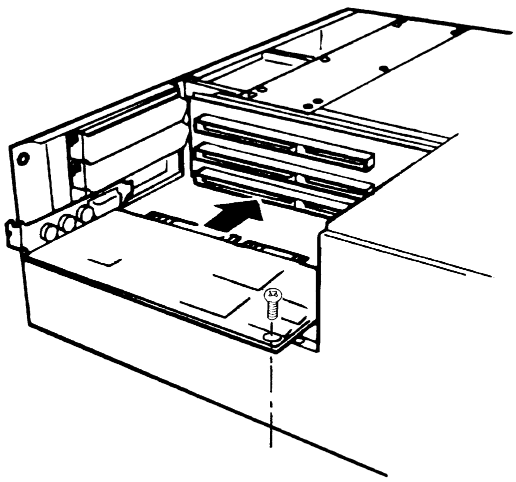
## STEP 5

Remove the panel fastening screw and then the panel hole blind plate.
To mount a µVision board, remove the lower blind plate.
To mount an Ethernet board or DeviceNet board, remove the upper or the middle blind plate and then skip to STEP 7.



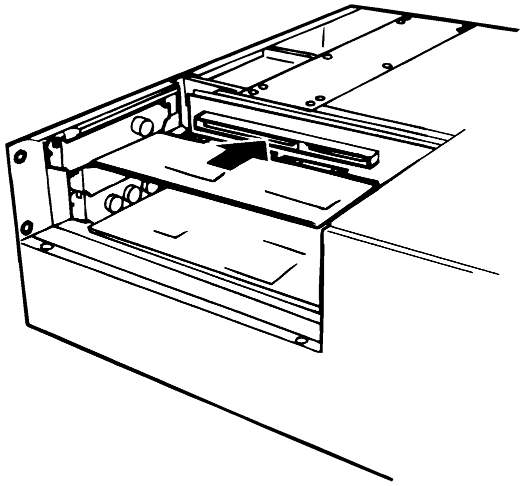
## STEP 6

Fully insert the µVision board in the lower slot connector and secure it with an attached machine screw.



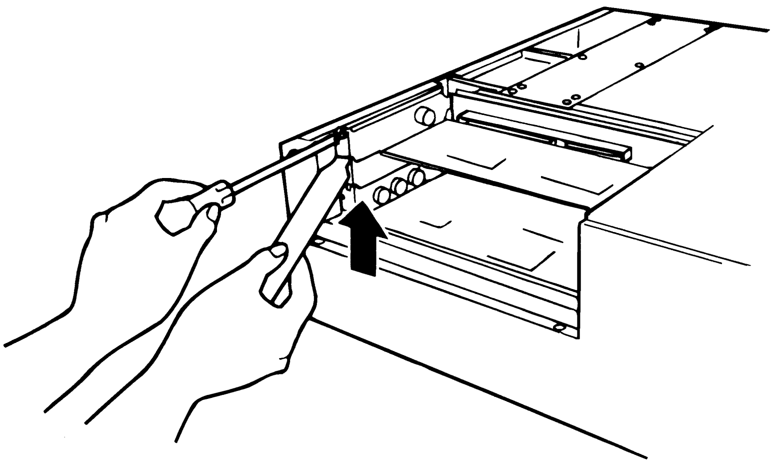
## STEP 7

Fully insert the Ethernet board or DeviceNet board into the upper or the middle slot connector.



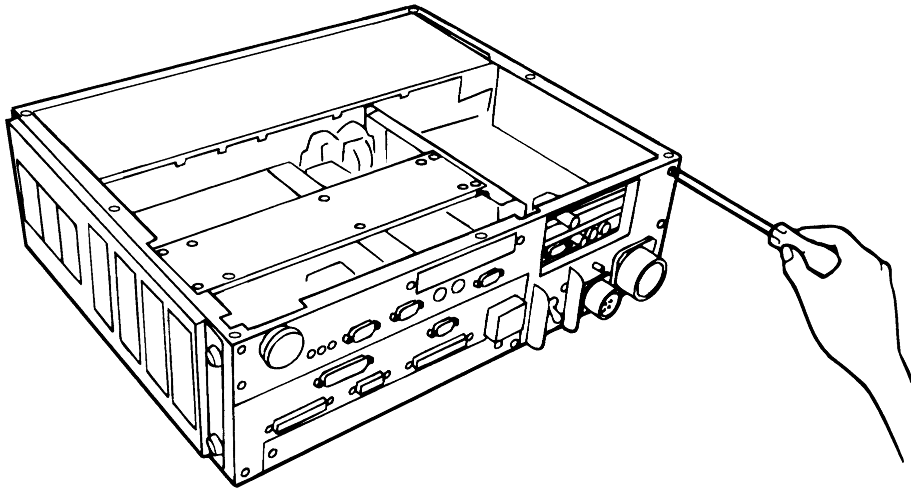
## STEP 8

Using the removed panel hole blind plate, push up the panel of each extension board.  Secure the extension board with a panel fastening screw.



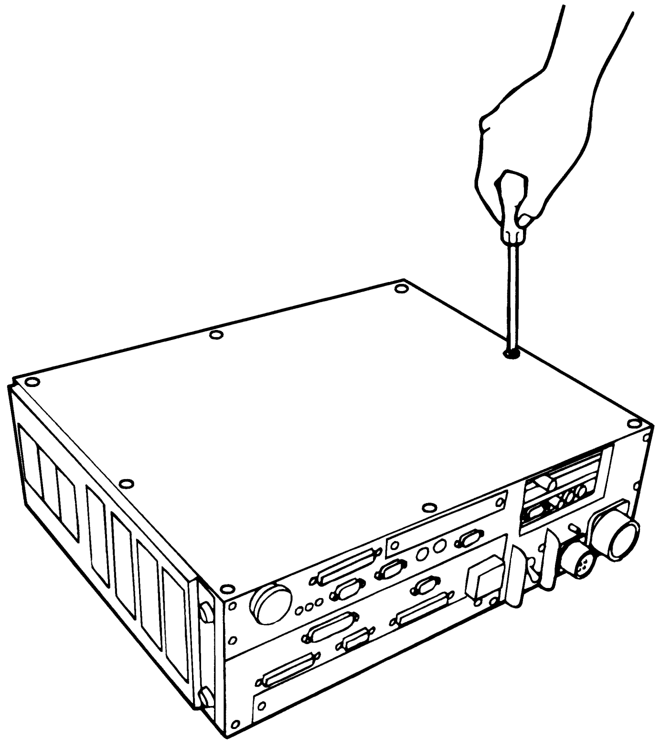
## STEP 9

Install the side plate and tighten the two screws.



## STEP 10

Put the top cover and secure it with eight screws.



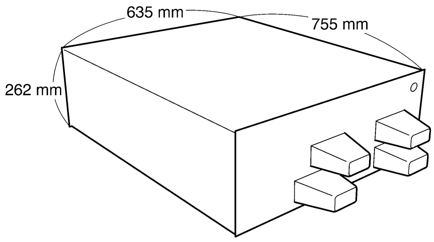
The mounting of the extension boards is completed.

# 3.12 Controller Protective Box (FB-10)

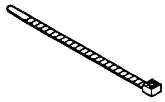
A controller protective box is an optional heat exchanger box to protect the robot controller from an undesirable environment (dust, oil mist) in plant.

## 3.12.1 Components in Package

Check that the following components are contained in the package of the controller protective box.

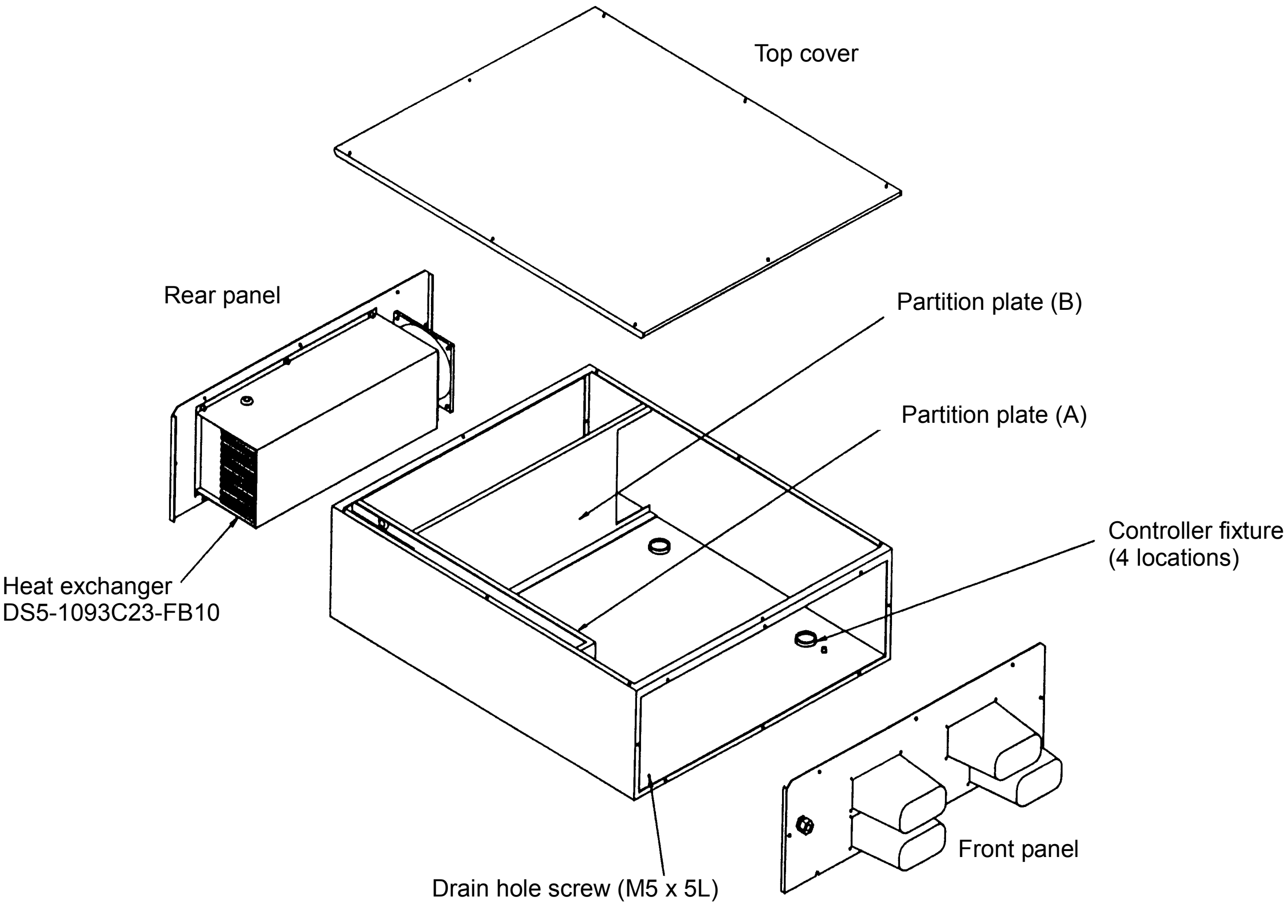



Controller protective box (1 pc)



Binding band (4 pcs)

## 3.12.2 Names of the Components



## 3.12.3 Setting up the Controller Protective Box

### Placing the controller protective box

Place the controller protective box on a flat, level plane.

### Preparing a power supply

Make a single-phase 200 VAC(35W) power supply ready for use.
Connect the power supply to the fan motor drive terminal.
Recommended cable: 1.25 mm$^2$ x 3-core (outside diameter: 11 to 13 mm)

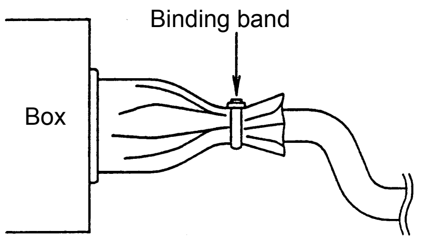
| | |
|---|---|
| **Note 1:** | **Make the controller protective box share the same circuit breaker of the power supply (200 VAC) with the robot controller.** |
| **Note 2:** | **Ground the controller protective box to prevent an electric shock.** |

### Setting the robot controller into the protective box

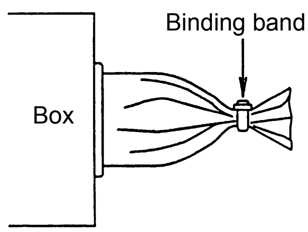
(1) Remove the top cover from the controller protective box.

(2) Put the robot controller into the protective box so that its rubber feet will be fitted into the controller fixtures of the protective box.

(3) Route the necessary cables through the ducts and connect them. As shown below, tie up each duct with an attached binding band.




**Note: Tying up duct(s) not in use**




| | |
|---|---|
| **Note:** | **Tie up the opening of each duct not in use with an attached binding band to prevent entry of dust, water, etc. into the controller protective box.** |

## 3.12.4 Precautions

(1) The controller protective box is a dust-proof, splash-proof structure equivalent to JIS IP53.

The controller protective box is not explosion-proof and must not be installed in the following environments and locations to ensure safety:

- in an environment full of combustible gas, flammable liquid, etc;
- in an environment full of acid or alkali corrosive gas;
- in a location close to electric noise sources, such as large inverters, high-output high-frequency generators, large conductors and welders;
- in a location where the controller protective box will not be used outside the ambient temperature range from 0°C to 40°C;
- in a location where the controller protective box will be exposed to rain or dew;
- in an environment where the controller protective box will be exposed directly to water, oil or chips;
- in an environment where fine chips will be produced from cutting, etc;
- in an environment using oil other than DENSO's recommended oil. DENSO's recommended oil: YUSHIRON OIL No. 4

(2) Seal the mounting face and screws of the controller protective box when using it in an environment full of oil mist. Otherwise oil mist may accumulate on the fin, resulting in a collection of oil. Periodically clean the controller protective box.

(3) If oil mist, etc. collects in the controller protective box, remove the drain hole screw and drain off the oil.

(4) The controller protective box is not equipped with a power switch. Use external means to turn the controller on or off.

(5) The controller protective box must be installed horizontally. Vertical installation will cause accidents.

# Chapter 4

# Customizing Your Robot

This chapter describes how to customize your robot.

# 4.1 What Is Customization?

You may customize your robot by modifying or setting the following:

- Software motion limits for defining motion space
- Mechanical ends for defining restricted space
- Control set of motion optimization
- Robot installation conditions

You are recommended to define new motion space and restricted space in order to prevent interference with other devices or entanglement of the end-effector wiring and piping.

**WARNING:**

Always set the software motion limits and mechanical ends so that the motion space will be within the restricted space. Otherwise, the robot will bump the mechanical stops, causing serious accidents.

# 4.2 Modifying Software Motion Limits to Define New Motion Space

## 4.2.1 What Is a Software Motion Limit?

A limit to the operation range of the robot defined by the software is called a software motion limit. Software motion limits become valid after CAL of the robot has been completed and the robot has entered the range set by the limits.

A mechanical motion limit is called a mechanical end and set by a mechanical stop. To prevent the robot from striking against a mechanical stop, each software motion limit is set slightly in front of the mechanical end as shown in Figure 4-1. Although there is no mechanical stop for the sixth axis, a software motion limit is set.

If the robot reaches a software motion limit during manual or automatic operation, an error message will be displayed (error code starting from 6070; the first digit represents the axis number) and the robot will come to a stop. The power to the motor is also turned OFF in such a case during automatic operation.

All axes are assigned a software motion limit in both the positive and negative direction of the operation range. The software motion limit in the positive direction is called the positive-direction software motion limit and that in the negative direction is called the negative-direction software motion limit.

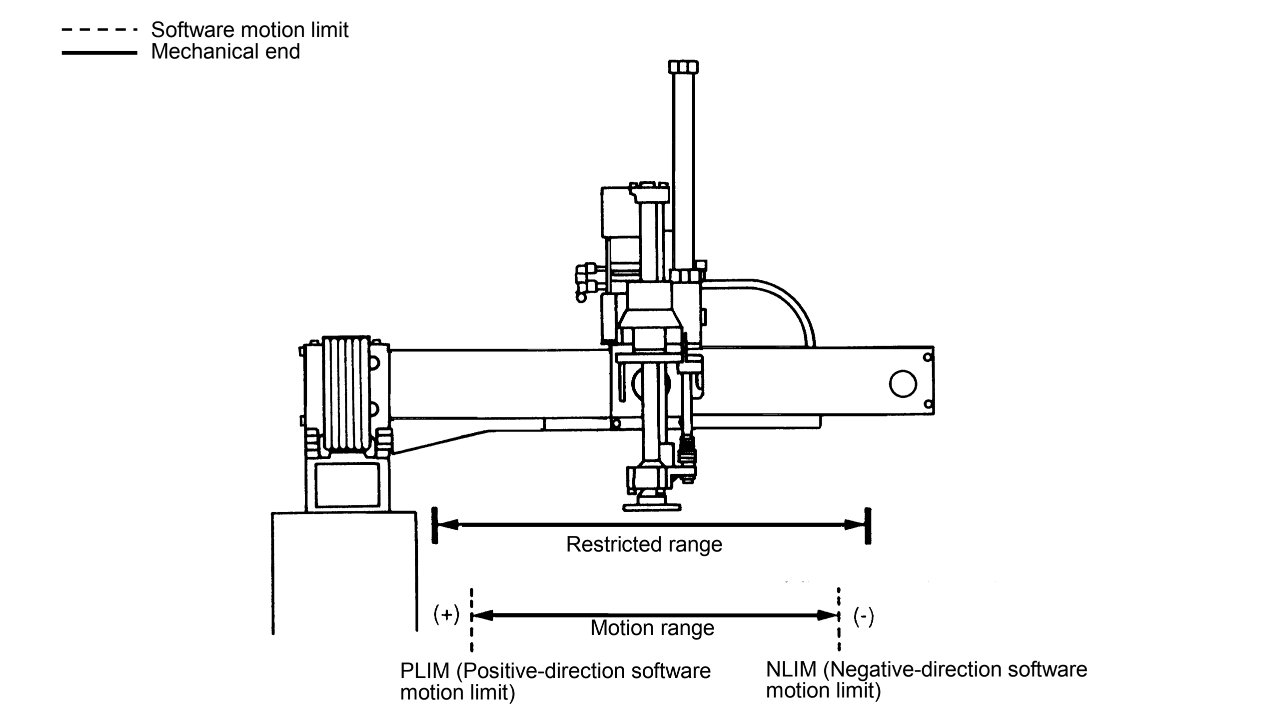



**Figure 4-1 Software Motion Limits and Mechanical Ends**

## 4.2.2 Software Motion Limits (Factory defaults)

Table 4-1 lists the software motion limits that are set at the time of delivery.

**Table 4-1 Software Motion Limits (Factory defaults)**

**1st axis (X axis)** (Unit: mm)

| | | | | |
|---|---|---|---|---|
| 1st-axis (X) stroke | 250 | 350 | 450 | 550 |
| Positive direction | 125 | 175 | 225 | 275 |
| Negative direction | -125 | -175 | -225 | -275 |

**2nd axis (Y axis)** (Unit: mm)

| | | | | | | |
|---|---|---|---|---|---|---|
| 2nd-axis (Y) stroke | 300 | 400 | 500 | 600 | 700 | 900 |
| Positive direction | 150 | 200 | 250 | 300 | 350 | 450 |
| Negative direction | -150 | -200 | -250 | -300 | -350 | -450 |

**3rd axis (Z axis)** (Unit: mm)

| | |
|---|---|
| 3rd-axis (Z) stroke | 200 |
| Positive direction | 105 |
| Negative direction | -95 |

**4th-axis (T axis)** (Unit: degree)

| | |
|---|---|
| 4th axis (T) stroke | 540 |
| Positive direction | 270 |
| Negative direction | -270 |

## 4.2.3 Changing Software Motion Limits

If the robot interferes with any other device, change the software motion limits to make the motion space smaller as shown in Figure 4-2.

If the air piping and wiring of the end-effector become taut as the robot runs, then change the software motion limits to make the motion space smaller as shown in Figure 4-2.

**NOTE:** When changing software motion limits, always make the new motion space smaller than the motion space defined by initial settings.

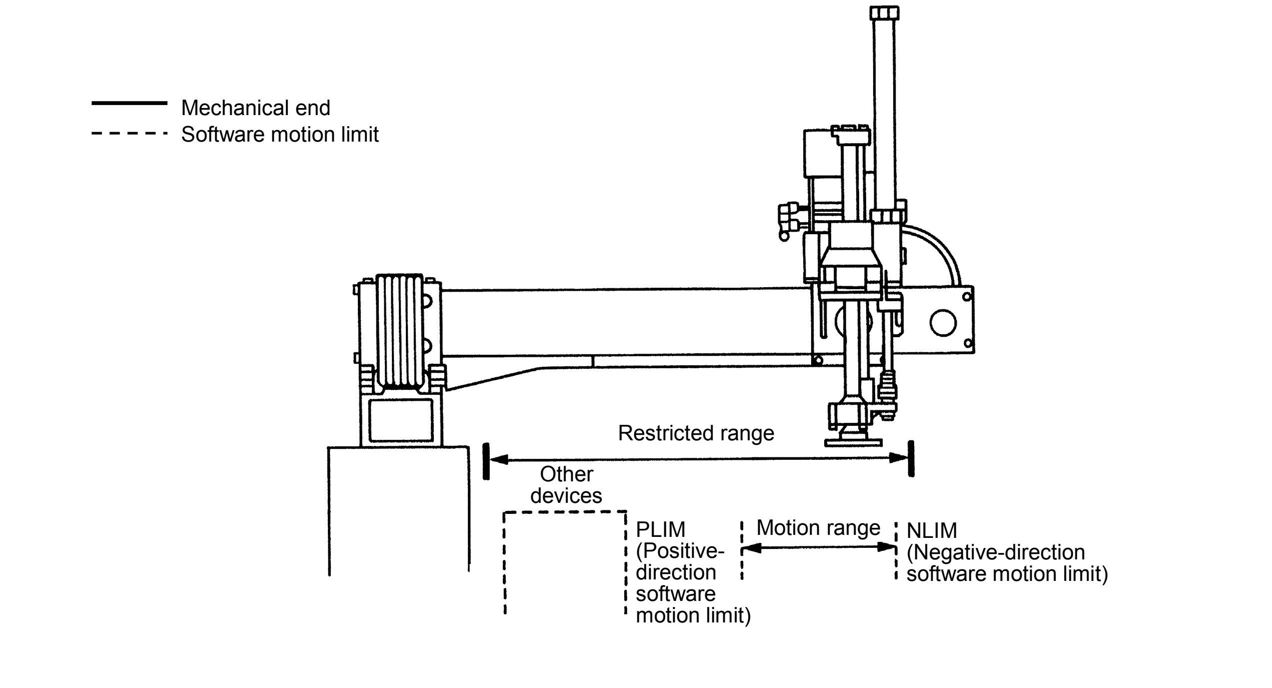



**Figure 4-2 (a) Changing Software Motion Limits (Example 1)**

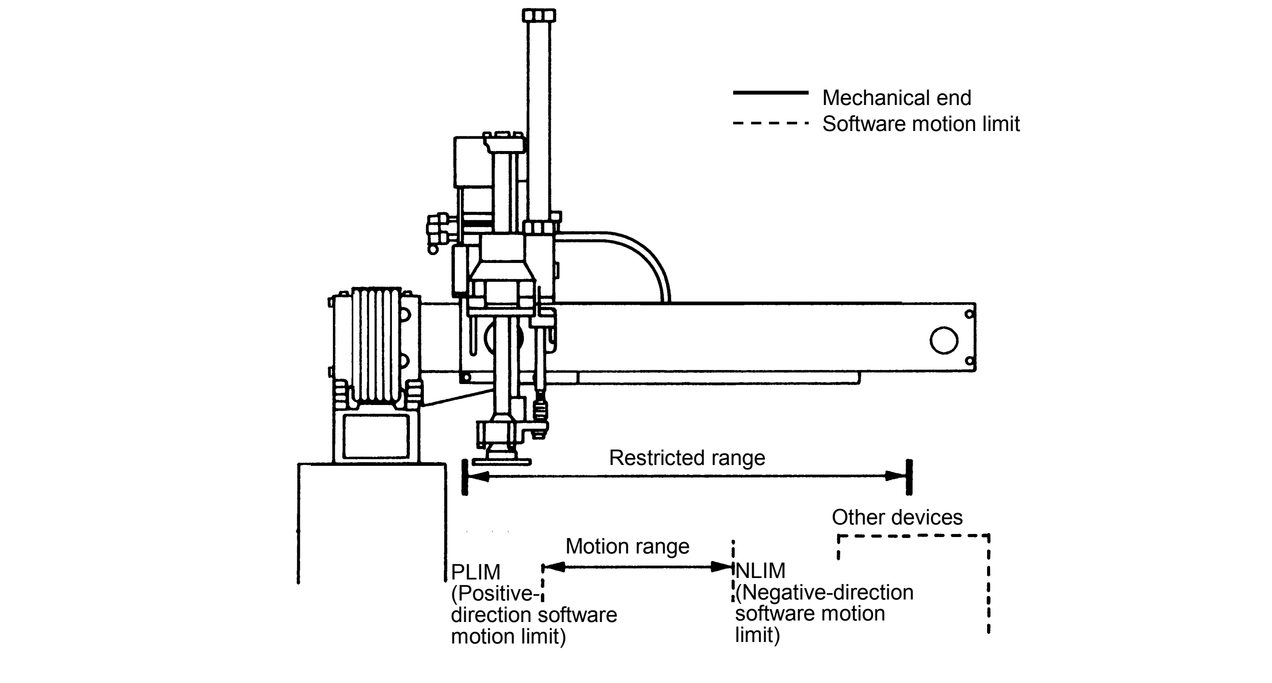



**Figure 4-2 (b) Changing Software Motion Limits (Example 2)**

## 4.2.4 Precautions When Changing the Software Motion Limits

(1) The software motion limits are invalid until CAL is completed.

(2) Confirm the operating space of the robot in the actual working environment. Set the software motion limits using the correct unit of measurement.

If the operating space is too small, the robot may seem to become inoperable.

## 4.2.5 Procedure for Changing the Software Motion Limits

Described below is the procedure for changing the software motion limits.

### STEP 1

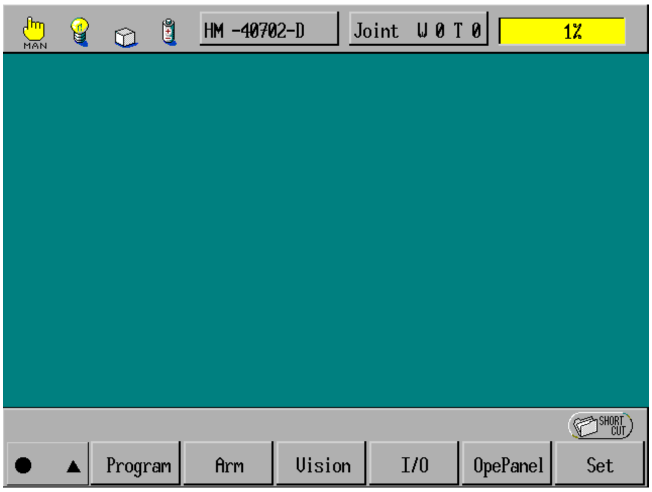
**Turn the power switch of the robot controller ON.**

### STEP 2

**Set the mode selector switch of the teach pendant to MANUAL.**

### STEP 3

**Press [F2 Arm] on the top screen of the teach pendant.**

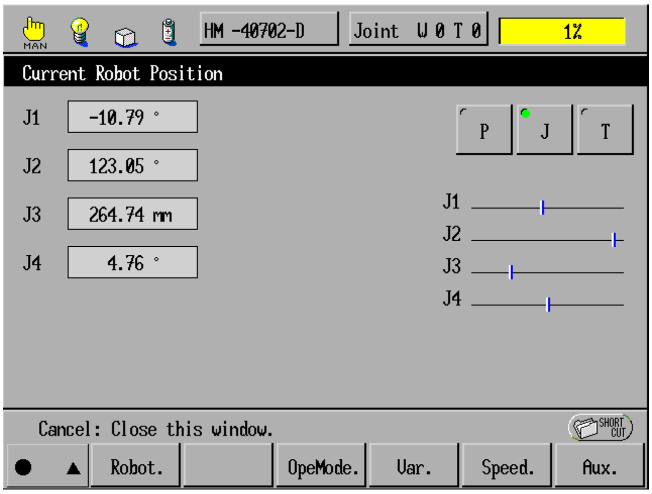



F2

The Current Robot Position window appears as shown in Step 4.

## STEP 4

**Press the SHIFT key and then press [F12 Maint.].**



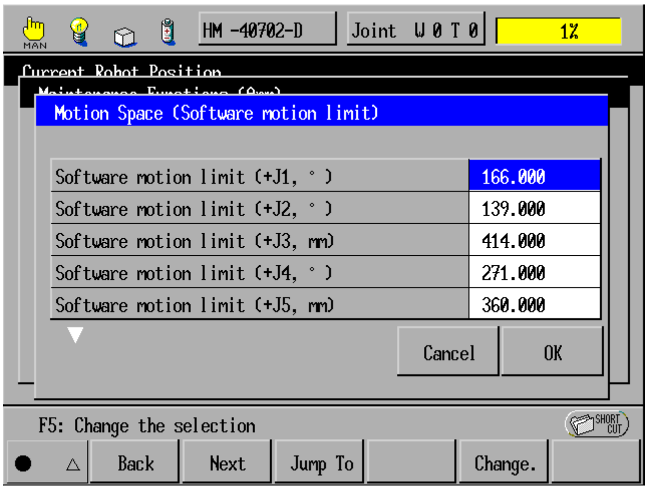

F12

The Maintenance Functions (Arm) window will appear.

## STEP 5

**In the Maintenance Functions (Arm) window, press [F1 M Space].**
The Motion Space window will appear as shown below.

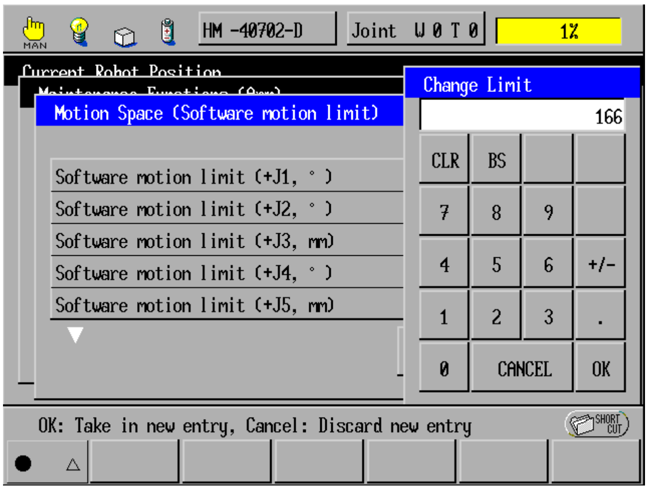
**Select the item to be modified, then press [F5 Change].**




F5

## STEP 6

The numeric keypad will appear as shown below.
**Enter a desired value using the numeric keys, then press OK.**




## STEP 7

The new value will be set on the line of the item selected in the Motion Space window.
If two or more items must be changed, repeat Steps 4 and 5.

## STEP 8

**Press OK in the Motion Space window.**

## STEP 9

**Turn the robot controller off.**

**Caution:** The new software motion limit(s) specified for the motion space will take effect after the robot controller restarts and CAL is completed.

# 4.3 CALSET

## 4.3.1 What Is CALSET?

Calibrating the relationship between position-related information recognized by the robot controller and the actual position of the robot unit is called CALSET.

CALSET must be performed when the motor is replaced or when the encoder backup battery goes dead and the position-related data retained in the encoder is lost as a result.

After CALSET is completed, the calibrated data of the robot unit will be stored in the robot controller. This data is called CALSET data which is different on each robot.

This robot has been CALSET before delivery and the CALSET data is stored in the floppy disks that come with the robot unit. Therefore, even if the memory backup battery in the robot controller dies so that the CALSET data is lost, you do not need to CALSET the robot. Just reload the CALSET data from the floppy disks.

## 4.3.2 CALSET Procedure

Record the positions of 1st to 4th axes by manually bringing them into contact with the mechanical ends.

CALSET requires some space to do so.

**Caution**
(1) When CALSETing, move the axis to be CALSET in the vicinity of the mechanical stop, release the brake, and bring the axis into contact with the mechanical stop.
(2) After CALSET, confirm in the manual mode that each axis stops at the software motion limit before coming into contact with the mechanical end.
(3) In automatic operation, start to run the robot at low speed. Ensuring safety, gradually increase the speed. It makes adjustment easy.
(4) Position-related data in some programs made before CALSET may vary somewhat after CALSET.

### What is CALSET position?

The limit position of an arm to be CALSET is called a CALSET position.

Each axis has a mechanical end in each of the positive and negative directions. The mechanical ends shown in Figure 4-3 are the CALSET positions that are set by default.

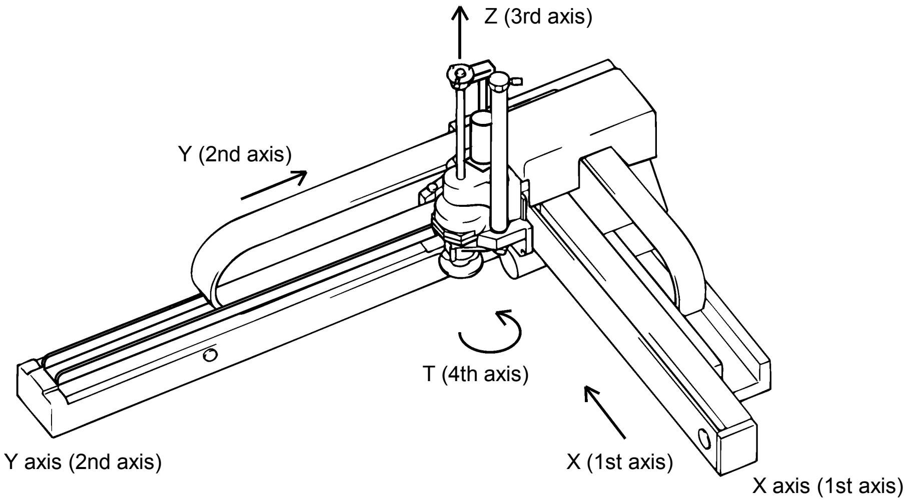
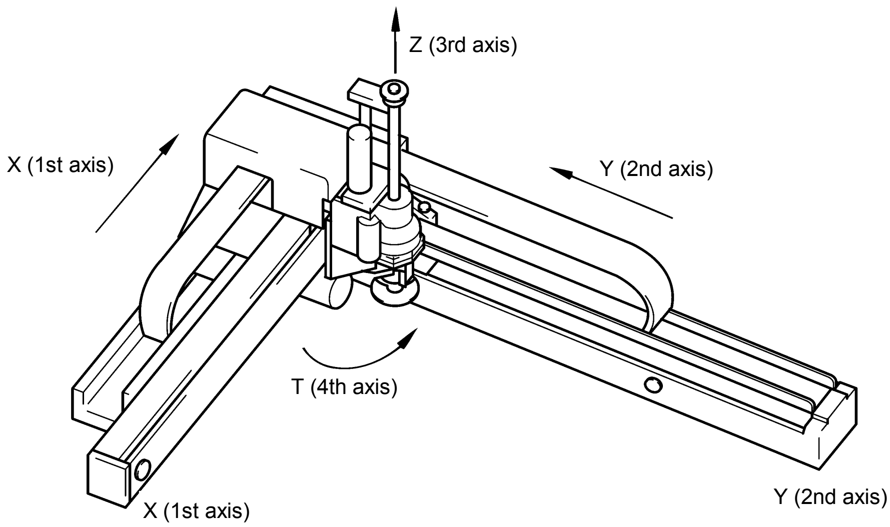
<table>
<tr><td colspan="2">Robot series</td><td>XYC-4D</td></tr>
<tr><td rowspan="4">Location</td><td>X axis (1st axis)</td><td>Linear movement end in the positive direction</td></tr>
<tr><td>Y axis (2nd axis)</td><td>Left-hand version: Linear movement end in the negative direction<br>Right-hand version: Linear movement end in the positive direction</td></tr>
<tr><td>Z axis (3rd axis)</td><td>Upward movement end (in the positive direction)</td></tr>
<tr><td>T axis (4th axis)</td><td>Turning end in the positive direction (clockwise end when viewed from the top)</td></tr>
<tr><td colspan="2">Left-hand version<br>(XYC-40***D-L)</td><td>
</td></tr>
<tr><td colspan="2">Right-hand version<br>(XYC-40***D-R)</td><td>
</td></tr>
</table>

**Figure 4-3  CALSET Position (when shipped)**

## 4.3.3 CALSET Procedure

### [ 1 ] CALSETing a Single Axis

CALSETing a specified single axis only is called single-axis CALSET.

Perform single-axis CALSET if the motor of an axis is replaced so that the axis must be CALSET, or if some axes cannot be moved to the CALSET positions (mechanical stop positions) at any given time because of interference between the robot unit and its surrounding facilities.

In the procedure below, releasing the brake is required only for the 3rd axis.

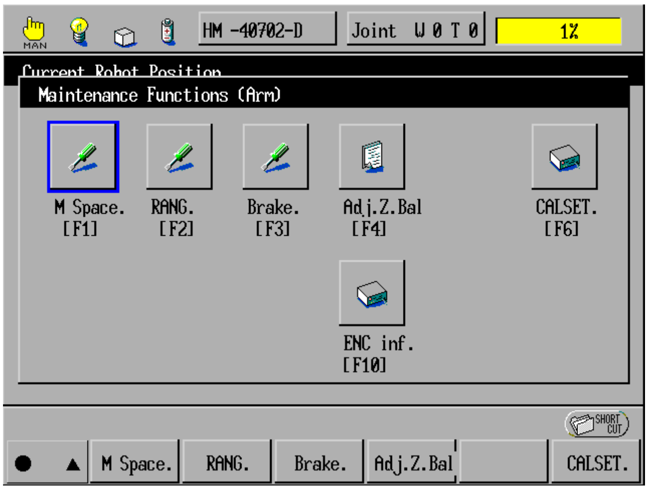
**STEP 1** **Move the axis to be CALSET to the mechanical stop position.**

**STEP 2** **On the top screen of the teach pendant, press [F2 Arm].**

**STEP 3** **Press the SHIFT key.**

**STEP 4** **Press [F12 Maint.].**

The Maintenance Functions (Arm) window appears as shown below.

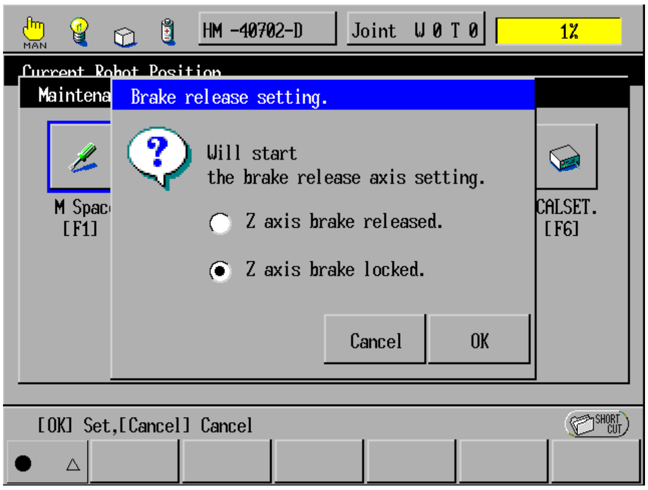



F3

**Press [F3 Brake.].**

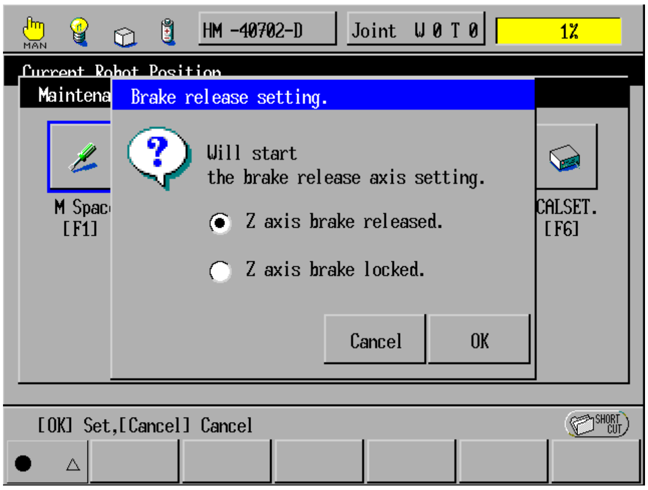
## STEP 5

The Brake release setting window appears as shown below.




## STEP 6

**Select "Z axis brake released."**



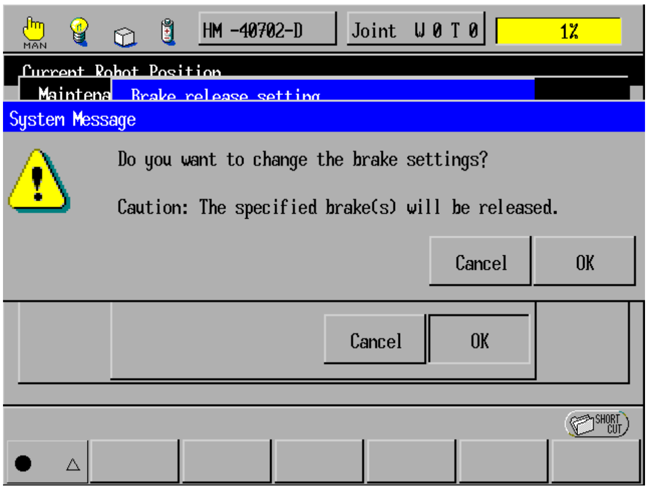

## STEP 7

Confirm that there is no danger even if the arm falls as a result of the brake being released.

**Then press OK.**

## STEP 8

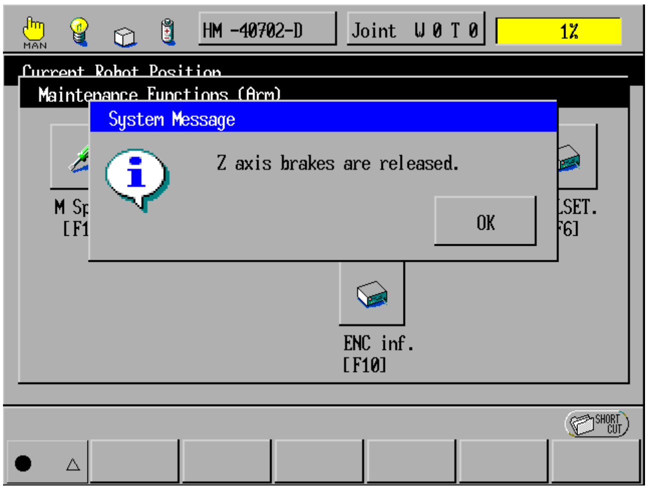
The system message appears asking you whether you want to change the brake settings.




**Press OK.**

## STEP 9

The system message appears informing that the brake is released and warning against drop of arms.



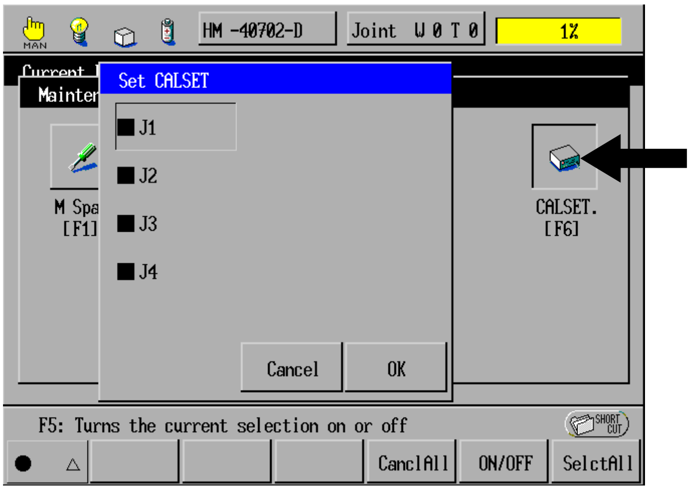

**Press OK.**

## STEP 10

**Press the axis to be CALSET against the mechanical stop by hand.**

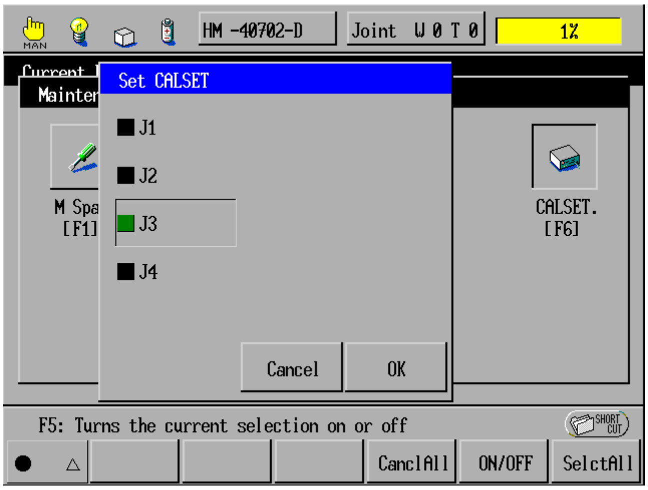
**STEP 11**

**Press [F6 CALSET.].**
The Set CALSET window appears as shown below.




**STEP 12**

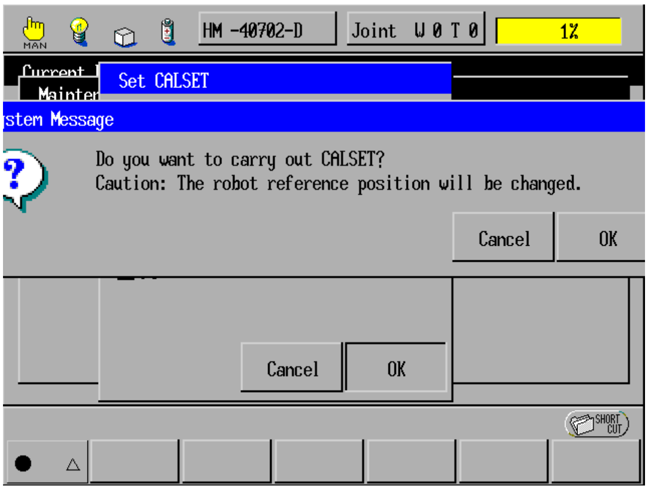
**Press the axis number to be CALSET to turn ON CALSET (green display). Turn OFF CALSET (black display) for the other axes that are not to be set.**




**Press OK.**

## ▶ STEP 13

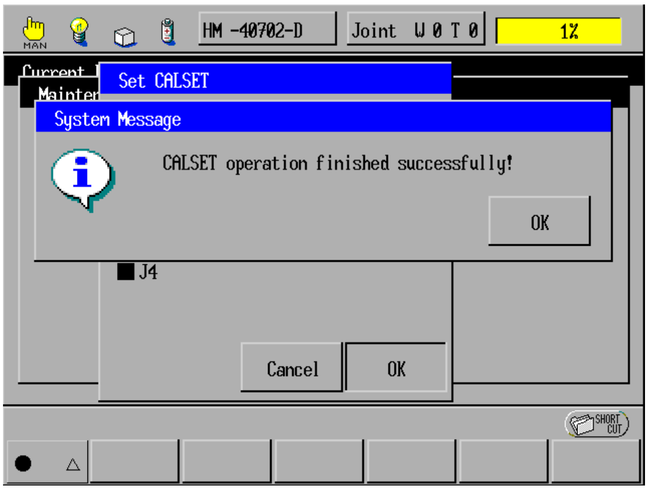
The system message appears asking whether you want to carry out CALSET with a caution that the robot reference position will change.




**Press OK.**

## ▶ STEP 14

The system message appears informing that CALSET is completed.




**Press OK.**

## ▶ STEP 15

**Press the ROBOT STOP button.**
The robot brake becomes activated.

## ▶ STEP 16

**Turn the ROBOT STOP button to cancel robot stop.**

## ▸ STEP 17

**Press the MOTOR key to turn the motor ON.**

| | |
|---|---|
| **Caution:** | A "motor lock overload" error may occur just after the power to the motor is turned ON. In this case, try to turn ON the power to the motor several times, or release the brake, move the axis a little in the opposite direction of the mechanical end, and turn ON the power to the motor again. |

## ▸ STEP 18

**Move the CALSETed axis in the opposite direction from the mechanical end by the manual operation of the teach pendant.**

## ▸ STEP 19

**Perform CAL. The single-axis CALSET of the specified axis is completed.**

### [ 2 ] CALSETing All Axes

The CALSET of all axes is called all-axis CALSET.

The procedure is the same as that for single-axis CALSET except that you should select all axes in Step 12. For details of the procedure, see "[ 1 ] CALSETing a Single Axis."

# 4.4 Setting Control Set of Motion Optimization

The optimum speed or acceleration will vary depending upon the payload and center of gravity of an end-effector or workpiece that is to be set at the end of the robot flange. Set the payload and center of gravity position of the end-effector or workpiece and the control set of motion optimization according to the payload and robot posture.

For further information, see the PROGRAMMER'S MANUAL, Section 4.7 "Setting the Master Control Parameters in User Preferences." For the setting procedure, refer to the SETTING-UP MANUAL, Section 2.9, "Setting the Master Control Parameters of the Payload, Center of Gravity, and Control Set of Motion Optimization."

# Chapter 5

# Robot Controller Interface

This chapter describes the necessary requirements to connect the PLC and other external devices to the controller.

# 5.1 General Information about the Interface

## 5.1.1 Standard Mode and Compatible Mode

The robot controller can be operated in two different modes – standard mode and compatible mode. The default is standard mode. Select either mode before operating the robot controller.

In the standard mode, all of the advantages can be expected from the new model of the robot controller by simultaneously running two or more programs with multitasking.

The compatible mode focuses on compatibility with conventional DENSO robots. Use this mode whenever compatibility is required. For example, when replacing a conventional robot with a new model. However, there are some restrictions on the use of new functions, such as multitasking, in this mode.

## 5.1.2 Switching between Modes

Switch from one mode to the other using the teach pendant or the PC teaching system.

**Caution: After switching between those modes, restart the robot controller to make the new setting go into effect.**

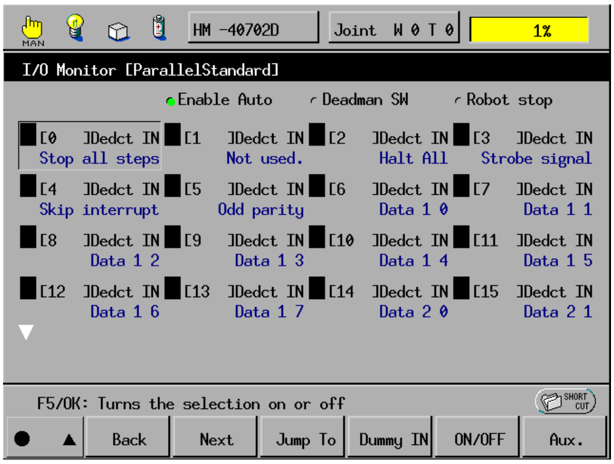
## [ 1 ]  Switching from the Teach Pendant

Follow the procedure below when switching from one mode to the other from the teach pendant:

▶ STEP 1

On the top screen, press [F4 I/O].

The I/O Monitor window appears.

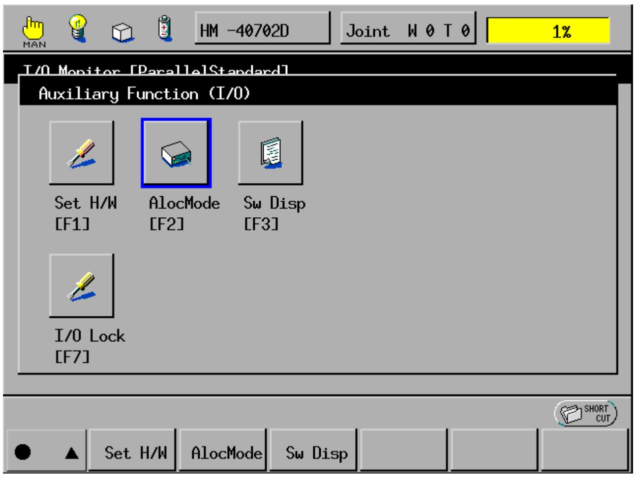



F6

**Press [F6 Aux.].**

▶ STEP 2

The Auxiliary Functions (I/O) window appears as shown below.




F2

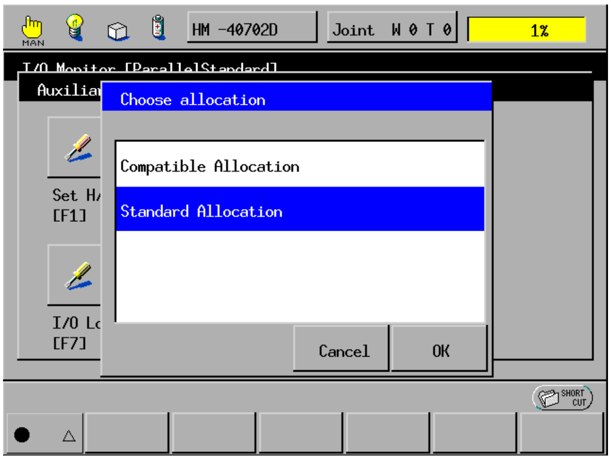
Press [F2 AlocMode]. (For Version 1.6 or later)

**NOTE:** For Version 1.5 or earlier, press [F1 Set H/W] and select the Allocation mode field in the I/O Hardware Settings window.

## ▶ STEP 3

The Choose allocation window appears as shown below.

**NOTE:** If your robot controller has a built-in DeviceNet master, the Select Port Assignment window will appear instead of the Select I/O Assignment Mode window.  Refer to the DeviceNet Master Unit user's manual, Chapter 3, "I/O Assignment."




**Using the jog dial or cursor keys, select the desired assignment mode. Then press OK.**

## ▶ STEP 4

The following system message appears.


**Press OK.**

## ▶ STEP 5

The screen returns to the Auxiliary Functions (I/O) window.

**Turn the controller power OFF.**

## ▶ STEP 6

**Turn the controller power ON again.**

The I/O assignment mode is switched.

## [ 2 ]  Switching from the Computer

Follow the procedure below when switching from one mode to the other from the computer.

### STEP 1

**Start WINCAPSII on the computer. Log in with Programmer.**

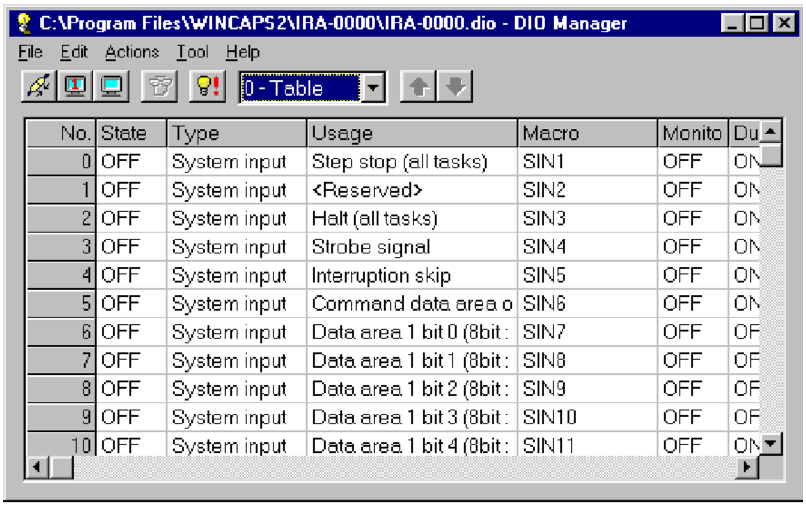
Start WINCAPSII according to the procedure given in WINCAPSII GUIDE, Chapter 3, Section 3.1.

For details on the user level of Programmer, refer to the WINCAPSII GUIDE, Chapter 1, Section 1.3.

### STEP 2

**Click on the DIO Manager button in the System Manager.**

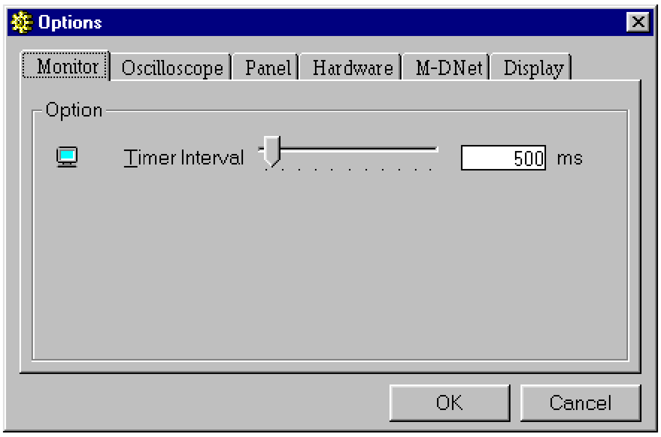
DIO Manager starts and the DIO Manager window opens.



## ▶ STEP 3

**Select the SETTING command from the Tools menu of DIO Manager.**

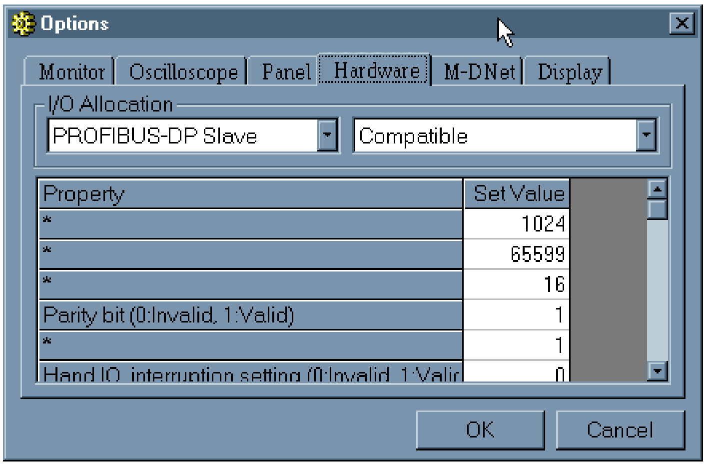
The Options window will appear as shown below.




## ▶ STEP 4

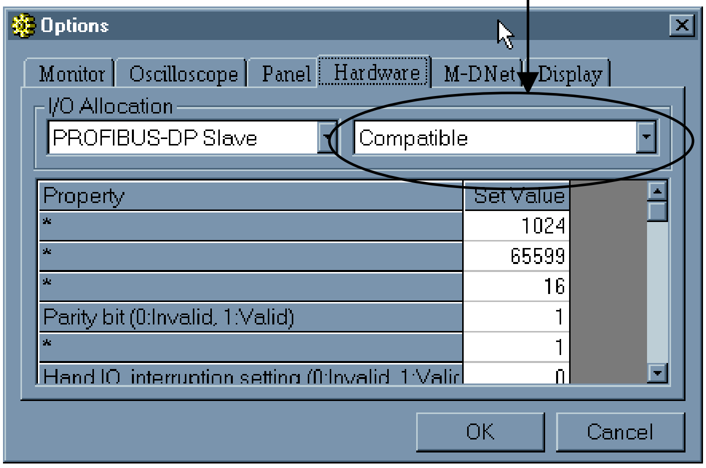
**Click on the Hardware tab in the Options window.**

The hardware settings will appear.



# STEP 5

**Select the desired assignment mode from the right-hand popup menu in the I/O Allocation frame (Ver. 1.6 or later).**




# STEP 6

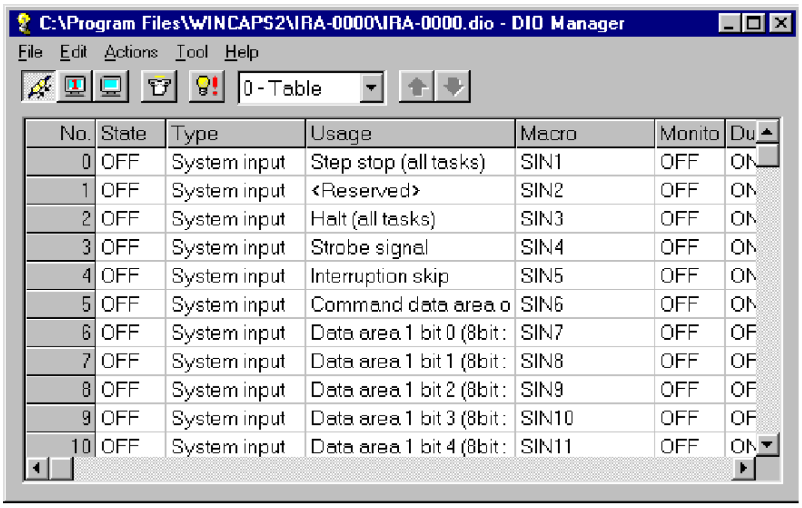
**Click on OK in the Options window.**

The Options window closes.

# STEP 7

**Click on the Connect button to connect the computer to the robot controller.**

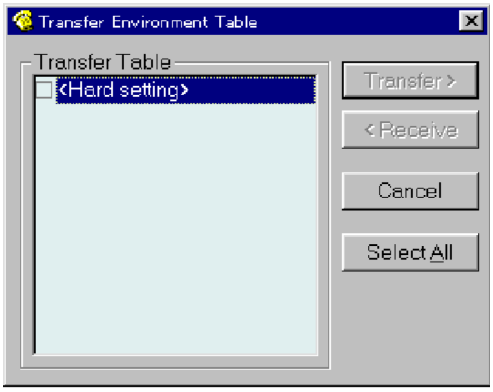
The Connect button appears in a pressed state.



## ▶ STEP 8

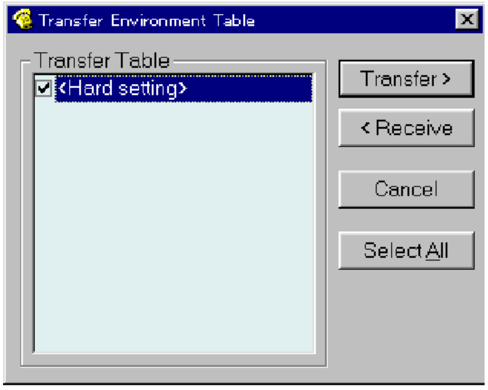
**Click on the Transfer button.**

The Transfer Environment Table window appears.




## ▶ STEP 9

**Check off the check box by clicking on the Hard setting field.**

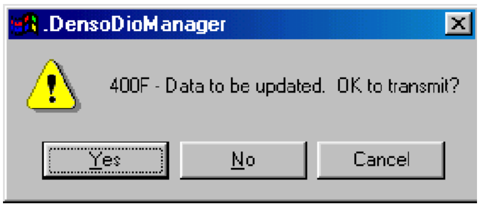



**Click on the Transfer button.**

## ▶ STEP 10

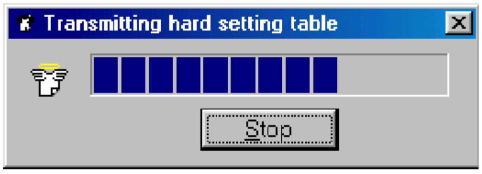
The following message window appears confirming that you are sure to update the data.

**Click on the Yes button.**



## STEP 11

The Transmitting hard setting table window appears displaying a bar graph that indicates the transfer progress.




## STEP 12

**After the Transmitting hard setting table window disappears, turn the controller power OFF.**

## STEP 13

**Turn the controller power ON.**

The I/O assignment mode is switched.

## 5.1.3 Robot Controller Appearance and Connector Names

Figure 5-1 shows the appearance of the Robot Controller and Table 5-1 lists the connector names.

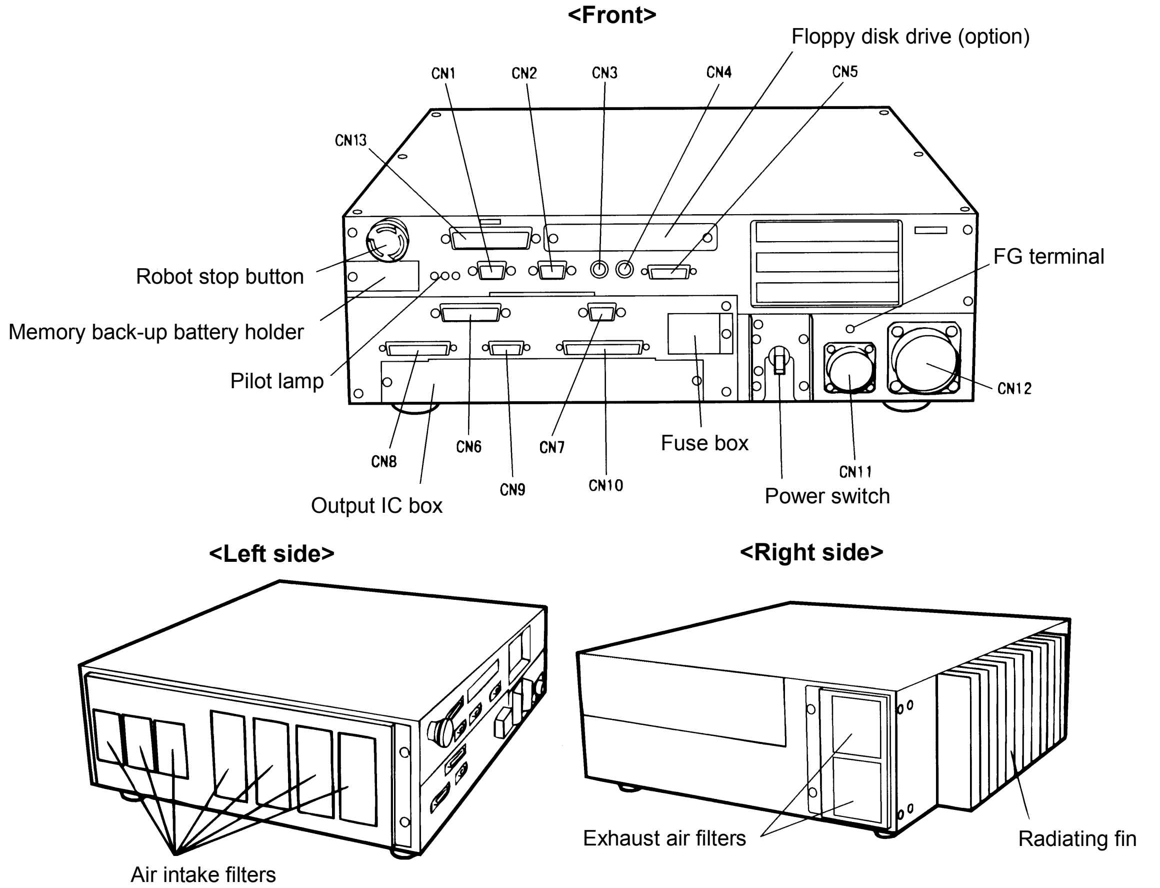



**Figure 5-1  Robot Controller Appearance**

**Table 5-1  Connector Names**

| No. | Mark | Name | No. | Mark | Name |
|---|---|---|---|---|---|
| CN1 | RS232C | Serial communication connector | CN8 | INPUT | User-input/system-input connector |
| CN2 | CRT | CRT connector | CN9 | HAND I/O | End-effector I/O connector |
| CN3 | KEYBD | Keyboard connector | CN10 | OUTPUT | User-output/system-output connector |
| CN4 | MOUSE | PS/2 mouse connector | CN11 | INPUT AC | Power connector |
| CN5 | PENDANT | Teach pendant connector | CN12 | MOTOR | Motor connector |
| CN6 | PRINTER | Printer connector (Not used.) | CN13 | ENCODER | Encoder connector |
| CN7 | I/O POWER | I/O power connector | | | |

⚠**Caution** **The robot controller connectors have a screw or ring locking mechanism. Lock them securely. If not securely locked, an incomplete contact may occur, resulting in an error.**

**Engaging or disengaging the power connector or motor connector with the robot controller being powered on may damage the internal circuits of the controller. Turn OFF the power switch before engaging or disengaging any of the connectors.**

## 5.1.4 Example of Control System Configuration

Figure 5-2 shows an example of the control system configuration.

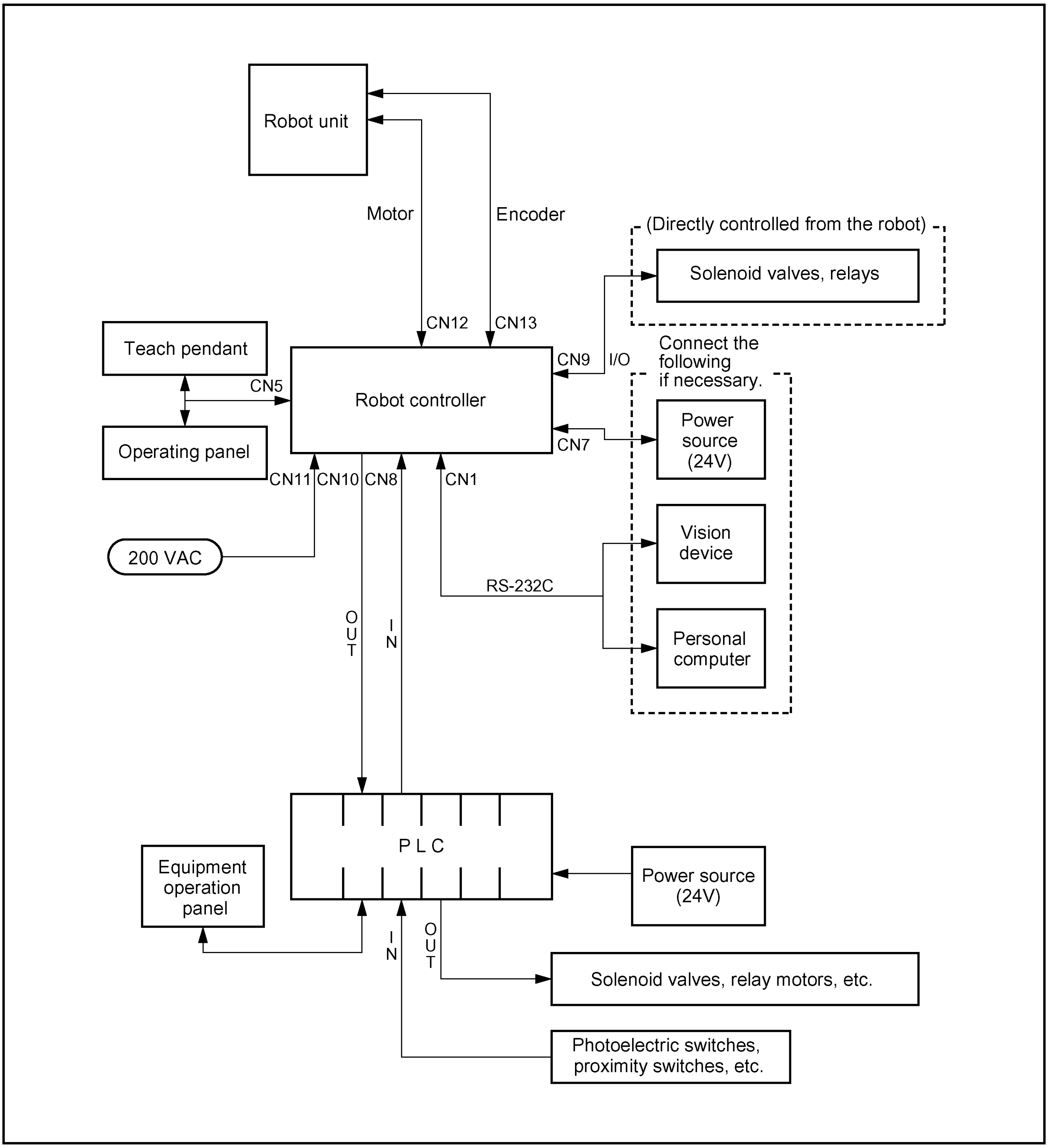



**Figure 5-2 System Configuration Example**

## 5.1.5 Types and General Information about I/O Signals

This section describes the I/O signals for the Robot Controller.
The I/O signals are grouped into user I/O signals and system I/O signals.
User I/O signals are compatible with conventional signals, including the pin pattern, in compatible mode. Note that the connector pin meanings are different between standard mode and compatible mode. Some of the signal lines used for user I/O in compatible mode are used for system input in standard mode. Additionally, part of the signal lines used for system I/O in compatible mode is used for command execution I/O signals in standard mode.

### 5.1.5.1 Standard Mode

In standard mode, 30 input points for command execution are used to direct program start and other instructions as I/O commands.
Table 5-2 shows the types of I/O signals used in standard mode.

**Table 5-2 Types of System I/O Signals Used in Standard Mode**

| Fixed by system | | |
|---|---|---|
| **Type** | **No. of points** | **Function** |
| System input | 5 | Robot stop, Enable Auto, interrupt skip, instantaneous stop (all tasks), step stop (all tasks) |
| System output | 12 | Robot initialization complete, automatic operation mode, external mode, servo ON, robot-in-operation, normal CPU, robot failure, robot warning, dead battery warning, continue start permitted, SS mode, emergency stop |
| Input for command execution | 30 | Command (4 bits) data area 1 (8 bits), data area 2 (16 bits), odd parity bit, strobe signal |
| Output for command execution | 18 | Command processing complete, status area (16 bits), odd parity bit |
| **Controlled by user program** | | |
| **Type** | **No. of points** | **Function** |
| User input | 12 | Inputs to read the external I/O status with an IN command or IO [ ] variable.<br>Used for analysis condition identification, condition satisfaction wait, data input from the external device, etc. |
| User output | 24 | Outputs to issue a signal to the external device during program execution with a SET command, RESET command, etc. |
| Hand input | 8 | Inputs to read the external I/O status with an IN command or IO [ ] variable.<br>Used to confirm the end-effector check status, etc. |
| Hand output | 8 | Outputs to issue a signal to the external device with a SET command, RESET command, etc.<br>Used to control the opening and closing of the end-effector. |

## 5.1.5.2 Compatible Mode

In the compatible mode, the input and output points are arranged in disregard of compatibility with conventional VS series robots.
Table 5-3 shows the types of I/O signals used in compatible mode.

**Table 5-3 Types of I/O Signals Used in Compatible Mode**

| Fixed by system | | |
|---|---|---|
| **Type** | **No. of points** | **Function** |
| System input | 22 | Inputs to turn ON the power to the robot from the external device (PLC), start CAL or select and start a program instead of operations by the operating panel or teach pendant. |
| System output | 27 | Outputs to inform the external device (PLC) of the robot status, such as robot-in-operation or occurrence of an error. |
| **Controlled by user program** | | |
| **Type** | **No. of points** | **Function** |
| User input | 25 | Inputs to read the external I/O status with an IN command or IO [ ] variable.<br>Used for analysis condition identification, condition satisfaction wait, data input from the external device, etc. |
| User output | 24 | Outputs to issue a signal to the external device during program execution with a SET command, RESET command, etc. |
| Hand input | 8 | Inputs to read the external I/O status with an IN command or IO [ ] variable.<br>Used to confirm the end-effector check status, etc. |
| Hand output | 8 | Outputs to issue a signal to the external device (valve) with a SET command, RESET command, etc.<br>Used to control the opening and closing of the end-effector. |

# 5.2 Using User I/O Signals

To use user I/O signals you need to first declare, in the program, the use of user I/O as I/O type variables with a DEFIO command. Next, access the user I/O by writing it to the I/O type variables or reading it.

## 5.2.1 I/O Type Variable Declaration

I/O type variables are classified into I/O type global variables that are available without any declaration, and I/O type local variables that are not available without a declaration.

### 5.2.1.1 I/O Type Global Variables

I/O type global variables are used to refer to or change user I/O signals bit by bit. Since they are global variables, they can be used without any declaration.
I/O type global variables are expressed in either of the following two ways:

IO[nn] (nn: terminal number) Example: IO[104]

IOnn (nn: terminal number) Example: IO104

### 5.2.1.2 I/O Type Local Variables

I/O type local variables are used to collectively refer to or change 1-bit, 8-bit, 16-bit or 32-bit user I/O signals starting from a specified terminal number.
I/O type local variables require a declaration, which will be made with a DEFIO command, before they are used. For further information about declarations with a DEFIO command, refer to the PROGRAMMER'S MANUAL, Chapter 9, Section 9.7 "DEFIO (Statement) [Conforms to SLIM]."

## 5.2.2 User Input Commands

There are two types of user input commands, IN and WAIT. The IN command substitutes the input result for a variable. The WAIT command waits until the input result meets specified conditions.

### 5.2.2.1 IN Command

The IN command inputs a signal from the user input specified by an IO type variable and substitutes it for an arithmetic variable.
For further information about the IN command, refer to the PROGRAMMER'S MANUAL, Chapter 13, Section 13.1 "IN."

### 5.2.2.2 WAIT Command

The WAIT command suspends the execution of the program until specified conditions are met. If an I/O type variable is used for the conditional statement, this command suspends the execution of the program until the status of the signal from a specified user input is checked and meets the specified conditions. For further information about the WAIT command, refer to the PROGRAMMER'S MANUAL, Chapter 12, Section 12.5 "WAIT."

## 5.2.3 User Output Commands

There are three types of user output commands, SET, RESET and OUT. The SET and RESET commands turn ON and OFF all user outputs specified by I/O type variables. The OUT command outputs data to a specified user output.

### 5.2.3.1 SET Command

The SET command turns ON all user outputs specified by I/O type variables.
For further information about the SET command, refer to the PROGRAMMER'S MANUAL, Chapter 13, Section 13.1 "SET."

### 5.2.3.2 RESET Command

The RESET command turns OFF all user outputs specified by I/O type variables.
For further information about the RESET command, refer to the PROGRAMMER'S MANUAL, Chapter 13, Section 13.1 "RESET."

### 5.2.3.3 OUT Command

The OUT command outputs data to the user output specified by an I/O type variable.
For further information about the OUT command, refer to the PROGRAMMER'S MANUAL, Chapter 13, Section 13.1 "OUT."

# 5.3 System I/O Signals Standard Mode

## 5.3.1 Types and Functions of System Output Signals (Standard Mode)

Table 5-4 lists the system output signals used in standard mode.

**Table 5-4 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). |
| Error/Warning | Normal CPU | Outputs when the CPU (hardware) of the Robot Controller is normal. |
| | 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. |

## 5.3.2 Usage of System Output Signals (Standard Mode)

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

### 5.3.2.1 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) Terminal number**

No.5 of connector CN10.

**(3) 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.

**(4) 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 operating panel or teach pendant or by a CLEAR ROBOT FAILURE command, after the power is turned OFF.

**(5) OFF condition**

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

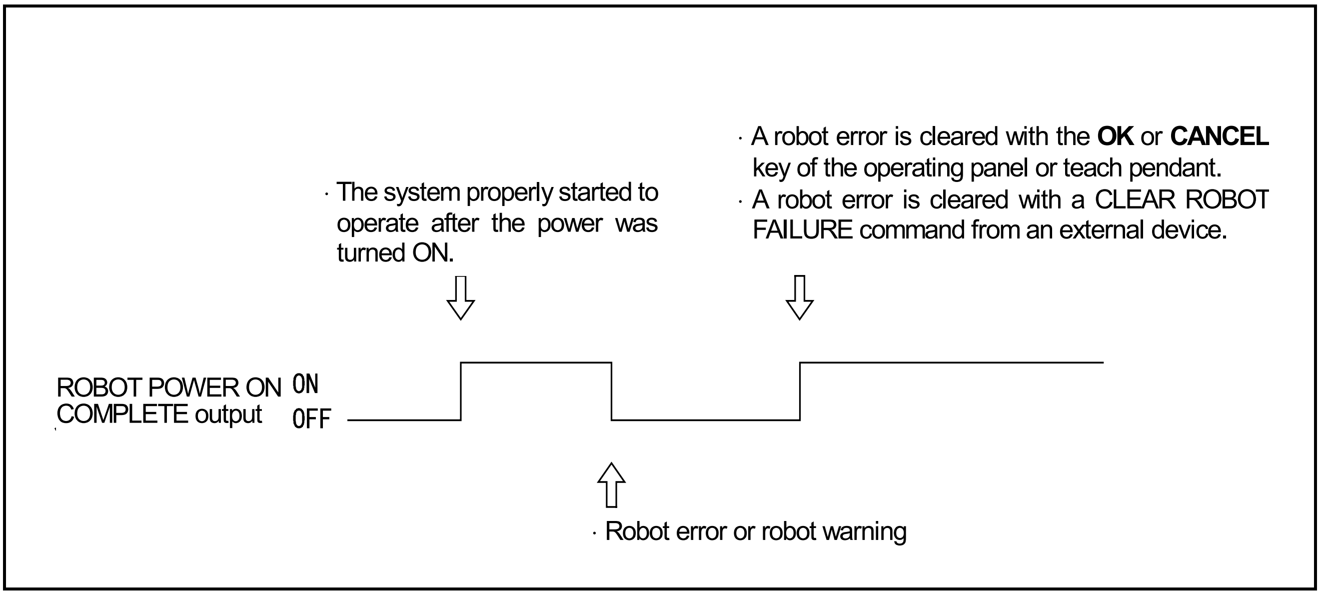



**Figure 5-3 Robot Power ON Complete Output**

## 5.3.2.2 Auto Mode (Output)

**(1) Function**

The signal outputs to the external device that the robot is in auto mode.

**(2) Terminal number**

No.6 of connector CN10.

**(3) 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.

**(4) ON condition**

The signal will be output when the robot enters auto mode by setting the mode selector switch of the operating panel or teach pendant to AUTO.

**(5) OFF conditions**

The signal will be turned OFF under the following conditions.
① The mode selector switch of the operating panel is set to MANUAL or the teach 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 Chapter 3, Subsection 3.2.3, "[ 3 ] Pendantless State.")

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

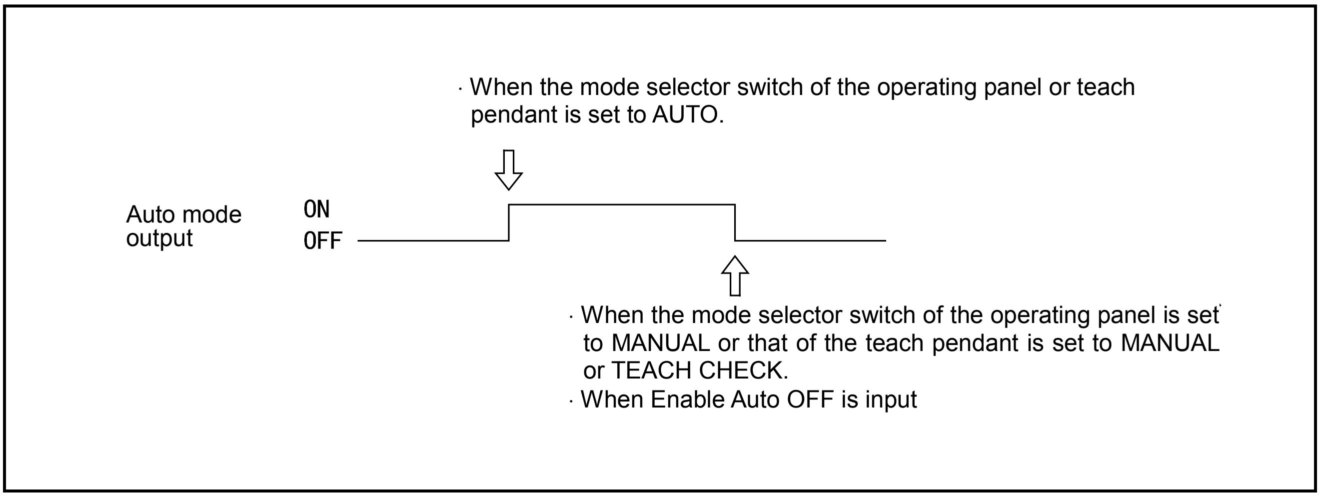



**Figure 5-4 Auto mode Output**

### 5.3.2.3 External Mode (Output)

**(1) Function**

The signal outputs to the external device that the robot is in external mode.

**(2) Terminal number**

No.7 of connector CN10.

**(3) 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.

**(4) 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/INTERNAL is input on the operating panel in AUTO MODE and in the INTERNAL CONTROL ON state.
③ The EXTERNAL MODE SWITCHING BY MODE SWITCHING COMMAND is input from the external device.

**(5) OFF conditions**

The signal will be turned ON under the following conditions.
① When internal mode is selected on the teach pendant.
② When the mode selector switch of the teach pendant is set to MANUAL or TEACH CHECK in external mode.
③ When EXTERNAL/INTERNAL is input on the operating panel in AUTO MODE and in the INTERNAL CONTROL OFF state.
④ When ROBOT STOP is input.
⑤ When ROBOT FAILURE is outputted.

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

⑥ When an Enable Auto input is turned OFF.

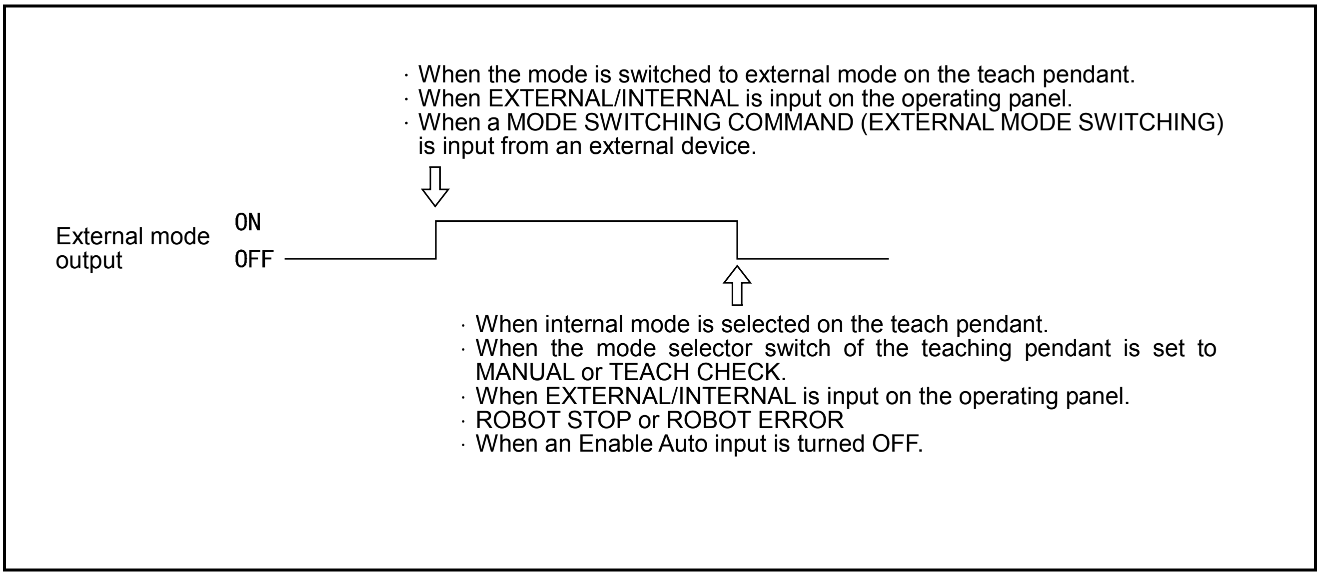



**Figure 5-5 External Mode Output**

## 5.3.2.4 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) Terminal number**

No.4 of connector CN10.

**(3) 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.

**(4) ON conditions**

The signal will be turned ON when the power to the motor is turned ON.
① When the MOTOR key of the operating panel or teach 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.

**(5) OFF conditions**

The signal will be turned OFF when the power to the motor is turned OFF.
① When the MOTOR key of the operating panel or teach 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.

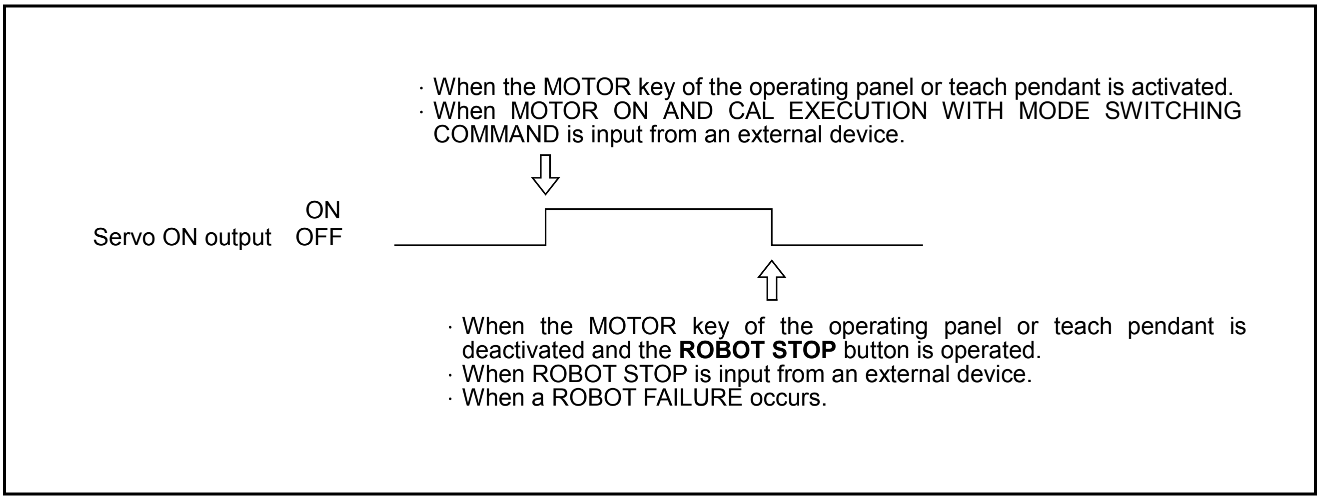



**Figure 5-6 Servo ON Output**

## 5.3.2.5 Robot-in-operation (Output)

**(1) Function**

This signal outputs to the external device that the robot is in operation.

**(2) Terminal number**

No.2 of connector CN10.

**(3) 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.

**(4) 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.

**(5) 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.**

## 5.3.2.6 Normal CPU (Output)

**(1) Function**

The signal outputs to the external device that the Robot Controller CPU (hardware) is normal.

**(2) Terminal number**

No.1 of connector CN10.

**(3) Usage**

① The signal is used to light the Robot Controller external operating panel error indicator lamp.
② The signal is used when a normal CPU SIGNAL is turned OFF because of an error and the PLC corrects it.

**(4) ON conditions**

The signal will be turned ON by the hardware when the Robot Controller CPU operates normally with the power turned ON.

**(5) OFF conditions**

The signal will be turned OFF by the hardware when the CPU does not operate normally.

| | |
|---|---|
| **Caution:** | **The OFF state of this signal indicates that the Robot Controller internal arithmetic circuit may be damaged. Therefore, ROBOT ERROR, ERROR NUMBER, and other outputs may not be correct.** |

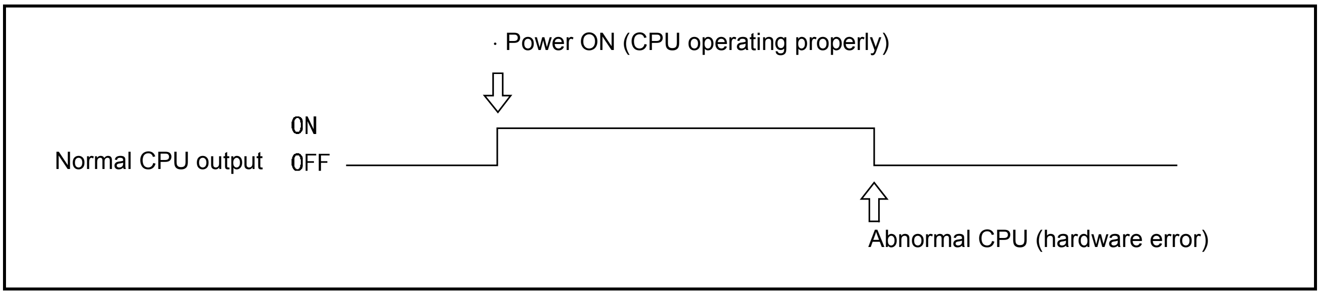



**Figure 5-7 Normal CPU Output**

## 5.3.2.7 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) Terminal number**

No.3 of connector CN10.

**(3) 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.

**(4) ON conditions**

As shown in Figure 5-8, 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 operating panel or the teach 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."**

**(5) OFF conditions**

As shown in Figure 5-8, 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 operating panel or the teach pendant.

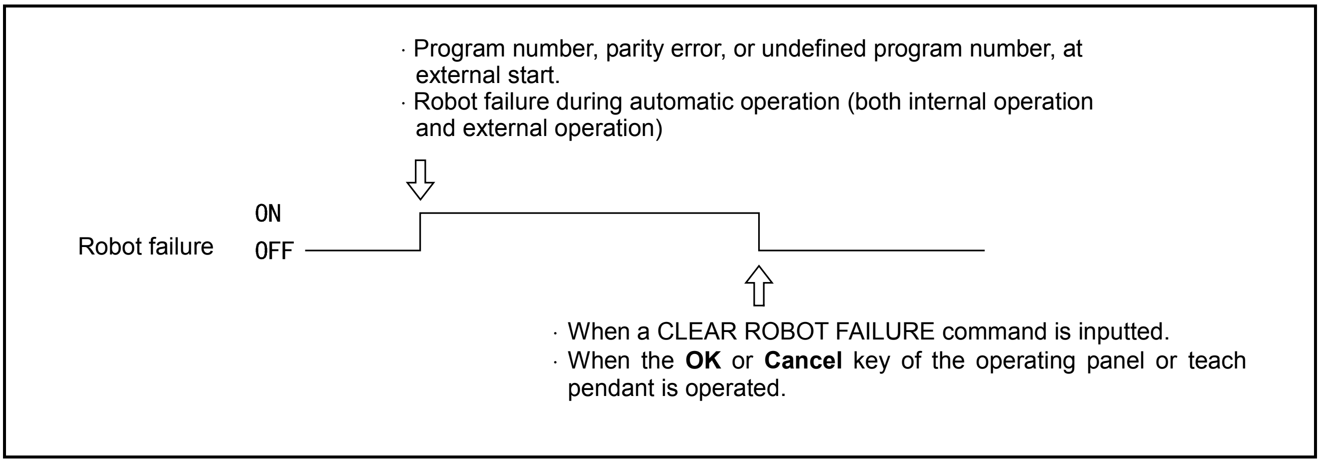



**Figure 5-8 Robot Failure Output**

## 5.3.2.8 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 operating panel.** |

**(2) Terminal number**

No.9 of connector CN10.

**(3) 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.

**(4) ON condition**

As shown in Figure 5-9, 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.

**(5) OFF conditions**

As shown in Figure 5-9, 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 operating panel or the teach pendant clears the existing error.

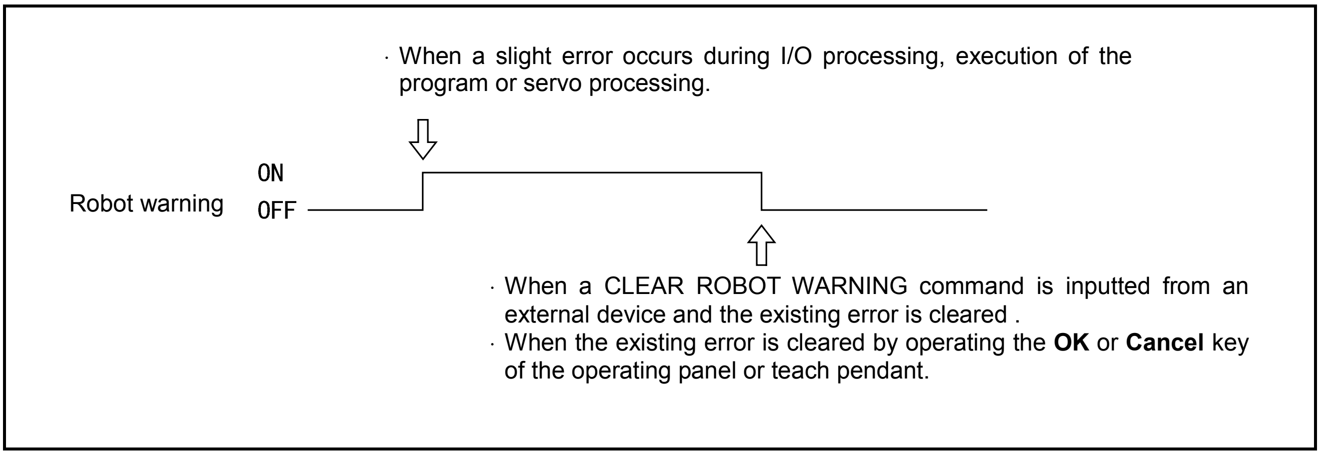



**Figure 5-9 Robot Warning Output**

## 5.3.2.9 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) Terminal number**

No.8 of connector CN10.

**(3) Usage**

The signal is used to check the timing battery replacement. For example, the battery voltage becomes lower than acceptable.

**(4) 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 operating panel shows any of ERROR64A1 to 64A6 when the encoder back-up battery voltage is low. Meanwhile, the teach pendant shows ERROR6103 when the memory back-up battery voltage is low.**<br>**(Refer to Chapter 6, Section 6.5, "Biennial Inspections.")** |

**(5) OFF condition**

The signal will be turned OFF when the power is turned ON after the dead battery was replaced.

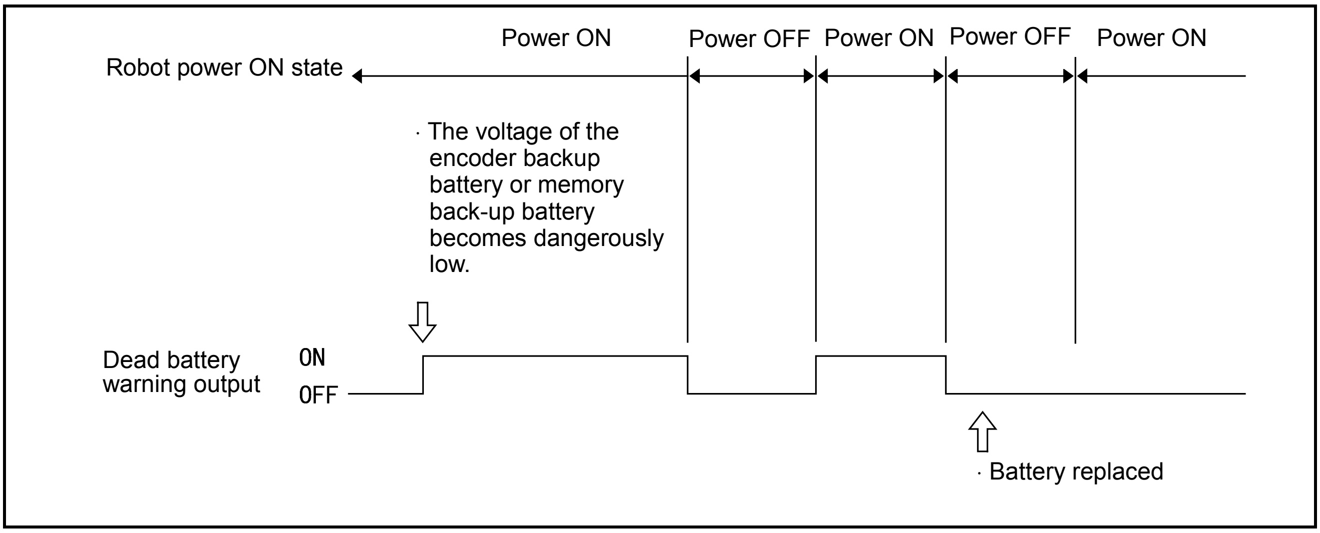



**Figure 5-10 Dead Battery Warning Output**

### 5.3.2.10 Continue Start Permitted (Output)

**(1) Function**

The controller will output this signal when the continue start is permitted.

**(2) Terminal number**

No.10 of connector CN10.

**(3) Usage**

Use this signal when you want to know whether the continue start is permitted.

**(4) ON condition**

This signal comes on when the continue start is permitted. For details, refer to the SETTING-UP MANUAL.

**(5) OFF condition**

This signal goes off by carrying out the "Task Status Change Operation."

### 5.3.2.11 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) Terminal number**

No.11 of connector CN10

**(3) Usage**

This signal is used to warn workers that the robot is in the SS mode by beeping or lighting the lamp.

**(4) ON condition**

This signal comes on when the SS mode is selected.

**(5) 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.

## 5.3.2.12 Emergency Stop (Output from a contact)

**(1) Function**

This signal outputs from a contact exclusively designed for an emergency stop circuitry you may configure. It allows red mushroom buttons provided on the front panel of the robot controller, on the teach pendant, and on the operating panel to be used as emergency stop buttons of the facilities.

A 0.3A fuse is built in the contact.

**(2) Terminal number**

No. 65 of connector CN10: Emergency stop (+)

No. 66 of connector CN10: Emergency stop (-)

**(3) Usage**

This signal is used to stop the facilities or robot in an emergency. (Refer to Subsection 5.6.2.4 "Emergency Stop Circuit.")

**(4) Contact**

This contact is a normal close one (b contact). If any of the emergency stop buttons is pressed, then the contact turns off to output an emergency stop signal.

## 5.3.3 Types and Functions of System Input Signals (Standard Mode)

Table 5-5 shows the system input signals to be used in standard mode:

**Table 5-5 Types and Functions of System Input Signals to be Used in Standard Mode**

| Application | Signal Name | Function |
|---|---|---|
| Start-up | Enable Auto | Enables switching to automatic operation. |
| Stop | Robot stop | Stops the robot with canceling signals. |
| | 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. |

## 5.3.4 Usage of System Input Signals (Standard Mode)

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

### 5.3.4.1 Enable Auto (Input)

**(1) Function**

① The signal enables switching of the robot mode to auto mode (shorted state).
② The signal enables switching of the robot mode to manual mode or teach check mode (open state).

**(2) Terminal number**

No. 4 of connector CN8.

**(3) Usage**

The signal is used for the AUTO/TEACHING selector switch of an external operating panel and can be combined with a safety fence switch.

**(4) Input conditions and operation**

① As shown in Table 5-6, the selectable operation mode depends on whether this input is shorted or open.
② If the input becomes open during automatic operation, the mode will be switched to manual mode and ERROR21FC will be displayed.
③ If manual operation or a teach check is conducted with this input shorted, ERROR21F2 will be displayed.
④ If the mode selector switch of the teach pendant or operating panel is set to AUTO with this input open, ERROR21F3 will be displayed.
Since this state is shown as × in Table 5-5, this error will remain displayed until the robot exits this state.
⑤ Although ERROR21FD or ERROR21FC will be displayed when the state is changed from ○ to ∆ or ×, they will not be displayed when the state is changed from ∆ or × to ○.
⑥ When the input is turned OFF (open) in external mode, the external mode output will also be turned OFF.

**Table 5-6 Relationship Between Enable Auto Input and Selectable Mode**

| Operation mode | Application | Enable Auto | |
|---|---|---|---|
| | | ON (shorted) | OFF (open) |
| Manual mode | Manual operation with the operating panel or the teach pendant. | ∆ | ○ |
| Teach check mode | Program check with the teach pendant. | ∆ | ○ |
| Internal auto mode | Automatic operation with the operating panel or teach pendant. | ○ | × |
| External auto mode | Automatic operation with the external device. | ○ | × |

Note: ○ = Mode selectable × = Mode not selectable
∆ = Mode selectable but manual operation program not executable

**Caution: In the pendantless state described in Chapter 3, Subsect. 3.2.3 [ 3 ], auto mode is valid even if the Enable Auto input is open. (The external mode cannot be switched and the program cannot begin execution.)**
**Perform the following when operating the robot in the pendantless state:**
**① Set the robot so that it will not start to operate when the Enable Auto input is open.**
**② Enable Auto input open state and auto mode output (See "5.3.2.2 Auto mode" and "5.5.2.2 "Auto Mode".)**
**Set the equipment to make an emergency stop in an AND state.**
**Add ① and ② with the external sequence circuit.**

### 5.3.4.2 Robot Stop (Input)

**(1) Function**

① The signal stops the robot from the external device by opening the robot stop input.
② The signal readies the power to the robot motor to be turned ON by shorting the robot stop input.

**(2) Terminal number**

No.2 of connector CN8.

**(3) Input conditions and operation**

① The robot stops with this input OFF (open).
② The power to the robot motor is made ready to be turned ON with this input ON (shorted).
③ Irrespective of whether internal mode, operation by the teach pendant, or external mode, remote operation by the external device, is selected, the power to the robot motor cannot be turned ON with this input OFF (open) and neither manual nor automatic operation can be performed until this input is turned ON (shorted). (ERROR2008 will be displayed.)
④ By turning OFF (open) this input the following conditions may result.
  1) The power to the motor will be turned OFF irrespective of whether manual, automatic, internal or external mode is selected.
  2) During execution of the program (Robot-in-operation signal ON), the power to the motor will be turned OFF and the mode will be switched to internal mode after the robot decelerates to a stop;
  3) When the program is not executed in manual and auto modes in manual and auto modes, everything will be the same except the power to the motor will be turned OFF. The power to the motor can be turned ON and the suspended operation can, therefore, be resumed by shorting the ROBOT STOP input. (However, the program will be executed from the beginning.)
⑤ Opening the ROBOT STOP input and pressing the **ROBOT STOP** button of the operating panel or the teach pendant function is the same.

**(4) Timing of the input**

This input will be processed prior to all commands and input signals.

## 5.3.4.3 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) Terminal**

No.5 of connector CN8.

**(3) 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 Figure 5-11.

② For resuming the program after a step stop, see Chapter 5, "5.4.3.2 Program Operation Command (0001)".

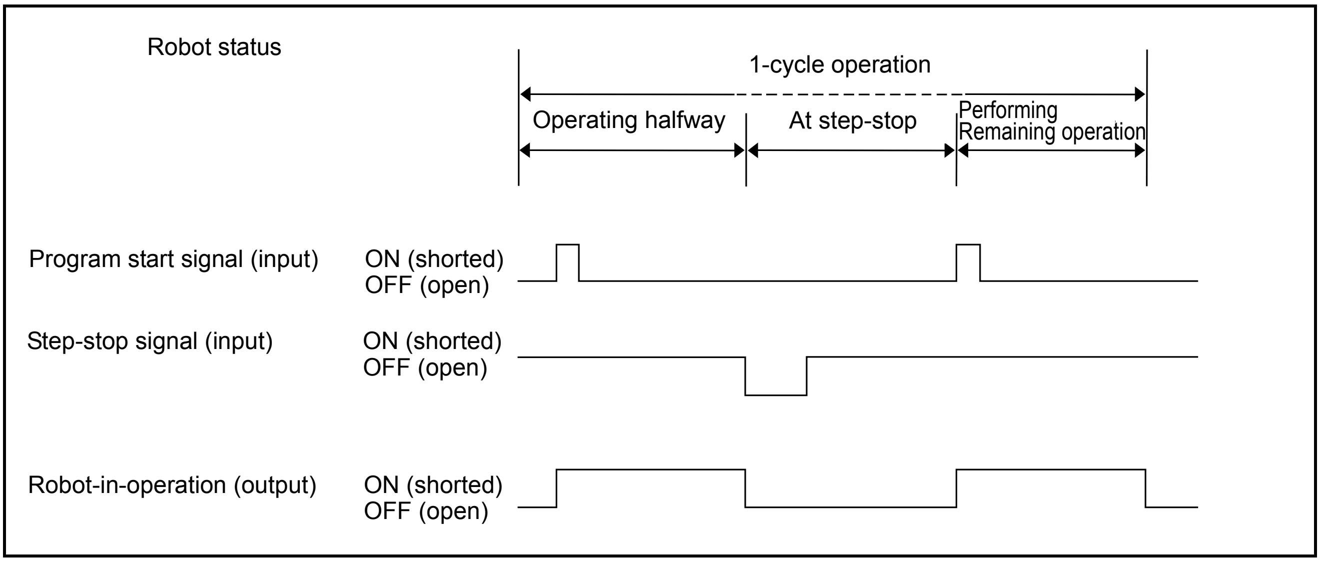



**Figure 5-11 Step Stop Signal**

## 5.3.4.4 Instantaneous Stop (All Tasks) (Input)

**(1) Function**

Input this signal to instantaneously stop the running programs from an external device. All tasks will stop.

**(2) Terminal number**

No.7 of connector CN8.

**(3) 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 Chapter 5, "5.4.3.2 Program Operation Command (0001)".
③ The minimum required pulse width is 50 milliseconds (msec.) or more.

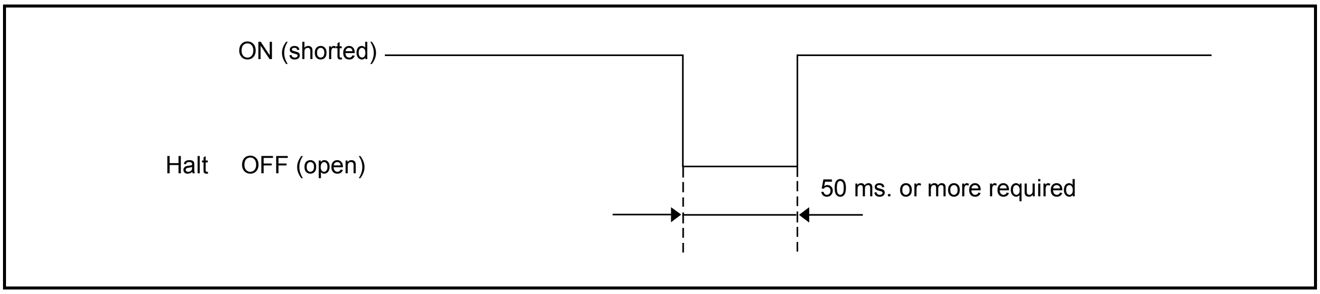



**Figure 5-12 Minimum Instantaneous Stop Pulse Width**

## 5.3.4.5 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, Chapter 12, "12.3 INTERRUPT ON/OFF (Statement)."**<br>**For further information about the robot operation command, see the PROGRAMMER'S MANUAL, Chapter 12, "Robot Control Statements."** |

**(2) Terminal number**

No.9 of connector CN8.

**(3) Usage**

See the PROGRAMMER'S MANUAL, Chapter 12, "12.3 INTERRUPT ON/OFF."

**(4) 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.

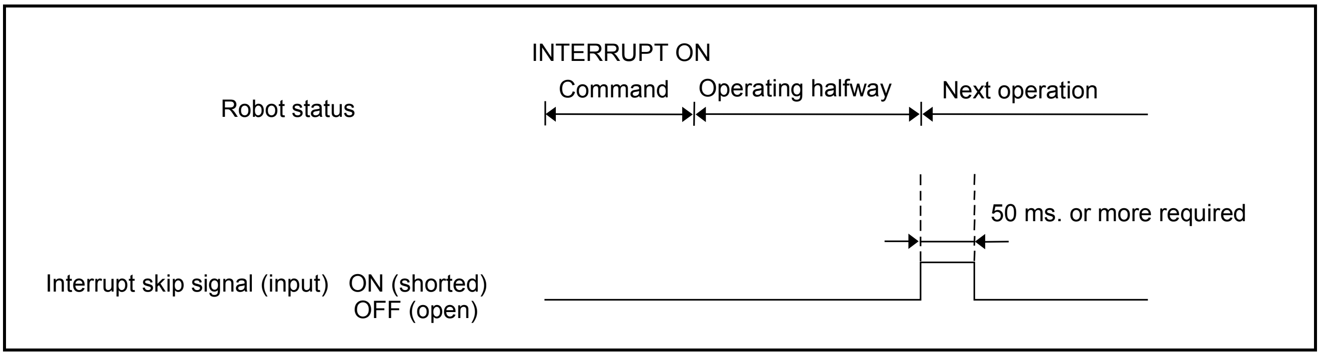



**Figure 5-13 Input Conditions and Operation of Interrupt Skip**

**⚠Caution: When turning ON (shorting) the interrupt skip signal, at a minimum 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 immediately turned OFF (open). Consequently, the program selected with the program No. selection signal will be executed from the beginning. (See Figure 5-14 below.)**

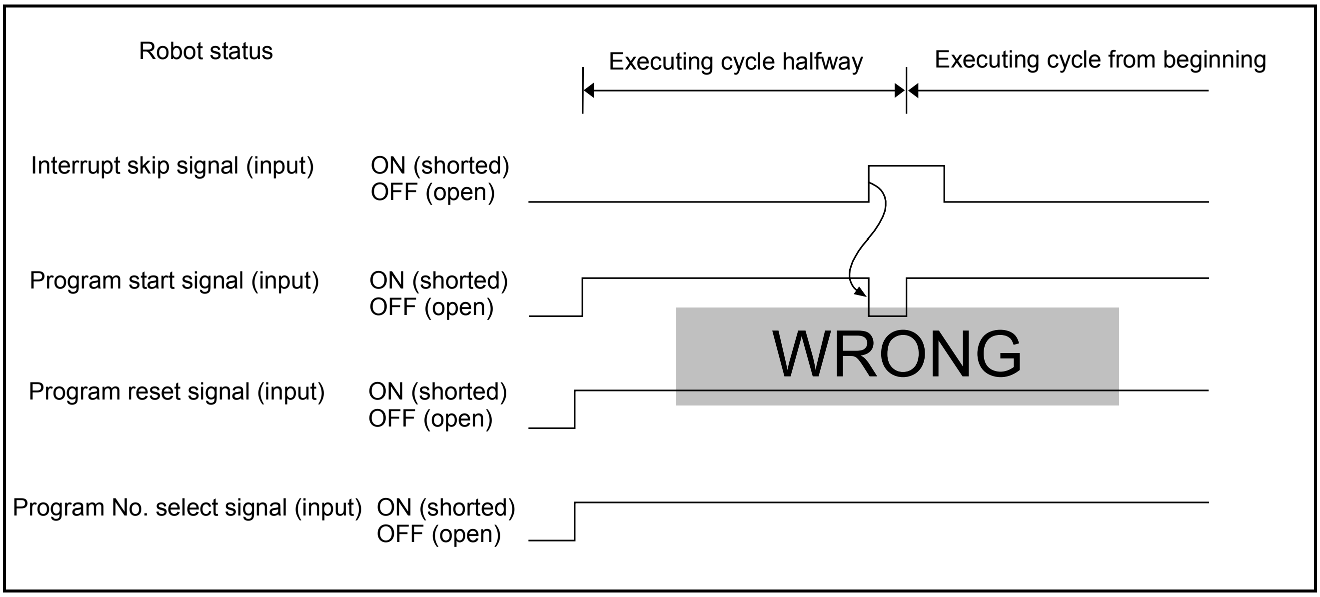



**Figure 5-14 Example of Operation When an Interrupt Skip is Input**

# 5.4 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.

## 5.4.1 General Information about Commands

Table 5-7 shows the I/O commands functions.

**Table 5-7 I/O Command Functions**

| Command | Description of function |
|---|---|
| Program operation | · Starts the program cycle (specified program).<br>· Step-stops the program (specified program/all programs).<br>· Immediately stops the program (specified program/all programs).<br>· Resets the program (specified program/all programs). |
| Speed setting | · Sets the external speed.<br>· Sets the external acceleration.<br>· 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. |

## 5.4.2 Processing I/O Commands

### 5.4.2.1 General Information about Processing

I/O commands to be executed are processed as shown in Figure 5-15.

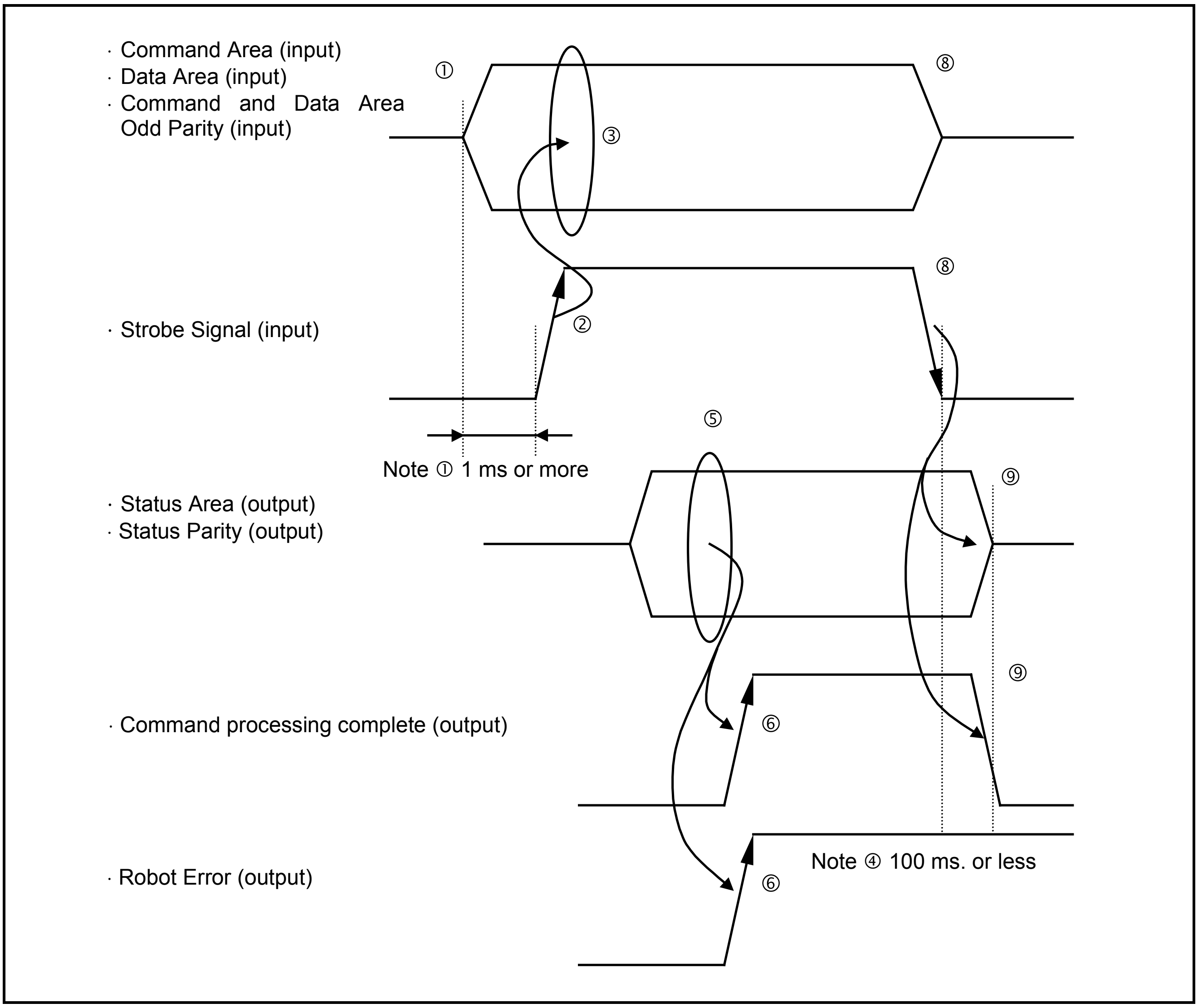



**Figure 5-15  Outline of I/O Command Processing**

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.**<br>**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.**<br>**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.** |

## 5.4.2.2 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) Terminal numbers**

Command area: No.35 to No.38 of connector CN8.
Data area 1: No.11 to No.18 of connector CN8.
Data area 2: No.19 to No.34 of connector CN8.
Command and data area odd parity: No.10 of connector CN8.

**(3) 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) Terminal number

No. 8 of connector CN8.

### (3) 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) Terminal number**

No. 15 of connector CN10.

**(3) 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.

**(4) 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.

**(5) 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) Terminal numbers

Nos. 17 to 32 of connector CN10.

### (3) Usage

The signal is used to execute an I/O command and obtain the result of the PLC.

### (4) 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 Parity can be set valid or invalid with a parameter. When parity is invalid, no parity check will be performed.

### (5) 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.

## 5.4.3 I/O Commands Details

### 5.4.3.1 List of I/O Commands

Table 5-8 shows a list of I/O commands.

**Table 5-8 List of I/O Commands**

| Command area | Data area 1 | Data area 2 | Status area |
|---|---|---|---|
| 0001<br>Program operation | 00000001 Program reset start<br>00000010 Program start<br>00000100 Continue start<br>00010000 Step stop<br>00100000 Instantaneous stop<br>01000000 Reset | Program number<br>Program number<br>**(Note)**<br>Program number<br>Program number<br>Program number | —<br>—<br><br>—<br>—<br>— |
| 0010<br>External speed and acceleration setting | 00000001 Speed setting<br>00000010 Acceleration setting<br>00000100 Deceleration setting | Set speed value<br>Set acceleration value<br>Set deceleration value | —<br>—<br>— |
| 0100<br>Error read | — | — | Error number |
| 0101<br>Type I variable write | Type I variable number | Set variable value (lower 16 bits) | — |
| 0110<br>Type I variable read | Type I variable number | — | Variable value (lower 16 bits) |
| 0111<br>Mode switching | 00000001 Motor ON, CAL execution<br>00000010 External speed 100<br>10000000 External mode switching<br>10000011 Execution of all above<br>(Motor ON→CAL→SP100→External) | — | — |
| 1000<br>Clear robot failure | — | — | — |
| 1001<br>I/O write | Set I/O value | First internal I/O port address | — |
| 1010<br>I/O read | — | First internal I/O port address | I/O |

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

## 5.4.3.2 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.

## 5.4.3.3 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.

## 5.4.3.4 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 operating panel.**

### (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 Fig. 5-16.

| | | | | | | |
|---|---|---|---|---|---|---|
| ×××× | → 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 |

Figure 5-17 shows an example of error number output when ERROR6174 (overload error with the fourth axis) occurs.

| | Thousands of error | Hundreds of error No. | Tens of error No. | Units of error No. |
|---|---|---|---|---|
| | 32 31 30 29 | 28 27 26 25 | 24 23 22 21 | 20 19 18 17 |
| Terminal No. (Connector CN10) | × O O × | × × × O | × O O O | × O × × |
| | ⇧ | ⇧ | ⇧ | ⇧ |
| ERROR | 6 | 1 | 7 | 4 |

**Figure 5-17 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.

### 5.4.3.5 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.

## 5.4.3.6 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.

### 5.4.3.7 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.

## 5.4.3.8 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.

## 5.4.3.9 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.

## 5.4.3.10 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.

# 5.4.4 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 example

Equipment, which makes the robot perform operations by operating an external equipment operating panel connected to the Robot Controller through a PLC as shown in Figure 5-18 and equipped with a display, lamps and switches listed in Table 5-9.

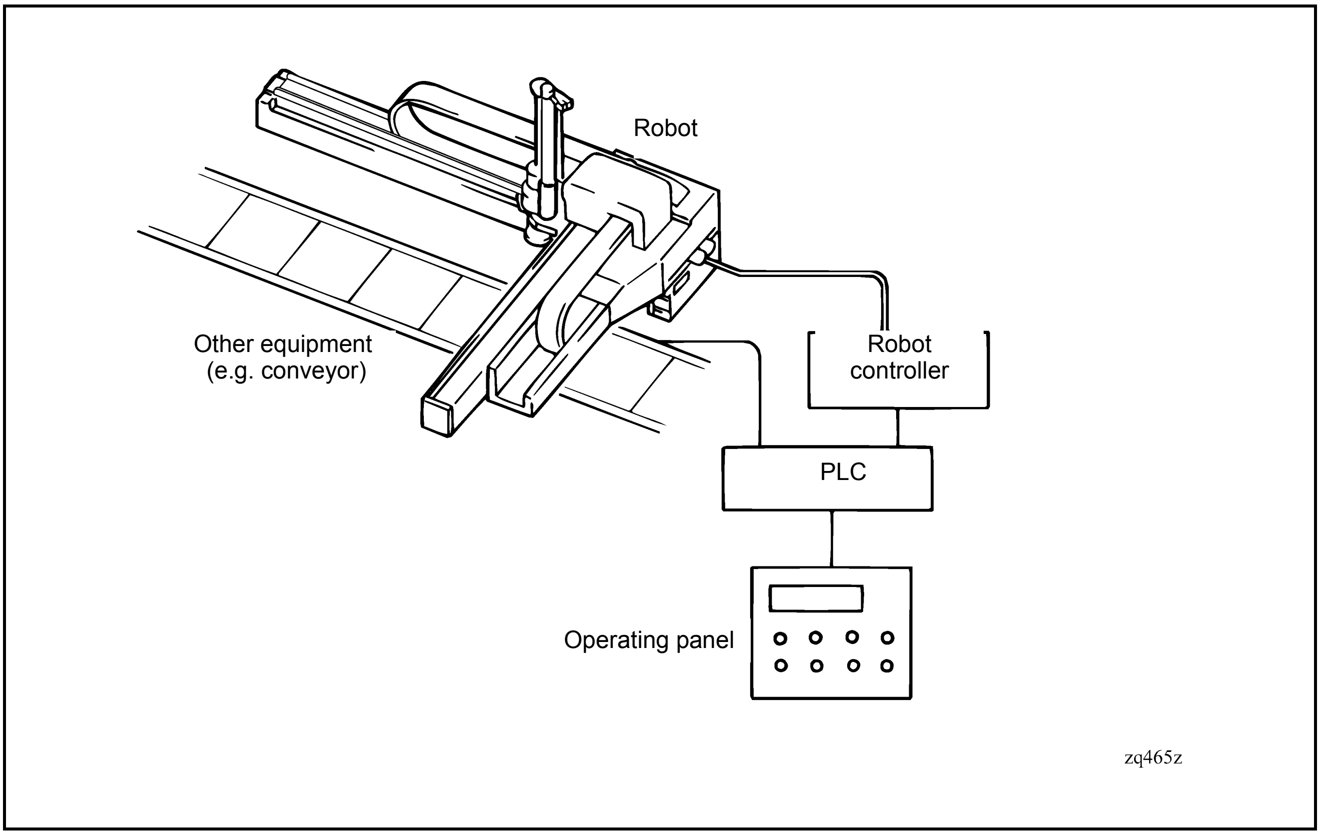



**Figure 5-18 Example of Equipment Using a Robot**

**Table 5-9 Example of Equipment Operating Panel Functions**

| Classification | Part | Application |
|---|---|---|
| Display | Display | Displays messages, such as ROBOT PREPARATION OK. |
| Lamp | ① Automatic operation indicator lamp | · Lights during automatic operation.<br>· Turned OFF when the robot is not in automatic operation. |
| | ② Robot external mode indicator lamp | · Lights when the robot is in external mode.<br>· Turned OFF when the robot is not in external mode. |
| | ③ Operation OK indicator lamp | · Lights when the Enable Auto signal is ON.<br>· Turned OFF when the Enable Auto signal 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.<br>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 in Figure 5-18.
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

Figures 5-19 and 5-20 show the relationship between the system I/O signals and*

① The operations by the operator.
② The display on the equipment operating panel, processing by the PLC.
③ The operation of the robot when starting and stopping the robot.

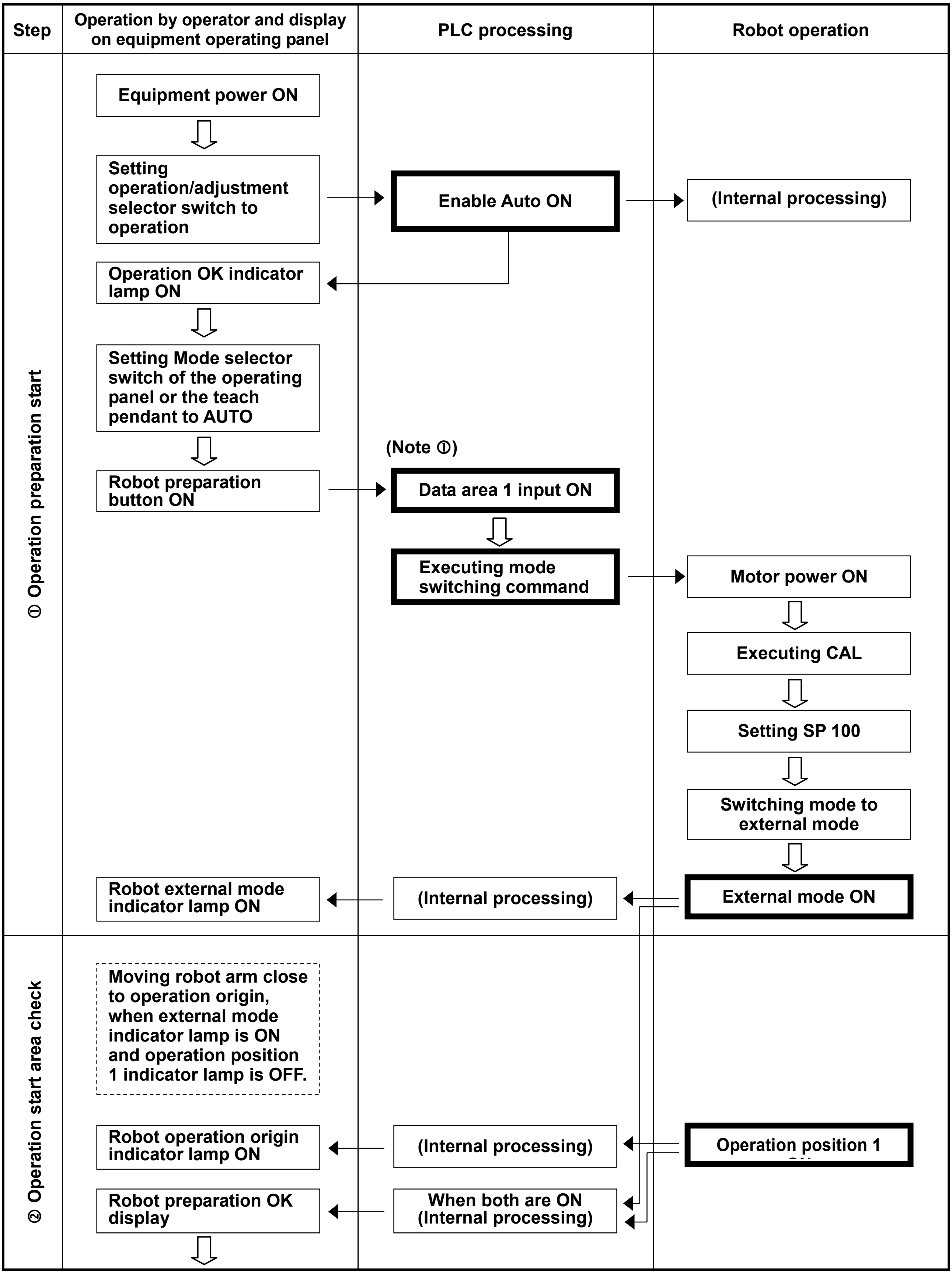
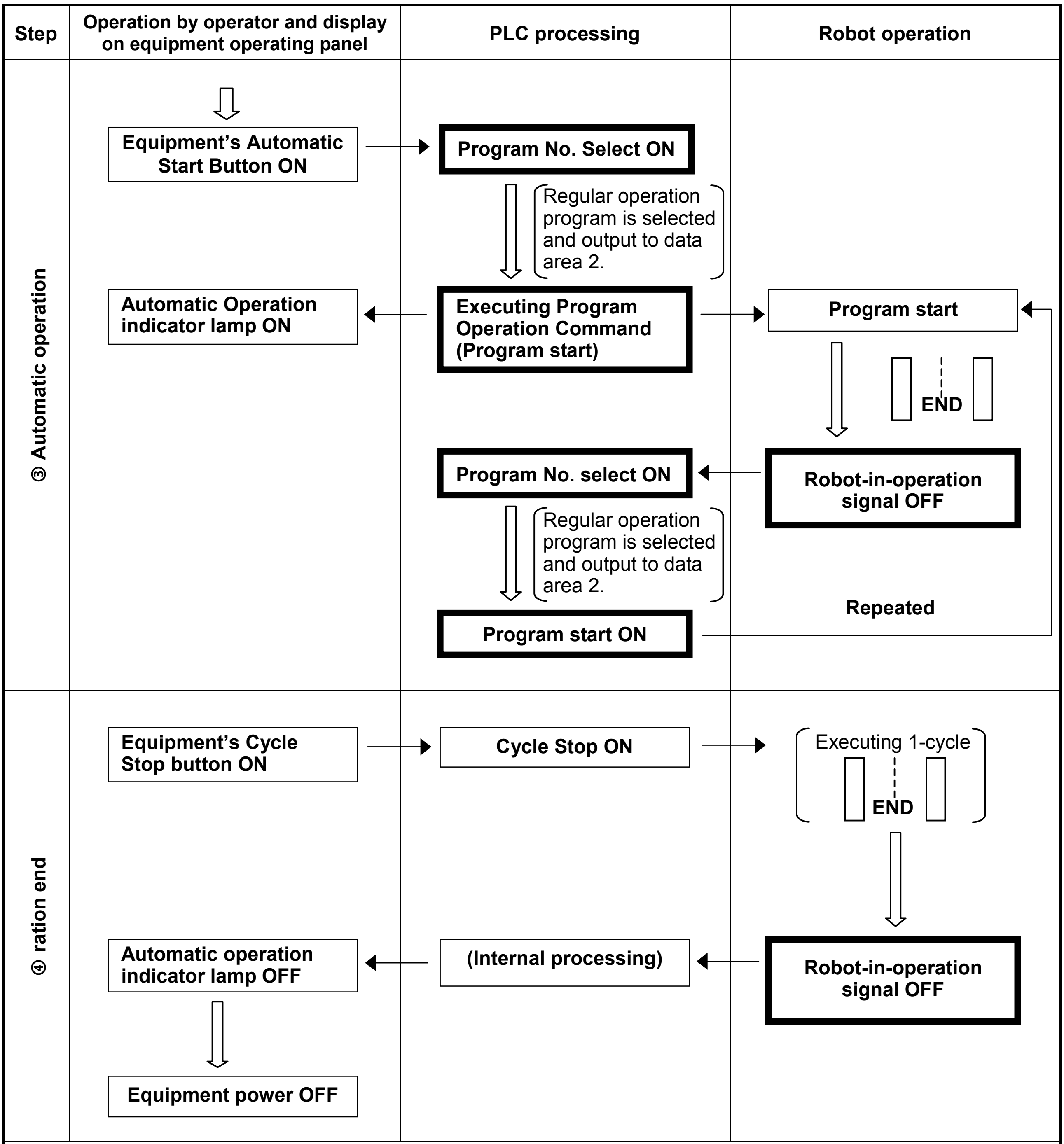



Figure 5-19 Start and Stop Procedure and System I/O Signals-1

(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 "5.4.3.7 Mode Switching (0111)".**

**④: ▭ the figure indicates a system I/O signal, and ←represents the flow of the signal.**

**Figure 5-20 Start and Stop Procedure and System I/O Signals-2**

# 5.5 System I/O Signals Compatible Mode

## 5.5.1 Types and Functions of System Output Signals (Compatible Mode)

Table 5-10 shows the system output signals used in the compatible mode.

**Table 5-10 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 | Normal CPU | Outputs when the CPU (hardware) of the Robot Controller is normal. |
| | 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." |
| Emergency stop | Emergency stop | Outputs from a contact exclusively designed for an emergency stop circuitry. |

## 5.5.2 Usage of System Output Signals in the Compatible Mode

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

### 5.5.2.1 Robot Power ON Complete

**(1) Function**

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

**(2) Terminal number**

No.9 of connector CN10.

**(3) Usage**

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

**(4) 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 operating panel or the teach pendant or by CLEAR ROBOT FAILURE and OPERATION PREPARATION START signals, after the power was turned OFF.

**(5) OFF conditions**

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

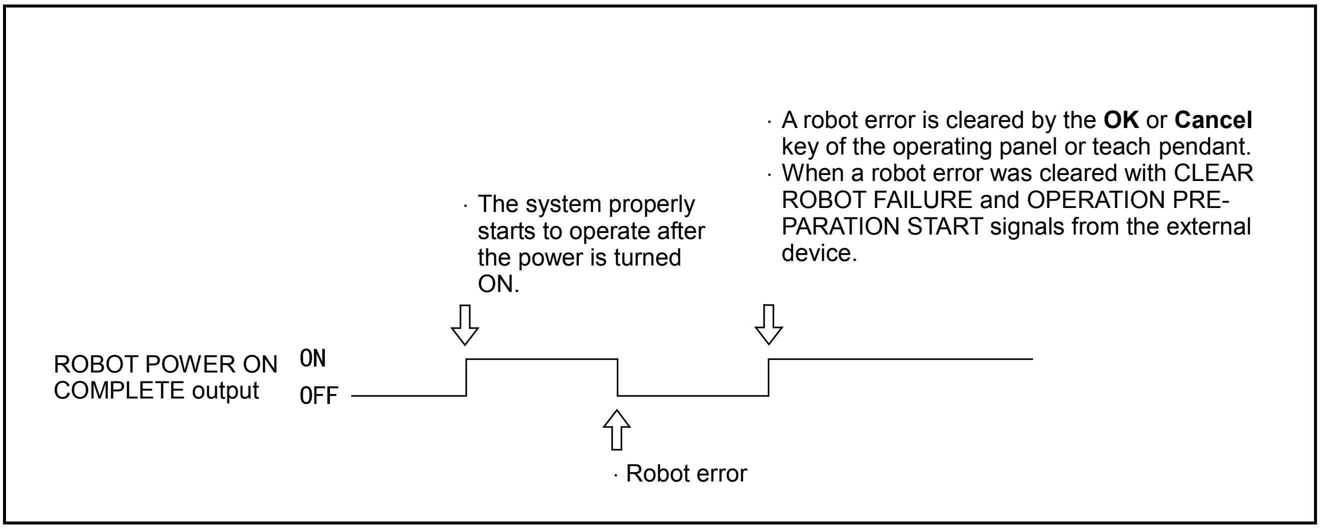



**Figure 5-21 Robot Power ON Complete Output**

## 5.5.2.2 Auto Mode (Output)

**(1) Function**

The signal outputs to the external device that the robot is in the auto mode.

**(2) Terminal number**

No.4 of connector CN10.

**(3) 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.

**(4) 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 operating panel or the teach pendant is set to AUTO.

**(5) OFF conditions**

The signal will be turned OFF under the following conditions.

① When the mode selector switch of the operating panel is set to MANUAL or the teach 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 Chapter 3, Subsection 3.2.3, "[ 3 ] Pendantless State."

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

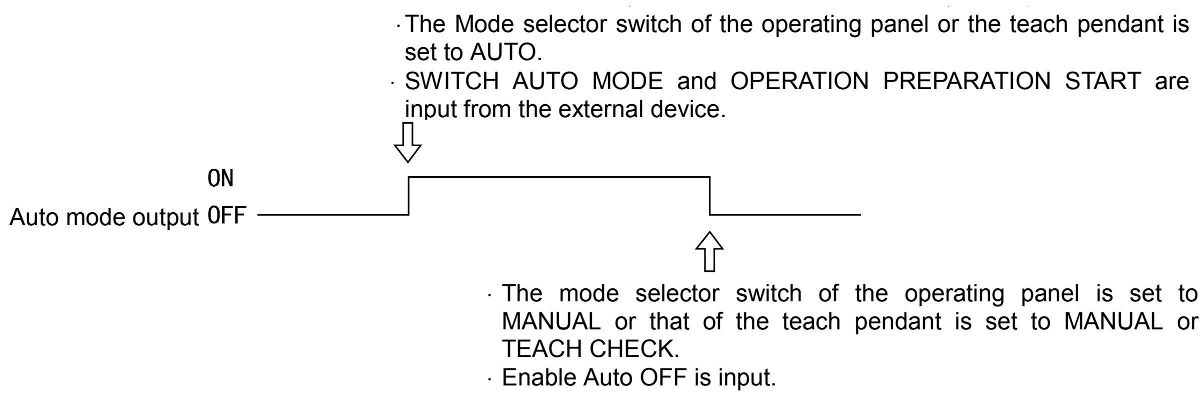



**Figure 5-22 Auto Mode Output**

## 5.5.2.3 Servo ON (Output)

**(1) Function**

The signal outputs to the external device that the power to the robot motor is turned ON.

**(2) Terminal number**

No. 10 of connector CN10.

**(3) 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.

**(4) 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 operating panel or the teach pendant is activated.

② MOTOR POWER ON + OPERATION PREPARATION START signals are input from the external device.

**(5) 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 operating panel or the teach 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.

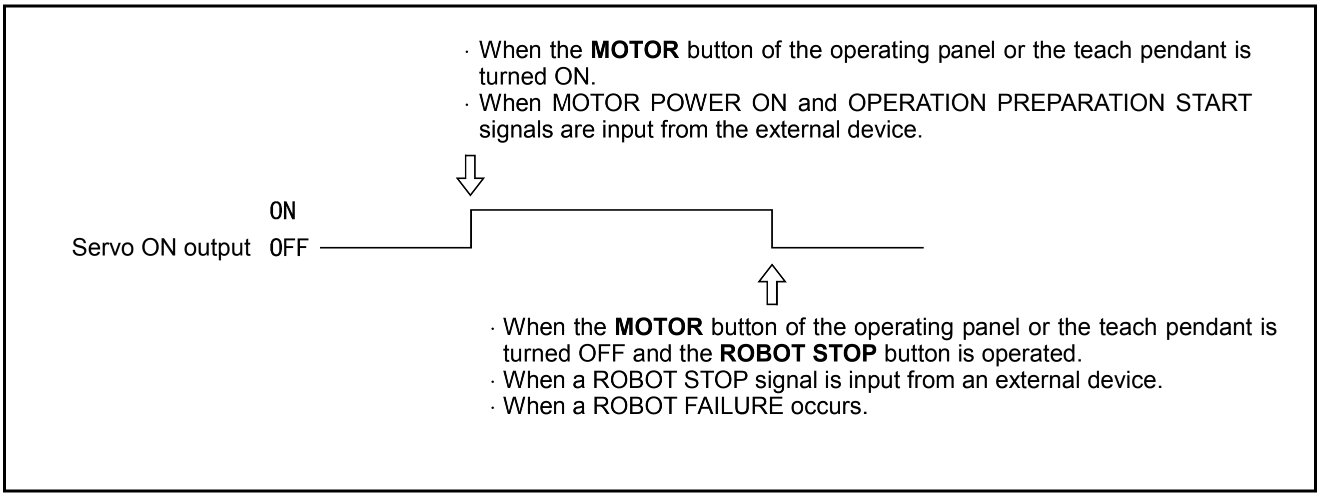



**Figure 5-23 Servo ON Output**

## 5.5.2.4 CAL Complete (Output)

**(1) Function**

The signal outputs to the external device that CAL is completed.

**(2) Terminal number**

No. 11 of connector CN10.

**(3) 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.

**(4) ON conditions**

The signal will be turned ON upon proper completion of CAL under the following conditions.

① When CAL is performed by the operating panel or teach pendant.

② When CAL EXECUTION and OPERATION PREPARATION START signals are input from the external device.

**(5) OFF conditions**

The signal will be turned OFF when CAL is not properly completed as shown in Figure 5-24.
It will remain OFF until CAL is performed again and properly completed.

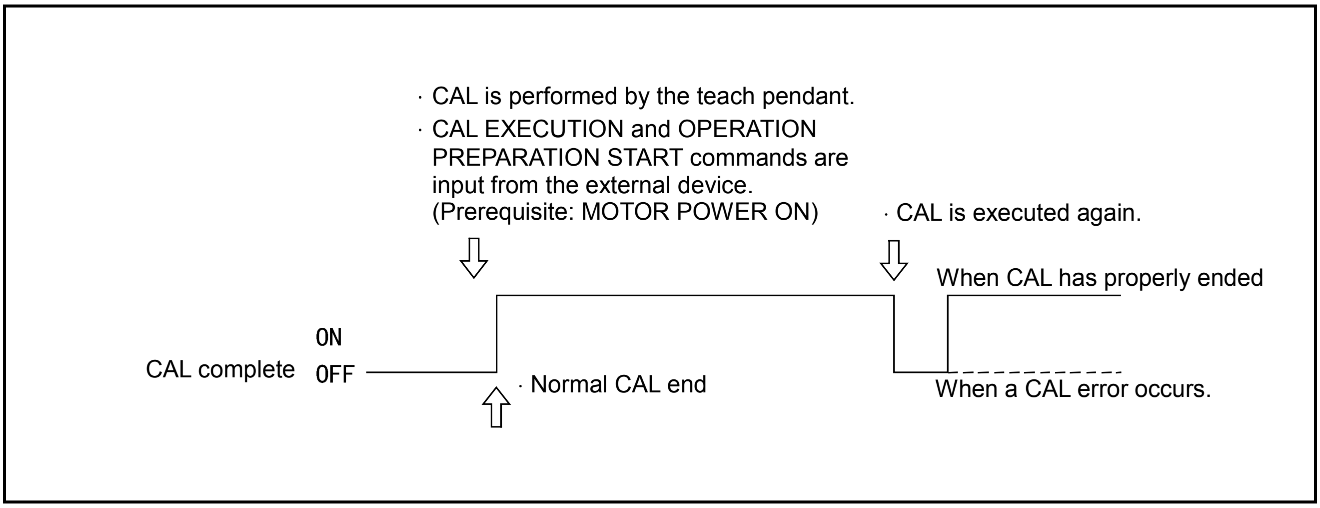



**Figure 5-24 CAL Complete Output**

## 5.5.2.5 External Mode (Output)

**(1) Function**

The signal outputs to the external device that the robot is in the external mode.

**(2) Terminal number**

No. 5 of connector CN10.

**(3) 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.

**(4) ON conditions**

The signal will be turned ON under the following conditions.

① When INTERNAL/EXTERNAL is input on the teach pendant and the external mode is selected.
② When EXTERNAL/INTERNAL is input on the operating panel in AUTO MODE and in the INTERNAL CONTROL ON state.
③ When SWITCH EXT MODE and OPERATION PREPARATION START signals are input from the external device.

**(5) OFF conditions**

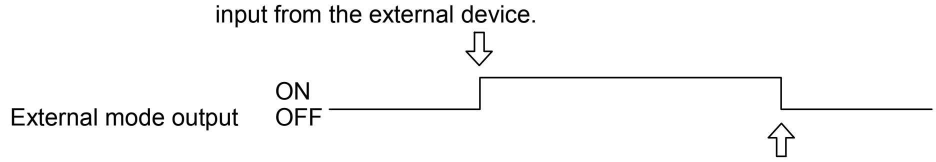
The signal will be turned OFF under the following conditions.

① When the mode selector switch of the teach pendant is set to MANUAL or TEACH CHECK in external mode.
② When EXTERNAL/INTERNAL is input on the teach pendant and external mode is selected.
③ When EXTERNAL/INTERNAL is input on the operating panel in AUTO MODE and in the INTERNAL CONTROL OFF state.
④ When ROBOT STOP is input.
⑤ When ROBOT FAILURE is outputted.

| **Caution: The signal will not be turned OFF with STEP STOP.** |
|---|

⑥ When an Enable Auto input is turned OFF.

· When INTERNAL/EXTERNAL is input on the teach pendant and external mode is selected.
· When INTERNAL/EXTERNAL is input on the operating panel in AUTO MODE and in the INTERNAL CONTROL ON state.
· When EXTERNAL MODE SWITCHING and OPERATION PREPARATION START signals are input from the external device.




· When internal mode is selected on the teach pendant.
· When INTERNAL/EXTERNAL is input on the teach pendant and external mode is selected.
· When INTERNAL/EXTERNAL is input on the operating panel in AUTO MODE and in the INTERNAL CONTROL ON state.
· When ROBOT STOP is input.
· When ROBOT ERROR is output.
· When an Enable Auto input is turned OFF.

**Figure 5-25 External Mode Output**

## 5.5.2.6 Teaching (Output)

**(1) Function**

The signal outputs to the external device that the robot is in the manual mode or teaches check mode.

**(2) Terminal number**

No. 12 of connector CN10.

**(3) Usage**

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

**(4) ON conditions**

The signal will be turned ON when the mode selector switch of the operating panel or the teach pendant is set to MANUAL or TEACH CHECK, as shown in Figure 5-26.

**(5) OFF conditions**

The signal will be turned OFF when the mode selector switch of the operating panel or teach pendant is set to AUTO and the Enable Auto input is turned ON.

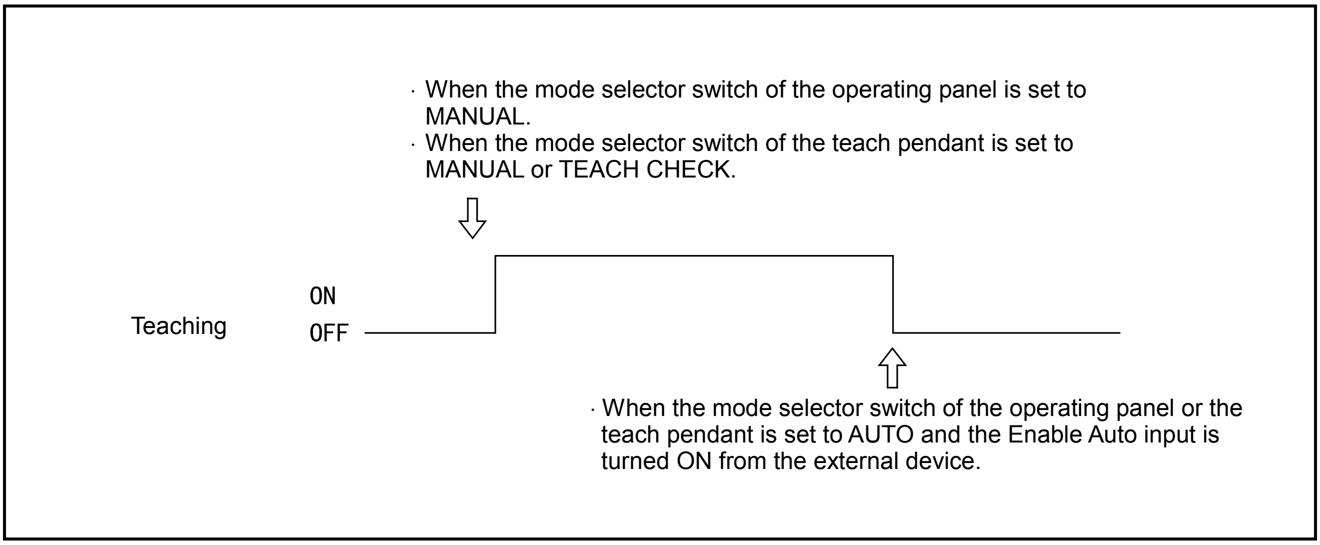



**Figure 5-26 Teaching Output**

## 5.5.2.7 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) Terminal number**

No. 6 of connector CN10.

**(3) 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.

**(4) ON conditions**

The signal will be turned ON immediately after the robot program starts to run, as shown in Figure 5-27.

**(5) OFF conditions**

The signal will be turned OFF automatically when the PROGRAM START signal sent to the robot is turned OFF.

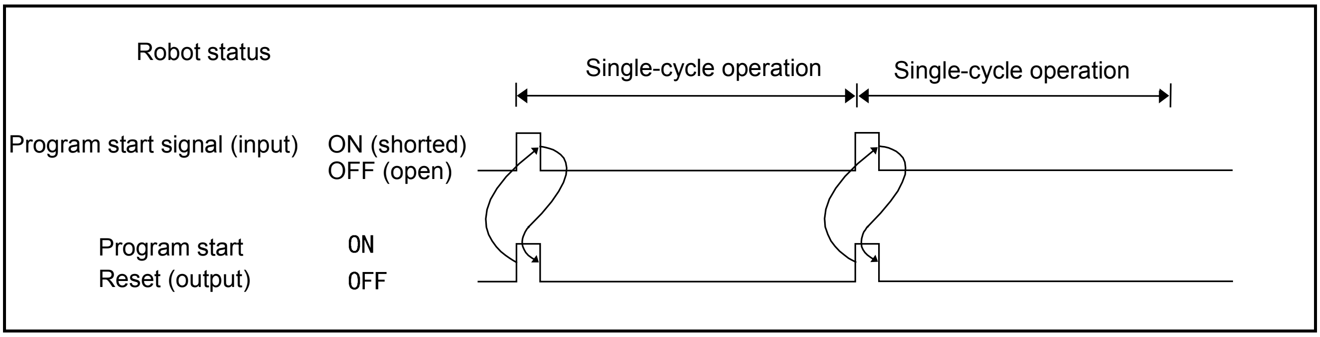



**Figure 5-27 Program Start Reset Output ON Condition**

### 5.5.2.8 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) Terminal number**

No. 2 of connector CN10.

**(3) 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.

**(4) 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.

**(5) 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 operating panel or the teach pendant and INSTANTANEOUS TOP (ALL TASKS), STEP STOP (ALL TASKS) and ROBOT STOP inputs.**

# 5.5.2.9 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.**<br>**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) Terminal number**

No. 13 of connector CN10.

**(3) Usage**

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

**(4) ON conditions**

The signal will be turned ON when the program is read to the end.

**(5) OFF conditions**

The signal will be turned OFF immediately after the program starts to run.

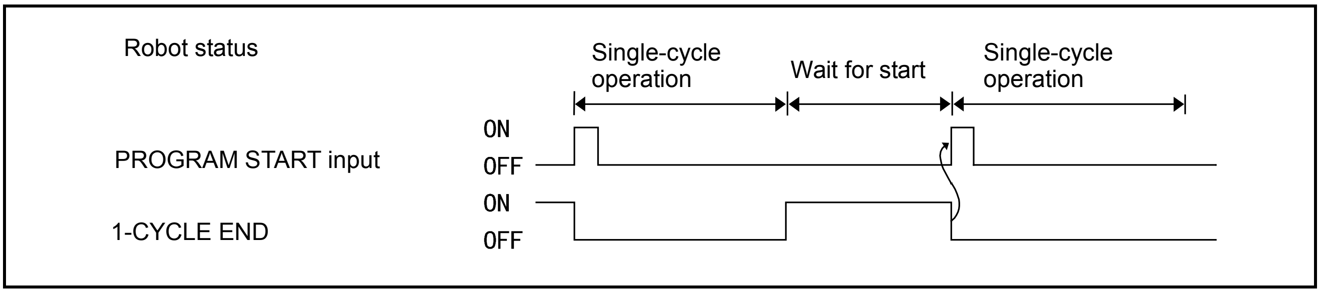



**Figure 5-28 Single-Cycle End Output**

### 5.5.2.10 Normal CPU (Output)

**(1) Function**

The signal outputs to the external device that the CPU (hardware) of the Robot Controller is normal.

**(2) Terminal number**

No. 1 of connector CN10.

**(3) Usage**

① The signal is used to light the Robot Controller error indicator lamp of an external operating panel.
② The signal is used when the NORMAL CPU signal is turned OFF because of an error and the PLC corrects it.

**(4) ON conditions**

The signal will be turned ON by the hardware when the CPU of the Robot Controller operates normally with the power turned ON.

**(5) OFF conditions**

The signal will be turned OFF by the hardware when the CPU does not operate normally.

**Caution: The OFF state of this signal indicates that the internal arithmetic circuit of the Robot Controller may be damaged and ROBOT ERROR, ERROR NUMBER and other outputs may not be correct.**

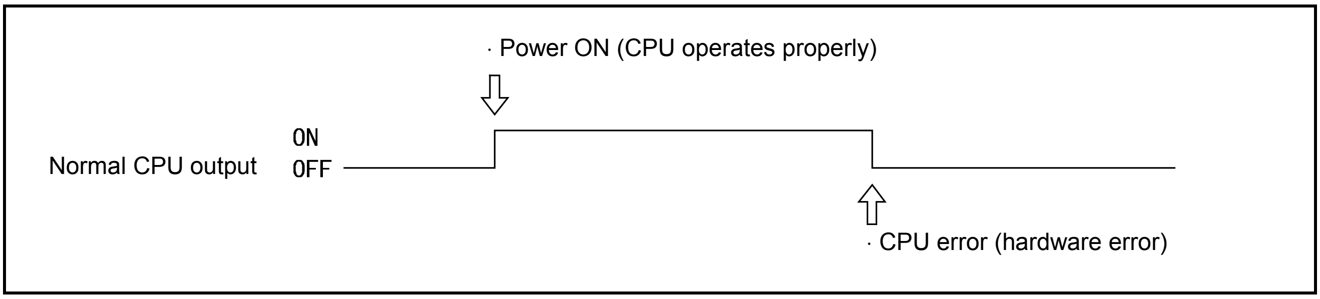



**Figure 5-29 Normal CPU Output**

## 5.5.2.11 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) Terminal number**

No. 3 of connector CN10.

**(3) 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.

**(4) ON conditions**

As shown in Figure 5-30, 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 operating panel or the teach 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."** |

**(5) OFF conditions**

As shown in Figure 5-30, 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 operating panel or the teach pendant.

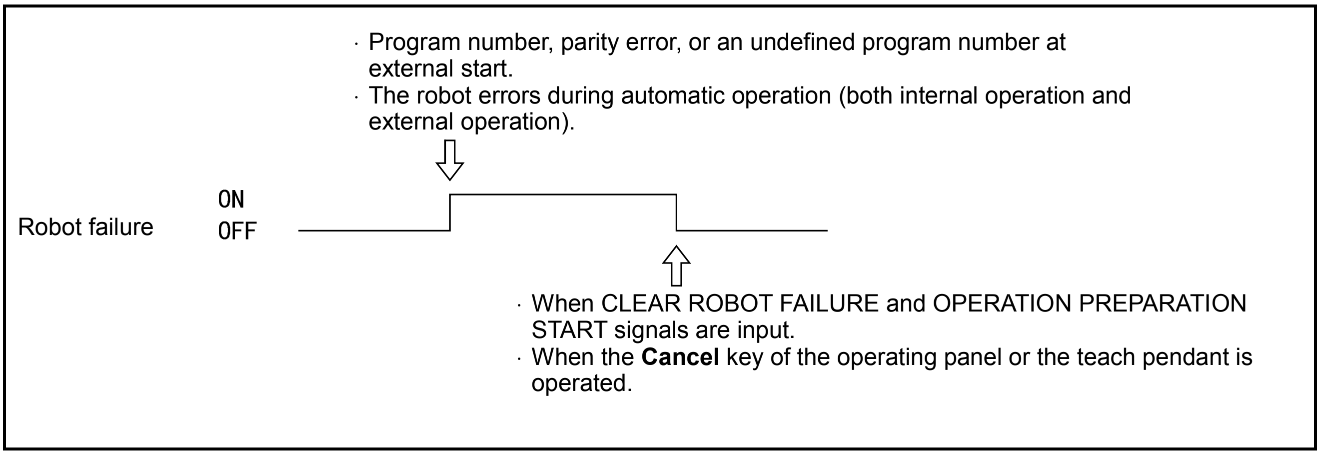



**Figure 5-30 Robot Failure Output**

### 5.5.2.12 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 operating panel.**

**(2) Terminal number**

No. 15 of connector CN10.

**(3) 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.

**(4) ON conditions**

As shown in Figure 5-31, 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.

**(5) OFF conditions**

As shown in Figure 5-31, 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 operating panel or the teach pendant.

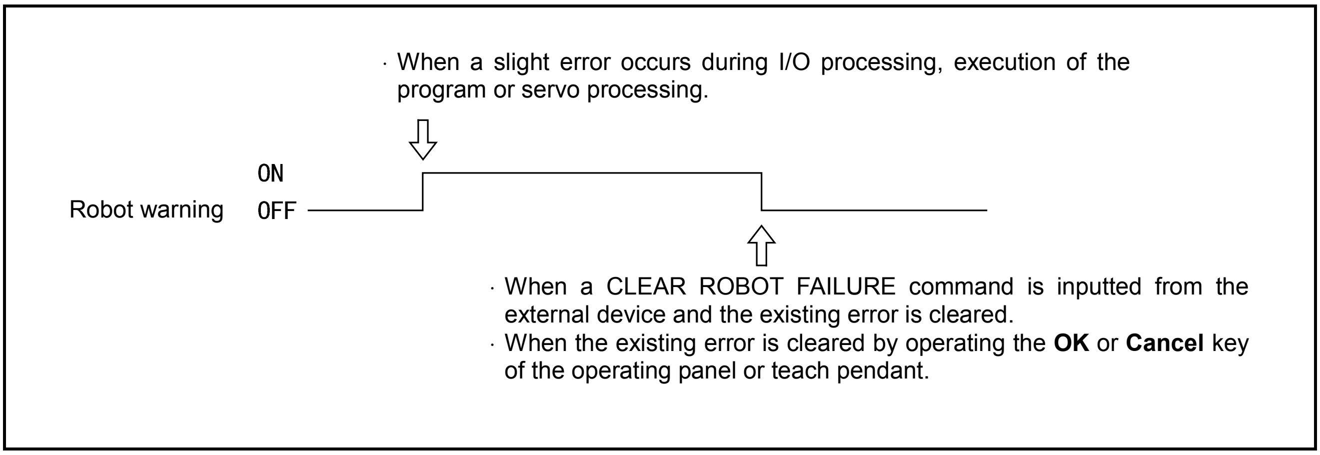



**Figure 5-31 Robot Warning Output**

## 5.5.2.13 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) Terminal number**

No. 14 of connector CN10.

**(3) Usage**

The signal is used to check the timing of battery replacement (lowering of the battery voltage).

**(4) ON conditions**

The signal will be turned ON when the voltage of the encoder back-up battery or memory back-up 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 operating panel and the teach pendant respectively.**<br>**(For details, refer to Section 6.5 "Biennial Inspections.")** |

**(5) OFF conditions**

The signal will be turned OFF when the power is turned ON after the dead battery was replaced.

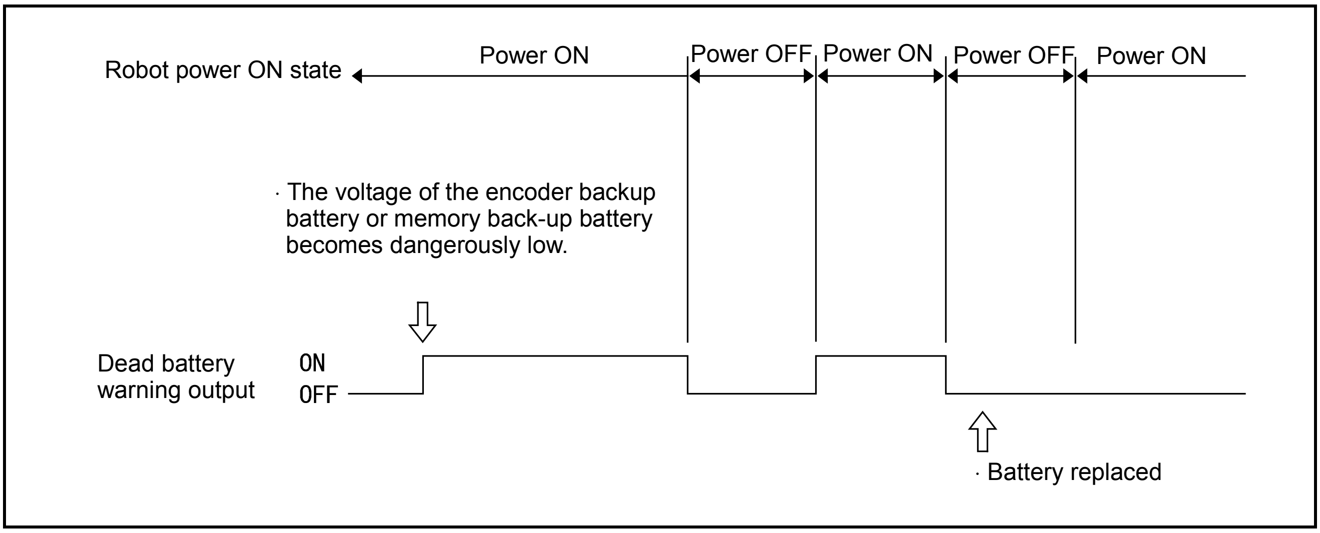



**Figure 5-32 Dead Battery Warning Output**

## 5.5.2.14 Error No. (Output)

**(1) Function**

When an error occurs, the signal outputs the error number in a 3-digit (12-bit) hexadecimal code.

**(2) Terminal numbers**

No.17 to No.28 of connector CN10.

**(3) Usage**

The signal is used to display an error number on the external device.

**(4) Output conditions**

The signal will be output when an error occurs.

**(5) 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 operating panel or the teach pendant. When this signal is cleared, all states will become OFF (0).

**(6) Hexadecimal codes**

See Figure 5-33.

| | | | | | | |
|---|---|---|---|---|---|---|
| ×××× | → 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 |

**Figure 5-33 Hexadecimal Codes**

Figure 5-34 shows an example of error number output, when ERROR174 (overload error with the fourth axis) occurs.

| | Hundreds of error No. | | | | Tens of error No. | | | | Units of error No. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Terminal No. (connector CN10□ j | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 |
| | × | × | × | O | × | O | O | O | × | O | × | × |
| ERROR | 1 | | | | 7 | | | | 4 | | | |

**Figure 5-34 Example of Error Number Output**

## 5.5.2.15 Continue Start Permitted (Output)

**(1) Function**

The controller will output this signal when the continue start is permitted.

**(2) Terminal number**

No.16 of connector CN10.

**(3) Usage**

Use this signal when you want to know whether the continue start is permitted.

**(4) ON condition**

This signal comes on when the continue start is permitted. For details, refer to the SETTING-UP MANUAL.

**(5) OFF condition**

This signal goes off by carrying out the "Task Status Change Operation."

## 5.5.2.16 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) Terminal number**

No. 29 of connector CN10

**(3) Usage**

This signal is used to warn workers that the robot is in the SS mode by beeping or lighting the lamp.

**(4) ON condition**

This signal comes on when the SS mode is selected.

**(5) 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.

### 5.5.2.17 Emergency Stop (Output from a contact)

**(1) Function**

This signal outputs from a contact exclusively designed for an emergency stop circuitry you may configure. It allows red mushroom buttons provided on the front panel of the robot controller, on the teach pendant, and on the operating panel to be used as emergency stop buttons of the facilities.

A 0.3A fuse is built in the contact.

**(2) Terminal number**

No. 10 of connector CN10: Emergency stop (+)

No. 10 of connector CN10: Emergency stop (-)

**(3) Usage**

This signal is used to stop the facilities or robot in an emergency. (Refer to Subsection 5.6.2.4 "Emergency Stop Circuit.")

**(4) Contact**

This contact is a normal close one (b contact). If any of the emergency stop buttons is pressed, then the contact turns off to output an emergency stop signal.

## 5.5.3 Types and Functions of System Input Signals (Compatible Mode)

Table 5-11 shows the system input signals to be used in compatible mode.

**Table 5-11 Types and Functions of System Input Signals to be Used in Compatible Mode**

| Application | Signal name | Function |
|---|---|---|
| Start-up | Enable Auto | Enables switching to Auto mode. |
| | Motor power ON<br>+ operation preparation start | Turns ON the power to the motor. |
| | CAL execution<br>+ operation preparation start | Executes calibration. |
| | SP100<br>+ operation preparation start | Sets the speed to 100%. |
| | Switch Ext Mode<br>+ operation preparation start | Switches the mode to external mode. |
| | Program reset<br>+ operation preparation start | Initializes all programs on halt. Starting a program after initialization will execute the program from the beginning. |
| | Program No. select<br>+ program start | Executes a specified program. |
| Program execution | Program reset<br>+ program No. select<br>+ program start | Cancels the current program and starts executing a specified program from the beginning. |
| | Robot stop | Stops the robot by opening signals. |
| Stop | Robot stop | Stops the robot by canceling signals. |
| | Step stop | Step-stops all programs by opening signals. |
| | Instantaneous stop | Instantaneously stops all programs by opening signals. |
| Error clear | Clear robot failure<br>+ 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<br>+ 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.**

## 5.5.4 Usage of System Input Signals in Compatible Mode

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

### 5.5.4.1 Enable Auto (Input)

**(1) Function**

① The signal enables switching of the robot mode to the Auto mode (shorted state).
② The signal enables switching of the robot mode to the manual mode or the teach check mode (open state).

**(2) Terminal number**

No.4 of connector CN8.

**(3) Usage**

The signal is used for the **AUTO/TEACHING** selector switch of the external operating panel and can be combined with the safety fence switch.

**(4) Input conditions and operation**

① As shown in Table 5-12, the selectable operation mode depends on whether this input is shorted or open.
② If the input becomes open during automatic operation, the mode will be switched to manual mode and ERROR21FC will be displayed.
③ If manual operation or a teach check is conducted with this input shorted, ERROR21F2 will be displayed.
④ If the mode selector switch of the teach pendant or the operating panel is set to AUTO with this input open, ERROR21F3 will be displayed.
Since this state is × in Table 5-5, this error will remain displayed until the robot leaves this state.
⑤ Although ERROR21FD or ERROR21FC will be displayed when the state is changed from ○ to ∆ or × shown in Table 5-5, they will not be displayed when the state is changed from ∆ or × to ○.
⑥ When the input is turned OFF (open) in external mode, the external mode output will also be turned OFF.

**Table 5-12 Relationship Between Enable Auto Input and Selectable Mode**

| Operation Mode | Application | Enable Auto | |
|---|---|---|---|
| | | ON (shorted) | OFF (open) |
| Manual mode | Manual operation with the operating panel or teach pendant | ∆ | ○ |
| Teach check mode | Program check with the teach pendant | ∆ | ○ |
| Internal Auto mode | Automatic operation with the operating panel or teach pendant | ○ | × |
| External Auto mode | Automatic operation with the external device | ○ | × |

**Note:○ = Mode selectable × = Mode not selectable**
**∆ = Mode selectable, but manual operation and program execution impossible**

**Caution: In the pendantless state described in Chapter 3, subsection 3.2.3 [ 3 ], auto mode is valid even if the Enable Auto input is open (external mode cannot be switched and the program cannot start to run).**
**Perform the following when operating the robot in the pendantless state:**
**① Set the robot not to start to operate when the Enable Auto input is open.**
**② Enable Auto input open state and auto mode output (See 5.3.2.2 and 5.5.2.2 "Auto Mode ".)**
**Set the equipment to make an emergency stop in an AND state.**
**Add ① and ② with the external sequence circuit.**

# 5.5.4.2 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) Terminal number**

No.8 of connector CN8.

**(3) 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.

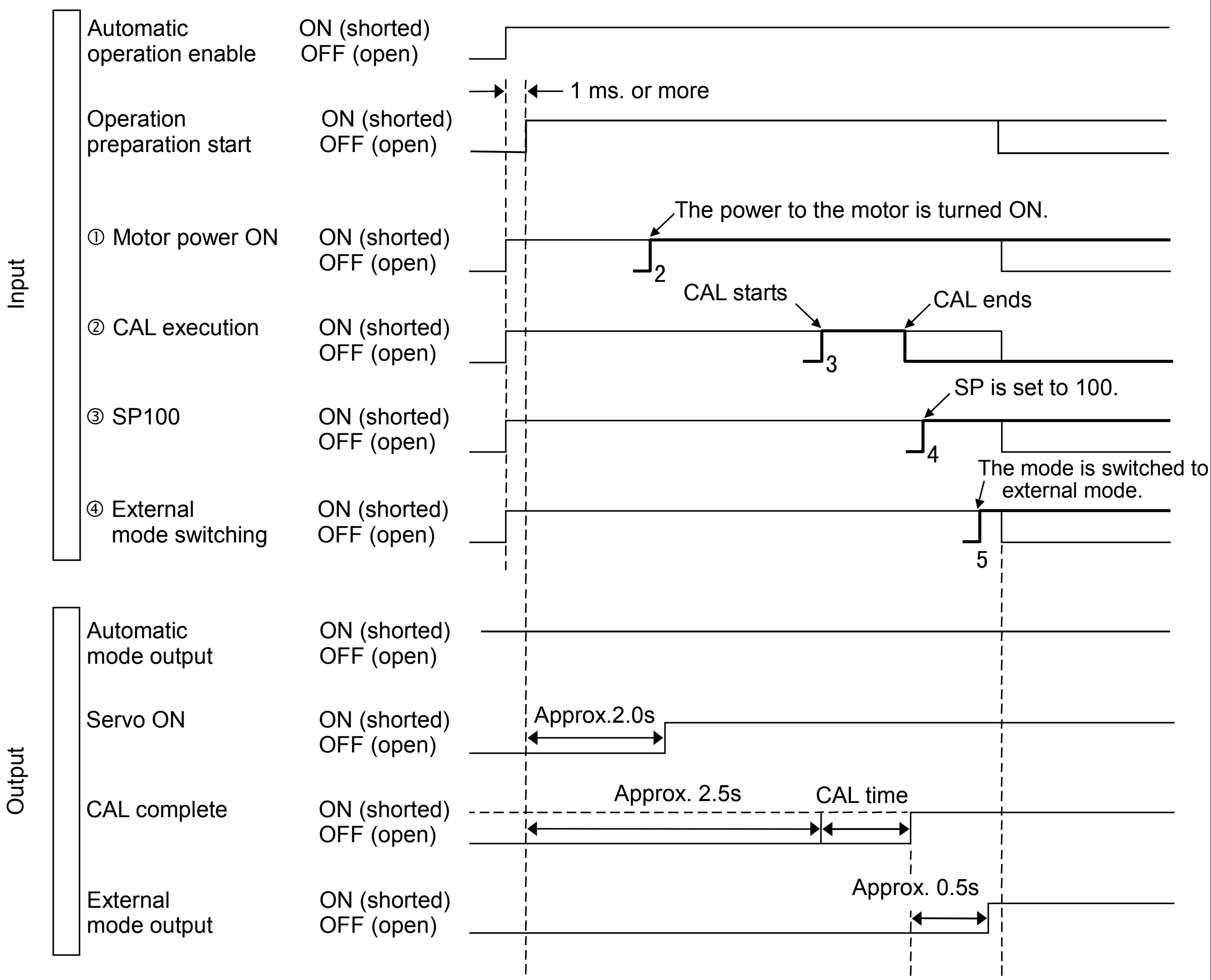
**④ Switch Ext Mode (input)**
- Terminal number: No.23 of connector CN8
- By turning ON (short) the operation preparation start signal with this signal turned ON (shorted), the mode will be set to the external mode. However, this signal cannot be used when the power to the motor is turned OFF and CAL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

For the input timing of the operation preparation start signal and ① to ④, see Figure 5-35.

**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.**




**Note: ―― indicates the input or output of the signal, and ━━ indicates robot operation.**

**Figure 5-35 Example of Operation Preparation Start Signal Timing Chart**

# 5.5.4.3 Program No. Select (Input)

**(1) Function**

The program number to be executed can be specified from the external device by inputting this signal.

**(2) Terminal numbers**

No.11 to No.18 of connector CN8.

**(3) 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 Table 5-13, 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 in Figure 5-36, 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.

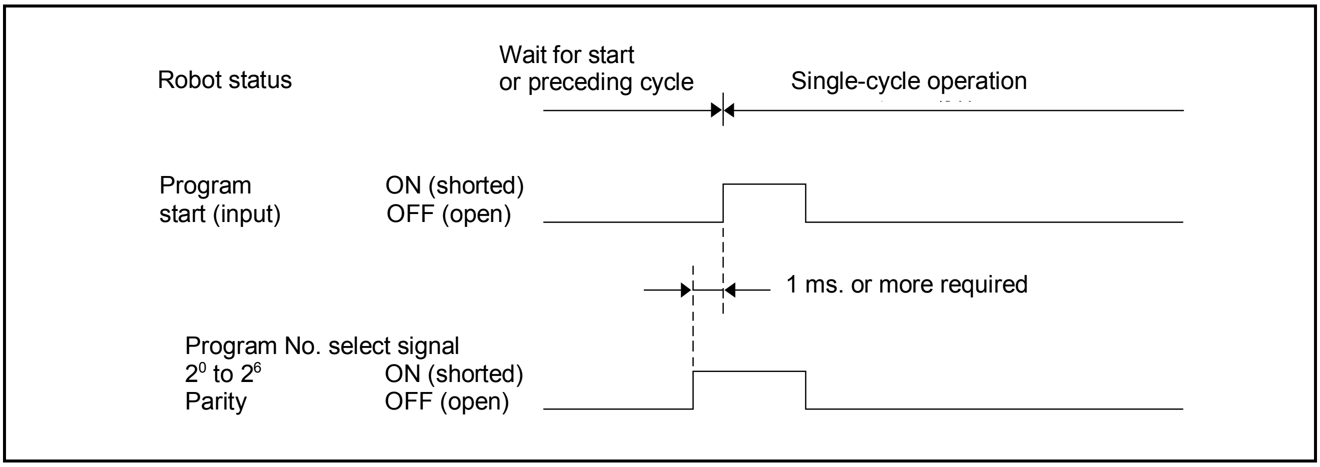



**Figure 5-36 Program No. Select Signal**

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.**<br>**② The program numbers executable from the external device are limited to Pro0 to Pro127.** |

**Table 5-13 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 |

Figure 5-37 shows an example of a program No. select signal sequence circuit considering parity.

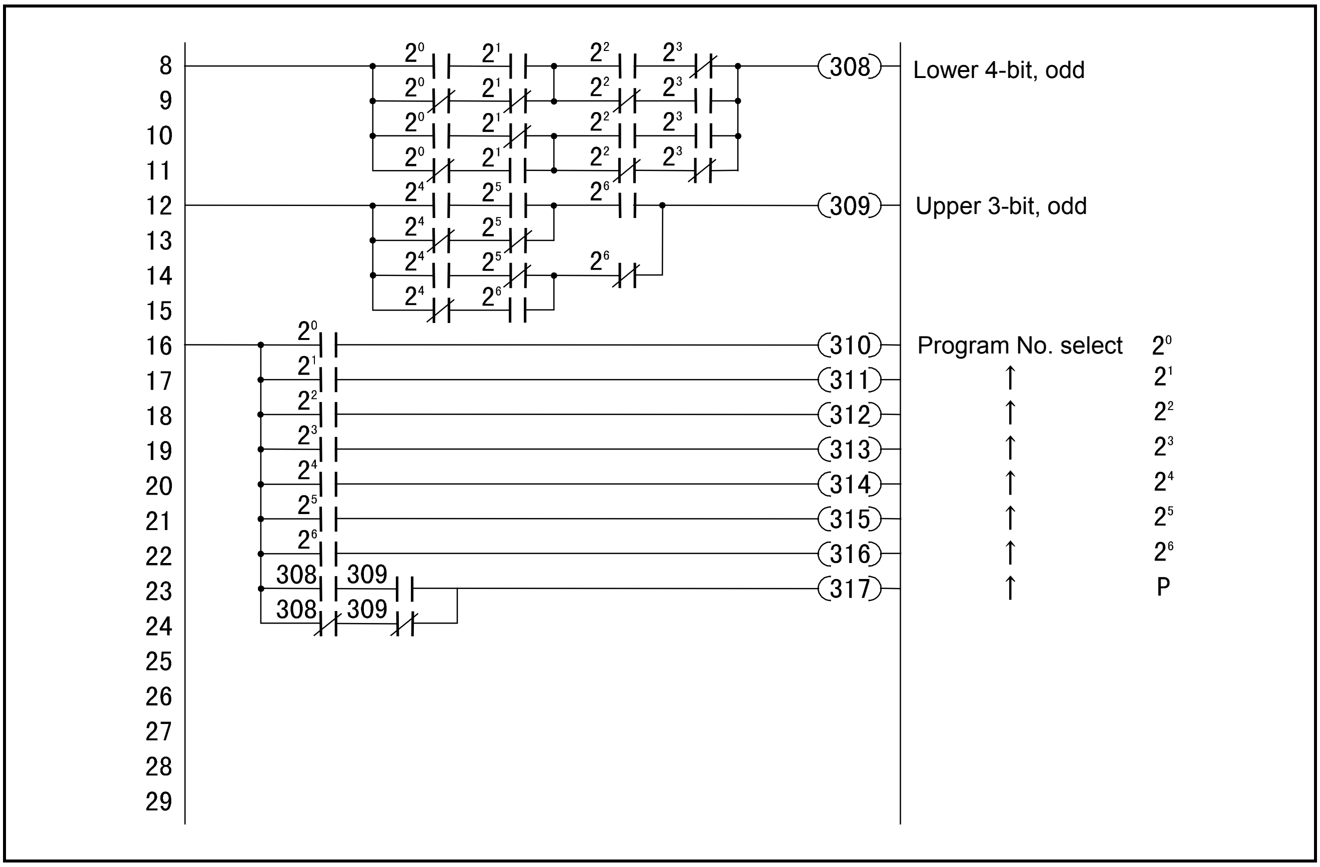



**Figure 5-37 Example of Program No. Select Signal Sequence Circuit**

## 5.5.4.4 Program Start (Input)

**(1) Function**

This signal starts the program specified with the program No. select signal from the external device.

**(2) Terminal number**

No.10 of connector CN8.

**(3) 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.

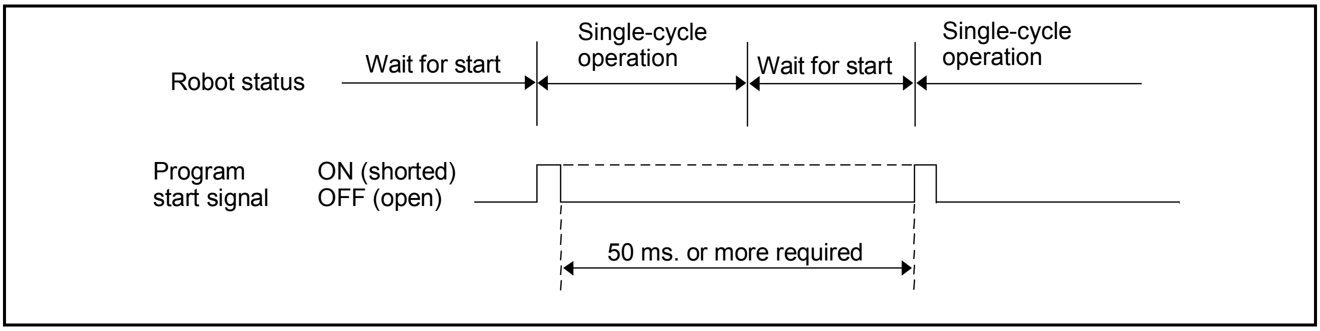



**Figure 5-38 Program Start Operation-1**

| | |
|---|---|
| **Caution:** | **The program start signal requires program start preparation time (50 msec. or more) before input from OFF (open) to ON (shorted).**<br>**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.**<br>**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.

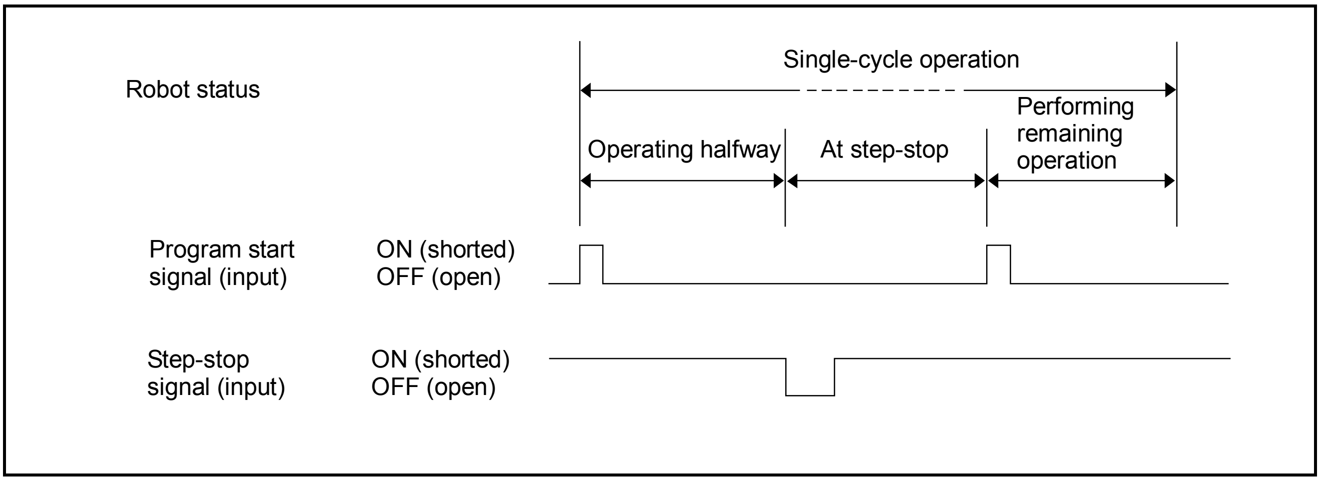



**Figure 5-39 Program Start Operation-2**

**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 Chapter 5 "5.5.4.5 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.

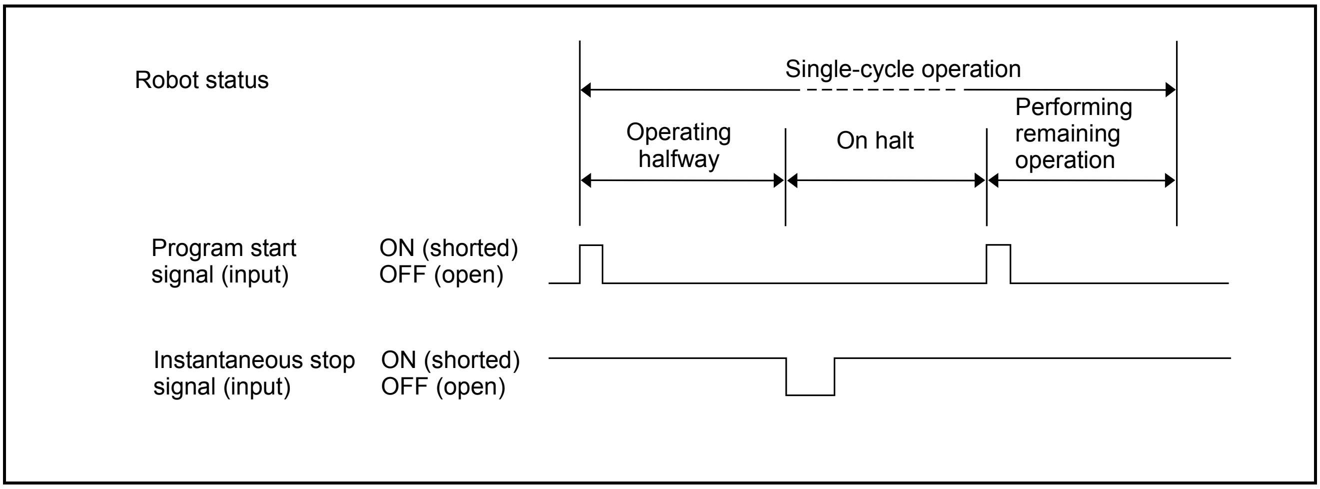



**Figure 5-40 Program Start Operation-3**

**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 Chapter 5 "5.5.4.5 Program Reset (Input)".**

### (4) Example of program start signal (rise) ON and (fall) OFF timing

#### ① Example of program start signal rise (ON) timing

Figure 5-41 shows how to make the program start signal rise with robot system outputs (external mode output and single-cycle end output).

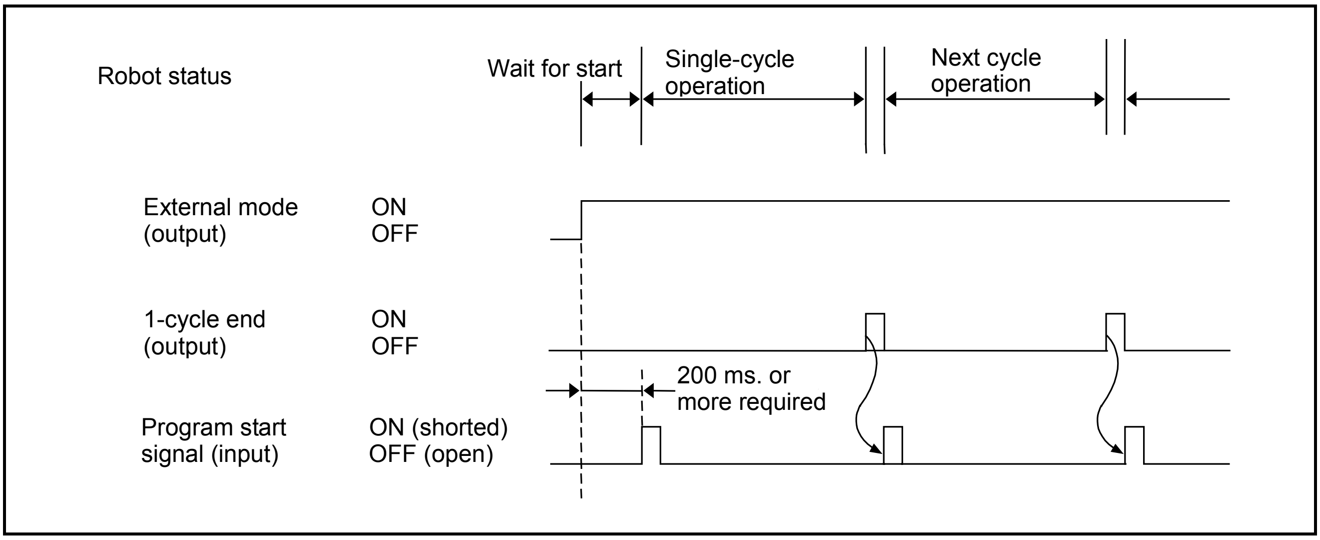



**Figure 5-41 Example of Program Start Signal Rise Timing**

| | |
|---|---|
| **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) Figure 5-42 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).

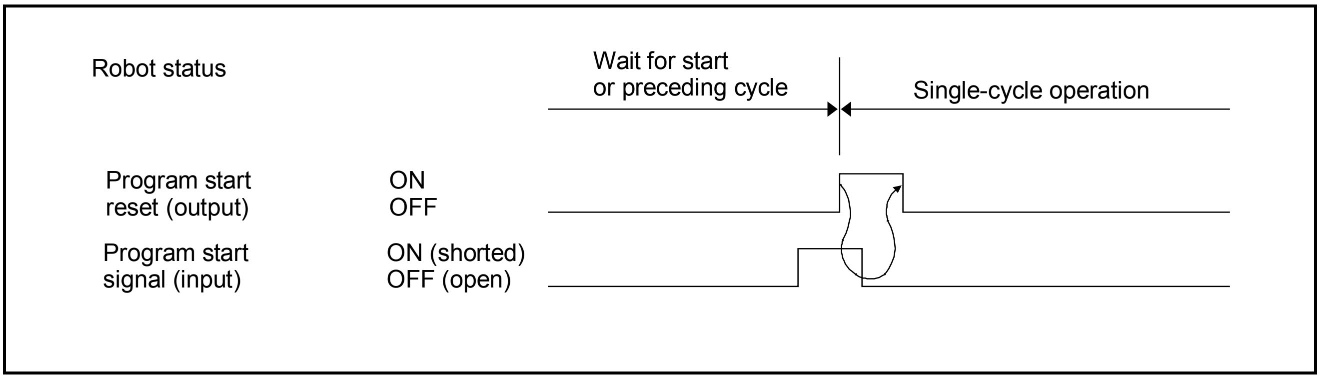



**Figure 5-42  Example of Program Start Signal Fall Timing-1**

b) Figure 5-43 shows how to make the program start signal fall with the simplified method (1 shot method using a timer).

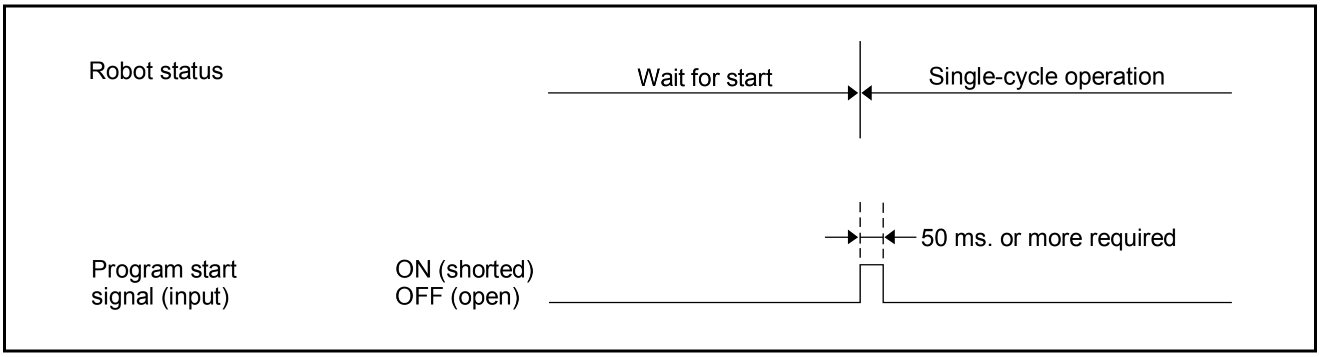



**Figure 5-43  Example of Program Start Signal Fall Timing-2**

**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 Figure 5-44).**
**The change of the status of these signals takes place within 100 msec. after the program start signal rises (ON). See Figure 5-44.**

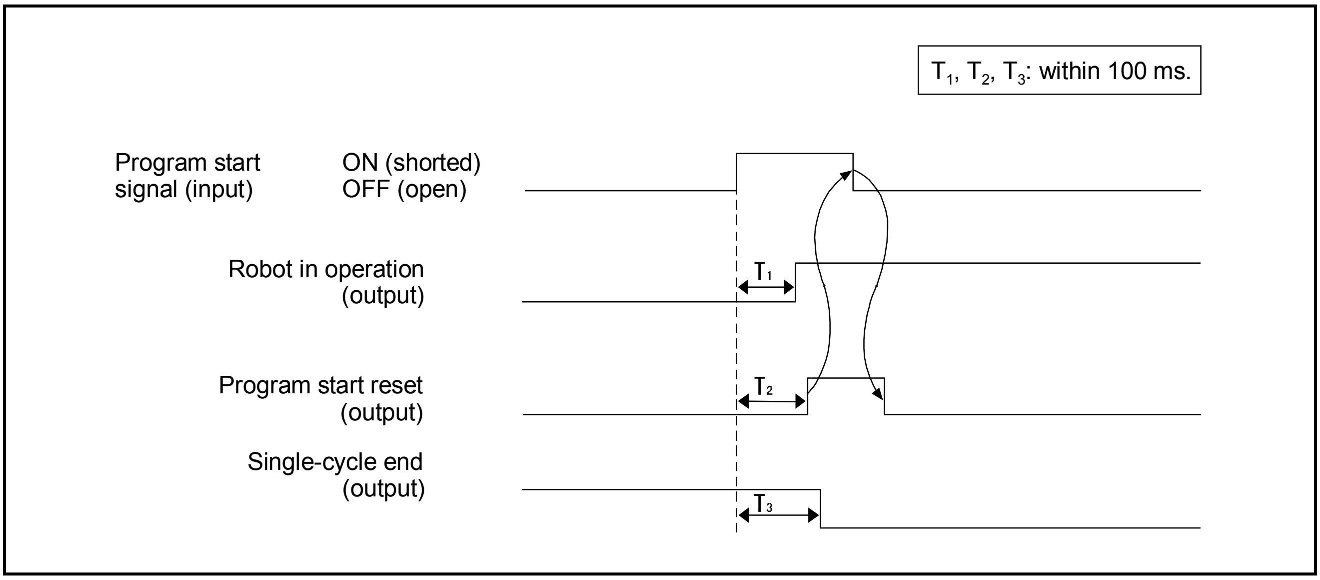



**Figure 5-44 Program Start Signal Rise Output Signal Timing**

### 5.5.4.5 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) Terminal number**

No.24 of connector CN8.

**(3) Input conditions and operation**

**When issued with the Program Start**

① Figure 5-45 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.

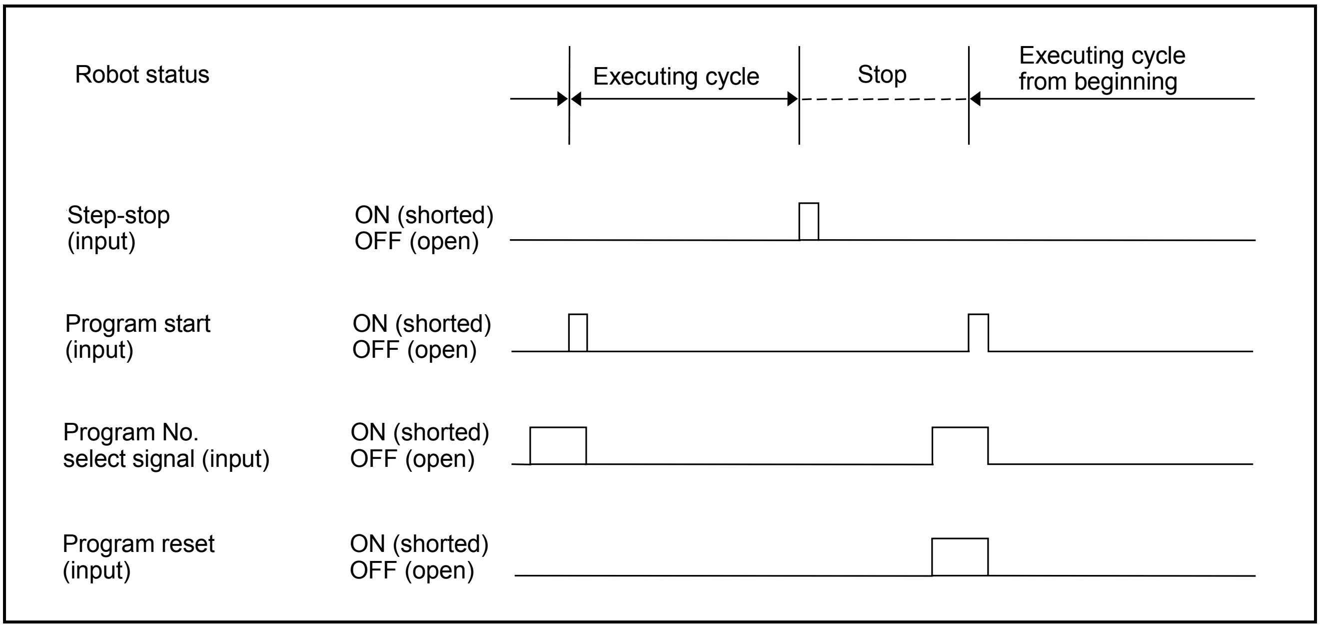



**Figure 5-45 Input Conditions and Operation of Program Reset Signal**

**When issued with the Operation Preparation Start**

① Figure 5-46 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.

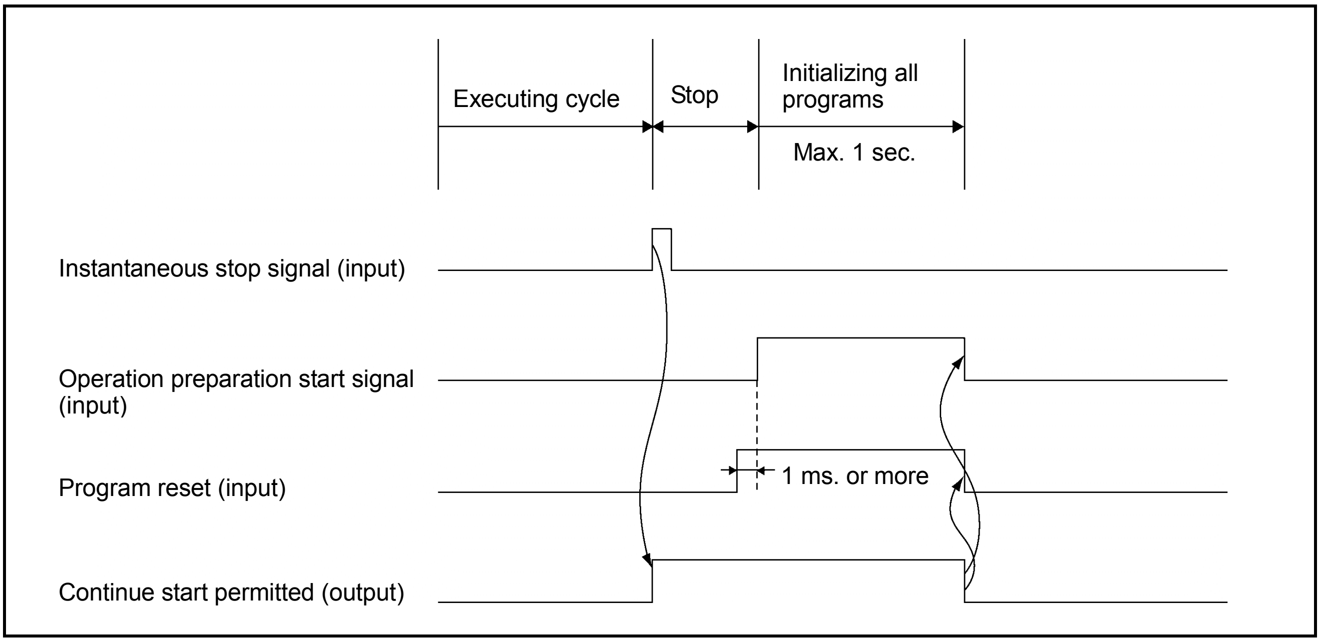



**Figure 5-46 Input Conditions and Operation of Program Reset Signal**

## 5.5.4.6 Robot Stop (Input)

**(2) Function**

① The signal stops the robot with the external device by opening the robot stop input

② The signal readies the power to the robot motor to be turned ON by shorting the robot stop input.

**(2) Terminal number**

No.2 of connector CN8.

**(3) Input conditions and operation**

① The robot stops with this signal OFF (open).

② The power to the robot motor is ready to be turned ON with this signal ON (shorted).

③ Irrespective of whether internal mode (operation with the teach pendant) or external mode (remote operation by the external device) is selected, the power to the robot motor cannot be turned ON with this signal OFF (open). Neither manual nor automatic operation can be performed until this signal is turned ON (shorted). (ERROR2008 will be displayed.)

④ By turning OFF (open) this signal under the following conditions.

1) The power to the motor will be turned OFF, irrespective of whether Manual, Internal Auto, or External Auto mode is selected.
2) During execution of the program (Robot-in-operation signal ON), the power to the motor will be turned OFF and the mode will be switched to internal mode after the robot decelerates to a stop.
3) When the program is at a stop in the Manual and the Auto mode the power to the motor will be turned OFF. The suspended operation can be resumed by turning ON the power to the motor and shorting the ROBOT STOP signal.

⑤ Opening the ROBOT STOP signal and pressing the **ROBOT STOP** button of the operating panel or the teach pendant function the same.

**(4) Input timing**

This signal will be processed prior to all commands and input signals.

## 5.5.4.7 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) Terminal number

No.5 of connector CN8.

### (3) 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 Figure 5-47.
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 Chapter 5 "5.5.4.4 Program Start (Input)".

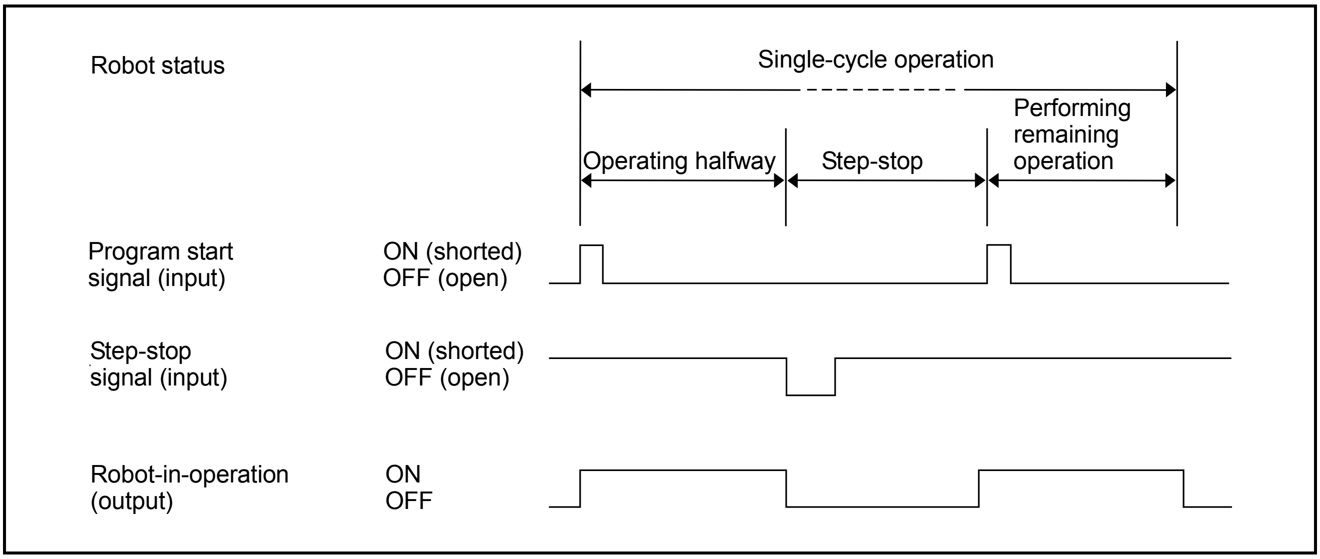



**Figure 5-47  Step Stop Signal**

# 5.5.4.8 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) Terminal number**

No.7 of connector CN8.

**(3) 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 Chapter 5 "5.5.4.4 Program Start (Input)".
④ The minimum required pulse width is 50 msec. or more.

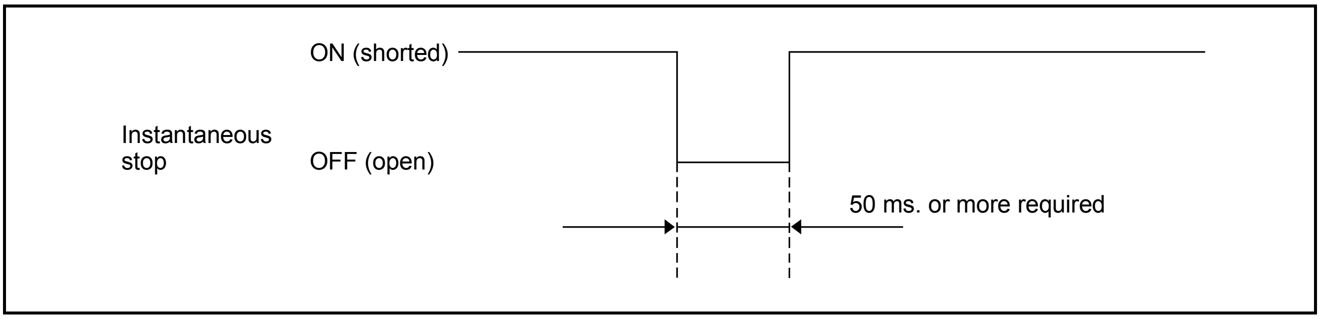



**Figure 5-48 Minimum Instantaneous Stop Pulse Width**

### 5.5.4.9 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) Terminal number**

No.25 of connector CN8.

**NOTE:** Operation preparation start signal is inputted through No. 8 of connector CN8.

**(3) Usage**

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

**(4) Input conditions and operation**

① When a robot failure occurs, clear the error display on the teach 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 in Figure 5-49.

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

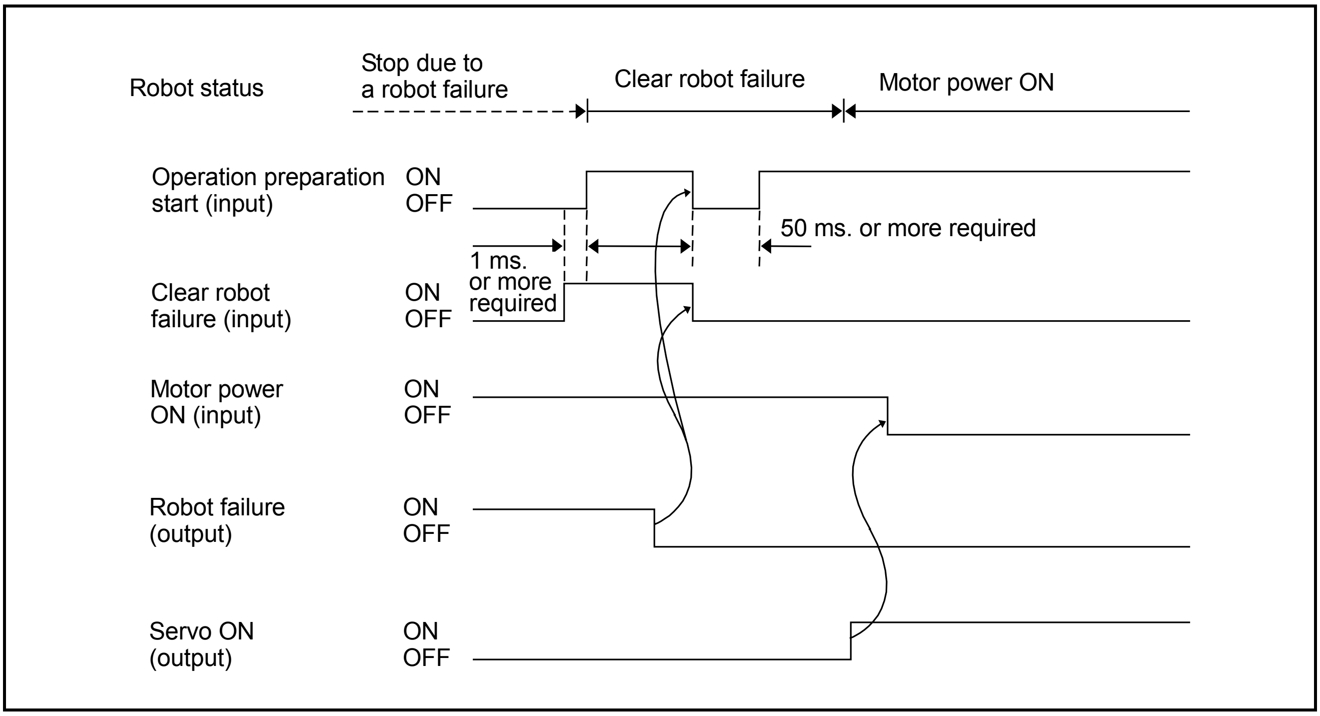



**Figure 5-49  Input Conditions and Operation of Clear Robot Failure Signal**

## 5.5.4.10 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, Chapter 12 "12.3 INTERRUPT ON/OFF (Statement)."**

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

### (2) Terminal number

No.9 of connector CN8.

### (3) Usage

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

### (4) 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.

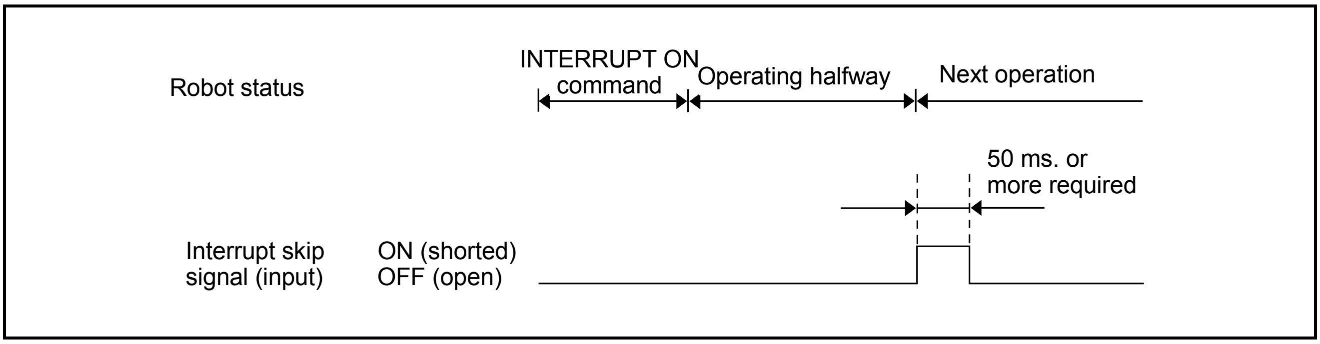



**Figure 5-50 Input Conditions and Operation of Interrupt Skip**

| | |
|---|---|
| ⚠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 Figure 5-51.)** |

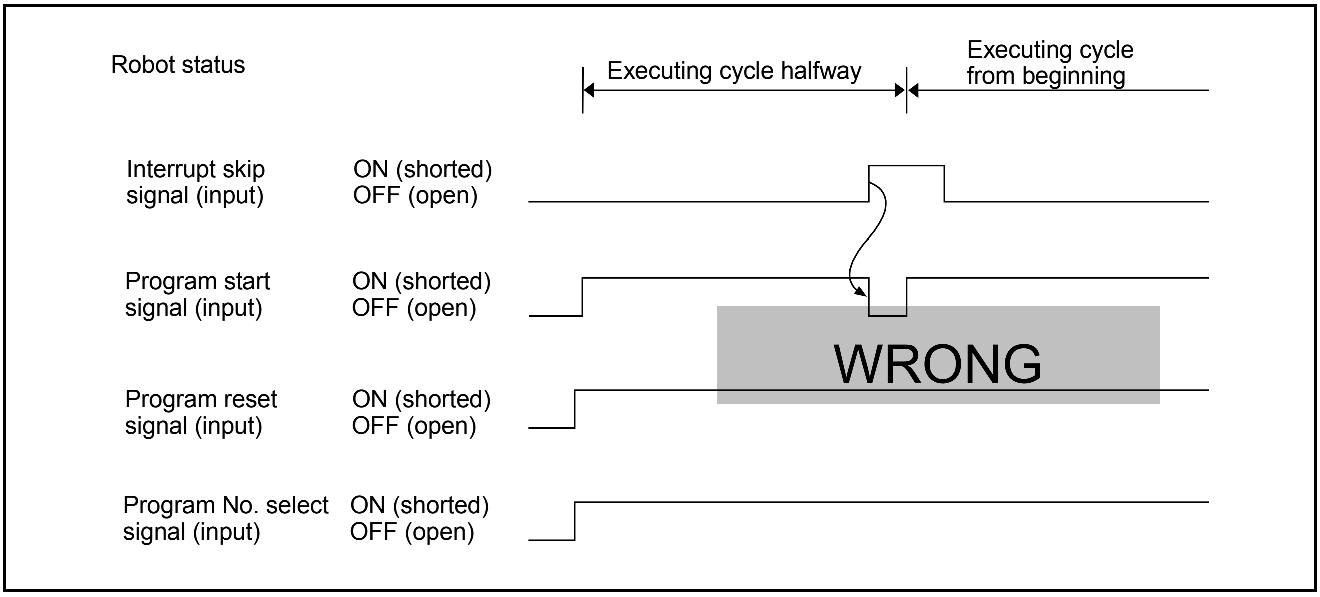



**Figure 5-51 Example of Operation When an Interrupt Skip Signal is Input**

## 5.5.4.11 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) Terminal number

No.6 of connector CN8.

### (3) 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.

# 5.5.5 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 example

In this example there is equipment which makes the robot perform operations by operating an external equipment operating panel connected to the Robot Controller through a PLC as shown in Figure 5-52 and equipped with a display, lamps and switches listed in Table 5-14.

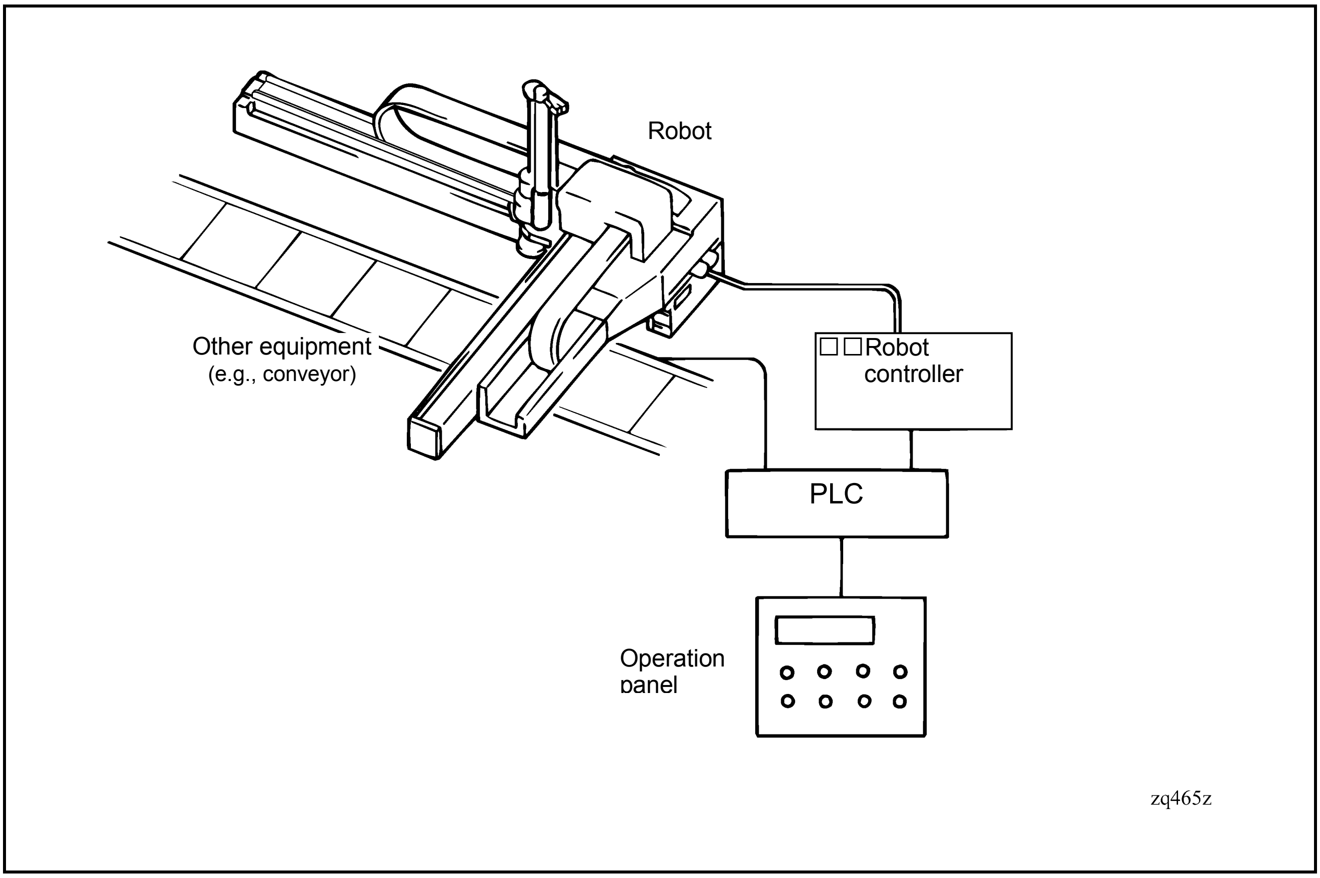



**Figure 5-52 Example of Equipment Using a Robot**

**Table 5-14 Example of Equipment Operating Panel Functions**

| Classification | Part | Application |
|---|---|---|
| Display | Display | Displays messages, such as ROBOT PREPARATION OK. |
| Lamp | ① Automatic operation indicator lamp | · Lights during automatic operation.<br>· Not illuminated when the robot is not in automatic operation. |
| | ② Robot external mode indicator lamp | · Lights when the robot is in external mode.<br>· Turned OFF when the robot is not in external mode. |
| | ③ Operation OK indicator lamp | · Lights when the Enable Auto signal is ON.<br>· 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.<br>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 in Figure 5-52.
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

Figures 5-53 and 5-54 show the relationship between the system I/O signals and the operations by the operator display on the equipment operating panel, processing by the PLC and the operation of the robot when starting and stopping the robot.

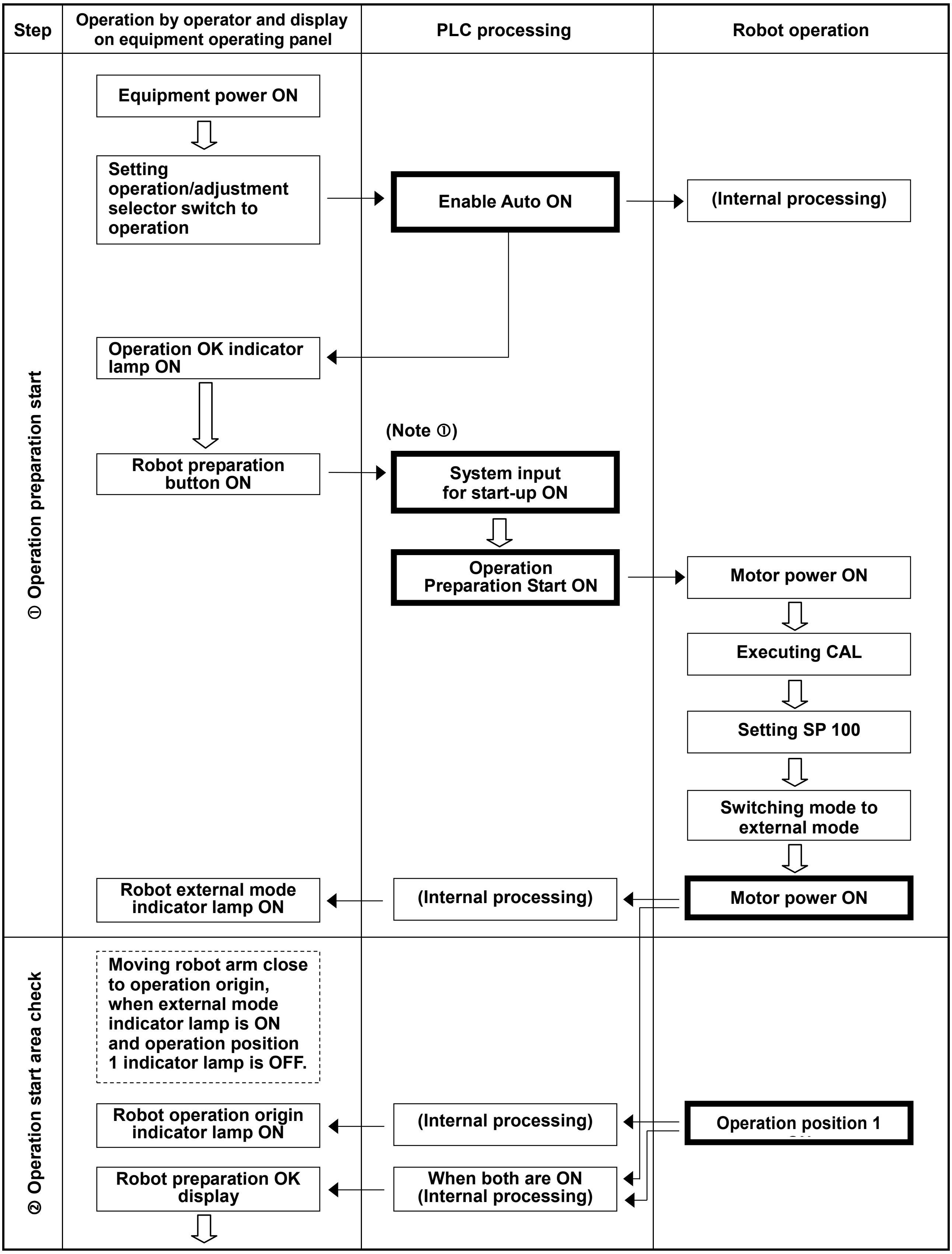
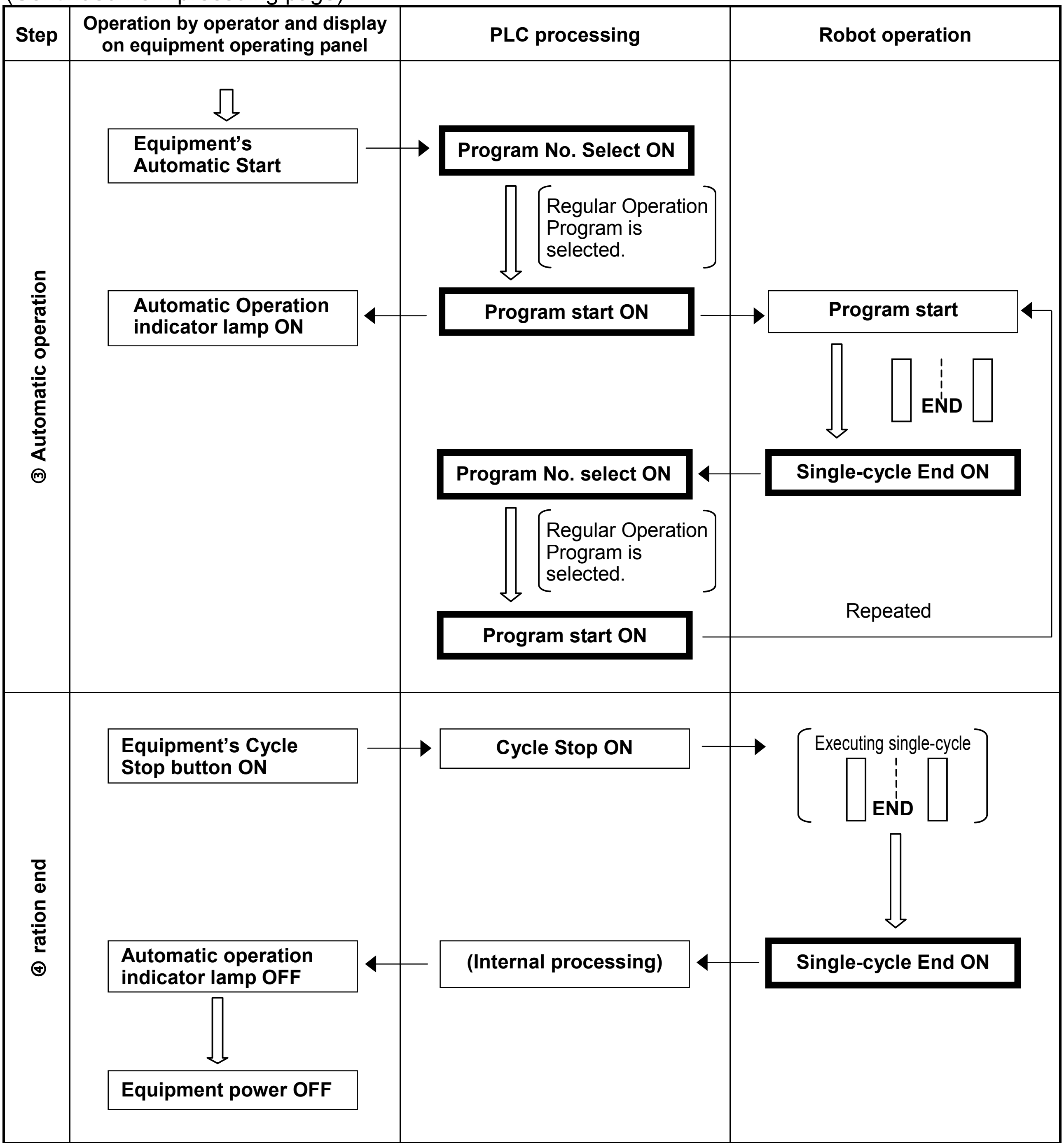



**Figure 5-53 Start and Stop Procedure and System I/O Signals-1**

(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 Chapter 5 "5.5.4.2 Operation Preparation Start (Input)".**

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

**Figure 5-54 Start and Stop Procedure and System I/O Signals-2**

# 5.6 I/O Circuits and Connectors (PNP type)

This section explains the I/O circuit of PNP type (sink input and source output). For the circuit of NPN type (source input and sink output), refer to Appendix 1.

## 5.6.1 I/O Signal Connector Pin Layout

This section describes the Robot Controller connector pin layouts for I/O signals.

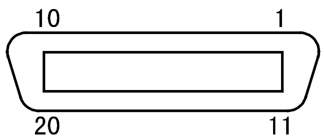
The definitions of the signals and pins of the output connector CN10 and input connector CN8 are different between the standard mode and the compatible mode.

As for the other connectors, the definitions of the pins are common to the standard mode and the compatible mode.

### 5.6.1.1 Connector Pin Layout Common to Both Modes

**(1) HAND I/O CN9: Connector for end-effector I/O (common to both modes)**

**Table 5-15 CN9 Pin Layout, common to both modes (PNP type)**

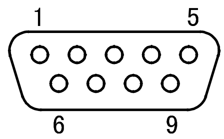



**View from the pin face of cable**

| Terminal No. | Name | Port number | Wire color | | Terminal No. | Name | Port number | Wire color | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Standard | High strength | | | | Standard | High strength |
| 1 | Hand output | 64 | Black | Blue | 11 | Hand Input | 50 | Pink | White |
| 2 | Hand output | 65 | Brown | Yellow | 12 | Hand Input | 51 | Pink | White |
| 3 | Hand output | 66 | Black | Green | 13 | Hand Input | 52 | White | White |
| 4 | Hand output | 67 | Brown | Red | 14 | Hand Input | 53 | White | White |
| 5 | Hand output | 68 | Red | Violet | 15 | Hand Input | 54 | White | White |
| 6 | Hand output | 69 | Orange | Blue | 16 | Hand Input (interrupt input) | 55 | White | Brown |
| 7 | Hand output | 70 | Yellow | Yellow | 17 | Power E0V for Hand | — | White | Brown |
| 8 | Hand output | 71 | Green | Green | 18 | Power E24V for Hand | — | White | Brown |
| 9 | Hand input | 48 | Blue | Red | 19 | Not connected | — | White | Brown |
| 10 | Hand input | 49 | Violet | Violet | 20 | Not connected | — | White | Brown |

### (2) I/O POWER CN7: Power connector for I/O (common to both modes)

**Table 5-16 CN7 Pin Layout, common to both modes (PNP type)**




**View from the pin face of cable**

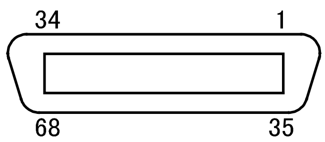
| Terminal No. | Name |
|---|---|
| 1 | Internal power source output +24V |
| 2 | Internal power source output +24V |
| 3 | Internal power source output 0V |
| 4 | Internal power source output 0V |
| 5 | FG |
| 6 | Power input E0V |
| 7 | Power input E0V |
| 8 | Power input E24V |
| 9 | Power input E24V |

⚠**Caution: When using the internal power source, keep the total current capacity below 1.3 A. To use the internal power source of the robot controller, connect the wiring so that the internal power source will be separated from the external power source. Improper wiring may damage the internal circuit.**

## 5.6.1.2 Connector Pin Layout for Standard Mode

### (1) OUTPUT CN10: User-/System-output connector (standard mode)

**Table 5-17 CN10 Pin Layout, for standard mode (PNP type)**

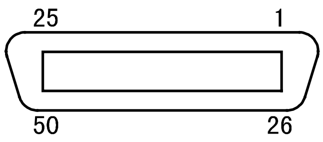



**View from the pin face of cable**

| Terminal number | Name | Port number | Wire color | Terminal number | Name | Port number | Wire color |
|---|---|---|---|---|---|---|---|
| 1 | Normal CPU | 72 | Black | 35 | User output | 106 | Pink |
| 2 | Robot-in-operation | 73 | Brown | 36 | User output | 107 | Pink |
| 3 | Robot Failure | 74 | Red | 37 | User output | 108 | Pink |
| 4 | Servo ON | 75 | Orange | 38 | User output | 109 | Pink |
| 5 | Robot initialization complete | 76 | Yellow | 39 | User output | 110 | Pink |
| 6 | Auto mode | 77 | Black | 40 | User output | 111 | White |
| 7 | External mode | 78 | Brown | 41 | User output | 112 | White |
| 8 | Dead battery warning | 79 | Red | 42 | User output | 113 | White |
| 9 | Robot warning | 80 | Orange | 43 | User output | 114 | White |
| 10 | Continue start permitted | 81 | Yellow | 44 | User output | 115 | White |
| 11 | SS mode | 82 | Green | 45 | User output | 116 | White |
| 12 | Reserved | 83 | Blue | 46 | User output | 117 | White |
| 13 | Reserved | 84 | Violet | 47 | User output | 118 | White |
| 14 | Reserved | 85 | Gray | 48 | User output | 119 | White |
| 15 | Command processing complete | 86 | Pink | 49 | User output | 120 | White |
| 16 | Status area odd parity | 87 | Black | 50 | User output | 121 | Gray |
| 17 | Status area bit 0 | 88 | Black | 51 | User output | 122 | Violet |
| 18 | Status area bit 1 | 89 | Brown | 52 | User output | 123 | Violet |
| 19 | Status area bit 2 | 90 | Red | 53 | User output | 124 | Violet |
| 20 | Status area bit 3 | 91 | Orange | 54 | User output | 125 | Violet |
| 21 | Status area bit 4 | 92 | Yellow | 55 | User output | 126 | Violet |
| 22 | Status area bit 5 | 93 | Green | 56 | User output | 127 | Violet |
| 23 | Status area bit 6 | 94 | Blue | 57 | Not used. | — | Violet |
| 24 | Status area bit 7 | 95 | Gray | 58 | Not used. | — | Violet |
| 25 | Status area bit 8 | 96 | Pink | 59 | Not used. | — | Violet |
| 26 | Status area bit 9 | 97 | Brown | 60 | Not used. | — | Gray |
| 27 | Status area bit 10 | 98 | Red | 61 | Not used. | — | Gray |
| 28 | Status area bit 11 | 99 | Orange | 62 | Not used. | — | Gray |
| 29 | Status area bit 12 | 100 | Yellow | 63 | Not used. | — | Gray |
| 30 | Status area bit 13 | 101 | Green | 64 | Not used. | — | Gray |
| 31 | Status area bit 14 | 102 | Blue | 65 | Emergency stop + | — | Gray |
| 32 | Status area bit 15 | 103 | Pink | 66 | Emergency stop – | — | Gray |
| 33 | User output | 104 | Black | 67 | Not used. | — | Blue |
| 34 | User output | 105 | Brown | 68 | Not used. | — | Blue |

### (2) INPUT CN8: User-/System-input connector (standard mode)

**Table 5-18 CN8 Pin Layout, for standard mode (PNP type)**



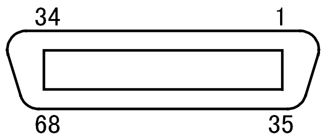

**View from the pin face of cable**

| Terminal number | Name | Port number | Wire color | Terminal number | Name | Port number | Wire color |
|---|---|---|---|---|---|---|---|
| 1 | Power for robot stop (internal +24V) | — | Black | 26 | Data area 2 bit 7 | 21 | Pink |
| 2 | Robot stop | — | Brown | 27 | Data area 2 bit 8 | 22 | Pink |
| 3 | Power for Enable Auto (internal +24V) | — | Red | 28 | Data area 2 bit 9 | 23 | Pink |
| 4 | Enable Auto | — | Black | 29 | Data area 2 bit 10 | 24 | White |
| 5 | Step-stop (all tasks) | 0 | Brown | 30 | Data area 2 bit 11 | 25 | White |
| 6 | Not used. | 1 | Red | 31 | Data area 2 bit 12 | 26 | White |
| 7 | Instantaneous stop (all tasks) | 2 | Orange | 32 | Data area 2 bit 13 | 27 | White |
| 8 | Strobe signal | 3 | Yellow | 33 | Data area 2 bit 14 | 28 | White |
| 9 | Interrupt skip | 4 | Green | 34 | Data area 2 bit 15 | 29 | White |
| 10 | Command and data odd parity | 5 | Blue | 35 | Command area 0 bit 0 | 30 | White |
| 11 | Data area 1 bit 0 | 6 | Violet | 36 | Command area 0 bit 1 | 31 | White |
| 12 | Data area 1 bit 1 | 7 | Black | 37 | Command area 0 bit 2 | 32 | Gray |
| 13 | Data area 1 bit 2 | 8 | Brown | 38 | Command area 0 bit 3 | 33 | Gray |
| 14 | Data area 1 bit 3 | 9 | Red | 39 | User input | 34 | Gray |
| 15 | Data area 1 bit 4 | 10 | Orange | 40 | User input | 35 | Gray |
| 16 | Data area 1 bit 5 | 11 | Yellow | 41 | User input | 36 | Gray |
| 17 | Data area 1 bit 6 | 12 | Green | 42 | User input | 37 | Gray |
| 18 | Data area 1 bit 7 | 13 | Blue | 43 | User input | 38 | Gray |
| 19 | Data area 2 bit 0 | 14 | Violet | 44 | User input | 39 | Gray |
| 20 | Data area 2 bit 1 | 15 | White | 45 | User input | 40 | Gray |
| 21 | Data area 2 bit 2 | 16 | Pink | 46 | User input | 41 | Gray |
| 22 | Data area 2 bit 3 | 17 | Black | 47 | User input | 42 | Violet |
| 23 | Data area 2 bit 4 | 18 | Brown | 48 | User input | 43 | Violet |
| 24 | Data area 2 bit 5 | 19 | Red | 49 | User input | 44 | Violet |
| 25 | Data area 2 bit 6 | 20 | Orange | 50 | User input | 45 | Violet |

## 5.6.1.3 Connector Pin Layout for Compatible Mode

### (1) OUTPUT CN10: User-/System-output connector (compatible mode)

**Table 5-19 CN10 Pin Layout, for compatible mode (PNP type)**

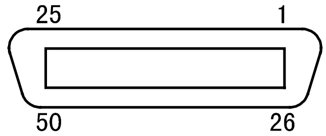



**View from the pin face of cable**

| Terminal number | Name | Port number | Wire color | Terminal number | Name | Port number | Wire color |
|---|---|---|---|---|---|---|---|
| 1 | Normal CPU | 72 | Black | 35 | User output | 106 | Pink |
| 2 | Robot-in-operation | 73 | Brown | 36 | User output | 107 | Pink |
| 3 | Robot failure | 74 | Red | 37 | User output | 108 | Pink |
| 4 | Auto mode | 75 | Orange | 38 | User output | 109 | Pink |
| 5 | External mode | 76 | Yellow | 39 | User output | 110 | Pink |
| 6 | Program start reset | 77 | Black | 40 | User output | 111 | White |
| 7 | Not used. | 78 | Brown | 41 | User output | 112 | White |
| 8 | Not used. | 79 | Red | 42 | User output | 113 | White |
| 9 | Robot power ON complete | 80 | Orange | 43 | User output | 114 | White |
| 10 | Servo ON | 81 | Yellow | 44 | User output | 115 | White |
| 11 | CAL complete | 82 | Green | 45 | User output | 116 | White |
| 12 | Teaching | 83 | Blue | 46 | User output | 117 | White |
| 13 | Single-cycle complete | 84 | Violet | 47 | User output | 118 | White |
| 14 | Dead battery warning | 85 | Gray | 48 | User output | 119 | White |
| 15 | Robot warning | 86 | Pink | 49 | User output | 120 | White |
| 16 | Continue start permitted | 87 | Black | 50 | User output | 121 | Gray |
| 17 | Error units bit 0 | 88 | Black | 51 | User output | 122 | Violet |
| 18 | Error units bit 1 | 89 | Brown | 52 | User output | 123 | Violet |
| 19 | Error units bit 2 | 90 | Red | 53 | User output | 124 | Violet |
| 20 | Error units bit 3 | 91 | Orange | 54 | User output | 125 | Violet |
| 21 | Error tens bit 0 | 92 | Yellow | 55 | User output | 126 | Violet |
| 22 | Error tens bit 1 | 93 | Green | 56 | User output | 127 | Violet |
| 23 | Error tens bit 2 | 94 | Blue | 57 | Not connected | — | Violet |
| 24 | Error tens bit 3 | 95 | Gray | 58 | Not connected | — | Violet |
| 25 | Error hundreds bit 0 | 96 | Pink | 59 | Not connected | — | Violet |
| 26 | Error hundreds bit 1 | 97 | Brown | 60 | Not connected | — | Gray |
| 27 | Error hundreds bit 2 | 98 | Red | 61 | Not connected | — | Gray |
| 28 | Error hundreds bit 3 | 99 | Orange | 62 | Not connected | — | Gray |
| 29 | SS mode | 100 | Yellow | 63 | Not connected | — | Gray |
| 30 | Not used. | 101 | Green | 64 | Not connected | — | Gray |
| 31 | Not used. | 102 | Blue | 65 | Emergency stop + | — | Gray |
| 32 | Not used. | 103 | Pink | 66 | Emergency stop – | — | Gray |
| 33 | User output | 104 | Black | 67 | Not connected | — | Blue |
| 34 | User output | 105 | Brown | 68 | Not connected | — | Blue |

### (2) INPUT CN8: User-/System-input connector (compatible mode)

**Table 5-20 CN8 Pin Layout, for compatible mode (PNP type)**




**View from the pin face of cable**

| Terminal number | Name | Port number | Wire color | Terminal number | Name | Port number | Wire color |
|---|---|---|---|---|---|---|---|
| 1 | Power for robot stop (internal +24V) | - | Black | 26 | User input | 21 | Pink |
| 2 | Robot stop | - | Brown | 27 | User input | 22 | Pink |
| 3 | Power for Enable Auto (internal +24V) | - | Red | 28 | User input | 23 | Pink |
| 4 | Enable Auto | - | Black | 29 | User input | 24 | White |
| 5 | Step-stop (all tasks) | 0 | Brown | 30 | User input | 25 | White |
| 6 | Continue start | 1 | Red | 31 | User input | 26 | White |
| 7 | Instantaneous stop (all tasks) | 2 | Orange | 32 | User input | 27 | White |
| 8 | Operation preparation start | 3 | Yellow | 33 | User input | 28 | White |
| 9 | Interrupt skip | 4 | Green | 34 | User input | 29 | White |
| 10 | Program start | 5 | Blue | 35 | User input | 30 | White |
| 11 | Program No. select bit 0 | 6 | Violet | 36 | User input | 31 | White |
| 12 | Program No. select bit 1 | 7 | Black | 37 | User input | 32 | Gray |
| 13 | Program No. select bit 2 | 8 | Brown | 38 | User input | 33 | Gray |
| 14 | Program No. select bit 3 | 9 | Red | 39 | User input | 34 | Gray |
| 15 | Program No. select bit 4 | 10 | Orange | 40 | User input | 35 | Gray |
| 16 | Program No. select bit 5 | 11 | Yellow | 41 | User input | 36 | Gray |
| 17 | Program No. select bit 6 | 12 | Green | 42 | User input | 37 | Gray |
| 18 | Program No. select odd parity bit | 13 | Blue | 43 | User input | 38 | Gray |
| 19 | Motor power ON | 14 | Violet | 44 | User input | 39 | Gray |
| 20 | CAL execution | 15 | White | 45 | User input | 40 | Gray |
| 21 | Reserved | 16 | Pink | 46 | User input | 41 | Gray |
| 22 | SP100 | 17 | Black | 47 | User input | 42 | Violet |
| 23 | Switch Ext Mode | 18 | Brown | 48 | User input | 43 | Violet |
| 24 | Program reset | 19 | Red | 49 | User input | 44 | Violet |
| 25 | Clear robot failure | 20 | Orange | 50 | User input | 45 | Violet |

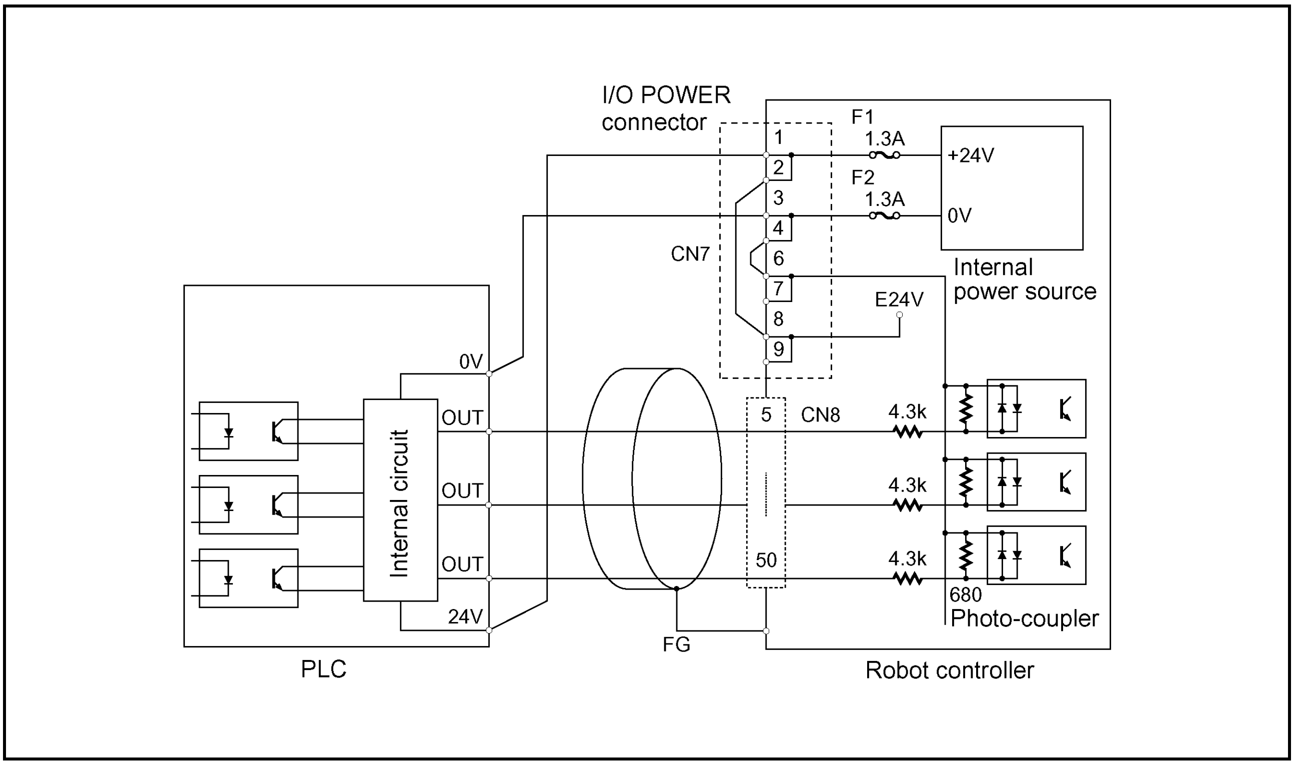
## 5.6.2 Robot Controller I/O Circuits

### 5.6.2.1 User-Input, System-Input and Hand-Input Circuits

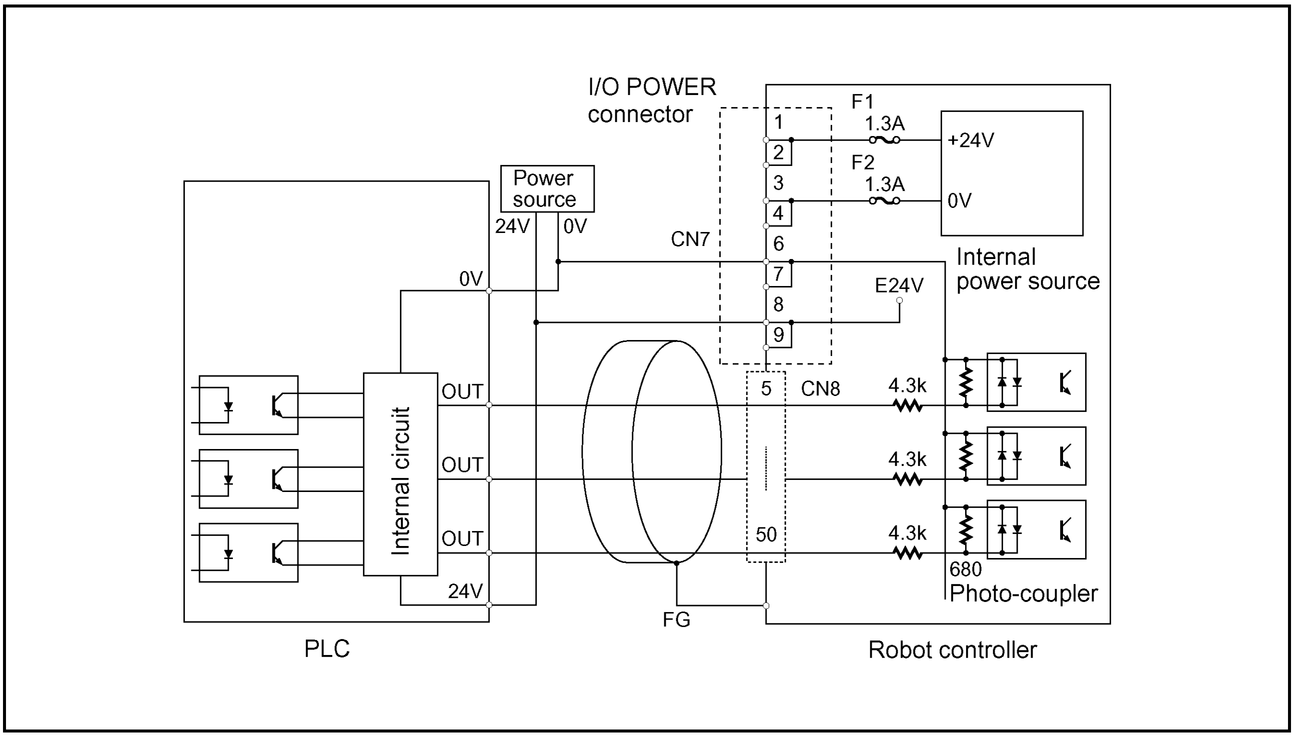
Figures 5-55 and 5-56 show examples of the user-input, system-input and hand-input circuit configurations and connections of the robot controller.

The maximum allowable current capacity of the robot controller's internal power source is 1.3 A. Use the internal power source within this allowable range.

| | | |
|---|---|---|
| **Caution** | 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. The 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, set a PLC Output card for each robot.** |
| | ③ | **Other than a PLC, a proximity switch, or a relay contact may be connected directly to the input terminal of the Robot Controller. In such a case, use the power input to pins 6 to 9 of the I/O power connector. A two-wire photoelectric switch or proximity switch can be connected if its leakage current is 1 mA or less.** |
| | ④ | **Use a multi-core shielding cable for the purpose of protecting the robot controller from noise. Ground it to the robot controller.** |

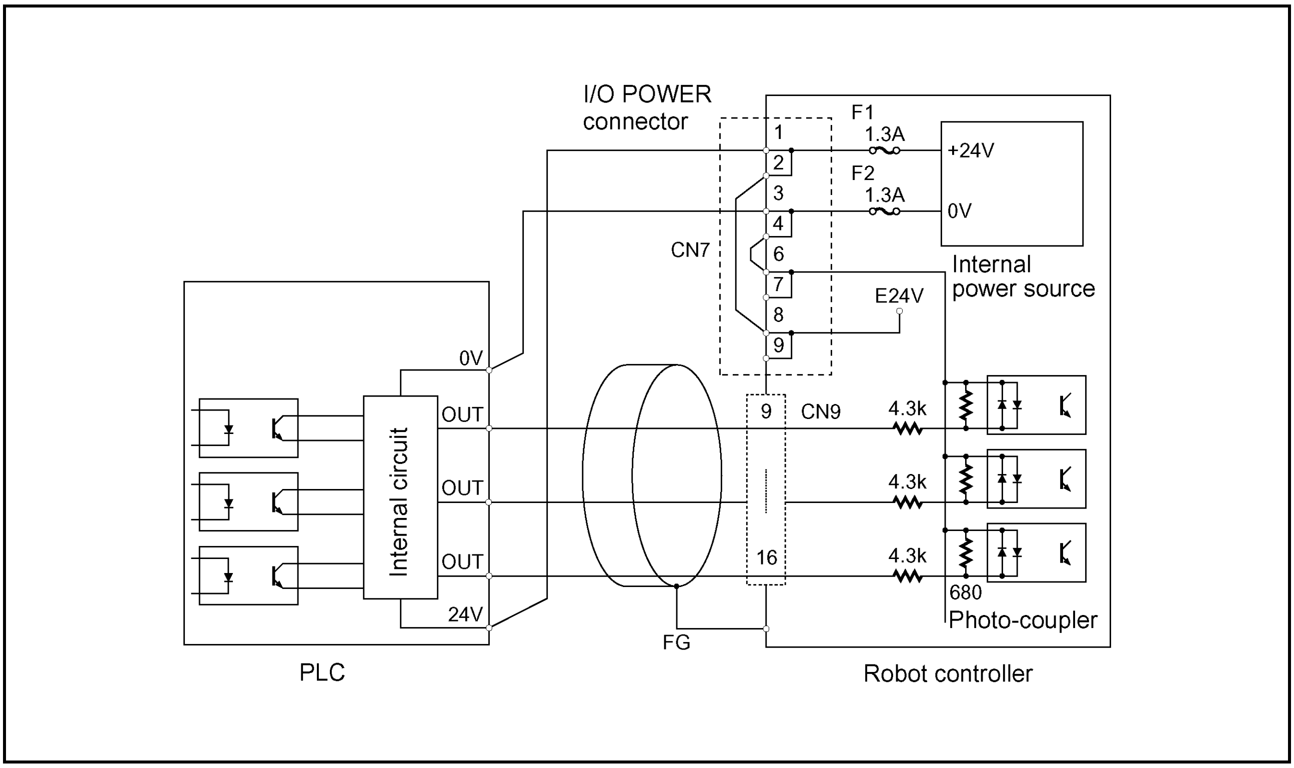



(When the internal power source is used)

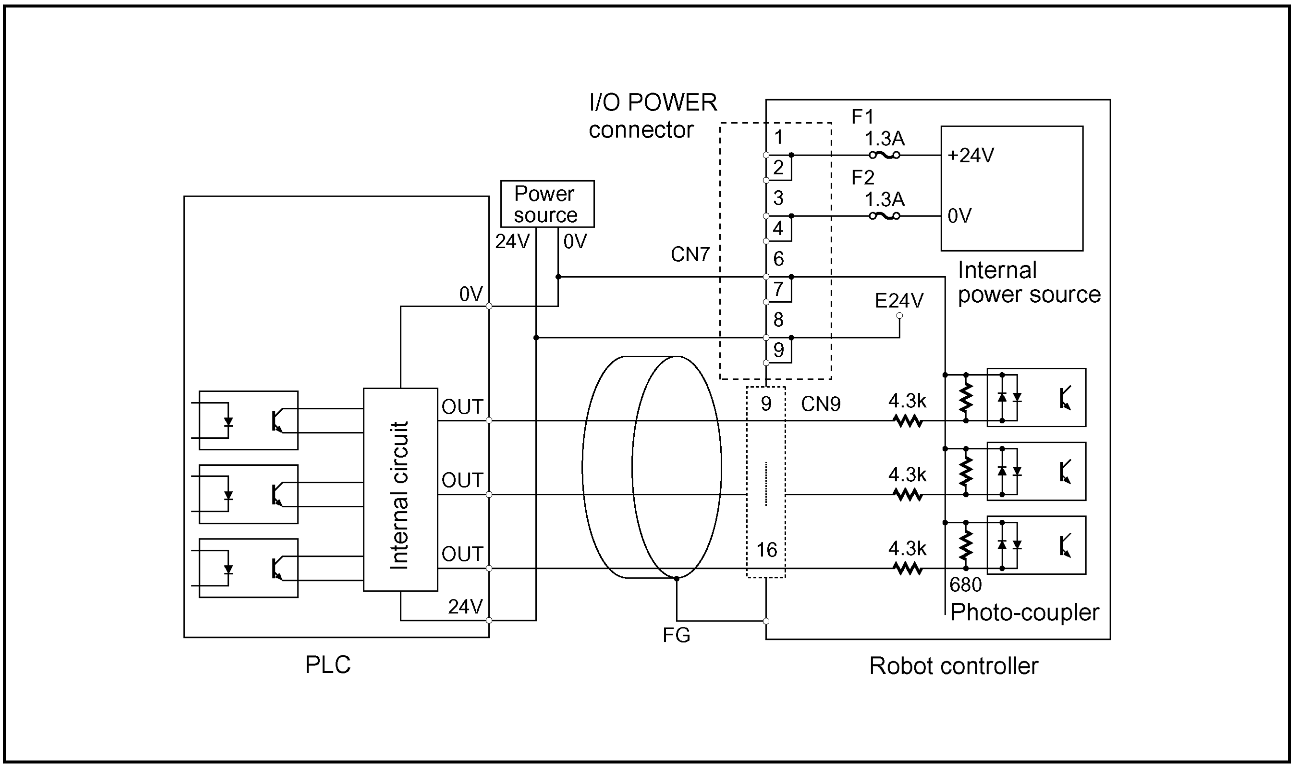



(When an external power source is used)

**Figure 5-55 User-Input and System-Input Circuits (PNP type)**




(When the internal power source is used)




(When an external power source is used)

**Figure 5-56 Hand-Input Circuits (PNP type)**

## 5.6.2.2 Robot Stop and Enable Auto Input Circuits

The Robot Stop and Enable Auto signals are important for safety. The input circuit for these signals must have contacts as shown in Figure 5-57.

Use the INPUT CN8 (pins 1 and 3) of the robot controller for the power source, irrespective of whether the power source to be used for other I/O signals is the internal power source or an external power source.

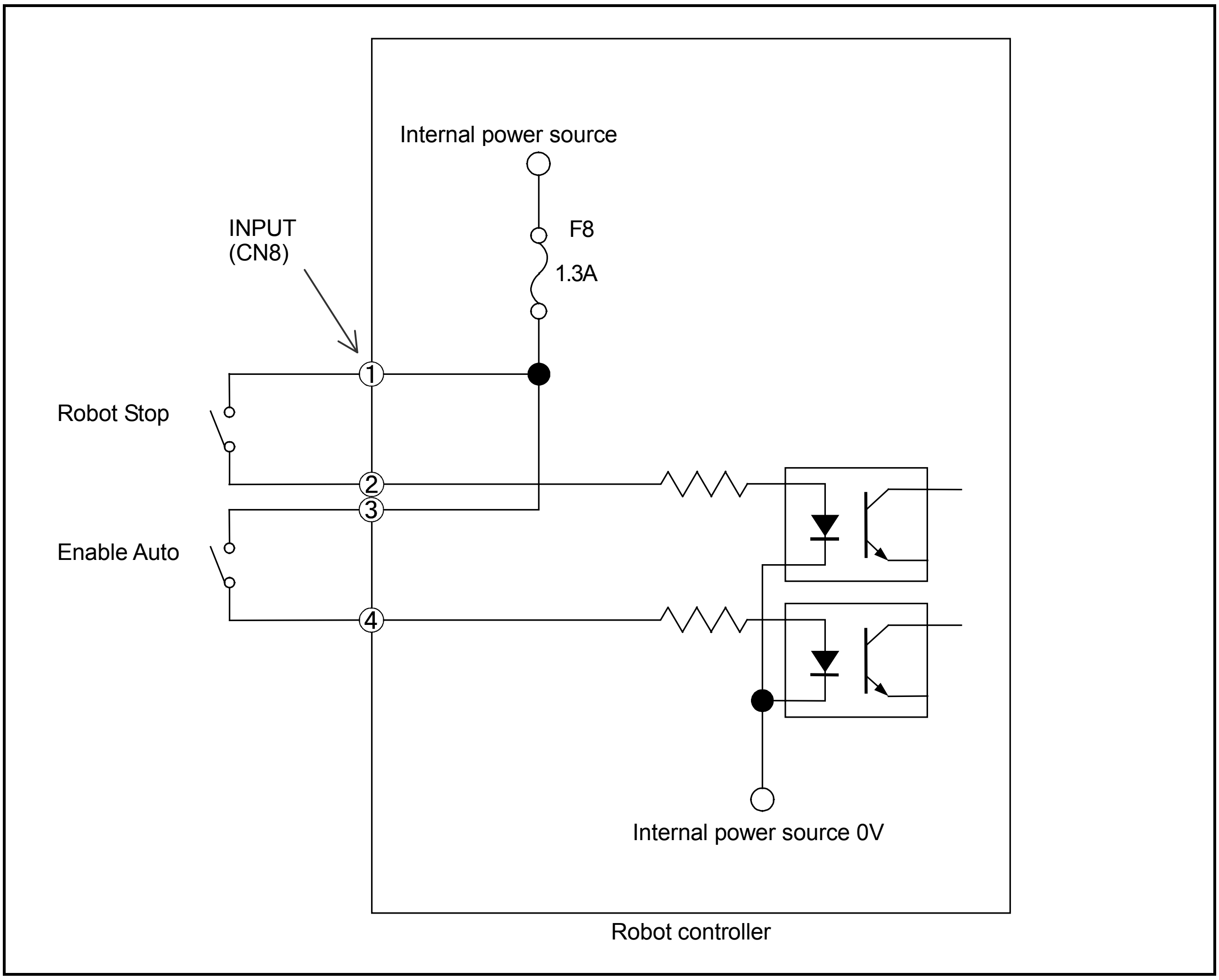



**Figure 5-57 Robot Stop and Enable Auto Input Circuits**

**TIP:** The configuration sample of an emergency stop output circuitry is shown in Subsection 5.6.2.4.

## 5.6.2.3 User-Output, System-Output, and Hand-Output Circuits

Figures 5-58 and 5-59 show an example of the configuration and connection of the Robot Controller's user-input output, system-output and hand-output circuit.

Since the initial resistance of a lamp is small, the output circuit may be damaged by rush current that flows when the lamp lights.

When directly turning a lamp ON or OFF, use a lamp whose rating is 0.5W or less.

To reduce rush current, connect a resistor R that allows dark current 1/3 or less of the rated current to flow when the lamp goes OFF.

Figure 5-60 shows an example of connecting a lamp.

**(1) The User-Output, System-Output and Hand-Output Circuit are open collector output circuits.**

**(2) The maximum allowable source current is 70mA.**
**Keep the current consumption of a device to be connected to the Robot Controller, such as a PLC and a relay coil, below the allowable current.**

**(3) Select an induction load, such as a relay coil, which has a built-in diode (for absorbing inverse electromotive force).**
**To use an induction load without a built-in diode, add a diode equivalent to the 1S1888 (Toshiba) in close vicinity to the coil.**

> ⚠**Caution: When externally attaching a diode, connect it with correct polarity. Incorrect polarity may damage the Output circuit.**

**(4) Connecting a lamp requires a circuit through which dark current flows.**

> ⚠**Caution: Since the initial resistance of a lamp is small, the output circuit may be damaged by rush current that flows when the lamp lights.**
> **Refer to Figure 5-60.**

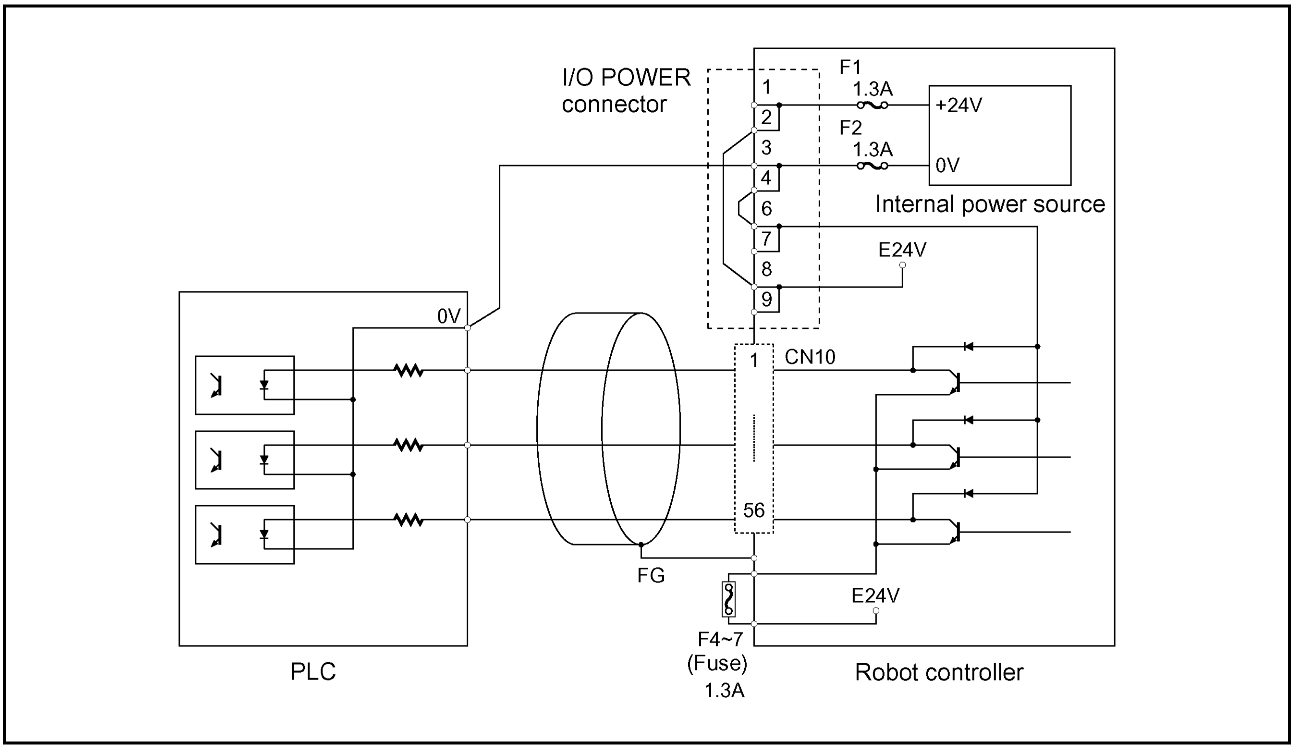
**(5) When using the internal power source, prepare a PLC input circuit unit that does not contain a power source.**

> ⚠**Caution: Keep the total current capacity of the internal power source below 1.3A.**

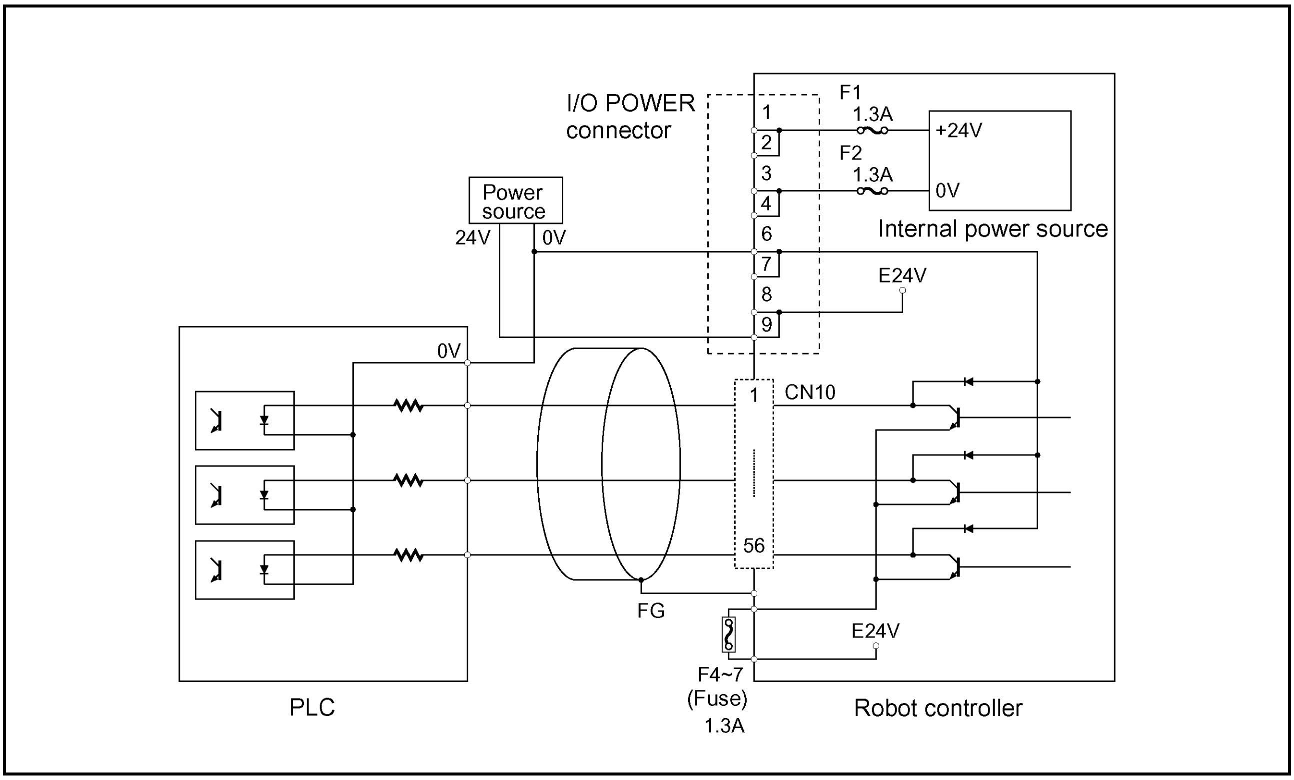
**(6) Use a multi-core shielding cable for the purpose of protecting the devices from external noise. Ground it to the robot controller.**

**(7) 24V internal power source of the robot controller must not be grounded.**

> ⚠**Caution: If the output terminal +24V of internal power source is grounded, there may be a case where the controller is damaged.**

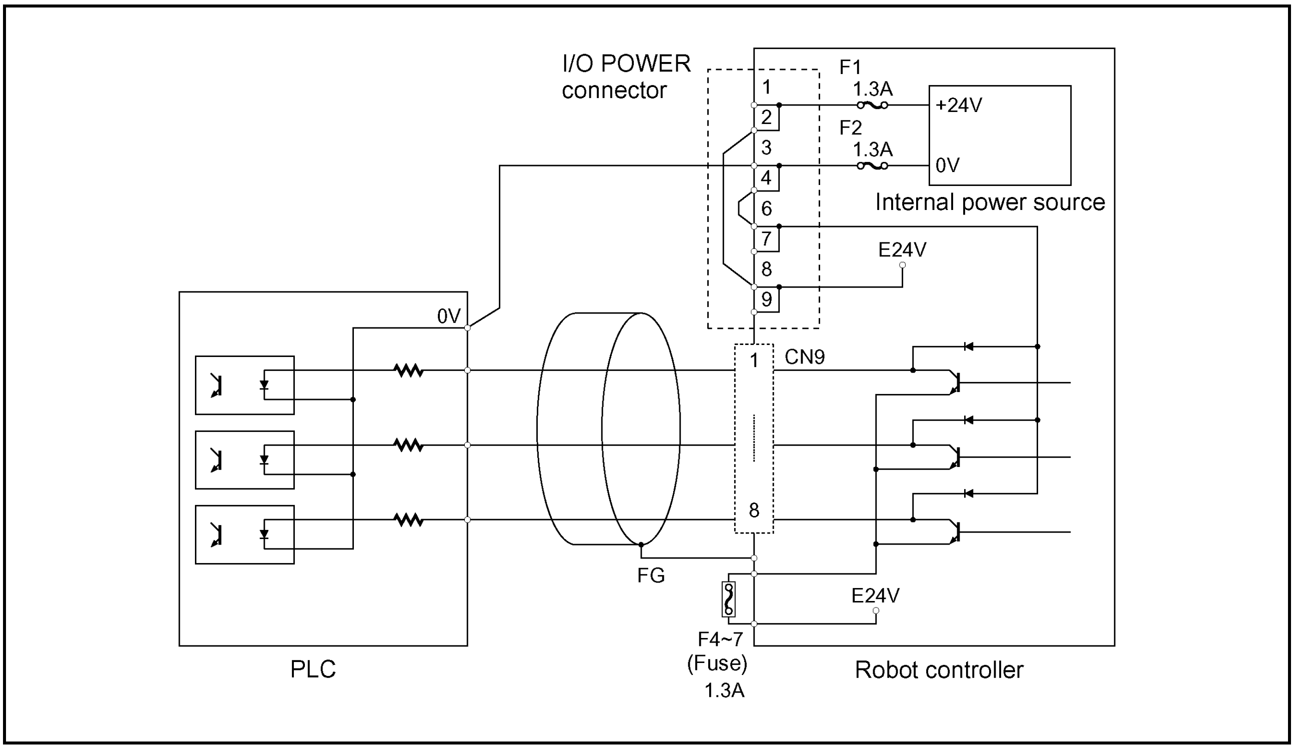



**(When the internal power source is used)**

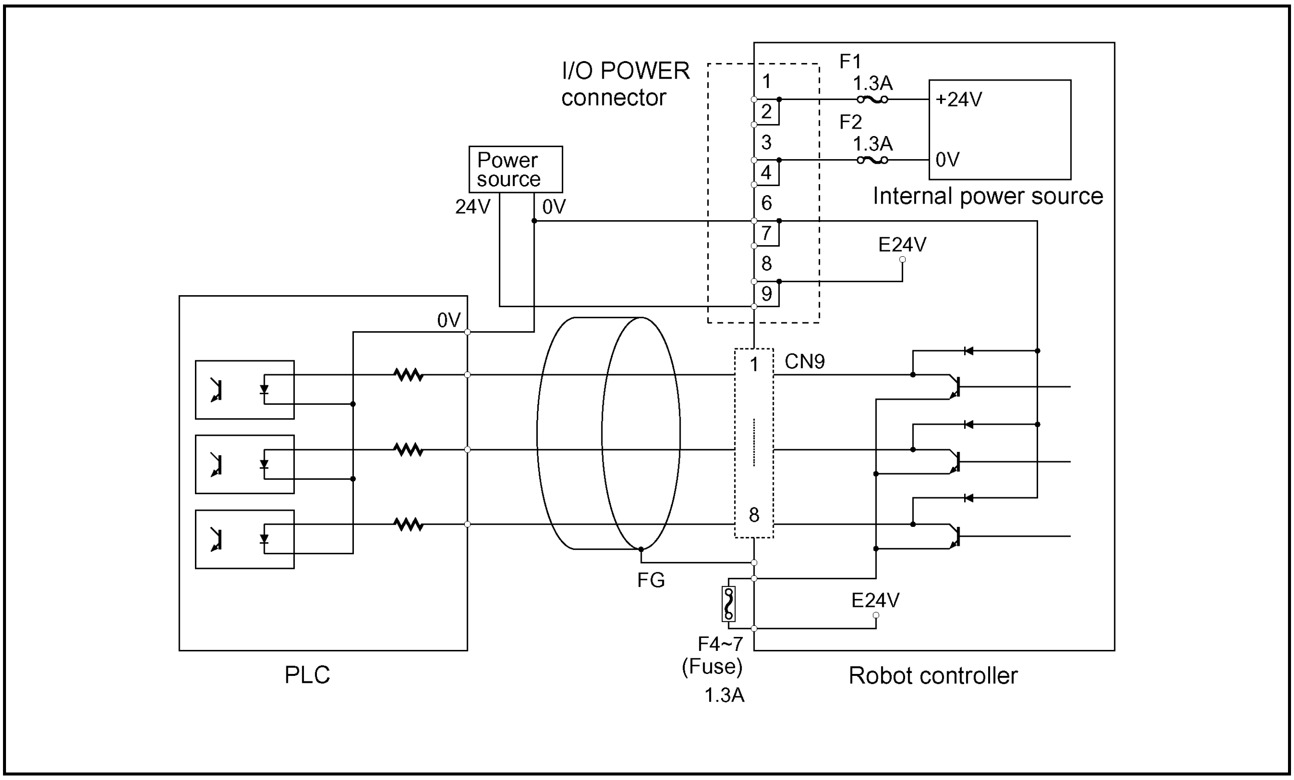



**(When an external power source is used)**

**Figure 5-58 User-Output and System-Output Circuits (PNP type)**




**(When the internal power source is used)**




**(When an external power source is used)**

**Figure 5-59 Hand-Output Circuits (PNP type)**

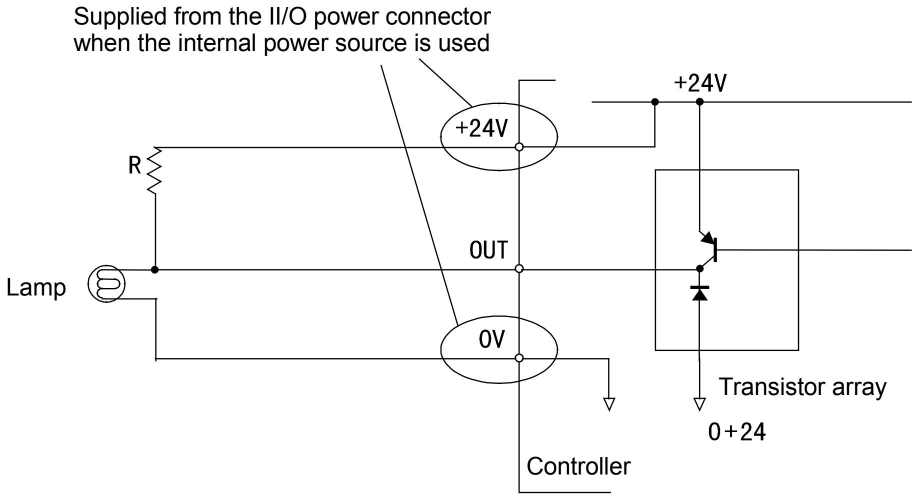
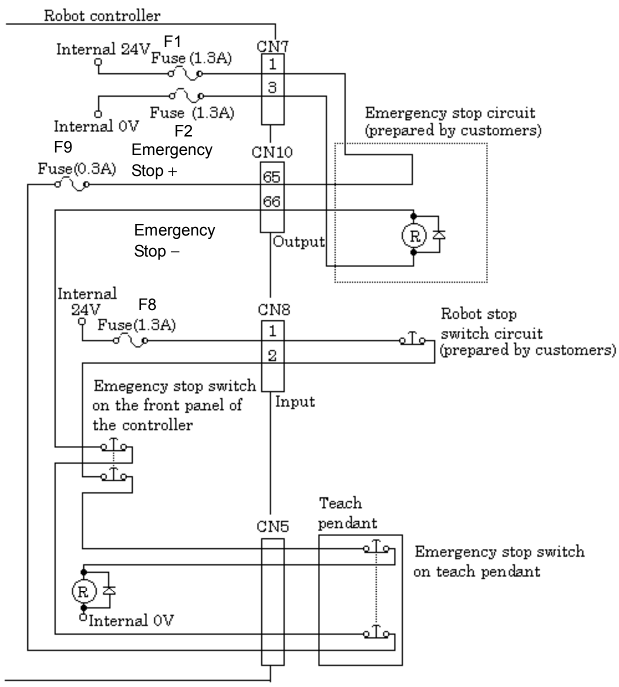



**Figure 5-60  Example of Circuit with Lamp (PNP type)**

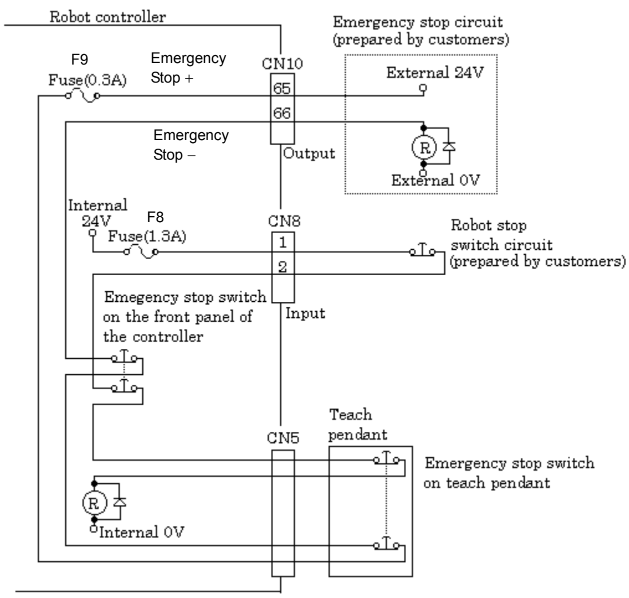
## 5.6.2.4 Emergency Stop Output Circuit

Figure 5-61 shows the examples of configuration and connection of emergency stop circuit for the robot controller.

The red mushroom-shaped switch provided on the robot controller front panel, on the teach pendant, or on the operating panel can be used as a switch for stopping the equipment in case of emergency.




**(When the internal power source is used)**




**(When an external power source is used)**

**Figure 5-61 Emergency Stop Output Circuit**

## 5.6.2.5 I/O Power Connector

For the power source to communicate signals between the robot controller and the external device, the internal power source of the robot controller or an external power source is used.

Figure 5-62 (a) shows an example of connecting I/O power connectors when the internal power source is used, and Figure 5-62 (b) shows an example of connecting I/O power connectors when an external power source is used.

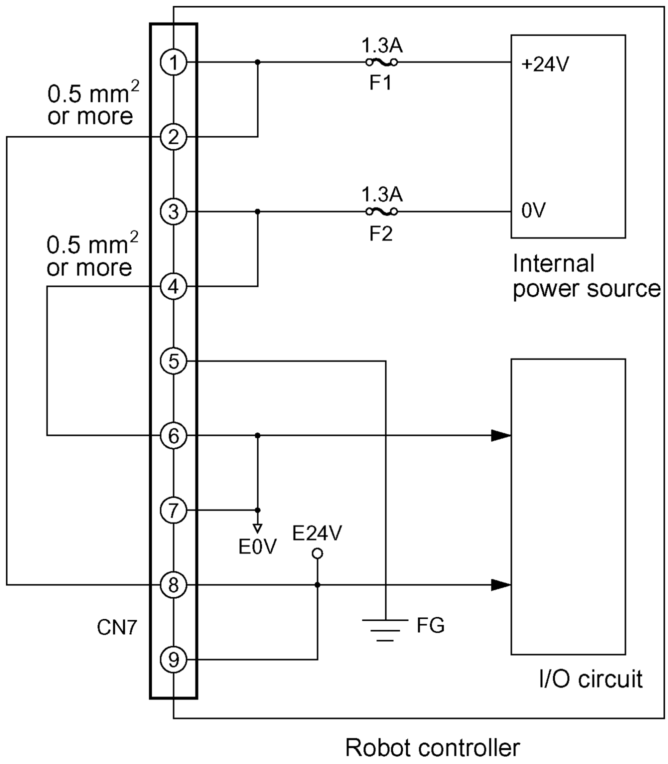



**Figure 5-62 (a) I/O Power Connection Sample (When the internal power source is used) (PNP type)**

| | |
|---|---|
| ⚠**Caution:** | **To use the internal power source of the robot controller, connect the wiring so that the internal power source will be separate from the external power source. Improper wiring may damage the internal circuit.**<br>**The +24V internal power source of the robot controller must not be grounded.** |

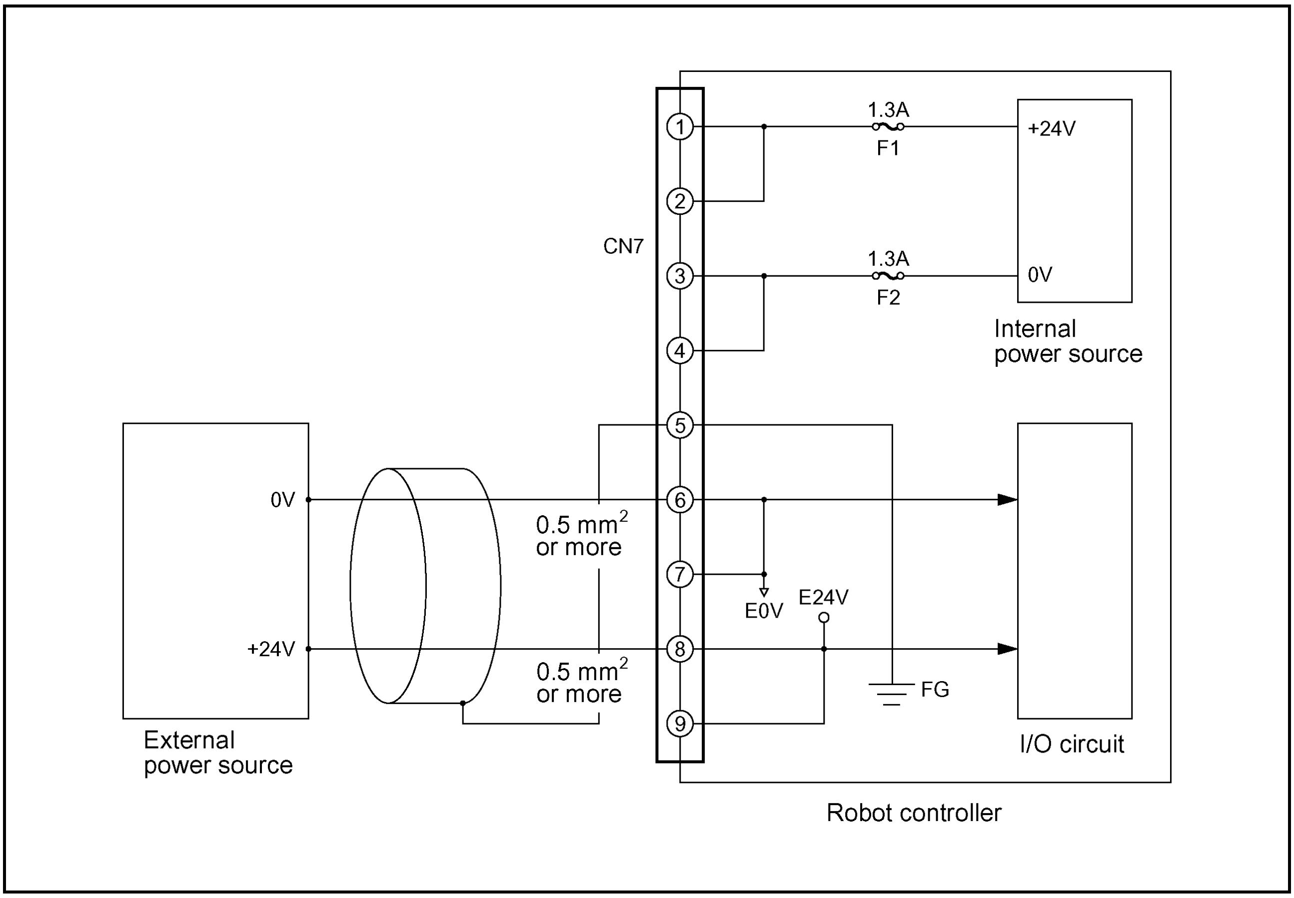



**Figure 5-62 (b) I/O Power Connection Sample (When an external power source is used) (PNP type)**

| | |
|---|---|
| **Caution:** | **Use a cable of 0.5 $mm^2$ or more in size for the wiring between the external power source and the I/O power input connectors of the robot controller.** |

## 5.6.3 Wiring Notes for Robot Controller I/O Connectors

After the wiring of the controller's I/O connectors is completed, check the following before turning ON the power:

**Check point (1)**

Using a circuit tester, check across the **"+24V terminal"** and **"0V terminal"** of each connector and across the **"E24V terminal"** and the **"E0V terminal"** to see that there is no continuity. See Figure 5-63 and Table 5-21.

> ⚠**Caution: If the connector wiring between the robot controller's "+24V terminal" and "0V terminal" and between the "E24V terminal" and the "E0V terminal" is shorted, damage to the power circuit of the Robot Controller will result.**

**Check point (2)**

Using a circuit tester, check across **"each signal Output terminal"** and **"+24V terminal"** or **"E24V terminal"** of each connector to see that there is no continuity. See Figure 5-63 and Table 5-21.

> ⚠**Caution: If the wiring between "each signal Output terminal" and "+24V terminal" or "E24V terminal" of each connector is shorted, damage to the Output circuit and power circuit of the robot controller will result.**

> ⚠**Caution: Wind adhesive vinyl tape around all ends of the unconnected wiring of each connector to prevent them from contacting other wiring and parts, which results in shorting.**

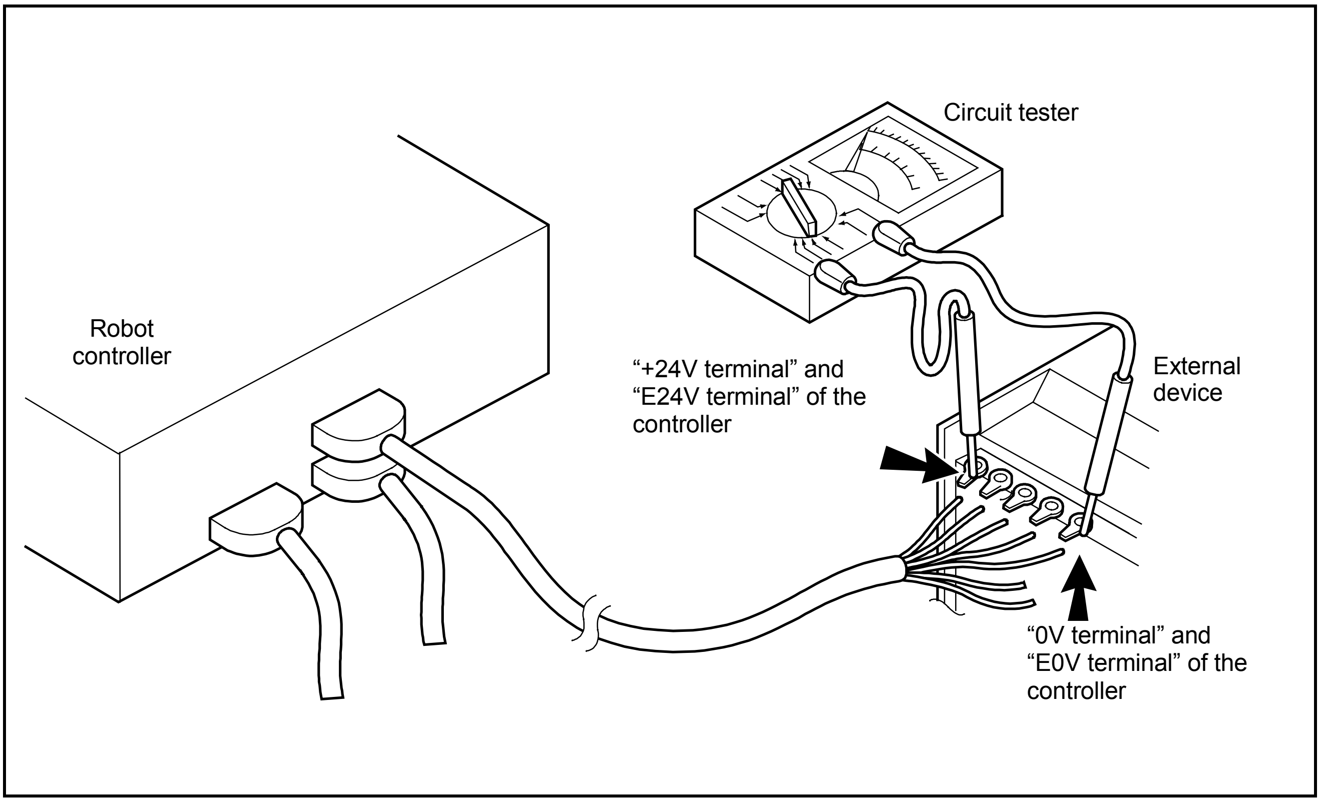
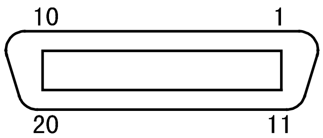



**Figure 5-63 Checking Example**

**Table 5-21  Connector Terminals and Check Points (PNP type)**

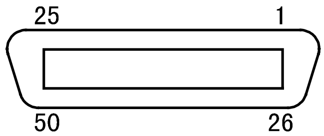
**Connector for hand I/O**




**View from cable side engaging face**

| Terminal Number | Name | Meaning | Check point |
|---|---|---|---|
| 1 to 8 | Hand output terminal | 24V at output | **(2)** |
| 17 | Power terminal for hand (E0V) | Power (GND) output | **(1)** |
| 18 | Power terminal for hand (E24V) | 24V power output | **(1)** |

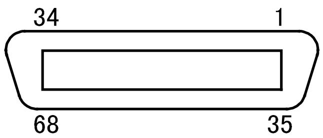
**Connector for user/system input**




**View from cable side engaging face**

| Terminal Number | Name | Meaning | Check point |
|---|---|---|---|
| 1, 3 | +24V internal power source terminal | +24V internal power source output | **(1)** |

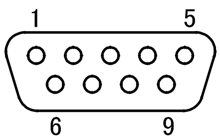
**Connector for user/system output**




**View from cable side engaging face**

| Terminal number | Name | Meaning | Check point |
|---|---|---|---|
| 1 to 56 | Signal output terminal | 24V at output | **(2)** |

**Connector for I/O power source**




**View from cable side engaging face**

| Terminal number | Name | Meaning | Check point |
|---|---|---|---|
| 1, 2 | +24V internal power source terminal | +24V internal power source output | **(1)** |
| 3, 4 | 0V internal power source terminal | 0V internal power source output | **(1)** |
| 6, 7 | E0V (GND) input terminal | Power (GND) input | **(1)** |
| 8, 9 | E24V input terminal | 24V power input | **(1)** |

# 5.7 I/O Wiring

## 5.7.1 Multi-core Cables with Connectors

Multi-core cables with connectors to be used for the I/O wiring of the Robot Controller are options. Select an appropriate cable from Table 5-22 if necessary.

**Table 5-22 I/O Cables (Optional items)**

| Classification | No. | Name | Remarks | Part Number |
|---|---|---|---|---|
| I/O Cable | 1 | I/O Cable Set | (8m) (3-cable set of Nos. 1-1 to 1-3) | 410149-0330 |
| | 1-1 | Input Cable | (8m) | 410141-1630 |
| | 1-2 | Output Cable | (8m) | 410141-1650 |
| | 1-3 | Hand I/O Cable | (8m) | 410141-1740 |
| | 2 | I/O Cable Set<br>(hand I/O cable: high strength type) | (8m) (3-cable set of Nos. 2-1 to 2-3) | 410149-0350 |
| | 2-1 | Input Cable | (8m) | 410141-1630 |
| | 2-2 | Output Cable | (8m) | 410141-1650 |
| | 2-3 | Hand I/O Cable (high strength type) | (8m) | 410141-1670 |
| I/O Cable | 3 | I/O Cable Set | (15m) (3-cable set of Nos. 3-1 to 3-3) | 410149-0340 |
| | 3-1 | Input Cable | (15m) | 410141-1640 |
| | 3-2 | Output Cable | (15m) | 410141-1660 |
| | 3-3 | Hand I/O Cable | (15m) | 410141-1750 |
| | 4 | I/O Cable Set<br>(hand I/O cable: high strength type) | (15m) (3-cable set of Nos. 4-1 to 4-3) | 410149-0360 |
| | 4-1 | Input Cable | (15m) | 410141-1640 |
| | 4-2 | Output Cable | (15m) | 410141-1660 |
| | 4-3 | Hand I/O Cable (high strength type) | (15m) | 410141-1680 |

If you do not use optional cables listed on the previous page, use the recommended connectors and cables listed in Table 5-23.

**Table 5-23 Recommended Connectors for I/O Cables and Cable Standards**

| Connector name | Connector model/manufacturer | Cable Standards | Remarks |
|---|---|---|---|
| OUTPUT | PCR-E68FS connector<br>PCS-E68LA cover<br>Honda Communications Industry Co., Ltd. | UL2789 - With shield<br>Equivalent to AWG28-68P | **Caution:** Be sure to modify the shielding wire at the end of the cable to be used, as shown in Figure 5-64. Without this modification, the robot may malfunction due to noise. |
| HAND I/O | PCR-E20FS connector<br>PCS-E20LA cover<br>Honda Communications Industry Co., Ltd. | UL2789 - With shield<br>Equivalent to AWG28-20P | |
| INPUT | PCR-E50FS connector<br>PCS-E50LA cover<br>Honda Communications Industry Co., Ltd. | UL2789 - With shield<br>Equivalent to AWG28-50P | |
| I/O POWER | DE-9P connector<br>DE-C4-J6 cover<br>Japan Aviation Electronics Industry, Ltd. | UL2405 - With shield<br>Equivalent to AWG20-2P | |

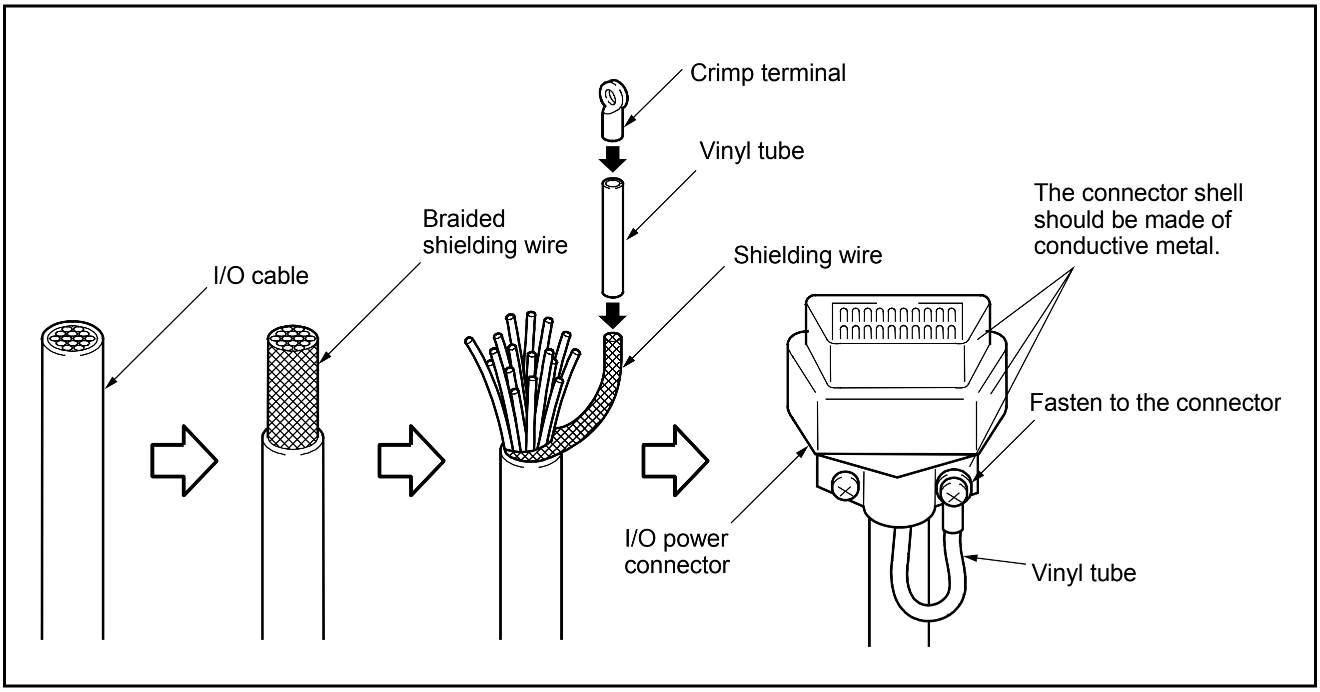



**Figure 5-64 Modifying the Shielding Wire (Example)**

## 5.7.2 Wiring

Observe the following precautions when wiring the primary power source of the robot controller:

(1) Connect the robot power cable to a power source separate from the welder power source.

(2) Ground the grounding wire (green) of the robot power cable.

(3) Ground the grounding terminal of the robot controller using a wire of 1.25 $mm^2$ or more in size.

(4) For the robot power supply, use a grounding wire with grounding resistance of 100 Ω or less.

(5) If the supply power source for the robot controller requires a leakage breaker, use a high frequency-proof leakage breaker for inverters.

(6) Prepare wires of an appropriate capacity for the 200 VAC main line and other cables according to Tables 5-24 and 5-25.

**Table 5-24 Robot Controller Specifications**

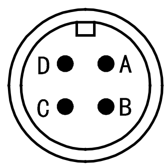
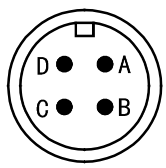
| | | |
|---|---|---|
| Power voltage: | 3-phase, 200 VAC -15% to 230 VAC + 10%, 50/60 Hz | Pin assignment on connector (CN11), 3-phase   A: 200 VAC, phase R<br>B: 200 VAC, phase S<br>C: 200 VAC, phase T<br>D: Ground<br>(View from pin face) |
| Power voltage: | Singe-phase, 230 VAC -10% to 230 VAC + 10%, 50/60 H | Pin assignment on connector (CN11), single-phase   A: 230 VAC, phase R<br>B: 230 VAC, phase S<br>C: Not used.<br>D: Ground<br>(View from pin face) |
| Max. rush current when the power is turned ON: | 50 A (for 1/50 or 1/60 second) | |

**Table 5-25 Power Consumption of Robot**

| Robot | Power consumption |
|---|---|
| XYC-4D series | 1.5 kVA |

**Caution: If ERROR6102 (power voltage drop) occurs when the robot is in operation, it may be attributable to an insufficient capacity of the primary side power source.**

(7) Do not bundle the teach pendant cables, I/O cables or motor cables together with high power lines such as 200 VAC lines and peripheral device cables, or route the motor cables near high power devices (motor, welder, parts feeder, etc.).

(8) Do not route any additional cables or air tubes of end-effectors through the robot unit. Doing so will result in broken cables or tubes.

# Chapter 6

# Maintenance and Inspection

This chapter describes the regular maintenance and inspections necessary for maintaining the performance and functions of the robot.

# 6.1 Maintenance & Inspection Intervals and Purposes

Table 6-1 lists the intervals and purposes of maintenance & inspection required for your robot.

> ⚠**Caution: Before performing maintenance and inspection jobs, read the SAFETY PRECAUTIONS, "3 Precautions while robot is running" and "4 Daily and periodical inspections."**

**Table 6-1  Maintenance & Inspection Intervals and Purposes**

**■ XYC-4D series**

| No. | Intervals | | Purposes |
|---|---|---|---|
| 1 | Daily | Perform inspection jobs specified in Section 6.2 every day before starting operations. | To use your robot safely. |
| 2 | Quarterly | Perform inspection jobs specified in Section 6.3 every three months. | To check the rotary sections and slideways of the robot and its controller for wear, preventing seizure, breakage, and other serious failures that could result from wear. |
| 3 | Biennial | Replace backup batteries as specified in Section 6.4 every two years. | To retain the robot-specific data (programs, parameters, etc.) stored in the internal memory of the robot controller and the position data stored in the electronic absolute encoder built in the robot unit. |

# 6.2 Daily Inspections

## 6.2.1 Check Items

Before starting operations, check the items listed in Table 6-2 every day.

**Table 6-2 Daily Inspections Table**

| No. | Check: | Controller Power | How to check: | Criterion | What to do: (Note 1) |
|---|---|---|---|---|---|
| 1 | Connectors (CN1 to CN12 on the robot controller) and their mating parts | OFF | Visually | No looseness, disengagement or dirt. | Engage the parts properly and clean them. |
| 2 | Cables (connected to CN1 to CN12 on the robot controller) and robot’s external cables | OFF | Visually | Free of damage or gouges. | Repair or replace. |
| 3 | LCD on the teach pendant | ON | Visually | Properly displayed | Repair or replace. |
| 4 | Pilot lamps on the robot controller | ON | Visually | Should light. | Repair or replace. |
| 5 | Cooling fan in the robot controller | ON | Visually **(Note 2)** | Should work properly. | Repair or replace. |
| 6 | Calibration | ON | Visually | No error or unusual noise. | Repair or replace. |
| 7 | ROBOT STOP button on the operating panel, mini-pendant, or teach pendant | ON | Press the ROBOT STOP button. | The robot should come to an emergency stop. | Repair or replace. |
| 8 | Safety door | ON | Operate the safety door switch and open the switch-wiring door. | The robot should come to an emergency stop. | Repair or replace. |

**Note 1** Some repair and replacement operations, shown in "What to do:" column, may involve special work. Contact the DENSO Robot Service Section.

**Note 2** The normal operation of the cooling fan is as shown in Figure 6-1.

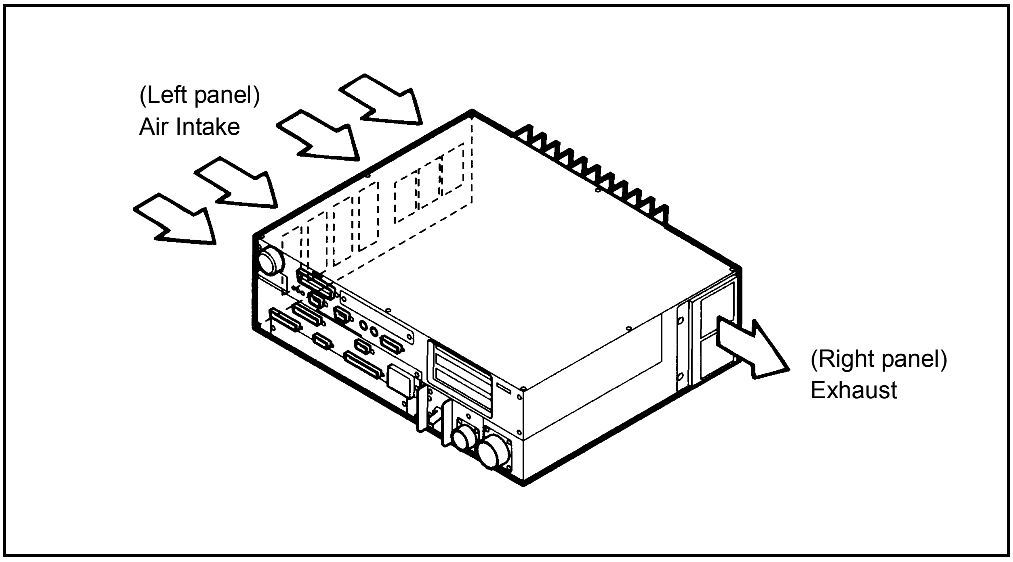



**Figure 6-1 Normal Operation of Cooling Fan**

# 6.3 Quarterly Inspections

## 6.3.1 Check Items and Lubrication

Check the items and lubricate your robot as listed in Table 6-3 every three months.

**Table 6-3 Quarterly Inspections Table**

■ **XYC-4D series**

<table>
<tr><th>No.</th><th>Check:</th><th>Controller power</th><th>How to check:</th><th>Criterion</th><th>What to do:</th></tr>
<tr><td>1</td><td>Robot base mounting bolts</td><td>OFF</td><td>Measure the tightening torque with a torque wrench.</td><td>No looseness.<br>Specified torque:<br>14.7 ±2 N•m</td><td>Tighten the bolts to the specified torque.</td></tr>
<tr><td>2</td><td>Axis motor mounting bolts</td><td>OFF</td><td>Measure the tightening torque with a torque wrench.</td><td>No looseness.<table><tr><th>Motor</th><th>Specified torque</th></tr><tr><td>1st-axis</td><td>4 ±0.8 N•m</td></tr><tr><td>2nd-axis</td><td>4 ±0.8 N•m</td></tr><tr><td>3rd-axis</td><td>2 ±0.4 N•m</td></tr><tr><td>4th-axis</td><td>2 ±0.4 N•m</td></tr></table></td><td>Tighten the bolts to the specified torque.</td></tr>
<tr><td>3</td><td>Rotary sections and slideways of the robot</td><td>OFF</td><td colspan="3">Apply the specified lubricants to the specified points.<br>(Refer to Subsect. 6.3.3.)</td></tr>
<tr><td>4</td><td>Cooling fan filters in the robot controller</td><td>OFF</td><td>Visually</td><td>No dust or dirt.</td><td>Clean the cooling fan filters. (Refer to Subsect. 6.3.2.)</td></tr>
</table>

## 6.3.2 Cleaning the Cooling Fan Filters in the Robot Controller

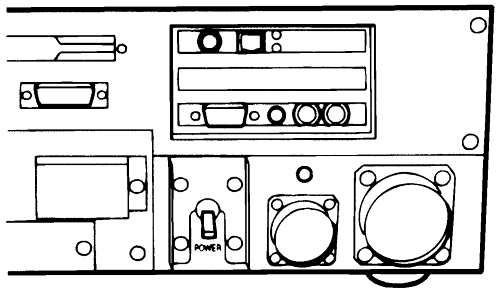
The robot controller has two cooling fan filters—inlet port filter and exhaust port filter.

If either of the filters is clogged, the robot controller becomes badly ventilated to overheat so that the internal electronic devices may fail due to heat.

If a power module error appears, it may be caused by clogged filters, so clean those filters.

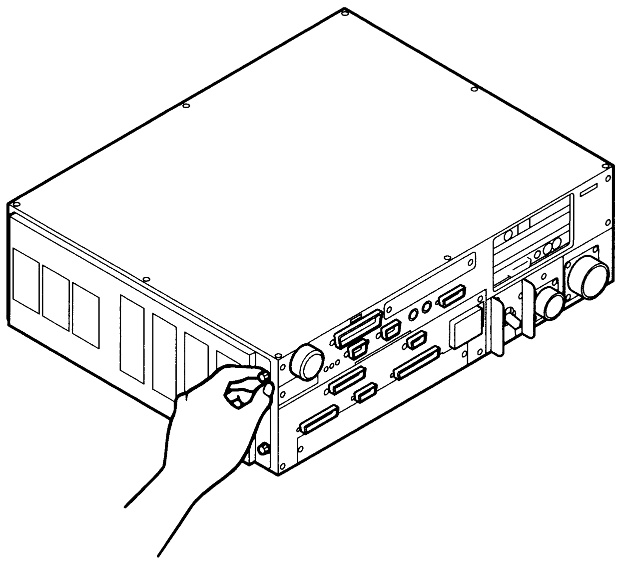
### ▶STEP 1

Turn the POWER switch of the robot controller OFF.



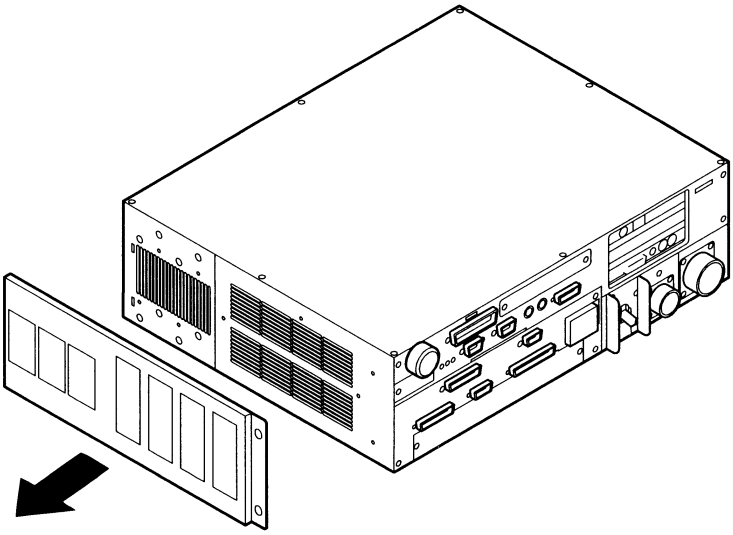
### ▶STEP 2

Remove the screws with your fingers to release the inlet port filter.



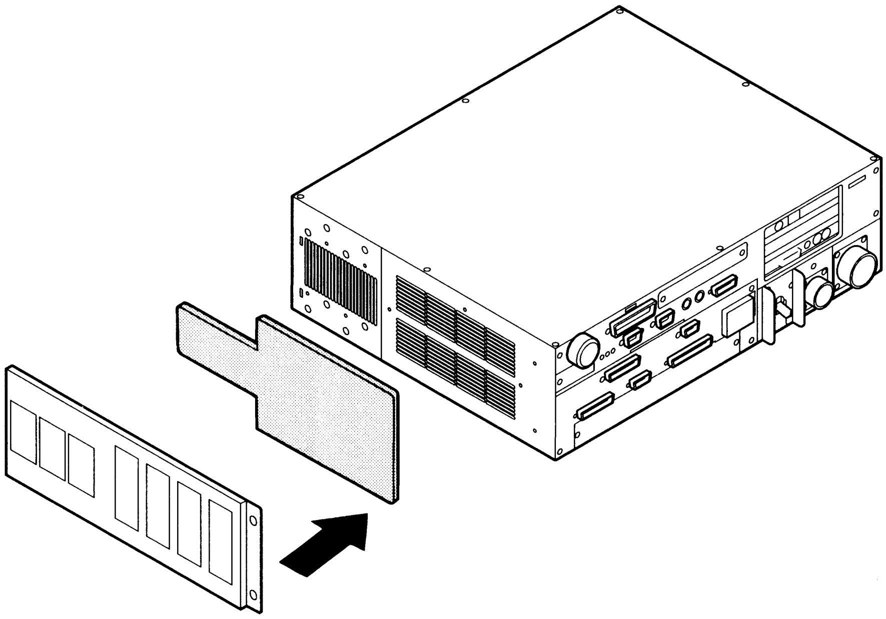
## ▸ STEP 3

Remove the support frame of the inlet port filter.



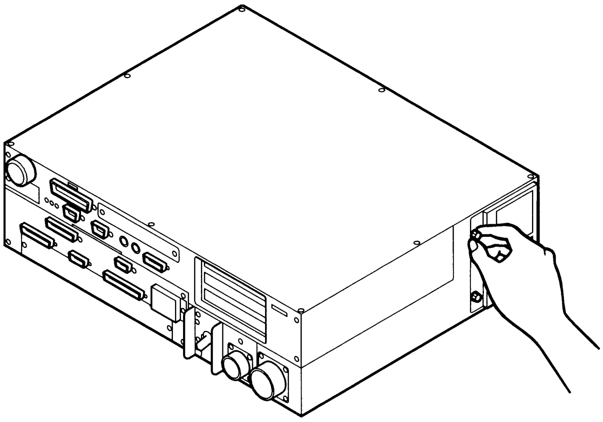
## ▸ STEP 4

Remove the filter element from the support frame.



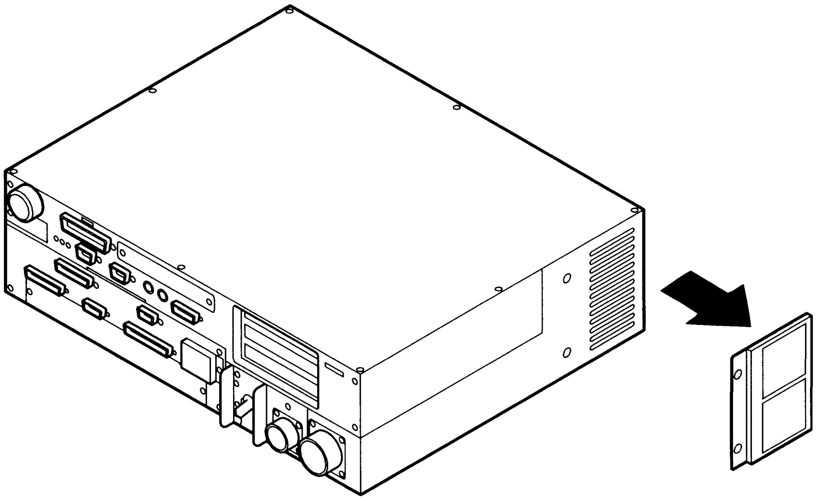
## ▶ STEP 5

Remove the screws with your fingers to release the exhaust port filter.



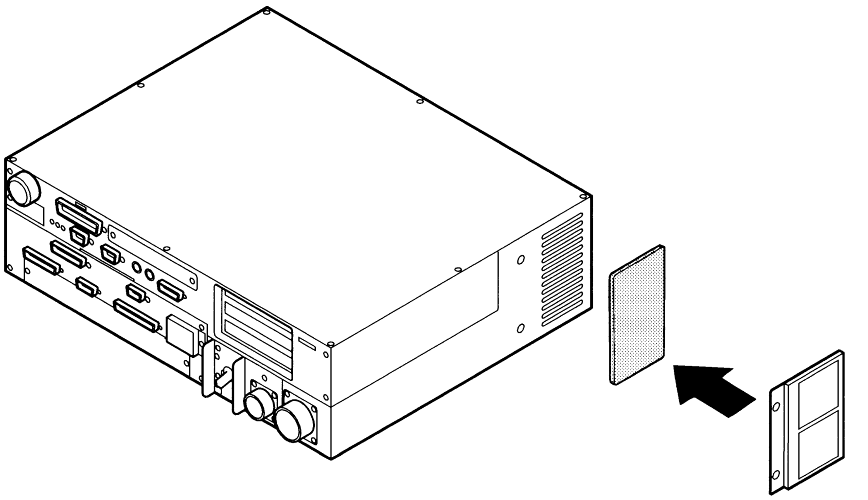
## ▶ STEP 6

Remove the support frame of the exhaust port filter.



## STEP 7

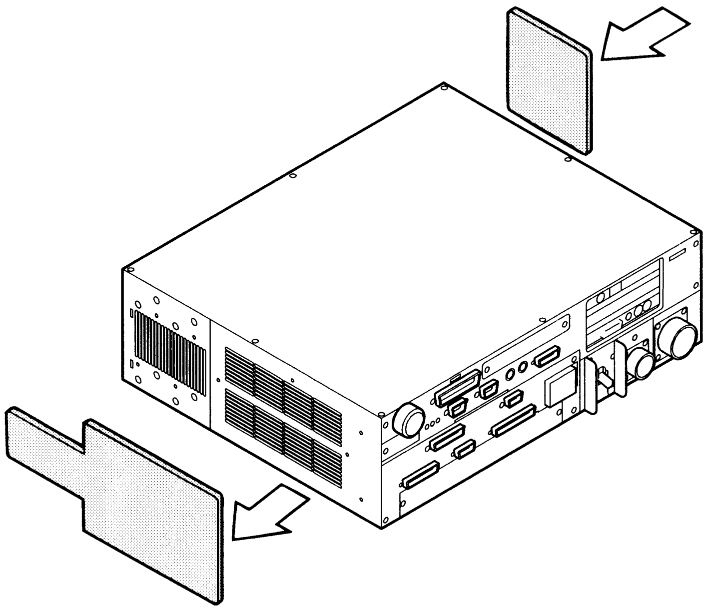
Remove the filter element from the support frame.



## STEP 8

Blow compressed air to the filter elements in the direction opposite to the regular air flow.

NOTE: Use dehumidified, oil-free, pure compressed air for cleaning.



If the filters are excessively dirty, wash them with water or warm water (40°C or lower). A neutral detergent is most effective.

Notes: (1) Dry the washed filters completely before replacing them.
(2) If the filters are still dirty after air blowing or washing, replace them with new ones.

## STEP 9

Reinstall the filters in the reverse order of removal.

## 6.3.3 Lubrication Jobs

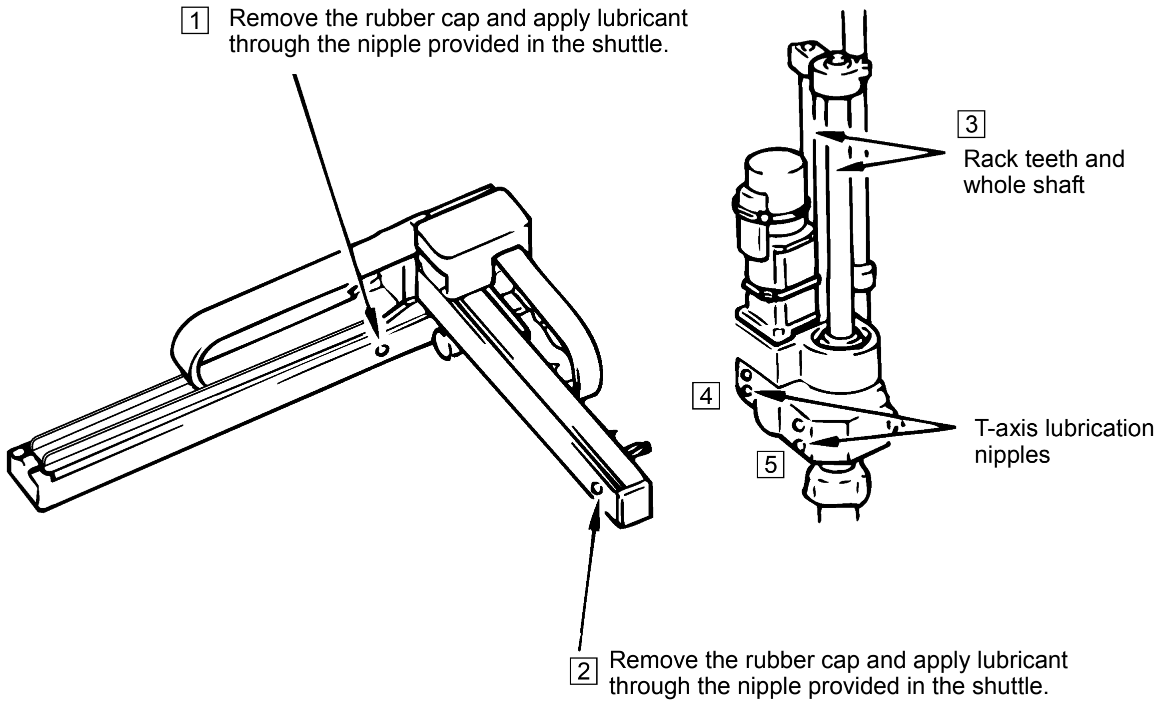
Apply the specified lubricants to the rotary sections and slideways of the robot unit as listed below every three months.

> **NOTE: Use a recommended grease gun listed in Section 6.5. One push of the grease gun will discharge 1.4 cc of grease.**

**Table 6-4 Lubrication Points and Lubricants**

■ **XYC-4D series**

| No. | Lubrication points | Lubricant type | Lubricant amount |
|---|---|---|---|
| 1 | Y-axis lubrication nipple | Epinoc AP1 | 2 to 3 cc |
| 2 | X-axis lubrication nipple | ↑ | 2 to 3 cc |
| 3 | Z-axis rack teeth and whole shaft | ↑ | 2 to 3 cc |
| 4 | T-axis lubrication nipple | ↑ | 1.5 cc |
| 5 | T-axis lubrication nipple | ↑ | 3 cc |




**NOTE:** Move the X-axis and Y-axis and check to see nipples through holes, then apply lubricant through those nipples.

# 6.4 Biennial Inspections

## 6.4.1 Battery Replacement

Replace the two types of backup batteries listed below during biennial inspections.

**Table 6-5  Backup Battery Type**

| | Battery type | Used to: | Located: | Refer to: |
|---|---|---|---|---|
| 1 | Encoder backup battery | Back up the position data of the servomotor encoder. | In the robot unit | 6.4.2 |
| 2 | Memory backup battery | Back up programs, parameters, and CAL data. | In the robot controller | 6.4.3 |

The position data of the encoder built in the servomotor is stored in the internal memory of the encoder.

Programs, parameters, CAL data, etc. are stored in the internal memory of the robot controller.

The backup battery for each memory retains the above data, while the power to the robot controller is turned OFF.  However, these batteries have a limited lifetime and must, therefore, be replaced regularly.

**NOTE:** If two years elapse from replacement of either backup battery, the "Time to change controller backup battery" message will appear on the teach pendant.

⚠**Caution: Without replacing the backup batteries, important robot-specific data stored in each memory will be lost.**

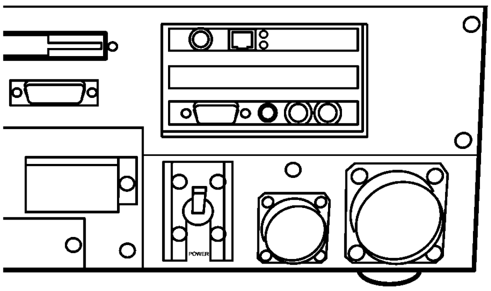
## 6.4.2 Replacing the Encoder Backup Battery

Replace the encoder backup battery according to the procedure given below.

### ▸ STEP 1

Turn the controller power ON.

**⚠Caution: Do not turn the motor power ON.**



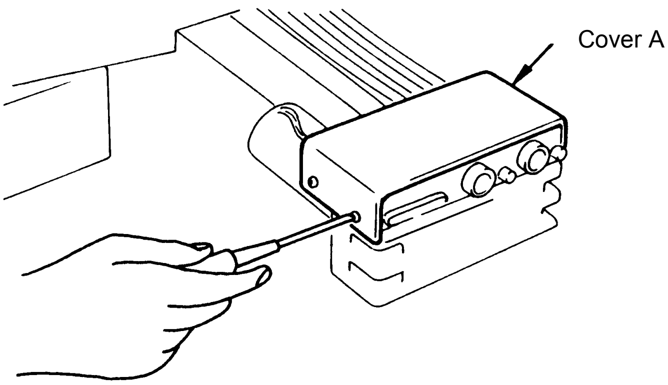

### ▸ STEP 2

Press and lock the robot stop button on the controller (or on the teach pendant, mini-pendant or operating panel) in order to prevent the motor power from becoming turned on accidentally.

**Note:** To unlock the robot stop button, slightly turn it clockwise.

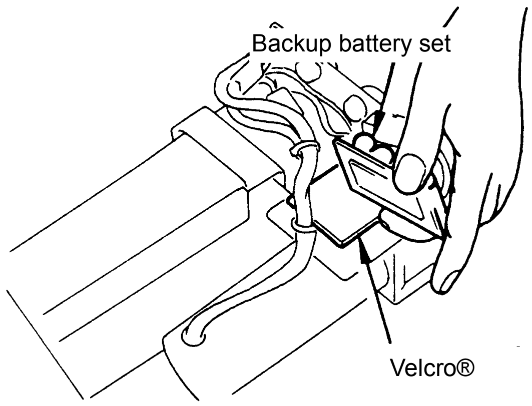
### ▸ STEP 3

Remove four screws from cover A and take it off from the robot unit.



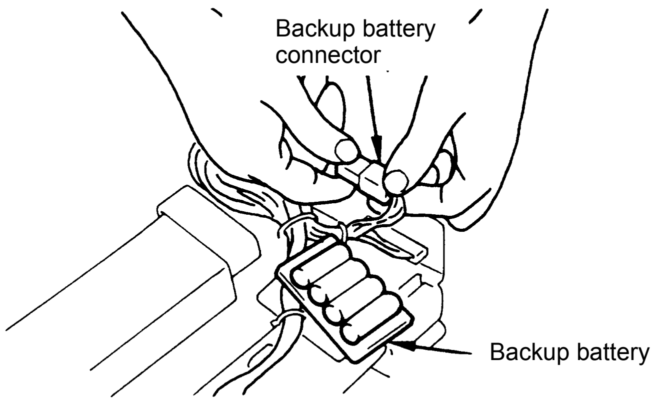
## ▶ STEP 4

Cut off insulator locks that secure the backup battery wires, and then remove the backup battery set that is secured with Velcro®.




## ▶ STEP 5

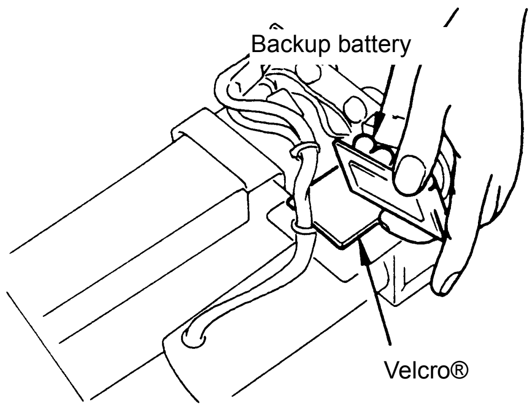
Disconnect the backup battery connector and connect a new one.




## ▶ STEP 6

Set the new backup battery with Velcro®.

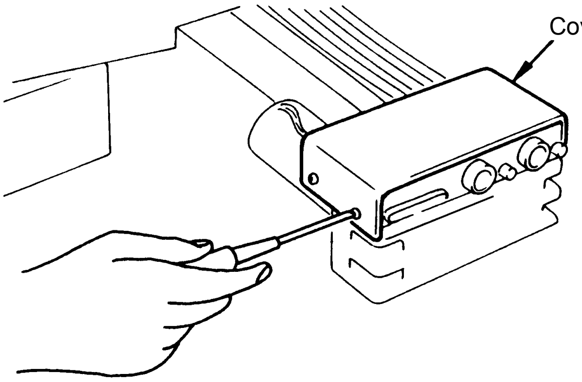
Secure the backup battery wires with insulator locks.



## STEP 7

Fit cover A to the robot unit.

Tightening torque: 0.8 ±0.2 N•m



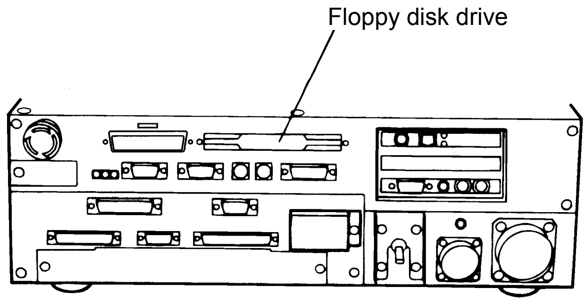
## 6.4.3 Replacing the Memory Backup Battery

This section gives an example of replacing the memory backup battery. This procedure requires a floppy disk.

**Caution: Before replacing the memory backup battery, be sure to save (write) the memory data of the robot controller onto a floppy disk. The built-in floppy disk drive is an option.**

### ▸ STEP 1

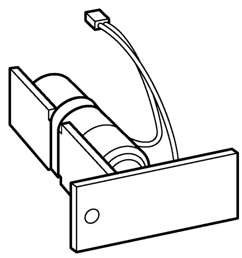
Save (write) the controller memory data onto a floppy disk.




For the data saving procedure, refer to the SETTING-UP MANUAL, Section 5.7 "Displaying the FDD Access Menu, [F6 Set]-[F3 FD.]-[F2 Write.].

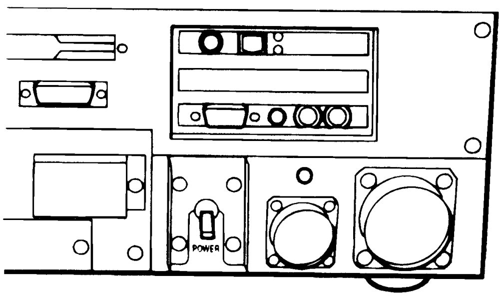
### ▸ STEP 2

Prepare a new memory backup battery.



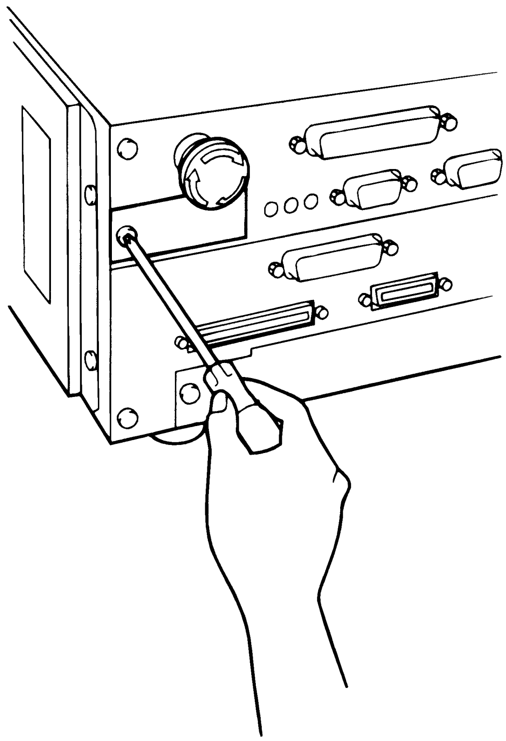
### ▸ STEP 3

Turn the controller power ON, wait at least one minute, and turn it OFF again.



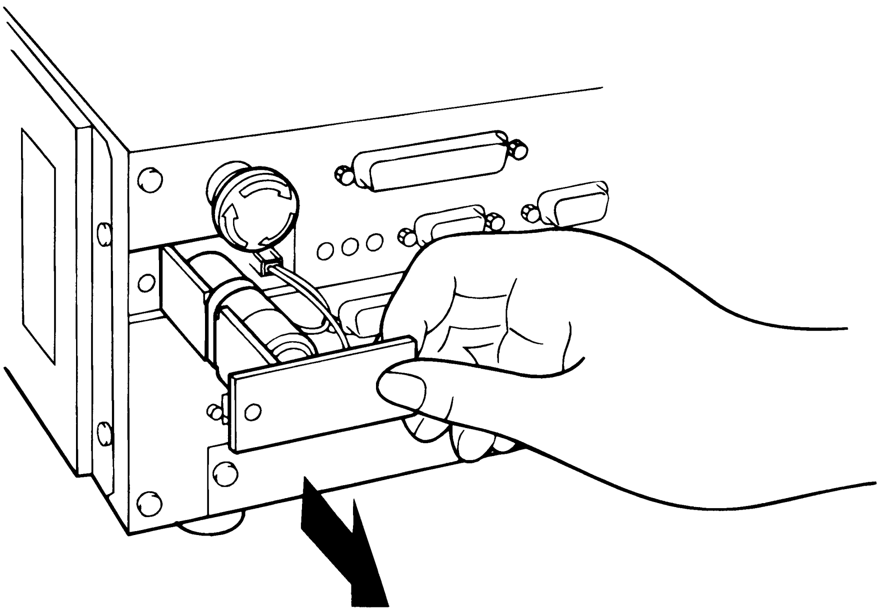
## STEP 4

Remove the screw to release the backup battery support.



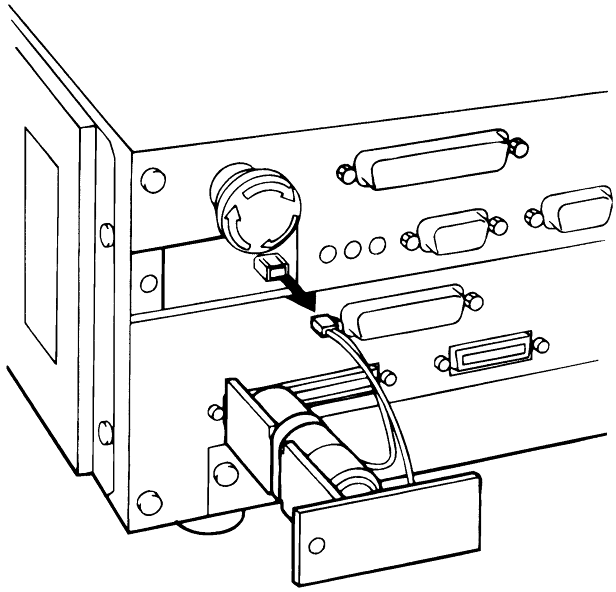
## STEP 5

Pull out the backup battery support.



## ▸ STEP 6

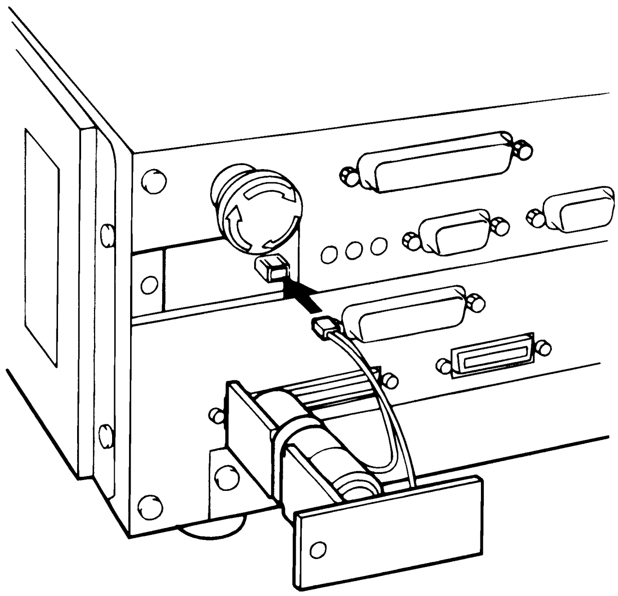
Disconnect the memory backup battery connector.



**⚠Caution: Complete the operations in Steps 6 and 7 within three minutes. If the battery is disconnected for over three minutes, the memory data will be lost.**

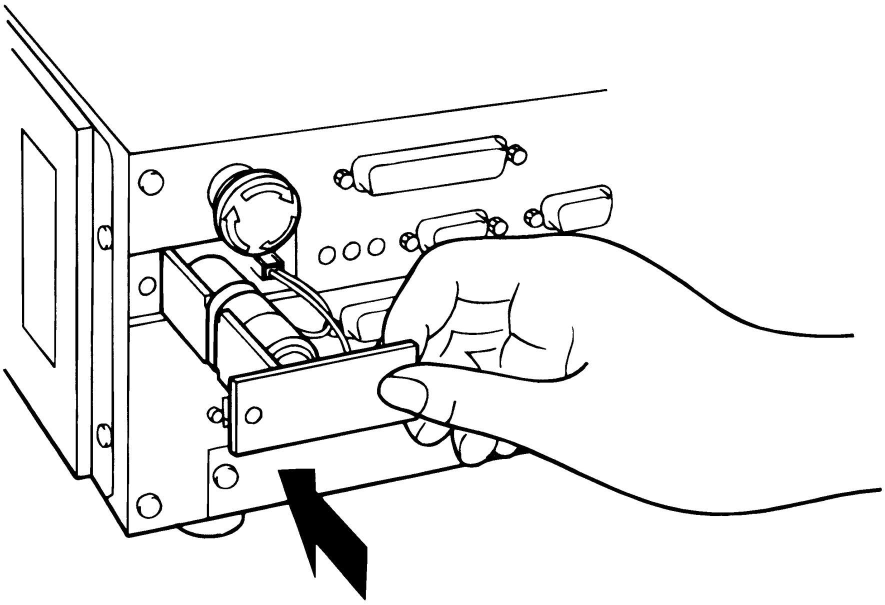
## ▸ STEP 7

Connect the new backup battery prepared in Step 2, to the robot controller.



# ▶ STEP 8

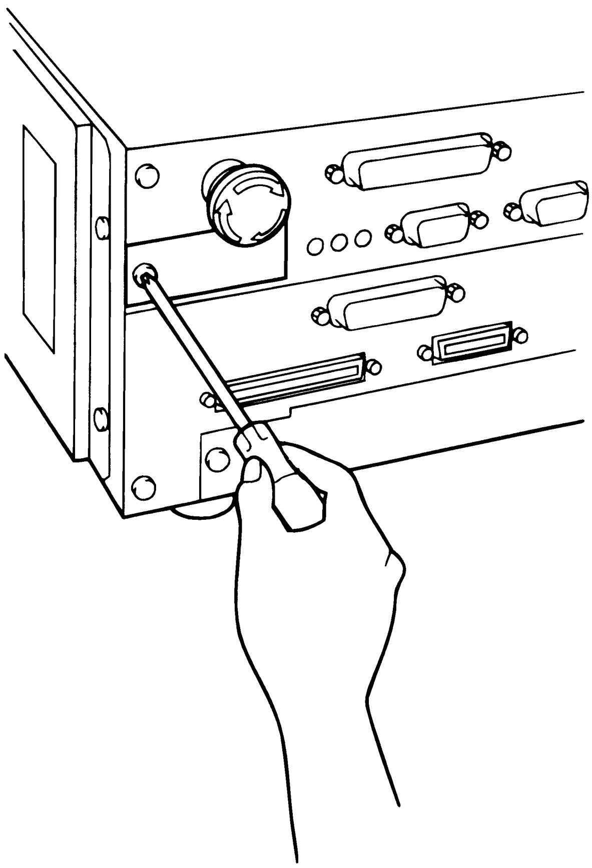
Push the backup battery support into the robot controller.



⚠**Caution: Take care not to pinch the battery lead wires between the unit and the cover or internal parts. Shorting may occur, resulting in an unexpected failure.**

# ▶ STEP 9

Secure the backup battery support with a screw.



### 6.4.4 Setting the Next Battery Replacement Date

After replacing the memory backup battery, set the next battery replacement date from the teach pendant, according to the following procedure.

**NOTE:** This procedure cannot be performed with the operating panel.

**NOTE:** Check that the system clock of the robot controller shows the correct date beforehand. If it is incorrect, the next replacement date will also become incorrect.

STEP 1

**On the top screen of the teach pendant, press [F6 Set].**
The Settings (Main) window appears.

STEP 2

**Press [F6 Maint.] in the Settings (Main) window.**
The Maintenance menu appears.

STEP 3

**Press [F4 Battery] in the Maintenance menu.**
The Next Battery Replacement Date window appears.

In the top of the window, the current setting is displayed.

**TIP:** The date entry areas show the default replacement date that is two years later the current data at which you open this window, assuming that the battery service life is two years.

STEP 4

**Press OK.**

If you do not want to change the replacement date, press Cancel.

The message "Are you sure you want to set the next battery replacement date?" appears.

STEP 5

**Press OK.**
The screen returns to the Settings (Main) window.

# 6.5 Supplies and Tools for Maintenance

Tables 6-6 lists the supplies and components to be replaced regularly, out of components used in Denso robots. Table 6-7 lists the recommended tools necessary for maintenance and inspection.

## 6.5.1 Supplies and Components Required

**Table 6-6 List of Supplies and Components**

| No | Name | Part No. | Remarks | |
|---|---|---|---|---|
| 1 | Grease | 410971-0040 | 2.5 kg can | Epinoc AP-1 |
| 2 | Grease | 410971-0050 | 16 kg can | |
| 3 | Filter (left) | 410041-0760 | Cooling fan filter (inlet port filter) in the robot controller | |
| 4 | Filter (for fan 60) | 410041-1220 | Cooling fan filter (exhaust port filter) in the robot controller | |
| 5 | Memory backup unit | 410076-0090 | Memory backup battery for controller (with metal plate) | |
| 6 | Encoder backup battery | 410611-0020 | | |
| 7 | Fuse (1.3A) | 410054-0230 | Fuse LM13 for controller I/O | |
| 8 | Fuse (0.3A) | 410054-0240 | Fuse LM03 for controller I/O | |
| 9 | IC for output (NPN) | 410077-0010 | IC (M54522P) for controller output | |
| 10 | IC for output (PNP) | 410077-0020 | IC (M54564P) for controller output | |

## 6.5.2 Recommended Tools

**Table 6-7 List of Recommended Tools**

| No | Tool name | Recommended tool (manufacturer) | Application |
|---|---|---|---|
| 1 | Grease gun | (Yamada Corporation)<br>·Body: KH-32<br>·Flexible attachment: SPK-3C | Force grease into nipple |

# 6.6 Replacing Fuses

The robot controller is equipped with fuses to protect it from external wiring shorted.

If any fuse is blown, replace it according to the following procedure

The fuse box containing fuses is mounted on the panel of the robot controller. See Figure 6-2.

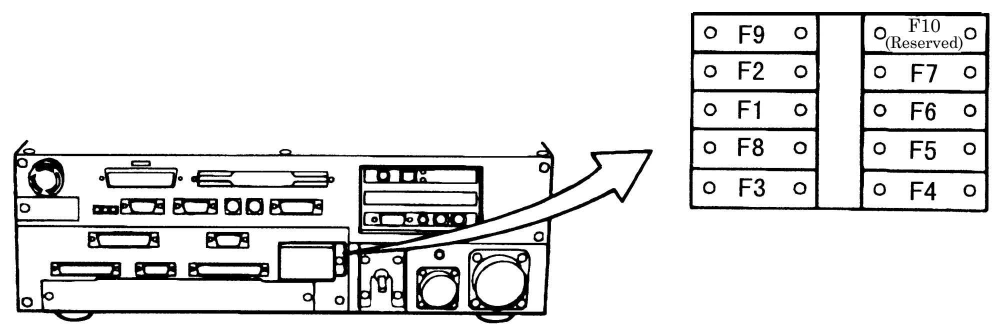



**Figure 6-2 Positions and Names of Fuses**

Table 6-8 lists connectors corresponding to the fuses. If an output signal error occurs, check the corresponding fuse.

**Table 6-8 Output Connectors and Fuses**

| Connector No. | Connector terminal No. | Output IC No. | Fuse No. |
|---|---|---|---|
| I/O POWER CN7 | 1 | — | F1 (1.3A) |
| | 2 | — | |
| | 3 | — | F2 (1.3A) |
| | 4 | — | |
| HAND I/O CN9 | 17 | — | F3 (1.3A) |
| | 1 | IC 1 | F4 (1.3A) |
| | 2 | | |
| | 3 | | |
| | 4 | | |
| | 5 | | |
| | 6 | | |
| | 7 | | |
| | 8 | | |
| OUTPUT CN10 | 1 | IC 2 | |
| | 2 | | |
| | 3 | | |
| | 4 | | |
| | 5 | | |
| | 6 | | |
| | 7 | | |
| | 8 | | |
| | 9 | IC 3 | F5 (1.3A) |
| | 10 | | |
| | 11 | | |
| | 12 | | |
| | 13 | | |
| | 14 | | |
| | 15 | | |
| | 16 | | |
| | 17 | IC 4 | |
| | 18 | | |
| | 19 | | |
| | 20 | | |
| | 21 | | |
| | 22 | | |
| | 23 | | |
| | 24 | | |
| | 25 | IC 5 | F6 (1.3A) |
| | 26 | | |
| | 27 | | |
| | 28 | | |
| | 29 | | |
| | 30 | | |
| | 31 | | |
| | 32 | | |
| | 33 | IC 6 | |
| | 34 | | |
| | 35 | | |
| | 36 | | |
| | 37 | | |
| | 38 | | |
| | 39 | | |
| | 40 | | |
| | 41 | IC 7 | F7 (1.3A) |
| | 42 | | |
| | 43 | | |
| | 44 | | |
| | 45 | | |
| | 46 | | |
| | 47 | | |
| | 48 | | |
| | 49 | IC 8 | |
| | 50 | | |
| | 51 | | |
| | 52 | | |
| | 53 | | |
| | 54 | | |
| | 55 | | |
| | 56 | | |
| | 65 | — | F9 (0.3A) |
| INPUT CN8 | 1 | — | F8 (1.3A) |
| | 3 | — | |

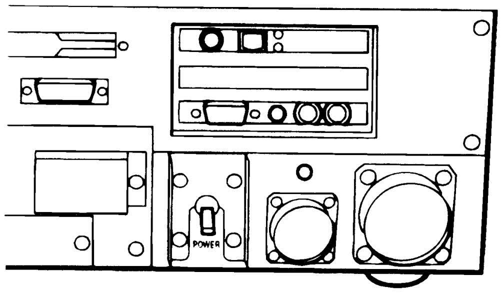
Note: For the connector pin layout, refer to Chapter 5, Subsection 5.6.1, "I/O Signal Connector Pin Layout."

## 6.6.1 Replacing Fuses

Replace fuses according to the following procedure:

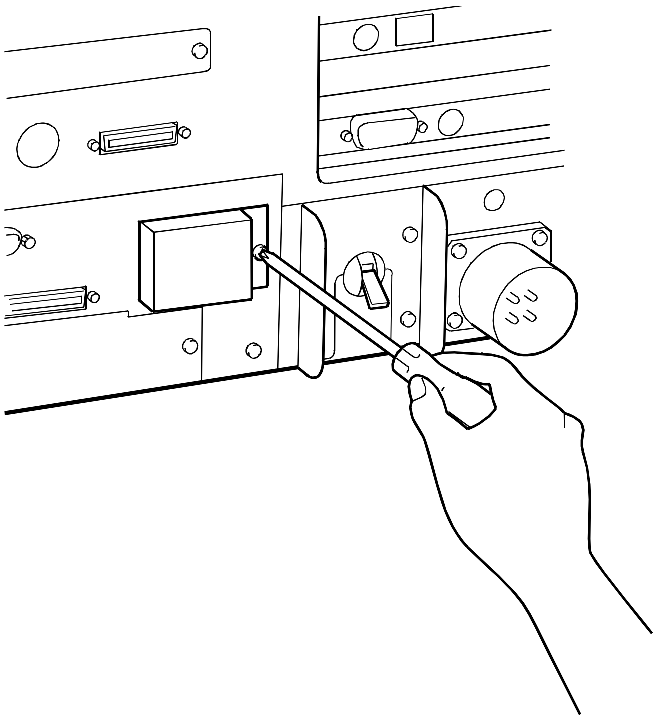
### ▶ STEP 1

Turn the controller power OFF.



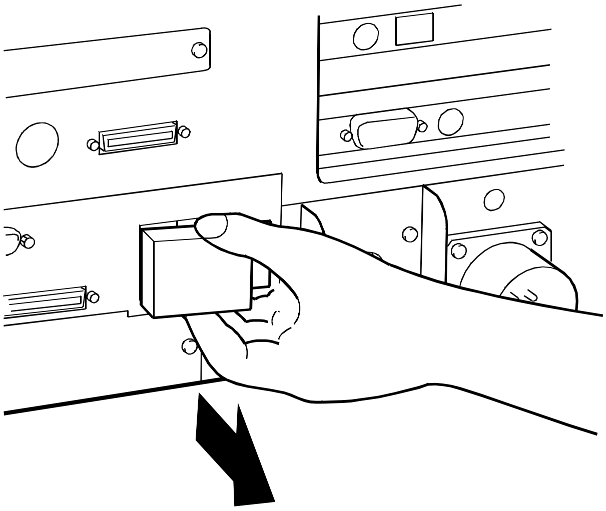

### ▶ STEP 2

Remove the fuse cover mounting screw with a screwdriver.



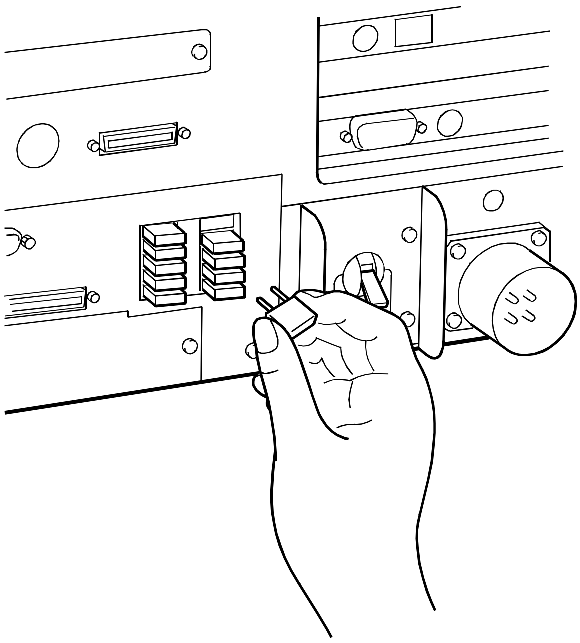
## STEP 3

Remove the fuse cover.



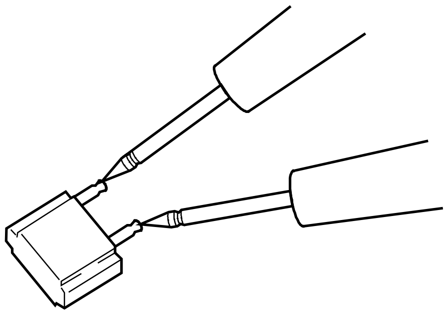
## STEP 4

Pull out the fuse to be checked.



## ▶ STEP 5

Using a circuit tester, check the removed fuse for continuity.

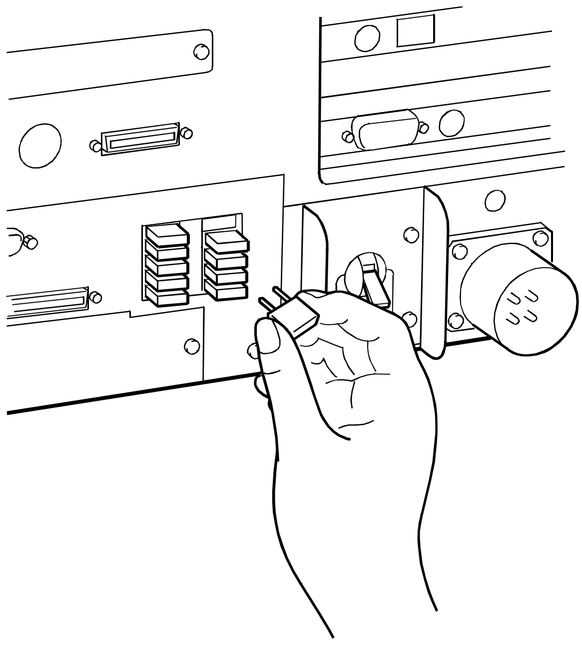


## ▶ STEP 6

If no continuity is observed with the fuse in Step 5:

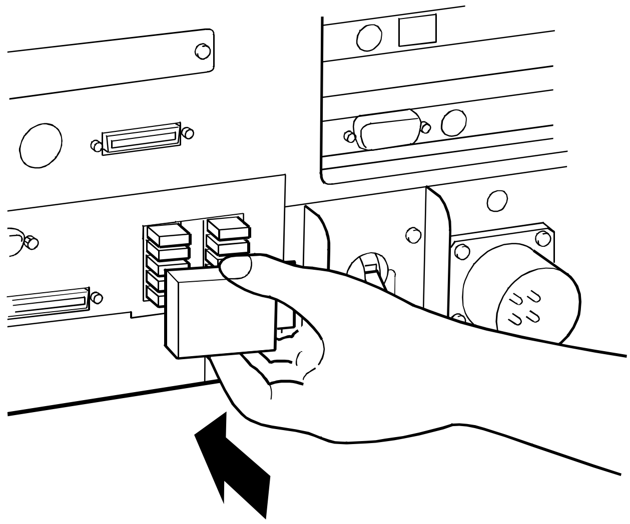
(1) Check the wiring of the related output connector and remove the cause of the blown fuse.
(2) Insert a new fuse into place in the fuse box.

If continuity is observed with the fuse in Step 5:
Set the removed fuse back into place in the fuse box.



## ▶ STEP 7

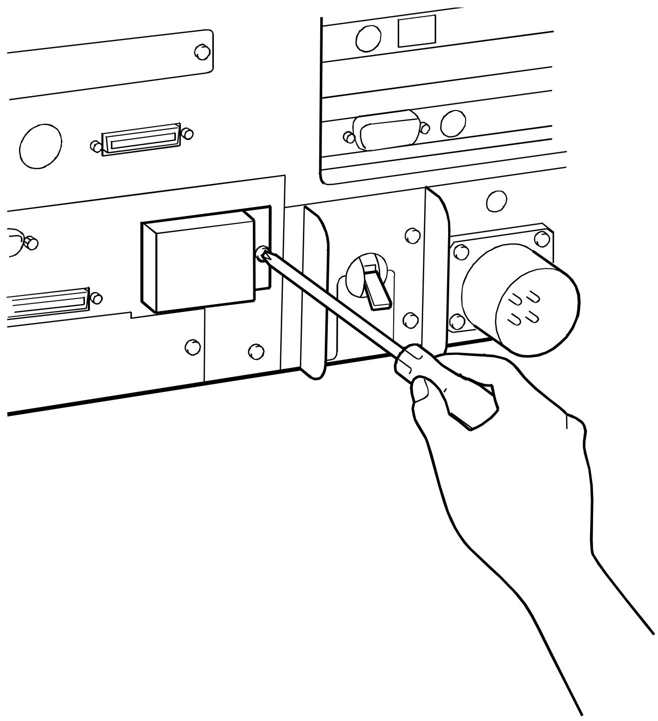
Set the fuse cover to the robot controller.



## ▶ STEP 8

Secure the fuse cover with mounting screw with a screwdriver.

Tightening torque: 0.6 ±0.2 Nm



# 6.7 Replacing the Output ICs

If an output signal error persists even after replacement of the output fuse, the related output IC needs to be replaced.

Output ICs are located in the panel of the robot controller as shown below.

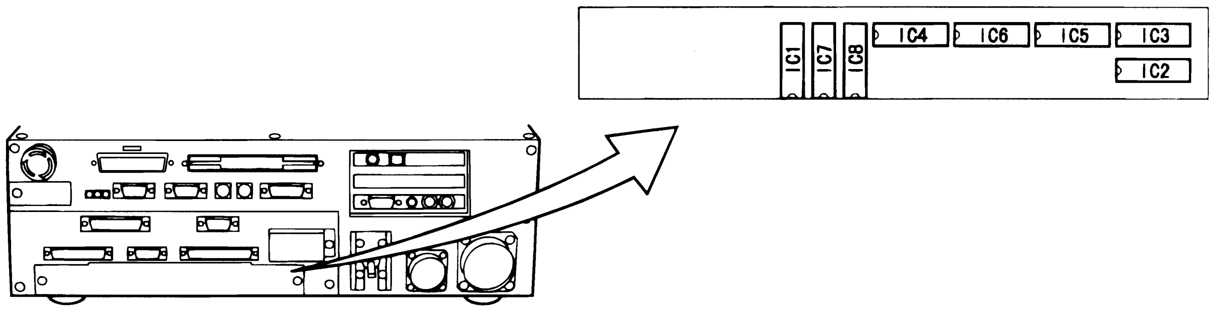



**Figure 6-3  Positions and Names of ICs for Output**

Table 6-9 lists output signals and related IC numbers and fuses.

## Table 6-9 Output ICs and Fuses

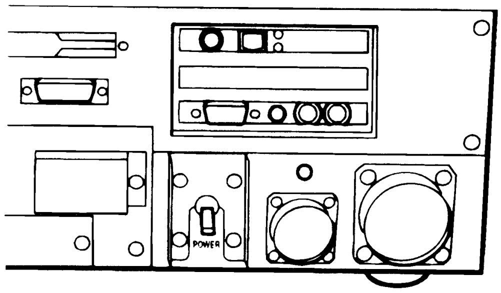
| Connector No. | Connector terminal No. | I/O Port No. | Output IC No. | Fuse No. |
|---|---|---|---|---|
| HAND I/O CN9 | 1 | 64 | IC 1 | F4 (1.3A) |
| | 2 | 65 | | |
| | 3 | 66 | | |
| | 4 | 67 | | |
| | 5 | 68 | | |
| | 6 | 69 | | |
| | 7 | 70 | | |
| | 8 | 71 | | |
| OUTPUT CN10 | 1 | 72 | IC 2 | |
| | 2 | 73 | | |
| | 3 | 74 | | |
| | 4 | 75 | | |
| | 5 | 76 | | |
| | 6 | 77 | | |
| | 7 | 78 | | |
| | 8 | 79 | | |
| | 9 | 80 | IC 3 | F5 (1.3A) |
| | 10 | 81 | | |
| | 11 | 82 | | |
| | 12 | 83 | | |
| | 13 | 84 | | |
| | 14 | 85 | | |
| | 15 | 86 | | |
| | 16 | 87 | | |
| | 17 | 88 | IC 4 | |
| | 18 | 89 | | |
| | 19 | 90 | | |
| | 20 | 91 | | |
| | 21 | 92 | | |
| | 22 | 93 | | |
| | 23 | 94 | | |
| | 24 | 95 | | |
| | 25 | 96 | IC 5 | F6 (1.3A) |
| | 26 | 97 | | |
| | 27 | 98 | | |
| | 28 | 99 | | |
| | 29 | 100 | | |
| | 30 | 101 | | |
| | 31 | 102 | | |
| | 32 | 103 | | |
| | 33 | 104 | IC 6 | |
| | 34 | 105 | | |
| | 35 | 106 | | |
| | 36 | 107 | | |
| | 37 | 108 | | |
| | 38 | 109 | | |
| | 39 | 110 | | |
| | 40 | 111 | | |
| | 41 | 112 | IC 7 | F7 (1.3A) |
| | 42 | 113 | | |
| | 43 | 114 | | |
| | 44 | 115 | | |
| | 45 | 116 | | |
| | 46 | 117 | | |
| | 47 | 118 | | |
| | 48 | 119 | | |
| | 49 | 120 | IC 8 | |
| | 50 | 121 | | |
| | 51 | 122 | | |
| | 52 | 123 | | |
| | 53 | 124 | | |
| | 54 | 125 | | |
| | 55 | 126 | | |
| | 56 | 127 | | |

## 6.7.1 Replacing an Output IC

Replace an output IC according to the procedure given below:

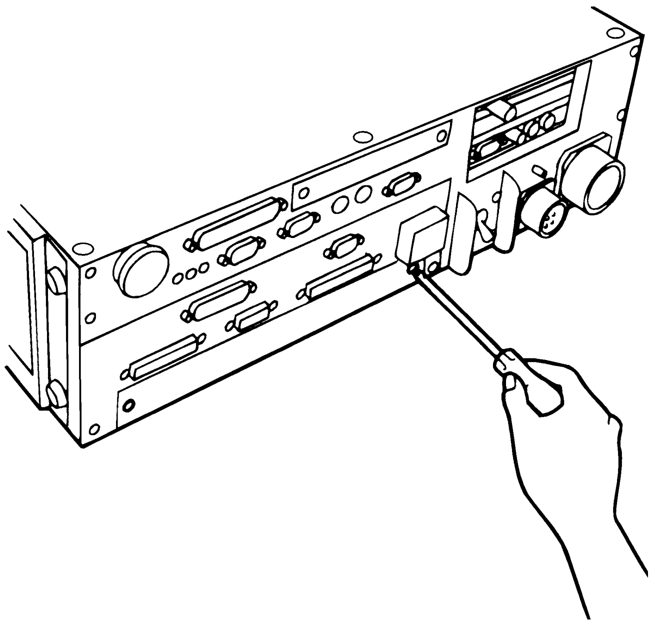
### STEP 1

Turn the controller power OFF.



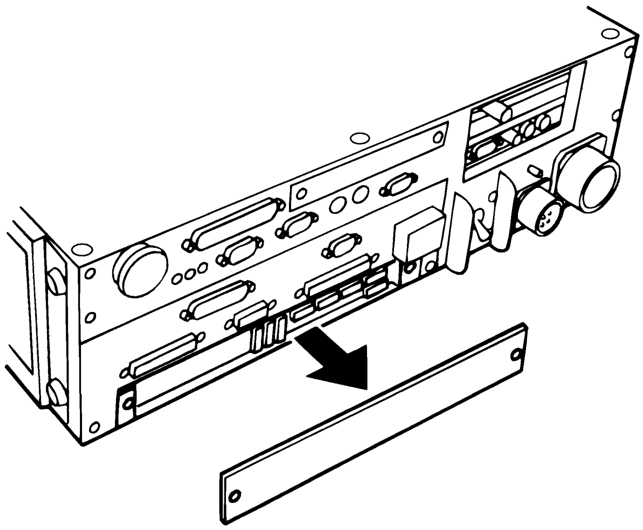

### STEP 2

Remove the two screws to release the output IC cover with a screwdriver.



## ▸ STEP 3

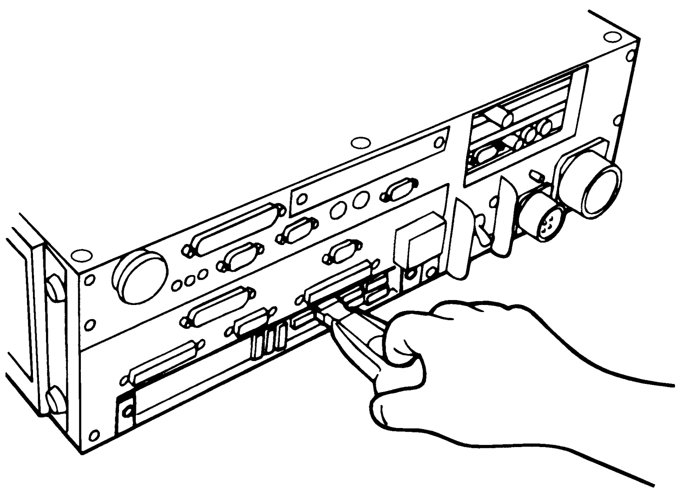
Remove the output IC cover.



## ▸ STEP 4

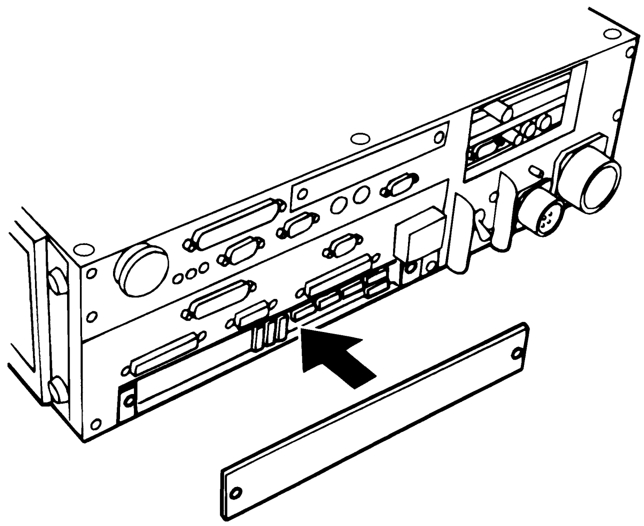
Check the ICs marked with "IC1” to “IC8” on the PC board, and remove the defective output IC with an IC pull-out jig and replace the IC.

| | | |
|---|---|---|
| ⚠**Caution** | **(1)** | **If any output IC is damaged, remove the cause of damage, and replace it with a new output IC.** |
| | **(2)** | **Do not directly touch the elements and their terminals on each PC board.** |



## ▸ STEP 5

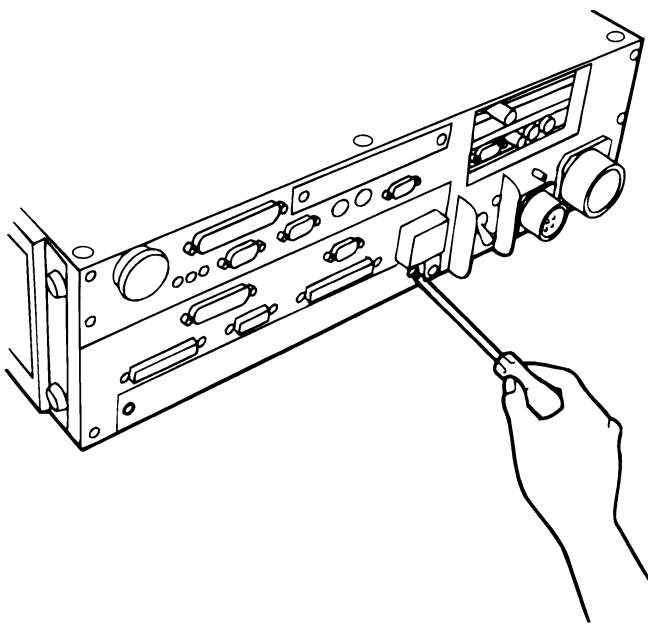
Install the output IC cover to the robot controller.



## ▸ STEP 6

Secure the output IC cover with the two mounting screws.

Tightening screws: 0.6 ±0.2 Nm.



# 6.8 Checking the Odometer and Trip Meter

You may check the odometer and trip meter which count traversed distance of each axis in the Odometer window of the teach pendant.

The access to the Odometer window is [F6 Set]—[F6 Maint.]—[F5 Odometer].

The Odometer window shows the following items:

| | |
|---|---|
| [Odometer] | Shows the total distance of each axis traversed after the robot leaves the factory. You cannot reset the odometer. |
| [Trip meter] | Shows the distance of each axis traversed after you reset the trip meter to zero. |

## 6.8.1 Displaying the Odometer and Trip Meter

**STEP 1**

Turn the robot controller ON.

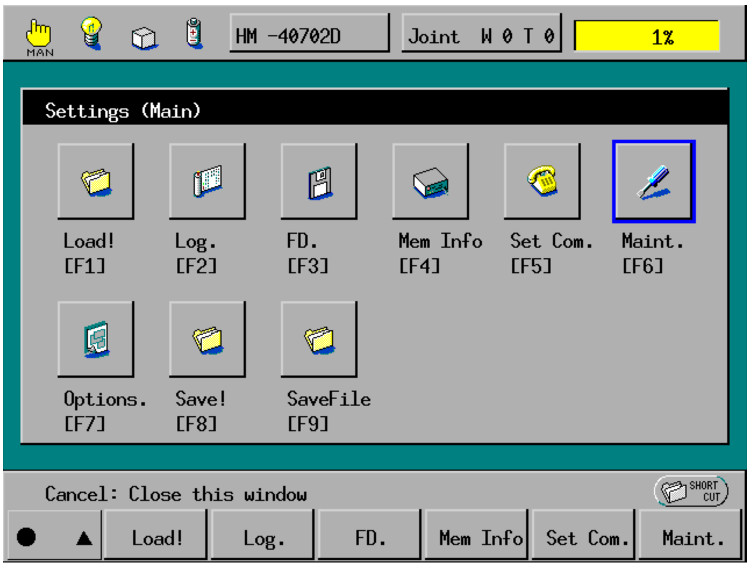
**STEP 2**

On the teach pendant, set the mode switch to the MANUAL position.

**STEP 3**

On the top screen, press [F6 Set].

The Settings (Main) window appears as shown below.

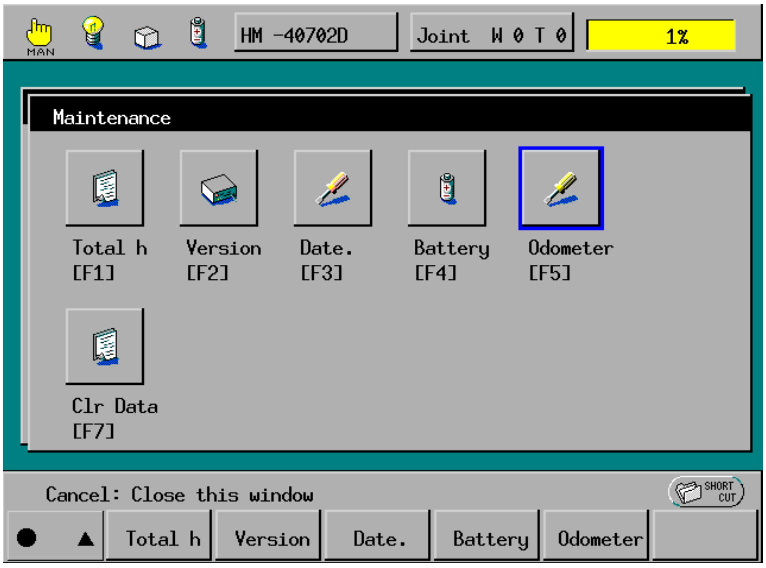



F6

Press [F6 Maint.].

## ▶ STEP 4

The Maintenance menu appears as shown below.

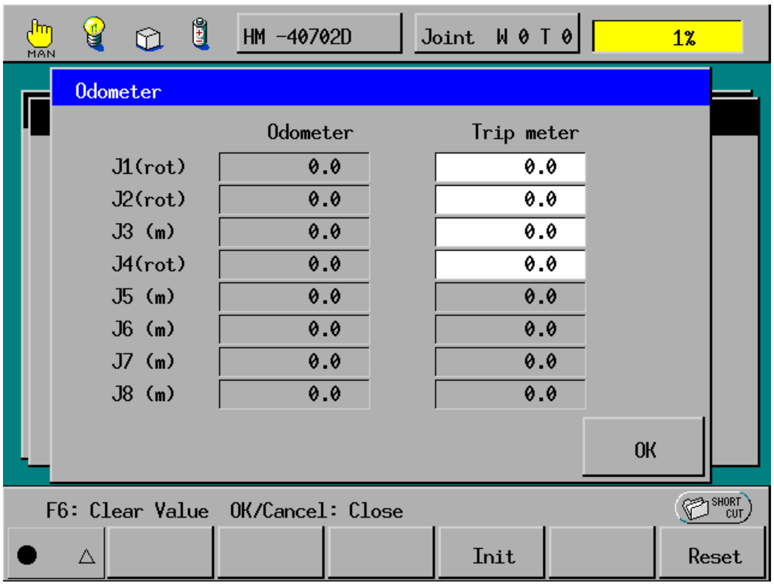



F5

Press [F5 Odometer].

## ▶ STEP 5

The Odometer window appears as shown below.




F6

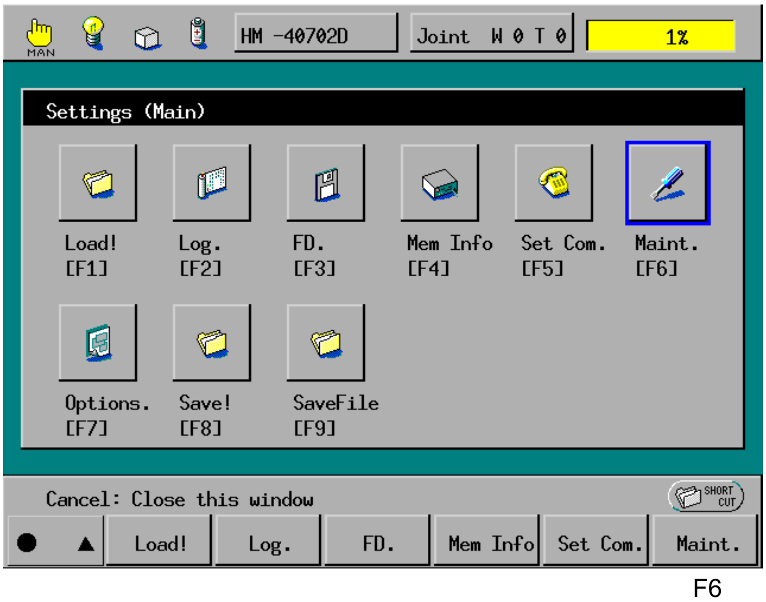
In the above Odometer window, the J1, J2 and J4 are expressed in number of revolutions and J3 in meter.

## 6.8.2 Resetting the Trip Meter to Zero

**STEP 1**

On the top screen, press [F6 Set].

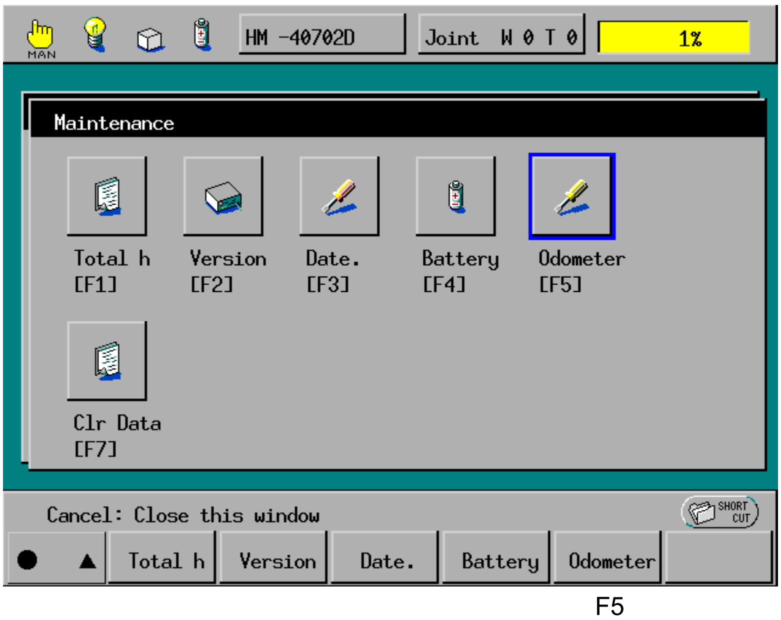
The Settings (Main) window appears as shown below.




Press [F6 Maint.].

**STEP 2**

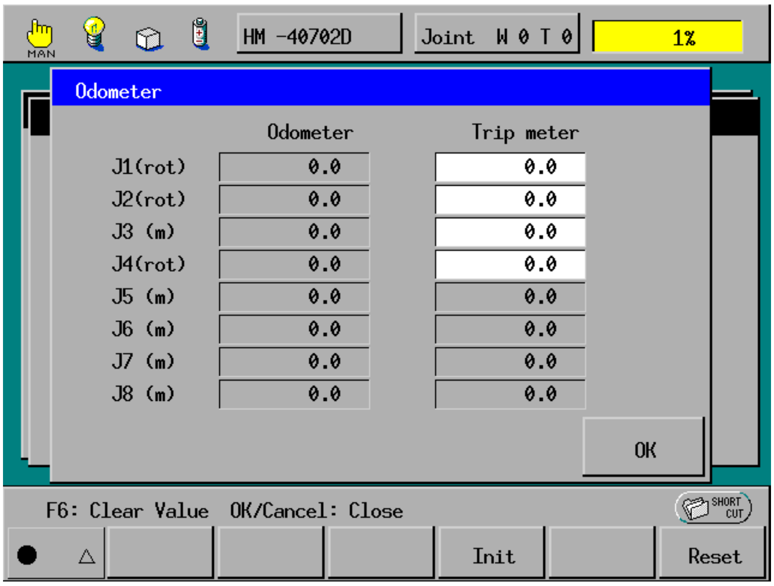
The Maintenance menu appears as shown below.




Press [F5 Odometer].

## ▶ STEP 3

The Odometer window appears as shown below.

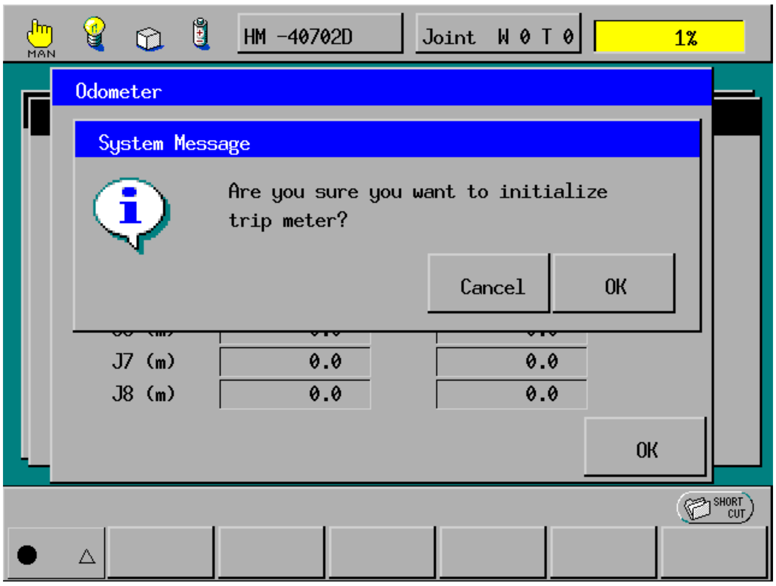



F6

Press [F6 Reset].

## ▶ STEP 4

The following message appears.




Press the OK button.

The trip meter has been reset to zero.

# 6.9 Checking the Controller ON-Time and the Robot Running Time and Resetting Their User Counters

You may check the robot controller ON-time and the robot running time in the Total hours window of the teach pendant.

The Total hours window shows the following items:

| | |
|---|---|
| [Total operation] | Shows the grand total of the robot controller ON-time counted after the controller leaves the factory. |
| [Total running] | Shows the grand total of the robot running time counted after the robot leaves the factory. |
| [Cumu. operation] | Shows the total of the robot controller ON-time counted after you reset the user counter to zero. |
| [Cumu. running] | Shows the total of the robot running time counted after you reset the user counter to zero. |
| [Operation] | Shows the ON-time of the robot controller counted after it is turned ON this time. |
| [Running] | Shows the running time of the robot counted after the robot controller is turned ON this time. |

## 6.9.1 Displaying the Controller ON-time and the Robot Running Time

STEP 1

Turn the robot controller power ON.

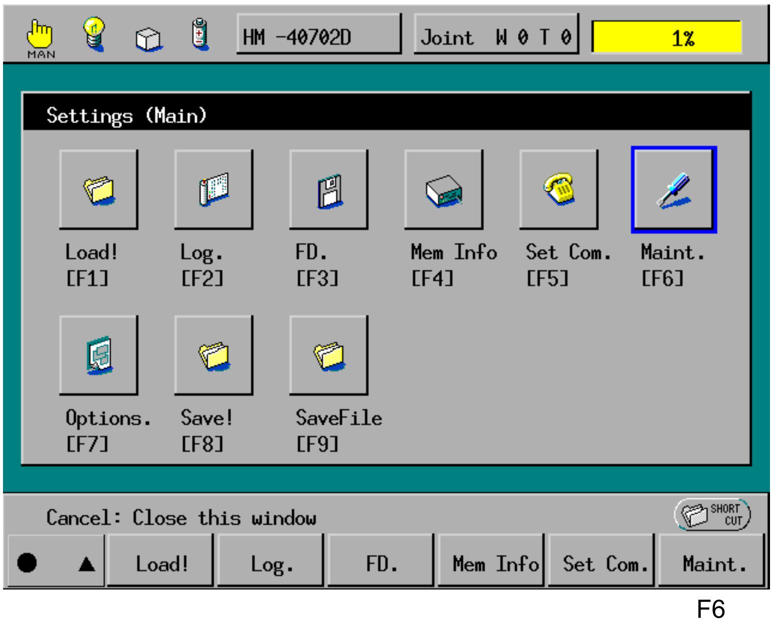
STEP 2

On the teach pendant, set the mode switch to the MANUAL position.

STEP 3

On the top screen, press [F6 Set].

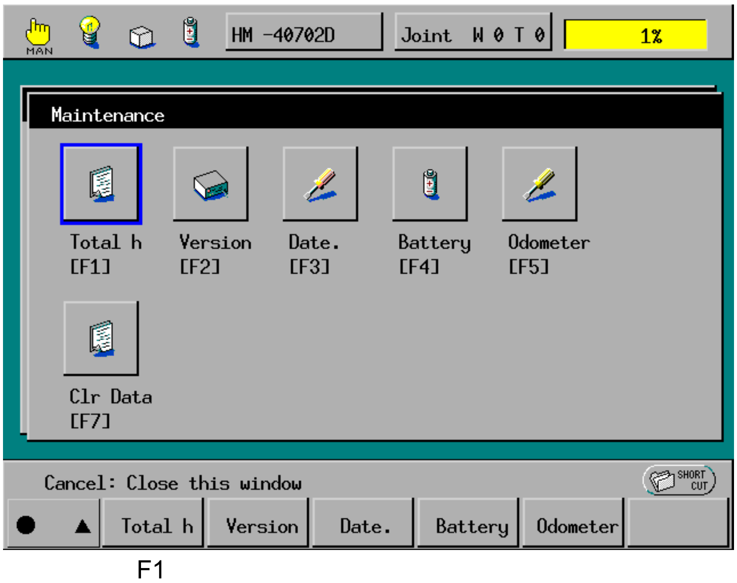
The Settings (Main) window appears as shown below.




Press [F6 Maint.].

## STEP 4

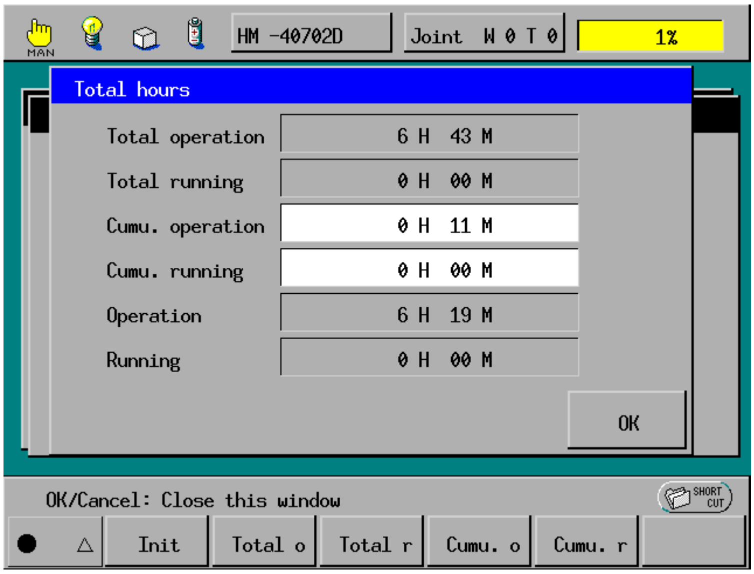
The Maintenance menu appears as shown below.




Press [F1 Total h].

## STEP 5

The Total hours window appears as shown below.

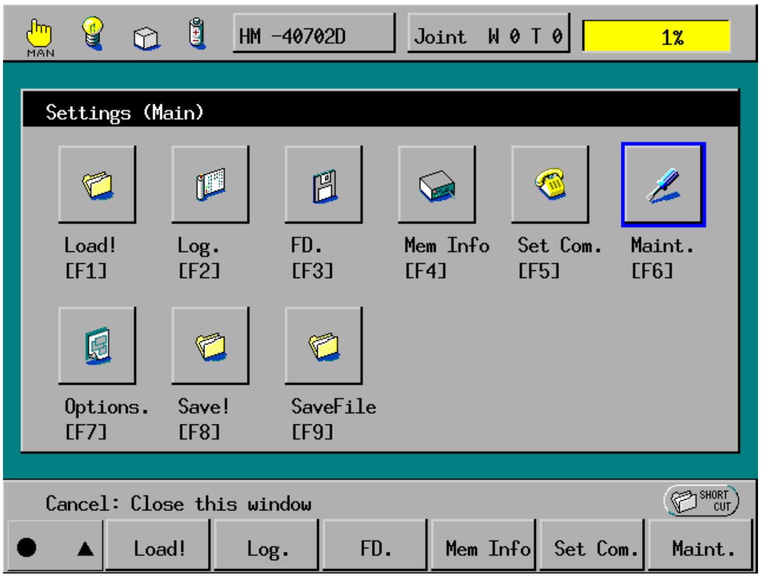


## 6.9.2 Resetting the User Counters of the Controller ON-Time and the Robot Running Time

### STEP 1

On the teach pendant, press [F6 Set].

The Settings (Main) window appears as shown below.

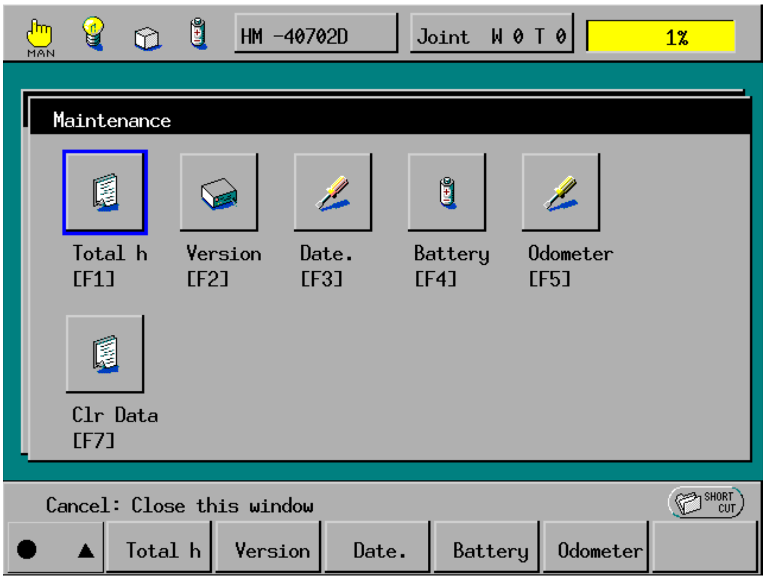



F6

Press [F6 Maint.].

### STEP 2

The Maintenance menu appears as shown below.

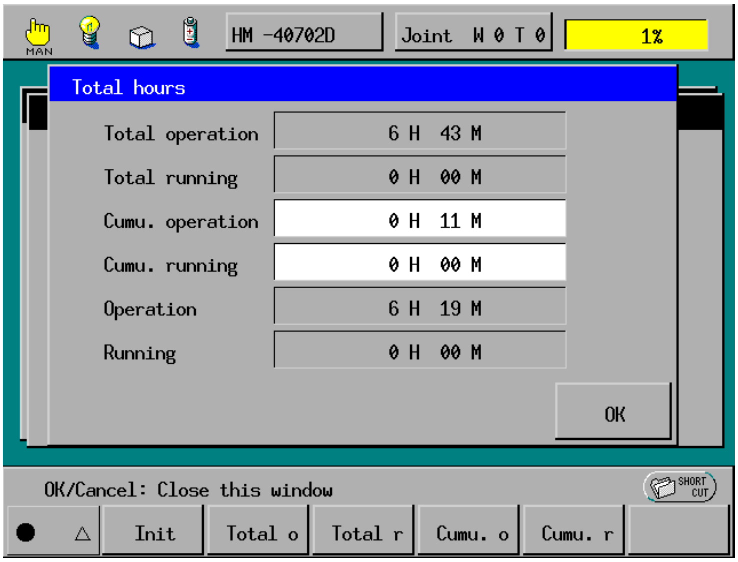



F1

Press [F1 Total h].

## ▶ STEP 3

The Total hours window appears as shown below.

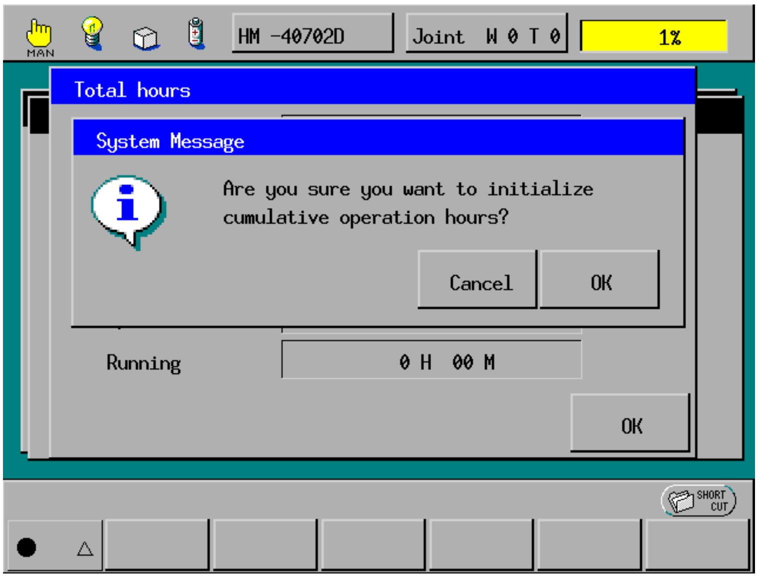



F4

To reset the user counter of the controller ON-time to zero, press [F4 Cumu. o].

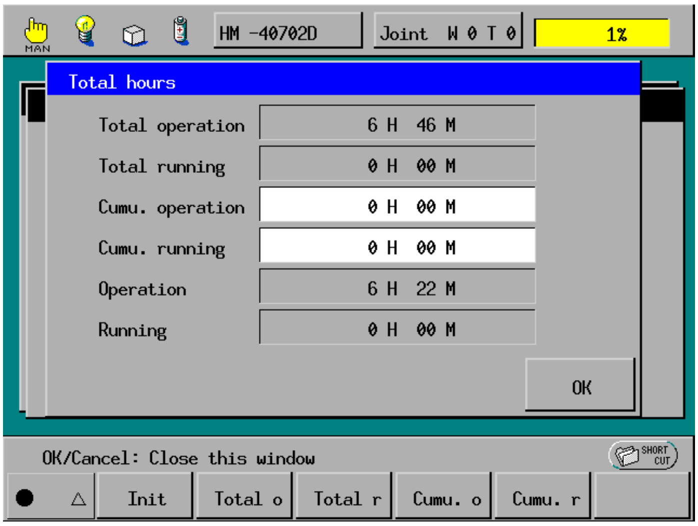
## ▶ STEP 4

The following system message appears.




Press the OK button.

The user counter of the controller ON-time has been reset to zero.



# 6.10 Using the Initialization Floppy Disk

The initialization floppy disk (*.arm) stores arm data in WINCAPSII format.

You transfer the stored arm data to the robot controller in these two steps:

(1) Create a project by using the data stored in the floppy disk.

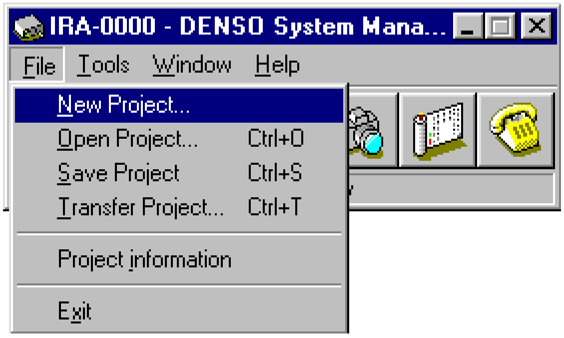
(2) Transfer the trajectory generation file in the project to the robot controller.

## Creating a project to be transferred

### STEP 1

**Create a new project.**

Start WINCAPSII. From the File menu of System Manager, click the New Project.

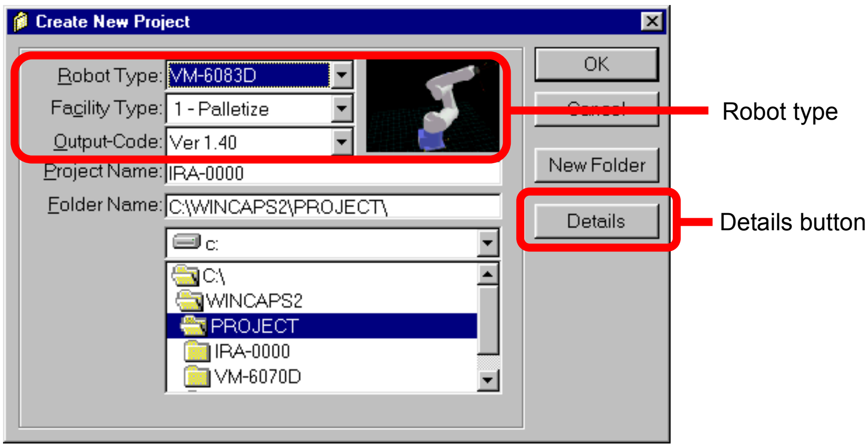



[File menu: Creating a new project]

### STEP 2

**Select your robot type.**

Select the robot type of the controller to which you want to transfer data.

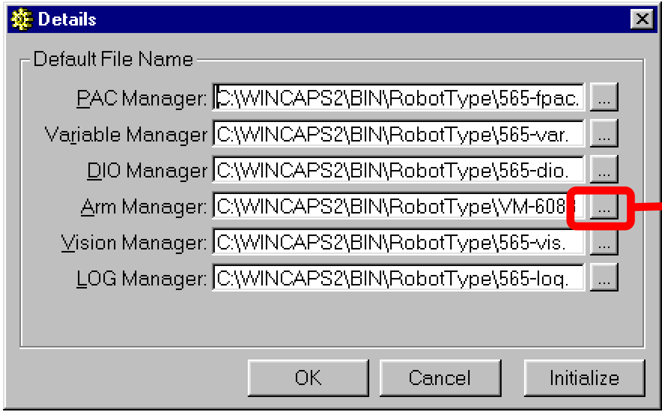



[Create New Project window]

## ▶ STEP 3

**Select arm data.**

(1) Press the Details button to call up the window below.

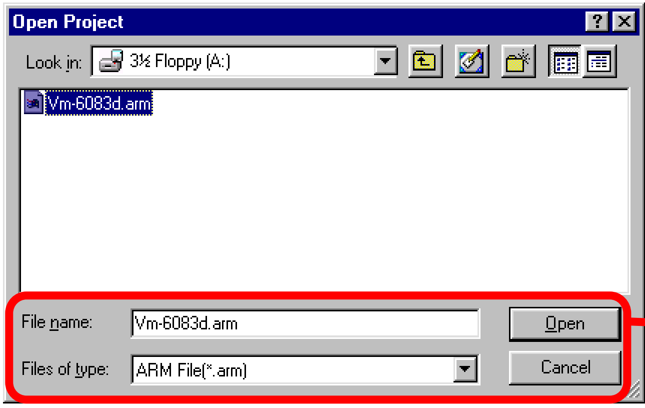



Browse button

[Details window]

(2) Press the Browse button in Arm Manager to call up the Open Project window.

Select desired file in the floppy disk, then press the Open button.




File "Vm-6083d.arm" in drive A is selected.

[Selecting a file]

(3) The screen will return to the Details window where you press OK button.

## ▶ STEP 4

**Create a project.**

**On the Create New Project window, press OK button. Now, a project to be transferred has been created.**

## Transferring the trajectory generation file

### STEP 1

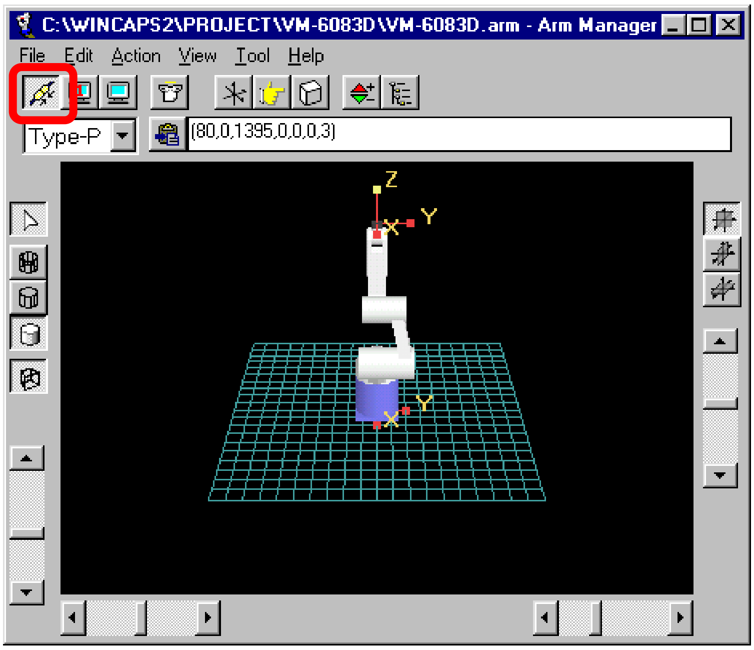
**Start of Arm Manager**

From System Manager, run Arm Manager.

### STEP 2

**Connection with the robot controller**

Press the Connect button to connect with the robot controller.

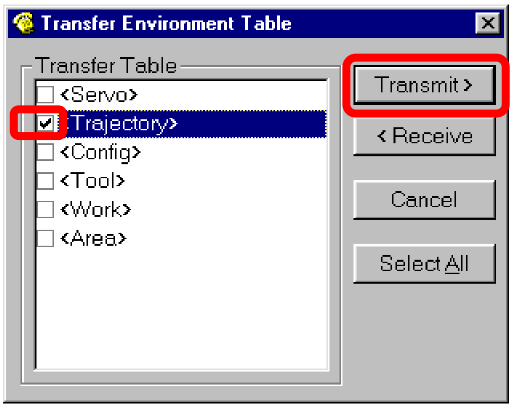



[Arm Manager window]

## ▶ STEP 3

**Data transmission**

(1) From the File menu of Arm Manager window, click Transfer command. The Transfer Environment Table appears as shown below.




[Transfer Environment Table]

(2) On the table shown above, select the Trajectory and press the Transmit> button.

(3) The following message appears.

Press Yes.

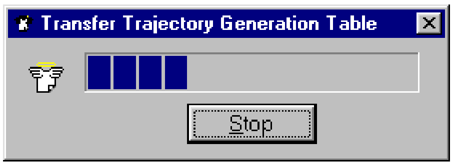

[Confirmation dialog]

The following message appears.

Press OK.


[Configuration transfer dialog]

During data transfer, the following dialog is displayed.




[Transfer Trajectory Generation Table]

(4) Upon completion of transfer, the following message appears.

Press OK.

The arm data stored in the initialization floppy disk has been transferred to the robot controller.

Turn the controller power off and then on.


[Transfer completion message]

# Appendix

# Appendix 1 I/O Circuits and Connectors (NPN type)

This section explains the I/O circuit of NPN type (source input and sink output). For the circuit of PNP type (sink input and source output), refer to Chapter 5, Section 5.6, "I/O Circuits and Connectors (PNP type)."

## 1.1 I/O Signal Connector Pin Layout

This section describes the Robot Controller connector pin layouts for I/O signals.

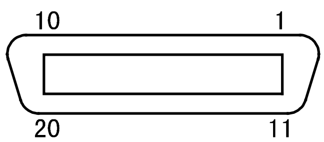
The definitions of the signals and pins of the output connector CN10 and input connector CN8 are different between the standard mode and the compatible mode.

As for the other connectors, the definitions of the pins are common to the standard mode and the compatible mode.

### 1.1.1 Connector Pin Layout Common to Both Modes

**(1) HAND I/O CN9: Connector for end-effector I/O (common to both modes)**

**Table 1-1 CN9 Pin Layout, common to both modes (NPN type)**

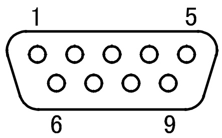



**View from the cable side**

| Terminal No. | Name | Port number | Wire color | | Terminal No. | Name | Port number | Wire color | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Standard | High strength | | | | Standard | High strength |
| 1 | Hand output | 64 | Black | Blue | 11 | Hand Input | 50 | Pink | White |
| 2 | Hand output | 65 | Brown | Yellow | 12 | Hand Input | 51 | Pink | White |
| 3 | Hand output | 66 | Black | Green | 13 | Hand Input | 52 | White | White |
| 4 | Hand output | 67 | Brown | Red | 14 | Hand Input | 53 | White | White |
| 5 | Hand output | 68 | Red | Violet | 15 | Hand Input | 54 | White | White |
| 6 | Hand output | 69 | Orange | Blue | 16 | Hand Input (interrupt input) | 55 | White | Brown |
| 7 | Hand output | 70 | Yellow | Yellow | 17 | Power E24V for Hand | — | White | Brown |
| 8 | Hand output | 71 | Green | Green | 18 | Power E0V for Hand | — | White | Brown |
| 9 | Hand input | 48 | Blue | Red | 19 | Not connected | — | White | Brown |
| 10 | Hand input | 49 | Violet | Violet | 20 | Not connected | — | White | Brown |

### (2) I/O POWER CN7: Power connector for I/O (common to both modes)

**Table 1-2 CN7 Pin Layout, common to both modes (NPN type)**




**View from the cable side**

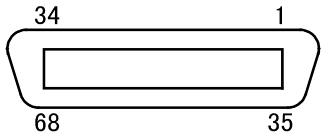
| Terminal No. | Name |
|---|---|
| 1 | Internal power source output +24V |
| 2 | Internal power source output +24V |
| 3 | Internal power source output 0V |
| 4 | Internal power source output 0V |
| 5 | FG |
| 6 | Power input E24V |
| 7 | Power input E24V |
| 8 | Power input E0V |
| 9 | Power input E0V |

**⚠Caution: When using the internal power source, keep the total current capacity below 1.3A. To use the internal power source of the robot controller, connect the wiring so that the internal power source will be separated from the external power source. Improper wiring may damage the internal circuit.**

## 1.1.2 Connector Pin Layout for Standard Mode

### (1) OUTPUT CN10: User-/System-output connector (standard mode)

**Table 1-3 CN10 Pin Layout, for standard mode (NPN type)**

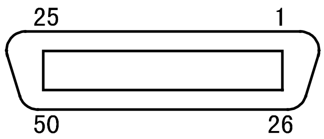



**View from the cable side**

| Terminal number | Name | Port number | Wire color | Terminal number | Name | Port number | Wire color |
|---|---|---|---|---|---|---|---|
| 1 | Normal CPU | 72 | Black | 35 | User output | 106 | Pink |
| 2 | Robot in operation | 73 | Brown | 36 | User output | 107 | Pink |
| 3 | Robot failure | 74 | Red | 37 | User output | 108 | Pink |
| 4 | Servo ON | 75 | Orange | 38 | User output | 109 | Pink |
| 5 | Robot initialization complete | 76 | Yellow | 39 | User output | 110 | Pink |
| 6 | Automatic mode | 77 | Black | 40 | User output | 111 | White |
| 7 | External mode | 78 | Brown | 41 | User output | 112 | White |
| 8 | Dead battery warning | 79 | Red | 42 | User output | 113 | White |
| 9 | Robot warning | 80 | Orange | 43 | User output | 114 | White |
| 10 | Continue start permitted | 81 | Yellow | 44 | User output | 115 | White |
| 11 | SS mode | 82 | Green | 45 | User output | 116 | White |
| 12 | Reserved | 83 | Blue | 46 | User output | 117 | White |
| 13 | Reserved | 84 | Violet | 47 | User output | 118 | White |
| 14 | Reserved | 85 | Gray | 48 | User output | 119 | White |
| 15 | Command processing complete | 86 | Pink | 49 | User output | 120 | White |
| 16 | Status area odd parity | 87 | Black | 50 | User output | 121 | Gray |
| 17 | Status area bit 0 | 88 | Black | 51 | User output | 122 | Violet |
| 18 | Status area bit 1 | 89 | Brown | 52 | User output | 123 | Violet |
| 19 | Status area bit 2 | 90 | Red | 53 | User output | 124 | Violet |
| 20 | Status area bit 3 | 91 | Orange | 54 | User output | 125 | Violet |
| 21 | Status area bit 4 | 92 | Yellow | 55 | User output | 126 | Violet |
| 22 | Status area bit 5 | 93 | Green | 56 | User output | 127 | Violet |
| 23 | Status area bit 6 | 94 | Blue | 57 | Not used. | — | Violet |
| 24 | Status area bit 7 | 95 | Gray | 58 | Not used. | — | Violet |
| 25 | Status area bit 8 | 96 | Pink | 59 | Not used. | — | Violet |
| 26 | Status area bit 9 | 97 | Brown | 60 | Not used. | — | Gray |
| 27 | Status area bit 10 | 98 | Red | 61 | Not used. | — | Gray |
| 28 | Status area bit 11 | 99 | Orange | 62 | Not used. | — | Gray |
| 29 | Status area bit 12 | 100 | Yellow | 63 | Not used. | — | Gray |
| 30 | Status area bit 13 | 101 | Green | 64 | Not used. | — | Gray |
| 31 | Status area bit 14 | 102 | Blue | 65 | Emergency stop + | — | Gray |
| 32 | Status area bit 15 | 103 | Pink | 66 | Emergency stop – | — | Gray |
| 33 | User output | 104 | Black | 67 | Not used. | — | Blue |
| 34 | User output | 105 | Brown | 68 | Not used. | — | Blue |

## (2) INPUT CN8: User-/System-input connector (standard mode)

**Table 1-4 CN8 Pin Layout, for standard mode (NPN type)**



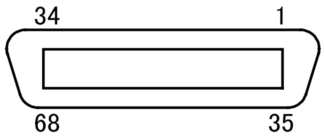

**View from the cable side**

| Terminal number | Name | Port number | Wire color | Terminal number | Name | Port number | Wire color |
|---|---|---|---|---|---|---|---|
| 1 | Power for robot stop (internal +24V) | — | Black | 26 | Data area 2 bit 7 | 21 | Pink |
| 2 | Robot stop | — | Brown | 27 | Data area 2 bit 8 | 22 | Pink |
| 3 | Power for Enable Auto (internal +24V) | — | Red | 28 | Data area 2 bit 9 | 23 | Pink |
| 4 | Enable Auto | — | Black | 29 | Data area 2 bit 10 | 24 | White |
| 5 | Step-stop (all tasks) | 0 | Brown | 30 | Data area 2 bit 11 | 25 | White |
| 6 | Not used. | 1 | Red | 31 | Data area 2 bit 12 | 26 | White |
| 7 | Instantaneous stop (all tasks) | 2 | Orange | 32 | Data area 2 bit 13 | 27 | White |
| 8 | Strobe signal | 3 | Yellow | 33 | Data area 2 bit 14 | 28 | White |
| 9 | Interrupt skip | 4 | Green | 34 | Data area 2 bit 15 | 29 | White |
| 10 | Command and data odd parity | 5 | Blue | 35 | Command area 0 bit 0 | 30 | White |
| 11 | Data area 1 bit 0 | 6 | Violet | 36 | Command area 0 bit 1 | 31 | White |
| 12 | Data area 1 bit 1 | 7 | Black | 37 | Command area 0 bit 2 | 32 | Gray |
| 13 | Data area 1 bit 2 | 8 | Brown | 38 | Command area 0 bit 3 | 33 | Gray |
| 14 | Data area 1 bit 3 | 9 | Red | 39 | User input | 34 | Gray |
| 15 | Data area 1 bit 4 | 10 | Orange | 40 | User input | 35 | Gray |
| 16 | Data area 1 bit 5 | 11 | Yellow | 41 | User input | 36 | Gray |
| 17 | Data area 1 bit 6 | 12 | Green | 42 | User input | 37 | Gray |
| 18 | Data area 1 bit 7 | 13 | Blue | 43 | User input | 38 | Gray |
| 19 | Data area 2 bit 0 | 14 | Violet | 44 | User input | 39 | Gray |
| 20 | Data area 2 bit 1 | 15 | White | 45 | User input | 40 | Gray |
| 21 | Data area 2 bit 2 | 16 | Pink | 46 | User input | 41 | Gray |
| 22 | Data area 2 bit 3 | 17 | Black | 47 | User input | 42 | Violet |
| 23 | Data area 2 bit 4 | 18 | Brown | 48 | User input | 43 | Violet |
| 24 | Data area 2 bit 5 | 19 | Red | 49 | User input | 44 | Violet |
| 25 | Data area 2 bit 6 | 20 | Orange | 50 | User input | 45 | Violet |

## 1.1.3 Connector Pin Layout for Compatible Mode

### (1) OUTPUT CN10: User-/System-output connector (compatible mode)

**Table 1-5 CN10 Pin Layout, for compatible mode (NPN type)**

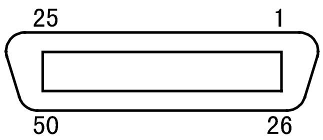



**View from the cable side**

| Terminal number | Name | Port number | Wire color | Terminal number | Name | Port number | Wire color |
|---|---|---|---|---|---|---|---|
| 1 | Normal CPU | 72 | Black | 35 | User output | 106 | Pink |
| 2 | Robot running | 73 | Brown | 36 | User output | 107 | Pink |
| 3 | Robot failure | 74 | Red | 37 | User output | 108 | Pink |
| 4 | Auto mode | 75 | Orange | 38 | User output | 109 | Pink |
| 5 | External mode | 76 | Yellow | 39 | User output | 110 | Pink |
| 6 | Program start reset | 77 | Black | 40 | User output | 111 | White |
| 7 | Not used. | 78 | Brown | 41 | User output | 112 | White |
| 8 | Not used. | 79 | Red | 42 | User output | 113 | White |
| 9 | Robot power ON complete | 80 | Orange | 43 | User output | 114 | White |
| 10 | Servo ON | 81 | Yellow | 44 | User output | 115 | White |
| 11 | CAL complete | 82 | Green | 45 | User output | 116 | White |
| 12 | Teaching | 83 | Blue | 46 | User output | 117 | White |
| 13 | Single-cycle complete | 84 | Violet | 47 | User output | 118 | White |
| 14 | Dead battery warning | 85 | Gray | 48 | User output | 119 | White |
| 15 | Robot warning | 86 | Pink | 49 | User output | 120 | White |
| 16 | Continue start permit | 87 | Black | 50 | User output | 121 | Gray |
| 17 | Error units bit 0 | 88 | Black | 51 | User output | 122 | Violet |
| 18 | Error units bit 1 | 89 | Brown | 52 | User output | 123 | Violet |
| 19 | Error units bit 2 | 90 | Red | 53 | User output | 124 | Violet |
| 20 | Error units bit 3 | 91 | Orange | 54 | User output | 125 | Violet |
| 21 | Error tens bit 0 | 92 | Yellow | 55 | User output | 126 | Violet |
| 22 | Error tens bit 1 | 93 | Green | 56 | User output | 127 | Violet |
| 23 | Error tens bit 2 | 94 | Blue | 57 | Not connected | — | Violet |
| 24 | Error tens bit 3 | 95 | Gray | 58 | Not connected | — | Violet |
| 25 | Error hundreds bit 0 | 96 | Pink | 59 | Not connected | — | Violet |
| 26 | Error hundreds bit 1 | 97 | Brown | 60 | Not connected | — | Gray |
| 27 | Error hundreds bit 2 | 98 | Red | 61 | Not connected | — | Gray |
| 28 | Error hundreds bit 3 | 99 | Orange | 62 | Not connected | — | Gray |
| 29 | SS mode | 100 | Yellow | 63 | Not connected | — | Gray |
| 30 | Not used. | 101 | Green | 64 | Not connected | — | Gray |
| 31 | Not used. | 102 | Blue | 65 | Emergency stop + | — | Gray |
| 32 | Not used. | 103 | Pink | 66 | Emergency stop – | — | Gray |
| 33 | User output | 104 | Black | 67 | Not connected | — | Blue |
| 34 | User output | 105 | Brown | 68 | Not connected | — | Blue |

## (2) INPUT CN8: User-/System-input connector (compatible mode)

**Table 1-6  CN8 Pin Layout, for compatible mode (NPN type)**




**View from the cable side**

| Terminal number | Name | Port number | Wire color | Terminal number | Name | Port number | Wire color |
|---|---|---|---|---|---|---|---|
| 1 | Power for robot stop (internal +24V) | - | Black | 26 | User input | 21 | Pink |
| 2 | Robot stop | - | Brown | 27 | User input | 22 | Pink |
| 3 | Power for Enable Auto (internal +24V) | - | Red | 28 | User input | 23 | Pink |
| 4 | Enable Auto | - | Black | 29 | User input | 24 | White |
| 5 | Step-stop (all tasks) | 0 | Brown | 30 | User input | 25 | White |
| 6 | Continue start | 1 | Red | 31 | User input | 26 | White |
| 7 | Instantaneous stop (all tasks) | 2 | Orange | 32 | User input | 27 | White |
| 8 | Operation preparation start | 3 | Yellow | 33 | User input | 28 | White |
| 9 | Interrupt skip | 4 | Green | 34 | User input | 29 | White |
| 10 | Program start | 5 | Blue | 35 | User input | 30 | White |
| 11 | Program No. select bit 0 | 6 | Violet | 36 | User input | 31 | White |
| 12 | Program No. select bit 1 | 7 | Black | 37 | User input | 32 | Gray |
| 13 | Program No. select bit 2 | 8 | Brown | 38 | User input | 33 | Gray |
| 14 | Program No. select bit 3 | 9 | Red | 39 | User input | 34 | Gray |
| 15 | Program No. select bit 4 | 10 | Orange | 40 | User input | 35 | Gray |
| 16 | Program No. select bit 5 | 11 | Yellow | 41 | User input | 36 | Gray |
| 17 | Program No. select bit 6 | 12 | Green | 42 | User input | 37 | Gray |
| 18 | Program No. select odd parity bit | 13 | Blue | 43 | User input | 38 | Gray |
| 19 | Motor power ON | 14 | Violet | 44 | User input | 39 | Gray |
| 20 | CAL execution | 15 | White | 45 | User input | 40 | Gray |
| 21 | Reserved | 16 | Pink | 46 | User input | 41 | Gray |
| 22 | SP100 | 17 | Black | 47 | User input | 42 | Violet |
| 23 | Switch Ext Mode | 18 | Brown | 48 | User input | 43 | Violet |
| 24 | Program reset | 19 | Red | 49 | User input | 44 | Violet |
| 25 | Clear robot failure | 20 | Orange | 50 | User input | 45 | Violet |

# 1.2 Robot Controller I/O Circuits

## 1.2.1 User-Input, System-Input and Hand-Input Circuits

Figures 1-1 and 1-2 show examples of the user-input, system-input, and hand-input circuit configurations and connections of the robot controller.

The maximum allowable current capacity of the robot controller's internal power source is 1.3 A. Use the internal power source within this allowable range.

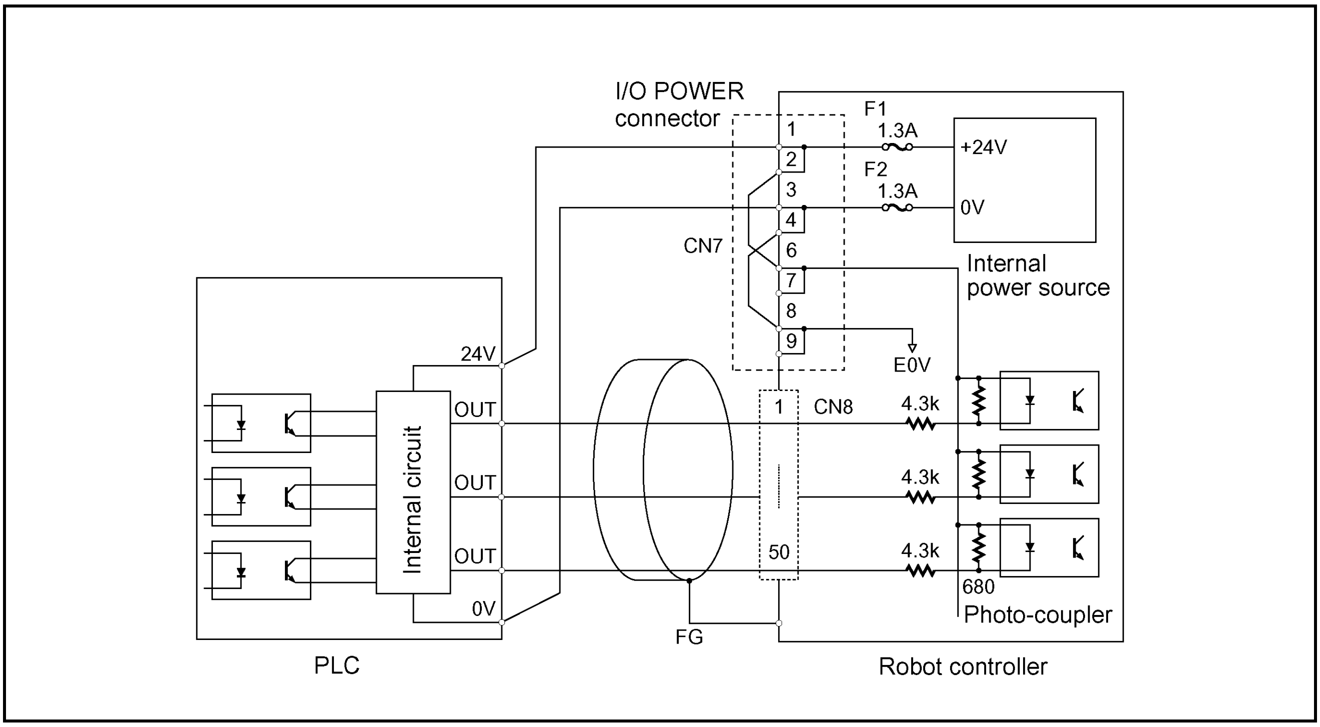
**Caution**

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. The power capacity is 15W or more.**

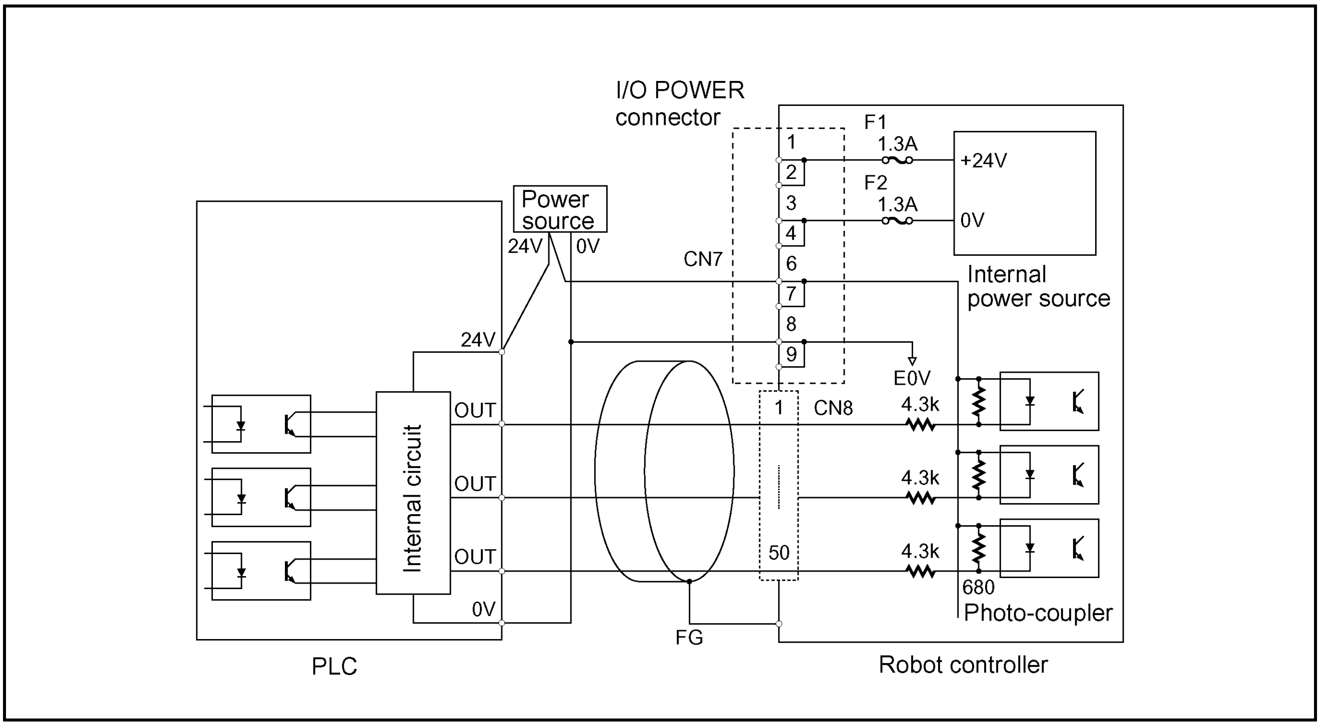
② **When controlling two or more robots with a single PLC using the internal power source of the Robot Controller, set a PLC Output card for each robot.**

③ **Other than a PLC, a proximity switch, or a relay contact may be connected directly to the input terminal of the Robot Controller. In such a case, use the power input to pins 6 to 9 of the I/O power connector. A two-wire photoelectric switch or proximity switch can be connected if its leakage current is 1 mA or less.**

④ **Use a multi-core shielding cable for the purpose of protecting the Robot Controller from noise. Ground it to the Robot Controller.**

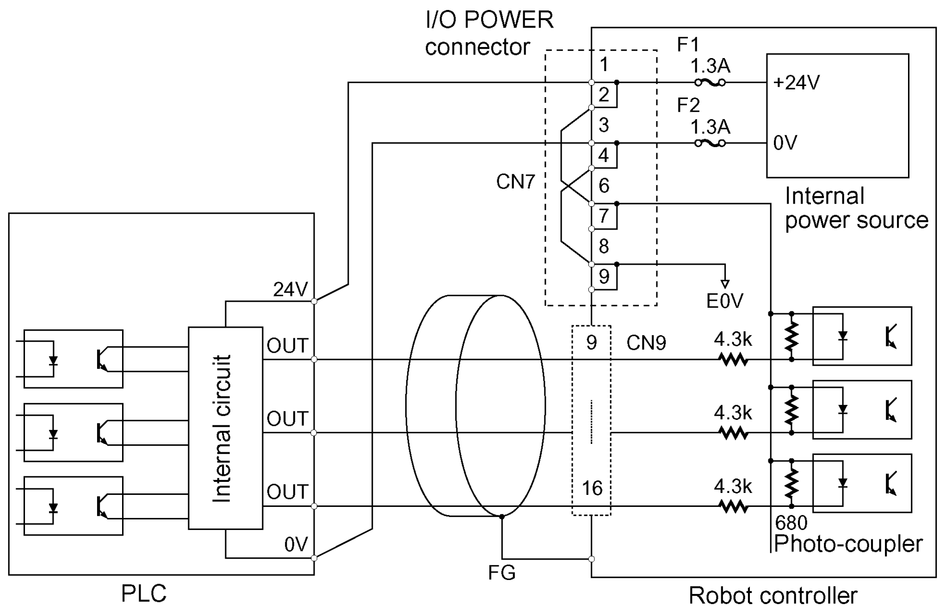



**(When the internal power source is used)**

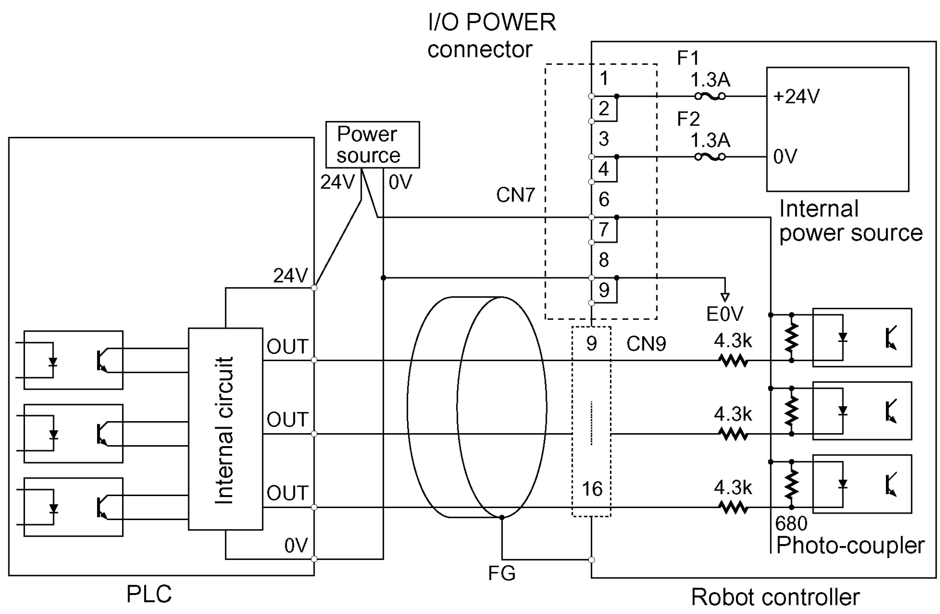



**(When an external power source is used)**

**Figure 1-1 User-Input and System-Input Circuits (NPN type)**




(When the internal power source is used)




(When an external power source is used)

**Figure 1-2  Hand-Input Circuits (NPN type)**

## 1.2.2 *Robot stop* and *Enable auto* Input Circuits

The *Robot stop* and *Enable auto* signals are important for safety. The input circuit for these signals must have contacts as shown in Figure 1-3.

Use the INPUT CN8 (pins 1 and 3) of the robot controller for the power source, irrespective of whether the power source to be used for other I/O signals is the internal power source or an external power source.

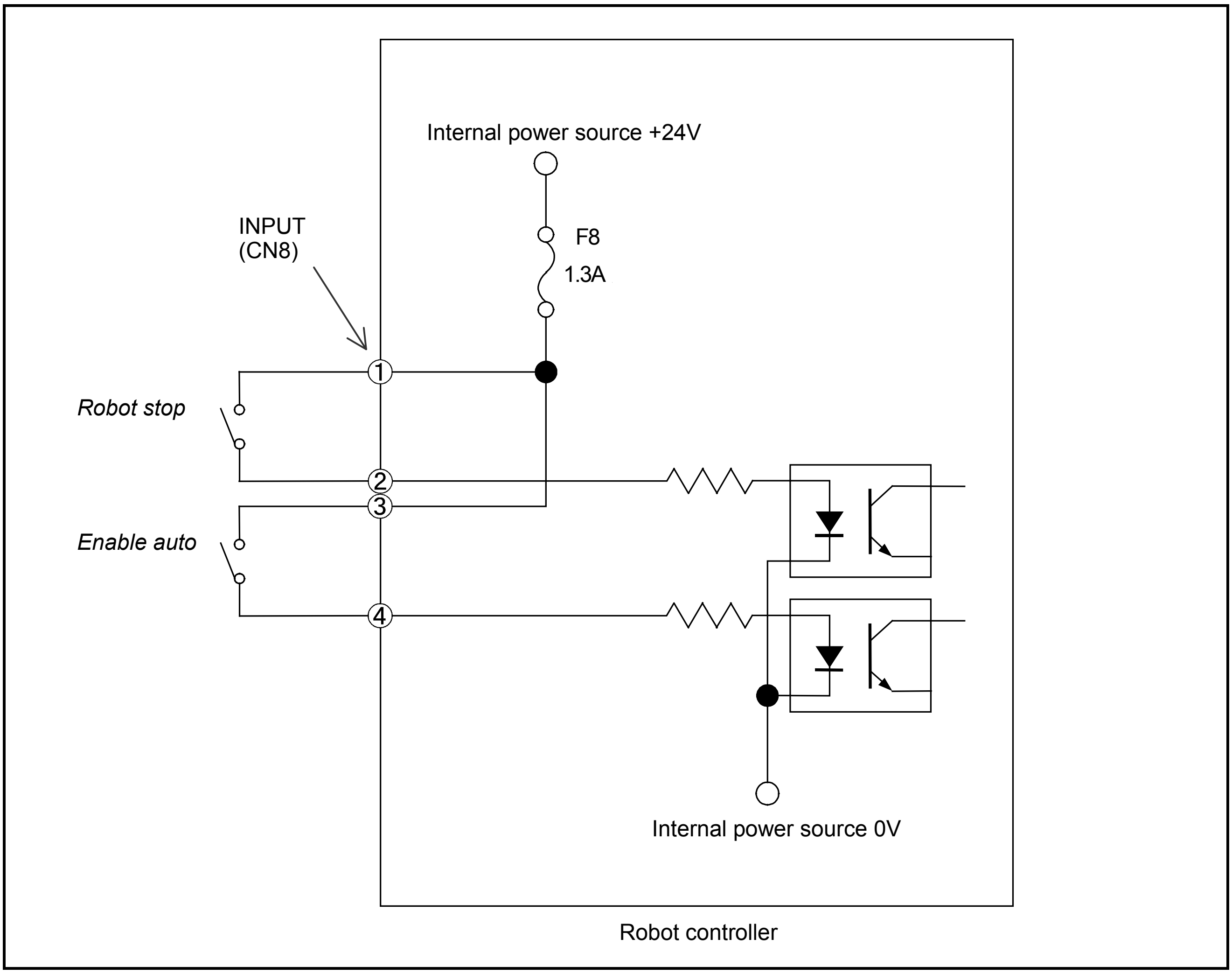



**Figure 1-3 *Robot stop* and *Enable auto* Input Circuits**

**TIP:** For the configuration sample of an emergency stop output circuitry is shown in Appendix 1.2.4.

### 1.2.3 User-Output, System-Output, and Hand-Output Circuits

Figures 1-4 and 1-5 show an example of the configuration and connection of the Robot Controller's user-input output, system-output and hand-output circuit.

Since the initial resistance of a lamp is small, the output circuit may be damaged by rush current that flows when the lamp lights.

When directly turning ON and OFF a lamp, use a lamp whose rating is 0.5W or less.

To reduce rush current, select and connect a resistor R that allows dark current 1/3 or less of the rated current to flow when the lamp goes OFF.

Figure 1-6 shows an example of connecting a lamp.

(1) The User-Output, System-Output and Hand-Output Circuit are open collector output circuits.

(2) The maximum allowable sink current is 70mA.
Keep the current consumption of a device to be connected to the Robot Controller, such as a PLC and a relay coil, below the allowable current.

(3) Select an induction load, such as a relay coil, which has a built-in diode (for absorbing inverse electromotive force).
To use an induction load without a built-in diode, add a diode equivalent to the 1S1888 (Toshiba) in close vicinity to the coil.

| ⚠Caution: | **When externally attaching a diode, connect it with correct polarity. Incorrect polarity may damage the Output circuit.** |
|---|---|

(4) Connecting a lamp requires a circuit through which dark current flows.

| ⚠Caution: | **Since the initial resistance of a lamp is small, the output circuit may be damaged by rush current that flows when the lamp lights.<br>Refer to Figure 1-6.** |
|---|---|

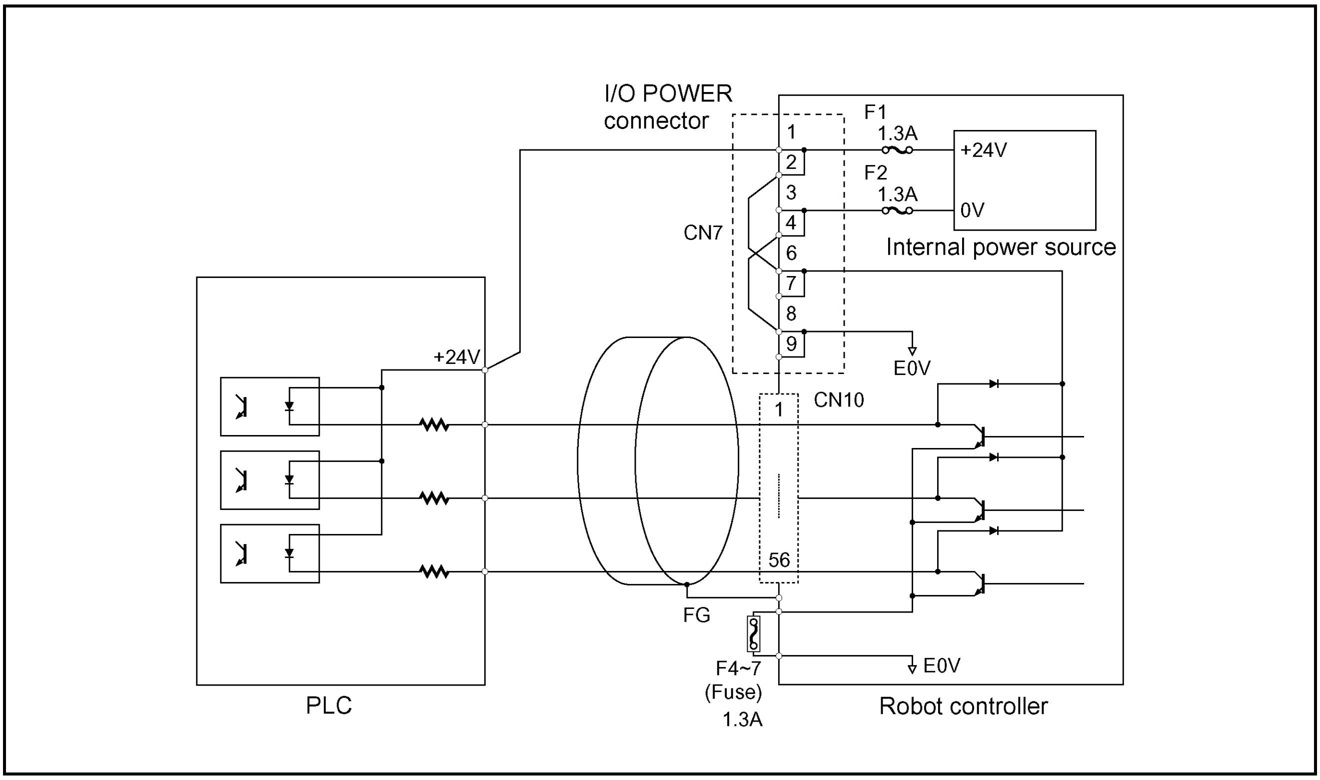
(5) When using the internal power source, prepare a PLC input circuit unit that does not contain a power source.

| ⚠Caution: | **Keep the total current capacity of the internal power source below 1.3A.** |
|---|---|

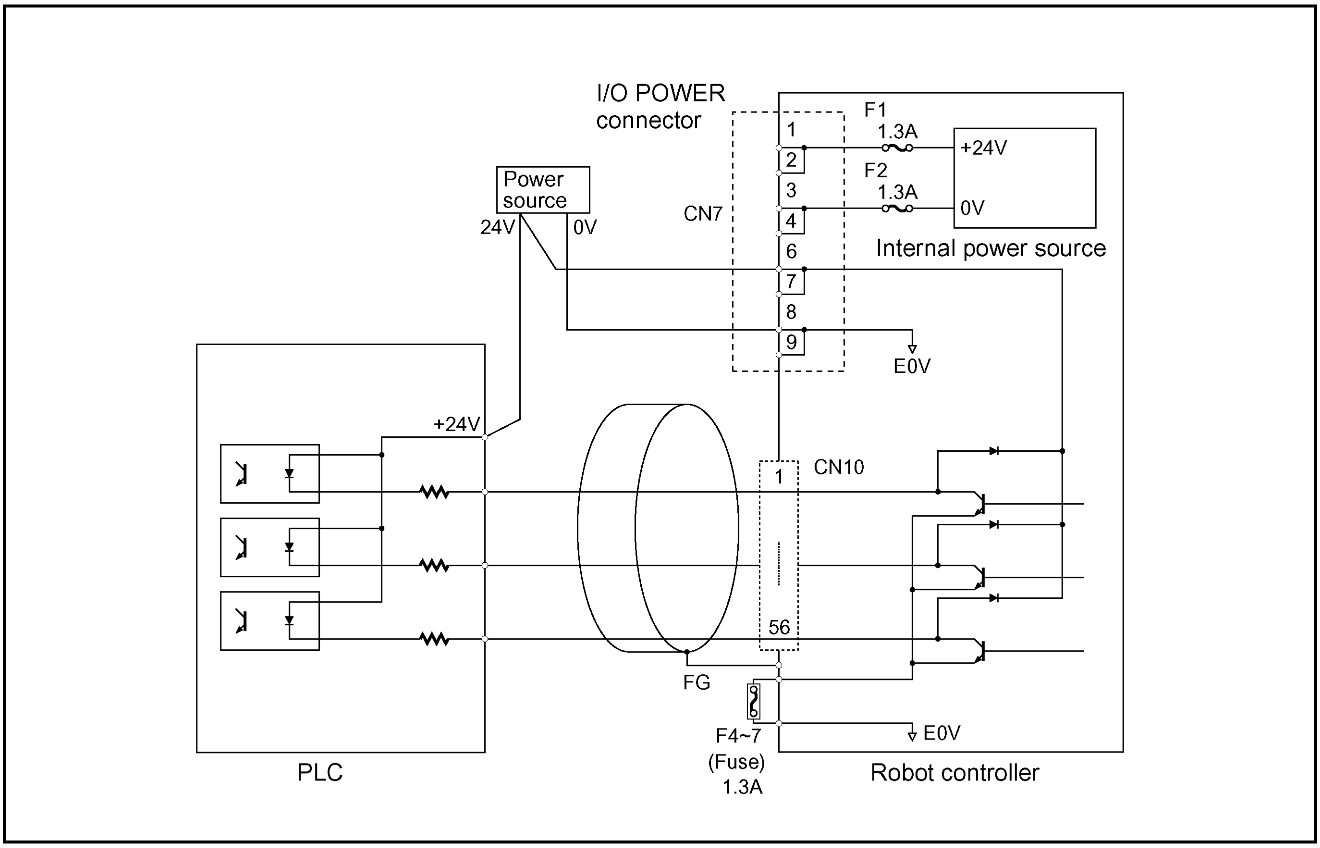
(6) Use a multi-core shielding cable for the purpose of protecting the devices from external noise. Ground it to the robot controller.

(7) +24V internal power source of the robot controller must not be grounded.

| ⚠Caution: | **If the output terminal +24V of internal power source is grounded, there may be a case where the controller is damaged.** |
|---|---|

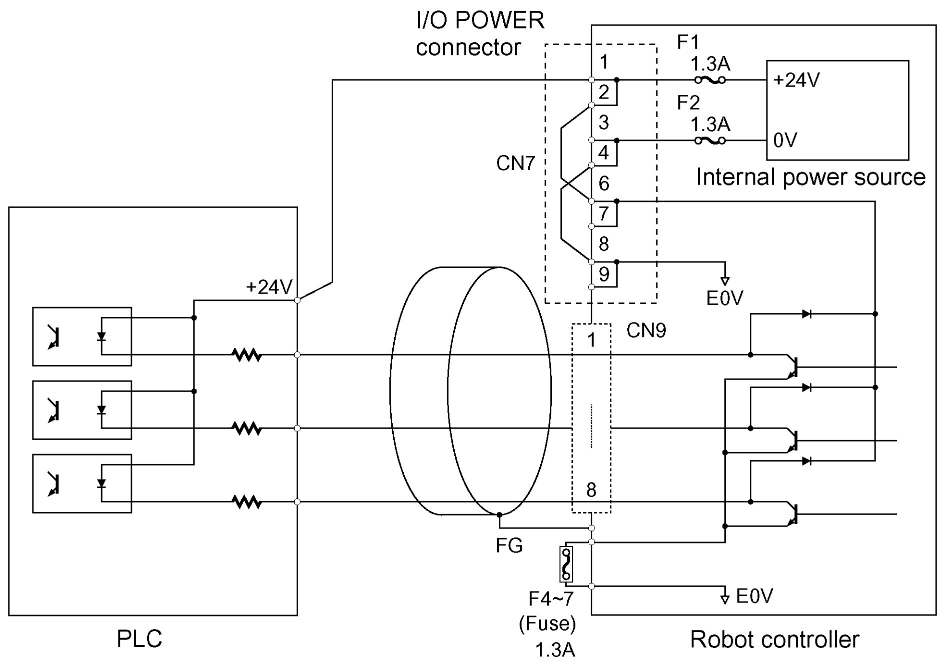



**(When the internal power source is used)**

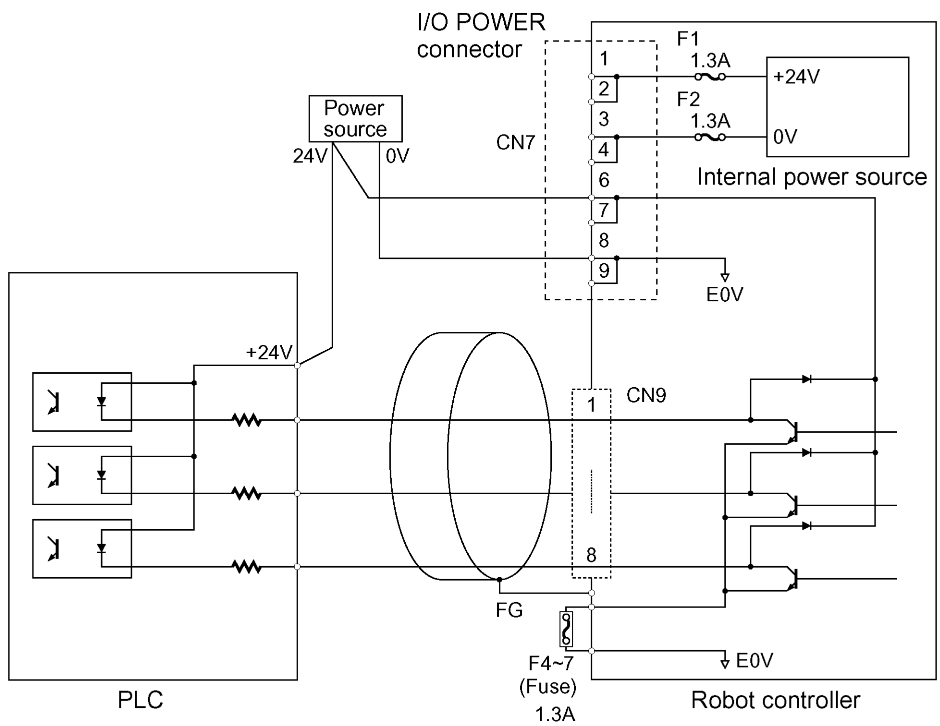



**(When an external power source is used)**

**Figure 1-4 User-Output and System-Output Circuits (NPN type)**




**(When the internal power source is used)**




**(When an external power source is used)**

**Figure 1-5 Hand-Output Circuits (NPN type)**

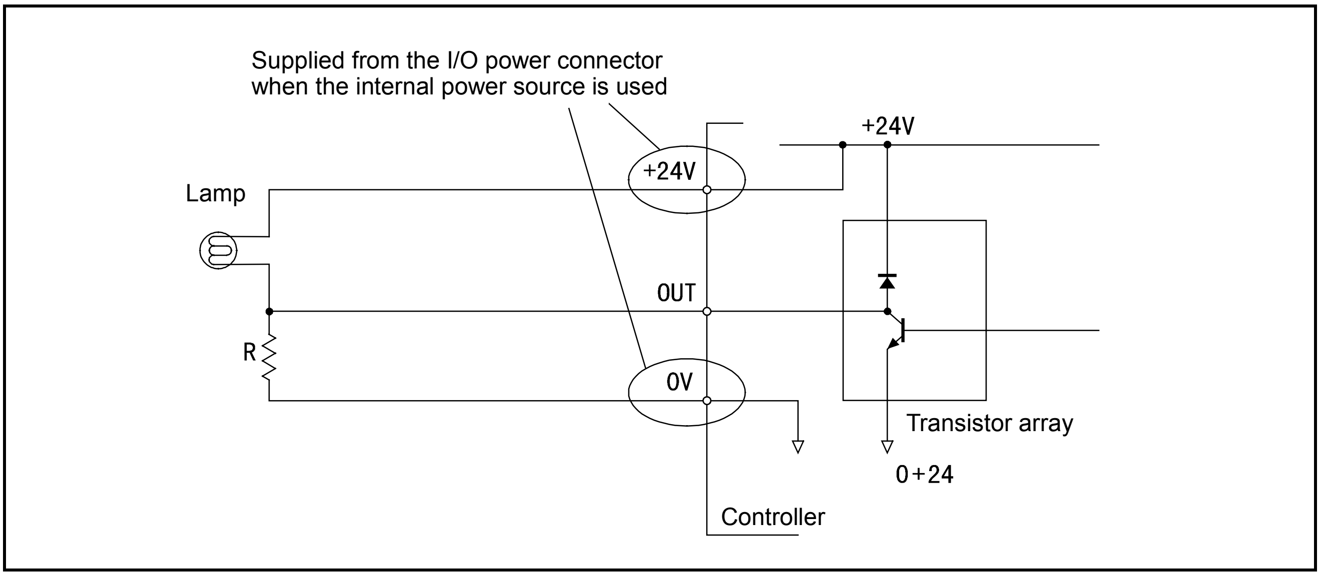
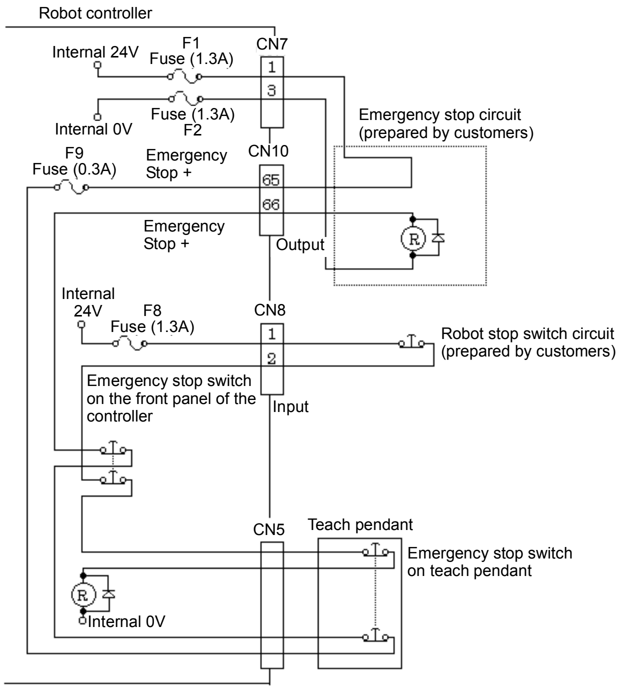



**Figure 1-6  Example of Circuit with Lamp (NPN type)**

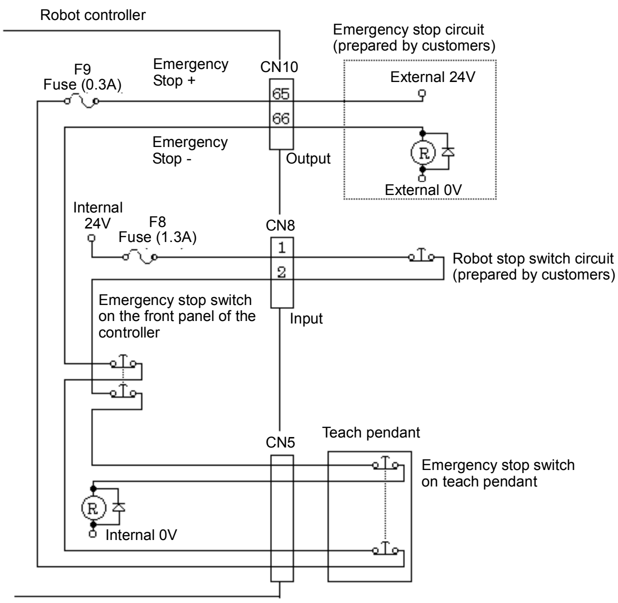
## 1.2.4 Emergency Stop Output Circuit

Figure 1-7 shows the examples of configuration and connection of emergency stop circuit for the robot controller.

The red mushroom-shaped switch provided on the robot controller front panel, on the teach pendant, or on the operating panel can be used as a switch for stopping the equipment in case of emergency.




**(When the internal power source is used)**




**(When an external power source is used)**

**Figure 1-7 Emergency Stop Output Circuit**

# 1.2.5 I/O Power Connector

For the power source to communicate signals between the robot controller and the external device, the internal power source of the robot controller or an external power source is used.

Figure 1-8 (a) shows an example of connecting I/O power connectors when the internal power source is used, and Figure 1-8 (b) shows an example of connecting I/O power connectors when an external power source is used.

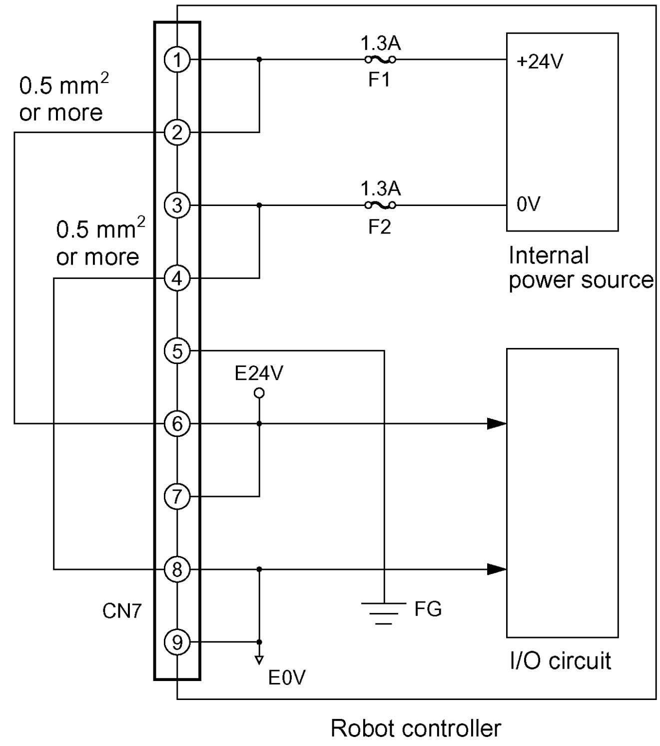



**Figure 1-8 (a) I/O Power Connection Sample (When the internal power source is used) (NPN type)**

| | |
|---|---|
| **⚠Caution:** | **To use the internal power source of the robot controller, connect the wiring so that the internal power source will be separate from the external power source. Improper wiring may damage the internal circuit.** |

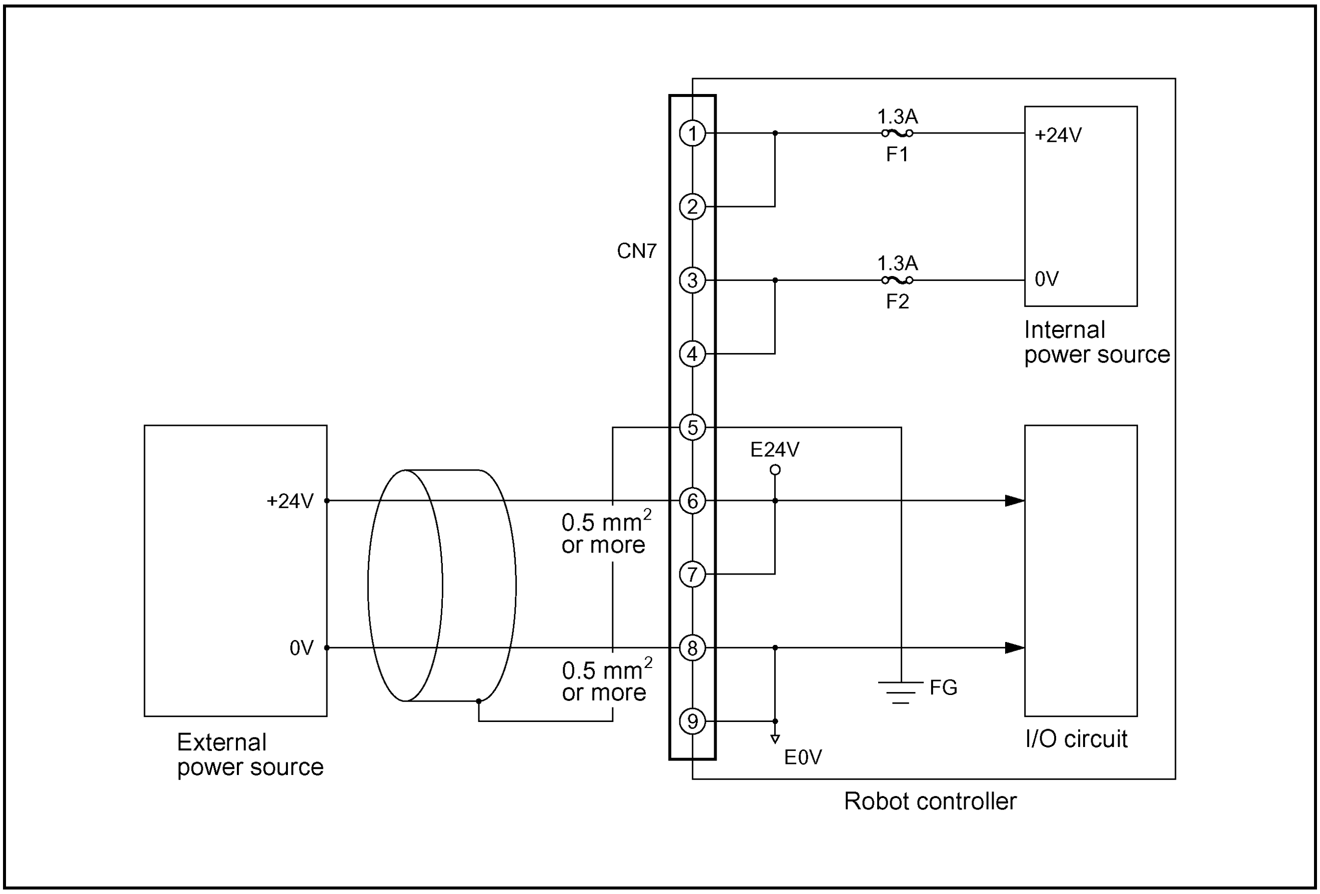



**Figure 1-8 (b) I/O Power Connection Sample (When an external power source is used) (NPN type)**

**⚠Caution: Use a cable of 0.5 $mm^2$ or more in size for the wiring between the external power source and the I/O power input connectors of the robot controller.**

# 1.3 Wiring Notes for the Robot Controller I/O Connectors

After the wiring of the controller's I/O connectors is completed, check the following before turning ON the power:

**Check point (1)**

Using a circuit tester, check across the **“+24V terminal”** and **“0V terminal”** of each connector and across the **“E24V terminal"** and the **“E0V terminal”** to see that there is no continuity. See Figure 1-9 and Table 1-7.

> ⚠Caution: **If the connector wiring between the Robot Controller's “+24V terminal” and “0V terminal” and between the “E24V terminal” and the “E0V terminal” is shorted, damage to the power circuit of the Robot Controller will result.**

**Check point (2)**

Using a tester, check across **“each signal Output terminal”** and **“+24V terminal”** or **“E24V terminal”** of each connector to see that there is no continuity. See Figure 1-9 and Table 1-7.

> ⚠Caution: **If the wiring between “each signal Output terminal” and “+24V terminal” or “E24V terminal” of each connector is shorted, damage to the Output circuit and power circuit of the Robot Controller will result.**

> ⚠Caution: **Wind adhesive vinyl tape around all ends of the unconnected wiring of each connector to prevent them from contacting other wiring and parts, which results in shorting.**

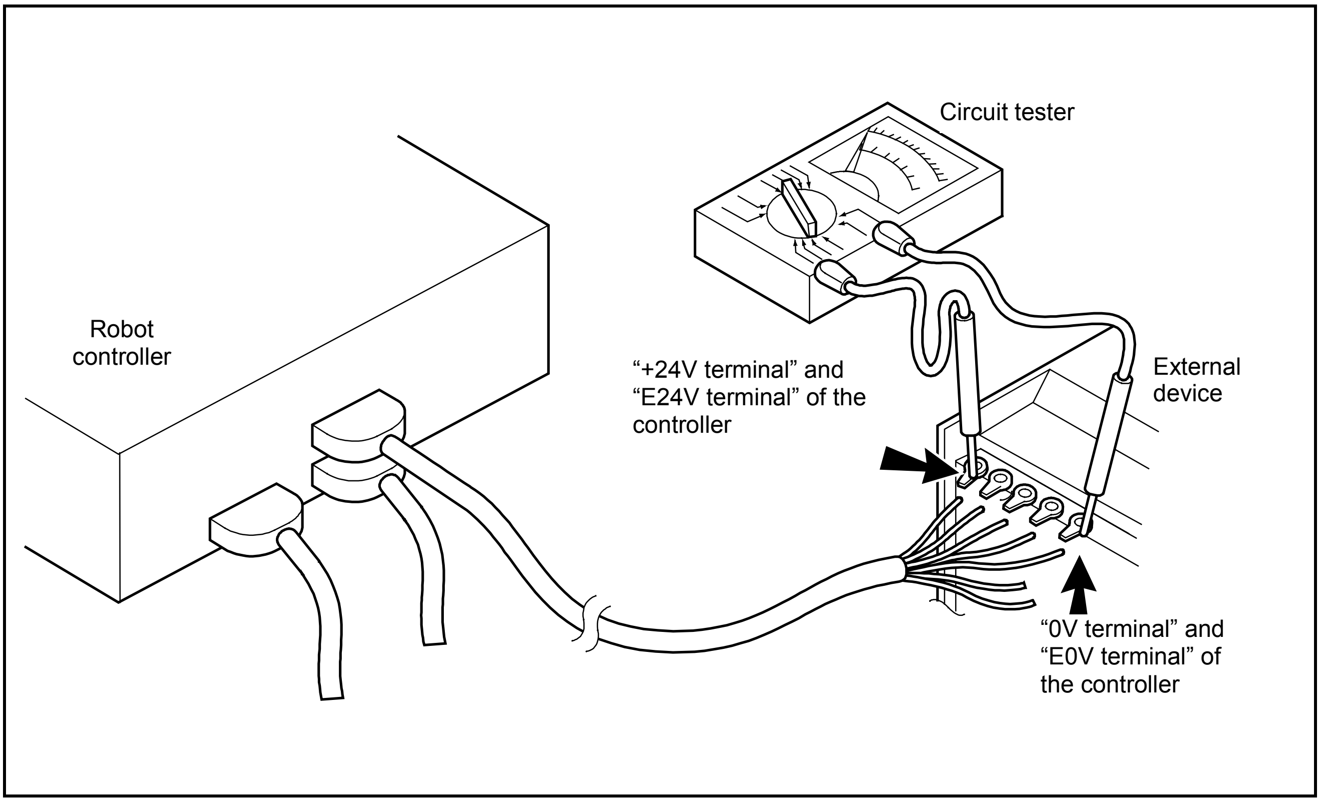
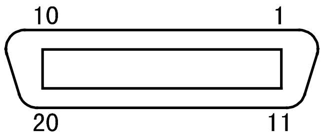



**Figure 1-9 Checking Example**

### Table 1-7 Connector Terminals and Check Points (NPN type)

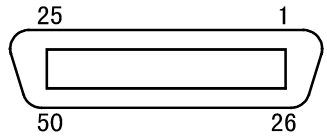
**Connector for hand I/O**




**View from cable side engaging face**

| Terminal Number | Name | Meaning | Check point |
|---|---|---|---|
| 1 to 8 | Hand output terminal | 0V (GND) at output | **(2)** |
| 17 | Power terminal for hand (E24V) | 24V power output | **(1)** |
| 18 | Power terminal for hand (E0V) | Power (GND) output | **(1)** |

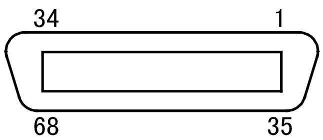
**Connector for user/system input**




**View from cable side engaging face**

| Terminal Number | Name | Meaning | Check point |
|---|---|---|---|
| 1, 3 | +24V internal power source terminal | +24V internal power source output | **(1)** |

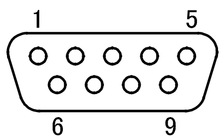
**Connector for user/system output**




**View from cable side engaging face**

| Terminal number | Name | Meaning | Check point |
|---|---|---|---|
| 1 to 56 | Signal output terminal | 0V (GND) at output | **(2)** |

**Connector for I/O power source**




**View from cable side engaging face**

| Terminal number | Name | Meaning | Check point |
|---|---|---|---|
| 1, 2 | +24V internal power source terminal | +24V internal power source output | **(1)** |
| 3, 4 | 0V internal power source terminal | 0V internal power source output | **(1)** |
| 6, 7 | E24V input terminal | 24V power input | **(1)** |
| 8, 9 | E0V (GND) input terminal | Power (GND) input | **(1)** |

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# Cartesian coordinate
# XYC-4D SERIES

## INSTALLATION & MAINTENANCE GUIDE


First Edition July 2001
Second Edition October 2001

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Factory Automation Division

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The purpose of this manual is to provide accurate information in the handling and operating of the robot. Please feed 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.