

**Motoman NX100 Controller**

# **Operator's Manual**

## **for Spot Welding**

using Air Gun

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## Chapter 1

# Introduction

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The Motoman Operator's Manual for Spot Welding Using Air Gun provides information about spot welding applications for Motoman robots using the XRC controller, including job teaching, playback, and editing. Also included is information about the robot instruction set, user variables, alarm/error messages and special robot settings (e.g., tool constant, user coordinates, etc.).

This manual is intended to teach basic controller and robot operation and programming to operators, programmers, engineers, and maintenance personnel who design, install, use, and maintain a Motoman robotic system. This manual contains the following sections:

### **SECTION 1 - INTRODUCTION**

This section contains general information about this manual, a list of reference documents, and customer service information.

### **SECTION 2 - SAFETY**

This section provides information regarding the safe use and operation of Motoman products.

### **SECTION 3 - NX100 OPERATOR'S MANUAL FOR SPOT WELDING USING AIR GUN**

This section provides information about spot welding applications for Motoman robots using the XRC controller, including job teaching, playback, and editing. Also included is information about the robot instruction set, user variables, alarm/error messages and special robot settings (e.g., tool constant, user coordinates, etc.).

## 1.1 Reference to Other Documentation

For additional information refer to the following:

- Concurrent I/O and Parameters Manual (P/N 149230-1)
- Operator's Manual for Arc Welding (P/N 149235-1)
- Manipulator Manual
- Vendor manuals for system components not manufactured by Motoman

## 1.2 Customer Service Information

If you are in need of technical assistance, contact the Motoman service staff at (937) 847-3200. Please have the following information ready before you call:

- Robot Type (ES165N, HP6, EA1400N, etc.)
- Application Type (spot welding)
- Robot Serial Number (located on back side of robot arm)
- Robot Sales Order Number (located on back of NX100 controller)

## Chapter 2

# Safety

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### 2.1 Introduction

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**It is the purchaser's responsibility to ensure that all local, county, state, and national codes, regulations, rules, or laws relating to safety and safe operating conditions for each installation are met and followed.**

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We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems. This information can be obtained from the Robotic Industries Association by requesting ANSI/RIA R15.06. The address is as follows:

**Robotic Industries Association**

900 Victors Way

P.O. Box 3724

Ann Arbor, Michigan 48106

TEL: (734) 994-6088

FAX: (734) 994-3338

Ultimately, the best safeguard is trained personnel. The user is responsible for providing personnel who are adequately trained to operate, program, and maintain the robot cell. **The robot must not be operated by personnel who have not been trained!**

We recommend that all personnel who intend to operate, program, repair, or use the robot system be trained in an approved Motoman training course and become familiar with the proper operation of the system.

This safety section addresses the following:

- Standard Conventions (Section 2.2)
- General Safeguarding Tips (Section 2.3)
- Mechanical Safety Devices (Section 2.4)
- Installation Safety (Section 2.5)
- Programming Safety (Section 2.6)
- Operation Safety (Section 2.7)
- Maintenance Safety (Section 2.8)

## 2.2 Standard Conventions

This manual includes information essential to the safety of personnel and equipment. As you read through this manual, be alert to the four signal words:

DANGER!

WARNING!

CAUTION!

*NOTE:*

Pay particular attention to the information provided under these headings which are defined below (in descending order of severity).



### **DANGER!**

Information appearing under the **DANGER** caption concerns the protection of personnel from the immediate and imminent hazards that, if not avoided, will result in immediate, serious personal injury or loss of life in addition to equipment damage.



### **WARNING!**

Information appearing under the **WARNING** caption concerns the protection of personnel and equipment from potential hazards that can result in personal injury or loss of life in addition to equipment damage.



### **CAUTION!**

Information appearing under the **CAUTION** caption concerns the protection of personnel and equipment, software, and data from hazards that can result in minor personal injury or equipment damage.



*Note: Information appearing in a Note caption provides additional information which is helpful in understanding the item being explained.*

## 2.3 General Safeguarding Tips

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this robot system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the robot cell.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06, section 6.13.4 and 6.13.5, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

## 2.4 Mechanical Safety Devices

The safe operation of the robot, positioner, auxiliary equipment, and system is ultimately the user's responsibility. The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, ANSI/RIA R15.06 safety standards, and other local codes that may pertain to the installation and use of industrial equipment. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety measures are available:

- Safety fences and barriers
- Light curtains
- Door interlocks
- Safety mats
- Floor markings
- Warning lights

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.

## 2.5 Installation Safety

Safe installation is essential for protection of people and equipment. The following suggestions are intended to supplement, but not replace, existing federal, local, and state laws and regulations. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. Installation tips are as follows:

- Be sure that only qualified personnel familiar with national codes, local codes, and ANSI/RIA R15.06 safety standards are permitted to install the equipment.
- Identify the work envelope of each robot with floor markings, signs, and barriers.
- Position all controllers outside the robot work envelope.
- Whenever possible, install safety fences to protect against unauthorized entry into the work envelope.
- Eliminate areas where personnel might get trapped between a moving robot and other equipment (pinch points).
- Provide sufficient room inside the workcell to permit safe teaching and maintenance procedures.

## 2.6 Programming Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Programming tips are as follows:

Any modifications to PART 1 of the NX100 controller PLC can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to PART 1. Making any changes without the written permission of Motoman will VOID YOUR WARRANTY!

Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. YOUR WARRANTY WILL BE VOID if you use these special passwords.

Back up all programs and jobs onto a floppy disk whenever program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.

The concurrent I/O (Input and Output) function allows the customer to modify the internal ladder inputs and outputs for maximum robot performance. Great care must be taken when making these modifications. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations that may damage the robot or other parts of the system.

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.
- Inspect the robot and work envelope to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Be sure that all safeguards are in place.
- Check the E-STOP button on the teach pendant for proper operation before programming.
- Carry the teach pendant with you when you enter the workcell.
- Be sure that only the person holding the teach pendant enters the workcell.
- Test any new or modified program at low speed for at least one full cycle.

## 2.7 Operation Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Operation tips are as follows:

- Be sure that only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories are permitted to operate this robot system.
- Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Inspect the robot and work envelope to ensure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Ensure that all safeguards are in place.
- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.

- All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot. This includes controller parameters, ladder parts 1 and 2, and I/O (Input and Output) modifications. Check and test all changes at slow speed.

## 2.8 Maintenance Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Maintenance tips are as follows:

- Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.
- Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.
- Back up all your programs and jobs onto a floppy disk whenever program changes are made. A backup must always be made before any servicing or changes are made to options, accessories, or equipment to avoid loss of information, programs, or jobs.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- Be sure all safeguards are in place.
- Use proper replacement parts.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot. This includes controller parameters, ladder parts 1 and 2, and I/O (Input and Output) modifications. Check and test all changes at slow speed.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).

# NX100

# OPERATOR'S MANUAL

## FOR SPOT WELDING USING AIR GUN

Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

### MOTOMAN INSTRUCTIONS

MOTOMAN-□□□ INSTRUCTIONS  
NX100 INSTRUCTIONS  
NX100 OPERATOR'S MANUAL  
NX100 MAINTENANCE MANUAL

The NX100 operator's manuals above correspond to specific usage.  
Be sure to use the appropriate manual.





## MANDATORY

- **This manual explains the various components of the NX100 system and general operations. Read this manual carefully and be sure to understand its contents before handling the NX100.**
- **General items related to safety are listed in Section 1: Safety of the NX100 Instructions. To ensure correct and safe operation, carefully read the NX100 Instructions before reading this manual.**



## CAUTION

- **Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating this product.**
- **The drawings and photos in this manual are representative examples and differences may exist between them and the delivered product.**
- **YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such modification is made, the manual number will also be revised.**
- **If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.**
- **YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.**

## Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the NX100.

In this manual, the Notes for Safe Operation are classified as “WARNING,” “CAUTION,” “MANDATORY,” or “PROHIBITED.”



### WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.



### CAUTION

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.



### MANDATORY

Always be sure to follow explicitly the items listed under this heading.



### PROHIBITED

Must never be performed.

Even items described as “CAUTION” may result in a serious accident in some situations. At any rate, be sure to follow these important items.



To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “CAUTION” and “WARNING.”



## WARNING

- **Before operating the manipulator, check that servo power is turned OFF when the emergency stop buttons on the front door of the NX100 and programming pendant are pressed. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.**

Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the emergency stop buttons do not function.

Emergency Stop Button



- **Once the emergency stop button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn the servo power ON.**

Injury may result from unintentional or unexpected manipulator motion.

Release of Emergency Stop



- **Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator :**
  - **View the manipulator from the front whenever possible.**
  - **Always follow the predetermined operating procedure.**
  - **Ensure that you have a safe place to retreat in case of emergency.**

Improper or unintended manipulator operation may result in injury.

- **Confirm that no persons are present in the P-point maximum envelope of the manipulator and that you are in a safe location before:**
  - **Turning ON the NX100 power**
  - **Moving the manipulator with the programming pendant**
  - **Running the system in the check mode**
  - **Performing automatic operations**

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an emergency stop button immediately if there are problems. The emergency stop buttons are located on the right of the front door of the NX100 and the programming pendant.



## CAUTION

- **Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately, and be sure that all other necessary processing has been performed.**
  - Check for problems in manipulator movement.**
  - Check for damage to insulation and sheathing of external wires.**

- **Always return the programming pendant to the hook on the NX100 cabinet after use.**

The programming pendant can be damaged if it is left in the P-point maximum envelope of the manipulator, on the floor, or near fixtures.

- **Read and understand the Explanation of the Warning Labels in the NX100 Instructions before operating the manipulator.**

## Definition of Terms Used Often in This Manual


The MOTOMAN manipulator is the YASKAWA industrial robot product.

The manipulator usually consists of the controller, the programming pendant, and supply cables.

In this manual, the equipment is designated as follows.

Equipment	Manual Designation
NX100 Controller	NX100
NX100 Programming Pendant	Programming Pendant
Cable between the manipulator and the controller	Manipulator cable

Descriptions of the programming pendant keys, buttons, and displays are shown as follows:

Equipment		Manual Designation
Programming Pendant	Character Keys	The keys which have characters printed on them are denoted with [ ]. ex. [ENTER]
	Symbol Keys	The keys which have a symbol printed on them are not denoted with [ ] but depicted with a small picture. ex. page key  The cursor key is an exception, and a picture is not shown.
	Axis Keys Numeric Keys	“Axis Keys” and “Numeric Keys” are generic names for the keys for axis operation and number input.
	Keys pressed simultaneously	When two keys are to be pressed simultaneously, the keys are shown with a “+” sign between them, ex. [SHIFT]+[COORD]
	Displays	The menu displayed in the programming pendant is denoted with { }. ex. {JOB}

## Description of the Operation Procedure

In the explanation of the operation procedure, the expression "Select •••" means that the cursor is moved to the object item and the SELECT key is pressed, or that the item is directly selected by touching the screen.

# 1 Introduction

<b>1.1</b>	<b>NX100 Overview</b>	1-1
<b>1.2</b>	<b>Programming Pendant</b>	1-2
<b>1.2.1</b>	Programming Pendant Overview	1-2
<b>1.2.2</b>	Key Description	1-3
■	Character Keys	1-3
■	Symbol Keys	1-3
■	Axis Keys and Numeric Keys	1-3
■	Keys Pressed Simultaneously	1-3
<b>1.2.3</b>	Programming Pendant Keys	1-4
<b>1.2.4</b>	Programming Pendant Display	1-10
■	The Five Display Areas	1-10
■	General-purpose Display Area	1-11
■	Main Menu Area	1-12
■	Status Display Area	1-12
■	Human Interface Display Area	1-14
■	Menu Area	1-14
<b>1.2.5</b>	Screen Descriptions	1-14
■	Denotation	1-14
■	Screen	1-15
<b>1.2.6</b>	Guidance Display	1-16
<b>1.2.7</b>	Character Input	1-16
■	Operation	1-17
■	Alphanumeric Input	1-18
■	Symbol Input	1-18
<b>1.3</b>	<b>Modes</b>	1-19
<b>1.3.1</b>	Teach Mode	1-19
<b>1.3.2</b>	Play Mode	1-19
<b>1.3.3</b>	Remote Mode	1-19
<b>1.3.4</b>	Teach Mode Priority	1-20
<b>1.3.5</b>	Edit Jobs and Active Jobs	1-20
<b>1.4</b>	<b>About the Security Mode</b>	1-21
<b>1.4.1</b>	Types of Security Modes	1-21
<b>1.4.2</b>	Switching Security Modes	1-26

# 2 Manipulator Coordinate Systems

<b>2.1</b>	<b>Robot Axes and Coordinate Systems</b>	2-1
<b>2.1.1</b>	Types of Coordinate Systems	2-2
<b>2.2</b>	<b>General Operations</b>	2-3
<b>2.2.1</b>	Selecting a Coordinate System	2-3
<b>2.2.2</b>	Selecting Manual Speed	2-3
■	Selecting with Manual Speed Keys	2-3
■	Using the High Speed Key	2-4
<b>2.2.3</b>	Axis Operations	2-4
■	Switching the Group Axis to be Operated	2-4

<b>2.3</b>	<b>Joint Coordinates</b>	2-5
<b>2.4</b>	<b>Cartesian Coordinates</b>	2-6
<b>2.5</b>	<b>Cylindrical Coordinates</b>	2-7
<b>2.6</b>	<b>Tool Coordinates</b>	2-8
<b>2.6.1</b>	Axis Motion	2-8
<b>2.6.2</b>	Selecting the Tool Number	2-10
<b>2.7</b>	<b>User Coordinates</b>	2-11
<b>2.7.1</b>	User Coordinates	2-11
<b>2.7.2</b>	Examples of User Coordinate Utilization	2-12
<b>2.7.3</b>	Selecting a User Coordinate Number	2-13
<b>2.8</b>	<b>Tool Tip Operations</b>	2-14
<b>2.8.1</b>	Motion about TCP	2-14
<b>2.8.2</b>	TCP Change Operations	2-16

### 3 Simplified Teaching and Playback

<b>3.1</b>	<b>Teaching</b>	3-1
<b>3.1.1</b>	Preparation for Teaching	3-1
<b>3.1.2</b>	Teaching Procedure	3-4
■	Teaching a Job	3-5
■	Step 1 -- Start Position	3-6
■	Step 2 -- Near the Work Start Position	3-7
■	Step 3 -- Work Start Position	3-8
■	Step 4 -- Work End Position	3-9
■	Step 5 -- Position Away from Workpiece and Fixture	3-10
■	Step 6 -- Near the Start Position	3-11
■	Ensuring the First and Last Step are Identical	3-12
<b>3.1.3</b>	Path Confirmation	3-13
<b>3.1.4</b>	Correcting a Job	3-14
■	Before Correcting a Job	3-14
■	Changing the Position Data	3-15
■	Adding a Step	3-16
■	Deleting a Step	3-17
■	Changing the Speed between Steps	3-18
<b>3.2</b>	<b>Playback</b>	3-19
<b>3.2.1</b>	Preparation Before Playback	3-19
<b>3.2.2</b>	Playback Procedure	3-19
<b>3.3</b>	<b>Example for Arc Welding Application</b>	3-20
<b>3.3.1</b>	Example Job	3-20
<b>3.3.2</b>	Teaching Procedure	3-21
■	Step 2 -- Near Welding Start Point	3-21
■	Step 3 -- Welding Start Point	3-22
■	Step 4 -- Welding End Point	3-23
<b>3.3.3</b>	Setting Welding Conditions	3-24
■	Shielding Gas Flow Rate	3-24

<b>3.3.4</b> Welding Test .....	3-25
■ Welding Execution .....	3-25
■ Adjustments for Welding Defects .....	3-26
<b>3.4</b> Example for Handling Application .....	3-29
<b>3.4.1</b> Example Job .....	3-29
<b>3.4.2</b> Usage of HAND Instruction .....	3-30
■ SP (single-solenoid) .....	3-30
■ 2P (double-solenoid) .....	3-30
■ 3P (triple-solenoid) .....	3-30
■ Instruction and Additional Items .....	3-30
<b>3.4.3</b> Teaching Procedure .....	3-31
■ Step 2 -- Near Gripping Position (before gripping) .....	3-31
■ Step 3 -- Gripping Position .....	3-31
■ Step 4 -- Near Gripping Position (after gripping) .....	3-33
■ Step 6 -- Near Release Position (before releasing) .....	3-34
■ Step 7 -- Release Assistance Position .....	3-35
■ Step 8 -- Release Position .....	3-36
■ Step 9 -- Near Release Position (after release) .....	3-38
<b>3.4.4</b> Handling Test .....	3-39
■ Handling Execution .....	3-39
<b>3.5</b> Example for General Purpose Application .....	3-40
<b>3.5.1</b> Example Job .....	3-40
<b>3.5.2</b> Teaching Procedure .....	3-41
■ Step 2 -- Near cutting position .....	3-41
■ Step 3 -- Cutting Start Position .....	3-42
■ Step 4 -- Cutting End Position .....	3-43
<b>3.5.3</b> Cutting Test .....	3-44
■ Cutting Execution .....	3-44
<b>3.6</b> Example for Spot Welding Application .....	3-45
<b>3.6.1</b> Example Job .....	3-45
<b>3.6.2</b> Setting Welding Conditions .....	3-46
■ Setting Spot Welding Gun Condition Files .....	3-46
■ Setting Welding Condition for the Power Source .....	3-47
<b>3.6.3</b> Teaching Procedure .....	3-47
■ Step 2 -- Near Welding Start Point .....	3-47
■ Step 3 -- Welding Start Point .....	3-48
<b>3.6.4</b> Welding Test .....	3-49
■ Welding Execution .....	3-49
<b>3.7</b> Example for Painting Application .....	3-50
<b>3.7.1</b> Example Job .....	3-50
<b>3.7.2</b> Setting Painting Conditions .....	3-51
<b>3.7.3</b> Teaching Procedure .....	3-51
■ Step 2 -- Near Painting Start Position .....	3-51
■ Step 3 -- Painting Start Position .....	3-52
■ Step 10 -- Painting End Position .....	3-53
<b>3.7.4</b> Painting Test .....	3-54
■ Painting Execution .....	3-54

## 4 Teaching

<b>4.1</b>	<b>Preparation for Teaching</b>	4-1
4.1.1	Checking Emergency Stop Buttons	4-1
4.1.2	Setting the Teach Lock	4-1
4.1.3	Registering a Job	4-2
■	Registering Job Names	4-2
■	Registering Comments	4-3
■	Registering Control Groups	4-3
■	Switching to the Teaching Window	4-3
<b>4.2</b>	<b>Teaching Operation</b>	4-4
4.2.1	The Teaching Window	4-4
4.2.2	Interpolation Type and Play Speed	4-5
■	Joint Interpolation	4-5
■	Linear Interpolation	4-6
■	Circular Interpolation	4-7
■	Spline Interpolation	4-8
4.2.3	Teaching Steps	4-9
■	Registering Move Instructions	4-9
■	Registering Reference Point Instructions	4-15
■	Registering Timer Instructions	4-16
4.2.4	Overlapping the First and Last Steps	4-18
<b>4.3</b>	<b>Checking Steps</b>	4-19
4.3.1	FWD/BWD Key Operations	4-19
■	Precautions When Using FWD / BWD Operations	4-20
■	Selecting Manual Speed	4-22
■	Moving to Reference Point	4-22
■	Test Operations	4-23
<b>4.4</b>	<b>Modifying Steps</b>	4-24
4.4.1	Displaying the JOB CONTENT Window for Editing	4-28
■	Currently Called Up Job	4-28
■	Calling Up Other Jobs	4-28
4.4.2	Inserting Move Instructions	4-29
4.4.3	Deleting Move Instructions	4-30
4.4.4	Modifying Move Instructions	4-31
■	Modifying Position Data	4-31
■	Modifying Interpolation Type	4-31
4.4.5	Undo Operation after Editing a Move Instruction	4-32
4.4.6	Modifying Reference Point Instructions	4-32
■	Deleting Reference Point Instructions	4-32
■	Modifying Reference Point Instructions	4-33
4.4.7	Modifying Timer Instructions	4-33
■	Deleting Timer Instructions	4-33
■	Modifying Timer Instructions	4-34
<b>4.5</b>	<b>Modifying Jobs</b>	4-35
4.5.1	Calling Up a Job	4-35
4.5.2	Windows Related to Job	4-35
■	JOB HEADER Window	4-35

■JOB CONTENT Window .....	4-37
■COMMAND POSITION Window.....	4-38
■JOB CAPACITY Window .....	4-39
<b>4.6 Editing Instructions .....</b>	<b>4-40</b>
<b>4.6.1</b> Instruction Group.....	<b>4-40</b>
<b>4.6.2</b> Inserting Instructions .....	<b>4-42</b>
<b>4.6.3</b> Deleting Instructions .....	<b>4-45</b>
<b>4.6.4</b> Modifying Instructions .....	<b>4-45</b>
<b>4.6.5</b> Undo Operation after Modifying Instructions .....	<b>4-47</b>
<b>4.6.6</b> Viewing Description for an Instruction .....	<b>4-48</b>
<b>4.6.7</b> Modifying Additional Numeric Data .....	<b>4-49</b>
<b>4.6.8</b> Modifying Additional Items.....	<b>4-50</b>
<b>4.6.9</b> Inserting Additional Items .....	<b>4-51</b>
<b>4.6.10</b> Deleting Additional Items .....	<b>4-52</b>
<b>4.6.11</b> Undo Operation after Modifying Additional Items .....	<b>4-53</b>
<b>4.7 Editing Jobs .....</b>	<b>4-54</b>
<b>4.7.1</b> Selecting the Range .....	<b>4-56</b>
<b>4.7.2</b> Copying .....	<b>4-57</b>
<b>4.7.3</b> Cutting.....	<b>4-57</b>
<b>4.7.4</b> Pasting.....	<b>4-58</b>
<b>4.7.5</b> Reverse Pasting .....	<b>4-59</b>
<b>4.8 Test Operations .....</b>	<b>4-60</b>
<b>4.9 Other Job-editing Functions .....</b>	<b>4-61</b>
<b>4.9.1</b> Editing Play Speed .....	<b>4-61</b>
■ Modification of Speed Type.....	4-61
■ Relative Modification .....	4-61
■ Modification by TRT (Traverse Time) .....	4-63
<b>4.9.2</b> Editing Interpolation Type .....	<b>4-65</b>
<b>4.9.3</b> Editing Condition Files.....	<b>4-66</b>
<b>4.9.4</b> Editing User Variables.....	<b>4-67</b>
■ Displaying Byte, Integer, Double Precision Integer, and Real Type Variables .....	4-69
■ Setting Byte, Integer, Double Precision Integer, and Real Type Variables .....	4-70
■Displaying Character Type Variables.....	4-71
■Setting Character Type Variables .....	4-72
■Registering Variable Name .....	4-73
■Displaying Position Variables.....	4-74
■ Setting Position Variables .....	4-75
■ Setting Position Variables Using the Numeric Keys .....	4-76
■ Setting Position Variables Using the Axis Keys .....	4-78
■Deleting Data Set of Position Variables .....	4-79
■Checking Positions by Position Variables .....	4-80
■ Manipulator Types.....	4-81
<b>4.9.5</b> Editing Local Variables .....	<b>4-85</b>
■ Setting the Number of Local Variables .....	4-87
<b>4.9.6</b> Searching .....	<b>4-88</b>
■ Line Search .....	4-89
■ Step Search.....	4-89

■ Label Search . . . . .	4-90
■ Instruction Search . . . . .	4-91
■ Tag Search . . . . .	4-92

## 5 Playback

<b>5.1 Preparation for Playback . . . . .</b>	<b>5-1</b>
■ Calling a Job . . . . .	5-1
■ Registering the Master Job . . . . .	5-2
■ Calling the Master Job . . . . .	5-3
<b>5.2 Playback . . . . .</b>	<b>5-5</b>
<b>5.2.1 The PLAYBACK Window . . . . .</b>	<b>5-5</b>
■ Setting Display or Non-display of Cycle Time. . . . .	5-6
<b>5.2.2 Playback Operation . . . . .</b>	<b>5-6</b>
■ Selecting the Start Device . . . . .	5-6
■ Start Operation . . . . .	5-7
■ About the Operation Cycle . . . . .	5-7
<b>5.2.3 Special Playback Operations . . . . .</b>	<b>5-9</b>
■ Low Speed Operation . . . . .	5-10
■ Limited Speed Operations . . . . .	5-10
■ Dry-run Speed Operations . . . . .	5-11
■ Machine Lock Operation . . . . .	5-11
■ Check Mode Operation . . . . .	5-12
■ Weaving Prohibit Setting during Check Mode Operation . .	5-12
■ Cancel All Special Operations . . . . .	5-12
<b>5.3 Stop and Restart . . . . .</b>	<b>5-13</b>
<b>5.3.1 Hold . . . . .</b>	<b>5-13</b>
■ Using the Programming Pendant . . . . .	5-13
■ Using an External Input Signal (System Input) . . . . .	5-13
<b>5.3.2 Emergency Stop . . . . .</b>	<b>5-14</b>
<b>5.3.3 Restart After Emergency Stop . . . . .</b>	<b>5-16</b>
<b>5.3.4 Stop by Alarm . . . . .</b>	<b>5-16</b>
<b>5.3.5 Others . . . . .</b>	<b>5-17</b>
■ Temporary Stop by Mode Change . . . . .	5-17
■ Temporary Stop by the PAUSE Instruction . . . . .	5-17
<b>5.4 Modifying Play Speed . . . . .</b>	<b>5-18</b>
<b>5.4.1 Modifying with Speed Override . . . . .</b>	<b>5-18</b>
■ Setting Speed Overrides . . . . .	5-20
■ Modifying Play Speed . . . . .	5-20
■ Modifying Speed Override Ratio . . . . .	5-21
■ Releasing Speed Override Settings . . . . .	5-21
<b>5.5 Playback with Reserved Start . . . . .</b>	<b>5-22</b>
<b>5.5.1 Preparation for Reserved Start . . . . .</b>	<b>5-22</b>
■ Enabling Reserved Start . . . . .	5-23
■ Registering Reserved Start I/O Signal . . . . .	5-24
■ Registering Jobs to Stations . . . . .	5-25
■ Deleting Registered Jobs from Stations . . . . .	5-26

<b>5.5.2</b>	Playback from Reserved Start . . . . .	5-27
■	Start Operation . . . . .	5-27
■	Checking Job Reservation Status . . . . .	5-28
■	Resetting Job Reservation . . . . .	5-29
<b>5.5.3</b>	Hold Operation . . . . .	5-30
■	[HOLD] on the Programming Pendant . . . . .	5-30
■	Hold by External Input Signal (System Input) . . . . .	5-30
■	Hold at the Station . . . . .	5-31
<b>5.6</b>	Displaying Job Stack . . . . .	5-32

## 6 Editing Jobs

<b>6.1</b>	Copying Jobs . . . . .	6-2
<b>6.1.1</b>	Copying Jobs on the JOB CONTENT Window . . . . .	6-2
<b>6.1.2</b>	Copying Jobs on the JOB LIST Window . . . . .	6-4
<b>6.2</b>	Deleting Jobs . . . . .	6-6
<b>6.2.1</b>	Deleting Jobs on the JOB CONTENT Window . . . . .	6-6
<b>6.2.2</b>	Deleting Jobs on the JOB LIST Window . . . . .	6-7
<b>6.3</b>	Modifying Job Names . . . . .	6-8
<b>6.3.1</b>	Modifying Job Names on the JOB CONTENT Window . . . . .	6-8
<b>6.3.2</b>	Modifying Job Names on the JOB LIST Window . . . . .	6-10
<b>6.4</b>	Editing Comments . . . . .	6-11
<b>6.5</b>	Setting Edit Lock on Individual Job Units . . . . .	6-12
<b>6.6</b>	Enabling the Modification of Position Data Only . . . . .	6-13

## 7 Convenient Functions

<b>7.1</b>	One-touch Operation “Direct Open” . . . . .	7-1
<b>7.2</b>	Parallel Shift Function . . . . .	7-3
<b>7.2.1</b>	Function Overview . . . . .	7-3
<b>7.2.2</b>	Setting the Shift Value . . . . .	7-5
■	Registering Position Variables . . . . .	7-5
■	Coordinate Systems . . . . .	7-5
■	Setting the Shift Value . . . . .	7-6
<b>7.2.3</b>	Registering Shift Instructions . . . . .	7-7
■	SFTON Instruction . . . . .	7-8
■	SFTOF Instruction . . . . .	7-10
■	MSHIFT Instruction . . . . .	7-10
<b>7.2.4</b>	Continuation of the Parallel Shift Function . . . . .	7-13
<b>7.2.5</b>	Examples of Use . . . . .	7-14
■	Example of Use of Shift Addition/Subtraction . . . . .	7-14
■	Example of Use of MSHIFT Instruction . . . . .	7-15
<b>7.3</b>	Parallel Shift Job Conversion Function . . . . .	7-16
<b>7.3.1</b>	Function Overview . . . . .	7-16

■ Coordinate Systems for Conversion . . . . .	7-16
<b>7.3.2</b> Operating Methods . . . . .	7-21
■ Specifying the Conversion Items . . . . .	7-21
■ Specifying the Shift Value . . . . .	7-22
■ Executing Conversion . . . . .	7-26
<b>7.4</b> PAM Function . . . . .	7-27
<b>7.4.1</b> Function Overview . . . . .	7-27
■ Input Ranges for Adjustment Data . . . . .	7-27
<b>7.4.2</b> Operating Methods . . . . .	7-28
■ Setting Adjustment Data . . . . .	7-28
■ Executing the Adjustment . . . . .	7-30
■ Editing Data . . . . .	7-31
<b>7.5</b> Mirror Shift Function . . . . .	7-33
<b>7.5.1</b> Function Overview . . . . .	7-33
<b>7.5.2</b> Pulse Mirror-shift Function . . . . .	7-33
■ Parameter Setting . . . . .	7-33
■ Object Job . . . . .	7-34
■ Group Axes Specification . . . . .	7-34
■ Position Variables . . . . .	7-34
<b>7.5.3</b> Robot-coordinates Mirror-shift Function . . . . .	7-34
■ Object Job . . . . .	7-34
■ Group Axes Specification . . . . .	7-34
■ Position Variables . . . . .	7-35
<b>7.5.4</b> User-coordinates Mirror-shift Function . . . . .	7-35
■ Object Job . . . . .	7-35
■ Group Axes Specification . . . . .	7-35
■ Position Variables . . . . .	7-35
<b>7.5.5</b> Notes on the Mirror Shift Function . . . . .	7-36
<b>7.5.6</b> Operation Procedures . . . . .	7-37
■ Calling Up the JOB CONTENT Window . . . . .	7-37
■ Executing the Mirror Shift Conversion . . . . .	7-38

## 8 Controlling Peripheral Devices

<b>8.1</b> External Memory Devices . . . . .	8-1
<b>8.1.1</b> Compact Flash Memory Card . . . . .	8-1
■ Precautions . . . . .	8-1
■ Inserting a Compact Flash . . . . .	8-2
<b>8.1.2</b> File Management . . . . .	8-3
■ Data that can be Saved and Save Destination File Names . . . . .	8-4
■ Saving Data . . . . .	8-7
■ Loading Data . . . . .	8-18
■ Verifying Data . . . . .	8-31
■ Deleting Data . . . . .	8-34
■ Job Selection Mode . . . . .	8-38

## 9 Parameter

<b>9.1</b>	<b>Parameter Configuration</b>	9-1
<b>9.2</b>	<b>Motion Speed Setting Parameters</b>	9-2
■	S1CxG000: IN-GUARD SAFE OPERATION MAX. SPEED	9-2
■	S1CxG001: DRY-RUN SPEED	9-2
■	S1CxG002 to S1CxG009: JOINT SPEED FOR REGISTRATION	9-2
■	S1CxG010 to S1CxG017: LINEAR SPEED FOR REGISTRATION	9-2
■	S1CxG018 to S1CxG025: POSITION ANGLE SPEED	9-3
■	S1CxG026 to S1CxG029: JOG OPERATION ABSOLUTE VALUE SPEED	9-3
■	S1CxG030 to S1CxG032: INCHING MOVE AMOUNT	9-3
■	S1CxG033 to S1CxG040: POSITIONING ZONE	9-3
■	S1CxG044: LOW-SPEED START	9-4
■	S1CxG045 to S1CxG048: JOG OPERATION LINK SPEED	9-5
■	S1CxG056: WORK HOME POSITION RETURN SPEED	9-5
■	S1CxG057: SEARCH MAX. SPEED	9-5
■	S2C153: POSTURE CONTROL AT CARTESIAN OPERATION OF JOG	9-5
■	S2C154: OPERATION IN USER COORDINATE SYSTEM (WHEN EXTERNAL REFERENCE POINT CONTROL FUNCTION USED)	9-5
■	S2C238: CONTROLLED GROUP JOB TEACHING POSITION CHANGE	9-6
■	S2C324, S2C325: OPERATION AFTER RESET FROM PATH DEVIATION	9-6
■	S2C326: DEVIATED POSITION	9-8
■	S2C515: EMERGENCY STOP CURSOR ADVANCE CONTROL FUNCTION	9-8
■	S2C516: EMERGENCY STOP CURSOR ADVANCE CONTROL FUNCTION CONT PROCESS COMPLETION POSITION	9-8
■	S2C517: EMERGENCY STOP ADVANCE CONTROL FUNCTION WORK START INSTRUCTION STEP MOTION COMPLETION DELAY TIME	9-9
■	S2C560: BASE AXIS OPERATION KEY ALLOCATION SETTING	9-9
■	S3C806 to S3C808: POSITION CORRECTING FUNCTION DURING PLAYBACK	9-9
<b>9.3</b>	<b>Mode Operation Setting Parameters</b>	9-10
■	S2C147: SECURITY MODE WHEN CONTROL POWER SUPPLY IS TURNED ON	9-10
■	S2C148: SELECTION OF CARTESIAN/CYLINDRICAL	9-10
■	S2C149: COORDINATE SWITCHING PROHIBITED	9-10
■	S2C150: EXECUTION UNITS AT "FORWARD" OPERATION	9-11

■ S2C151: INSTRUCTION (EXCEPT FOR MOVE) EXECUTION AT “FORWARD” OPERATION . . . . .	9-11
■ S2C155: CHANGING STEP ONLY . . . . .	9-11
■ S2C156: MANUAL SPEED STORING FOR EACH COORDINATE . . . . .	9-11
■ S2C158: ADDITIONAL STEP POSITION. . . . .	9-12
■ S2C159: MASTER JOB CHANGING OPERATION . . . . .	9-12
■ S2C160: CHECK AND MACHINE-LOCK KEY OPERATION IN PLAY MODE. . . . .	9-13
■ S2C161: RESERVED WORK JOB CHANGING OPERATION . . . . .	9-13
■ S2C162: MASTER OR SUBMASTER CALL OPERATION IN PLAY MODE. . . . .	9-13
■ S2C163: LANGUAGE LEVEL. . . . .	9-13
■ S2C166: INSTRUCTION INPUT LEARNING FUNCTION .	9-14
■ S2C167: ADDRESS SETTING WHEN CONTROL POWER IS TURNED ON . . . . .	9-14
■ S2C168: JOB LIST DISPLAY METHOD AT JOB SELECTION . . . . .	9-14
■ S2C169: INITIAL OPERATION OF MANIPULATOR . . . . .	9-14
■ S2C170: PLAYBACK EXECUTION AT CYCLE MODE “1-STEP” . . . . .	9-15
■ S2C171: EXTERNAL START . . . . .	9-15
■ S2C172: PROGRAMMING PENDANT START . . . . .	9-15
■ S2C173: SPEED DATA INPUT FORM. . . . .	9-15
■ S2C174: RESERVED START . . . . .	9-16
■ S2C176: JOB SELECTION AT REMOTE FUNCTION (PLAY MODE) . . . . .	9-16
■ S2C177: EXTERNAL MODE SWITCH. . . . .	9-16
■ S2C178: MODE SWITCHING FROM PROGRAMMING PENDANT . . . . .	9-16
■ S2C179: EXTERNAL CYCLE SWITCHING . . . . .	9-16
■ S2C180: PROGRAMMING PENDANT CYCLE SWITCHING . . . . .	9-16
■ S2C181: SERVO ON FROM EXTERNAL DEVICE PROHIBITION . . . . .	9-17
■ S2C182: PROGRAMMING PENDANT OPERATION WHEN “IO” IS SELECTED FOR REMOTE MODE . . . . .	9-17
■ S2C186: STEP REGISTRATION AT TOOL NO. CHANGE . . . . .	9-17
■ S2C211: REMOTE FIRST CYCLE MODE . . . . .	9-18
■ S2C212: LOCAL FIRST CYCLE MODE. . . . .	9-18
■ S2C230: POWER ON FIRST CYCLE MODE. . . . .	9-18
■ S2C231: TEACH MODE FIRST CYCLE MODE. . . . .	9-18
■ S2C232: PLAY MODE FIRST CYCLE MODE . . . . .	9-18
■ S2C234: START CONDITION AFTER ABSOLUTE DATA ALLOWABLE RANGE ERROR OCCURS. . . . .	9-19
■ S2C317 to S2C321: TIME RESET . . . . .	9-19
■ S2C333: TOOL NO. SWITCHING . . . . .	9-19
■ S2C335: POSITION TEACHING BUZZER. . . . .	9-19

■ S2C336: JOB LINKING DESIGNATION (When Twin Synchronous Function Used) . . . . .	9-20
<b>9.4 Parameters according to Interference Area . . . . .</b>	<b>9-20</b>
■ S1CxG200 to S1CxG215: PULSE SOFT LIMIT . . . . .	9-20
■ S2C001: CUBE SOFT LIMIT CHECK . . . . .	9-21
■ S2C002: S-AXIS INTERFERENCE CHECK . . . . .	9-21
■ S2C003 to S2C050: CUBE/AXIS INTERFERENCE CHECK . . . . .	9-22
■ S2C051 to S2C114: CUBE USING METHOD . . . . .	9-24
■ S2C188 to S2C193: ROBOT INTERFERENCE CHECK . . . . .	9-26
■ S3C000 to S3C023: CUBE SOFT LIMIT . . . . .	9-26
■ S3C024 to S3C031: S-AXIS INTERFERENCE AREA . . . . .	9-27
■ S3C032 to S3C543: CUBIC INTERFERENCE AREA . . . . .	9-27
■ S3C801 to S3C804: ROBOT INTERFERENCE AREA . . . . .	9-27
■ S3C805: A SIDE LENGTH OF WORK-HOME-POSITION CUBE . . . . .	9-27
<b>9.5 Parameters according to Status I/O . . . . .</b>	<b>9-27</b>
■ S2C187: USER OUTPUT RELAY WHEN CONTROL POWER IS ON . . . . .	9-27
■ S4C000 to S4C007: PARITY OF USER INPUT GROUPS . . . . .	9-28
■ S4C008 to S4C015: PARITY OF USER OUTPUT GROUPS . . . . .	9-29
■ S4C016 to S4C023: DATA OF USER INPUT GROUPS . . . . .	9-30
■ S4C024 to S4C031: DATA OF USER OUTPUT GROUPS . . . . .	9-31
■ S4C032 to S4C039: USER OUTPUT GROUP TO BE INITIALIZED AT SWITCHING MODE . . . . .	9-32
■ S4C126: USER OUTPUT NO. WHEN MANIPULATOR DROP ALLOWABLE RANGE ERROR OCCURS . . . . .	9-32
<b>9.6 Parameters according to Coordinated or Synchronized Operation . . . . .</b>	<b>9-32</b>
■ S2C164: +MOV or +SMOV INSTRUCTION SPEED INPUT . . . . .	9-33
■ S2C165: +MOV INSTRUCTION INTERPOLATION INPUT . . . . .	9-33
■ S2C183: OPERATION METHOD AT FWD/BWD OPERATION OR TEST RUN BY INDEPENDENT CONTROL . . . . .	9-33
■ S2C184: JOB AT CALLING MASTER OF SUBTASK 1, 2, 3, 4, 5 BY INDEPENDENT CONTROL . . . . .	9-34
■ S2C194: STATION AXIS CURRENT VALUE DISPLAY FUNCTION . . . . .	9-34
■ S2C195 to S2C206: STATION AXIS DISPLAYED UNIT . . . . .	9-34
■ S2C322: POSTURE CONTROL OF SYNCHRONIZED MANIPULATOR (When Twin Synchronous Function Used) . . . . .	9-35
■ S2C323: POSTURE CONTROL OF MANIPULATOR IN MULTI-JOB (When Twin Synchronous Function Used) . . . . .	9-35
■ S2C549: OPERATION OF JOB WITHOUT CONTROL GROUP SPECIFICATION . . . . .	9-35

■ S2C550: EXECUTION OF “BWD” OPERATION . . . . .	9-36
■ S3C809: MAXIMUM DEVIATION ANGLE OF CURRENT STATION POSITION (When Twin Synchronous Function Used) . . . . .	9-36
<b>9.7 Parameters for Other Functions or Applications . . .</b>	<b>9-37</b>
■ S1CxG049 to S1CxG051: YAG LASER SMALL CIRCLE CUTTING . . . . .	9-37
■ S1CxG052 to S1CxG053: YAG LASER SMALL CIRCLE CUTTING DIRECTION LIMIT VALUE . . . . .	9-37
■ S1CxG054 to S1CxG055: YAG LASER SMALL CIRCLE CUTTING OVERLAP VALUE . . . . .	9-37
■ S1CxG063, S1CxG064: PATTERN CUTTING DIMENSION . . . . .	9-37
■ S1CxG065: MIRROR SHIFT SIGN INVERSION . . . . .	9-37
■ S2C332: RELATIVE JOB OPERATION METHOD. . . . .	9-38
■ S3C819 to S3C898: ANALOG OUTPUT FILTER CONSTANT (When analog output corresponding to speed function is used) . . . . .	9-38
■ S3C899: CUT WIDTH CORRECTION VALUE (When form cutting function is used) . . . . .	9-38
<b>9.8 Hardware Control Parameters . . . . .</b>	<b>9-38</b>
■ S2C646: COOLING FAN ALARM DETECTION. . . . .	9-38
■ S4C181 to S4C212: SETTING OF OPERATING RELAY NO. . . . . .	9-38
■ S4C213 to S4C244: OPERATING METHOD OF RELAYS . . . . .	9-39
■ S2C647 to S2C649: COOLING FAN ALARM 1 OPERATION . . . . .	9-39
■ S2C650 to S2C652: COOLING FAN ALARM 2 OPERATION . . . . .	9-39
■ S2C653 to S2C655: COOLING FAN ALARM 3 OPERATION . . . . .	9-39
<b>9.9 TRANSMISSION PARAMETERS . . . . .</b>	<b>9-40</b>
■ RS000: COMMUNICATION PROTOCOL . . . . .	9-40
<b>9.9.1 Basic Protocol. . . . .</b>	<b>9-40</b>
■ RS030: NUMBER OF DATA BITS . . . . .	9-40
■ RS031: NUMBER OF STOP BITS . . . . .	9-40
■ RS032: PARITY . . . . .	9-40
■ RS033: TRANSMISSION SPEED . . . . .	9-40
■ RS034: RESPONSE WAITING TIMER (TIMER A) . . . . .	9-40
■ RS035: TEXT TERMINATION MONITORING TIMER (TIMER B) . . . . .	9-40
■ RS036: NUMBER OF ENQ RE-TRANSMISSION RETRIES . . . . .	9-40
■ RS037: NUMBER OF DATA RE-TRANSMISSION RETRIES . . . . .	9-40
■ RS038: BLOCK CHECK METHOD . . . . .	9-41
<b>9.9.2 FC1 Protocol. . . . .</b>	<b>9-41</b>
■ RS050: NUMBER OF DATA BITS . . . . .	9-41
■ RS051: NUMBER OF STOP BITS . . . . .	9-41

■ RS052: PARITY .....	9-41
■ RS053: TRANSMISSION SPEED .....	9-41
■ RS054: RESPONSE WAITING TIMER (TIMER A) .....	9-41
■ RS055: TEXT TERMINATION MONITORING TIMER (TIMER B) .....	9-41
■ RS056: NUMBER OF ENQ RE-TRANSMISSION RETRIES .....	9-41
■ RS057: NUMBER OF DATA RE-TRANSMISSION RETRIES .....	9-41
■ RS058: FC2 FORMAT SPECIFICATION .....	9-42
■ RS059: EXTERNAL MEMORY FILE OVERWRITE SPECIFICATION .....	9-42
<b>9.10 Application Parameters .....</b>	<b>9-42</b>
<b>9.10.1 Arc Welding .....</b>	<b>9-42</b>
■ AxP000: APPLICATION .....	9-42
■ AxP003: WELDING ASSIGNMENT OF WELDING START CONDITION FILE .....	9-42
■ AxP004: WELDING ASSIGNMENT OF WELDING END CONDITION FILES .....	9-42
■ AxP005: WELDING SPEED PRIORITY .....	9-43
■ AxP009: WORK CONTINUING .....	9-43
■ AxP010: WELDING INSTRUCTION OUTPUT .....	9-43
■ AxP011, AxP012: MANUAL WIRE OPERATION SPEED .....	9-43
■ AxP013, AxP014: WELDING CONTROL TIME .....	9-43
■ AxP015 to AxP017: NUMBER OF WELDING CONTROL .....	9-43
■ AxP026 to AxP029: TOOL ON/OFF USER OUTPUT NO. (Jigless system) .....	9-43
<b>9.10.2 Handling Application .....</b>	<b>9-43</b>
■ AxP002, AxP004: f1 KEY FUNCTION .....	9-43
■ AxP003, AxP005: f2 KEY FUNCTION .....	9-43
<b>9.10.3 Spot Welding .....</b>	<b>9-44</b>
■ AxP003: MAXIMUM NUMBERS OF CONNECTED POWER SOURCES .....	9-44
■ AxP004: GUN FULL OPEN STROKE ON/OFF SIGNAL .....	9-44
■ AxP005: STROKE CHANGE ANSWER TIME LIMIT .....	9-44
■ AxP006: PARITY SPECIFICATION FOR WELDING CONDITIONS .....	9-44
■ AxP007: ANTICIPATE TIME .....	9-44
■ AxP015: WELDING ERROR RESET OUTPUT TIME .....	9-44
■ AxP016, AxP017: ELECTRODE WEAR AMOUNT ALARM VALUE .....	9-45
<b>9.10.4 General-purpose Application .....</b>	<b>9-45</b>
■ AxP009: WORK CONTINUE PROHIBIT .....	9-45

## 10 System Setup

<b>10.1 Home Position Calibration .....</b>	<b>10-1</b>
<b>10.1.1 Home Position Calibration .....</b>	<b>10-2</b>
<b>10.1.2 Calibrating Operation .....</b>	<b>10-3</b>

■ Registering All Axes at One Time . . . . .	10-3
■ Registering Individual Axes . . . . .	10-4
■ Changing the Absolute Data . . . . .	10-5
■ Clearing Absolute Data . . . . .	10-6
10.1.3 Home Position of the Robot . . . . .	10-7
10.2 Second Home Position (Check Point) . . . . .	10-8
10.2.1 Purpose of Position Check Operation . . . . .	10-10
10.2.2 Setting the Second Home Position (Check Point) . . . . .	10-12
10.2.3 Procedure After an Alarm . . . . .	10-13
10.3 Setting the Controller Clock . . . . .	10-14
10.4 Setting Play Speed . . . . .	10-15
10.5 All Limits Releasing . . . . .	10-16
10.6 Overrun / Tool Shock Sensor Releasing . . . . .	10-18
10.7 Interference Area . . . . .	10-20
10.7.1 Interference Area . . . . .	10-20
10.7.2 Cubic Interference Area . . . . .	10-20
■ Cubic Interference Area . . . . .	10-20
■ Cube Setting Method . . . . .	10-21
■ Setting Operation . . . . .	10-22
10.7.3 Axis Interference Area . . . . .	10-27
■ Axis Interference Area . . . . .	10-27
■ Setting Operation . . . . .	10-27
10.7.4 Clearing Interference Area Data . . . . .	10-30
10.8 Work Home Position . . . . .	10-31
10.8.1 What is the Work Home Position? . . . . .	10-31
10.8.2 Setting Work Home Position . . . . .	10-31
■ Work Home Position Window . . . . .	10-31
■ Registering/Changing the Work Home Position . . . . .	10-32
■ Returning to the Work Home Position . . . . .	10-32
■ Output of the Work Home Position Signal . . . . .	10-33
10.9 Tool Data Setting . . . . .	10-33
10.9.1 Registering Tool Files . . . . .	10-33
■ Number of Tool Files . . . . .	10-33
■ Registering Coordinate Data . . . . .	10-33
■ Registering Tool Angle . . . . .	10-36
■ Setting the Tool Load Information . . . . .	10-37
10.9.2 Tool Calibration . . . . .	10-38
■ Tool Calibration . . . . .	10-38
■ Teaching . . . . .	10-38
■ Clearing Calibration Data . . . . .	10-42
■ Checking the TCP . . . . .	10-43
10.9.3 Automatic Measurement of the Tool Load and the Center of Gravity . . . . .	10-44
■ What is the Automatic Measurement of the Tool Load and the Center of Gravity? . . . . .	10-44
■ Measurement of the Tool Load and the Center of Gravity . . . . .	10-44

<b>10.10</b>	<b>User Coordinates Setting</b>	10-48
<b>10.10.1</b>	<b>User Coordinates</b>	10-48
■	Definition of User Coordinates	10-48
■	User Coordinates File	10-48
<b>10.10.2</b>	<b>User Coordinates Setting</b>	10-49
■	Selecting User Coordinates File	10-49
■	Teaching User Coordinates	10-50
■	Clearing User Coordinates	10-52
<b>10.11</b>	<b>ARM Control</b>	10-53
<b>10.11.1</b>	<b>ARM Control</b>	10-53
<b>10.11.2</b>	<b>ARM CONTROL Window</b>	10-53
■	Robot Setup Condition	10-54
■	Setting	10-57
<b>10.11.3</b>	<b>Tool Load Information Setting</b>	10-58
■	Tool Load Information	10-58
■	How to Calculate Tool Load Information	10-58
■	Tool load Information registering	10-65
<b>10.12</b>	<b>Shock Detection Function</b>	10-67
<b>10.12.1</b>	<b>Shock Detection Function</b>	10-67
<b>10.12.2</b>	<b>Shock Detection Function Setting</b>	10-67
■	Shock Detection Level Setting	10-67
■	Tool load Information Setting	10-70
■	Instruction of Shock Detection Function	10-72
■	Reset Shock detected	10-77
<b>10.13</b>	<b>Instruction Level Setting</b>	10-78
<b>10.13.1</b>	<b>Setting Contents</b>	10-78
■	Instruction Set	10-78
■	Learning Function	10-79
<b>10.13.2</b>	<b>Setting Instruction Set Level Operation</b>	10-80
<b>10.14</b>	<b>Numeric Key Customize Function</b>	10-81
<b>10.14.1</b>	<b>What is the Numeric Key Customize Function?</b>	10-81
<b>10.14.2</b>	<b>Allocatable Functions</b>	10-81
■	Key Allocation (EACH)	10-81
■	Key Allocation (SIM)	10-82
<b>10.14.3</b>	<b>Allocating an Operation</b>	10-83
■	Allocation Window	10-83
■	Instruction Allocation	10-84
■	Job Call Allocation	10-86
■	Window Allocation	10-87
■	Alternate Output Allocation	10-88
■	Momentary Output Allocation	10-89
■	Pulse Output Allocation	10-89
■	Group (4-bit/8-bit) Output Allocation	10-90
■	Analog Output Allocation	10-91
■	Analog Incremental Output Allocation	10-92
<b>10.14.4</b>	<b>Allocation of I/O Control Instructions</b>	10-93
<b>10.14.5</b>	<b>Execution of Allocation</b>	10-95
■	Executing the Instruction/Output Control Allocation	10-95

■ Executing the Job Call Allocation .....	10-95
■ Executing the Window Allocation .....	10-95
■ Executing the I/O Control Allocation .....	10-95
<b>10.15</b> Changing the Output Status .....	10-96
<b>10.16</b> Temporary Release of Soft Limits .....	10-98
<b>10.17</b> Changing the Parameter Setting .....	10-99
<b>10.18</b> File Initialize .....	10-101
<b>10.18.1</b> Initialize Job File .....	10-101
<b>10.18.2</b> Initialize Data File .....	10-102
<b>10.18.3</b> Initialize Parameter File .....	10-103
<b>10.18.4</b> Initializing I/O Data .....	10-104
<b>10.18.5</b> Initializing System Data .....	10-105

## **11 Spot Welding Application Using an Air Gun**

<b>11.1</b> Spot Welding System Overview .....	11-1
<b>11.2</b> Function Keys .....	11-2
<b>11.3</b> Teaching .....	11-4
<b>11.3.1</b> Manual Spot Welding Function .....	11-4
■ Manual Welding .....	11-4
■ Manual Dry Spotting .....	11-4
■ Stroke Switching .....	11-5
■ Welding On/Off .....	11-5
■ Resetting Alarms .....	11-5
<b>11.3.2</b> Registering Work Instructions .....	11-6
■ GUNCL Instruction .....	11-6
■ Example .....	11-7
■ SPOT Instruction .....	11-8
■ STROKE Instruction .....	11-10
■ STRWAIT Instruction .....	11-11
<b>11.4</b> Setting Welding Conditions .....	11-13
<b>11.4.1</b> Manual Spot Window .....	11-13
<b>11.4.2</b> Spot Welder Condition Data File .....	11-14
<b>11.4.3</b> Spot Gun Condition Data File .....	11-16
<b>11.5</b> Spot Welding Diagnosis .....	11-18
<b>11.5.1</b> Spot Welding Diagnosis Window .....	11-18
■ Tip Hit Count Clear .....	11-19
<b>11.6</b> Spot Gun Motion Control .....	11-20
<b>11.6.1</b> Gun Motion Control .....	11-20
■ X Type Gun .....	11-21
■ C Type Gun .....	11-22
<b>11.6.2</b> Process Timing .....	11-23
■ OPERATION MODE = 0 (SINGLE GUN, OPEN → WELDING → OPEN) .....	11-23

■ OPERATION MODE = 1 (SHORT OPEN → WELDING → SHORT OPEN) .....	11-24
■ OPERATION MODE = 2 (SHORT OPEN → WELDING → FULL OPEN) .....	11-25
■ OPERATION MODE = 3 (FULL OPEN → WELDING → SHORT OPEN) .....	11-26
■ OPERATION MODE = 4 (FULL OPEN → WELDING → FULL OPEN) .....	11-27
<b>11.6.3</b> Stroke Change Control Method .....	11-28
■ Single Gun, C Double Gun, X Double Cylinder Gun .....	11-28
■ X Double Mechanical Stopper Type .....	11-28
<b>11.7</b> I/O Signals for a Spot Gun .....	11-30
<b>11.7.1</b> I/O Signal Overview .....	11-30
<b>11.7.2</b> I/O Allocation .....	11-31
■ Input Allocation Window .....	11-31
■ Output Allocation Window .....	11-32
■ Pseudo Input Signal Window .....	11-33
<b>11.7.3</b> Allocation Signal Meanings .....	11-34
<b>11.7.4</b> Monitor Function for Spot Welding Equipment .....	11-36
<b>11.7.5</b> Spot Welding Exclusive Signal Allocation List .....	11-37
<b>11.8</b> Instruction List .....	11-41

## 12 Table of Basic Instructions

<b>12.1</b> Move Instructions .....	12-1
<b>12.2</b> I/O Instructions .....	12-5
<b>12.3</b> Control Instructions .....	12-8
<b>12.4</b> Shift Instructions .....	12-11
<b>12.5</b> Operating Instructions .....	12-12

## 13 Error

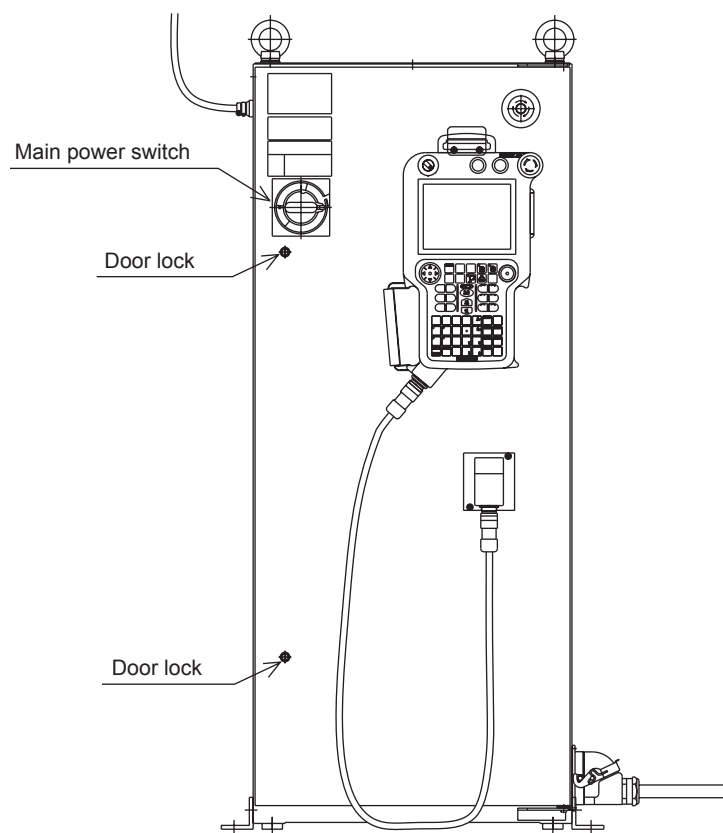
<b>13.1</b> Error Message List .....	13-1
<b>13.1.1</b> System and General Operation .....	13-2
<b>13.1.2</b> Editing .....	13-5
<b>13.1.3</b> Job Defined Data .....	13-5
<b>13.1.4</b> External Memory Equipment .....	13-9
<b>13.1.5</b> Concurrent I/O .....	13-15
<b>13.1.6</b> Maintenance Mode .....	13-16

# 1 Introduction

## 1.1 NX100 Overview

The main power switch and the door lock are located on the front of the NX100 controller. The emergency stop button is installed in the upper right corner of the cabinet door and the programming pendant hangs from a hook below the button.

For information on setup, installation, and connection of the NX100 system, refer to the “NX100 INSTRUCTIONS.”

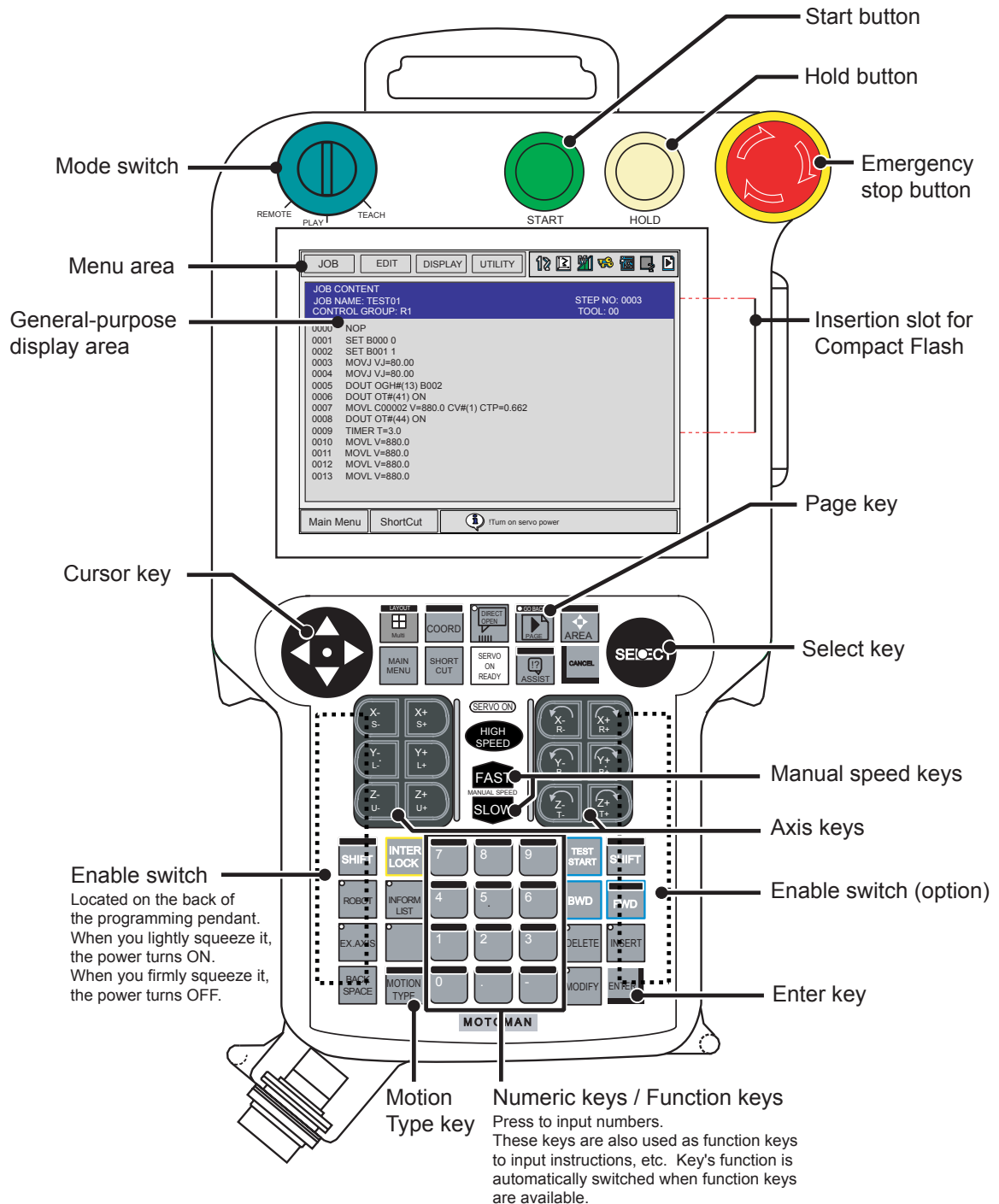


NX100 Front View

## 1.2 Programming Pendant


### 1.2.1 Programming Pendant Overview


The programming pendant is equipped with the keys and buttons used to conduct manipulator teaching operations and to edit jobs.



## 1.2.2 Key Description

### ■ Character Keys

The keys which have characters printed on them are denoted with [ ]. For example,  is shown as [ENTER].

The Numeric keys have additional functions along with their number values. Dual function keys are used in the context of the operation being performed. For example:  may be described in the text as [1] or [TIMER].

### ■ Symbol Keys

The keys which have a symbol printed on them are not denoted with [ ] but depicted with a small picture, with the exception of the cursor key, which is not shown with a picture.



Cursor



Emergency Stop button



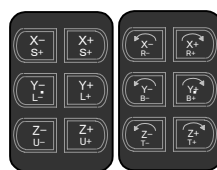
Direct Open key



Page key

### ■ Axis Keys and Numeric Keys

The keys pictured in the following are referred to as the axis keys and Numeric keys when described.



Axis Keys








Numeric Keys








### ■ Keys Pressed Simultaneously






When two keys are to be pressed simultaneously, the keys are shown with a “+” sign between them, such as [SHIFT]+[COORD].

## 1.2.3 Programming Pendant Keys









<p>E.STOP Button</p> 	<p><b>Turns OFF the servo power.</b></p> <p>When the servo power is turned OFF, the SERVO ON LED on the programming pendant will extinguish. An emergency stop message is displayed on the screen.</p>
<p>Enable Switch</p> 	<p><b>Turns ON the servo power.</b></p> <p>The Enable switch is active only when the SERVO ON LED is blinking, the safety plug is ON, and the Mode Switch is set to "TEACH." When this switch is lightly squeezed, the power turns ON. When firmly squeezed, the power turns OFF.</p>
<p>Cursor</p> 	<p><b>Moves the cursor in the direction of the arrow.</b></p> <p>The size of the cursor and the range/place where the cursor can move will vary depending on the window. If the UP cursor button is pressed when the cursor is on the first line, the cursor will move to the last line of the job. Conversely, if the cursor is on the last line of the job and the DOWN cursor button is pressed, the cursor will jump to the first line of the job.</p> <ul style="list-style-type: none"> <li>• [SHIFT] + UP Goes back to the previous page.</li> <li>• [SHIFT] + DOWN Goes to the next page.</li> <li>• [SHIFT] + RIGHT Scrolls the instruction area of the job content or play back display to the right.</li> <li>• [SHIFT] + LEFT Scrolls the instruction area of the job content or playback display to the left.</li> </ul>
<p>[SELECT]</p> 	<p><b>Selects menu items such as main menu, pull-down menu, etc.</b></p>
<p>[MAIN MENU]</p> 	<p><b>Displays the main menu.</b></p> <p>When pressed while the main menu is displayed, the main menu disappears.</p>








## 1.2 Programming Pendant

<p>[AREA]</p> 	<p><b>Moves the cursor between "Menu Area" and "General Purpose Display Area."</b> When [SHIFT] is pressed simultaneously:</p> <ul style="list-style-type: none"> <li>• [SHIFT] + [AREA] The language can be switched when the bilingual function is valid. (Bilingual function is optional.)</li> <li>• DOWN cursor button + [AREA] Moves the cursor to the operation button on the screen if displayed.</li> <li>• UP cursor button + [AREA] Moves the cursor to the general-purpose display area when the cursor is on the operation button.</li> </ul>
<p>[PAGE]</p> 	<p><b>Displays the next page.</b></p> <p>[SHIFT] + [PAGE] The previous page is displayed.</p> <p>The page can be changed when  appears in the status area on the screen.</p>
<p>[DIRECT OPEN]</p> 	<p><b>Displays the content related to the current line.</b></p> <p>To display the content of a CALL job or condition file, move the cursor to the next line and press [DIRECT OPEN]. The file will be displayed for the selected line. Display content will vary depending on the type of instruction used in the job.</p> <p>Example: For a CALL instruction, the content of the called job will be displayed. For a work instruction, the content of the condition file will be displayed. For Input/output instructions, the input/output condition will be displayed.</p>
<p>[COORD]</p> 	<p><b>Select the operation coordinate system when the manipulator is operated manually.</b></p> <p>Five coordinate systems (joint, cartesian, cylindrical, tool and user) can be used. Each time this key is pressed, the coordinate system is switched in the following order: "JOINT"→"WLD/CYL"→"TOOL"→"USER"</p> <p>The selected coordinate system is displayed on the status display area.</p> <p>[SHIFT] + [COORD] The coordinate number can be changed when the "TOOL" or "USER" coordinate system is selected.</p>
<p>MANUAL SPEED keys</p> 	<p><b>Sets the speed for manual operation.</b></p> <p>This speed is also valid for operations with [FWD] and [BWD]. There are four speed levels (slow, medium, fast, and inching). Each time [FAST] is pressed, manual speed changes in the following order: "INCH"→" SLOW"→"MED"→"FST"</p> <p>Each time [SLOW] is pressed, manual speed changes in the following order: "FST"→" MED"→"SLOW"→"INCH"</p> <p>The selected speed is displayed on the status area.</p>
<p>[HIGH SPEED]</p> 	<p><b>Changes the speed of axis operation when the axis button is pressed.</b></p> <p>The speed of the manipulator will change to high regardless of the programmed speed while this key is pressed.</p> <p>The speed for [HIGH SPEED] is specified in advance.</p>







<p>[MOTION TYPE]</p> 	<p><b>Selects the interpolation type for playback operation.</b></p> <p>The selected interpolation type is shown in the status display area on the screen.</p> <p>Each time this key is pressed, the interpolation type changes in the following order:  "MOVJ"→" MOVL"→"MOVC"→"MOVS"</p> <p>[SHIFT] + [MOTION TYPE]  The interpolation mode changes in the following order:  "STANDARD"→" EXTERNAL REFERENCE POINT"*→" CONVEYOR"*</p> <p>Interpolation type can be changed in any mode.</p> <p>*: These modes are purchased options.</p>
<p>[ROBOT]</p> 	<p><b>Enables the robot axis operation.</b></p> <p>[ROBOT] is active for the system where multiple manipulators are controlled by one NX100 or the system with external axes.</p>
<p>[EX.AXIS]</p> 	<p><b>Enables the external axis (base axis or station axis) operation.</b></p> <p>[EX.AXIS] is active for the system with external axes.</p>
<p>Axis Key</p> 	<p><b>Moves specified axes on manipulator.</b></p> <p>The manipulator axes only move while the key is held down. Multiple axes can be operated simultaneously by pressing two or more keys at the same time.</p> <p>The manipulator operates in the selected coordinate system at the selected manual speed. Make sure that the selected coordinate system and the manual speed are the desired ones before starting the axis operation.</p>
<p>[TEST START]</p> 	<p><b>Moves the manipulator through taught steps in a continuous motion when [TEST START] and [INTERLOCK] are simultaneously pressed.</b></p> <p>The manipulator can be moved to check the path of taught steps. The manipulator operates according to the currently selected operation cycle: "AUTO," "1CYCLE," or "STEP."</p> <p>The manipulator operates at the taught speed. However, if the taught speed exceeds the maximum teaching speed, the operation proceeds at the maximum teaching speed.</p> <p>Operation stops immediately when this key is released.</p>

## 1.2 Programming Pendant

<p>[FWD]</p> 	<p><b>Moves the manipulator through the taught steps while this key is pressed.</b> Only move instructions are executed (one instruction at a time, no welding instructions).</p> <p>[INTERLOCK] + [FWD] All instructions except move instructions are executed.</p> <p>[SHIFT] + [FWD] Move instructions are executed in succession.</p> <p>As for the operation of pressing [REFP] simultaneously, see the description of “■ Moving to Reference Point” (page 4-22). The manipulator operates at the selected manual speed. Make sure that the selected manual speed is the desired one before starting operation.</p>
<p>[BWD]</p> 	<p><b>Moves the manipulator through the taught steps in the reverse direction while this key is pressed.</b> Only move instructions are executed (no weld commands).</p>
<p>[INFORM LIST]</p> 	<p><b>Displays instruction lists of commands available for job editing.</b></p>
<p>[CANCEL]</p> 	<p><b>Cancels data input and resets errors.</b></p>
<p>[DELETE]</p> 	<p><b>Deletes registered instructions and data.</b> Deletion completes when [ENTER] is pressed while this key lamp is lit.</p>
<p>[INSERT]</p> 	<p><b>Inserts new instructions or data.</b> Insertion completes when [ENTER] is pressed while this key lamp is lit.</p>
<p>[MODIFY]</p> 	<p><b>Modifies taught position data, instructions, and data.</b> Modification completes when [ENTER] is pressed while this key lamp is lit.</p>
<p>[ENTER]</p> 	<p><b>Registers instructions, data, current position of the manipulator, etc.</b> When [ENTER] is pressed, the instruction or data displayed in the input buffer line moves to the cursor position to complete a registration, insertion, or modification.</p>

<p>[SHIFT]</p> 	<p><b>Changes the functions of other keys by pressing together.</b> Can be used with [MAIN MENU], [COORD], [MOTION TYPE], cursor key, Numeric key, page key  to access alternate functions. Refer to the description of each key for the alternate [SHIFT] functions.</p>
<p>[INTERLOCK]</p> 	<p><b>Changes the functions of other keys by pressing together.</b> Can be used with [TEST START], [FWD], Numeric key (Numeric key customize function). Refer to the description of each key for the alternate [INTERLOCK] functions.</p>
<p>Numeric Key</p> 	<p><b>Enters the number or symbol when the "&gt;" prompt appears on the input line.</b> "." is the decimal point. "-" is a minus sign or hyphen. The Numeric keys are also used as function keys. Refer to the explanation of each function for details.</p>
<p>[START]</p>  <p>START</p>	<p><b>Starts the manipulator motion in playback operation.</b> The lamp on this button is lit during the playback operation. The lamp also lights when the playback operation is started by the system input START signal. The lamp turns OFF when the playback operation is stopped by alarm occurrence, HOLD signal, or mode change.</p>
<p>[HOLD]</p>  <p>HOLD</p>	<p><b>Holds the manipulator motion.</b> This button is enabled in any mode. The lamp on this button is lit only while the button is being pressed. Although the lamp turns OFF when the button is released, the manipulator stays stopped until a START command is input. The HOLD lamp automatically lights in the following cases to indicate that the system is in HOLD status. The start and axis operations are disabled while the lamp is lit.</p> <ul style="list-style-type: none"> <li>• The HOLD signal of system input is ON.</li> <li>• The HOLD request is being sent from an external device in remote mode.</li> <li>• In HOLD status caused by an error occurred in working process such as wire sticking at arc welding</li> </ul>
<p>Mode Switch</p> 	<p><b>Selects the Play mode, Teach mode, or Remote mode.</b></p> <p>PLAY: Play Mode The playback of taught job is enabled. The START signal from an external device is disabled.</p> <p>TEACH: Teach Mode The axis operation and edition from the programming pendant are enabled. The START signal from an external device is disabled.</p> <p>REMOTE: Remote Mode The operation by external signals is enabled. [START] is invalid during the remote mode.</p>

## 1.2 Programming Pendant

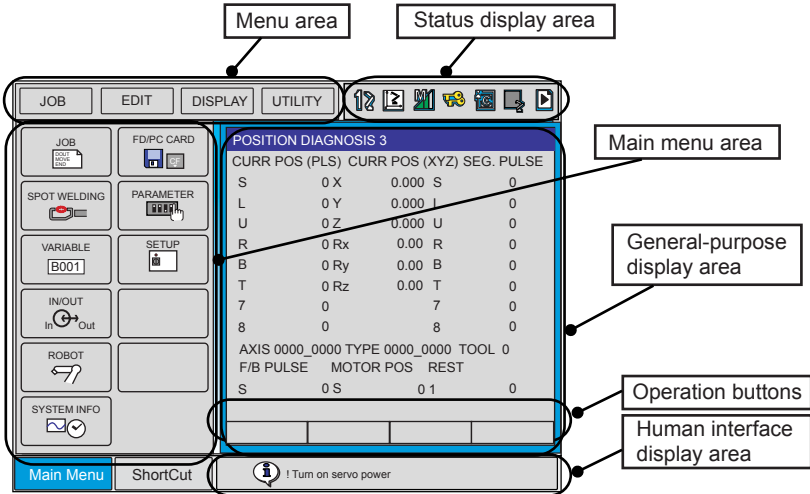
<p>[MAIN MENU]</p> 	<p><b>Displays the main menu.</b></p> <p>If this button is pressed while the main menu is displayed, the main menu disappears.</p> <p>[SHIFT] + [MAIN MENU] While a window opens, the window is switched in the following order: Whindow → Sub-menu → Main menu</p>
<p>[Multi]</p> 	<p><b>Displays multiple windows.</b></p> <p><b>This function is for future use. (Cannot be used with the NX100 of the current version.)</b></p> <p>Up to four windows can be displayed at the same time.</p> <p>[SHIFT] + [Multi] The dialog box to select the display form for Multi-windows Display appears.</p>
<p>[SHORTCUT]</p> 	<p><b>Displays the shortcut selection dialog box.</b></p> <p><b>This function is for future use. (Cannot be used with the NX100 of the current version.)</b></p> <p>Those windows opened frequently can be registered. Once the window is registered in the shortcut selection dialog box, it can be displayed by one-touch operation.</p>
<p>[SERVO ON READY]</p> 	<p><b>Enables the servo power supply to be turned ON.</b></p> <p>Press this button to enable the servo power supply to be turned ON if the servo power supply is shut OFF by the emergency stop or overrun signal. When this button is pressed:</p> <ul style="list-style-type: none"> <li>• In the play mode, the servo power supply is turned ON if the safeguarding is securely closed.</li> <li>• In the teach mode, the SERVO ON lamp flashes and the servo power supply is turned ON when the Enable switch is ON.</li> <li>• The SERVO ON lamp is lit while the servo power is ON.</li> </ul>
<p>[ASSIST]</p> 	<p><b>Displays the menu to assist the operation for the currently displayed window.</b></p> <p><b>This function is for future use. (Cannot be used with the NX100 of the current version.)</b></p> <p>Pressing this button when the cursor is on the job editing window displays the job editing menu commands such as COPY, CUT, PASTE, UNDO, and ADD.</p> <p>Pressing this button when the file-editing window is displayed displays the help guidance for the operation.</p> <ul style="list-style-type: none"> <li>• [SHIFT] + [ASSIST] The function list of key combinations with [SHIFT] appears.</li> <li>• [INTERLOCK] + [ASSIST] The function list of key combinations with [INTERLOCK] appears.</li> </ul>
<p>[BACK SPACE]</p> 	<p><b>Deletes the last character while typing characters.</b></p>

# 1.2.4 Programming Pendant Display

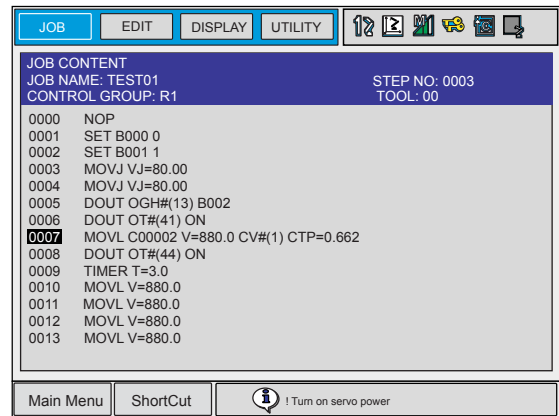
## ■ The Five Display Areas

The programming pendant display is a 6.5 inch color display. Alphanumeric characters can be used.

The general display area, menu area, human interface display area, and main menu area among the following five areas can be moved by pressing [AREA], or can be selected by directly touching the screen.



Each window displayed during operations is provided with its name on the upper left of the general display area.



## ■ General-purpose Display Area

On the general-purpose display area, various settings and contents such as jobs and characteristics files can be displayed and edited.

The operation buttons are also displayed at the bottom of the window according to the window contents.

- To move the cursor to the operation button, press [AREA] + DOWN cursor key.
- To move the cursor to the general-purpose display area, press [AREA] + UP cursor key or press [CANCEL].
- To move the cursor between the operation buttons, use the RIGHT or LEFT cursor key.
- To execute the operation button, move the cursor to the button and press [SELECT].

EXECUTE: Continues operation with the displayed contents.

CANCEL: Cancels the displayed contents and returns to the previous window.

COMPLETE: Completes the setting operation displayed on the general-purpose display area.

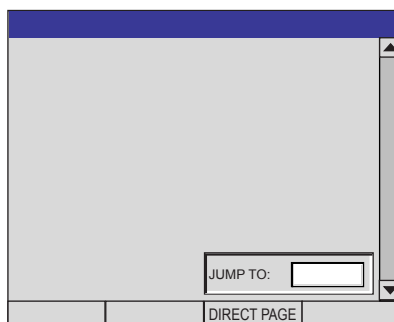
STOP: Stops operation when loading, saving, or verifying with an external memory device.

RELEASE: Releases the overrun and shock sensor function.

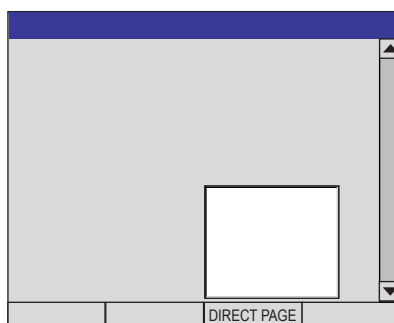
RESET: Resets an alarm. (Cannot reset major alarms.)

DIRECT PAGE: Jumps to the desired page.

- When the page can be switched by specifying the page number, the following input box appears when "DIRECT PAGE" is selected. Directly type the desired page number and press [ENTER].

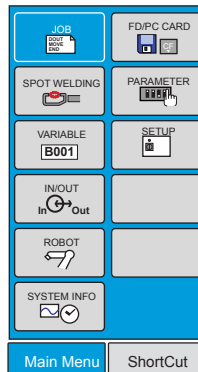


- When the page can be switched by selecting an item, the following selection list appears when "DIRECT PAGE" is selected. Select a desired item using the UP and DOWN cursor key and press [ENTER].



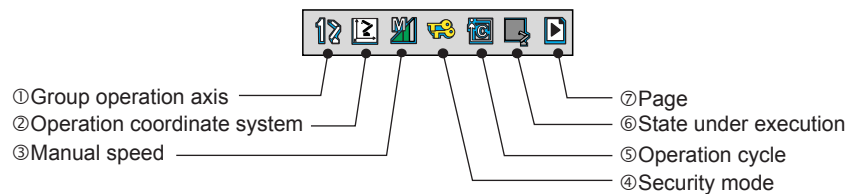
## ■ Main Menu Area

Each menu and submenu are displayed in the main menu area. Press [MAIN MENU] or touch {Main Menu} on the right bottom of the window to display the main menu.



## ■ Status Display Area

The Status Display area shows controller status. The displayed information will vary depending on the controller mode (Play/Teach).



### ①Group Operation Axis

Displays the active group axis for systems equipped with station axes or several robot axes.

to : Robot Axes

to : Base Axes

to : Station Axes

### ②Operation Coordinate System

Displays the selected coordinate system. Switched by pressing [COORD].

: Joint Coordinates

: Cartesian Coordinates

: Cylindrical Coordinates

: Tool Coordinates

: User Coordinates

## 1.2 Programming Pendant

### ③ Manual Speed

Displays the selected speed. For details, refer to " 2.2.2 Selecting Manual Speed. "



: Inching



: Low Speed



: Medium Speed



: High Speed

### ④ Security Mode



: Operation Mode



: Edit Mode



: Management Mode

### ⑤ Operation Cycle

Displays the present operation cycle.



: Step



: Cycle



: Continuous

### ⑥ State Under Execution

Displays the present system status (STOP, HOLD, ESTOP, ALARM, or RUN).



: Stop Status



: Hold Status



: Emergency Stop Status



: Alarm Status




: Operating Status

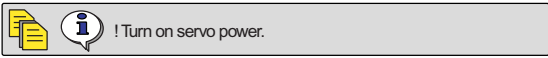
### ⑦ Page



: Displayed when the page can be switched.

■ Human Interface Display Area

When two or more error messages are displayed,  appears in the human interface display area.



To view the list of current errors, activate the human interface display area and press [SELECT]. To close the error list, press [CANCEL].

■ Menu Area

The menu area is used to edit a job, manage jobs, and execute various utilities.



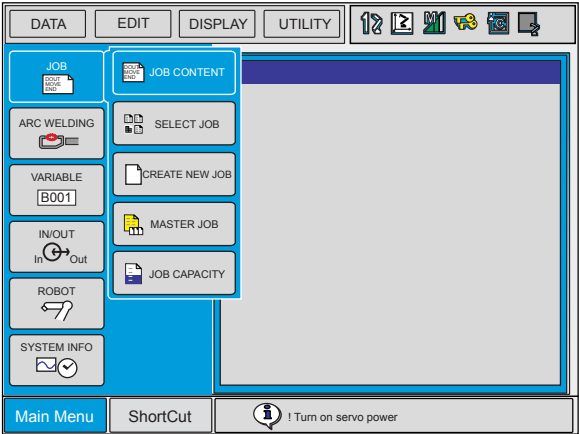
1.2.5 Screen Descriptions

■ Denotation

The menu displayed in the programming pendant is denoted with { }.



The above menu items are denoted with {DATA}, {EDIT}, {DISPLAY}, AND {UTILITY}.

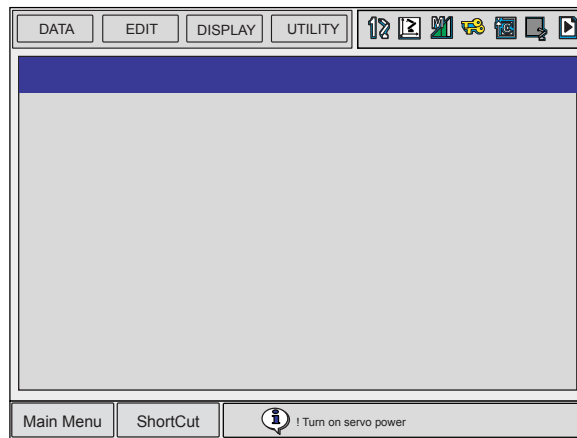


The pull-down menu commands are denoted in the same manner.

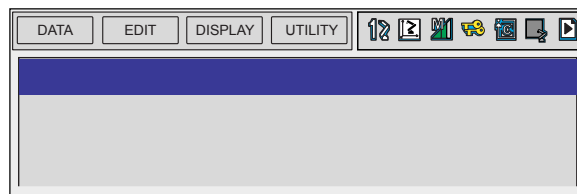
## 1.2 Programming Pendant

### ■ Screen

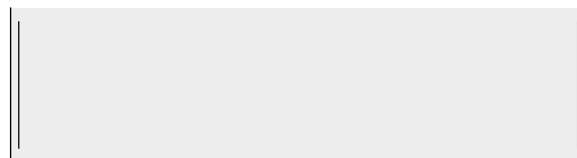
The window can be displayed according to the view desired.



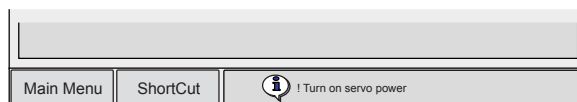
Full Window View



Upper Window View



Middle Window View



Lower Window View

## 1.2.6 Guidance Display

This function is for future use. (Cannot be used with the NX100 of the current version.)

Information to assist the operation can be displayed by the following key operation.

- Press [SHIFT] + [ASSIST] to display the function list of key combinations with [SHIFT].
- Press [INTERLOCK] + [ASSIST] to display the function list of key combinations with [INTERLOCK].

## 1.2.7 Character Input











To input characters, display the software keypad on the programming pendant display.

Move the cursor to the data for which characters are to be input, and press [SELECT] to display the software keypad.

There are three types of software keypads: the alphanumeric keypads each for upper-case and lower-case characters and the symbol keypad. To switch between the alphanumeric keypads and the symbol keypad, touch the button tab on the screen or press [PAGE]. To switch the alphanumeric keypads between upper-case and lower-case characters, touch “CapsLock OFF” or “CapsLock ON.”

## 1.2 Programming Pendant


## ■ Operation

Keypad	Button on the Programming Pendant	Explanation
*1		Moves the cursor (focus).
*1		Selects a character.
"Cancel"		Clears all the characters being typed. Pressing this second time cancels the IME (Input Method Editor).
"BackSpace"		Deletes the last one character.
"Enter"		Enters the input characters.
Button Tab		Switches the keypads displayed on the programming pendant.
"Cancel"	 or 	Closes the IME window.
"1" to "0"	 to 	Enters numbers.

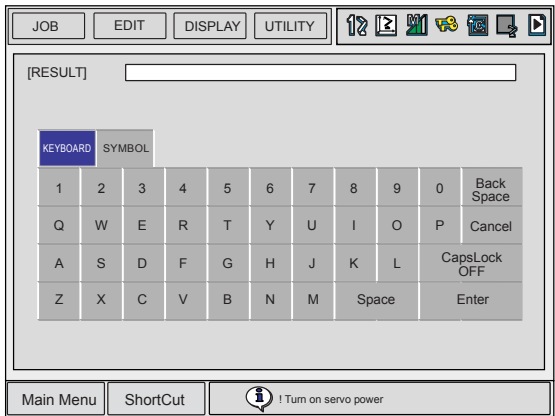
\*1 Directly touch the desired item on the screen.

■    Alphanumeric Input

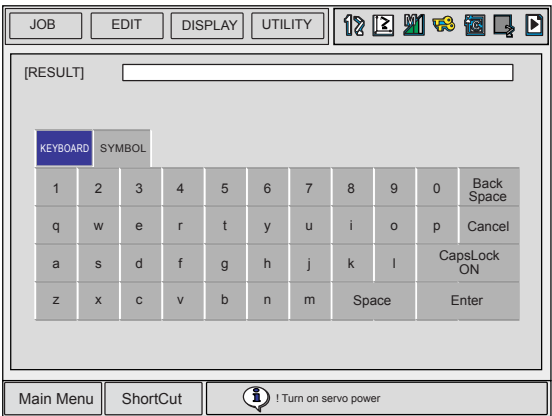
Number input is performed with the Numeric keys or on the following alphanumeric input window. Numbers include 0 to 9, the decimal point (.), and the minus sign/hyphen (-).  
Note however, that the decimal point cannot be used in job names.

Press the page key  to display the alphanumeric input window. Move the cursor to the desired letter and press [SELECT] to enter the letter.


For Numbers and Upper-case Characters

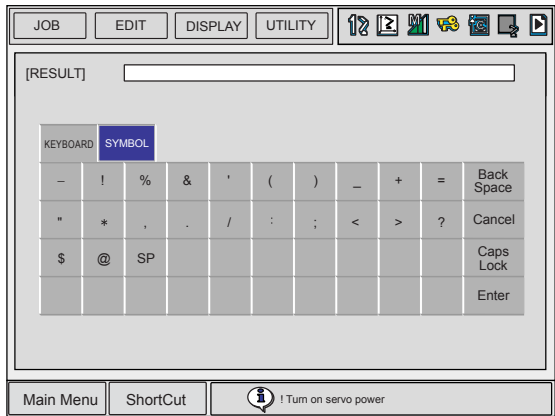


For Numbers and Lower-case Characters



■    Symbol Input

Press the page key  to display the symbol input window.  
Move the cursor to the desired symbol and press [SELECT] to enter the symbol.  
Note that the symbol input window is not available for naming jobs since job names can only have alphanumeric characters.



SP: Space

## 1.3 Modes

The following three modes are available for NX100.

- Teach Mode
- Play Mode
- Remote Mode

### 1.3.1 Teach Mode

In the teach mode, the following can be done.

- Preparation and teaching of a job
- Modification of a registered job
- Setting of various characteristic files and parameters

### 1.3.2 Play Mode

In the play mode, the following can be done.

- Playback of a taught job
- Setting, modification, or deletion of various condition files

### 1.3.3 Remote Mode

In the remote mode, the operations such as Servo ON Ready, Start, Cycle Change, Call Master Job can be commanded by external input signals.

The operations by external input signals become enabled in the remote mode, while [START] on the programming pendant becomes disabled.

The data transmission function (optional function) is also available in the remote mode.

The following table shows how each operation is input in each mode.

	Teach Mode	Play Mode	Remote Mode
Servo ON Ready	PP	PP	External input signal
Start	Invalid	PP	External input signal
Cycle Change	PP	PP	External input signal
Call Master Job	PP	PP	External input signal

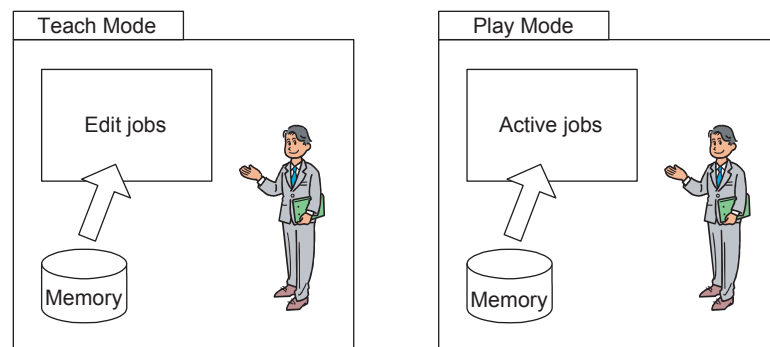
Note: "PP" indicates the programming pendant.

## 1.3.4 Teach Mode Priority

For safety reasons, the teach mode always takes priority in mode switching operations. In the teach mode, operations from external input signals and playback operation using [START] are disabled.

## 1.3.5 Edit Jobs and Active Jobs

The NX100 can call a job stored in the memory at any time in order to edit or execute the job. Jobs to be edited are called “edit jobs.” The name of the edit job is displayed in the status display area in teach mode. Jobs to be executed are called “active jobs.” The name of the active job is displayed in the status display area in play mode.



Switching the modes on the programming pendant does not switch between edit jobs and active jobs. To execute an edit job in the play mode, switch the mode to the play mode first and read out the job.



## 1.4 About the Security Mode

### 1.4.1 Types of Security Modes

The following three types of security modes are available.

Any operations in the edit mode and the management mode require a user ID. The user ID must contain between 4 and 8 letters, numbers, or symbols.

- Operation Mode

During the operation mode, the operator can monitor the line operation and start and stop the manipulator. Repairs, etc. can be performed if any abnormalities are detected.

- Edit Mode

During the edit mode, teaching, robot jog operations, and editing of jobs and various operation files can be performed in addition to the operations enabled in the operation mode.

- Management Mode

During the management mode, the operator who performs setup and maintenance for the system can set the machine control parameter, set the time, change the user ID, etc. in addition to the operations enabled in the edit mode.

Menu &amp; Security Mode

Main Menu	Sub Menu	Security Mode	
		DISPLAY	EDIT
JOB	JOB	Operation	Edit
	SELECT JOB	Operation	Operation
	CREATE NEW JOB <sup>*1</sup>	Edit	Edit
	MASTER JOB	Operation	Edit
	JOB CAPACITY	Operation	-
	RES. START(JOB) <sup>*1</sup>	Edit	Edit
	RES. STATUS <sup>*2</sup>	Operation	-
VARIABLE	BYTE	Operation	Edit
	INTEGER	Operation	Edit
	DOUBLE	Operation	Edit
	REAL	Operation	Edit
	STRING	Operation	Edit
	POSITION(ROBOT)	Operation	Edit
	POSITION(BASE)	Operation	Edit
	POSITION(ST)	Operation	Edit
IN/OUT	EXTERNAL INPUT	Operation	-
	EXTERNAL OUTPUT	Operation	-
	USER INPUT	Operation	-
	USER OUTPUT	Operation	Edit
	SYSTEM INPUT	Operation	-
	SYSTEM OUTPUT	Operation	-
	RIN	Operation	-
	CPRIN	Operation	-
	REGISTER	Operation	-
	AUXILIARY RELAY	Operation	-
	CONTROL INPUT	Operation	-
	PSEUDO INPUT SIG	Operation	Management
	NETWORK INPUT	Operation	-
	ANALOG OUTPUT	Operation	-
	SERVO POWER ON STATUS	Operation	-
	LADDER PROGRAM	Management	Management
	I/O ALARM	Management	Management
	I/O MESSAGE	Management	Management

<sup>\*1</sup> Displayed in the teach mode only.

<sup>\*2</sup> Displayed in the play mode only.

## 1.4 About the Security Mode

Menu &amp; Security Mode

Main Menu	Sub Menu	Security Mode	
		DISPLAY	EDIT
ROBOT	CURRENT POSITION	Operation	-
	COMMAND POSITION	Operation	-
	SERVO MONITOR	Management	-
	OPE ORIGIN POS	Operation	Edit
	SECOND HOME POS	Operation	Edit
	DROP AMOUNT	Management	Management
	POWER ON/OFF POS	Operation	-
	TOOL	Edit	Edit
	INTERFERENCE	Management	Management
	SHOCK SENS LEVEL	Operation	Management
	USER COORDINATE	Edit	Edit
	HOME POSITION	Management	Management
	MANIPULATOR TYPE	Management	-
	ROBOT CALIB	Edit	Edit
	ANALOG MONITOR	Management	Management
	OVERRUN&S-SENSOR <sup>*1</sup>	Edit	Edit
	LIMIT RELEASE <sup>*1</sup>	Edit	Management
	ARM CONTROL <sup>*1</sup>	Management	Management
	SHIFT VALUE	Operation	-
SYSTEM INFO	MONITORING TIME	Operation	Management
	ALARM HISTORY	Operation	Management
	I/O MSG HISTORY	Operation	Management
	VERSION	Operation	-
FD/PC CARD	LOAD	Edit	-
	SAVE	Operation	-
	VERIFY	Operation	-
	DELETE	Operation	-
	DEVICE	Operation	Operation

<sup>\*1</sup> Displayed in the teach mode only.

Menu & Security Mode			
Main Menu	Sub Menu	Security Mode	
		DISPLAY	EDIT
PARAMETER	S1CxG	Management	Management
	S2C	Management	Management
	S3C	Management	Management
	S4C	Management	Management
	A1P	Management	Management
	A2P	Management	Management
	A3P	Management	Management
	A4P	Management	Management
	RS	Management	Management
	S1E	Management	Management
	S2E	Management	Management
	S3E	Management	Management
	S4E	Management	Management
SETUP	TEACHING COND	Edit	Edit
	OPERATE COND	Management	Management
	DATE/TIME	Management	Management
	GRP COMBINATION	Management	Management
	SET WORD	Edit	Edit
	RESERVE JOB NAME	Edit	Edit
	USER ID	Edit	Edit
	SET SPEED	Management	Management
	KEY ALLOCATION <sup>*1</sup>	Management	Management
	RES. START(CNCT)	Management	Management
ARC WELDING	ARC START CONDITION	Operation	Edit
	ARC END CONDITION	Operation	Edit
	ARC AUXILIARY CONDITION	Operation	Edit
	POWER SOURCE CONDITION	Operation	Edit
	ARC WELD DIAGNOSIS	Operation	Edit
	WEAVING	Operation	Edit
HANDLING	HANDLING DIAGNOSIS	Operation	Edit
SPOT WELDING	WELD DIAGNOSIS	Operation	Edit
	I/O ALLOCATION	Management	Management
	GUN CONDITION	Management	Management
	POWER SOURCE CONDITION	Management	Management

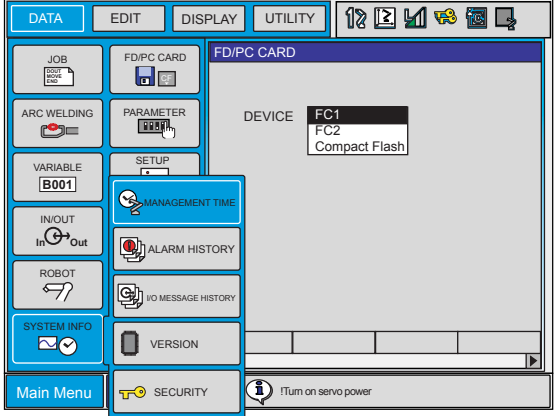
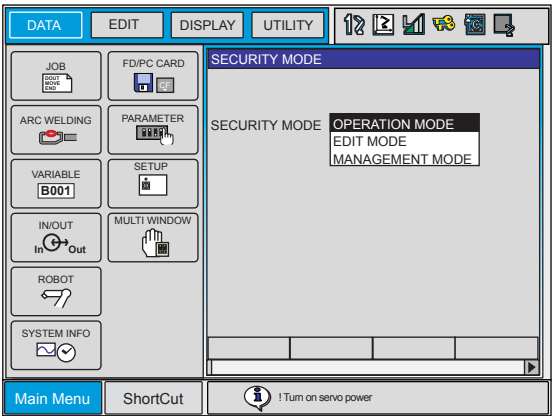
<sup>\*1</sup> Displayed in the teach mode only.

## 1.4 About the Security Mode

Menu &amp; Security Mode

Main Menu	Sub Menu	Security Mode	
		DISPLAY	EDIT
SPOT WELDING (MOTOR GUN)	WELD DIAGNOSIS	Operation	Edit
	GUN PRESSURE	Edit	Edit
	PRESSURE	Edit	Edit
	I/O ALLOCATION	Management	Management
	GUN CONDITION	Management	Management
	POWER SOURCE CONDITION	Management	Management
	CLEARANCE SETTING	Operation	Edit
GENERAL	GENERAL DIAGNOSIS	Operation	Edit
	WEAVING	Operation	Edit

## 1.4.2 Switching Security Modes

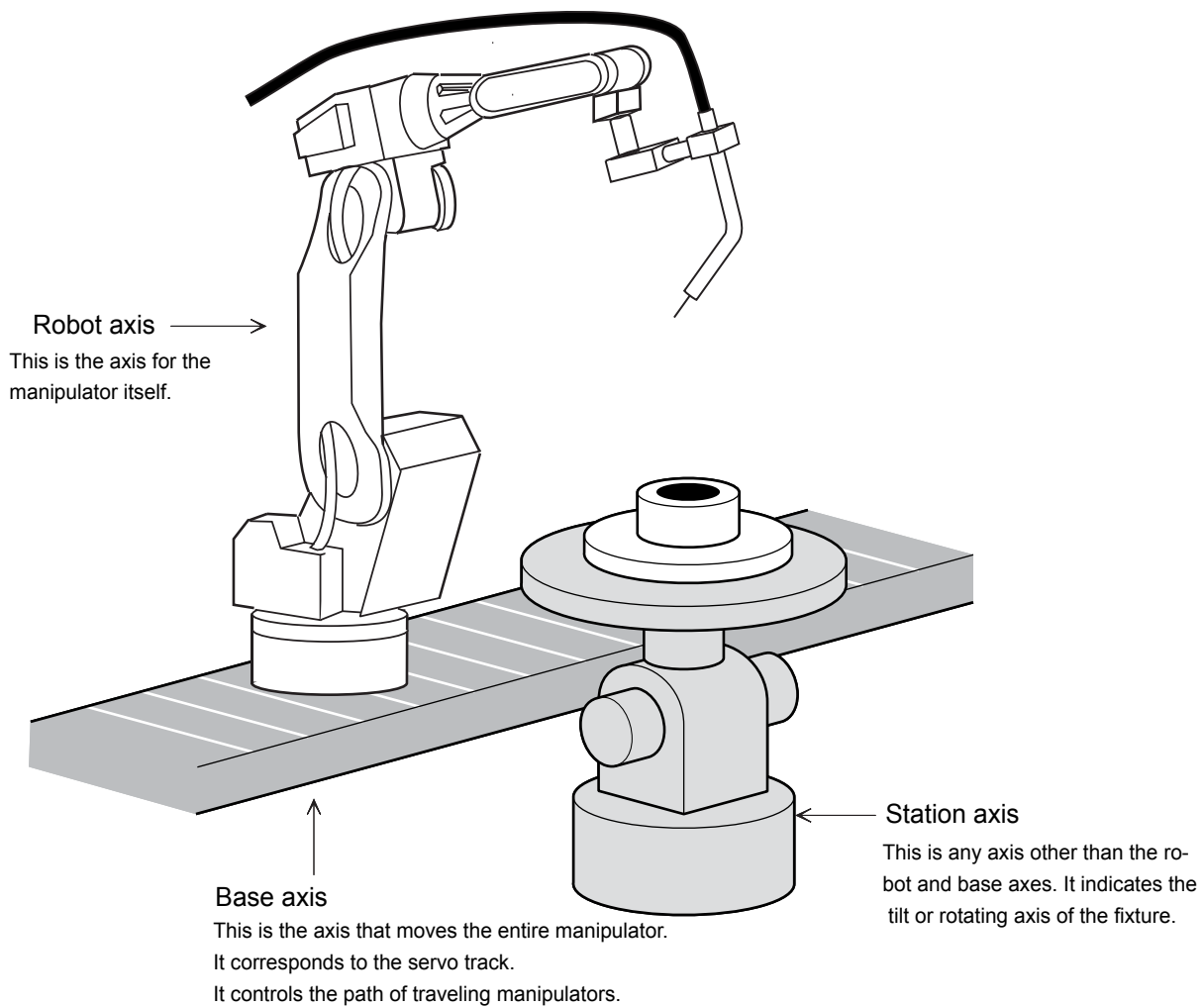
	Operation	Explanation
1	Select {SYSTEM INFO} under the main menu.	<p>The sub menu appears.</p> 
2	Select {SECURITY}.	<p>The selection dialog box appears. The security mode can be selected from operation mode, edit mode or management mode.</p> 
3	Select the desired security mode.	When the selected security mode is higher than the currently set mode, the user ID input status window appears.
4	Input user ID as required.	<p>At the factory, the user ID number is preset as follows:</p> <ul style="list-style-type: none"> <li>• Edit Mode: [00000000]</li> <li>• Management Mode: [99999999]</li> </ul>
5	Press [ENTER].	The selected security mode's input ID is checked. If the correct user ID is input, the security mode is changed.

## 2 Manipulator Coordinate Systems

### 2.1 Robot Axes and Coordinate Systems

#### Names for Robot System Axes

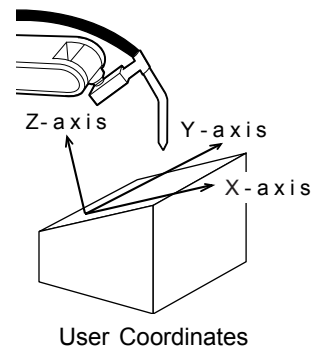
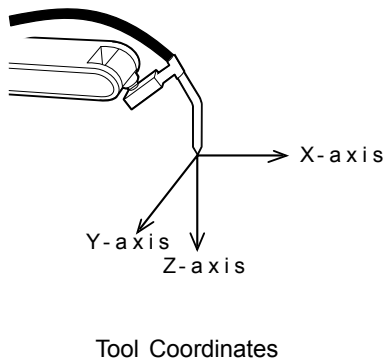
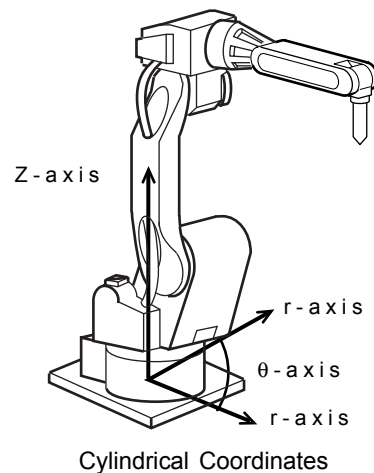
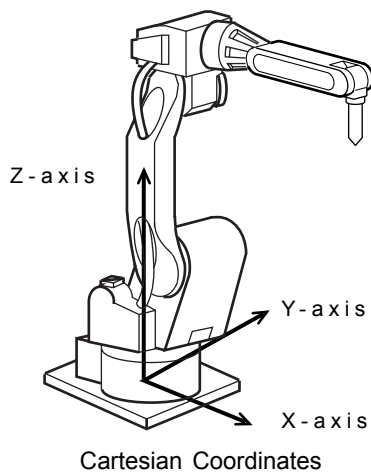
The external axes of the NX100 are divided into base and station axes. The relative individual axes of the robot system are divided by their function into robot, base, and station axes.



## 2.1.1 Types of Coordinate Systems

The following coordinate systems can be used to operate the manipulator:

- **Joint Coordinates**  
Each axis of the manipulator moves independently.
- **Cartesian Coordinates**  
The manipulator, regardless of its position, moves parallel to any of the X-, Y-, and Z-axes.
- **Cylindrical Coordinates**  
The  $\theta$  axis moves around the S-axis. The R-axis moves parallel to the L-axis arm. For vertical motion, the manipulator moves parallel to the Z-axis.
- **Tool Coordinates**  
The effective direction of the tool mounted in the wrist flange of the manipulator is defined as the Z-axis. This axis controls the coordinates of the end point of the tool.
- **User Coordinates**  
The manipulator moves parallel to the axes of the user coordinates.  
In coordinate systems other than the joint coordinates, it is possible to change only the wrist orientation at a fixed TCP position. This is called the motion about TCP.



## 2.2 General Operations

### 2.2.1 Selecting a Coordinate System

Select a coordinate system using the following procedure:

Press [COORD]. Each time this key is pressed, the coordinate system is switched in the following order:

Check the selection in the status area of the display.

**Joint→Cartesian(Cylindrical)→Tool→User**

### 2.2.2 Selecting Manual Speed

Manual speed can be set to fast, medium, slow, or inching. In addition, high speed is also possible using the [HIGH SPEED]. The manual speed set is also effective for [FWD] / [BWD] operations in addition to the axis operations.



When the manipulator is operated with the programming pendant, the highest speed of the TCP is limited to 250mm/s.

#### ■ Selecting with Manual Speed Keys

Press [FAST] or [SLOW]. Each time [FAST] or [SLOW] is pressed, manual speed is changed in the following order. Confirm the speed in the status display area.

- Each time [FAST] is pressed, the manual speed changes in the following order: INCH, SLOW, MED, and FST.



- Each time [SLOW] is pressed, the manual speed changes in the following order: FST, MED, SLOW, and INCH.



### ■ Using the High Speed Key

Pressing [HIGH SPEED] while the axis keys are being held down makes the manipulator operate at high speed.



[HIGH SPEED] has no effect if the manual speed is set to INCH.

## 2.2.3 Axis Operations

Pressing an axis key in the teach mode makes it possible to move the respective axis of the manipulator and station to a desired position. The motion of each axis depends on the specified coordinate system.

The axes move only while the axis key is being pressed.

### ■ Switching the Group Axis to be Operated

The coordination robot system (optional function) with two or more axes, switches the group axis by the following procedure:

#### When the Job Content is Displayed

When the job content is displayed, the group axes which are registered in the displayed job will be operated.

#### <Example>

#### Case that the group axes registered in the displayed job is R1 + S1

Press [EX. AXIS]. The station number is shown in the status display area and station axis operation becomes possible.

The station axis operation is shown below:

X + / X - : the first axis

Y + / Y - : the second axis

Z+ / Z - : the third axis

To return to the robot axes from the station axes, press [ROBOT].

#### When the Job Content is not Displayed

If the edit job does not exist, operate the manipulator or station by the following procedure:

1. Select the group axis as follows:

For manipulators:

Switch the manipulator by pressing [SHIFT] + [ROBOT].

The lamp on [ROBOT] is lit.

For stations:

Switch the station by pressing [SHIFT] + [EX. AXIS].

The lamp on [EX. AXIS] is lit.

2. Perform the axis operation.



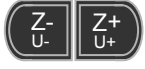



When [ROBOT] or [EX. AXIS] is pressed, the selection state of the group axis returns to the state that no group axis is selected.

## 2.3 Joint Coordinates

## 2.3 Joint Coordinates

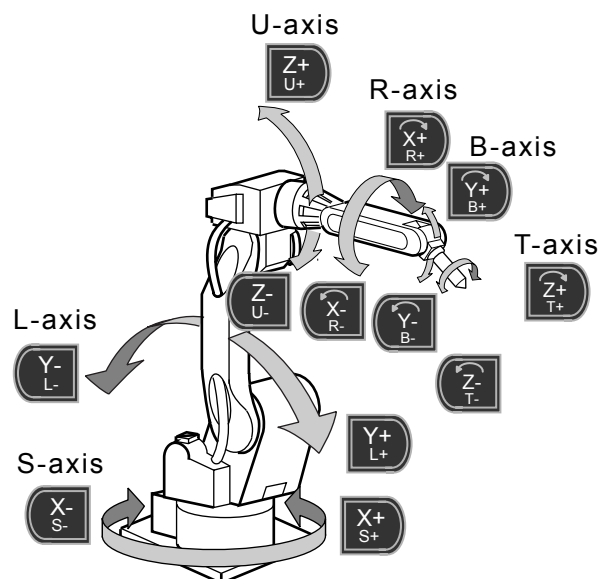
When operating in joint coordinates mode, the S, L, U, R, B, and T-axes of the manipulator move independently. The motion of each axis is described in the table below.

Axis Motion in Joint Coordinates

Axis Name		Axis Operation Key	Motion
Major Axes	S-axis		Main unit rotates right and left.
	L-axis		Lower arm moves forward and backward.
	U-axis		Upper arm moves up and down.
Wrist Axes	R-axis		Wrist rolls right and left.
	B-axis		Wrist moves up and down.
	T-axis		Wrist turns right and left.






- When two or more axis keys are pressed at the same time, the manipulator will perform a compound movement. However, if two different directional keys for the same axis are pressed at the same time (such as [S-] + [S+]), none of the axes operate.
- When using a manipulator of 7 axes or 8 axes, the C-axis (7th axis) is moved by pressing [SHIFT] + [S-] or [SHIFT] + [S+]; the W-axis (8th axis) by pressing [SHIFT] + [L-] or [SHIFT] + [L+].



# 2.4 Cartesian Coordinates

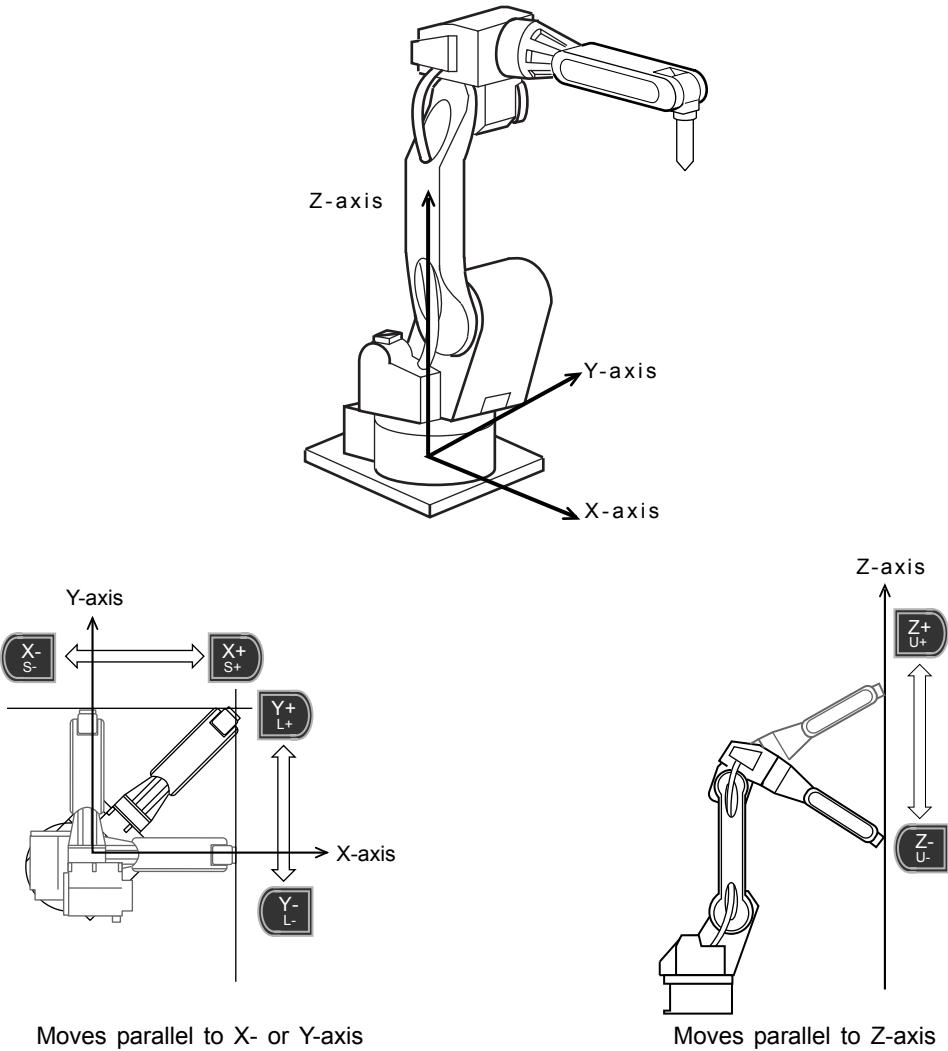
In the cartesian coordinates, the manipulator moves parallel to the X-, Y-, or Z-axes. The motion of each axis is described in the following table:

Axis Motion in Cartesian Coordinates

Axis Name		Axis Operation Key	Motion
Basic Axes	X-axis		Moves parallel to X-axis.
	Y-axis		Moves parallel to Y-axis.
	Z-axis		Moves parallel to Z-axis.
Wrist Axes		Motion about TCP is executed. See Section " 2.8 Tool Tip Operations. "	






When two or more axis keys are pressed at the same time, the manipulator will perform compound movement. However, if two different directional keys for the same axis are pressed at the same time (such as [X-] + [X+]), none of the axes operate.



## 2.5 Cylindrical Coordinates

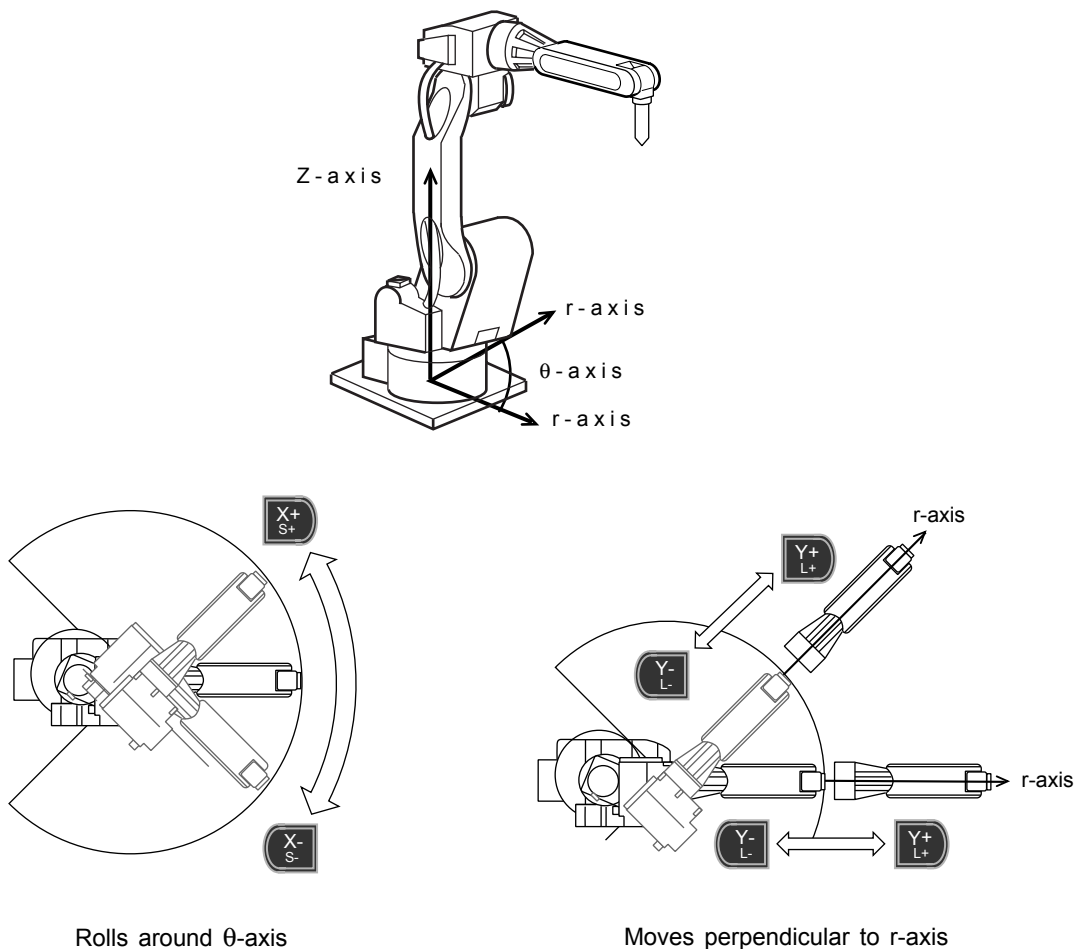
In the cylindrical coordinates, the manipulator moves as follows. The motion of each axis is described in the following table.

Axis Motion in Cylindrical Coordinates

Axis Name		Axis Operation Key	Motion
Basic Axes	θ-axis		Main unit rolls around S-axis.
	r-axis		Moves perpendicular to Z-axis.
	Z-axis		Moves parallel to Z-axis.
Wrist Axes		Motion about TCP is executed. See " 2.8 Tool Tip Operations. "	



When two or more axis keys are pressed at the same time, the manipulator will perform compound movement. However, if two different directional keys for the same axis are pressed at the same time (such as [Z-] + [Z+]), none of the axes operate.



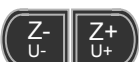



# 2.6 Tool Coordinates

## 2.6.1 Axis Motion

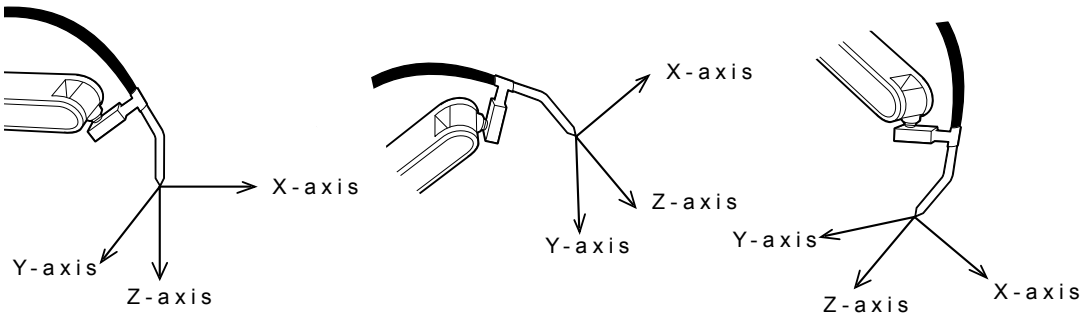
In the tool coordinates, the manipulator moves parallel to the X-, Y-, and Z-axes, which are defined at the tip of the tool. The motion of each axis is shown in the following table:

Axis Motion in Tool Coordinates

Axis Name		Axis Operation Key	Motion
Basic Axes	X- axis		Moves parallel to X-axis.
	Y- axis		Moves parallel to Y-axis.
	Z- axis		Moves parallel to Z-axis.
Wrist Axes		Motion about TCP is executed. See " 2.8 Tool Tip Operations. "	



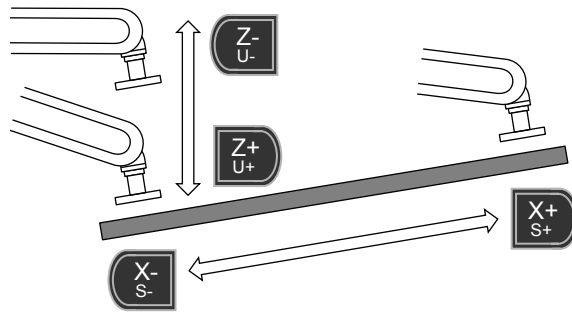
When two or more axis keys are pressed at the same time, the manipulator will perform compound movement. However, if two different directional keys for the same axis are pressed at the same time (such as [X-] + [X+]), none of the axes operate.



The tool coordinates are defined at the tip of the tool, assuming that the effective direction of the tool mounted on the manipulator wrist flange is the Z-axis. Therefore, the tool coordinates axis direction moves with the wrist.

In tool coordinates motion, the manipulator can be moved using the effective tool direction as a reference regardless of the manipulator position or orientation. These motions are best suited when the manipulator is required to move parallel while maintaining the tool orientation with the workpieces.


## 2.6 Tool Coordinates



For tool coordinates, the tool file should be registered in advance. For further details, refer to the “NX100 INSTRUCTIONS.”

### 2.6.2 Selecting the Tool Number

Tool numbers are used to specify a tool when more than one tool is used on the system. You may select from registered tool files when you switch tools on the manipulator.



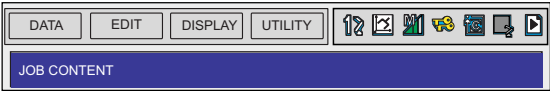
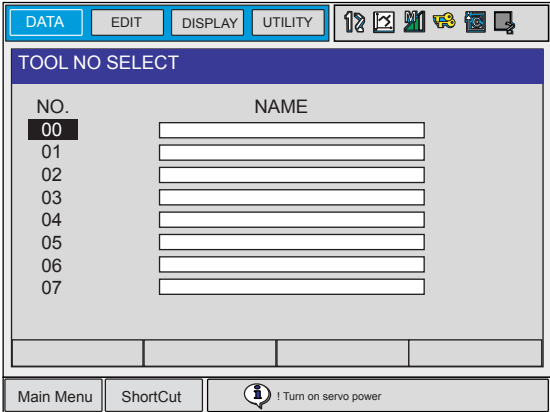
This operation can be performed only when numbers of the tool is more than one. To use several tool files with one manipulator, set the following parameter.

S2C333: Tool number switch specifying parameter

1: Can be switched

0: Cannot be switched

See “Concurrent I/O” for details.

	Operation	Explanation
1	Press [COORD] and set to “TOOL.”	<p>When [COORD] is pressed, the status area displays JOINT→XYZ → TOOL → USER.</p> 
2	Press [SHIFT] + [COORD].	<p>The TOOL NO SELECT window appears.</p> 
3	Select the desired tool number.	







## 2.7 User Coordinates

### 2.7.1 User Coordinates

In the user coordinates, the manipulator moves parallel to each axis of the coordinates which are set by the user. Up to 24 coordinate types can be registered. Each coordinate has a user number and is called a user coordinate file. The motion of each axis is described in the following table:

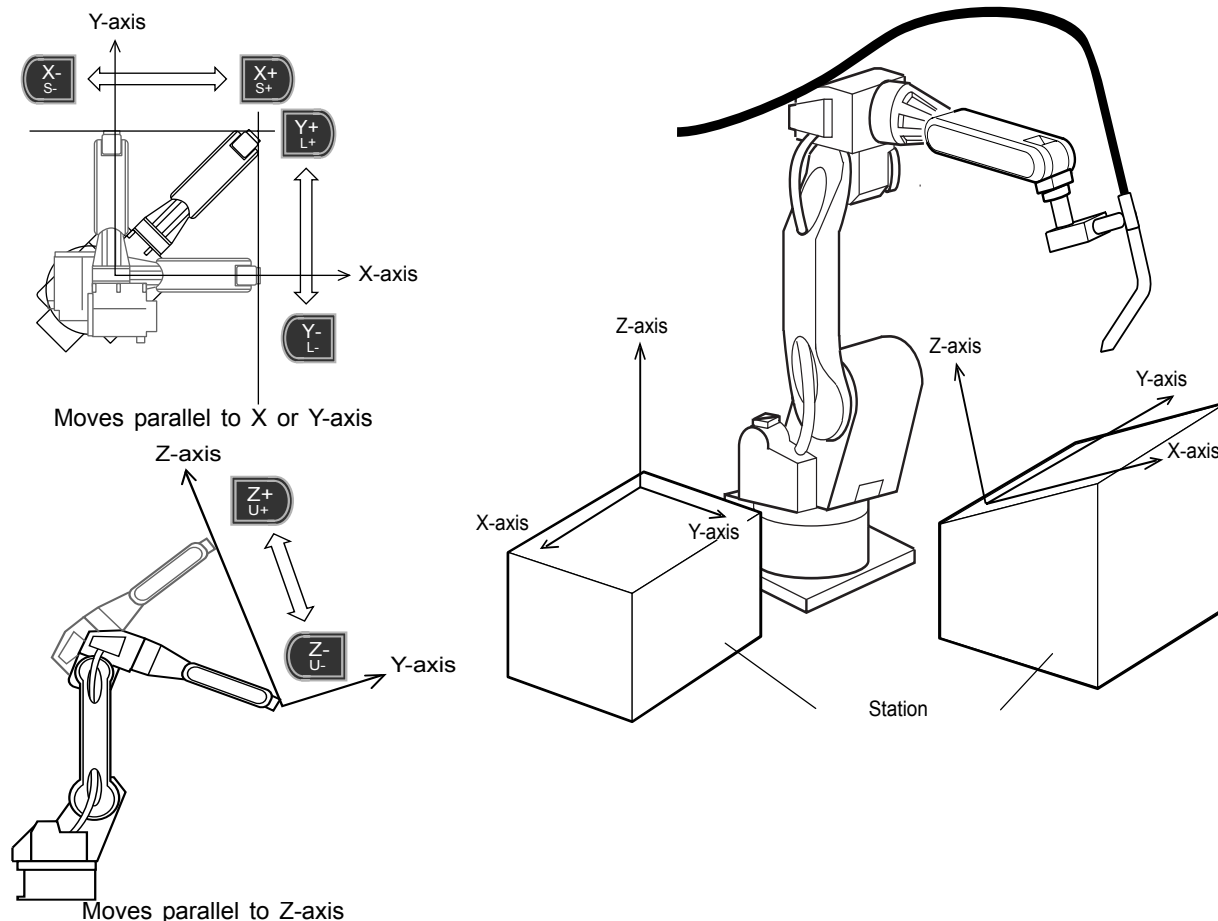
The figure and the table below describe the motion of each axis when the axis key is pressed.

Axis Motion in User Coordinates

Axis Name		Axis Key	Motion
Basic Axes	X- axis	 	Moves parallel to X-axis.
	Y- axis	 	Moves parallel to Y-axis.
	Z- axis	 	Moves parallel to Z-axis.
Wrist Axes		Motion about TCP is executed. See " 2.8 Tool Tip Operations. "	



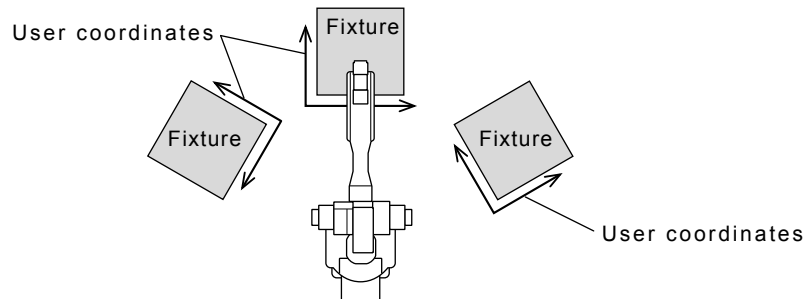
When two or more axis keys are pressed at the same time, the manipulator will perform compound movement. However, if two different directional keys for the same axis are pressed at the same time (such as [X-] + [X+]), none of the axes operate.



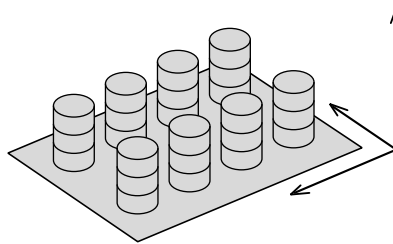
## 2.7.2 Examples of User Coordinate Utilization

The user coordinate settings allow easy teaching in various situations. For example:

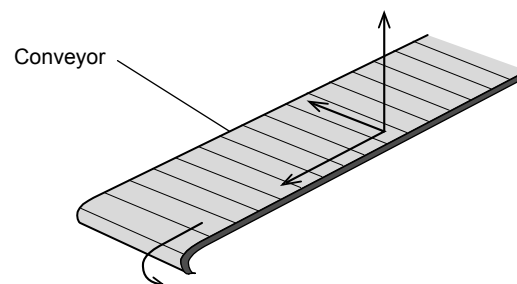
- When multiple positioners are used, manual operation can be simplified by setting the user coordinates for each fixture.



- When performing arranging or stacking operations, the incremental value for shift can be easily programmed by setting user coordinates on a pallet.



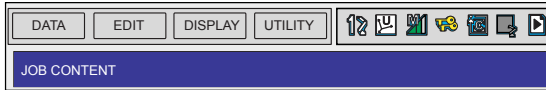
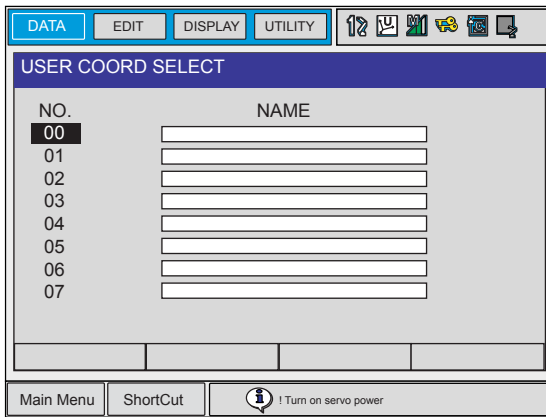

- When performing conveyor tracking operations, the moving direction of the conveyor is specified.



## 2.7 User Coordinates

## 2.7.3 Selecting a User Coordinate Number







Follow these procedures to select the desired coordinate system from among the registered user coordinates.


	Operation	Explanation
1	Press [COORD] and set to "USER."	<p>When [COORD] is pressed, the status area displays JOINT → XYZ → TOOL → USER.</p> 
2	Press [SHIFT] + [COORD].	<p>The USER COORD SELECT window appears.</p>  <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">  For more information on registration of the user coordinates, refer to "NX100 INSTRUCTIONS."         </div>
3	Select the desired user number.	

# 2.8 Tool Tip Operations

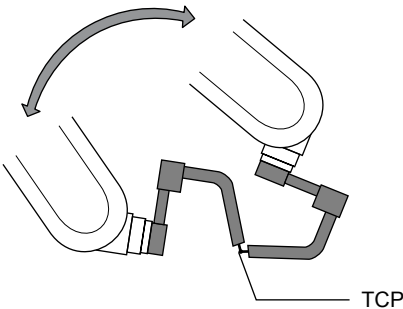
## 2.8.1 Motion about TCP

Motion about TCP can only change the wrist orientaion at a fixed TCP position in all coordi-  
nate systems except the joint coordinates. The motion of each axis is described in the follow-  
ing table.

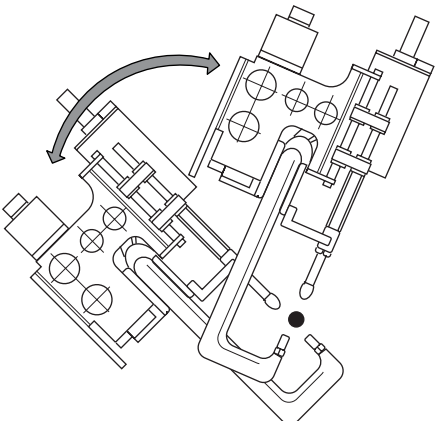
Axis Motion in Motion about TCP		
Axis Name	Axis Key	Motion
Basic Axes		TCP moves. These movements differ depending on cartesian, cylindrical, tool and user coordinates.
		
		
Wrist Axes		Wrist axes move with the TCP fixed. These movements differ depending on cartesian, cylindrical, tool and user coordinates.
		
		



When two or more axis keys are pressed at the same time, the manipulator will perform compound movement. However, if two different directional keys for the same axis are pressed at the same time (such as [X-] + [X+]), none of the axes operate.



Torch Welding

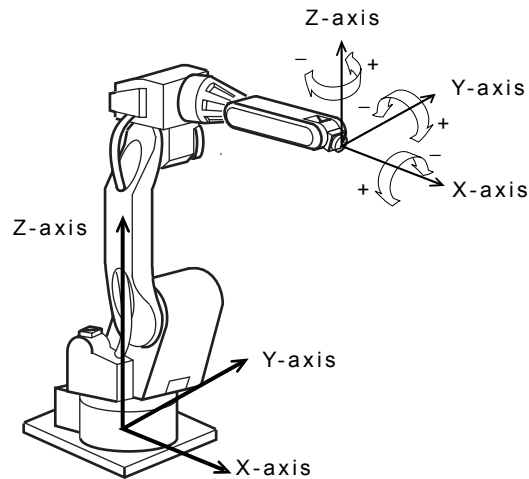


Gun Spot Welding

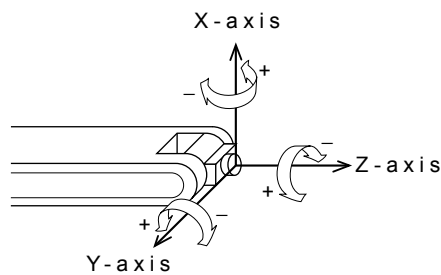
## 2.8 Tool Tip Operations

Turning of each wrist axis differs in each coordinate system.

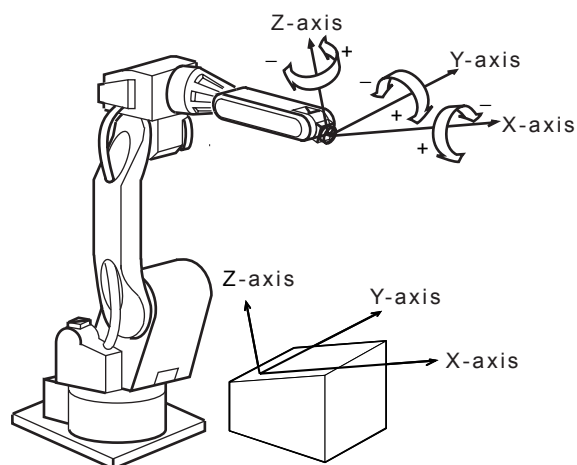
- In cartesian or cylindrical coordinates, wrist axis rotations are based on the X-, Y-, or Z-axis.



- In tool coordinates, wrist axis rotations are based on X-, Y-, or Z-axis of the tool coordinates.



- In user coordinates, wrist axis rotations are based on X-, Y-, or Z-axis of the user coordinates.

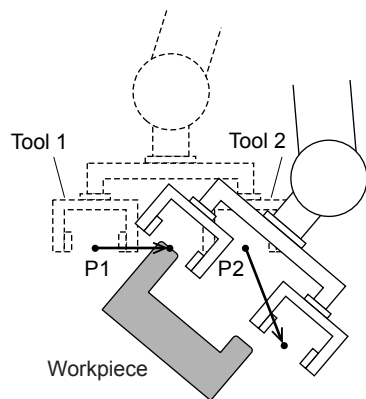


## 2.8.2 TCP Change Operations

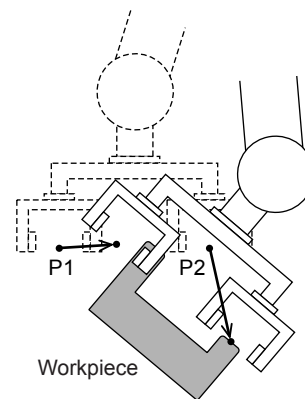
The tool tip position (TCP) is registered in a tool file. The TCP is the target point of axis operations and it is set as the distance from the flange face. The TCP change operation is an axis operation that involves selecting the desired tool file from a list of registered files (Refer to "2.6.2 Selecting the Tool Number"), and then manipulating the axes while changing the TCP. This can be performed with all coordinates except the joint coordinates. The axis operation is the same as that of the motion about TCP.

### <Example 1>TCP Change Operation with Multiple Tools

The TCPs for Tool 1 and Tool 2 are taken as P1 and P2, respectively. When Tool 1 is selected to perform axis operation, P1 (Tool 1's TCP) is the target point of the operation. Tool 2 follows Tool 1 and is not controlled by axis operation. On the other hand, Tool 2 is selected to perform axis operation, P2 (Tool 2's TCP) is the target point of axis operation. In this case, Tool 1 follows Tool 2.



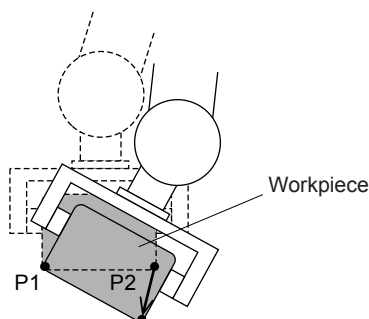
Selection of Tool 1 and axis operations with controlling P1



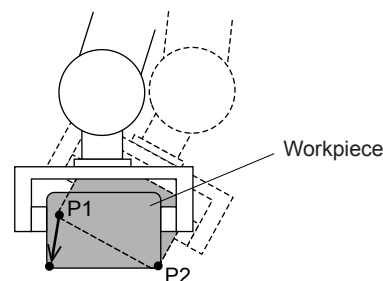
Selection of Tool 2 and axis operations with controlling P2

### <Example 2>TCP Change Operation with a Single Tool

The two corners of the workpiece that the tool is holding are taken as TCPs P1 and P2 respectively. By selecting two TCPs alternately, the workpieces can be moved as shown below:



Motion about TCP with P1 selected



Motion about TCP with P2 selected



For registration of the tool file, refer to "NX100 INSTRUCTIONS."

## 3 Simplified Teaching and Playback

### 3.1 Teaching

#### 3.1.1 Preparation for Teaching

Perform the following tasks before starting to teach.

- Set the operation mode to teach mode.
- Enter the job name.

1. Confirm that the mode switch on the programming pendant is set to “TEACH.” If not, set the switch to “TEACH.”

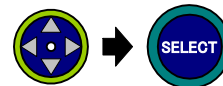
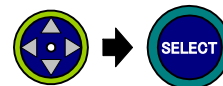
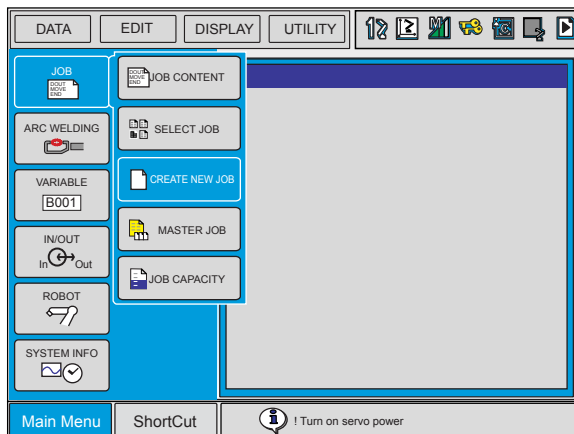


2. Press [SERVO ON READY].

The SERVO ON lamp will blink. If [SERVO ON READY] is not pressed, the servo power supply cannot be turned ON using the Enable switch.



3. Select {JOB} under the main menu, and select {CREATE NEW JOB} in the sub menu.



4. After the NEW JOB CREATE window appears, press [SELECT].



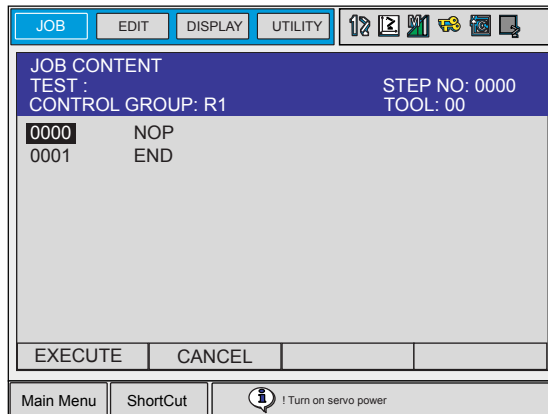
5. After the following window appears, input the job name. The word "TEST" is used in this example job name.

6. Move the cursor to "T" and press [SELECT]. Enter "E," "S," and "T" in the same manner. The characters can also be entered by directly touching each character on the screen.

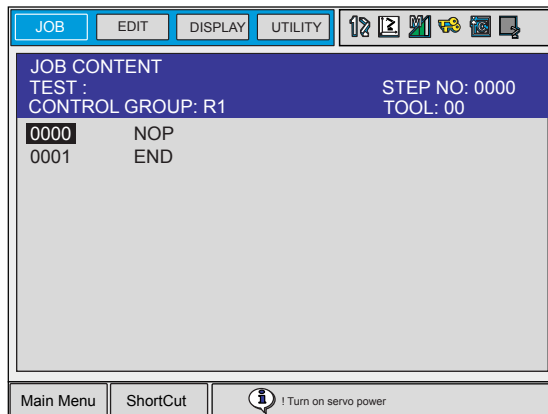


### 3.1 Teaching


7. Press [ENTER] to register.



8. Move the cursor to “EXECUTE” and press [SELECT]. The job “TEST” is registered and the job is displayed. The NOP and END instructions are automatically registered.



#### Characters which can be Used for Job Names

Job names can be created from numbers and the alphabetical letters. The input display can be switched between upper-case characters, lower-case characters, and symbols by pressing the page key  during the operation 5. Up to 8 characters can be used.

### 3.1.2 Teaching Procedure

To playback the manipulator, the instruction to move the manipulator must be written in a job. This instruction is called a move instruction. The destination position, the interpolation method, the play speed, etc. are registered in the move instruction.

Main move instructions begin with "MOV" in the INFORM III language used by the NX100.

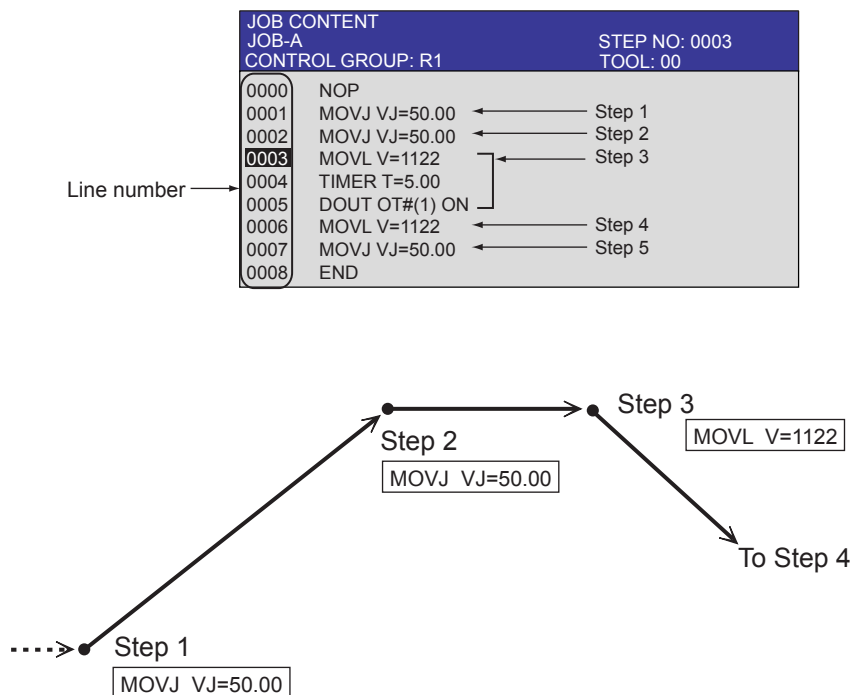
<Example>

MOVJ VJ=50.00

MOVL V=1122 PL=1

<Example>

Refer to the following JOB CONTENT window. When executing playback, the manipulator moves to the position of Step 1 with the interpolation type and play speed registered in Step 1's move instruction. Then, the manipulator moves between Steps 1 and 2 with the interpolation type and play speed registered in Step 2's move instruction. Then, the manipulator moves between Steps 2 and 3 with the interpolation type and play speed registered in Step 3's move instruction. After the manipulator reaches the position of Step 3, the manipulator then executes the TIMER instruction followed by the DOUT instruction, and then continues on to Step 4.



## 3.1 Teaching

### ■ Teaching a Job

A job is a work program that describes the tasks that the manipulator will execute. Jobs are created using a robot programming language called INFORM III.

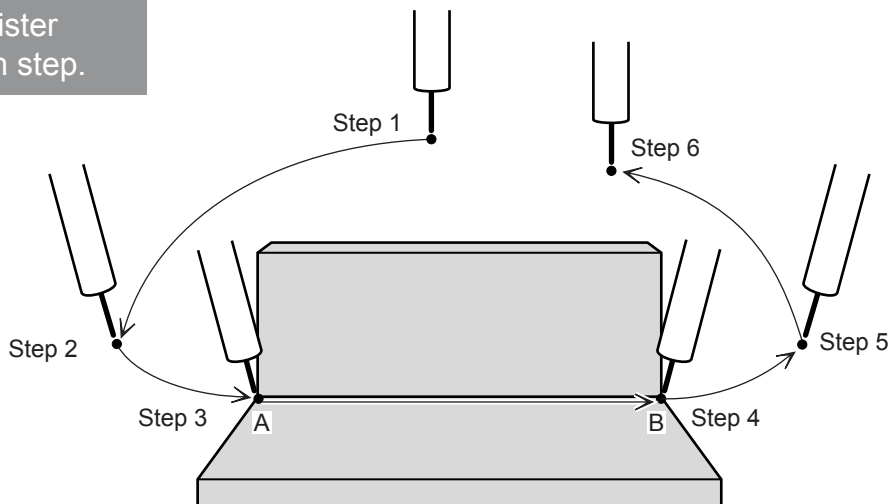
The following example will instruct you how to teach the manipulator all of the steps from Point A to Point B of the following workpiece. This job can be completed in 6 steps.

#### Safety Check

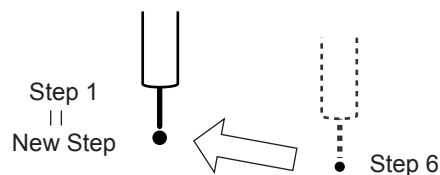
Ensure that there is a safe distance between you and the manipulator.

#### TEACHING

Register each step.



Overlap the first step and last step.



#### Step Confirmation

INTER  
LOCK



TEST  
START

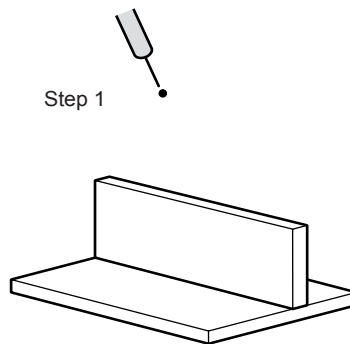
BWD

FWD

Actual work is not performed here.

## ■ Step 1 -- Start Position

Always be sure the manipulator is in a safe work area before operation.



1. Grip the Enable switch and the servo power will turn ON. The manipulator can then be operated.



2. Move the manipulator to the desired position using the axis operation keys. Be sure the position is safe and that the work area is appropriate for the job to be programmed.



3. Select joint interpolation by pressing [MOTION TYPE]. Joint instruction "MOVJ..." will be displayed in the input buffer line.



⇒ MOVJ VJ=0.78


4. Move the cursor to the line number 0000 and press [SELECT].

0000	NOP
0001	END



5. The input buffer line appears. Move the cursor to the right to VJ=\*.\*\*, which shows the speed. While pressing [SHIFT]



simultaneously, move the cursor  up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed to 50%.



⇒ MOVJ VJ=50.00

6. Press [ENTER]. Step1 (Line 0001) is registered.

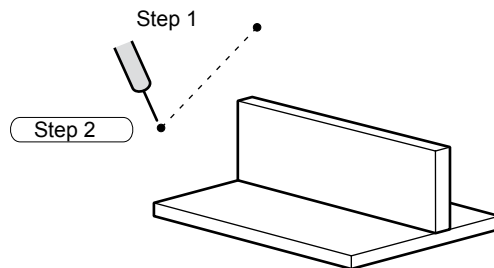
0000	NOP
0001	MOVJ VJ=50.00
0002	END



### 3.1 Teaching

#### ■ Step 2 -- Near the Work Start Position

Define the manipulator work pose.



1. Move the manipulator to the working position using the axis operation keys.



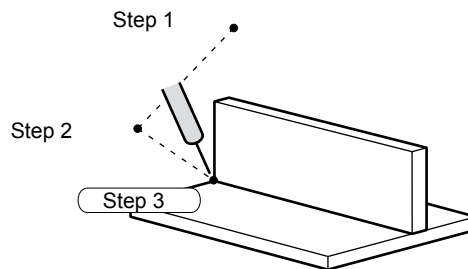
2. Press [ENTER]. Step 2 (Line 0002) is registered.


0000	NOP
0001	MOVJ VJ=50.00
<b>0002</b>	MOVJ VJ=50.00
0003	END



## ■ Step 3 -- Work Start Position

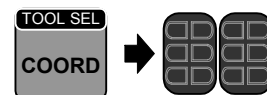
Move the manipulator to the work start position with the pose as shown in Step 2.



1. Change to medium speed by pressing [FAST] or [SLOW] until  is displayed in the status area.




2. Do not release the pose in Step 2. Press [COORD] to select the cartesian coordinates. Move the manipulator to the welding start position using the axis operation keys.



3. With the cursor located on the line number 0002, press [SELECT].



4. The input buffer line appears. Move the cursor to the right to VJ=\*.\*\*, which shows the speed. While pressing [SHIFT] simultaneously, move the cursor  up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed to 12.50%.



⇒ MOVJ VJ=12.50

5. Press [ENTER]. Step 3 (Line 0003) is registered.

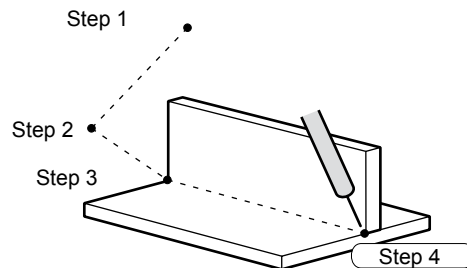


```
0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  END
```

## 3.1 Teaching

## ■ Step 4 -- Work End Position

Specify the work end position.



1. Move the manipulator to the work end position with the axis operation keys. While the manipulator is moving, keep a wide enough distance to ensure it will not strike the workpiece. There is no need to follow the work line too closely.



2. Press [MOTION TYPE] to select linear interpolation (MOVL).


⇒ MOVL V=66



3. With the cursor located on the line number 0003, press [SELECT].

⇒ MOVL V=66



4. The input buffer line appears. Move the cursor to the right to V=\*.\*\*, which shows the speed. While pressing [SHIFT] simultaneously, move the cursor  up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed to 138 cm/min.

⇒ MOVL V=138



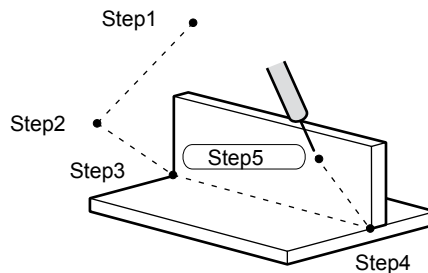
5. Press [ENTER]. Step 4 (Line 0004) is registered.

```
0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVL V=138
0005  END
```



## ■ Step 5 -- Position Away from Workpiece and Fixture

Move the manipulator to a position where it will not strike the workpiece or fixture.



1. Change the speed to high speed by pressing [FAST].



This button only affects teaching speed. When the job is played, the job will execute at the speed defined in Step 4.

2. Move the manipulator with the axis operation keys to a position where it will not strike the fixture.



3. Press [MOTION TYPE] to set to the joint interpolation type (MOVJ).

⇒ MOVJ V=12.50




4. With the cursor located on line number 0004, press [SELECT].

⇒ MOVJ VJ=12.50



5. The input buffer line appears. Move the cursor to the right to VJ=12.50, which shows the speed. While pressing [SHIFT]

simultaneously, move the cursor  up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed to 50%.

⇒ MOVJ VJ=50.00



6. Press [ENTER]. Step5 (Line 0005) is registered.

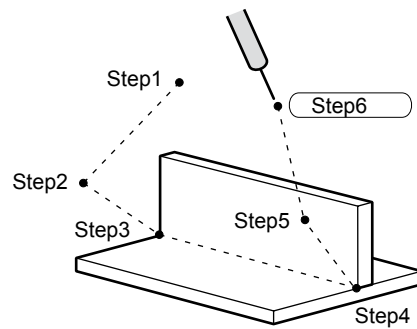
```
0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVL V=138
0005  MOVJ VJ=50.00
0006  END
```



## 3.1 Teaching

## ■ Step 6 -- Near the Start Position

Move the manipulator near the start position.



1. Move the manipulator near the start position with the axis operation keys.



2. Press [ENTER]. Step6 (Line 0006) is registered.



```

0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVL V=138
0005  MOVJ VJ=50.00
0006  MOVJ VJ=50.00
0007  END

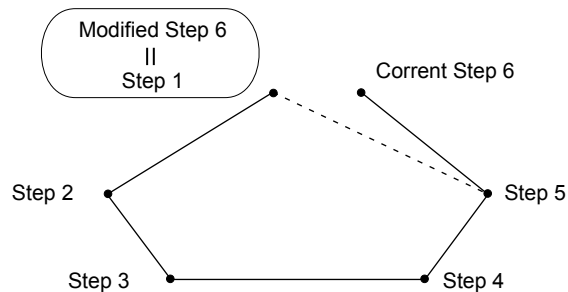
```

## ■ Ensuring the First and Last Step are Identical

The manipulator has stopped at Step 6, which should be very close to Step1.

It is possible to move directly from the welding end position of Step 5 to Step1, so the manipulator can begin the next welding job quickly and efficiently.

The following operation will make Step 6 (end position) and Step1 (start position) identical.



1. Move the cursor to Step1 (Line 0001).

```
0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVL V=138
0005  MOVJ VJ=50.00
0006  MOVJ VJ=50.00
0007  END
```



2. Press [FWD]. The manipulator will move to Step1.

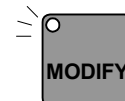


3. Move the cursor to Step 6 (Line 0006).

```
0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVL V=138
0005  MOVJ VJ=50.00
0006  MOVJ VJ=50.00
0007  END
```



4. Press [MODIFY].



5. Press [ENTER]. This will change the position of Step 6 to be the same as Step1.



## 3.1 Teaching

### 3.1.3 Path Confirmation

The job is now complete. Try to check each step separately to ensure there are no problems.

1. Move the cursor to Step 1 (Line 0001).

0000	NOP
0001	MOVJ VJ=50.00
0002	MOVJ VJ=50.00
0003	MOVJ VJ=12.50
0004	MOVL V=138
0005	MOVJ VJ=50.00
0006	MOVJ VJ=50.00
0007	END



2. Change to medium speed by pressing [FAST] or [SLOW].



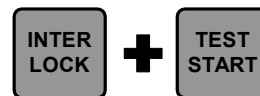
3. Press [FWD] to confirm each step executed by the manipulator. Each time [FWD] is pressed, the manipulator moves one step.



4. When you finish step confirmation, move the cursor to the beginning of the job.



5. Run all the steps continuously. Hold down [INTERLOCK] and press [TEST START]. The manipulator plays back all the steps continuously and stops when one cycle is finished.



Proceed to the next section to change the position and speed of the job steps.

### 3.1.4 Correcting a Job



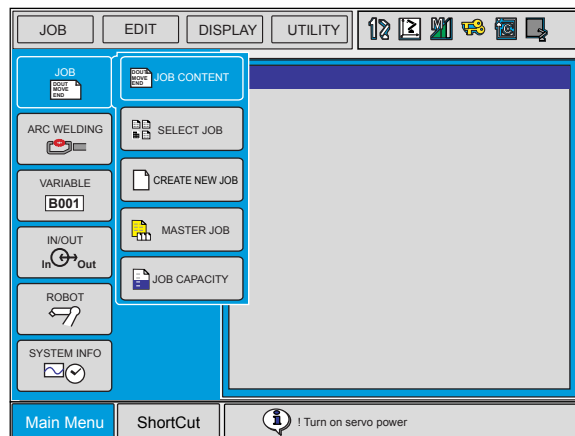
## CAUTION

- **After the job is corrected, be sure to confirm the path.**

#### ■ Before Correcting a Job

Confirm the manipulator's motion in each step. If any position modification or adding or deleting of steps is necessary, display the job content first with the following procedure.

1. Select {JOB} under the main menu and {JOB} under the sub menu.



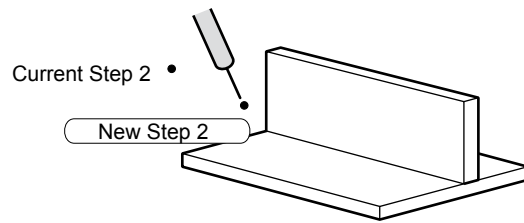
MAIN  
MENU



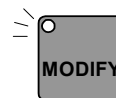
### 3.1 Teaching

#### ■ Changing the Position Data

Change the position registered in Step 2.

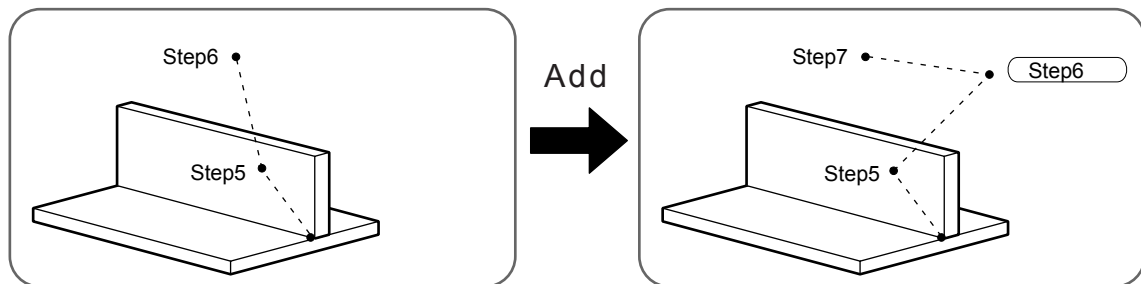


- 1.** Move the manipulator to Step 2 (Line 0002) by pressing [FWD].
- 2.** Move the manipulator to the modified position with the axis operation keys.
- 3.** Press [MODIFY].
- 4.** Press [ENTER]. The step's position data is changed.



## ■ Adding a Step

Add a new step between Step 5 and Step 6.



1. Move the manipulator to Step 5 (Line 0005) by pressing [FWD].

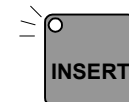
```
0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVL V=138
0005  MOVJ VJ=50.00
0006  MOVJ VJ=50.00
0007  END
```



2. Move the manipulator to the position at which you wish to add a step using the axis operation keys.



3. Press [INSERT].



4. Press [ENTER]. The step is added. When a step is added, the numbering is automatically adjusted to count the new step.

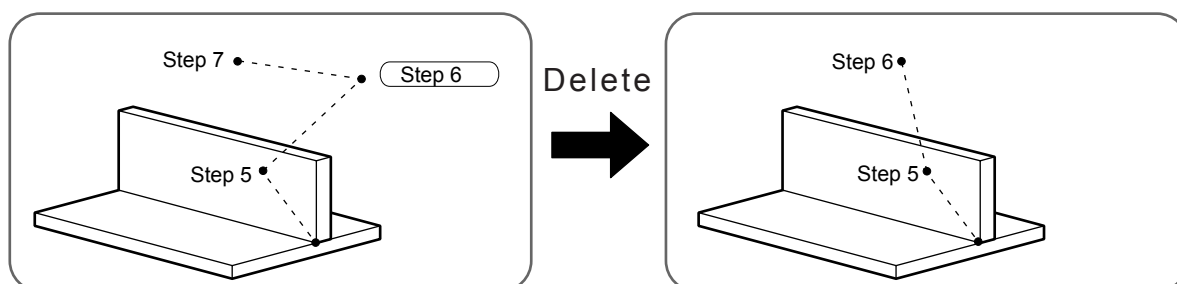


```
0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVL V=138
0005  MOVJ VJ=50.00
0006  MOVJ VJ=50.00
0007  MOVJ VJ=50.00
0008  END
```

## 3.1 Teaching

## ■ Deleting a Step

Delete the step you just added.



1. Move the manipulator to Step 6 (Line 0006) by pressing [FWD].

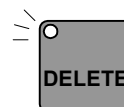


```

0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVL V=138
0005  MOVJ VJ=50.00
0006  MOVJ VJ=50.00
0007  MOVJ VJ=50.00
0008  END

```

2. Make sure the cursor is on the step you wish to delete, and press [DELETE].



3. Press [ENTER]. The step is deleted.

```

0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVL V=138
0005  MOVJ VJ=50.00
0006  MOVJ VJ=50.00
0007  END

```



### When "Error 2070: Set Robot Exactly to Taught Position" Occurs

When the operator presses [ENTER] during the previous operation, an error can occur in some cases. The error occurs because the manipulator has not been moved exactly to the taught position. Cancel the error with either of the following two procedures:

- Press [CANCEL] and press [FWD] to move the manipulator to the position of the step.
- Press [MODIFY] and press [ENTER] to change the position data of the step, then press [DELETE] and press [ENTER].

If the cursor in the window is blinking, the manipulator is not in the taught position.

## ■ Changing the Speed between Steps

Change the manipulator speed. Slow the speed between Step 3 and Step 4.

1. Move the cursor to Step 4.

```
0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVJ V=138
0005  MOVJ VJ=50.00
0006  MOVJ VJ=50.00
0007  END
```




2. Move the cursor to the instruction and press [SELECT].

```
0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVJ V=138
0005  MOVJ VJ=50.00
0006  MOVJ VJ=50.00
0007  END
```



3. The input buffer line appears. Move the cursor to the right to "V=138," which shows the speed. While pressing [SHIFT]

simultaneously, move the cursor  up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed to 66cm/min.



```
0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVJ V=66
0005  MOVJ VJ=50.00
0006  MOVJ VJ=50.00
0007  END
```

4. Press [ENTER]. The speed is changed.

```
0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVJ V=66
0005  MOVJ VJ=50.00
0006  MOVJ VJ=50.00
0007  END
```



## 3.2 Playback

### 3.2.1 Preparation Before Playback



To run the program from the beginning of the job, perform the following operation.

- Move the cursor to the beginning of the job.
- Move the manipulator close to Step 1 with the axis operation keys.

When playback is started, the manipulator begins to move from the Step 1.

### 3.2.2 Playback Procedure

Begin operation only after ensuring there is no one in the working envelope of the manipulator.

1. Switch the mode switch on the programming pendant to "PLAY."



2. Press [SERVO ON READY] to turn ON the servo power.



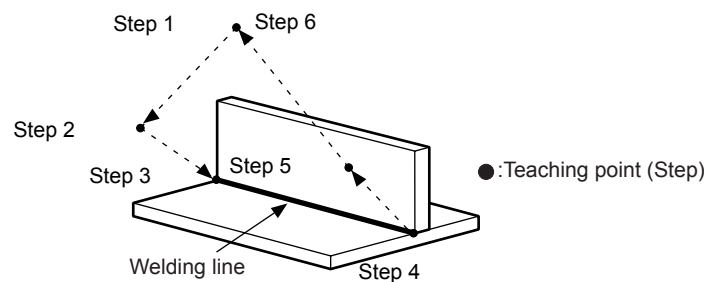
3. Press [START]. The manipulator will perform one complete taught cycle and then stop.



## 3.3 Example for Arc Welding Application

### 3.3.1 Example Job

The figure below shows an example of welding a workpiece with an explanation of each step.



Line	Instruction	Explanation
0000	NOP	
0001	MOVJ VJ=25.00	Moves manipulator to standby position. (Step 1)
0002	MOVJ VJ=25.00	Moves manipulator near welding start point. (Step 2)
0003	MOVJ VJ=12.50	Moves manipulator to welding start point. (Step 3)
0004	ARCON	Specifies manipulator arc start.
0005	MOVL V=50	Moves manipulator to welding end point. (Step 4)
0006	ARCOF	Specifies manipulator arc end.
0007	MOVJ VJ=25.00	Moves manipulator to position a safe distance away from equipment. (Step 5)
0008	MOVJ VJ=25.00	Moves manipulator to standby position. (Step 6)
0009	END	

### 3.3 Example for Arc Welding Application

## 3.3.2 Teaching Procedure

The teaching procedures are explained in Step 2 (welding pose definition), Step 3 (welding start), and Step 4 (welding end).

### NOTE

- Step 1 and 6, which are both the waiting position, are adjusted to a safe position where the manipulator does not collide with the workpiece and the fixture, etc.
- Ensure that the length of the wire is the same during teaching and playback. The appropriate wire length can be determined by using the inching procedure.
- When the manipulator comes in contact with the workpiece during the teaching procedure, extend the wire 50-100mm and cut at an appropriate length.
- After teaching is completed, confirm the welding path with [FWD] and [BWD].

### ■ Step 2 -- Near Welding Start Point

Define the pose of the welding torch.

1. Using the axis operation keys, specify the correct posture for the manipulator to begin welding.



2. Press [ENTER]. Step 2 is registered.




0000	NOP
0001	MOVJ VJ=25.00
<b>0002</b>	MOVJ VJ=25.00
0003	END

## ■ Step 3 -- Welding Start Point

Move the welding torch to the welding start point with the pose as shown in Step 2, and register the ARCON instruction.

1. Change to medium speed by pressing [FAST] or [SLOW] until

 is displayed in the status area.



2. Move the manipulator to the welding start point with the axis operation keys. At this time, do not release the pose input in Step 2.




3. With the cursor located on the line number, press [SELECT].

⇒ MOVJ VJ=50.00



4. The input buffer line appears. Move the cursor to the right to VJ=\*.\*\*, which shows the speed. While pressing [SHIFT]

simultaneously, move the cursor  up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed to 12.50%.



⇒ MOVJ VJ= 12.50

5. Press [ENTER]. Step 3 is registered.

```
0000  NOP
0001  MOVJ VJ=25.00
0002  MOVJ VJ=25.00
0003  MOVJ VJ=12.50
0004  END
```



6. Press [ARCON]. ARCON is displayed in the input buffer line.

⇒ ARCON



7. Press [ENTER]. The ARCON instruction is registered.



### 3.3 Example for Arc Welding Application

#### ■ Step 4 -- Welding End Point

Specify the welding end point.

1. Move the manipulator to the welding end point with the axis operation keys. While the manipulator is moving, keep a wide enough distance to ensure it will not strike the workpiece. There is no need to follow the work line too closely.



2. Set the interpolation type to linear interpolation (MOVL) by pressing [MOTION TYPE].



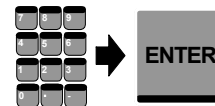
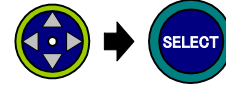
⇒ MOVL V=66

3. With the cursor located on the line number, press [SELECT].

⇒ MOVL V=66



4. The input buffer line appears. Move the cursor to the right to V=66, which shows the speed. Press [SELECT] to enable the input of numbers. Then, input the desired value of 50cm/min with the Numeric keys and press [ENTER].



5. Press [ENTER]. Step 4 is registered.



```
0000  NOP
0001  MOVJ VJ=25.00
0002  MOVJ VJ=25.00
0003  MOVJ VJ=12.50
0004  ARCON ASF#(1)
0005  MOVL V=50
0006  END
```

6. Press [GAS ARCOFF]. ARCOF is displayed in the input buffer line.

⇒ ARCOF



7. Press [ENTER]. The ARCOF instruction is registered.



### 3.3.3 Setting Welding Conditions

There are two ways to register the welding condition, one way is using the arc start condition file and the other way is using the additional items of the ARCON instruction.

The latter way is described here.

See "NX100 OPERATOR'S MANUAL FOR ARC WELDING" for the arc start condition file.

1. Move the cursor to the ARCON instruction and press [SELECT]. The line can then be edited. Press [SELECT]. The DETAIL EDIT window appears.

⇒ ARCON



2. Press [SELECT] if the "MENU" setting is "UNUSED" or "ASF# ( )" in the DETAIL EDIT window. Select "AC=" in the selection dialog box. The DETAIL EDIT window is shown as follows.

DETAIL EDIT ARCON		
WELDING CURR	AC= 200	✓
WELDING VOLT	AVP= 100	✓
TIMER	T= 3.00	✓
SPPED	UNUSED	
RETRY	UNUSED	



3. To change the current data "AC=" and voltage data "AVP=" or "AV=," move the cursor to the welding current value or the welding voltage value and press [SELECT]. Inputting numbers is now enabled. Type the desired value with the Numeric keys and press [ENTER]. The welding condition specified in the DETAIL EDIT window is displayed in the input buffer line. Press [ENTER]. The welding condition is registered in the job.



If the setting for the welding power supply is "A/%, " the input unit for voltage is %. If the setting for the welding power supply is "A/V," the input unit for voltage is V. These settings must be made in the Power Source condition file. Refer to "NX100 OPERATOR'S MANUAL FOR ARC WELDING."

#### ■ Shielding Gas Flow Rate

The shielding gas flow must be adjusted depending on nozzle shape, welded joint shape, length of the wire stickout, and the welding speed.

CO<sub>2</sub>/MAG Gas Flow Rate for a Nozzle with a 20mm diameter

Wire Stickout (mm)	CO <sub>2</sub> Gas Flow Rate (ℓ/min.)	MAG Gas Flow Rate (ℓ/min.)
8 to 15	10 to 20	15 to 25
12 to 20	15 to 25	20 to 30
15 to 25	20 to 30	25 to 30

The table above is for a nozzle diameter of 20mm. If the nozzle diameter is smaller, lower the gas flow rate.

### 3.3 Example for Arc Welding Application

## 3.3.4 Welding Test

### Check Run

Perform the check run in order to confirm that the teaching procedure was done correctly. The check run can be performed without performing actual work. This is possible because the work output instruction such as an ARCON instruction is not executed.

1. Switch the mode switch on the programming pendant to "PLAY."



2. Select {UTILITY} and {SETUP SPECIAL RUN}. The SPECIAL PLAY window appears.

SPECIAL PLAY	
LOW SPEED START	INVALID
SPEED LIMIT	INVALID
DRY-RUN SPEED	INVALID
MACHINE LOCK	INVALID
CHECK-RUN	INVALID
WEAV PROHIBIT IN CHK-RUN	INVALID
COMPLETE	

3. Move the cursor to the "CHECK-RUN" setting and press [SELECT]. The condition becomes "VALID" and the check run is turned ON.



SPECIAL PLAY	
LOW SPEED START	INVALID
SPEED LIMIT	INVALID
DRY-RUN SPEED	INVALID
MACHINE LOCK	INVALID
CHECK-RUN	VALID
WEAV PROHIBIT IN CHK-RUN	INVALID
COMPLETE	

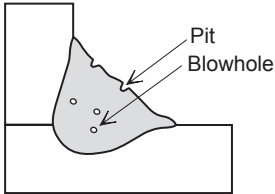
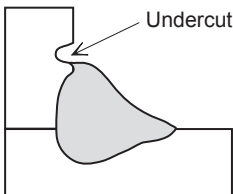
4. Confirm that no persons are present in the P-point maximum envelope of the manipulator and then press [START].  
Confirm that the manipulator correctly operates.

### ■ Welding Execution

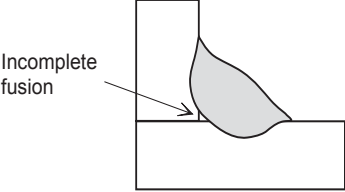
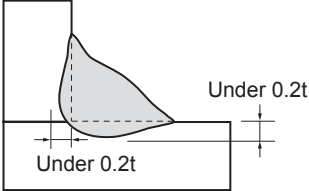
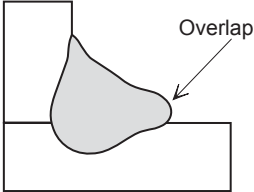
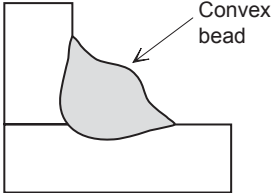
Once the path has been determined, the welding is finally executed. If the job is played back with the check run disabled, the ARCON and the ARCOF instructions are executed.

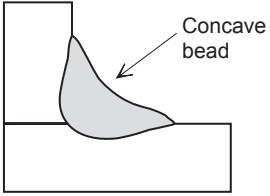
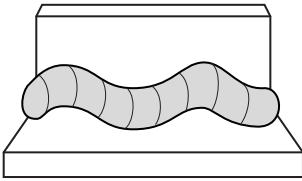
## ■ Adjustments for Welding Defects

To adjust welding conditions after welding, check the appearance of the welding bead.

Welding Defect	Cause	Correction Method
<b>Pore:</b> Generic name of defect caused by the influence of H <sub>2</sub> , N <sub>2</sub> , CO <sub>2</sub> , and Ar. Pits and blowholes, etc. may exist. 	Shortage of shielding gas flow rate	<ul style="list-style-type: none"> <li>• With no influence from the wind, and when the torch angle and wire stick-out are correct, 15 to 30 ℓ/min is assumed to be the suitable shielding gas rate.</li> <li>• Change the gas flow rate according to the workpiece construction condition.</li> </ul>
	Spatter adheres to nozzle	<ul style="list-style-type: none"> <li>• Remove the spatter frequently and thoroughly.</li> <li>• Choose the best welding condition to prevent frequent spattering.</li> <li>• Adjusting the torch angle and nozzle height will also reduce the amount of spatter.</li> </ul>
	Influence of wind	<ul style="list-style-type: none"> <li>• Close the shutter, door, and window.</li> <li>• Avoid using a fan during welding.</li> <li>• Use a screen.</li> </ul>
	Adhesion of rust and oil to surface	Remove rust and oil with thinner, brush, and grinder, etc.
	Paint adhesion	Remove paint using thinner.
	Welding current, voltage, and welding speed are incorrect.	<ul style="list-style-type: none"> <li>• Reset the voltage within the voltage range.</li> <li>• Adjust the voltage in accordance with the arc length.</li> </ul>
	Torch angle and wire stick-out are incorrect.	<ul style="list-style-type: none"> <li>• Make the torch angle smaller.</li> <li>• Set the wire stickout in accordance with the welding condition.</li> </ul>
<b>Undercut:</b> Defect name for when the groove is made and not completely filled along the toe of the weld. 	Excessive welding current	Lower the welding current.
	Incorrect welding voltage	Adjust the voltage.
	Excessive welding speed	Lower the welding speed.
	Unsuitable torch angle and aim position	Adjust the torch angle and aim position.

## 3.3 Example for Arc Welding Application

Welding Defect	Cause	Correction Method
<p><b>Incomplete fusion:</b> State in which the welding surfaces do not melt together well enough.</p> 	Unsuitable welding condition	Adjust the welding current, welding speed, wire aim position, torch angle, etc.
	Dirt on welding surface	Remove rust and oil.
<p><b>Incomplete penetration:</b> State where there is insufficient distance between the surface of the metal and the bottom of the welded area.</p> 	Unsuitable welding condition (It often occurs when the welding current is too low or the voltage is too low for the current.)	Adjust the welding current, welding speed, wire aim position, torch angle, etc.
<p><b>Overlap:</b> State where the toe of weld is not fused with the base metal. (It often occurs in T joint welding.)</p> 	<ul style="list-style-type: none"> <li>• Excessive welding current</li> <li>• Unsuitable aim position</li> <li>• Inappropriate torch angle</li> </ul>	<ul style="list-style-type: none"> <li>• For T joint welding, set the welding current low or set the voltage to the proper value or slightly higher value.</li> <li>• For T joint welding, move the wire aim position forward by several millimeters.</li> <li>Adopt angle of advance for the torch angle.</li> <li>• Move the wire aim position forward by 1 to 1.5mm during thin plate welding.</li> </ul>
<p><b>Convex bead:</b> Part of the fillet weld has a swelled bead surface. It can be seen in an upward weld at vertical position and an incline position.</p> 	<ul style="list-style-type: none"> <li>• Welding current is too high.</li> <li>• Welding voltage is too low.</li> <li>• Welding speed is too slow or too fast.</li> </ul>	<ul style="list-style-type: none"> <li>• Adjust the welding speed.</li> <li>• Adjust the voltage to the proper value or slightly higher value.</li> </ul>

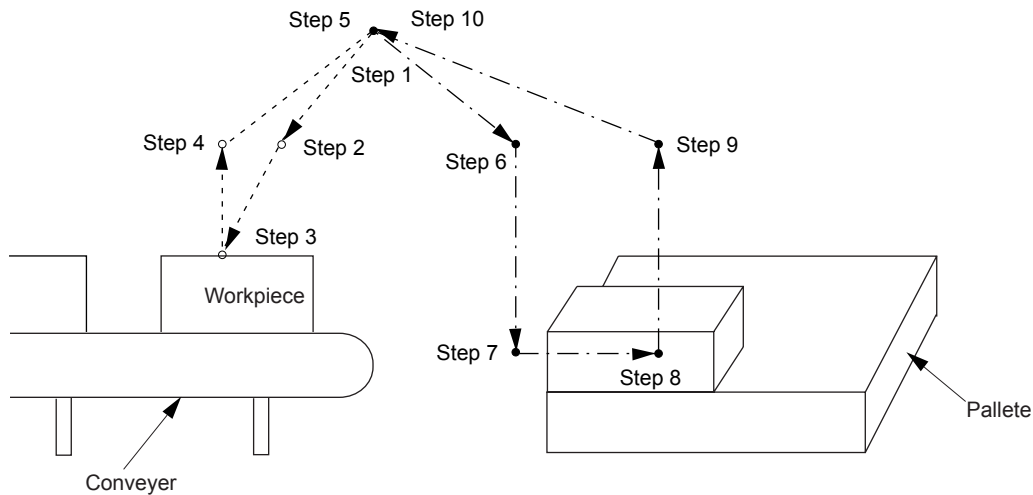
Welding Defect	Cause	Correction Method
<p>Concave bead: Part of the fillet weld has a dented bead surface. It can be seen in a downward weld at a vertical position or incline position</p> 	<ul style="list-style-type: none"> <li>• Welding voltage is too high.</li> <li>• Welding speed is too slow.</li> </ul>	<ul style="list-style-type: none"> <li>• Adjust the welding speed.</li> <li>• Adjust the voltage to the proper value or slightly lower value.</li> </ul>
<p>Meandering of beads: State in which welding bead is shaped like a snake.</p> 	<ul style="list-style-type: none"> <li>• The welding wire is bent and twisted.</li> <li>• The welding chip's hole diameter is growing larger.</li> <li>• Magnetic blow influences welding.</li> </ul>	<ul style="list-style-type: none"> <li>• Shorten the wire stickout.</li> <li>• Use a pail.</li> <li>• Exchange old tips for new tips.</li> <li>• Change earthing condition.</li> <li>• Change welding direction.</li> </ul>

### 3.4 Example for Handling Application

## 3.4 Example for Handling Application

### 3.4.1 Example Job

The figure below shows an example of handling a workpiece. The job creating procedure is then explained.



Line	Instruction	Explanation
0000	NOP	
0001	MOVJ VJ=25.00	Move to standby position (Step 1)
0002	MOVJ VJ=25.00	Move near gripping position (before gripping) (Step 2)
0003	MOVL V=100.0	Move to the gripping position (Step 3)
0004	HAND 1 ON	Gripping the workpiece
0005	TIMER T=0.50	Waiting for gripping the workpiece to be completed
0006	MOVL V=100.0	Move to near gripping position (after gripping) (Step 4)
0007	MOVJ VJ=25.00	Move to standby position (Step 5)
0008	MOVJ VJ=25.00	Move near release position (before releasing) (Step 6)
0009	MOVL V=100.0	Move to release assistance position (Step 7)
0010	MOVL V=50.0	Move to release position (Step 8)
0011	HAND 1 OFF	Releasing the workpiece
0012	TIMER T=0.50	Waiting for releasing the workpiece to be completed
0013	MOVL V=100.0	Move to near release position (after releasing) (Step 9)
0014	MOVJ VJ=25.00	Move to standby position (Step 10)
0015	END	

## 3.4.2 Usage of HAND Instruction

These instructions open and close each hand mounted to the manipulator. They correspond to single-, double-, and triple solenoids. Up to four hands can be controlled by a single manipulator.

The following solenoid signal controls are available according to the valve selected.

### ■ SP (single-solenoid)

The HAND instruction turns the tool valve (x-1) ON/OFF. The inverse signal is output to the tool valve (x-2). Connect it to the either one when used as a single-solenoid.

### ■ 2P (double-solenoid)

The HAND instruction turns the tool valve (x-1) ON/OFF. The inverse signal is output to the tool valve (x-2).

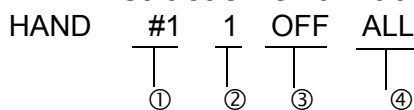
### ■ 3P (triple-solenoid)

Adding "ALL" to the HAND instruction allows both tool valve (x-1) and tool valve (x-2) to be turned ON/OFF simultaneously. Functions as a double-solenoid if ALL is not added to the HAND instruction.

Valve 1/2 condition of each solenoid

Instruction (x:TOOL No.)	SP (Valve x-1/x-2)	2P (Valve x-1/x-2)	3P (Valve x-1/x-2)
HAND x ON	ON/-(-/OFF)	ON/OFF	ON/OFF
HAND x OFF	OFF/-(-/OFF)	OFF/ON	OFF/ON
HAND x ON ALL	-	-	ON/ON
HAND x OFF ALL	-	-	OFF/OFF

### ■ Instruction and Additional Items



#### ①Device Number (#1 or #2)

Set when two manipulators are used for handling.

#### ②Tool Number (1 to 4)

Setting always required.

#### ③Tool Output Status (ON/OFF)

Select ON or OFF. Setting always required.

#### ④Valve Simultaneous Control (ALL)

Add to turn tool valves 1 and 2 ON or OFF simultaneously.

## 3.4 Example for Handling Application

### 3.4.3 Teaching Procedure

The teaching procedure is explained in Step 2, 3, and 4 concerning gripping movement and Step 6, 7, 8, and 9 concerning release movement.



- Step1, which is the standby position, is adjusted to a safe position where the manipulator does not collide with the workpiece and jig, etc.
- Confirm the welding path by using [FWD] and [BWD].

#### ■ Step 2 -- Near Gripping Position (before gripping)

Define the pose of the gripping torch.

1. Specify the correct posture with the axis operation keys for the manipulator to begin gripping the workpiece. It is necessary to choose a direction in which the tools and the workpiece do not interfere when the manipulator approaches the workpiece, and teach that position. (It is usually located right above the gripping position.)



2. Press [ENTER]. Step 2 is registered.

```
0000 NOP
0001 MOVJ VJ=25.00
0002 MOVJ VJ=25.00
0003 END
```



#### ■ Step 3 -- Gripping Position

Move the torch to the gripping position with the pose as shown in Step 2, and register the HAND instruction.

1. Change to medium speed by pressing [FAST] or [SLOW].

Medium speed: is displayed in the status area.



2. Move the manipulator to the gripping position with the axis operation keys. At this time, do not release the pose input in Step2.



3. Set the linear interpolation "MOVL" by pressing [MOTION TYPE].

⇒ MOVL V=11.0



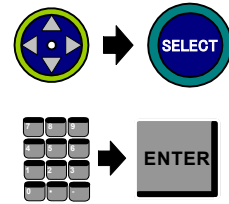
4. With the cursor located on the line number, press [SELECT].

⇒ **MOVL** V=11.0



5. The input buffer line appears. Move the cursor to the right to "V=11.0," which shows the speed.

Press [SELECT] to enable the input of numbers. Then, input the desired value of 100mm/s with the Numeric keys and press [ENTER].



6. Press [ENTER]. Step 3 is registered.

```
0000  NOP
0001  MOVJ VJ=25.00
0002  MOVJ VJ=25.00
0003  MOVJ V=100.0
0004  END
```



7. Press [TOOL1 ON/OFF]. "HAND 1 ON" is displayed in the input buffer line.

⇒ HAND 1 ON

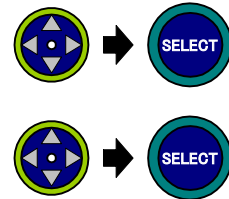


8. Press [ENTER]. The HAND instruction (gripping) is registered.



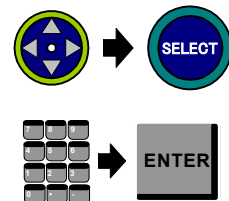
9. Press [INFORM LIST]. The inform list is displayed. Move the cursor to "CONTROL" and press [SELECT]. Then, move the cursor to "TIMER" and press [SELECT].

⇒ TIMER T=1.00



10. The input buffer line appears. Move the cursor to the right to "T=1.00," which shows the time.

Press [SELECT] to enable the input of numbers. Then, input the desired value of 0.5s with the Numeric keys and press [ENTER].



⇒ TIMER T=0.50

11. Press [ENTER]. The TIMER instruction is registered.



12. Press [INFORM LIST] again to turn OFF the LED of the INFORM LIST key.



### 3.4 Example for Handling Application

#### ■ Step 4 -- Near Gripping Position (after gripping)

Define the standby position after gripping.

1. Move the manipulator near the gripping position with the axis operation keys. It is necessary to choose a direction in which the treatment device and the tools do not interfere when the manipulator moves, and teach that position. (It is usually located right above the gripping position. The same position as the step 2 is also available.)

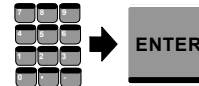
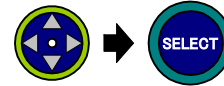


2. With the cursor located on the line number, press [SELECT].

⇒ **MOV L** V=11.0



3. The input buffer line appears. Move the cursor to the right to "V=11.0," which shows the speed. Press [SELECT] to enable the input of numbers. Then, input the desired value of 100.0mm/s with the Numeric keys and press [ENTER].



4. Press [ENTER]. Step 4 is registered.



```

0000  NOP
0001  MOVJ VJ=25.00
0002  MOVJ VJ=25.00
0003  MOVL V=100.0
0004  HAND 1 ON
0005  TIMER T=0.50
0006  MOVL V=100.0
0007  END

```

## ■ Step 6 -- Near Release Position (before releasing)

Define the pose of the release torch.

1. Specify the correct position with the axis operation keys for the manipulator to begin releasing the workpiece. It is necessary to choose a position where the held workpiece and the piled-up workpiece do not interfere when the manipulator approaches the palette, and teach that position. (It is usually located right above of the release assistance position.)



2. Set the joint interpolation (MOVJ) by pressing [MOTION TYPE].


⇒ MOVJ V=0.78



3. With the cursor located on the line number, press [SELECT].

⇒ MOVJ V=0.78



4. The input buffer line appears. Move the cursor to the right to "VJ=0.78," which shows the speed. While pressing [SHIFT] simultaneously, move the cursor  up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed to 25.00%.



⇒ MOVJ VJ=25.00

5. Press [ENTER]. Step 6 is registered.



```
0000 NOP
0001 MOVJ VJ=25.00
0002 MOVJ VJ=25.00
0003 MOVL V=100.0
0004 HAND 1 ON
0005 TIMER T=0.50
0006 MOVL V=100.0
0007 MOVJ VJ=25.00
0008 MOVJ VJ=25.00
0009 END
```

### 3.4 Example for Handling Application

#### ■ Step 7 -- Release Assistance Position

Define the assistance position for releasing.

1. When moving directly from the position in Step 6 to the release position, the workpiece which has already been piled up and the holding workpiece interfere occasionally. The release assistance position to conduct a detour operation is taught at this time. The pose is set the same as Step 6.



2. Set linear interpolation (MOVL) by pressing [MOTION TYPE].

⇒ MOVL V=11.0

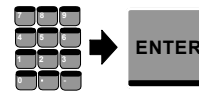
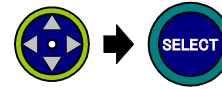


3. With the cursor located on the line number, press [SELECT].

⇒ MOVL V=11.0



4. The input buffer line appears. Move the cursor to the right to "V=11.0," which shows the speed.  
Press [SELECT] to enable the input of numbers. Then, input the desired value of 100.0mm/s with the Numeric keys and press [ENTER].



5. Press [ENTER]. Step 7 is registered.



```

0000  NOP
0001  MOVJ VJ=25.00
0002  MOVJ VJ=25.00
0003  MOVL V=100.0
0004  HAND 1 ON
0005  TIMER T=0.50
0006  MOVL V=100.0
0007  MOVJ VJ=25.00
0008  MOVJ VJ=25.00
0009  MOVL V=100.0
0010  END

```

## ■ Step 8 -- Release Position

Move the torch to the release position with the pose as shown in Step 7, and register the HAND instruction.

1. Change to medium speed by pressing [FAST] or [SLOW].

Medium speed:  is displayed in the status area.



2. Move the manipulator to the release position with the axis operation keys. At this time, do not release the pose input in Step 7.



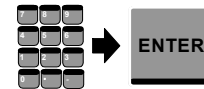
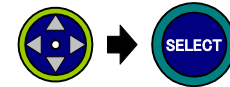
3. With the cursor located on the line number, press [SELECT].

⇒ **MOV** V=11.0



4. The input buffer line appears. Move the cursor to the right to "V=11.0," which shows the speed.

Press [SELECT] to enable the input of numbers. Then, input the desired value of 50.0mm/s with the Numeric keys and press [ENTER].



5. Press [ENTER]. Step 8 is registered.




```
0000  NOP
0001  MOVJ VJ=25.00
0002  MOVJ VJ=25.00
0003  MOVL V=100.0
0004  HAND 1 ON
0005  TIMER T=0.50
0006  MOVL V=100.0
0007  MOVJ VJ=25.00
0008  MOVJ VJ=25.00
0009  MOVL V=100.0
0010  MOVL V=50.0
0011  END
```

6. Press [TOOL1 ON/OFF]. "HAND 1 ON" is displayed in the input buffer line.

⇒ **HAND** 1 ON



7. The input buffer line appears. Move the cursor to the right to "ON," which shows the tool status. While pressing [SHIFT] simultaneously, move the cursor  up and down until "OFF" is specified.

⇒ HAND 1 **OFF**



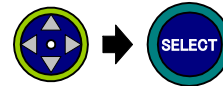
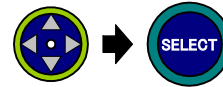
8. Press [ENTER]. The HAND instruction (releasing) is registered.



### 3.4 Example for Handling Application

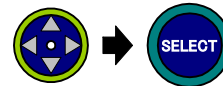
- 9.** Press [INFORM LIST]. The inform list is displayed.  
Move the cursor to “CONTROL” and press [SELECT]. Then, move the cursor to “TIMER” and press [SELECT].

⇒ **TIMER** T=1.00



- 10.** The input buffer line appears. Move the cursor to the right to “T=1.00,” which shows the time.  
Press [SELECT] to enable the input of numbers. Then, input the desired value of 0.5s with the Numeric keys and press [ENTER].

⇒ **TIMER** T=**0.50**



- 11.** Press [ENTER]. The TIMER instruction is registered.



- 12.** Press [INFORM LIST] again to turn OFF the LED of the INFORM LIST key.



## ■ Step 9 -- Near Release Position (after release)

Define the temporary standby position.

1. Move the manipulator near the release position with the axis operation keys. It is necessary to choose a direction in which the tools and workpiece do not interfere, and teach that position. (It is usually located right above the release position.)



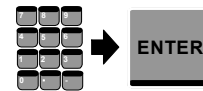
2. With the cursor located on the line number, press [SELECT].

⇒ **MOVL** V=11.0



3. The input buffer line appears. Move the cursor to the right to "V=11.0," which shows the speed.

Press [SELECT] to enable the input of numbers. Then, input the desired value of 100.0mm/s with the Numeric keys and press [ENTER].



4. Press [ENTER]. Step 9 is registered.



```
0000  NOP
0001  MOVJ VJ=25.00
0002  MOVJ VJ=25.00
0003  MOVL V=100.0
0004  HAND 1 ON
0005  TIMER T=0.50
0006  MOVL V=100.0
0007  MOVJ VJ=25.00
0008  MOVJ VJ=25.00
0009  MOVL VJ=100.0
0010  MOVL VJ=50.0
0011  HAND 1 OFF
0012  TIMER T=0.50
0013  MOVL V=100.0
0014  END
```

### 3.4 Example for Handling Application

## 3.4.4 Handling Test

### Speed Limitation Drive

To confirm the taught path, the speed limitation drive is executed. All the operations operate below the limitation speed in the teach mode (250mm/s usually) during speed limitation drive. If the taught speed is below the limitation speed, the operation is executed at the same speed as teaching.

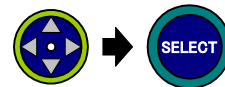
1. Switch the mode switch on the programming pendant to "PLAY."



2. Select {UTILITY} and {SETUP SPECIAL RUN}. The SPECIAL PLAY window appears.

SPECIAL PLAY	
LOW SPEED START	INVALID
SPEED LIMIT	INVALID
DRY-RUN SPEED	INVALID
MACHINE LOCK	INVALID
CHECK-RUN	INVALID
WEAV PROHIBIT IN CHK-RUN	INVALID
COMPLETE	

3. Move the cursor to the "SPEED LIMIT" setting and press [SELECT]. The condition becomes "VALID" and the speed limit is turned ON.



SPECIAL PLAY	
LOW SPEED START	INVALID
SPEED LIMIT	VALID
DRY-RUN SPEED	INVALID
MACHINE LOCK	INVALID
CHECK-RUN	INVALID
WEAV PROHIBIT IN CHK-RUN	INVALID
COMPLETE	

4. Confirm that no persons are present in the P-point maximum envelope of the manipulator and then press [START].  
Confirm that the manipulator correctly operates.

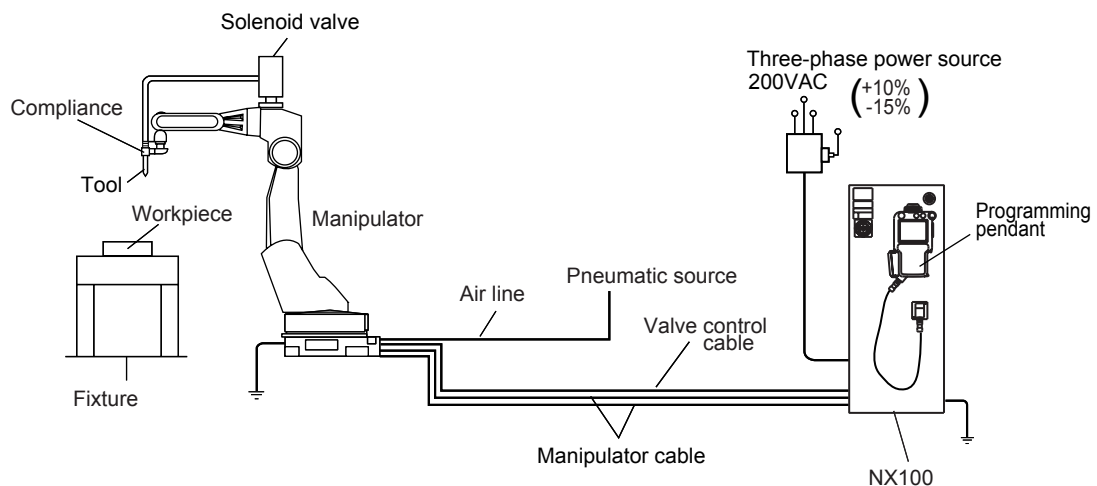
### ■ Handling Execution

Once the path has been determined, the handling is finally executed at actual speed. If the job is played back with the speed limitation drive disabled, the handling is executed at taught speed.

## 3.5 Example for General Purpose Application

### 3.5.1 Example Job

The figure below shows an example of cutting. The job creation procedure is then explained.



Line	Instruction	Explanation
0000	NOP	
0001	MOVJ VJ=25.00	Moves manipulator to the standby position. (Step 1)
0002	MOVJ VJ=25.00	Moves manipulator near the cutting start position. (Step 2)
0003	MOVJ VJ=12.50	Moves manipulator to the cutting start position. (Step 3)
0004	TOOLON	Starts cutting.
0005	MOVL V=50.0	Moves manipulator to the cutting end position. (Step 4)
0006	TOOLOF	Ends cutting.
0007	MOVJ VJ=25.00	Moves manipulator to the position where the tools and workpieces do not interfere. (Step 5)
0008	MOVJ VJ=25.00	Moves manipulator to the standby position. (Step 6)
0009	END	

### 3.5 Example for General Purpose Application

## 3.5.2 Teaching Procedure

The teaching procedure of Step 2 which specifies the cutting pose and Step 3 and 4 (cutting section) are explained.



Teach Step 1, which is the standby position, to a safe position where the manipulator will not collide with the workpiece and the tool.  
Confirm the cutting path with [FWD] and [BWD] after teaching.

### ■ Step 2 -- Near cutting position

Define the cutting pose.

1. Specify the correct posture with the axis operation keys for the manipulator to start cutting.



2. Press [ENTER]. Step 2 is registered.



0000	NOP
0001	MOVJ VJ=25.00
<b>0002</b>	MOVJ VJ=25.00
0003	END

## ■ Step 3 -- Cutting Start Position

Move to the cutting start position with the pose as shown in Step 2, and register the TOOLON instruction.

1. Change to medium speed by pressing [FAST] or [SLOW].

Medium speed:  is displayed in the status area.



2. Move the manipulator to the cutting start position with the axis operation keys. At this time, do not release the pose input in Step 2.




3. With the cursor located on the line number, press [SELECT].

⇒ **MOVJ** VJ=25.00



4. The input buffer line appears. Move the cursor to the right to "VJ=25.00," which shows the speed. While pressing [SHIFT]

simultaneously, move the cursor  up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed to 12.50%.



⇒ MOVJ VJ= **12.50**

5. Press [ENTER]. Step 3 is registered.

```
0000  NOP
0001  MOVJ VJ=25.00
0002  MOVJ VJ=25.00
0003  MOVJ VJ=12.50
0004  END
```



6. Press [2/TOOL ON]. "TOOLON" is displayed in the input buffer line.

⇒ **TOOLON**



7. Press [ENTER]. The TOOLON instruction is registered.



### 3.5 Example for General Purpose Application

#### ■ Step 4 -- Cutting End Position

Define the cutting end position.

1. Move the manipulator to the cutting end position with the axis operation keys. It is necessary to choose a direction in which the treatment device and the tools do not interfere when the manipulator moves, and teach that position.



2. Set linear interpolation (MOVL) by pressing [MOTION TYPE].

⇒ MOVL V=11.0

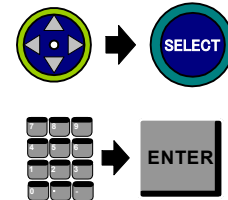


3. With the cursor located on the line number, press [SELECT].

⇒ MOVL V=11.0



4. The input buffer line appears. Move the cursor to the right to "V=11.0," which shows the speed. Press [SELECT] to enable the input of numbers. Then, input the desired value of 50.0mm/s with the Numeric keys and press [ENTER].



5. Press [ENTER]. Step 4 is registered.

```
0000 NOP
0001 MOVJ VJ=25.00
0002 MOVJ VJ=25.00
0003 MOVJ VJ=12.50
0004 TOOLON
0005 MOVL V=50.0
0006 END
```



6. Press [./TOOL OF]. "TOOLOF" is displayed in the input buffer line.

⇒ TOOLOF



7. Press [ENTER]. The TOOLOF instruction is registered.



### 3.5.3 Cutting Test

#### Speed Limitation Drive

The speed limitation drive is executed to confirm the taught path. All the operations operate below the limitation speed during teach mode (250mm/s usually) in the speed limitation drive. If the taught speed is below the limitation speed, the operation is executed at the same speed as the teaching procedure.

- 1. Switch the mode switch on the programming pendant to “PLAY.”



- 2. Select {UTILITY} and {SETUP SPECIAL RUN}. The SPECIAL PLAY window appears.

SPECIAL PLAY	
LOW SPEED START	INVALID
SPEED LIMIT	INVALID
DRY-RUN SPEED	INVALID
MACHINE LOCK	INVALID
CHECK-RUN	INVALID
WEAV PROHIBIT IN CHK-RUN	INVALID
COMPLETE	

- 3. Move the cursor to the “SPEED LIMIT” setting and press [SELECT]. The condition becomes “VALID” and the speed limit is turned ON.



SPECIAL PLAY	
LOW SPEED START	INVALID
SPEED LIMIT	VALID
DRY-RUN SPEED	INVALID
MACHINE LOCK	INVALID
CHECK-RUN	INVALID
WEAV PROHIBIT IN CHK-RUN	INVALID
COMPLETE	

- 4. Confirm that no persons are present in the P-point maximum envelope of the manipulator and then press [START]. Confirm that the manipulator correctly operates.

#### ■ Cutting Execution

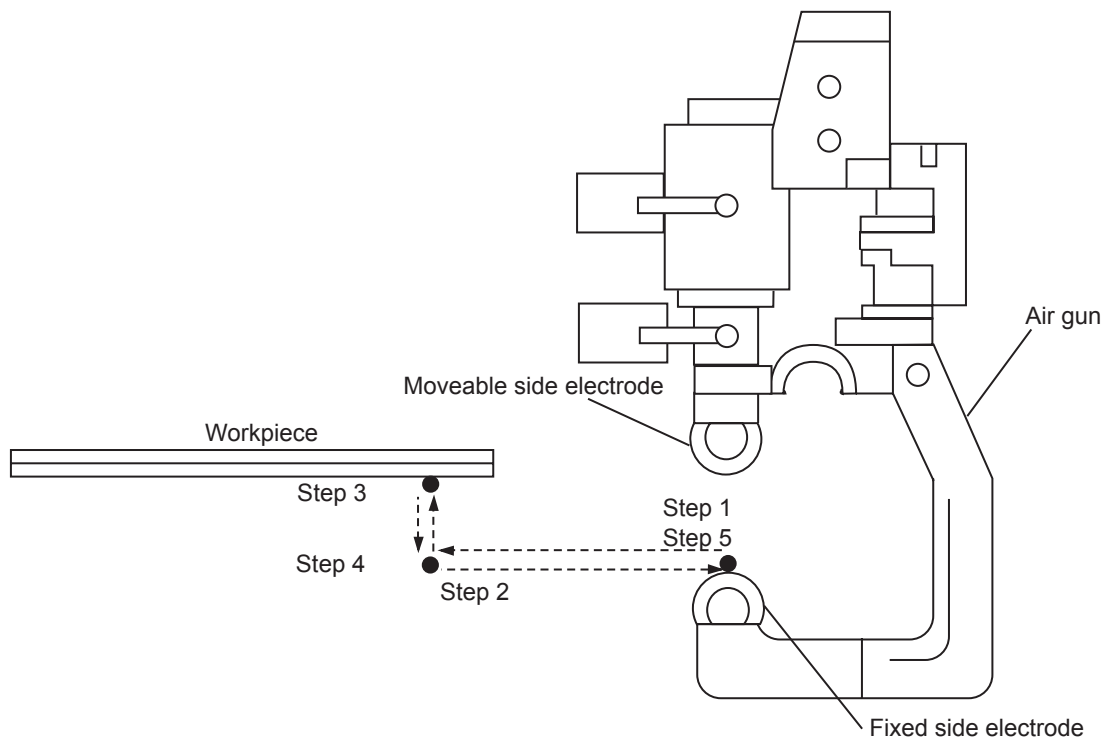
Once the path has been determined, cutting is finally executed at actual speed. If the job is played back with the speed limitation drive disabled, cutting is executed at taught speed.

## 3.6 Example for Spot Welding Application

### 3.6 Example for Spot Welding Application

#### 3.6.1 Example Job

The figure below shows an example of the spot welding of a workpiece. The job content procedure is then explained.



Line	Instruction	Explanation
0000	NOP	
0001	MOVJ VJ=25.00	Moves manipulator to standby position. (Step 1)
0002	MOVJ VJ=25.00	Moves manipulator near welding start position. (Step 2)
0003	MOVJ VJ=25.00	Moves manipulator to welding start position (Step 3)
0004	SPOT GUN#(1) MODE=0 WTM=1	Welding starts. Specifies spot welding gun no.1. Specifies single gun. Specifies welding condition 1.
0005	MOVJ VJ=25.00	Moves manipulator to position a safe distance away from equipment. (Step 4)
0006	MOVJ VJ=25.00	Moves manipulator to standby position. (Step 5)
0007	END	

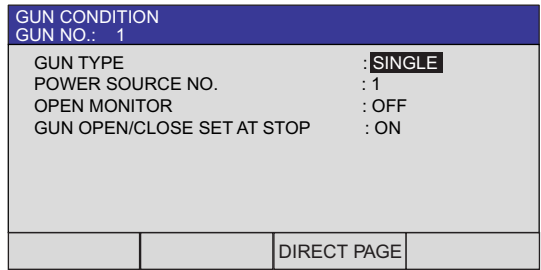
## 3.6.2 Setting Welding Conditions

### ■ Setting Spot Welding Gun Condition Files

The following items are specified in the spot welding gun condition files.

- GUN NO. (Initial:1)
- GUN TYPE (Initial:SINGLE GUN)
- POWER SOURCE NO. (Initial:1)
- OPEN MONITOR (Initial:OFF)
- GUN OPEN/CLOSE SET AT STOP (Initial:ON (open))

If your setting contents are different from the system, change the file content.

	Operation	Explanation
1	Select {SPOT WELDING} under the main menu.	
2	Select {GUN CONDITION}.	<p>The GUN CONDITION window appears.</p> 
3	Move the cursor to the item to be set.	
4	Press [SELECT].	

### 3.6 Example for Spot Welding Application

#### ■ Setting Welding Condition for the Power Source

It is necessary to set the welding power supply and the welding time for the Power Source during spot welding.

For the setting method, refer to the manual of the Power Source being used.

Specify the Welding Condition No. that you set in the SPOT instruction line 0004.

(Example.WTM=1)

For the welding power supply and the welding time, refer to the following table:

Board Thickness (mm)	Large Current - Short Time			Small Current - Long Time		
	Time (cycle)	Pressurizing Power (kgf)	Current (A)	Time (cycle)	Pressurizing Power (kgf)	Current (A)
1.0	10	225	8800	36	75	5600
2.0	20	470	13000	64	150	8000
3.2	32	820	17400	105	260	10000

(1cycle =16.7ms)

### 3.6.3 Teaching Procedure

The teaching procedure is explained in Step 2 (welding pose definition) and Step 3 (welding start).



- Step1, which is standby position, is adjusted to a safe position where the manipulator does not collide with the workpiece and jig, etc.
- Set the gun to the opening condition during teaching.
- Confirm the welding path by using [FWD] and [BWD] after teaching is completed.

#### ■ Step 2 -- Near Welding Start Point

Define the pose of the welding torch.

1. Use the axis operation keys to specify the correct posture for the manipulator to begin welding.



2. Press [ENTER] to register Step 2.




```
0000  NOP
0001  MOVJ VJ=25.00
0002  MOVJ VJ=25.00
0003  END
```

## ■ Step 3 -- Welding Start Point

Move the torch to the welding start point and register the SPOT instruction.

1. Change the speed to medium by pressing [FAST] or [SLOW].

 appears in status area.



2. Press the axis operation keys to move the manipulator to the welding start point.



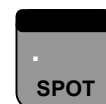
3. Press [ENTER] to register Step 3.

0000	NOP
0001	MOVJ VJ=25.00
0002	MOVJ VJ=25.00
0003	MOVJ VJ=25.00
0004	END



4. Press [./SPOT]. "SPOT GUN#(1) MODE=0 WTM=1" is displayed in the input buffer line.

⇒ **SPOT** GUN#(1) MODE=0 WTM=1



5. Press [ENTER]. The SPOT instruction is registered.



## 3.6 Example for Spot Welding Application

### 3.6.4 Welding Test

#### Check Run

Execute the check run in order to confirm that the teaching procedure is done correctly. The check run can be conducted without actually performing work. This is because the work output instruction of the SPOT instruction is not executed.

1. Switch the mode switch on the programming pendant to "PLAY."



2. Select {UTILITY} and {SETUP SPECIAL RUN}. The SPECIAL PLAY window appears.

SPECIAL PLAY	
LOW SPEED START	INVALID
SPEED LIMIT	INVALID
DRY-RUN SPEED	INVALID
MACHINE LOCK	INVALID
CHECK-RUN	INVALID
WEAV PROHIBIT IN CHK-RUN	INVALID
COMPLETE	

3. Move the cursor to the "CHECK-RUN" setting and press [SELECT]. The condition becomes "VALID" and the check run is turned ON.



SPECIAL PLAY	
LOW SPEED START	INVALID
SPEED LIMIT	INVALID
DRY-RUN SPEED	INVALID
MACHINE LOCK	INVALID
CHECK-RUN	VALID
WEAV PROHIBIT IN CHK-RUN	INVALID
COMPLETE	

4. Confirm that no persons are present in the P-point maximum envelope of the manipulator and then press [START].  
Confirm that the manipulator correctly operates.

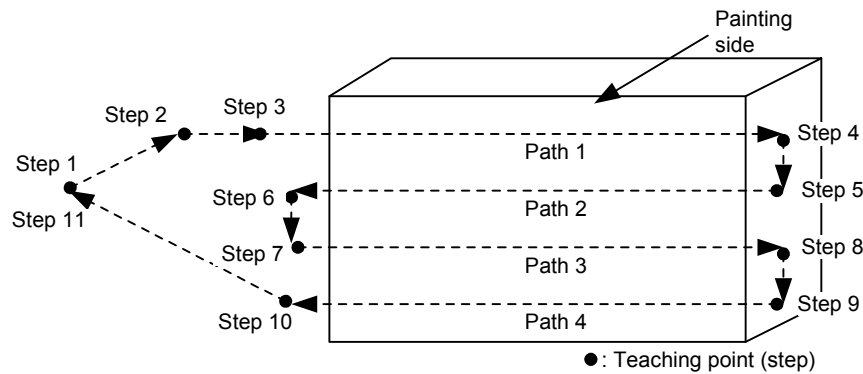
#### ■ Welding Execution

Once the path has been determined, the welding is finally executed. If the job is played back with the check run disabled, the SPOT instruction is executed.

## 3.7 Example for Painting Application

### 3.7.1 Example Job

The figure below shows an example of painting job with an explanation of each step.



Line	Instruction	Explanation
0000	NOP	
0001	MOVJ VJ=25.00	Moves manipulator to standby position. (Step 1)
0002	MOVL V=50	Moves manipulator near painting start position. (Step 2)
0003	MOVL V=50 NWAIT	Moves manipulator to Path 1 start position. (Step 3)
0004	PAINTSET PCF# (1)	Set painting condition number 1.
0005	SPYON ANT=1.00	Spray ON.
0006	MOVL V=100	Moves manipulator to Path 1 end position. (Step 4)
0007	MOVL V=100	Moves manipulator to Path 2 start position. (Step 5)
0008	MOVL V=100	Moves manipulator to Path 2 end position. (Step 6)
0009	MOVL V=100	Moves manipulator to Path 3 start position. (Step 7)
0010	MOVL V=100	Moves manipulator to Path 3 end position. (Step 8)
0011	MOVL V=100	Moves manipulator to Path 4 start position. (Step 9)
0012	MOVL V=100 NWAIT	Moves manipulator to Path 4 end position. (Step 10)
0013	SPYOF ANT=-1.00	Spray OFF.
0014	PAINTEND	Painting end
0015	MOVL V=50	Moves manipulator to standby position. (Step 11)
0016	END	

## 3.7 Example for Painting Application


### 3.7.2 Setting Painting Conditions

1. Select {PAINT} under the main menu.  
Select {PAINT CONDITION} under the sub menu.  
The PAINT CONDITION window appears.

PAINT CONDITION CONDITION NO.: 1	
COMMENT	: *****
PAINT VOLUME	: 2 Level
BELL ROTATION	: 3 Level
SHAPING AIR	: 2 Level
HIGH VOLTAGE	: 1 Level
<div style="text-align: right;">DIRECT PAGE</div>	



2. Move the cursor to "PAINT VOLUME," "BELL ROTATION," "SHAPING AIR," and "HIGH VOLTAGE" to specify the value with the Numeric keys.

The window of the next condition number is shown by pressing the page key .

The window of the desired condition number can be searched by inputting the condition number as follows:

Move the cursor to the condition number, press [SELECT], input the desired number with the Numeric keys, and press [ENTER].



### 3.7.3 Teaching Procedure

The teaching procedure is explained in Step 2 (painting pose definition), Step 3 (painting start position), and Step 10 (painting end position).

**NOTE**

- Teach Step 1 and 11, which are both the standby position, to a safe position where the manipulator does not collide with the workpiece and the fixture, etc.
- After teaching is completed, confirm the painting path with [FWD] and [BWD].

#### ■ Step 2 -- Near Painting Start Position

Define the pose of the painting start position.

1. Using the axis operation keys, specify the correct pose for the manipulator to begin painting.




2. Press [ENTER]. Step 2 is registered.

0000	NOP
0001	MOVJ VJ=25.00
0002	MOVL V=50.0
0003	END



### ■ Step 3 -- Painting Start Position

Move to the painting start position with the pose as shown in Step 2, and register the PAINT-SET instruction and the SPYON instruction.

1. Change to medium speed by pressing [FAST] or [SLOW] until  is displayed in the status area.



2. Move the manipulator to the painting start position with the axis operation keys. At this time, do not release the pose input in Step 2.



3. Press [INFORM LIST] to display the INFORM command list. Select {DEVICE} and then select "PAINTSET."



⇒ PAINTSET PCF#(0)

4. The input buffer line appears. Move the cursor to PCF#(0), which shows the painting condition number. Set the number 1 with the Numeric keys.



Press [ENTER] to register the PAINTSET instruction.

⇒ PAINTSET PCF#(1)



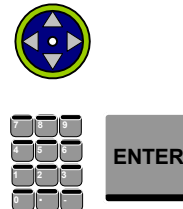
5. Select "SPYON" in the INFORM command list.

⇒ SPYON ANT=0.00



6. Move the cursor to the ANT=0.00. Input "1.00" with the Numeric keys. Press [ENTER] to register the SPYON instruction.

⇒ SPYON ANT=1.00



7. With the cursor located on the line number, press [SELECT].

⇒ MOVJ VJ=50.00



8. Set the interpolation type to linear interpolation (MOVL) by pressing [MOTION TYPE].

⇒ MOVL V=66



9. Move the cursor to the right to V=66, which shows the speed. Set to 100mm/s with the Numeric keys.

⇒ MOVL V=100



10. Press [ENTER]. Step 3 is registered.



### 3.7 Example for Painting Application

#### ■ Step 10 -- Painting End Position

Move to the painting end position and register the SPYOF instruction.

1. Change to medium speed by pressing [FAST] or [SLOW] until



is displayed in the status area.



2. Move the manipulator to the painting end position with the axis operation keys.



3. Press [INFORM LIST] to display the INFORM command list.  
Select "SPYOF."

⇒ SPYOF ANT=0.00



4. The input buffer line appears. Move the cursor to the ANT=0.00.

Input "-1.00" with the Numeric keys.

Press [ENTER] to register the SPYOF instruction.

⇒ SPYOF ANT=1.00



5. With the cursor located on the line number, press [SELECT].

⇒ MOVJ VJ=50.00



6. Set the interpolation type to linear interpolation (MOVL) by pressing [MOTION TYPE].

⇒ MOVL V=66



7. Move the cursor to the right to V=66, which shows the speed.  
Set to 100mm/s with the Numeric keys.

⇒ MOVL V=100



8. Press [ENTER]. Step 10 is registered.



### 3.7.4 Painting Test

#### Speed Limitation Drive

The speed limitation drive is executed to confirm the taught path. All the operations operate below the limitation speed during teach mode (250mm/s usually) in the speed limitation drive. If the taught speed is below the limitation speed, the operation is executed at the same speed as the teaching procedure.

- 1. Switch the mode switch on the programming pendant to “PLAY.”



- 2. Select {UTILITY} and {SETUP SPECIAL RUN}. The SPECIAL PLAY window appears.

SPECIAL PLAY	
LOW SPEED START	INVALID
SPEED LIMIT	INVALID
DRY-RUN SPEED	INVALID
MACHINE LOCK	INVALID
CHECK-RUN	INVALID
WEAV PROHIBIT IN CHK-RUN	INVALID
COMPLETE	

- 3. Move the cursor to the “SPEED LIMIT” setting and press [SELECT]. The condition becomes “VALID” and the speed limit is turned ON.



SPECIAL PLAY	
LOW SPEED START	INVALID
SPEED LIMIT	VALID
DRY-RUN SPEED	INVALID
MACHINE LOCK	INVALID
CHECK-RUN	INVALID
WEAV PROHIBIT IN CHK-RUN	INVALID
COMPLETE	

- 4. Confirm that no persons are present in the P-point maximum envelope of the manipulator and then press [START]. Confirm that the manipulator correctly operates.

#### ■ Painting Execution

Once the path has been determined, painting is finally executed at actual speed. If the job is played back with the speed limitation drive disabled, painting is executed at the specified speed during teaching.

## 4 Teaching

### 4.1 Preparation for Teaching

To ensure safety, the following operations should always be performed before teaching:

- Check the emergency stop buttons to be sure they function properly.
- Set the mode switch to “TEACH.”
- Register a job.

#### 4.1.1 Checking Emergency Stop Buttons

The Servo ON button on the programming pendant should be lit while the power is ON for the servo system. Perform the following operation to ensure that the emergency stop buttons on both the NX100 and the programming pendant are functioning correctly before operating the manipulator.

	Operation	Explanation
1	Press E. STOP button.	Press the emergency stop button on the NX100 or the programming pendant.
2	Confirm the servo power is turned OFF.	The SERVO ON button on the programming pendant lights while servo supply is turned ON. When the emergency stop button is pressed and the servo power is turned OFF, the SERVO ON lamp will turn OFF.
3	Press [SERVO ON READY].	After confirming correct operation, press [SERVO ON READY]. The servo power will be ready to turn ON. The servo power can be turned ON with the Enable switch while the SERVO ON button lamp blinks.

#### 4.1.2 Setting the Teach Lock

For safety purposes, always set the mode switch to “TEACH” before beginning to teach. While the teach lock is set, the mode of operation is tied to the teach mode and the machines cannot be played back using either [START] or external input.

### 4.1.3 Registering a Job

Specify the name, comments (as required), and control group to register a job.

#### ■ Registering Job Names

Job names can use up to 8 alphanumeric and symbol characters. These different types of characters can coexist within the same job name.

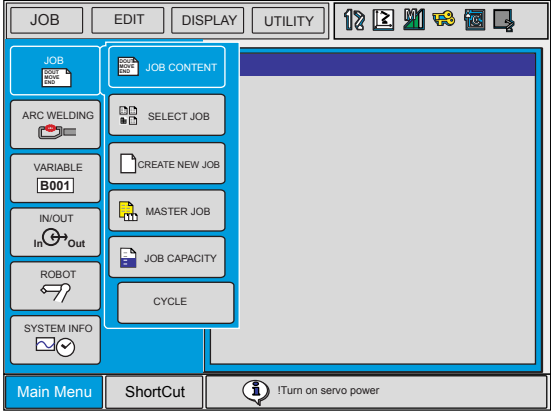
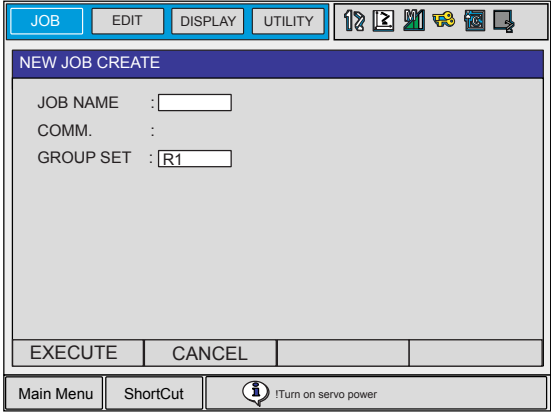
The following rules apply to the designation of names for reserved jobs:

A maximum of six characters can be used for a reserved job name.

When a reserved job name is used, additional characters are added by the system.

**<Example>**

001      JOB - 1      WORK - A

	Operation	Explanation
1	Select {JOB} under the main menu.	The sub-menu appears. 
2	Select {CREATE NEW JOB}.	The NEW JOB CREATE window appears. 
3	Input job name.	Move the cursor to JOB NAME, and press [SELECT]. Input job names using the character input operation. For information on character input operation, refer to "1.2.7 Character Input."
4	Press [ENTER].	
5	Select "EXECUTE."	Job names are registered to NX100 memory. Then, the JOB CONTENT window appears. NOP and END instructions are automatically registered.

## 4.1 Preparation for Teaching

## ■ Registering Comments

Register a comment using up to 32 alphanumeric and symbol characters as required.

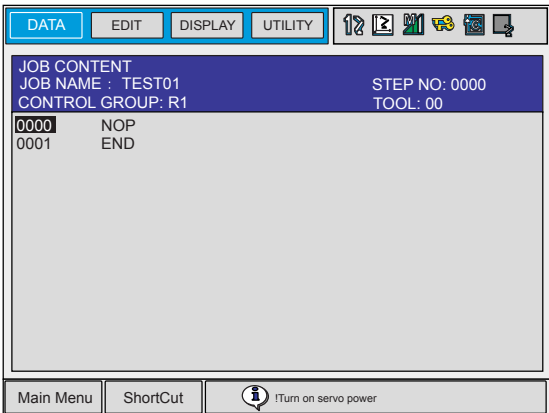
	Operation	Explanation
1	In the NEW JOB CREATE window, move the cursor to the comment and press [SELECT].	
2	Enter the comment.	For information on character input operation, refer to "1.2.7 Character Input."
3	Press [ENTER].	

## ■ Registering Control Groups

Select the control group to be registered from the control groups which have been registered in advance. If external axes (base axis or station axis) or multiple robot systems are not used, the registration of control groups is not required.

## ■ Switching to the Teaching Window

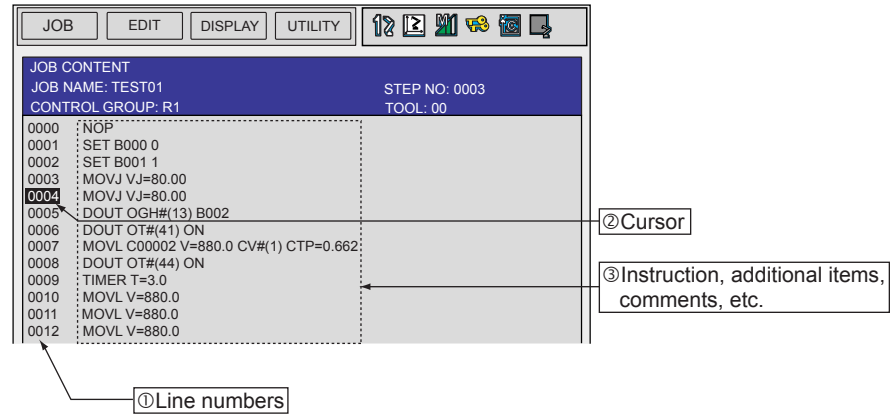
After the name, comments (can be omitted), and the control groups have been registered, switch the window to the teaching window as follows:

	Operation	Explanation
1	In the NEW JOB CREATE window, press [ENTER] or select "EXECUTE."	<p>Job name, comments, and control groups are all registered. Then, the JOB CONTENT window appears. NOP and END instructions are automatically registered.</p> 

## 4.2 Teaching Operation

### 4.2.1 The Teaching Window

Teaching is conducted in the JOB CONTENT window. The JOB CONTENT window contains the following items:



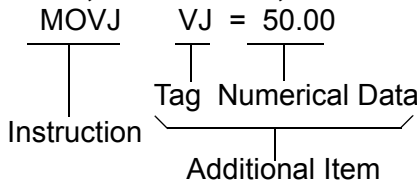
#### ① Line Numbers

The number of the job line is automatically displayed. Line numbers are automatically regenerated if lines are inserted or deleted.

#### ② Cursor

The cursor for manipulator control. For the FWD, BWD, and test operation, the manipulator motion starts from the line this cursor points.

#### ③ Instructions, Additional Items, Comments, Etc.



Instructions : These are instructions needed to process or perform an operation. In the case of MOVE instructions, the instruction corresponding to the interpolation type is automatically displayed at the time position is taught.

Additional items : Speed and time are set depending on the type of instruction. Numerical or character data is added when needed to the tags which set conditions.

## 4.2.2 Interpolation Type and Play Speed

Interpolation type determines the path along which the manipulator moves between playback steps. Play speed is the rate at which the manipulator moves.

Normally the three elements of position data, Interpolation type, and play speed are registered for the robot axes steps at one time. If the interpolation type or play speed settings are omitted during teaching, the data used from the previously taught step is automatically used.

### ■ Joint Interpolation

The joint interpolation is used when the manipulator does not need to move in a specific path toward the next step position. When the joint interpolation is used for teaching a robot axis, the move instruction is MOVJ. For safety purposes, use the joint interpolation to teach the first step.

When [MOTION TYPE] is pressed, the move instruction on the input buffer line changes.

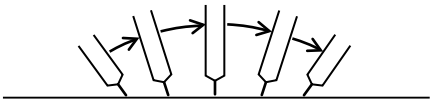
### Play Speed Setting Window

- Speeds are indicated as percentages of the maximum rate.
- Setting "0:Speed Omit" sets the same speed as the previous determination.

	Operation	Explanation
1	Move the cursor to the play speed.	
2	Set the play speed by pressing [SHIFT] + the cursor key.	<p>The joint speed value increases or decreases.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p>⇒ MOVJ VJ=0.78</p> <div style="border: 1px solid black; padding: 5px; margin: 5px auto; width: 150px;"> <p>Fast 100.00</p> <p>↑ 50.00</p> <p>25.00</p> <p>12.50</p> <p>6.25</p> <p>3.12</p> <p>↓ 1.56</p> <p>Slow 0.78 (%)</p> </div> </div>

■ Linear Interpolation

The manipulator moves in a linear path from one taught step to the next. When the linear interpolation is used to teach a robot axis, the move instruction is MOVL. Linear interpolation is used for work such as welding. The manipulator moves automatically changing the wrist position as shown in the figure below.



Play Speed Setting Window (same for circular and spline interpolation)

There are two types of displays, and they can be switched depending on the application.

	Operation	Explanation
1	Move the cursor to the play speed.	
2	Set the play speed by pressing [SHIFT] + the cursor key.	<div>The play speed value increases or decreases.</div> <div>⇒ MOVL V=<b>660</b></div> <div><div><div>Fast 1500.0</div><div>↑</div><div>750.0</div><div>375.0</div><div>187.0</div><div>93.0</div><div>46.0</div><div>23.0</div><div>↓</div><div>Slow 11 (mm/s)</div></div><div><div>Fast 9000</div><div>↑</div><div>4500</div><div>2250</div><div>1122</div><div>558</div><div>276</div><div>138</div><div>↓</div><div>Slow 66 (cm/min)</div></div></div>

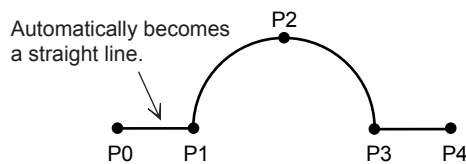
## 4.2 Teaching Operation

### ■ Circular Interpolation

The manipulator moves in an arc that passes through three points. When circular interpolation is used for teaching a robot axis, the move instruction is MOVJ.

#### Single Circular Arc

When a single circular movement is required, teach the circular interpolation for three points, P1 to P3, as shown in the following figure. If joint or linear interpolation is taught at P0, the point before starting the circular operation, the manipulator moves from P0 to P1 in a straight line.

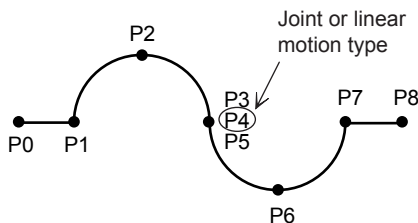


Interpolation Type for Single Circular Arc

	Interpolation Type	Instruction
P0	Joint or Linear	MOVJ MOVL
P1 P2 P3	Circular	MOVJ
P4	Joint or Linear	MOVJ MOVL

#### Continuous Circular Arcs

When continuous circular movement is required, the two arcs must be separated from each other by a joint or linear interpolation step. This step must be inserted between two steps at an identical point. The step at the end point of the preceding circular move must coincide with the beginning point of the following circular move.



Interpolation Type for Continuous Circular Arc

Point	Interpolation Type	Instruction
P0	Joint or Linear	MOVJ MOVL
P1 P2 P3	Circular	MOVJ
P4	Joint or Linear	MOVJ MOVL
P5 P6 P7	Circular	MOVJ
P8	Joint or Linear	MOVJ MOVL

Play Speed

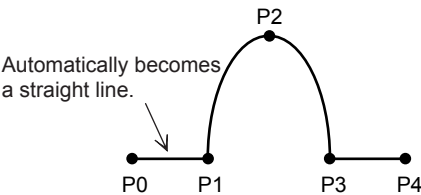
The play speed set display is identical to that for the linear interpolation. The speed taught at P2 is applied from P1 to P2. The speed taught at P3 is applied from P2 to P3. If a circular operation is taught at high speed, the actual arc path has a shorter radius than that taught.

■ Spline Interpolation

When performing operations such as welding, cutting, and applying primer, using the spline interpolation makes teaching for workpieces with irregular shapes easier. The path of motion is a parabola passing through three points. When spline interpolation is used for teaching a robot axis, the move instruction is MOVJ.

Single Spline Curve

When a single spline curve movement is required, teach the spline interpolation for three points, P1 to P3, as shown in the figure below. If joint or linear interpolation is taught at point P0, the point before starting the spline interpolation, the manipulator moves from P0 to P1 in a straight line.

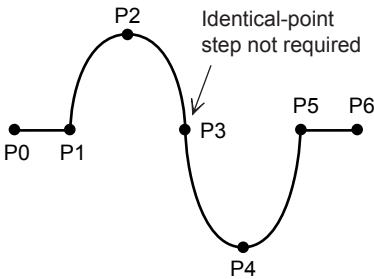


Interpolation Type for a Single Spline Curve

Point	Interpolation Type	Instruction
P0	Joint or Linear	MOVJ MOVL
P1 P2 P3	Spline	MOVJ
P4	Joint or Linear	MOVJ MOVL

Continuous Spline Curves

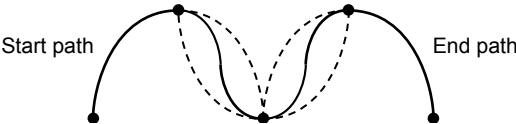
The manipulator moves through a path created by combining parabolic curves. This differs from the circular interpolation in that steps with identical points are not required at the junction between two spline curves.



Interpolation Type for Continuous Spline Curves

Point	Interpolation Type	Instruction
P0	Joint or Linear	MOVJ MOVL
P1 to P5	Spline	MOVJ
P6	Joint or Linear	MOVJ MOVL

When the parabolas overlap, a composite motion path is created.



## 4.2 Teaching Operation

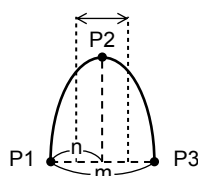
### Play Speed

The play speed setting window is identical to that for the linear interpolation.

As with the circular interpolation, the speed taught at P2 is applied from P1 to P2, and the speed taught at P3 is applied from P2 to P3.

#### NOTE

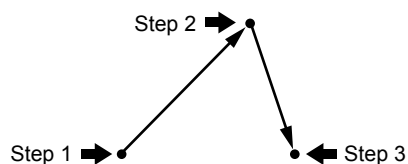
Teach points so that the distances between the three points are roughly equal. If there is any significant difference, an error will occur on playback and the manipulator may operate in an unexpected, dangerous manner. Ensure that the ratio of distances between steps  $m:n$  is within the range of 0.25 to 0.75.



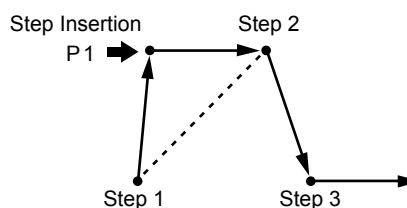
### 4.2.3 Teaching Steps

#### ■ Registering Move Instructions

Whenever one step is taught, one move instruction is registered. There are two ways to teach a step. Steps can be taught in sequence as shown in the following left figure "Registering Move Instructions" or they can be done by inserting steps between already registered steps, as shown in the right figure "Inserting Move Instructions." This paragraph explains the teaching of "Registering Move Instructions," the operations involved in registering new steps.



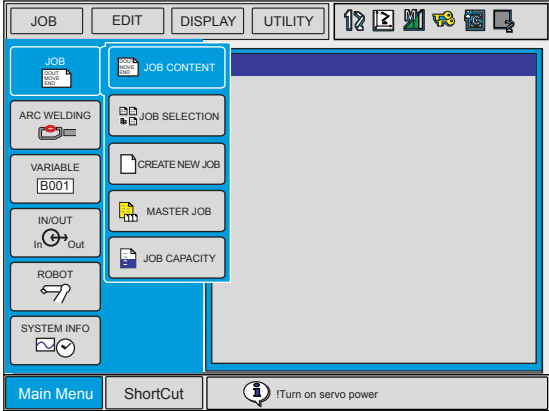
Registering Move Instructions



Inserting Move Instructions

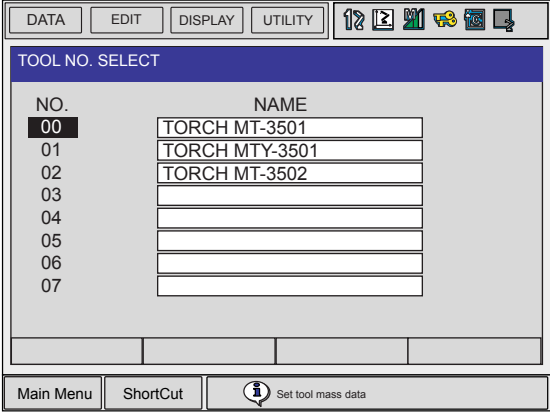

Teaching of "Inserting Move Instructions" is called "Inserting move instruction," to distinguish it from the method shown in "Registering Move Instructions." For more details on this operation, see "4.4.2 Inserting Move Instructions." The basic operations for registration and insertion are the same. The only difference is pressing [INSERT] in the case of insertion. For registration ("Registering Move Instructions"), the instruction is always registered before the END instruction. Therefore, it is not necessary to press [INSERT]. For insertion ("Inserting Move Instructions"), [INSERT] must be pressed.

## Setting the Position Data

	Operation	Explanation
1	Select {JOB} under the main menu.	<p>The sub-menu appears.</p> 
2	Select {JOB}.	<p>The contents of the currently-selected job is displayed.</p> <pre> 0000  NOP 0001  MOVJ VJ=25.00 0002  MOVJ VJ=25.00 0003  MOVJ VJ=12.50 0004  ARCON ASF#(1) 0005  MOVL V=66 0006  END           </pre>
3	Move the cursor on the line immediately before the position where a move instruction to be registered.	
4	Grasp the Enable switch.	Grasp the Enable switch to turn the servo power ON.
5	Move the manipulator to the desired position using the axis key.	Use the axis operation key to move the manipulator to the desired position.

## 4.2 Teaching Operation

## Selecting the Tool Number

	Operation	Explanation
1	Press [SHIFT] + [COORD].	<p>When selecting the "JOINT," "XYZ/CYLINDRICAL," or "TOOL" coordinates, press [SHIFT] + [COORD] and the TOOL NO. SELECT window will be shown.</p> 
2	Select desired tool number.	<p>The contents of the currently-selected job is displayed.</p> 
3	Press [SHIFT] + [COORD].	The JOB CONTENT window appears.


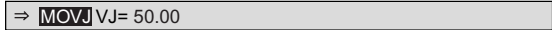

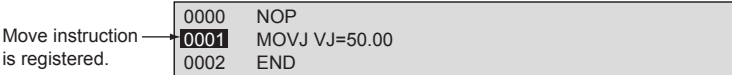
**Using Multiple Tools with One Manipulator**

When multiple tools are to be used with one manipulator, set parameter S2C261 to 1.  
See " 2.6.2 Selecting the Tool Number " for details on this operation.

## Setting the Interpolation Type

	Operation	Explanation
1	Press [MOTION TYPE].	When [MOTION TYPE] is pressed, MOVJ → MOV L → MOV C → MOV S are displayed in order in the input buffer line.
2	Select the desired interpolation type.	

## Setting the Play Speed

	Operation	Explanation
1	Move the cursor to the instruction.	
2	Press [SELECT].	The cursor moves to the input buffer line. 
3	Move the cursor to the play speed to be set.	
4	Press [SHIFT] + the cursor key [↑] or [↓] simultaneously.	The joint speed moves up and down. 
5	Press [ENTER].	The MOV instruction is registered. 

Follow the above instructions when conducting teaching. (Tool number, interpolation type, or play speed does not need to be set if it is same as the previous step.)



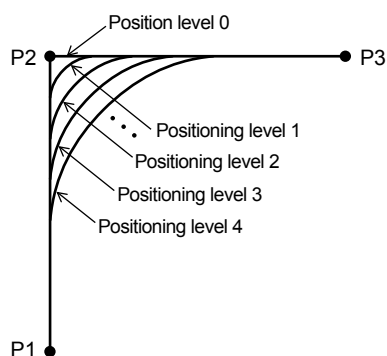
- The position level can be set at the same time that the move instruction is registered.
- To make the setting so that the play speed tag is not displayed as a default, select {EDIT} from the menu and then select "ENABLE PLAY SPEED TAG" to delete "\*."

## Setting Position Level

The position level is the degree of approximation of the manipulator to a taught position. The position level can be added to move instructions MOVJ (joint interpolation) and MOVL (linear interpolation). If the position level is not set, the precision depends on the operation speed. Setting an appropriate level moves the manipulator in a path suitable to circumferential conditions and the workpiece. The relationship between path and accuracy for position levels is as shown below.

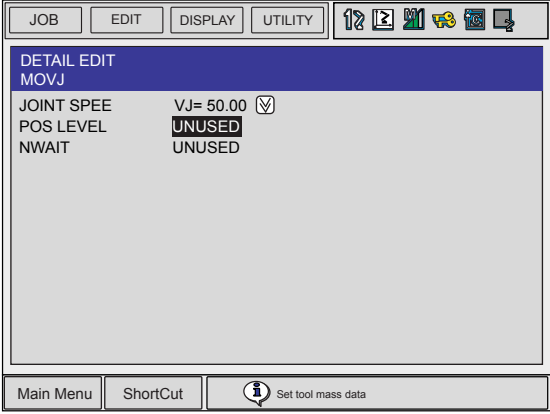
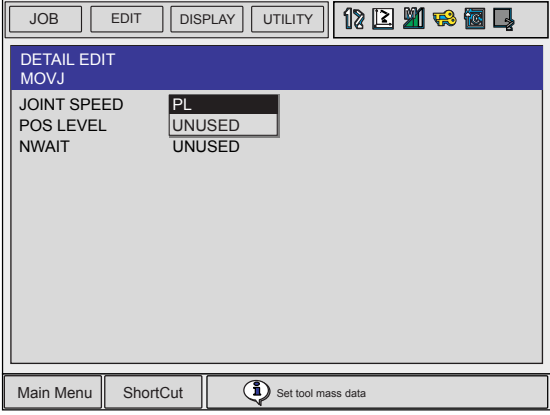
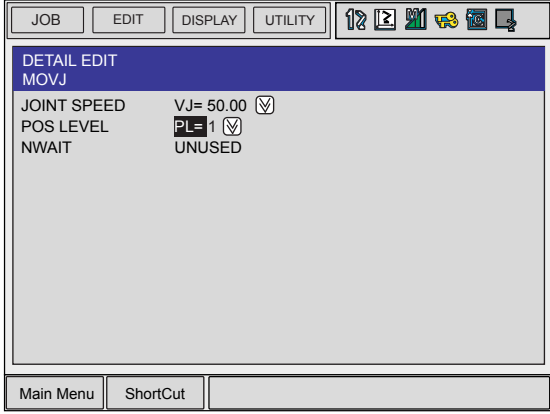


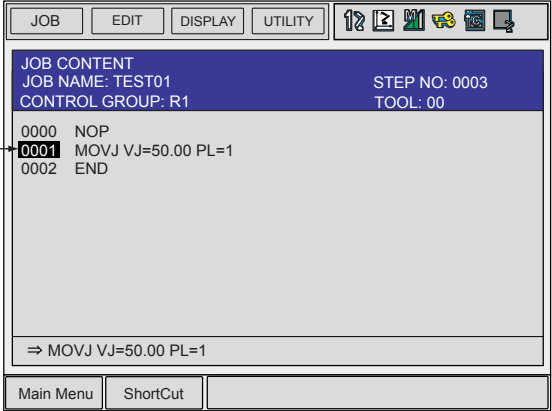
To display the position level tag as a default, select {EDIT} from the menu and then select "ENABLE POS LEVEL TAG."



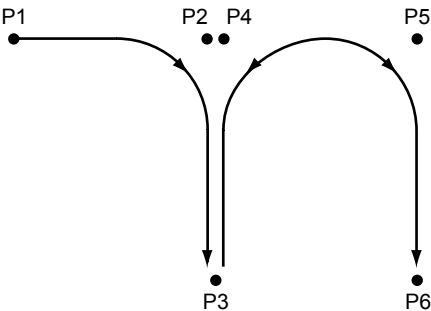
Position Levels	Accuracy
0	Teaching position
1 to 8	Fine   Rough

## 4.2 Teaching Operation

	Operation	Explanation
1	Select move instruction.	<p>The DETAIL EDIT window appears.</p>  <p>The screenshot shows a software window titled 'DETAIL EDIT' with a sub-header 'MOVJ'. It contains three rows of data: 'JOINT SPEED' with a value of 'VJ= 50.00' and a dropdown arrow, 'POS LEVEL' with the text 'UNUSED', and 'NWAIT' with the text 'UNUSED'. The window has a menu bar with 'JOB', 'EDIT', 'DISPLAY', and 'UTILITY'. To the right of the menu bar are several icons. At the bottom, there are buttons for 'Main Menu', 'ShortCut', and a button with an information icon labeled 'Set tool mass data'.</p>
2	Select the position level "UNUSED."	<p>The selection dialog box appears.</p>  <p>This screenshot is similar to the previous one, but a small selection dialog box is now open over the 'POS LEVEL' field. The dialog box contains two options: 'PL' and 'UNUSED'. The 'PL' option is currently selected and highlighted. The rest of the window remains the same as in the previous screenshot.</p>
3	Select "PL."	<p>The position level is displayed. The position initial value is 1.</p>  <p>The screenshot shows the 'DETAIL EDIT' window after the selection. The 'POS LEVEL' field now displays 'PL= 1' with a dropdown arrow, indicating that 'PL' has been selected from the dialog box. The 'JOINT SPEED' and 'NWAIT' fields remain unchanged from the previous screenshots.</p>

	Operation	Explanation
4	Press [ENTER].	<div>To change the position level, select the level in the input buffer line, type the value using the Numeric keys, and press [ENTER]. The position level's move instruction is registered.</div> <div></div>
5	Press [ENTER].	

To perform the movement steps shown below, set as follows:



Steps P2, P4, and P5 are simple passing points, and do not require accurate positioning. Adding PL=1 to 8 to the move instructions of these steps moves the manipulator around the inner corners, thereby reducing the cycle time. If complete positioning is necessary as P3 or P6, add PL=0.

**<EXAMPLE>**

- Passing points P2, P4, and P5:  
    MOVL V=138 PL=3
- Positioning point P3 and P6:  
    MOVL V=138 PL=0

## 4.2 Teaching Operation

## ■ Registering Reference Point Instructions

Reference point instructions (REFP) set an auxiliary point such as a wall point for weaving. Reference point Nos. 1 to 8 are assigned for each application. Follow these procedures to register reference point instructions.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	
3	Move the cursor.	<p>Move the cursor to the line immediately before the position where the reference point to be registered.</p> <div> <p>Place immediately before where reference point is to be registered.</p> <pre> 0003  MOVL V=558 0004  CALL JOB: TEST 0005  MOVL V=138 </pre> </div>
4	Grasp the Enable switch.	The servo power is turned ON.
5	Press the axis operation key.	Move the manipulator to the position to be registered as the reference point.
6	Press [REFP].	<p>The reference point instruction is displayed in the input buffer line.</p> <div>⇒ REFP 1</div>
7	Change the reference point number.	<p>Move the cursor to the reference point number, and press [SHIFT] + the cursor key to change the reference point number.</p> <div>⇒ REFP 2</div> <p>If you use the Numeric keys to input the reference point number, press [SELECT] when the cursor is on the reference point number. The data input line appears. Input the number and press [ENTER].</p> <div> Ref-point no. =  ⇒ REFP  </div>
8	Press [INSERT].	<p>The [INSERT] key lamp lights.</p> <p>When registering before the END instruction, pressing [INSERT] is not needed.</p>
9	Press [ENTER].	<p>The REFP instruction is registered.</p> <div> <p>Reference point is registered.</p> <pre> 0003  MOVL V=558 0004  CALL JOB: TEST 0005  REFP 1 0006  MOVL V=138 </pre> </div>

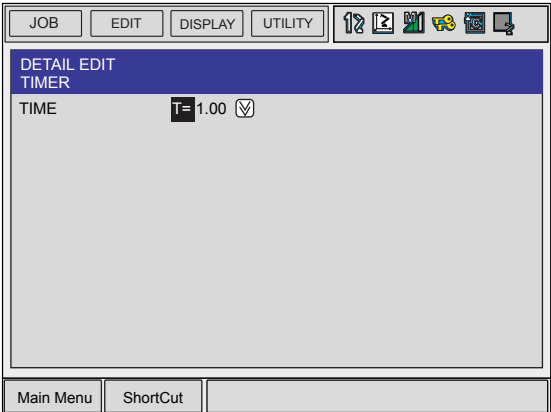
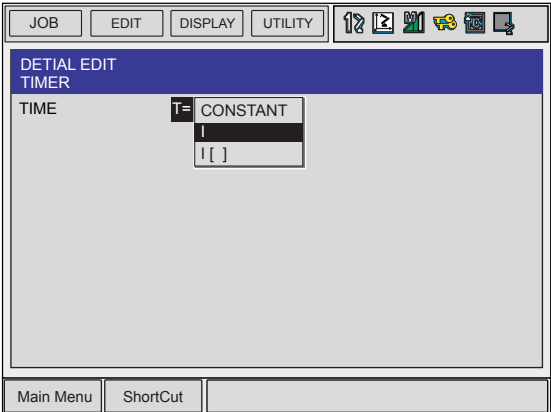


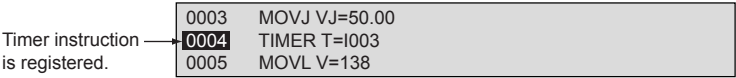
■     **Registering Timer Instructions**

The timer instruction stops the manipulator for a specified time. Follow these procedures to register timer instructions.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	
3	Move the cursor.	<p>Move the cursor to the line immediately before the position where the timer instruction is to be registered.</p> <div><p>Line immediately before where timer instruction is to be registered.</p><div><div>0003</div><div>MOVJ VJ=50.00</div></div><div><div>0004</div><div>MOVL V=138</div></div></div>
4	Press [TIMER].	<p>The TIMER instruction is displayed on the input buffer line.</p> <div><div>⇒</div><div>TIMER T=1.00</div></div>
5	Change the timer value.	<p>Move the cursor to the timer value and change it by pressing [SHIFT] + the cursor key. The timer unit of adjustment is 0.01 seconds.</p> <div><div>⇒</div><div>TIMER T=<u>2.00</u></div></div> <p>If you use the Numeric keys to input the timer value, press [SELECT] when the cursor is on the timer value. The data input line appears. Input the value and press [ENTER].</p> <div><div>Time =</div><div>⇒ TIMER T=</div></div>
6	Press [INSERT].	<p>The [INSERT] key lamp lights.</p> <p>When registering before the END instruction, pressing [INSERT] is not needed.</p>
7	Press [ENTER].	<p>The TIMER instruction is registered.</p> <div><p>Timer instruction is registered.</p><div><div>0003</div><div>MOVJ VJ=50.00</div></div><div><div>0004</div><div>TIMER T=2.00</div></div><div><div>0005</div><div>MOVL V=138</div></div></div>

## 4.2 Teaching Operation

## Changing Timer Value

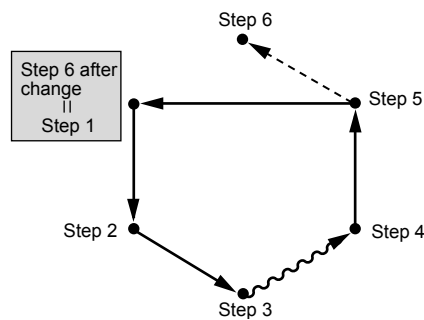
	Operation	Explanation
1	Press [TIMER].	
2	Press [SELECT].	<p>The DETAIL EDIT window for the TIMER instruction appears.</p> 
3	Input the timer value on the instruction DETAIL EDIT window.	<p>When <input checked="" type="checkbox"/> is selected, the items available to be changed are displayed in the dialog box. Select the particular item to be changed.</p>  <p>When a number is to be changed, move the cursor to the number and press [SELECT]. Input the desired value using the Numeric keys, and press [ENTER].</p> 
4	Press [ENTER].	<p>The DETAIL EDIT window is closed and the JOB CONTENT window appears again. Modified content is displayed in the input buffer line.</p> 
5	Press [INSERT].	The [INSERT] key lamp lights. When registering before the END instruction, pressing [INSERT] is not needed.
6	Press [ENTER].	<p>The TIMER instruction is registered.</p> 

## 4.2.4 Overlapping the First and Last Steps



### Why is overlapping the first and last step necessary?

Assume that the job shown below is to be repeated. The manipulator moves from the last step (Step 6) to the first step (Step 1). If Step 6 and Step 1 are the same position, the manipulator moves directly Step 5 to Step 1, thereby improving work efficiency.



The position of step 6 is changed to overlap with step 1.

	Operation	Explanation
1	Move the cursor to the first step line.	
2	Press [FWD].	The manipulator moves to the first step position.
3	Move the cursor to the last step line.	The cursor starts blinking. When the cursor line position and the manipulator position are different in the JOB CONTENT window, the cursor blinks.
4	Press [MODIFY].	The key lamp lights.
5	Press [ENTER].	The position data for the first step is registered on the line of the last step. At this time, only the position data can be changed in the last step. Interpolation type and play speed do not change.

## 4.3 Checking Steps

## 4.3 Checking Steps

### 4.3.1 FWD/BWD Key Operations

Check whether the position of the taught steps is appropriate using [FWD] or [BWD] on the programming pendant. Each time [FWD] or [BWD] is pressed, the manipulator moves by a single step.

[FWD] : Moves the manipulator ahead in step number sequence. Only the move instruction is executed when [FWD] is pressed, but when [INTERLOCK] + [FWD] are pressed, all instructions are executed. When [SHIFT] + [FWD] are pressed, the move instructions are executed in succession.

[BWD] : Moves the manipulator backward a step at a time in reverse step number sequence. Only the move instruction is executed.



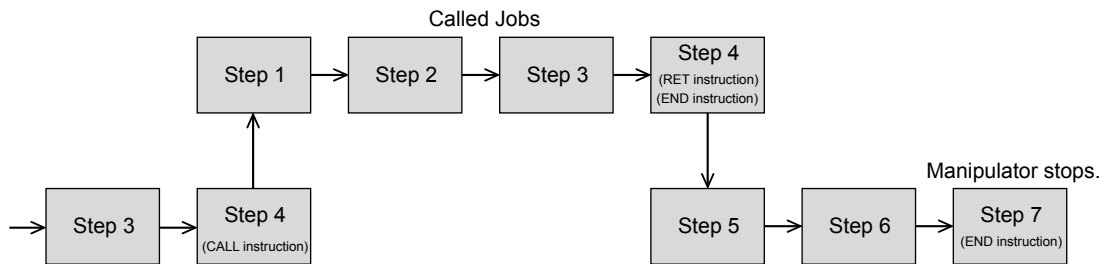
For safety, set manual speed at or below.

	Operation	Explanation
1	Move the cursor to the step to be confirmed.	
2	Press [FWD] or [BWD].	<p>If [FWD] / [BWD] are continuously pressed, the manipulator reaches the following / previous step and stops.</p> <div> </div> <p>Even if [FWD] is pressed, the manipulator does not proceed to the next job when an instruction other than the move instruction is registered. To proceed to the next job, perform either of the following operations:</p> <p><b>When executing instructions other than the move instruction :</b> Press [INTERLOCK] + [FWD].</p> <p><b>When not executing instructions other than the move instruction :</b> Move the cursor to the next move instruction and press [FWD].</p> <p><b>When executing move instructions in succession :</b> Press [SHIFT] + [FWD].</p> <p>To skip over a step, press [SHIFT] + the cursor key to move the cursor to desired position and press [FWD] or [BWD]. The manipulator moves directly to the step where the cursor is currently positioned.</p>

## ■ Precautions When Using FWD / BWD Operations

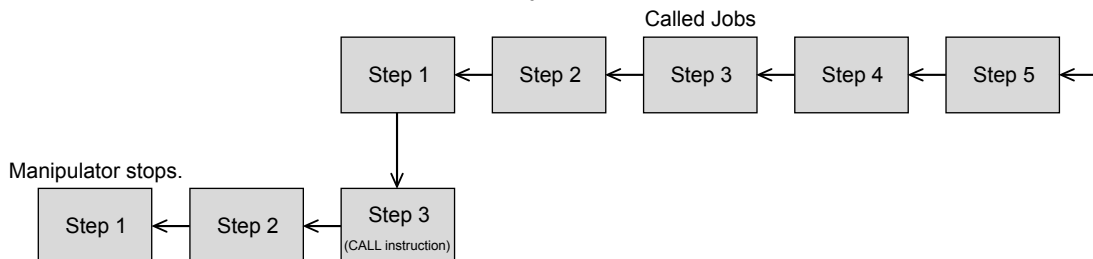
### FWD Movements

- The manipulator moves in step number sequence. Only move instructions are executed when [FWD] is pressed. To execute all instructions, press [INTERLOCK] + [FWD].
- The manipulator stops after playing a single cycle. It does not move after the END instruction is reached, even if [FWD] is pressed. However, at the end of a called job, the manipulator moves the instruction next to the CALL instruction.



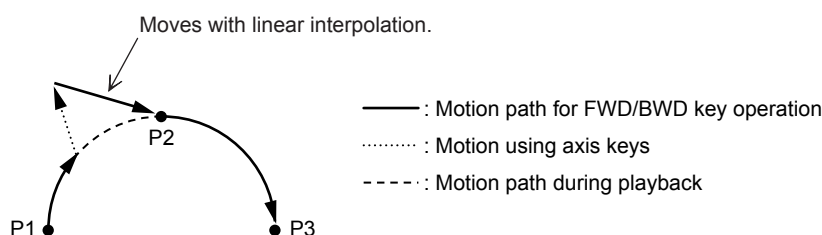
### BWD Movements

- The manipulator moves in reverse step number sequence. Only move instructions are executed.
- The manipulator stops after playing a single cycle. It does not move after the first step is reached, even if [BWD] is pressed. However, at the beginning of a called job, the manipulator moves to the instruction immediately before the CALL instruction.



### Circular Movements with FWD/BWD Key Operations

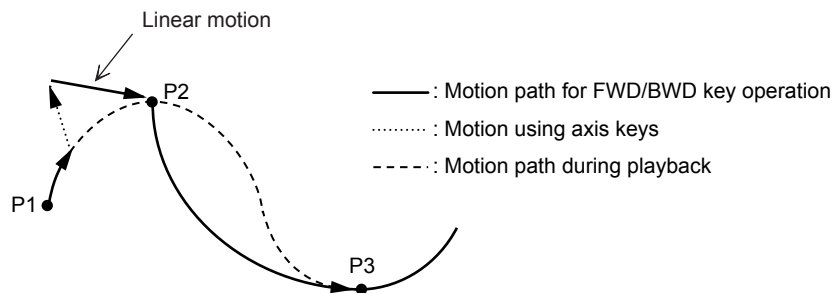
- The manipulator moves in a straight line to the first step of the circular interpolation.
- There must be three circular interpolation steps in a row to move the manipulator in an arc.
- If [FWD] or [BWD] operation is restarted after being stopped to move the cursor or to perform search, the manipulator moves in a straight line to the next step.
- If [FWD] or [BWD] operation is restarted after being stopped to move the axis as shown in the following, the manipulator moves in a straight line to P2, the next circular interpolation. Circular motion is restored from P2 and P3.



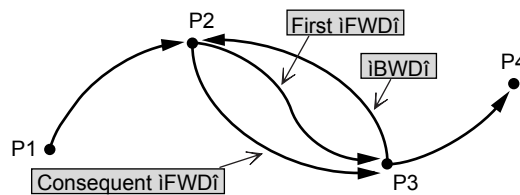
### 4.3 Checking Steps

#### Spline Curve Movements with FWD/BWD Operations

- The manipulator moves in a straight line to the first step of spline interpolation.
- There must be three spline curve motion steps in a row to perform a spline curve operation.
- Depending on the position where the [FWD] / [BWD] operation is performed, the alarm “IRREGULAR DISTANCES BETWEEN TEACHING POINTS” may occur. Note that FWD/BWD inching operations change the path of the manipulator and **caution is therefore required**. Performing these operations also increases the likelihood that the “IRREGULAR DISTANCES BETWEEN TEACHING POINTS” will occur.
- If the [FWD] or [BWD] operation is restarted after being stopped to move the cursor or perform a search, the manipulator moves in a straight line to the next step.
- If the [FWD] or [BWD] operation is restarted after being stopped to move the axis as shown in the following, the manipulator moves in a straight line to P2, the next spline curve motion step. Spline curve motion is restored from P2 onward. However, the path followed between P2 and P3 is somewhat different from the path followed at playback.



- If the manipulator is moved to P3 with [FWD], stopped, and then returned to P2 with [BWD], the path followed between P2 and P3 is different for each of the following: the first FWD operation, the BWD operation, and the consequent FWD operation.



## ■ Selecting Manual Speed

When [FWD] or [BWD] is pressed, the manipulator moves at the manual speed selected at that time. Selected manual speed can be checked by the manual speed indication on the programming pendant.



Manual speed is set with [FAST] and [SLOW]. FWD operation can be performed at a high speed by pressing [HIGH SPEED]. Follow these procedures to select a manual speed.

- Each time [FAST] is pressed, the speed is changed to the next setting in the following sequence: INCH, SLW, MED, and FST.



- Each time [SLOW] is pressed, the speed is changed to the next setting in the following sequence: FST, MED, SLW, and INCH.



- FWD/BWD operation is performed with SLW speed even if INCH is selected.
- [HIGH SPEED] is available only for the FWD operation but not for BWD operation.

## ■ Moving to Reference Point

To check the position of a taught reference point, follow these procedures to move the manipulator to the reference point.

	Operation	Explanation
1	Move the cursor to the reference point instruction line to be checked.	
2	Press [REFP] + [FWD].	The manipulator moves to the reference point of the cursor line.

## 4.3 Checking Steps

### ■ Test Operations

Playback operations can be simulated in the teach mode with test operations. This function is convenient for checking continuous paths and operation instructions.

Test operation differs in the following ways from actual playback in the play mode.



- Operation speeds greater than the maximum teaching speed are reduced to the maximum teaching speed.
- Only machine lock is available among special operations for playback in the play mode.
- Work instruction output, such as arc output, is not executed.

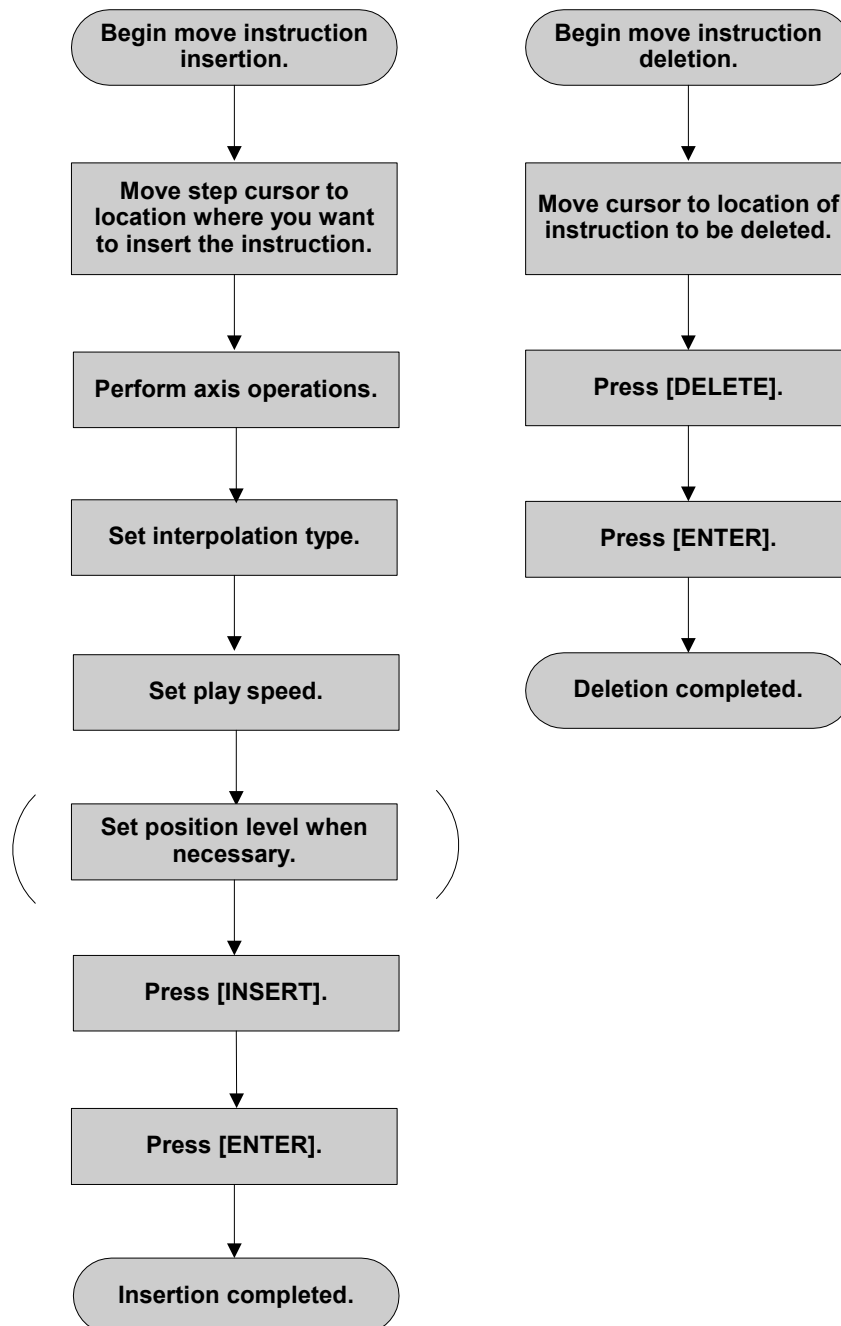
Test operation is performed by pressing [INTERLOCK] and [TEST START]. For safety purposes, these keys will only function while the keys are held down.



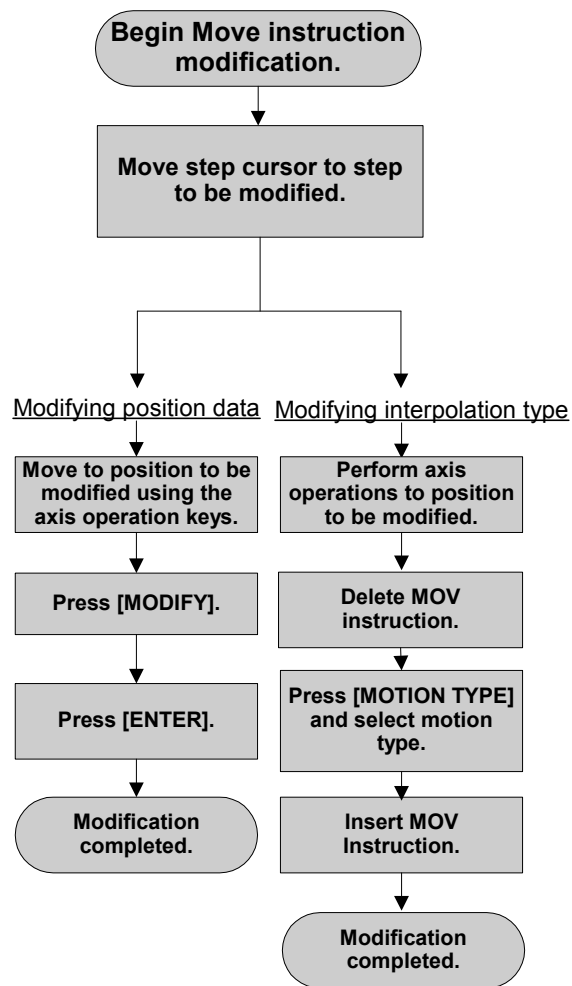
Always check safety conditions before pressing [INTERLOCK] + [TEST START] to start the manipulator in motion.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Press {JOB}.	The test operation JOB CONTENT window appears.
3	Press [INTERLOCK] + [TEST START].	The manipulator starts the test cycle operation. However, after the operation starts, the motion continues even if [INTERLOCK] is released. The manipulator moves only while these keys are held down. The manipulator stops immediately when [TEST START] is released.

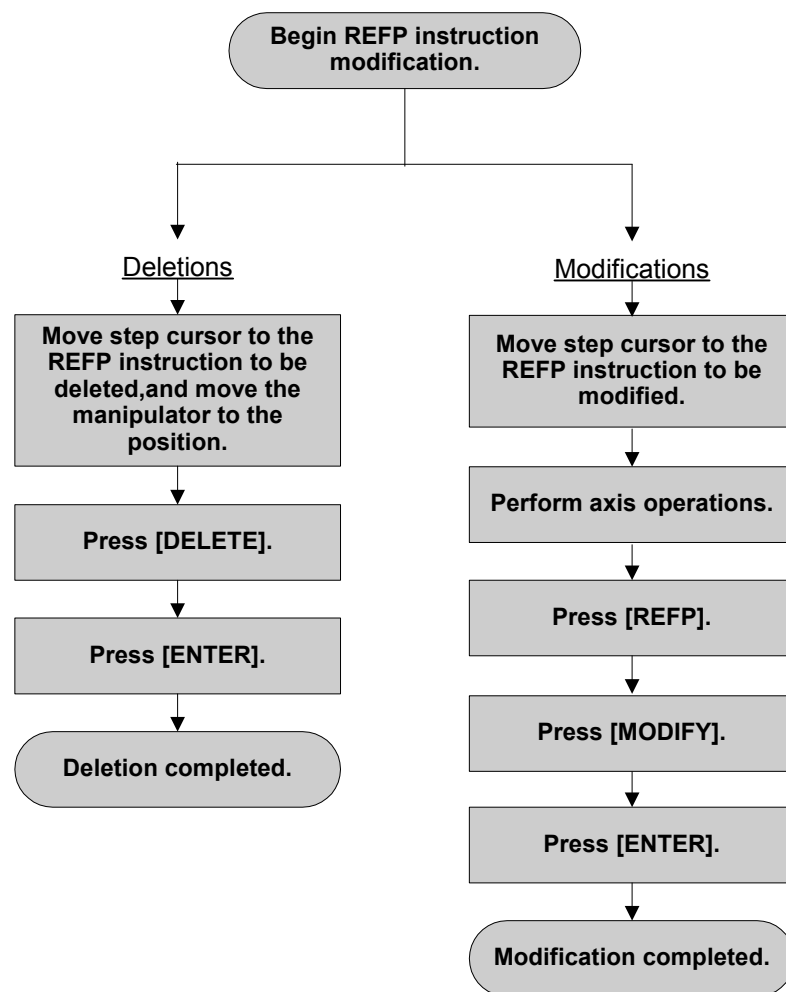
## 4.4 Modifying Steps



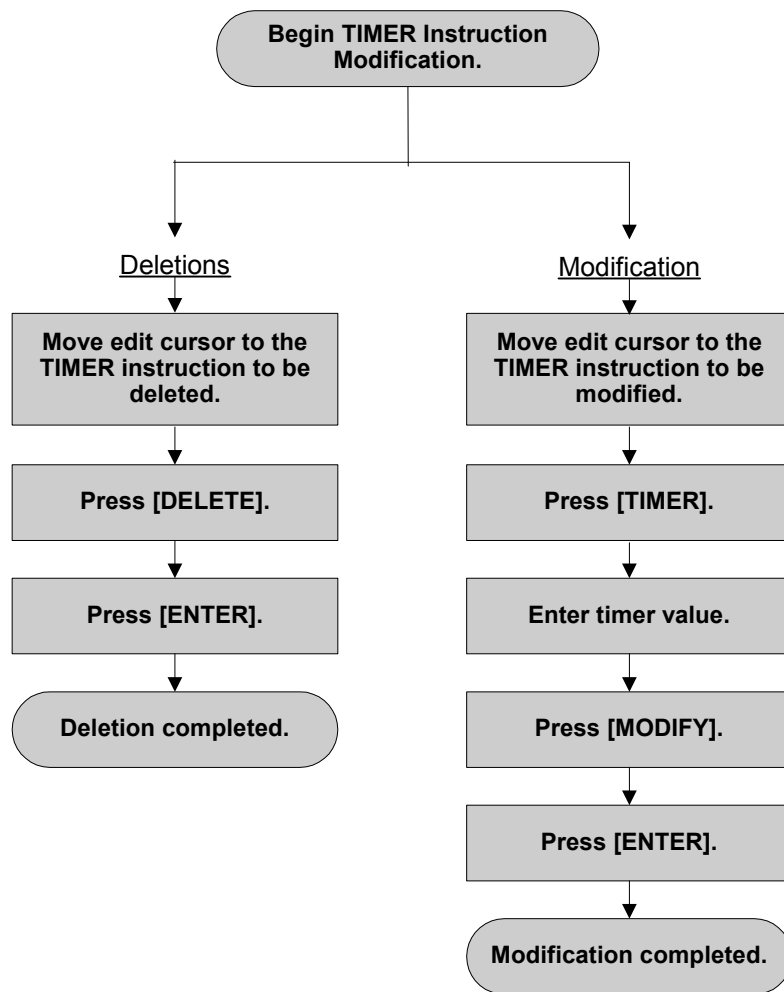
## 4.4 Modifying Steps



It is not possible to change a move instruction to a reference point instruction and vice versa.



#### 4.4 Modifying Steps



4.4.1     Displaying the JOB CONTENT Window for Editing

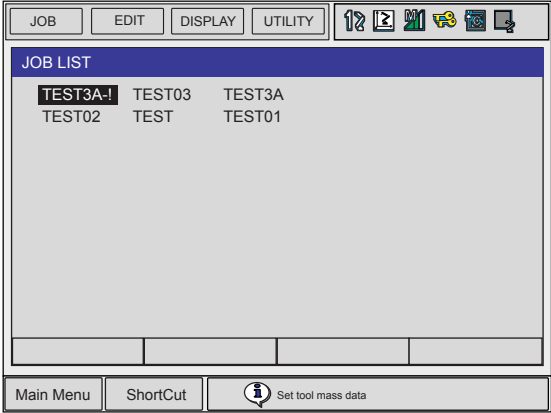
■     Currently Called Up Job

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	The JOB CONTENT window appears.

■     Calling Up Other Jobs

NOTE

In any other than the teach mode, set the mode switch to “TEACH.”

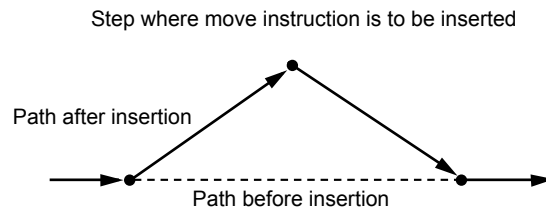
	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {SELECT JOB}.	The JOB LIST window appears. <div></div>
3	Select the job name to be called.	

## 4.4 Modifying Steps

## 4.4.2 Inserting Move Instructions



Move instructions cannot be inserted when the servo power is OFF.



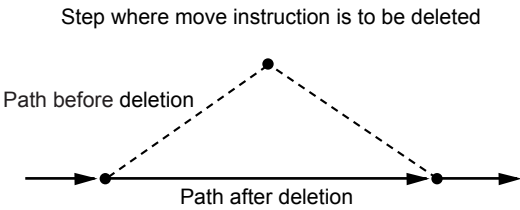
	Operation	Explanation
1	Move the cursor to the line immediately before the insert position.	<div> <div>Place immediately before where move instruction is to be added.</div> <div> <pre> 0006  MOVL V=276 0007  TIMER T=1.00 0008  DOUT OT#(1) ON 0009  MOVJ VJ=100.0 </pre> </div> </div>
2	Press the axis operation key.	Turn ON the servo power and press the axis operation key to move the manipulator to the position to be inserted. <div> <div>NOTE</div>           Confirm the move instruction on the input buffer line and set desired interpolation type and play speed.         </div>
3	Press [INSERT].	The key lamp will light. <div> <div>NOTE</div>           When the inserting position is immediately before the END instruction, pressing [INSERT] is not needed.         </div>
4	Press [ENTER].	The move instruction is inserted after the cursor line. <div> <div>Move instruction is added.</div> <div> <pre> 0006  MOVL V=276 0007  TIMER T=1.00 0008  DOUT OT#(1) ON 0009  MOVL V=558 0010  MOVJ VJ=100.0 </pre> </div> </div> <p><b>&lt;Examples of Inserting a Move Instruction&gt;</b></p> <p>When a move instruction is inserted in the following job, it is placed on different lines according to the setting in the TEACHING CONDITION window.</p> <div> <div>Before adding</div> <div>           Cursor line → <pre> 0006  MOVL V=276 0007  TIMER T=1.00 0008  DOUT OT#(1) ON 0009  MOVJ VJ=100.0 </pre> </div> <div> <div>After adding: when inserting before the next step</div> <div>           Add → <pre> 0006  MOVL V=276 0007  TIMER T=1.00 0008  DOUT OT#(1) ON 0009  MOVL V=558 0010  MOVJ VJ=100.0 </pre> </div> </div> <div> <div>After adding: when inserting after the cursor line</div> <div>           Add → <pre> 0006  MOVL V=276 0007  MOVL V=558 0008  TIMER T=1.00 0009  DOUT OT#(1) ON 0010  MOVJ VJ=100.0 </pre> </div> </div> </div>



**Positions where the move instructions are inserted.**

The default location for insertions is for “before the next step,” but it is also possible to insert “after the cursor line.” This setting is made in the “Move Instruction Register Method” in the TEACHING CONDITION window.

**4.4.3 Deleting Move Instructions**




	Operation	Explanation
1	Move the cursor to the move instruction to be deleted.	<div><div>Move instruction to be deleted</div><div><div>0003</div><div>MOVL V=138</div></div><div><div>0004</div><div>MOVL V=558</div></div><div><div>0005</div><div>MOVJ VJ=50.00</div></div></div> <div><div><div>NOTE</div></div><div>If the manipulator position differs from the cursor position on the window, the cursor blinks. Stop the blinking by either of the following procedures.<ul style="list-style-type: none"><li>• Press [FWD] and move the manipulator to the position where the move instruction is to be deleted.</li><li>• Press [MODIFY]→ [ENTER] to change the position data of the blinking cursor position to the current manipulator position.</li></ul></div></div>
2	Press [DELETE].	The key lamp will blink.
3	Press [ENTER].	The step indicated by cursor line is deleted. <div><div><div>0003</div><div>MOVL V=138</div></div><div><div>0004</div><div>MOVJ VJ=50.00</div></div></div>

## 4.4 Modifying Steps

## 4.4.4 Modifying Move Instructions

### ■ Modifying Position Data

	Operation	Explanation
1	Move the cursor to the MOV instruction to be modified.	Display the JOB CONTENT window and move the cursor to the move instruction to be changed.
2	Press the axis operation key.	Turn ON the servo power and press the axis operation key to move the manipulator to the desired position.
3	Press [MODIFY].	The key lamp will blink.
4	Press [ENTER].	The position data in the present position is registered.
		 For MOV instructions for which position variables have been set, the position variables will not be changed.

### ■ Modifying Interpolation Type



Modifying only interpolation type is impossible. The interpolation type can be modified as a choice for modifying the position data.

	Operation	Explanation
1	Move the cursor to the move instruction to be modified.	Display the JOB CONTENT window, and move the cursor to the move instruction for which interpolation type is to be changed.
2	Press [FWD].	Turn ON the servo power and press [FWD] to move the manipulator to the position of the move instruction.
3	Press [DELETE].	The key lamp will blink.
4	Press [ENTER].	The cursor line step is deleted.
5	Press [MOTION TYPE].	Press [MOTION TYPE] to change the interpolation type. Each time [MOTION TYPE] is pressed, the input buffer line instruction alternates.
6	Press [INSERT].	
7	Press [ENTER].	The interpolation type and position data are changed at the same time.


## 4.4.5 Undo Operation after Editing a Move Instruction

This function is for future use. (Cannot be used with the NX100 of the current version.)

After inserting, deleting, or modifying a move instruction, the operation can be undone.



The undo operation can be performed even after the manipulator is moved by the FWD or BWD operation or test operation after inserting, deleting, or modifying a move instruction. However, the undo operation cannot be performed if other instructions are edited or a job is executed in the play mode after editing the move instruction. When the undo operation is invalid, it cannot be selected by pressing [ASSIST]. The undo operation works only for the last edited instruction only.

	Operation	Explanation
1	Press [ASSIST].	The assist menu appears. 
2	Select {UNDO}.	The last operation is undone.

## 4.4.6 Modifying Reference Point Instructions

### ■ Deleting Reference Point Instructions



If the manipulator position differs from the cursor position, an error message is displayed. If this occurs, follow either of the procedures below.

- Press [REFP] + [FWD] to move the manipulator to the position to be deleted.
- Press [MODIFY] then [ENTER] to change the reference point position data to the current position of the manipulator.

	Operation	Explanation
1	Move the cursor to the reference point instruction to be deleted.	
2	Press [DELETE].	The key lamp will blink.
3	Press [ENTER].	The reference point instruction at the cursor line is deleted.

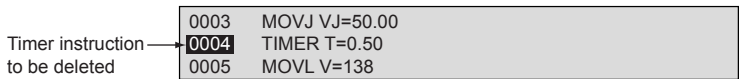

## 4.4 Modifying Steps

### ■ Modifying Reference Point Instructions

	Operation	Explanation
1	Move the cursor to the reference point instruction to be modified.	
2	Move the manipulator with the axis operation keys.	Turn ON the servo power and use the axis operation keys to move the manipulator to the desired position.
3	Press [REFP].	
4	Press [MODIFY].	The key lamp will light.
5	Press [ENTER].	The reference point instruction at the cursor line is changed.

## 4.4.7 Modifying Timer Instructions

### ■ Deleting Timer Instructions

	Operation	Explanation
1	Move the cursor to the timer instruction to be deleted.	
2	Press [DELETE].	The key lamp will light.
3	Press [ENTER].	The timer instruction at the cursor line is deleted.
		

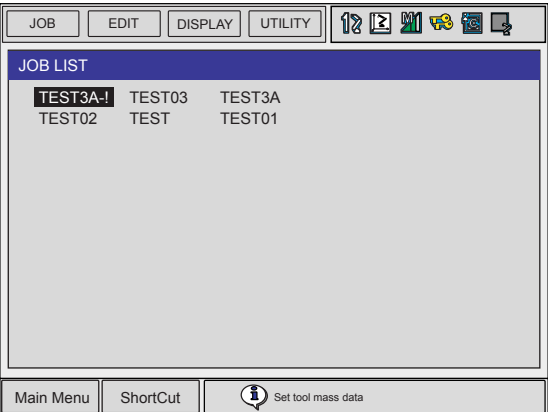
## ■ Modifying Timer Instructions

	Operation	Explanation
1	Move the cursor to the timer instruction to be modified.	<div> 0003 MOVJ VJ=50.00  0004 <b>TIMER T=0.50</b>  0005 MOVL VJ=138  0006 MOVL VJ=138 </div>
2	Press [TIMER].	<div> 0003 MOVJ VJ=50.00  0004 <b>TIMER</b>T=0.50  0005 MOVL VJ=138  0006 MOVL VJ=138 </div>
3	Move the cursor to the input buffer line timer value.	<p>Move the cursor to the input buffer line timer value and press [SHIFT] + the cursor key to set the data. To use the Numeric keys to input data, move the cursor to the input buffer line timer value and press [SELECT].</p> <div>⇒ TIMER T=<b>0.50</b></div>
4	Change the timer value.	
5	Press [MODIFY].	This key lamp will light.
6	Press [ENTER].	<p>The timer instruction at the cursor line is changed.</p> <div> 0003 MOVJ VJ=50.00  <b>0004</b> TIMER T=1.00  0005 MOVL VJ=138  0006 MOVL VJ=138 </div>

## 4.5 Modifying Jobs

## 4.5 Modifying Jobs

### 4.5.1 Calling Up a Job

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {SELECT JOB}.	<p>The JOB LIST window appears.</p> 
3	Select the desired job.	

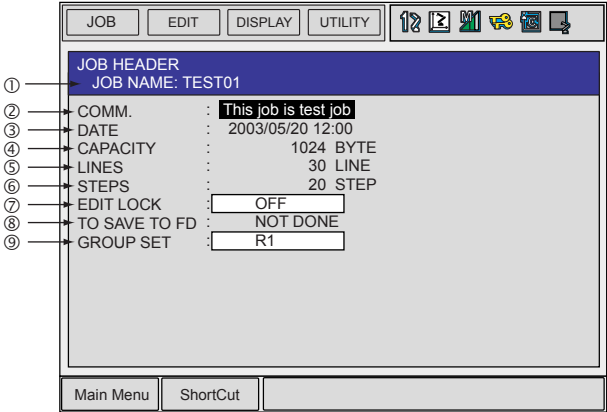

### 4.5.2 Windows Related to Job

There are five types of job windows. Jobs can be checked and edited in these windows.

- **JOB HEADER Window**  
Comments, data and time of registration, edit prohibit status, and so on are displayed and edited.
- **JOB CONTENT Window**  
The content of the registered job can be displayed and edited.
- **COMMAND POSITION Window**  
The taught data is displayed.
- **JOB LIST Window**  
The registered job is sorted alphabetically, then displayed, and the job is selected.
- **JOB CAPACITY Window**  
The number of registered jobs, amount of memory, number of steps used, etc. is shown.



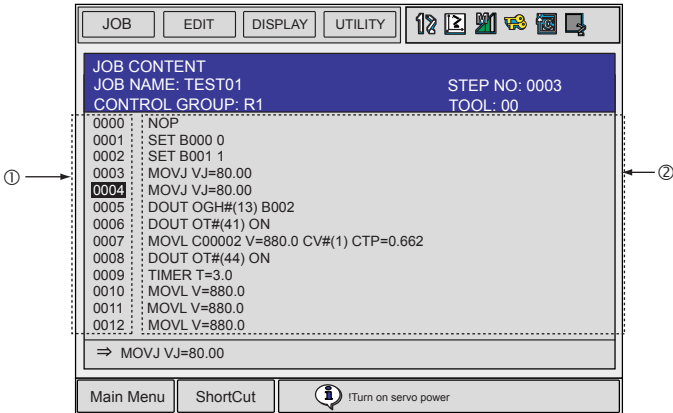
#### ■ JOB HEADER Window

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	

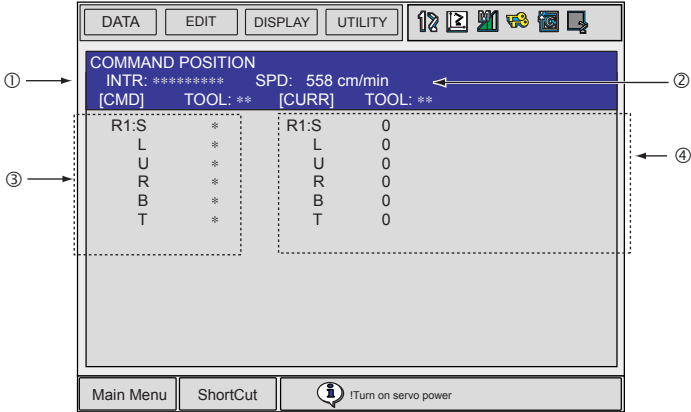
	Operation	Explanation
3	Select {DISPLAY} under the menu.	
4	Select {JOB HEADER}.	<p>The JOB HEADER window appears. Scroll the window using the cursor.</p> <div></div> <p>①<b>JOB NAME</b> Displays the name of the current job.</p> <p>②<b>COMM</b> Displays the comments attached to the current job. This can be edited in this window.</p> <p>③<b>DATE</b> Displays the date and time of the last editing of the job.</p> <p>④<b>CAPACITY</b> Displays the amount of memory that is being used to register this job.</p> <p>⑤<b>LINES</b> Displays the total number of instructions registered in this job.</p> <p>⑥<b>STEPS</b> Displays the total number of move instructions registered in this job.</p> <p>⑦<b>EDIT LOCK</b> Displays whether the edit prohibit setting for this job is at ON or OFF. This can be changed in this window.</p> <p>⑧<b>TO SAVE TO FD</b> Displays “DONE” if the contents of the job are saved to a floppy disk since the date and time of the last editing operation, and displays “NOT DONE” if they are not saved. The job is marked as “DONE” only if it is saved as an independent job or as a related job. If it is saved in a CMOS batch operation, it is not marked as “DONE.”</p> <p>⑨<b>GROUP SET</b> Displays the setting status for the group axes that this job controls. If the master axis is specified, the master axis is highlighted.</p> <div> To return to the JOB CONTENT window from the JOB HEADER window, select {DISPLAY} from the menu and then select {JOB CONTENT}.</div>

## 4.5 Modifying Jobs

## ■ JOB CONTENT Window

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	<p>The JOB CONTENT window appears.</p> <p>  ← (Left) : The cursor is moved to the address area.              → (Right): The cursor is moved to the instruction area.         </p>  <p> <b>①Address Area</b>            Displays line numbers.         </p> <p> <b>②Instruction Area</b>            Displays instructions, additional items, and comments. Line editing is possible.         </p>

■ COMMAND POSITION Window

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {COMMAND POSITION}.	<div>Edit operations cannot be conducted from this window, but the taught play speed and position data can be viewed on this window.</div> <div><p>The screenshot shows the 'COMMAND POSITION' window. At the top are tabs: DATA, EDIT, DISPLAY, and UTILITY. Below the tabs is a header bar with 'COMMAND POSITION' and 'INTR: *****'. To the right of the header is 'SPD: 558 cm/min'. Below the header is a table with columns: [CMD], TOOL: **, [CURR], and TOOL: **. The table has two sections: 'R1:S' and 'R1:S'. The first section has rows for L, U, R, B, and T, all marked with an asterisk (*). The second section has rows for L, U, R, B, and T, all with numerical values (0). Callout 1 points to the 'INTR' field. Callout 2 points to the 'SPD' field. Callout 3 points to the first section of the table. Callout 4 points to the second section of the table. At the bottom of the window are buttons: 'Main Menu', 'ShortCut', and a button with an 'i' icon and the text 'i Turn on servo power'.</p></div> <div><div>①<b>Interpolation</b> Displays the interpolation type.</div><div>②<b>Speed</b> Displays the play speed.</div><div>③<b>Command Position</b> Displays the tool file number and position data that has been taught for this job. Steps which have no position data, such as move instructions which use position variables, are marked with an asterisk (*).</div><div>④<b>Current Data</b> Displays the current tool file number and position of the manipulator.</div></div>

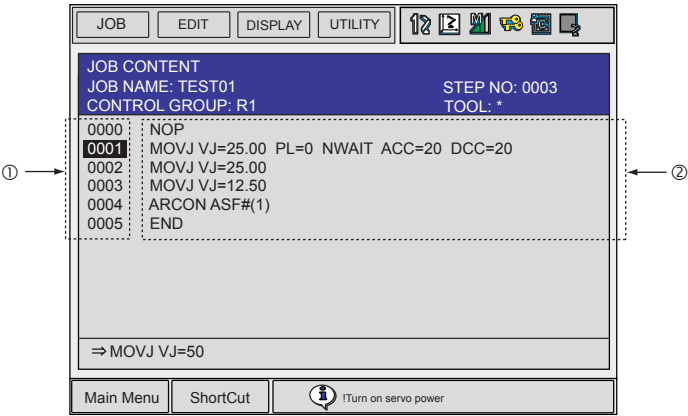
## 4.5 Modifying Jobs

## JOB CAPACITY Window

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB CAPACITY}.	<div> </div> <p>① <b>NUMBER OF JOBS</b> Displays the total number of jobs currently registered in the memory of NX100.</p> <p>② <b>USED MEMORY</b> Displays the total amount of memory used in the NX100.</p> <p>③ <b>STEPS</b> Displays the total number of used steps.</p>

# 4.6 Editing Instructions

The content of editing differs depending on where the cursor is in the address area or instruction area.



①**When the cursor is in the address area**

Instructions can be inserted, deleted, or modified.

②**When the cursor is in the instruction area**


Date of additional items of already-registered instructions can be modified, inserted, or deleted.

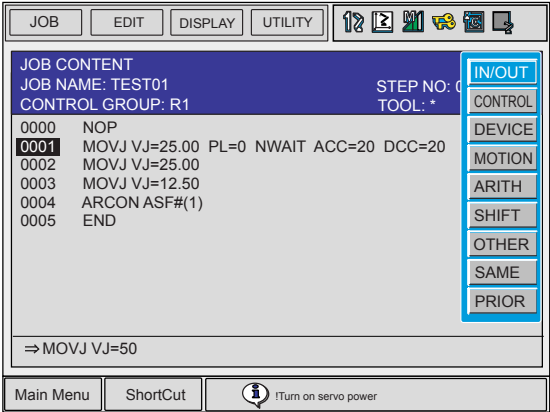
Editing additional items only is called “line editing.”

When inserting or modifying instructions, input the instruction with the function keys such as [TIMER], etc. or using the instruction list dialog box. The selected instruction is displayed on the input buffer line with the same additional items as registered previously.

## 4.6.1 Instruction Group

The instructions are divided into eight groups by processing or each work.

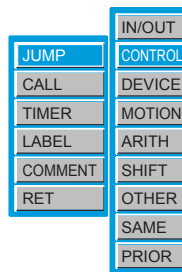
By pressing [INFORM LIST] , the instruction group list dialog box appears.



## 4.6 Editing Instructions

Display	Instruction Group	Contents	Example
IN/OUT	I/O Instructions	Controls input and output	DOUT, WAIT
CONTROL	Control Instructions	Controls processing of each work	JUMP, TIMER
DEVICE	Work Instructions	Operates arc welding, spot welding, handling, painting, etc.	ARCON, WVON, SVSPOT, SPYON
MOTION	Move Instructions	Moves the manipulator	MOVJ, REFP
ARITH	Operating Instructions	Performs arithmetic calculation	ADD, SET
SHIFT	Shift Instructions	Shifts the teaching point	SFTON, SFTOF
SENS (Option)	Sensor Instructions (Option)	Instructions related to the sensor	COMARCON
OTHER	Other Instructions	Instructions for functions other than above	SHCKSET
SAME	-	Specifies the instruction where the cursor is.	
PRIOR	-	Specifies the previously-registered instruction.	



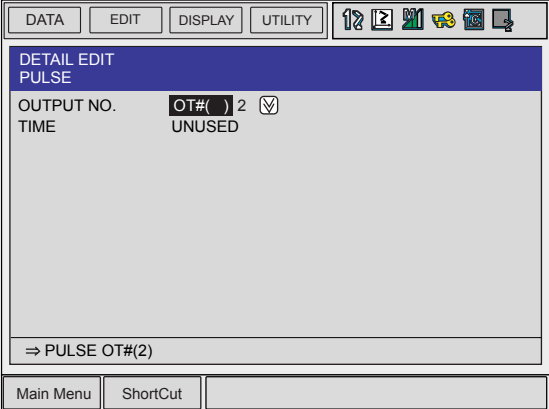
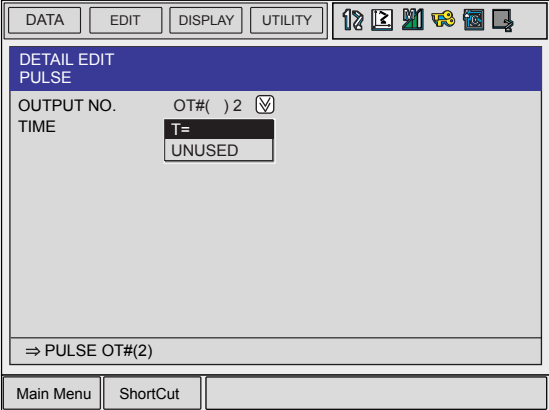
By selecting a group, the instruction list dialog box of the selected group appears.


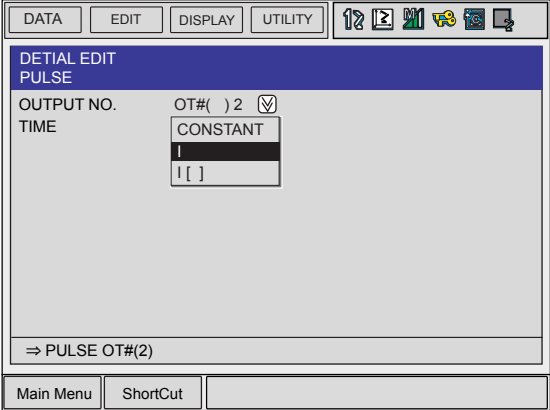
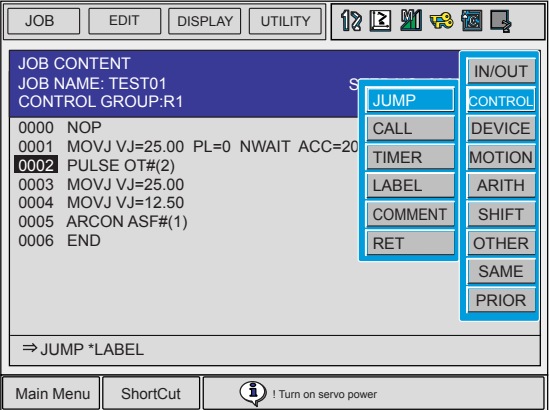


4.6.2 Inserting Instructions

	Operation	Explanation
1	Move the cursor to the address area in the JOB CONTENT window.	<p>Move the cursor to the line immediately before where the instruction is to be inserted, in the teach mode.</p> <div><div>Line before where instruction is to be added.</div><div><div>0000</div><div>NOP</div></div><div><div>0001</div><div>MOVJ VJ=25.00 PL=0 NWAIT ACC=20 DCC=20</div></div><div><div>0002</div><div>MOVJ VJ=25.00</div></div></div>
2	Press [INFORM LIST].	<p>The INFORM command list appears, and an underline is displayed beneath the line number in the address area.</p> <div><div><div>JOB</div><div>EDIT</div><div>DISPLAY</div><div>UTILITY</div><div><div>12</div><div>2</div><div>3</div><div>4</div><div>5</div><div>6</div><div>7</div><div>8</div><div>9</div><div>0</div><div>.</div><div>,</div><div>[F1]</div><div>[F2]</div><div>[F3]</div><div>[F4]</div><div>[F5]</div><div>[F6]</div><div>[F7]</div><div>[F8]</div><div>[F9]</div><div>[F10]</div><div>[F11]</div><div>[F12]</div></div></div><div><div>JOB CONTENT</div><div>JOB NAME: TEST01</div><div>CONTROL GROUP: R1</div><div>STEP NO: 0</div><div>TOOL: *</div><div><div>0000</div><div>NOP</div></div><div><div>0001</div><div>MOVJ VJ=25.00 PL=0 NWAIT ACC=20 DCC=20</div></div><div><div>0002</div><div>MOVJ VJ=25.00</div></div><div><div>0003</div><div>MOVJ VJ=12.50</div></div><div><div>0004</div><div>ARCON ASF#(1)</div></div><div><div>0005</div><div>END</div></div><div><div>⇒ MOVJ VJ=50</div></div></div><div><div>Main Menu</div><div>ShortCut</div><div><div>!</div><div>Turn on servo power</div></div></div></div>
3	Select the instruction group.	<p>The instruction list dialog box appears. The selected instruction is displayed on the input buffer line with the same additional items as registered previously.</p> <div><div><div>JOB</div><div>EDIT</div><div>DISPLAY</div><div>UTILITY</div><div><div>12</div><div>2</div><div>3</div><div>4</div><div>5</div><div>6</div><div>7</div><div>8</div><div>9</div><div>0</div><div>.</div><div>,</div><div>[F1]</div><div>[F2]</div><div>[F3]</div><div>[F4]</div><div>[F5]</div><div>[F6]</div><div>[F7]</div><div>[F8]</div><div>[F9]</div><div>[F10]</div><div>[F11]</div><div>[F12]</div></div></div><div><div>JOB CONTENT</div><div>JOB NAME: TEST01</div><div>CONTROL GROUP: R1</div><div>STEP NO: 0</div><div>TOOL: *</div><div><div>0000</div><div>NOP</div></div><div><div>0001</div><div>MOVJ VJ=25.00 PL=0 NWAIT ACC=</div></div><div><div>0002</div><div>MOVJ VJ=25.00</div></div><div><div>0003</div><div>MOVJ VJ=12.50</div></div><div><div>0004</div><div>ARCON ASF#(1)</div></div><div><div>0005</div><div>END</div></div><div><div>⇒ JUMP *LABEL</div></div></div><div><div>Main Menu</div><div>ShortCut</div><div><div>!</div><div>Turn on servo power</div></div></div></div>
4	Select the instruction.	

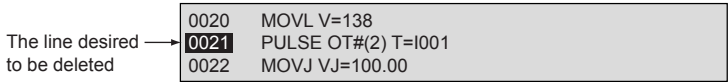
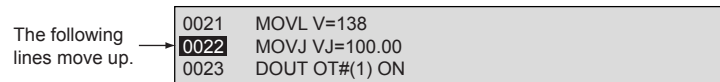
## 4.6 Editing Instructions

	Operation	Explanation
5	Change the data of additional items or variables as required.	<p><b>&lt;When Nothing is to be Changed&gt;</b> Proceed to Step 6.</p> <p><b>&lt;When Additional Items are to be edited&gt;</b></p> <ul style="list-style-type: none"> <li>Changing numeric data Move the cursor to the desired item and press [SHIFT] + the cursor key to increase or decrease the value.</li> </ul>  <p>To directly input the value using Numeric keys, press [SELECT] to display the input buffer line.</p>  <p>Type the value and press [ENTER]. The value on the input buffer line is changed.</p> <ul style="list-style-type: none"> <li>Adding, modifying, or deleting an item To add, modify, or delete an additional item, move the cursor to the instruction on the input buffer line and press [SELECT]. The DETAIL EDIT window appears.</li> </ul>  <p>To add an item, move the cursor to “UNUSED” and press [SELECT]. The selection dialog box appears. Move the cursor to the desired item and press [SELECT].</p> <p>To delete an item, move the cursor to the item to be deleted and select “UNUSED.”</p> 

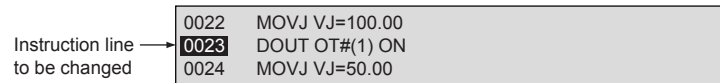
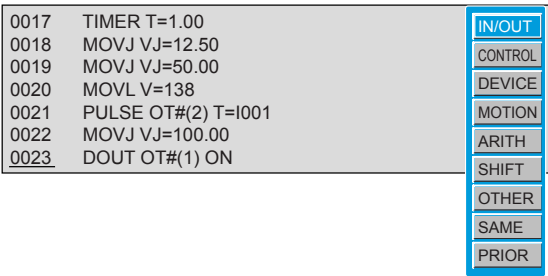
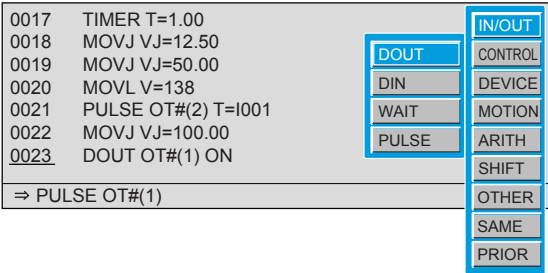
	Operation	Explanation
5	(cont'd)	<div><div>• Changing the data type</div><div>To change the data type of an additional item, move the cursor to  of the item and press [SELECT]. The data type list appears. Select the desired data type.</div></div> <div></div> <div>After additional items have been added, modified, or deleted as required, press [ENTER]. The DETAIL EDIT window closes and the JOB CONTENT window appears.</div>
6	Press [INSERT] and [ENTER].	<div>The instruction displayed in the input buffer line is inserted. When adding immediately before the END instruction, pressing [INSERT] is not needed.</div> <div></div>

## 4.6 Editing Instructions

## 4.6.3 Deleting Instructions


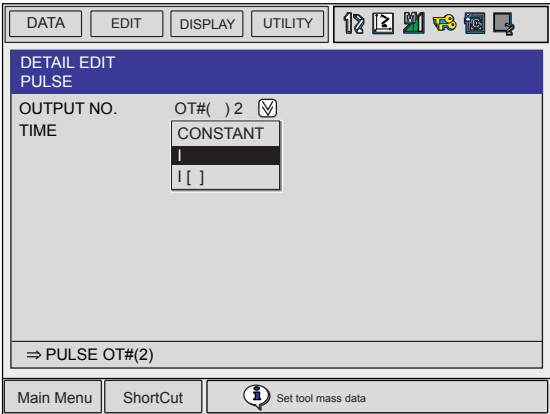
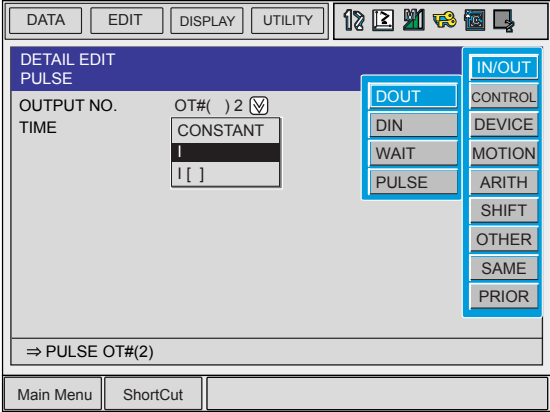
	Operation	Explanation
1	Move the cursor to the address area in the JOB CONTENT window.	Move the cursor to the instruction line to be deleted, in the teach mode.
2	Move the cursor to the deleting line in the address area.	 <p>The line desired to be deleted</p> <pre> 0020  MOVL V=138 0021  PULSE OT#(2) T=I001 0022  MOVJ VJ=100.00           </pre>
3	Press [DELETE] and [ENTER].	<p>The instruction is deleted and the following lines move up.</p>  <p>The following lines move up.</p> <pre> 0021  MOVL V=138 0022  MOVJ VJ=100.00 0023  DOUT OT#(1) ON           </pre>

## 4.6.4 Modifying Instructions

	Operation	Explanation
1	Move the cursor to the address area in the JOB CONTENT window.	<p>Move the cursor to the instruction line to be modified, in the teach mode.</p>  <p>Instruction line to be changed</p> <pre> 0022  MOVJ VJ=100.00 0023  DOUT OT#(1) ON 0024  MOVJ VJ=50.00           </pre>
2	Press [INFORM LIST].	<p>The INFORM command list appears, and an underline is displayed beneath the line number in the address area.</p> 
3	Select the instruction group.	<p>The instruction list dialog box appears. The selected instruction is displayed on the input buffer line with the same additional items as registered previously.</p> 
4	Select the instruction to be modified.	

	Operation	Explanation
5	Change the data of additional items or variables as required.	<div><div>&lt;Editing Additional Items&gt;</div><div><div>• Changing numeric data</div><div>Move the cursor to the desired item and press [SHIFT] + the cursor key to increase or decrease the value.</div><div><div>⇒ PULSE OT#(2)</div></div><div>To directly input the value using Numeric keys, press [SELECT] to display the input buffer line.</div><div><div>OUTPUT NO.=</div><div>⇒ PULSE OT#( )</div></div><div>Type the value and press [ENTER]. The value on the input buffer line is changed.</div></div><div><div>• Adding, modifying, or deleting an item</div><div>To add, modify, or delete an additional item, move the cursor to the instruction on the input buffer line and press [SELECT]. The DETAIL EDIT window appears.</div><div><div><div><div>DATA</div><div>EDIT</div><div>DISPLAY</div><div>UTILITY</div></div><div><div>1234567890</div><div>DETAIL EDIT</div><div>PULSE</div><div>OUTPUT NO. OT#( ) 2</div><div>TIME UNUSED</div></div><div><div>⇒ PULSE OT#(2)</div></div><div><div>Main Menu</div><div>ShortCut</div><div>Set tool mass data</div></div></div></div><div>To add an item, move the cursor to “UNUSED” and press [SELECT]. The selection dialog box appears.</div><div>Move the cursor to the desired item and press [SELECT].</div><div>To delete an item, move the cursor to the item to be deleted and select “UNUSED.”</div><div><div><div><div>DATA</div><div>EDIT</div><div>DISPLAY</div><div>UTILITY</div></div><div><div>1234567890</div><div>DETAIL EDIT</div><div>PULSE</div><div>OUTPUT NO. OT#( ) 2</div><div>TIME T=</div><div>UNUSED</div></div><div><div>⇒ PULSE OT#(2)</div></div><div><div>Main Menu</div><div>ShortCut</div><div>Set tool mass data</div></div></div></div></div></div>


## 4.6 Editing Instructions

	Operation	Explanation
5	(cont'd)	<p>• Changing the data type</p> <p>To change the data type of an additional item, move the cursor to  of the item and press [SELECT]. The data type list appears. Select the desired data type.</p>  <p>After additional items have been added, modified, or deleted as required, press [ENTER]. The DETAIL EDIT window closes and the JOB CONTENT window appears.</p>
6	Press [MODIFY] and [ENTER].	<p>The instruction is modified to the instruction displayed in the input buffer line.</p> 

## 4.6.5 Undo Operation after Modifying Instructions

This function is for future use. (Cannot be used with the NX100 of the current version.)

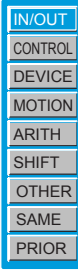
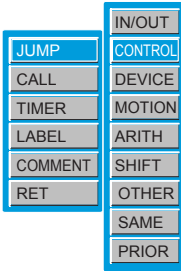
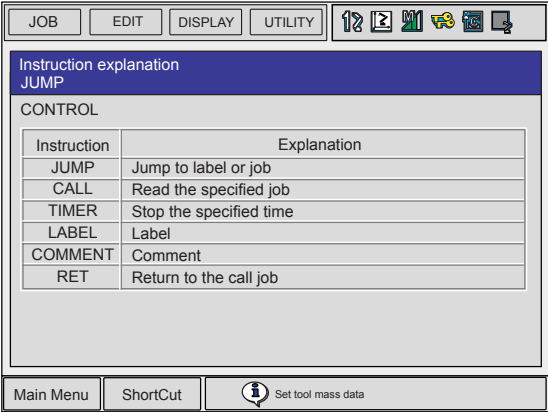
After modifying an instruction, the operation can be undone.

	Operation	Explanation
1	Press [ASSIST].	<p>The assist menu appears.</p> 
2	Select {UNDO}.	The last operation is undone.

### 4.6.6 Viewing Description for an Instruction

This function is for future use. (Cannot be used with the NX100 of the current version.)

When registering an instruction, the description for the specified instruction can be viewed.

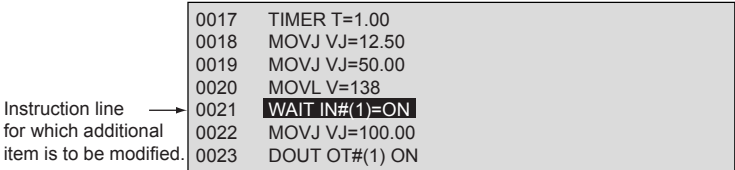
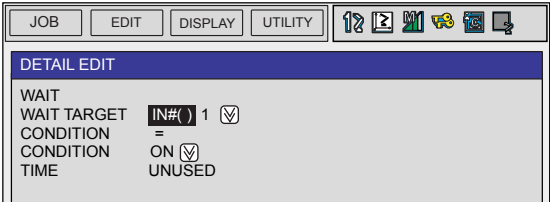
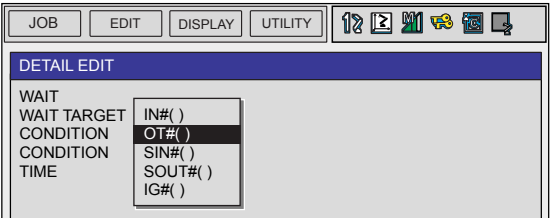
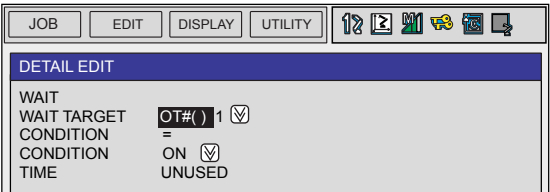
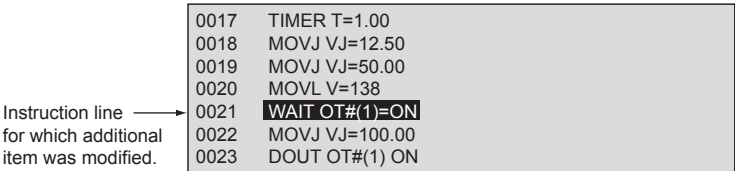
	Operation	Explanation
1	Press [INFORM LIST].	The instruction list dialog box appears. <div></div>
2	Select the instruction group.	The instruction list of the selected group appears. <div></div>
3	Move the cursor to the desired instruction and press [ASSIST].	The description window for the instruciton where the cursor points appears. <div></div>
4	Press [CANCEL].	The description window closes and the instruction list appears again.

## 4.6 Editing Instructions

**4.6.7** Modifying Additional Numeric Data

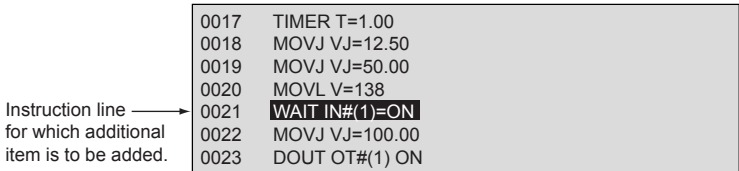
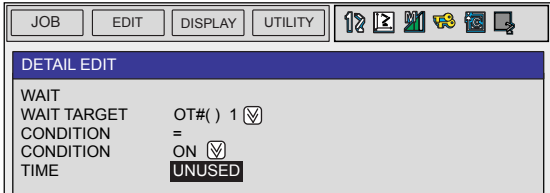
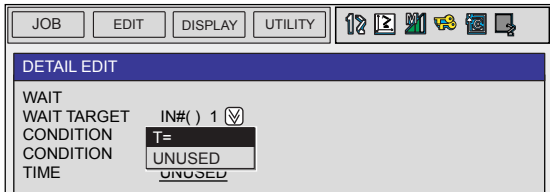
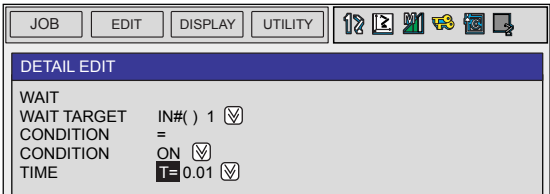

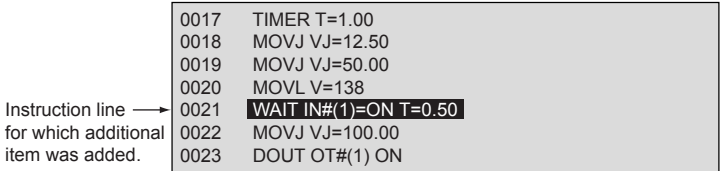
	Operation	Explanation
1	Mote the cursor to the instruction area in the JOB CONTENT window.	
2	Select the line where the number data is to be modified.	<p>The selected line can now be edited.</p> <div> <p>Number data to be modified →</p> <pre> 0017  TIMER T=1.00 0018  MOVJ VJ=12.50 0019  MOVJ VJ=50.00 0020  MOVL V=138 0021  PULSE OT#(2) T=I001 0022  MOVJ VJ=100.00 0023  DOUT OT#(1) ON </pre> </div>
3	Move the cursor to the numeric data to be modified.	
4	Input the desired number.	<p>Press [SHIFT] + the cursor key to increase or decrease the value. To directly input the number, press [SELECT]. The input buffer line appears. Type the number and press [ENTER].</p> <div> <p>⇒ PULSE OT#(2) T=I001</p> </div>
5	Press [ENTER].	<p>The numeric data is modified.</p> <div> <p>Instruction line for which numeric data was changed. →</p> <pre> 0017  TIMER T=1.00 0018  MOVJ VJ=12.50 0019  MOVJ VJ=50.00 0020  MOVL V=138 0021  PULSE OT#(1) T=I001 0022  MOVJ VJ=100.00 0023  DOUT OT#(1) ON </pre> </div>

## 4.6.8 Modifying Additional Items

	Operation	Explanation
1	Move the cursor to the instruction area in the JOB CONTENT window.	
2	Select the instruction line for which the additional item is to be modified.	<p>The selected line can now be edited.</p>  <pre> 0017  TIMER T=1.00 0018  MOVJ VJ=12.50 0019  MOVJ VJ=50.00 0020  MOVL V=138 0021  WAIT IN#(1)=ON 0022  MOVJ VJ=100.00 0023  DOUT OT#(1) ON           </pre>
3	Select the instruction.	<p>The DETAIL EDIT window appears.</p> 
4	Select the additional item to be modified.	<p>The selection dialog box appears.</p> 
5	Select the desired additional item.	<p>The modified additional item is displayed on the DETAIL EDIT window.</p> 
6	Press [ENTER].	<p>The DETAIL EDIT window closes, and the JOB CONTENT window appears.</p>
7	Press [ENTER].	<p>Contents of the input buffer line are registered on the cursor line of the instruction area.</p>  <pre> 0017  TIMER T=1.00 0018  MOVJ VJ=12.50 0019  MOVJ VJ=50.00 0020  MOVL V=138 0021  WAIT OT#(1)=ON 0022  MOVJ VJ=100.00 0023  DOUT OT#(1) ON           </pre>

## 4.6 Editing Instructions

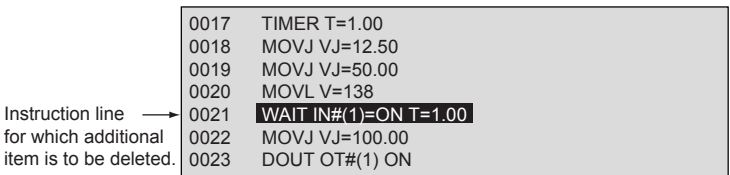
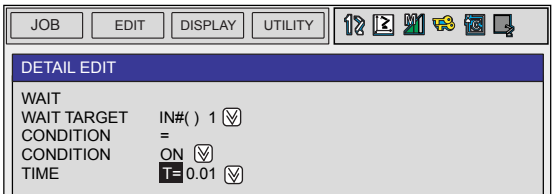
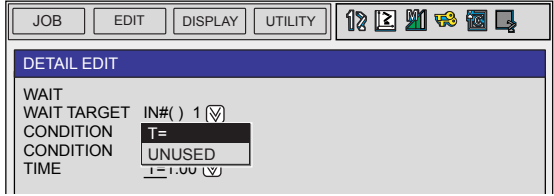
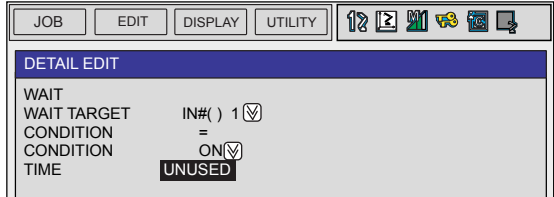
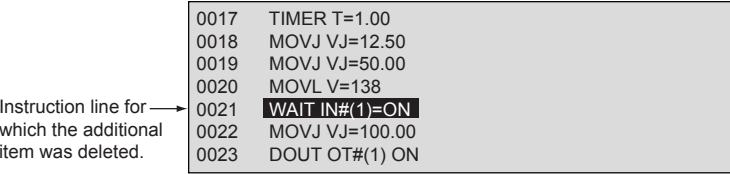
## 4.6.9 Inserting Additional Items

	Operation	Explanation
1	Move the cursor to the instruction area in the JOB CONTENT window.	
2	Select the instruction line for which the additional item is to be inserted.	<p>The selected line can now be edited.</p> 
3	Select the instruction.	<p>The DETAIL EDIT window appears.</p> 
4	Select the additional item to be inserted.	<p>The selection dialog box appears.</p> 
5	Select inserting additional item.	<p>The additional item is inserted.</p>  <p>When the additional item needs the numeric data, move the cursor to the number and press [SELECT]. The input buffer line appears. Type the number and press [ENTER].</p> 
6	Press [ENTER].	The DETAIL EDIT window closes, and the JOB CONTENT window appears.
7	Press [ENTER].	<p>Contents of the the input buffer line are registered on the cursor line of the instruction area.</p> 

## 4.6.10 Deleting Additional Items



This operation cannot be used for the additional item which is locked.


	Operation	Explanation
1	Move the cursor to the instruction area in the JOB CONTENT window.	
2	Select the line where the additional item is to be deleted.	<p>The selected line can be now be edited.</p>  <pre> 0017  TIMER T=1.00 0018  MOVJ VJ=12.50 0019  MOVJ VJ=50.00 0020  MOVL V=138 0021  WAIT IN#(1)=ON T=1.00 0022  MOVJ VJ=100.00 0023  DOUT OT#(1) ON           </pre>
3	Select the instruction.	<p>The DETAIL EDIT window appears.</p> 
4	Select the additional item to be deleted.	<p>The selection dialog box appears.</p> 
5	Select "UNUSED."	<p>"UNUSED" is displayed on the DETAIL EDIT window.</p> 
6	Press [ENTER].	<p>The DETAIL EDIT window closes, and the JOB CONTENT window appears.</p>
7	Press [ENTER].	<p>Contents of the input buffer line are registered on the cursor line of the instruction area.</p>  <pre> 0017  TIMER T=1.00 0018  MOVJ VJ=12.50 0019  MOVJ VJ=50.00 0020  MOVL V=138 0021  WAIT IN#(1)=ON 0022  MOVJ VJ=100.00 0023  DOUT OT#(1) ON           </pre>

---

### 4.6.11 Undo Operation after Modifying Additional Items

This function is for future use. (Cannot be used with the NX100 of the current version.)

After modifying an additional item, the operation can be undone.

	Operation	Explanation
1	Press [ASSIST].	The assist menu appears. 
2	Select {UNDO}.	The last operation is undone.

## 4.7 Editing Jobs

The following five operations are to edit jobs.

### Copy Cut

:Copies a specified range to the buffer.

:Copies a specified range from a job to the buffer, and deletes it in a job.

### Paste

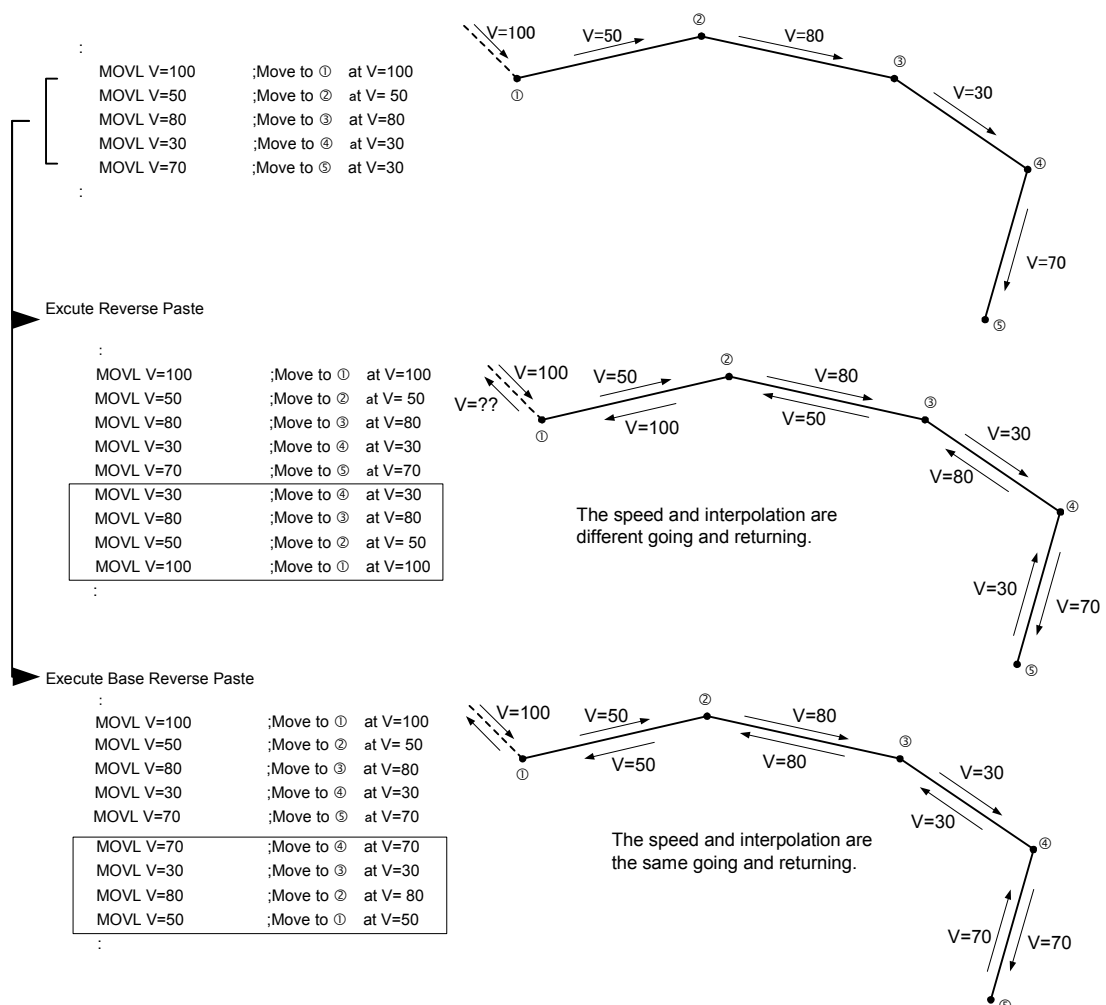
:Inserts the contents of the buffer into a job.

### Reverse Paste

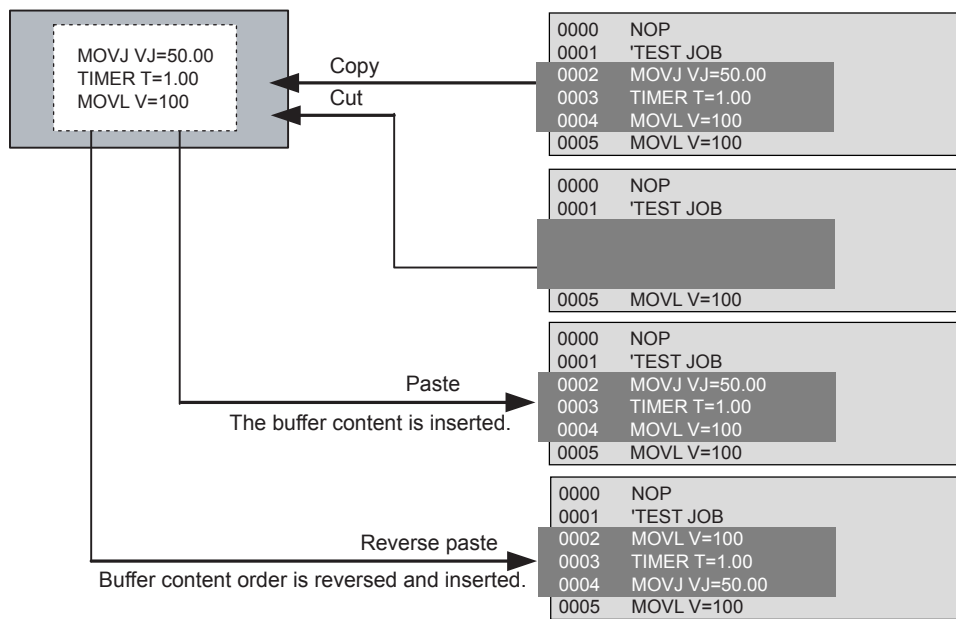
:Reverses the order of the contents of the buffer, and inserts them into a job. (Refer to the following figure.)

### Base Reverse Paste

:Reverses the order of the contents of the buffer and adjusts the to-and-from speeds same, and inserts them into a job. (Refer to the following figure.)

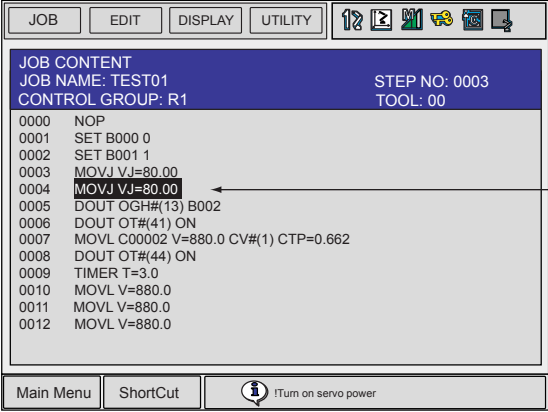
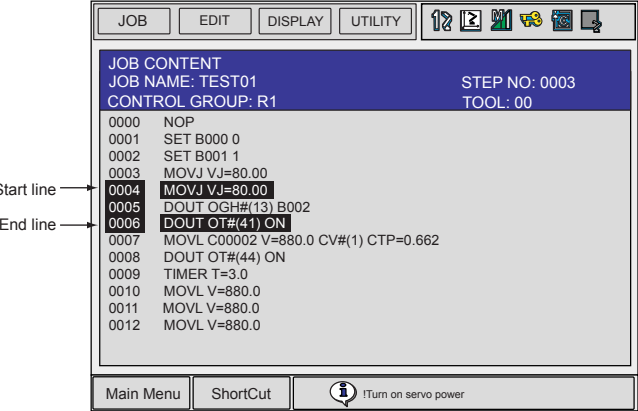


## 4.7 Editing Jobs



### 4.7.1 Selecting the Range

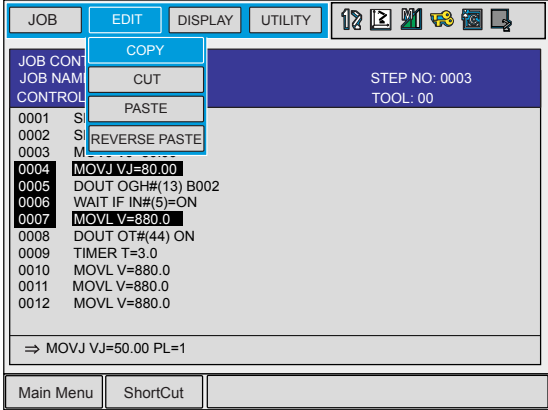
After setting the range, Copy and Delete can be performed.

	Operation	Explanation
1	Move the cursor to the instruction area in the JOB CONTENT window.	<div><p>Move the cursor to instruction area.</p></div>
2	Move the cursor to the start line and press [SHIFT] + [SELECT].	<div><p>The range specification begins, and the address is displayed in reverse.</p><div><p>Start line → 0004 End line → 0006</p></div></div>
3	Move the cursor to the end line.	<p>Moving the cursor effects to the range. Up to the line specified by the cursor is the range.</p>

## 4.7 Editing Jobs

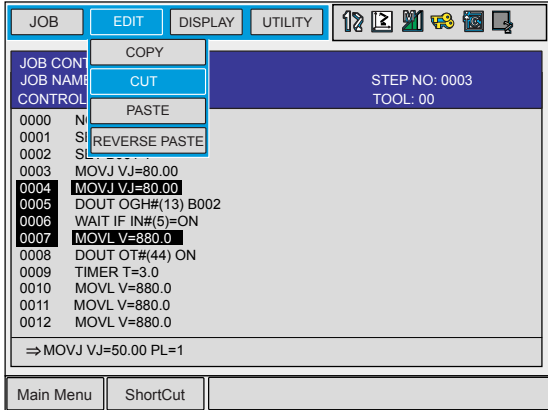
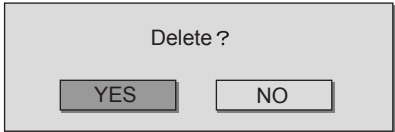
## 4.7.2 Copying

Before copying, the range to be copied has to be specified.

	Operation	Explanation
1	Select {EDIT} under the menu.	The pull-down menu appears.
		
2	Select {COPY}.	The specified range is copied to the buffer.

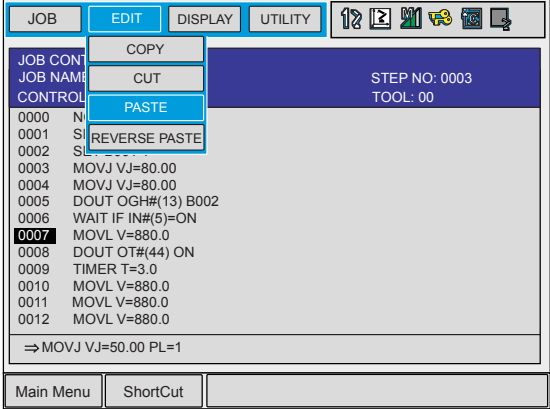

## 4.7.3 Cutting

Before cutting, the range to be cut has to be specified.

	Operation	Explanation
1	Select {EDIT} under the menu.	The pull-down menu appears.
		
2	Select {CUT}.	<p>The confirmation dialog box appears. When “YES” is selected, the specified range is deleted and copied to the buffer. When “NO” is selected, the cutting operation is cancelled.</p> 

4.7.4 Pasting

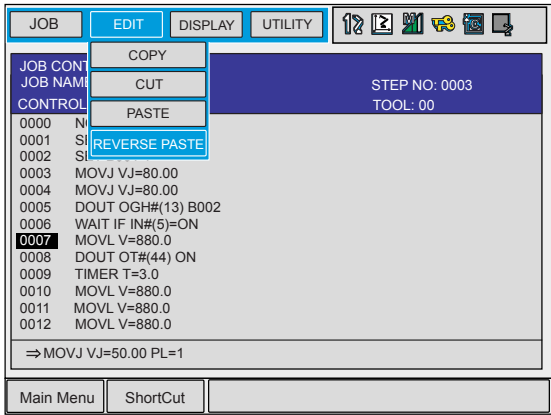

Before pasting, the range to be pasted has to be stored in the buffer.

	Operation	Explanation
1	Move the cursor to the line immediately before the desired position in the JOB CONTENT window.	
2	Select {EDIT} under the menu.	<div>The pull-down menu appears.</div> <div></div>
3	Select {PASTE}.	<div>The confirmation dialog box appears. When “YES” is selected, the contents of the buffer are inserted to the job. When “NO” is selected, the pasting operation is cancelled.</div> <div></div>

## 4.7 Editing Jobs

## 4.7.5 Reverse Pasting

Before pasting, the range to be pasted has to be stored in the buffer.

	Operation	Explanation
1	Move the cursor to the line immediately before the desired position in the JOB CONTENT window.	
2	Select {EDIT} under the menu.	<p>The pull-down menu appears.</p> 
3	Select {REVERSE PASTE}.	<p>The confirmation dialog box appears. When "YES" is selected, the contents of the buffer are reverse pasted to the job. When "NO" is selected, the pasting operation is cancelled.</p> 

## 4.8 Test Operations

Playback operations can be simulated in the teach mode with test operations. This function is convenient for checking continuous paths and operation instructions.

Test operation differs in the following ways from actual playback in the play mode.



- Operation speeds greater than the maximum teaching speed are reduced to the maximum teaching speed.
- Only machine lock is available among special operations for playback in the play mode.
- Work instruction output, such as arc output, is not executed.

Test operation is performed by pressing [INTERLOCK] and [TEST START]. For safety purposes, these keys will only function while the keys are held down.



Always check safety conditions before pressing [INTERLOCK] + [TEST START] to start the manipulator in motion.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Press {JOB}.	The test operation JOB CONTENT window appears.
3	Press [INTERLOCK] + [TEST START].	The manipulator starts the test cycle operation. However, after the operation starts, the motion continues even if [INTERLOCK] is released. The manipulator moves only while these keys are held down. The manipulator stops immediately when [TEST START] is released.

## 4.9 Other Job-editing Functions

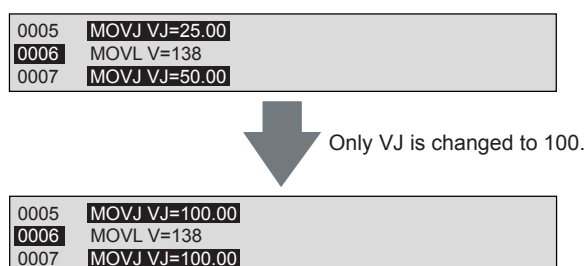
### 4.9.1 Editing Play Speed

There are two ways to modify play speed:

- Modification of Speed Type
- Relative Modification

#### ■ Modification of Speed Type

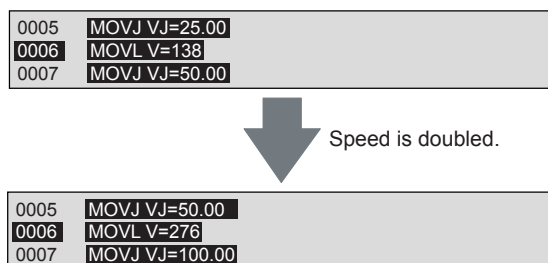
This method is used to modify the speed type (such as VJ, V, VR, etc.).



Type of Play Speed	Explanation	
VJ	Joint Speed	Normal robot axes
V	TCP Speed	
VR	Posture Angle Speed	
VE	Base Axis Speed	

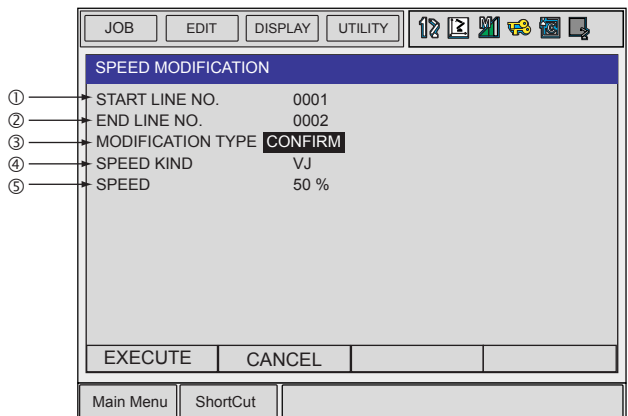
#### ■ Relative Modification

All steps are selected regardless of the play speed type. This method is used to change all steps by a specified percentage (1% to 200%). This is called relative modification.



The speed of the entire job or specified section can be changed.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	The JOB CONTENT window appears.

	Operation	Explanation
3	Move the cursor to the instruction area.	
4	Press [SHIFT] + [SELECT] in the speed modify start line.	If the section is not specified, the speed of the entire job will be changed.
5	Move the cursor to the end line.	The line numbers of the selected lines are highlighted.
6	Select {EDIT} under the menu.	
7	Select {CHANGE SPEED}.	The SPEED MODIFICATION window appears.
		
8	Set desired items.	<p><b>① START LINE NO.</b> Displays the first line number of the section to be modified.</p> <p><b>② END LINE NO.</b> Displays the last line number of the section to be modified.</p> <p><b>③ MODIFICATION TYPE</b> Selects the confirmation before changing: "CONFIRM" or "NO CONFIRM." Each time [SELECT] is pressed when the cursor is on this item, the setting alternates between "CONFIRM" and "NO CONFIRM."</p> <p><b>④ SPEED KIND</b> Selects the speed type. When [SELECT] is pressed when the cursor is on this item, selection dialog box appears. Select the speed type to be changed.</p> <p><b>⑤ SPEED</b> Specifies the speed value. When [SELECT] is pressed when the cursor is on this item, the mode changes to number input mode. Input the speed value and press [ENTER].</p>
9	Select "EXECUTE."	<p>The speed begins to change.</p> <p>If "MODIFICATION TYPE" is set to "CONFIRM," the confirmation dialog box "Modifying speed" is displayed. Press [ENTER] to change the speed on the first line and search for the next speed. Press the UP/DOWN cursor button to keep the speed on the first line and search for the next speed. To cancel the speed modification, press [CANCEL].</p> <p>If "MODIFICATION TYPE" is set to "NOT CONFIRM," all the speeds of the specified section are changed.</p>

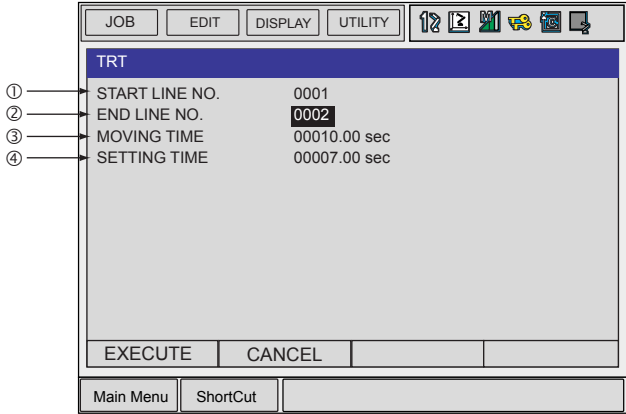
## 4.9 Other Job-editing Functions


## ■ Modification by TRT (Traverse Time)

Modifications made by TRT have the following characteristics:

- By setting the time required to execute a move instruction (moving time) to a desired value, the speeds can be modified.
- It is possible to measure the moving time without actually moving the manipulator.

For example, when the movement from lines 5 through 20 currently requires 34 seconds, and you want to reduce it to 15 seconds or extend it to 50 seconds, this function is used.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	The JOB CONTENT window appears.
3	Move the cursor to the instruction area.	
4	Press [SHIFT] + [SELECT] in the weaving time measure start line.	
5	Move the cursor to the end line.	The line numbers of the selected lines are highlighted.
6	Select {EDIT} under the menu.	
7	Select {TRT}.	The TRT window appears. 

	Operation	Explanation
8	Set the desired items.	<p><b>①START LINE NO.</b> Displays the first line number of the section to be measured and modified.</p> <p><b>②END LINE NO.</b> Displays the last line number of the section to be measured and modified.</p> <p><b>③MOVING TIME</b> The weaving time needed to move from the first number to last number is measured and displayed.</p> <p><b>④SETTING TIME</b> Set the desired weaving time. When [SELECT] is pressed when the cursor is on this item, the input buffer line appears. Input the desired weaving time and press [ENTER].</p>
9	Select "EXECUTE."	<p>The speed is changed according to the setting.</p> <div style="border: 1px solid black; padding: 10px;"> <p><b>NOTE</b></p> <ul style="list-style-type: none"> <li>• If instructions that include specific speed data such as SPEED or ARCON instructions (including speed data of the welding condition file) exist in the specified section, the speed data for those steps are not changed. Therefore, in such cases, the set time and the actual time required are not same.</li> <li>• If the speed data is limited by the maximum value, the following message is displayed.</li> </ul> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">  !Limited to maximum speed </div> </div>

## 4.9.2 Editing Interpolation Type

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	The JOB CONTENT window appears.
3	Move the cursor to the instruction area.	
4	Select the line to be modified.	The instruction on the cursor is displayed in the input buffer line. <div> <p>The screenshot shows the 'JOB CONTENT' window with a toolbar at the top containing buttons for JOB, EDIT, DISPLAY, UTILITY, and various icons. The main area lists instructions: 0001 NOP, 0002 'CAR TYPE-A JOB, 0003 JUMP JOB:JOB-01, 0004 MOVJ VJ=50.00 (highlighted), 0005 MOVJ VJ=50.00, 0006 MOVJ VJ=50.00, 0007 MOVJ VJ=50.00. The input buffer at the bottom shows '⇒MOVJ VJ=50.00'. At the bottom of the window are buttons for 'Main Menu', 'ShortCut', and a power icon with the text 'Turn on servo power'.</p> </div>
5	Press [SHIFT] + the cursor key simultaneously.	The interpolation type in the input buffer line changes. The modification of the speed according to the modification of the interpolation type is calculated by the ratio to maximum speed at each speed.  Joint Speed: MAX=100.0% Linear Speed: MAX=9000cm/min (e.g.) Joint Speed: 50% = Linear Speed: 4500cm/min Linear Speed: 10% = Linear Speed: 900cm/min <div> <p>This screenshot is similar to the previous one, but the input buffer at the bottom now shows '⇒MOVL V=4500', indicating that the interpolation type has been changed from JOINT to LINEAR.</p> </div>
6	Press [ENTER].	The instruction on the cursor line is replaced with one on the input buffer line. <div> <p>This screenshot shows the result after pressing [ENTER]. The instruction 'MOVJ VJ=50.00' from line 0004 in the list has been replaced with 'MOVL V=4500'. The input buffer still shows '⇒MOVL V=4500'.</p> </div>

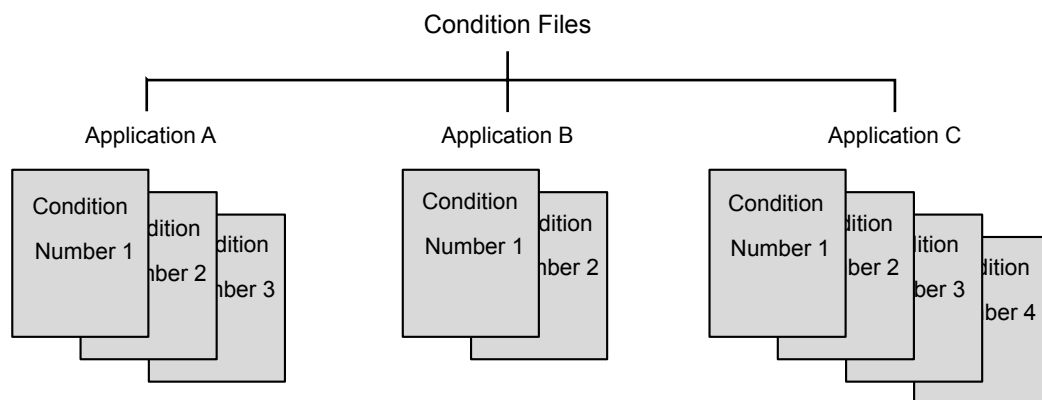
### 4.9.3 Editing Condition Files

Condition files are prepared in order to set the conditions for the manipulator to execute instructions. The desired conditions are saved in the condition file, and a file number is assigned.

Multiple condition files are provided. More than one pattern can be set up in each condition file. The patterns are listed by “condition numbers.”



Refer to NX100 Instructions for information regarding the contents and editing methods for the condition file.



## 4.9.4 Editing User Variables

User variables are used for temporary storage for counters, calculations and input signals. It is possible to edit which variables are used for what purpose for each job. Since the same user variable can be used in multiple jobs, save the numerical values as common references for the jobs.

User variables have the following applications:

- Controlling of the number of workpieces
- Controlling of the number of jobs
- Sending/receiving of information between jobs

User variable values are maintained even when the power is turned OFF. The data formats for user variables are as described in the following table:

User Variables

Data Format		Variable No. (pcs)	Functions
Byte Type		B000 to B099 (100)	Range of storable values is from 0 to 255. Can store I/O status. Can perform logical operations (AND, OR, etc.).
Integer Type		I000 to I099 (100)	Range of storable values is from -32768 to 32767.
Double Precision Integer Type		D000 to D099 (100)	Range of storable values is from -2147483648 to 2147483647.
Real Type		R000 to R099 (100)	Range of storable values is from -3.4E+38 to 3.4E38. Accuracy: $1.18E-38 < x \leq 3.4E38$
Character Type		S000 to S099 (100)	Maximum storable number of characters is 16.
Position Type	Robot Axes	P000 to P127 (128)	Can store position data in pulse form or in XYZ form. XYZ type variable can be used as target position data for move instructions, and as incremental values for parallel shift instructions.
	Base Axes	BP000 to BP127 (128)	
	Station Axes	EX000 to EX127 (128)	

**• Play Speed V:**

MOVL V=I000

The variable I000 is used for speed V with this move instruction.

The unit for V is 0.1mm per second.

For example, if I000 were set as 1000, the following would be true:

$I000=1000 \rightarrow \text{unit for V is } 0.1\text{mm/s} \rightarrow V=100.0\text{mm per second}$

Note that, depending on the unit being used, the value of the variable and the value of the actual speed on occasion might not match.

**• Play Speed VJ:**

MOVL VJ=I000

The unit for VJ is 0.01%.

For example, if I000 were set as 1000, the following would be true:

$I000=1000 \rightarrow \text{unit for VJ is } 0.01\% \rightarrow VJ=10.00\%$

**• Timer T:**

TIMER T=I000

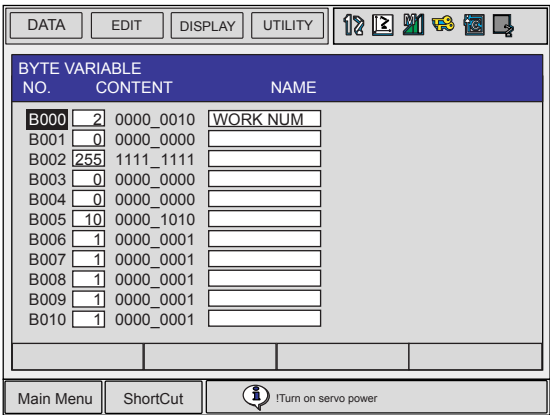
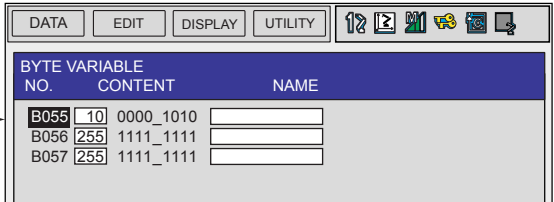
The unit for T is 0.01 seconds.

For example, if I000 were set as 1000, the following would be true:

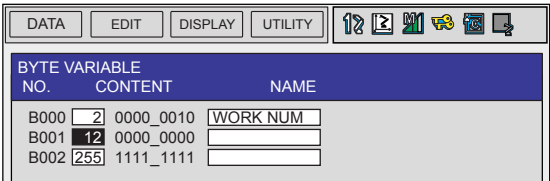
$I000=1000 \rightarrow \text{unit for T is } 0.01 \text{ seconds} \rightarrow T=10.00 \text{ seconds.}$

## 4.9 Other Job-editing Functions

## ■ Displaying Byte, Integer, Double Precision Integer, and Real Type Variables

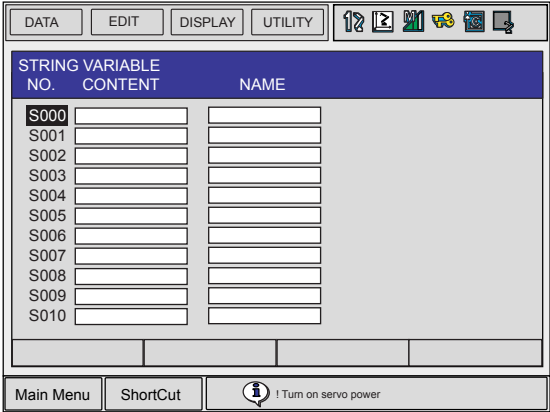
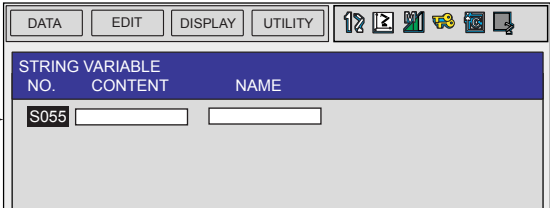
	Operation	Explanation
1	Select {VARIABLE} under the main menu.	
2	Select desired variable type.	<p>Select any variable among {BYTE}, {INTEGER}, {DOUBLE}, and {REAL} under the sub menu. The BYTE VARIABLE window appears. (Following is a case that {BYTE} is selected.)</p> 
3	Move the cursor to the desired variable No.	<p>When the desired variable number is not displayed, move the cursor with either of the following operations.</p> <ul style="list-style-type: none"> <li>• Move the cursor on the variable No. and press [SELECT]. Then input the variable No. using the Numeric keys and press [ENTER].</li> <li>• Move the cursor to the menu area and select {EDIT} → {SEARCH}. Then input the variable No. with the Numeric keys and press [ENTER].</li> </ul> 

## ■ Setting Byte, Integer, Double Precision Integer, and Real Type Variables

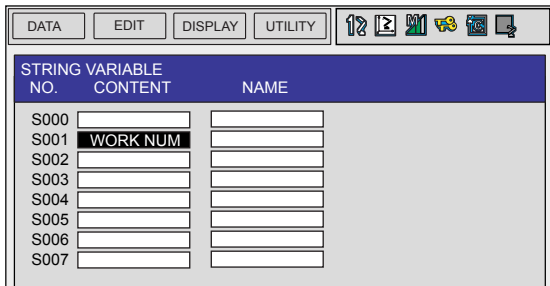
	Operation	Explanation
1	Select {VARIABLE} under the main menu.	
2	Select desired variable type.	Select any variable among {BYTE}, {INTEGER}, {DOUBLE}, and {REAL} under the sub menu.
3	Move the cursor to the desired variable No.	<p>When the desired variable number is not displayed, move the cursor with either of the following operations.</p> <ul style="list-style-type: none"> <li>• Move the cursor on the variable No. and press [SELECT]. Then input the variable No. using the Numeric keys and press [ENTER].</li> <li>• Move the cursor to the menu area and select {EDIT} → {SEARCH}. Then input the variable No. with the Numeric keys and press [ENTER].</li> </ul>
4	Move the cursor to the data of the variable.	
5	Press [SELECT].	The number can be directly typed.
6	Input the desired number.	
7	Press [ENTER].	<p>Input value is set to the variable on the cursor position.</p> 

## 4.9 Other Job-editing Functions

## ■ Displaying Character Type Variables


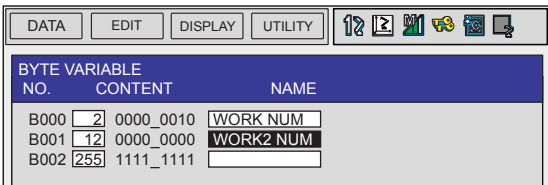
	Operation	Explanation
1	Select {VARIABLE} under the main menu.	
2	Select {STRING}.	<p>The STRING VARIABLE window appears.</p> 
3	Move the cursor to the desired variable No.	<p>When the desired variable number is not displayed, move the cursor with either of the following operations.</p> <ul style="list-style-type: none"> <li>• Move the cursor on the variable No. and press [SELECT]. Then input the variable No. using the Numeric keys and press [ENTER].</li> <li>• Move the cursor to the menu area and select {EDIT} → {SEARCH}. Then input the variable No. with the Numeric keys and press [ENTER].</li> </ul> 

## ■ Setting Character Type Variables

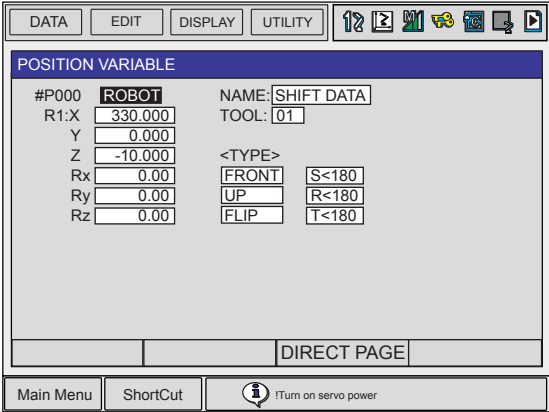


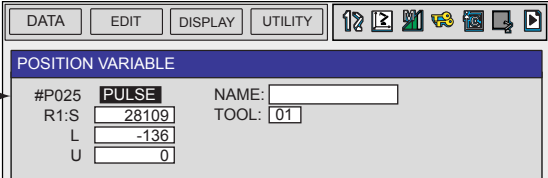
	Operation	Explanation
1	Select {VARIABLE} under the main menu.	
2	Select {STRING}.	
3	Move the cursor to the desired variable No.	<p>When the desired variable number is not displayed, move the cursor with either of the following operations.</p> <ul style="list-style-type: none"> <li>• Move the cursor on the variable No. and press [SELECT]. Then input the variable No. using the Numeric keys and press [ENTER].</li> <li>• Move the cursor to the menu area and select {EDIT} → {SEARCH}. Then input the variable No. with the Numeric keys and press [ENTER].</li> </ul>
4	Move the cursor to the data of the variable.	
5	Press [SELECT].	The characters can be directly typed.
6	Input the desired characters.	For information on character input operation, refer to "1.2.7 Character Input."
7	Press [ENTER].	<p>The input characters are set to the variable on the cursor position.</p> 

## 4.9 Other Job-editing Functions

## ■ Registering Variable Name

	Operation	Explanation
1	Select {VARIABLE} under the main menu.	
2	Select desired variable.	Select any variable type from among byte type, integer type, double precision integer type, real type, robot position type, base position type, and station position type.
3	Move the cursor to desired variable number.	<p>If desired variable number is not displayed, move the cursor by either of following operations.</p> <ul style="list-style-type: none"> <li>• Select the variable number, input desired variable number and press [ENTER] The cursor moves to the variable number to be input.</li> <li>• Move the cursor to the menu area and select {EDIT}→{SEARCH}. Input desired variable number and press [ENTER]. The cursor moves to the variable number to be input.</li> </ul>
4	Select "NAME."	<p>The input buffer line appears.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">  Refer to " 1.2.7 Character Input " for the character input operation.         </div>
5	Input name.	
6	Press [ENTER].	<p>The variable name is registered.</p> 

■ Displaying Position Variables

	Operation	Explanation
1	Select {VARIABLE} under the main menu.	
2	Select desired position variable type.	<p>The POSITION VARIABLE window of desired type among robot type, base type, and station type appears.</p> 
3	Press the page key  .	<p>Select the desired number by pressing the page key .</p> <p>If [SHIFT] is pressed simultaneously, the window returns to previous page.</p> <p>When the desired variable number is not displayed, move the cursor with either of the following operations.</p> <ul style="list-style-type: none"><li>• Press [DIRECT PAGE]. Then input the variable No. using the Numeric keys and press [ENTER].</li><li>• Move the cursor to the menu area and select {EDIT} → {SEARCH}. Then input the variable No. with the Numeric keys and press [ENTER].</li></ul> 

## 4.9 Other Job-editing Functions

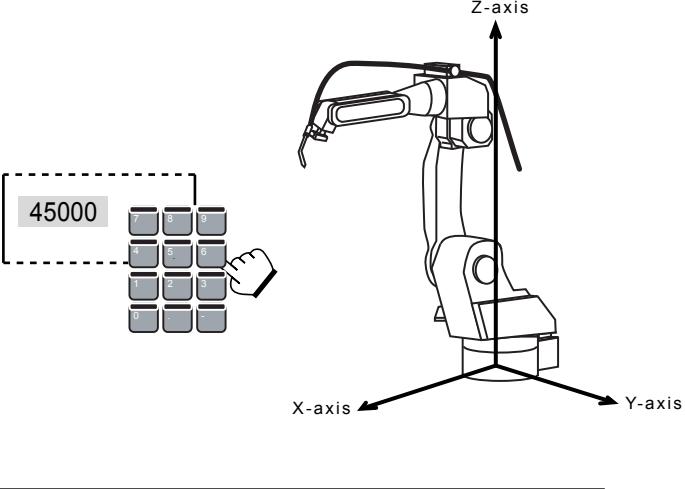
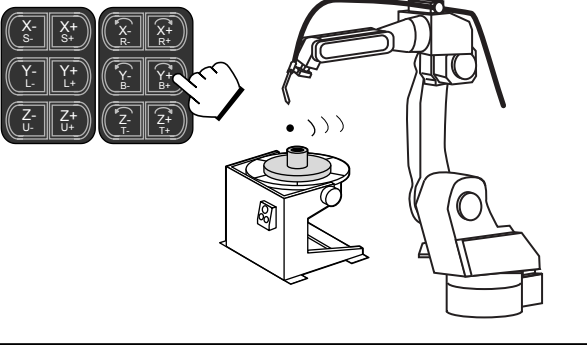
## ■ Setting Position Variables

The following table shows the types of position variables and setting methods.



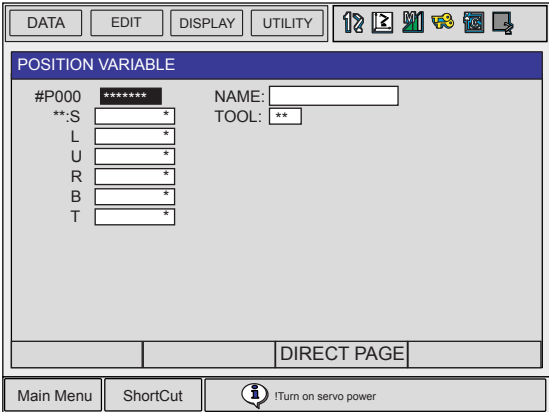
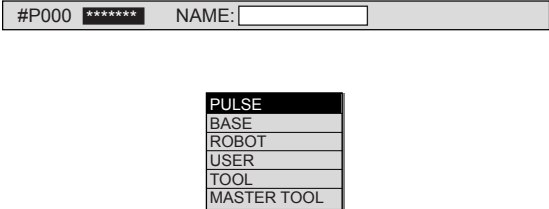
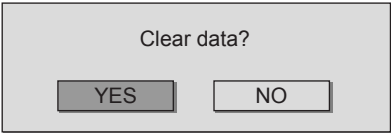
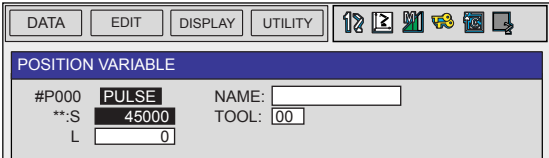
The setting of position variables is done in the teach mode.  
Turn the servo power ON when setting the variables with the axis keys.

Types of Position Variables and Setting Methods

Type	Pxxx (Robot Axes)		BPxxx (Base Axes)		EXxxx (Station Axes)
	Pulse Type	XYZ Type	Pulse Type	XYZ Type	Pulse Type
Setting Method		Select coordinates from base, robot, user, tool.			
		<p>Using the numeric keys</p> 			
		<p>Using the axis keys</p> 			

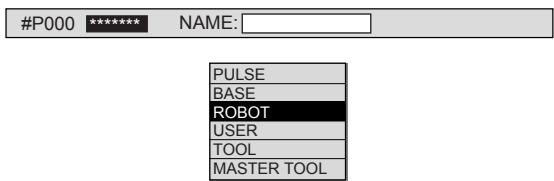
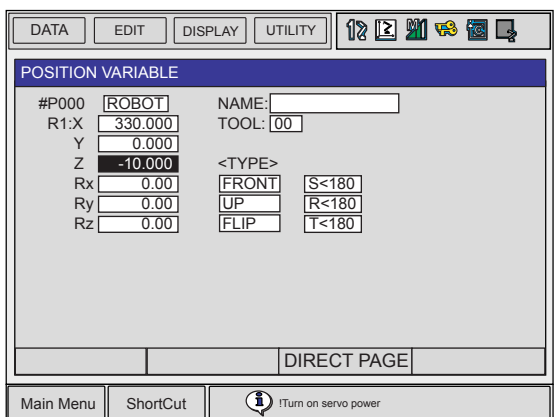
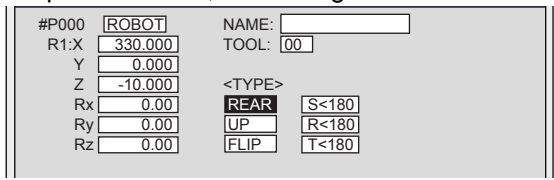
■ Setting Position Variables Using the Numeric Keys

Pulse Type

	Operation	Explanation
1	Select {VARIABLE} under the main menu.	
2	Select desired position variable type.	<p>The desired variable window appears (robot, base, or station). (The POSITION VARIABLE window is used for this example.)</p> 
3	Select the variable data type.	<p>The selection dialog box appears.</p>  <p>If the position variable was set before, confirmation dialog box appears for data clear. If “YES” is selected, the data is cleared.</p> 
4	Select {PULSE}.	
5	Move the cursor to desired data to be input and press [SELECT].	
6	Input the value.	
7	Press [ENTER].	<p>The value is set in the cursor position.</p> 

## 4.9 Other Job-editing Functions

**XYZ Type**

	Operation	Explanation
1	Select {VARIABLE} under the main menu.	
2	Select desired position variable type.	
3	Select the variable data type.	The selection dialog box appears. 
4	Select desired coordinates except PULSE.	
5	Move the cursor to desired data to be input and press [SELECT].	
6	Input the value.	
7	Press [ENTER].	The value is set in the cursor position.  <p><b>Setting of “&lt;TYPE&gt;”</b> Each time [SELECT] is pressed when the cursor is on the setting data in the input buffer line, the settings alternate.</p> 

**About “<TYPE>”**

- It is not necessary to set a type if the position variable is to be used for parallel shift operations.
  - When the position variable is used with a move instruction such as “MOVJ P001,” it is necessary to set a type. For details on types, refer to " Manipulator Types " on the page 4-81.
- Current Position Window (XYZ) shows the current setting of a type.

## ■ Setting Position Variables Using the Axis Keys

### Pulse Type

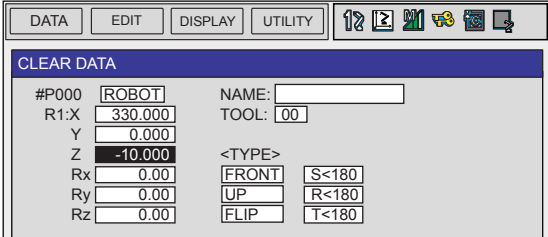
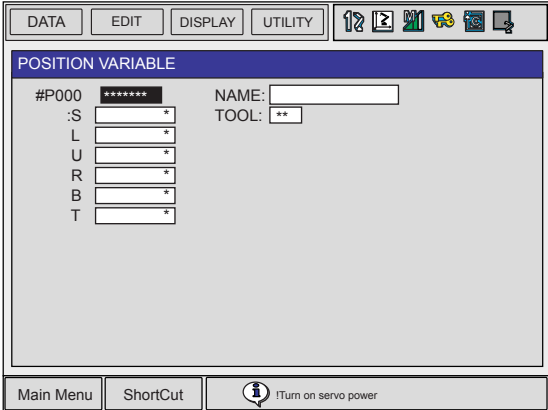
	Operation	Explanation
1	Select {VARIABLE} under the main menu.	
2	Select desired position variable type.	The desired variable window appears (robot, base, or station).
3	Press [SHIFT] + [ROBOT].	When you need an external axis position, press [SHIFT]+[EX.AXIS]. When there are two or more robot axis, base axis, or a station axis, specify the axis with following operation. <ul style="list-style-type: none"> <li>• <b>Robot Axis</b> Each time [SHIFT] + [ROBOT] is pressed, the axis displayed on the status line changes: R1 → R2 → R3 → R4.</li> <li>• <b>Base or Station Axis</b> Each time [SHIFT]+[EX.AXIS] is pressed, the axis displayed on the status line changes: B1 → B2 → B3 → B4 → S1 → S2 → S3 → ... → S12</li> </ul>
4	Move the manipulator with the axis keys.	Move the manipulator or the external axis to the desired position to be set to position variable.
5	Press [MODIFY].	
6	Press [ENTER].	

### XYZ Type

	Operation	Explanation
1	Select {VARIABLE} under the main menu.	
2	Select desired position variable type.	When there are two or more robot axis, base axis, or a station axis, specify the axis with following operation. <ul style="list-style-type: none"> <li>• <b>Robot Axis</b> Each time [SHIFT] + [ROBOT] is pressed, the axis displayed on the status line changes: R1 → R2 → R3 → R4.</li> <li>• <b>Base or Station Axis</b> Each time [SHIFT]+[EX.AXIS] is pressed, the axis displayed on the status line changes: B1 → B2 → B3 → B4 → S1 → S2 → S3 → ... → S12</li> </ul>
3	Move the manipulator with the axis keys.	Move the manipulator or the external axis to the desired position to be set to position variable.
4	Press [MODIFY].	
5	Press [ENTER].	

## 4.9 Other Job-editing Functions

## ■ Deleting Data Set of Position Variables

	Operation	Explanation
1	Select {VARIABLE} under the main menu.	
2	Select desired position variable type.	
3	Select {DATA} under the menu.	<p>The pull-down menu appears.</p> 
4	Select {CLEAR DATA}.	<p>The position variable data on the displayed page are deleted.</p> 

## ■ Checking Positions by Position Variables

	Operation	Explanation
1	Select {VARIABLE} under the main menu.	
2	Select desired position variable type.	<p>When there are two or more robot axis, base axis, or a station axis, specify the axis with following operation.</p> <ul style="list-style-type: none"> <li>• <b>Robot Axis</b> Each time [SHIFT] + [ROBOT] is pressed, the axis displayed on the status line changes: R1 → R2 → R3 → R4.</li> <li>• <b>Base or Station Axis</b> Each time [SHIFT]+[EX.AXIS] is pressed, the axis displayed on the status line changes: B1 → B2 → B3 → B4 → S1 → S2 → S3 → ... → S12</li> </ul>
3	Press [FWD].	<p>Selected axis moves to the position specified by the variable.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p><b>NOTE</b> The selected axis (maipulator, base, or station) moves directly to the set variable position. Before pressing [FWD], check that the surrounding area is safe.</p> </div>

## ■ Manipulator Types

When robot axis position data is described in the XYZ format, a number of solutions are obtained from the manipulator's structure when moving it to the described position. In order to select one appropriate solution, it is necessary to specify the manipulator type. This manipulator type is called "Type." There are up to six types in NX100 system. These types also vary according to the manipulator models.

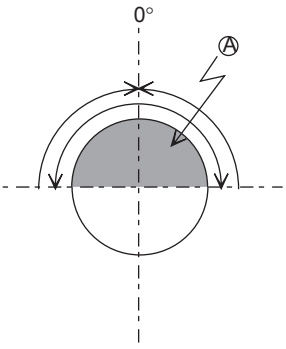
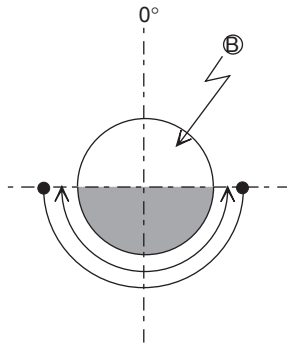
- Flip/No Flip: R-axis Position
- R-axis Angle
- T-axis Angle
- Front/Back: Relationship Between the S-axis and TCP
- Upper Arm/Lower Arm: Type Comprised of the L- and U-axes
- S-axis Angle

These six types are described in the following:

### • Flip/No Flip

This shows the R-axis position.

When the R-axis is in the position at A as shown in the following diagram, it is known as "Flip;" when it is in the B position, it is called "No Flip." However, in a manipulator in which the R-axis can move more than  $\pm 180^\circ$  even in position A, it is necessary to specify whether the R-axis is from  $-90^\circ$  to  $90^\circ$ , or from  $270^\circ$  to  $360^\circ$ , or from  $-360^\circ$  to  $-270^\circ$ . The same is true for the B position. This is set at the following "R-axis Angle."

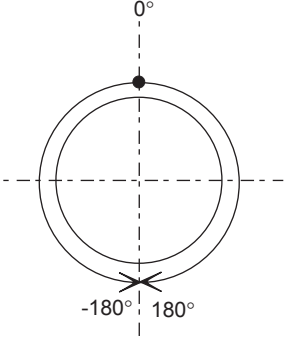
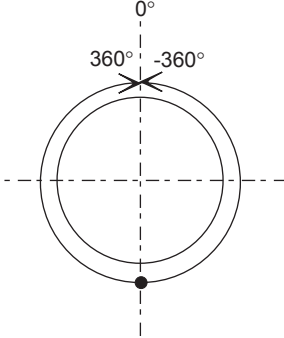
Flip	No Flip
 <p> <math>-90 &lt; \theta R \leq 90</math>  <math>270 &lt; \theta R \leq 360, -360 &lt; \theta R \leq -270</math> </p>	 <p> <math>90 &lt; \theta R \leq 270</math>  <math>-270 &lt; \theta R \leq -90</math> </p>



$\theta R$  is the angle when the R-axis home position is  $0^\circ$ .

• **R-axis Angle**

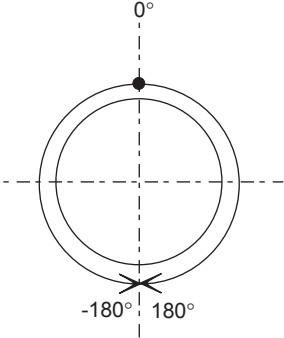
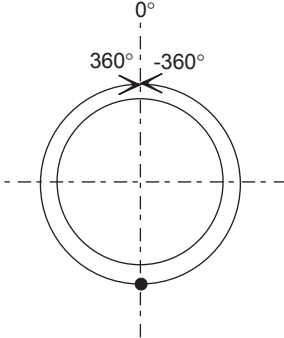
This specifies whether the R-axis angle is less than  $\pm 180^\circ$  or greater than  $\pm 180^\circ$ .

$R < 180^\circ$	$R \geq 180^\circ$
	
$-180 < \theta R \leq 180$	$180 < \theta R \leq 360, -360 < \theta R \leq -180$

**NOTE**  $\theta R$  is the angle when the R-axis home position is  $0^\circ$ .

• **T-axis Angle**

This specifies positions of the R-, B-, and T-axis.  
For manipulators with wrist axes (three axes), this specifies whether the T-axis angle is less than  $\pm 180^\circ$  or greater than  $\pm 180^\circ$ .

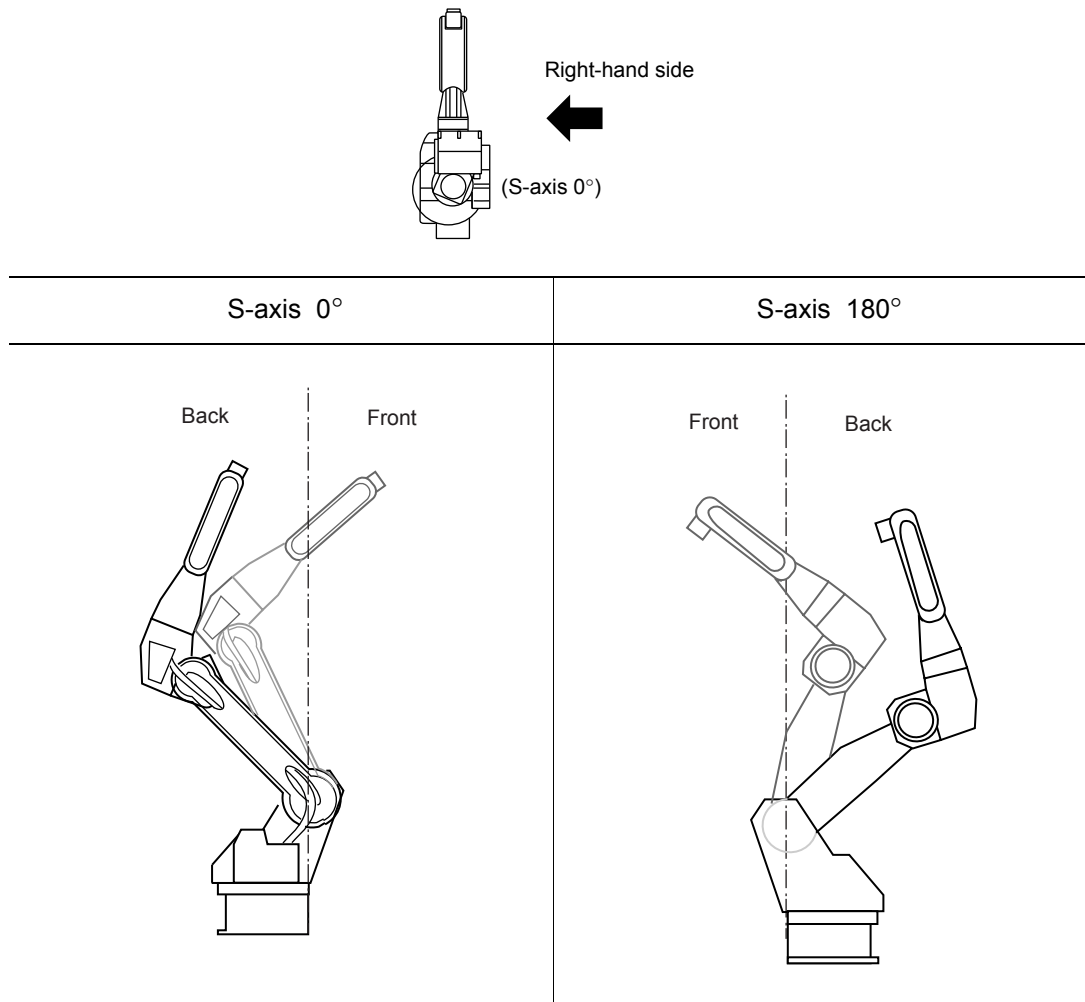
$T < 180^\circ$	$T \geq 180^\circ$
	
$-180 < \theta T \leq 180$	$180 < \theta T \leq 360, -360 < \theta T \leq -180$

**NOTE**  $\theta T$  is the angle when the T-axis home position is  $0^\circ$ .

## 4.9 Other Job-editing Functions

### • Front/Back

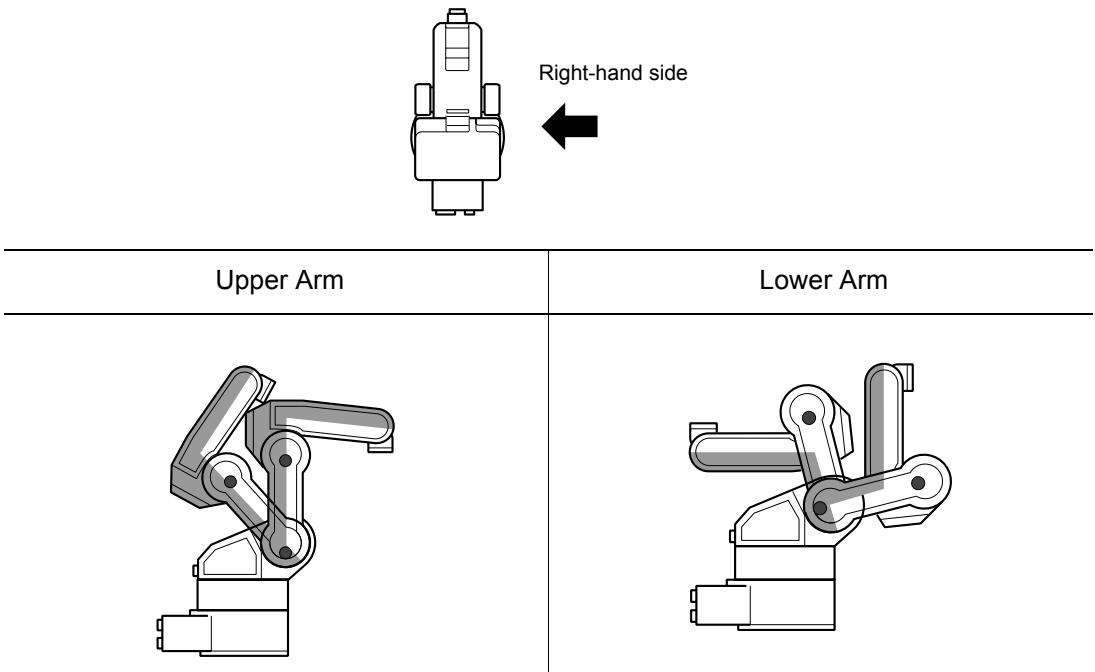
This specifies where in the S-axis rotation center the B-axis rotation center locates when viewing the L-axis and U-axis from the right-hand side. When viewed from the right-hand side, the right of the S-axis rotation center is called the front, and the left is called the back.



The diagram above shows the S-axis at 0° and at 180°. This is the configuration when the L-axis and the U-axis are viewed from the right-hand side.

• **Upper Arm/Lower Arm**

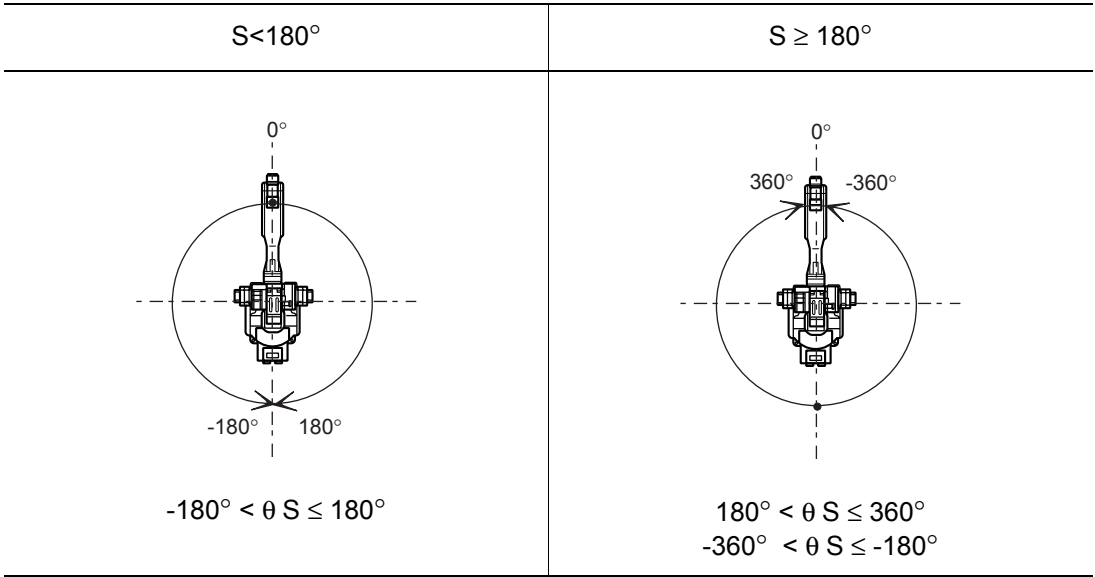
This specifies a type comprised of L-axis and U-axis when the L-axis and U-axis are viewed from the right-hand side.



• **S-axis Angle**

This designation is required for the manipulators which have working envelopes greater than  $\pm 180^\circ$ .

This specifies whether the S-axis angle is less than  $\pm 180^\circ$  or greater than  $\pm 180^\circ$ .



NOTE

θ S is the angle when the S-axis home position is 0°.

## 4.9.5 Editing Local Variables

User variables and local variables can be used in the storage of counters, calculations, and input signals. The data format is the same as that of user variables. As shown in the following table, the letter L is affixed to the variable number to indicate a local variable.

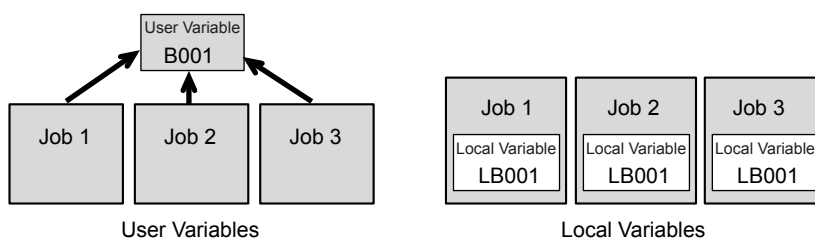
Local Variables

Data Format		Variable No.	Functions
Byte Type		LB000 to LB□□□	Range of storeable values is from 0 to 255. Can store I/O status. Can perform logical operations (AND, OR, etc.).
Integer Type		LI000 to LI□□□	Range of storeable values is from -32768 to 32767.
Double Precision Integer Type		LD000 to LD□□□	Range of storeable values is from -2147483648 to 2147483647.
Real Type		LR000 to LR□□□	Range of storeable values is from $-3.4E+38$ to $3.4E+38$ Accuracy: $1.18E-38 < x \leq 3.4E+38$
Character Type		LS000 to LS□□□	Maximum storeable number of characters is 16.
Position Type	Robot Axes	LP000 to LP□□□	Can store position data in pulse form or in XYZ form. XYZ type variables can be used as target position data for move instructions, and as incremental values for parallel shift instructions.
	Base Axes	LBP000 to LBP□□□	
	Station Axes	LEX000 to LEX□□□	

Local variables differ from user variables in the following four ways:

- **Used in One Job Only**

With user variables it is possible to define and use one variable in multiple jobs, but local variables are used only in the one job in which they are defined, and cannot be read from other jobs. Accordingly, local variables do not affect other jobs, so it is possible to define a variable number (such as LB001) separately in different jobs, and use it in different ways in each of these jobs.



- **Able to Use Any Number of Variables**

The number is set in the JOB HEADER window. When the number is set, the area for the value is saved in memory.

---

- **Not Able to Display the Variable Contents**

To display the local variable contents, user variables are needed.

For example, to view the contents of local variable LP000, save it temporarily as user variable P001. Then execute the instruction SET P001 LP000, and view the POSITION VARIABLE window for P001.

- **Enabled Only During the Execution of the Defined Job**

The contents of the local variables are enabled only during the execution of the defined job.

The local variable field is assured when the defined job is called (when the job is executed by a CALL or JUMP instruction, or the job is selected by the menu). Once the job is completed by the execution of a RET, END, or JUMP instruction, the local variable data that was set is disabled. However, if a job which uses local variables itself calls a separate job, then is returned to by use of a RET instruction, the data that was present prior to the CALL instruction remains in effect and can be used.

**Precautions for Variables and Units**

As was the case with user variables, note that, depending on the value of the unit being used, the value of the variable and the value of the actual speed or time an occasion might not match. Refer to "4.9.4 Editing User Variables."

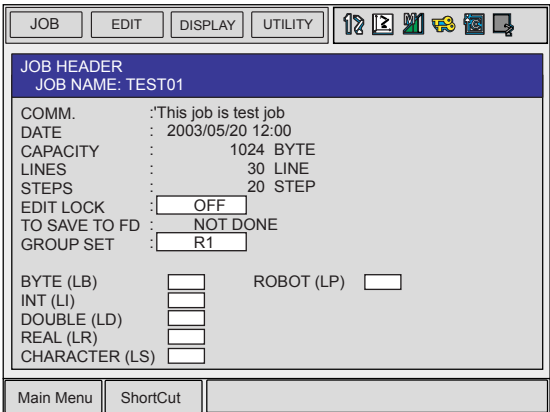
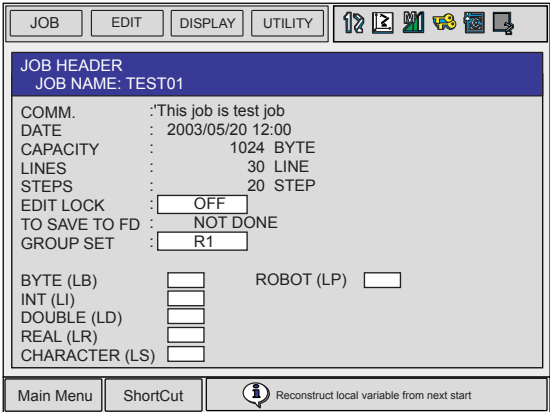
## 4.9 Other Job-editing Functions

## ■ Setting the Number of Local Variables

How many local variables are to be used in a job is set in the JOB HEADER window. When setting the number of variables, the memory area needed for those variables is saved.

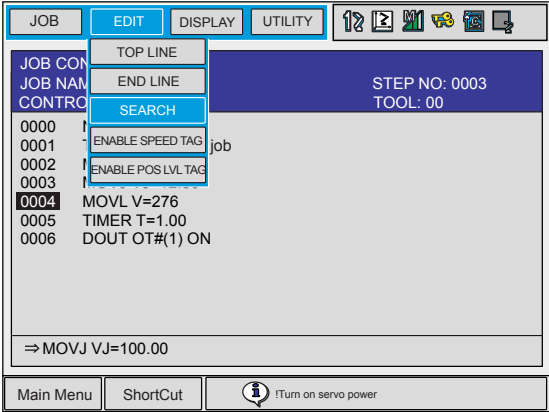
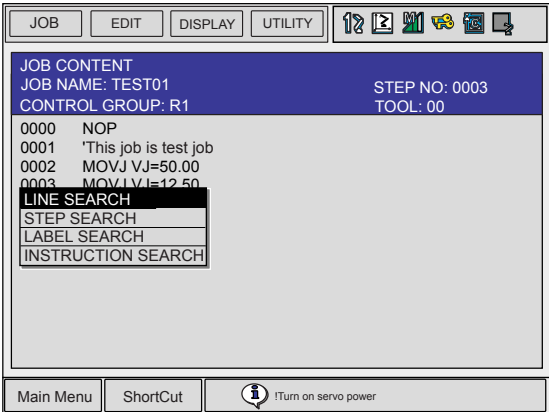


Only when expanding the “LANGUAGE LEVEL,” it is possible to use local variables. Refer to “9.14 Instruction Level Setting” of “NX100 INSTRUCTIONS” for details on setting the language level.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	
3	Select {DISPLAY} under the menu.	
4	Select {JOB HEADER}.	<p>The JOB HEADER window appears. Scroll the window using the cursor.</p> 
5	Select the number of local variables to be set.	The input buffer line appears.
6	Input the number of variables.	
7	Press [ENTER].	<p>The number of local variables are set.</p> 

4.9.6 Searching

When performing editing or confirmation, a search for the job or step can be done. The search can be done when the cursor is in either the address or instruction area on the JOB CONTENT window.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	The JOB CONTENT window appears.
3	Select {EDIT} under the menu.	The pull-down menu appears. <div></div>
4	Select {SEARCH}.	The selection dialog box appears. <div></div>
5	Select the searching type.	

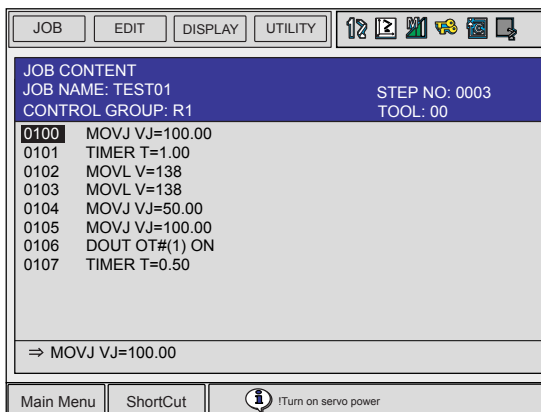
Searching is an operation by which the cursor is moved to a specific step or instruction in the edit job. A target point can be instantaneously searched out without using the cursor.

## 4.9 Other Job-editing Functions

## ■ Line Search

This function moves the cursor to the desired line number.

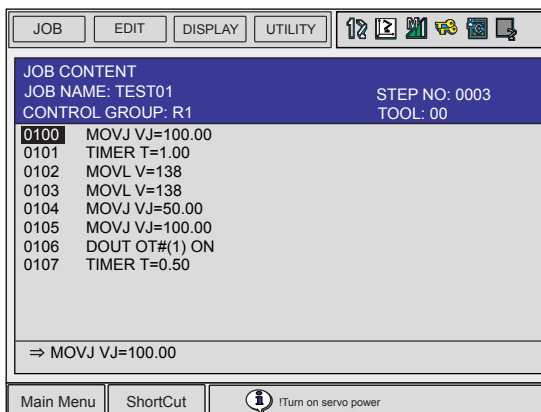
	Operation	Explanation
1	Select "LINE SEARCH."	The input buffer line appears.
2	Input desired line number.	
3	Press [ENTER].	The cursor is moved to the line number and the window appears.



## ■ Step Search

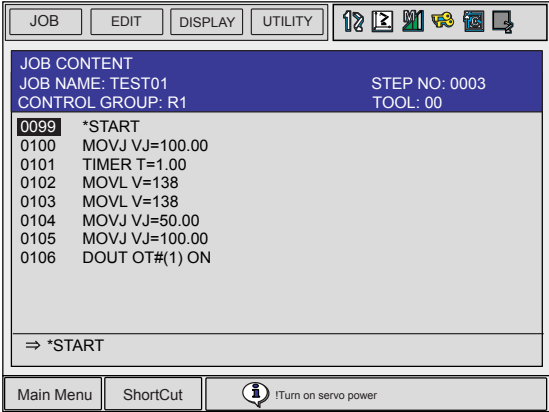
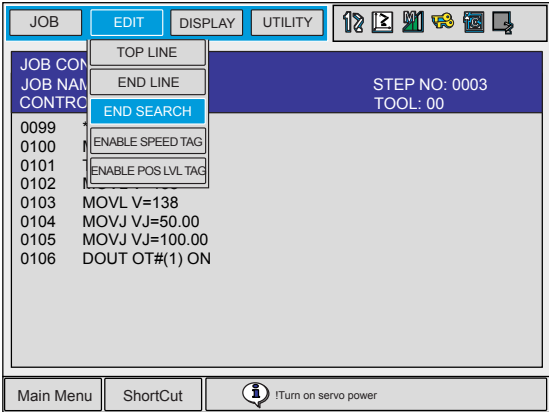
This function moves the cursor to the desired step number (move instruction).

	Operation	Explanation
1	Select "STEP SEARCH."	The input buffer line appears.
2	Input desired step number.	
3	Press [ENTER].	The cursor is moved to the input step and the window appears.



■ Label Search

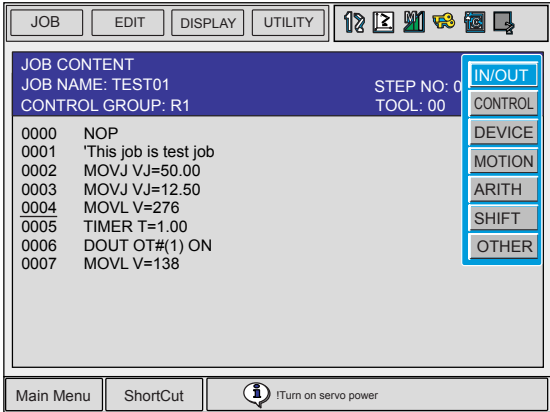
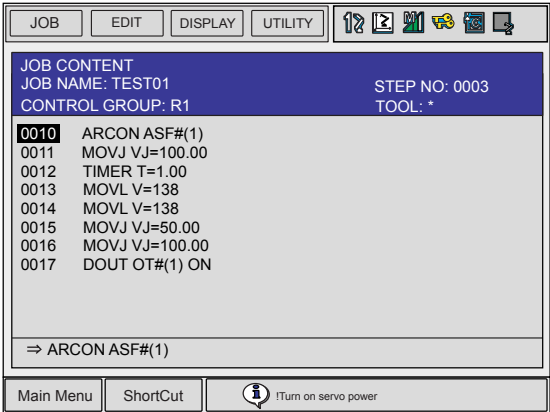
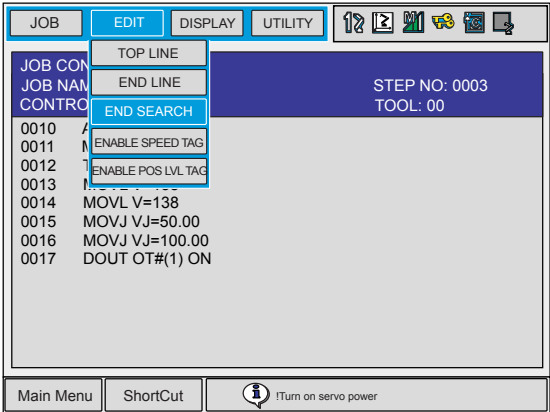
This function searches for the desired label and the instruction using that label.

	Operation	Explanation
1	Select "LABEL SEARCH."	The input buffer line appears.
2	Input desired label name.	For information on character input operation, refer to "1.2.7 Character Input." At this time, search can be conducted by entering any one character of the label. For example, to search for the "START" label, enter only "S," and the search can be done.
3	Press [ENTER].	The label is searched out and the cursor is on its line number. <div></div>
4	Use the cursor to continue searching.	It is possible to continue searching by pressing the cursor key. To end searching, select {EDIT} → {END SEARCH} on the menu and press [SELECT]. <div></div>

## 4.9 Other Job-editing Functions

## ■ Instruction Search

This function moves the cursor to a desired instruction.

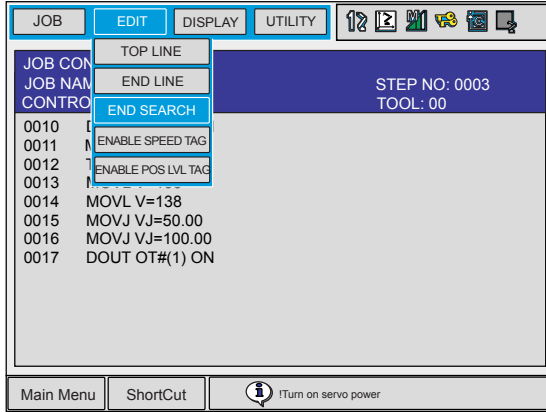
	Operation	Explanation
1	Select "INSTRUCTION SEARCH."	<p>The INFORM command list appears.</p> 
2	Select desired instruction group.	
3	Select desired instruction.	<p>The instruction is searched out and the cursor is on its line number.</p> 
4	Use the cursor to continue searching.	<p>It is possible to continue searching by pressing the cursor key. To end searching, select {EDIT} → {END SEARCH} on the menu and press [SELECT].</p> 

■ Tag Search

This function moves the cursor to the desired tag.

	Operation	Explanation
1	Select "TAG SEARCH."	<div>The instruction list dialog box appears.</div> <div></div>
2	Select desired instruction group.	
3	Select desired instruction for which the tag is to be searched.	<div>The tag list dialog box for selected instruction appears.</div> <div></div>
4	Select the desired tag.	<div>The cursor is moved to the selected tag and the window appears.</div> <div></div>

## 4.9 Other Job-editing Functions

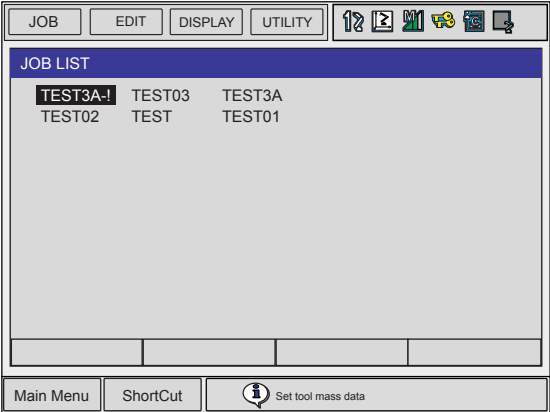
	Operation	Explanation
5	Use the cursor to continue searching.	<p>It is possible to continue searching by pressing the cursor key. To end searching, select {EDIT} → {END SEARCH} on the menu and press [SELECT].</p>  <p>The screenshot shows the CNC control interface with the following elements:</p> <ul style="list-style-type: none"> <li><b>Top Menu Bar:</b> JOB, EDIT, DISPLAY, UTILITY, and several icons.</li> <li><b>Left Panel:</b> JOB CON, JOB NAM, and CONTRO. The CONTRO menu is expanded, showing options: TOP LINE, END LINE, END SEARCH, ENABLE SPEED TAG, and ENABLE POS LVL TAG.</li> <li><b>Main Display Area:</b> <ul style="list-style-type: none"> <li>Header: STEP NO: 0003, TOOL: 00</li> <li>Program List:           <ul style="list-style-type: none"> <li>0010</li> <li>0011</li> <li>0012</li> <li>0013</li> <li>0014 MOVL V=138</li> <li>0015 MOVJ VJ=50.00</li> <li>0016 MOVJ VJ=100.00</li> <li>0017 DOUT OT#(1) ON</li> </ul> </li> </ul> </li> <li><b>Bottom Bar:</b> Main Menu, ShortCut, and a button with an 'i' icon labeled 'Turn on servo power'.</li> </ul>

# 5 Playback

## 5.1 Preparation for Playback

Playback is the act of executing a taught job. Before playback operation, first call the job to be executed.

■ Calling a Job

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {SELECT JOB}.	<div>The JOB LIST window appears. </div>
3	Select the desired job.	

## 5.1 Preparation for Playback

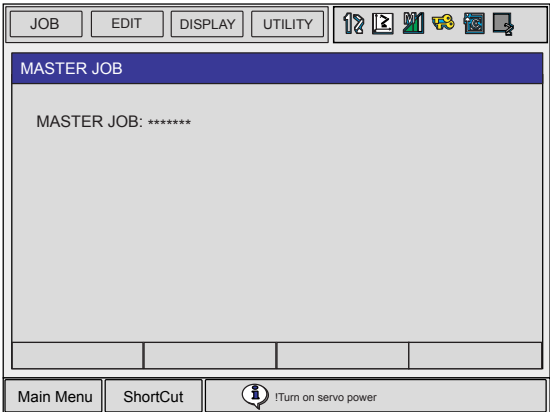
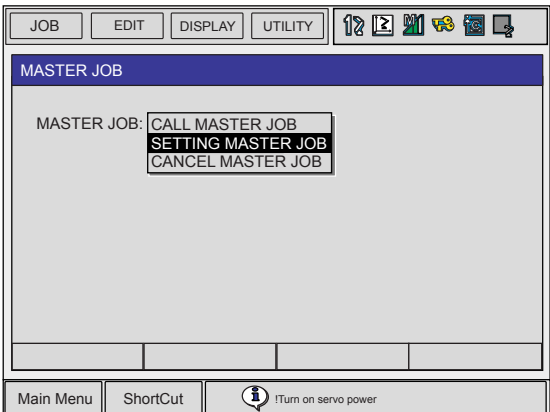
### ■ Registering the Master Job

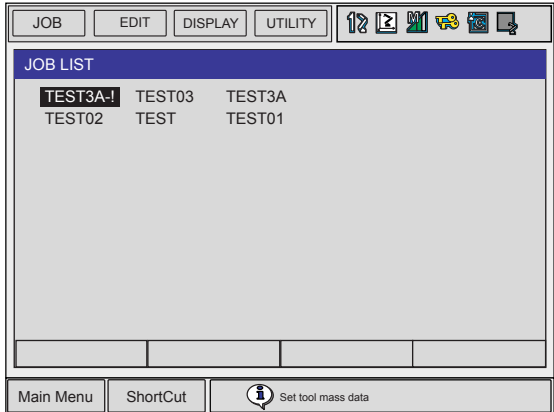
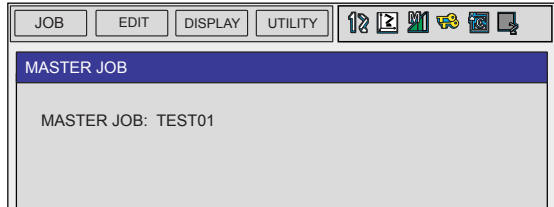
If a particular job is played back frequently, it is convenient to register that job as a master job (master registraton). A job registered as the master job can be called more easily than the method described on the preceding page.



Only one job can be registered as the master job. Registering a master job automatically releases the previously registered master job.

Be sure to register a master job in the teach mode.

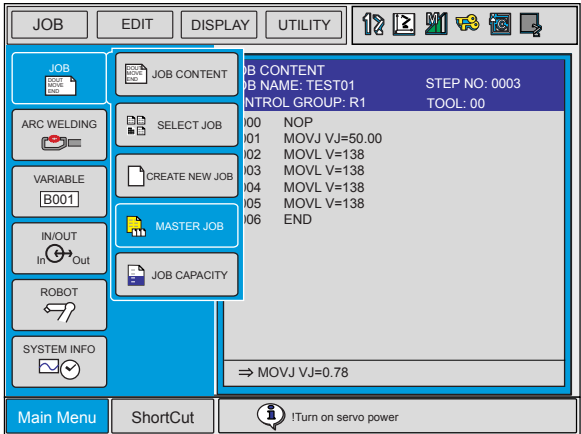
	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {MASTER JOB}.	<p>The MASTER JOB window appears.</p> 
3	Press [SELECT].	<p>The selection dialog box appears.</p> 

	Operation	Explanation
4	Select {CALL MASTER JOB}.	The JOB LIST window appears. 
5	Select a job to be registered as a master job.	The selected job is registered as the master job. 

## ■ Calling the Master Job



This operation is to call a master job. The job can be called in the JOB CONTENT window, PLAYBACK window, JOB SELECT window, or the MASTER JOB window.

### Calling from the JOB CONTENT, PLAYBACK, JOB SELECT Window

	Operation	Explanation
1	Select {JOB} under the menu.	The pull-down menu appears. 
2	Select {MASTER JOB}.	The master job is called, and the JOB CONTENT window appears.

## 5.1 Preparation for Playback

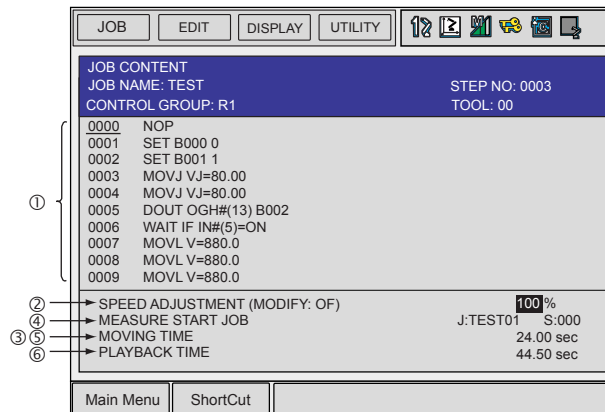
**Calling from the MASTER JOB Window**

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {MASTER JOB}.	<p>The MASTER JOB window appears.</p> 
3	Press [SELECT].	<p>The selection dialog box appears.</p> 
4	Select {CALL MASTER JOB}.	<p>The master job is called, and the JOB CONTENT window (during the teach mode), or the PLAYBACK window (during the play mode) appears.</p>

## 5.2 Playback

### 5.2.1 The PLAYBACK Window

When the mode switch on the programming pendant is switched to “PLAY” while displaying the JOB CONTENT window, the PLAYBACK window appears.



#### ① Job Content

The cursor moves according to the playback operation. The contents are automatically scrolled as needed.

#### ② Override Speed Settings

Displayed when override speed setting is performed.

#### ③ Cycle Time

Displays the operating time of the manipulator. Each time the manipulator is started, the previous cycle time is reset, and a new measurement begins. The setting can be made for display or no display.

#### ④ Start No.

First step in the measurement. Measurement starts when the start button lamp lights and the playback starts.

#### ⑤ Motion Time

Displays the weaving time of the manipulator.

#### ⑥ Playback Time

Displays the time from beginning to the end of the measurement. Measurement ends when the manipulator stops and the start button lamp goes off.

## 5.2 Playback

### ■ Setting Display or Non-display of Cycle Time

Follow the procedure below to set whether or not to display the cycle time on the PLAYBACK window.

	Operation	Explanation
1	Select {DISPLAY} under the menu.	
2	Select {CYCLE TIME}.	The cycle time is displayed. Doing the same operation one more time will delete the cycle time display.

### 5.2.2 Playback Operation

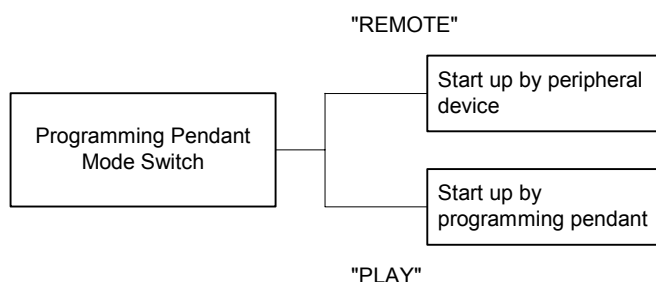
Playback is the operation by which the taught job is played back. Follow the procedures below to start the playback operation.



After checking to be sure there is no one near the manipulator, start the playback operation by following the procedures below.

- Programming pendant (start button)
- Peripheral device (external start input)

Which is used to start playback is specified by the mode switch on the programming pendant.



For playback using the programming pendant, follow the procedures below.

### ■ Selecting the Start Device

	Operation	Explanation
1	Set the mode switch on the programming pendant to "PLAY."	The remote mode is disabled and the play mode is enabled so the machines are to be started up by the programming pendant.

## ■ Start Operation

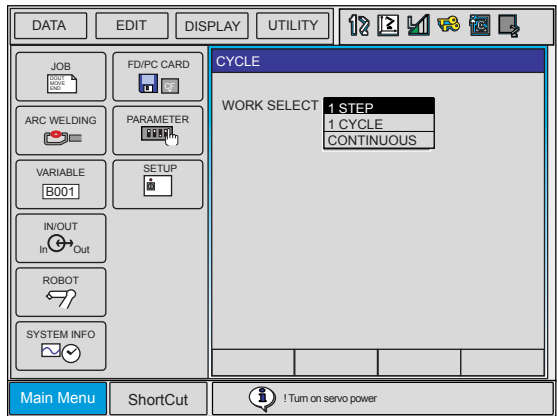
	Operation	Explanation
1	Press [START].	The start button lamp lights and the manipulator begins operation.

## ■ About the Operation Cycle

There are three types of manipulator operation cycles:

- AUTO : Repeats a job continuously.
- 1 CYCLE : Executes a job once. If there is a called job during execution, it is performed, after which the manipulator returns to the original job.
- 1 STEP : Executes one step (instruction) at a time.

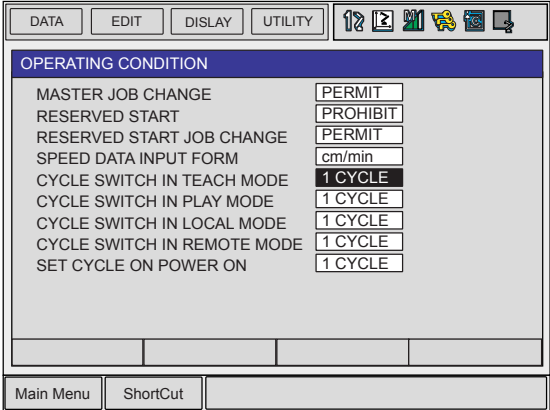
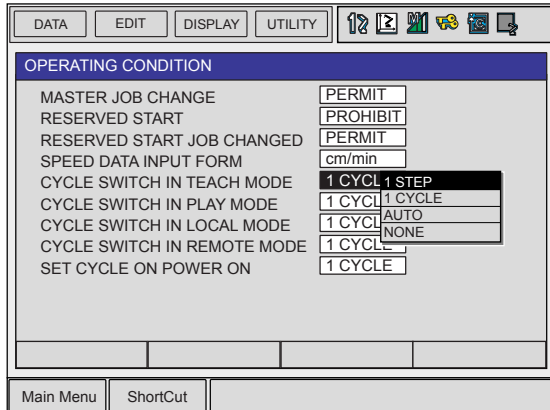
The operation cycle can be changed using the following:

	Operation	Explanation
1	Select {JOB} under the main menu, and then select {CYCLE}.	
2	Select the operation cycle to be changed.	<p>The operation cycle is changed.</p> 

## 5.2 Playback

## Automatic Setting for Operation Cycle

Automatic setting of the operation cycle can be changed by the following operation.  
This can be done in the management mode only.

	Operation	Explanation
1	Select {SETUP} under the main menu.	
2	Select {OPERATE COND}.	<p>The OPERATING CONDITION window appears. Use the cursor to scroll the screen.</p> 
3	Select desired operation.	<p>The selection dialog box appears.</p>  <div style="border: 1px solid black; padding: 10px; margin-top: 10px;"> <p><b>“NONE” setting</b></p> <p>The operation cycle is not changed when “NONE” is set.</p> <p>For example, if the setting is “CYCLE SWITCH IN TEACH MODE = NONE,” the operation cycle after selecting the teach mode is the same as the one before.</p> </div>

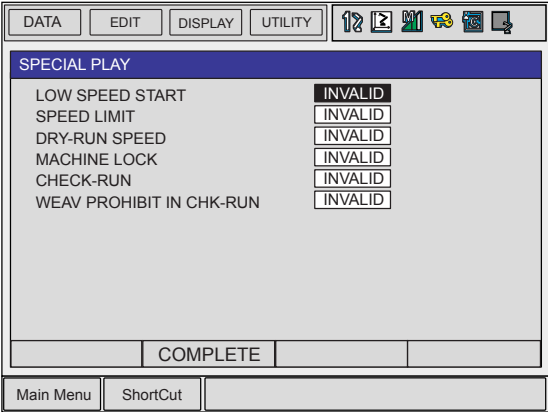
	Operation	Explanation
4	Select desired cycle.	<div>The operation cycle set automatically is changed.<div><div>DATAEDITDISPLAYUTILITY</div><div><div>OPERATING CONDITION</div><div><div>MASTER JOB CHANGE</div><div>PERMIT</div></div><div><div>RESERVED START</div><div>PROHIBIT</div></div><div><div>RESERVED START JOB CHANGED</div><div>PERMIT</div></div><div><div>SPEED DATA INPUT FORM</div><div>cm/min</div></div><div><div>CYCLE SWITCH IN TEACH MODE</div><div>1 STEP</div></div><div><div>CYCLE SWITCH IN PLAY MODE</div><div>1 CYCLE</div></div><div><div>CYCLE SWITCH IN LOCAL MODE</div><div>1 CYCLE</div></div><div><div>CYCLE SWITCH IN REMOTE MODE</div><div>1 CYCLE</div></div><div><div>SET CYCLE ON POWER ON</div><div>1 CYCLE</div></div></div></div><div><div></div><div></div><div></div><div></div></div><div><div>Main Menu</div><div>ShortCut</div><div></div></div></div>

5.2.3 Special Playback Operations

The following special operations can be performed during playback:

- Low speed operation
- Limited speed operation
- Dry run speed operation
- Machine lock operation
- Check mode operation

Two or more special operations can be performed at the same time. If multiple operations are selected, the speed during playback is limited to the speed of the slowest of the operations. Settings for special operations are done in the SPECIAL PLAY window. When displaying the PLAYBACK window, move the cursor to the menu area and select {UTILITY} → {SETUP SPECIAL RUN}. The SPECIAL PLAY window appears.



## 5.2 Playback

### ■ Low Speed Operation

The manipulator moves at low speed during the first step after starting. After the operation of this step, the manipulator stops regardless of the selection of the operation cycle. Low speed operation is canceled when the manipulator stops. Even if the manipulator is manually stopped during low speed operation, the low speed is cancelled.

	Operation	Explanation
1	Select "LOW SPEED START" on the SPECIAL PLAY window.	The setting alternates between "VALID" and "INVALID."
2	Select "COMPLETE."	The window returns to the PLAYBACK window.
3	Press [START].	When set to "VALID," the manipulator starts playback operation at a low speed for the first step and stops. After this, press [START] to execute each of the remaining steps. The manipulator moves at the speeds taught.

### ■ Limited Speed Operations

The manipulator operates within the limited speed for the teach mode. Usually, the limited speed is set to 250mm/s. Therefore, steps with speeds faster than 250mm/s are restricted to this speed limit. However, operation is performed at actual playback speeds for steps in which the set speed is under this limit.

	Operation	Explanation
1	Select "SPEED LIMIT" under the SPECIAL PLAY window.	The setting alternates between "VALID" and "INVALID."
2	Select "COMPLETE."	The window returns to the PLAYBACK window.
3	Press [START].	When set to "VALID," the manipulator starts playback operation at limited speed.

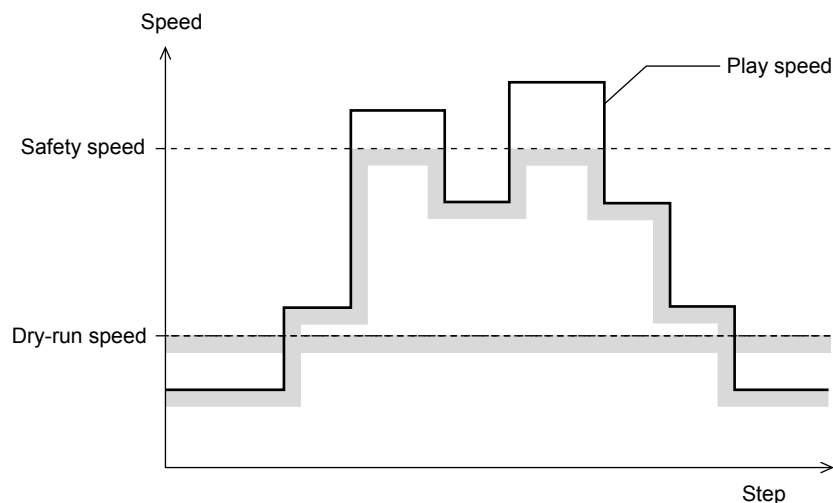
## ■ Dry-run Speed Operations

The dry-run speed is a constant speed that is independent of the teaching speeds. When the dry-run operation is started, the manipulator executes all the steps at a constant dry-run speed. Dry-run operation is convenient for quick check of a job consisting of slow operations. The dry-run speed is 10% of maximum speed.



Be careful of steps programmed at lower speeds than the dry-run speed, because they are executed at greater speeds than programmed.

	Operation	Explanation
1	Select the "DRY-RUN SPEED" under the SPECIAL PLAY window.	The setting alternates between "VALID" and "INVALID."
2	Select "COMPLETE."	The window returns to the PLAYBACK window.
3	Press [START].	When set to "VALID," the manipulator starts playback operation at dry-run speed.



Safety Speed and Dry-run Speed

## ■ Machine Lock Operation

In machine lock operation, a job is played back without moving the manipulator to check the status of input and output.

	Operation	Explanation
1	Select "MACHINE LOCK" under the SPECIAL PLAY window.	The setting alternates between "VALID" and "INVALID."
2	Select "COMPLETE."	The window returns to the PLAYBACK window.
3	Press [START].	When set to "VALID," the manipulator starts machine lock operation.

## 5.2 Playback

### ■ Check Mode Operation

During check mode operation, the machine runs without issuing work instructions, such as the ARCON instruction. It is used primarily to check the path of the program.

	Operation	Explanation
1	Select "CHECK-RUN" under the SPECIAL PLAY window.	The setting alternates between "VALID" and "INVALID."
2	Select "COMPLETE."	The window returns to the PLAYBACK window.
3	Press [START].	When set to "VALID," the manipulator starts check operation.

### ■ Weaving Prohibit Setting during Check Mode Operation

When weaving prohibit is specified for the check mode operation, the weaving operation is not executed in the weaving section of the job.

	Operation	Explanation
1	Select "WEAV PROHIBIT IN CHK-RUN" under the SPECIAL PLAY window.	The setting alternates between "VALID" and "INVALID."
2	Select "COMPLETE."	The window returns to the PLAYBACK window.
3	Press [START].	When set to "VALID," the manipulator does not execute the weaving operation during check run execution.

### ■ Cancel All Special Operations

	Operation	Explanation
1	Select {EDIT} from the menu.	
2	Select "CANCEL ALL SELECT."	The message "All special functions canceled" appears.



Special operations are also automatically cancelled if the main power is shut OFF.

# 5.3 Stop and Restart

The manipulator stops in the following conditions:

- Hold
- Emergency stop
- Stop by alarm
- Others
- During each application

## 5.3.1 Hold


Hold operation causes the manipulator to stop all motion. There are two ways to hold the manipulator motion.

- [HOLD] on the programming pendant
- External input signal (system input)

### ■ Using the Programming Pendant

#### Hold

When [HOLD] on the programming pendant is pressed, the manipulator stops.




[HOLD] lamp lights while it is held down. At the same time, [START] lamp goes OFF.

#### Release

Press [START] on the programming pendant. The manipulator restarts its operation from the position where it was stopped.

### ■ Using an External Input Signal (System Input)

#### Hold

	Operation	Explanation
1	Turn ON the hold signal from an external input (system input).	<div>The manipulator stops momentarily.<div> External holding</div><div>The output signal “HOLD” turns ON. The programming pendant [HOLD] lamp lights. At the same time, [START] lamp on the programming pendant turns OFF.</div></div>

## 5.3 Stop and Restart

### Release






	Operation	Explanation
1	Turn off the hold signal from an external input (system input).	Hold is released. To continue the operation, press [START] or turn ON the external input signal (system input). The manipulator restarts its operation, beginning from the position where it was stopped.

## 5.3.2 Emergency Stop






At an emergency stop, the servo power supply that drives the manipulator is turned OFF and the manipulator stops immediately. An emergency stop can be performed by using either of the following:

- Programming pendant
- External input signal (system input)

### Emergency Stop

	Operation	Explanation
1	Press the emergency stop button  .	<p>The servo power turns OFF and the manipulator stops immediately.</p> <p style="text-align: center;">EMERGENCY STOP</p> <p>On the front door of the NX100: </p> <p>On the programming pendant: </p> <p>Using the Emergency Stop Button on the Programming Pendant</p> <div style="border: 1px solid gray; padding: 5px; margin: 5px 0;">  Robot stops by P.P. emergency stop     </div> <p>Using the External Input Signal (System Input)</p> <div style="border: 1px solid gray; padding: 5px; margin: 5px 0;">  Robot stops by external emergency stop     </div>

Release

	Operation	Explanation
1	Turn the emergency stop button  in the direction of the arrows.	<p>On the front door of the NX100:  TURN</p> <p>On the programming pendant:  TURN</p> <p>To turn ON the servo power supply again, press [SERVO ON READY] and then grasp the Enable switch of the programming pendant.</p> <div></div> <div></div>

### 5.3.3 Restart After Emergency Stop



## CAUTION

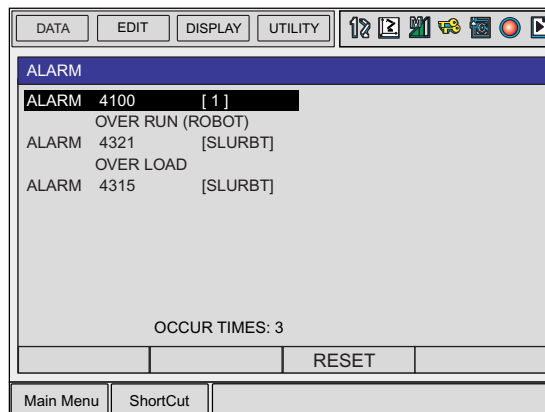
- **Prior to restarting after an emergency stop, confirm the position for the next operation and make sure there is no interference with the workpiece or fixture.**

The application of an emergency stop during high speed operations on continuous steps can result in the manipulator stopping two or three steps prior to the step that is being displayed. There is a risk of interference with the workpiece or fixture when the manipulator is restarted under such conditions.

### 5.3.4 Stop by Alarm

If an alarm occurs during operation, the manipulator stops immediately and the ALARM window appears on the programming pendant indicating that the machine was stopped by an alarm.

If more than one alarm occurs simultaneously, all alarms can be viewed on the window. Scroll down the viewing area of the window when necessary.



The following operations are available in the alarm status: window change, mode change, alarm reset, and emergency stop.

To display the ALARM window again when the window is changed during alarm occurrence, select {SYSTEM INFO} and then {ALARM HISTORY}.

### Releasing Alarms

Alarms are classified by minor and major alarms.

- Releasing Minor Alarms

	Operation	Explanation
1	Press [SELECT].	Select "RESET" under the ALARM window to release the alarm status. When using an external input signal (system input), turn ON the "ALARM RESET" setting.

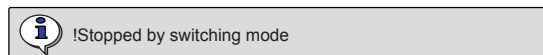
- Releasing Major Alarms

	Operation	Explanation
1	Turn OFF the main power supply and remove the cause of the alarm.	If a severe alarm, such as hardware failure occurs, servo power is automatically shut off and the manipulator stops. If releasing does not work, turn OFF the main power and correct the cause of the alarm.

## 5.3.5 Others

### ■ Temporary Stop by Mode Change

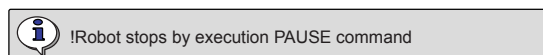
When the play mode is switched to the teach mode during playback, the manipulator stops immediately.



To restart the operation, return to the play mode and perform a start operation.

### ■ Temporary Stop by the PAUSE Instruction

When the PAUSE instruction is executed, the manipulator stops operating.



To restart the operation, perform a start operation. The manipulator restarts from the next instruction.

## **5.4** Modifying Play Speed

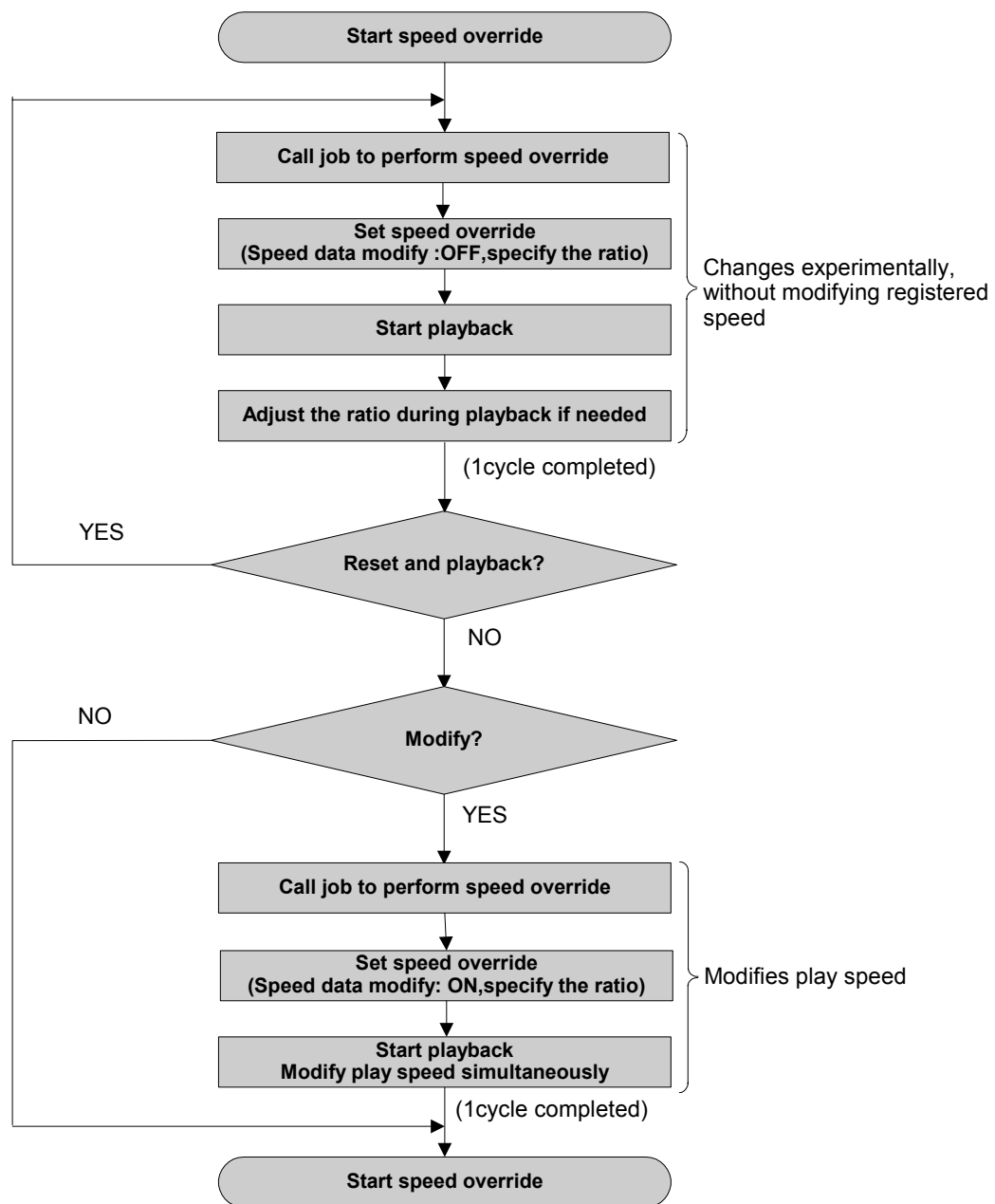
### **5.4.1** Modifying with Speed Override

Speed modifications using the speed override have the following features:

- Speed can be modified during playback.
- The job can be played back at various speeds until the play speed is properly adjusted.
- Speed can be increased or decreased by a ratio of the current play speed. The ratio settings range from 50% to 150% in increments of 1%.
- All play speed values used in the job can be increased or decreased by a constant ratio.

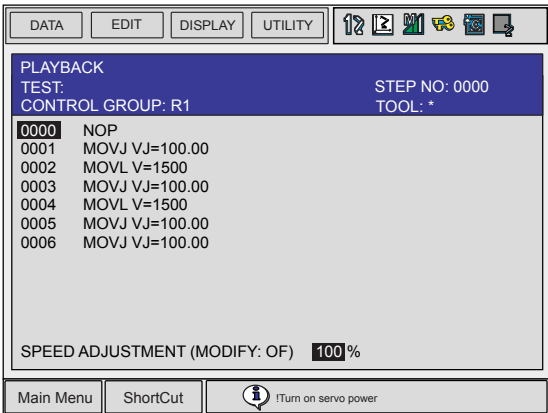

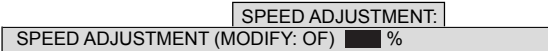
Therefore, it is convenient when, for example, all play speed settings are to be increased by 150% at the same time.

The operation flow override of play speeds is as shown in the following:



## 5.4 Modifying Play Speed

## ■ Setting Speed Overrides

	Operation	Explanation
1	Select {UTILITY} under the menu in the PLAYBACK window.	
2	Select {SPEED OVERRIDE}.	<p>The PLAYBACK window becomes the speed override condition.</p> 
3	Select "ON" or "OFF" under "MODIFY."	<p>Each time [SELECT] is pressed when the cursor is on the data of the item "MODIFY," "ON" and "OFF" alternate.</p> <p>Select "ON" to modify the registered play speed during playback. When "OFF" is selected, the registered play speed is not modified. To change the play speed temporarily (for example, to experiment with various speeds), select "OFF."</p> 
4	Set the override ratio.	<p>Line up the cursor with the override ratio and move the cursor up and down to change the ratio.</p> <p>If you want to input the ratio number directly, move the cursor to the override ratio and press [SELECT]. The number input line appears. Input the override ratio using the Numeric keys.</p> 

## ■ Modifying Play Speed

	Operation	Explanation
1	Set speed override.	
2	Playback the manipulator.	<p>The manipulator starts operating. The play speed is increased or decreased in the set ratio. When setting "MODIFY" to "ON," the step's play speed is modified when each step is reached.</p> <p>When one cycle is completed by the END instruction, the speed override setting is released.</p>

**NOTE**

- Assuming that the manipulator moves from step 1 to step 2, the play speed of step 2 is not modified if the speed override is released before reaching step 2.
- When the play speed is changed by speed override, the maximum and minimum speed is limited by the manipulator.
- When the safety speed operation is commanded with the setting of "MODIFY: ON," the manipulator operates at safety speed. However, the play speed in memory is modified as set using speed override.
- Play speed set by the SPEED instruction is not modified.

## ■ Modifying Speed Override Ratio

	Operation	Explanation
1	Select {UTILITY} under the menu in the PLAYBACK window.	
2	Select {SPEED OVERRIDE}.	
3	Set the desired speed override ratio with the cursor.	Line up the cursor with the speed ratio and press [SHIFT] + the cursor key to change the ratio. To set the value directly, first select the speed ratio and the number input line will appear. Use the Numeric keys to input the new ratio. If [CANCEL] is pressed, the modified ratio is released.

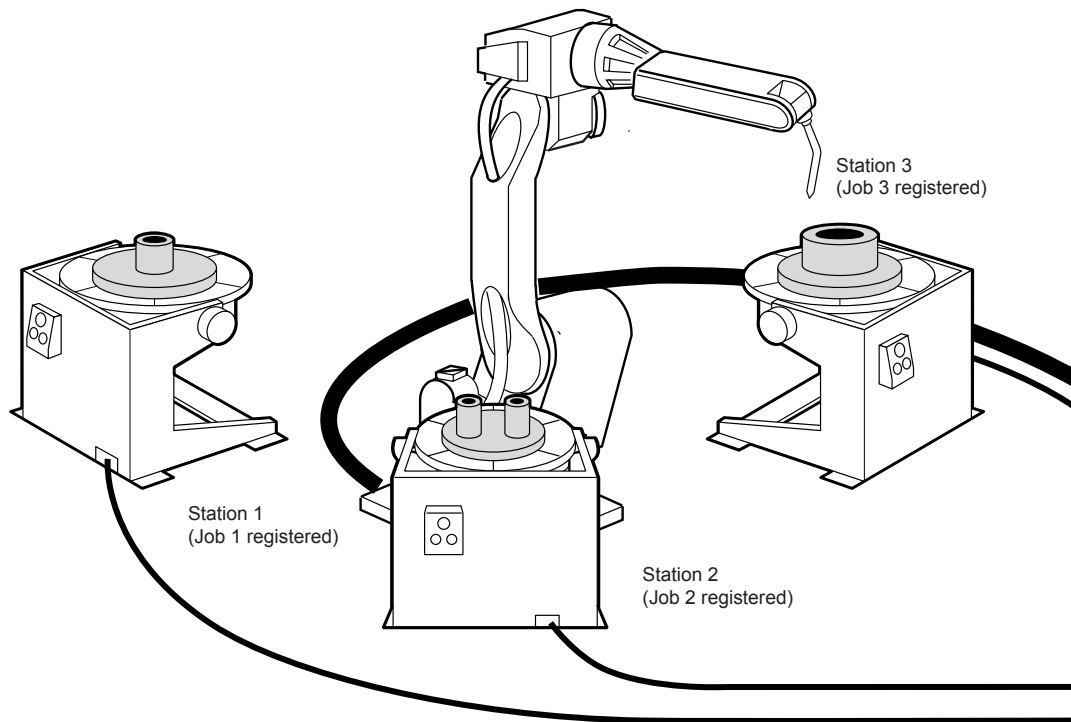
## ■ Releasing Speed Override Settings

	Operation	Explanation
1	Select {UTILITY} under the menu in the PLAYBACK window.	
2	Select {SPEED OVERRIDE}.	<p>The setting of the speed override ratio is released. If it is released, the speed ratio setting is not displayed on the PLAYBACK window.</p> <p>The speed override settings are automatically released in the following cases:</p> <ul style="list-style-type: none"> <li>• When dry-run speed operation is set.</li> <li>• When the mode is changed to any mode other than the play mode.</li> <li>• When an alarm or error occurs.</li> <li>• When one cycle operation is completed with the END instruction.</li> <li>• When the power supply is turned OFF.</li> </ul>

## 5.5 Playback with Reserved Start

### 5.5.1 Preparation for Reserved Start

In the reserved start function, jobs registered at different stations are played back in the reserved order using the start buttons on the stations.



For example, in a case where three stations handle three different workpieces, as shown in the illustration above, the jobs would be registered as follows:

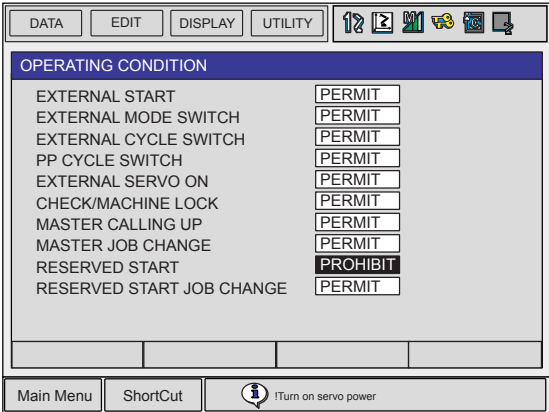
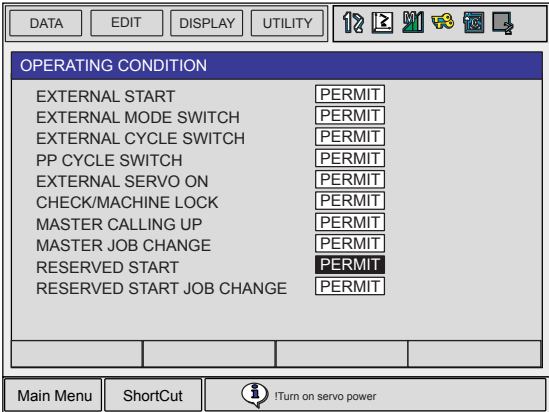
- Job 1 is registered to process workpiece 1 at Station 1
- Job 2 is registered to process workpiece 2 at Station 2
- Job 3 is registered to process workpiece 3 at Station 3

To play back the jobs, prepare workpiece 1 and press the start button on Station 1. The manipulator executes Job 1. Prepare workpieces 2 and 3 while Job 1 is being executed, and press the start buttons on Stations 2 and 3. Even if Job 1 is being executed at that time, jobs on different stations are reserved in the order that the start buttons were pressed, and will be executed in that order. During playback, the status of the reservation can be checked on the start reservation window.

■ Enabling Reserved Start

The start button on the station is operative when the reserved start function is enabled, and the following start operations are impossible.

- [START] on the programming pendant
- Start operation from external input signal (system input)

	Operation	Explanation
1	Select {SETUP} under the main menu.	
2	Select {OPERATE COND}.	<p>The OPERATING CONDITION window appears. The screen is scrolled up/down by the cursor key when it locates at the top/bottom of the items.</p> <div></div> <div><p><b>NOTE</b> The OPERATING CONDITION window is shown only when the security mode is management mode.</p></div>
3	Select “RESERVED START.”	<p>Each time [SELECT] is pressed, “PERMIT” and “PROHIBIT” alternate. Select “PERMIT.”</p> <div></div> <div><p><b>NOTE</b> When reserved start is enabled, the external start and the programming pendant start are prohibited even if setting is “PERMIT.” Regardless of the operation cycle selected, it is automatically set to 1 CYCLE.</p></div>

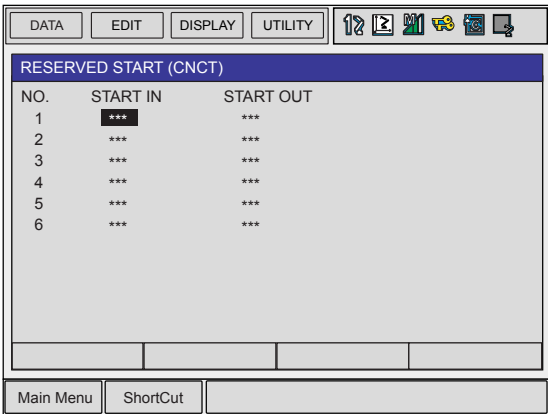
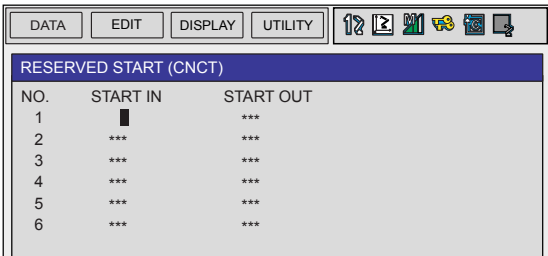
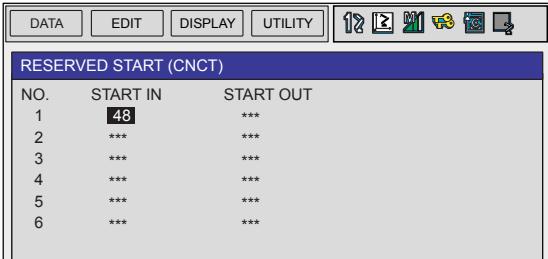
## 5.5 Playback with Reserved Start

## ■ Registering Reserved Start I/O Signal

Register the start I/O signal as a preparation to perform start operation from the station.



This operation can be done only when the operation mode is teach mode and the security mode is management mode.

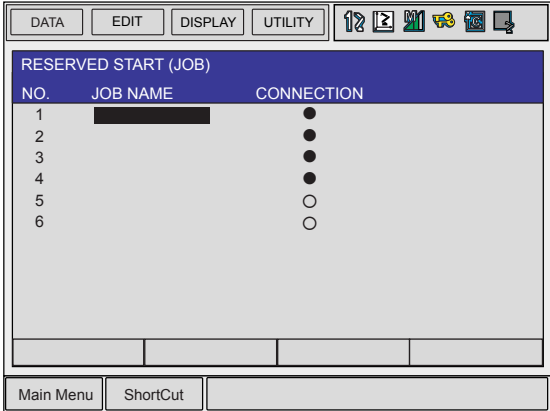
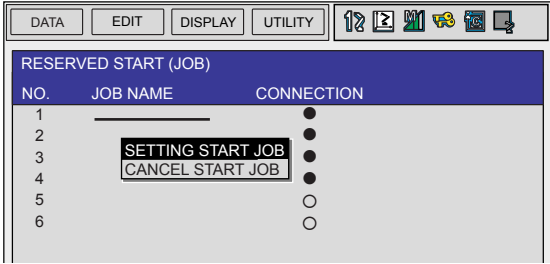
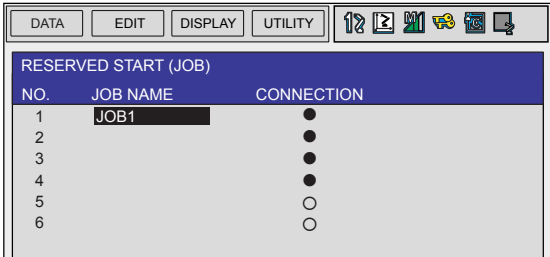
	Operation	Explanation
1	Select {SETUP} under the main menu.	
2	Select {RES. START(CNCT)}.	<p>The RESERVED START (CNCT) window appears.</p> 
3	Select "START IN" or "START OUT" for each station.	<p>The number can now be entered.</p> 
4	Input desired signal number.	
5	Press [ENTER].	<p>The input/output signal number is registered.</p> 

## ■ Registering Jobs to Stations

Register the starting job of each station.



This operation can be done only when the operation mode is teach mode and the setting of “RESERVED START JOB CHANGE” is “PERMIT” in the OPERATING CONDITION window. For operation, refer to “Enabling Reserved Start” on the page 5-23.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {RES. START(JOB)}.	<p>The RESERVED START (JOB) window appears.</p> <p>● indicates that the input/output number is registered. ○ indicates that the input/output number is not registered.</p> 
3	Select job name for each station.	<p>The selection dialog box appears.</p> 
4	Select “SETTING START JOB.”	The JOB LIST window appears.
5	Select desired job.	<p>The starting job is registered.</p> 

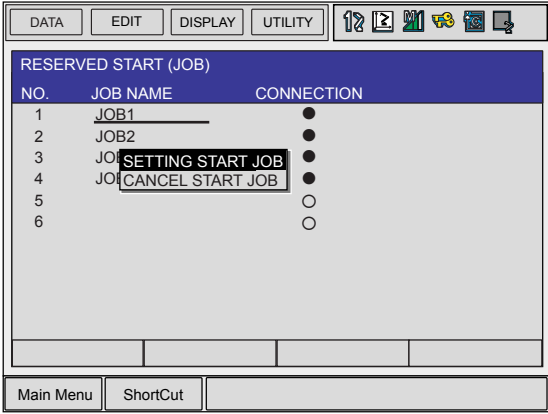
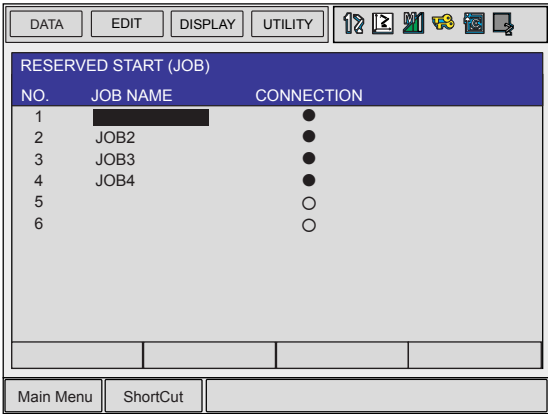
## 5.5 Playback with Reserved Start

## ■ Deleting Registered Jobs from Stations

Delete the registered job of each station.



This operation can be done only when the operation mode is teach mode and the setting of “RESERVED START JOB CHANGE” is “PERMIT” in the operation condition display. For operation, refer to “Enabling Reserved Start” on the page 5-23.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {RES. START(JOB)}.	The RESERVED START (JOB) window appears.
3	Select job name for each station.	The selection dialog box appears. 
4	Select “CANCEL START JOB.”	Registered job is deleted. 

## 5.5.2 Playback from Reserved Start

### ■ Start Operation

	Operation	Explanation
1	Set the mode switch to "PLAY."	
2	Press start button on the station.	The job registered for the station starts up and the manipulator performs one cycle operation.



- While the job is being executed, the start button lamp on the station lamps.
- If the workpiece must be prepared at the station, prepare it before pressing the start button.
- If the start button of another station is pressed during execution of a job at one station, the job on the station is reserved and prepares to start. Jobs are reserved and executed in the order that the start buttons are pressed.
- When a job is reserved, the start button lamp on the station blinks.
- No station job is reserved when it is being executed even if its start button is pressed.
- To suspend a job being executed, perform the Hold operation.

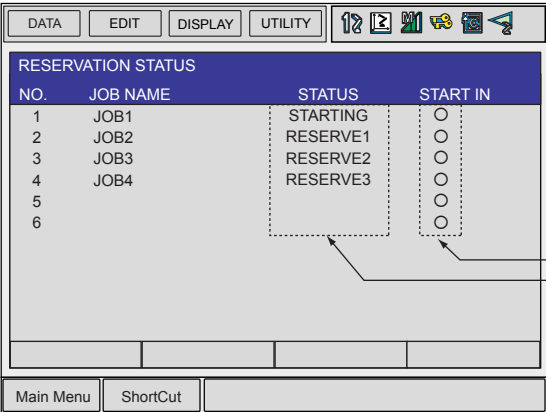


Reservations are cancelled when the start button is pressed again during the job reservation operation.

## 5.5 Playback with Reserved Start

## ■ Checking Job Reservation Status

The job reservation status during playback can be checked.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {RES. STATUS}.	<p>The RESERVATION STATUS window appears.</p>  <p>① <b>STATUS</b>  Reservation status is displayed.  STARTING: Indicates the station currently working.  STOP: Indicates any station where work has been temporarily stopped by a hold operation.  RESERVE1,RESERVE2,...: Indicates the order in which jobs have been reserved for start.</p> <p>② <b>START IN</b>  Input signal status is displayed.  “●”: Input signal ON  “○”: Input signal OFF</p>

■    Resetting Job Reservation

The job reservation can be reset.

NOTE

If “STARTING” is displayed, the job cannot be reset.

	Operation	Explanation																												
1	Select {JOB} on the RESERVATION STATUS window.																													
2	Select {RESET RESERVATION} or {RESET ALL}.	<div>When {RESET RESERVATION} is selected, job reservation stated to “RESERVE“ is reset.</div> <div>When {RESET ALL} is selected, job reservation stated to “STOP” and “RESERVE” is reset.</div> <div><div><div><div>DATA</div><div>EDIT</div><div>DISPLAY</div><div>UTILITY</div></div><div><div><div>12345678910</div><div>11121314151617181920</div><div>21222324252627282930</div><div>31323334353637383940</div><div>41424344454647484950</div></div></div><div><div>RESERVATION STATUS</div><table><thead><tr><th>NO.</th><th>JOB NAME</th><th>STATUS</th><th>START IN</th></tr></thead><tbody><tr><td>1</td><td>JOB1</td><td></td><td><input type="radio"/></td></tr><tr><td>2</td><td>JOB2</td><td></td><td><input type="radio"/></td></tr><tr><td>3</td><td>JOB3</td><td></td><td><input type="radio"/></td></tr><tr><td>4</td><td>JOB4</td><td></td><td><input type="radio"/></td></tr><tr><td>5</td><td></td><td></td><td><input type="radio"/></td></tr><tr><td>6</td><td></td><td></td><td><input type="radio"/></td></tr></tbody></table></div><div><div>Main Menu</div><div>ShortCut</div><div></div></div></div></div> <div><div><div>NOTE</div><div><div>All job reservations are reset automatically in the following conditions:</div><div><div>• When the reserved start sets to “PROHIBIT.” (When “RESERVED START” is set to “PROHIBIT” on the OPERATING CONDITION window.)</div><div>• When another job is called or an edit operation is performed.</div></div></div></div></div> <div>The confirmation dialog box appears.</div> <div><div><div>Clear data?</div><div><div>YES</div><div>NO</div></div></div></div>	NO.	JOB NAME	STATUS	START IN	1	JOB1		<input type="radio"/>	2	JOB2		<input type="radio"/>	3	JOB3		<input type="radio"/>	4	JOB4		<input type="radio"/>	5			<input type="radio"/>	6			<input type="radio"/>
NO.	JOB NAME	STATUS	START IN																											
1	JOB1		<input type="radio"/>																											
2	JOB2		<input type="radio"/>																											
3	JOB3		<input type="radio"/>																											
4	JOB4		<input type="radio"/>																											
5			<input type="radio"/>																											
6			<input type="radio"/>																											
3	Select “YES.”																													

### 5.5.3 Hold Operation

Hold operation causes the manipulator to stop all motion. It can be performed by the the following buttons or signal.

- [HOLD] on the programming pendant
- External Input Signal (system input)
- Hold button for the station axis

#### ■ [HOLD] on the Programming Pendant

##### Hold

The manipulator stops temporarily when [HOLD] on the programming pendant is pressed.



The [HOLD] lamp lights while it is held down. At the same time, the [START] lamp goes OFF.

##### Release

Press the start button on the suspended station. The manipulator restarts its operation from the position where it was stopped.

#### ■ Hold by External Input Signal (System Input)

##### Hold


	Operation	Explanation
1	Input ON signal to the external input (system input) specified for hold operation.	<p>The manipulator stops temporarily.</p> <div> </div> <p>The hold lamp for the external output signal lights. The [HOLD] lamp on the programming pendant lights and the [START] lamp turns OFF.</p>

##### Release

	Operation	Explanation
1	Input OFF signal to the external input (system input) specified for hold operation.	<p>Hold is released. To continue the operation, press the start button on the suspended station. The manipulator restarts its operation from the position where it was stopped.</p>

## ■ Hold at the Station

### Hold

	Operation	Explanation
1	Press the hold button on the station.	The manipulator stops temporarily.  External holding

### Release

	Operation	Explanation
1	Press the hold button on the suspended station.	Hold is released. To continue the operation, press the start button on the station. The manipulator restarts its operation from the position where it was stopped.

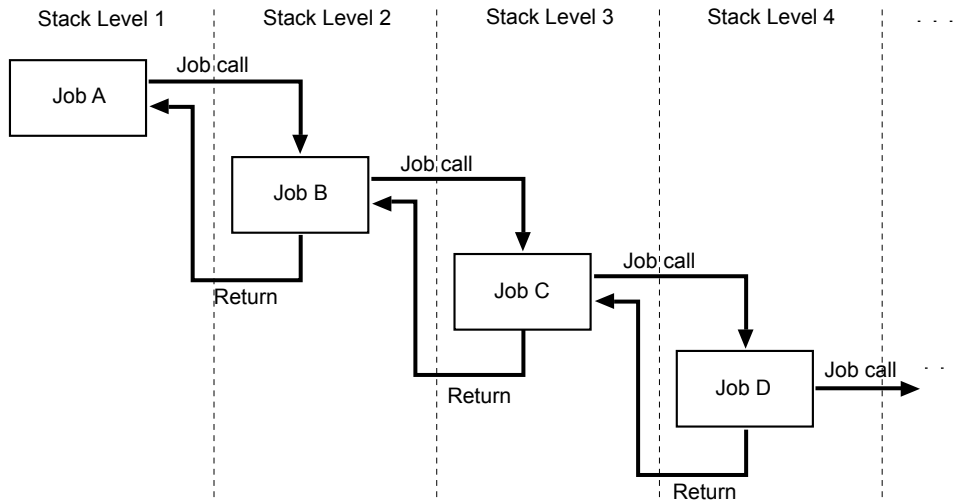


Pressing the start button on a station that is not in Hold status does not start manipulator operation. The job registered for the station is reserved or the reservation, if it has been made, is canceled.

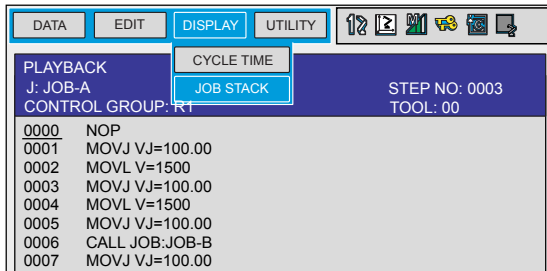
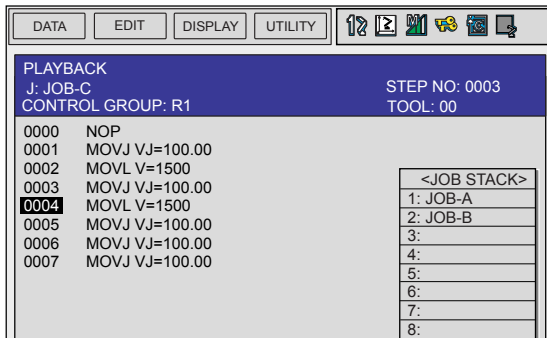
## 5.6 Displaying Job Stack

## 5.6 Displaying Job Stack

During execution of the series of jobs that combined with CALL or JUMP instructions, the job stack can be displayed to check where the current job is and how many jobs left.



Job calls can be used for up to 8 stack levels.

	Operation	Explanation
1	Select {DISPLAY} under the menu on the PLAYBACK window.	<p>The pull-down menu appears.</p> 
2	Select {JOB STACK}.	<p>The job stack status dialog box appears. To close the job stack status dialog box, select {DISPLAY} and then {JOB STACK} under the menu again.</p>  <p>For above example, the playback of Job C is being executed and the Job C is called from Job B. Also, the Job B is called from Job A.</p>

## 6 Editing Jobs

This section explains how to manage the jobs without moving the manipulator. Copying, deleting, and modifying of the jobs can be done in the teach mode only. Other operations can be done in any mode.



Edit operations are restricted when the edit lock is applied.



### Editing Move Instructions

See " 4 Teaching " for basic information on editing move instructions. It is not possible to add, delete, or modify move instructions which have position data. See " 4.4 Modifying Steps " for details.

The following MOV instruction edit operations are explained in this section:

For move instructions:

- Insertion, deletion, or modification of additional items
- Modification of interpolation type or play speed for move instructions
- Setting, modification, or deletion of UNTIL statements (interruption conditions based on input signals)
- Setting and deletion of NWAIT instructions

For move instructions using position variables:

- Insertion and deletion of move instruction.

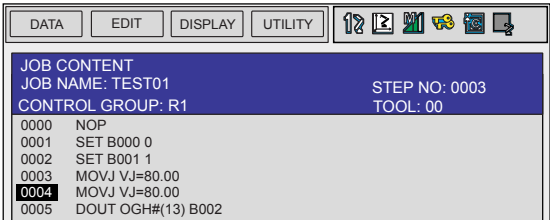
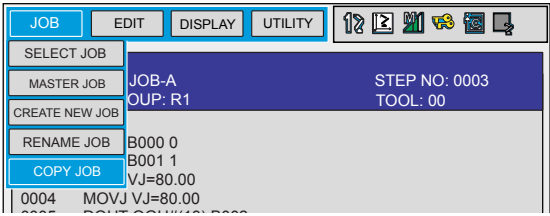


## 6.1 Copying Jobs

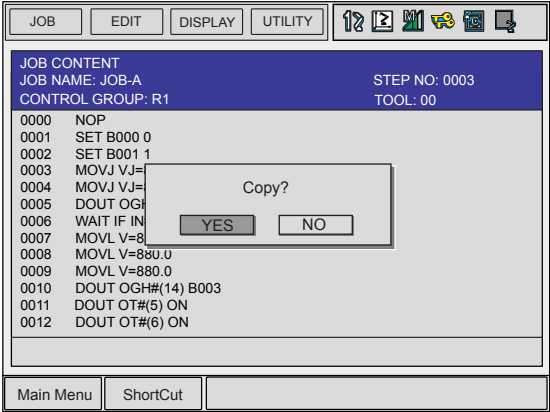
## 6.1 Copying Jobs

This operation is used to copy registered jobs and use them to create new jobs. It can be done using either the JOB CONTENT window or the JOB LIST window.

### 6.1.1 Copying Jobs on the JOB CONTENT Window

On the JOB CONTENT window, the current edit job becomes the copy source job.

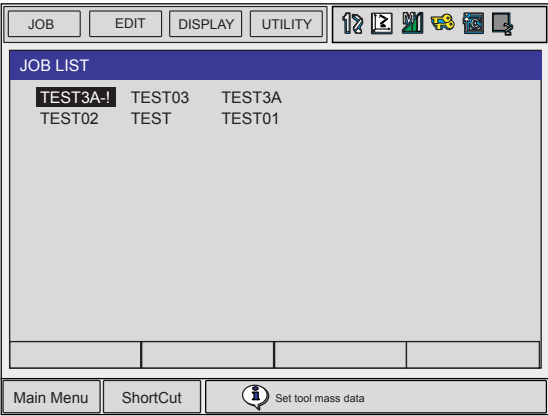
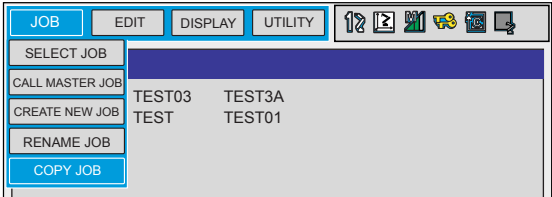


	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	<p>The JOB CONTENT window appears.</p> 
3	Select {JOB} under the menu.	<p>The pull-down menu appears.</p> 
4	Select {COPY JOB} under the pull-down menu.	
5	Input the new job name.	<p>The name of the copy source job is displayed on the input area. It is possible to partially change this name to enter a new name.</p>  <div style="border: 1px solid blue; padding: 5px; margin-top: 10px;">  See " 1.2.7 Character Input " for information on letter input operations.         </div>

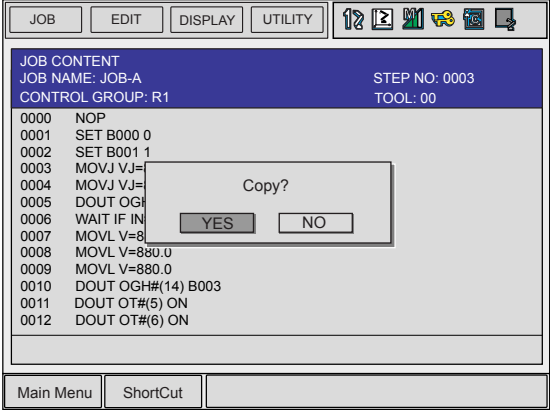
	Operation	Explanation
6	Press [ENTER].	<p>The confirmation dialog box appears.</p> <p>If “YES” is selected, the job is copied and the new job appears.</p> <p>If “NO” is selected, the job copy is not executed, and the process is cancelled.</p> 

## 6.1 Copying Jobs

## 6.1.2 Copying Jobs on the JOB LIST Window

On the JOB LIST window, select the copy source job from the registered jobs and specify the copy destination directory.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {SELECT JOB} under the pull-down menu.	<p>The JOB LIST window appears.</p> 
3	Move the cursor to the copy source job.	
4	Select {JOB} under the menu.	
5	Select {COPY JOB} under the pull-down menu.	
6	Input the new job name.	<p>The name of the copy source job is displayed on the input area. It is possible to partially change this name to enter a new name.</p>  <div style="border: 1px solid blue; padding: 5px; margin-top: 10px;">  See " 1.2.7 Character Input " for information on letter input operations.         </div>

	Operation	Explanation
7	Press [ENTER].	<p>The confirmation dialog box appears.</p> <p>If “YES” is selected, the job is copied and the new job appears.</p> <p>If “NO” is selected, the job copy is not executed, and the process is cancelled.</p> 

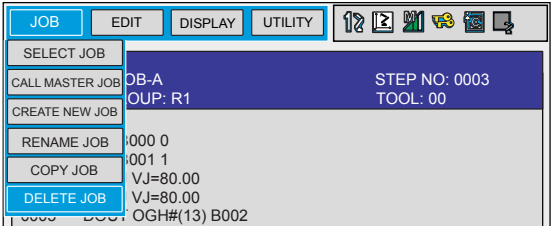
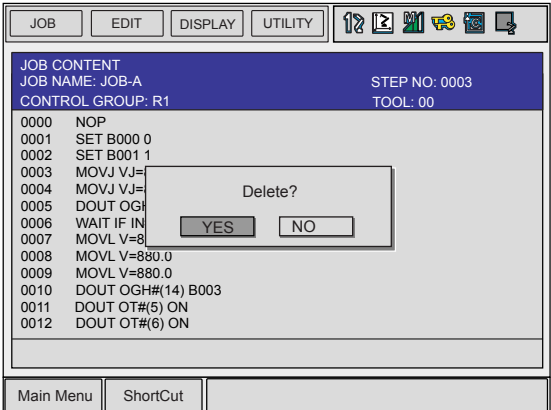
## 6.2 Deleting Jobs

## 6.2 Deleting Jobs

This operation is used to delete jobs that are registered on the NX100. It can be performed in either the JOB CONTENT window or the JOB LIST window.

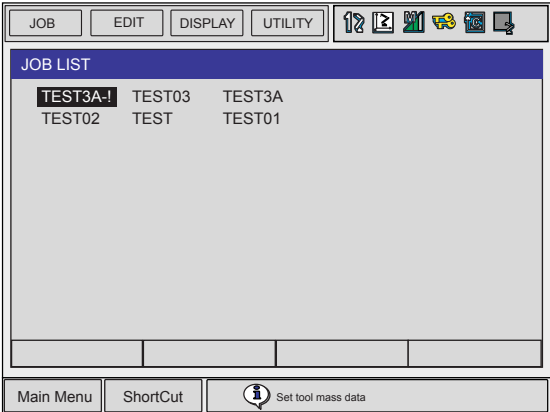
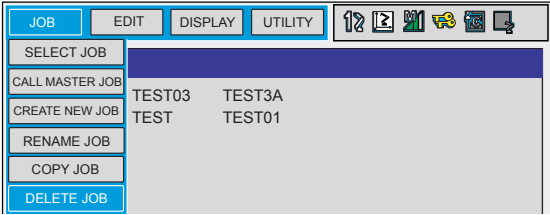
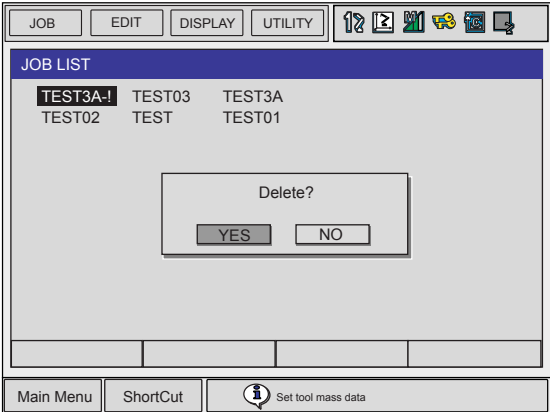
### 6.2.1 Deleting Jobs on the JOB CONTENT Window

On the JOB CONTENT window, the current edit job is deleted.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	The JOB CONTENT window appears.
3	Select {JOB} from the menu.	The pull-down menu appears. 
4	Select {DELETE JOB} under the pull-down menu.	The confirmation dialog box appears. When "YES" is selected, the edit job is deleted. When deletion is completed, the JOB LIST window appears. When "NO" is selected, the job deletion is cancelled. 

### 6.2.2 Deleting Jobs on the JOB LIST Window

On the JOB LIST window, select the job to be deleted from the list of the registered jobs.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {SELECT JOB}.	<div>The JOB LIST window appears. </div>
3	Move the cursor to the job to be deleted.	
4	Select {JOB} from the menu.	<div></div>
5	Select {DELETE JOB} under the pull-down menu.	<div><div>The confirmation dialog box appears. </div><div>If "NO" or [CANCEL] is selected, the job deletion is cancelled and the JOB LIST window appears.</div></div>
6	Select "YES."	



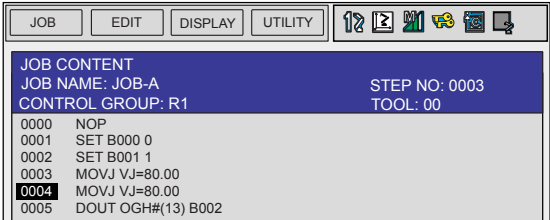
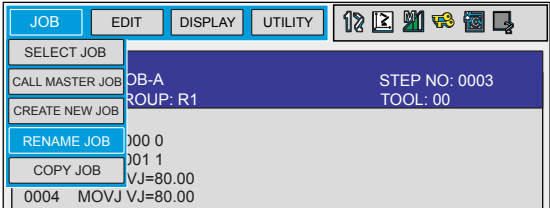
To select all the registered jobs at a time, select {EDIT} from the menu and then select "SELECT ALL."


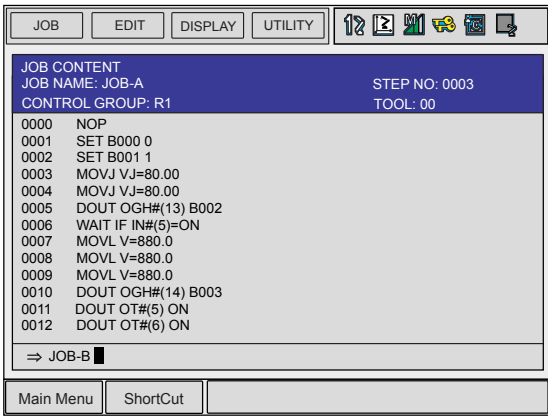
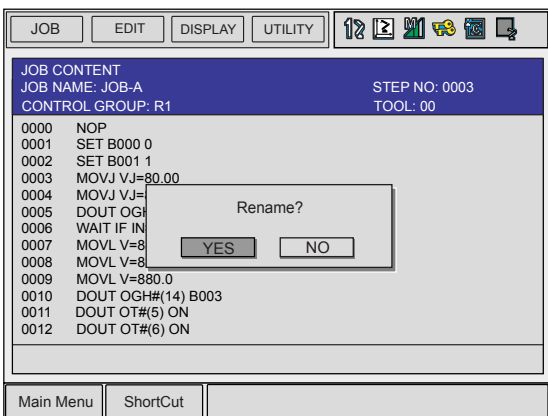
## 6.3 Modifying Job Names

### 6.3 Modifying Job Names

This operation is used to modify the name of a job that is registered. The operation can be performed in either the JOB CONTENT window or the JOB LIST window.

#### 6.3.1 Modifying Job Names on the JOB CONTENT Window

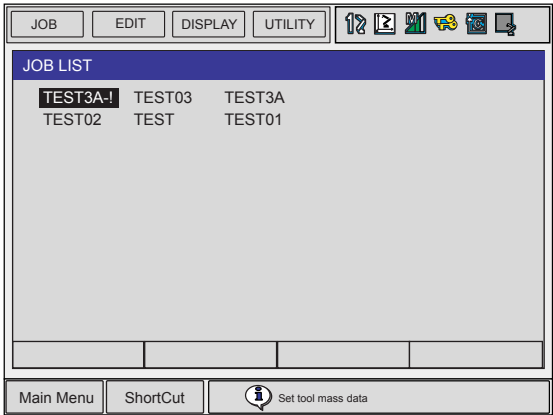
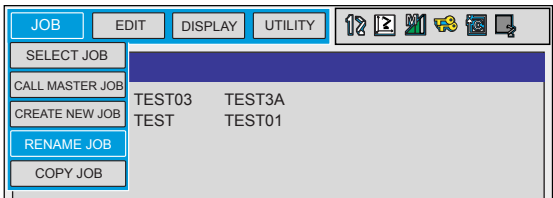
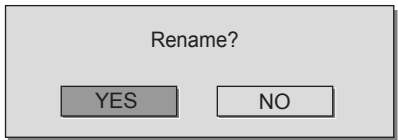
	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	<p>The JOB CONTENT window appears.</p> 
3	Select {JOB} from the menu.	<p>The pull-down menu appears.</p> 
4	Select {RENAME JOB} under the pull-down menu.	

	Operation	Explanation
5	Input the job name.	<p>Input the new job name on the input area. The name of the source job is displayed on the input area. It is possible to partially change this name to enter a new name.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;">  See " 1.2.7 Character Input " for information on letter input operations.         </div> 
6	Press [ENTER].	<p>The confirmation dialog box appears. When "YES" is selected, the job name is changed and a new job name is displayed. When "NO" is selected, the job name is not changed, and the process is cancelled.</p> 

## 6.3 Modifying Job Names

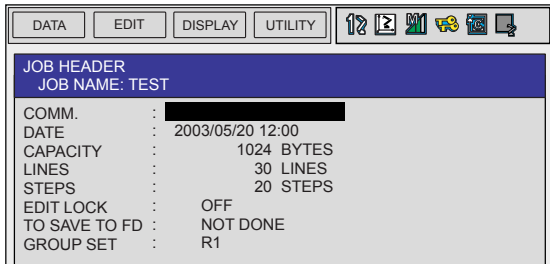


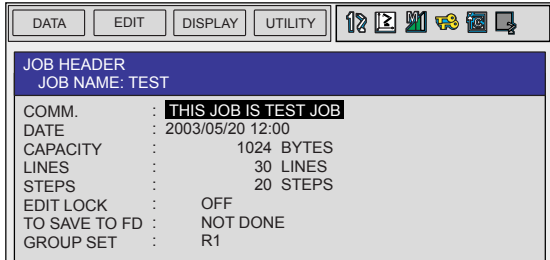
## 6.3.2 Modifying Job Names on the JOB LIST Window

On the JOB LIST window, select the job whose name is to be modified from the list of the registered jobs.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {SELECT JOB}.	<p>The JOB LIST window appears.</p> 
3	Move the cursor to the name to be changed.	
4	Select {JOB} from the menu.	
5	Select {RENAME JOB} under the pull-down menu.	
6	Enter the job name and press [ENTER].	<p>The confirmation dialog box appears.</p> 
7	Select "YES."	

## 6.4 Editing Comments

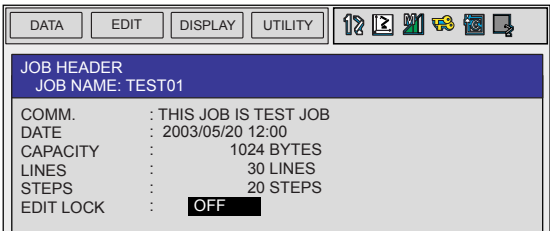
Comments of up to 32 characters can be affixed to jobs to identify them more specifically. Comments are displayed and edited on the JOB HEADER window.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	
3	Select {DISPLAY} under the pull-down menu.	
4	Select {JOB HEADER}.	<p>The JOB HEADER window appears.</p> 
5	Select "COMM."	The window for character input appears.
6	Input comments.	<p>For jobs that are already registered, comments are displayed on the input area. It is possible to partially change comments to enter new comments.</p>  <div style="border: 1px solid blue; padding: 5px; margin-top: 10px;">  <p>See " 1.2.7 Character Input " for information on character input operations.</p> </div>
7	Press [ENTER].	<p>The input area comment is registered and is displayed in the "COMM." area on the JOB HEADER window.</p> 

## 6.5 Setting Edit Lock on Individual Job Units

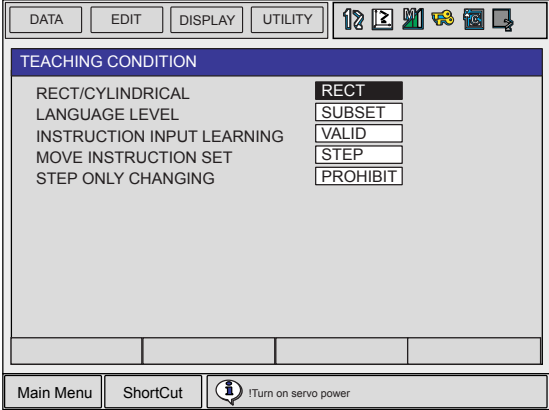
## 6.5 Setting Edit Lock on Individual Job Units

In order to prevent inadvertent changes in registered jobs or data, it is possible to apply an edit lock to individual jobs. When a job is protected from editing, the job cannot be edited or deleted. Edit lock is set and cancelled on the JOB HEADER window.

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	
3	Select {DISPLAY} under the pull-down menu.	
4	Select {JOB HEADER}.	<p>The JOB HEADER window appears.</p> 
5	Select "EDIT LOCK" and set the edit prohibit.	Each time [SELECT] is pressed, the setting alternates between "ON" (edit disabled) and "OFF" (edit enabled).

# 6.6 Enabling the Modification of Position Data Only

It is possible to set conditions to allow changes of position data only, in jobs which are locked.


	Operation	Explanation
1	Select {SETUP} under the main menu.	
2	Select {TEACHING COND}.	<div>The TEACHING CONDITION window appears.</div> <div></div> <div><div>NOTE</div>TEACHING CONDITION window is shown only when the security mode is edit mode or management mode.</div>
3	Select “STEP ONLY CHANG-ING.”	
4	Press [SELECT].	Each time [SELECT] is pressed, the setting alternates between “PROHIBIT” and “PERMIT.”

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## 7 Convenient Functions

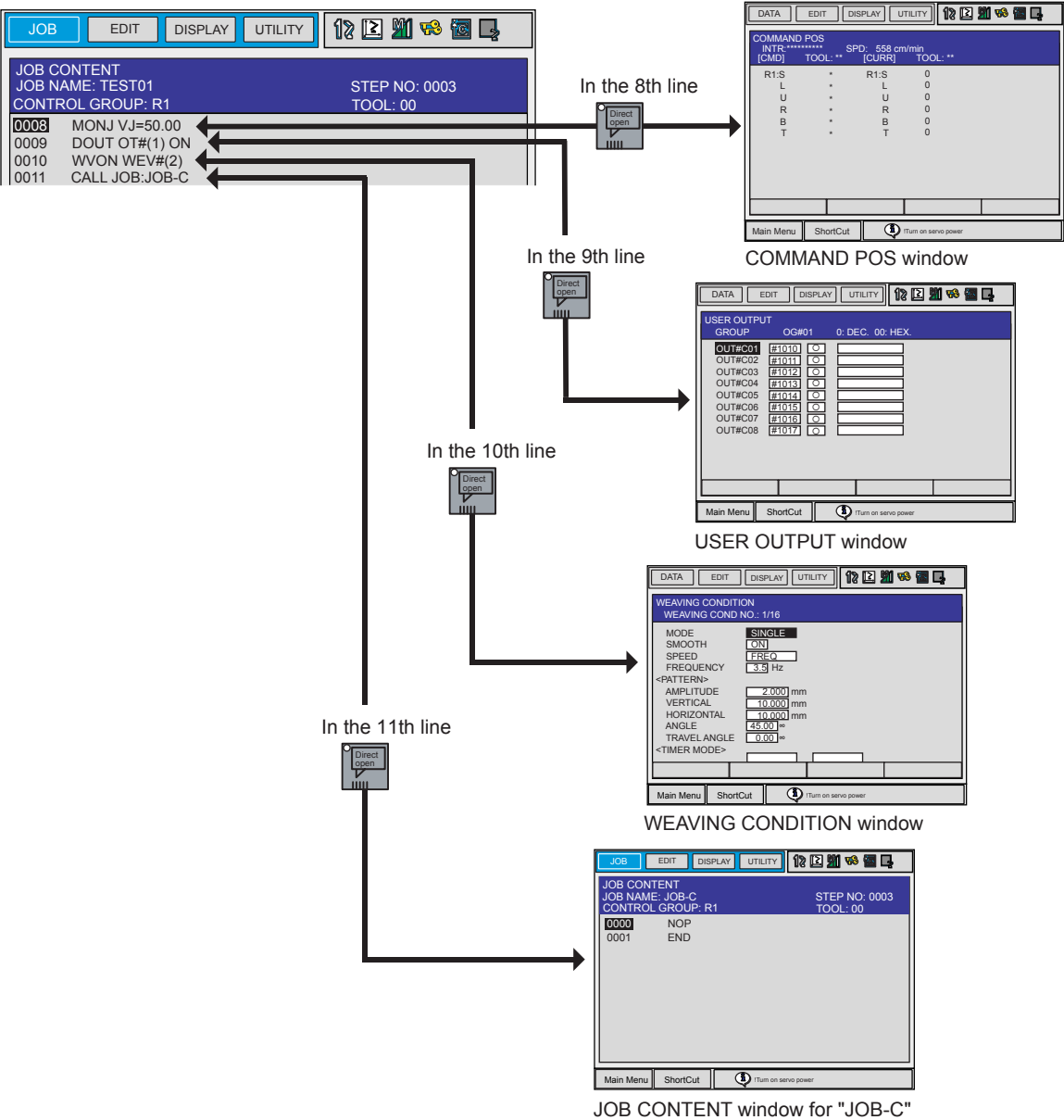
### 7.1 One-touch Operation "Direct Open"



The direct open function immediately shows the JOB CONTENT window or condition file contents of a job called with the CALL instruction. Move the cursor to the desired job name or

condition file name and simply press the direct open key  to display the contents of the file. This function can be used for the following window:

- JOB CONTENT window for a job name directly specified by a CALL instruction
- CONDITION FILE window for a file name directly specified by a work instruction
- COMMAND POS window for a move instruction
- I/O window with an I/O instruction (when I/O numbers are specified)

<Example> Example Using Direct Open



	Operation	Explanation
1	In the JOB CONTENT window, move the cursor to the job name or condition file for which the window is to be displayed.	
2	Press the direct open key  .	This key lamp lights and the JOB CONTENT window or the condition file window appears. When the direct open key  is pressed once more, the key lamp turns OFF, and the window returns to the former JOB CONTENT window.

## 7.2 Parallel Shift Function

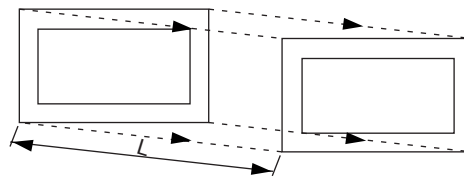
### NOTE

- The direct open function cannot be used again while a directly opened window is shown.
- If another window is selected while the direct open function is effective, the function is automatically cancelled and the lamp on the direct open key goes out.
- Once another JOB CONTENT window is opened by the direct open function, the source job cannot be continuously operated. (Stopped until the opened JOB CONTENT window is closed.)

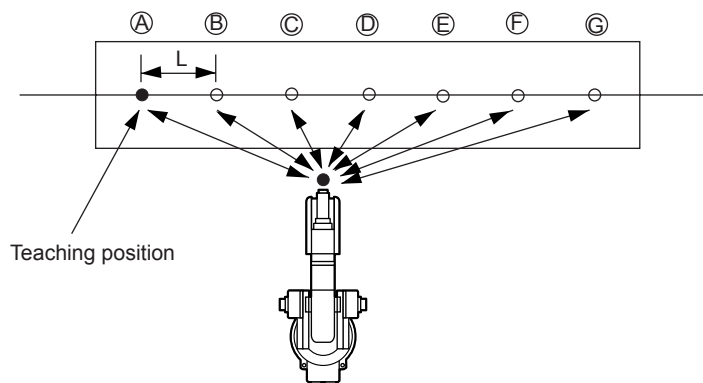
## 7.2 Parallel Shift Function

### 7.2.1 Function Overview

Parallel shift refers to the shifting of an object from a fixed position in such a way that all points within the object move an equal distance. In the model for parallel shift shown in the following, the shift value can be defined as the distance  $L$  (three-dimensional coordinate displacement). The parallel shift function is relevant to the actual operation of the manipulator because it can be used to reduce the amount of work involved in teaching by shifting a taught path (or position).

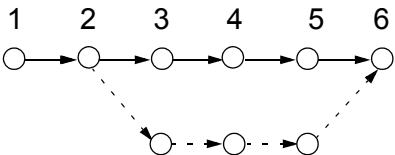


In the example in the figure below, the taught position A is shifted in increments of the distance  $L$  (this is actually a three-dimensional XYZ displacement that can be recognized by the robot) in order to enable the operation that was taught at position A to also be performed at positions B through G.

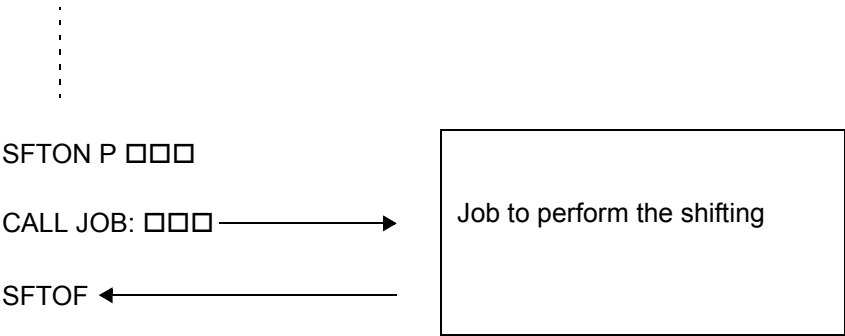


The block from the SFTON to the SFTOF instructions is subject to the shift operation.

Line (Step)	Instruction	
0000	NOP	
0001(001)	MOVJ VJ=50.00	
0002(002)	MOVL V=138	
0003	SFTON P□□□UF# (1)	} Shifted block
0004(003)	MOVL V=138	
0005(004)	MOVL V=138	
0006(005)	MOVL V=138	
0007	SFTOF	
0008(006)	MOVL V=138	



When shifting an entire series of operations, the range to be shifted by the shift instruction can be set using the method indicated above, but the method shown in the following, in which just the part to be shifted is made into a separate job, can also be used.



## 7.2.2 Setting the Shift Value

### ■ Registering Position Variables

The NX100 has 128 position variables (P000 to P127); these can be used to define parallel shift values. When using the parallel shift function, it is necessary to measure the distance between the teaching point and the shift destination position (XYZ displacement of each coordinate) and then register this in advance as a position variable.

When the shift instruction is executed in playback, the operation is performed at a location shifted from the taught position by the amount registered for the specified position variable. The POSITION VARIABLE window is shown in the following.

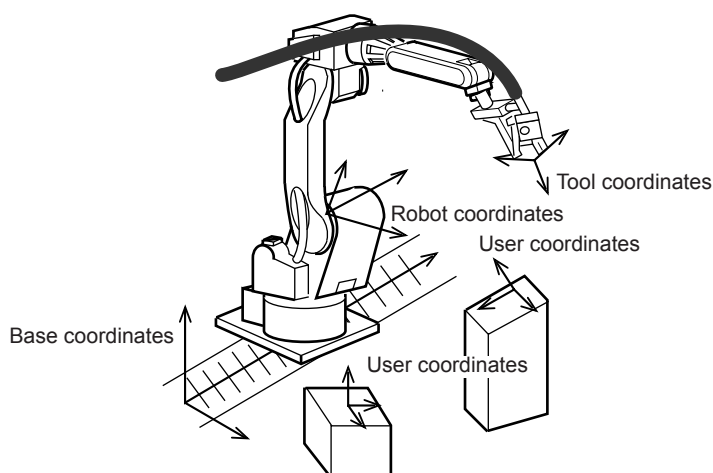
Amount of shift (mm)

Amount of wrist displacement (° )

⇒ SFTON P000

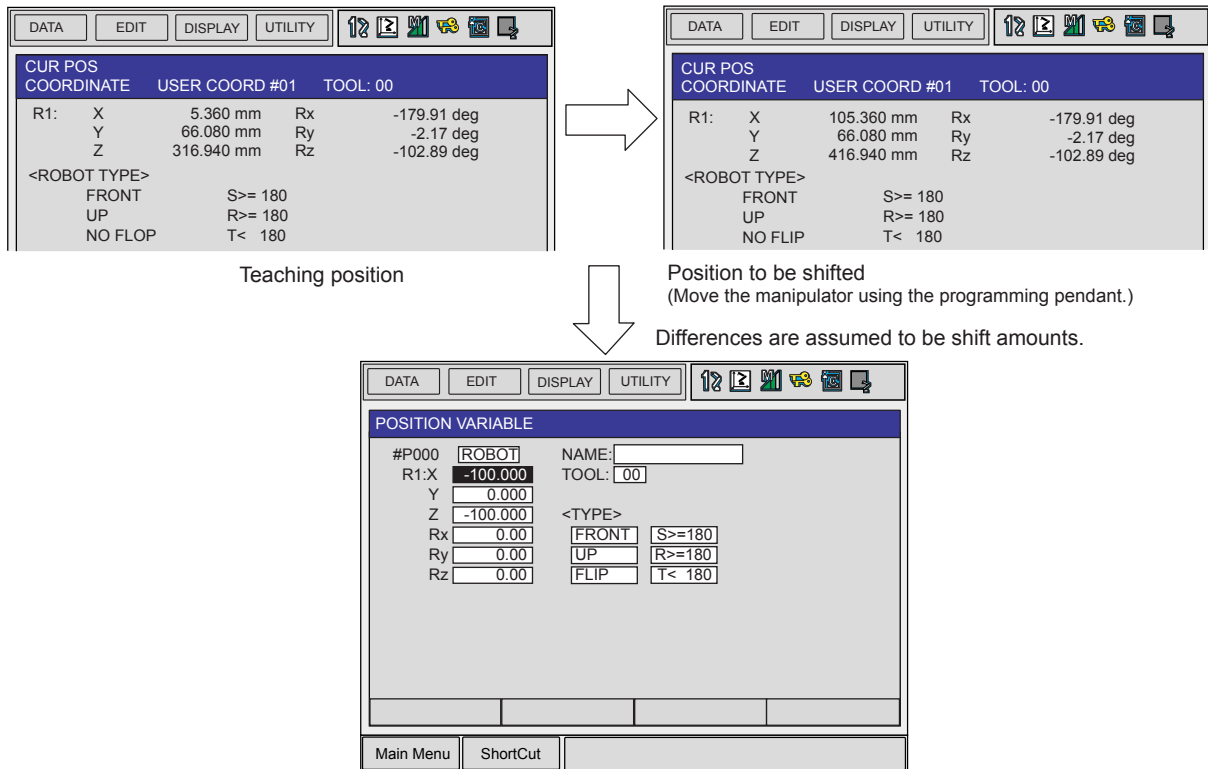
### ■ Coordinate Systems

The shift value for parallel shift is X, Y, and Z increment in each coordinates. There are four coordinates: base coordinates, robot coordinates, tool coordinates, and user coordinates. In systems with no servo track, the base coordinates and robot coordinates are the same.

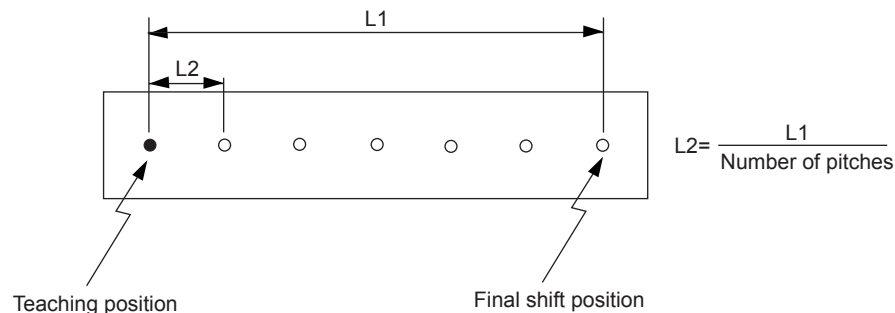


## ■ Setting the Shift Value

When setting the shift value for the position variables, use the current position (coordinates) of the manipulator in the window.

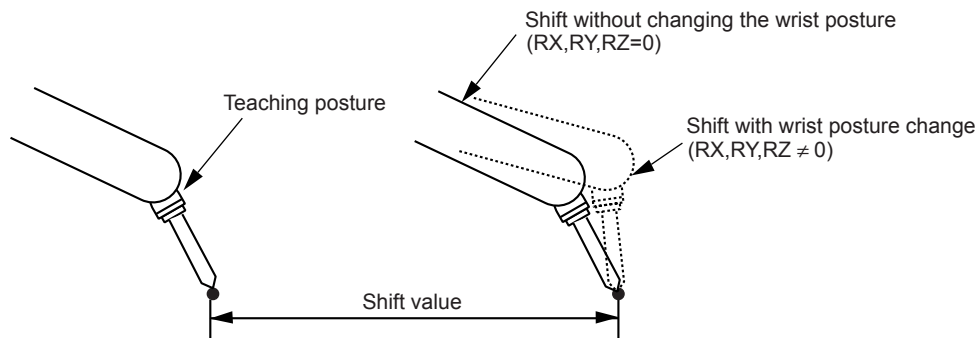


The shift value is the X, Y, and Z difference between the shift position and teaching position and the difference in angular displacement RX, RY, And RZ (normally set at "0"). If shifting is executed at equal pitch intervals, for example for palletizing, find the difference between the teaching position and the final shift position, then divide by the number of pitch intervals (number of divisions) to calculate the shift value per pitch.



The posture of the wrist is defined by the angular displacement of the coordinates of the wrist axes. Consequently, if the shift value is specified with X, Y, and Z only (RX, RY, RZ=0), the wrist is shifted while maintaining the same posture as at the teaching point. Since shifting is normally performed without changing the posture, there is no need to specify an angular displacement for the wrist. The motion when a parallel shift is performed is shown in the following:

## 7.2 Parallel Shift Function



The shift value is calculated on the position data window for the coordinates in which the shift is performed. Since this is normally performed in the user coordinates, the position data window for the user coordinates is used.

### 7.2.3 Registering Shift Instructions

To register the instruction, move the cursor to the address area in the JOB CONTENT window during teach mode as follows:

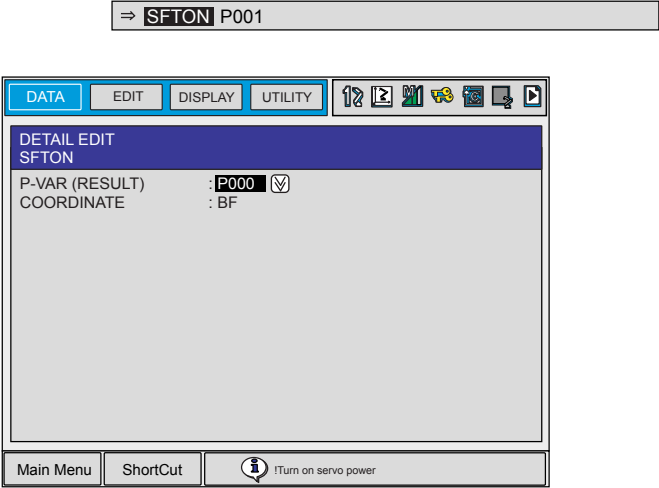
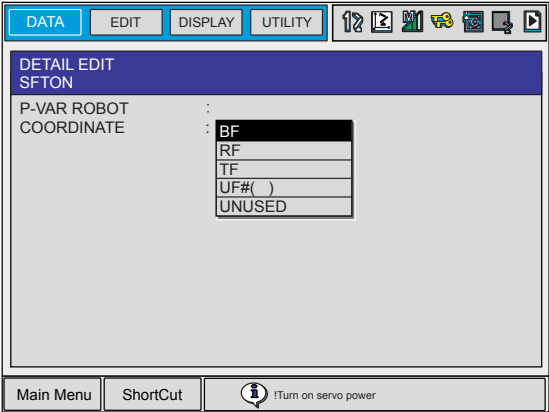
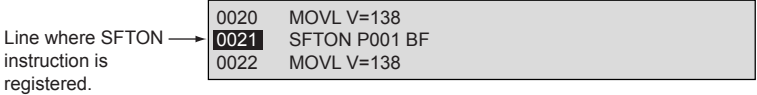
	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	<p>The JOB CONTENT window appears.</p>
3	Move the cursor to the address area.	

■ SFTON Instruction

This is the instruction that starts a parallel shift.



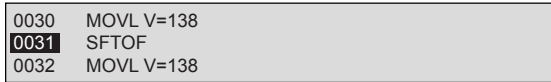
	Operation	Explanation
1	Move the cursor to the line immediately before where the SFTON instruction is to be registered.	<div>Line immediately before where SFTON instruction is to be registered.</div> <div><div>0020</div><div>0021</div><div>0022</div></div> <div><div>MOVL V=138</div><div>MOVL V=138</div><div>MOVL V=138</div></div>

## 7.2 Parallel Shift Function

	Operation	Explanation
5	(cont'd)	<p>• Adding the coordinate system in which the shift is performed Move the cursor to the instruction in the input buffer line and press [SELECT]. The DETAIL EDIT window appears.</p>  <p>Line up the cursor with "UNUSED" and press [SELECT]. The selection dialog box appears. Line up the cursor with the coordinate system to be added, and press [SELECT].</p>  <p>After the coordinate system addition is completed, press [ENTER]. The DETAIL EDIT window closes and the JOB CONTENT window appears.</p>
6	Press [INSERT] and then [ENTER].	<p>The instruction displayed in the input buffer line is registered.</p> 

## ■ SFTOF Instruction

This is the instruction that ends a parallel shift.

	Operation	Explanation
1	Move the cursor to the line immediately before where the SFTOF instruction is to be registered.	<div> Line immediately before where SFTOF instruction is to be registered.  </div>
2	Press [INFORM LIST].	The instruction list dialog box appears.
3	Select {SHIFT}.	
4	Select the SFTOF instruction.	The SFTOF instruction is displayed in the input buffer line. <div>  </div>
5	Press [INSERT] and then [ENTER].	The SFTOF instruction is registered. <div>  </div>

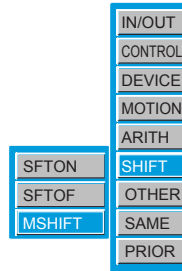
## ■ MSHIFT Instruction


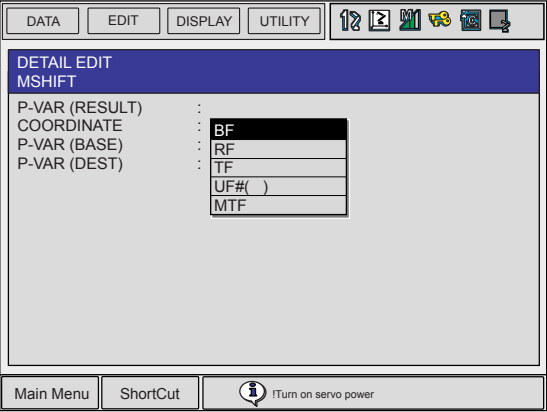
When a parallel shift of the wrist posture is attempted, the manipulator may not be shifted to the target posture in the following cases.

- Posture displacement (Rx, Ry, Rz) is specified to the shift value set by the user.
- When a displacement between two points is calculated using an INFORM operating instruction (ADD instruction, SUB instruction, etc.), and a posture displacement (Rx, Ry, Rz) is specified in the shift value.

In such cases, the MSHIFT instruction can be used to automatically calculate the optimum shift value for an operation to reach the target shift position and posture. With an MSHIFT instruction, the shift value between the reference position and target position (shift position) when parallel shift is performed is determined in the specified coordinate system, and set as the specified position variable.

## 7.2 Parallel Shift Function

	Operation	Explanation
1	Move the cursor to the line immediately before where the MSHIFT instruction is to be registered.	<p>Line immediately before where MSHIFT instruction is registered.</p> <pre> 0003  MOVJ VJ=10.00 0004  GETS PX001 \$PX000 0005  END </pre>
2	Press [INFORM LIST].	<p>The instruction list dialog box appears.</p> 
3	Select {SHIFT}.	
4	Select the MSHIFT instruction.	The MSHIFT instruction is displayed in the input buffer line.
5	Change the number data or additional items as required.	<p><b>&lt;When Notiong is to be Changed&gt;</b> Proceed to Step 6.</p> <p><b>&lt;When Editing Additional Items&gt;</b></p> <ul style="list-style-type: none"> <li>Adding or modifying additional items</li> </ul> <p>To change the position variable number, move the cursor to the position variable number and press [SHIFT] + the cursor key to increase or decrease the value.</p> <pre> ⇒ MSHIFT PX000 BF PX001 PX002 </pre> <p>To directly input the value using the Numeric keys, press [SELECT] to display the input buffer line.</p> <pre> PX = ⇒ MSHIFT 0 BF PX001 PX002 </pre> <p>After the number is input, press [ENTER] to modify the number value in the input buffer line.</p>

	Operation	Explanation
5	(cont'd)	<div><div>• Changing the coordinate system in which the shift is performed</div><div>Move the cursor to the instruction in the input buffer line and press [SELECT]. The DETAIL EDIT window appears.</div><div></div><div><div>Line up the cursor with “BF” and press [SELECT]. The selection dialog box appears.</div><div>Line up the cursor with the coordinate system to be changed, and press [SELECT].</div><div></div><div><div>After the coordinate system modification is complete, press [ENTER]. The DETAIL EDIT window closes and the JOB CONTENT window appears.</div></div></div></div>
6	Press [INSERT] and then [ENTER].	<div><div>The instruction displayed in the input buffer line is registered.</div><div><div>Line where MSHIFT is registered. →</div><div><div>0003    MOVJ VJ=10.00</div><div>0004    GETS PX001 \$PX000</div><div>0005    MSHIFT PX000 RF PX001 PX002</div></div></div></div>

## 7.2.4 Continuation of the Parallel Shift Function



### CAUTION

- **If the shift function is cancelled through a job editing operation after execution of a parallel shift instruction, the job must be started again from the beginning.**

Because no shift is performed when the operation is restarted, there is a possibility of interference between the workpiece and fixture.

If any of the following operations are performed after executing a parallel shift instruction, the shift function is cancelled.

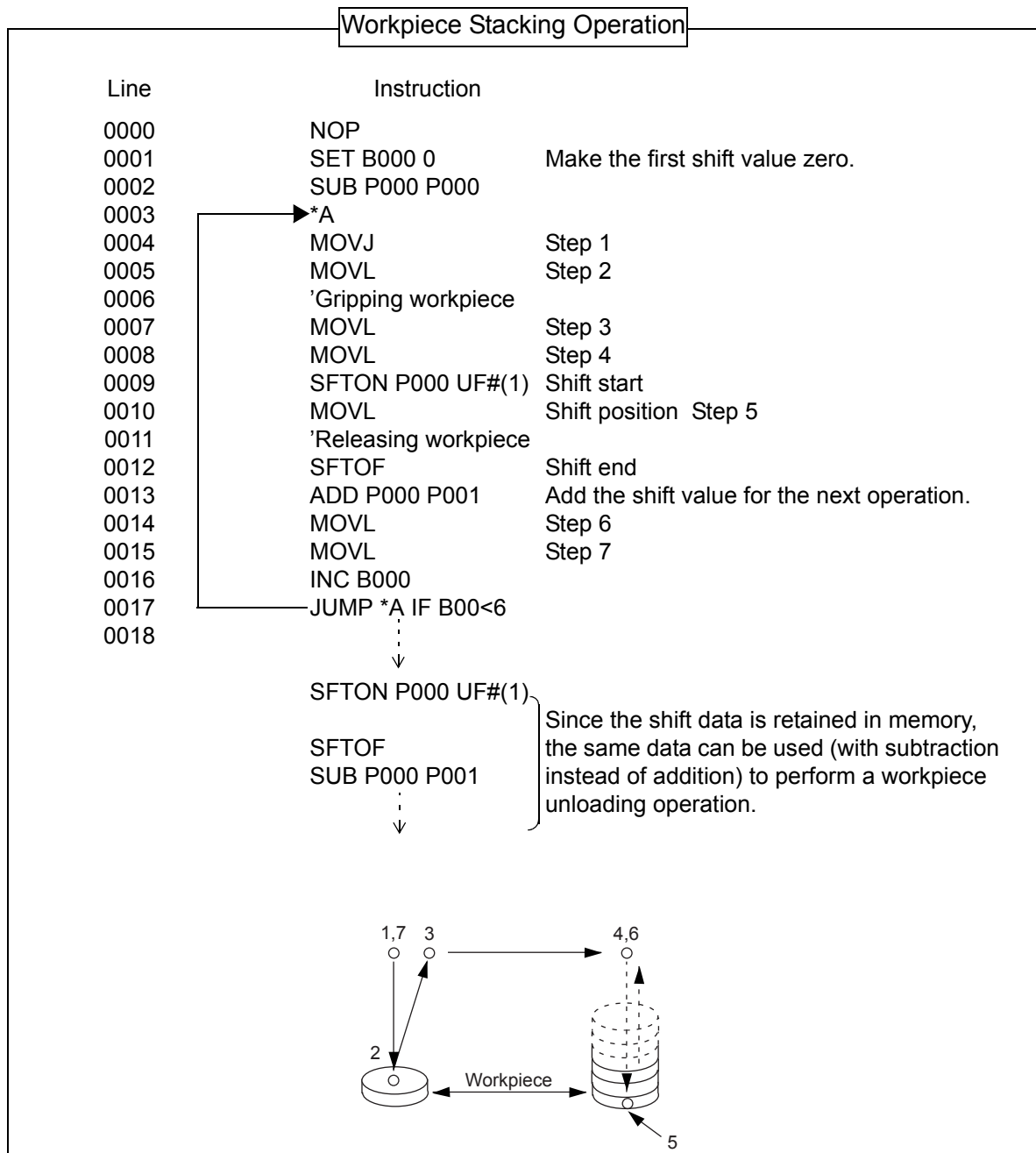
- Job editing operation (changing, deleting, adding)
- Job copy, job name change
- Registering a new job, deleting a job, or modifying a selected job
- Restart after the alarm occurs
- When control power is turned OFF



The parallel shift function remains in effect even if the control power supply is turned OFF.

## 7.2.5 Examples of Use

### ■ Example of Use of Shift Addition/Subtraction



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7.2 Parallel Shift Function

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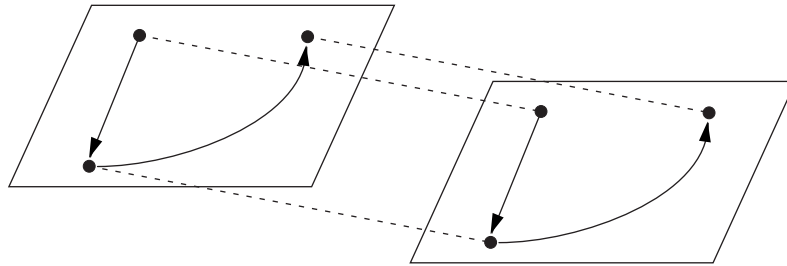
## ■ Example of Use of MSHIFT Instruction

Line	Instruction	Explanation
0000	NOP	
0001	MOVJ VJ=20.00	Move the manipulator to the reference position.
0002	GETS PX000 \$PX000	Set the reference position as position variable P000.
0003	MOVJ VJ=20.00	Move the manipulator to the target position.
0004	GETS PX001 \$PX000	Set the target position as position variable P001.
0005	MSHIFT PX010 BF PX000 PX001	Set shift value and set it as position variable P010.
0006	END	

## 7.3 Parallel Shift Job Conversion Function

### 7.3.1 Function Overview

If the manipulator and base positions are moved after a job has been taught, the entire job has to be modified. The parallel shift conversion function shortens the modification time required in cases like this by shifting all steps of the job by the same value to create a new job.



When parallel shift conversion is performed, all job steps are shifted by the same value.



#### Steps Outside the P-point Maximum Envelope

“/OV” is displayed for steps which result in a position outside the P-point maximum envelope of the manipulator. When the position is corrected, “/OV” display disappears.

#### Position Variable

Position variables are not subject to parallel shift job conversion.

#### Not Converted Job

The following jobs cannot be converted. If conversion is attempted, no operation is performed.

- Jobs without any group axes
- Concurrent jobs (optional)

### ■ Coordinate Systems for Conversion

When performing parallel shift job conversion, it is necessary to specify the coordinate systems in which the conversion is to be performed. The coordinate system can be selected from the following:

- Base coordinates
- Robot coordinates
- Tool coordinates
- User coordinates (24 types)
- Master tool coordinates (R1+R2 job)
- Joint coordinates

In the case of an ordinary job for which group axes are registered, shift conversion is performed in accordance with the selected coordinate system. The relationship between group combinations and coordinates are shown in the following table.

## 7.3 Parallel Shift Job Conversion Function

① to ④ in the table are followed by their explanations.

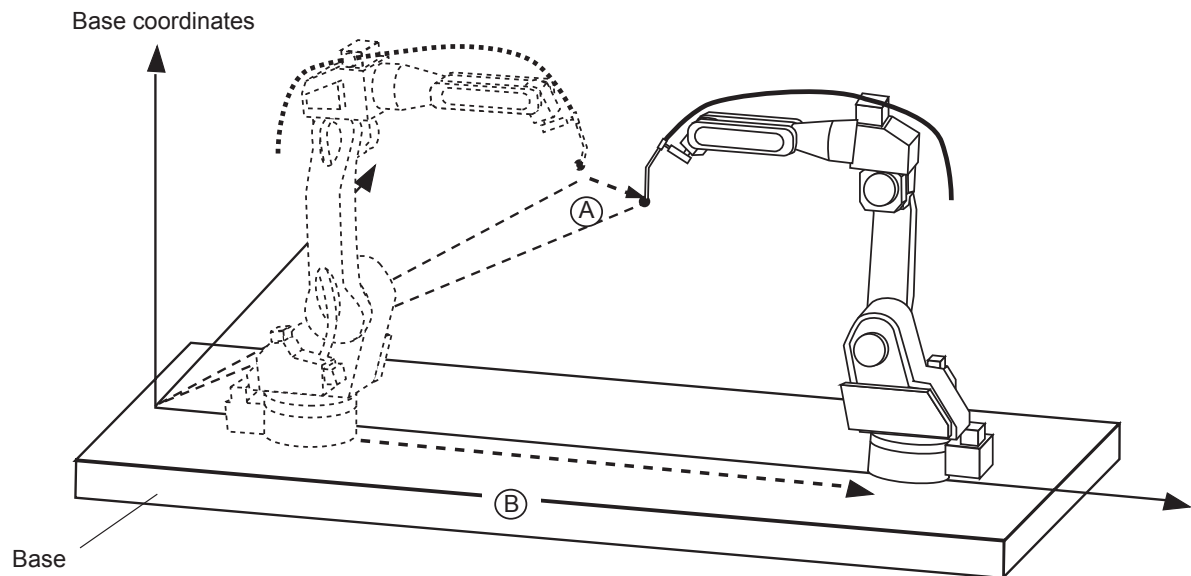
Relationship Between Group Combinations and Coordinates at Conversion

Group Combination in Job	Explanation	
	Usable Coordinate System	
R	Shift is performed on basis of selected coordinates.	
	Base coordinates, robot coordinates, tool coordinates, user coordinates	
R(B)	Shift is performed on basis of selected coordinates.	
	①Base Coordinates	The base axis is shifted by the specified amount and the TCP of the manipulator is shifted by the specified amount in the base coordinates.
	②Robot Coordinates	The base axis is shifted by the specified amount. The TCP of the manipulator is shifted by the specified amount in the robot coordinates. These shifts are carried out independently.
	③Tool Coordinates	The base axis is shifted by the specified amount. The TCP of the manipulator is shifted by the specified amount in the tool coordinates. These shifts are carried out independently.
	④User Coordinates	The base axis is shifted by the specified amount and the TCP of the manipulator is shifted by the specified amount in the user coordinates.
S	Shift is performed on the basis of pulse values regardless of the coordinates.	
R+S	The manipulator is shifted in the selected coordinates. The station axis is shifted on the basis of pulse values regardless of the coordinates.	
	Base coordinates, robot coordinates, tool coordinates, user coordinates	
R(B)+S	The manipulator is shifted in the selected coordinates, as in ① to ④ above. The station axis is shifted on the basis of pulse values regardless of the coordinates.	
R+R	Two manipulators are shifted in the selected coordinates.	
	Base coordinates, robot coordinates, tool coordinates, user coordinates, master tool coordinates <sup>*1</sup>	
R(B)+R(B)	Two manipulators are shifted in the selected coordinate system, as in ① to ④ above. Two base axes are also shifted.	

<sup>\*1</sup> In the master tool coordinates, conversion only occurs at the “slave” from the standpoint of the SMOV instruction.

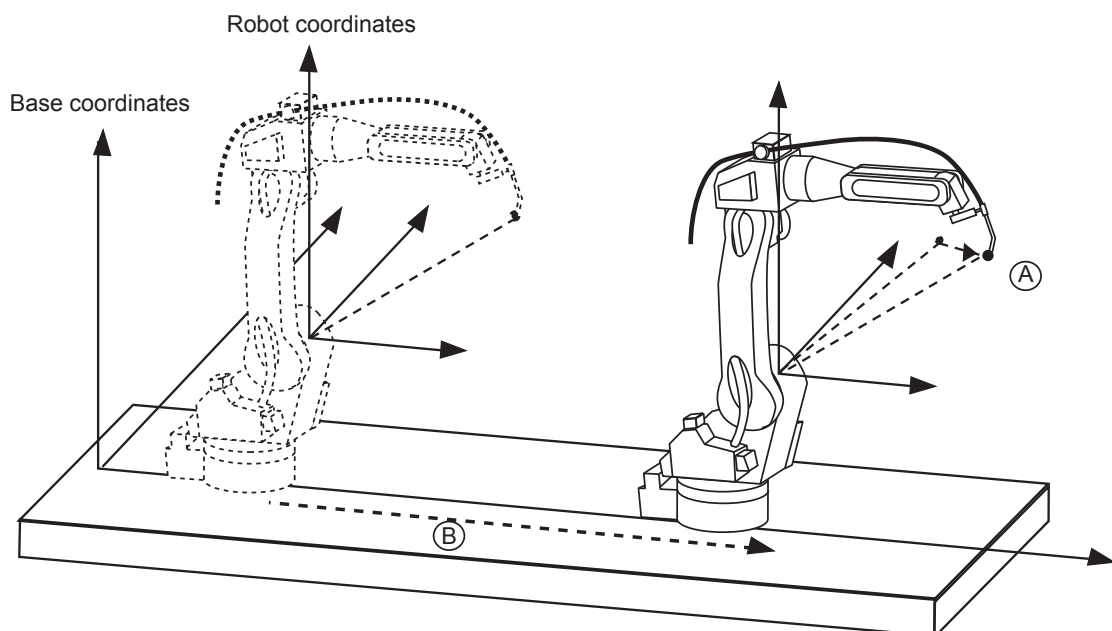
### ① Base Coordinates

The base axis is shifted by B and the TCP of the manipulator is shifted by A in the base coordinates.



### ② Robot Coordinates

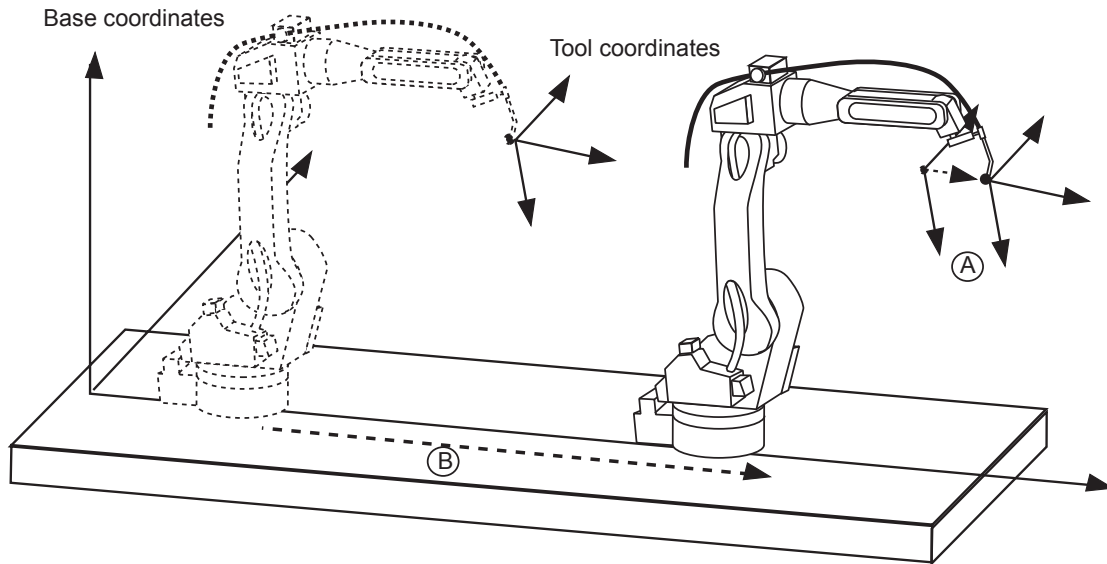
The base axis is shifted by B. The TCP of the manipulator is shifted by A in the robot coordinates. These shifts are carried out independently.



### 7.3 Parallel Shift Job Conversion Function

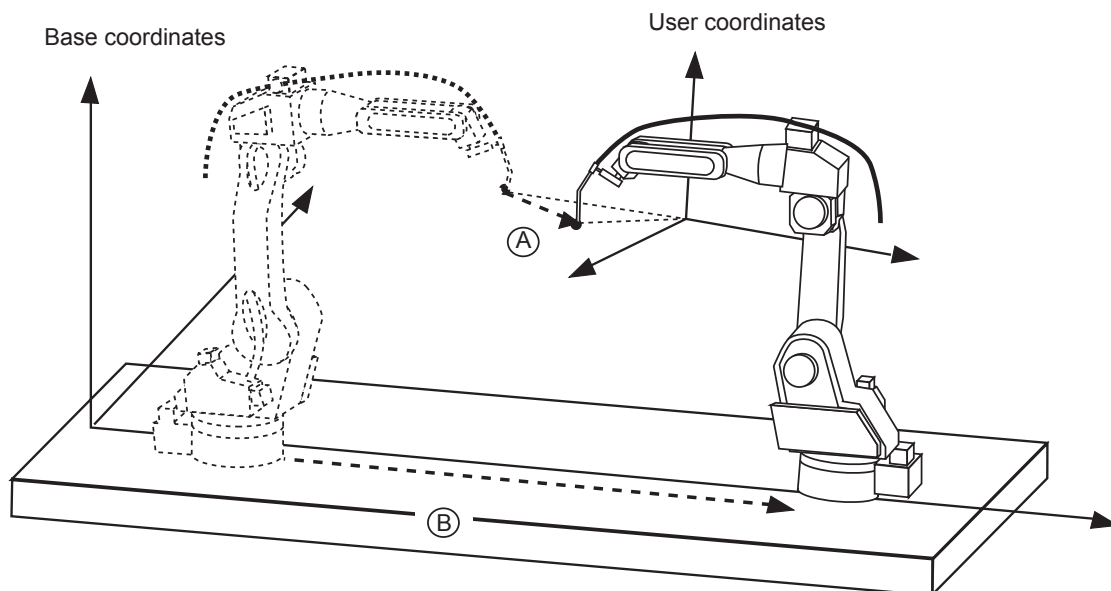
#### ③ Tool Coordinates

The base axis is shifted by B and the TCP of the manipulator is shifted by A in the tool coordinates. These shifts are carried out independently.



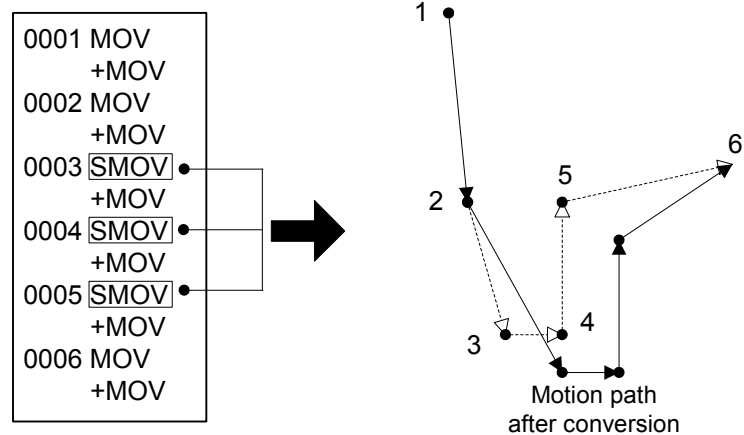
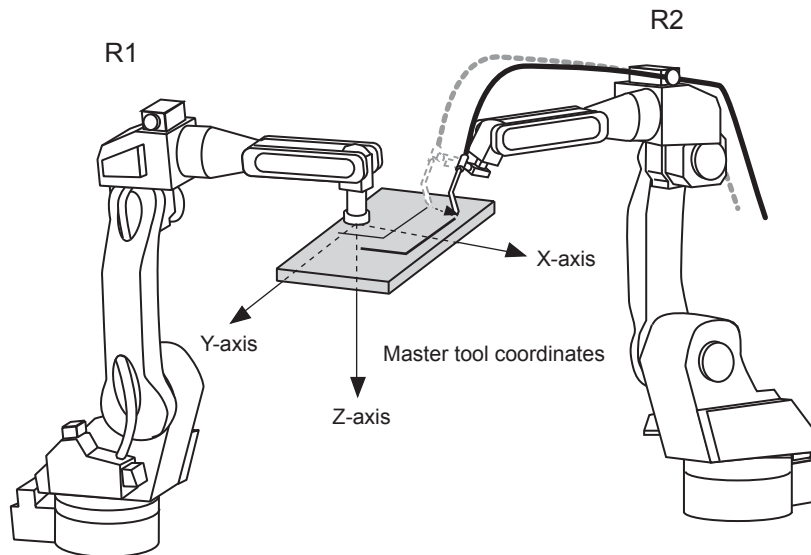
#### ④ User Coordinates

The base axis is shifted by B and the TCP of the manipulator is shifted by A in the user coordinates. These shifts are carried out independently.



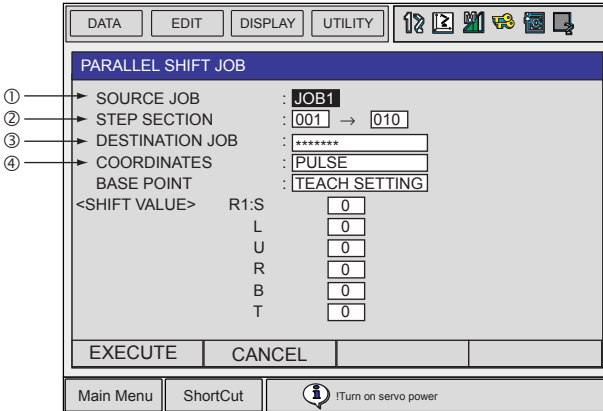
## Converting R1+R2 Jobs with Master Tool Coordinates

R1+R2 coordinated jobs can be subjected to parallel shift job conversion in the master tool coordinates. Only steps taken at the “slave” from the standpoint of the SMOV instruction are subject to conversion.



## 7.3.2 Operating Methods

### ■ Specifying the Conversion Items

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	The JOB CONTENT window appears.
3	Select {UTILITY} under the pull-down menu.	
4	Select {PARALLEL SHIFT JOB}.	<p>The PARALLEL SHIFT JOB window appears.</p> 
5	Specify the conversion items.	<p>Specify the following items.</p> <p><b>①SOURCE JOB</b>  Selects the job before conversion. The job which is shown in the JOB CONTENT window is set initially. To change the job, perform the following procedure.  Move the cursor to the job name and press [SELECT]. The JOB LIST window appears. Select the desired job.</p> <p><b>②STEP SECTION (Start Step → End Step)</b>  Specifies the step section of the source job. All the steps are set initially. If there is no steps in the source job, "*****" is displayed. To change the section, perform the following procedure.  Move the cursor to the step section indication and press [SELECT]. The input buffer line appears. Input the step number and press [ENTER].</p>

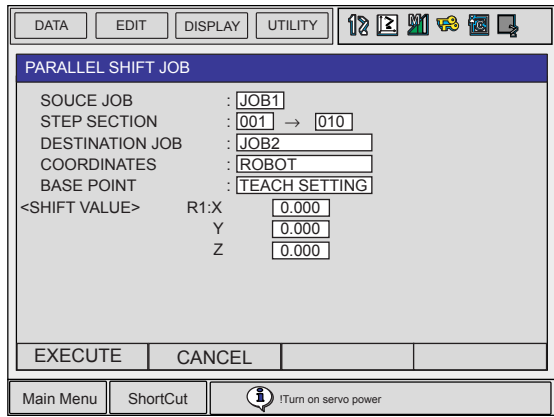
	Operation	Explanation
5	(cont'd)	<p><b>③ DESTINATION JOB</b></p> <p>Specifies the converted job. If this is not specified( "*****" is displayed), the source job is specified. To change the job, perform the following procedure.</p> <p>Move the cursor to the converted job name indication and press [SELECT]. The character input line appears. The source job name is displayed in the input line. To enter job name without using the source job name, press [CANCEL] and then input a job name.</p> <p><b>④ COORDINATES</b></p> <p>Selects the conversion coordinates. Move the cursor to the coordinates name and press [SELECT]. The selection dialog box appears. Select the desired coordinates.</p> <p>When the user coordinates are selected, the input buffer line appears. Input the desired user coordinate number and press [ENTER].</p>

## ■ Specifying the Shift Value

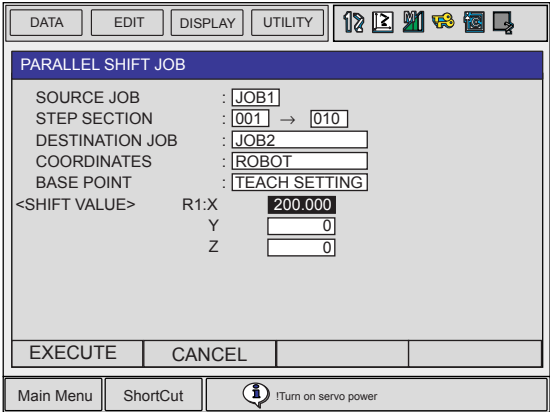
There are two methods for specifying the shift value.

- Directly input the shift value by numerical value.
- Calculate the shift value by teaching the original base point and converted base point.

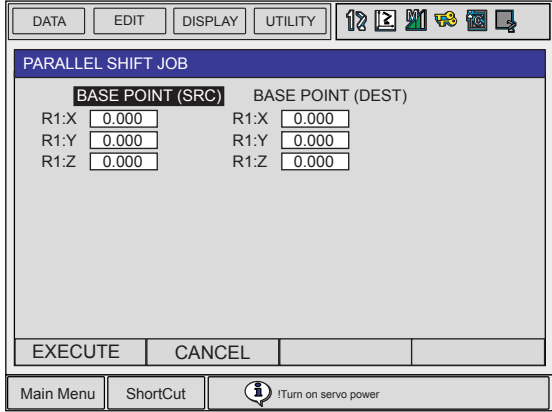
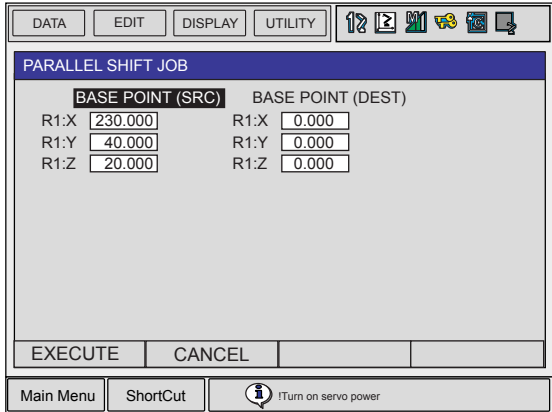
### Numerical Value Input

	Operation	Explanation
1	Display the PARALLEL SHIFT JOB window.	
2	Select the shift value to be set.	<p>The number can now be entered.</p> 
3	Type the shift value using the Numeric keys.	

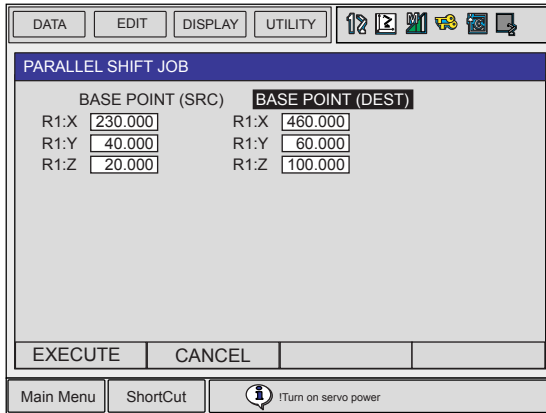
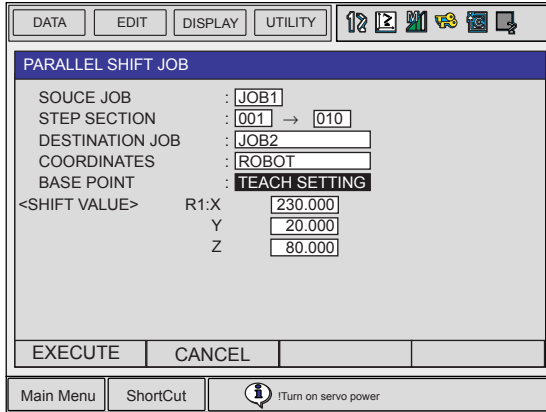
## 7.3 Parallel Shift Job Conversion Function

	Operation	Explanation
4	Press [ENTER].	<p>The shift value is set.</p> 

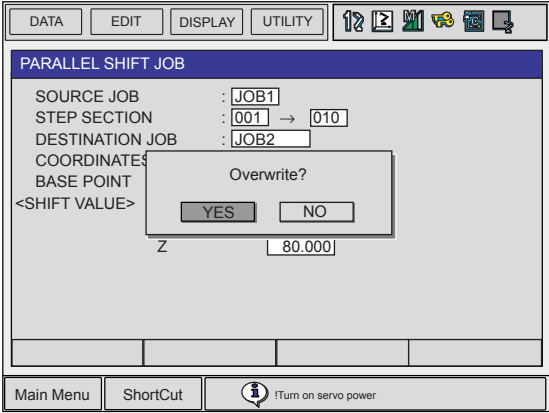

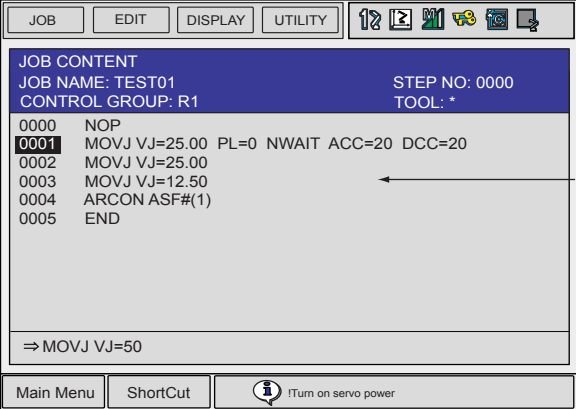
## Calculation by Teaching

	Operation	Explanation
1	Display the PARALLEL SHIFT JOB window.	
2	Select "TEACH SETTING" in the item of "BASE POINT."	
3	Select "BASE POINT(SRC)."	
4	Move the manipulator to the original base point by the axis keys.	
5	Press [MODIFY] and [ENTER].	<p>The original base point is set.</p> 
6	Select "BASE POINT(DEST)."	
7	Move the manipulator to the converted base point by the axis keys.	

## 7.3 Parallel Shift Job Conversion Function

	Operation	Explanation
8	Press [MODIFY] and [ENTER].	<p>The conversion base point is set.</p>  <p>The screenshot shows the 'PARALLEL SHIFT JOB' screen. At the top are buttons for DATA, EDIT, DISPLAY, and UTILITY, followed by a row of icons. The main area is divided into two columns: 'BASE POINT (SRC)' and 'BASE POINT (DEST)'. Under 'BASE POINT (SRC)', the coordinates are R1:X: 230.000, R1:Y: 40.000, and R1:Z: 20.000. Under 'BASE POINT (DEST)', the coordinates are R1:X: 460.000, R1:Y: 60.000, and R1:Z: 100.000. At the bottom are buttons for EXECUTE, CANCEL, and a status bar with 'Main Menu', 'ShortCut', and 'Turn on servo power'.</p>
9	Select "EXECUTE."	<p>The difference is calculated by the two teaching points and set as a shift value.</p>  <p>The screenshot shows the 'PARALLEL SHIFT JOB' screen after selecting 'EXECUTE'. The 'BASE POINT' is now set to 'TEACH SETTING'. The 'SHIFT VALUE' is calculated and displayed as R1:X: 230.000, Y: 20.000, and Z: 80.000. The other fields (SOURCE JOB, STEP SECTION, DESTINATION JOB, COORDINATES) remain the same as in the previous screenshot. The bottom buttons and status bar are also present.</p>

■ Executing Conversion

	Operation	Explanation
1	Display the PARALLEL SHIFT JOB window.	
2	Select "EXECUTE."	<p>The confirmation dialog box appears when the converted job is not specified. Select "YES" then the conversion is executed. The JOB CONTENT window appears when the conversion is completed.</p> <div></div> <div> If an alarm occurs during conversion, conversion is suspended.</div> <div></div> <p>At step outside the P-point maximum envelope, "/OV" is displayed after the move instruction.</p>

## 7.4 PAM Function

### 7.4.1 Function Overview

The function for position adjustment during playback (PAM: Position Adjustment by Manual) allows position adjustment by simple operations while observing the motion of the manipulator and without stopping the manipulator. Positions can be adjusted in both teach mode and play mode.

The following data can be adjusted by key input at the programming pendant.

- Teaching Point
- Operation Speed
- Position Level

#### ■ Input Ranges for Adjustment Data

The input ranges for adjustment data are indicated in the following table.

Data	Input Range
Number of Steps for Adjustment	Up to 10 steps can be adjusted at the same time.
Position Adjustment Range (X, Y, Z)	Unit: mm, valid to two decimal places, maximum $\pm 10\text{mm}$
Speed Adjustment Range (V)	Unit: %, valid to two decimal places, maximum $\pm 50\%$
PL Adjustment Range	0 to 8
Adjustment Coordinates	Robot coordinates, base coordinates, tool coordinates, user coordinates (Default coordinates: robot coordinates)



The input ranges for adjustment data can be changed by the following parameters:

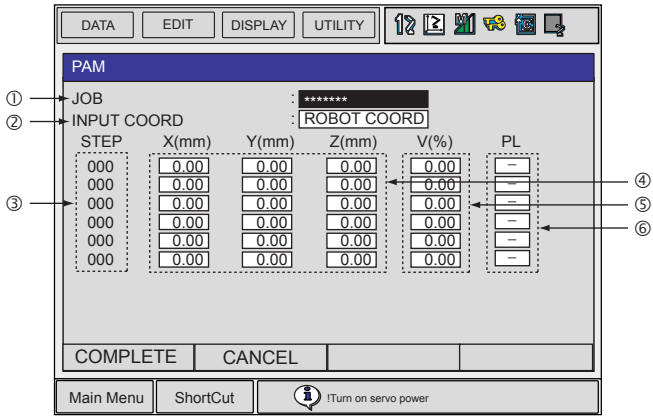
S3C806: Position adjustment range (unit: mm)  
 S3C807: Speed adjustment range (unit: 0.01%)  
 S3C808: Adjustment coordinate specification  
 For details, refer to “9 Parameter Description.”



- Base axis and station axis data cannot be adjusted.
- Adjustment when a TCP instruction is executed is performed by adjusting the data of the selected tool.
- When the coordinates for adjustment are user coordinates, an error occurs if teaching has not been performed in the user coordinates.
- If an attempt is made to adjust “PL” when there is no “PL” in the step subject to the adjustment, an error occurs.
- Position variable and reference point steps cannot be adjusted. An error occurs if adjustment is attempted.
- An attempt to adjust the speed at a step that has no speed tag will cause an error.

## 7.4.2 Operating Methods

### ■ Setting Adjustment Data

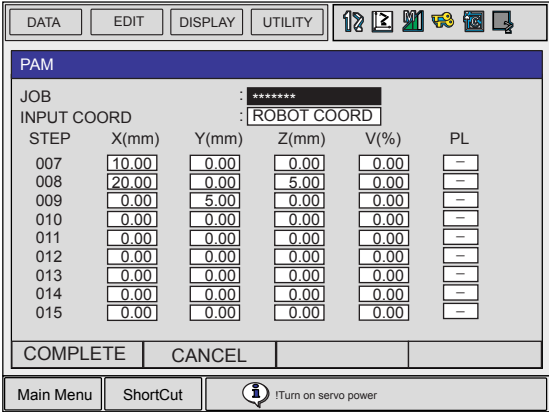
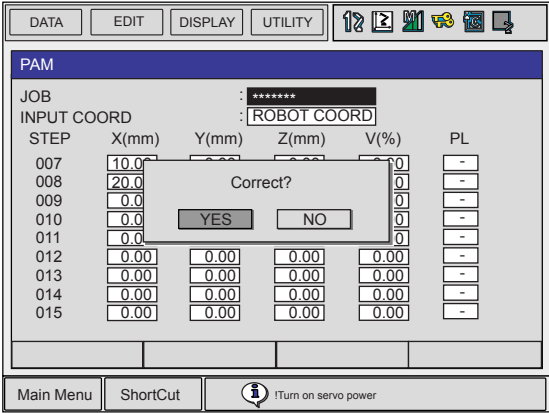
	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	The JOB CONTENT window (in the teach mode) or the PLAY-BACK window (in the playback mode) appears.
3	Select {UTILITY} under the pull-down menu.	
4	Select {PAM}.	<p>The PAM window appears.</p> 
5	Set adjustment data.	<p>Set adjustment data.</p> <p><b>①JOB</b> Set the job name to be adjusted. Line up the cursor and press [SELECT] to display the JOB LIST window. Move the cursor to the desired job and press [SELECT] to set the adjusted job.</p> <p><b>②INPUT COORD</b> Set the desired coordinates. Line up the cursor and press [SELECT] to display the selection dialog box. Move the cursor to the desired coordinate system and press [SELECT] to set the input coordinates.</p> <p><b>③Step Number</b> Set the step number to be adjusted. Line up the cursor and press [SELECT] to display the number input buffer line. Input the step number and press [ENTER] to set the value.</p>

## 7.4 PAM Function

	Operation	Explanation
5	(cont'd)	<p><b>④XYZ Coordinate Adjustment</b> Set the direction and amount of the X, Y, and Z coordinates. Line up the cursor with the data to be adjusted and press [SELECT] to display the number input buffer line. Input the number data and press [ENTER] to set the adjusted data.</p> <p><b>⑤V Coordinate Adjustment</b> Set the speed. Line up the cursor and press [SELECT] to display the number input buffer line. Input the number data and press [ENTER] to set the adjusted data.</p> <p><b>⑥PL</b> This is displayed when the position level of the job to be adjusted for the step set in ③ is already decided, and the data can be modified. When the position level is not decided, [-] is displayed, and cannot be set. To modify the position level, line up the cursor, press [SELECT], input the number value and press [ENTER].</p>

■ Executing the Adjustment

Executing the Adjustment

	Operation	Explanation
1	Touch “COMPLETE” on the screen.	<div></div> <p>The confirmation dialog box appears.</p> <div></div>
2	Select “YES.”	<p>In the teach mode, the job adjustment can be immediately executed. In the play mode, the job can be adjusted just before execution (move operation).</p> <p>When the job adjustment is completed, the set data shown in the PAM window is cleared. However, if the step’s adjusted position exceeds the software limit, an error occurs, and the data in only that step cannot be cleared on the window.</p>

## 7.4 PAM Function

### Cancelling the Execution

In the play mode, during the adjustment wait status, “CANCEL” is displayed in the PAM window. To cancel the adjustment process, touch “CANCEL” on the screen. Also, if the following occurs before executing, the process is automatically cancelled.

- If the mode is changed
- If an alarm occurs
- If the power is turned OFF

### ■ Editing Data

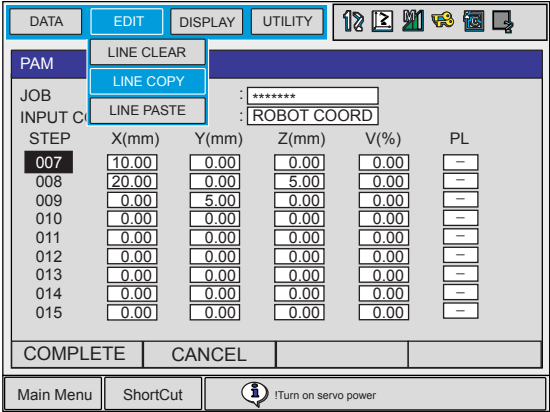
#### Clearing Data

If there is a mistake made when adjusting the data, or if the adjustment of the step becomes unnecessary, the data can be cleared.

	Operation	Explanation
1	Move the cursor to the step of the data to be cleared.	
2	Select {EDIT} under the menu.	The pull-down menu appears.
3	Select {LINE CLEAR}.	The line data is cleared.

Copying Data

To input the same data as those set previously, perform the following operation.

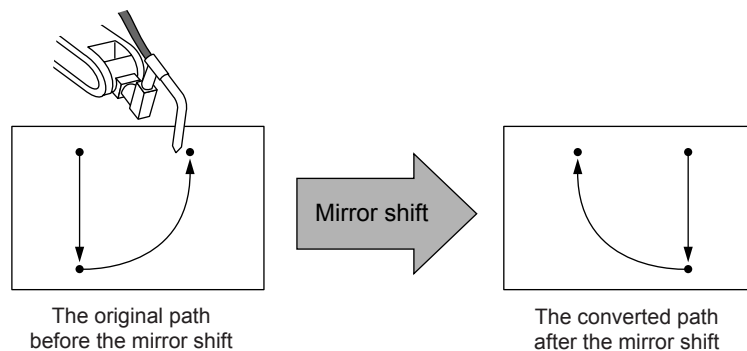
	Operation	Explanation
1	Move the cursor to the line to be copied.	
2	Select {EDIT} under the menu.	The pull-down menu appears. <div></div>
3	Select {LINE COPY} under the pull-down menu.	
4	Move the cursor to the line where the item is to be copied.	
5	Select {EDIT} under the menu.	
6	Select {LINE PASTE}.	The desired data is copied to the line. However, if the line where the data is to be copied does not have a speed value or PL value, it cannot be copied.

## 7.5 Mirror Shift Function

### 7.5.1 Function Overview

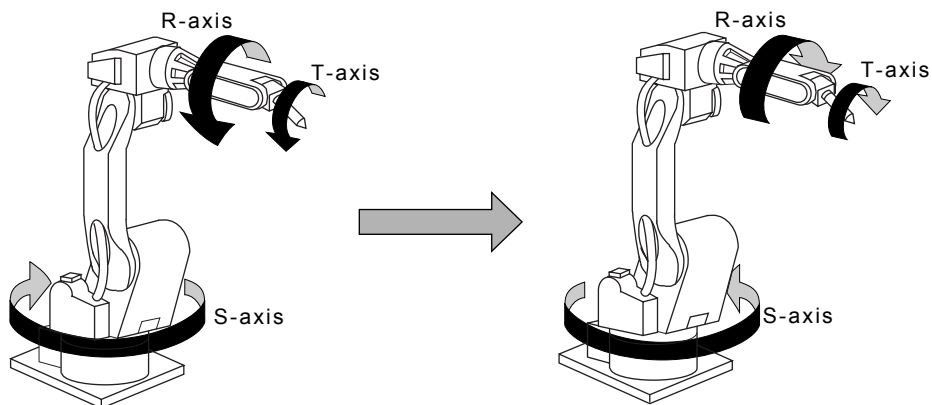
With the mirror shift function, a job is converted to the job in which the path is symmetrical to that of the original job. This conversion can be performed for the specified coordinate among the X-Y, X-Z, or Y-Z coordinate of the robot coordinates and the user coordinates.

The mirror shift function is classified into the following three: the pulse mirror-shift function, the robot-coordinates mirror-shift function, and the user-coordinates mirror-shift function.



### 7.5.2 Pulse Mirror-shift Function

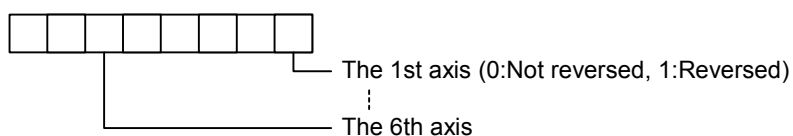
With the pulse mirror-shift function, the mirror shift is performed by reversing the sign (+/-) for the axes which are specified with the parameter in advance.



#### ■ Parameter Setting

Using the following parameter, specify the axes for which the sign is to be reversed.

S1CxG065: Mirror Shift Sign Reversing Axis Specification



## ■ Object Job

Jobs without group axes and relative jobs cannot be converted.

## ■ Group Axes Specification

When specifying the group axes for the converted job in a multiple group axes system, the group axes specified in the original and converted jobs must be the same.

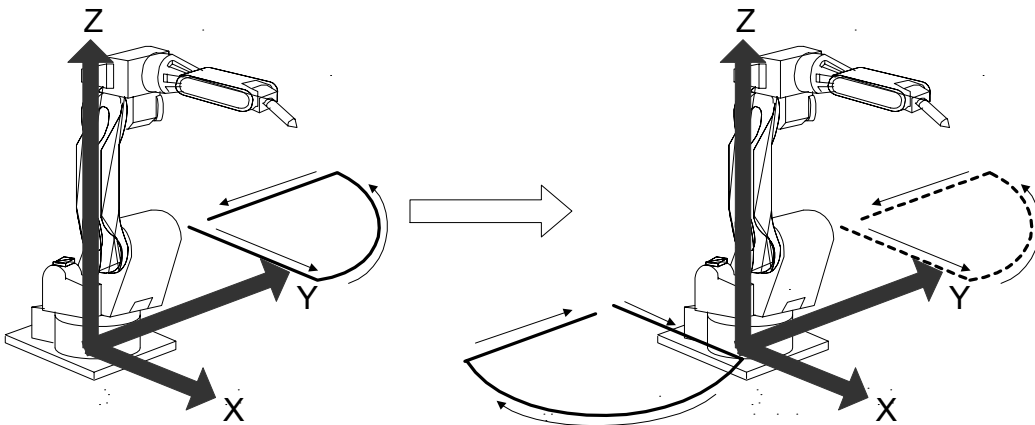
- Robot Axis: Same model
- Base Axis: Same configuration
- Station Axis: Same configuration

## ■ Position Variables

Position variables are not converted by the mirror shift function.

### 7.5.3 Robot-coordinates Mirror-shift Function

With the robot-coordinates mirror-shift function, the mirror shift is performed on the X-Z coordinate of the robot coordinates.



## ■ Object Job

Jobs without group axes cannot be converted.

## ■ Group Axes Specification

When specifying the group axes for the converted job in a multiple group axes system, the group axes specified in the original and converted jobs must be the same.

- Robot Axis: Same model
- Base Axis: Same configuration
- Station Axis: Same configuration

## 7.5 Mirror Shift Function

### ■ Position Variables

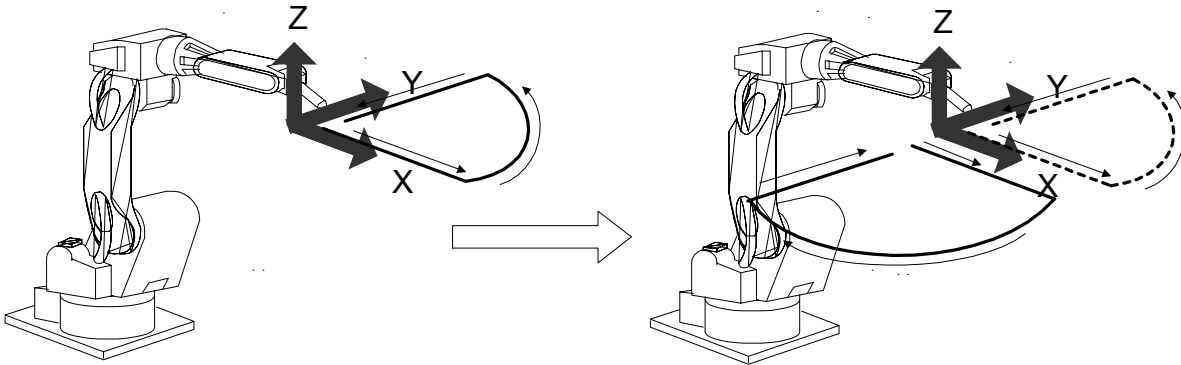
Position variables are not converted by the mirror shift function.



- Mirror shift conversion for the base axis is not performed with the robot-coordinates mirror shift function.
- With the robot-coordinates mirror shift function, mirror shift conversion for the station axis is performed by reversing the sign for the axes specified with the parameter S1CxG065 "Mirror Shift Sign Reversing Axis Specification."

### 7.5.4 User-coordinates Mirror-shift Function

With the user-coordinates mirror-shift function, the mirror shift is performed on the X-Z, X-Y, or Y-Z coordinate of the specified user coordinates.



### ■ Object Job

Jobs without group axes cannot be converted.

### ■ Group Axes Specification

When specifying the group axes for the converted job in a multiple group axes system, the group axes specified in the original and converted jobs must be the same.

- Robot Axis: Same model
- Base Axis: Same configuration
- Station Axis: Same configuration

### ■ Position Variables

Position variables are not converted by the mirror shift function.



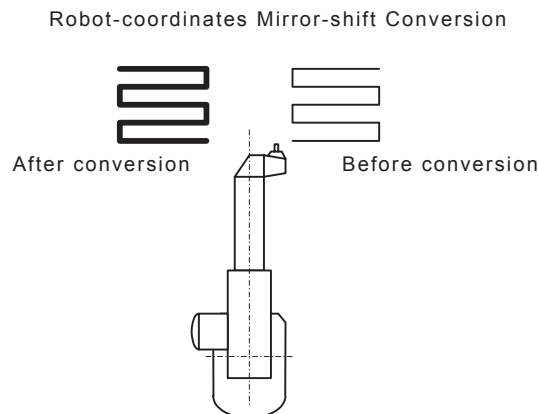
With the user-coordinates mirror shift function, mirror shift conversion for the station axis is performed by reversing the sign for the axes specified with the parameter S1CxG065 "Mirror Shift Sign Reversing Axis Specification."

## 7.5.5 Notes on the Mirror Shift Function

For manipulators, such as a polishing wrist, whose center of S-axis rotation and T-axis rotation are offset in the X-coordinate direction, the mirror shift cannot correctly be performed by the pulse mirror-shift function. Be sure to use the robot-coordinates mirror-shift function or use the user-coordinates mirror-shift function with the user coordinates specified on the center of the T-axis rotation.

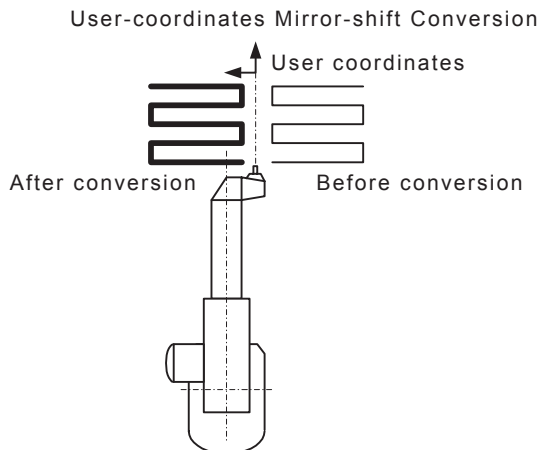
- Using the Robot-coordinates Mirror-shift Function

When the robot-coordinates mirror-shift function is performed, the mirror shift is performed on the X-Z coordinate of the robot coordinates. The path of the converted job is as follows:



- Using the User-coordinates Mirror-shift Function

To use the user-coordinates mirror-shift function, specify the user coordinates on the center of T-axis rotation in advance.



---

## 7.5.6 Operation Procedures

### ■ Calling Up the JOB CONTENT Window

Call up the JOB CONTENT window of the job to be converted as follows:

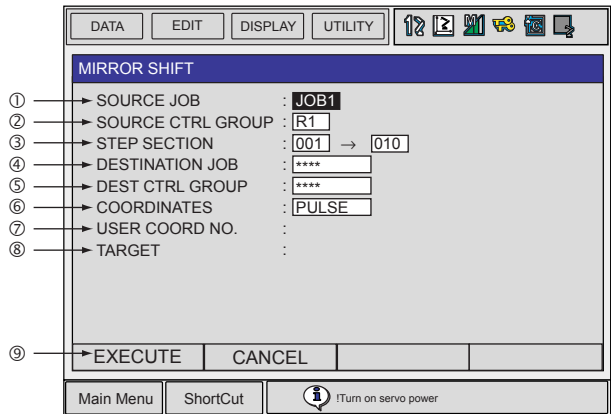
#### For Current Job

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {JOB}.	

#### For Another Job

	Operation	Explanation
1	Select {JOB} under the main menu.	
2	Select {SELECT JOB}.	The JOB LIST window appears.
3	Select desired job.	

## ■ Executing the Mirror Shift Conversion

	Operation	Explanation
1	Display the JOB CONTENT window of the job to be converted.	
2	Select {UTILITY} under the menu.	
3	Select {MIRROR SHIFT}.	The MIRROR SHIFT window appears.
4	Set items as required.	 <p>① <b>SOURCE JOB</b> Selects the conversion source job. To select another job to be converted, move the cursor to the name and press [SELECT] to call up the list of jobs. Select the desired job and press [SELECT].</p> <p>② <b>SOURCE CTRL GROUP</b> Displays the control group of the conversion source job.</p> <p>③ <b>STEP SELECTION</b> Specifies the steps to be converted. From the first step to the last step of the selected job are specified as initial value.</p> <p>④ <b>DESTINATION JOB</b> Specifies the converted job name. To enter the name, move the cursor to the name and press [SELECT]. The name of the conversion source job is displayed in the input line as initial value. When "****" is displayed, the name for the converted job is to be the same as that of the conversion source job.</p>

## 7.5 Mirror Shift Function

	Operation	Explanation
4	(cont'd)	<p><b>⑤DEST CTRL GROUP</b>  Selects the control group for the converted job. When the destination job name is entered, the same control group as the conversion source job is automatically set. To change it, move the cursor to the control group and press [SELECT] to call up the selection dialog box.</p> <p><b>⑥COORDINATES</b>  Specifies the coordinates used for conversion. "PULSE," "ROBOT," or "USER" can be selected. The initial value is "PULSE."  "PULSE": Executes the pulse mirror-shift conversion.  "ROBOT": Executes the mirror-shift conversion on the basis of the cartesian coordinates.  "USER": Executes the mirror-shift conversion on the basis of the specified user coordinates.</p> <p><b>⑦USER COORD NO.</b>  Specifies the user coordinates number when "USER" is selected in ⑥. "01" is automatically set as initial value when the "USER" is selected in ⑥.  This item cannot be set when "PULSE" or "ROBOT" is selected in ⑥.</p> <p><b>⑧TARGET</b>  Specifies the coordinate where conversion is to be done when "ROBOT" or "USER" is selected in ⑥. "XY," "XZ," or "YZ" can be selected. The "XZ" is automatically set as initial value when "ROBOT" or "USER" is selected in ⑥. Always specify "XZ" for "ROBOT."</p> <p><b>⑨EXECUTE</b>  Executes the conversion. When the conversion destination job name is entered, the converted job is created with that name as a new job. When the conversion destination job name is not entered, the conversion source job is converted and overwritten.</p>
5	Select "EXECUTE."	

## 8 Controlling Peripheral Devices

### 8.1 External Memory Devices

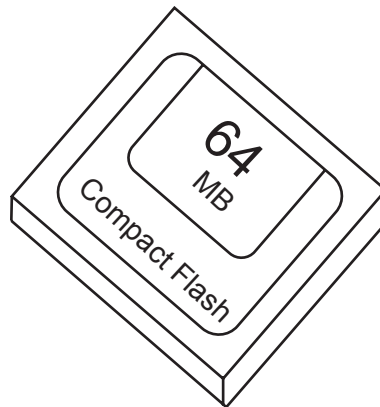
#### 8.1.1 Compact Flash Memory Card

Insert a compact flash memory card (ATA Flash) in the compact flash slot on the programming pendant in advance.

The following compact flashes are recommended for the programming pendant. (These are to be sold on the open market and also by YASKAWA.)

- "CFI-\*\*\*MBA" made by HAGIWARA sys-com.
- "SDCFBI-\*\*-\*\*\*\*\*" made by SUN DISK.

The following illustration shows the appearance of the compact flash.



Note: Compact Flash is a registered trademark of SUN DISK.

#### ■ Precautions

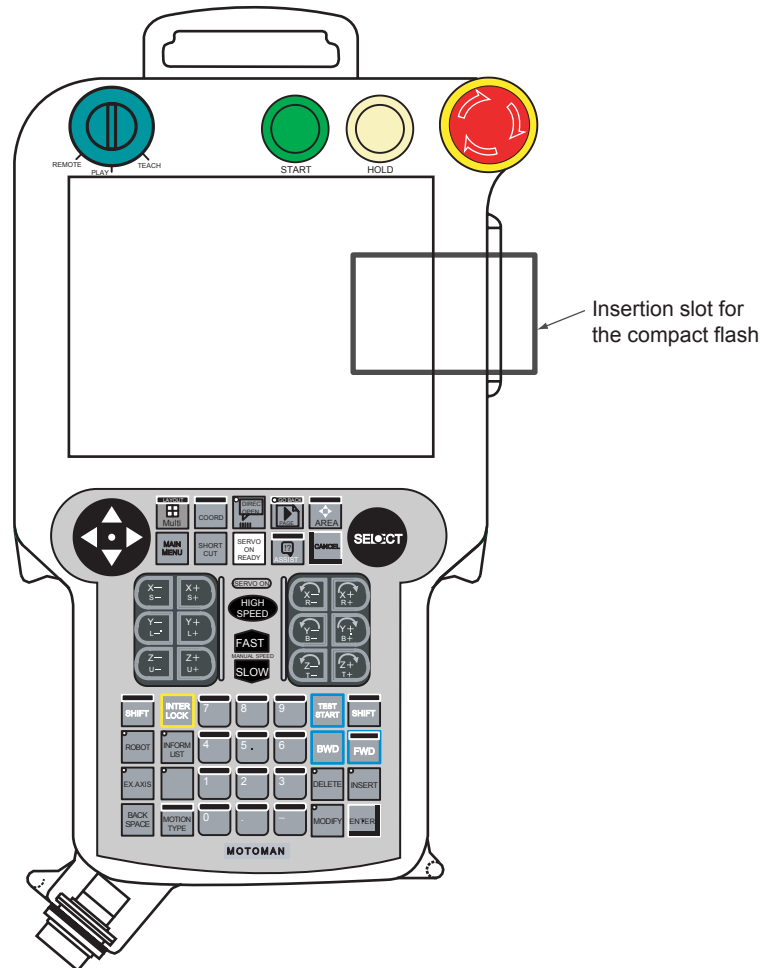
Observe the following precautions when using the compact flash.

- Handle the compact flash with care to protect the stored data.
- Do not use or keep the compact flash in places where strong static electricity or electronic noise may occur.
- Do not drop or exert any shock or strong force to the compact flash.
- Do not remove the compact flash or turn OFF the power when accessing the compact flash (writing-in or reading-out the compact flash data). The data in the compact flash may be lost.
- Back up the data from the compact flash to other media such as floppy disks or hard disks.

## 8.1 External Memory Devices

### ■ Inserting a Compact Flash

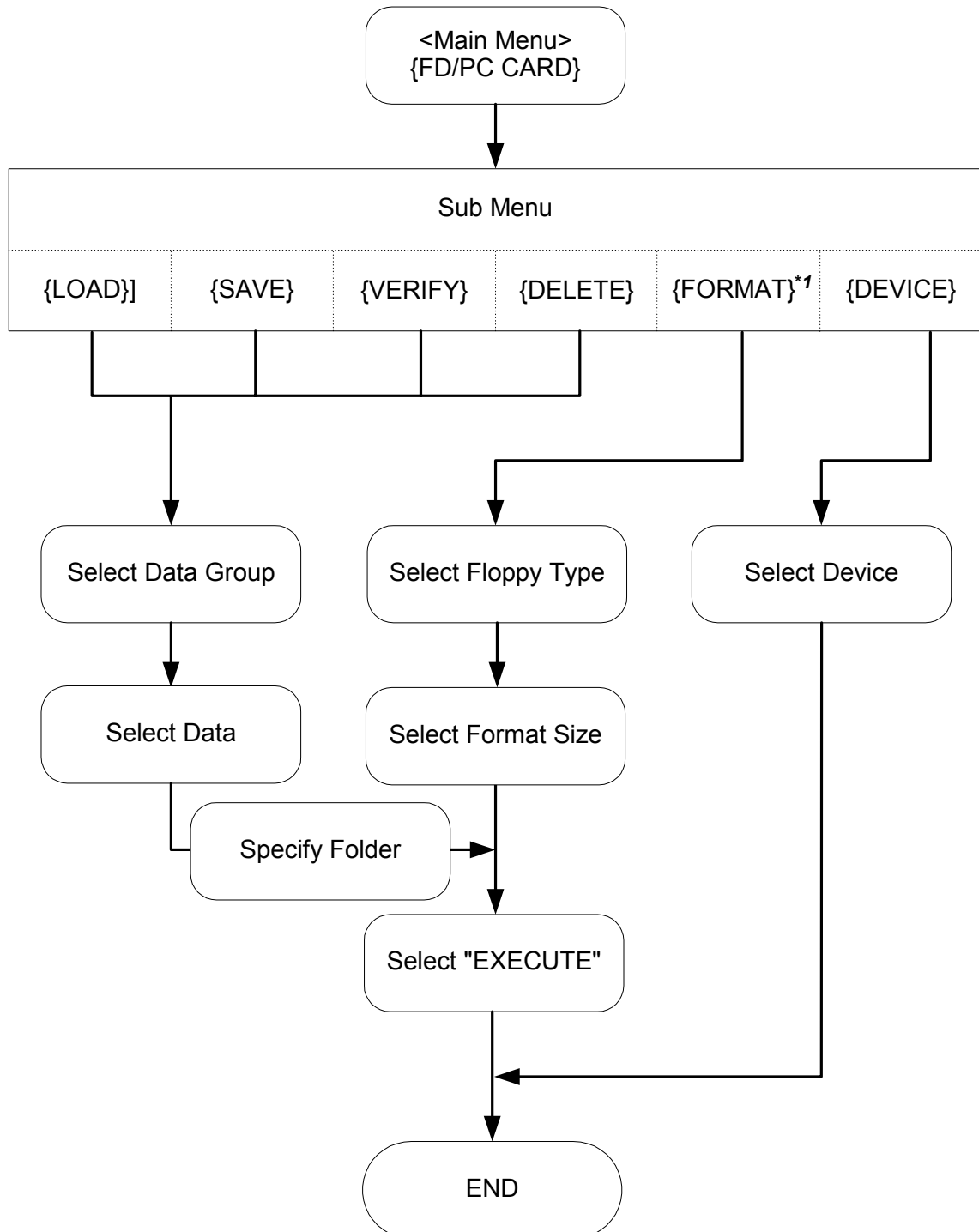
To insert a compact flash into the programming pendant, open the cover on the rear of the programming pendant. Insert the compact flash so that the product label is on the front side. The card cannot be inserted in any other position. Do not forcibly insert the card. After inserting the card, be sure to close the cover before starting operation.



Installing the Compact Flash

## 8.1.2 File Management

The flowchart below shows file transfer and file management. The operations are performed with the programming pendant.

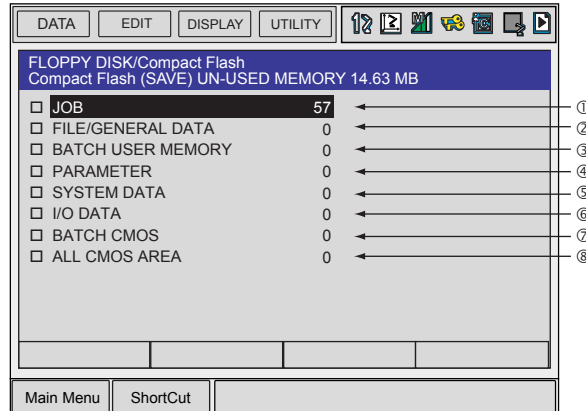


**\*1** For future use. (Cannot be used with the NX100 of the current version.)

## 8.1 External Memory Devices

### ■ Data that can be Saved and Save Destination File Names

The FLOPPY DISK/PC CARD window is shown below. Data that can be saved are classified into eight groups. The following table lists the data of the eight groups. The table also shows different file names provided for saving different types of data.



Data saved at an external memory unit can be reloaded into the memory of the NX100. The numbers ① through ⑧ in the above window correspond to the numbers ① through ⑧ in the following table.

- If the operator selects ③ “BATCH USER MEMORY,” all data belonging to groups ① and ② are saved as one file.
- When ③ “BATCH USER MEMORY,” ⑦ “BATCH CMOS,” or ⑧ “ALL CMOS AREA” is selected, jobs are also saved, but the indication of “TO SAVE TO FD” in the JOB HEADER window of the saved jobs does not become “DONE.” This becomes “DONE” only when ① “JOB” is selected to save the data.

Data that can be Saved		File Name (Saved Data)	Save		Load	
			EDIT	MAN	EDIT	MAN
⑧ ALL CMOS AREA		ALCMSxx.HEX	○	○	X	X
⑦ BATCH CMOS		CMOSxx.HEX	○	○	X	○
③ BATCH USER MEMORY		JOBxx.HEX	○	○	○	○
① JOB	Single job	JOBNAME.JBI	○	○	○	○
	Related job (Job+Condition)	JOBNAME.JBR	○	○	○	○
② FILE/ GENERAL DATA	Tool data	TOOL.CND	○	○	○	○
	Weaving data	WEAV.CND	○	○	○	○
	User coordinate data	UFRAME.CND	○	○	○	○
	Variable data	VAR.DAT	○	○	○	○
	Arc start condition data	ARCSRT.CND	○	○	○	○
	Arc end condition data	ARCEND.CND	○	○	○	○
	Welding condition auxiliary data	ARCSUP.DAT	○	○	○	○
	Power Source condition assist data	ARCSUP.DAT	○	○	○	○
	Power Source characteristic data	WELDER.DAT	○	○	○	○
	Power Source characteristic definition data	WELDUDEF.DAT	○	○	○	○
	Shock detection level data	SHOCKLVL.CND	○	○	○	○
	Motor gun pressure power data	SPRESS.CND	○	○	○	○
	Motor gun dry spot pressure data	SPRESSCL.CND	○	○	○	○
	Spot gun characteristic data	SGUN.DAT	○	○	○	○
	Spot gun condition auxiliary data	SGUNSUP.DAT	○	○	○	○
	Spot welding Power Source characteristic data	SWELDER.DAT	○	○	○	○
	Spot I/O allocation data	SPOTIO.DAT	○	○	○	○
	Spot welding condition data	SPOTWELD.DAT	○	○	○	○
	Short/Full open position data	STROKE.DAT	○	○	○	○
	Paint color condition data	PAINTSPE.DAT	○	○	○	○
	Painting condition data	PAINTCND.DAT	○	○	○	○
	Paint filling amount data	PLUGVOL.DAT	○	○	○	○
	EVB gun condition data	EVBGUN.DAT	○	○	○	○
	EVB turbine condition data	EVBTRBIN.DAT	○	○	○	○
	EVB painting condition data	EVBPAINT.DAT	○	○	○	○

EDIT : Edit Mode, MAN: Management Mode

○ : Can be done, X : Cannot be done

## 8.1 External Memory Devices

Data that can be Saved				File Name (Saved Data)		Save		Load	
						EDIT	MAN	EDIT	MAN
⑧	⑦	④ PARAMETER BATCH		ALL.PRM		○	○	X	○
		④ PARAME- TER	Robot matching parameter	RC.PRM		○	○	X	○
			System definition parameter	SD.PRM		○	○	X	○
			Coordinate home position parameter	RO.PRM		○	○	X	○
			System matching parameter	SC.PRM		○	○	X	○
			CIO parameter	CIO.PRM		○	○	X	○
			Function definition parameter	FD.PRM		○	○	X	○
			Application parameter	AP.PRM		○	○	X	○
			Transmission(general) parameter	RS.PRM		○	○	X	○
			Sensor parameter	SE.PRM		○	○	X	○
			Servo parameter	SV.PRM		○	○	X	○
			Servomotor parameter	SVM.PRM		○	○	X	○
			Operation control parameter	AMC.PRM		○	○	X	○
			Servo power block parameter	SVP.PRM		○	○	X	○
			Motion function parameter	MF.PRM		○	○	X	○
			SERVOPACK parameter	SVS.PRM		○	○	X	○
			Converter parameter	SVC.PRM		○	○	X	○
		⑤ I/O DATA	Concurrent I/O program	CIOPRG.LST		○	○	X	○
			I/O name data	IONAME.DAT		○	○	X	○
			Pseudo input signals	PSEUDOIN.DAT		○	○	X	○
		⑥ SYSTEM DATA	User word registration	UWORD.DAT		○	○	X	○
			SV monitor signals	SVMON.DAT		○	○	X	○
			Variable name	VARNAME.DAT		○	○	X	○
			Second home position	HOME2.DAT		○	○	X	○
			Alarm history data	ALMHIST.DAT		○	○	X	X
			Home position calibrating data	ABSO.DAT		○	○	X	○
			System information	SYSTEM.SYS		○	○	X	X
			Work home position data	OPEORG.DAT		○	○	X	X
			I/O message history data	IOMSGHST.DAT		○	○	X	X
			Function key allocation data	KEYALLOC.DAT		○	○	X	X
			Painting system setting data	PAINTSYS.DAT		○	○	X	X
			Painting device condition data	PAINTDEV.DAT		○	○	X	X
			CCV paint color data	CCVPAINT.DAT		○	○	X	X

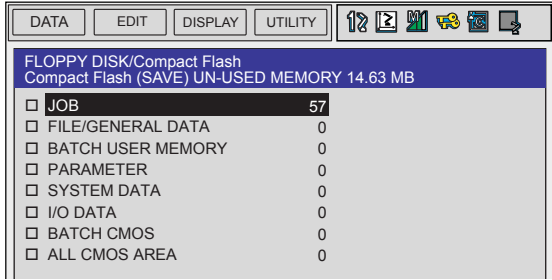
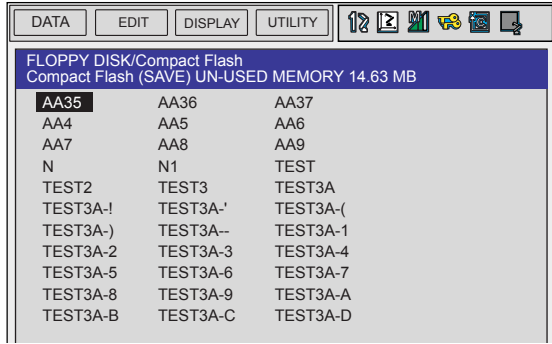
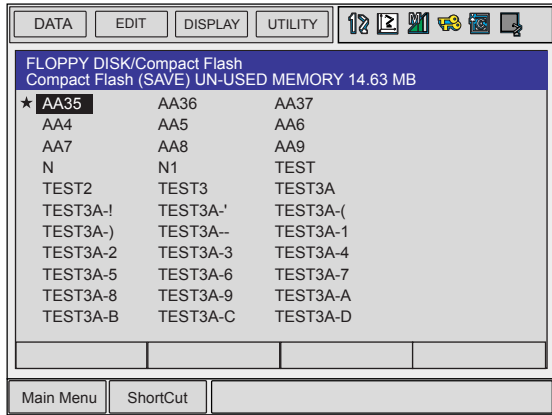
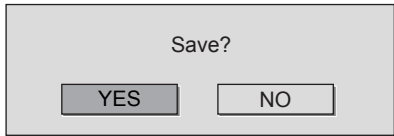
EDIT : Edit Mode, MAN: Management Mode

○ : Can be done, X : Cannot be done

## ■ Saving Data

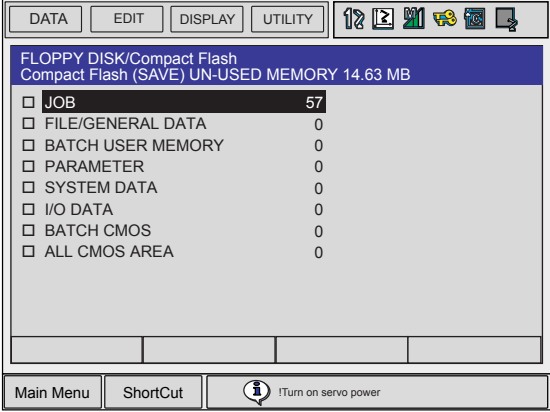
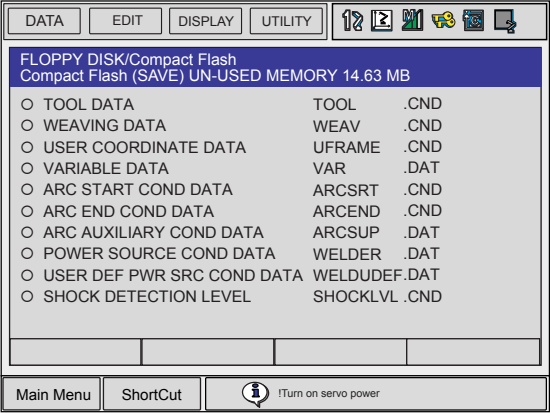
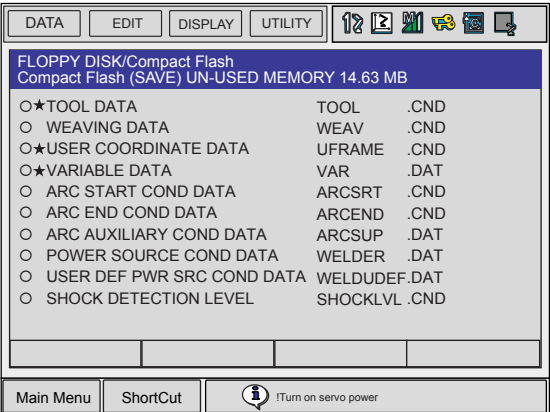
To download data from the memory of the NX100 to the external memory device, perform the following procedure.

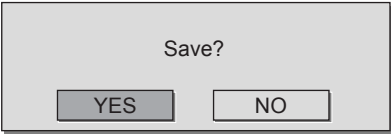
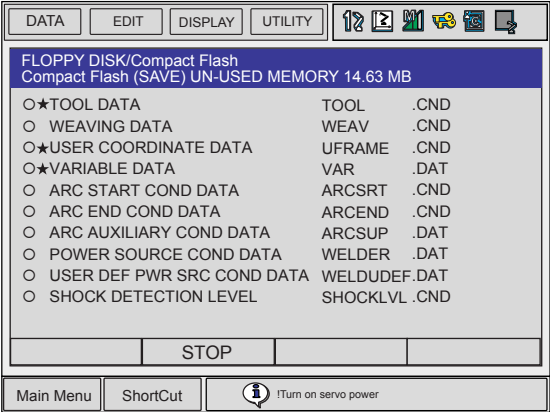
### Saving a Job

	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {SAVE}.	<p>The following window appears.</p> 
3	Select {JOB}.	<p>The JOB LIST window appears.</p> 
4	Select a job to be saved.	<p>The selected job is marked with “★.”</p> 
5	Press [ENTER].	<p>The confirmation dialog box appears.</p> 
6	Select “YES.”	<p>Saving the job starts.</p> <p>To cancel saving, select “STOP.”</p> <p>Once saving is completed or cancelled, the JOB LIST window appears.</p>

## 8.1 External Memory Devices

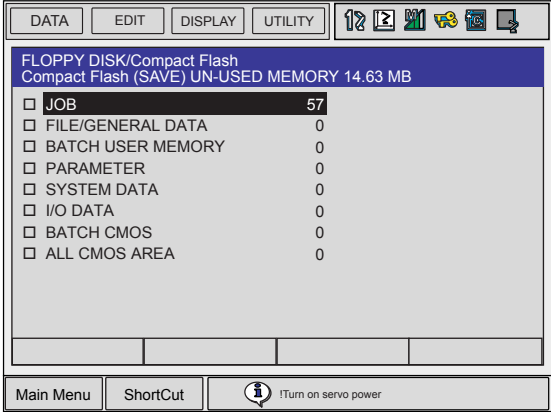
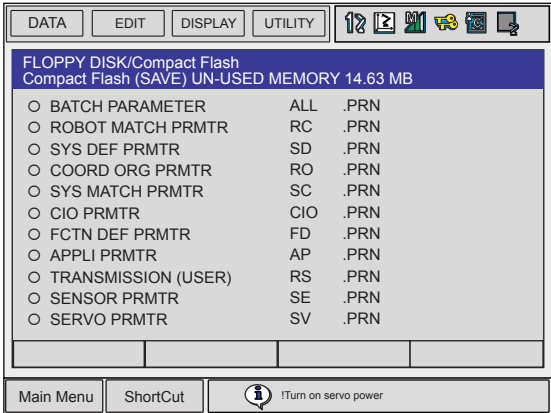
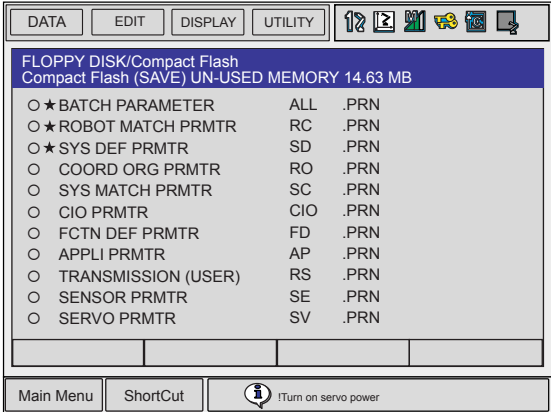
## Saving a Condition File or General Data

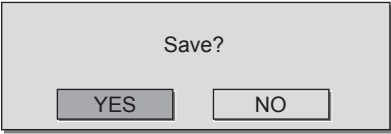
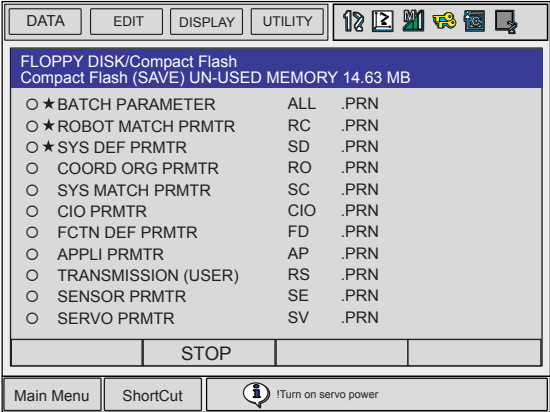
	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {SAVE}.	<p>The following window appears.</p> 
3	Select {FILE/GENERAL DATA}.	<p>The selection window appears.</p> 
4	Select condition files or general data to be saved.	<p>The selected files are marked with "★".</p> 

	Operation	Explanation
5	Press [ENTER].	<div>The confirmation dialog box appears.</div> <div></div>
6	Select "YES."	<div>Saving the data starts.</div> <div></div> <div>To cancel saving, select "STOP." Once saving is completed or cancelled, the selection window for condition files or general data appears.</div>

## 8.1 External Memory Devices

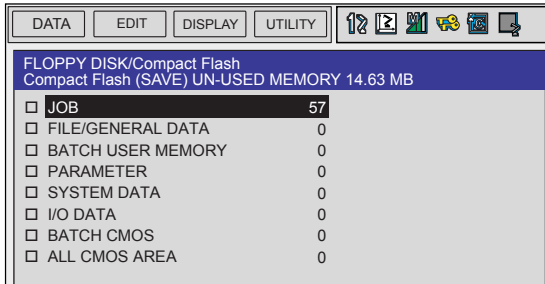
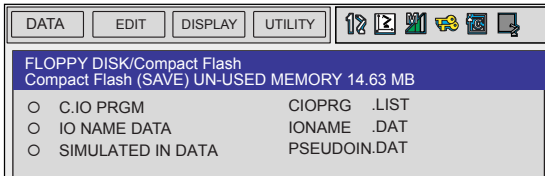
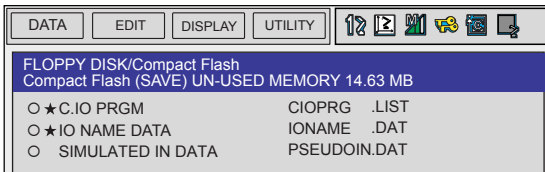
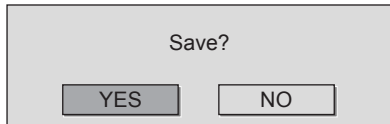
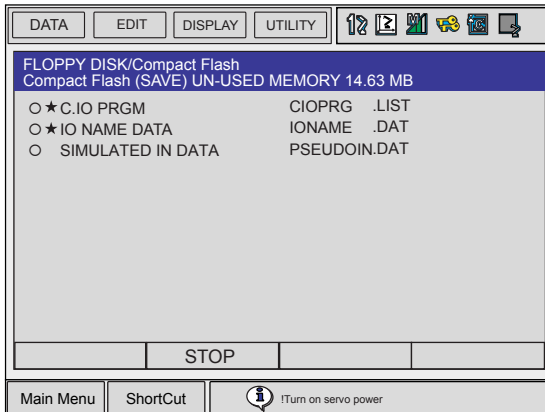
## Saving a Parameter

	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {SAVE}.	<p>The following window appears.</p> 
3	Select {PARAMETER}.	<p>The selection window for parameters appears.</p> 
4	Select parameters to be saved.	<p>The selected parameters are marked with "★."</p> 

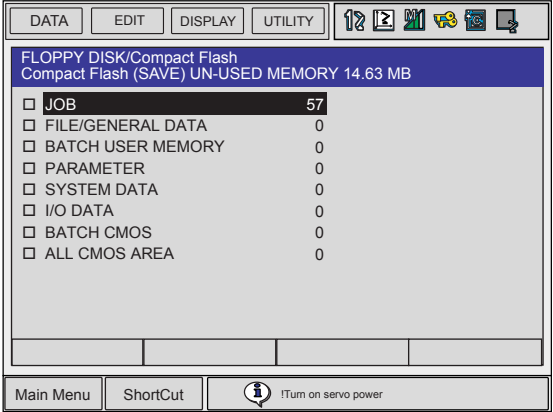
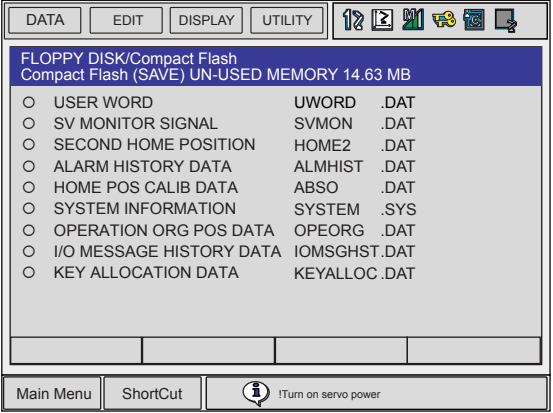
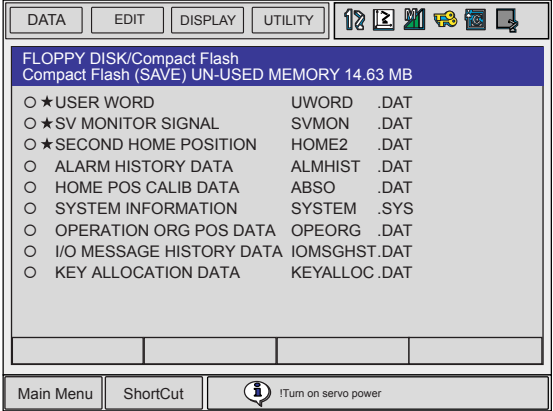
	Operation	Explanation
5	Press [ENTER].	<div>The confirmation dialog box appears.</div> <div></div>
6	Select "YES."	<div><div>Saving the file starts.</div><div></div><div>To cancel saving, select "STOP." Once saving is completed or cancelled, the selection window for parameters appears.</div></div>

## 8.1 External Memory Devices

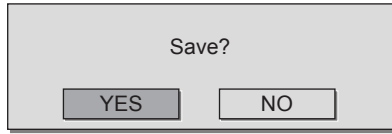
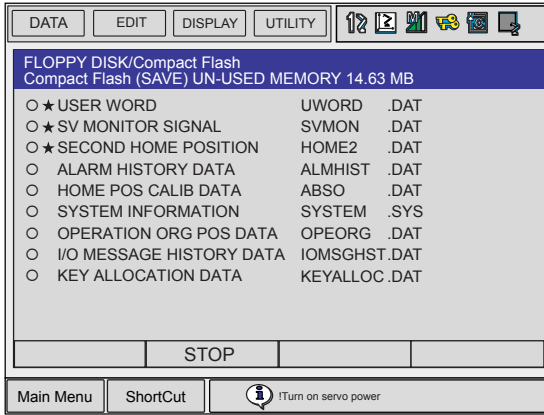
## Saving I/O Data

	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {SAVE}.	<p>The following window appears.</p> 
3	Select {I/O DATA}.	<p>The selection window for I/O data appears.</p> 
4	Select I/O data to be saved.	<p>The selected I/O data are marked with “★.”</p> 
5	Press [ENTER].	<p>The confirmation dialog box appears.</p> 
6	Select “YES.”	<p>Saving the file starts.</p>  <p>To cancel saving, select “STOP.” Once saving is completed or cancelled, the selection window for I/O data appears.</p>

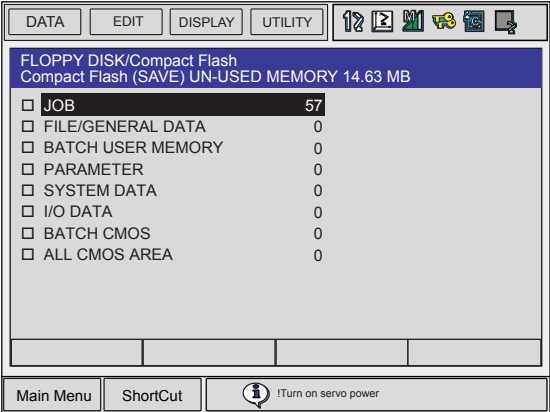
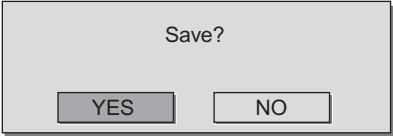
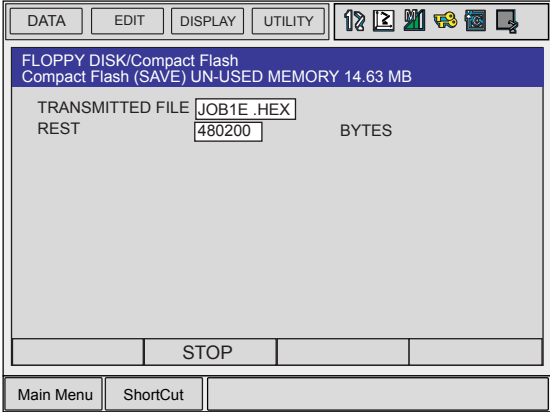
## Saving System Data

	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {SAVE}.	<p>The following window appears.</p> 
3	Select {SYSTEM DATA}.	<p>The selection window for system data appears.</p> 
4	Select system data to be saved.	<p>The selected system data are marked with “★.”</p> 

## 8.1 External Memory Devices

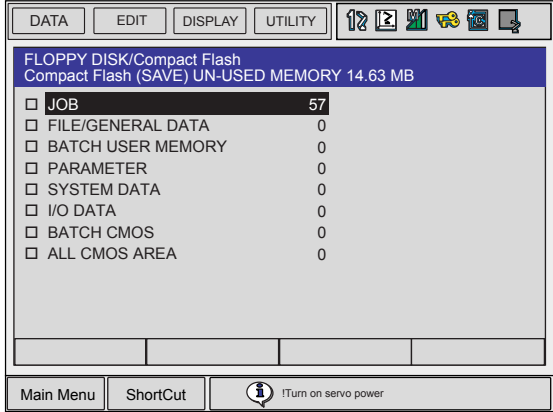
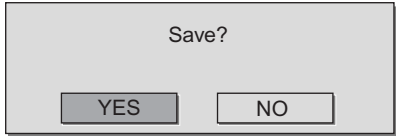
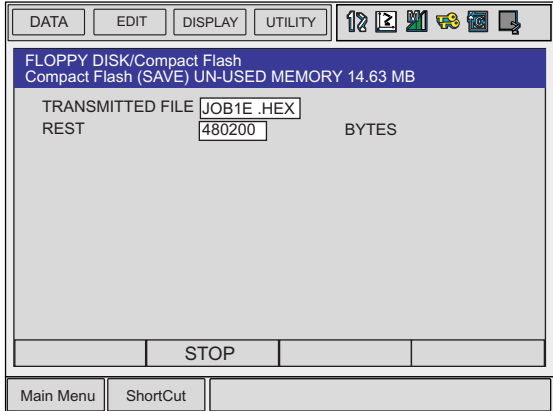
	Operation	Explanation
5	Press [ENTER].	<p>The confirmation dialog box appears.</p> 
6	Select "YES."	<p>Saving the file starts.</p>  <p>To cancel saving, select "STOP." Once saving is completed or cancelled, the selection window for system data appears.</p>

Saving All User’s Programs

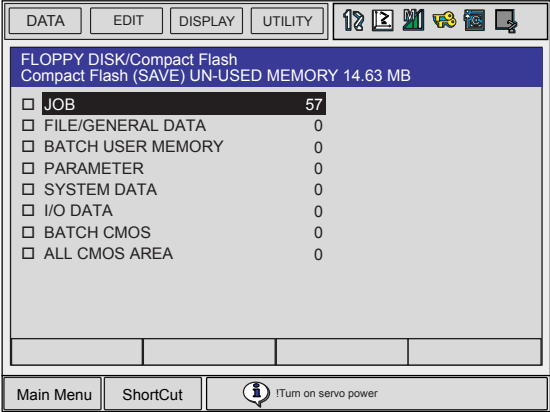
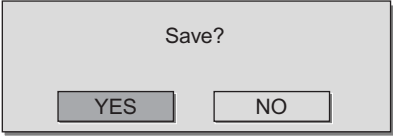
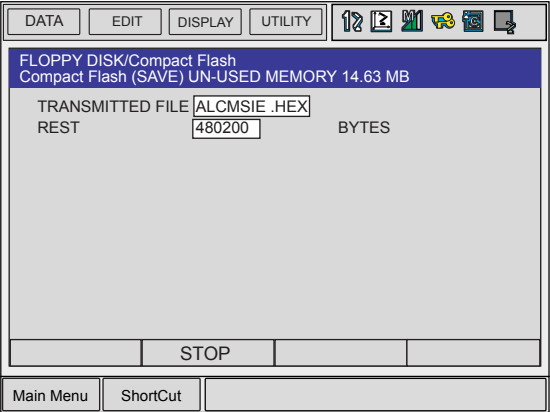
	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {SAVE}.	<p>The following window appears.</p> 
3	Select {BATCH USER MEMORY}.	
4	Select “EXECUTE.”	<p>The confirmation dialog box appears.</p> 
5	Select “YES.”	<p>Saving all user’s programs starts.</p>  <p>To cancel saving, select “STOP.” Once saving is completed or cancelled, the job selection window appears.</p>

## 8.1 External Memory Devices

## Saving All CMOS Data

	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {SAVE}.	<p>The following window appears.</p> 
3	Select {BATCH CMOS}.	
4	Select "EXECUTE."	<p>The confirmation dialog box appears.</p> 
5	Select "YES."	<p>Saving all CMOS data starts.</p>  <p>To cancel saving, select "STOP." Once saving is completed or cancelled, the job selection window appears.</p>

Saving All Data in CMOS Area

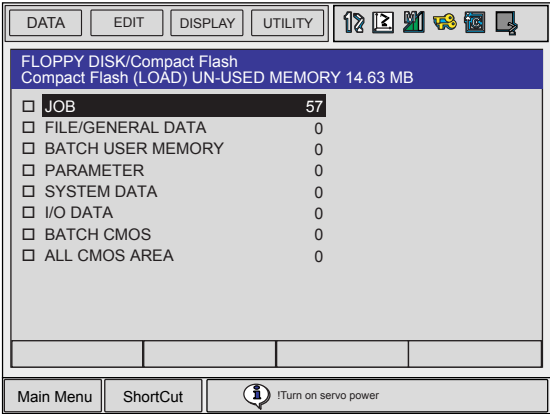
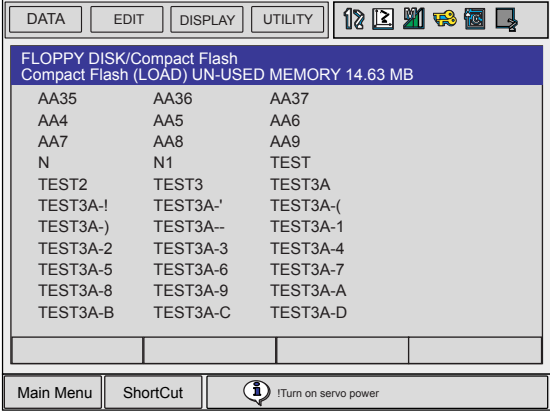
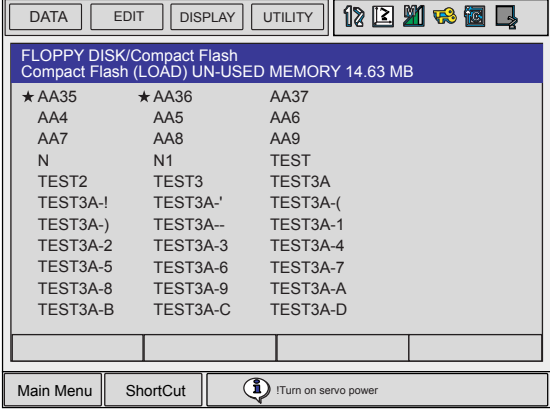
	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {SAVE}.	<p>The following window appears.</p> 
3	Select {ALL CMOS AREA}.	
4	Select "EXECUTE."	<p>The confirmation dialog box appears.</p> 
5	Select "YES."	<p>Saving all data in CMOS area starts.</p>  <p>To cancel saving, select "STOP." Once saving is completed or cancelled, the job selection window appears.</p>

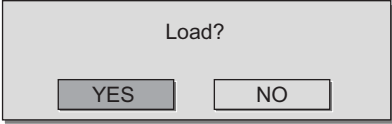
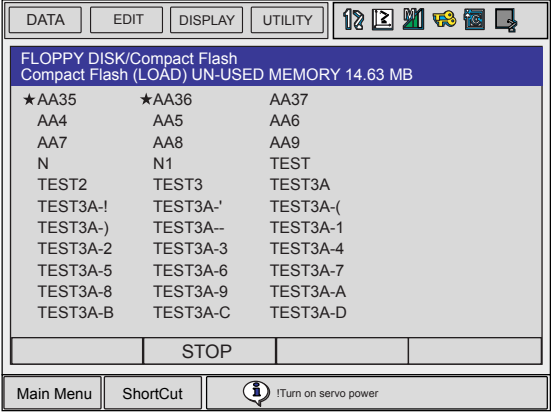
## 8.1 External Memory Devices

### ■ Loading Data

To upload data from the external memory device to the memory of the NX100, follow the procedure in the following.

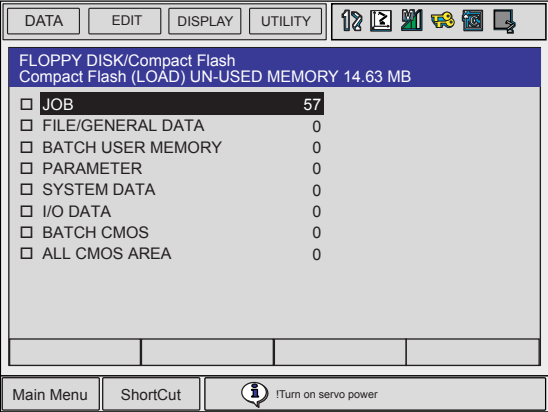
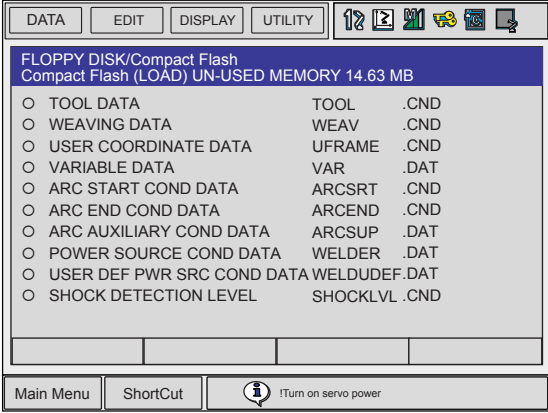
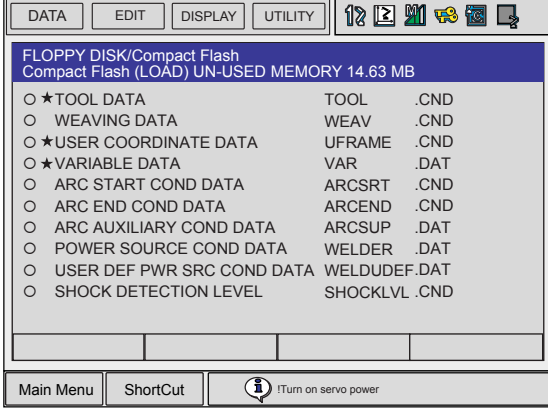
#### Loading a Job

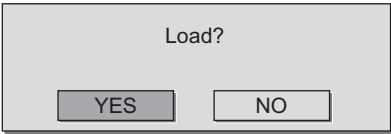
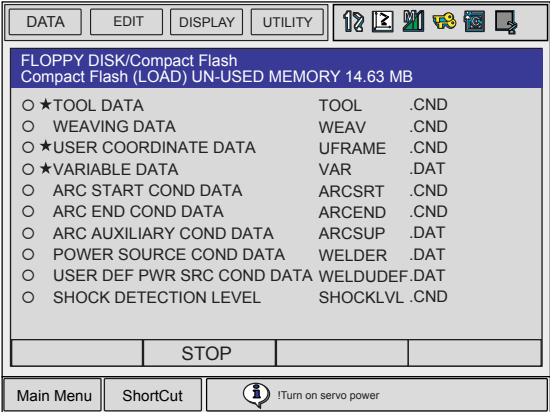
	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {LOAD}.	<p>The following window appears.</p> 
3	Select {JOB}.	<p>The job selection window appears.</p> 
4	Select a job to be loaded.	<p>The selected jobs are marked with "★."</p> 

	Operation	Explanation
5	Press [ENTER].	<div>The confirmation dialog box appears.</div> <div></div>
6	Select "YES."	<div>Loading the job starts.</div> <div></div> <div>To cancel loading, select "STOP." Once loading is completed or cancelled, the job selection window appears.</div>

## 8.1 External Memory Devices

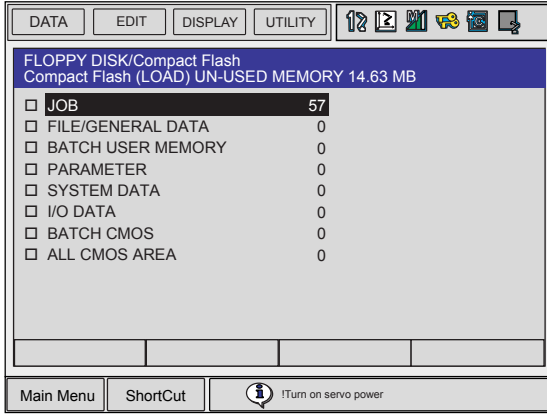
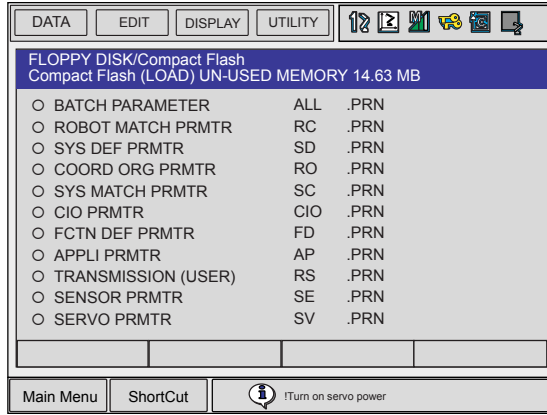
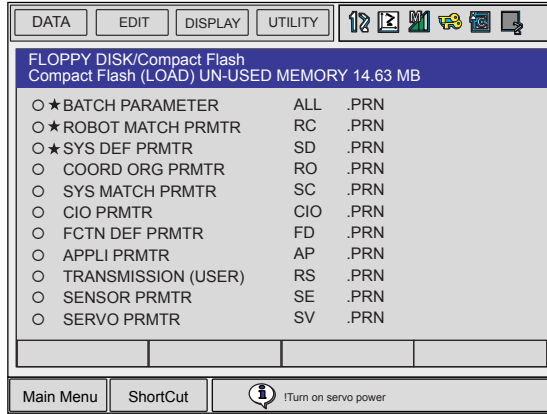
## Loading a Condition File or General Data

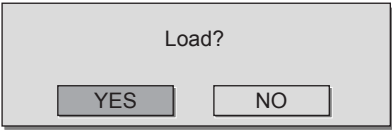
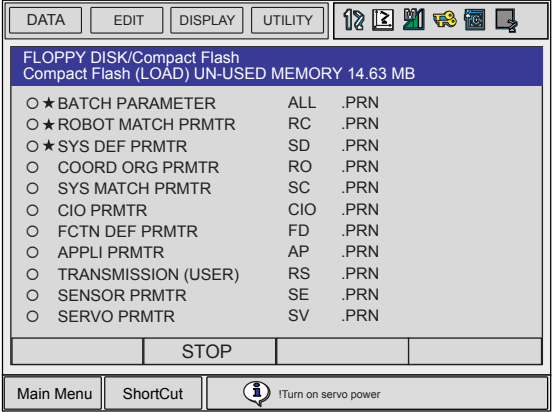
	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {LOAD}.	<p>The following window appears.</p> 
3	Select {FILE/GENERAL DATA}.	<p>The selection window for condition file or general data appears.</p> 
4	Select a condition file or general data to be loaded.	<p>The selected files are marked with "★."</p> 

	Operation	Explanation
5	Press [ENTER].	<div>The confirmation dialog box appears.</div> <div></div>
6	Select "YES."	<div>Loading the file starts.</div> <div></div> <div>To cancel loading, select "STOP." Once loading is completed or cancelled, the selection window for condition file or general data appears.</div>

## 8.1 External Memory Devices

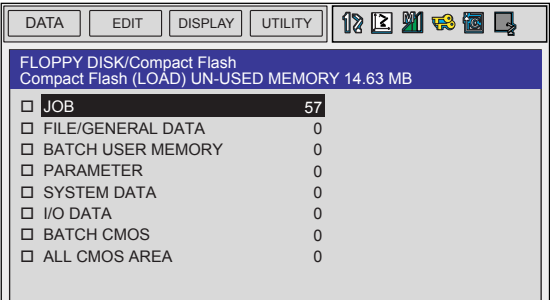
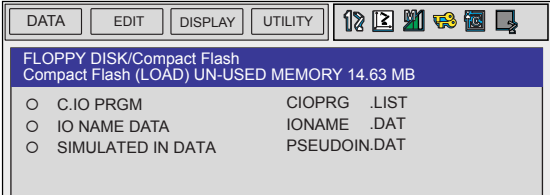
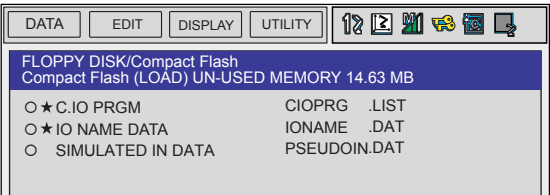
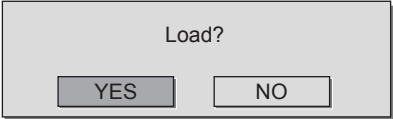
## Loading a Parameter

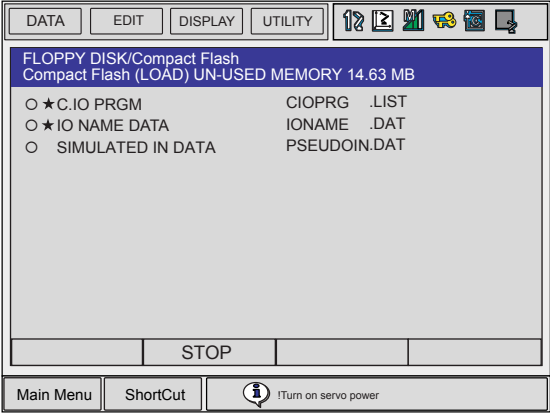
	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {LOAD}.	<p>The following window appears.</p> 
3	Select {PARAMETER}.	<p>The selection window for parameters appears.</p> 
4	Select parameters to be loaded.	<p>The selected parameters are marked with "★."</p> 

	Operation	Explanation
5	Press [ENTER].	<div>The confirmation dialog box appears.</div> <div></div>
6	Select "YES."	<div>Loading the file starts.</div> <div></div> <div>To cancel loading, select "STOP." Once loading is completed or cancelled, the selection window for parameters appears.</div>

## 8.1 External Memory Devices

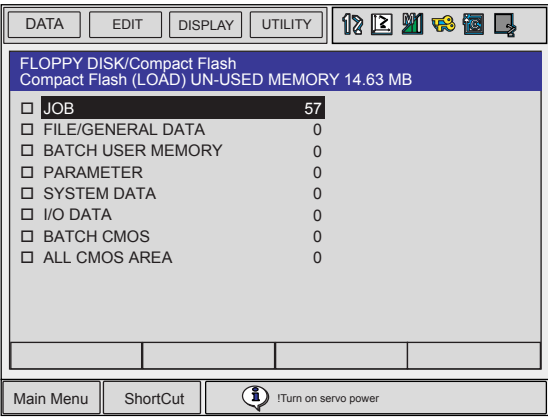
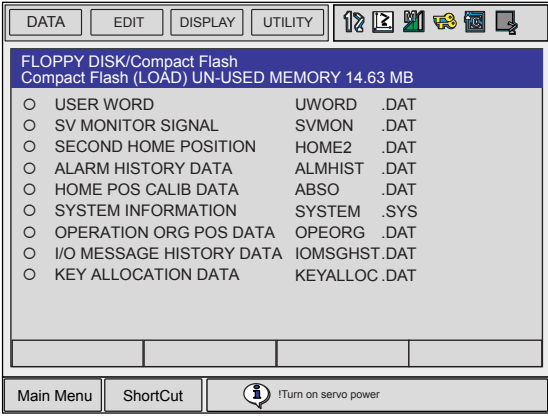
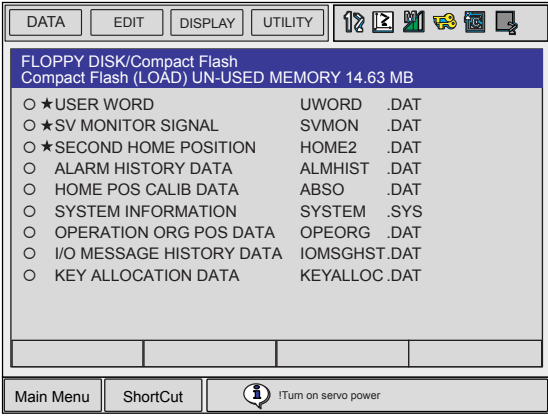
## Loading I/O Data

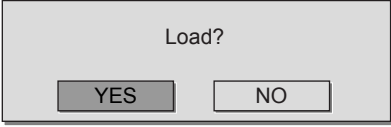
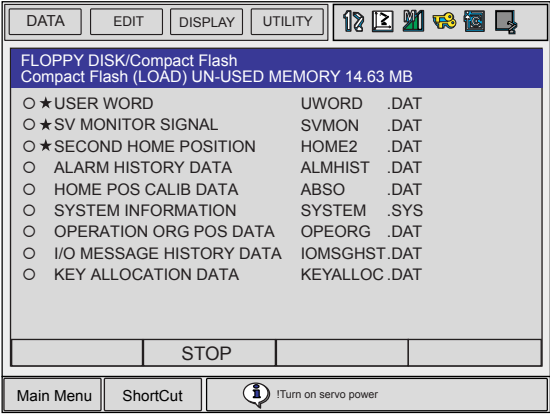
	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {LOAD}.	<p>The following window appears.</p> 
3	Select {I/O DATA}.	<p>The selection window for I/O data appears.</p> 
4	Select I/O data to be loaded.	<p>The selected I/O data are marked with "★."</p> 
5	Press [ENTER].	<p>The confirmation dialog box appears.</p> 

	Operation	Explanation
6	Select "YES."	<div>Loading the file starts.</div> <div></div> <div>To cancel loading, select "STOP." Once loading is completed or cancelled, the selection window for I/O data appears.</div>

## 8.1 External Memory Devices

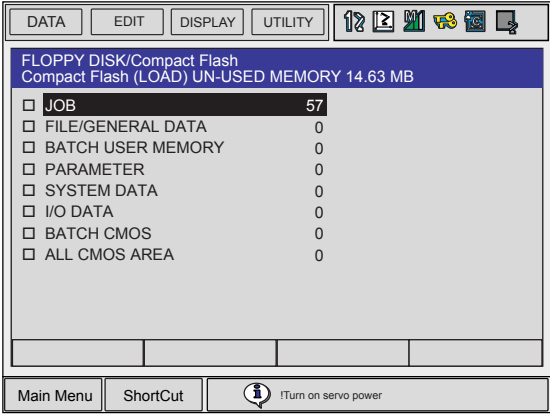
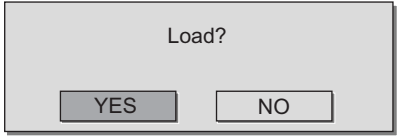
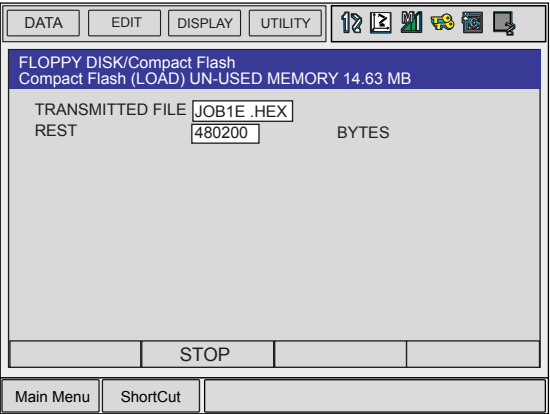
## Loading System Data

	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {LOAD}.	<p>The following window appears.</p> 
3	Select {SYSTEM DATA}.	<p>The selection window for system data appears.</p> 
4	Select system data to be loaded.	<p>The selected system data are marked with "★."</p> 

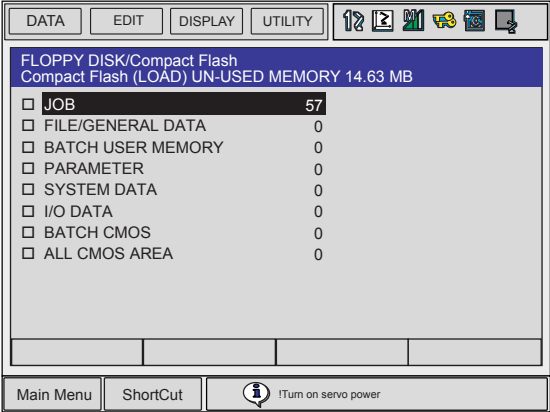
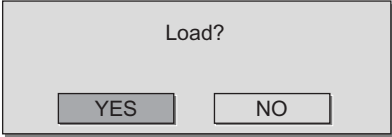
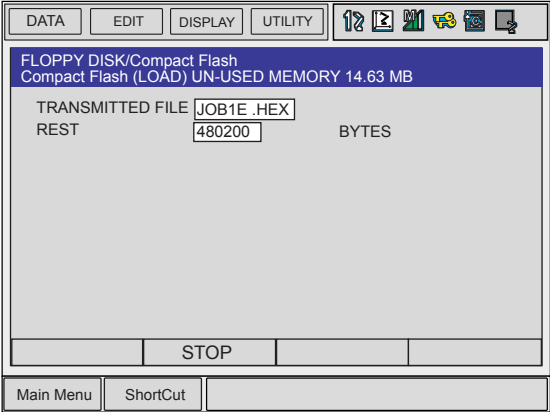
	Operation	Explanation
5	Press [ENTER].	<div>The confirmation dialog box appears.</div> <div></div>
6	Select "YES."	<div>Loading the file starts.</div> <div></div> <div>To cancel loading, select "STOP." Once loading is completed or cancelled, the selection window for system data appears.</div>

## 8.1 External Memory Devices

## Loading All User's Programs

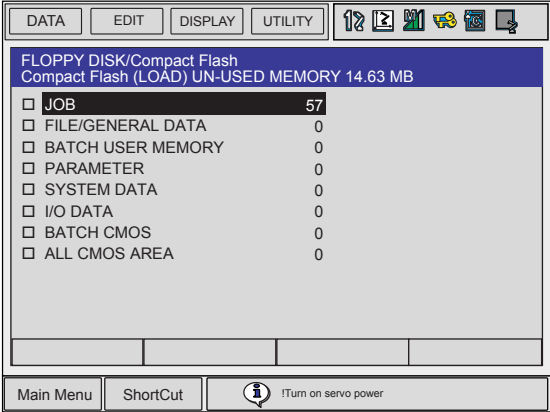
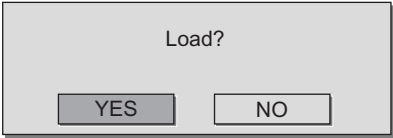
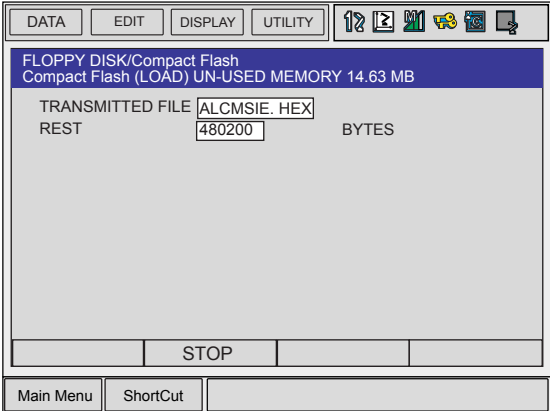
	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {LOAD}.	<p>The following window appears.</p> 
3	Select {BATCH USER MEMORY}.	
4	Select "EXECUTE."	<p>The confirmation dialog box appears.</p> 
5	Select "YES."	<p>Loading all user's programs starts.</p>  <p>To cancel loading, select "STOP." Once loading is completed or cancelled, the job selection window appears.</p>

Loading All CMOS Data

	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {LOAD}.	<p>The following window appears.</p> 
3	Select {BATCH CMOS}.	
4	Select "EXECUTE."	<p>The confirmation dialog box appears.</p> 
5	Select "YES."	<p>Loading all CMOS data starts.</p>  <p>To cancel loading, select "STOP." Once loading is completed or cancelled, the job selection window appears.</p>


## 8.1 External Memory Devices

## Loading All Data in CMOS Area

	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {LOAD}.	<p>The following window appears.</p> 
3	Select {ALL CMOS AREA}.	
4	Select "EXECUTE."	<p>The confirmation dialog box appears.</p> 
5	Select "YES."	<p>Loading all system data starts.</p>  <p>To cancel loading, select "STOP." Once loading is completed or cancelled, the job selection window appears.</p>

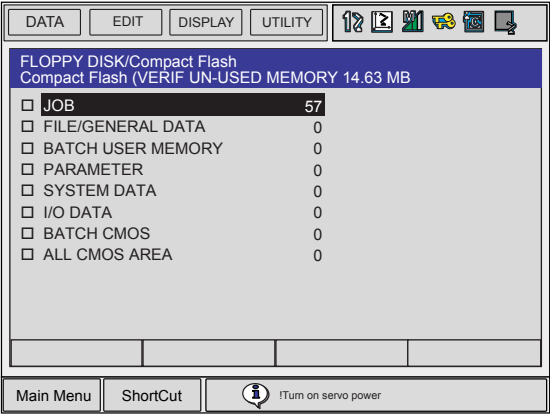
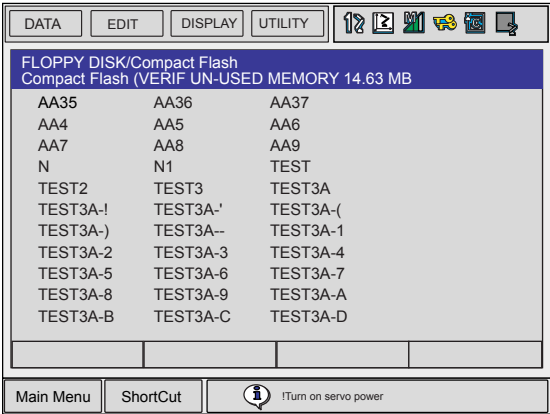
■ Verifying Data

Follow the procedure below to verify data in the memory of the NX100 with data saved in the external memory device.

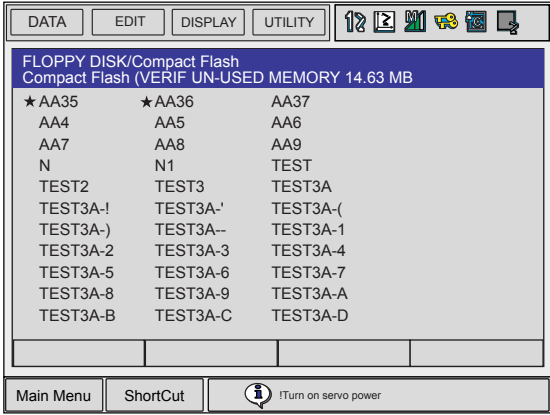

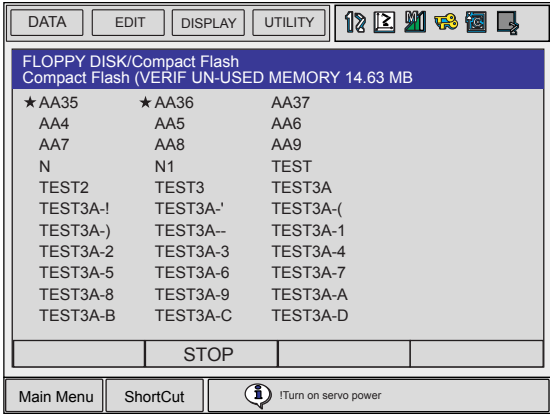


This function cannot be executed with “BATCH USER MEMORY,” “BATCH CMOS,” or “ALL CMOS AREA” specified.

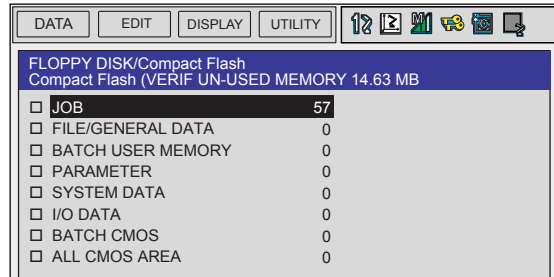
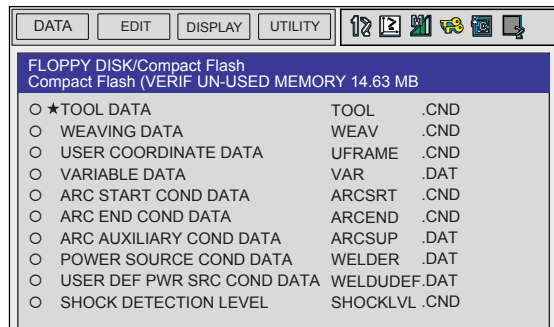

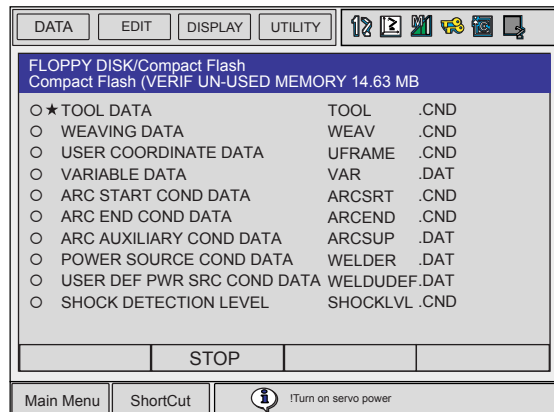
Verifying a Job

	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {VERIFY}.	<div>The following window appears.</div>
3	Select {JOB}.	<div>The job selection window appears.</div>

## 8.1 External Memory Devices

	Operation	Explanation
4	Select a job to be verified.	<p>The selected jobs are marked with “★.”</p> 
5	Press [ENTER].	<p>The confirmation dialog box appears.</p> 
6	Select “YES.”	<p>Verifying the job starts.</p>  <p>To cancel verifying, select “STOP.” Once verifying is completed or cancelled, the job selection window appears.</p>

## Verifying a File

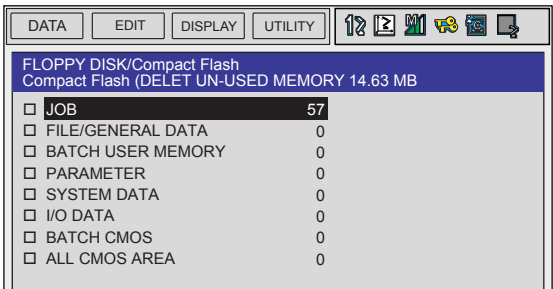
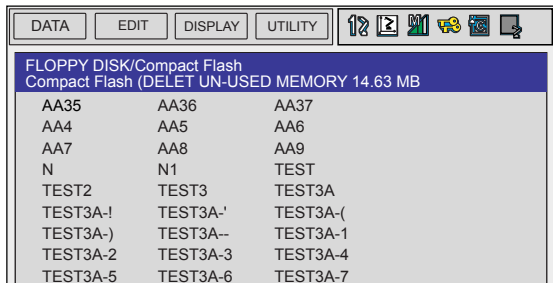
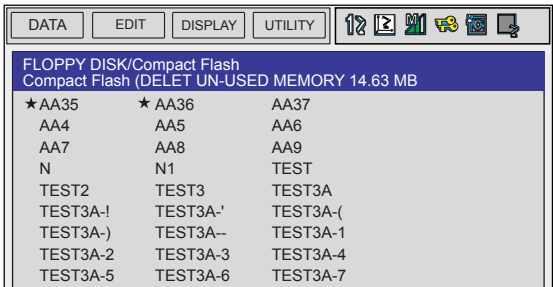

	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {VERIFY}.	<p>The following window appears.</p> 
3	Select the group of the file to be verified.	
4	Select a file to be verified.	<p>The selected files are marked with “★.”</p> 
5	Press [ENTER].	<p>The confirmation dialog box appears.</p> 
6	Select “YES.”	<p>Verifying the data starts.</p>  <p>To cancel verifying, select “STOP.” Once verifying is completed or cancelled, the job selection window appears.</p>

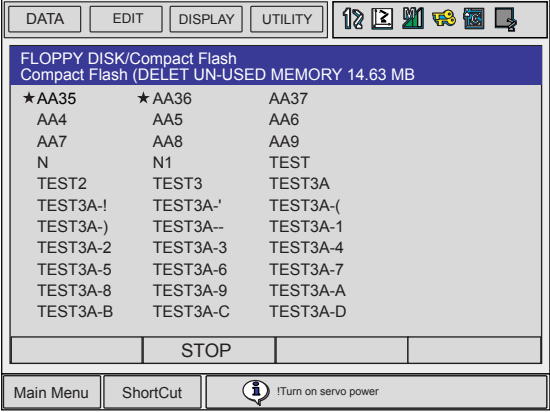
## 8.1 External Memory Devices

## ■ Deleting Data

Follow the procedure below to delete a file or files on an external memory device.

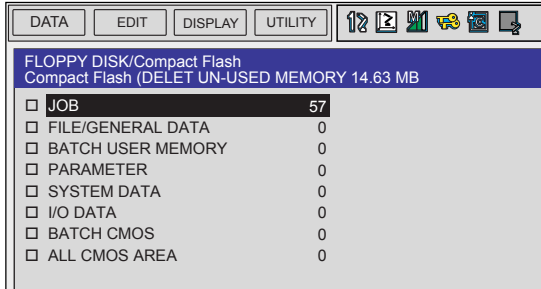
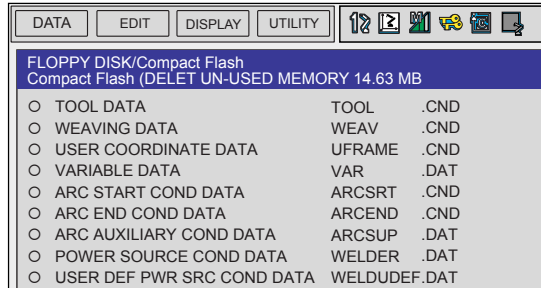
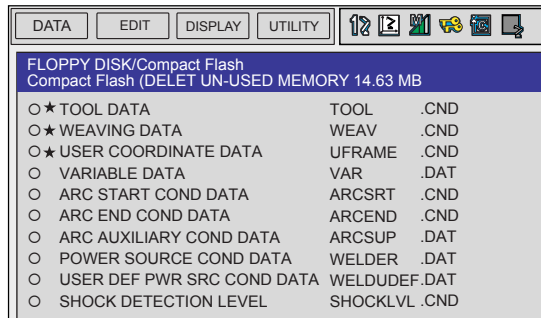
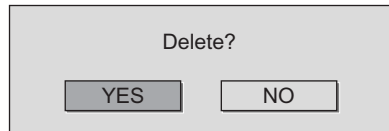
### Deleting a Job

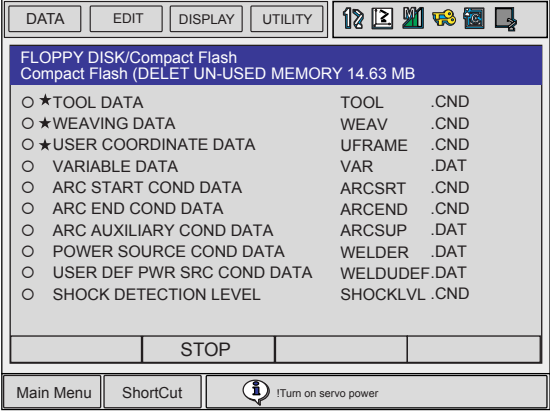
	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {DELETE}.	<p>The following window appears.</p> 
3	Select {JOB}.	<p>The job selection window appears.</p> 
4	Select a job to be deleted.	<p>The selected jobs are marked with “★.”</p> 
5	Press [ENTER].	<p>The confirmation dialog box appears.</p> 

	Operation	Explanation
6	Select "YES."	<div>Deleting the data starts.</div> <div></div> <div>To cancel deleting, select "STOP." Once deleting is completed or cancelled, the job selection window appears.</div>

## 8.1 External Memory Devices

## Deleting a File

	Operation	Explanation
1	Select {FD/PC CARD} under the main menu.	
2	Select {DELETE}.	<p>The following window appears.</p> 
3	Select the group of the file to be deleted.	
4	Select a file to be deleted.	<p>The selected files are marked with “★.”</p> 
5	Press [ENTER].	<p>The confirmation dialog box appears.</p> 

	Operation	Explanation
6	Select "YES."	<div>Deleting the data starts.</div> <div></div> <div>To cancel deleting, select "STOP." Once deleting is completed or cancelled, the DELETE (JOB) win- dow appears.</div>

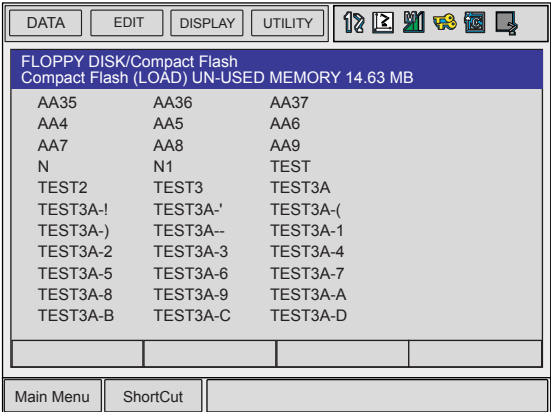
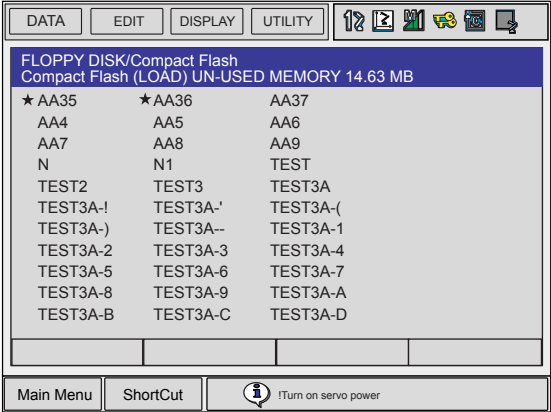
## 8.1 External Memory Devices

### ■ Job Selection Mode

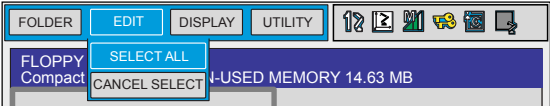
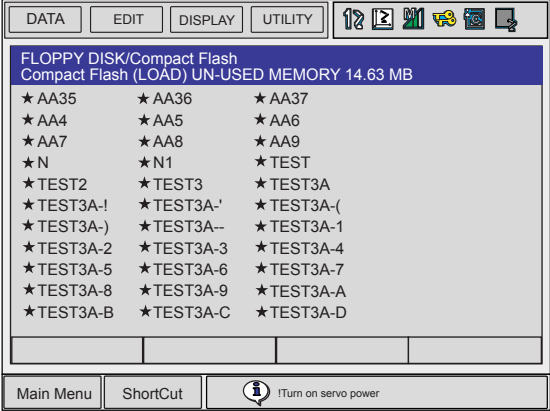
The method of selecting a job and various data files when loading, saving, verifying, and deleting are described in the following:

- Individual Selection  
Jobs and data files are selected individually one at a time.
- Batch Selection  
Jobs and data files are selected all at one time.

### Using Individual Selection

	Operation	Explanation
1	In either the external memory JOB LIST window or the file selection window, move the cursor to a job or a file to be selected.	
2	Press [SELECT].	<p>The selected jobs are marked with “★.”</p> 

Using Batch Selection

	Operation	Explanation
1	In either the external memory JOB LIST window or the file selection window, select {EDIT} under the menu.	<div>The pull-down menu appears.</div> <div></div>
2	Select {SELECT ALL}.	<div>All jobs are selected.</div> <div></div> <div>To cancel the selected items, select {EDIT} and then {CANCEL SELECT}.</div>

## 9 Parameter

### 9.1 Parameter Configuration

The parameters of NX100 can be classified into the following seven:

#### **Motion Speed Setting Parameter**

Determines the manipulator motion speed for jog operation at teaching, test operation, or playback operation.

#### **Mode Operation Setting Parameter**

Makes the setting for various operations in the teach mode or remote mode.

#### **Parameter according to Interference Area**

Limits the P-point maximum envelope of the manipulator or sets the interference area for axis interference or cubic interference.

#### **Parameter according to Status I/O**

Sets the parity check or I/O setting for user input/output signals.

#### **Parameter according to Coordinated or Synchronized Operation**

Makes the settings for coordinated or synchronized operations between manipulators or between manipulators and stations.

#### **Parameter for Other Functions or Applications**

Makes the settings for other functions or applications.

#### **Hardware Control Parameter**

Makes the hardware settings for fan alarm or relay operation, etc.



#### **S1CxG Parameters**

The initial setting of S1CxG parameters depends on the manipulator model. For a system in which two manipulators are controlled, the following two types of parameters are used: S1C1G type and S1C2G type.

## 9.2 Motion Speed Setting Parameters

These parameters set the manipulator motion speed for jog operation at teaching, test operation, or playback operation.

### ■ S1CxG000: IN-GUARD SAFE OPERATION MAX. SPEED

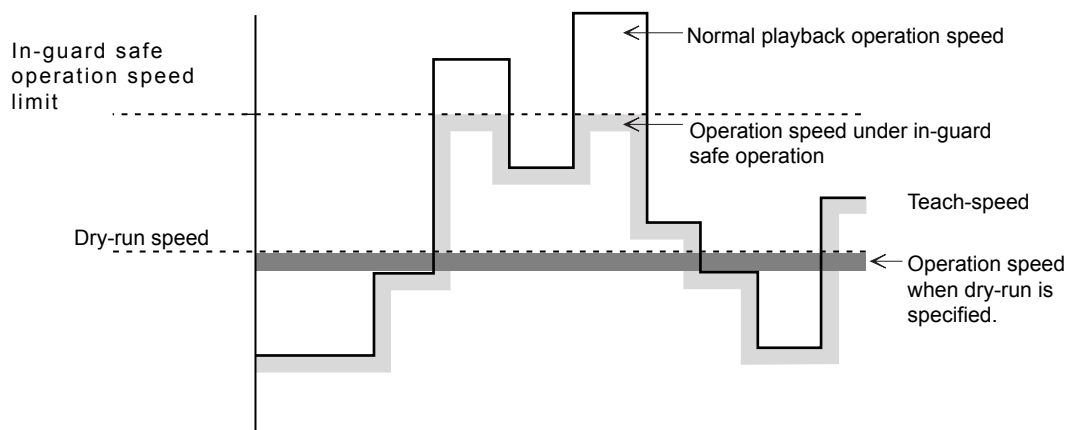
Units: 0.01%

The upper speed limit is set for in-guard safe operation. While the in-guard safe operation command signal is being input, the TCP speed is limited to the TCPmax speed.

### ■ S1CxG001: DRY-RUN SPEED

Units: 0.01%

This is a dry-run operation speed setting value used when checking the path. Take safety into consideration when setting changes are unnecessary.



### ■ S1CxG002 to S1CxG009: JOINT SPEED FOR REGISTRATION

Units: 0.01%

The value set in these parameters is registered as the joint speed for each speed level when teaching the position data with the programming pendant. The percentage corresponding to the set value at each level is registered as 100% of the value set in the playback speed limit. Values greater than those set as speed limit values cannot be set.

### ■ S1CxG010 to S1CxG017: LINEAR SPEED FOR REGISTRATION

Units: 0.1mm/s

The value set in these parameters is registered as the linear speed for each speed level when teaching the position data with the programming pendant. Values greater than those set as playback speed limit values cannot be set.

## 9.2 Motion Speed Setting Parameters

### ■ S1CxG018 to S1CxG025: POSITION ANGLE SPEED

Units: 0.1°/s

The value set in these parameters is registered as the position angle speed for each speed level when teaching the position data with the programming pendant. Values greater than those set as playback speed limit cannot be set.

### ■ S1CxG026 to S1CxG029: JOG OPERATION ABSOLUTE VALUE SPEED

Units: 0.1mm/s

These are setting values of jog operation speed set by the programming pendant. Values greater than those set as jog operation speed limit value cannot be set.

Low level	:	Jog operation speed when "LOW" manual speed is specified.
Medium level	:	Jog operation speed when "MEDIUM" manual speed is specified.
High level	:	Jog operation speed when "HIGH" manual speed is specified.
High-speed-level	:	Jog operation speed when [HIGH SPEED] is pressed.

### ■ S1CxG030 to S1CxG032: INCHING MOVE AMOUNT

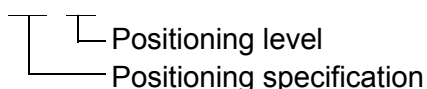
These parameters specify the amount per move at inching operation by the programming pendant. The referenced parameter differs according to the operation mode at inching operation.

Joint Operation	:	1 to 10 pulses in units of 1 pulse
Cartesian/cylindrical,user,tool	:	0.01 to 2.55mm in units of 0.01mm
Motion about TCP	:	0.1 to 1.0° in units of 0.1°

### ■ S1CxG033 to S1CxG040: POSITIONING ZONE

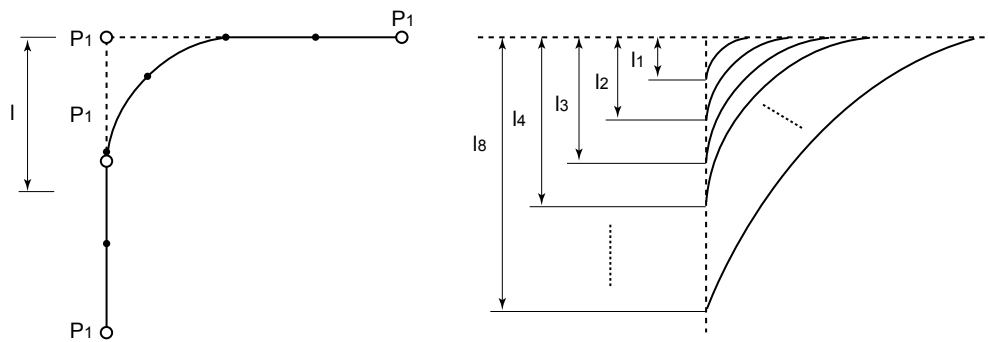
This parameter value will be referenced when positioning is specified with the "MOVE" instruction : MOVJ (joint movement) or MOVL (linear movement).

**<Example>** MOVL V=100.0 PL=1



The value set in this parameter specifies the range to enter in relation to the teaching point for that step positioning. After entering the specified positioning zone, the manipulator starts moving to the next step. The system is also set up so circular movement is carried out in the moving section when moving to the next path; speed changeover is smooth.

Since operation will be turning inward during playback, as shown in the following diagram, use setting values taking safety aspects into consideration.



This process becomes effective when change in direction of steps is between  $250^\circ$  and  $155^\circ$ .



### Position Level

Position levels are divided into nine stages of 0 to 8 with the “MOV” instruction.  
e.g. MOVL V=500 PL=1 (PL:Position Level)

The functions at each level are as follows:

0 : Complete positioning to the target point

1 to 8 : Inward turning operation

Following are explanations of the respective processing details and their relations with the parameter.

- Level 0

Determines positioning completion when the amount of deviation (number of pulses) to the target point of each axis comes within the position set zone specified by the parameter.

After the positioning completes, the instruction system starts instruction to the next target point.

- Level 1 to 8

Recognizes virtual positioning before the target point. The distance of the virtual target position from the target point is specified at the positioning level.

Distance data corresponding to each level are set in the parameter. Determination of the virtual target position is carried out in the instruction system.

Set zone: The zone of each positioning level set in the parameter. ( $\mu\text{m}$ )

## ■ S1CxG044: LOW-SPEED START

Units: 0.01%

This parameter specifies max. speed at low speed start. Specify the starting method for “initial operation speed of manipulator” (S2C169).

## 9.2 Motion Speed Setting Parameters

### ■ S1CxG045 to S1CxG048: JOG OPERATION LINK SPEED

Units: 0.01%

These parameters prescribe the link speed at jog operation by the programming pendant. Specify the percentage (%) for the jog operation speed limit, the joint max. speed.

S1CxG045: Jog operation link speed at level “LOW”

S1CxG046: Jog operation link speed at level “MEDIUM”

S1CxG047: Jog operation link speed at level “HIGH”

S1CxG048: Jog operation link speed at level “HIGH SPEED”

### ■ S1CxG056: WORK HOME POSITION RETURN SPEED

Units: 0.01%

This parameter specifies the speed for returning to work home position against the maximum speed.

### ■ S1CxG057: SEARCH MAX. SPEED

Units: 0.1mm/s

This parameter specifies the max. speed for searching.

### ■ S2C153: POSTURE CONTROL AT CARTESIAN OPERATION OF JOG

This parameter specifies whether or not posture control is performed at cartesian operation of “JOG” by the programming pendant. Use posture control unless a special manipulator model is used.

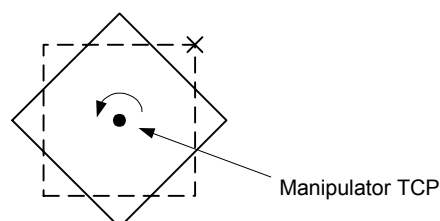
0: With posture control

1: Without posture control

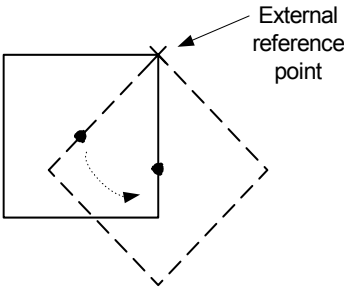
### ■ S2C154: OPERATION IN USER COORDINATE SYSTEM (WHEN EXTERNAL REFERENCE POINT CONTROL FUNCTION USED)

This parameter specifies the TCP or reference point of motion about TCP when the external reference point control function is used and the user coordinate system is selected by the programming pendant.

0: When manipulator TCP is selected



1: When external reference point is selected



■ S2C238: CONTROLLED GROUP JOB TEACHING POSITION CHANGE

This parameter is used to change only the job teaching position of controlled group axis.

- 0: Not changed
- 1: Changed

■ S2C324, S2C325: OPERATION AFTER RESET FROM PATH DEVIATION

These parameters specify the method of restarting the manipulator that has deviated from the normal path such as an emergency stop or jog operation.

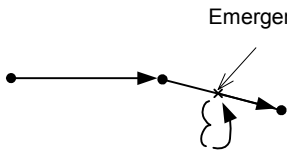
- 0: Move to the indicated step (initial setting).
- 1: After moving back to the deviated position, move to the indicated step.
- 2: Move back to the deviated position and stop.

S2C324

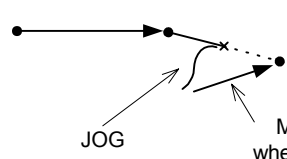
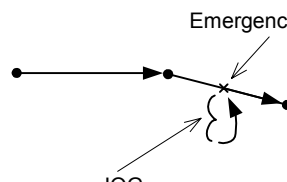
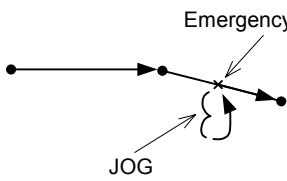
Parameter Setting Value	Movement When Restarting
0	<div>Move to next step.</div> <div></div>
1	<div>After moving back to the deviated position, move to the indicated step.</div> <div></div>

## 9.2 Motion Speed Setting Parameters

S2C324

Parameter Setting Value	Movement When Restarting
2	 <p>Move back to the deviated position and stop. When restarting, move to the indicated step.</p>

S2C325

Parameter Setting Value	Movement When Restarting
0	<p>Move to the next step.</p>  <p>Move to next step.</p>
1	<p>After moving back to the deviated position, move to the indicated step.</p>  <p>Move back to the deviated position and then move to the indicated step.</p>
2	 <p>Move back to the deviated position and stop. When restarting, move to the indicated step.</p>



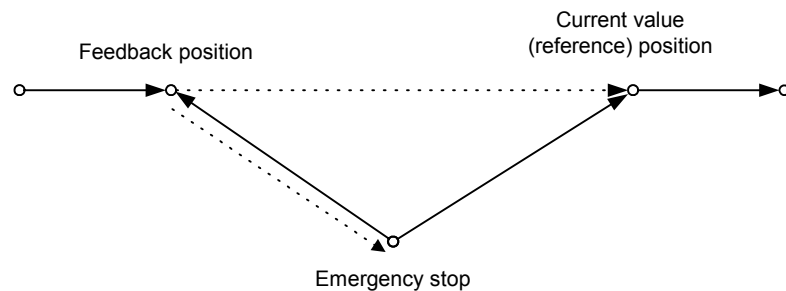
Moving speed to the deviated position is the same as the speed at low-speed starting. It is linear movement. After resetting from deviation, the speed becomes the same as taught speed.

## ■ S2C326: DEVIATED POSITION

This parameter specifies whether deviated position is to be robot current (reference) position or feedback position.

- 0: Return to the feedback position.
- 1: Return to the current value (reference) position.

When emergency stop is applied during high-speed motion, the deviated position differs from the robot current value (reference) position and feedback position as shown in the following.



## ■ S2C515: EMERGENCY STOP CURSOR ADVANCE CONTROL FUNCTION

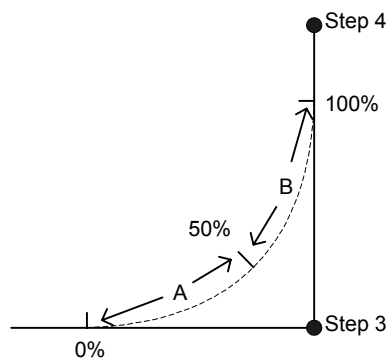
This parameter specifies whether to use the cursor advance control function or not.

- 0: Not use
- 1: Use

## ■ S2C516: EMERGENCY STOP CURSOR ADVANCE CONTROL FUNCTION CONT PROCESS COMPLETION POSITION

Units: %

When the manipulator stops during moving inner corner by CONT process, this parameter specifies which position of the inner corner should be considered as the end of step.



When 50% is set, moves to Step 3 if the manipulator stops in A section, and to Step 4 if the manipulator stops in B section.

## 9.2 Motion Speed Setting Parameters

### ■ S2C517: EMERGENCY STOP ADVANCE CONTROL FUNCTION WORK START INSTRUCTION STEP MOTION COMPLETION DELAY TIME

Units: ms

In order to recognize securely the completion of motion to the step of work start instruction (such as ARCON instruction), this parameter specifies the delay time for motion completion of the work start instruction step only.

### ■ S2C560: BASE AXIS OPERATION KEY ALLOCATION SETTING

Parameter Setting and Jog Operation Key Allocation

Coordinates/Parameter	S2C560= "0"	S2C560= "1"
Joint	Axis number order	Specified
Cylindrical	Axis number order	Specified
Cartesian	Specified	Specified
Tool	Specified	Specified
User	Specified	Specified

Axis number order: X: First axis, Y: Second axis, Z: Third axis

Specified: X: X-direction(RECT-X), Y: Y-direction(RECT-Y), Z: Z-direction(RECT-Z)

### ■ S3C806 to S3C808: POSITION CORRECTING FUNCTION DURING PLAYBACK

These parameters specify the necessary data for position correcting function (PAM) during playback operation.

- S3C806 Specifies the limit of position correcting range (Units:  $\mu\text{m}$ )
- S3C807 Specifies the limit of speed correcting range (Units: 0.01%)
- S3C808 Specifies the correcting coordinates
  - 0 : Base
  - 1 : Robot
  - 2 : Tool
  - 3 : User 1
  - to
  - 26:User 24

## 9.3 Mode Operation Setting Parameters

These parameters set various operations in the teach mode or remote mode.

### ■ S2C147: SECURITY MODE WHEN CONTROL POWER SUPPLY IS TURNED ON

The operation level when the control power supply is turned ON is set.

- 0: Operation Mode
- 1: Editing Mode
- 2: Management Mode

### ■ S2C148: SELECTION OF CARTESIAN/CYLINDRICAL

This parameter specifies whether the cartesian mode or cylindrical mode is affected when cartesian/cylindrical mode is selected by operation (coordinate) mode selection at axis operation of programming pendant. This specification can be done on the TEACHING CONDITION window.

- 0: Cylindrical mode
- 1: Cartesian mode

### ■ S2C149: COORDINATE SWITCHING PROHIBITED



This parameter prohibits switching coordinates during JOG operation by the programming pendant.

- 0: Switching permitted for tool coordinates and user coordinates
- 1: Switching prohibited for tool coordinates
- 2: Switching prohibited for user coordinates
- 3: Switching prohibited for tool coordinates and user coordinates

## 9.3 Mode Operation Setting Parameters

### ■ S2C150: EXECUTION UNITS AT “FORWARD” OPERATION

This parameter specifies the execution units at step mode of “FORWARD” operation by the programming pendant.

Parameter Setting Value	Operation Units		
0	MOVL DOUT TIMER DOUT MOVL		Stops at every instruction
1	MOVL DOUT TIMER DOUT MOVL		Stops at move instruction

### ■ S2C151: INSTRUCTION (EXCEPT FOR MOVE) EXECUTION AT “FORWARD” OPERATION

This parameter specifies the method of instruction (except for move) execution at “FORWARD” operation by the programming pendant.

- 0: Executed by pressing [FWD] + [INTERLOCK]
- 1: Executed by pressing [FWD] only
- 2: Instruction not executed

### ■ S2C155: CHANGING STEP ONLY

This parameter specifies whether to permit only step changes in an editing-prohibited job. When permitted, only position data can be changed but additional data such as speed cannot be changed. This specification can be done on the TEACHING CONDITION window.

- 0: Permitted
- 1: Prohibited

### ■ S2C156: MANUAL SPEED STORING FOR EACH COORDINATE

This parameter specifies whether to assign different manual speeds for the joint coordinates and other coordinates. If “NOT STORED” is selected, manual speed is not affected by changing the coordinates. If “STORED” is selected, manual speeds can be selected separately for the joint coordinates and other coordinates.

- 0: Not stored
- 1: Stored

## ■ S2C158: ADDITIONAL STEP POSITION

This parameter designates either “before next step” or “after the cursor position (between instructions)” as additional step position. This specification can be done on the TEACHING CONDITION window.

### <Example>

Line	Instruction
10	MOVL V=100
11	TIMER T=1.00
12	DOU OT# (1) ON
13	MOVL V=50

Cursor position

### S2C158-0 (Before the Next Step)

Line	Instruction
10	MOVL V=100
11	TIMER T=1.00
12	DOU OT# (1) ON
13	MOVL V=100
14	MOVL V=50

Added step

### S2C158-1 (Between Instructions)

Line	Instruction
10	MOVL V=100
11	TIMER T=1.00
12	MOVL V=100
13	DOU OT# (1) ON
14	MOVL V=50

Added step

## ■ S2C159: MASTER JOB CHANGING OPERATION

This parameter specifies whether to permit or prohibit master job changing operation. If “PROHIBIT” is specified, the master job cannot be changed (or registered) easily. The specification can be done on the OPERATING CONDITION window.

- 0: Permitted
- 1: Prohibited

### ■ S2C160: CHECK AND MACHINE-LOCK KEY OPERATION IN PLAY MODE

This parameter specifies whether to permit or prohibit in play mode to change the operation that changes the operation condition. Even if an error occurs because of the operation with the keys, the manipulator does not stop. The specification can be done on the OPERATING CONDITION window.

- 0: Permitted
- 1: Prohibited

### ■ S2C161: RESERVED WORK JOB CHANGING OPERATION

This parameter specifies whether to permit reserved work job changing operation. The designation can be done on the OPERATING CONDITION window.

- 0: Permitted
- 1: Prohibited

### ■ S2C162: MASTER OR SUBMASTER CALL OPERATION IN PLAY MODE

This parameter specifies whether the master or submaster call operation in play mode is permitted or not. When the independent control function is valid, the master job for sub-task is specified at the same time. The specification can be done on the OPERATING CONDITION window.

- 0: Permitted
- 1: Prohibited

### ■ S2C163: LANGUAGE LEVEL

This parameter specifies the level of the robot language (INFORM III). The levels simplify the instruction registering operation. With NX100, all robot instructions can be executed regardless of specification of instruction sets. The specification can be done on the TEACHING CONDITION window.

#### 0: Contracted Level

Only frequently used robot instructions are selected to reduce the number of instructions to be registered. Robot instructions displayed on the instruction dialog box are also reduced so that specification is simplified.

#### 1: Standard Level

#### 2: Expanded Level

All the robot instructions are available in standard and expanded levels. The two levels are distinguished by the number of additional information items (tags) that can be used with robot instructions. At the expanded level, the flowing functions are available.

- Local Variables and Array Variables
- Use of Variables for Tags (Example: MOVJ VJ=I000)

The above functions are not available at the standard level, however, which reduces the number of data required to register instructions, thereby simplifying the operation.

### ■ S2C166: INSTRUCTION INPUT LEARNING FUNCTION

This parameter specifies whether to set a line of instructions that has been input on the input buffer line when pressing the first soft key for each instruction. If "PROVIDED" is selected, the instructions are set.

- 0: Without learning function
- 1: With learning function

### ■ S2C167: ADDRESS SETTING WHEN CONTROL POWER IS TURNED ON

This parameter specifies the processing of the job name, step No., and line No. that are set when the control power supply is turned ON.

- 0: Reproduces the address when power supply is turned ON.
- 1: Lead address (Line"0") of the master job.

### ■ S2C168: JOB LIST DISPLAY METHOD AT JOB SELECTION

These parameters specify the displaying method on the JOB LIST window at job selection.

- 0: Order of Names
- 1: Order of Date
- 2: Order of Registration



### ■ S2C169: INITIAL OPERATION OF MANIPULATOR

This parameter specifies the operation speed level of the first section when starting. Specify the operation speed with the low-speed start (S1CxG044). When starting at low-speed, the manipulator stops after reaching the indicated step regardless of the cycle setting. Once the manipulator is paused during the low-speed operation, it moves at teaching speed when restarted.

- 0: Specified on the SPECIAL PLAY window. Operates at low speed only when low speed start is set. Operates at taught speed when not instructed.
- 1: Starts at low speed after editing regardless of soft key instructions.

## 9.3 Mode Operation Setting Parameters

## ■ S2C170: PLAYBACK EXECUTION AT CYCLE MODE “1- STEP”

Parameter Setting Value	Operation Units		
0	MOVL DOUT TIMER DOUT MOVL		Stops at every instruction.
1	MOVL DOUT TIMER DOUT MOVL		Stops at move instruction.



When operating “FORWARD” by the programming pendant, the units for execution are set in another parameter (S2C150).

## ■ S2C171: EXTERNAL START

This parameter specifies whether a start instruction from external input is accepted or not. The specification can be done on the OPERATING CONDITION window.

- 0: Permitted
- 1: Prohibited

## ■ S2C172: PROGRAMMING PENDANT START

This parameter specifies whether a start instruction from the programming pendant is accepted or not.

- 0: Permitted
- 1: Prohibited

## ■ S2C173: SPEED DATA INPUT FORM

This parameter specifies the units for speed data input and display.

- mm/s : in units of 0.1 mm/s
- cm/min : in units of 1cm/min
- inch/min : in units of 1 inch/min
- mm/min : in units of 1 mm/min

The specification can be done on the OPERATING CONDITION window.

- 0: mm/s
- 1: cm/min
- 2 inch/min
- 3 mm/min

### ■ S2C174: RESERVED START

This parameter specifies whether a reserved start instruction from the programming pendant is accepted or not. The specification can be done on the OPERATING CONDITION window.

- 0: Permitted
- 1: Prohibited

### ■ S2C176: JOB SELECTION AT REMOTE FUNCTION (PLAY MODE)

This parameter specifies whether a job selection in play mode at remote function is prohibited or not.

- 0: Permitted
- 1: Prohibited

### ■ S2C177: EXTERNAL MODE SWITCH

This parameter specifies whether mode switching from the outside is accepted or not. The specification can be done on the OPERATING CONDITION window.

- 0: Permitted
- 1: Prohibited

### ■ S2C178: MODE SWITCHING FROM PROGRAMMING PENDANT

This parameter specifies whether mode switching from the programming pendant is accepted or not. The specification can be done on the OPERATING CONDITION window.

- 0: Permitted
- 1: Prohibited

### ■ S2C179: EXTERNAL CYCLE SWITCHING

This parameter specifies whether cycle switching from the outside is accepted or not. The specification can be done on the OPERATING CONDITION window.

- 0: Permitted
- 1: Prohibited

### ■ S2C180: PROGRAMMING PENDANT CYCLE SWITCHING

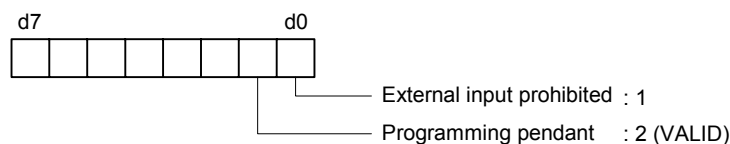
This parameter specifies whether cycle switching from the programming pendant is accepted or not. The specification can be done on the OPERATING CONDITION window.

- 0: Permitted
- 1: Prohibited

### 9.3 Mode Operation Setting Parameters

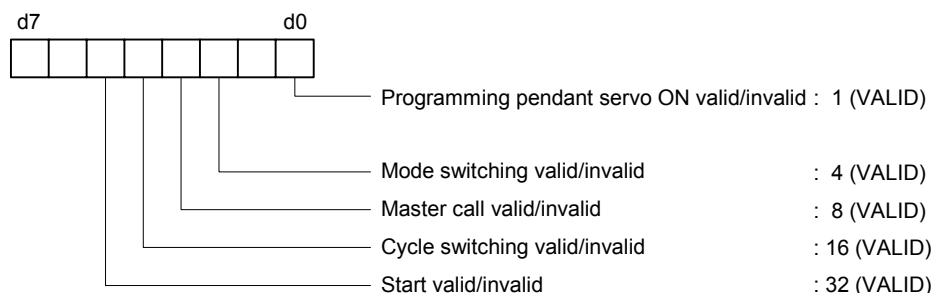
#### ■ S2C181: SERVO ON FROM EXTERNAL DEVICE PROHIBITION

This parameter specifies whether a servo ON instruction is accepted or not. More than one instruction can be specified. For example, to permit the servo ON instruction from an external input only, set “6.” In this case, servo ON instruction from the programming pendant is not accepted. The specification can be done on the OPERATING CONDITION window.



#### ■ S2C182: PROGRAMMING PENDANT OPERATION WHEN “IO” IS SELECTED FOR REMOTE MODE

This parameter specifies whether each operation of the following is valid when “IO” is selected for remote function selection. IO and command are available for remote function selection: “IO” is set prior to shipping. “Command” is valid when transmission function (optional) is specified.



#### ■ S2C186: STEP REGISTRATION AT TOOL NO. CHANGE

The registration of the step when the tool number is changed allows the setting to be made as prohibited.

If this parameter is set to “1” (prohibited), the following operations are prohibited.

- 0: Permitted
- 1: Prohibited

- Modification of a step

When the tool number of the teaching step differs from the currently-selected tool number, the step cannot be modified.

- Deletion of a step

Even if the teaching step position coincides with the current position, the step cannot be deleted when the tool number of the teaching step differs from the currently-selected tool number.

- Addition of a step

When the tool number of the teaching step indicated by the cursor differs from the currently-selected tool number, the step cannot be added.

### ■ S2C211: REMOTE FIRST CYCLE MODE

This parameter sets the cycle that changes from the local mode to the remote mode.

The setting can be made on the OPERATING CONDITION window.

- 0: Step
- 1: 1 cycle
- 2 Continuous
- 3 Setting retained

### ■ S2C212: LOCAL FIRST CYCLE MODE

This parameter sets the cycle that changes from the remote mode to the local mode.

The setting can be made on the OPERATING CONDITION window.

- 0: Step
- 1: 1 cycle
- 2 Continuous
- 3 Setting retained

### ■ S2C230: POWER ON FIRST CYCLE MODE

This parameter sets the first cycle mode for when the power is turned ON.

The setting can be made on the OPERATING CONDITION window.

- 0: Step
- 1: 1 cycle
- 2 Continuous
- 3 Setting retained

### ■ S2C231: TEACH MODE FIRST CYCLE MODE

This parameter sets the cycle that changes from the play mode to the teach mode.

The setting can be made on the OPERATING CONDITION window.

- 0: Step
- 1: 1 cycle
- 2 Continuous
- 3 Setting retained

### ■ S2C232: PLAY MODE FIRST CYCLE MODE

This parameter sets the cycle that changes from the teach mode to the play mode.

The setting can be made on the OPERATING CONDITION window.

- 0: Step
- 1: 1 cycle
- 2 Continuous
- 3 Setting retained

### 9.3 Mode Operation Setting Parameters

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#### ■ S2C234: START CONDITION AFTER ABSOLUTE DATA ALLOWABLE RANGE ERROR OCCURS

This parameter specifies the activating method after the absolute data allowable range error occurs.

- 0: Position check operation required
- 1: Low-speed start up

#### ■ S2C317 to S2C321: TIME RESET

These parameters specify whether resetting operation of the specified times is permitted or not.

- S2C317 : CONTROL POWER ON TIME
- S2C318 : SERVO POWER ON TIME
- S2C319 : PLAYBACK TIME
- S2C320 : WORK TIME
- S2C321 : WEAVING TIME

- 0: Prohibit Resetting
- 1: Permit Resetting

“PERMIT” is set as the initial value for the work time and motion time.

#### ■ S2C333: TOOL NO. SWITCHING

This parameter specifies whether tool number switching is permitted or not. If “PERMIT” is selected, 24 types of tools from number 0 to 23 can be switched. If “NOT PERMIT” is selected, only number “0” can be used.

- 0: Prohibited
- 1: Permitted

#### ■ S2C335: POSITION TEACHING BUZZER

This parameter specifies whether the buzzer sound at position teaching is used or not.

- 0: With buzzer
- 1: Without buzzer

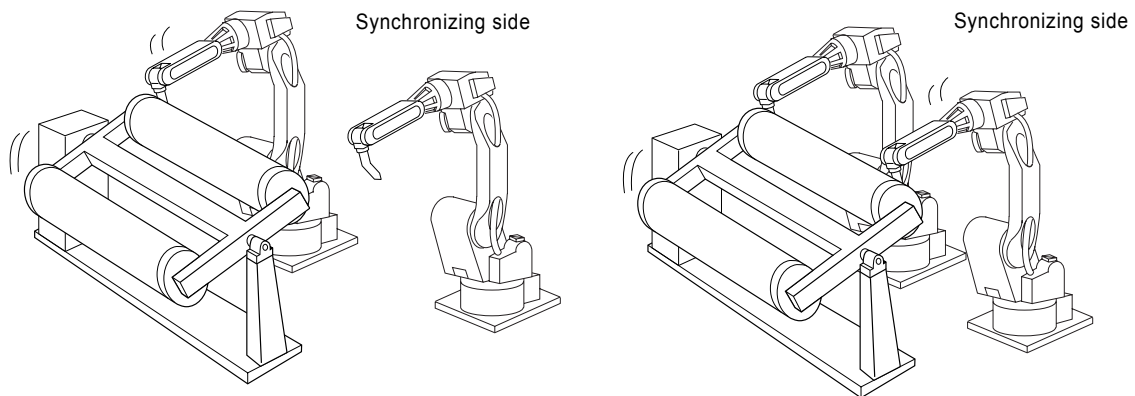
### ■ S2C336: JOB LINKING DESIGNATION (When Twin Synchronous Function Used)

This parameter specifies whether the manipulator at the synchronizing side is to be linked when the manipulator and the station at the synchronized side are performing FWD/BWD or test run, by using the twin synchronous function.

- 0: Not operating
- 1: Linking

0 : Does not operate the synchronizing side while teaching the synchronized side.

1 : Links the synchronizing side while teaching the synchronized side.

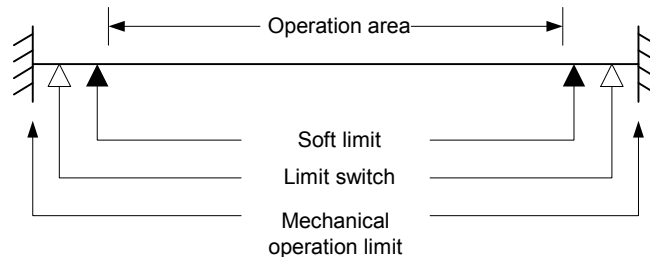


## 9.4 Parameters according to Interference Area

These parameters limit the P-point maximum envelope of the manipulator or set the interference area for axis interference or cubic interference.

### ■ S1CxG200 to S1CxG215: PULSE SOFT LIMIT

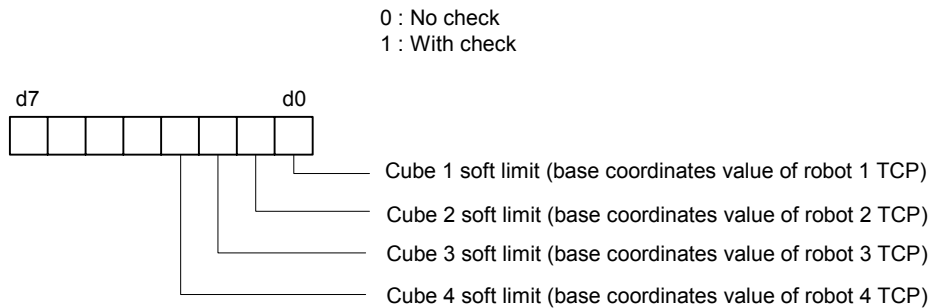
Soft limit is set independently for each axis by pulse value setting. Set current value (pulse value) of the axis at the soft limit set up position.



## 9.4 Parameters according to Interference Area

### ■ S2C001: CUBE SOFT LIMIT CHECK

This parameter specifies whether to check the cube soft limit. More than one soft limit can be specified.



If "WITH CHECK" is selected, set up the following parameters.

S3C000 to S3C023: Cube Soft Limit

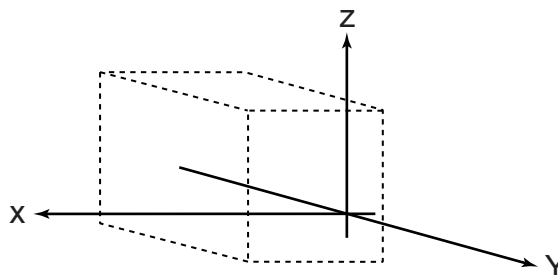


#### Soft Limit

Soft limit is a software-type function to limit the range of movement of the manipulator. If the TCP reaches the soft limit during operation, the manipulator automatically stops and no longer moves in that same direction. An alarm occurs if this soft limit is exceeded during playback. This soft limit is classified into two types.

- Cube Soft Limit

Soft limit is set with the absolute value on the base coordinates.



- Pulse Soft Limit (Independent Axis Soft Limit)

Refer to " S1CxG200 to S1CxG215: PULSE SOFT LIMIT. "

### ■ S2C002: S-AXIS INTERFERENCE CHECK

This parameter specifies whether to check for interference with each manipulator. If "WITH CHECK" is selected, set up the following parameters.

S3C024 to S3C031: S-axis Interference Area

## ■ S2C003 to S2C050: CUBE/AXIS INTERFERENCE CHECK

### 1. Designation of checking

These parameters specify the cube/axis interference to be used by bit.

0 : Cube Interference/Axis Interference Not Used

1 : Robot 1

2 : Robot 2

3 : Robot 3

4 : Robot 4

5 : Base Axis 1

6 : Base Axis 2

7 : Base Axis 3

8 : Base Axis 4

9 : Station Axis 1

10 : Station Axis 2

11 : Station Axis 3

12 : Station Axis 4

13 : Station Axis 5

14 : Station Axis 6

15 : Station Axis 7

16 : Station Axis 8

17 : Station Axis 9

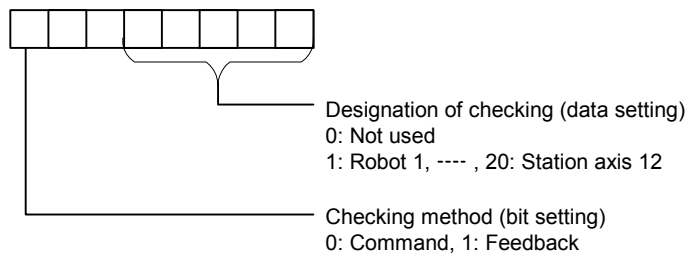
18 : Station Axis 10

19 : Station Axis 11

20 : Station Axis 12

### 2. Checking method

Designates whether checking is performed by command or feedback.



### Checking method

The cheking method differs according to ON/OFF status of servo power supply.

Checking Method Designation	Servo Power Supply ON	Servo Power Supply OFF
Command	Command	Feedback
Feedback	Feedback	Feedback

During the servo float function operation, checking is performed by feedback regardless of the checking method designation.

## 9.4 Parameters according to Interference Area

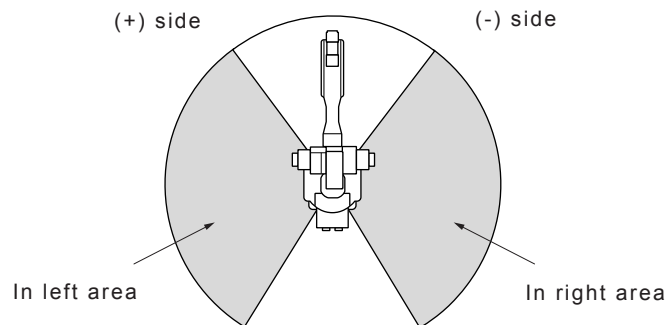


### Interference Area

It is possible to output whether the TCP during operation is inside or outside as a status signal, and to set the area to control the position by parameters S2C003 to S2C114. When the manipulator attempts to enter this area, the corresponding input signal (e.g. an "entrance prohibit signal") is detected. The manipulator stops immediately if there is an input signal and goes into waiting status until this signal is cleared. This signal is processed in the I/O section. Three methods of interference area settings are prepared for manipulators and stations. For a system with one manipulator, use robot 1.

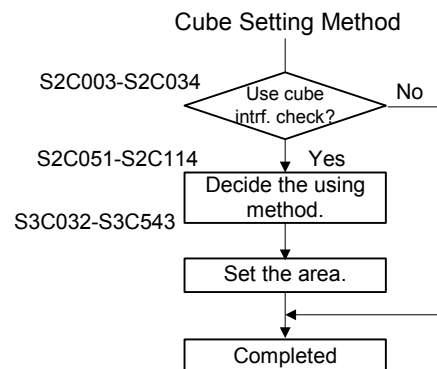
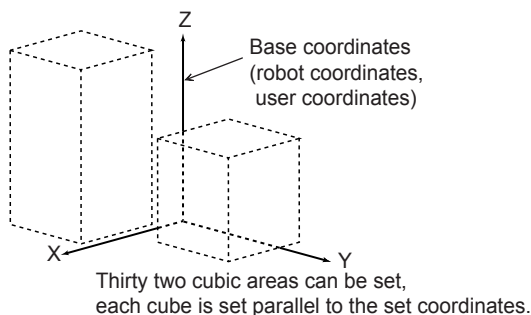
- S-axis Interference Area

Position is controlled by the pulse value of the S-axis.



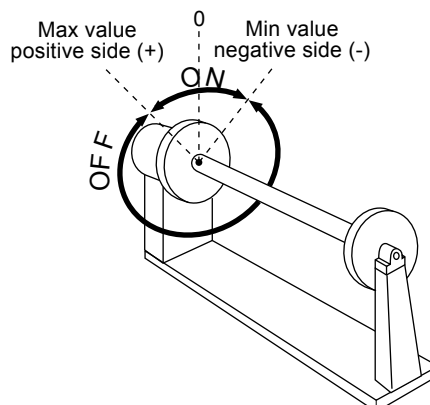
- Cubic Interference Area

Up to 32 cubic areas can be set. The edges of the cubes are set parallel to the robot coordinates or the user coordinates.



- Axis Interference Area

Up to 32 areas can be set. Each operation area maximum and minimum value are set for the robot, base axis, and station axis plus and minus side.



## ■ S2C051 to S2C114: CUBE USING METHOD

These parameters specify the coordinates for defining the cube. If the user coordinates are selected, also specify the user coordinate system numbers. Set cubic area referring to the cubic interference areas shown below.

Coordinate specification

- 0 : Pulse(axis interference)
- 1 : Base coordinates
- 2 : Robot coordinates
- 3 : User coordinates

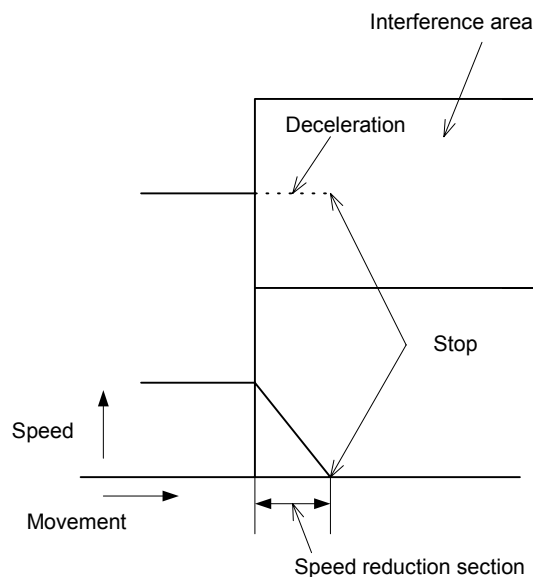
Coordinate No. : Specify the user coordinate number when selecting “3: User Coordinates.”

Units: 1 $\mu$ m

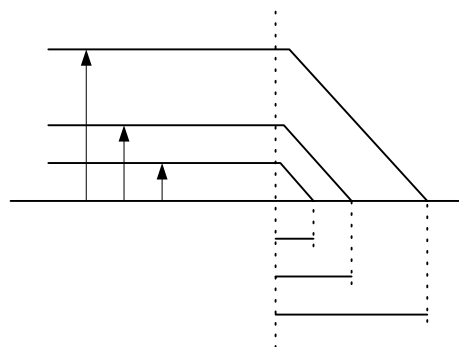


### Precaution When Setting the Interference Area

It will be necessary to consider the following when setting the cubic interference and S-axis interference areas. The manipulator is processed to decelerate to stop from the point where it enters in the area. Therefore, set the areas in consideration of the amount of the manipulator movement in the deceleration section shown in the figure below.



The move amount in the speed reduction section is dependent on the moving speed of the manipulator at that time:



$V = 1500\text{mm/s} \rightarrow \text{approx. } 300\text{mm (Max.)}$

$V = 1000\text{mm/s} \rightarrow \text{approx. } 160\text{mm}$

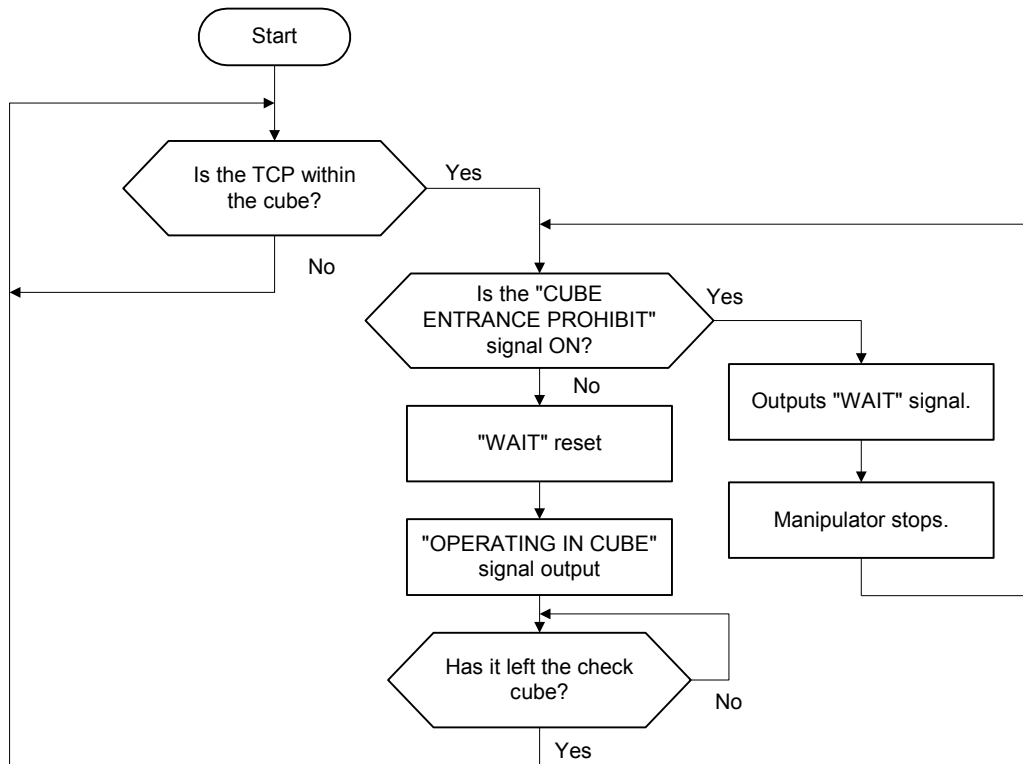
$V = 30\text{mm/s} \rightarrow \text{approx. } 3 \text{ to } 4 \text{ mm}$

$V = 20\text{mm/s} \rightarrow \text{approx. } 2\text{mm}$

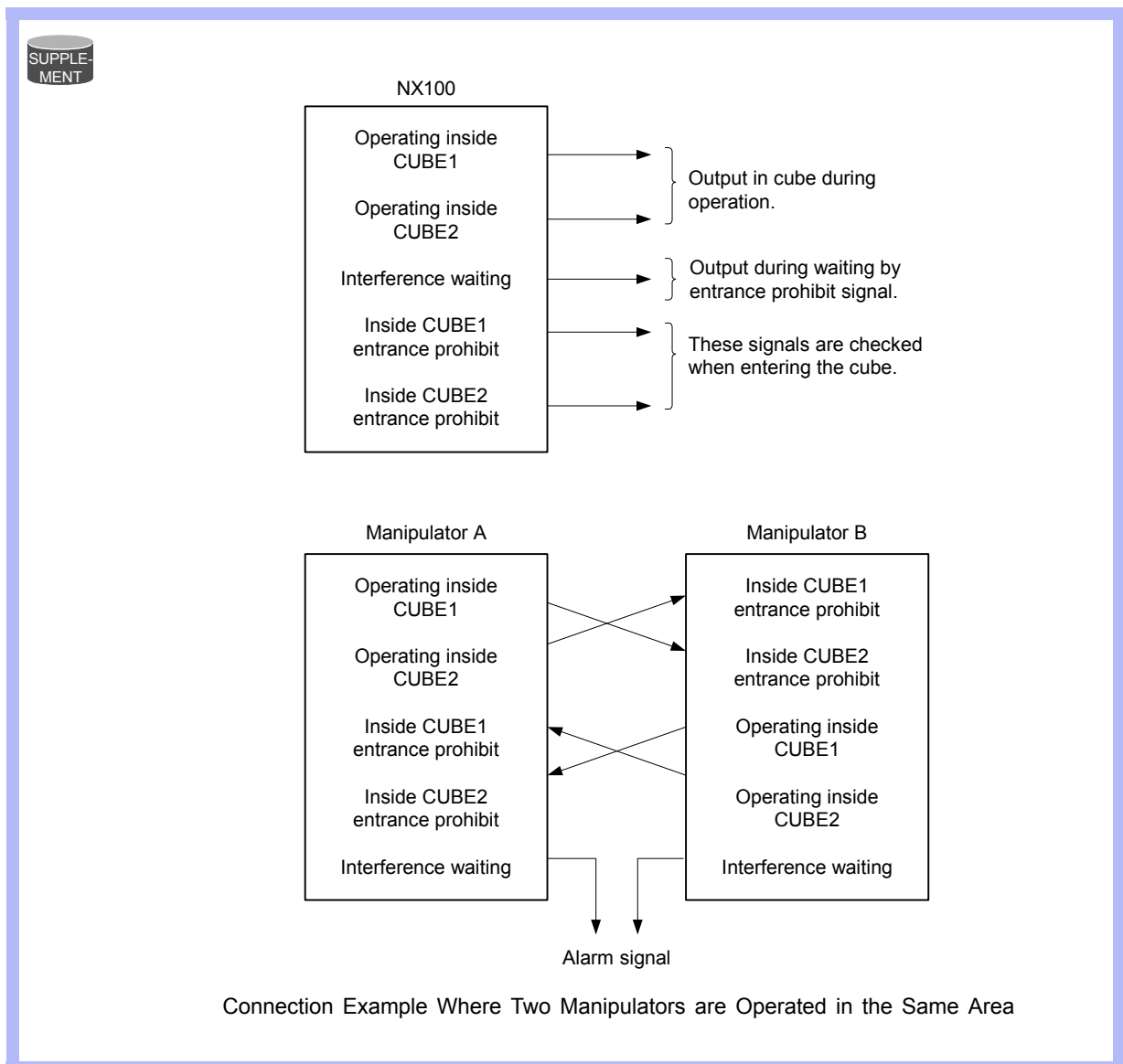
## 9.4 Parameters according to Interference Area

**Interference Prevention in Interference Area**

Processing to prevent interference is executed in the I/O processing section. The relation between the NX100 I/O signal and manipulator operation is shown below.



In wait status with the entrance prohibit signal, the manipulator just barely enters the area for speed reduction processing and then stops.



## ■ S2C188 to S2C193: ROBOT INTERFERENCE CHECK

This parameter specifies whether to check interference between robots 1, 2, 3, and 4. Interference check is executed in the spherical range having the TCP in the center. If “provided” is selected, also select the following parameters.

ROBOT INTERFERENCE CHECK (units:  $\mu\text{m}$ )

S3C801 : ROBOT1 SPHERE RADIUS

S3C802 : ROBOT2 SPHERE RADIUS

S3C803 : ROBOT3 SPHERE RADIUS

S3C804 : ROBOT4 SPHERE RADIUS

## ■ S3C000 to S3C023: CUBE SOFT LIMIT

These parameters specify auxiliary functions of S2C001 parameter. For details, see the explanation of the S2C001 parameter.

## 9.5 Parameters according to Status I/O

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### ■ S3C024 to S3C031: S-AXIS INTERFERENCE AREA

These parameters specify auxiliary functions of S2C002 parameter. For details, see the explanation of the S2C002 parameter.

### ■ S3C032 to S3C543: CUBIC INTERFERENCE AREA

These parameters specify auxiliary functions of S2C003 to S2C034 parameters. For details, see the explanation of the S2C003 to S2C050 parameters.

### ■ S3C801 to S3C804: ROBOT INTERFERENCE AREA

These parameters specify auxiliary functions of S2C188 to S2C193 parameters. For details, see the explanation of the S2C188 to S2C193 parameters.

### ■ S3C805: A SIDE LENGTH OF WORK-HOME-POSITION CUBE

Units: 1 $\mu$ m

This parameter specifies a side length of the cube for the work home position.

---

## 9.5 Parameters according to Status I/O

These parameters set the parity check or I/O setting for user input/output signals.

### ■ S2C187: USER OUTPUT RELAY WHEN CONTROL POWER IS ON

This parameter specifies the state of the user output relays when the control power is turned ON. Since the power OFF state, including peripheral devices, cannot be completely reproduced, take note when restarting.

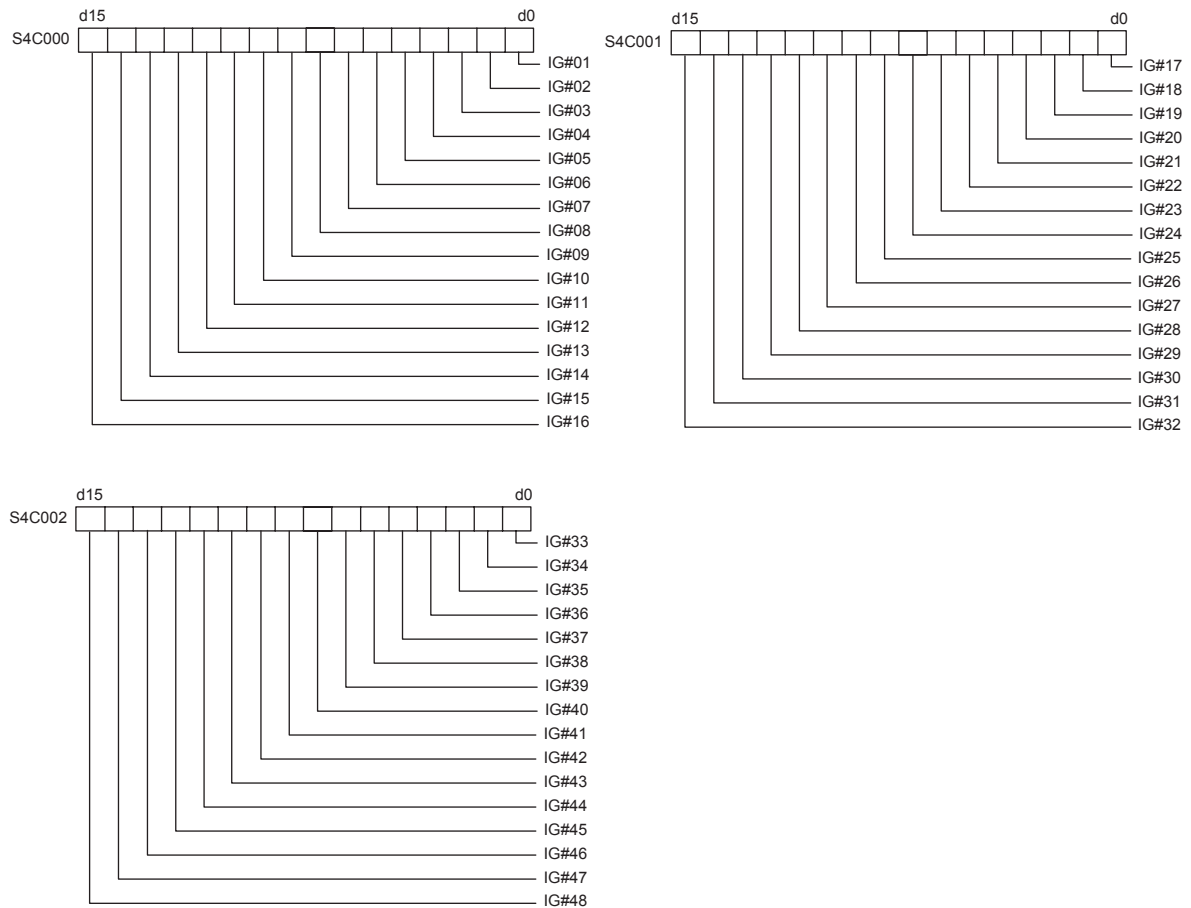
0: Reset to the power OFF state

1: Initialized (all user relays OFF)

## ■ S4C000 to S4C007: PARITY OF USER INPUT GROUPS

These parameters specify whether to execute priority checks with parameters when instructions covering the input group (1G#) are executed. The instructions covering the input groups are as shown below.

- IF Sentence (JUMP, CALL, RET, PAUSE)
- Pattern Jump, Pattern Job Call
- DIN
- WAIT

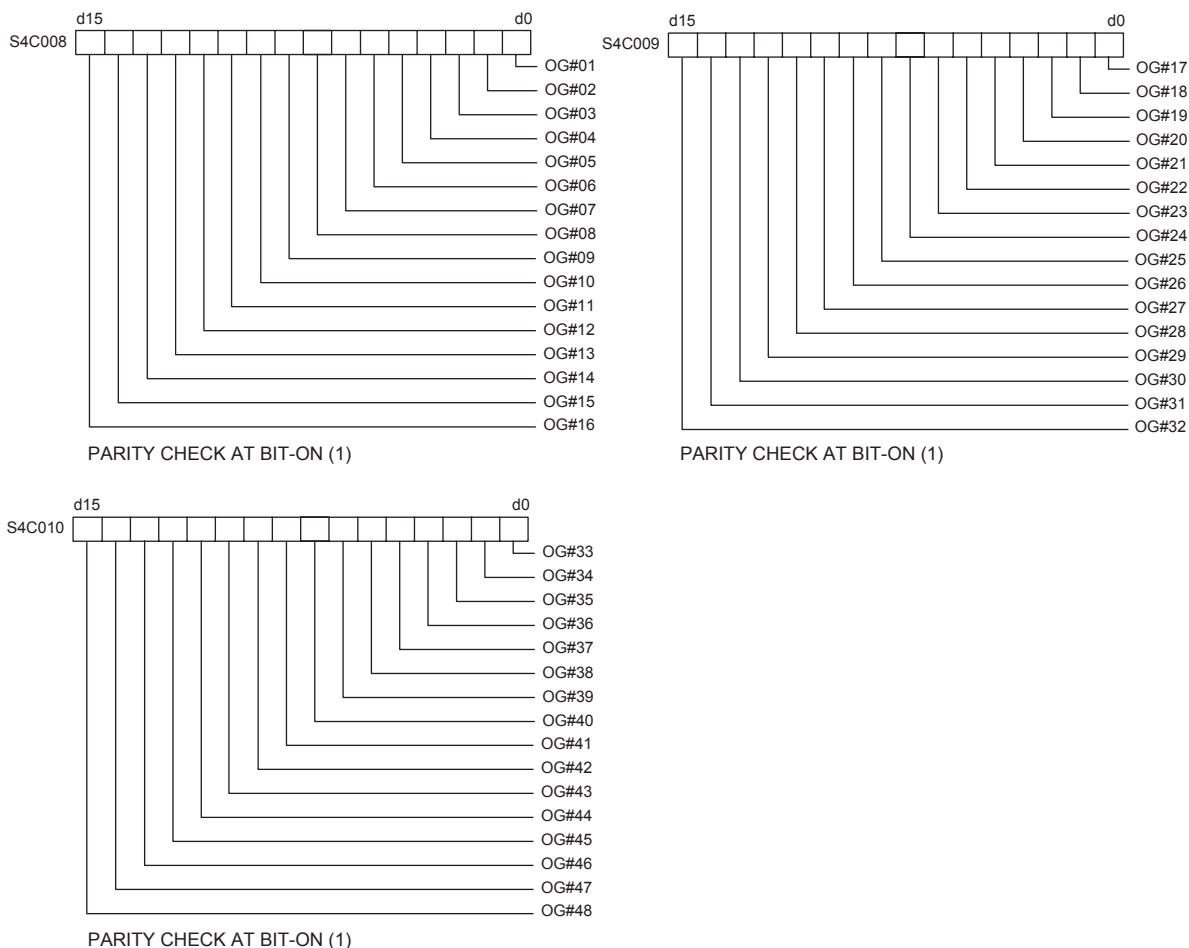


Parity bits are set as the highest level bits of each input group and are written in even parity. If an error is detected during parity check, an alarm occurs and the manipulator stops. Remains unchanged if no parity check is specified.

## 9.5 Parameters according to Status I/O

## ■ S4C008 to S4C015: PARITY OF USER OUPUT GROUPS

These parameters specify whether the output group instruction is executed with parity check (even parity).



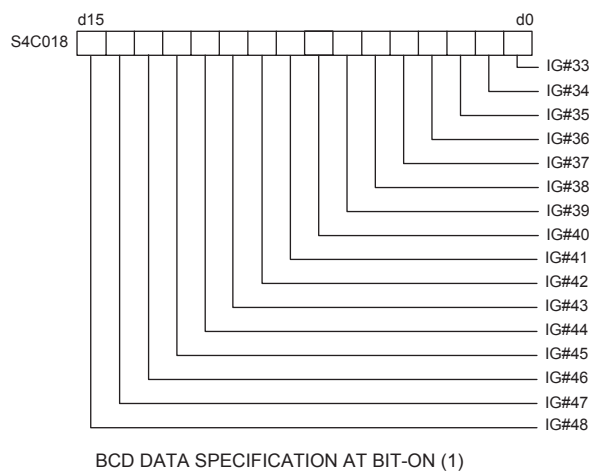
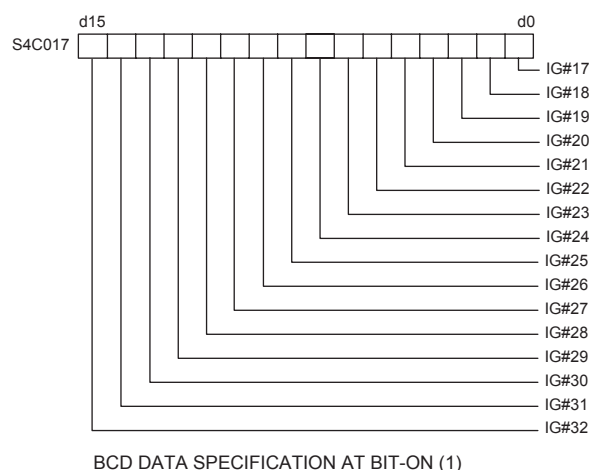
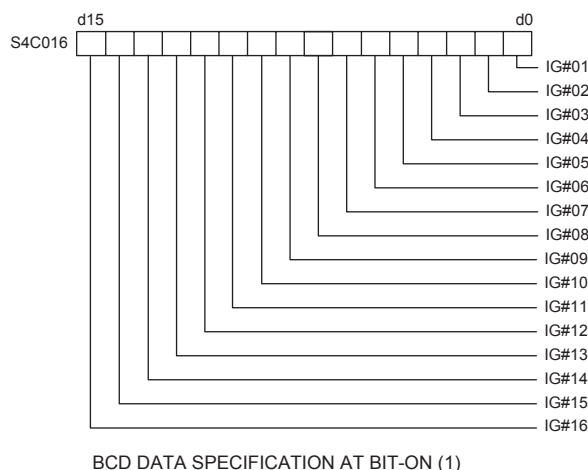
Parity bits are set as the highest level bits of each output group. For example, if OG#01 is specified with parity and DOUT OG# (1) 2 is executed, the result will be 00000010 if 2 is binary converted. Since there will be only one bit (odd) ON at this time, the parity bit (highest level bit) will be set to ON and 10000010 (130) will be output to OG# (1).

As in the case of a variable such as DOUT OG# (1) B003 parity bits are added to the contents of the variable data. However, if the contents of the variable exceed 127, as in the case of DOUT OG# (1) 128, an alarm will occur. Remains unchanged if no parity check is specified.

## ■ S4C016 to S4C023: DATA OF USER INPUT GROUPS

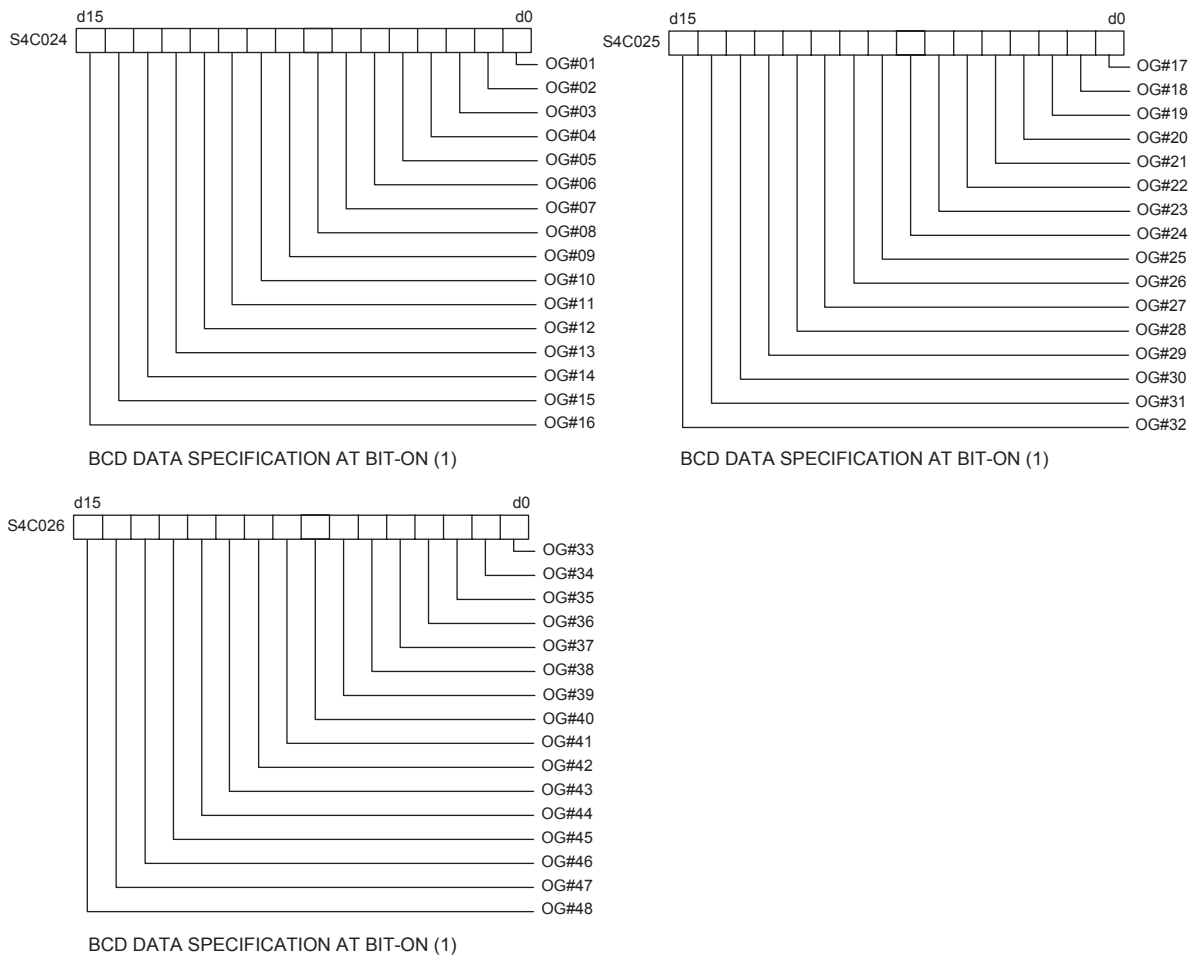
These parameters specify whether to handle the input group data as binary data or as BCD data when an instruction for the input group (1G#) is executed. The instructions covering the input groups are as shown below.

- IF Sentence (JUMP, CALL, RET, PAUSE)
- Pattern Jump, Pattern Job Call
- DIN
- WAIT



■ S4C024 to S4C031: DATA OF USER OUTPUT GROUPS

These parameters specify whether the output group instruction is executed with binary data or BCD data.




## Differences Between Binary Data and BCD Data

For the input group and output group, the result will depend on whether the binary or BCD formula is used.

**<Example>** When the input function is [10101010]

USER INPUT GROUP			IG#01
IN#0001	#10010	<input checked="" type="radio"/>	
IN#0002	#10011	<input type="radio"/>	
IN#0003	#10012	<input checked="" type="radio"/>	
IN#0004	#10013	<input type="radio"/>	
IN#0005	#10014	<input type="radio"/>	
IN#0006	#10015	<input type="radio"/>	
IN#0007	#10016	<input checked="" type="radio"/>	
IN#0008	#10017	<input type="radio"/>	



State	Binary	Case	BCD		Case
1	$2^0 = 1$	1	$2^0 = 1$	<div>                     } Total is in ones.                 </div>	1
0	$2^1 = 2$	0	$2^1 = 2$		0
1	$2^2 = 4$	4	$2^2 = 4$		4
0	$2^3 = 8$	0	$2^3 = 8$		0
1	$2^4 = 16$	16	$2^0 = 1$	<div>                     } Total is in tens.                 </div>	1
0	$2^5 = 32$	0	$2^1 = 2$		0
1	$2^6 = 64$	64	$2^2 = 4$		4
0	$2^7 = 128$	0	$2^3 = 8$		0
		85			55

Binary data value

BCD data value

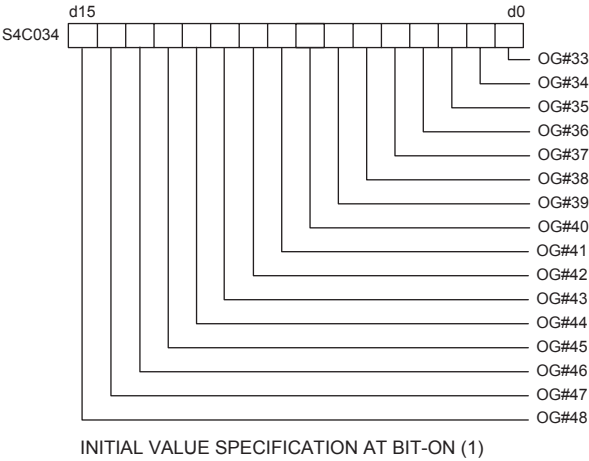
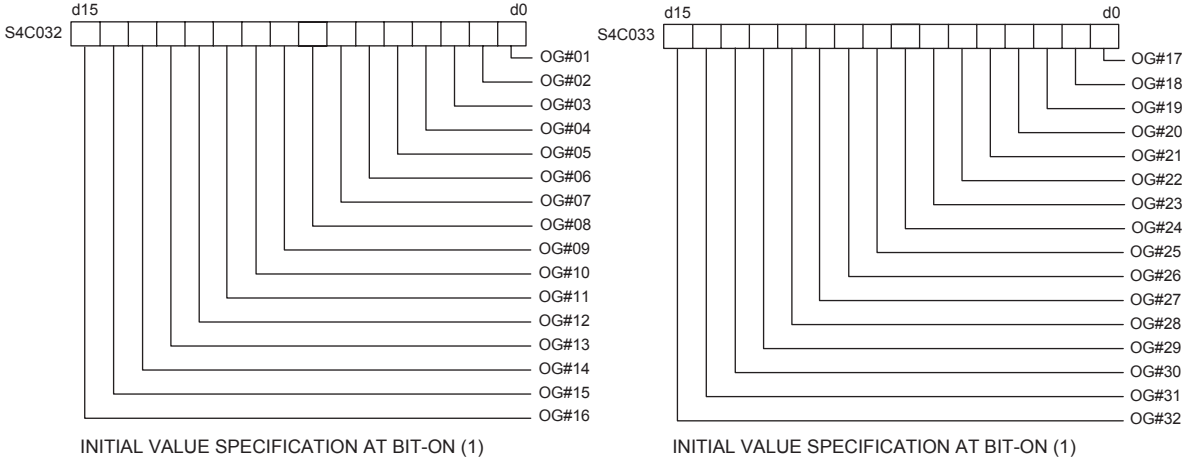
Binary data value

BCD data value

However, in the case of BCD data, because the upper bound value is 99, it is not possible to use any value which exceeds nine in the one or ten digit place.

■ S4C032 to S4C039: USER OUTPUT GROUP TO BE INITIALIZED AT SWITCHING MODE

Set the user output group with bit to be initialized at switching mode. Use these parameters when using user output signals as work instructions for peripheral devices.



■ S4C126: USER OUTPUT NO. WHEN MANIPULATOR DROP ALLOWABLE RANGE ERROR OCCURS

This parameter specifies the user output number to output the manipulator drop allowable range error alarm occurrence externally. When this function is not used, set “0.”

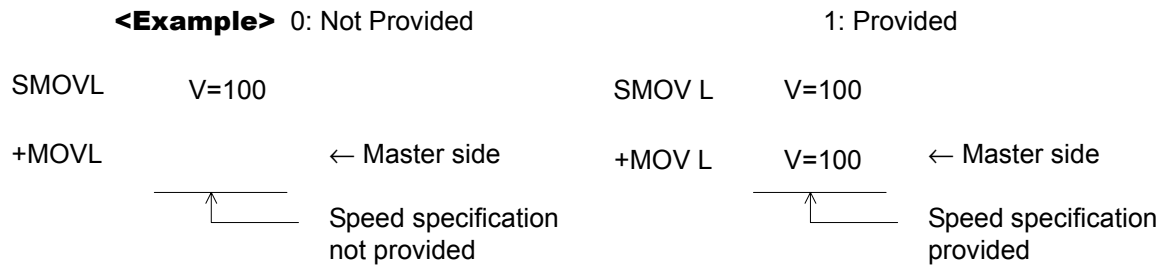
**9.6** Parameters according to Coordinated or Synchronized Operation

These parameters make the settings for coordinated or synchronized operations between manipulators or between manipulators and stations.

## 9.6 Parameters according to Coordinated or Synchronized Operation

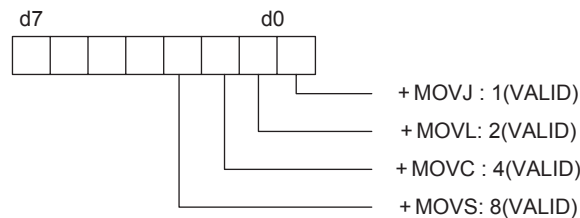
### ■ S2C164: +MOV or +SMOV INSTRUCTION SPEED INPUT

This parameter specifies whether the speed inputting for move instructions of the master robot in a coordinated job is permitted or not.



### ■ S2C165: +MOV INSTRUCTION INTERPOLATION INPUT

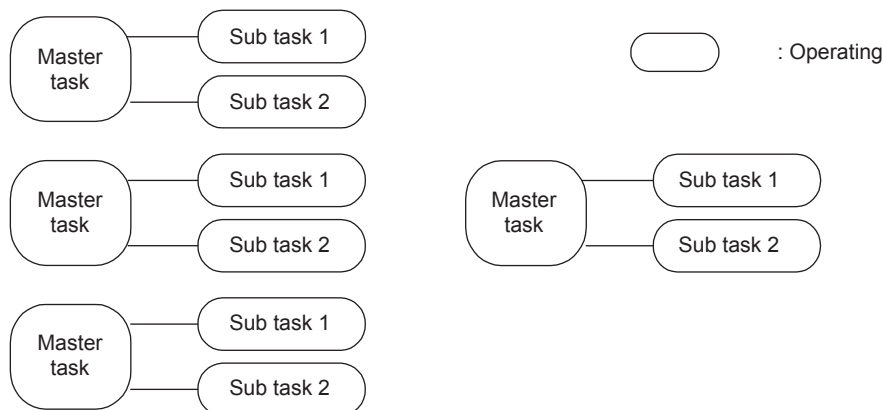
This parameter specifies which interpolation is permitted for move instructions for the master robot in a coordinated job. More than one instruction can be specified.



### ■ S2C183: OPERATION METHOD AT FWD/BWD OPERATION OR TEST RUN BY INDEPENDENT CONTROL

This parameter specifies the operation method at FWD/BWD operation or test run by independent control.

- 0: The job of the task that is currently displayed operates.
- 1: Jobs of all the tasks operate.



0: One of the task jobs that are currently displayed operates.

1: All task jobs operate.

## ■ S2C184: JOB AT CALLING MASTER OF SUBTASK 1, 2, 3, 4, 5 BY INDEPENDENT CONTROL

This parameter specifies the job which is called up when the master of the subtask is called up by independent control.

- 0: Master job
- 1: Root job

Master Job: Job registered in the master control window

Root Job: Job activated by PSTART instruction

## ■ S2C194: STATION AXIS CURRENT VALUE DISPLAY FUNCTION

This parameter specifies whether the function to display the current value of the station axis in the following units is valid/invalid.

- Rotary axis : Angle (deg)
- Servo track : Distance (mm)

- 0: Invalid
- 1: Valid

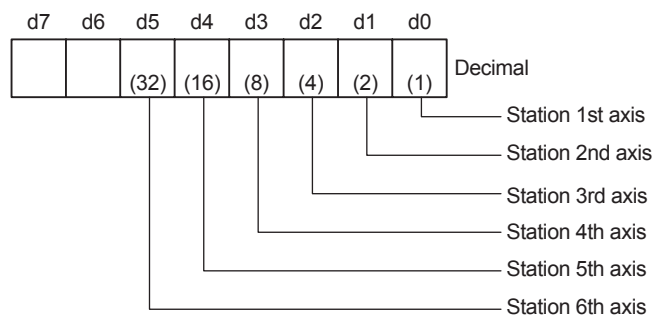
## ■ S2C195 to S2C206: STATION AXIS DISPLAYED UNIT

This parameter specifies the station axis displayed unit (bit specification).

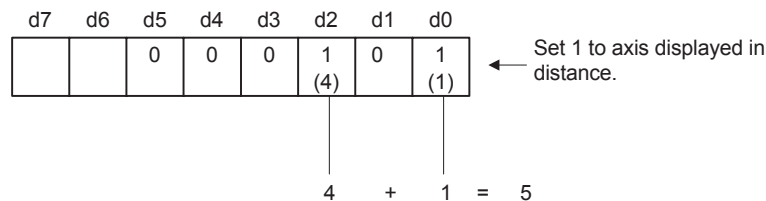
- 0: Display angle (deg)
- 1: Display in distance (mm)

### Setting Method

Set a numerical value (decimal) where the bit of the axis to be displayed in the units of distance becomes 1.



**<Example>** When 1st and 3rd axes of station 1 are displayed in the units of distance:



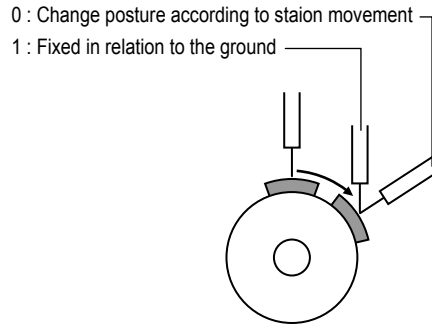
Therefore, set parameter S2C195 of station 1 to 5.

## 9.6 Parameters according to Coordinated or Synchronized Operation

### ■ S2C322: POSTURE CONTROL OF SYNCHRONIZED MANIPULATOR (When Twin Synchronous Function Used)

This parameter specifies the posture control method for synchronized manipulator performing compensation during playback by using the twin synchronous function.

- 0: Change posture according to station movement
- 1: Fixed in relation to the ground



### ■ S2C323: POSTURE CONTROL OF MANIPULATOR IN MULTI-JOB (When Twin Synchronous Function Used)

This parameter specifies the posture control method for manipulator executing compensation at the linking side when job linking is performed during FWD/BWD operation by the twin synchronous function.

- 0: Change posture according to station movement
- 1: Fixed in relation to the ground

### ■ S2C549: OPERATION OF JOB WITHOUT CONTROL GROUP SPECIFICATION

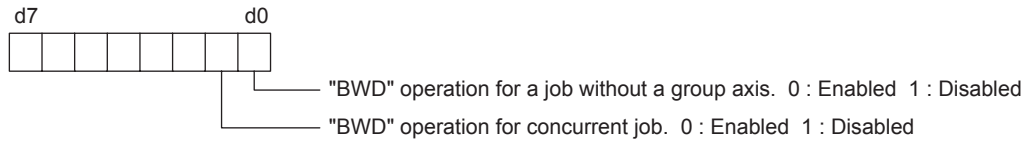
When the servo power supply is individually turned OFF where jobs in multiple number of tasks are operated using the independent control function, the job execution of the control group whose servo power supply is turned OFF is interrupted. The jobs of other control groups continue their execution.

For the jobs without control group specification such as master job, the conditions for execution can be set by the parameter.

- 0: Execution possible only when servo power supply to all the axes have been turned ON.
- 1: Execution possible when servo power supply to any axis is turned ON.

## ■ S2C550: EXECUTION OF “BWD” OPERATION

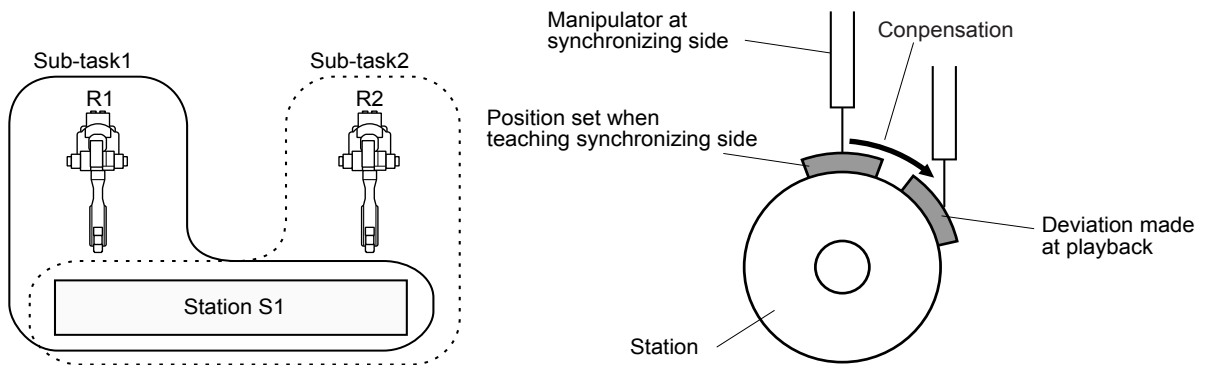
This parameter prohibits step-back operation of a job without a step.



## ■ S3C809: MAXIMUM DEVIATION ANGLE OF CURRENT STATION POSITION (When Twin Synchronous Function Used)

Used when the twin synchronous function is used. This parameter specifies the maximum deviation between the teaching position and the current station position.

- 0 : No deviation check
- Other than 0: Deviation angle (units : 0.1°)



In the above figure on the left, the follower R2 executes the job of subtask 2 in synchronization with the motion of the station axis which is moved by the R1 job. In this procedure, the job of subtask 2 controls only the R2 robot axis.

If the teaching position of the station in the subtask 2 differs from the station current position (controlled by the subtask 1 job), the difference is automatically offset so that R2 keeps the taught position in relation to the station.

Difference between the taught and the station current positions is always monitored. If the difference exceeds a set value of the parameter, the message “PULSE LIMIT (TWIN COORDINATED)” appears.

## 9.7 Parameters for Other Functions or Applications

These parameters make the settings for other functions or applications.

### ■ S1CxG049 to S1CxG051: YAG LASER SMALL CIRCLE CUTTING

These parameters prescribe cutting operation at small circle cutting by YAG laser.

- S1CxG049 : Set the minimum diameter of a figure in the units of  $\mu\text{m}$  that can (Minimum diameter) be processed by small-circle cutting machine.
- S1CxG050 : Set the maximum diameter of a figure in the units of  $\mu\text{m}$  that can (Maximum diameter) be processed by small-circle cutting machine.
- S1CxG051 : Set the maximum cutting speed at operation by CUT instruction (Maximum speed) in the units of 0.1mm/s.

### ■ S1CxG052 to S1CxG053: YAG LASER SMALL CIRCLE CUTTING DIRECTION LIMIT VALUE

These parameters set the cutting direction limits at small circle cutting by YAG laser.

- S1CxG052 : Set the limit value in the positive direction of cutting angle DIR (+ direction) set by CUT instruction, in the units of  $0.01^\circ$ .
- S1CxG053 : Set the limit value in the negative direction of cutting angle DIR (- direction) set by CUT instruction, in the units of  $0.01^\circ$ .

### ■ S1CxG054 to S1CxG055: YAG LASER SMALL CIRCLE CUTTING OVERLAP VALUE

These parameters set the overlapped value at small circle cutting by YAG laser.

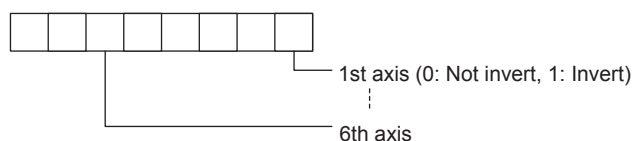
- S1CxG054 : Set the operation radius at inner rotation in the units of 1  $\mu\text{m}$  after (Operation radius) overlapping by CUT instruction.
- S1CxG055 : Set the rotation angle at inner rotation in the units of  $0.1^\circ$  after (Rotation angle) overlapping by CUT instruction.

### ■ S1CxG063, S1CxG064: PATTERN CUTTING DIMENSION

These parameters set the minimum diameter (S1CxG063) and the maximum diameter (S1CxG064) for the pattern cutting in units of  $\mu\text{m}$ .

### ■ S1CxG065: MIRROR SHIFT SIGN INVERSION

This parameter sets which axis to be shifted (mirror-shift: invert the sign).



## ■ S2C332: RELATIVE JOB OPERATION METHOD

This parameter specifies how to operate a relative job. A method to convert a relative job into a standard job (pulse), and a conversion method to calculate the aimed position (pulse position) when a relative job is operated can be specified.

- 0: Previous step with priority (B-axis moving distance minimized.)
- 1: Form with priority
- 2: Previous step with priority (R-axis moving distance minimized.)

## ■ S3C819 to S3C898: ANALOG OUTPUT FILTER CONSTANT (When analog output corresponding to speed function is used)

By setting a constant to filter, a filter processing can be performed for the output analog signal.

## ■ S3C899: CUT WIDTH CORRECTION VALUE (When form cutting function is used)

This parameter specifies the path correction value for pattern cutting operation. A value 1/2 of the cut width is set in units of  $\mu\text{m}$ .

# 9.8 Hardware Control Parameters

These parameters make the hardware settings for fan alarm or relay operation, etc.

## ■ S2C646: COOLING FAN ALARM DETECTION

This parameter specifies a detection for cooling fan 1 to 3 with alarm sensor, connected to power ON unit.

- 0: No detection
- 1: Detected with message display
- 2: Detected with message and alarm display

## ■ S4C181 to S4C212: SETTING OF OPERATING RELAY NO.





Up to 32 output signals can be turned ON/OFF with the programming pendant. The output relay No. is set in these parameters. Although it is possible to set optional values for output Nos. 1 to 1024 in the parameters, the following must be taken into consideration.

- Avoid setting duplicate numbers.
- The signal turned ON or OFF with the programming pendant is operated again or remains unchanged until the instruction is executed.

## 9.8 Hardware Control Parameters

## ■ S4C213 to S4C244: OPERATING METHOD OF RELAYS

These parameters specify the operating method of output signals by the programming pendant. The operating method can be specified for each output signal.

Parameter Setting Value	Operation of Output Signal
0	<div> <div><b>+ON</b></div> <div> ON</div> </div> <div> <div><b>-OFF</b></div> <div> OFF</div> </div>
1	<div> <div><b>+ON</b></div> <div>ON/OFF with the key ON while the key is pressed</div> <div> ON</div> </div> <div> <div>OFF if the key is not pressed</div> <div> OFF</div> </div>

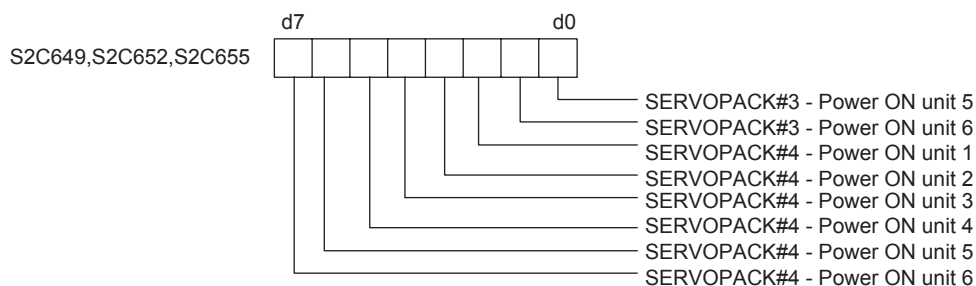
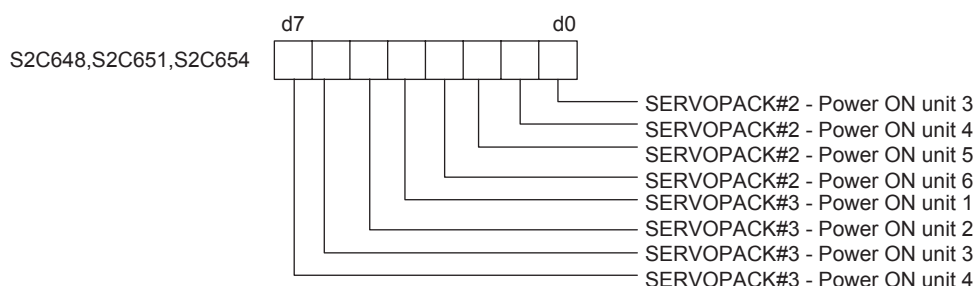
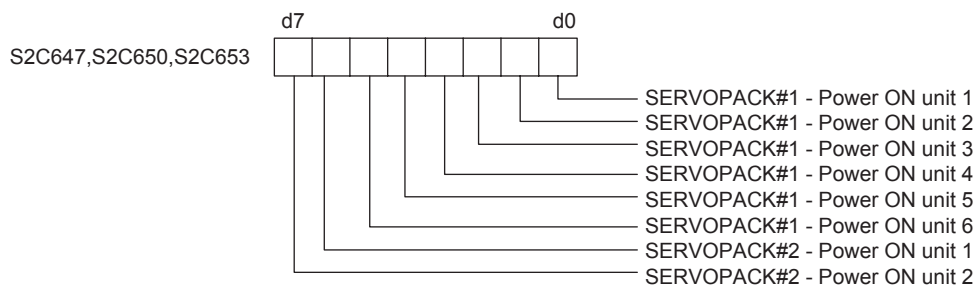
## ■ S2C647 to S2C649: COOLING FAN ALARM 1 OPERATION

## ■ S2C650 to S2C652: COOLING FAN ALARM 2 OPERATION

## ■ S2C653 to S2C655: COOLING FAN ALARM 3 OPERATION

These parameters specify the operation of cooling fan 1 to 3 with alarm sensor, connected to power ON unit.

Each bit specifies the power ON unit to which the detecting sensor is connected.



## **9.9** TRANSMISSION PARAMETERS

### ■ RS000: COMMUNICATION PROTOCOL

The protocol of the serial port of the NCP01 circuit board is specified.

- 0: No protocol
- 2: Basic protocol
- 3: FC1 protocol

### **9.9.1** Basic Protocol

Specify when using Yaskawa data transmission functions.

#### ■ RS030: NUMBER OF DATA BITS

This parameter specifies the number of data bits.

#### ■ RS031: NUMBER OF STOP BITS

This parameter specifies the number of stop bits.

#### ■ RS032: PARITY

This parameter specifies the parity bits.

#### ■ RS033: TRANSMISSION SPEED

This parameter specifies the transmission speed in units of bauds.

#### ■ RS034: RESPONSE WAITING TIMER (TIMER A)

Units: 0.1 seconds

This timer monitors the sequence. It specifies the response waiting time for invalid or missing responses.

#### ■ RS035: TEXT TERMINATION MONITORING TIMER (TIMER B)

This timer monitors text reception. Specify the monitoring time to wait for text termination character.

#### ■ RS036: NUMBER OF ENQ RE-TRANSMISSION RETRIES

This parameter specifies the number of re-transmission attempts of the control characters for invalid or missing responses.

#### ■ RS037: NUMBER OF DATA RE-TRANSMISSION RETRIES

This parameter specifies the number of re-transmission attempts of text for block check error (NAK reception).

## 9.9 TRANSMISSION PARAMETERS

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### ■ RS038: BLOCK CHECK METHOD

This parameter specifies the checking method for text transmission errors. Set “0” for this protocol.

## 9.9.2 FC1 Protocol

The following protocols naturally correspond to the external memory unit, YASNAC FC1 or FC2.

### ■ RS050: NUMBER OF DATA BITS

This parameter specifies the number of data bits.

### ■ RS051: NUMBER OF STOP BITS

This parameter specifies the number of stop bits.

### ■ RS052: PARITY

This parameter specifies the parity bits.

### ■ RS053: TRANSMISSION SPEED

This parameter specifies the transmission speed in units of bauds.

### ■ RS054: RESPONSE WAITING TIMER (TIMER A)

Units: 0.1 seconds

This timer monitors the sequence. It specifies the response waiting time for invalid or missing responses.

### ■ RS055: TEXT TERMINATION MONITORING TIMER (TIMER B)

This timer monitors text reception. Specify the monitoring time to wait for text termination character.

### ■ RS056: NUMBER OF ENQ RE-TRANSMISSION RETRIES

This parameter specifies the number of re-transmission attempts of the control characters for invalid or missing responses.

### ■ RS057: NUMBER OF DATA RE-TRANSMISSION RETRIES

This parameter specifies the number of re-transmission attempts of text for block check error (NAK reception).

## ■ RS058: FC2 FORMAT SPECIFICATION

Specify the format type of the floppy disk used with external memory (YASNAC FC2).



720 kilobytes are unconditionally specified for YASNAC FC2 (2DD floppy disk exclusive use).

## ■ RS059: EXTERNAL MEMORY FILE OVERWRITE SPECIFICATION

Specify whether to accept the file overwrite of the external memory (YASNAC FC2 or FC1).

# 9.10 Application Parameters

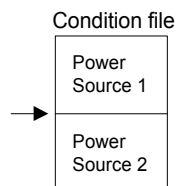
## 9.10.1 Arc Welding

### ■ AxP000: APPLICATION

This parameter specifies the application. Set "0" for arc welding.

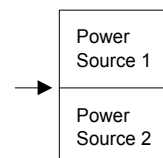
### ■ AxP003: WELDING ASSIGNMENT OF WELDING START CONDITION FILE

This parameter specifies the beginning condition number in the welding start condition file to be assigned to Power Source 2. Condition files of a lower number are automatically assigned to Power Source 1. For a system with one Power Source, set "49" (maximum value).



### ■ AxP004: WELDING ASSIGNMENT OF WELDING END CONDITION FILES

This parameter specifies the beginning condition number in the welding END condition file to be assigned to Power Source 2. Condition files of a lower number are automatically assigned to Power Source 1. For a system with one Power Source, set "13" (maximum value).



## 9.10 Application Parameters

### ■ AxP005: WELDING SPEED PRIORITY

This parameter specifies whether the welding speed is specified by the “ARCON” instruction, by the welding start condition file, or by the additional times of the “MOV” instruction.

### ■ AxP009: WORK CONTINUING

This parameter specifies whether to output an “ARCON” instruction to restart after the manipulator stopped while the “ARCON” instruction is being output.

### ■ AxP010: WELDING INSTRUCTION OUTPUT

This parameter specifies the beginning number (0 to 12) of the analog output channel to the Power Source. “0” indicates that no Power Source exists.

### ■ AxP011, AxP012: MANUAL WIRE OPERATION SPEED

These parameters specify the manual wire operation speed as a percentage of the maximum instruction value. Instruction polarity is determined by the current instruction in the Power Source characteristic file. The setting range is from 0 to 100.

### ■ AxP013, AxP014: WELDING CONTROL TIME

These parameters specify the welding control time in units of minutes. The setting range is from 0 to 999.

### ■ AxP015 to AxP017: NUMBER OF WELDING CONTROL

These parameters specify the number of welding controls. The setting range is from 0 to 99.

### ■ AxP026 to AxP029: TOOL ON/OFF USER OUTPUT NO. (Jigless system)

These parameters specify the user output number for the tool open/close operation by specific keys.

## 9.10.2 Handling Application

### ■ AxP002, AxP004: f1 KEY FUNCTION

These parameters set the output signal to assign for f1 key.

0: Not specified

1 to 4: Specific outputs for HAND-1 to HAND4-1

5: User output (No. is specified by AxP004).

### ■ AxP003, AxP005: f2 KEY FUNCTION

These parameters set the output signal to assign for f2 key.

0: Not specified

1 to 4: Specific outputs for HAND-2 to HAND4-2

5: User output (No. is specified by AxP005)

### 9.10.3 Spot Welding

#### ■ AxP003: MAXIMUM NUMBERS OF CONNECTED POWER SOURCES

The initial value is set to 4. The value is automatically set at start-up. No modification is needed.

#### ■ AxP004: GUN FULL OPEN STROKE ON/OFF SIGNAL

This parameter specifies which stroke switching signal is output ON or OFF to make the gun fully-opened for each gun.

Bit specification (1 for 01) for 8 guns. The initial setting is "0."

0	0	0	0	0	0	0	0
8	7	6	5	4	3	2	1

Gun number

#### ■ AxP005: STROKE CHANGE ANSWER TIME LIMIT

When using the X2 gear mechanical stopper gun and switching gun stroke, this parameter sets the time from the stroke-switching-sequence start until the pressure instruction end.

Setting range : 0.0 to 9.9 sec.

The initial setting is "0," with which the switching signal is output for the "stopper-type stroke switching time" set in the file, and then the gun pressure instruction is turned OFF.

#### ■ AxP006: PARITY SPECIFICATION FOR WELDING CONDITIONS

When adding the parity signal to the welding condition signal with the Power Source connected to each welding gun, this parameter specifies odd or even parity.

Bit specification for 4 Power Sources. (0 : odd number, 1 : even number) The initial setting is "0."

0	0	0	0	0	0	0	0
				4	3	2	1

Power Source number

#### ■ AxP007: ANTICIPATE TIME

When executing the GUNCL or SPOT instruction with NWAIT specified in the previous move instruction but the time is not specified by ATT in the GUNCL or SPOT instruction, this parameter specifies the anticipate condition (time). The initial setting is "0," with which the each instruction is executed as soon as the taught position of the previous move instruction is reached, as normal operation.

#### ■ AxP015: WELDING ERROR RESET OUTPUT TIME

This parameter sets the output time of the welding error reset signal to the Power Source when the alarm reset signal is input.

If the setting is "0," the welding error reset signal is not output to the Power Source even if the alarm reset signal is input.

**■ AxP016, AxP017: ELECTRODE WEAR AMOUNT ALARM VALUE**

These parameters set the electrode wear amount alarm values (AxP016: movable side, AxP017: fixed side) at the wear detection.

**9.10.4 General-purpose Application****■ AxP009: WORK CONTINUE PROHIBIT**

This parameter specifies whether to output TOOLON instruction or not at restarting when the work is stopped for some reasons during the output of TOOLON instruction.

# 10 System Setup

## 10.1 Home Position Calibration



### WARNING

- **Before operating the manipulator, check that the SERVO ON lamp goes out when the emergency stop buttons on the right of the front door of the NX100 and the programming pendant are pressed.**

Injury or damage to machinery may result if the manipulator cannot be stopped in case of an emergency.

- **Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator :**
  - **View the manipulator from the front whenever possible.**
  - **Always follow the predetermined operating procedure.**
  - **Ensure that you have a safe place to retreat in case of emergency.**

Improper or unintended manipulator operation may result in injury.

- **Prior to performing the following operations, be sure that no one is in the P-point maximum envelope of the manipulator, and be sure that you are in a safe place when:**
  - **Turning ON the NX100 power.**
  - **Moving the manipulator with the programming pendant.**

Injury may result from contact with the manipulator if persons enter the P-point maximum envelope of the manipulator.

- **Always press the emergency stop button immediately if there are problems.**  
**Emergency stop buttons are located on the right of the front door of the NX100 and the programming pendant.**



## CAUTION

- **Perform the following inspection procedures prior to teaching the manipulator. If problems are found, correct them immediately, and be sure that all other necessary tasks have been performed.**
  - **Check for problems in manipulator movement.**
  - **Check for damage to the insulation and sheathing of external wires.**
- **Always return the programming pendant to its hook on the NX100 cabinet after use.**

If the programming pendant is inadvertently left on the manipulator, a fixture, or on the floor, the manipulator or a tool could collide with it during manipulator movement, possibly causing injury or equipment damage.

### 10.1.1 Home Position Calibration



Teaching and playback are not possible before home position calibration is complete. In a system with two or more manipulators, the home position of all the manipulators must be calibrated before starting teaching or playback.

Home position calibration is an operation in which the home position and absolute encoder position coincide. Although this operation is performed prior to shipment at the factory, the following cases require this operation to be performed again.

- Change in the combination of the manipulator and NX100
- Replacement of the motor or absolute encoder
- Clearing stored memory (by replacement of NCP01 circuit board, weak battery, etc.)
- Home position deviation caused by hitting the manipulator against a workpiece, etc.

To calibrate the home position, use the axis keys to calibrate the home position mark on each axis so that the manipulator can take its posture for the home position. There are two operations for home position calibration:

- All the axes can be moved at the same time: Recalibrate the home position by moving all the axes together if changing the combination of manipulator and circuit board.
- Axes can be moved individually: Recalibrate the home position for the individual axes that were affected by the replacement, if replacing the motor or absolute encoder.

If the absolute data of its posture for the home position is already known, set the absolute data again after completing home position registration.

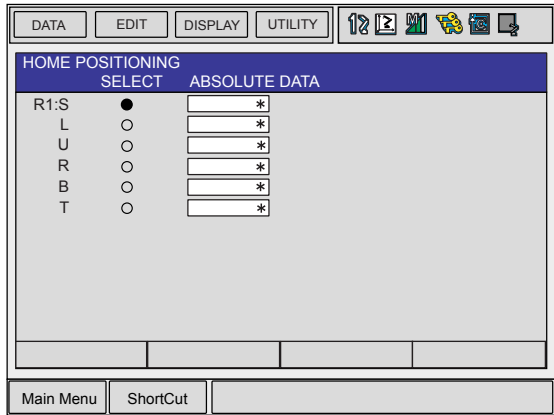
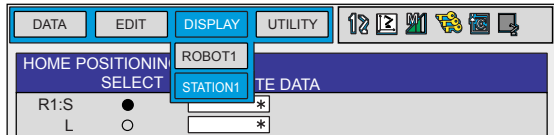
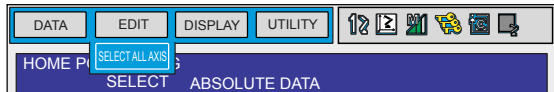
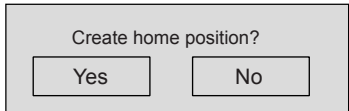


### Home Position

The home position is the pulse value "0" for each axis and its posture. The relative values between the home position and the control reference position are set to parameters. The relative values are specified as an angle in units of  $1/1000^\circ$  and vary for different manipulator types. See "10.1.3 Home Position of the Robot."

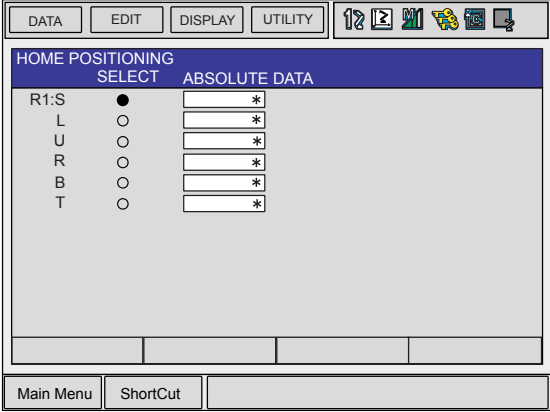
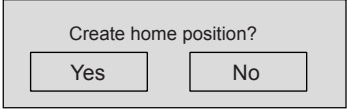
## 10.1.2 Calibrating Operation

### ■ Registering All Axes at One Time

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {HOME POSITION}.	The HOME POSITIONING window appears. 
3	Select {DISPLAY} under the menu.	The pull down menu appears. 
4	Select the desired control group.	
5	Select {EDIT} under the menu.	The pull down menu appears. 
6	Select {SELECT ALL AXES}.	The confirmation dialog box appears. 
7	Select "YES."	Shown position data of all axes are registered as home position. When "NO" is selected, the registration will be canceled.

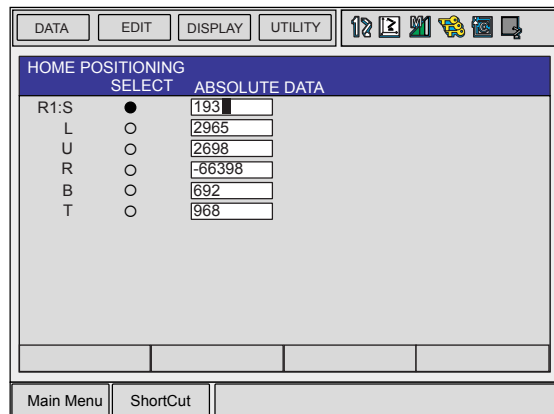
## 10.1 Home Position Calibration

## ■ Registering Individual Axes

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {HOME POSITION}.	The HOME POSITIONING window appears.
3	Select {DISPLAY} under the menu.	The pull down menu appears.
4	Select the desired control group.	
5	Select the axis to be registered.	<p>The confirmation dialog box appears.</p> 
6	Select "YES."	Shown position data of axis are registered as home position. When "NO" is selected, the registration will be canceled.

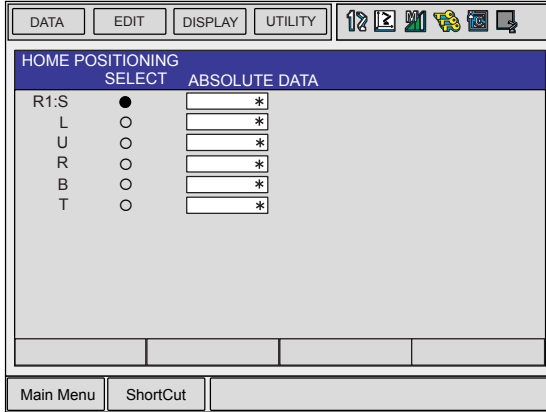
## ■ Changing the Absolute Data

To change the absolute data of the axis when home position calibration is completed, perform the following:

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {HOME POSITION}.	The HOME POSITIONING window appears.
3	Select {DISPLAY}.	The pull down menu appears.
4	Select the desired control group.	
5	Select the absolute data to be registered.	The number input buffer line appears.  <p>The screenshot shows a window titled 'HOME POSITIONING' with a menu bar containing 'DATA', 'EDIT', 'DISPLAY', and 'UTILITY'. Below the menu bar is a table with two columns: 'SELECT' and 'ABSOLUTE DATA'. The 'SELECT' column lists 'R1:S', 'L', 'U', 'R', 'B', and 'T'. The 'ABSOLUTE DATA' column shows values: '193', '2965', '2698', '-66398', '692', and '968'. At the bottom of the window are buttons for 'Main Menu' and 'ShortCut'.</p>
6	Enter the absolute data using the Numeric keys.	
	Press [ENTER].	Absolute data are changed.

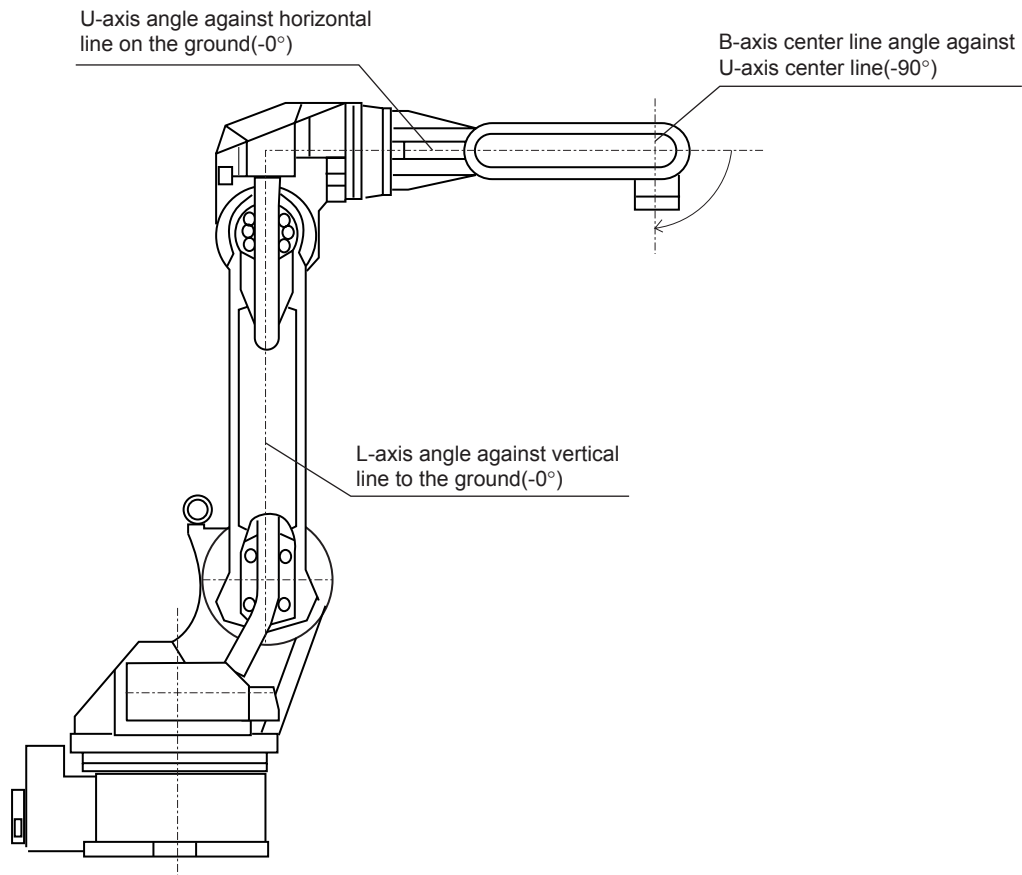
## 10.1 Home Position Calibration

## ■ Clearing Absolute Data

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {HOME POSITION}.	The HOME POSITIONING window appears.
3	Select {DISPLAY}.	The pull down menu appears.
4	Select the desired control group.	
5	Select {DATA} under the menu.	
6	Select {CLEAR ALL DATA}.	<p>The all absolute data are cleared.</p>  <p>The screenshot shows the 'HOME POSITIONING' window with the 'ABSOLUTE DATA' tab selected. The window has a menu bar with 'DATA', 'EDIT', 'DISPLAY', and 'UTILITY'. Below the menu bar, there are icons for various functions. The main area is divided into two sections: 'SELECT' and 'ABSOLUTE DATA'. Under 'SELECT', there is a list of items: 'R1:S', 'L', 'U', 'R', 'B', and 'T'. Each item has a radio button next to it. The 'R1:S' radio button is selected. To the right of each item is a text field containing an asterisk (*). At the bottom of the window, there are buttons for 'Main Menu' and 'ShortCut'.</p>

### 10.1.3 Home Position of the Robot

In case of UP6, the home position are as follows.



Other manipulator models have different positions. Always refer to "MANIPULATOR INSTRUCTIONS" for the correct manipulator model.

## 10.2 Second Home Position (Check Point)



### WARNING

- **Be aware of safety hazards when performing the position confirmation of the second home position (check point).**

Abnormality of the PG system may be a cause for alarm. The manipulator may operate in an unexpected manner, and there is a risk of damage to equipment or injury to personnel.

- **Before operating the manipulator, check that the SERVO ON lamp goes out when the emergency stop buttons on the front door of NX100 and the programming pendant are pressed.**

Injury or damage to machinery may result if the manipulator cannot be stopped in case of an emergency.

- **Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator :**

- **View the manipulator from the front whenever possible.**
- **Always follow the predetermined operating procedure.**
- **Ensure that you have a safe place to retreat in case of emergency.**

Improper or unintended manipulator operation may result in injury.

- **Prior to performing the following operations, be sure that no one is in the P-point maximum envelope of the manipulator, and be sure that you are in a safe place when:**

- **Turning ON the NX100 power**
- **Moving the manipulator with the programming pendant**
- **Running the system in the check mode**
- **Performing automatic operations**

Injury may result from contact with the manipulator if persons enter the P-point maximum envelope of the manipulator.

- **Always press the emergency stop button immediately if there are problems.**

Emergency stop buttons are attached on the right of the front door of the NX100 and the programming pendant.



## CAUTION

- **Perform the following inspection procedures prior to teaching the manipulator. If problems are found, correct them immediately, and be sure that all other necessary tasks have been performed.**

- **Check for problems in manipulator movement.**
- **Check for damage to the insulation and sheathing of external wires.**
- **Always return the programming pendant to its hook on the NX100 cabinet after use.**

If the programming pendant is inadvertently left on the manipulator, a fixture, or on the floor, the manipulator or a tool could collide with it during manipulator movement, possibly causing injury or equipment damage.

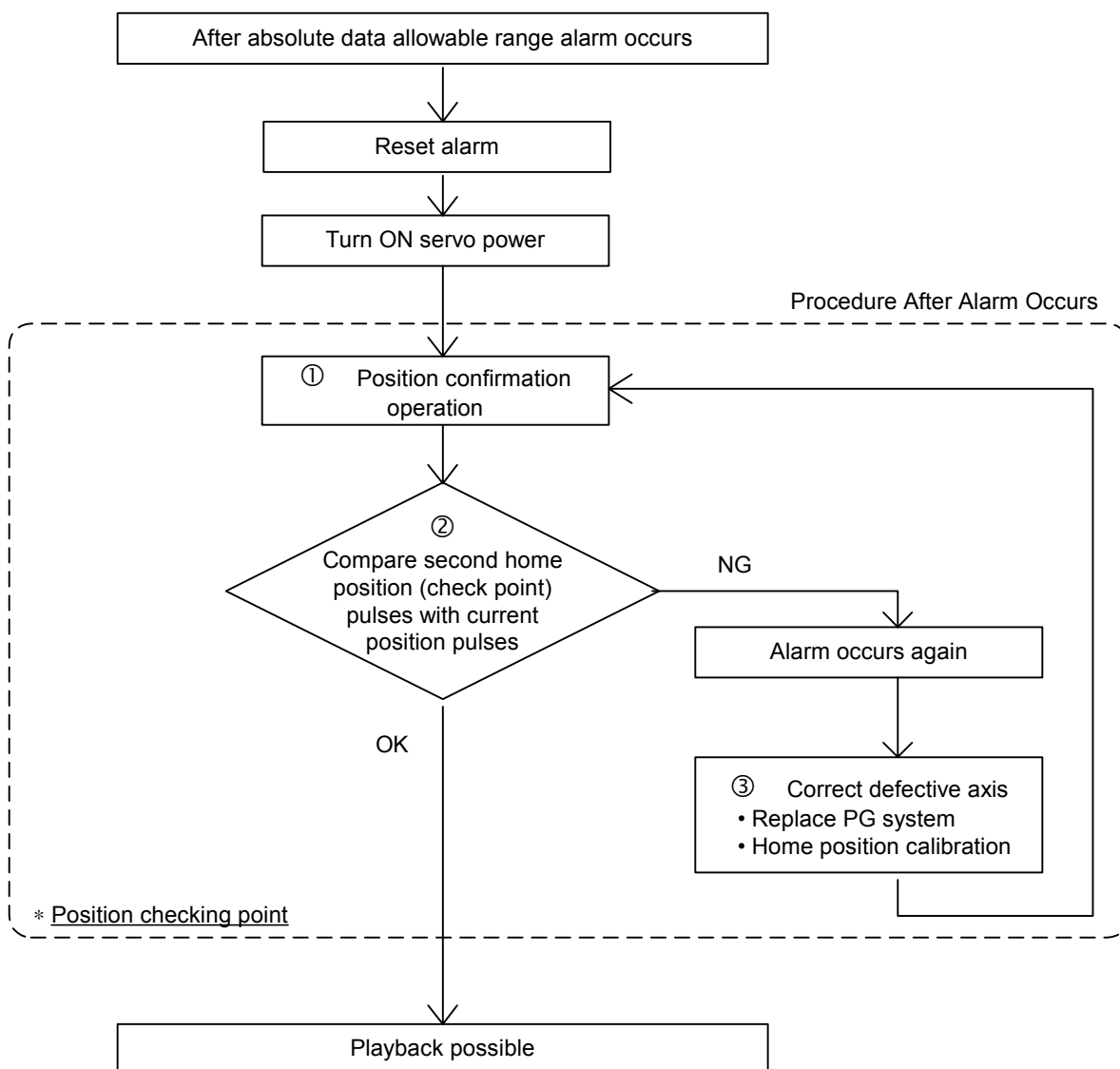
## 10.2.1 Purpose of Position Check Operation

If the absolute number of rotation detected at power supply ON does not match the data stored in the absolute encoder the last time the power supply was turned off, an alarm is issued when the controller power is turned ON.

There are two possible causes of this alarm:

- Error in the PG system
- The manipulator was moved after the power supply was turned OFF.

If there is an error with the PG system, the manipulator may stall when playback is started. If the absolute data allowable range error alarm has occurred, playback and test runs will not function and the position must be checked.



### ① Position Check

After the absolute data allowable range alarm occurs, move to the second home position using the axis keys and check the position. To prevent the position from changing, playback, test runs, and FWD operation will not function.

### ②Pulse Difference Check

The pulse number at the second home position is compared with that at the current position. If the difference is within the allowable range, playback is enabled. If not, the error alarm occurs again.

- The allowable range pulse is the number of pulses per rotation of the motor (PPR data).
- The initial value of the second home position is the home position (where all axes are at pulse 0). The second home position can be changed. For details, refer to "10.2 Second Home Position (Check Point)."

### ③Alarm Occurrence

If the error alarm occurs again, there may be an error in the PG system. Check the system. After adjusting the erroneous axis, calibrate the home position of the axis, then check the position again.



- Home position calibration of all the axes at the same time enables playback operations without having to check the position.

- Sometimes in a system with a manipulator that has no brake, it is possible to enable playback without position checking after the absolute data allowable range error alarm occurs. **However, as a rule, always check the position.**

Under the above special conditions, the manipulator moves as follows:

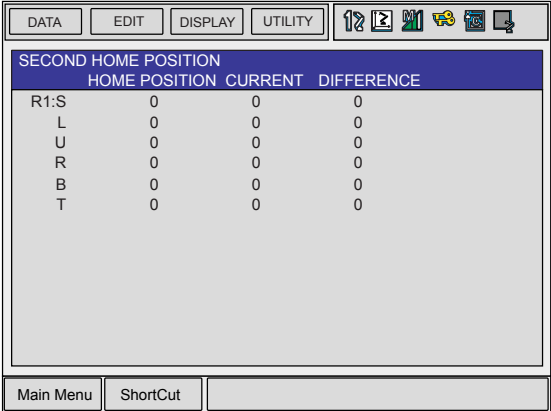

After starting, the manipulator moves at low speed (1/10 of the maximum speed) to the step indicated by the cursor. If it is stopped and restarted during this motion, the low speed setting is retained until the step at cursor is reached. Regardless of cycle setting, the manipulator stops after the cursor step is reached. Starting the manipulator again then moves it at the programmed speed and cycle of the job.

## 10.2 Second Home Position (Check Point)

## 10.2.2 Setting the Second Home Position (Check Point)

Apart from the normal home position of the manipulator, the second home position can be set up as a check point for absolute data. Use the following steps to set the specified point.

If two or more manipulators or stations are controlled by one controller, the second home position must be set for each manipulator or station.

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {SECOND HOME POS}.	<p>The SECOND HOME POSITION window appears. The message "Available to move to any modify second home position" is shown.</p> 
3	Press the page key  .	The group axes by which the second home position is set is selected when there are two or more group axes.
4	Press the axis keys.	Move the manipulator to the new second home position.
5	Press [MODIFY] and [ENTER].	The second home position is changed.

### 10.2.3 Procedure After an Alarm



#### WARNING

- **Be aware of safety hazards when performing the position confirmation of the specified point.**

Abnormality of the PG system may be cause for alarm. The manipulator may operate in an unexpected manner, and there is a risk of damage to equipment or injury to personnel.


If the absolute data allowable range alarm occurs, perform the followings

- Reset the alarm
- Turn Servo power ON

and confirm the second home position. After the confirmation, if the PG system is found to be the cause of the alarm, perform the necessary operation, such as replacing the PG, etc. The robot current position data when turning main power supply OFF and ON can be confirmed in "Power ON/OFF Position Window."



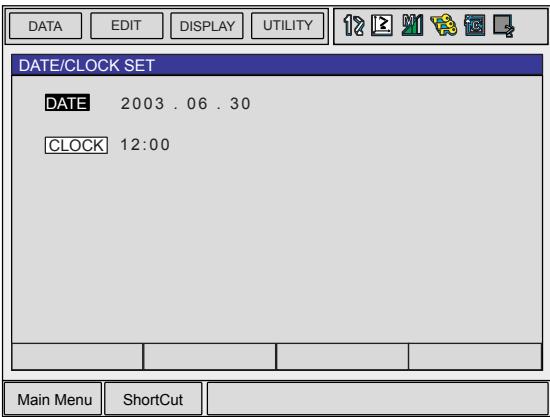
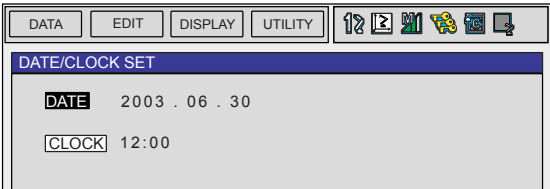
Refer to NX100 MAINTENANCE MANUAL " 7.7 Position Data When Power is Turned ON/OFF " for details on the "Power ON/OFF Position Window."

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {SECOND HOME POS}.	The SECOND HOME POSITION window appears.
3	Press the page key  .	The group axes by which the second home position is set is selected when there are two or more group axes.
4	Press [FWD].	TCP moves to the second home position. The robot moving speed is set as selected manual operation speed.
5	Select {DATA} under the menu.	
6	Select {CONFIRM POSITION}.	The message "Home position checked" appears. Pulse data of the second home position and current pulse data are compared. If the compared error is in allowed range, playback operation can be done. If the error is beyond the allowed range, the alarm occurs again.

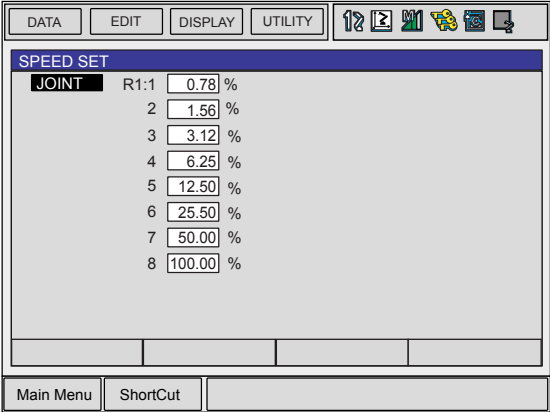


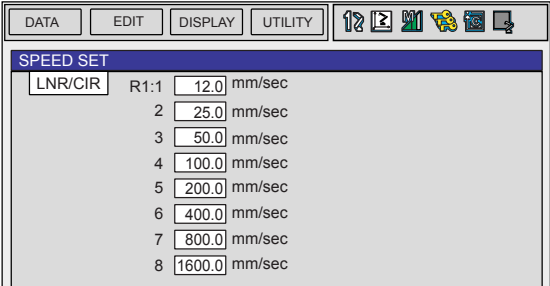
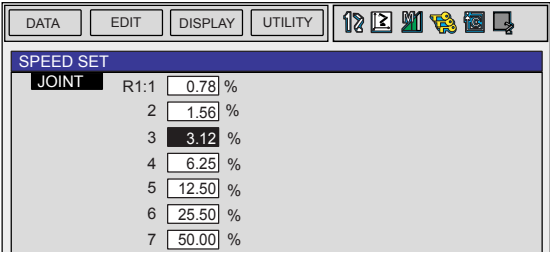
## 10.3 Setting the Controller Clock

## 10.3 Setting the Controller Clock

The clock inside of the NX100 controller can be set.

	Operation	Explanation
1	Select {SETUP} under the main menu.	
2	Select {DATE/TIME}.	<p>The DATE/CLOCK SET window appears.</p> 
3	Select "DATE" or "CLOCK."	The input buffer line appears.
4	Input the new date or time.	For instance, to make the date June 30, 2003, input [2003.6.30]. To set the time at exactly twelve o'clock, enter [12.00].
5	Press [ENTER].	Date and time are changed.
		

10.4 Setting Play Speed

	Operation	Explanation
1	Select {SETUP} under the main menu.	
2	Select {SET SPEED}.	<div>The SPEED SET window appears.</div> <div></div>
3	Press the page key  .	<div>When two or more manipulators and stations exist in the system, the control group is changed by the page key  .</div>
4	Select “JOINT” or “LNR/CIR.”	<div>The type of speed alternately changes from “JOINT” to “LNR/CIR”.</div> <div></div>
5	Select desired speed value.	<div>The input buffer line appears.</div>
6	Input the speed value.	
7	Press [ENTER].	<div>The speed value is changed.</div> <div></div>

## 10.5 All Limits Releasing



### CAUTION

- **To operate the manipulator with all limits released, pay extra attention to the operating environment around you.**

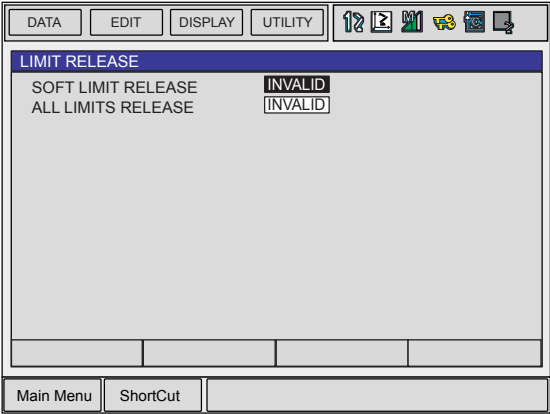
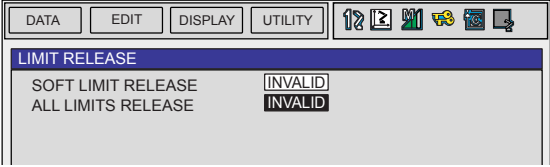
When all limits are released, the manipulator or equipment may be damaged.

The following limits can be released by the operation explained in the following.

Limit Type	Contents
Mechanical Limit	Limit for checking manipulator's range of motion
L-U Interference	Limit for checking L- and U-axes interference area
Software Limit	Every axis soft limit for checking manipulator's range of motion
Cube Interference	Limit for checking cube interference area set by user



If the security mode is not at management mode, all limits releasing is not allowed. Refer to "8 Security System" of the NX100 INSTRUCTIONS for details about security modes.

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {LIMIT RELEASE}.	<p>The LIMIT RELEASE window appears.</p> 
3	Select "ALL LIMITS RELEASE."	<p>"VALID" and "INVALID" are shown alternately every time [SELECT] is pressed.</p> <p>When ALL LIMITS RELEASE is changed to "VALID," the message "All limits have been released" appears. When the setting changes to "INVALID," the message "All limits release has been canceled" appears for three seconds.</p> 

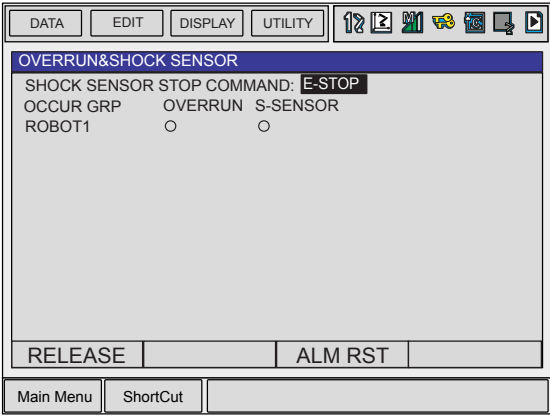
## 10.6 Overrun / Tool Shock Sensor Releasing

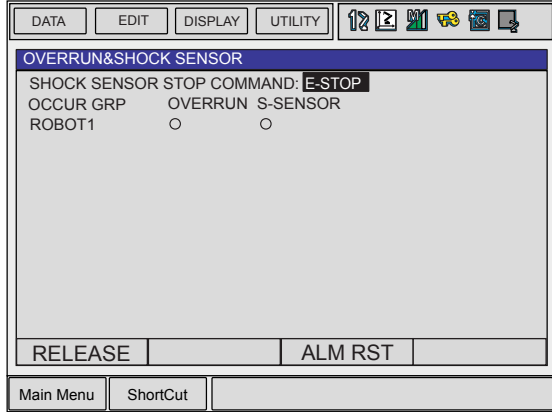


### CAUTION

- **To operate the manipulator with overrun released or with tool shock sensor released, pay extra attention to the operating environment around you.**

If the manipulator stops by overrun detection or tool shock sensor detection, release the overrun or tool shock sensor by the following procedure and reset the alarm and move the manipulator using the axis keys.

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {OVERRUN & S-SENSOR}.	<p>The OVERRUN &amp; TOOL SHOCK SENSOR window appears. The stopping condition when the tool shock sensor is detected can be selected "EMERGENCY STOP" or "HOLD" at the "TOOL SHOCK SENSOR STOP COMMAND". "E-STOP" and "HOLD" are displayed alternately every time [SELECT] is pressed.</p> 

	Operation	Explanation
3	Select "RELEASE."	<p>"●" is shown at the control group which detects overrun or tool shock sensor. If "RELEASE" is selected, overrun or tool shock sensor is released and "CANCEL" is shown.</p> 
4	Select "ALM RST."	Alarm is reset and manipulator can be moved using the axis keys.



- After overrun or tool shock sensor releasing, the manipulator can be moved using the axis keys with low speed or inching motion only.
- After overrun or tool shock sensor releasing, if "CANCEL" is selected or the window is changed to the other one, overrun or tool shock sensor releasing is canceled.
- The axis operation can be performed only in the joint.

## 10.7 Interference Area

### 10.7.1 Interference Area

The interference area is a function that prevents interference between multiple manipulators or the manipulator and peripheral device. The area can be set up to 32 area. There are two types of interference areas, as follows:

- Cubic Interference Area
- Axis Interference Area

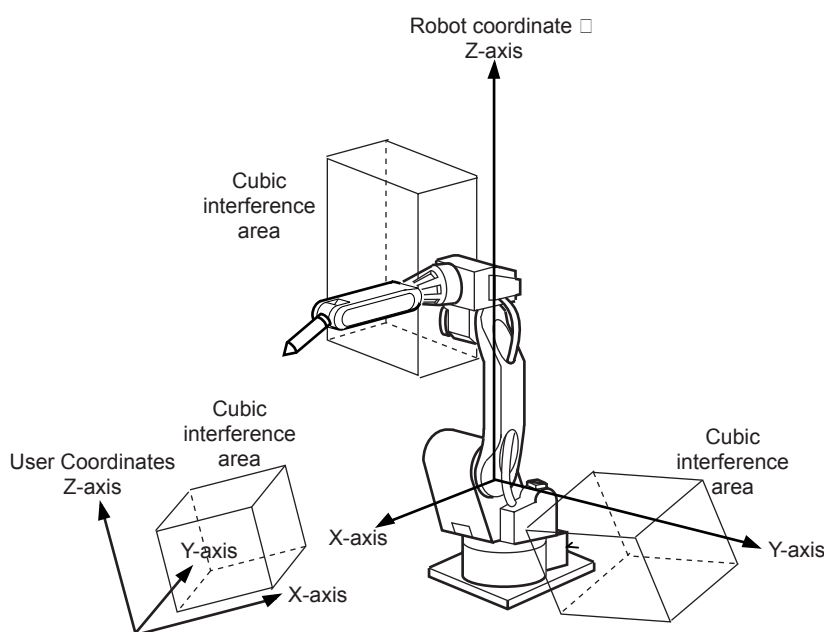
The NX100 judges whether the TCP of the manipulator is inside or outside this area, and outputs this status as a signal.

If the TCP of the manipulator is inside the area, the interference 1 inside signal or interference 2 inside signal are turned on and the manipulator automatically decelerates to a stop. The manipulator stands by until these signals are turned off, whereupon it automatically restarts.

### 10.7.2 Cubic Interference Area

#### ■ Cubic Interference Area

This area is a rectangular parallelepiped which is parallel to the base coordinate, robot coordinate, or user coordinate. The NX100 judges whether the current position of the manipulator's TCP is inside or outside this area, and outputs this status as a signal. The cubic interference areas can be set, parallel to the base coordinate or user coordinate.

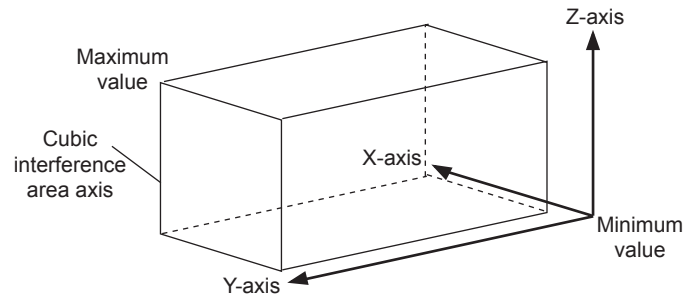


## ■ Cube Setting Method

There are three ways to set cubic interference areas, as described in the following:

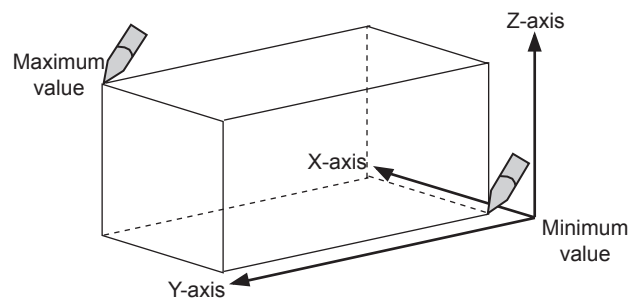
### Number Input of Cube Coordinates

Enter the maximum and minimum values for the cube coordinates.



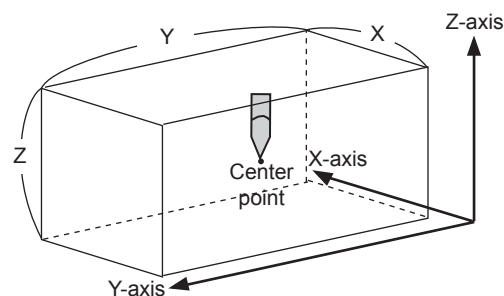
### Teaching Corner

Move the manipulator at the maximum and minimum value positions of the cube corner using the axis keys.



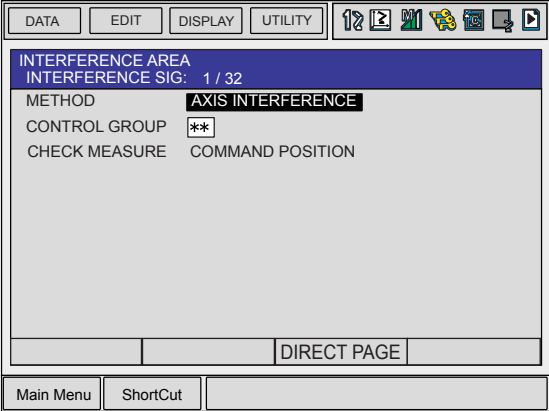

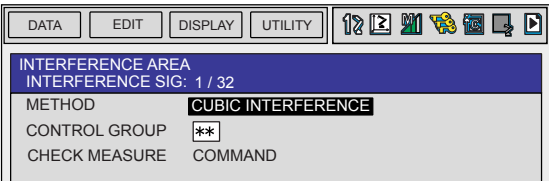
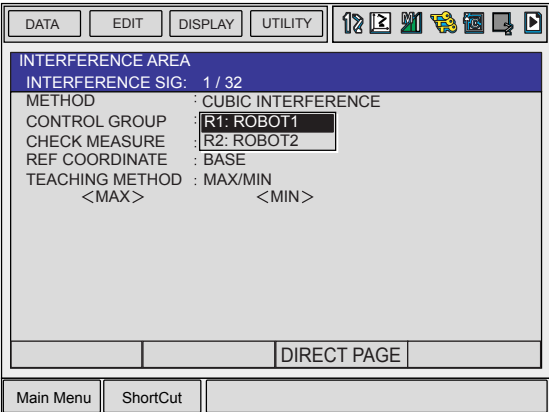
### Number Input of the Side of Cube and Teaching Center

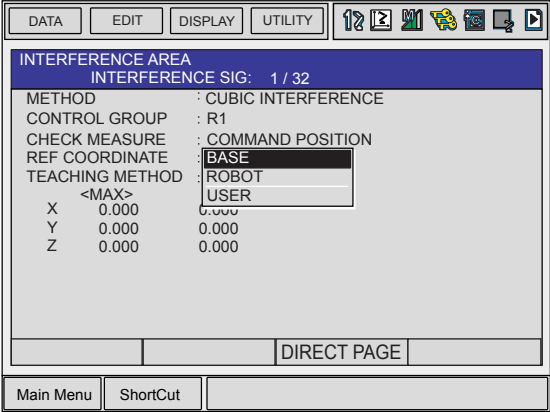
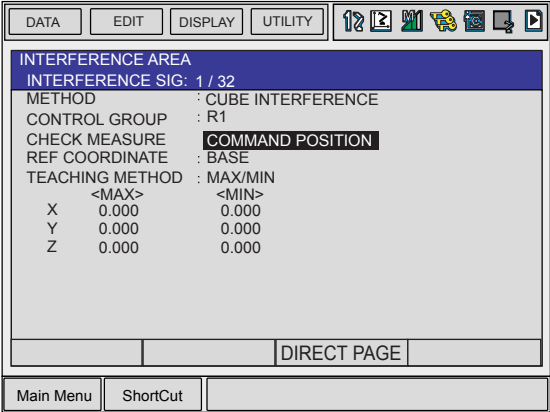
After entering the lengths of the three faces of the cube (axial length) using the Numeric keys, move the manipulator to the center point of the cube using the axis keys.



## 10.7 Interference Area

## ■ Setting Operation

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {INTERFERENCE}.	<p>The INTERFERENCE AREA window appears.</p> 
3	Select the desired cube number.	<p>Select the desired cube number using the page key  or by number input.</p> <p>The method for number input is as follows: Move cursor to "INTERFERENCE SIG" and press [ENTER] to display the number input line. Input desired signal number and press [ENTER].</p>
4	Select "METHOD."	<p>"AXIS INTERFERENCE" and "CUBIC INTERFERENCE" are displayed alternately every time [SELECT] is pressed. If "CUBIC INTERFERENCE" is selected, the window is changed.</p> 
5	Select "CONTROL GROUP."	<p>The selection dialog box appears. Select desired control group.</p> 

	Operation	Explanation
6	Select "REF COORDINATES."	<p>The selection dialog box appears. Select desired coordinate. If the user coordinates are selected, the number input line appears. Input the user coordinate number and press [ENTER].</p> 
7	Select "CHECK MEASURE."	<p>Each time [SELECT] is pressed, "COMMAND POSITION" and "FEEDBACK POSITION" are shown alternately.</p> 

NOTE

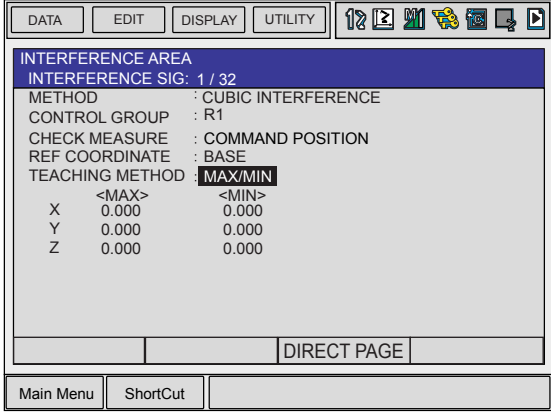
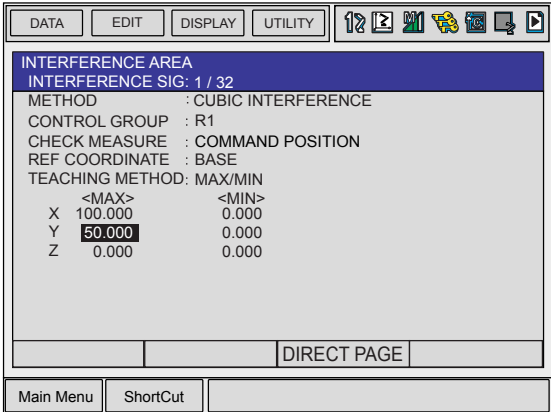
To stop the manipulator movement using the interference signal (use the cube interference signal for mutual interference between robots), set CHECK MEASURE to "COMMAND POSITION".

When set to the "FEEDBACK POSITION", the manipulator decelerates to a stop after entering the interference area.

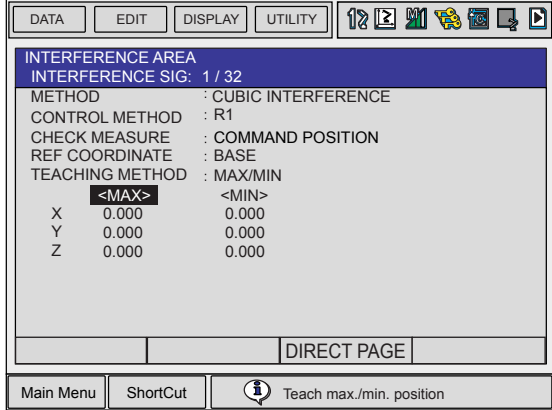
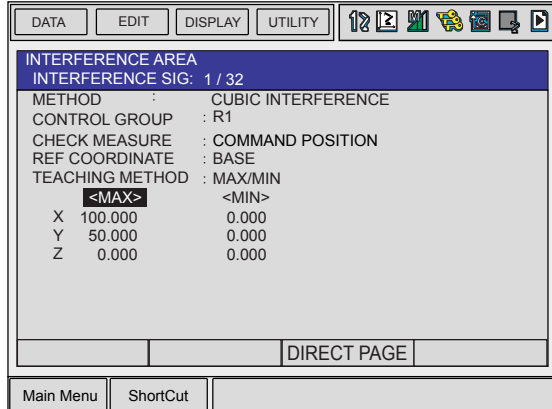
When informing an external unit of the actual manipulator position, use the "FEEDBACK POSITION" setting so the timing of the output signal is more accurate.

## 10.7 Interference Area

## Number Input of Cube Coordinates

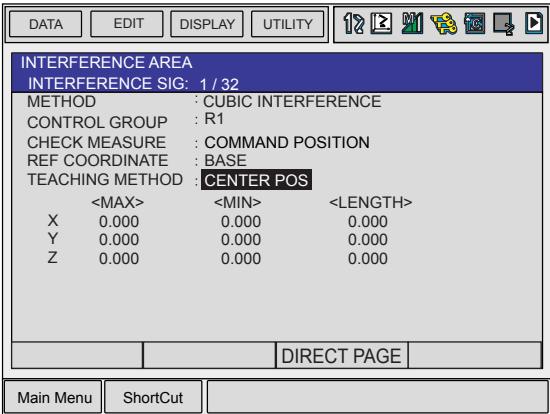
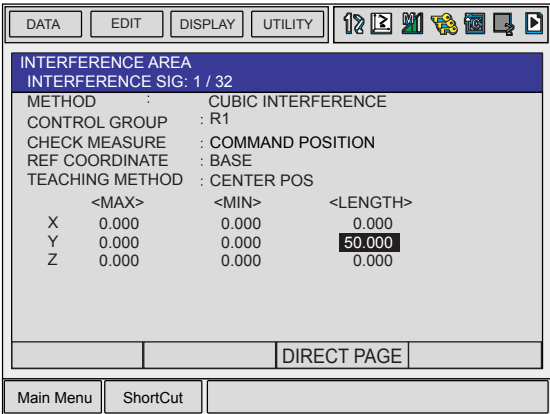
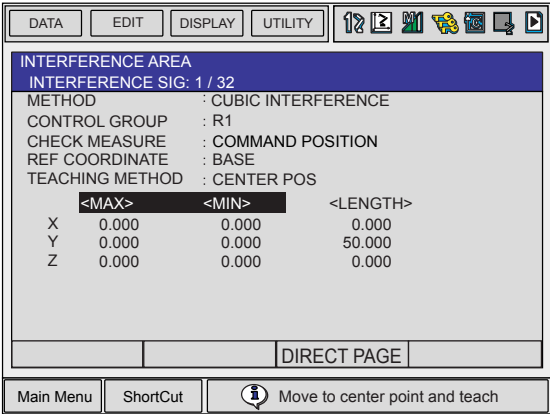
	Operation	Explanation
1	Select "METHOD."	<p>Each time [SELECT] is pressed, "MAX/MIN" and "CENTER POS" alternate. Select "MAX/MIN".</p>  <p>The screenshot shows the 'INTERFERENCE AREA' screen. At the top, there are buttons for DATA, EDIT, DISPLAY, and UTILITY, followed by a row of icons. Below this, the text 'INTERFERENCE SIG: 1 / 32' is displayed. The main area lists several parameters: METHOD (CUBIC INTERFERENCE), CONTROL GROUP (R1), CHECK MEASURE (COMMAND POSITION), REF COORDINATE (BASE), and TEACHING METHOD (MAX/MIN, which is highlighted with a black box). Below these, a table shows coordinates for X, Y, and Z, with columns for &lt;MAX&gt; and &lt;MIN&gt;. The values are all 0.000. At the bottom, there is a 'DIRECT PAGE' button and a 'Main Menu' button.</p>
2	Input number for "MAX" and "MIN" data and press [ENTER].	<p>The cubic interference area is set.</p>  <p>The screenshot shows the 'INTERFERENCE AREA' screen after the coordinates have been updated. The parameters are the same as in the previous screenshot, but the TEACHING METHOD is still MAX/MIN. The coordinate table now shows: X (100.000 for MAX, 0.000 for MIN), Y (50.000 for MAX, 0.000 for MIN), and Z (0.000 for both). The Y value 50.000 is highlighted with a black box. The 'DIRECT PAGE' and 'Main Menu' buttons are still present at the bottom.</p>

## Teaching Corner

	Operation	Explanation
1	Select "METHOD."	Each time [SELECT] is pressed, "MAX/MIN" and "CENTER POS" alternate. Select "MAX/MIN".
2	Press [MODIFY].	The message "Teach max./min. position" appears. 
3	Move the cursor to "<MAX>" or "<MIN>."	Move cursor to "<MAX>" for changing maximum value and move cursor to "<MIN>" for changing minimum value. The cursor moves to only either "<MIN>" or "<MAX>" at this time. The cursor moves freely when this operation is canceled by pressing [CANCEL].
4	Move the manipulator using the axis keys.	Move the manipulator to the maximum or minimum position of the cube using the axis keys.
5	Press [ENTER].	The cubic interference area is registered. 

## 10.7 Interference Area

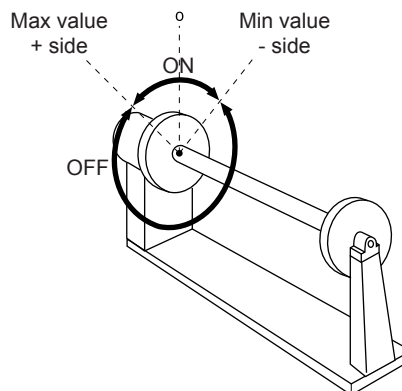
## Number Input of the Side of Cube and Teaching Center

	Operation	Explanation
1	Select "METHOD."	<p>Each time [SELECT] is pressed, "MAX/MIN" and "CENTER POS" alternate. Select "CENTER POS"</p> 
2	Input data for length of the cube and press [ENTER].	<p>The length is set.</p> 
3	Press [MODIFY].	<p>The message "Move to center point and teach" appears. The cursor moves to only either "&lt;MIN&gt;" or "&lt;MAX&gt;" at this time. The cursor moves freely when this operation is canceled by pressing [CANCEL].</p> 
4	Move the manipulator using the axis keys.	Move the manipulator to the center point of the cube using the axis keys.
5	Press [ENTER].	The current position is registered as the center point of the cube.

### 10.7.3 Axis Interference Area

#### ■ Axis Interference Area


The axis interference area is a function that judges the current position of the each axis and outputs a signal. Once the maximum and minimum values have been set at the plus and minus sides of the axis to define the working range, a signal indicating whether the current position of the axis is inside or outside this range is output. (ON: inside, OFF: outside)



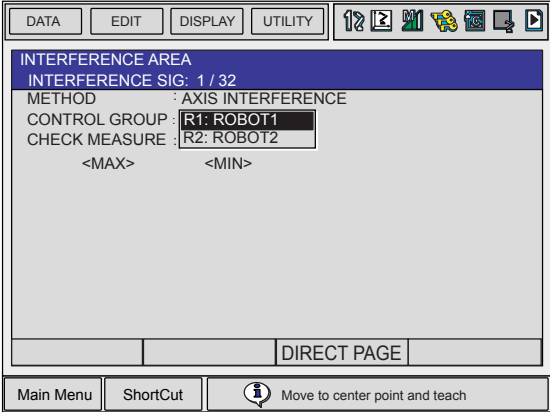
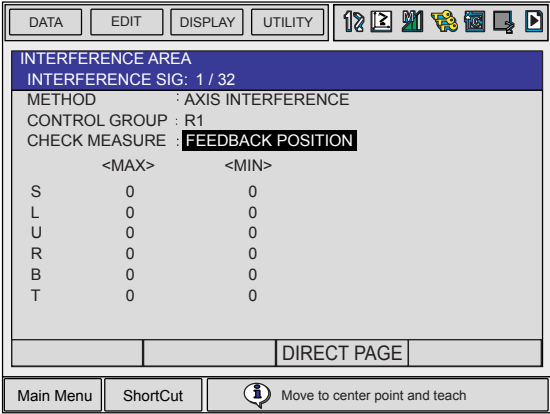
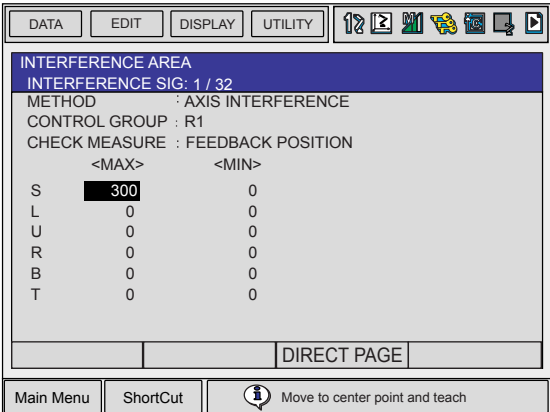
Axis Interference Signal for Station Axis

#### ■ Setting Operation

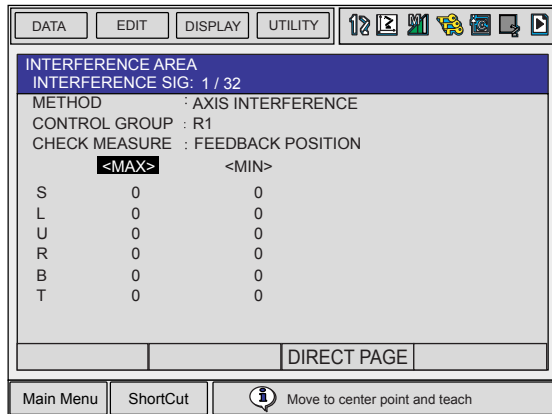
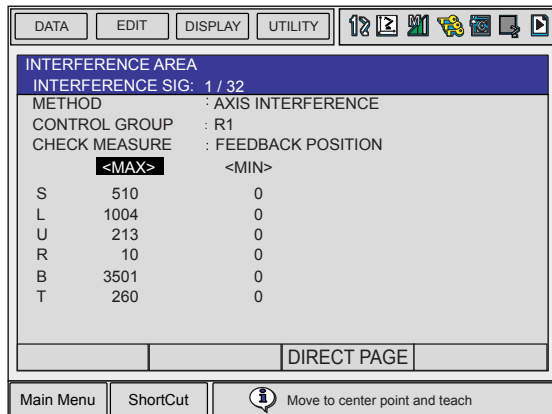
##### Number Input of Axis Data

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {INTERFERENCE}.	<p>The INTERFERENCE AREA window appears.</p>
3	Select the desired interference signal number.	<p>Select the desired interference signal number using the page key  or by number input.</p> <p>The method for number input is as follows: Move cursor to "INTERFERENCE SIG" and press [SELECT] to display the number input line. Input desired signal number and press [ENTER].</p>
4	Select "METHOD."	<p>"AXIS INTERFERENCE" and "CUBIC INTERFERENCE" are shown alternately every time [SELECT] is pressed. Select "AXIS INTERFERENCE."</p>

## 10.7 Interference Area


	Operation	Explanation																					
5	Select "CONTROL GROUP."	<p>The selection dialog box appears. Select desired control group.</p> 																					
6	Select "CHECK MEASURE."	<p>Each time [SELECT] is pressed, "COMMAND POSITION" and "FEEDBACK POSITION" alternate.</p>  <table border="1"> <thead> <tr> <th></th> <th>&lt;MAX&gt;</th> <th>&lt;MIN&gt;</th> </tr> </thead> <tbody> <tr><td>S</td><td>0</td><td>0</td></tr> <tr><td>L</td><td>0</td><td>0</td></tr> <tr><td>U</td><td>0</td><td>0</td></tr> <tr><td>R</td><td>0</td><td>0</td></tr> <tr><td>B</td><td>0</td><td>0</td></tr> <tr><td>T</td><td>0</td><td>0</td></tr> </tbody> </table>		<MAX>	<MIN>	S	0	0	L	0	0	U	0	0	R	0	0	B	0	0	T	0	0
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S	0	0																					
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7	Input data for desired axis and press [ENTER].	<p>The axis interference area is set.</p>  <table border="1"> <thead> <tr> <th></th> <th>&lt;MAX&gt;</th> <th>&lt;MIN&gt;</th> </tr> </thead> <tbody> <tr><td>S</td><td>300</td><td>0</td></tr> <tr><td>L</td><td>0</td><td>0</td></tr> <tr><td>U</td><td>0</td><td>0</td></tr> <tr><td>R</td><td>0</td><td>0</td></tr> <tr><td>B</td><td>0</td><td>0</td></tr> <tr><td>T</td><td>0</td><td>0</td></tr> </tbody> </table>		<MAX>	<MIN>	S	300	0	L	0	0	U	0	0	R	0	0	B	0	0	T	0	0
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## Setting Axis Data by Moving Manipulator Using the Axis Key

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {INTERFERENCE}.	
3	Select the desired interference signal number.	
4	Select "METHOD."	
5	Select "CONTROL GROUP."	Operate in the same way as shown in Explanation 2 to 5 in "Number Input of Axis Data".
6	Press [MODIFY].	<p>Move cursor to "&lt;MAX&gt;" for changing maximum value and move cursor to "&lt;MIN&gt;" for changing minimum value. The cursor moves to only either "&lt;MIN&gt;" or "&lt;MAX&gt;" at this time. The cursor moves freely when this operation is canceled by pressing [CANCEL].</p> 
7	Move the manipulator using the axis keys.	Move the manipulator to the desired position using the axis keys.
8	Press [ENTER].	<p>The axis interference area is registered.</p> 

## 10.7 Interference Area

**10.7.4** Clearing Interference Area Data

	Operation	Explanation
1	Select interference signal for clearing.	<p>Select the desired interference signal number for clearing using the page key  or by number input.</p> <p>The method for number input is as follows: Move cursor to the signal number and press [SELECT] to display the number input line. Input desired signal number and press [ENTER].</p>
2	Select {DATA} under the menu.	
3	Select {CLEAR DATA}.	<p>The confirmation dialog box appears.</p> <div> </div>
4	Select "YES."	<p>All the data of the interference signal number are cleared.</p> <div> </div>



# 10.8 Work Home Position

## 10.8.1 What is the Work Home Position?

The Work Home Position is a reference point for manipulator operations. It prevents interference with peripheral device by ensuring that the manipulator is always within a set range as a precondition for operations such as starting the line. The manipulator can be moved to the set work home position by operation from the programming pendant, or by signal input from an external device. When the manipulator is in the vicinity of the work home position, the work home position signal turns ON.

## 10.8.2 Setting Work Home Position

### ■ Work Home Position Window

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {WORK HOME POSITION}.	<div>The WORK HOME POSITION window appears.<div><div>DATAEDITDISPLAYUTILITY</div><div><div>WORK HOME POSITION</div><div>INTERFERENCE SIG:HOME POSCUR POS</div><div><div>R1:S00</div><div>L00</div><div>U00</div><div>R00</div><div>B00</div><div>T00</div></div></div><div>Main MenuShortCut</div></div></div>
3	Press the page key  .	<div>When two or more manipulators exist in the system, the control group is changed using the page key  .</div>

## 10.8 Work Home Position

## ■ Registering/Changing the Work Home Position

	Operation	Explanation
1	Press the axis keys in the work home position display.	Move the manipulator to the new work home position.
2	Press [MODIFY] and [ENTER].	New work home position is set.

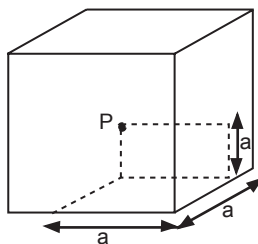
### NOTE

When the work home position is changed, the cubic interference area is automatically set as cube 32 to 29 in the base coordinate system.

- The cube 32 is for ROBOT1
- The cube 31 is for ROBOT2
- The cube 30 is for ROBOT3
- The cube 29 is for ROBOT4

The work home position cube is a cube like the one shown in the figure below; the length of its sides is determined by a parameter setting made by the user (units:  $\mu\text{m}$ ). By changing this parameter setting, the size of the cube can be changed.

S3C805 : The work home position cube length of its sides(  $\mu\text{m}$ )



Specify whether “COMMAND POSITION” or “FEEDBACK POSITION” is to be set to the work home position cube signal’s CHECK MEASURE in the interference area settings. “COMMAND POSITION” is the default setting.

## ■ Returning to the Work Home Position

### In the teach mode

	Operation	Explanation
1	Press [FWD] in the work home position display.	The manipulator moves to the new work home position. During movement, the message “Manipulator is moving to work home position” is shown. The moving speed is the selected manual speed.

### In the play mode

When the work home position return signal is input (detected at leading edge), the TCP of the manipulator is moved to the work home position using the same operation as the teach mode. However, the speed for this is set in the parameters.

## ■ Output of the Work Home Position Signal

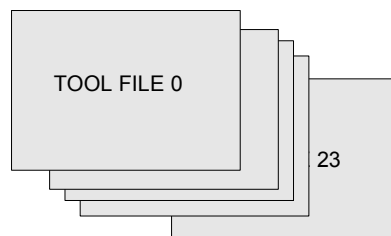
This signal is output any time the current position of the TCP of the manipulator is checked and found to be within the work home position cube.

# 10.9 Tool Data Setting

## 10.9.1 Registering Tool Files

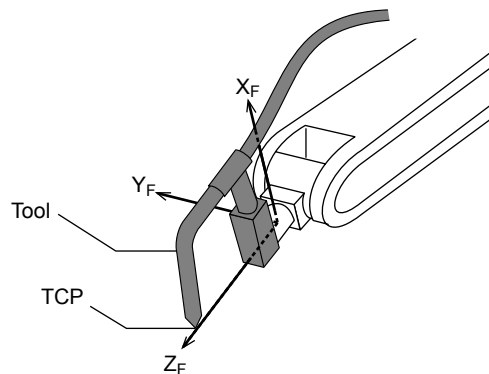
### ■ Number of Tool Files

There are 24 tool files numbered 0 to 23. Each file is called as a tool file.




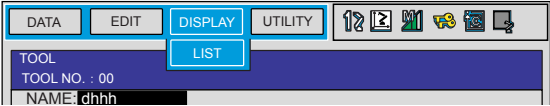
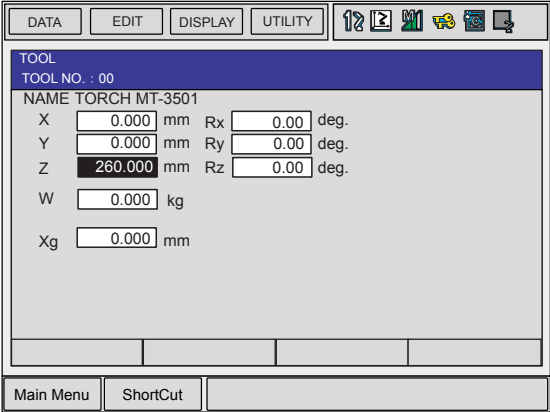
### ■ Registering Coordinate Data

When the number input operation is used for registering the tool file, input the TCP of the tool on the flange coordinates.

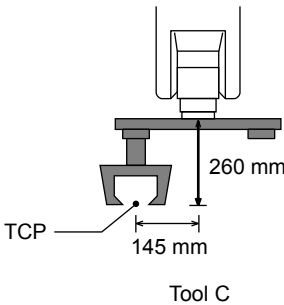
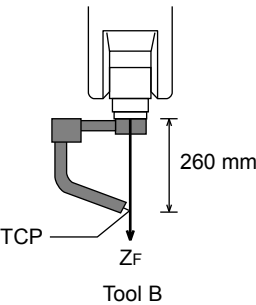
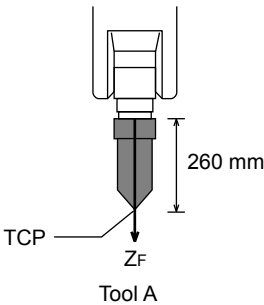


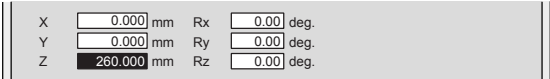
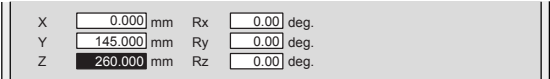
## 10.9 Tool Data Setting

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {TOOL}.	<p>The TOOL window appears. When the tool extension function is valid, the list is shown. When the tool extension function is invalid, the TOOL COORDINATE window is shown.</p> <div> </div> <p><b>Tool File Extension Function</b>  Normally, one robot uses one kind of tool file. The tool file extension function can change many tool files to be used by one robot. Use the following parameter to set this function.  S2C333: TOOL NO. SWITCHING (1: enabled, 0: disabled)  For more details, refer to "9 Parameter."</p> <div> <p>The screenshot shows the 'TOOL' window with a menu bar (DATA, EDIT, DISPLAY, UTILITY) and a toolbar. The main area displays a table with columns 'NO.' and 'NAME'. The 'NO.' column has values 00, 01, 02, 03, 04, 05, 06, and 07. The 'NAME' column has values 'TORCH MT-3501', 'TORCH MTY-3501', 'TORCH MT-3502', and empty fields for the remaining numbers. At the bottom, there are buttons for 'Main Menu' and 'ShortCut'.</p> </div> <div> <p>The screenshot shows the 'TOOL COORDINATE' window with a menu bar (DATA, EDIT, DISPLAY, UTILITY) and a toolbar. The main area displays fields for 'TOOL NO. : 00' and 'NAME: dhhh'. Below these are fields for X, Y, Z, W, Xg, Yg, Zg, Rx, Ry, Rz, lx, ly, and lz, each with a unit (mm, deg, or kg.m2). At the bottom, there are buttons for 'Main Menu' and 'ShortCut'.</p> </div>

	Operation	Explanation
3	Select the desired tool number.	When the TOOL window is shown, move the cursor and press [SELECT]. The coordinate window of the selected tool appears. If the coordinate window appears, press the page key  to select the desired tool. To switch the TOOL window and the coordinate window, press {DISPLAY} → {LIST} or {DISPLAY} → {COORDINATE DATA}. 
4	Select the desired coordinate axis to modify.	The number input line appears.
5	Input the tool data.	
6	Press [ENTER].	The tool data is registered. 

<SettingExample>



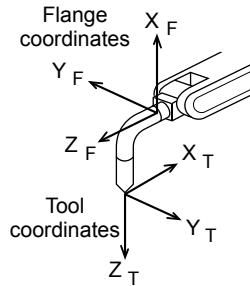
Case of Tool A, B	Case of Tool C
	

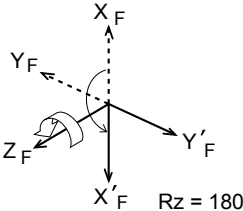
## 10.9 Tool Data Setting

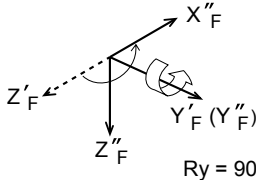
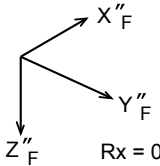
## ■ Registering Tool Angle

The tool pose data is angle data which shows the relation between the flange coordinates and the tool coordinates. The angle when the flange coordinates are rotated to meet to the tool coordinates becomes an input value. Clockwise toward the arrow is the positive direction. Register in the order of  $R_z \rightarrow R_y \rightarrow R_x$ .

The following, register  $R_z=180$ ,  $R_y=90$ ,  $R_x=0$



	Operation	Explanation																		
1	Select {ROBOT} under the main menu.																			
2	Select {TOOL}.																			
3	Select the desired tool number.	In the same way shown in Explanation 2, 3 in "■Registering Coordinate Data," the desired TOOL COORDINATE window appears.																		
4	Select the desired coordinate axis to modify.	First, select Rz.																		
5	Input the tool pose data.	Input rotation angle around $Z_F$ of the flange coordinates. <div><p><math>R_z = 180</math></p></div> <div><table><tr><td>X</td><td>0.000</td><td>mm</td><td>Rx</td><td>0.00</td><td>deg.</td></tr><tr><td>Y</td><td>0.000</td><td>mm</td><td>Ry</td><td>0.00</td><td>deg.</td></tr><tr><td>Z</td><td>0.000</td><td>mm</td><td>Rz</td><td>180.00</td><td>deg.</td></tr></table></div>	X	0.000	mm	Rx	0.00	deg.	Y	0.000	mm	Ry	0.00	deg.	Z	0.000	mm	Rz	180.00	deg.
X	0.000	mm	Rx	0.00	deg.															
Y	0.000	mm	Ry	0.00	deg.															
Z	0.000	mm	Rz	180.00	deg.															

	Operation	Explanation																																				
6	Press [ENTER].	<p>The rotation angle of Rz is registered. In the same way, register the angle of Ry,Rx. Ry must be the input rotation angle around Y'F flange coordinates.</p> <div><p>Ry = 90</p><table><tr><td>X</td><td>0.000</td><td>mm</td><td>Rx</td><td>0.00</td><td>deg.</td></tr><tr><td>Y</td><td>0.000</td><td>mm</td><td>Ry</td><td>90.00</td><td>deg.</td></tr><tr><td>Z</td><td>0.000</td><td>mm</td><td>Rz</td><td>180.00</td><td>deg.</td></tr></table></div> <p>Rx must be the input rotation angle around X'F of flange coordinates.</p> <div><p>Rx = 0</p><table><tr><td>X</td><td>0.000</td><td>mm</td><td>Rx</td><td>0.00</td><td>deg.</td></tr><tr><td>Y</td><td>0.000</td><td>mm</td><td>Ry</td><td>90.00</td><td>deg.</td></tr><tr><td>Z</td><td>0.000</td><td>mm</td><td>Rz</td><td>180.00</td><td>deg.</td></tr></table></div>	X	0.000	mm	Rx	0.00	deg.	Y	0.000	mm	Ry	90.00	deg.	Z	0.000	mm	Rz	180.00	deg.	X	0.000	mm	Rx	0.00	deg.	Y	0.000	mm	Ry	90.00	deg.	Z	0.000	mm	Rz	180.00	deg.
X	0.000	mm	Rx	0.00	deg.																																	
Y	0.000	mm	Ry	90.00	deg.																																	
Z	0.000	mm	Rz	180.00	deg.																																	
X	0.000	mm	Rx	0.00	deg.																																	
Y	0.000	mm	Ry	90.00	deg.																																	
Z	0.000	mm	Rz	180.00	deg.																																	

NOTE

If tool data is registered in the tool file by tool calibration, the old data will be deleted.

■ Setting the Tool Load Information

The tool load information includes weight, a center of gravity position, and moment of inertia at the center of gravity of the tool installed at the flange.

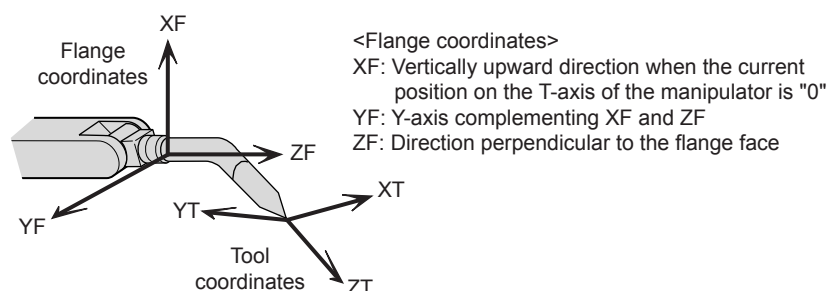
SUPPLEMENT

For more details on the tool load information, refer to " 10.11.3 Tool Load Information Setting."

## 10.9.2 Tool Calibration

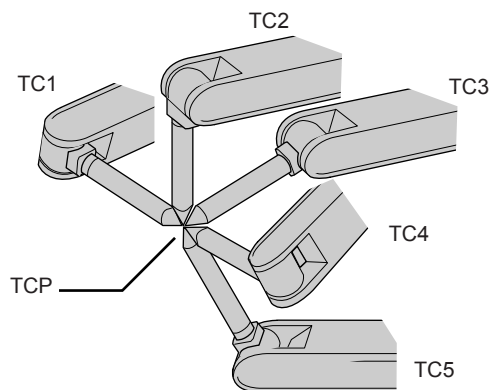
### ■ Tool Calibration

To ensure that the manipulator can perform motion type operations such as linear and circular motion type correctly, accurate dimensional information on tools such as torches, tools, and guns must be registered and the position of the TCP must be defined. Tool calibration is a function that enables this dimensional information to be registered easily and accurately. When this function is used, the TCP is automatically calculated and registered in the tool file. What is registered in tool calibration is the coordinates of the TCP in the flange coordinates.



### ■ Teaching

In order to perform tool calibration, five different angle (TC1 to 5) must be taught with the TCP as the reference point. The tool dimensions are automatically calculated on the basis of these five points.



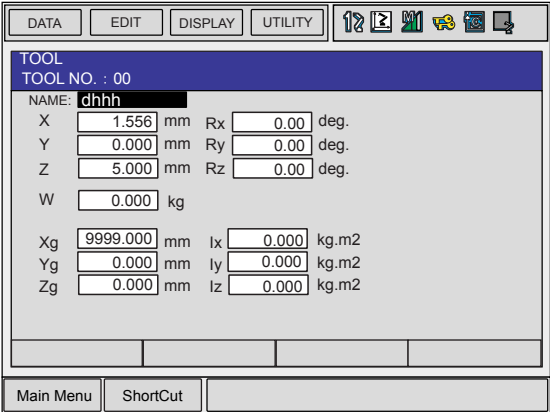
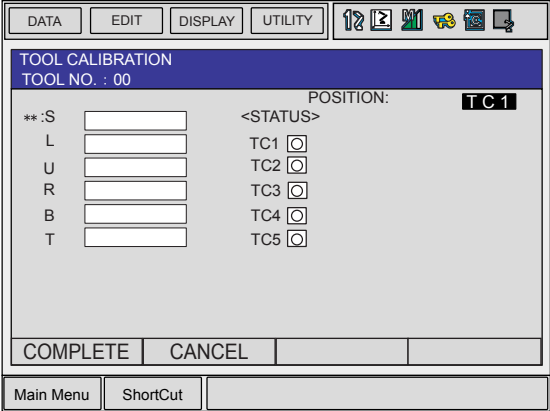
Each angle must be arbitrary. Accuracy may decrease when pose setting is rotated in a constant direction.



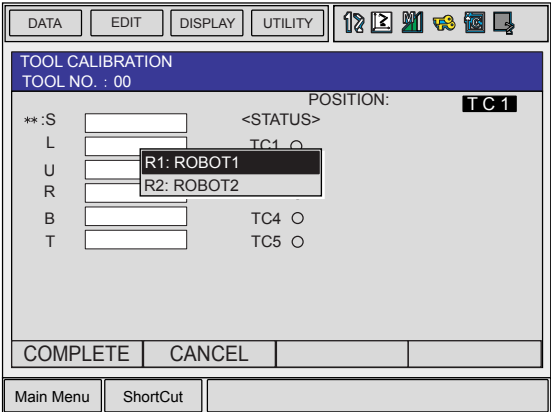
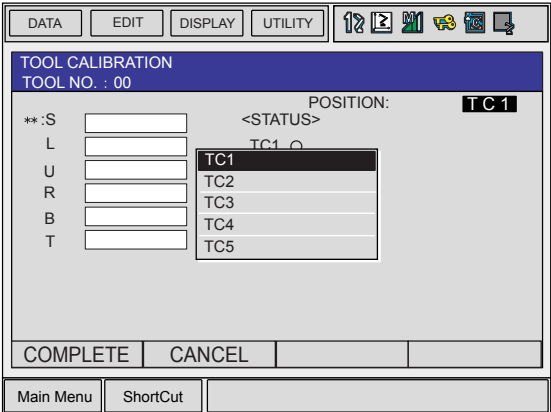
There are 24 tool files numbered 0 to 23. In a basic system with one manipulator and one tool, the tool file for tool No.0 is used. If there is more than one tool, for example when using a multihand, use the tool numbers in the order 0, 1, 2, .... etc.



Tool pose data is not registered in tool calibration. For details on how to register pose data, refer to "■Registering Tool Angle" of "10.9.1 Registering Tool Files."

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {TOOL}.	
3	Select the desired tool number.	<p>In the same way shown in Explanation 2, 3 in "■Registering Coordinate Data" of "10.9.1 Registering Tool Files," the desired coordinate window appears.</p> 
4	Select {UTILITY} under the menu.	
5	Select {CALIBRATION}.	<p>The TOOL CALIBRATION window appears.</p> 

## 10.9 Tool Data Setting

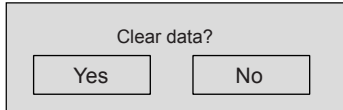
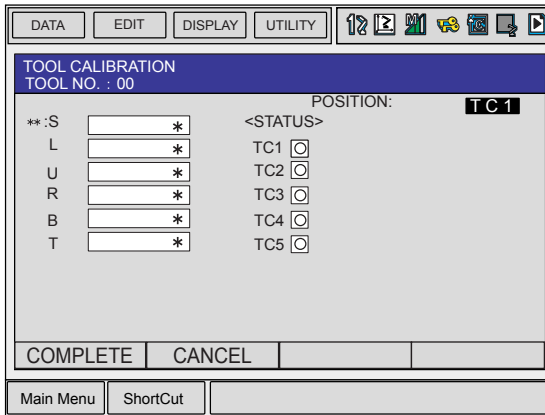
	Operation	Explanation
6	Select the robot.	<p>Select the robot to calibrate. (When the robot has already been selected or there is only one of robot, this operation should not be performed.) Select "***" in the TOOL CALIBRATION window and select the robot in the shown selection dialog box.</p> 
7	Select "POSITION."	<p>The selection dialog box appears. Select the teaching point for calibration.</p> 
8	Move the manipulator using the axis key.	

	Operation	Explanation
9	Press [MODIFY] and [ENTER].	<p>Taught position is registered.</p> <p>Repeat 7 to 9 operation to teach TC1 to TC5.</p> <p>● indicates that teaching is completed and ○ indicates that it is not completed.</p> <div><div>DATAEDITDISPLAYUTILITY123456789101112131415161718192021222324252627282930313233343536373839404142434445464748495051525354555657585960616263646566676869707172737475767778798081828384858687888990919293949596979899100</div><div><div>TOOL CALIBRATION</div><div>TOOL NO. : 00</div><div><div>**S0&lt;STATUS&gt;</div><div>L10</div><div>U1000</div><div>R53</div><div>B200</div><div>T8</div><div>POSITION:TC4</div><div>TC1●</div><div>TC2●</div><div>TC3●</div><div>TC4●</div><div>TC5○</div></div><div>COMPLETECANCEL</div></div><div>Main MenuShortCut</div></div> <p>To check the taught positions, call up the required window among TC1 to TC5 and press [FWD]. The manipulator moves to the set position.</p> <p>If there is a difference between the current position of the manipulator and the shown position data, “TC□” next to “POSITION” in the window flashes.</p>
10	Select “COMPLETE.”	<p>Calibration data is registered in the tool file. Once calibration is completed, the coordinate window appears.</p> <div><div>DATAEDITDISPLAYUTILITY123456789101112131415161718192021222324252627282930313233343536373839404142434445464748495051525354555657585960616263646566676869707172737475767778798081828384858687888990919293949596979899100</div><div><div>TOOL CALIBRATION</div><div>TOOL NO. : 00</div><div><div>X0.000 mmRx0.00 deg.</div><div>Y0.000 mmRy0.00 deg.</div><div>Z300.000 mmRz0.00 deg.</div><div>W0.000 kg</div><div>Xg0.000 mm</div></div></div><div>Main MenuShortCut</div></div>

## 10.9 Tool Data Setting

## ■ Clearing Calibration Data

Before the calibration of a new tool, clear the robot information and calibration data.

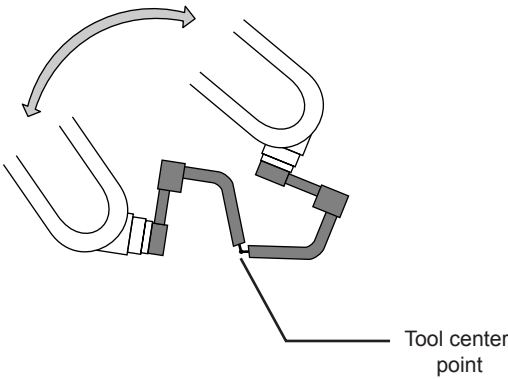
	Operation	Explanation
1	Select {DATA} under the main menu.	
2	Select {CLEAR DATA}.	The confirmation dialog box appears. 
3	Select "YES."	All data is cleared. 


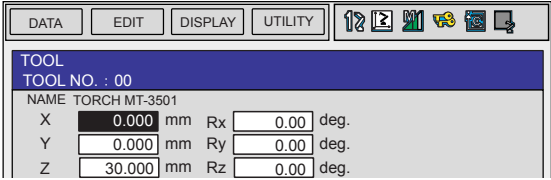

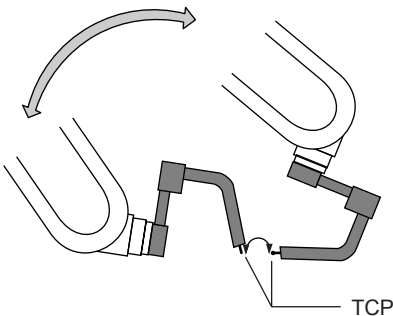


Only tool coordinate data are calculated using tool calibration. If tool angle data is required, input the data number in the coordinate window.  
Refer to "■Registering Tool Angle" of "10.9.1 Registering Tool Files" for the operation.

■ Checking the TCP

After registering the tool file, check if the TCP is correctly registered by performing a TCP fixed operation like the one shown below, in any coordinate system other than the joint.



	Operation	Explanation
1	Press [COORD].	Select any coordinate system except “  JOINT” by pressing [COORD]. 
2	Select desired tool number.	Show the coordinate window of the desired tool by pressing the page key  or selecting it in the TOOL window.
3	Move the R, B, or T axes using the axis key.	By pressing the axis keys for the R, B, and T axes, change the manipulator pose without changing the TCP position. If this operation shows a large TCP error, adjust the tool data. 



For details on TCP fixed operation, see "2.8.1 Motion about TCP."

### 10.9.3 Automatic Measurement of the Tool Load and the Center of Gravity

#### ■ What is the Automatic Measurement of the Tool Load and the Center of Gravity?

With this function, the user can register the load of tool and the position of the tools center of gravity.

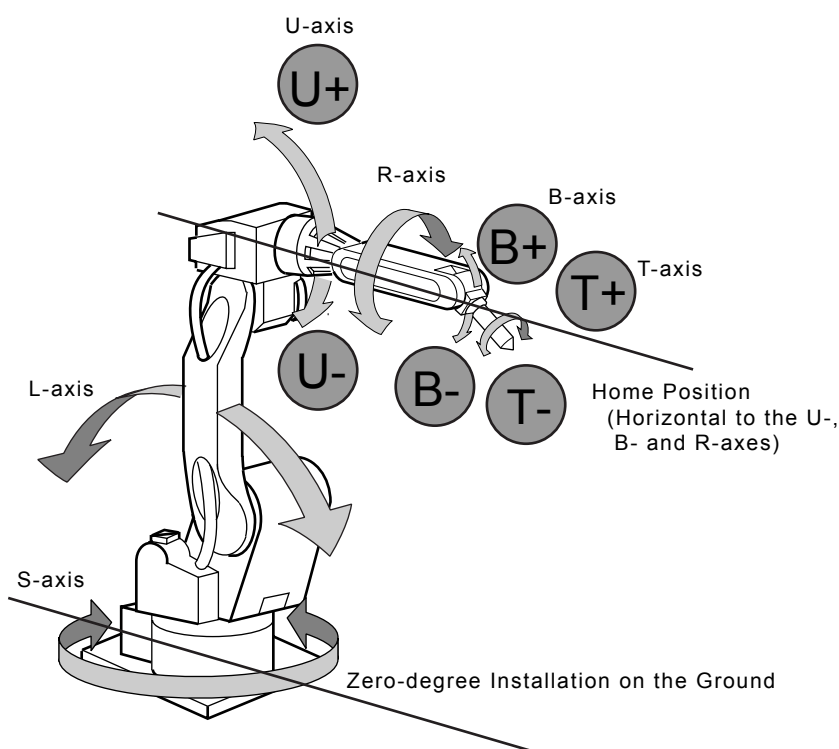
The tool load and the position of it's center of gravity are measured and registered in a tool file.




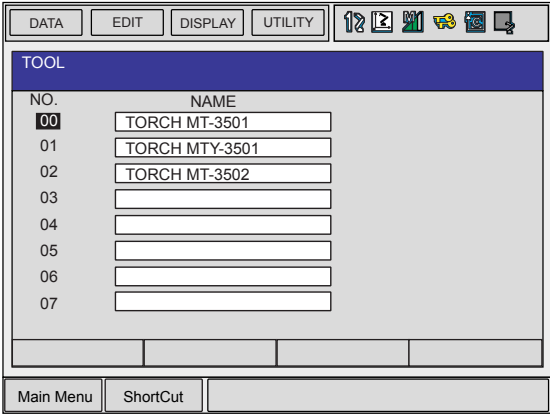
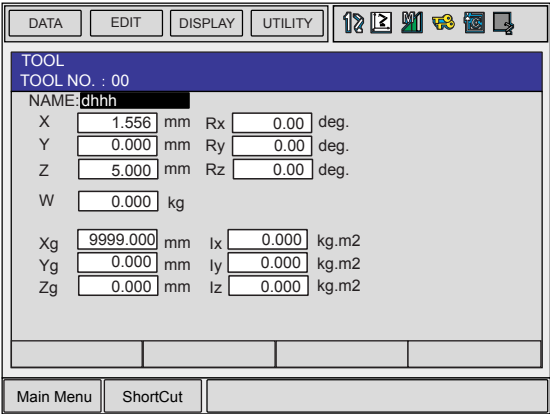

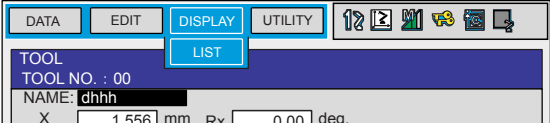
This function can be used where the manipulator is installed level on the ground.  
For the conditions required for manipulator installation, refer to "10.11 ARM Control."

#### ■ Measurement of the Tool Load and the Center of Gravity

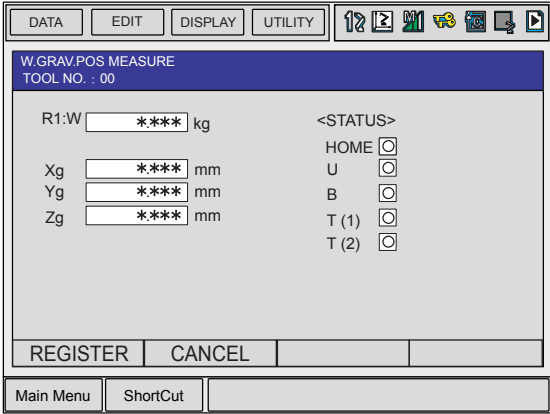


To measure the tool load and the center of gravity, move the manipulator to its home position (horizontal to the U-, B- and R-axes) and operate the U-, B- and T-axes.

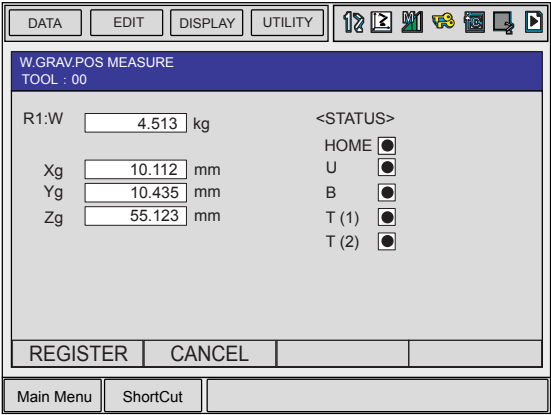


To measure the tool load or the center of gravity, remove the cables or wires connected to the tool. Otherwise, the measurements may not be correct.

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {TOOL}.	<p>The TOOL window appears. The TOOL window is called up only when the file extension function is valid. If the file extension function is invalid, the coordinate window appears.</p> <div><div></div><div><p>Tool File Extension Function</p><p>Use the following parameter to set the Tool File Extension Function.</p><p>S2C261: TOOL NO. SWITCHING</p><p>“0”: Tool switching prohibited.</p><p>“1”: Can change 24 kinds of tools numbering from 0 to 23.</p></div></div> <div></div> <div></div>
3	Select the desired tool number.	<p>Move the cursor to the desired number in the TOOL window and press [SELECT]. The coordinate window of the selected number appears. In the coordinate window, change the desired number</p> <p>by pressing the page key . To alternate between the TOOL and the coordinate window, select {DISPLAY} and {LIST}, or {DISPLAY} and {COORDINATE VALUE} under the menu.</p> <div></div>

## 10.9 Tool Data Setting

	Operation	Explanation
4	Select {UTILITY} under the menu.	
5	Select {W.GRAV.POS MEASURE}.	<p>The window for the automatic measurement of the tool load and the center of gravity appears.</p> 
6	Press the page key  .	<p>In a system with several manipulators, use the page key  to change the group to be controlled.</p>
7	Press [FWD].	Press [FWD] once, and the manipulator moves to the home position (horizontal to the U-, B- and R-axes).

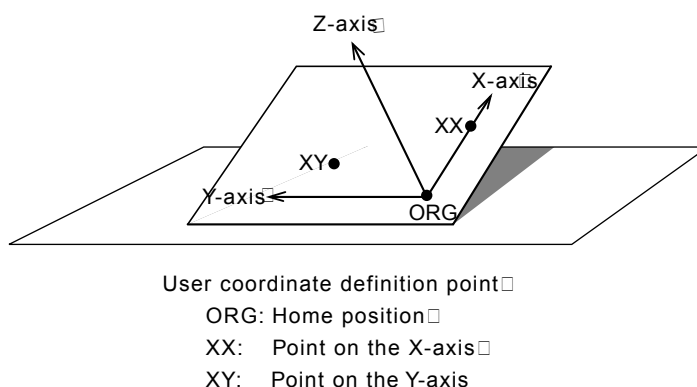
	Operation	Explanation
8	Press [FWD] again.	<p>Press [FWD] again, and measurement starts. Keep the button pressed until measurement is completed. The manipulator moves in the order listed below. Once measurement is completed, "○" changes to "●".</p> <ol style="list-style-type: none"> <li>① Measurement of the U-axis: U-axis home position + 4.5 degrees → -4.5 degrees</li> <li>② Measurement of the B-axis: B-axis home position + 4.5 degrees → -4.5 degrees</li> <li>③ First measurement of the T-axis: T-axis home position + 4.5 degrees → -4.5 degrees</li> <li>④ Second measurement of the T-axis: T-axis home position +60 degrees → + 4.5 degrees → -4.5 degrees</li> </ol> <div style="border: 1px solid black; padding: 10px; margin-top: 10px;"> <p><b>NOTE</b></p> <ul style="list-style-type: none"> <li>• The speed during measurement automatically changes to "Medium".</li> <li>• During measurement, "HOME" or "U" blinks on the screen.</li> <li>• During measurement, the [FWD] button has to be kept pressed. If the button is released during measurement or if it is released before "○" changes into "●", measurement is aborted and the following message appears. "Stopped measurement" Measurement starts again from the first home position.</li> </ul> </div> <p>When all measurements are completed or when all the "○" marks have changed into "●", the measurements appears on the screen.</p>  <p>The screenshot shows a screen titled "W.GRAV.POS MEASURE" with "TOOL : 00". It displays measurement results for R1:W (4.513 kg), Xg (10.112 mm), Yg (10.435 mm), and Zg (55.123 mm). On the right, under "&lt;STATUS&gt;", there are checkboxes for HOME, U, B, T (1), and T (2), all of which are checked. At the bottom, there are buttons for "REGISTER", "CANCEL", "Main Menu", and "ShortCut".</p>
9	Select "REGISTER."	<p>The measurements are registered in the tool file, and the coordinate window are shown. Select "CANCEL" to call up the TOOL window without registering the measurements in the tool file.</p>

## 10.10 User Coordinates Setting

### 10.10.1 User Coordinates

#### ■ Definition of User Coordinates

User coordinates are defined by three points that have been taught to the manipulator through axis operations. These three defining points are ORG, XX, and XY, as shown in the diagram below. These three points of positional data are registered in a user coordinate file.



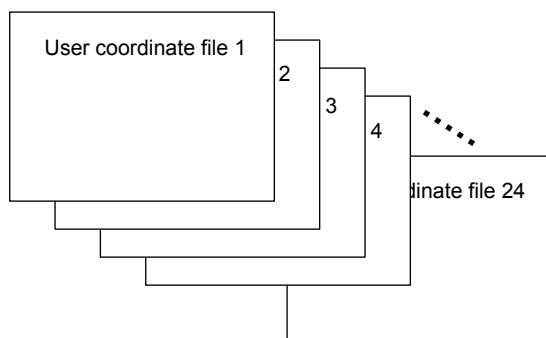
ORG is the home position, and XX is a point on the X-axis. XY is a point on the Y-axis side of the user coordinates that has been taught, and the directions of Y- and Z-axes are determined by point XY.

#### NOTE

It is important that the two points ORG and XX be taught accurately.

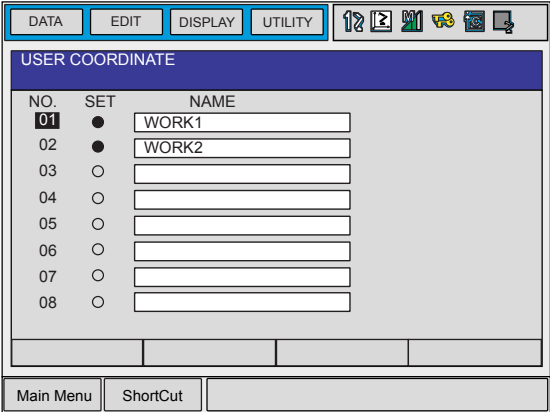
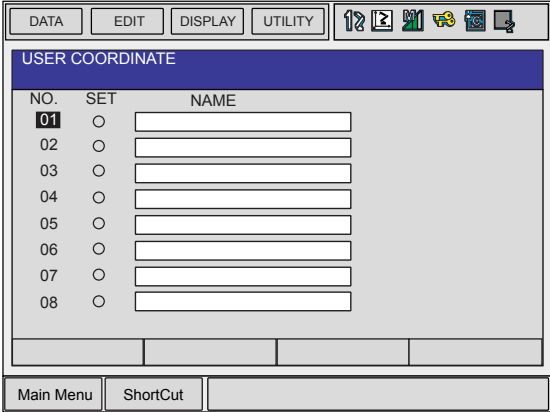
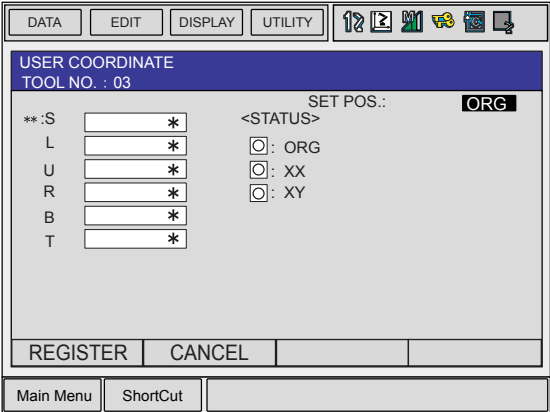
#### ■ User Coordinates File

Up to 24 kinds of user coordinates can be registered. Each coordinate has a user coordinate No. and is called a user coordinate file.



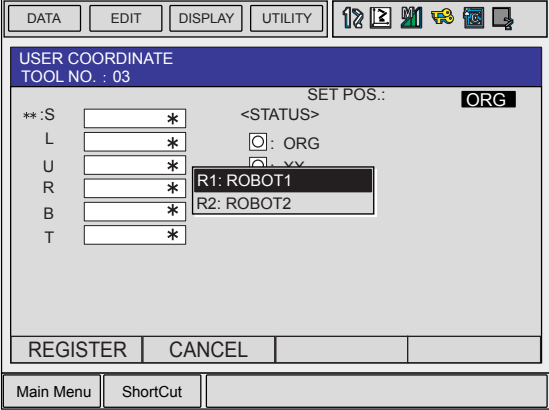
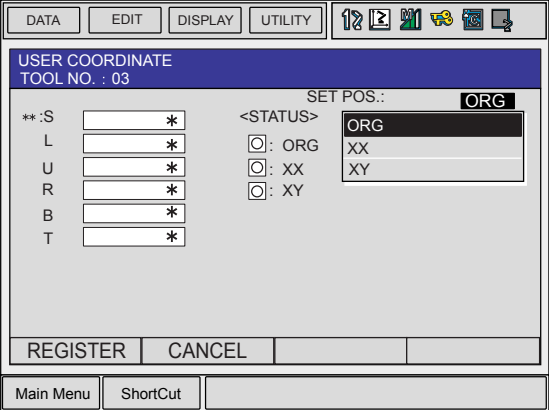
10.10.2 User Coordinates Setting

■ Selecting User Coordinates File

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {USER COORDI-NATE}.	<div>The USER COORDINATE window appears.</div> <div></div> <div>● indicates that the user coordinates is completed to set and ○ indicates that it is not completed. To check the position of the user coordinates select {DISPLAY} → {COORDINATE DATA}. The following window appears.</div> <div></div>
3	Select desired user coordinate number.	<div>Select the desired user coordinate number for setting in the USER COORDINATE window. The following window appears.</div> <div></div>

## 10.10 User Coordinates Setting

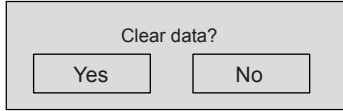
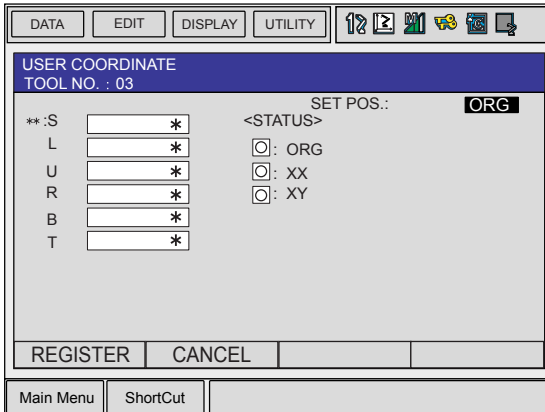
## Teaching User Coordinates

	Operation	Explanation
1	Select the robot.	<p>Select the robot for teaching user coordinates. (When the robot has already been selected or there is only one robot, this operation should not be performed.) Select "***" in the following window and select the robot in the shown selection dialog box. The robot is registered.</p> 
2	Select "SET POS."	<p>The selection dialog box appears. Select the teaching point.</p> 
3	Move the manipulator using the axis key.	

	Operation	Explanation																											
4	Press [MODIFY] and [ENTER].	<p>Taught position is registered.</p> <p>Repeat 2 to 4 operation to teach ORG, XX and XY.</p> <p>● indicates that teaching is completed and ○ indicates that it is not completed.</p> <div><div>DATAEDITDISPLAYUTILITY12345678910</div><div>USER COORDINATE USER COORDINATE NO. : 03</div><div><div>SET POS.: XY</div><div>** : S0&lt;STATUS&gt; L10● : ORG U100● : XX R53● : XY B200 T8</div></div><div>REGISTERCANCEL</div><div>Main MenuShortCut</div></div> <p>To check the taught positions, call up the required window among ORG to XY and press [FWD]. The manipulator moves to the set position.</p> <p>If there is a difference between the current position of the manipulator and the shown position data, “ORG”, “XX”, or “XY” flashes.</p>																											
5	Select “COMPLETE.”	<p>User coordinates are registered in the file. Once the user coordinate setting is completed, the following window appears.</p> <div><div>DATAEDITDISPLAYUTILITY12345678910</div><div>TOOL</div><div><table><tr><th>NO.</th><th>SET</th><th>NAME</th></tr><tr><td>01</td><td>●</td><td>WORK1</td></tr><tr><td>02</td><td>●</td><td>WORK2</td></tr><tr><td>03</td><td>○</td><td></td></tr><tr><td>04</td><td>●</td><td>WORK3</td></tr><tr><td>05</td><td>○</td><td></td></tr><tr><td>06</td><td>○</td><td></td></tr><tr><td>07</td><td>○</td><td></td></tr><tr><td>08</td><td>○</td><td></td></tr></table></div><div></div><div>Main MenuShortCut</div></div>	NO.	SET	NAME	01	●	WORK1	02	●	WORK2	03	○		04	●	WORK3	05	○		06	○		07	○		08	○	
NO.	SET	NAME																											
01	●	WORK1																											
02	●	WORK2																											
03	○																												
04	●	WORK3																											
05	○																												
06	○																												
07	○																												
08	○																												

## 10.10 User Coordinates Setting

## ■ Clearing User Coordinates

	Operation	Explanation
1	Select {DATA} under the main menu.	
2	Select {CLEAR DATA}.	<p>The confirmation dialog box appears.</p> 
3	Select "YES."	<p>All data is cleared.</p> 

## 10.11 ARM Control

### 10.11.1 ARM Control

In NX100, the operation performance of the robot which satisfies various demands on the production site such as the improvement of the path accuracy and the cycle time shortening is achieved by adopting the ARM(Advanced Robot Motion) control which Yaskawa originally developed.

The moment of inertia and the gravity moment etc. of each axis are calculated in the ARM control, and NX100 controls robot motion according to it. It is necessary to set the Robot setup condition and the tool load information to request these accurately.

The robot setup condition is robot installation angle relative to ground and the weight and a center of gravity position of the load installed at each part of robot, etc.

The tool load information is weight, a center of gravity position, and moment of inertia at the center of gravity, of the tool installed at the flange.

It is necessary to set these information correctly to do a better operation control by the ARM control.

### 10.11.2 ARM CONTROL Window

In ARM CONTROL window, the robot setup condition etc. are set.



#### CAUTION

- **Set the robot setup condition exactly.**

Set the robot setup condition very noting of mistake the unit, the value or the positive and negative of number.

An appropriate operation control cannot be done, decrease the speed reducer longevity, or occur the alarm when these are not correctly set.

- **Confirm the operation path of robot of each job when you change setting.**

Set the robot setup condition when you basically set up the robot.

Confirm the operation path of robot of each job afterwards when you change the setting unavoidably.

Injury or damage to machinery may result by collision between tool and positioner because the operation path might be changed slightly when the setting about the ARM control is changed.

## ■ Robot Setup Condition

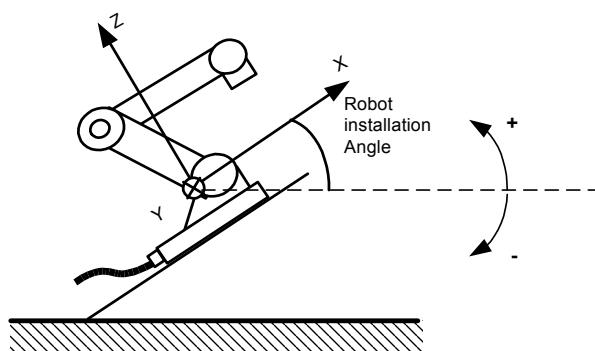
It is necessary to set the following robot setup condition to execute the ARM control appropriately.

- Robot installation angle
- S-head payload
- U-arm payload

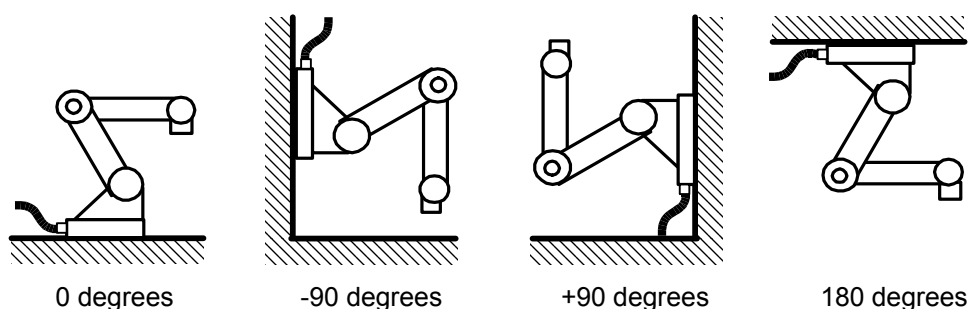
### Robot installation angle

The angle of the manipulator installed relative to ground is set in **ANGLE REL. TO GROUND** to calculate the gravity moment which loads to each axis of the manipulator.

The robot installation angle sets how much X axis of the robot coordinates has inclined with the earth around Y axis of the robot coordinates. The direction of + in the U axis operation from the home position posture of the manipulator becomes direction of + of the robot installation angle. Therefore, the robot installation angle for a vertical downward wall mount specification becomes -90 degrees.



<Example>



Because the gravity moment which loads to each axis can't be calculated correctly when this value is not correctly set, it can not be possible to control the manipulator appropriately. Set the value correctly. Especially, note the direction "+" or "-".

#### NOTE

Only rotation angle around Y axis of the robot coordinates can be set in the robot installation angle.  
Contact YASKAWA representative when robots is installed to incline Y axis of the robot coordinates relative to ground.

## S-head payload

Set the weight and the center of gravity position roughly when the equipment such as transformer is installed at the S-head.

It is not necessary to set these value when there is no installed load at the S-head.

### WEIGHT (Unit:kg)

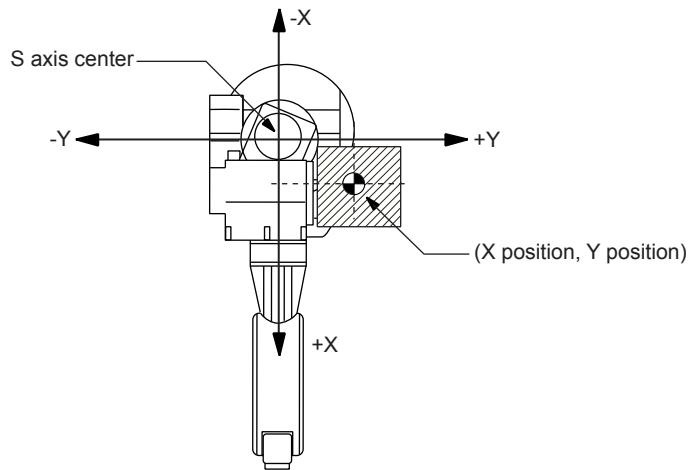
The weight of the installed load is set.

Set a little large value though it does not care by a rough value. (Rase to a unit in each 0.5 to 1kg)

### X (From S-Axis). Y (From S-Axis) (unit: mm)

The center of gravity position of the installed load is set by the distance in the direction of X and the direction of Y from S axis center here. It does not care by a rough value.

The direction of X and Y applies to the robot coordinates. The value is set by a negative number when the position is in “-” direction.



Load at S-head (Top View)

## U-arm payload

Set the weight and the center of gravity position roughly when the equipment such as the wire supplying motors is installed on U arm.

A standard value is set when shipping from the factory.

Set the weight in “0” if there is no installing equipment on U arm.

### WEIGHT (Unit:kg)

The weight of the installing load is set here.

Set a little large value though it does not care by a rough value. (Rase to a unit in each 0.5 to 1kg)

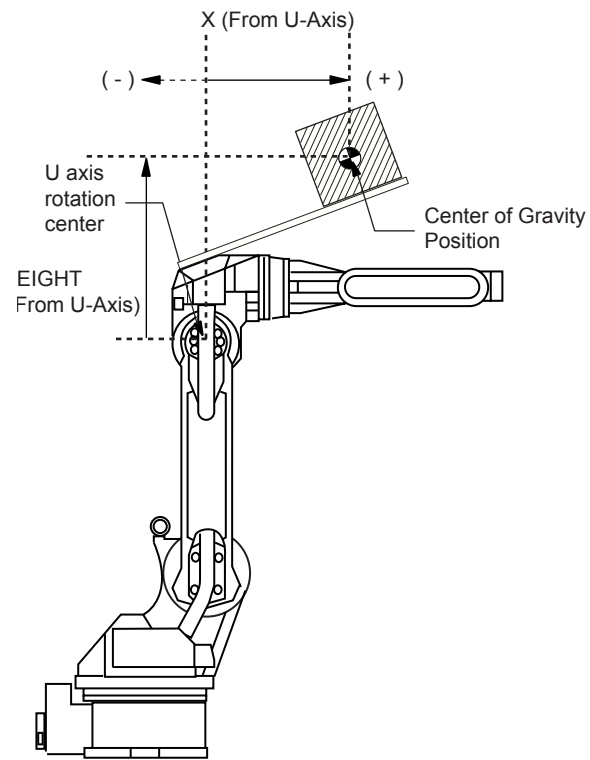
### X (From U-Axis). HEIGHT (From U-Axis) (unit: mm)

The center of gravity position of the installing load is set here. It does not care by a rough value.

X (From U-Axis) is horizontal distance from U axis rotation center to the center of gravity position of the load. Set negative number when there is mass side in the back from U axis rotation center.

HEIGHT (From U-Axis) is height of the vertical direction from U axis rotation center to the center of gravity position of the load.

## 10.11 ARM Control




Load on U arm : Center of gravity position (Side View )

■ Setting

NOTE

The ARM CONTROL window is shown only when the security mode is set as management mode.

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {ARM CONTROL}.	<div>The ARM CONTROL window appears.<div><div>DATAEDITDISPLAYUTILITY</div><div>ARM CONTROL CONTROL GROUP: ROBOT1</div><div>&lt;ROBOT SETUP CONDITION&gt; ANGLE REL. TO GROUND 0 deg. S-HEAD PAYLOAD WEIGHT 0.000 kg X (FROM S-AXIS) 0 mm Y (FROM S-AXIS) 0 mm U-ARM PAYLOAD WEIGHT 9.000 kg X (FROM U-AXIS) 12 mm HEIGHT (FROM U-AXIS) 198 mm</div><div>Main MenuShortCut</div></div></div>
3	Press the page key  .	Select the desired control group when there are two or more group axes.
4	Select the desired item.	
5	Input the value and press [ENTER].	

## 10.11.3 Tool Load Information Setting



### CAUTION

- **Set the tool load information correctly.**

The speed reducer longevity might decrease or the alarm might occur when the tool load information is not set correctly.

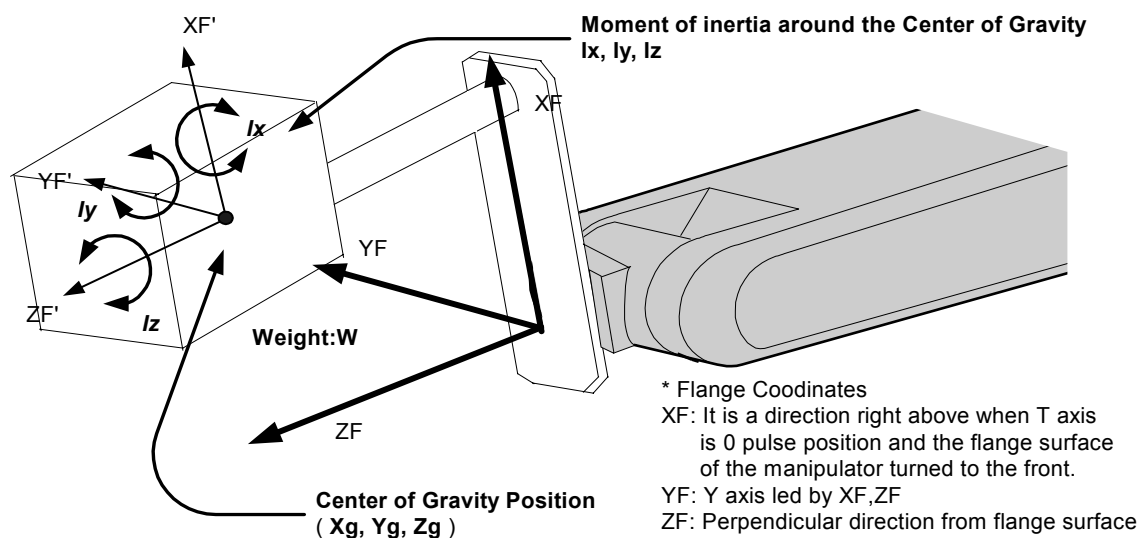
- **Confirm the operation path of robot of each job which uses the tool file after the tool load information is changed.**

Set the tool load information basically before teaching the job after the tool is installed. Confirm the operation path of each job which uses the tool file when the tool load information is changed after teaching, unavoidably.

Injury or damage to machinery may result by collision between tool and positioner because the operation path might be changed slightly when the tool load information is changed.

### ■ Tool Load Information

Tool load information includes weight, a center of gravity position, and moment of inertia at the center of gravity of the tool installed at the flange. These are registered in the tool file.



### ■ How to Calculate Tool Load Information

#### Weight : $W$ (Unit:kg)

The total weight of the installing tool is set.

Set a little large value though it does not care by a rough value. Rase to a unit in each 0.5 to 1kg for small or middle robot and rase to a unit in each 1 to 5kg for large robot.

### Center of gravity position : $x_g, y_g, z_g$ (Unit : mm)

The center of gravity position of the installed tool is set as the position in the flange coordinates.

It does not care by setting a rough value because it is usually difficult to get a strict center of gravity position. Presume and set a center of gravity position roughly from outline of the tool. Set the value when the center of gravity position of the installed tool is clear from specifications etc.

### moment of inertia at the center of gravity: $I_x, I_y, I_z$ (Unit : $\text{kg}\cdot\text{m}^2$ )

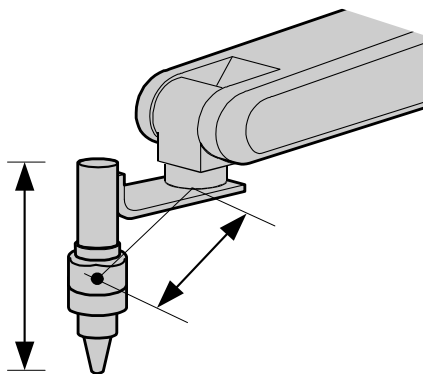
It is an moment of inertia of the tool at the center of gravity position.

The value is calculated around the each axis of the coordinates which is in parallel to the flange coordinates and which home position is the center of gravity position of the tool.

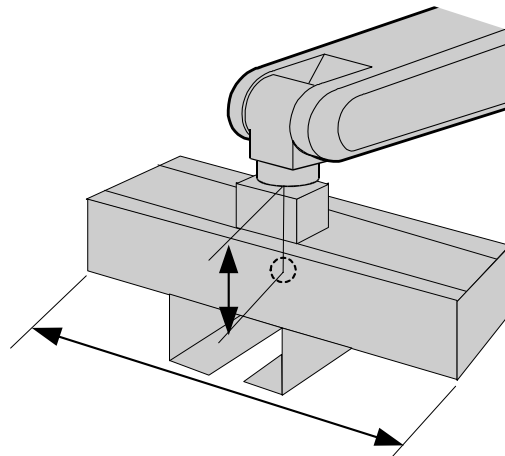
Set a little large value though it does not care by a rough value.

This setting is used to calculate the moment of inertia which loads to each axis of the manipulator. However, the moment of inertia at the center of gravity need not usually set because this data is small enough to the moment of inertia calculated from weight and the center of gravity position.

Only when the moment of inertia of the tool is large (The size of the tool is, as a standard, in case of about twice or more the distance from the flange to the center of gravity position), this setting is needed.



The size of the tool is not too big.  
Setting the moment of inertia at center of gravity is not necessary.



The size of the tool is big enough.  
Setting the moment of inertia at center of gravity is necessary.

Rough value of the moment of inertia at the center of gravity can be calculated by followings methods.

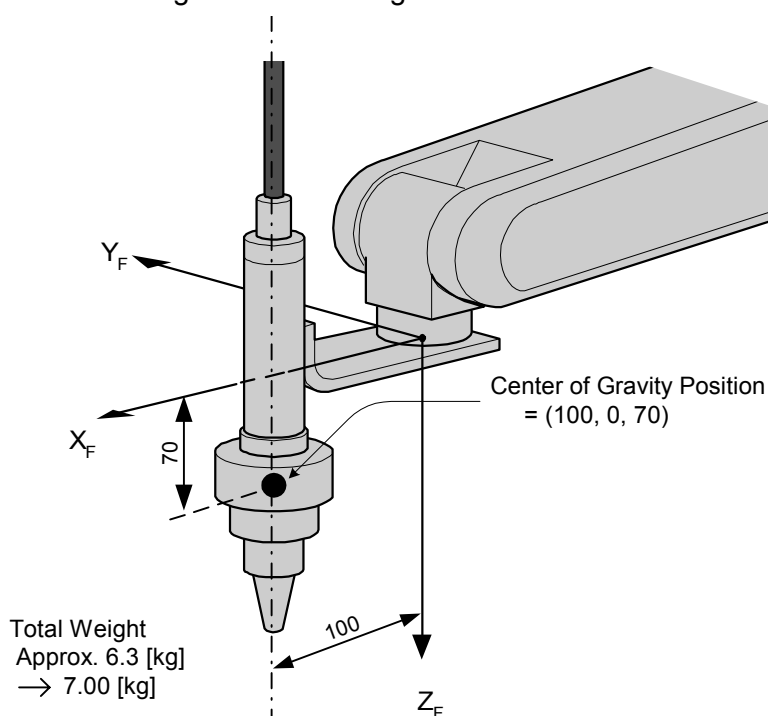
- Method to approximate the entire tool in hexahedron or cylinder.
- Method to calculate from each weight and center of gravity position of plural mass.

Refer to the following setting examples for details.

**<Example1>**

In the example of sealing gun of the figure below, it is assumed that there is center of gravity in the position where inclined to head from the center a little, and sets the center of gravity position on the flange coordinates.

There is no problem even if the moment of inertia at the center of gravity is not set because the size of the gun is not too large.

**<Setting>**

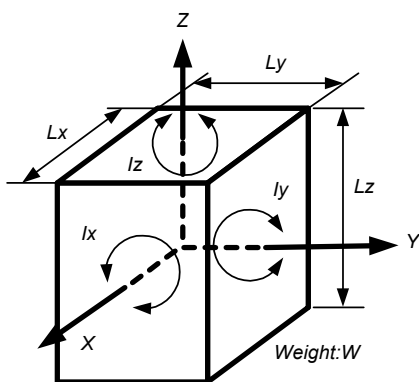
- W : 7.000 kg
- Xg : 100.000 mm
- Yg : 0.000 mm
- Zg : 70.000 mm
- Ix : 0.000 kg·m<sup>2</sup>
- Iy : 0.000 kg·m<sup>2</sup>
- Iz : 0.000 kg·m<sup>2</sup>



• The own moment of inertia calculation for hexahedron and cylinder

The own moment of inertia of hexahedron and cylinder can be calculated by the next expression when the center of gravity is at the center.

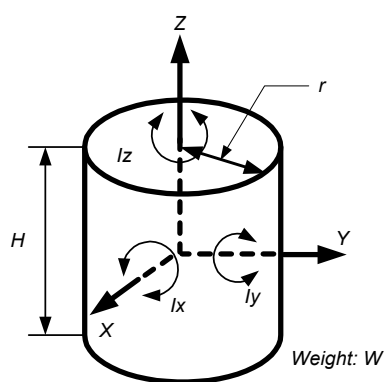
Refer to the expression when the calculation of the moment of inertia at the center of gravity.



$$I_x = \frac{Ly^2 + Lz^2}{12} * W$$

$$I_y = \frac{Lx^2 + Lz^2}{12} * W$$

$$I_z = \frac{Lx^2 + Ly^2}{12} * W$$



$$I_x = I_y = \frac{3r^2 + H^2}{12} * W$$

$$I_z = \frac{r^2}{2} * W$$

\* Unit of Weight : [kg]

\* Unit of Length : [m]

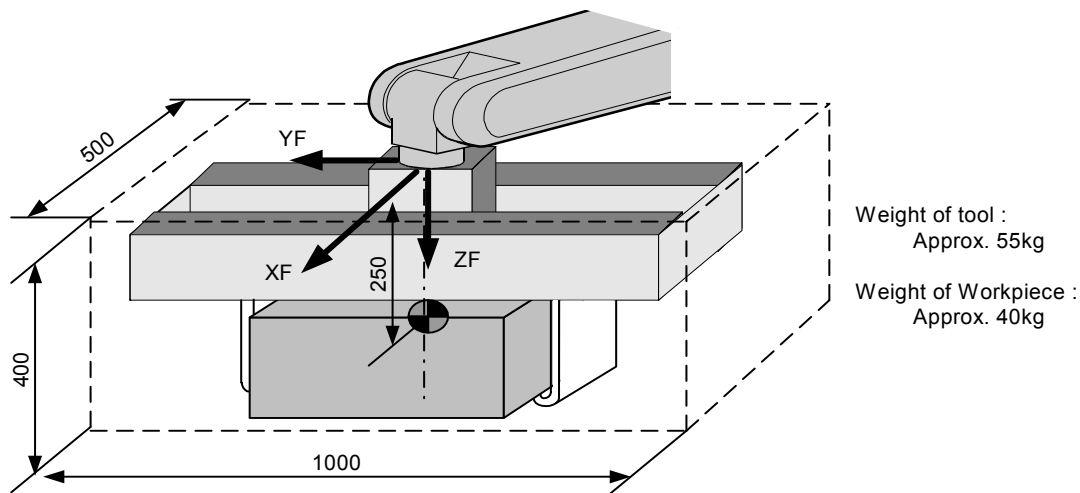
\* Unit of Ix, Iy, Iz : [kg·m<sup>2</sup>]

**<Example 2>**

It is necessary to set the moment of inertia at the center of gravity when the entire size of the tool and workpiece is large enough comparing with the distance from the flange to the center of gravity position.

Calculate the moment of inertia at the center of gravity roughly from the expression (Refer to the above-mentioned supplement: "The own moment of inertia calculation for hexahedron and cylinder"), by approximating the entire tool in the shape of the hexahedron or the cylinder.

If the weight of held workpiece is greatly different like in the handling usage etc, it is more effective to set tool load information on each workpiece and to switch the tool on each step according to the held workpiece. Set the tool load information in the state to hold the heaviest workpiece when the tool is not switched.



Weight :  $W = 55 + 40 = 95$   
= approx. 100[kg]

Center of gravity : Position at flange right under 250mm almost  
(Xg, Yg, Zg) = (0,0,250)

Moment of inertia at the center of gravity :

The hexahedron of 0.500 x 0.400 x 1.000[m] which encloses the entire tool + workpiece is assumed.

By the expression to calculate the own moment of inertia of hexahedron,

$$I_x = (L_y^2 + L_z^2 / 12) * W$$

$$= ((0.400^2 + 1.000^2) / 12) * 100 = 9.667 = \text{approx. } 10.000$$

$$I_y = (L_x^2 + L_z^2 / 12) * W = ((0.500^2 + 0.400^2) / 12) * 100 = 3.417 = \text{approx. } 3.500$$

$$I_z = (L_x^2 + L_y^2 / 12) * W = ((0.500^2 + 1.000^2) / 12) * 100 = 10.417 = \text{approx. } 10.500$$

<Setting>

- W : 100.000 kg
- Xg : 0.000 mm
- Yg : 0.000 mm
- Zg : 250.000 mm
- Ix : 10.000 kg.m<sup>2</sup>
- Iy : 3.500 kg.m<sup>2</sup>
- Iz : 10.500 kg.m<sup>2</sup>



- How to calculate "Center of gravity position" and "moment of inertia at center of gravity" for plural mass

The center of gravity position and the moment of inertia at the center of gravity of the entire tool can be calculated by the weight and the center of gravity position of each mass when the tool can be thought that the tool consists of two or more big mass like the twin gun system etc.

1. Divide the tool into some parts as the weight and the center of gravity position can be roughly presumed. It is not necessary to divide in detail. The tool is approximated in construction of rough parts.
2. Calculate the weight and the center of gravity position of the each parts on flange coordinates. It does not care by a rough value. Calculate the own moments of inertia of the big parts. (If parts are small, it is not necessary to calculate the own moments of inertia. Refer to above-mentioned supplement : "The own moment of inertia calculation for hexahedron and cylinder" for how to calculate the own moment of inertia.)

$w_i$  : Weight of the i-th parts [kg]

$(x_i, y_i, z_i)$  : Center of gravity position of the i-th parts (On flange coordinates)[mm]

$I_{cxi}, I_{c yi}, I_{c zi}$  : Own moments of inertia of the i-th parts [kg\*m<sup>2</sup>]

3. The center of gravity position of the entire tool is calculated by the next expression.

$$x_g = \{w_1 * x_1 + w_2 * x_2 + \dots + w_i * x_i\} / (w_1 + w_2 + \dots + w_i)$$

$$y_g = \{w_1 * y_1 + w_2 * y_2 + \dots + w_i * y_i\} / (w_1 + w_2 + \dots + w_i)$$

$$z_g = \{w_1 * z_1 + w_2 * z_2 + \dots + w_i * z_i\} / (w_1 + w_2 + \dots + w_i)$$

4. The moment of inertia at the center of gravity position of the entire tool is calculated by the next expression.

$$\begin{aligned} I_x = & \{ w_1 * ((y_1 - y_g)^2 + (z_1 - z_g)^2) * 10^{-6} + I_{cx1} \} \\ & + \{ w_2 * ((y_2 - y_g)^2 + (z_2 - z_g)^2) * 10^{-6} + I_{cx2} \} \\ & \dots \dots \dots \\ & + \{ w_i * ((y_i - y_g)^2 + (z_i - z_g)^2) * 10^{-6} + I_{cxi} \} \end{aligned}$$

$$\begin{aligned} I_y = & \{ w_1 * ((x_1 - x_g)^2 + (z_1 - z_g)^2) * 10^{-6} + I_{cy1} \} \\ & + \{ w_2 * ((x_2 - x_g)^2 + (z_2 - z_g)^2) * 10^{-6} + I_{cy2} \} \\ & \dots \dots \dots \\ & + \{ w_i * ((x_i - x_g)^2 + (z_i - z_g)^2) * 10^{-6} + I_{c yi} \} \end{aligned}$$

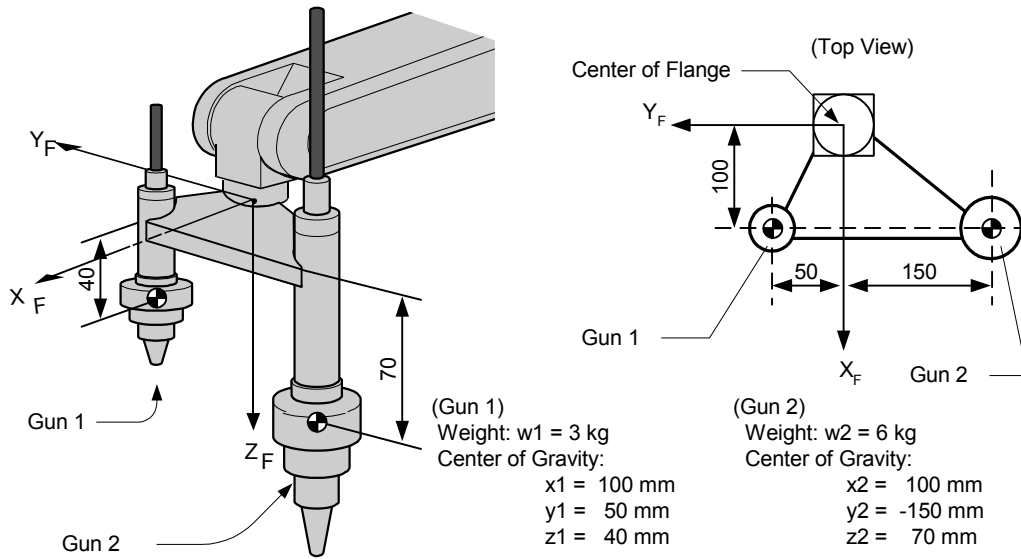
$$\begin{aligned} I_z = & \{ w_1 * ((x_1 - x_g)^2 + (y_1 - y_g)^2) * 10^{-6} + I_{cz1} \} \\ & + \{ w_2 * ((x_2 - x_g)^2 + (y_2 - y_g)^2) * 10^{-6} + I_{cz2} \} \\ & \dots \dots \dots \\ & + \{ w_i * ((x_i - x_g)^2 + (y_i - y_g)^2) * 10^{-6} + I_{c zi} \} \end{aligned}$$

**<Example 3>**

When there is two or more big mass like the twin gun system like the figure below,

1. Set the center of gravity position when the center of gravity position of the entire tool is roughly understood, and set the moment of inertia at the center of gravity calculated by approximating the entire tool in the shape of hexahedron or cylinder. (It is enough in this setting usually)
2. Or, when weight in each mass and the center of gravity position are understood, the center of gravity position and the moment of inertia at the center of gravity of the entire tool can be calculated. (Refer to above-mentioned supplement: "How to calculate "Center of gravity position" and "moment of inertia at the center of gravity" for plural mass")

How by the method of 2 to calculate the value is shown here.



Weight :  $W = w_1 + w_2$

$$= 3 + 6 = 9 = \text{approx. } 10[\text{kg}]$$

Center of gravity  $X_g = (w_1 * x_1 + w_2 * x_2) / (w_1 + w_2)$

$$= (3 * 100 + 6 * 100) / (3+6) = 100.0 [\text{mm}]$$

$$Y_g = (3 * 50 + 6 * (-150)) / (3+6) = -83.333 [\text{mm}]$$

$$Z_g = (3 * 40 + 6 * 70) / (3+6) = 60.0 [\text{mm}]$$

The moment of inertia at the center of gravity position :

$$\begin{aligned} I_x &= \{ w_1 * ((y_1 - Y_g)^2 + (z_1 - Z_g)^2) * 10^{-6} + I_{cx1} \} \\ &+ \{ w_2 * ((y_2 - Y_g)^2 + (z_2 - Z_g)^2) * 10^{-6} + I_{cx2} \} \\ &= 3 * ((50 - (-83))^2 + (40 - 60)^2) * 10^{-6} \\ &+ 6 * (((-150) - (-83))^2 + (70 - 60)^2) * 10^{-6} \\ &= 0.082 = \text{approx. } 0.100 \end{aligned}$$

$$\begin{aligned} I_y &= 3 * ((100 - 100)^2 + (40 - 60)^2) * 10^{-6} \\ &+ 6 * ((100 - 100)^2 + (70 - 60)^2) * 10^{-6} \\ &= 0.002 = \text{approx. } 0.010 \end{aligned}$$

$$\begin{aligned} I_z &= 3 * ((100 - 100)^2 + (50 - (-83))^2) * 10^{-6} \\ &+ 6 * ((100 - 100)^2 + ((-150) - (-83))^2) * 10^{-6} \\ &= 0.080 = \text{approx. } 0.100 \end{aligned}$$

---

10.11 ARM Control

---

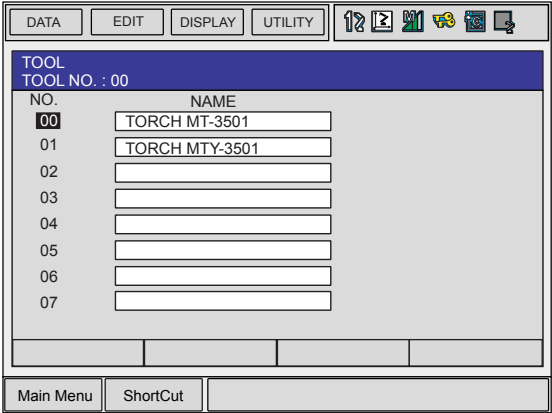
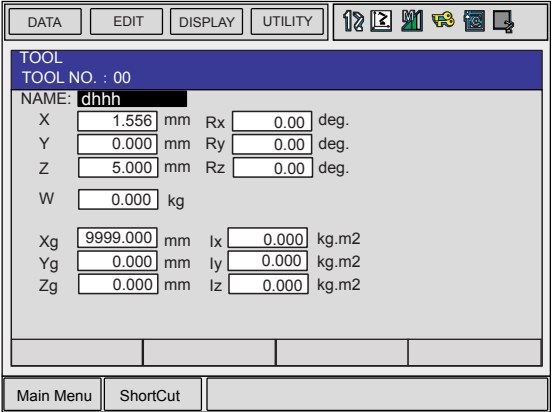

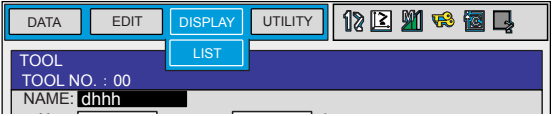
\* Here, the own moment of inertia ( $I_{cxi}, I_{c yi}, I_{c zi}$ ) of the gun is disregarded, because each gun are smaller enough than the entire tool.

<Setting>

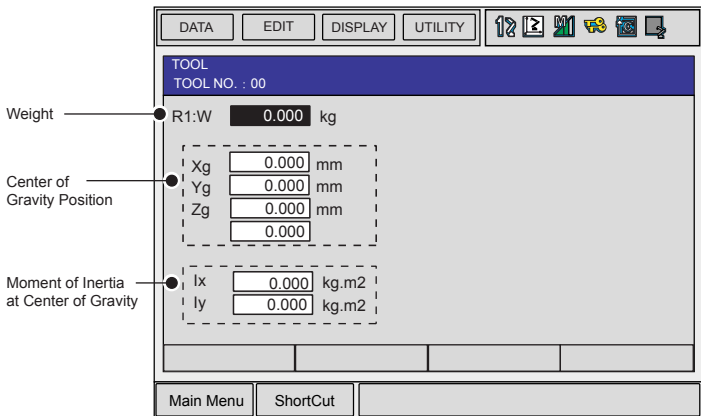
- W : 10.000 kg
- Xg : 100.000 mm
- Yg : -83.333 mm
- Zg : 60.000 mm
- Ix : 0.100 kg.m<sup>2</sup>
- Iy : 0.010 kg.m<sup>2</sup>
- Iz : 0.100 kg.m<sup>2</sup>

■ Tool load Information registering

Tool load Information is registered in the tool file.

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {TOOL}.	<p>The TOOL window appears. Only when the file expansion function is valid, the TOOL window appears. When the file expansion function is invalid, the coordinate window appears.</p> <div></div> <div></div>
3	Select the desired tool number.	<p>Move the cursor to the number of the desired tool, and press [SELECT] in the TOOL window. The coordinate window of the selected number appears. Select the desired number with page</p> <div></div> <p>key in the coordinate window.</p> <p>Select { DISPLAY } → { LIST } or { DISPLAY } → { COORDINATE DATA } under the menu in order to switch between the TOOL window and the coordinate window.</p> <div></div>

## 10.11 ARM Control

	Operation	Explanation
4	Select the desired item to register and input the value.	<p>The window can be scrolled by the cursor. The menu enters the state of a numeric input if the cursor is on the desired item to register and the [SELECT] is pressed.</p> 
5	Press [ENTER].	<p>The input value is registered. The servo power is automatically turned off when editing the value during the servo power turned on, and the message "Servo off by changing data " is shown for three seconds.</p>



- When the data setting is not done

It is considered that data is not set correctly in tool load information in the following cases.

- When the weight (W) is "0".
- When the center of gravity position (Xg, Yg, Zg) are all "0".

In these cases, the manipulator is controlled by using the standard parameter value (Differ in each robot model) which were set when shipping.

Standard Value.....Weight : W = Payload

Center of gravity position :

(Xg, Yg, Zg) = (0, 0, Allowed value of B axis for payload)

In this case, when an actual tool load is not too heavy, the manipulator can't be performed enough.

Moreover, when the tool which an actual tool center of gravity position greatly offsets in X direction or Y direction is installed the generated moment by the tool cannot be compensated.

- Switch of the tool file

In case that two or more tool files are used, Information on an effective tool file is referred for tool load information used by the ARM control at that time in according to switch tool file.

Set the same value of tool load information in each tool file when the tool file is switched to change only TCP (when neither the weight nor the center of gravity position of the entire tool installed in the flange is changed).

Moreover, set tool load information to the corresponding tool file respectively when total weight and the center of gravity position etc. of the tool is changed (when the system which exchange the tool by automatic tool changer).

## 10.12 Shock Detection Function

### 10.12.1 Shock Detection Function

The shock detection function is a function to decrease damage because of the collision by instantaneously detecting the shock and stopping the manipulator without any external sensor when the tool or the manipulator collide with peripheral device.

When the shock is detected either in teach mode and in play mode, the manipulator is stopped instantaneously.



#### WARNING

- **This function cannot do away with the damage to peripheral device completely. Moreover, this function does not guarantee safety to the person. Prepare the safety measures such as the safeguarding etc. Refer to the NX100 INSTRUCTIONS for the safety measures in detail.**

Injury or damage to machinery may result by contact with the manipulator.

### 10.12.2 Shock Detection Function Setting

The shock detection function is set not to mis-detect the shock even if operating by the ratings load with the maximum speed when shipping from the factory. If tool load information is set correctly, the detection sensitivity can be improved. Moreover, it is possible to set the lower sensitivity of detection only for a specific section where the contact work etc. The sensitivity of detection is set by setting the detection level.

#### ■ Shock Detection Level Setting

The shock detection level is set in the shock detection level set file.

The shock detection level set file are nine condition files as following figure.

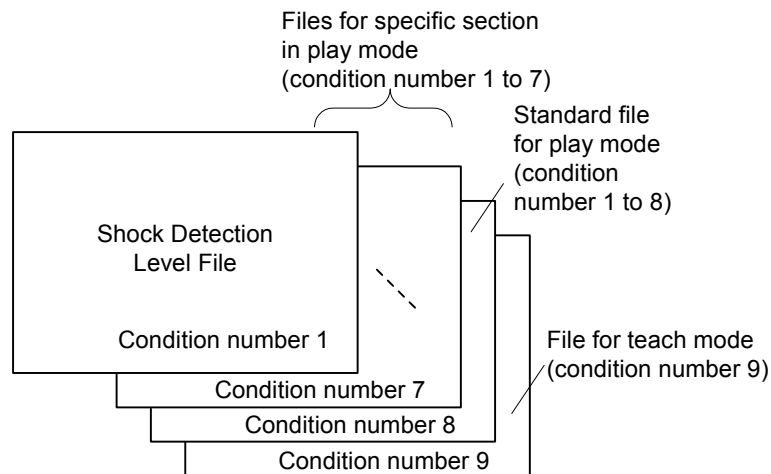
Condition number 1 to 7 are used when the detection level is changed in a specific section in play mode.

Condition number 8 is a file used as standard in play mode. This function is operated by the detection level set in this file when playback operation.

Condition number 9 is a file for teach mode. The shock is detected by the detection level set in this file when the manipulator is operated in teach mode.

The detection level is changed by the SHCKSET instruction. After this instruction is executed, the shock will be detected by the detection level of the specified file when the condition number is specified at SHCKSET instruction. The detection level is returned to standard level when the SHCKRST instruction is executed.

## 10.12 Shock Detection Function



The detection level of condition number 8 which is a standard file in play mode is adopted in play mode excluding the range between SHCKSET and SHCKRST in the job.

### Method of Shock Detection Level File Setting

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {SHOCK SENS LEVEL}.	<p>The SHOCK DETECTION LVL window appears.</p> <p><b>① Detection Mode</b> The shock detection mode is indicated.</p> <p><b>② Condition Number (1 to 9)</b>            1 to 7 : For changing detection level in play mode            8 : For standard detection level in play mode            9 : For detection level in teach mode</p> <p>Do either of the following operations to display the desired condition number. When the desired condition number is input with a Numeric key and the [ENTER] is pressed after the cursor is moved on the condition number and [SELECT] is pressed, the file of the selected condition number is shown.</p> <p>When page key  is pressed, the condition number file is changed.</p>

	Operation	Explanation
2	(cont'd)	<p><b>③Function Select</b>            VALID/INVALID of the shock detection function is specified here. The shock detection function is specified by each manipulator or each station axes which has this function.            The cursor is moved to the robot or the station axis which is desired to change the function "VALID" or "INVALID" and [SELECT] is pressed. "VALID" and "INVALID" is changed alternately whenever [SELECT] is pressed. The changing of "VALID" or "INVALID" is effective for all the condition number files.</p> <p><b>④Max. Disturbance Force</b>            The maximum disturbance force to the manipulator when the manipulator is moved in paly back operation or axis operation is shown here.            Refer to this value when the detection level in ⑤ is input.            The maximum disturbance force can be cleared by setting in menu {DATA} → {CLEAR MAX VALUE }.</p> <p><b>⑤Detection Lebel (Level range : 1 to 500)</b>            The shock detection level is specified here. Bigger value than the maximum disturbance force should be set.            The value (The detection level:100) not mis-detected the shock even if robot is operated at the maximum speed is set when shipping from the factory.            To change "Detection level", move the cursor to the robot or the station axis which is desired to change to appear the numeric input status and press [SELECT] moreover input the value by a Numeric key and press [ENTER]. Set the level to small value to raise the detection sensitivity or set the level to large value to lower sensitivity.</p>
3	Select the desired condition number.	
4	Select the desired item and set it.	



Set the level 20% or more greatly than the maximum disturbance force for the mis-detection prevention when the manipulator works.  
 An instaneously stopping the manipulator by the mis-detection may become a factor to damage the speed reducer or the tool.

**<Example>**

When the maximum disturbance force is 80, set the detection level 96 or more.



"Detection level" can be changed only when the security mode is set as management mode.

## 10.12 Shock Detection Function

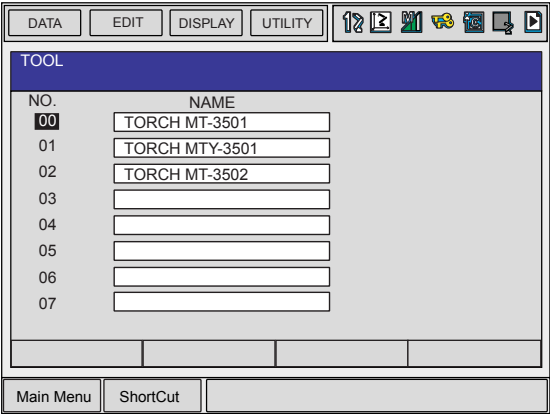
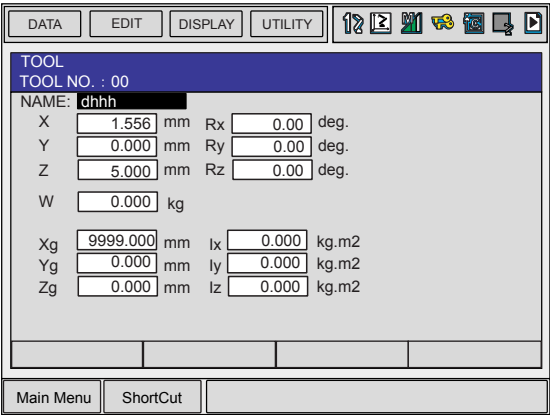
## ■ Tool load Information Setting


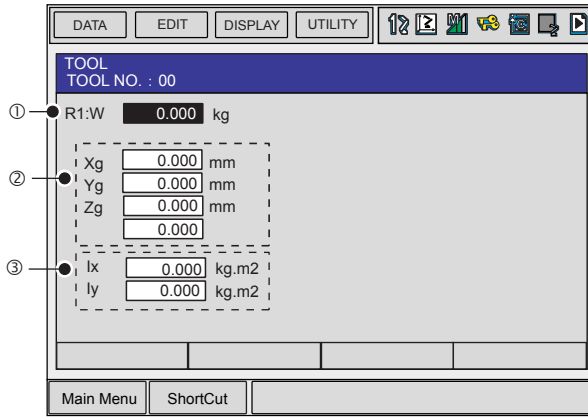
To be the more accurate shock detection, the tool load information is set in the tool file.



Refer to " 10.11.3 Tool Load Information Setting " for details concerning the tool load information setting.

### Method of the Tool load Information Setting

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {TOOL}.	<p>The TOOL window appears. Only when the file expansion function is valid, the TOOL window appears. When the file expansion function is invalid, the coordinate window appears.</p>  

	Operation	Explanation
3	Select the desired tool number.	<p>Move the cursor to the number of the desired tool and press [ENTER] in the TOOL window. The coordinate window of the selected number is shown. Select the desired number with page key  in the coordinate window.</p> <p>Select { DISPLAY } → { LIST } or { DISPLAY } → { COORDINATE DATA } under the menu in order to switch between the TOOL and the coordinate window. The coordinate window is scrolled by the cursor.</p>  <p><b>①Weight</b> This is total weight of the installed tool. Input weight by a Numeric key and press [ENTER] after the numeric input status is appeared by moving the cursole and pressing [SELECT].</p> <p><b>②Center of Gravity Position</b> This is center of gravity position of the installed tool. The value are specified by the coordinates value on each axis of the flange coordinates. Input the center of gravity position by a Numeric key and press [ENTER] after the numeric input status is appeared by moving the cursole and pressing [SELECT].</p> <p><b>③Moment of inertia at the Center of Gravity</b> This is Moment of inertia of the tool at the Center of Gravity in ②. The value are specified around each axis of the coordinates which is in parallel to the flange coordinates and which home position is the center of gravity position. Input the moment of inertia by a Numeric key and press [ENTER] after the numeric input status is appeared by moving the cursole and pressing [SELECT].</p>
4	Select the desired item and set it.	

## ■ Instruction of Shock Detection Function

### SHCKSET instruction

The SHCKSET instruction changes the shock detection level to the value set in the shock detection level file during play back operation.

The additional items of the SHCKSET instruction are as follows.

SHCKSET R1 SSL#(1)

↓  
①

↓  
②

#### ①Robot / Station Setting

The robot or the station axis which is desired to change the shock detection level is specified. If nothing is specified, the shock detection level of the control group of the job to which this instruction is registered is changed.

However, if the job is coordinated job, the shock detection level of the slave axis group is changed.

#### ②Shock Detection Level File (1 to 7)

The shock detection level file number is specified here. The shock detection level value when playback operation is set in the file. The shock detection level is changed by the condition of the file set here.

### SHCKRST instruction

The shock detection level changed by the SHCKSET instruction is reset and returned to the detection level of the standard (value set in condition number 8) by the SHCKRST instruction. The additional item of the SHCKRST instruction is as follows.

SHCKRST R1

↓  
①

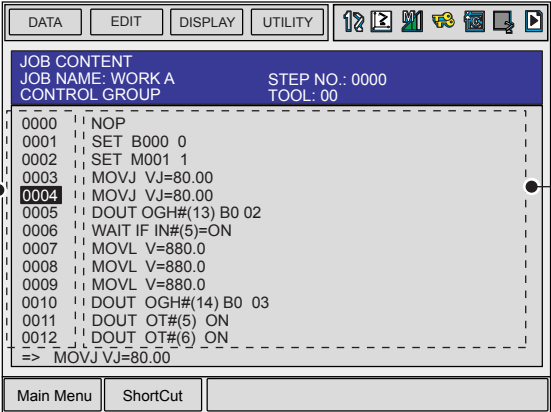
#### ①Robot / Station Setting

The robot or the station axis which is desired to reset the shock detection level is specified here. If nothing is specified, the shock detection level of the control group of the job to which this instruction is registered is changed.


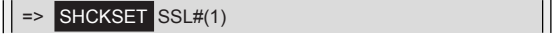
However, if the job is coordinated job, the shock detection level of the slave axis group is changed.

Instruction Registration

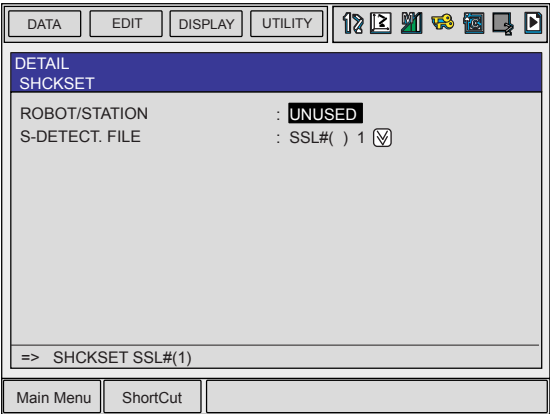
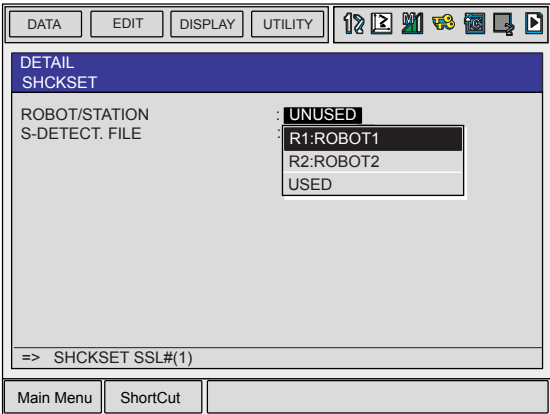
The instruction is registered when the cursor is in the address area in the JOB CONTENT window in teach mode.

	Operation	Explanation
1	Select {JOB} under the main menu.	 <p>The screenshot shows the 'JOB CONTENT' window with a blue header bar containing 'JOB NAME: WORK A' and 'STEP NO.: 0000'. Below the header is a list of instructions with addresses from 0000 to 0012. The instruction at address 0004, 'MOVJ VJ=80.00', is highlighted. A label 'Address Area' points to the address column, and a label 'Instruction' points to the instruction text. At the bottom of the window are buttons for 'Main Menu' and 'ShortCut'.</p>
2	Select {JOB}.	
3	Move the cursole in the address area.	

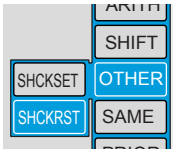

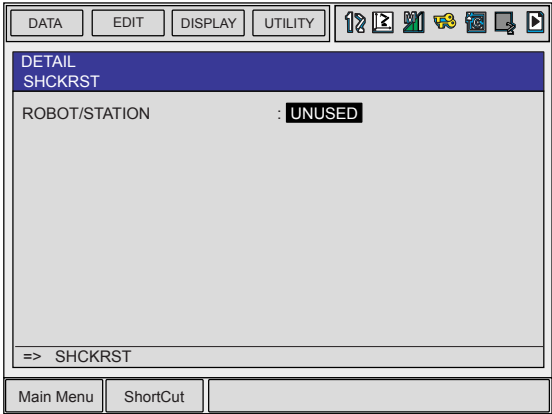
SHCKSET

	Operation	Explanation
1	Move the cursole to the line just before the location where SHCKSET instruction is desired to register.	
2	Press [INFORM LIST].	The inform list dialog box appears. 
3	Select SHCKSET instruction.	The SHCKSET instruction appears in the input buffer line. 

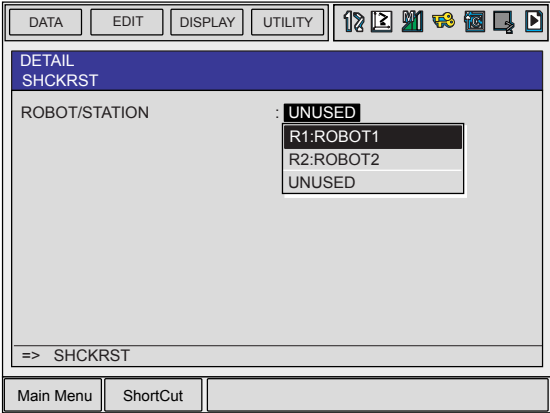
## 10.12 Shock Detection Function

	Operation	Explanation
4	Change the value of additional item and numerical data.	<p>&lt; When registering as it is &gt; Operate 5 procedure when the instruction the input buffer line as it is should be registered.</p> <p>&lt; When adding or changing the additional item &gt;  <ul style="list-style-type: none"> <li>When the shock detection level file is changed, move the cursor to the shock detection level file number, and increase or decrease the file number by pressing about [SHIFT] and the cursor key simultaneously.</li> </ul> <pre>=&gt; SHCKSET SSL#(1)</pre> <p>When the value is input with the Numeric key, press [SELECT] to display the input buffer line.</p> <pre>Shock_sens_file no. = =&gt; SHCKSET SSL#( )</pre> <p>And press [ENTER] to change the number in the input buffer line.</p> <ul style="list-style-type: none"> <li>When robot/station specification is added, move the cursor to the instruction in the input buffer line and press [SELECT] to show the DETAIL window.</li> </ul>  <p>Move the cursor to "UNUSED" of "ROBOT/STATION", and press [SELECT]. The selection dialog box appears. Move the cursor to added robot or station and press [SELECT].</p>  <p>When the addition of robot/station ends, press [ENTER]. The DETAIL window shuts and the JOB CONTENT window appears.</p> </p>
5	Press [INSERT] and [ENTER].	The instruction shown in the input buffer line is registered.

SHCKRST

	Operation	Explanation
1	Move the cursole to the line just before the location where SHCKRST instruction is desired to register.	
2	Press [INFORM LIST].	<p>The inform list dialog box appears.</p> 
3	Select SHCKRST instruction.	<p>The SHCKRST instruction appears in the input buffer line.</p> 
4	Change the value of additional item.	<p>&lt; When registering as it is &gt; Operate 5 procedure when the instruction the input buffer line as it is should be registered.</p> <p>&lt; When adding or changing the additional item &gt; When robot/station specification is added, move the cursor to the instruction in the input buffer line and press [SELECT] to show the DETAIL window.</p>  <p>Move the cursor to "UNUSED" of "ROBOT/STATION", and press [SELECT]. The selection dialog box appears. Move the cursor to added robot or station and press [SELECT].</p>

## 10.12 Shock Detection Function

	Operation	Explanation
4	(cont'd)	 <p>When the addition of the robot/the station ends, press [ENTER]. The DETAIL window shuts and the JOB CONTENT window appears.</p>
5	Press [INSERT] and [ENTER].	The instruction shown in the input buffer line is registered.

■    Reset Shock detected

When the tool and the manipulator are collided with peripheral device and it is detected by the shock detection function, the manipulator is stopped in the instantaneously with alarm output. At this time, the shock detection alarm is shown.



The shock detection alarm in teach mode and play mode can be reset by the following operation.

	Operation	Explanation
1	Press [SELECT].	The alarm is reset when "RESET" is selected on the alarm display, and the shock detection status is released.
2	Operation after resetting the detection status.	In teach mode, the JOG operation of the manipulator becomes possible again after resetting. In play mode, confirm the damage after moving the manipulator to the safety position once with teach mode though the playback operation is possible after resetting.

NOTE

When manipulator was stopped instantaneously while having contact with the object and the detection alarm is tried to reset on the alarm window, the situation in which the alarm cannot be reset might be occurred because the collision might be detected again after resetting.  
In this case, set the collision detection function "INVALID" with the shock detection level file or enlarge the detection level in teach mode and move the manipulator to safety position.

## 10.13 Instruction Level Setting

### 10.13.1 Setting Contents

#### ■ Instruction Set

There are three instruction sets that can be used when registering the instructions for the robot programming language (INFORM III) : the subset instruction set, the standard instruction set, and the expanded instruction set.

#### Subset Instruction Set

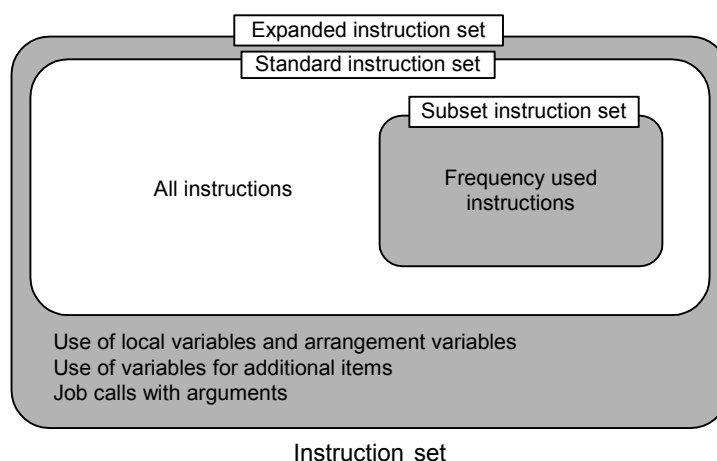
The instructions displayed in the instruction list are limited to just those that are most frequently used, reducing the number of instructions that can be registered. Since few instructions are shown, selection and input are simple.

#### Standard Instruction Set / Expanded Instruction Set

All the INFORM III instructions can be used. The number of additional items to be used in each instruction differ in the standard instruction set and expansion instruction set. In the standard instruction set, the following functions cannot be used. However, operation becomes easier because the number of data items decreases when registering an instruction.

- Use of local variables and arrangement variable
- Use of variables for additional items (Example: MOVJ VJ = I000)

When instructions are executed, for example during playback, all the instructions can be executed regardless of the instruction set used.



## ■ Learning Function

When an instruction is entered from the instruction list, the additional items that were entered last time are also shown. This function can simplify instruction input.

To register the same additional items as those in the former operation, register them without changing.

Register an  
instruction

0003 WAIT IN#(1)=ON  
0004 END

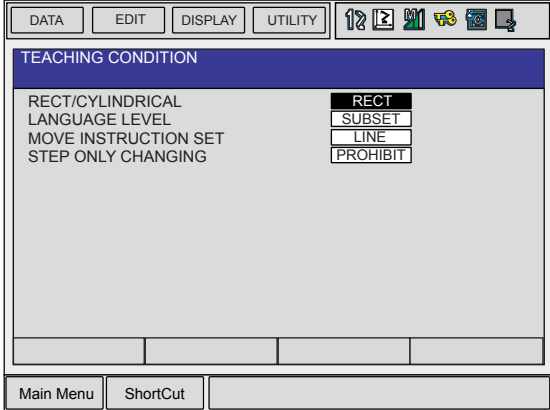
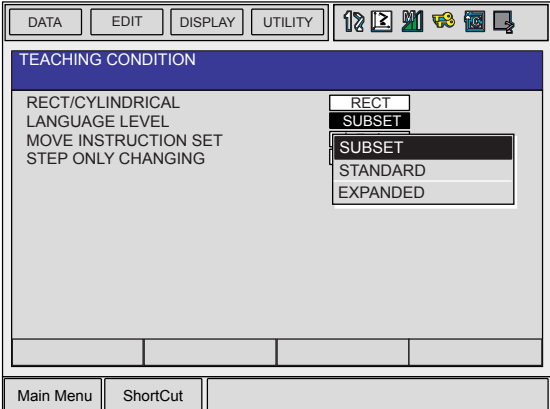
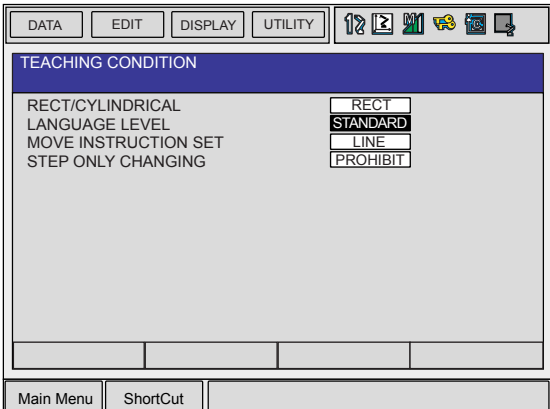
① An instructions are regis-  
tered

The instruction and  
the additional items  
that were entered  
last time are shown.

=> WAIT IN#(1)=ON  
!  
Main Menu ShortCut

② The next time an attempt is  
made to register the same  
instruction as in ①, the  
same additional items as  
were registered last time  
are also shown in the input  
buffer line.

## 10.13.2 Setting Instruction Set Level Operation

	Operation	Explanation
1	Select {SETUP} under the main menu.	
2	Select {TEACHIG COND}.	<p>The TEACHING CONDITION window appears.</p> 
3	Select "LANGUAGE LEVEL."	<p>The selection dialog box appears.</p> 
4	Select desired language level.	<p>Language level is set.</p> 

## 10.14 Numeric Key Customize Function

### 10.14.1 What is the Numeric Key Customize Function?

With this function, the user can set the function of an application that has been allocated to the Numeric key of the programming pendant to the other function.

Since any frequently used operation can be allocated to a Numeric keys on the programming pendant, decreasing the number of key operations reduces the teaching time.



The Numeric Key Customize Function is only valid when the security mode is set to the management mode.

### 10.14.2 Allocatable Functions

There are two allocation methods as follows:

- Key Allocation (EACH)
- Key Allocation (SIM)

#### ■ Key Allocation (EACH)

With key allocation (EACH), the manipulator operates according to the allocated function when the Numeric key is pressed. The following shows the functions that can be allocated.

Function	Description
Manufacturer allocation	Allocated by Yaskawa. Allocating another function invalidates the function allocated by the manufacturer.
Instruction allocation	Allocates any instructions assigned by the user.
Job call allocation	Allocates job call instructions (CALL instructions). The jobs to be called are only those registered in the reserved job names. (Specify it by the registration No.)
Display allocation	Allocates any displays assigned by the user.

## ■ Key Allocation (SIM)

With key allocation (SIM), the manipulator operates according to the allocated function when the [INTERLOCK] and the Numeric key are pressed at the same time. The following shows the functions that can be allocated.

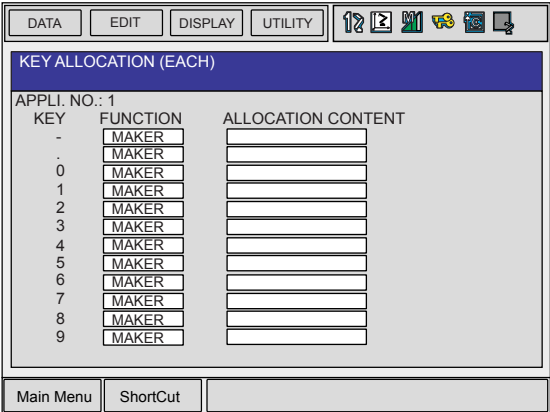
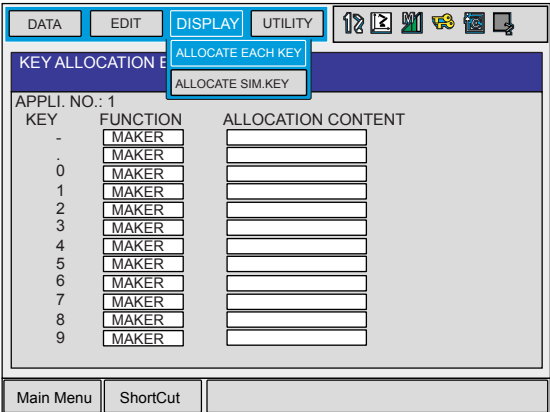

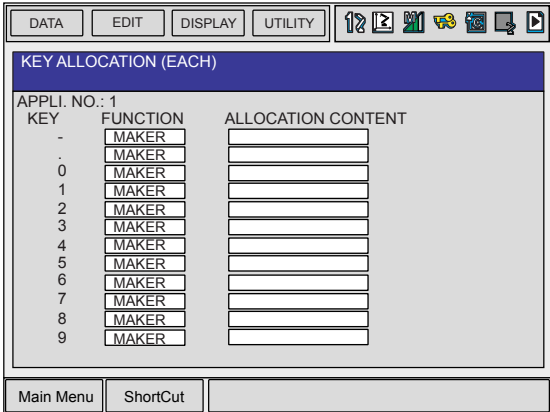
Function	Description
Alternate output allocation	Turns ON/OFF the specified user output signal when [INTERLOCK] and the allocated Numeric key are pressed at the same time.
Momentary output allocation	Turns ON the specified user output signal user when [INTERLOCK] and the allocated user key are pressed at the same time.
Pulse output allocation	Turns ON the specified user output signal only for the specified period when [INTERLOCK] and the allocated Numeric key are pressed at the same time.
Group output allocation (4-bit/8-bit)	Sends the specified output to the specified general group output signals when [INTERLOCK] and the allocated Numeric key are pressed at the same time.
Analog output allocation	Sends the specified voltage to the specified output port when [INTERLOCK] and the allocated Numeric key are pressed at the same time.
Analog incremental output allocation	Sends the voltage increased by the specified value to the specified output port when [INTERLOCK] and the allocated Numeric key are pressed at the same time.



In a system for multiple applications, a Numeric key can be allocated for each application.

10.14.3 Allocating an Operation

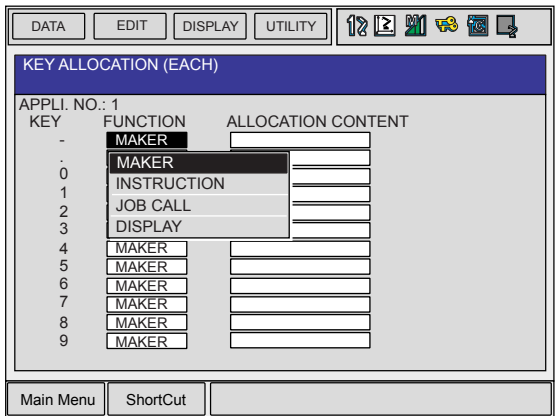
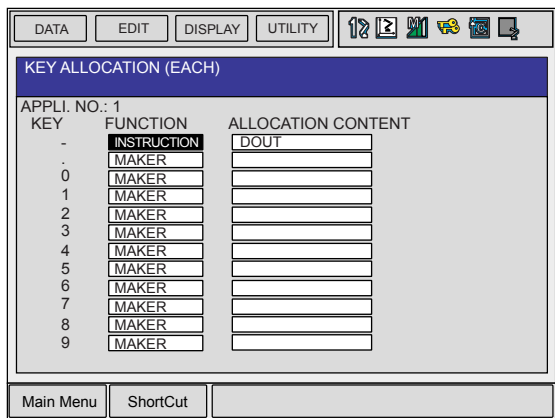
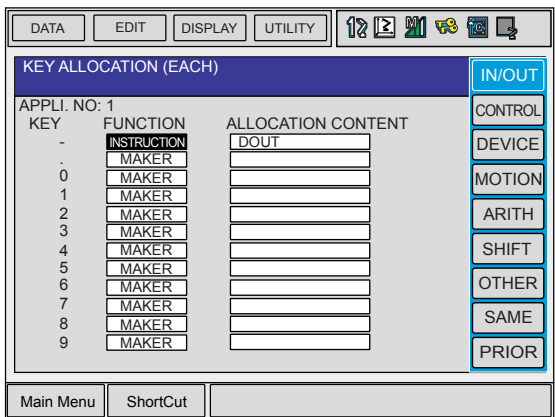
Allocation Window

	Operation	Explanation
1	Select {SETUP} under the main menu.	
2	Select {KEY ALLOCATION}.	<p>The KEY ALLOCATION (EACH) window appears.</p> 
3	Select {DISPLAY}.	<p>The pull-down menu appears. To call up the KEY ALLOCATION (SIM) window, select {ALLOCATE SIM. KEY}.</p> 
4	Select {ALLOCATE SIM. KEY}.	<p>The KEY ALLOCATION (SIM) window appears.</p> <p>In a system multiple applications, press the page key  to change the window to the allocation window for each application.</p> 

## 10.14 Numeric Key Customize Function

## ■ Instruction Allocation

Use this function in the KEY ALLOCATION (EACH) window.

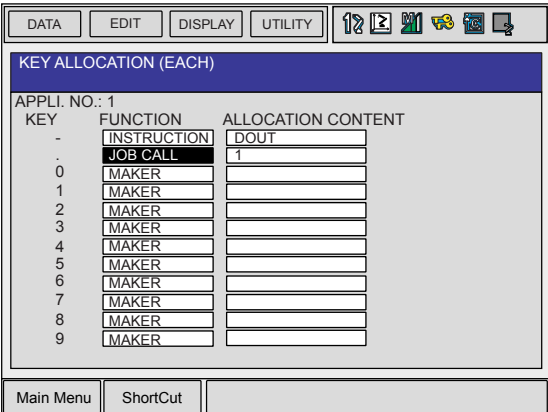
	Operation	Explanation
1	Move the cursor to "FUNCTION" of the key to be allocated and press [SELECT].	<p>The selection dialog box appears.</p> 
2	Select "INSTRUCTION."	<p>The instruction is shown in the "ALLOCATION CONTENT."</p>  <p>To change the instruction, move the cursor to the instruction and press [SELECT]. Then the instruction group list dialog box appears. Select the group containing the instruction to be changed.</p>  <p>When the instruction list dialog box is shown, select the instruction to be changed.</p>

	Operation	Explanation																																							
2	(cont'd)	<div><div><div>DATAEDITDISPLAYUTILITY</div><div><div>KEY ALLOCATION (EACH)</div><div>APPLI. NO.: 1</div><table><thead><tr><th>KEY</th><th>FUNCTION</th><th>ALLOCATION CONTENT</th></tr></thead><tbody><tr><td>-</td><td>INSTRUCTION</td><td>WAIT</td></tr><tr><td>.</td><td>MAKER</td><td></td></tr><tr><td>0</td><td>MAKER</td><td></td></tr><tr><td>1</td><td>MAKER</td><td></td></tr><tr><td>2</td><td>MAKER</td><td></td></tr><tr><td>3</td><td>MAKER</td><td></td></tr><tr><td>4</td><td>MAKER</td><td></td></tr><tr><td>5</td><td>MAKER</td><td></td></tr><tr><td>6</td><td>MAKER</td><td></td></tr><tr><td>7</td><td>MAKER</td><td></td></tr><tr><td>8</td><td>MAKER</td><td></td></tr><tr><td>9</td><td>MAKER</td><td></td></tr></tbody></table></div><div>Main MenuShortCut</div></div></div>	KEY	FUNCTION	ALLOCATION CONTENT	-	INSTRUCTION	WAIT	.	MAKER		0	MAKER		1	MAKER		2	MAKER		3	MAKER		4	MAKER		5	MAKER		6	MAKER		7	MAKER		8	MAKER		9	MAKER	
KEY	FUNCTION	ALLOCATION CONTENT																																							
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## 10.14 Numeric Key Customize Function

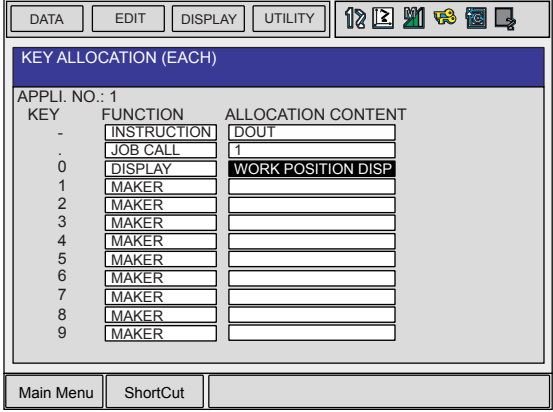
## ■ Job Call Allocation

Use this function in the KEY ALLOCATION (EACH) window.

	Operation	Explanation
1	Move the cursor to the "FUNCTION" of the key to be allocated and press [SELECT].	The selection dialog box appears.
2	Select "JOB CALL."	<p>The reserved job registration No. is shown in the "ALLOCATION CONTENT" (reserved job registration No.: 1 to 10).</p>  <p>To change the reserved job registration No., move the cursor to the No. and press [SELECT]. Numeric values can now be entered. Input the number to be changed, and press [ENTER].</p>

## ■ Window Allocation

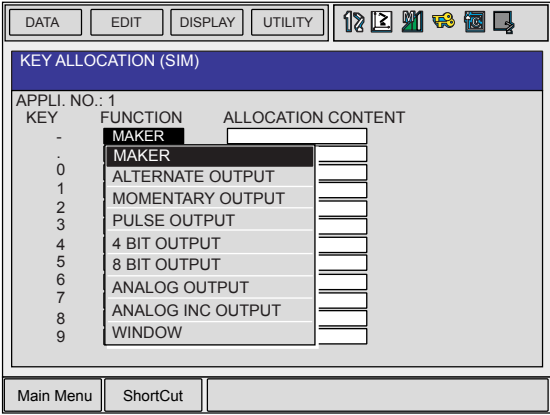
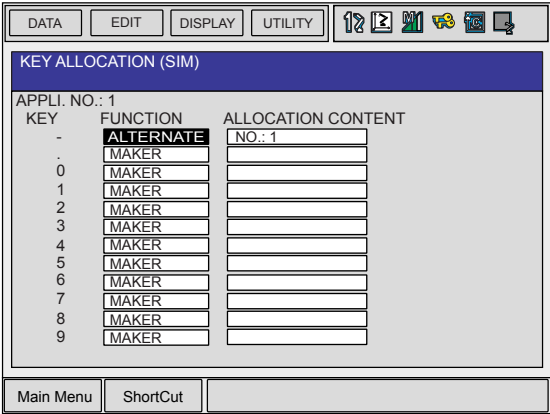
Use this function is used in the KEY ALLOCATION (EACH) window.

	Operation	Explanation
1	Move the cursor to the "FUNCTION" of the key to be allocated and press [SELECT].	The selection dialog box appears.
2	Select "DISPLAY."	
3	Move the cursor to "ALLOCATION CONTENT" and press [SELECT].	The character input status is entered.
4	Input the name of the reserved window and press [ENTER].	The reserved name input to the "ALLOCATION CONTENT" is shown. 
5	Open the window for allocation.	
6	Press [INTERLOCK] and the allocated key at the same time.	A message "Reserved window registered" appears, and the window is registered.

## 10.14 Numeric Key Customize Function

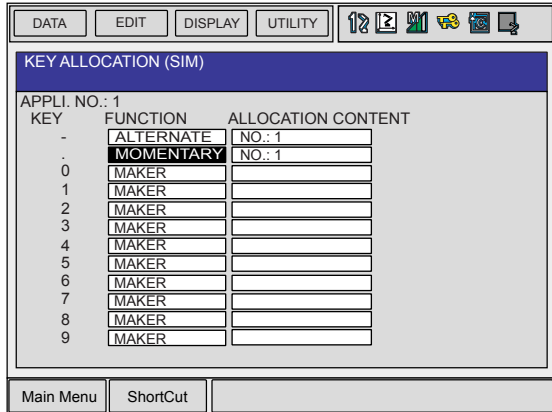
## ■ Alternate Output Allocation

Use this function is used in the KEY ALLOCATION (SIM) window.

	Operation	Explanation
1	Move the cursor to the "FUNCTION" of the key to be allocated and press [SELECT].	<p>The selection dialog box appears.</p> 
2	Select "ALTERNATE OUTPUT."	<p>The output No. is shown in the "ALLOCATION CONTENT."</p>  <p>To change the output No., move the cursor to the No. and press [SELECT]. Numeric values can now be entered. Input the number to be changed, and press [ENTER].</p>

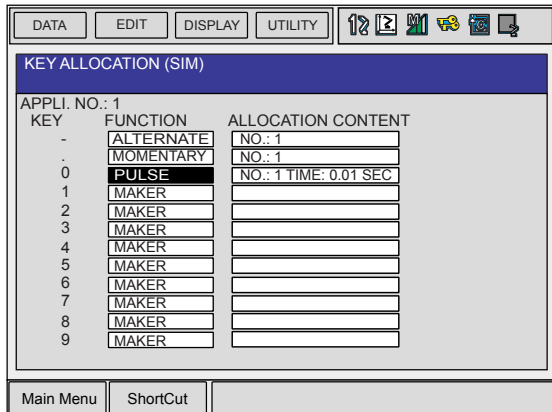
## ■ Momentary Output Allocation

Use this function in the KEY ALLOCATION (SIM) window.

	Operation	Explanation
1	Move the cursor to the "FUNCTION" of the key to be allocated and press [SELECT].	The selection dialog box appears.
2	Select "MOMENTARY OUTPUT."	<p>The output No. is shown in the "ALLOCATION CONTENT."</p>  <p>To change the output No., move the cursor to the No. and press [SELECT]. Numeric values can now be entered. Input the number to be changed, and press [ENTER].</p>

## ■ Pulse Output Allocation

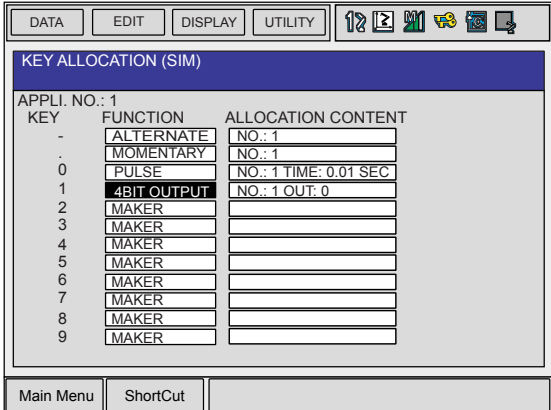
Use this function in the KEY ALLOCATION (SIM) window.

	Operation	Explanation
1	Move the cursor to the "FUNCTION" of the key to be allocated and press [SELECT].	The selection dialog box appears.
2	Select "PULSE OUTPUT."	<p>The output No. and output time are shown in the "ALLOCATION CONTENT."</p>  <p>To change the output No. or output time, move the cursor to the No. or time and press [SELECT]. Numeric values can now be entered. Input the number or time to be changed, and press [ENTER].</p>

## 10.14 Numeric Key Customize Function

## ■ Group (4-bit/8-bit) Output Allocation

Use this function in the KEY ALLOCATION (SIM) window.

	Operation	Explanation
1	Move the cursor to the "FUNCTION" of the key to be allocated and press [SELECT].	The selection dialog box appears.
2	Select "4 BIT OUTPUT" or "8 BIT OUTPUT."	<p>The output No. and output value are shown in the "ALLOCATION CONTENT."</p>  <p>To change the output No. or output value, move the cursor to the No. or value and press [SELECT]. Numeric values can now be entered. Input the number or value to be changed, and press [ENTER].</p>

■ Analog Output Allocation

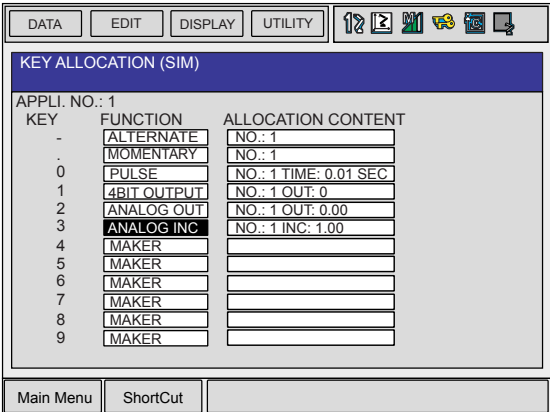
Use this function in the KEY ALLOCATION (SIM) window.

	Operation	Explanation																																							
1	Move the cursor to the “FUNCTION” of the key to be allocated and press [SELECT].	The selection dialog box appears.																																							
2	Select “ANALOG OUTPUT.”	<div><p>The output port number and the output voltage value are shown in the “ALLOCATION CONTENT.”</p><div><div><div>DATA</div><div>EDIT</div><div>DISPLAY</div><div>UTILITY</div><div></div></div><div><div>KEY ALLOCATION (SIM)</div><div>APPLI. NO.: 1</div><table><thead><tr><th>KEY</th><th>FUNCTION</th><th>ALLOCATION CONTENT</th></tr></thead><tbody><tr><td>-</td><td>ALTERNATE</td><td>NO.: 1</td></tr><tr><td>.</td><td>MOMENTARY</td><td>NO.: 1</td></tr><tr><td>0</td><td>PULSE</td><td>NO.: 1 TIME: 0.01 SEC</td></tr><tr><td>1</td><td>4BIT OUTPUT</td><td>NO.: 1 OUT: 0</td></tr><tr><td>2</td><td>ANALOG OUT</td><td>NO.: 1 OUT: 0.00</td></tr><tr><td>3</td><td>MAKER</td><td></td></tr><tr><td>4</td><td>MAKER</td><td></td></tr><tr><td>5</td><td>MAKER</td><td></td></tr><tr><td>6</td><td>MAKER</td><td></td></tr><tr><td>7</td><td>MAKER</td><td></td></tr><tr><td>8</td><td>MAKER</td><td></td></tr><tr><td>9</td><td>MAKER</td><td></td></tr></tbody></table></div><div><div>Main Menu</div><div>ShortCut</div><div></div></div></div></div> <p>To change the output port No. or output voltage value, move the cursor to the No. or voltage value and press [SELECT]. Numeric values can now be entered. Input the number or voltage value to be changed, and press [ENTER].</p>	KEY	FUNCTION	ALLOCATION CONTENT	-	ALTERNATE	NO.: 1	.	MOMENTARY	NO.: 1	0	PULSE	NO.: 1 TIME: 0.01 SEC	1	4BIT OUTPUT	NO.: 1 OUT: 0	2	ANALOG OUT	NO.: 1 OUT: 0.00	3	MAKER		4	MAKER		5	MAKER		6	MAKER		7	MAKER		8	MAKER		9	MAKER	
KEY	FUNCTION	ALLOCATION CONTENT																																							
-	ALTERNATE	NO.: 1																																							
.	MOMENTARY	NO.: 1																																							
0	PULSE	NO.: 1 TIME: 0.01 SEC																																							
1	4BIT OUTPUT	NO.: 1 OUT: 0																																							
2	ANALOG OUT	NO.: 1 OUT: 0.00																																							
3	MAKER																																								
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## 10.14 Numeric Key Customize Function

## ■ Analog Incremental Output Allocation

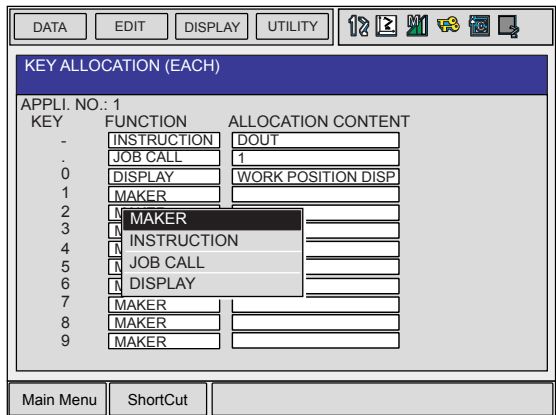
Use this function in the KEY ALLOCATION (SIM) window.

	Operation	Explanation
1	Move the cursor to the "FUNCTION" of the key to be allocated and press [SELECT].	The selection dialog box appears.
2	Select "ANALOG INC OUTPUT."	<p>The output port No. and incremental value are shown in the "ALLOCATION CONTENT."</p>  <p>The screenshot shows the 'KEY ALLOCATION (SIM)' window. It has a menu bar with 'DATA', 'EDIT', 'DISPLAY', 'UTILITY', and several icons. Below the menu bar, it says 'APPLI. NO.: 1'. There is a table with three columns: 'KEY', 'FUNCTION', and 'ALLOCATION CONTENT'. The 'ANALOG INC' function is selected for key 3, and the 'ALLOCATION CONTENT' for key 3 is 'NO.: 1 INC: 1.00'. At the bottom of the window, there are buttons for 'Main Menu' and 'ShortCut'.</p> <p>To change the output port No. or incremental value, move the cursor to the No. or incremental value and press [SELECT]. Numeric values can now be entered. Input the number or incremental value to be changed, and press [ENTER].</p>

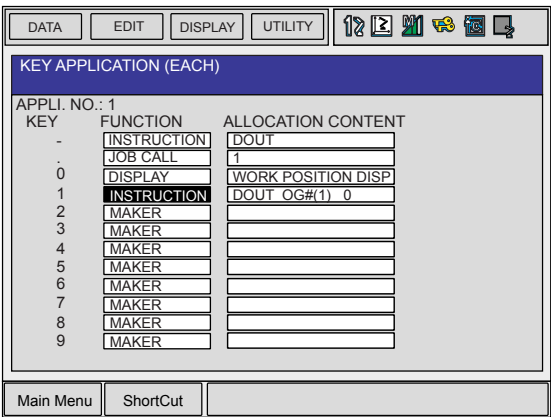
## 10.14.4 Allocation of I/O Control Instructions

In key allocation (SIM), output control instructions can be allocated to the Numeric keys that have been allocated one of the following I/O controls with key allocation (EACH).

Function	Output Control Instruction To Be Allocated
Alternate output allocation	DOUT OT# (No.) ON
Momentary output allocation	
Pulse output allocation	PULSE OT# (No.) T = output time
Group output allocation (4-bit)	DOUT OGH (No.) output value
Group output allocation (8-bit)	DOUT OG# (No.) output value
Analog output allocation	AOUT AO# (No.) output voltage value

	Operation	Explanation
1	Move the cursor to the "FUNCTION" of the key that has been allocated with I/O control with key allocation (SIM) and press [SELECT].	<p>The selection dialog box appears.</p> 

## 10.14 Numeric Key Customize Function

	Operation	Explanation
2	Select "OUTPUT CONTROL INST."	<p>The instruction corresponding to the I/O control allocated by key allocation (SIM) is shown in the "ALLOCATION CONTENT."</p>  <p>The allocated instruction changes automatically when "ALLOCATION CONTENT" is changed by key allocation (SIM). Even if the I/O control allocation is changed to the default setting allocated by the manufacturer with key allocation (SIM), the settings for key allocation (EACH) remain the same.</p>

## 10.14.5 Execution of Allocation

### ■ Executing the Instruction/Output Control Allocation

	Operation	Explanation
1	Press the key allocated for instruction allocation or output control allocation.	The allocated instruction appears in the input buffer line. <pre>   =&gt; WAIT IN#(1)=ON   </pre>
2	Press [INSERT] and [ENTER].	The instruction displayed in the input buffer line is registered.

### ■ Executing the Job Call Allocation

	Operation	Explanation
1	Press the key allocated for the job call allocation.	The CALL instruction appears in the input buffer line. <pre>   =&gt; CALL JOB:ARCON   </pre>
2	Press [INSERT] and [ENTER].	The CALL instruction shown in the input buffer line is registered.

### ■ Executing the Window Allocation

	Operation	Explanation
1	Press the key allocated for the window allocation.	The allocated window appears.

### ■ Executing the I/O Control Allocation

Alternate output allocation, momentary output allocation, pulse output allocation, group output allocation (4-bit/8-bit), analog output allocation, analog incremental output allocation are executed by the following operation.

	Operation	Explanation
1	Press [INTERLOCK] and the key allocated for I/O control allocation at the same time.	Allocated functions are executed.

## 10.15 Changing the Output Status

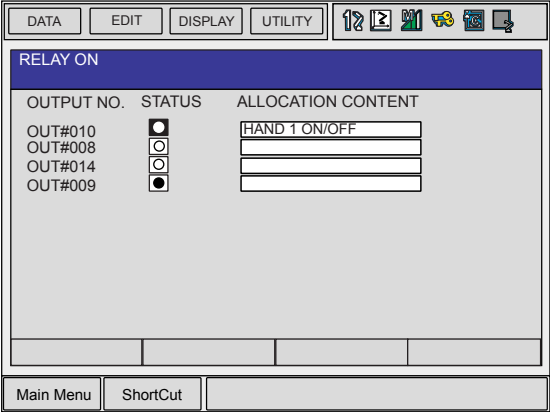
The status of external output signals can be changed from the programming pendant by using either of the following two methods.

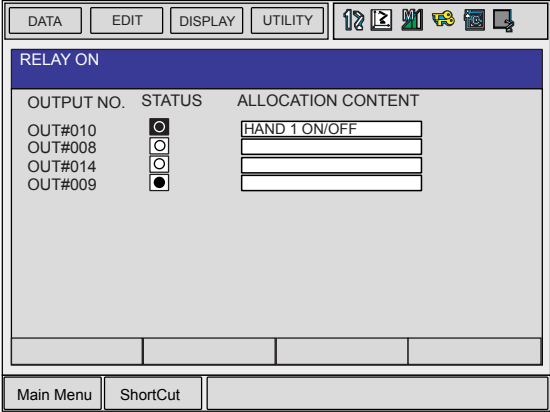
- On the user output status window
- On the RELAY ON window


The method that uses the RELAY ON window, which is described here, simplifies the operation for changing the status of signals that are used frequently.



A maximum of 16 output signals can be shown on the RELAY ON window and they must be set in advance with parameter settings S2C285 to S2C300. If not having set, the sub menu in the RELAY ON window is not displayed.

	Operation	Explanation
1	Select {IN/OUT} under the main menu.	
2	Select {RELAY ON}.	<p>The RELAY ON window appears.</p> 
3	Select the desired signal for changing.	Select the status (○ or ●) of the desired signal to change.

	Operation	Explanation
4	Press [INTERLOCK] +[SELECT].	<div>The status is changed. (●: status ON, ○ : status OFF)</div> <div></div>



It is also possible to turn the relevant external output signal on only for the duration that [INTERLOCK]+[SELECT] are pressed. This selection is made in advance by setting the parameter to “1.”

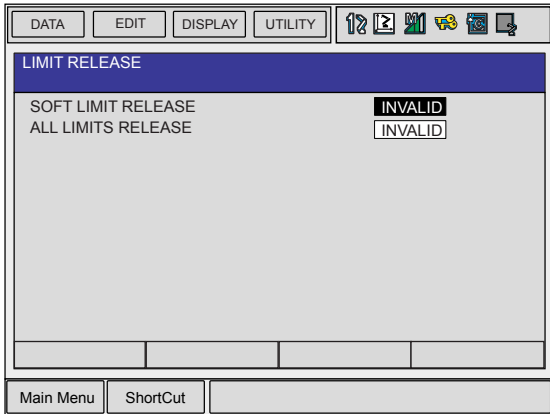
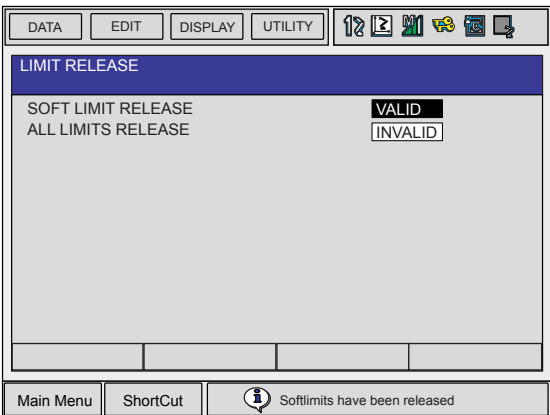
## 10.16 Temporary Release of Soft Limits

The switches that are set to detect the motion range of the manipulator are called limit switches. The operating range is monitored by the software in order to stop motion before these limit switches are reached. These software limits are called "soft limits." The operating range of the manipulator is controlled by the following two soft limits.

- Maximum motion range for each axis
- Cubic operation area set parallel to the robot coordinate system

These soft limits are continually monitored by the system. When it is detected that the manipulator (TCP) has reached a soft limit, the manipulator automatically stops.

When the manipulator is stopped at a soft limit, temporarily release the soft limit by following the procedure below, then move the manipulator away from that which exceeded the soft limit.

	Operation	Explanation
1	Select {ROBOT} under the main menu.	
2	Select {LIMIT RELEASE}.	<p>The LIMIT RELEASE window appears.</p> 
3	Select "SOFT LIMIT RELEASE."	<p>Each time [SELECT] is pressed, "VALID" and "INVALID" alternate. When "SOFT LIMIT RELEASE" is set to "VALID," the message "Soft limits have been released" appears.</p>  <p>When "SOFT LIMIT RELEASE" is set to "INVALID," the message "Soft limits have not been released" appears for three seconds.</p>

NOTE

The teaching data cannot be entered while releasing software limit.

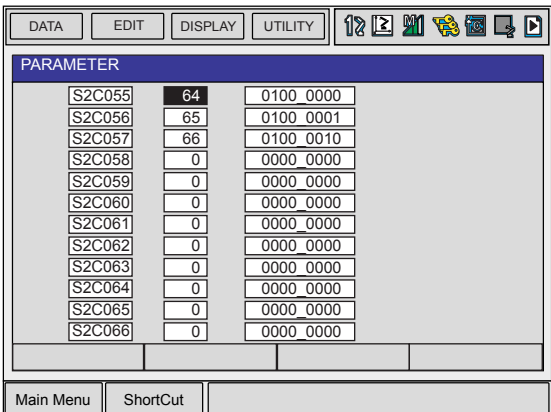
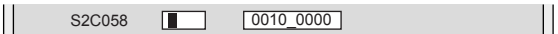

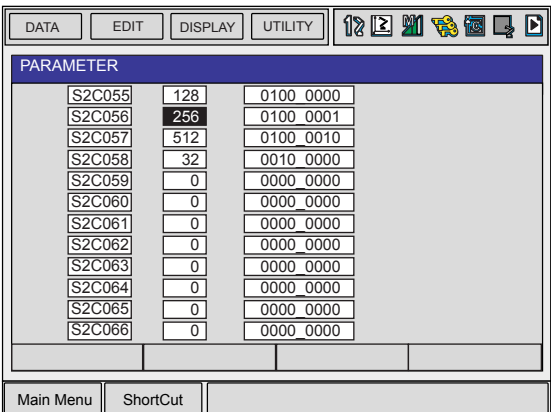
10.17Changing the Parameter Setting

The parameter settings can be changed only by the operator who has the correct user ID number for the management mode.

	Operation	Explanation																																	
1	Select {PARAMETER} under the main menu.																																		
2	Select the parameter type.	<div>The PARAMETER window appears. Select the desired parameter.</div> <div><div><div><div>DATA</div><div>EDIT</div><div>DISPLAY</div><div>UTILITY</div></div><div><div>PARAMETER</div><table><tr><td>S2C000</td><td>1</td><td>0000 0000</td></tr><tr><td>S2C001</td><td>2</td><td>0000 0000</td></tr><tr><td>S2C002</td><td>4</td><td>0000 0000</td></tr><tr><td>S2C003</td><td>8</td><td>0000 0000</td></tr><tr><td>S2C004</td><td>16</td><td>0000 0000</td></tr><tr><td>S2C005</td><td>2</td><td>0000 0000</td></tr><tr><td>S2C006</td><td>64</td><td>0000 0000</td></tr><tr><td>S2C007</td><td>89</td><td>0000 0000</td></tr><tr><td>S2C008</td><td>0</td><td>0000 0000</td></tr><tr><td>S2C009</td><td>0</td><td>0000 0000</td></tr><tr><td>S2C010</td><td>0</td><td>0000 0000</td></tr></table></div><div><div>Binary Data</div><div>Decimal Data</div></div><div><div>Main Menu</div><div>ShortCut</div></div></div></div>	S2C000	1	0000 0000	S2C001	2	0000 0000	S2C002	4	0000 0000	S2C003	8	0000 0000	S2C004	16	0000 0000	S2C005	2	0000 0000	S2C006	64	0000 0000	S2C007	89	0000 0000	S2C008	0	0000 0000	S2C009	0	0000 0000	S2C010	0	0000 0000
S2C000	1	0000 0000																																	
S2C001	2	0000 0000																																	
S2C002	4	0000 0000																																	
S2C003	8	0000 0000																																	
S2C004	16	0000 0000																																	
S2C005	2	0000 0000																																	
S2C006	64	0000 0000																																	
S2C007	89	0000 0000																																	
S2C008	0	0000 0000																																	
S2C009	0	0000 0000																																	
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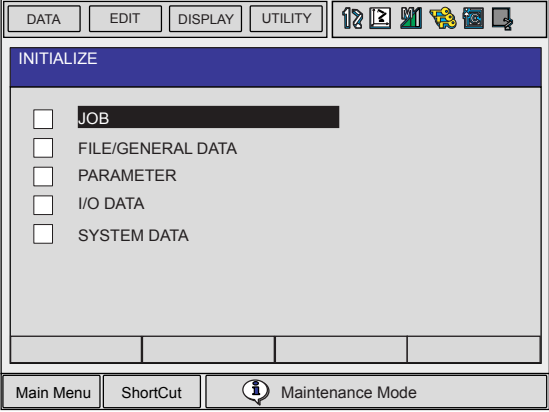
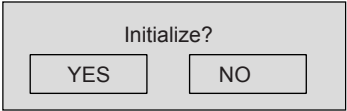
## 10.17 Changing the Parameter Setting

Set the parameters in the following manner.

	Operation	Explanation
1	Select a parameter setting.	<p>Move the cursor to the parameter number data (decimal or binary) in the PARAMETER window, and press [SELECT].</p> <ul style="list-style-type: none"> <li>- To enter a decimal setting, select the decimal figure.</li> <li>- To enter a binary setting, select the binary figure.</li> </ul> 
2	Enter the value.	<p>If a decimal figure is selected, enter a decimal value with the Numeric keys.</p>  <p>If a binary figure is selected, move the cursor to the binary figure data in the input buffer line, and press [SELECT]. Each time [SELECT] is pressed, "0" and "1" alternate in the window. "0" or "1" can also be entered with the Numeric keys.</p> 
3	Press [ENTER].	<p>The new setting appears in the position where the cursor is located.</p> 

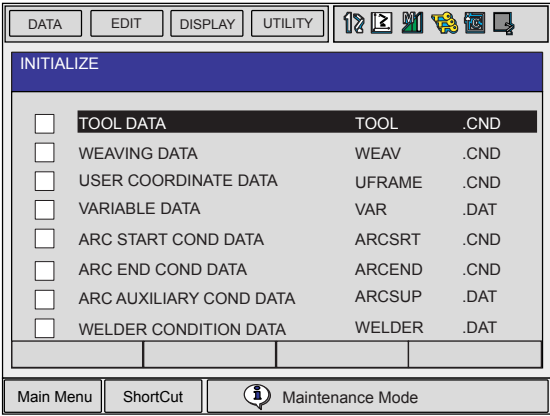
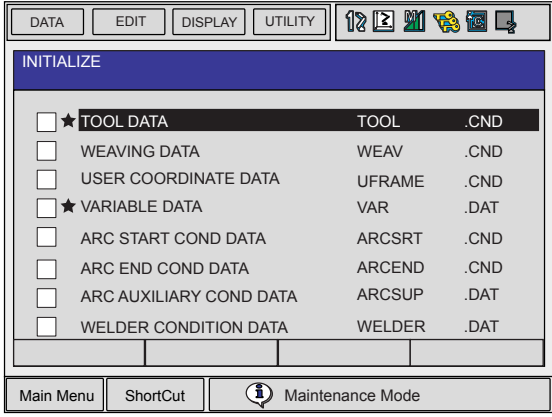
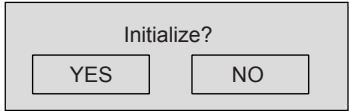
## 10.18 File Initialize

### 10.18.1 Initialize Job File

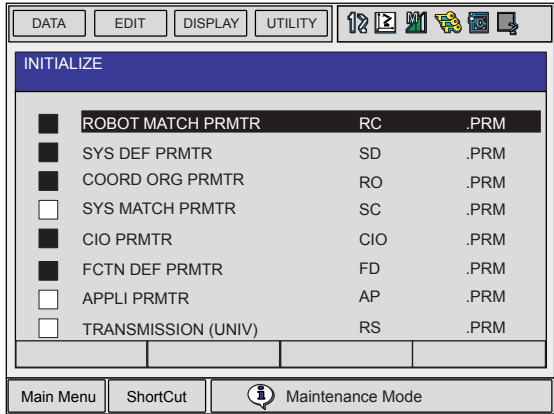
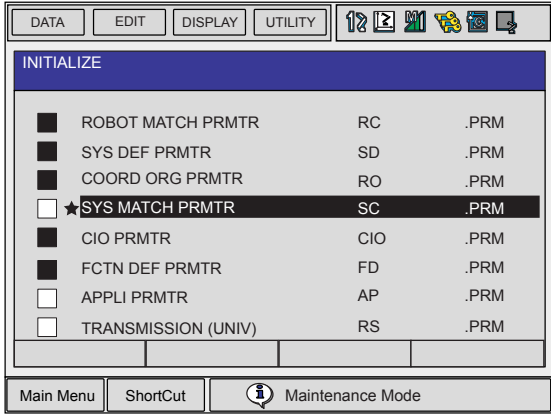

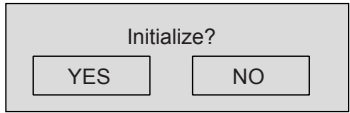
	Operation	Explanation
1	Turn the power supply ON again while pressing [MAIN MENU] simultaneously.	
2	Change the security mode to management mode.	
3	Select {FILE} under the main menu.	
4	Select {INITIALIZE}.	<p>The INITIALIZE window appears.</p>  <p>Item marked by ■ can not be selected.</p>
5	Select {JOB}.	<p>The confirmation dialog box appears.</p> 
6	Select "YES."	Job data is initialized.

## 10.18 File Initialize

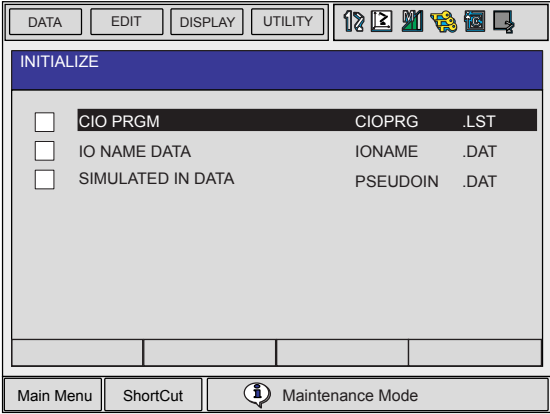
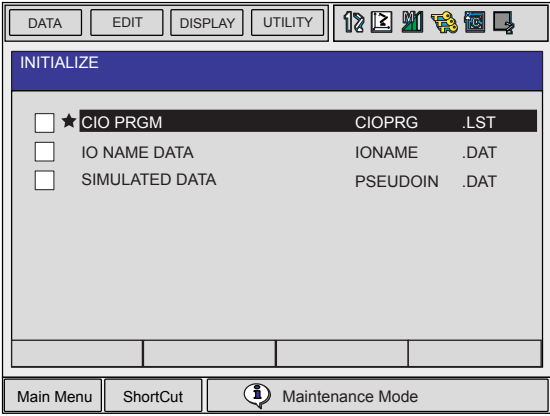
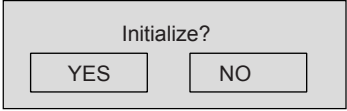
**10.18.2 Initialize Data File**

	Operation	Explanation
1	Turn the power supply ON again while pressing [MAIN MENU] simultaneously.	
2	Change the security mode to management mode.	
3	Select {FILE} under the main menu.	
4	Select {INITIALIZE}.	
5	Select {FILE/GENERAL DATA}.	<p>The INITIALIZE window appears.</p> 
6	Select data file for initializing.	<p>The selected data file /General data is marked with “★”.</p>  <p>File/Data marked by ★ can not be selected.</p>
7	Press[ENTER].	<p>The confirmation dialog box appears.</p> 
8	Select “YES.”	Selected data file /General data is initialized.

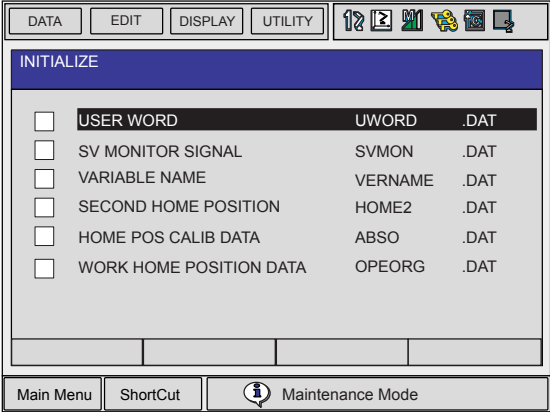
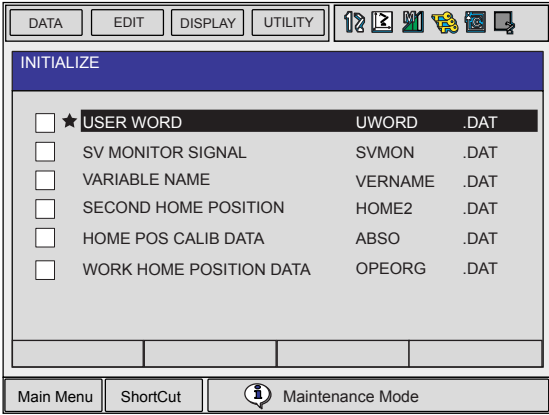

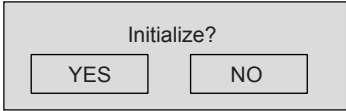
## 10.18.3 Initialize Parameter File

	Operation	Explanation
1	Turn the power supply ON again while pressing [MAIN MENU] simultaneously.	
2	Change the security mode to management mode.	
3	Select {FILE} under the main menu.	
4	Select {INITIALIZE}.	
5	Select {PARAMETER}.	<p>The parameter selection window appears.</p> 
6	Select parameter for initializing.	<p>The selected parameter is marked with "★".</p>  <p>Parameter marked by  can not be selected.</p>
7	Press [ENTER].	<p>The confirmation dialog box appears.</p> 
8	Select "YES."	Selected parameter is initialized.

## 10.18.4 Initializing I/O Data

	Operation	Explanation
1	Turn the power supply ON again while pressing [MAIN MENU] simultaneously.	
2	Change the security mode to management mode.	
3	Select {FILE} under the main menu.	
4	Select {INITIALIZE}.	
5	Select {I/O DATA}.	<p>The I/O data selection window appears.</p> 
6	Select data for initializing.	<p>The selected data is marked with “★”.</p>  <p>Parameters marked by ★ can not be selected.</p>
7	Press [ENTER].	<p>The confirmation dialog box appears.</p> 
8	Select “YES.”	The selected data is initialized.

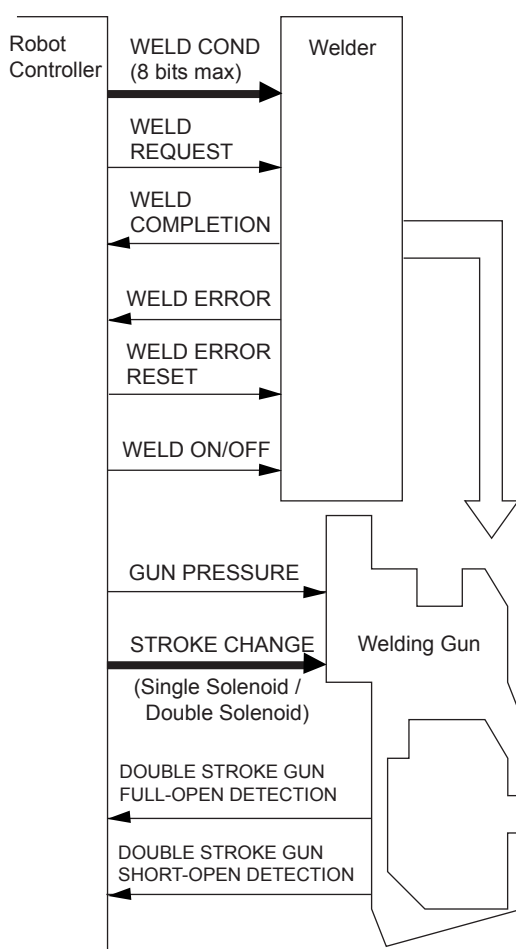
10.18.5 Initializing System Data

	Operation	Explanation
1	Turn the power supply ON again while pressing [MAIN MENU] simultaneously.	
2	Change the security mode to management mode.	
3	Select {FILE} under the main menu.	
4	Select {INITIALIZE}.	
5	Select {SYSTEM DATA}.	<div>The system data selection window appears.<div></div></div>
6	Select the parameter to be initialized.	<div>The selected data is marked with “★”.<div></div><div>Parameter marked by  can not be selected.</div></div>
7	Press [ENTER].	<div>The confirmation dialog box appears.<div></div></div>
8	Select “YES.”	The selected data is initialized.

# 11 Spot Welding Application Using an Air Gun

## 11.1 Spot Welding System Overview

An I/O signal diagram of a typical spot welding system is shown below.



### WELD COND (level signal)

- 1 (1) Sets the welding conditions for the
- 2 (2) welder. The output format can be set as
- 4 (3) binary or discrete. (( ) is for discrete.)
- 8 (4) Can handle up to 255 conditions (for
- 16 (5) binary).
- 32 (6)
- 64 (7)
- 128 (8)

### WELD REQUEST (level/pulse)

Outputs the start instruction to the welder.

### WELD ERROR RESET (level)

Resets the welding alarm status of the welder.

### GUN PRESSURE (level)

Outputs gun pressure instruction to the welding gun.

### STROKE CHANGE (level)

Select the stroke of the gun.

In case of single solenoid: Change by 1 signal  
In case of double solenoid: Change by 2 signal

I/O Signal Diagram for Spot Welding System









For details on signal contents, refer to "" 11.7 I/O Signals for a Spot Gun "."  
For details on I/O allocation, refer to ""11.7.2 I/O Allocation".



## 11.2 Function Keys

Each function used for spot welding is allocated on the Numeric keys of the programming pendant. These keys become available when the WORK HOME POSITION is on the display.



	Displays the MANUAL SPOT window.
	Displays the WORK HOME POSITION window.  [FWD] + [TASK ORIGIN] With the WORK HOME POSITION window in the teach mode, press these keys to move the manipulator to the work home position.
	Registers a SVSPOT instruction in a job.  [INTERLOCK] + [SPOT] With the MANUAL SPOT window, press these keys to execute manual spot welding. Refer to "11.3.1 Manual Spot Welding Function".
	Registers a SVGUNCL instruction in a job.  [INTERLOCK] + [GUN CLOSE] With the MANUAL SPOT window, press these keys to execute manual dry spot welding.
	[INTERLOCK] + [WELD ON/OFF] In the teach mode, press these keys to turn the welding ON/OFF signal ON or OFF.
	The SHORT OPEN POSITION SETTING window appears the first time the key is pressed. The selection No. for the short open position appears from the second time the key is pressed.  [INTERLOCK] + [SHORT OPEN] The movable side electrode moves to the selected short open position.

## 11.2 Function Keys

	<p>The FULL OPEN POSITION SETTING window appears the first time the key is pressed. The selection number for the full open position appears from the second time the key is pressed.</p> <p>[INTERLOCK] + [FULL OPEN] The movable side electrode moves to the selected full open position.</p>
	<p>[INTERLOCK] + [WELD ALM RESET] A Power Source alarm reset signal is output to the Power Source while these keys are held down.</p>



The keys [7/TOUCH MOTION], [8/PRESSURE], [9/RELEASE] are exclusively used for the application of spot welding by a motor gun: they will not be used for spot welding by an air gun.

## 11.3 Teaching

### 11.3.1 Manual Spot Welding Function

Press the [INTERLOCK] and a function key simultaneously on the programming pendant can test to check if the gun full/short open change operation, gun pressure or the spot welding conditions are proper.

The welding conditions set with manual spot welding are used as the initial data when work instructions are registered.



See "11.4.1 Manual Spot Window" for information on the manual spot welding file setting and editing.

#### ■ Manual Welding



To perform manual spot welding, press the [INTERLOCK] and the [SPOT] simultaneously while the manual spot start condition window or the manual spot welding condition window is called up.

These values which is set on manual spot welding window become the initial values for registration of the SPOT instruction, the spot welding instruction.

#### ■ Manual Dry Spotting



To perform dry spotting, press the [INTERLOCK] and the [GUN CLOSE] simultaneously. Also, when the number of the gun to be operated and the dry spot instruction GUNCL are registered, the number specified in the manual spot display becomes the initial value. While the key is being pressed, the dry spot move operation is performed. When the key is released, the operation stops.

## 11.3 Teaching

## ■ Stroke Switching



Press the [INTERLOCK] and the [FULL OPEN] simultaneously to switch to the full open position, or the [INTERLOCK] and the [SHORT OPEN] simultaneously to switch to the short open position.

Also, when the number of the gun to be operated and the stroke switching instruction STROKE are registered, the number specified in the manual spot display becomes the initial value. Whether full open status occurs when the stroke signal is on or off is set in the AP parameter.

(The initial value in OFF status is FULL OPEN)

## ■ Welding On/Off



Press the [INTERLOCK] and the [WELD ON/OFF] simultaneously in the teach mode to turn the welding ON/OFF signal on or off to all connected welders.

A user message appears when the welding ON/OFF signal turns ON in the teach mode. During manual spot welding, the welding current flows only when this message appears. The output destination must be allocated on the spot output allocation information window display before this function can be used.



For information on the signal allocation method, see "11.7.2 I/O Allocation".

## ■ Resetting Alarms



The alarm reset signal to all connected welders remains ON while the [INTERLOCK] and the [WELD ALM RESET] are pressed simultaneously. The welding conditions, gun pressure and weld request are reset with this function.

The output destination must be allocated on the spot input/output allocation information display before the use of this function.



For information on signal allocation method, see "11.7.2 I/O Allocation".

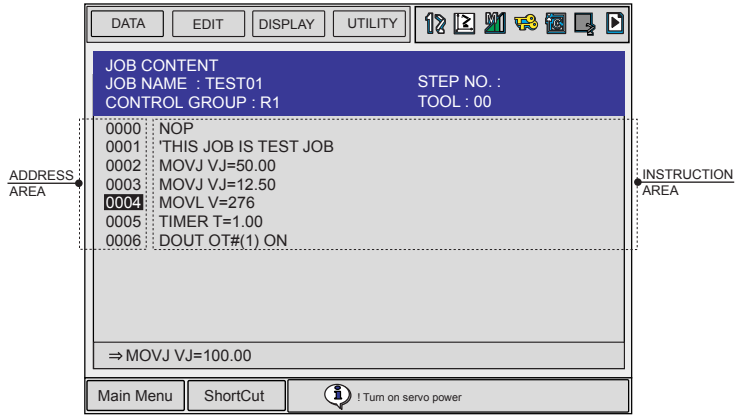
## 11.3.2 Registering Work Instructions

The function keys [GUNCL](GUNCL instruction), [SPOT](SPOT instruction), [SHORT OPEN]/[FULL OPEN](STROKE instruction) can be used for registering the work instructions.

The STRWAIT instruction is registered using the [INSTRUCTION LIST] key.

Specific Keys	Instructions
[GUN CLOSE]	GUNCL instruction
[SPOT]	SPOT instruction
[SHORT OPEN] [FULL OPEN]	STROKE instruction

Instructions are registered during the teach mode when the cursor is in the address area of the job content window.

	Operation	Explanation
1	Select {JOB} from the main menu.	
2	Select {JOB CONTENT}.	
3	Move the cursor to the address area.	

### ■ GUNCL Instruction

This is the dry spotting instruction. It performs dry spotting for the specified time. The gun performs dry spotting then returns to the start position after the time-up timer counts out. Use this instruction when spotting is required, such as after automatic tip dressing or automatic tip replacement.

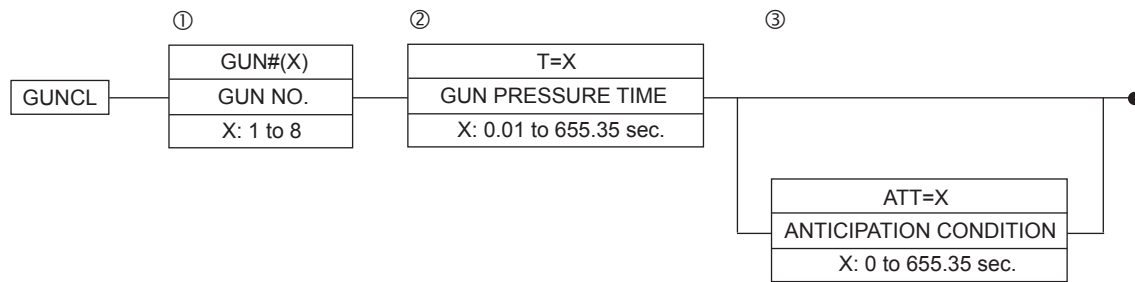


Be sure to use this instruction in the short open status with a double stroke gun other than X double stroke mechanical stopper type gun.

The instruction controls only one gun at one time. Two guns cannot perform dry spotting simultaneously. When GUNCL instruction is executed, it takes a time for the stroke action and dry spotting time is shortened.

## 11.3 Teaching

## Additional Items

①**Gun# (X)**

Specifies a gun to be pressed.

②**T = X**

Specifies the time when the gun is closed.

③**ATT = X**

Starts execution of GUNCL X second(s) before reaching the move instruction located immediately before it. However, it is necessary to specify “NWAIT” to the move instruction immediately before the GUNCL instruction.

## Operation

	Operation	Explanation
1	Select {JOB} from the main menu.	
2	Select {JOB CONTENT}.	
3	Move the cursor to the line before the place where the GUNCL instruction is to be registered.	
4	Press the number key [2/GUN CLOSE] or [INSTRUCTION LIST]	<p>When the number key [2/GUN CLOSE] is pressed, the “GUNCL” instruction appears in the input buffer line.</p> <pre>   =&gt; GUNCL GUN#(1) T=1.00   </pre> <p>When the [INSTRUCTION LIST] key is pressed, the instruction list dialog appears. Select “GUNCL” from the list.</p>
5	Add items and modify the number data.	
6	Press [ADD], then press [ENTER]	The GUNCL instruction is registered.

## ■ Example

The gun pressure signal is turned ON 0.5 seconds before the manipulator reaches the step 5 position and then turns OFF after 2 seconds (1.5 seconds after reaching there) and moves to the execution of step 6.

```

0005  MOVL V=1000 N WAIT
0006  GUNCL GUN#(1) T=2.00 ATT=0.50
0007  MOVL V=1000
  
```

## ■ SPOT Instruction

This instruction starts the spot welding sequence. It outputs the gun pressure signal then executes the welding sequence appropriate for the gun type. The function key [SPOT] can be used for its registration

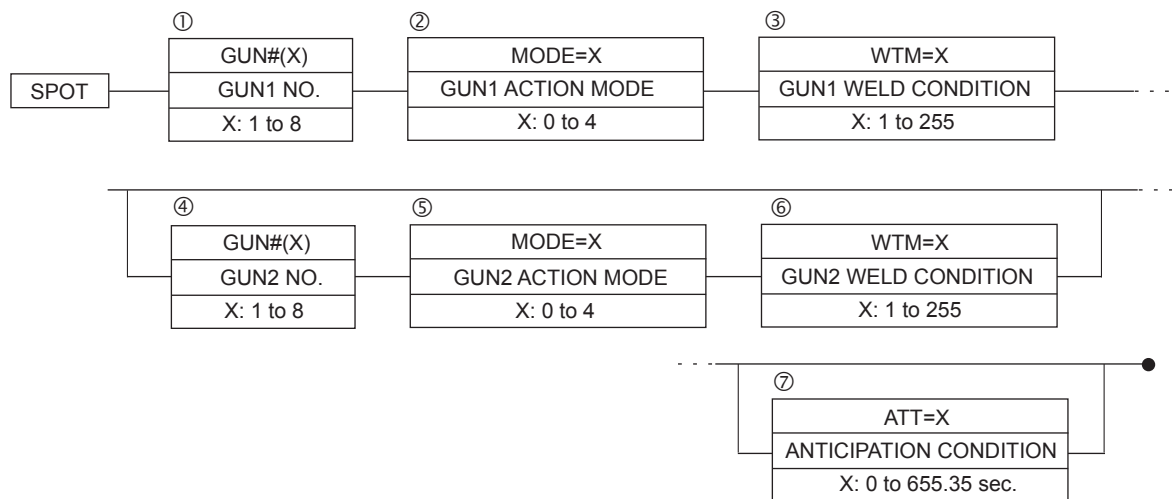
The condition number used for the registration of the spot instruction is a value set on the manual spot condition window.

Two guns can be controlled simultaneously.



Under two-gun control, this instruction is completed when the gun with the slower welding sequence completes welding. See " 11.6 Spot Gun Motion Control " for information on the welding sequence executed by this instruction.

## Additional Items



### ① GUN #(X)

Specifies the number of welding condition set to the welder.

### ② MODE = X

Specifies the gun move operation mode.

In the case of double stroke, specifies the open status before and after the welding.

Setting Data	Before Welding → After Welding
0	Single Gun
1	Short Open → Short Open
2	Short Open → Full Open
3	Full Open → Short Open
4	Full Open → Full Open

## 11.3 Teaching

**③WTM=X**

Specifies the number of welding conditions set to the welder.

**④GUN#(X)**

Specifies the second gun at two-gun control.

Cannot be omitted at simultaneous two-gun control. Do not set when only one gun is used.

**⑤MODE=X**

Specifies the operation mode of the second gun at two-gun control. Specifies the open status before and after welding in the case of double stroke.

Do not set when only one gun is used.

Setting data is the same as shown in the table in ②.

**⑥WTM=X**

Specifies the number of the welding conditions set to the second welder at two-gun control.

Do not set when only one gun is used.

**⑦ATT=X**

Starts execution of SPOT X second(s) before reaching the move instruction immediately before it. However, it is necessary to specify "NWAIT" to the move instruction immediately before the SPOT instruction. By omitting this item, the SPOT instruction is executed as usual after reaching the move instruction.

**Operation**

	Operation	Explanation
1	Select {JOB} from the main menu.	
2	Select {JOB CONTENT}.	
3	Move the cursor to the line before the place where the SPOT instruction is to be registered.	
4	Press the number key [./SPOT] or [INSTRUCTION LIST]	<p>When the number key [./SPOT] is pressed, the "SPOT" instruction appears in the input buffer line.</p> <pre>   =&gt; SPOT GUN#(1) MODE=0 WTM=1   </pre> <p>When the [INSTRUCTION LIST] key is pressed, the instruction list dialog appears. Select "SPOT" from the list.</p>
5	Add items and modify the number data.	
6	Press [ADD], then press [ENTER]	The SPOT instruction is registered.

**Examples**

The sequence of the SPOT instruction is started from the short open 0.5 seconds before the manipulator reaches the position of step 5. After completion of the sequence, the status becomes full open to move to the execution of step 6.

```
0005  MOVL V=1000 NWAIT
0006  SPOT GUN#(1) MODE=2 ATT=0.5
0007  MOVL V=1000
```

If the manipulator starts moving before the gun opens when gun open status is not verified, adjust the timing with the TIMER instruction as shown below.

```
0005  MOVL V=1000 NWAIT
0006  SPOT GUN#(1) MODE=2 WTM=2
0007  TIMER T=0.10
0008  MOVL V=1000
```



Do not use the "ATT" unless it is indispensable. As the gun will be closed during the robot move operation by the use of ATT, the robot might possibly move with its gun closed. Set the ATT value after setting the ATT minimum value (0.01 seconds) and execute a confirmatory operation.

## ■ STROKE Instruction

It is an instruction to alternate short open and full open of a double stroke gun at any time other than welding.

It executes the stroke changes sequence with an X double stroke mechanical stopper type gun, and with the other double stroke guns, it changes the change signal to full open or to short open status.

This instruction can control only one gun at a time. Two guns cannot be pressed at the same time.

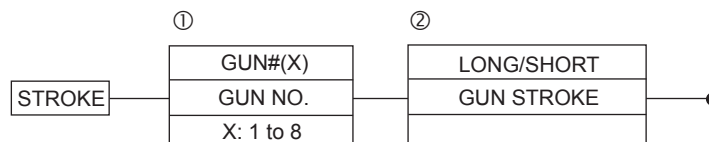


For details on the stroke change sequence of an X double stroke mechanical stopper type gun to be executed by this instruction, see " 11.6 Spot Gun Motion Control ".



When using an X double stroke mechanical stopper type gun, stroke change is enabled only at pressing. With an execution of this instruction, the gun performs dry spotting: the stroke can be changed while the dry spotting is executed. (In case of the other types of guns, this instruction only turns the stroke change signal ON/OFF.)

## Additional Items



### ① GUN# (X)

Specifies a gun characteristic file number of stroke to be changed.

### ② LONG or SHORT

Specifies the stroke status by alternating LONG and SHORT.

## 11.3 Teaching

## Operation

	Operation	Explanation
1	Select {JOB} from the main menu.	
2	Select {JOB CONTENT}.	
3	Move the cursor to the line before the place where the STROKE instruction is to be registered.	
4	Press the number key [-/SHORT OPEN] or [3/FULL OPEN] or [INSTRUCTION LIST]	<p>The “STROKE GUN#(1) SHORT” instruction appears in the input buffer line when the number key [-/SHORT OPEN] is pressed; the “STROKE GUN#(1) LONG” instruction appears in the input buffer line when the key [3/FULL OPEN] is pressed.</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">       =&gt; STROKE GUN#(1) LONG     </div> <p>When the [INSTRUCTION LIST] key is pressed, the instruction list dialog appears. Select “STROKE” from the list.</p>
5	Add items and modify the number data.	
6	Press [ADD], then press [ENTER]	The STROKE instruction is registered.

## Example

Stroke is fully opened in order to avoid interference when the manipulator reaches the position of step 5. Then the manipulator moves to step 6 to avoid interference.

```

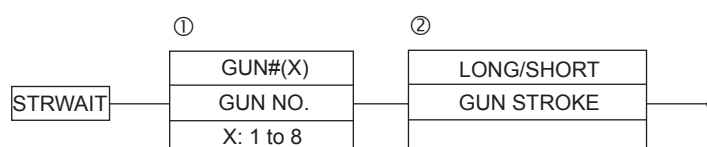
0005  MOVL V=1000
0006  STROKE GUN#(1) LONG
0007  MOVL V=1000

```

## ■ STRWAIT Instruction

It is an instruction to verify the double stroke gun status short open or full open, at any time other than welding. It waits until a signal to verify full open or short open is turned ON. This instruction can control only one gun at a time; it cannot control two guns simultaneously.

## Additional Items



**①GUN# (X)**

Specified a gun characteristic file number of which stroke is verified.

**②LONG or SHORT**

Specifies the stroke status to be verified by alternating LONG and SHORT.

**Operation**

	Operation	Explanation
1	Select {JOB} from the main menu.	
2	Select {JOB CONTENT}.	
3	Move the cursor to the line before the place where the STRWAIT instruction is to be registered.	
4	Press [INSTRUCTION LIST]	The instruction list dialog appears. Select the "STRWAIT" instruction.  <div style="border: 1px solid black; padding: 2px; display: inline-block;">           =&gt; STRWAIT GUN#(1) LONG         </div>
5	Add items and modify the number data.	
6	Press [ADD], then press [ENTER]	The STRWAIT instruction is registered.

**Example**

Stroke is fully opened in order to avoid interference when the manipulator reaches the position of step 5. Then the STRWAIT instruction verifies that the stroke has become full open status and the manipulator moves to step 6 to avoid interference.

```

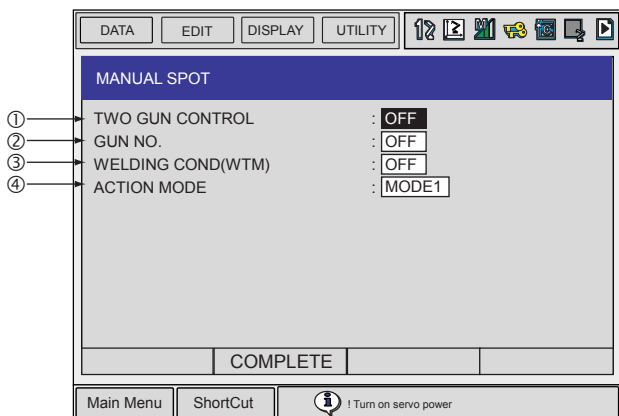
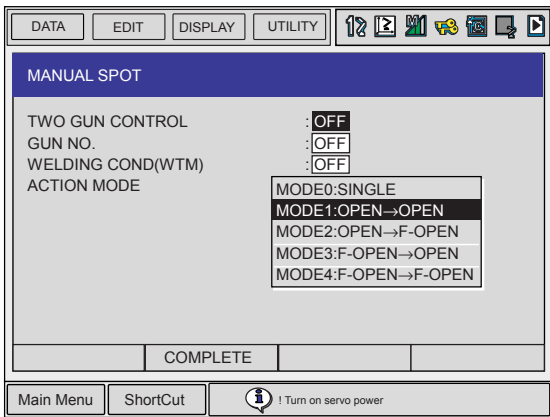
0005  MOVL V=1000
0006  STROKE GUN#(1) LONG
0007  STRWAIT GUN#(1) LONG
0008  MOVL V=1000

```

## 11.4 Setting Welding Conditions


### 11.4.1 Manual Spot Window

The operation to call the manual spot window and the items to be set are explained below.

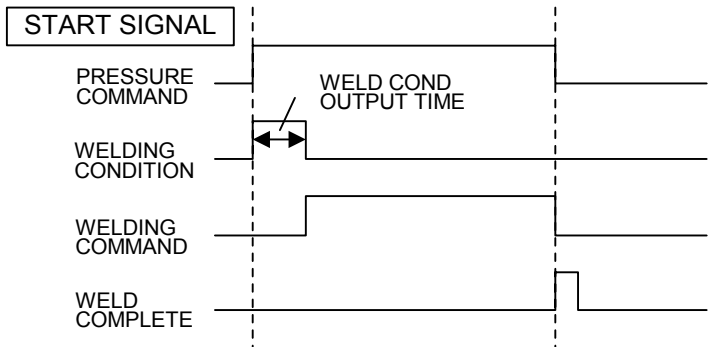
	Operation	Explanation
1	Press [0/MANUAL SPOT] of the Numeric keys.	<p>The manual spot window appears.</p>  <p>① <b>TWO GUN CONTROL</b> Specifies simultaneous manual spot welding by two guns. Press [SELECT] to alternate “ON” and “OFF” on the window.</p> <p>② <b>GUN NO.</b> Specifies the manual spot welder gun number for the welder to be used. Press [SELECT] to display the number input status, input the number value, and press [ENTER].</p> <p>③ <b>WELDING COND (WTM)</b> Specifies the manual spot welding condition number. Press [SELECT] to display the number input status, input the number value, and press [ENTER].</p> <p>④ <b>ACTION MODE</b> Specifies the gun operation mode. Shows the gun open status before and after the welding. To modify the open status, press [SELECT] to display the select dialog. Select the desired open status.</p>
2	Select the item to be set.	

11.4.2 Spot Welder Condition Data File

The spot welder condition data file makes the welder-related settings using the welding sequence I/O signal control method.

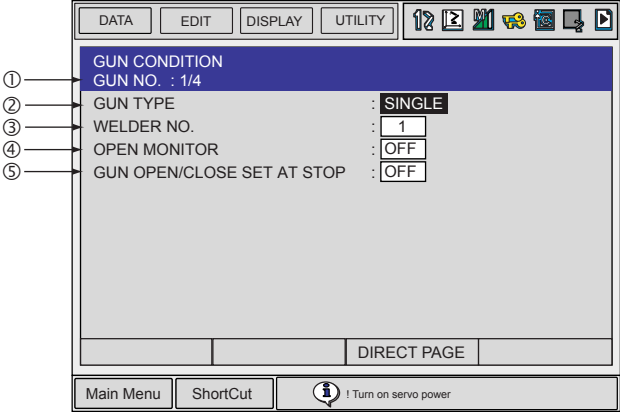

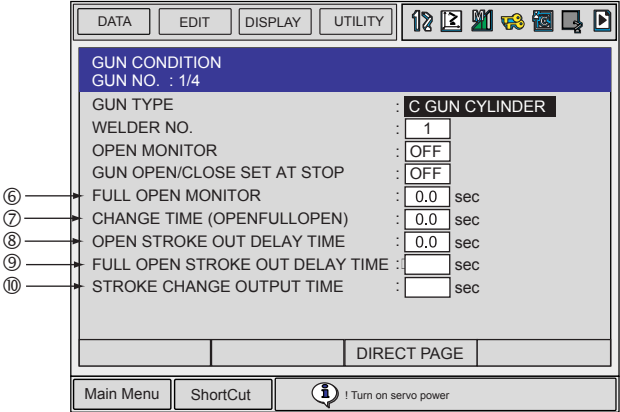
	Operation	Explanation
1	Select {SPOT WELDING} from the main menu.	
2	Select {WELDER CONDITION}.	<div>The welder condition window appears.<div></div></div> <div><div>①<b>WELD NO.</b> Welder (system) numbers are specified.  Press the page key to modify the welder number. .</div><div>②<b>WELD INST OUTPUT TYPE</b> Specifies welder output start timing. In the start timing, there are “PULSE”, “LEVEL”, and “START SIGNAL”.</div></div> <div><div><div>PULSE</div><div></div></div><div><div>LEVEL</div><div></div></div></div>

## 11.4 Setting Welding Conditions

	Operation	Explanation
2	(Cont'd.)	 <p>To modify start timing, press [SELECT] to display the select dialog. Select the desired start timing.</p> <p><b>③ WELD INST OUTPUT TIME</b>  When "WELD INST OUTPUT TYPE" is specified as "PULSE" or "START SIGNAL", set the welder condition signal to the pulse output time.  When "WELD INST OUTPUT TYPE" is specified as "LEVEL", the time cannot be set.  Press [SELECT] to display the number input status, input the number value, and press [ENTER].</p> <p><b>④ WELD COND OUTPUT TYPE</b>  Specifies welding condition output form.  There are two output forms: "BINARY" and "DISCRETE".  To modify the welding output form, press [SELECT] to display the select dialog. Select the desired output form.</p> <p><b>⑤ WELD COND MAX NUM</b>  Specifies the number of welding conditions that can be set.  When "WELD COND OUTPUT TYPE" is "DISCRETE", the number of welding conditions cannot be set.  Press [SELECT] to display the number input status, input the number value, and press [ENTER].</p> <p><b>⑥ WELD END WAIT TIME</b>  Specifies how many seconds to monitor the welding complete signal after the welding command is output from the SPOT instruction execution. An alarm occurs if the welding complete signal is not received within the set time.  Press [SELECT] to display the number input status, input the number value, and press [ENTER].</p> <p><b>⑦ STICK DETECT DELAY TIME</b>  Once the welding end signal has been input, set the length of wait time that the wire sticking signal should be observed. After this wait time has elapsed, if a wire sticking signal has been input, an alarm occurs.  Press [SELECT] to display the number input status, input the number value, and press [ENTER].</p> <p><b>⑧ RETRY TIMES</b>  The number of automatic retry times (current re-conduction) at welding error occurrence after execution of the SPOT instruction. An alarm occurs if the welding erroneous status lasts after current re-conduction is performed at the set number.  Press [SELECT] to display the number input status, input the number value, and press [ENTER].</p>
3	Select the item to be set.	

11.4.3 Spot Gun Condition Data File

Set the type of a gun, the number of the welder to be used, etc. for welding gun numbers 1 to 8.

	Operation	Explanation
1	Select {SPOT WELDING} from the main menu.	
2	Select {GUN CONDITION}.	<div>The welder condition window appears.</div> <div></div> <div><b>①GUN NO.</b> Sets the gun condition file number. Press the page key  to modify the gun number.</div> <div><b>②GUN TYPE</b> Specifies the type of a welding gun. The sequence to be executed is specified according to this value. There are the following four types of guns: 1: Single Gun 2: C double stroke cylinder type gun 3: X double stroke mechanical stopper type gun 4: X double stroke cylinder type gun To modify the gun type, press [SELECT] to display the select dialog, and select the desired gun type. For any gun type except single gun, the new set item appears.</div> <div></div>

## 11.4 Setting Welding Conditions

	Operation	Explanation
2	(Cont'd.)	<p>③<b>WELDER NO.</b> Specifies the welder to which the gun is connected. Press [SELECT] to display the number input status, input the number value, and press [ENTER].</p> <p>④<b>OPEN MONITOR (0:OFF, 1:ON)</b> Specifies whether the short-open status is verified or not at welding sequence execution. Press [SELECT] to alternate "ON" and "OFF".</p> <p>⑤<b>GUN OPEN/CLOSE SET AT STOP</b> Specifies the gun open/close setting for when a hold, emergency stop, or alarm occurs during welding instruction execution. Press [SELECT] to alternate "ON" and "OFF". When set: welding condition, welding condition, pressure instruction turn off. When not set: welding instruction, welding condition turn off.</p> <p>⑥<b>FULL OPEN MONITOR (0:OFF, 1:ON)</b> Specifies whether the full-open status is verified or not at welding sequence execution. Press [SELECT] to display "ON" and "OFF" alternately.</p> <p>⑦<b>CHANGE TIME (OPEN -&gt; FULL-OPEN)</b> Sets the time from when the welding completion signal is received, becomes the short-open status, the full-open status, and when the manipulator actually starts moving. Valid when full-open is not observed. Press [SELECT] to display the number input status, input the number value, and press [ENTER].</p> <p>⑧<b>OPEN STROKE OUT DELAY TIME</b> Specifies the timing to change the stroke change signal to the short-open status after the gun pressure instruction is output (ON) when a mechanical stopper type gun is used. (Used when changing from the full-open status to the short-open status.) This function can be used when the LS pressure is not set. Press [SELECT] to display the number input status, input the number value, and press [ENTER].</p> <p>⑨<b>FUL OPEN STROKE OUT DDELAY TIME</b> Specifies the timing to change the stroke change signal to the full-open status after the gun pressure instruction is output (ON) when a mechanical stopper type gun is used. (Used when changing from the short-open status to the full-open status.) This function can be used when the LS pressure is not set. Press [SELECT] to display the number input status, input the number value, and press [ENTER].</p> <p>⑩<b>STROKE CHANGE OUTPUT TIME</b> Sets the time to output the stroke change signal when a mechanical stopper type gun is used. Press [SELECT] to display the number input status, input the number value, and press [ENTER].</p>
3	Select the item to be set.	

# 11.5 Spot Welding Diagnosis

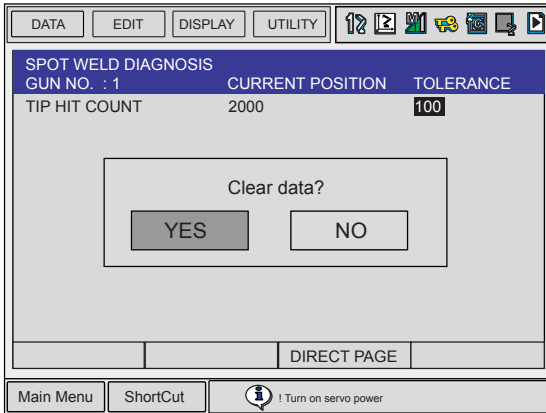
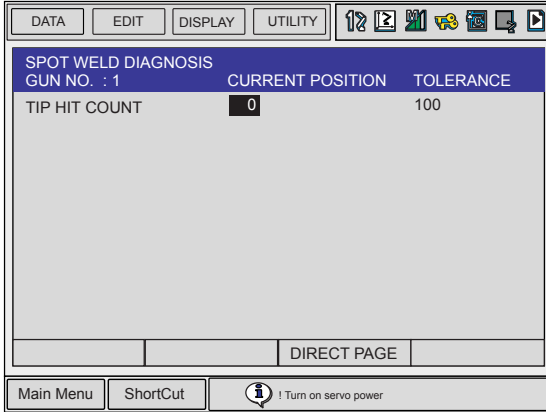
## 11.5.1 Spot Welding Diagnosis Window

This window shows the maintenance information for tip replacement. It shows the set number of welds to tip replacement and the number currently completed.

	Operation	Explanation
1	Select {SPOT WELDING} from the main menu.	
2	Select {WELD DIAGNOSIS}.	<div>The spot welding diagnosis window appears.<div><div><div>DATAEDITDISPLAYUTILITY</div><div><div>SPOT WELD DIAGNOSIS</div><div><div>GUN NO. : 1CURRENT POSITIONTOLERANCE</div><div><div>TIP HIT COUNT2000200</div></div></div></div><div><div>DIRECT PAGE</div></div><div><div>Main MenuShortCut</div><div><div>! Turn on servo power</div></div></div></div></div></div>
3	Select "GUN NO.".	<div>The number input status appears. Enter the desired gun number value, and press [ENTER].</div>
4	Select "TOLERANCE".	<div>The number input status appears. Input the desired tip replacement value, and press [ENTER].<div><div><div>DATAEDITDISPLAYUTILITY</div><div><div>SPOT WELD DIAGNOSIS</div><div><div>GUN NO. : 1CURRENT POSITIONTOLERANCE</div><div><div>TIP HIT COUNT2000100</div></div></div></div><div><div>DIRECT PAGE</div></div><div><div>Main MenuShortCut</div><div><div>! Turn on servo power</div></div></div></div></div></div>

## 11.5 Spot Welding Diagnosis

## ■ Tip Hit Count Clear

	Operation	Explanation
1	Select {SPOT WELDING} from the main menu.	
2	Select {WELD DIAGNOSIS}.	The spot welding diagnosis window appears.
3	Select {DATA} under the menu.	
4	Select {CLEAR CURRENT POS}.	<p>The confirmation dialog appears.</p>  <p>The screenshot shows the 'SPOT WELD DIAGNOSIS' window with 'GUN NO. : 1', 'CURRENT POSITION', and 'TOLERANCE' fields. The 'TIP HIT COUNT' is 2000. A dialog box asks 'Clear data?' with 'YES' and 'NO' buttons. The bottom of the window has 'Main Menu', 'ShortCut', and a warning icon with the text '! Turn on servo power'.</p>
5	Select "YES".	<p>The current tip hit count is cleared.</p>  <p>The screenshot shows the 'SPOT WELD DIAGNOSIS' window with 'GUN NO. : 1', 'CURRENT POSITION', and 'TOLERANCE' fields. The 'TIP HIT COUNT' is now 0. The bottom of the window has 'Main Menu', 'ShortCut', and a warning icon with the text '! Turn on servo power'.</p>



## **11.6** Spot Gun Motion Control

As regards to the guns for each stroke methods, the motion control described in "11.6.1 Gun Motion Control" can be executed.

The following gun types are available:

- X, C types single stroke method
- X type double stroke method
- C type double stroke method

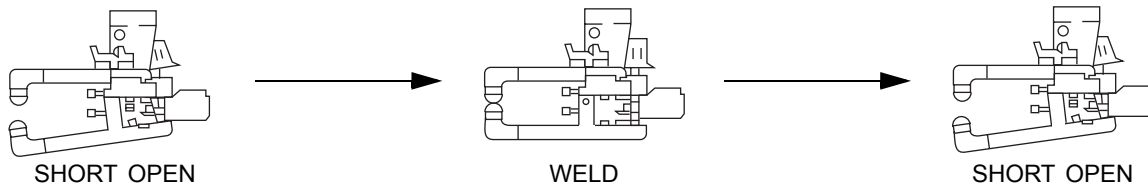
### **11.6.1** Gun Motion Control

The ways to control the gun motions are shown on the following pages.

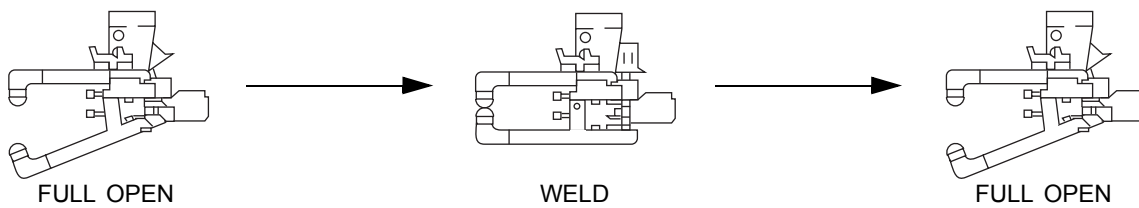
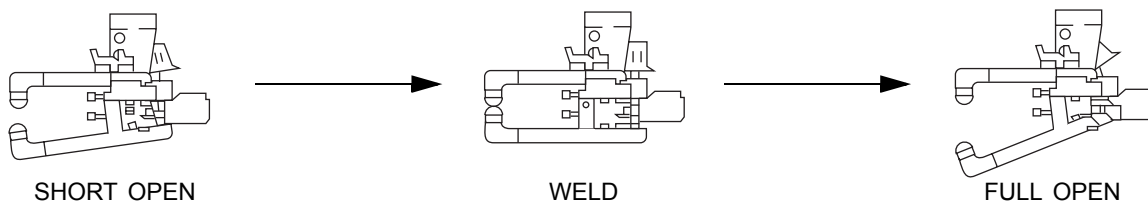
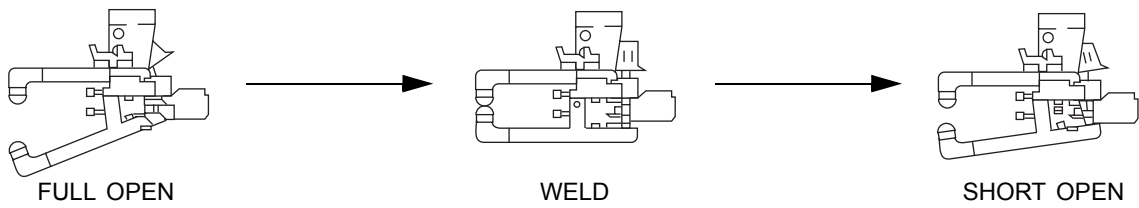
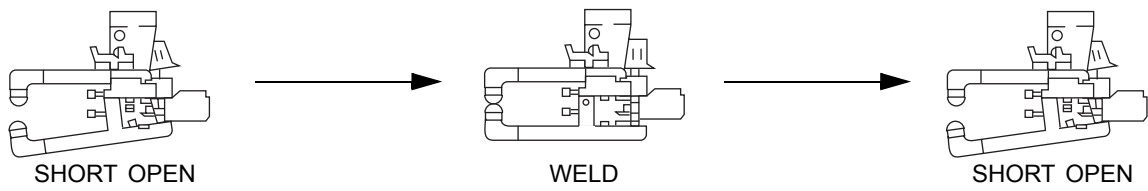
## 11.6 Spot Gun Motion Control

## ■ X Type Gun

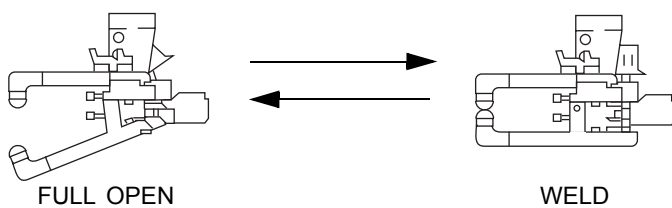
### Single stroke



### Double stroke

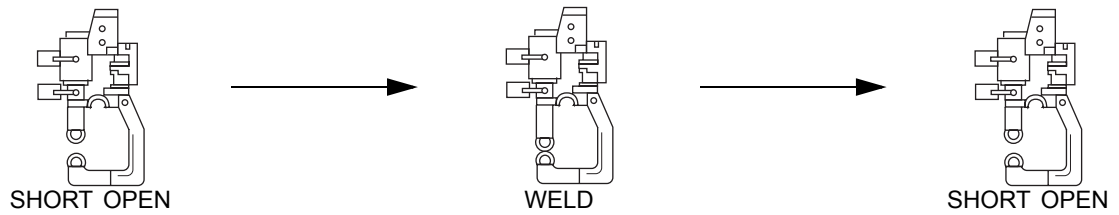


### Stroke change

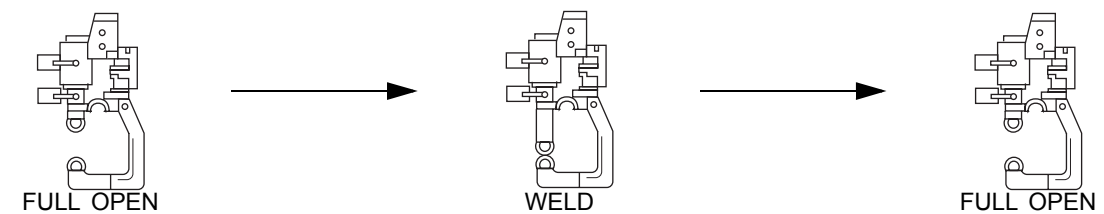
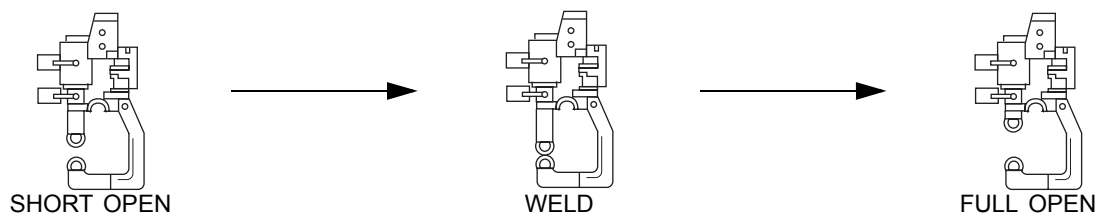
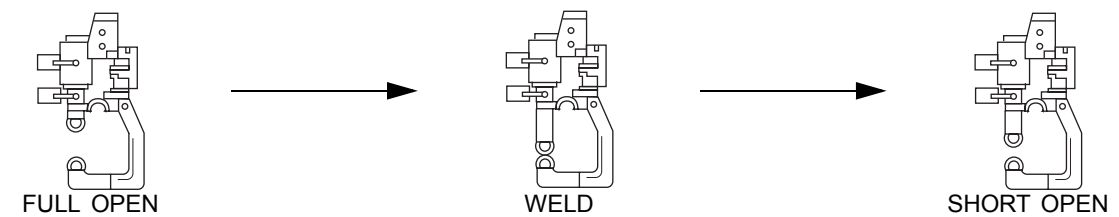
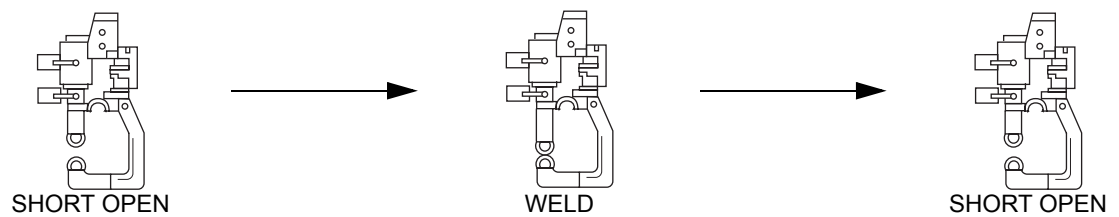


## ■ C Type Gun

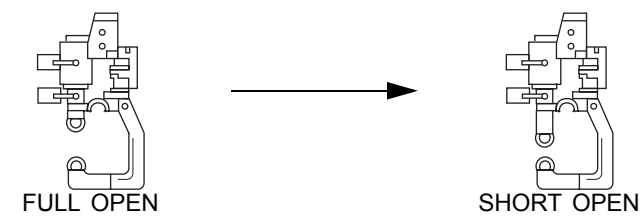
### Single stroke



### Double stroke



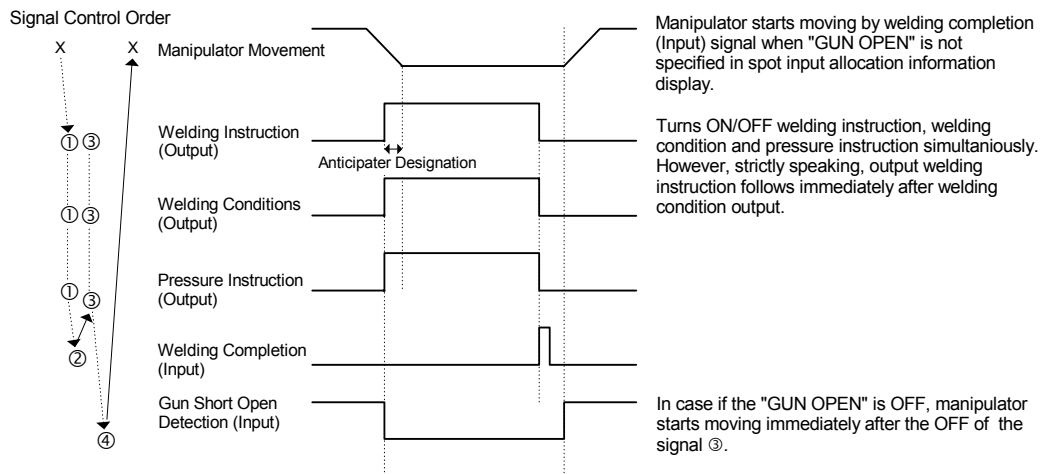
### Stroke change



## 11.6.2 Process Timing

- OPERATION MODE = 0 (SINGLE GUN, OPEN → WELDING → OPEN)

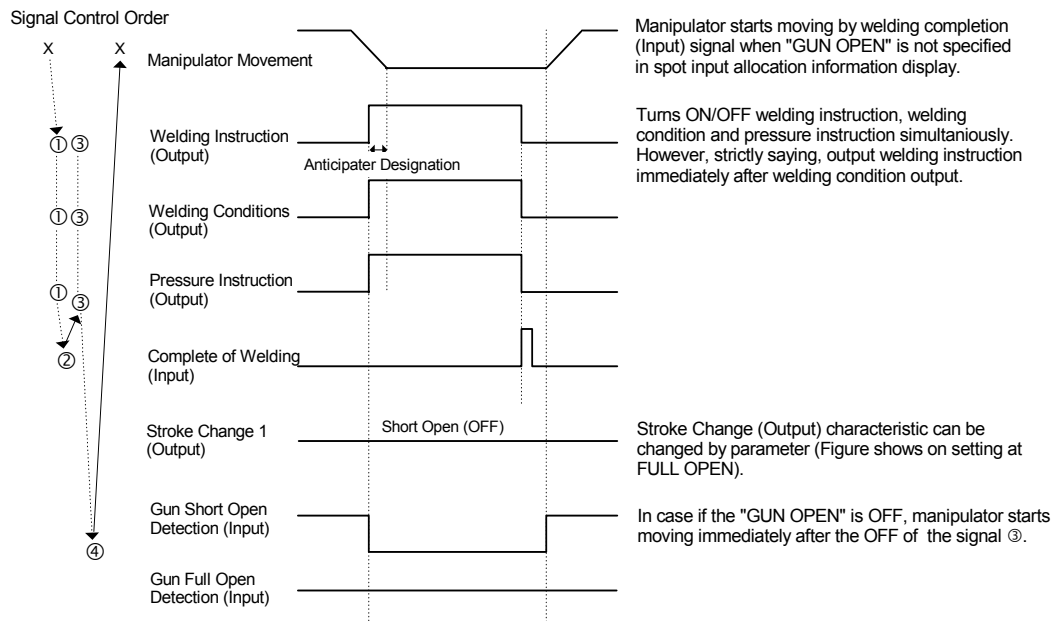
### Gun Motion Control (With X gun, C gun, single type)



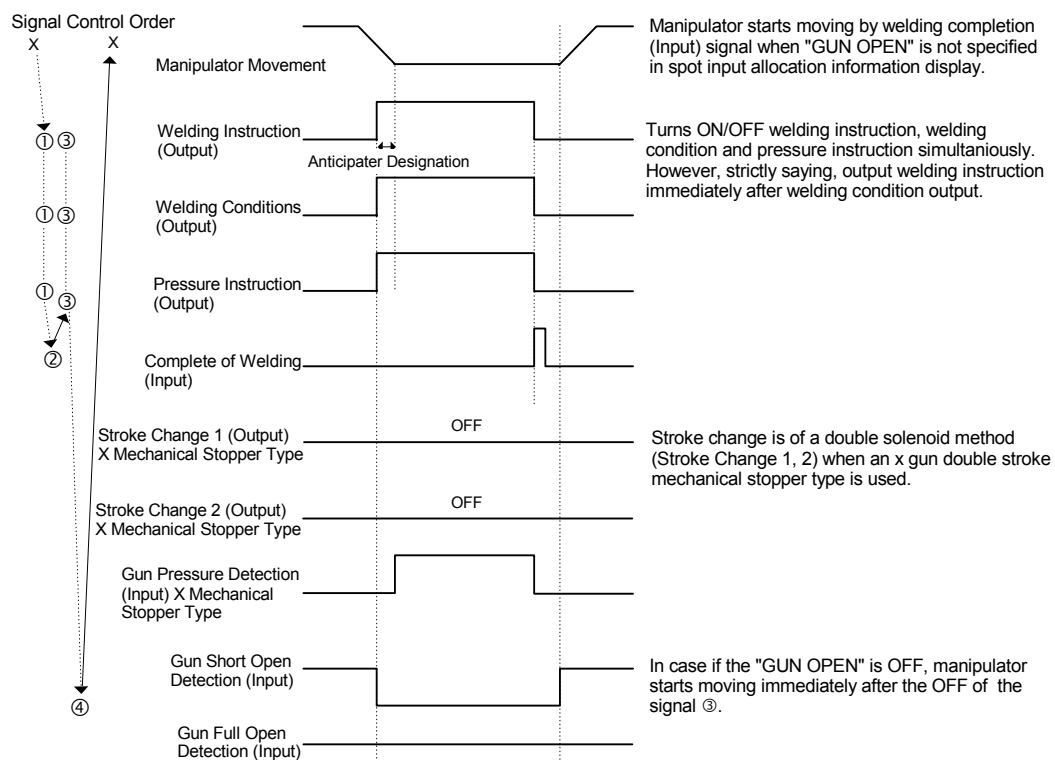
Connect "OPEN DETECTION" signal for "GUN OPEN" signal in case of using a single gun.

## ■ OPERATION MODE = 1 (SHORT OPEN → WELDING → SHORT OPEN)

### Gun Motion Control (With C gun double stroke) (With X gun double stroke, cylinder type)



### Gun Motion Control (With X gun double stroke, mechanical stopper type)

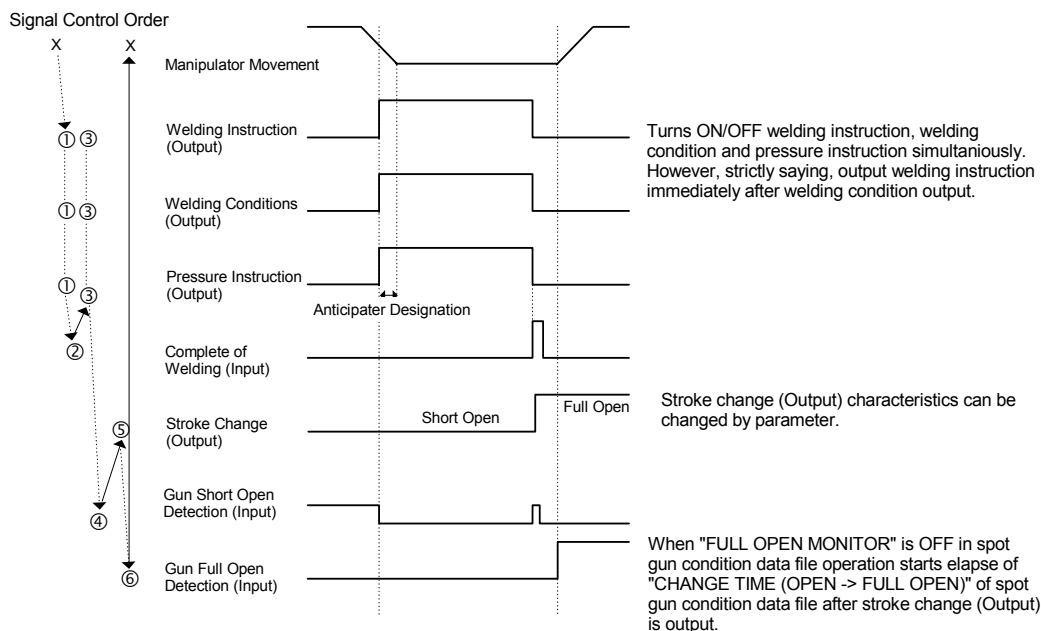


## 11.6 Spot Gun Motion Control

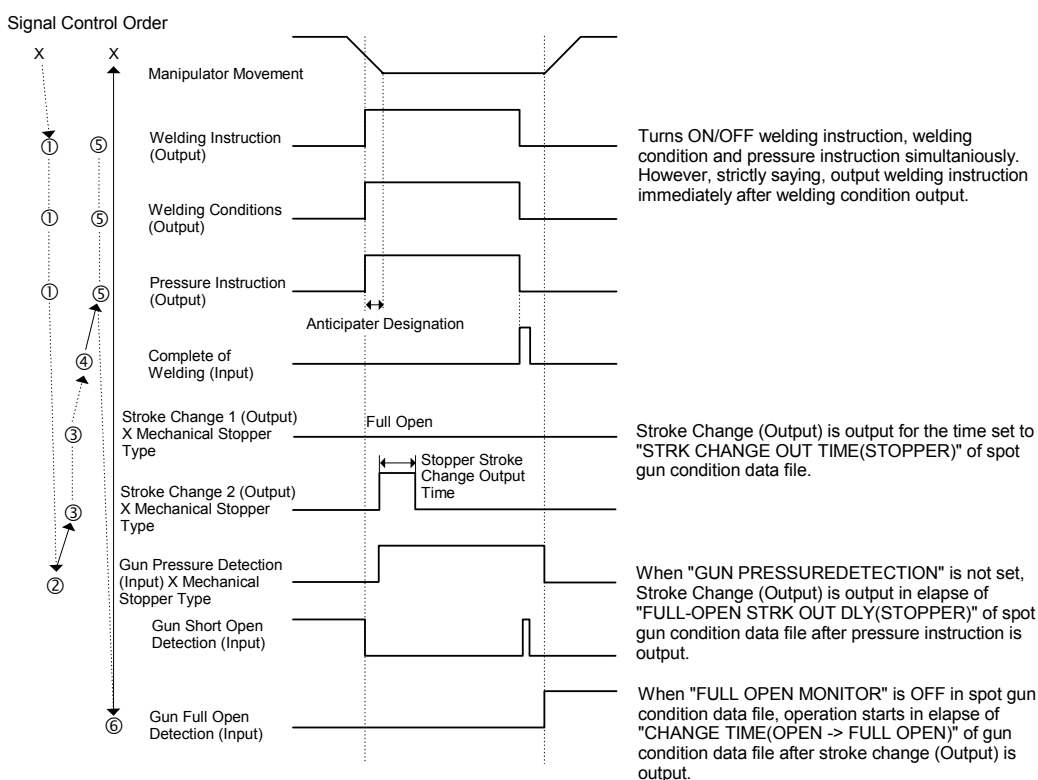
## ■ OPERATION MODE = 2 (SHORT OPEN → WELDING → FULL OPEN)

### Gun Motion Control (With C gun double stroke)

(With X gun double stroke, cylinder type)

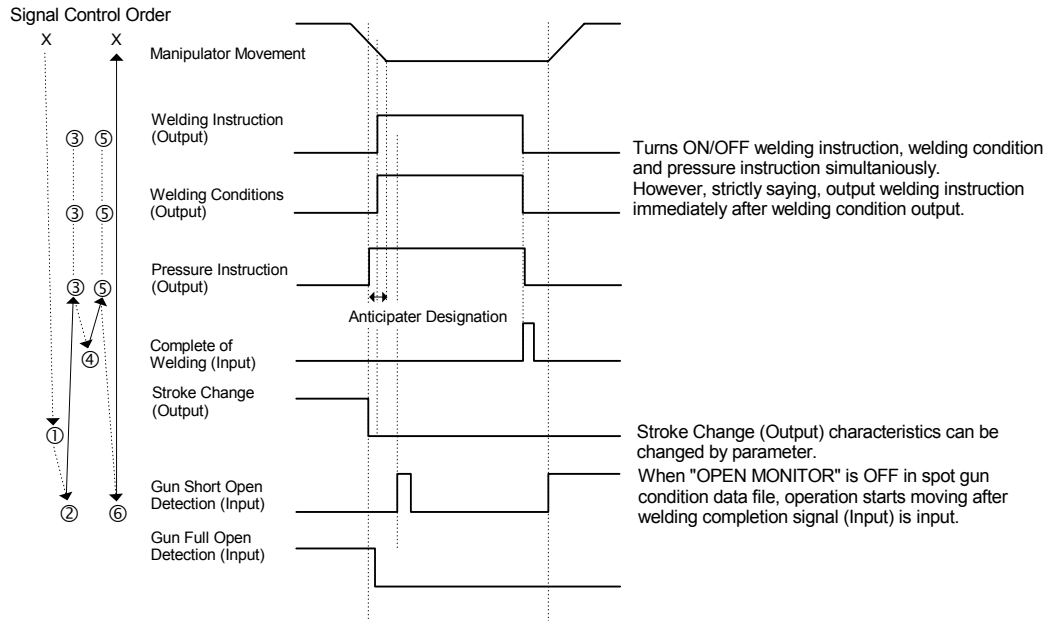


### Gun Motion Control (With X gun double stroke, mechanical stopper type)

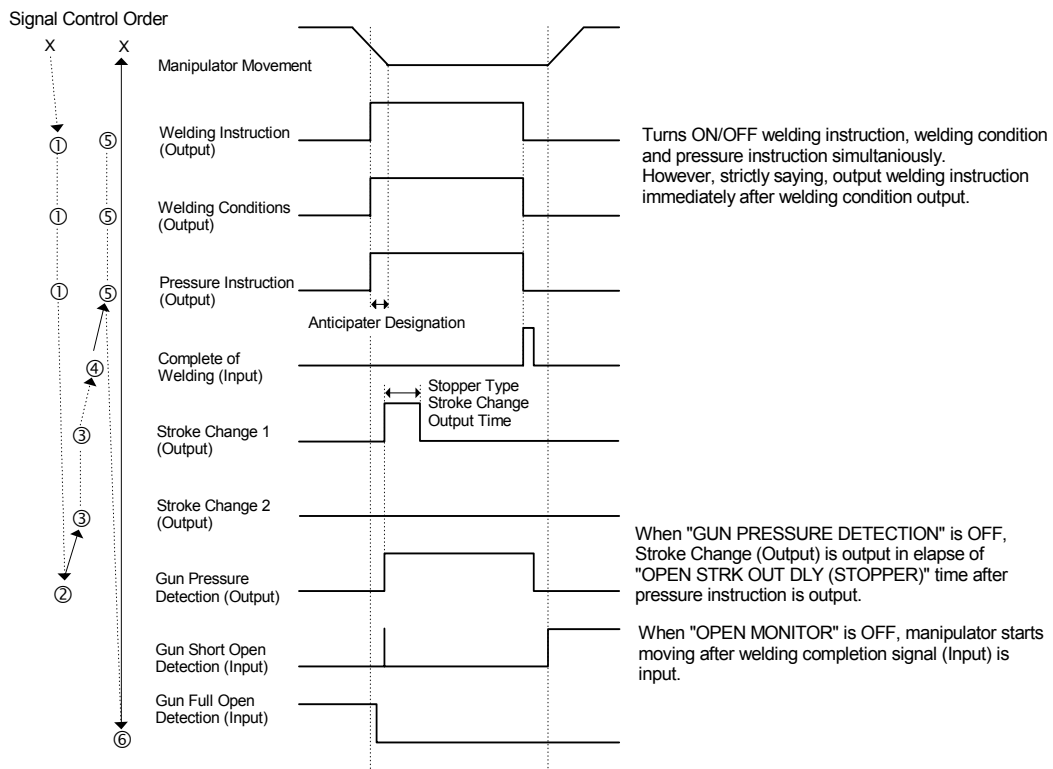


## ■ OPERATION MODE = 3 (FULL OPEN → WELDING → SHORT OPEN)

### Gun Motion Control (With C gun double stroke) (With X gun double stroke, cylinder type)



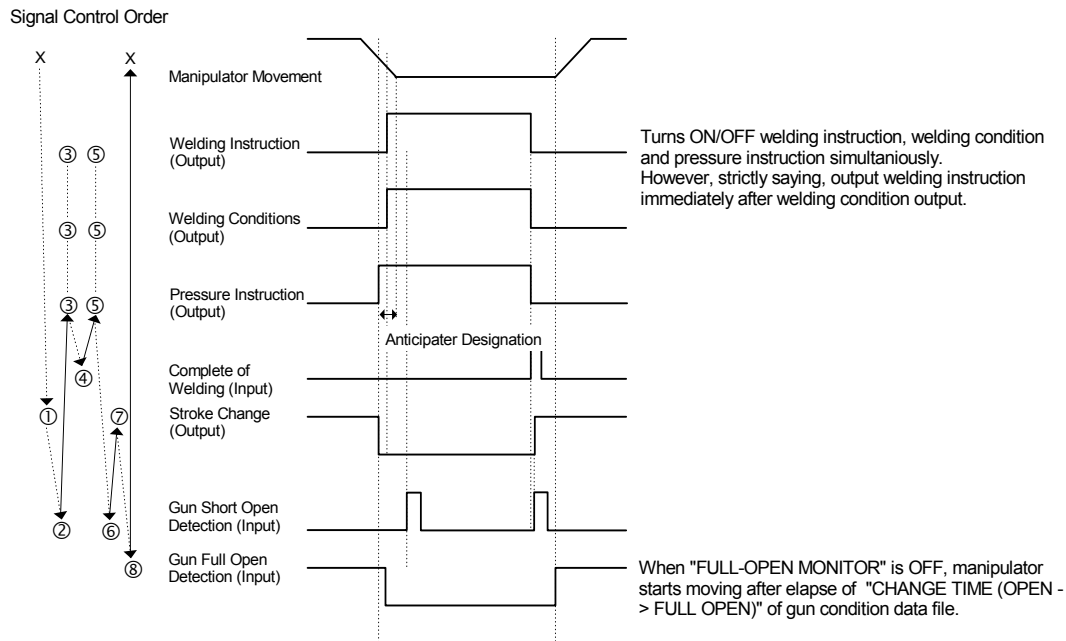
### Gun Motion Control (With X gun double stroke, mechanical stopper type)



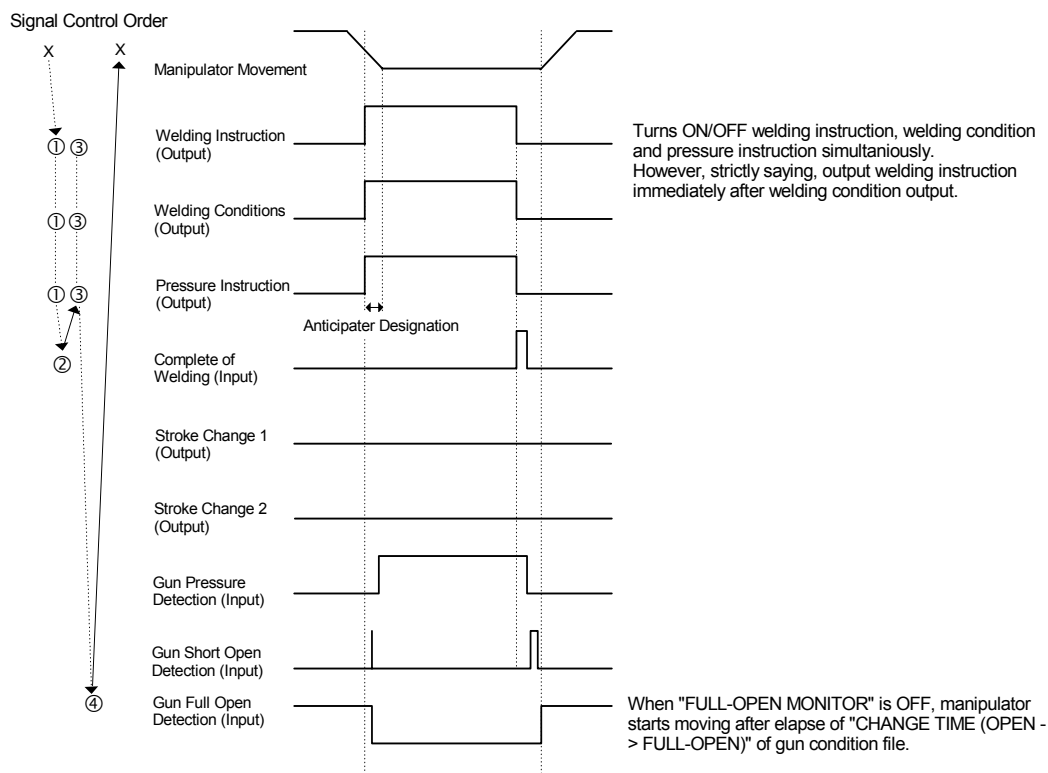
## 11.6 Spot Gun Motion Control

# ■ OPERATION MODE = 4 (FULL OPEN → WELDING → FULL OPEN)

## Gun Motion Control (With C gun double stroke) (With X gun double stroke, cylinder type)



## Gun Motion Control (With X gun double stroke, mechanical stopper type)



## 11.6.3 Stroke Change Control Method

### ■ Single Gun, C Double Gun, X Double Cylinder Gun

When OPEN (SHORT) is specified, change the stroke change signal (general output) to short open; when FULL OPEN (LONG) is specified, change the stroke change 1 signal (general output) to full open. However, the stroke change signal ON/OFF characteristics depend on the AP parameter setting.



#### **For the use of C double gun, X double cylinder gun with double solenoid specifications:**

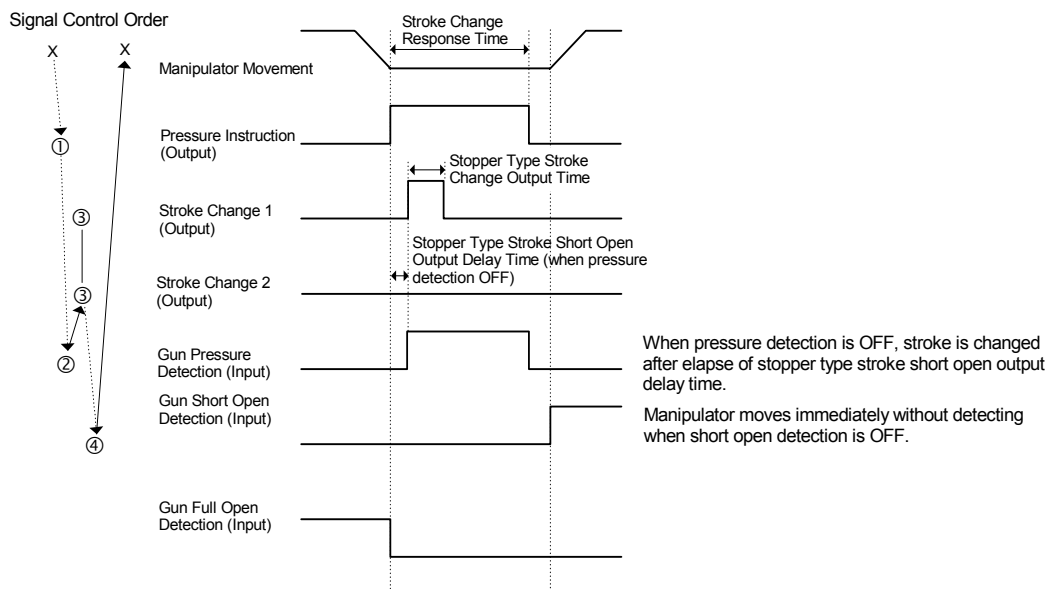
Set signal numbers for stroke change 1 and 2 in the spot I/O allocation information window. The inverse signal of stroke change 1 is output as stroke change 2 signal.

### ■ X Double Mechanical Stopper Type

Stroke change signal (output) is output with double solenoid specifications. The stroke change signal ON/OFF characteristics depend on the AP parameter setting.

#### **When OPEN (SHORT) is Specified**

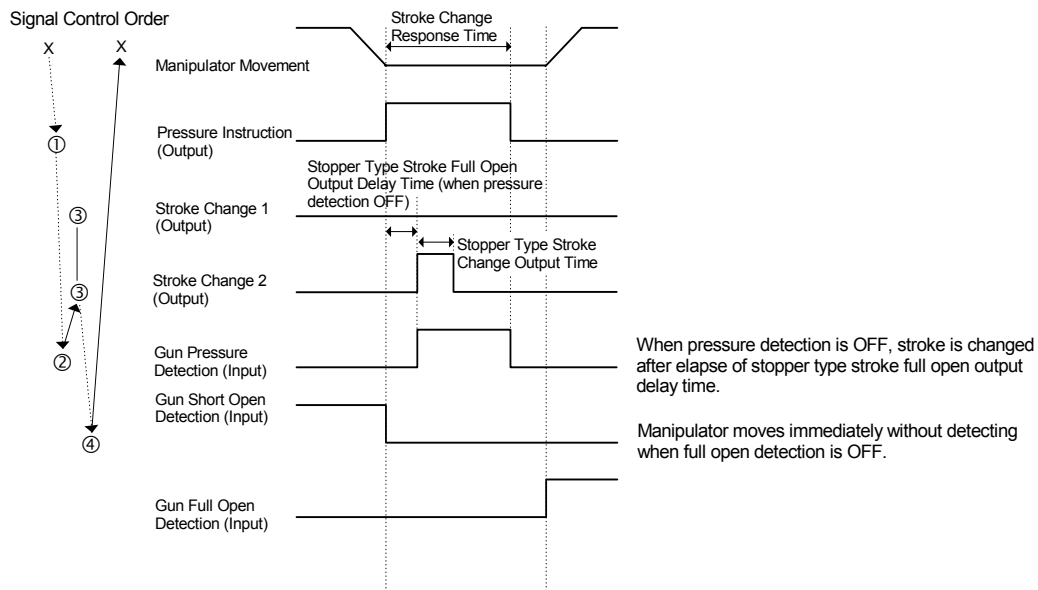
##### **Process Timing**



## 11.6 Spot Gun Motion Control

## When FULL OPEN (LONG) is Specified

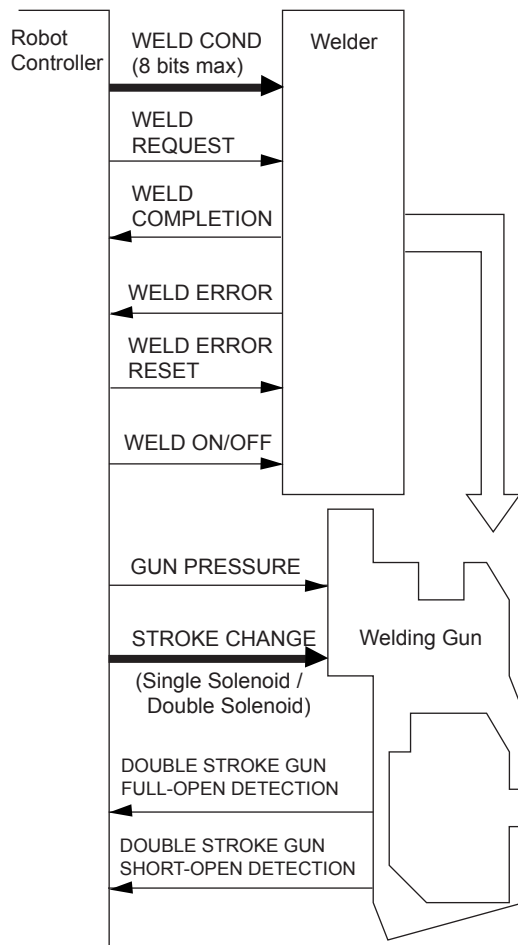
## Process Timing



## 11.7 I/O Signals for a Spot Gun

### 11.7.1 I/O Signal Overview

Specific signals are provided for spot-welding. An I/O diagram of a typical system is shown below.



I/O Signal Diagram for Spot Welding System

#### Welding conditions (level signal)

1 (1) Sets the welding conditions for the  
 2 (2) welder. The output format can be set as  
 4 (3) binary or discrete. (( ) is for discrete.)  
 8 (4) Can handle up to 255 conditions (for  
 16 (5) binary).  
 32 (6)  
 64 (7)  
 128 (8)

#### WELD REQUEST (level/pulse)

Outputs the start instruction to the welder.

#### WELD ERROR RESET (level)

Resets the welding alarm status of the welder.

#### GUN PRESSURE (level)

Outputs gun pressure instruction to the welding gun.

#### STROKE CHANGE (level)

Select the stroke of the gun.

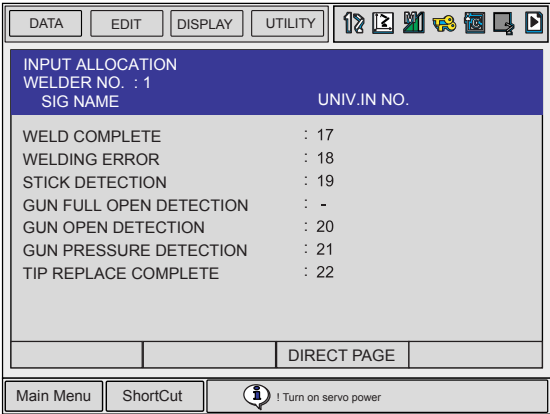
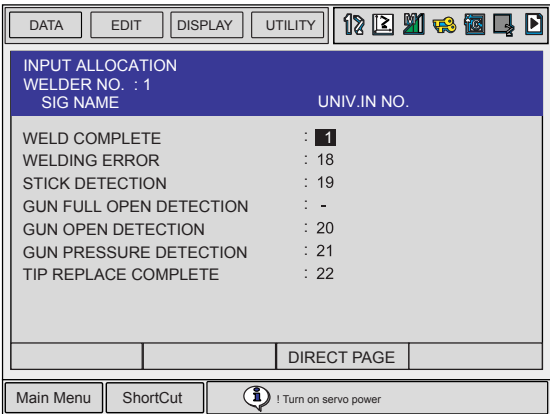
In case of single solenoid: Change by 1 signal  
 In case of double solenoid: Change by 2 signal

## 11.7.2 I/O Allocation

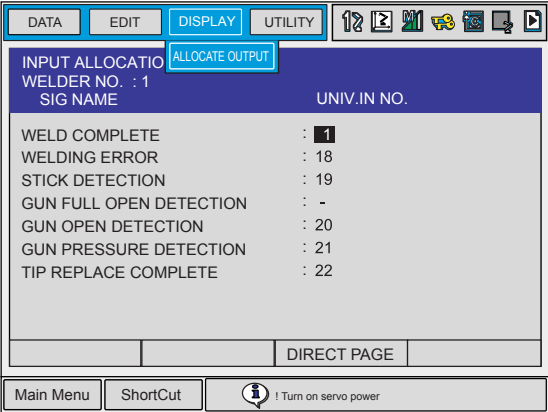
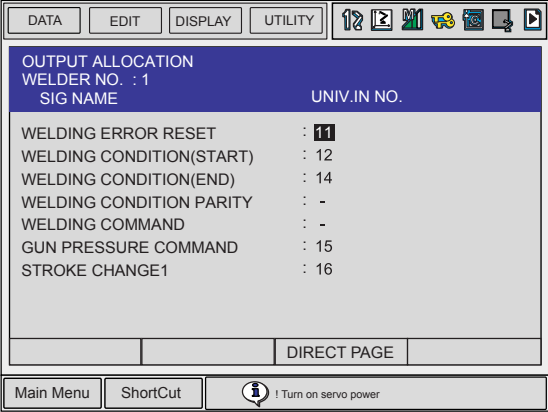
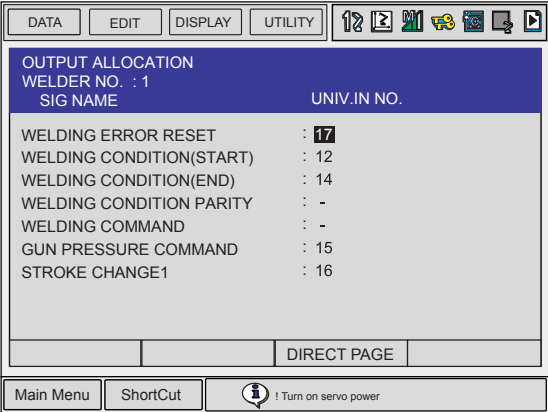
The I/O necessary for each welder can be set in the general-purpose I/O signal. The following signals are specified on the pseudo input signal window.

- Timer Cooling Water Error
- Gun Cooling Water Error
- Transthermo Error
- Air Pressure Decrease
- Weld On/Off

### ■ Input Allocation Window

	Operation	Explanation
1	Select {SPOT WELDING} from the main menu.	
2	Select {I/O ALLOCATION}.	<p>The input allocation window appears.</p> 
3	Select the signal number to be specified.	<p>The number input status appears. Input the numerical value of the desired signal number, and press [ENTER].</p> 

■ Output Allocation Window

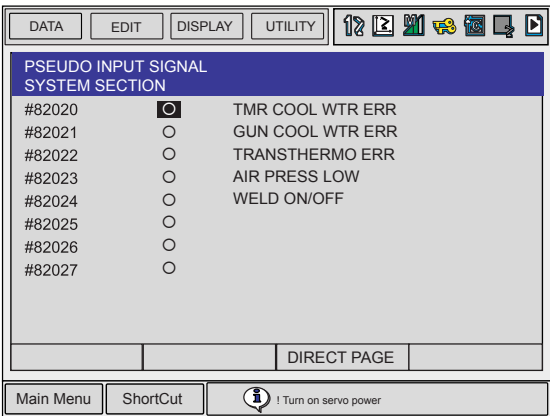
	Operation	Explanation
1	Select {DISPLAY} in the input allocation window.	<p>A pull down menu appears. Note that {ALLOCATE INPUT} appears in the pull down menu when the output window is on the display.</p> 
2	Select {ALLOCATE OUTPUT}.	<p>The output allocation window appears.</p> 
3	Select the signal number to be specified.	<p>The number input status appears. Input the numerical value of the desired signal number, and press [ENTER].</p> 

## 11.7 I/O Signals for a Spot Gun

**NOTE**

- Be sure to confirm that the allocated general-purpose signal is not used in the job. If it is used in the job, the signal is duplicated and the job does not operate normally.
- When the output “WELDING CONDITION PARITY” is set, the parity number is automatically output during welding condition output. The setting of the parity whether it is odd or even is established in the parameter.
- In case if the stroke switching signal is the double-solenoid type (X type 2 step stroke gun mechanical stopper type), allocate two guns; in case if it is the single-solenoid type (other guns), allocate one gun.

## ■ Pseudo Input Signal Window

	Operation	Explanation
1	Select {IN/OUT} under the main menu.	A pull down menu appears. Note that {ALLOCATE INPUT} appears in the pull down menu when the output window is on the display.
2	Select {PSEUDO INPUT SIG}.	The pseudo input signal window appears. 
3	Move the cursor to “ON or “OFF”, and press [INTER-LOCK]+[SELECT].	Each time [INTERLOCK] + [SELECT] is pressed, “○ (OFF)” and “● (ON)” alternate.

### 11.7.3 Allocation Signal Meanings

Robot Controller Input Signal			
Signal	Content	Source	Standard Setting
WELD COMPLETE	This signal specifies that welding has been completed. When the welding command manual spot operation is executed, it is used as a confirmation signal. When there is no LS open/close confirmation, the welding sequence ends and the next step is executed.	Welder	IN13
WELD ERR	This signal specifies an error in welding results or in the welder. During welding, an alarm occurs and the robot stops.	Welder	IN14
WIRE STICK DETECT	Specifies when a wire stick is detected. An alarm occurs and the robot stops.	Wire Stick Detector, Welder	NOT USED
TMR COOL WTR ERR	Specifies a timer cool water error. An alarm occurs and the robot stops. The servo power stays on.	Cool Water Flow Switch	IN9
GUN COOL WTR ERR	Specifies a gun cool water error. An alarm occurs and the robot stops. The servo power stays on.	Cool Water Flow Switch	IN10
TRANSTHERMO ERROR	Specifies an error from the gun transformer is transmitted directly to the robot controller. It is normally ON (NC), and when OFF, an alarm occurs. The servo power stays on.	Gun Transformer	IN11
WELD ON/OFF (from PLC)	Interlock Board, etc. PLC welder ON/OFF select switch. Welder status signal which outputs welder ON/OFF signal. While in the ON status, if the welder is switched OFF, spot welding is not performed.	Interlock Board, etc.	CN12-B6
TIP REPLACE COMPLETE	If this signal occurs after tip replacement, turn off the tip replacement demand signal, and the tip hit count is cleared.	Interlock Board, etc.	IN16
GUN FULL OPEN DETECT	When there is a 2 step stroke gun, this signal specifies stroke full open status.	Welding Gun (Full Open Status Detect LS)	NOT USED
GUN OPEN DETECT	The open/close confirmation LS of a single gun and short open confirmation LS of the 2 step stroke gun are connected, and the gun open/close confirmation is performed.	Welding Gun (Open/Close Confirmation Detect LS)	IN15

## 11.7 I/O Signals for a Spot Gun

Robot Controller Input Signal			
Signal	Content	Source	Standard Setting
GUN PRESS DETECT	Specifies the gun pressure status.	Welding Gun (Pressure Status Detect LS)	NOT USED
AIR PRESS LOW	An alarm occurs if the air pressure is low. The servo power stays on.		IN12
WELD COND (Level Signal) 1 (1) 2 (2) 4 (3) 8 (4) 16 (5) 32 (6) 64 (7) 128 (8) WELD COND PARITY	Specifies the welding condition for the welder. • Binary/discrete (bit number) can be selected as the output format • Corresponding to 255 conditions or less (Parity Bit (Specification) is the most significant bit).	Welder	OUT19 used from 4 bit  OUT19 OUT20 OUT21 OUT22  NOT USED
WELD COMMAND	The start instruction is output to the welder. It is not necessary for welders which assume the welding condition signal is a start instruction.	Welder	NOT USED
WELD ERR RESET	Resets the welder after welder error status. Programming pendant operation output.	Welder	OUT18
WELD ON/OFF	Screens the robot situation when a signal is input from the interlock board, etc., and outputs.	Welder	OUT17
TIP CHANGE REQUEST	Specifies when the set tip hit count limit has been reached.	Interlock Board, etc.	OUT9
GUN PRESS COMMAND	Outputs gun pressure command.	Welding Gun	NOT USED
STROKE CHANGE Single Solenoid Double Solenoid	When using a 2 step stroke gun, welder open/close status can be changed.	Welding Gun	NOT USED

## 11.7.4 Monitor Function for Spot Welding Equipment

Function List

Function	Content	Signal Condition	Method of Use
AIR PRESS LOW Input Signal	When the air pressure is low and this signal turns on, an alarm occurs. The servo power stays on. This function signal must be set in the Concurrent I/O Parameter.	Normal: OFF (NO) Signal Function	This signal can be used during the low air pressure signal in the spot input allocation display if the set general-purpose input external input is on. To reset the alarm, turn the signal off, and it will return to the alarm reset operation.
TIMER COOL WATER ERROR GUN COOL WATER ERROR	When the water cooling is low and this signal turns on, an alarm occurs. The servo power stays on. This function signal must be set in the Concurrent I/O Parameter.	Normal: OFF (NO) Signal Function	This signal can be used during the low water cooling signal in the spot input allocation display if the set general-purpose input external input is on. To reset the alarm, turn the signal off, and it will return to the alarm reset operation.
TRANSTHERMO ERROR	When a gun transformer error occurs, this input turns off and an alarm occurs. The servo power stays on. This function signal must be set in the Concurrent I/O Parameter.	Normal: ON (NC) Signal Function	Even though usually a timer error is transmitted to the timer from the gun, and the main signal is transmitted from the gun transformer, an alarm may occur. Also if the pressure, full open status, short open status signal, etc. is transmitted from the robot controller, the signal line from the timer to the gun becomes a transthermo error only. If this signal is checked on the robot side, the signal line transmitted to the timer disappears, and the cable handling is made easier.

## 11.7.5 Spot Welding Exclusive Signal Allocation List

○ :Connector

⊙ :Connector and terminal block

Spot Welding Exclusive Signal Allocation List

Input Signal Number	Input Method	Signal Name		
		No Allocation Set	Allocation Set	
20010	○	EXTERNAL START	EXTERNAL START	EXTERNAL START
20011	○	-	-	-
20012	○	MASTER JOB CALL	MASTER JOB CALL	MASTER JOB CALL
20013	○	ALARM/ ERROR RESET	ALARM/ ERROR RESET	ALARM/ ERROR RESET
20014	○	-	-	-
20015	○	-	-	-
20016	○	-	-	-
20017	○	IN128 (MOTOR FAN)	IN128 (MOTOR FAN)	IN128 (MOTOR FAN)
20020	○	INTERFERENCE 1 ENTRANCE PROHIBITED	INTERFERENCE 1 ENTRANCE PROHIBITED	INTERFERENCE 1 ENTRANCE PROHIBITED
20021	○	INTERFERENCE 2 ENTRANCE PROHIBITED	INTERFERENCE 2 ENTRANCE PROHIBITED	INTERFERENCE 2 ENTRANCE PROHIBITED
20022	○	-	WELD ON/OFF	-
20023	○	-	WELD INTERRUPT	-
20024	⊙	INTERFERENCE 3 ENTRANCE PROHIBITED	INTERFERENCE 3 ENTRANCE PROHIBITED	INTERFERENCE 3 ENTRANCE PROHIBITED
20025	⊙	INTERFERENCE 4 ENTRANCE PROHIBITED	INTERFERENCE 4 ENTRANCE PROHIBITED	INTERFERENCE 4 ENTRANCE PROHIBITED
20026	⊙	-	-	-
20027	⊙	-	-	-
20030	⊙	IN1	IN1	
20031	⊙	IN2	IN2	
20032	⊙	IN3	IN3	
20033	⊙	IN4	IN4	
20034	⊙	IN5	IN5	
20035	⊙	IN6	IN6	
20036	⊙	IN7	IN7	
20037	⊙	IN8	IN8	

○ :Connector

⊙ :Connector and terminal block

Spot Welding Exclusive Signal Allocation List (cont'd)

Output Signal Number	Input Method	Signal Name		
		No Allocation Set	Allocation Set	
30010	○	DURING RUNNING	DURING RUNNING	DURING RUNNING
30011	○	SERVO ON	SERVO ON	SERVO ON
30012	○	MASTER JOB HEAD	MASTER JOB HEAD	MASTER JOB HEAD
30013	○	DURING ALARM/ERROR OCCURRENCE	DURING ALARM/ERROR OCCURRENCE	DURING ALARM/ERROR OCCURRENCE
30014	○	BATTERY ALARM	BATTERY ALARM	BATTERY ALARM
30015	○	REMOTE MODE SELECTED	REMOTE MODE SELECTED	REMOTE MODE SELECTED
30016	○	PLAY MODE SELECTED	PLAY MODE SELECTED	PLAY MODE SELECTED
30017	○	TEACH MODE SELECTED	TEACH MODE SELECTED	TEACH MODE SELECTED
30020	○	IN CUBE 1	IN CUBE 1	IN CUBE 1
30021	○	IN CUBE 2	IN CUBE 2	IN CUBE 2
30022	○	TASK ORIGIN	TASK ORIGIN	TASK ORIGIN
30023	○	INTERMEDIATE START OK	INTERMEDIATE START OK	INTERMEDIATE START OK
30024	⊙	IN CUBE 3	IN CUBE 3	IN CUBE 3
30025	⊙	IN CUBE 4	IN CUBE 4	IN CUBE 4
30026	⊙	-	-	-
30027	⊙	-	-	-
30030	⊙	OUT1	OUT1	
30031	⊙	OUT2	OUT2	
30032	⊙	OUT3	OUT3	
30033	⊙	OUT4	OUT4	
30034	⊙	OUT5	OUT5	
30035	⊙	OUT6	OUT6	
30036	⊙	OUT7	OUT7	
30037	⊙	OUT8	OUT8	

## 11.7 I/O Signals for a Spot Gun

○ :Connector

⊙ :Connector and terminal block

Spot Welding Exclusive Signal Allocation List (cont'd)

Output Signal Number	Input Method	Signal Name		
		No Allocation Set	Allocation Set	
20040	○	IN9	TMR COOL WTR ERR	
20041	○	IN10	GUN COOL WTR ERR	
20042	○	IN11	TRANSTHERMO ERR	
20043	○	IN12	AIR PRESS LOW	
20044	○	IN13	WELD COMPLETE	
20045	○	IN14	WELD ERR	
20046	○	IN15		
20047	○	IN16	TIP REPL COMPLETE	
20050	○	IN17	IN17	
20051	○	IN18	IN18	
20052	○	IN19	IN19	
20053	○	IN20	IN20	
20054	○	IN21	IN21	
20055	○	IN22	IN22	
20056	○	IN23	IN23	
20057	○	IN24	IN24	
20060	○	IN25	IN25	
20061	○	IN26	IN26	
20062	○	IN27	IN27	
20063	○	IN28	IN28	
20064	○	IN29	IN29	
20065	○	IN30	IN30	
20066	○	IN31	IN31	
20067	○	IN32	IN32	

○ :Connector

⊙ :Connector and terminal block

Spot Welding Exclusive Signal Allocation List (cont'd)

Output Signal Number	Input Method	Signal Name		
		No Allocation Set	Allocation Set	
30040	○	OUT9	CHIP CHANGE REQUEST	
30041	○	OUT10	1ST PRESS	
30042	○	OUT11	OUT11	
30043	○	OUT12	OUT12	
30044	○	OUT13	OUT13	
30045	○	OUT14	OUT14	
30046	○	OUT15	OUT15	
30047	○	OUT16	OUT16	
30050	○	OUT17	WELD ON/OFF	
30051	○	OUT18	WELD ERR RESET	
30052	○	OUT19	WELD COND 1	
30053	○	OUT20	WELD COND 2	
30054	○	OUT21	WELD COND 3	
30055	○	OUT22	WELD COND 4	
30056	○	OUT23	SHUT OFF VALVE 1	
30057	○	OUT24	SHUT OFF VALVE 2	
30060	○	OUT25	OUT25	
30061	○	OUT26	OUT26	
30062	○	OUT27	OUT27	
30063	○	OUT28	OUT28	
30064	○	OUT29	OUT29	
30065	○	OUT30	OUT30	
30066	○	OUT31	OUT31	
30067	○	OUT32	OUT32	

## 11.8 Instruction List

Data variables are denoted in parentheses "<>". If multiple items are shown in one section, select one of the items.

Spot Welding Instructions

GUNCL	Function	Presses a gun.	
	Format	GUN # (<gun No.>)	1-8
		T=<gun pressing time (sec.)>	0.01-655.35
		ATT=<anticipator condition (sec.)>	0-655.35
	Example	MOVL V=1000 NWAIT GUNCL GUN # (1) T=2.0 ATT=0.5 MOVL V=1000	
SPOT	Function	Start up the welding sequence from gun pressure.	
	Format	GUN # (<gun 1 No.>)	1-8
		MODE=<gun 1 operation mode specification>	0-4
		WTM=<gun 1 welding condition>	1-255
		GUN # (<gun 2 No.>)	1-8
		MODE=<gun 2 operation mode specification>	0-4
		WTM=<gun 2 welding condition>	1-255
		ATT=<anticipator condition (sec.)>	0-655.35
	Example	MOVL V=1000 NWAIT SPOT GUN # (1) MODE=2 WTM=2 ATT=0.5 MOVL V=1000	
STROKE	Function	Alternates short open and full open of a double stroke gun at any time than welding.	
	Format	GUN # (<gun No.>)	1-8
		LONG SHORT	
	Example	MOVL V=1000 STROKE GUN #(1) LONG MOVL V=1000	
STRWAIT	Function	Verifies short open or full open status of a double stroke gun at any time other than welding.	
	Format	GUN # (<gun No.>)	1-8
		LONG SHORT	
	Example	MOVL V=1000 STROKE GUN # (1) LONG STRWAIT GUN # (1) LONG MOVL V=1000	

# 12 Table of Basic Instructions

- <> indicates numerical or alphabetical data.
- If multiple items are shown in one section, select one of the items.

## 12.1 Move Instructions

MOVJ	Function	Moves to a taught point with joint interpolation type.	
	Additional Item	Position data, Base axis position data, Station axis position data	These data do not appear on the screen.
		VJ=<play speed>	VJ: 0.01 to 100.00%
		PL=<position level>	PL:0 to 8
		NWAIT	
		UNTIL statement	
		ACC=(acceleration adjustment ratio)	ACC: 20 to 100%
		DEC=(deceleration adjustment ratio)	DEC: 20 to 100%
	Example	MOVJ VJ=50.00 PL=2 NWAIT UNTIL IN#(16)=ON	

## 12.1 Move Instructions

MOVL	Function	Moves to a taught point with linear interpolation type.	
	Additional Item	Position data, Base axis position data, Station axis position data	These data do not appear on the screen.
		V=<play speed>, VR=<play speed of the posture>, VE=<play speed of external axis>	V:0.1 to 1500.0 mm/s 1 to 9000.0 cm/min VR:0.1 to 180.0 deg/s VE:0.01 to 100.00%
		PL=<position level>	PL:0 to 8
		CR=(corner radius)	CR: 1.0 to 6553.5mm
		NWAIT	
		UNTIL statement	
		ACC=(acceleration adjustment ratio)	ACC: 20 to 100%
		DEC=(deceleration adjustment ratio)	DEC: 20 to 100%
	Example	MOVL V=138 PL=0 NWAIT UNTIL IN#(16)=ON	
MOVC	Function	Moves to a taught point with circular interpolation type.	
	Additional Item	Position data, Base axis position data, Station axis position data	These data do not appear on the screen.
		V=<play speed>, VR=<play speed of the posture>, VE=<play speed of external axis>	Same as MOVL.
		PL=<position level>	PL:0 to 8
		NWAIT	
		ACC=(acceleration adjustment ratio)	ACC: 20 to 100%
		DEC=(deceleration adjustment ratio)	DEC: 20 to 100%
	Example	MOVC V=138 PL=0 NWAIT	

MOVS	Function	Moves to a taught point with spline interpolation type.	
	Additional Item	Position data, Base axis position data, Station axis position data	These data do not appear on the screen.
		V=<play speed>, VR=<play speed of the posture>, VE=<play speed of external axis>	Same as MOVL.
		PL=<position level>	PL:0 to 8
		NWAIT	
		ACC=(acceleration adjustment ratio)	ACC: 20 to 100%
		DEC=(deceleration adjustment ratio)	DEC: 20 to 100%
	Example	MOVS V=120 PL=0	
IMOV	Function	Moves the specified increment from the current position with linear interpolation type.	
	Additional Item	P<variable number>, BP<variable number>, EX<variable number>	
		V=<play speed>, VR=<play speed of the posture>, VE=<play speed of external axis>	Same as MOVL.
		PL=<position level>	PL:0 to 8
		NWAIT	
		BF,RF,TF,UF# (<user coordinate number>)	BF: base coordinates RF: robot coordinates TF: tool coordinates UF: user coordinates
		UNTIL statement	
		ACC=(acceleration adjustment ratio)	ACC: 20 to 100%
		DEC=(deceleration adjustment ratio)	DEC: 20 to 100%
	Example	IMOV P000 V=138 PL=1 RF	

## 12.1 Move Instructions

REFP	Function	Defines a reference point (e.g. wall point for weaving).	
	Additional Item	<reference point number>	wall point 1 for weaving :1 wall point 2 for weaving :2
		Position data, Base axis position data, Station axis position data	These data do not appear on the screen.
	Example	REFP 1	
SPEED	Function	Sets play speed.	
	Additional Item	VJ=<joint speed>, V=<TCP speed>, VR=<play speed of the posture>, VE=<play speed of external axis>	VJ:Same as MOVJ. V,VR,VE: Same as MOVL.
	Example	SPEED VJ=50.00	

## 12.2 I/O Instructions

DOUT	Function	Turns the external output signals ON and OFF.	
	Additional Item	OT# (<output number>), OGH# (<output group number>), OG# (<output group number>)	
		Number of addressed output signals: OT#(xx)=1;OGH#(xx)=4(per group); OG#(xx)=8(per group)  OGH#(xx) is not subject to parity check; only the binary specification is allowed.	
		FINE	With a high degree of accuracy
	Example	DOUT OT#(12) ON	
PULSE	Function	Outputs a pulse signal as an external output signal.	
	Additional Item	OT# (<output number>), OGH# (<output group number>), OG# (<output group number>)	
		T=<time (seconds)>	0.01 to 655.35 s 0.30 s unless otherwise specified
	Example	PULSE OT# (10) T=0.60	

## 12.2 I/O Instructions

DIN	Function	Sets input signals in variables.	
	Additional Item	B<variable number>	
		IN# (<input number>), IGH# (<input group number>), IG# (<input group number>), OT# (<output number>), OGH# (<output group number>), OG# (<output group number>), SIN# (<system input number>), SOUT# (<system output number>)	
		Number of addressed input signals: IN#(xx)=1;IGH#(xx)=4(per group); IG#(xx)=8(per group)  Number of addressed output signals: OT#(xx)=1;OGH#(xx)=4(per group); OG#(xx)=8(per group)  IGH#(xx) and OGH#(xx) are not subject to parity check; only the binary specification is allowed.	
	Example	DIN B016 IN#(16) DIN B002 IG#(2)	
WAIT	Function	Waits until the external input signal status matches the specified status.	
	Additional Item	IN# (<input number>), IGH# (<input group number>), IG# (<input group number>), OT# (<user output number>), OGH# (<output group number>), SIN# (<system input number>), SOUT# (<system output number>)	
		<status>,B<variable number>	
		T=<time (seconds)>	0.01 to 655.35 s
	Example	WAIT IN# (12)=ON T=10.00 WAIT IN# (12)=B002	
AOUT	Function	Outputs the specified voltage to the general-purpose analog output port.	
	Additional Item	AO# (<output port number>)	1 to 40
		<output voltage(V)>	-14.0 to 14.0
	Example	AOUT AO# (2) 12.7	

ARATION	Function	Starts the analog output corresponding to the speed.	
	Additional Item	AO#(<output port number>)	1 to 40
		BV = <basic voltage>	-14.00 to 14.00
		V = <basic speed>	0.1 to 150.0 mm/s 1 to 9000 cm/min
		OFV = <offset voltage>	-14.00 to 14.00
	Example	ARATION AO#(1) BV=10.00 V=200.0 OFV=2.00	
ARATIOF	Function	Ends the analog output corresponding to the speed.	
	Additional Item	AO#(<output port number>)	1 to 40
	Example	ARATIOF AO#(1)	

## 12.3 Control Instructions

## 12.3 Control Instructions

JUMP	Function	Jumps to the specified label or job.	
	Additional Item	* <label character string>,JOB:<job name>, IG# (<input group number>), B<variable number>, I<variable number>,D<variable number>	
		UF# (user coordinates number)	
		IF statement	
	Example	JUMP JOB:TEST1 IF IN#(14)=OFF	
* (label)	Function	Indicates a jump destination.	
	Additional Item	<jump destination>	8 characters or less
	Example	*123	
CALL	Function	Calls the specified job.	
	Additional Item	JOB:<job name>,IG# (<input group number>), B<variable number>,I<variable number>, D<variable number>	
		UF# (user coordinates number)	
		IF statement	
	Example	CALL JOB:TEST1 IF IN# (24)=ON CALL IG#(2) (The job is called by the patterns of input signal. In this example, Job 0 cannot be called.)	
RET	Function	Returns to the call source job.	
	Additional Item	IF statement	
	Example	RET IF IN#(12)=OFF	
END	Function	Declares the end of a job.	
	Additional Item		
	Example	END	

NOP	Function	No operation.	
	Additional Item		
	Example	NOP	
TIMER	Function	Stops for the specified time.	
	Additional Item	T=<time (seconds)>	0.01 to 655.35 s
	Example	TIMER T=12.50	
IF statement	Function	Evaluates the specified condition and makes a judgment accordingly. Described after an instruction that specifies a certain action. Format:<Item1>=,<>,<=,>=,<,><Item2>	
	Additional Item	<Item1>	
		<Item2>	
	Example	JUMP *12 IF IN#(12)=OFF	
UNTIL statement	Function	Monitors the specified input signal during an action and stops the action when the specified signal status is observed. Described after an instruction that specifies a certain action.	
	Additional Item	IN# (<input number>)	
		<status>	
	Example	MOVL V=300 UNTIL IN#(10)=ON	
PAUSE	Function	Instructs a pause.	
	Additional Item	IF statement	
	Example	PAUSE IF IN#(12)=OFF	
' (comment)	Function	Displays a comment.	
	Additional Item	<comment>	32 characters or less
	Example	'Draws 100mm size square.	

## 12.3 Control Instructions

CWAIT	Function	Waits for execution of the instruction on the next line. Used with the NWAIT tag which is an additional item of a move instruction.	
	Additional Item		
	Example	MOVL V=100 NWAIT DOUT OT#(1) ON CWAIT DOUT OT#(1) OFF MOVL V=100	
ADVINIT	Function	Initializes the prereading instruction processing. Used to adjust the access timing for variable data.	
	Additional Item		
	Example	ADVINIT	
ADVSTOP	Function	Stops the prereading instruction processing. Used to adjust the access timing for variable data.	
	Additional Item		
	Example	ADVINIT	

## 12.4 Shift Instructions

SFTON	Function	Starts a shift operation.	
	Additional Item	P<variable number>, BP<variable number>, EX<variable number>, BF,RF,TF, UF#(<user coordinate number>)	BF: base coordinates RF: robot coordinates TF: tool coordinates UF: user coordinates
	Example	SFTON P001 UF#(1)	
SFTOF	Function	Stops a shift operation.	
	Additional Item		
	Example	SFTOF	
MSHIFT	Function	Obtains the shift value in the specified coordinate system from Data 2 and 3, and stores the obtained element values in Data 1. Format:MSHIFT <Data1><Coordinate><Data2><Data3>	
	Additional Item	Data1	PX<variable number>
		Coordinate	BF,RF,TF, UF# (<user coordinate number>), MTF
			BF: base coordinates RF: robot coordinates TF: tool coordinates UF: user coordinates MTF: tool coordinates for the master
		Data2	PX<variable number>
		Data3	PX<variable number>
	Example	MSHIFT PX000 RF PX001 PX002	

## 12.5 Operating Instructions

ADD	Function	Adds Data1 and Data2, and stores the result in Data1. Format:ADD<Data1><Data2>		
	Additional Item	Data1	B<variable number>, I<variable number>, D<variable number>, R<variable number>, P<variable number>, BP<variable number>, EX<variable number>	Data1 must always be a variable.
		Data2	Constant, B<variable number>, I<variable number>, D<variable number>, R<variable number>, P<variable number>, BP<variable number>, EX<variable number>	
	Example	ADD I012 I013		
SUB	Function	Subtracts Data2 from Data1, and stores the result in Data1. Format:SUB<Data1><Data2>		
	Additional Item	Data1	B<variable number>, I<variable number>, D<variable number>, R<variable number>, P<variable number>, BP<variable number>, EX<variable number>	Data1 must always be a variable.
		Data2	Constant, B<variable number>, I<variable number>, D<variable number>, R<variable number>, P<variable number>, BP<variable number>, EX<variable number>	
	Example	SUB I012 I013		

MUL	Function	Multiplies Data1 by Data2, and stores the result in Data1. Format: MUL<Data1><Data2>  Data1 can be an element in a position variable. Pxxx(0):all axis data, Pxxx(1):X-axis data, Pxxx(2):Y-axis data, Pxxx(3):Z-axis data, Pxxx(4):Tx-axis data, Pxxx(5):Ty-axis data, Pxxx(6):Tz-axis data		
	Additional Item	Data1	B<variable number>, I<variable number>, D<variable number>, R<variable number>, P<variable number> (<element number>), BP<variable number> (<element number>), EX<variable number> (<element number>)	Data1 must always be a variable.
		Data2	Constant, B<variable number>, I<variable number>, D<variable number>, R<variable number>	
	Example	MUL I012 I013 MUL P000 (3) 2 (Multiply the Z-axis data by 2.)		
DIV	Function	Divides Data1 by Data2, and stores the result in Data1. Format: DIV<Data1><Data2>  Data1 can be an element in a position variable. Pxxx(0):all axis data, Pxxx(1):X-axis data, Pxxx(2):Y-axis data, Pxxx(3):Z-axis data, Pxxx(4):Tx-axis data, Pxxx(5):Ty-axis data, Pxxx(6):Tz-axis data		
	Additional Item	Data1	B<variable number>, I<variable number>, D<variable number>, R<variable number>, P<variable number> (<element number>), BP<variable number> (<element number>), EX<variable number> (<element number>)	Data1 must always be a variable.
		Data2	Constant, B<variable number>, I<variable number>, D<variable number>, R<variable number>	
	Example	DIV I012 I013 DIV P000 (3) 2 (Divide the Z-axis data by 2.)		

## 12.5 Operating Instructions

INC	Function	Increments the value of the specified variable by 1.		
	Additional Item	B<variable number>,I<variable number>, D<variable number>		
	Example	INC I043		
DEC	Function	Decrements the value of the specified variable by 1.		
	Additional Item	B<variable number>,I<variable number>, D<variable number>		
	Example	DEC I043		
AND	Function	Obtains the AND of Data1 and Data2, and stores the result in Data1. Format:AND<Data1><Data2>		
	Additional Item	Data1	B<variable number>	
		Data2	B<variable number>, Constant	
	Example	AND B012 B020		
OR	Function	Obtains the OR of Data1 and Data2, and stores the result in Data1. Format:OR<Data1><Data2>		
	Additional Item	Data1	B<variable number>	
		Data2	B<variable number>, Constant	
	Example	OR B012 B020		
NOT	Function	Obtains the NOT of Data2, and stores the result in Data1. Format:NOT<Data1><Data2>		
	Additional Item	Data1	B<variable number>	
		Data2	B<variable number>, Constant	
	Example	NOT B012 B020		
XOR	Function	Obtains the exclusive OR of Data1 and Data2, and stores the result in Data1. Format:XOR<Data1><Data2>		
	Additional Item	Data1	B<variable number>	
		Data2	B<variable number>, Constant	
	Example	XOR B012 B020		

SET	Function	Sets Data2 to Data1. Format:SET<Data1><Data2>		
	Additional Item	Data1	B<variable number>, I<variable number>, D<variable number>, R<variable number>, P<variable number>, BP<variable number>, EX<variable number>	Data1 must always be a variable.
		Data2	Constant, B<variable number>, I<variable number>, D<variable number>, R<variable number>, EXPRESS	
	Example	SET I012 I020		
SETE	Function	Sets data to an element in a position variable.		
	Additional Item	Data 1	P<variable number> (<element number>), BP<variable number> (<element number>), EX<variable number> (<element number>)	
		Data 2	D<variable number>, <double-precision integer type constant>	
	Example	SETE P012 (3) D005		
GETE	Function	Extracts an element in a position variable.		
	Additional Item	D<variable number>		
		P<variable number> (<element number>), BP<variable number> (<element number>), EX<variable number> (<element number>)		
	Example	GETE D006 P012 (4)		

## 12.5 Operating Instructions

GETS	Function	Sets a system variable to the specified variable.		
	Additional Item	B<variable number>,I<variable number>,D<variable number>,R<variable number>,PX<variable number>		
		\$B<variable number>,\$I<variable number>,\$D<variable number>,\$R<variable number>,\$PX<variable number>, \$ERRNO, Constant, B<variable number>		System variable
	Example	GETS B000 \$B000 GETS I001 \$I[1] GETS PX003 \$PX001		
CNVRT	Function	Converts the position variable (Data2) into a position variable of the specified coordinate system, and stores the converted variable in Data1. Format:CNVRT<Data1><Data2><coordinate>		
	Additional Item	Data1	PX<variable number>	
		Data2	PX<variable number>	
		BF,RF,TF,UF# (<user coordinate number>),MTF		BF: base coordinates RF: robot coordinates TF: tool coordinates UF: user coordinates MTF:tool coordinates for the master
	Example	CNVRT PX000 PX001 BF		

CLEAR	Function	Starting with the variable number in Data1, clears (sets to zero) as many variables as specified by a number in Data2. Format: CLEAR<Data1><Data2>		
	Additional Item	Data1	B<variable number>,I<variable number>, D<variable number>,R<variable number>, \$B<variable number>,\$I<variable number>, \$D<variable number>,\$R<variable number>,	
		Data2	<number of variables>, ALL,STACK	ALL:Clears variables of the variable number in Data1 and of all the variable numbers that follow. STACK:Clears all variables in the job call stack.
	Example	CLEAR B000 ALL CLEAR STACK		
SIN	Function	Obtains the sine of Data2, and stores the result in Data1. Format:SIN<Data1><Data2>		
	Additional Item	Data1	R<variable number>	Data1 must always be a real type variable.
		Data2	<constant>,R<variable number>	
	Example	SIN R000 R001 (Sets the sine of R001 to R000.)		
COS	Function	Obtains the cosine of Data2, and stores the result in Data1. Format:COS<Data1><Data2>		
	Additional Item	Data1	R<variable number>	Data1 must always be a real type variable.
		Data2	<constant>,R<variable number>	
	Example	COS R000 R001 (Sets the cosine of R001 to R000.)		

## 12.5 Operating Instructions

ATAN	Function	Obtains the arc tangent of Data2, and stores the result in Data1. Format: ATAN<Data1><Data2>		
	Additional Item	Data1	R<variable number>	Data1 must always be a real type variable.
		Data2	<constant>,R<variable number>	
	Example	ATAN R000 R001 (Sets the arc tangent of R001 to R000.)		
SQRT	Function	Obtains the square root of Data2, and stores the result in Data1. Format: SQRT<Data1><Data2>		
	Additional Item	Data1	R<variable number>	Data1 must always be a real type variable.
		Data2	<constant>,R<variable number>	
	Example	SQRT R000 R001 (Sets the square root of R001 to R000.)		
MFRAME	Function	Creates a user coordinate using the position data for the given three points as definition points. <Data1> indicates the definition point ORG position data, <Data2> the definition point XX position data, and <Data3> the definition point XY position data. Format: MFRAME <user coordinate> <Data1> <Data2> <Data3>		
	Additional Item	UF#(<user coordinate number>)		1 to 24
		Data1	PX <variable number>	
		Data2	PX <variable number>	
		Data3	PX <variable number>	
	Example	MFRAME UF#(1) PX000 PX001 PX002		
MULMAT	Function	Obtains the matrix product of Data2 and Data3, and stores the result in Data1. Format: MULMAT <Data1> <Data2> <Data3>		
	Additional Item	Data1	P <variable number>	
		Data2	P <variable number>	
		Data3	P <variable number>	
	Example	MULMAT P000 P001 P002		

INVMAT	Function	Obtains the inverse matrix of Data2, and stores the result in Data1. Format: INVMAT <Data1> <Data2>		
	Additional Item	Data1	P <variable number>	
		Data2	P <variable number>	
	Example	INVMAT P000 P001		
SETFILE	Function	Changes the contents data of a condition file into the numeric data of Data1. The contents data of a condition file to be changed is specified by the element number.		
	Additional Item	Contents data of a condition file	WEV#(<condition file number>)(<element number>)	
		Data1	Constant, D<variable number>	
	Example	SETFILE WEV#(1)(1) D000		
GETFILE	Function	Stores the contents data of a condition file in Data1. The contents data of a condition file to be obtained is specified by the element number.		
	Additional Item	Data1	D <variable number>	
		Contents data of a condition file	WEV#(<condition file number>)(<element number>)	
	Example	GETFILE D000 WEV#(1)(1)		
GETPOS	Function	Stores the position data of Data2 (step number) in Data1.		
	Additional Item	Data1	PX <variable number>	
		Data2	STEP# (<step number>)	
	Example	GETPOS PX000 STEP#(1)		
VAL	Function	Converts the numeric value of the character string (ASCII) of Data2 into the real number, and stores the result in Data1. Format: VAL <Data1> <Data2>		
	Additional Item	Data1	B <variable number>, I <variable number>, D <variable number>, R <variable number>	
		Data2	Character string, S <variable number>	
	Example	VAL B000 "123"		

## 12.5 Operating Instructions

ASC	Function	Obtains the character code of the first letter of the character string (ASCII) of Data2, and stores the result in Data1. Format:ASC<Data1><Data2>		
	Additional Item	Data1	B <variable number>, I <variable number>, D <variable number>	
		Data2	Character string, S <variable number>	
	Example	ASC B000 "ABC"		
CHR\$	Function	Obtains the character (ASCII) with the character code of Data2, and stores the result in Data1. Format:CHR\$<Data1><Data2>		
	Additional Item	Data1	S <variable number>	
		Data2	Constant, B <variable number>	
	Example	CHR\$ S000 65		
MID\$	Function	Obtains the character string (ASCII) of any length (Data 3, 4) from the character string (ASCII) of Data2, and stores the result in Data1. Format:MID\$<Data1><Data2><Data3><Data4>		
	Additional Item	Data1	S <variable number>	
		Data2	Character string, S <variable number>	
		Data3	Constant, B <variable number>, I <variable number>, D <variable number>	
		Data4	Constant, B <variable number>, I <variable number>, D <variable number>	
	Example	MID\$ S000 "123ABC456" 4 3		
LEN	Function	Obtains the total number of bytes of the character string (ASCII) of Data2, and stores the result in Data1. Format:LEN<Data1><Data2>		
	Additional Item	Data1	B <variable number>, I <variable number>, D <variable number>	
		Data2	Character string, S <variable number>	
	Example	LEN B000 "ABCDEF"		

CAT\$	Function	Combines the character string (ASCII) of Data2 and Data3, and stores the result in Data1. Format:CAT\$<Data1><Data2><Data3>		
	Additional Item	Data1	S <variable number>	
		Data2	Character string, S <variable number>	
		Data3	Character string, S <variable number>	
	Example	CAT\$ S000 "ABC" "DEF"		

# 13 Error

## 13.1 Error Message List

Error warns the operator not to advance to the next operation caused by a wrong operation or the access method when using the programming pendant or an external equipment (computer, PLC, etc.).

When an error occurs, confirm the content of the error then release the error.


To release the error, perform either of the following operations:

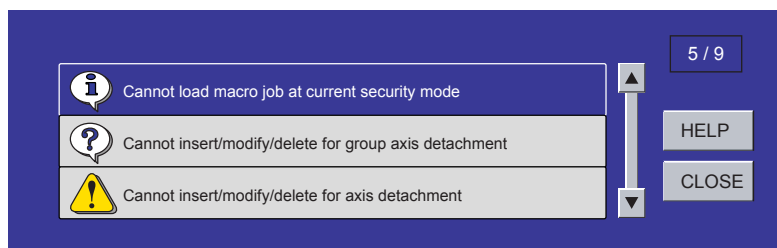
- Press [CANCEL] on programming pendant.
- Input alarm/error reset signal (system input).



An error is different from an alarm because it does not stop the robot even if it occurred while the robot was operated (during playback).



When two or more errors occur,  appears in the message display area. Activate the message display area and press [SELECT] to view the list of current errors.



To view details of the selected error contents, select "HELP." To close the error list, select "CLOSE." To release all the errors, press [CANCEL].

### 13.1.1 System and General Operation

Error No.	Data	Error Message	Contents
10	-	Turn off servo power and perform corrective action	It cannot be operated while servo power supply is ON.
20	-	Depress TEACH	Out of specified operation mode
30	-	Illegal setting for number of variables	Parameter setting error
40	-	Undefined robot position variables	Position variable cannot be used.
60	-	Undefined points (ORG, XX, XY)	Not registered user coordinates basic 3 points (ORG, XX, XY)
70	-	Program and current tool different	The tool number registered with teaching position data does not match the the tool number selected at the programing pendant.
80	-	Same position in the 3 points	
100	-	On overrun recovery status	
110	-	Turn ON servo power	
120	-	Set to PLAY mode	
130	-	No start using external signal	
140	-	No start using P.P.	
180	-	TEACH mode select signal ON	
190	-	Set variable number	
200	-	Defined group axis	
210	-	Undefined coordinated robots	
212		Cannot register group combination	
230	-	While releasing soft limit	
240	-	Undefined robot	
270	-	Undefined gun condition file	
280	-	Lack of number of I/O points	
290	-	Cannot set same No.	
300	-	Undefined user frame	
310	-	Cannot register Master JOB	
320	-	Cannot operate CHECK-RUN	
330	-	Cannot operate MACHINE LOCK	

## 13.1 Error Message List

Error No.	Data	Error Message	Contents
340	-	Cannot operate Master JOB	
350	-	Cannot initialize	
380	-	Position not checked	Second home position was not checked.
390	-	Can specify servo off by safety relay	
410	-	Time could not be measured	Time could not be measured for TRT function.
420	-	Incorrect number of taught points	The number of the taught points for tool calibration is incorrect.
430	-	Register start reserved JOB	
460	-	Excess time for measuring	
500	-	Undefined robot calibration data	
510	-	Undefined axis	
520	-	Cannot select two coordinated combination	
530	-	Start reservation mode	
550	-	Start reserved JOB change prohibit is set	
560	-	Cannot teach position while soft limit released	
590	-	Register group axis combination	[SYNCHRO] was pressed for coordinated job which was not registered as group.
600	-	Out of setting data range	
610	-	Cannot use the user coordinate	
620	-	Select JOB (robot)	
650	-	Incorrect measured data	
660	-	Wrong data type of position variable	
680	-	Defined data	
	XXX		File No.
700	-	Wrong CMOS memory board type	
760	-	Error in start condition set	
770	-	During robot operation	
800	-	The gun of designation is not connected	

Error No.	Data	Error Message	Contents
801	-	The group axis of designation is not connection	
810	-	Servo power supply is limited	
820	-	Modification range over	
930	-	Undefined conveyor calibration data	
940	-	Forced pressure signal ON	
950	-	Negative correction distance	
960	-	I/O axis mode requesting	
970	-	ERRSVCPU signal error	

## 13.1 Error Message List

### 13.1.2 Editing

Error No.	Data	Error Message	Contents
1010	-	EDIT LOCK mode	
1020	-	Enter correct value	
1030	-	Unauthorized ID No.	
1050	-	Enter correct date	
1060	-	Enter correct clock	
1070	-	Enter an ID number in 4-8 figures	
1080	-	Negative value can't be set	

### 13.1.3 Job Defined Data

Error No.	Data	Error Message	Contents
2010	-	Incorrect character	
2020	-	Name not entered	
2030	-	Undefined JOB name	
2040	-	Defined JOB name	
2050	-	Address not found	
2070	-	Set robot exactly to taught position	
2080	-	Press INSERT or MODIFY	
2090	-	Only modifying move instruction possible	
2100	-	JOB cannot be edited.	
2110	-	Over soft limit	
2120	-	Cannot insert/alter/delete with servo off	
2150	-	Inserting is not possible from this point	
2160	-	Cannot modify or delete this position	
2170	-	Press INSERT to record same step as previous step	
2180	-	Cannot insert data	
2210	-	Illegal data setting	
2220	-	Display edit instruction	
2240	-	Excessive instruction equation	

Error No.	Data	Error Message	Contents
2250	-	Unmatched number of parentheses in equation	
2260	-	Wrong group axis selection	
2270	-	Cannot insert any more instruction in JOB	
2280	*	JOB memory is full	
	1		Lack of position file memories
	2		Lack of JOB registering memories
	3		Lack of instruction file memories
	4		Lack of memory pool
	5		Lack of pass condition file for multi-layer
2290	-	Undefined master JOB	
2291	*	Undefined SUB Master JOB	
	1		Sub-master 1
	2		Sub-master 2
	3		Sub-master 3
	4		Sub-master 4
	5		Sub-master 5
	6		Sub-master 6
	7		Sub-master 7
	8		Sub-master 8
2292	-	Undefined MASTER START JOB	
2293	*	Undefined SUB START JOB	
	1		Sub-master 1
	2		Sub-master 2
	3		Sub-master 3
	4		Sub-master 4
	5		Sub-master 5
	6		Sub-master 6
	7		Sub-master 7
	8		Sub-master 8

## 13.1 Error Message List

Error No.	Data	Error Message	Contents
2300	-	Cannot teach JOB without group-axis specification	
2310	*	Same label exists	
	XXX		Line No.
2340	-	Pasted data not found	
2360	-	Cannot create editing area	
2370	-	Cannot cut/copy NOP and END instructions	
2390	-	Wrong group axis selection	
2400	-	Cannot move in cut & paste editing	
2430	-	Reverse data not found	
2440	-	Move C-and W-axis to basic position	Lazer cutting
2450	-	Relative JOB not permitted	
2470	-	Wrong JOB type	
2480	-	Wrong JOB coordinates setting	
2500	-	Cannot convert the JOB	
2510	-	Cannot correct position in the JOB	
2520	-	Enter JOB name	
2530	-	Illegal step number	
2540	-	Enter step number	
2550	-	Duplicated step number	
2551	-	Duplicated line number	
2560	-	Cannot correct steps of position variables and REFP	
2570	-	The step does not contain speed	
2580	-	The step dose not contain PL/CONT	
2590	-	Soft limit range over	
2600	-	Cannot teach position in concurrent JOB	
2610	-	Wrong JOB kind	
2620	-	Cannot correct play speed in the JOB	
2630	-	Conveyor position not reset	

Error No.	Data	Error Message	Contents
2640	-	Incorrect JOB name	
2670	-	Undefined target JOB	
2710	-	Relative job can't be shifted with pulse type	
2730	-	Cannot use robot macro JOB	
2740	-	Cannot use concurrent macro JOB	
2750	-	Cannot use JOB with group-axis specification	
2760	-	Cannot insert/modify/delete for group axis detachment	
2761	-	Axis is separated. Cannot add, modify, or delete.	
2770	-	Cannot reverse data of SVSPOTMOV instruction	
2780	-	Arithmetic error	

## 13.1 Error Message List

**13.1.4** External Memory Equipment

Error No.	Data	Error Message	Contents
3010	-	Floppy disk drive cable not connected	
3020	-	Floppy disk not inserted into floppy disk drive	
3030	-	Floppy disk protection is ON	
3040	-	File not saved on floppy disk or Compact Flash	
3050	-	File saved on floppy disk or Compact Flash	
3060	-	Out of memory on floppy disk or Compact Flash	
3070	-	Number of files on floppy disk or Compact Flash is full	
3080	-	I/O error on floppy disk or Compact Flash	
3090	*	Transmission error with floppy disk or Compact Flash	
	1		Framing error
	2		Overflow error
	3		Parity error
	4		Data code error
	5		Data read error
	6		Data write error
	7		Data time out
	8		Serial I/O error
	9		Error other than described above
3110	-	Syntax error	
3120	*	HEX code error	
	1		Specification error of data record
	2		Specification error of EOF record
	3		Record type error
	4		Total check error of record
3130	-	Verify error	

Error No.	Data	Error Message	Contents
3140	-	Wrong pseudo instruction	
3150	*	Concurrent I/O record error	
	1		Format error
	2		Ladder program is too long.
	3		Exceed the range of the data
	4		Specification error of channel No.
	5		Specification error of relay No.
	6		Timer value error
	7		Specification error of timer No.
3160	-	Cannot load illegal system data	
3170	*	Condition file data error	
	1		Format error
	2		Specified file No. is omitted.
	3		Specified tool No. is omitted.
	4		User file is not registered.

## 13.1 Error Message List

Error No.	Data	Error Message	Contents
3190	*	Error in JOB data record	
	1		Record on the number of position data (NPOS) is wrong for the format.
	2		Record on the user coordinate No. (USER) is wrong for the format.
	3		Record on the tool No. (TOOL) is wrong for the format.
	4		Record on the position data section is wrong for the format.
	5		Record on the robot type of XYZ data (RCONF) is wrong for the format.
	6		Date (DATE) record is wrong for the format.
	7		Comment (COMM) record is wrong for the format.
	8		Record on the JOB attribute data (ATTR) is wrong for the format.
	9		Control group (GROUP) record is wrong for the format.
	10		Local variable (LVAR) record is wrong for the format.
	11		JOB argument (JARGS) record is wrong for the format.
	12		Record on the teaching coordinates for relative job (FRAME) is wrong for the format.
	13		Position data coordinates do not match relative job coordinates.
3200	-	NOP or END instruction not found	
3210	-	Position No. storage area not found	
3220	*	Syntax error in instruction data	
	2		Interior control error
	3		Undefined instruction/tag
	4		Instruction/tag shortage
	5		Disuse instruction/tag
	6		Sub instruction

Error No.	Data	Error Message	Contents
3220	7		No instruction
	8		Invalid instruction
	9		Invalid tag
	10		Invalid character
	11		Undefined intermediate code
	12		Intermediate code shortage
	13		Syntax stack overflow
	14		Syntax stack underflow
	15		Array type tag incompleted Tag [ARRAY]
	16		Element type tag incompleted Tag [ELEMENT]
	17		Macro JOB unregistered
	18		Input format error
	19		Data size over
	20		MIN value over
	21		MAX value over
	22		Operation expression error
	23		Job call argument setting error
	24		Macro job call argument setting error
	25		Position vector setting error
	26		System error
	27		Soft key designate error
	28		Numerical input buffer overflow
	29		Real type data precision error
	30		Element format error
	35		BOOL TYPE data error
	36		CHAR data error
	37		BYTETYPE, BINARY / HEXADECI- MAL BYTE TYPE data error
	38		INTEGER TYPE, DECIMAL WORD TYPE data error

## 13.1 Error Message List

Error No.	Data	Error Message	Contents
3220	39		BINARY/HEXADECIMAL WORD TYPE data error
	40		DOUBLE PRECISION INTEGER TYPE, DECIMAL DWORD TYPE data error
	41		BINARY/HEXADECIMAL WORD TYPE data error
	42		REAL TYPE data error
	43		LADDER SPECIAL TYPE data error
	44		JCL text
	45		Invalid text
	46		LABEL NAME data error
	47		JOB NAME data error
	48		STRING data error
	49		COMMENT data error
	58		Invalid instruction/tag detection
3230	-	Syntax not matched	
3240	-	Undefined application	
3250	-	Cannot load this file	
3260	-	Excess input data	
3270	-	Cannot verify this file	
3280	-	Wrong welding condition (STANDARD/ ENHANCED)	
3290	-	Serial port not defined	
3300	-	Serial port being used	
3310	-	Protocol being used	
3350	-	Not enough memory	
3360	-	Invalid folder	
3370	-	Incorrect folder name	
3450	-	Cannot load macro JOB at current security mode	Load in management mode.

Error No.	Data	Error Message	Contents
3460	*	Cannot backup Compact Flash	
	1		Insufficient Compact Flash memory.
	2		Not accessible to Compact Flash.
3470	-	Database not found	
3480	-	Database access error	
3490	-	Same database exists	
3500	-	Check Compact Flash insertion	
3510	-	Cannot delete folder. Check attribute and inside file	
3520	-	Same folder exists	
3530	-	Cannot load at current security mode	

## 13.1 Error Message List

**13.1.5** Concurrent I/O

Error No.	Data	Error Message	Contents
4010	*	Illegal relay No.	
	XXX		Line No.
4030	*	Illegal instruction	
	XXX		Line No.
4040	*	Relay/register No. duplicated in OUT/ GOUT or arithmetic instruction	Multiple outputs are instructed to the relay or register.
	XXX		Line No.
4050	*	The relay is not used	
	XXX		Line No.
4060	*	Excess STR[-NOT] instructions	
	XXX		Line No.
4070	*	Excess AND [OR] STR instructions	
	XXX		Line No.
4080	*	Syntax error in CNT instructions	
	XXX		Line No.
4090	*	Enter STR [-NOT] at head of block	Need STR [-NOT]
	XXX		Line No.
4120	-	Concurrent I/O memory is full	Exceeds memory capacity (10000 steps)
4130	-	END instruction not found	END instruction not found
4140	-	Wrong ladder program	Position and number of PART instruction are wrong.
4150	*	Wrong use of GSTR, GOUT commands	GSTR and GOUT is not used together.
	XXX		Line No.
4220	-	Excess TMR/CNT or arithmetic instruc- tions	More than 100 TMR, CNT or arithmetic instruction used
4230	-	Syntax error in TMR/CNT instructions	

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## 13.1.6 Maintenance Mode

Error No.	Data	Error Message	Contents
8010	-	Too many axes	
8020	-	Too many I/O points	
8030	-	Too many boards (XFB01B (MASTER))	
8031	-	Too many boards (MSC01B)	
8040	-	Memory error (ControlNet output condition)	
8041	-	Memory error (UNIWIRED CONNECT DAT	
8050	-	Robot model is not registered	
8060	-	Cannot get UNIWIRED connection data	

## Symbols

* (label) .....	12-8
' (comment) .....	12-9

## A

absolute data .....	10-2
absolute data allowable range alarm occurs .....	10-10
absolute encoder .....	10-2
ACTION MODE .....	11-13
active jobs .....	1-20
ADD .....	12-10, 12-12, 12-19
additional items .....	4-4
adjustments for welding defects .....	3-26
ALARM HISTORY .....	1-23
alarm history data .....	8-6
ALL CMOS AREA .....	8-5
all limits releasing .....	10-16
allocating an operation .....	10-83
allocation of I/O control instructions .....	10-93
allocation window .....	10-83
alphanumeric input .....	1-18
alternate output allocation .....	10-82, 10-88
analog incremental output allocation .....	10-82, 10-92
ANALOG MONITOR .....	1-23
analog output allocation .....	10-82, 10-91
AND .....	12-14
AOUT .....	12-6
application parameter .....	8-6
ARATIOF .....	12-7
ARATION .....	12-7
arc end condition data .....	8-5
arc start condition data .....	8-5
arc welding .....	3-20
AREA key .....	1-5
ARM CONTROL .....	1-23
ARM control .....	10-53
ASSIST key .....	1-9
ATAN .....	12-18
automatic measurement of the tool load and the center of gravity .....	10-44
automatic tip dressing .....	11-6
automatic tip replacement .....	11-6
axis interference area .....	10-27
axis keys .....	1-2, 1-6
axis operations .....	2-4

## B

BACK SPACE key .....	1-9
base axis .....	1-12, 2-1
base coordinate .....	10-20
base reverse paste .....	4-54
basic axis .....	2-6, 2-7
BATCH CMOS .....	8-5
batch selection .....	8-38

BATCH USER MEMORY .....	8-5
B-axis .....	2-5
BWD key .....	1-7, 4-19
byte type .....	4-67

## C

C type double stroke method .....	11-20
C Type Gun .....	11-22
CALL .....	12-8
CANCEL key .....	1-7
cartesian coordinates .....	1-12, 2-2, 2-6
CHANGE TIME (OPEN -> FULL-OPEN) .....	11-17
changing the output status .....	10-96
changing the parameter setting .....	10-99
character input .....	1-16
character string type .....	4-67
check mode operation .....	5-12
checking the TCP .....	10-43
circular interpolation .....	4-7
CLEAR .....	12-17
clearing calibration data .....	10-42
clearing interference area data .....	10-30
clearing user coordinates .....	10-52
CIO parameter .....	8-6
CNVRT .....	12-16
COMMAND POSITION .....	1-23
COMMAND POSITION window .....	4-38
comments .....	4-4
compact flash .....	8-1
concurrent I/O program .....	8-6
Continuous (operation cycle) .....	1-13
continuous circular arcs .....	4-7
continuous spline curves .....	4-8
control groups .....	4-3
control instructions .....	4-41
Converter parameter .....	8-6
COORD key .....	1-5
coordinate home position parameter .....	8-6
coordinate system .....	1-12, 2-3
copy .....	4-54, 4-57
copying jobs .....	6-2
COS .....	12-17
CREATE NEW JOB .....	1-22
cube .....	10-21
cube interference .....	10-16
cube number .....	10-22
cubic interference area .....	10-20
CURRENT POSITION .....	1-23
cursor .....	4-4
cursor key .....	1-2, 1-4
cut .....	4-54, 4-57
Cycle (operation cycle) .....	1-13
cycle time .....	5-5
cylindrical coordinates .....	1-12, 2-2, 2-7

**D**

DATE/TIME .....	1-24
DEC.....	12-14, 12-21
definition of user coordinates.....	10-48
DELETE.....	1-23, 8-3
DELETE key.....	1-7
deleting a file .....	8-36
deleting a job .....	6-6, 8-34
deleting additional items .....	4-52
deleting instructions .....	4-45
detection label (level range 1 to 500).....	10-69
detection mode .....	10-68
DEVICE .....	1-23, 8-3
DIN .....	12-6
direct open .....	7-1
DIRECT OPEN key .....	1-5
display allocation .....	10-81
DIV .....	12-13, 12-20
double precision integer type.....	4-67
Double stroke .....	11-21, 11-22
DOUBLE STROKE GUN FULL-OPEN DETEC- TION.....	11-1
DOUBLE STROKE GUN SHORT-OPEN DETEC- TION.....	11-1
DOUT .....	12-5
DROP AMOUNT .....	1-23
Dry Spotting .....	11-4
dry-run speed operations .....	5-11

**E**

edit jobs .....	1-20
edit lock on individual job units .....	6-12
edit mode .....	1-13, 1-21
editing comments.....	6-11
editing condition files .....	4-66
editing interpolation type .....	4-65
editing play speed .....	4-61
emergency stop .....	5-14
emergency stop button .....	1-4, 4-1
emergency stop buttons .....	1-iv
Enable switch .....	1-2, 1-4
END.....	12-8
ENTER key .....	1-2, 1-7
error message list .....	13-1
EX.AXIS key.....	1-6
executing the I/O control allocation .....	10-95
executing the instruction/output control allocation. 10-95	
executing the job call allocation .....	10-95
executing the window allocation .....	10-95
execution of allocation .....	10-95
expanded instruction set .....	10-78
external memory devices .....	8-1

**F**

FD/PC CARD.....	1-23
file initialize .....	10-101
file management .....	8-3
FILE/ GENERAL DATA.....	8-5
flip/no flip .....	4-81
FORMAT .....	8-3
FUL OPEN STROKE OUT DDELAY TIME .....	11-17
FULL OPEN.....	11-3, 11-6
FULL OPEN MONITOR (0OFF, 1ON).....	11-17
function definition parameter .....	8-6
function keys.....	1-2
FWD key .....	1-7, 4-19

**G**

general-purpose application .....	3-40
general-purpose display area .....	1-2, 1-10
GETE .....	12-15
GETS .....	12-16
group (4-bit/8-bit) output allocation.....	10-90
group operation axis .....	1-12
group output allocation (4-bit/8-bit) .....	10-82
GRP COMBINATION.....	1-24
guidance display .....	1-16
GUN CLOSE .....	11-6
Gun Motion Control .....	11-20
GUN NO.....	11-13, 11-16
GUN OPEN/CLOSE SET AT STOP .....	11-17
GUN PRESSURE.....	11-1
GUN TYPE .....	11-16
GUNCL .....	11-2

**H**

handling .....	3-29
high speed.....	1-13
HIGH SPEED key.....	1-5, 2-4
hold at the station.....	5-31
hold by external input signal (system input).. 5-30	
hold by HOLD key .....	5-30
HOLD key.....	1-8
hold operation .....	5-13
HOME POSITION .....	1-23
home position .....	10-3
home position calibrating data .....	8-6
home position calibration .....	10-1
home position of the robot.....	10-7
how to calculate tool load information.....	10-58
human interface display area.....	1-10, 1-14

**I**

I/O DATA .....	8-6
I/O instructions .....	4-41
I/O MSG HISTORY .....	1-23
I/O name data .....	8-6
I/O signal .....	11-1
IF .....	12-9
IMOV .....	12-3
IN/OUT .....	1-22
INC .....	12-14, 12-20
inching .....	1-13
individual selection .....	8-38
INFORM LIST key .....	1-7
initialize data file .....	10-102
initialize job file .....	10-101
initialize parameter file .....	10-103
initializing I/O data .....	10-104
initializing system data .....	10-105
INSERT key .....	1-7
inserting additional items .....	4-51
inserting instructions .....	4-42
insertion slot for compact flash .....	1-2
instruction allocation .....	10-81, 10-84
instruction group .....	4-40
instruction level .....	10-78
instruction of shock detection function .....	10-72
instruction search .....	4-91
instruction set .....	10-78
integer type .....	4-67
INTERFERENCE .....	1-23
interference area .....	10-20
INTERLOCK key .....	1-8
interpolation type .....	4-5, 4-11
INVMAT .....	12-19

**J**

JOB .....	1-22, 8-5
job call .....	10-86
job call allocation .....	10-81
JOB CAPACITY .....	1-22
JOB CAPACITY window .....	4-39
JOB CONTENT window .....	4-37
JOB HEADER window .....	4-35
job stack .....	5-32
joint coordinates .....	1-12, 2-2, 2-5
joint interpolation .....	4-5
JUMP .....	12-8

**K**

KEY ALLOCATION .....	1-24
key allocation (EACH) .....	10-81
key allocation (SIM) .....	10-81
keypads .....	1-16

**L**

label search .....	4-90
L-axis .....	2-5
learning function .....	10-79
LIMIT RELEASE .....	1-23
limit switch .....	10-98
limited speed operations .....	5-10
line number .....	4-4
line search .....	4-89
linear interpolation .....	4-6
LOAD .....	1-23, 8-3
loading a condition file or general data .....	8-20
loading a job .....	8-18
loading a parameter .....	8-22
loading all CMOS data .....	8-29
loading all data in CMOS area .....	8-30
loading all user's programs .....	8-28
loading I/O data .....	8-24
loading system data .....	8-26
local variables .....	4-85
low speed .....	1-13
low speed operation .....	5-10
L-U interference .....	10-16

**M**

machine lock operation .....	5-11
main menu area .....	1-10, 1-12
MAIN MENU key .....	1-4, 1-9
major alarms .....	5-17
major axes .....	2-5
management mode .....	1-13, 1-21
manipulator coordinate systems .....	2-1
MANIPULATOR TYPE .....	1-23
manipulator type .....	4-81
manual speed .....	1-13, 2-3, 4-22
MANUAL SPEED keys .....	1-2, 1-5
Manual Spot Welding Function .....	11-4
MANUAL SPOT window .....	11-2
Manual Spot Window .....	11-13
Manual Welding .....	11-4
manufacturer allocation .....	10-81
MASTER JOB .....	1-22
master job .....	5-2
max. disturbance force .....	10-69
measurement of the tool load and the center of gravity .....	10-44
mechanical limit .....	10-16
medium speed .....	1-13
menu area .....	1-2, 1-10, 1-14
method of shock detection level file setting .....	10-68
method of the tool load information setting .....	10-70
MFRAME .....	12-18
minor alarms .....	5-17
mirror shift function .....	7-33
mode switch .....	1-8
modification of speed type .....	4-61
MODIFY key .....	1-7
modifying additional items .....	4-50

modifying additional numeric data .....	4-49
modifying instructions .....	4-45
modifying job names .....	6-8
momentary output allocation .....	10-82, 10-89
MONITORING TIME .....	1-23
motion about TCP .....	2-14
motion function parameter .....	8-6
motion time .....	5-5
MOTION TYPE key .....	1-2, 1-6
motor gun dry spot pressure data .....	8-5
motor gun pressure power data .....	8-5
MOVC .....	12-2
move instructions .....	4-9, 4-41
MOVJ .....	12-1
MOVL .....	12-2
MOVS .....	12-3
MSHIFT .....	12-11
MUL .....	12-10, 12-13, 12-19, 12-20
MULMAT .....	12-18
Multi key .....	1-9

## N

NEW JOB CREATE window .....	3-2
NOP .....	12-9
NOT .....	12-14
number of tool files .....	10-33
numeric key customize function .....	10-81
Numeric keys .....	1-2, 1-8

## O

OPE ORIGIN POS .....	1-23
OPEN MONITOR (0OFF, 1ON) .....	11-17
OPEN STROKE OUT DELAY TIME .....	11-17
OPERATE COND .....	1-24, 5-23
operating instructions .....	4-41
operation control parameter .....	8-6
operation cycle .....	1-13, 5-7
OPERATION MODE .....	11-23
operation mode .....	1-13, 1-21
OR .....	12-14
ORG .....	10-48
output of the work home position signal .....	10-33
override speed settings .....	5-5
overrun releasing .....	10-18
OVERRUN&S-SENSOR .....	1-23

## P

page .....	1-13
PAGE key .....	1-2, 1-5
painting application .....	3-50
painting conditions .....	3-51
PAM function .....	7-27

panel .....	1-iv
parallel shift function .....	7-3
parallel shift job conversion function .....	7-16
PARAMETER .....	1-24, 8-6
PARAMETER BATCH .....	8-6
paste .....	4-54, 4-58
PAUSE .....	12-9
play mode .....	1-19
play speed .....	4-5, 4-12
playback .....	3-19, 5-1
playback time .....	5-5
position level .....	4-12
position type .....	4-67
POWER ON/OFF POS .....	1-23
Power Source characteristic data .....	8-5
Power Source characteristic definition data .....	8-5
Power Source condition assist data .....	8-5
programming pendant .....	1-iv, 1-2
programming pendant display .....	1-10
PULSE .....	12-5
pulse mirror-shift function .....	7-33
pulse output allocation .....	10-82, 10-89

## R

R-axis .....	2-5
r-axis .....	2-7
real type .....	4-67
reference point instructions .....	4-15
REFP .....	12-4
registering a job .....	4-2
registering tool angle .....	10-36
registering tool load information .....	10-65
registering/changing the work home position .....	10-32
related job (job+condition) .....	8-5
relative modification .....	4-61
remote mode .....	1-19
RES. START(CNCT) .....	1-24, 5-24
RES. START(JOB) .....	1-22
RES. STATUS .....	1-22, 5-28
RESERVE JOB NAME .....	1-24
reserved start .....	5-22
RESET RESERVATION .....	5-29
reset shock detected .....	10-77
Resetting Alarms .....	11-5
restart .....	5-13
RET .....	12-8
RETRY TIMES .....	11-15
returning to the work home position .....	10-32
reverse paste .....	4-54, 4-59
ROBOT .....	1-23
robot axis .....	1-12, 2-1
ROBOT CALIB .....	1-23
robot coordinate .....	10-20
robot installation angle .....	10-54
ROBOT key .....	1-6
robot matching parameter .....	8-6
robot programming language (INFORM III) .....	10-78
robot setup condition .....	10-54
robot-coordinates mirror-shift function .....	7-33

**S**

SAVE .....	1-23, 8-3
saving a condition file or general data .....	8-8
saving a job .....	8-7
saving a parameter .....	8-10
saving all CMOS data .....	8-16
saving all data in CMOS area .....	8-17
saving all user's programs .....	8-15
saving I/O data .....	8-12
saving system data .....	8-13
S-axis .....	2-5
SECOND HOME POS .....	1-23
second home position .....	8-6
second home position (check point) .....	10-8
security mode .....	1-13, 1-21
SELECT JOB .....	1-22
SELECT key .....	1-2, 1-4
selecting a coordinate system .....	2-3
selecting the range .....	4-56
selecting user coordinates file .....	10-49
sensor parameter .....	8-6
SERVO MONITOR .....	1-23
SERVO ON READY key .....	1-9, 3-1
servo parameter .....	8-6
servo power .....	1-iv
servo power block parameter .....	8-6
servomotor parameter .....	8-6
SERVOPACK parameter .....	8-6
SET .....	12-15
SET SPEED .....	1-24
SET WORD .....	1-24
SETE .....	12-15
setting contents .....	10-78
setting play speed .....	10-15
setting shock detection function .....	10-67
setting the controller clock .....	10-14
setting the second home position (check point) .....	10-12
setting the tool load information .....	10-37, 10-58, 10-70
setting user coordinates .....	10-48
setting work home position .....	10-31
SETUP .....	1-24
SFTOF .....	12-11
SFTON .....	12-11
SHCKRST instruction .....	10-72
SHCKSET instruction .....	10-67, 10-72
S-head payload .....	10-55
shielding gas flow rate .....	3-24
shift instructions .....	4-41, 7-7
SHIFT key .....	1-8
shift value .....	7-5
shock detection function .....	10-67
shock detection level data .....	8-5
SHORT OPEN .....	11-2, 11-6
SHORT OPEN POSITION SETTING .....	11-2
short/full open position data .....	8-5
SHORTCUT key .....	1-9
SIN .....	12-17
single circular arc .....	4-7
single job .....	8-5
single spline curve .....	4-8

Single stroke .....	11-21, 11-22
software limit .....	10-16, 10-98
solenoid signal controls .....	3-30
special playback operations .....	5-9
SPEED .....	12-4
speed limitation drive .....	3-39
speed override .....	5-18
spline interpolation .....	4-8
SPOT .....	11-2, 11-6
spot gun characteristic data .....	8-5
Spot Gun Condition Data File .....	11-16
Spot Welder Condition Data File .....	11-14
spot welding .....	3-45
Spot Welding Diagnosis Window .....	11-18
spot welding gun condition .....	3-46
spot welding Power Source characteristic data .....	8-5
spot welding system .....	11-1
SQRT .....	12-18
standard instruction set .....	10-78
START key .....	1-8, 4-1
start No. ....	5-5
state under execution .....	1-13
station axis .....	1-12, 2-1
status display area .....	1-10, 1-12
Step (operation cycle) .....	1-13
step search .....	4-89
STICK DETECT DELAY TIME .....	11-15
stop .....	5-13
stop by alarm .....	5-16
STROKE CHANGE .....	11-1
Stroke change .....	11-21
STROKE CHANGE (Single Solenoid/Double Solenoid) .....	11-1
STROKE CHANGE OUTPUT TIME .....	11-17
Stroke Switching .....	11-5
SUB .....	12-10, 12-12, 12-19, 12-20
subset instruction set .....	10-78
SV monitor signals .....	8-6
SVGUNCL instruction .....	11-2
SVSPOT instruction .....	11-2
switch of the tool file .....	10-66
symbol input .....	1-18
SYSTEM DATA .....	8-6
system definition parameter .....	8-6
SYSTEM INFO .....	1-23
system information .....	8-6
system matching parameter .....	8-6

**T**

tag search .....	4-92
T-axis .....	2-5
teach lock .....	4-1
teach mode .....	1-19
teaching .....	3-1, 4-1
TEACHING COND .....	1-24
teaching user coordinates .....	10-50
temporary release of soft limits .....	10-98
test operations .....	4-23, 4-60
TEST START key .....	1-6
theta(q)-axis .....	2-7

TIMER .....	12-9
timer instruction .....	4-16
TIP HIT COUNT .....	11-18
TOOL .....	1-23
tool calibration .....	10-38
tool coordinates .....	1-12, 2-2, 2-8
tool data .....	8-5
tool data setting .....	10-33
tool file .....	10-33
tool file extension function .....	10-45
tool load information .....	10-58
tool number .....	2-10, 4-11
tool shock sensor releasing .....	10-18
tool tip .....	2-14
transmission(general) parameter .....	8-6
TRT .....	4-63
TWO GUN CONTROL .....	11-13

## U

U-arm payload .....	10-55
U-axis .....	2-5
undo .....	4-32
undo operation after modifying additional items .....	4-53
undo operation after modifying instructions .....	4-47
UNTIL .....	12-9
USER COORDINATE .....	1-23
user coordinate .....	10-20, 10-48
user coordinate data .....	8-5
user coordinate number .....	2-13
user coordinates .....	1-12, 2-2, 2-11
user coordinates file .....	10-48
USER ID .....	1-24
user variables .....	4-67
user word registration .....	8-6
user-coordinates mirror-shift function .....	7-33

## V

VARIABLE .....	1-22
variable data .....	8-5
variable name .....	8-6
VERIFY .....	1-23, 8-3
verifying a file .....	8-33
verifying a job .....	8-31
verifying data .....	8-31
VERSION .....	1-23
viewing description for an instruction .....	4-48

## W

WAIT .....	12-6
weaving data .....	8-5
weaving prohibit .....	5-12

WELD COND .....	11-1
WELD COND MAX NUM .....	11-15
WELD COND OUTPUT TYPE .....	11-15
WELD END WAIT TIME .....	11-15
WELD ERROR .....	11-1
WELD ERROR RESET .....	11-1
WELD INST OUTPUT TIME .....	11-15
WELD INST OUTPUT TYPE .....	11-14
WELD NO .....	11-14
WELD REQUEST .....	11-1
WELDER NO .....	11-17
WELDING COND .....	11-13
welding conditions setting .....	3-24
Welding On/Off .....	11-5
window allocation .....	10-87
work home position .....	10-31
work home position cube length of its sides .....	10-32
WORK HOME POSITION window .....	11-2
work instructions .....	4-41
wrist axis .....	2-5, 2-6, 2-7

## X

X type double stroke method .....	11-20
X, C types single stroke method .....	11-20
X-axis .....	2-6
XOR .....	12-14
XX .....	10-48
XY .....	10-48

## Y

Y-axis .....	2-6
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## Z

Z-axis .....	2-6, 2-7
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# NX100

# OPERATOR'S MANUAL

## FOR SPOT WELDING BY AN AIR GUN

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