Motoman XRC 2001 Controller

Operator’s Manual for Handling

Part Number: 142100-1
Release Date: November 28, 2006
Document Status: Final
COMPLETE OUR ONLINE SURVEY

Motoman is committed to total customer satisfaction! Please give us your feedback on the technical manuals you received with your Motoman robotic solution.

To participate, go to the following website:

# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 INTRODUCTION</td>
<td>1-1</td>
</tr>
<tr>
<td>2 SAFETY</td>
<td>2-1</td>
</tr>
<tr>
<td>3 XRC OPERATOR'S MANUAL FOR BEGINNERS</td>
<td>3-1</td>
</tr>
<tr>
<td>4 XRC OPERATOR'S MANUAL FOR HANDLING</td>
<td>4-1</td>
</tr>
</tbody>
</table>
SECTION 1
INTRODUCTION

1.1 About this Document

The XRC Operator’s Manual for Handling provides information about handling 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. Power users performing advanced programming and operation of the controller may need the XRC Inform II manual (P/N 142971-1). Please contact your salesman directly, or the Motoman service staff at (937) 847-3200, to order the XRC Inform II manual.

This manual is organized as follows:

SECTION 1 – INTRODUCTION
General information about this manual, a list of reference documents, and customer service information.

SECTION 2 – SAFETY
Provides information for the safe use and operation of Motoman products.

SECTION 3 – OPERATOR’S MANUAL FOR BEGINNERS
Provides an introduction to the XRC controller and programming pendant including basic operating instructions in teaching, playback, and editing modes. The handling section provides job examples and gives basic instructions for setting condition files and performing handling operations.

SECTION 4 – OPERATOR’S MANUAL FOR HANDLING
Provides detailed information about the XRC controller and programming pendant; manipulator coordinates; and teaching, playback, and editing modes. The handling section discusses specific keys, teaching, controlling peripheral devices, and I/O signal information.

1.2 Reference to Other Documentation

For additional information refer to the following:

• Concurrent I/O Parameters Manual (P/N 142102-1)
• Operator’s Manual for General Purpose (P/N 142099-1)
• Motoman UP6, XRC 2001 Manipulator Manual (P/N 145960-1)
• Motoman UP20, XRC 2001 Manipulator Manual (P/N 145965-1)
• Motoman UP50, XRC 2001 Manipulator Manual (P/N 145964-1)
• Motoman UP130/165, XRC 2001 Manipulator Manual (P/N 145967-1)
1.3 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 (UP6, UP130, UP165, etc.)
- Application Type (welding, handling, etc.)
- Robot Serial Number (located on the back side of the robot arm)
- Robot Sales Order Number (located on back side of XRC controller)
2.1 Introduction

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.

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: 313/994-6088
FAX: 313/994-3338

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

The YASNAC XRC operator’s manuals above correspond to specific usage. Be sure to use the appropriate manual.
MANDATORY

• This manual explains the various components of the YASNAC XRC system and general operations. Read this manual carefully and be sure to understand its contents before handling the YASNAC XRC.

• General items related to safety are listed in the Setup Manual Section 1: Safety. To ensure correct and safe operation, carefully read the Setup Manual 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 YASNAC XRC.

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.

**NOTE**

To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “CAUTION” and “WARNING”.
• Before operating the manipulator, check that servo power is turned off when the emergency stop buttons on the playback panel or programming pendant are pressed. When the servo power is turned off, the SERVO ON READY lamp on the playback panel and the SERVO ON LED on the programming pendant are 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

• Always set the Teach Lock before entering the robot work envelope to teach a job.

Operator injury can occur if the Teach Lock is not set and the manipulator is started from the playback panel.

• Observe the following precautions when performing teaching operations within the working 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 manipulator’s work envelope and that you are in a safe location before:
  - Turning on the YASNAC XRC power
  - Moving the manipulator with the programming pendant
  - Running check operations
  - Performing automatic operations

Injury may result if anyone enters the working envelope of the manipulator during operation. Always press an emergency stop button immediately if there are problems. The emergency stop button is located on the right side of both the YASNAC XRC playback panel and 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 XRC cabinet after use.

  The programming pendant can be damaged if it is left in the manipulator’s work area, on the floor, or near fixtures.

- Read and understand the Explanation of the Alarm Display in the Setup Manual 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 playback panel, the programming pendant, and supply cables.

In this manual, the equipment is designated as follows.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>YASNAC XRC Controller</td>
<td>XRC</td>
</tr>
<tr>
<td>YASNAC XRC Playback Panel</td>
<td>Playback Panel</td>
</tr>
<tr>
<td>YASNAC XRC Programming Pendant</td>
<td>Programming Pendant</td>
</tr>
</tbody>
</table>
Descriptions of the programming pendant and playback panel keys, buttons, and displays are shown as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Pendant</td>
<td>Character Keys</td>
</tr>
<tr>
<td></td>
<td>The keys which have characters printed on them are denoted with [ ].</td>
</tr>
<tr>
<td></td>
<td>ex. [ENTER]</td>
</tr>
<tr>
<td>Symbol Keys</td>
<td>The keys which have a symbol printed on them are not denoted with [ ] but depicted</td>
</tr>
<tr>
<td></td>
<td>with a small picture.</td>
</tr>
<tr>
<td></td>
<td>ex. page key ✶</td>
</tr>
<tr>
<td></td>
<td>The cursor key is an exception, and a picture is not shown.</td>
</tr>
<tr>
<td>Axis Keys</td>
<td>“Axis Keys” and “Number Keys” are generic names for the keys for axis operation</td>
</tr>
<tr>
<td>Number Keys</td>
<td>and number input.</td>
</tr>
<tr>
<td>Keys pressed simultaneously</td>
<td>When two keys are to be pressed simultaneously, the keys are shown with a “+” sign</td>
</tr>
<tr>
<td></td>
<td>between them, ex. [SHIFT]+[COORD]</td>
</tr>
<tr>
<td>Displays</td>
<td>The menu displayed in the programming pendant is denoted with { }.</td>
</tr>
<tr>
<td></td>
<td>ex. {JOB}</td>
</tr>
<tr>
<td>Playback Panel</td>
<td>Buttons</td>
</tr>
<tr>
<td></td>
<td>Playback panel buttons are enclosed in brackets. ex. [TEACH] on the playback panel</td>
</tr>
</tbody>
</table>

**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.
1 INTRODUCTION
   1.1 XRC Overview .................................................. 1-1
   1.2 Button Descriptions ........................................... 1-2
   1.3 Programming Pendant .......................................... 1-3
   1.4 Key Descriptions ............................................... 1-4
      ■ Named Keys .................................................. 1-4
      ■ Symbol Keys ................................................ 1-4
      ■ Axis Keys and Number Keys ............................... 1-4
      ■ Simultaneously Pressed Keys ......................... 1-4
   1.5 Screen Descriptions ........................................... 1-5
   1.6 Operation Sequence ............................................ 1-6

2 TURNING THE POWER ON
   2.1 Turning On the Main Power ................................. 2-1
      2.1.1 Startup Diagnostics ...................................... 2-1
      2.1.2 When Startup Diagnostics are Complete ........... 2-1
   2.2 Turning on the Servo Power ................................ 2-2
      2.2.1 During Play Mode ....................................... 2-2
      2.2.2 During Teach Mode ...................................... 2-2

3 TEACHING
   3.1 Manipulator Motion .......................................... 3-1
      3.1.1 Joint Coordinates ....................................... 3-1
      3.1.2 Rectangular Coordinates ............................... 3-3
      3.1.3 Move Instructions and Steps ......................... 3-4
   3.2 Teaching ...................................................... 3-5
      3.2.1 Preparation Before Teaching.......................... 3-5
      3.2.2 Teaching ................................................ 3-8
         ■ Teaching a Job ........................................... 3-8
         ■ Step 1 -- Start Position ................................ 3-9
         ■ Step 2 -- Near the Work Start Location ............. 3-10
         ■ Step 3 -- Work Start Location ......................... 3-10
         ■ Step 4 -- Work End Position ........................... 3-11
         ■ Step 5 -- Position Away From Workpiece and Fixture .3-12
         ■ Step 6 -- Near the Start Position .................... 3-13
         ■ Ensuring the First and Last Step are Identical .... 3-14
      3.2.3 Path Confirmation ....................................... 3-14
      3.2.4 Correcting a Job ........................................ 3-15
         ■ Before Correcting a Job ............................... 3-15
         ■ Change the Position Data .............................. 3-16
         ■ Add a Step ................................................ 3-16
         ■ Delete a Step ............................................ 3-17
         ■ Changing the Speed Between Steps .................... 3-18
4 PLAYBACK
  4.1 Preparation Prior to Playback ........................................... 4-1
  4.2 Playback .......................................................................... 4-1

5 ARC WELDING
  5.1 Example Job ................................................................. 5-1
  5.2 Teaching Procedure ...................................................... 5-1
    5.2.1 Teaching Procedure Items ........................................... 5-1
    5.2.2 Operation Method ...................................................... 5-2
      ■ Step 2 -- Near Welding Start Location .......................... 5-2
      ■ Step 3 -- Welding Start Position ................................. 5-2
      ■ Step 4 -- Welding End Condition ................................. 5-3
  5.3 Setting Welding Conditions ............................................ 5-4
    5.3.1 Registration of Welding Condition ............................. 5-4
    5.3.2 Setting Other Parameters .......................................... 5-5
      ■ Shielding Gas Flow Rate ........................................... 5-5
  5.4 Welding Test ............................................................... 5-6
    5.4.1 Check Run ................................................................ 5-6
    5.4.2 Welding Execution .................................................... 5-7
    5.4.3 Adjustments for Welding Defects ............................... 5-7

6 HANDLING
  6.1 Example Job ................................................................. 6-1
  6.2 Usage of HAND Instruction ............................................. 6-2
    6.2.1 Function ................................................................. 6-2
      ■ SP (single-solenoid) .................................................... 6-2
      ■ 2P (double-solenoid) .................................................. 6-2
      ■ 3P (triple solenoid) .................................................... 6-2
    6.2.2 Instruction and Additional Items ............................... 6-2
  6.3 Teaching Procedure ..................................................... 6-3
    6.3.1 Teaching Points ....................................................... 6-3
    6.3.2 Operation Procedure ................................................ 6-3
      ■ Step 2 -- Near Gripping Position (before gripping) ...... 6-3
      ■ Step 3 -- Gripping Position ........................................ 6-4
      ■ Step 4 -- Near Gripping Position (after gripping) ...... 6-5
      ■ Step 6 -- Near Release Position (before releasing) .... 6-6
      ■ Step 7 -- Release Assistance Position ....................... 6-6
      ■ Step 8 -- Release Position ......................................... 6-7
      ■ Step 9 -- Near Release Position (after release) ....... 6-9
  6.4 Handling Test ............................................................. 6-9
    6.4.1 Speed Limitation Drive ............................................ 6-9
    6.4.2 Handling Execution .................................................. 6-10
# GENERAL PURPOSE

## 7 Example Job

### 7.1 Teaching Procedure

#### 7.2.1 Teaching Points

#### 7.2.2 Operation Procedure

- Step 2 -- Near cutting position
- Step 3 -- Cutting Start Position
- Step 4 -- Cutting End Position

### 7.3 Cutting Test

#### 7.3.1 Speed Limitation Drive

#### 7.3.2 Cutting Execution

---

# SPOT WELDING

## 8 Example Job

### 8.1 Setting Welding Conditions

#### 8.2.1 Setting Spot Welding Gun Condition Files

#### 8.2.2 Setting Welding Condition for the Welder

### 8.3 Teaching Procedure

#### 8.3.1 Teaching Procedure Items

#### 8.3.2 Operation Procedure

- Step 2 -- Near Welding Start Position
- Step 3 -- Welding Start Position

### 8.4 Welding Test

#### 8.4.1 Check Run

#### 8.4.2 Welding Execution

---

# TURNING THE POWER OFF

## 9 Turning the Servo Power Off (Emergency Stop)

## 9.2 Turning the Main Power Off
1 INTRODUCTION

1.1 XRC Overview

The main power switch and the door lock are located on the front of the XRC controller. The programming pendant hangs from a hook located on the top right front face of the controller. The playback panel can be found mounted on the cabinet door of the controller. Find information for setup, installation, and connection of the XRC system by referring to the “MOTOMAN Setup Manual”.

Playback Panel Front View

- **SERVO ON READY**: Turns on the servo power.
- **PLAY and TEACH**: Switches back and forth between play and teach mode.
- **EDIT LOCK**: Switches editing enable/disable.
- **ALARM**: Lights on at error/alarm occurrence.
- **EMERGENCY STOP Button**: Starts playback.
- **START Button**: Stops playback.
- **HOLD Button**: Starts playback.
- **REMOTE Button**: Switches to remote mode.
1.2 Button Descriptions

Playback panel buttons are enclosed in brackets throughout this manual.

[TEACH] on the playback panel
1.3 Programming Pendant

Menu Area

Status Area

General Purpose Display Area

Page Key

Cursor Key

Select Key

Area Key

Deadman Switch
Located on the back of the programming pendant. When you squeeze it, the power comes on.

Manual Speed Key

Axis Key

Enter Key

Motion Type Key

Number Key / Specific Key
Press to input numbers

Programming Pendant
1.4 Key Descriptions

- **Named Keys**

  The keys which have a name on them are denoted with [ ]. [ENTER] is shown as [ENTER] and [TEACH LOCK] is shown as [TEACH LOCK]. The number keys have additional functions along with their number values. Dual function keys are used in the context of the operation being performed. For example: [TIMER] may be described in text as [1] or [TIMER].

- **Symbol Keys**

  The keys which have a symbol on them are not denoted with [ ] but depicted with a small picture excepted the cursor key. It is denoted as “Cursor”:

  - Cursor
  - Reserved Display Key
  - Direct Open Key
  - Page Key
  - Area Key

- **Axis Keys and Number Keys**

  The axis key and number key are denoted with “Axis Operation Keys” and “Number Keys” when all of the keys are shown at one time.

- **Simultaneously Pressed Keys**

  When two keys are pressed simultaneously, these keys are denoted through combining with “+” such as [SHIFT]+[COORD].
1.5 Screen Descriptions

Menu items shown in the programming pendant display are denoted with { }. In the case of the above menu, each item is shown as {JOB}, {EDIT}, {DISPLAY}, and {UTILITY}. The items of the pull down menu are shown in the same manner, e.g. {Rename Job}.

Four screen views are used in this manual to illustrate the programming pendant displays.
1.6 Operation Sequence

The following basic sequence is used to operate the manipulator.

1. Turn on the XRC controller.
2. Teach a job on the robot.
3. Replay the job on the manipulator. (called “playback”)
4. When finished, turn off the power. Be sure to follow the proper shutdown sequence as described in Section 6.
2 TURNING THE POWER ON

When turning on the power, always turn on the main power supply first and then the servo power supply. Ensure that the area around the manipulator is safe before turning on the power.

2.1 Turning On the Main Power

To turn on the main power, flip the main power switch on the front of the XRC to the ON position. Startup diagnostics will begin automatically.

2.1.1 Startup Diagnostics

The startup diagnostics are performed when the XRC main power is turned on, and the startup display is shown on the programming pendant screen.

2.1.2 When Startup Diagnostics are Complete

When the power is turned off, the XRC saves all condition data, including:

- Mode of operation
- Cycle
- Called job (active job if the XRC is in the play mode; edit job if the XRC is in the teach mode) and the cursor position in the job.
2.2 Turning on the Servo Power

2.2.1 During Play Mode

1. When the safety guard is closed, press [SERVO ON READY] on the playback panel to turn on the servo power supply. This button lights.

![ noting that when the safety guard is open, the servo power supply cannot be turned on.]

2.2.2 During Teach Mode

1. Press [SERVO ON READY] on the playback panel to turn on the servo power supply. The button will light when the servo power is turned on.

2. Press [TEACH LOCK] to enter the teach mode.

3. The servo power is turned on and [SERVO ON READY] on the playback panel lights when the operator grips the deadman switch.

![servo power on/off --- deadman switch]

When the operator squeezes the deadman switch, the servo power turns ON. However, if the operator squeezes the switch until a “click” is heard, the servo power will turn OFF.
When using the playback panel, programming pendant, or external signal to perform emergency stop, the servo power on operation from the deadman switch is cancelled. When turning the power back on, follow the previously listed instructions.
2.2 Turning on the Servo Power
3 TEACHING

3.1 Manipulator Motion

The robot is generally operated using two types of coordinates: joint coordinates and rectangular coordinates. Press the axis operation keys on the programming pendant to move each axis of the manipulator.

3.1.1 Joint Coordinates
3.1 Manipulator Motion

S  Rotates main body

L  Moves lower arm forward/backward

U  Moves upper arm up/down

R  Rotates upper arm

B  Moves wrist up/down

T  Rotates wrist
3.1.2 Rectangular Coordinates

- **X** Moves in parallel with X-Axis
- **Y** Moves in parallel with Y-Axis
- **Z** Moves in parallel with Z-Axis
- **TX** Rotates around X-axis
- **TY** Rotates around Y-axis
- **TZ** Rotates around Z-axis

(This figure shows direction only (not position) of rectangular coordinates.)
3.1.3 Move Instructions and Steps

The manipulator uses job instructions to move and execute playback. This is called a move instruction. The destination position, the interpolation method, the play speed, etc. are registered in the move instruction.

The reason it is called a move instruction is that the main instruction begins with “MOV” in the INFORM II language used by the XRC.

<Example>
MOVJ VJ=50.00
MOVL V=1122 PL=1

From one move instruction to the next move instruction is one step. Step 1 is 001 and step 2 is 002. The next step is 003, and so on.

“Position of Step1” corresponds to the position registered in the move instruction of Step number 001 (S:001).

<Example>
Refer to the job content display in the following. When executing playback, the manipulator moves between Step 1 and Step 2, and the play speed is registered in Step 2’s move instruction. After the manipulator reaches Step 2, the manipulator then executes the TIMER instruction followed by the DOUT instruction, and then continues on to Step 3.
3.2 Teaching

3.2.1 Preparation Before Teaching

Perform the following tasks before starting to teach.

- Enable the operation of the playback panel.
- Set the operation mode to teach mode.
- Set the teach lock.
- Enter the job name.

1. Confirm that [REMOTE] on the playback panel is not lit. If the lamp is lit, press [REMOTE] to turn it off so that the playback panel will be ready to operate.

2. Enter the teach mode by pressing [TEACH] on the playback panel.

3. Press [TEACH LOCK]. [TEACH LOCK] will light indicating the Teach Lock is turned on. The operation mode and cycle cannot be changed using the playback panel or an external input device. Playback cannot be performed. Also, if [TEACH LOCK] is not lit, the servo power supply cannot be turned on using the deadman switch.

4. Select {JOB} under the top menu, and select {CREATE NEW JOB} in the sub menu. The input line is displayed.
5. After the new job display is shown, press [SELECT].

6. The word “TEST” is used in this example job name. To enter the letters for “TEST”, press the page key to show the following display.

7. Move the cursor to “T” and press [SELECT]. Do the same to enter “E”, “S”, and “T”.

9. Move the cursor to “EXEC” and press [SELECT]. The job “TEST" is registered in the XRC memory and the job is displayed. The NOP and END instructions are automatically registered.

```
JOB EDIT DISPLAY UTILITY
JOB CONTENT R1 S: 000 R1 TOOL: *
J: TEST S: 000 NOP 0000 TOOL: *
0001 END
```

Characters Which Can Be Used for Job Names

Job names can be created from numbers, letters from the alphabet, or registered characters. The input display for each character is displayed when the page key is pressed during the operation between 5 and 6. Up to eight alphanumeric characters can be used.
3.2.2 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 II.

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

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 deadman 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 motion by pressing [MOTION TYPE]. Joint instruction “MOVJ...” will be displayed in the input buffer line.

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

5. The input buffer line is displayed. 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.

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

■ Step 2 -- Near the Work Start Location

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.

---

<table>
<thead>
<tr>
<th>Line</th>
<th>Command</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>MOVJ V J=50.00</td>
<td></td>
</tr>
<tr>
<td>0002</td>
<td>MOVJ V J=50.00</td>
<td></td>
</tr>
<tr>
<td>0003</td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>

---

■ Step 3 -- Work Start Location

Move the manipulator to the work start location as in Step 2 pose.

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

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

3. Move the cursor to the line number 0002 and press [SELECT].
4. The input buffer line is displayed. 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 12.50%.

![image]

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
```

### 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.


![image]

3. Move the cursor to the line number 0003 and press [SELECT].

![image]

4. The input buffer line is displayed. 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.

![image]
3.2 Teaching

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 [FST] or [SLW].

   ![JOB CONTENT]

   - FST
   - MAN SPEED

   **NOTE** 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 motion type (MOVJ).

   => MOVJ VJ=12.50

4. Move the cursor to line number 0004 and press [SELECT].

   => MOVJ VJ=12.50
5. The input buffer line is displayed. 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 50%.

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

- **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.
3.2 Teaching

### 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).

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

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

4. Press [MODIFY].

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

### 3.2.3 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).
3.2 Teaching

2. Change to medium speed by pressing [FST] or [SLW].

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.

Did the manipulator move exactly as you expected? Proceed to the next section to change the position and speed of the job steps.

3.2.4 Correcting a Job

⚠️ CAUTION

- After the job is corrected, 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 top menu and {JOB} under the sub menu.

Confirm that the teach lock is on.
### Change 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.

### Add a Step

Add a new step between Step 5 and Step 6.

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

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

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.

Delete a Step
Delete the step you just added.

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

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

3. Press [ENTER]. The step is deleted.
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 by pressing [CANCEL] and press [FWD] to move the manipulator. If the cursor in the display is blinking, the robot 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.

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

3. The input buffer line is displayed. 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.

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

4.1 Preparation Prior to Playback

Before executing manipulator playback, release the teach lock.

1. Press [TEACH LOCK]. After pressing the button, be sure [TEACH LOCK] lights.

Note: 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 ready to begin, the manipulator begins to move from the Step 1.

4.2 Playback

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

1. Press [PLAY] on the playback panel.

2. Press [START] on the playback panel. The manipulator will perform one complete taught cycle and then stop.

How did it go? Did the manipulator perform exactly as you expected?
5 ARC WELDING

5.1 Example Job

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

Example Job

<table>
<thead>
<tr>
<th>LINE</th>
<th>INSTRUCTION</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>MOVJ VJ=25.00</td>
<td>Moves manipulator to waiting position. (Step 1)</td>
</tr>
<tr>
<td>0002</td>
<td>MOVJ VJ=25.00</td>
<td>Moves manipulator near welding start position. (Step 2)</td>
</tr>
<tr>
<td>0003</td>
<td>MOVJ VJ=12.50</td>
<td>Moves manipulator to welding start position. (Step 3)</td>
</tr>
<tr>
<td>0004</td>
<td>ARCON</td>
<td>Specifies manipulator arc start. (Step 4)</td>
</tr>
<tr>
<td>0005</td>
<td>MOVL V=50</td>
<td>Moves manipulator to welding end position. (Step 5)</td>
</tr>
<tr>
<td>0006</td>
<td>ARCOF</td>
<td>Specifies manipulator arc end. (Step 6)</td>
</tr>
<tr>
<td>0007</td>
<td>MOVJ VJ=25.00</td>
<td>Moves manipulator to position a safe distance away from equipment. (Step 7)</td>
</tr>
<tr>
<td>0008</td>
<td>MOVJ VJ=25.00</td>
<td>Moves manipulator to waiting position. (Step 8)</td>
</tr>
<tr>
<td>0009</td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>

5.2 Teaching Procedure

5.2.1 Teaching Procedure Items

The teaching procedure is explained in Step 2 (welding pose definition) and the welding procedure is explained in Step 3 (welding start) and Step 4 (welding end).
5.2 Teaching Procedure

### 5.2.2 Operation Method

#### Step 2 -- Near Welding Start Location

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.

#### Step 3 -- Welding Start Position

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

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

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

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

---

**NOTE**

- Step 1 and 6, which are both the waiting position, are adjusted to a safe position where the robot 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].
4. The input buffer line is displayed. 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 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
```

Press [ENTER]. The ARCON instruction is registered.

### Step 4 -- Welding End Condition

Specify the welding end position.

1. Move the manipulator to the welding 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. Set the motion type to linear motion type (MOVL) by pressing [MOTION TYPE].

```
=> MOVL V=66
```

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

```
=> MOVL V=66
```

4. The input buffer line is displayed. Move the cursor to the right to V=66, which shows the speed. Set to 50 cm/min with the number keys.
5.3 Setting Welding Conditions

5.3.1 Registration of Welding Condition

There are two ways to register the welding condition, the 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 "OPERATOR’S MANUAL FOR ARC WELDING" for the arc start condition file.

1. Move the cursor to the ARCON instruction and press [ENTER]. The ARCON instruction is displayed in the input buffer line. Press [SELECT]. The detail edit display is shown.

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

6. Press [ARCOF]. ARCOF is displayed in the input buffer line. Press [ENTER]. The ARCOF instruction is registered.
5.3 Setting Welding Conditions

2. Press [SELECT] if the “MENU” setting is “UNUSED” or “ASF#(%)” in the detail edit display. Select “AC=” in the selection dialog. The detail edit display is shown as follows.

3. Input the current data “AC=” and voltage data “AVP=” or “AV=” with the number keys and press [ENTER]. The welding condition specified in the detail edit display is displayed in the input buffer line. Press [ENTER]. The welding condition is registered in the job.

5.3.2 Setting Other Parameters

- Shielding Gas Flow Rate

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

CO₂/MAG Gas Flow Rate for a Nozzle with a 20mm diameter

<table>
<thead>
<tr>
<th>Wire Length (mm)</th>
<th>CO₂ Gas Flow Rate (1/min.)</th>
<th>MAG Gas Flow Rate (1/min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-15</td>
<td>10-20</td>
<td>15-25</td>
</tr>
<tr>
<td>12-20</td>
<td>15-25</td>
<td>20-30</td>
</tr>
<tr>
<td>15-25</td>
<td>20-30</td>
<td>25-30</td>
</tr>
</tbody>
</table>

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

5.4.1 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 of the ARCON instruction is not executed.

1. Press [PLAY] on the playback panel to turn on the play mode.

2. Select {UTILITY} and {SPECIAL RUN}. The special play display is shown.

3. Move the cursor to the “CHECK-RUN” setting and press [SELECT]. The condition becomes “VALID” and the check run is turned on.
## 5.4.2 Welding Execution

Once the path has been determined, the welding is finally executed. If the check run is turned off, the ARCON and the ARCOF instructions are executed.

## 5.4.3 Adjustments for Welding Defects

To adjust welding conditions after welding, look at the appearance of the welding bead.

<table>
<thead>
<tr>
<th>Welding Defect</th>
<th>Reason for Occurrence</th>
<th>Correction Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pore: Generic name of defect caused by the influence of H2, N2, CO2, and Ar. Pits and blowholes, etc. may exist.</td>
<td>• Shortage of shield gas flow rate • Spatter adheres to nozzle • Influence of wind • Adhesion of rust and oil to surface • Paint adhesion • Welding current, voltage, and welding speed are incorrect • Torch angle and wire length are incorrect</td>
<td>• With no influence from the wind, and when the torch angle and wire length are correct, 15-301/min is assumed to be the suitable shield gas rate. • Change the gas flow rate according to the workpiece construction condition. • Remove the spatter frequently and thoroughly. • Choose the best welding condition and spatter will be prevented from occurring frequently. • Adjusting the torch angle and nozzle height will also reduce the amount of spatter. • Close the shutter, door, and window. • Avoid using a fan during welding. • Use a screen. • Remove rust and oil with thinner, brush, and grinder, etc. • Remove paint using thinner. • Define the proper voltage range. • Adjust the voltage in accordance with the arc length. • Make the torch angle smaller. • Set the wire length in accordance with the welding condition.</td>
</tr>
<tr>
<td>Welding Defect</td>
<td>Reason for Occurrence</td>
<td>Correction Method</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Undercut: Defect name for when the groove is not completely filled along the toe of the weld. | • Excessive welding current  
• Incorrect welding voltage  
• Excessive welding speed  
• Unsuitable torch angle and aim position | • Lower the welding current and speed. Adjust the voltage.  
• Adjust the torch angle and aim position. |
| Incomplete fusion: State in which the welding surfaces do not melt together well enough. | • Unsuitable welding work-piece condition  
• Dirt on welding surface | • Adjust the torch welding current, welding speed, wire aim position, angle, etc.  
• Remove rust and oil. |
| Incomplete penetration: State where there is insufficient distance between the surface of the metal and the bottom of the welded area. | • Unsuitable welding work-piece condition (It is easy for the welding current or the voltage corresponding to the current to be too low.) | • Adjust the torch welding current, welding speed, wire aim position, angle, etc. |
| Overlap: State where the toe of weld is not fused with the base metal. (Occurs often in T joint welding). | • Excessive welding current  
• Unsuitable aim position  
• Inappropriate torch angle  
• Welding speed is too slow | • Move the wire aim position forward by several millimeters during T joint welding or adjust the voltage.  
• Move the wire aim position forward by 1-1.5mm during thin plate welding. |
### Welding Defects

<table>
<thead>
<tr>
<th>Welding Defect</th>
<th>Reason for Occurrence</th>
<th>Correction Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Convex bead:</strong></td>
<td>• Welding current is too high&lt;br&gt;• Arc voltage is too low&lt;br&gt;• Welding speed is too slow or too fast</td>
<td>• Lower the welding speed.&lt;br&gt;• Adjust the voltage.</td>
</tr>
<tr>
<td>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</td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Convex Bead" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Concave bead:</strong></td>
<td>• Welding current is too high&lt;br&gt;• Arc voltage is too high&lt;br&gt;• Welding speed is too slow</td>
<td>• Lower the welding speed.&lt;br&gt;• Adjust the voltage appropriately.</td>
</tr>
<tr>
<td>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</td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Concave Bead" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Meandering of beads:</strong></td>
<td>• The welding wire is bent and twisted.&lt;br&gt;• The welding chip’s hole diameter is growing larger.&lt;br&gt;• Magnetic blow influences welding</td>
<td>• Shorten the wire length.&lt;br&gt;• Use a pail.&lt;br&gt;• Exchange old tips for new tips.&lt;br&gt;• Change earthing condition.&lt;br&gt;• Change welding direction.</td>
</tr>
<tr>
<td>State in which welding bead is shaped like a snake.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Meandering of Beads" /></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.4 Welding Test
6 HANDLING

6.1 Example Job

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

<table>
<thead>
<tr>
<th>LINE</th>
<th>INSTRUCTION</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>MOVJ VJ=25.00</td>
<td>Move to waiting position (Step1)</td>
</tr>
<tr>
<td>0002</td>
<td>MOVJ VJ=25.00</td>
<td>Move near gripping position (before gripping) (Step2)</td>
</tr>
<tr>
<td>0003</td>
<td>MOVL V=100.0</td>
<td>Move to the gripping position (Step3)</td>
</tr>
<tr>
<td>0004</td>
<td>HAND 1 ON</td>
<td>Gripping the workpiece</td>
</tr>
<tr>
<td>0005</td>
<td>TIMER T=0.50</td>
<td>Waiting for gripping the workpiece to be completed</td>
</tr>
<tr>
<td>0006</td>
<td>MOVL V=100.0</td>
<td>Move to near gripping position (after gripping) (Step4)</td>
</tr>
<tr>
<td>0007</td>
<td>MOVJ VJ=25.00</td>
<td>Move to waiting position (Step5)</td>
</tr>
<tr>
<td>0008</td>
<td>MOVJ VJ=25.00</td>
<td>Move near release position (before releasing) (Step6)</td>
</tr>
<tr>
<td>0009</td>
<td>MOVL V=100.0</td>
<td>Move to release assistance position (Step7)</td>
</tr>
<tr>
<td>0010</td>
<td>MOVL V=50.0</td>
<td>Move to release position (Step8)</td>
</tr>
<tr>
<td>0011</td>
<td>HAND 1 OFF</td>
<td>Releasing the workpiece</td>
</tr>
<tr>
<td>0012</td>
<td>TIMER T=0.50</td>
<td>Waiting for releasing the workpiece to be completed</td>
</tr>
<tr>
<td>0013</td>
<td>MOVL V=100.0</td>
<td>Move to near release position (after releasing) (Step9)</td>
</tr>
<tr>
<td>0014</td>
<td>MOVL VJ=25.00</td>
<td>Move to waiting position (Step10)</td>
</tr>
<tr>
<td>0015</td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>
6.2 Usage of HAND Instruction

6.2.1 Function

These instructions open and close the each of the hands 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.

<table>
<thead>
<tr>
<th>Valve 1/2 condition of each solenoid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction (x:TOOL NO)</td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td>HAND x ON</td>
</tr>
<tr>
<td>HAND x OFF</td>
</tr>
<tr>
<td>HAND x ON ALL</td>
</tr>
<tr>
<td>HAND x OFF ALL</td>
</tr>
</tbody>
</table>

6.2.2 Instruction and Additional Items

<table>
<thead>
<tr>
<th>HAND</th>
<th>#1</th>
<th>1</th>
<th>OFF</th>
<th>ALL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

ØDevice Number (#1 or #2)
Set when two manipulators are used for handling.
6.3 Teaching Procedure

6.3.1 Teaching Points

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

6.3.2 Operation Procedure

- 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 grip position usually.)

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

```
0000 NOP
0001 MOVJ VJ=25.00
0002 MOVJ VJ=25.00
0003 END
```
6.3 Teaching Procedure

- **Step 3 -- Gripping Position**

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

1. Change to medium speed by pressing [FST] or [SLW].
   Medium speed:  is displayed in the status area.

   ![FST SLW](image)

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

3. Set the linear motion “MOV L” by pressing [MOTION TYPE].

   => MOV L V=11.0

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

   => MOV L V=11.0

5. The input buffer line is displayed. Move the cursor to the right to “V=11.0”, which shows the speed.
   Set to 100 mm/s with the number keys.

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

   ![ENTER](image)

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

   => HAND 1 ON

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

8. Press [INFORM LIST]. The inform list is displayed.

   Move the cursor up and down until the “TIMER” instruction is specified. Press [SELECT].

   => TIMER T=1.00
9. The input buffer line is displayed. Move the cursor to the right to “T=1.00”, which shows the time. Set to 0.5s with the number keys.

```
=> TIMER T=0.50
```

Press [ENTER]. The TIMER instruction is registered.

Press [INFORM LIST] again. And turn off the LED of the INFORM LIST key.

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

Define the waiting 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 grip position. The same position as the steps is also available.)

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

```
=> MOVL V=11.0
```

3. The input buffer line is displayed. Move the cursor to the right to “V=11.0”, which shows the speed. Set to 100 mm/s with the number keys.

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
```
6.3 Teaching Procedure

- **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 place in which the holding workpiece and the piling 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 motion (MOVJ) by pressing [MOTION TYPE].

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

4. The input buffer line is displayed. 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 25.00%.

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

- **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 motion (MOVL) by pressing [MOTION TYPE].
3. Move the cursor to the line number and press [SELECT].

4. The input buffer line is displayed. Move the cursor to the right to “V=11.0”, which shows the speed.
   Set to 100 mm/s with the number keys.

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

---

**Step 8 -- Release Position**

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

1. Change to medium speed by pressing [FST] or [SLW].
   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. Move the cursor to the line number and press [SELECT].

4. The input buffer line is displayed. Move the cursor to the right to “V=11.0”, which shows the speed.
   Set to 50 mm/s with the number keys.
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.

7. The input buffer line is displayed. 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 ON
```

```
=> HAND 1 OFF
```

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

8. Press [INFORM LIST]. The inform list is displayed.

Move the cursor up and down until the “TIMER” instruction is specified. Press [SELECT].

```
=> TIMER T=1.00
```

9. The input buffer line is displayed. Move the cursor to the right to “T=1.00”, which shows the time.

Set to 0.5s with the number keys.

```
=> TIMER T=0.50
```

Press [ENTER]. The TIMER instruction is registered.

Press [INFORM LIST] again and turn off the LED of the INFORM LIST key.
6.4 Handling Test

6.4.1 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. Press [PLAY] on the playback panel to turn on the play mode.
2. Select {UTILITY} and {SPECIAL RUN}. The special play display is shown.

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

6.4.2 Handling Execution

Once the path has been determined, the handling is finally executed at actual speed. If the speed limitation drive is turned off, the handling is executed at taught speed.
7 GENERAL PURPOSE

7.1 Example Job

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

![Diagram of cutting process]

<table>
<thead>
<tr>
<th>LINE</th>
<th>INSTRUCTION</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>MOVJ VJ=25.00</td>
<td>Move to the waiting position. (Step1)</td>
</tr>
<tr>
<td>0002</td>
<td>MOVJ VJ=25.00</td>
<td>Move near the cutting position. (Step2)</td>
</tr>
<tr>
<td>0003</td>
<td>MOVJ VJ=12.50</td>
<td>Move to the cutting start position. (Step3)</td>
</tr>
<tr>
<td>0004</td>
<td>TOOLON</td>
<td>Start cutting.</td>
</tr>
<tr>
<td>0005</td>
<td>MOVL V=50.0</td>
<td>Move to the cutting end position. (Step4)</td>
</tr>
<tr>
<td>0006</td>
<td>TOOLOF</td>
<td>End cutting.</td>
</tr>
<tr>
<td>0007</td>
<td>MOVJ VJ=25.00</td>
<td>Move to the position which does not interfere with the tools or workpieces. (Step5)</td>
</tr>
<tr>
<td>0008</td>
<td>MOVJ VJ=25.00</td>
<td>Move to the waiting position. (Step6)</td>
</tr>
<tr>
<td>0009</td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>

7.2 Teaching Procedure

7.2.1 Teaching Points

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

7.2.2 Operation Procedure

■ 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.

■ Step 3 -- Cutting Start Position

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

1. Change to medium speed by pressing [FST] or [SLW]. 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. Move the cursor on the line number and press [SELECT].

4. The input buffer line is displayed. 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%.

Step 1, which is the waiting position, is adjusted to a safe position where the robot will not collide with the workpiece and the tool. Confirm the cutting path with [FWD] and [BWD] after teaching.
Step 4 -- Cutting End Position

Define the cutting end position.

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.

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

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

4. The input buffer line is displayed. Move the cursor to the right to “V=11.0”, which shows the speed. Set to 50 mm/s with the number keys.

5. Press [ENTER]. Step 4 is registered.
7.3 Cutting Test

7.3.1 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. Press [PLAY] on the playback panel to turn on the play mode.

2. Select {UTILITY} and {SPECIAL RUN}. The special play display is shown.

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

Once the path has been determined, cutting is finally executed at actual speed. If the speed limitation drive is turned off, cutting is executed at the same speed as during teaching.
7.3 Cutting Test
8 SPOT WELDING

8.1 Example Job

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

<table>
<thead>
<tr>
<th>LINE</th>
<th>INSTRUCTION</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0002</td>
<td>MOVJ VJ=25.00</td>
<td>Move to waiting position. (Step 1)</td>
</tr>
<tr>
<td>0003</td>
<td>MOVJ VJ=25.00</td>
<td>Move near welding start position. (Step 2)</td>
</tr>
<tr>
<td>0004</td>
<td>MOVJ VJ=25.00</td>
<td>Move to welding start position (Step 3)</td>
</tr>
<tr>
<td>0005</td>
<td>SPOT GUN#(1)</td>
<td>Welding starts.</td>
</tr>
<tr>
<td></td>
<td>MODE=0</td>
<td>Specifies spot welding gun no.1.</td>
</tr>
<tr>
<td></td>
<td>WTM=1</td>
<td>Specifies single gun.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specifies welding condition 1.</td>
</tr>
<tr>
<td>0006</td>
<td>MOVJ VJ=25.00</td>
<td>Moves to position a safe disatance away from equipment. (Step 4)</td>
</tr>
<tr>
<td>0007</td>
<td>MOVJ VJ=25.00</td>
<td>Moves to waiting position. (Step 5)</td>
</tr>
<tr>
<td>0008</td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>
8.2 Setting Welding Conditions

8.2.1 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)
- WELDER NO. (Initial:1)
- OPEN MONITOR (Initial:OFF)
- GUN OPEN/CLOSE SET AT STOP (Initial:ON)

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

**Operation**

Select {SPOT WELDING} under the top menu ➔ Select {GUN CONDITION}™ ➔
Move the cursor to the item to be set ➔ Press [SELECT]

**Explanation**

™ The gun condition display is shown.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>GUN CONDITION</td>
<td>R1</td>
<td>☰</td>
<td>☰</td>
</tr>
<tr>
<td>GUN NO.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GUN TYPE</td>
<td>SINGLE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WELDER NO.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPEN MONITOR</td>
<td>OFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GUN OPEN/CLOSE SET AT STOP</td>
<td>ON</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8.2.2 Setting Welding Condition for the Welder

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

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

Specify the Welding Condition No. that you set in the SPOT instruction line 0005.

(Example.WTM=1)

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

8.3.1 Teaching Procedure Items

The teaching procedure is explained in Step2 (welding pose definition) and the welding procedure is explained in Step3 (welding start) and Step4 (welding end).

- Step1, which is waiting position, is adjusted to a safe position where the robot 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.

8.3.2 Operation Procedure

**Step 2 -- Near Welding Start Position**

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.

<table>
<thead>
<tr>
<th>Board Thickness (mm)</th>
<th>Large Current - Short Time</th>
<th>Small Current - Long Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time (cycle)</td>
<td>Pressurizing Power (kgf)</td>
</tr>
<tr>
<td>1.0</td>
<td>10</td>
<td>225</td>
</tr>
<tr>
<td>2.0</td>
<td>20</td>
<td>470</td>
</tr>
<tr>
<td>3.2</td>
<td>32</td>
<td>820</td>
</tr>
</tbody>
</table>

(1 cycle = 16.7 msec)
8.3 Teaching Procedure

- Step 3 -- Welding Start Position

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

1. Change the speed to medium by pressing [HIGH] + [SLW].
   * is displayed in status area.

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

3. Press [ENTER] to register Step 3.

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

Press [ENTER]. The SPOT instruction is registered.
8.4 Welding Test

8.4.1 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. Press [PLAY] on the playback panel to turn on the play mode.

2. Select {UTILITY} and {SETUP SPECIAL RUN}. The special play display is shown.

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

8.4.2 Welding Execution

Once the path has been determined, the welding is finally executed. If the check run is turned off, the SPOT instruction is executed.
8.4 Welding Test
9 TURNING THE POWER OFF

9.1 Turning the Servo Power Off (Emergency Stop)

When the emergency stop button is pressed, the servo power supply is turned off and the manipulator cannot be operated. The emergency stop button is on both the programming pendant and the playback panel. The brake operates once the servo power supply is turned off, and the manipulator can no longer operate. The emergency stop mode can be operated at any time.

9.2 Turning the Main Power Off

After turning off the servo power, then turn off the main power. When the main power switch on the front of the XRC is turned off, the main power is cut.
9.2 Turning the Main Power Off
Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

The YASNAC XRC operator’s manuals above correspond to specific usage. Be sure to use the appropriate manual.
Mandatory

- This manual explains the various components of the YASNAC XRC system and general operations. Read this manual carefully and be sure to understand its contents before handling the YASNAC XRC.

- General items related to safety are listed in the Setup Manual Section 1: Safety. To ensure correct and safe operation, carefully read the Setup Manual 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 YASNAC XRC.

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.

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

---

iii
• Before operating the manipulator, check that servo power is turned off when the emergency stop buttons on the playback panel or programming pendant are pressed. When the servo power is turned off, the SERVO ON READY lamp on the playback panel and the SERVO ON LED on the programming pendant are 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.

• 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.

• Always set the Teach Lock before entering the robot work envelope to teach a job.

Operator injury can occur if the Teach Lock is not set and the manipulator is started from the playback panel.

• Observe the following precautions when performing teaching operations within the working 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 manipulator’s work envelope and that you are in a safe location before:
  - Turning on the YASNAC XRC power
  - Moving the manipulator with the programming pendant
  - Running check operations
  - Performing automatic operations

Injury may result if anyone enters the working envelope of the manipulator during operation. Always press an emergency stop button immediately if there are problems. The emergency stop button is located on the right side of both the YASNAC XRC playback panel and 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 XRC cabinet after use.

The programming pendant can be damaged if it is left in the manipulator’s work area, on the floor, or near fixtures.

- Read and understand the Explanation of the Alarm Display in the Setup Manual 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 playback panel, the programming pendant, and supply cables. In this manual, the equipment is designated as follows.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>YASNAC XRC Controller</td>
<td>XRC</td>
</tr>
<tr>
<td>YASNAC XRC Playback Panel</td>
<td>Playback Panel</td>
</tr>
<tr>
<td>YASNAC XRC Programming Pendant</td>
<td>Programming Pendant</td>
</tr>
</tbody>
</table>
Descriptions of the programming pendant and playback panel keys, buttons, and displays are shown as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Pendant</td>
<td>Character Keys The keys which have characters printed on them are denoted with [ ]. ex. [ENTER]</td>
</tr>
<tr>
<td></td>
<td>Symbol Keys The keys which have a symbol printed on them are not denoted with [ ] but depicted with a small picture. ex. page key</td>
</tr>
<tr>
<td></td>
<td>The cursor key is an exception, and a picture is not shown.</td>
</tr>
<tr>
<td></td>
<td>Axis Keys Number Keys “Axis Keys” and “Number Keys” are generic names for the keys for axis operation and number input.</td>
</tr>
<tr>
<td></td>
<td>Keys pressed simultaneously When two keys are to be pressed simultaneously, the keys are shown with a “+” sign between them, ex. [SHIFT]+[COORD]</td>
</tr>
<tr>
<td></td>
<td>Displays The menu displayed in the programming pendant is denoted with { }. ex. {JOB}</td>
</tr>
<tr>
<td>Playback Panel</td>
<td>Buttons Playback panel buttons are enclosed in brackets. ex. [TEACH] on the playback panel</td>
</tr>
</tbody>
</table>

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.
1 An Introduction to XRC

1.1 Controller..............................................................1-1

1.2 Playback Panel......................................................1-2
   1.2.1 Playback Panel Overview ....................................1-2
   1.2.2 Button Description ...........................................1-2
   1.2.3 Playback Panel Buttons .....................................1-3

1.3 Programming Pendant.............................................1-4
   1.3.1 Programming Pendant Overview .............................1-4
   1.3.2 Key Description ...............................................1-5
      ■ Character Keys .................................................1-5
      ■ Symbol Keys ..................................................1-5
      ■ Axis Keys and Number Keys ..................................1-5
      ■ Keys Pressed Simultaneously .................................1-5
   1.3.3 Programming Pendant Keys ..................................1-6
   1.3.4 Programming Pendant Display ...............................1-10
      ■ The Four Display Areas .....................................1-10
      ■ Status Display Area .........................................1-10
      ■ Human Interface Display Area ...............................1-12
   1.3.5 Screen Descriptions .........................................1-12
      ■ Denotation ......................................................1-12
      ■ Screen .........................................................1-13
   1.3.6 Character Input ...............................................1-14
      ■ Number Input ..................................................1-14
      ■ Letter Input ...................................................1-14
      ■ Symbol Input ..................................................1-14

1.4 Modes ..............................................................1-15
   1.4.1 Operation Mode ..............................................1-15
   1.4.2 Operation Location Mode ....................................1-15
   1.4.3 Teach Mode Priority .........................................1-16
   1.4.4 Edit Jobs and Active Jobs .................................1-16

1.5 About the Security Mode .........................................1-17
   1.5.1 Types of Security Modes ....................................1-17
   1.5.2 Modifying the Security Mode ...............................1-20

2 Manipulator Coordinates

2.1 Robot Axes and Coordinates ....................................2-1
   2.1.1 Types of Coordinates .......................................2-2

2.2 General Operations ...............................................2-3
   2.2.1 Selecting a Coordinate System .............................2-3
      ■ Motion Type Key ...............................................2-3
   2.2.2 Selecting Manual Speed ......................................2-3
      ■ Selecting with Manual Speed Keys ..........................2-3
      ■ Using the High Speed Key ....................................2-4
   2.2.3 Axis Operations ...............................................2-4
      ■ Switching the Group Axis to be Operated ..................2-4

2.3 Joint Coordinates ..................................................2-5
2.4 Rectangular Coordinates ............................................. 2-6
2.5 Cylinder Coordinates .................................................. 2-8
2.6 Tool Coordinates ....................................................... 2-9
  2.6.1 Axis Motion ......................................................... 2-9
  2.6.2 Selecting the Tool Number ...................................... 2-11
2.7 User Coordinates ...................................................... 2-12
  2.7.1 User Coordinates .................................................. 2-12
  2.7.2 Examples of User Coordinate Utilization ...................... 2-13
  2.7.3 Selecting a User Coordinate Number ......................... 2-14
2.8 Tool Tip Operations .................................................. 2-15
  2.8.1 TCP Fixed Operations ......................................... 2-15
  2.8.2 TCP Change Operations ....................................... 2-17

3 Teaching

3.1 Preparation for Teaching ........................................... 3-1
  3.1.1 Checking Emergency Stop Buttons ......................... 3-1
  3.1.2 Setting the Teach Lock ....................................... 3-1
  3.1.3 Registering Job Names ........................................ 3-2
    ■ Characters that Can Be Used in Job Names .................. 3-2
    ■ Registering Job Names ......................................... 3-2

3.2 Teaching ............................................................... 3-3
  3.2.1 Teaching Display Screens .................................... 3-3
  3.2.2 Motion Type and Play Speed ................................ 3-4
    ■ Joint Motion Type .............................................. 3-4
    ■ Linear Motion Type ............................................ 3-5
    ■ Circular Motion Type ........................................ 3-5
    ■ Spline Motion Type ............................................ 3-7
  3.2.3 Teaching Steps .................................................. 3-8
    ■ Registering Move Instructions ............................... 3-8
    ■ Registering Reference Point Instructions ................. 3-13
    ■ Registering Timer Instructions ................................ 3-14
  3.2.4 Overlapping the First and Last Steps ....................... 3-16

3.3 Checking Steps ....................................................... 3-17
  3.3.1 FWD/BWD Key Operations .................................. 3-17
    ■ Precautions When Using FWD / BWD Operations .......... 3-17
    ■ Selecting Manual Speed ...................................... 3-19
    ■ Moving to Reference Point .................................. 3-20
    ■ Test Operations ............................................... 3-20

3.4 Modifying Steps ...................................................... 3-22
  3.4.1 Displaying the Job Content Display for Editing .......... 3-25
    ■ Currently Called Up Job ..................................... 3-25
    ■ Calling Up Other Jobs ........................................ 3-25
  3.4.2 Inserting Move Instructions ................................ 3-26
  3.4.3 Deleting Move Instructions ................................. 3-28
3.4.4 Modifying Move Instructions ............................................. 3-28
  ■ Modifying Position Data ............................................. 3-28
  ■ Modifying Motion Type ............................................... 3-29

3.4.5 Modifying Reference Point Instructions ................................. 3-30
  ■ Deleting Reference Point Instructions ................................. 3-30
  ■ Modifying Reference Point Instructions ................................ 3-30

3.4.6 Modifying Timer Instructions ............................................... 3-31
  ■ Deleting Timer Instructions ........................................... 3-31
  ■ Modifying Timer Instructions ........................................... 3-31

3.5 Operations After Teaching ................................................... 3-32
  3.5.1 Releasing the teach lock ............................................... 3-32

4 Playback
  4.1 Preparation for Playback .................................................. 4-1
    ■ Calling a Job .......................................................... 4-1
    ■ Registering the Master Job ........................................... 4-1
    ■ Calling the Master Job ................................................ 4-3

4.2 Playback ................................................................. 4-5
  4.2.1 The Playback Display ................................................ 4-5
    ■ Setting Display or Non-Display of Cycle Time .......................... 4-6

4.2.2 Playback ............................................................. 4-6
    ■ Selecting the start device ............................................ 4-6
    ■ Selecting Mode ........................................................ 4-7
    ■ Start Operation ......................................................... 4-7
    ■ About the Operation Cycle ........................................... 4-7

4.2.3 Special Playback Operations ............................................. 4-10
    ■ Low Speed Operation .................................................. 4-10
    ■ Limited Speed Operations .......................................... 4-11
    ■ Dry Run Speed Operations .......................................... 4-11
    ■ Machine Lock Operation ............................................ 4-12
    ■ Check Operation ....................................................... 4-12
    ■ Check Run and Weaving Prohibit ................................... 4-13
    ■ Cancel All Special Operations .................................... 4-13

4.3 Stop and Restart .......................................................... 4-14
  4.3.1 Hold ................................................................. 4-14
    ■ Using the Playback Panel ............................................. 4-14
    ■ Using an External Input Signal (Specific) .......................... 4-14

4.3.2 Emergency Stop ......................................................... 4-15
  4.3.3 Restart After Emergency Stop ......................................... 4-17
  4.3.4 Stop by Alarm ........................................................ 4-17
  4.3.5 Others ................................................................. 4-18
    ■ Temporary Stop By Mode Change .................................... 4-18
    ■ Temporary Stop By the PAUSE Instruction .......................... 4-18
### 4.4 Modifying Play Speed

#### 4.4.1 Modifying With Speed Override
- Setting Speed Overrides
- Modifying Play Speed
- Modifying Speed Override Ratio
- Releasing Speed Override Settings

### 4.5 Playback With Reserved Start

#### 4.5.1 Preparation for Reserved Start
- Enabling Reserved Start
- Registering Reserved Start I/O Signal
- Registering Jobs to Stations
- Deleting Registered Jobs from Stations

#### 4.5.2 Playback from Reserved Start
- Start Operation
- Checking Job Reservation Status
- Resetting Job Reservation

#### 4.5.3 Hold Operation
- [HOLD] on the Playback Panel
- Hold by External Input Signal (Specific)
- Hold at the Station

### 4.6 Displaying Job Stack

### 5 Editing

#### 5.1 Editing Jobs

<table>
<thead>
<tr>
<th>Displays Related to Job</th>
<th>5-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB HEADER DISPLAY</td>
<td>5-1</td>
</tr>
<tr>
<td>Job Content Display</td>
<td>5-2</td>
</tr>
<tr>
<td>Command Pos Display</td>
<td>5-3</td>
</tr>
<tr>
<td>Job List Display</td>
<td>5-3</td>
</tr>
<tr>
<td>Job Capacity Display</td>
<td>5-4</td>
</tr>
</tbody>
</table>

#### 5.1.2 Editing Jobs

- Copying Jobs
- Deleting Jobs
- Modifying Job Names
- Editing Comments
- Setting Edit Lock on Individual Job Units
- Enabling Modification of Position Data Only

#### 5.2 Editing Instructions

<table>
<thead>
<tr>
<th>Editing Instructions</th>
<th>5-13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction Group</td>
<td>5-14</td>
</tr>
<tr>
<td>Inserting Instructions</td>
<td>5-15</td>
</tr>
<tr>
<td>Deleting Instructions</td>
<td>5-16</td>
</tr>
<tr>
<td>Modifying Instructions</td>
<td>5-16</td>
</tr>
</tbody>
</table>

#### 5.2.2 Editing Additional Items (Line Edit)

- Modifying Additional Numeric Data
- Modifying Additional Items
- Inserting Additional Items
- Deleting Additional Items
5.2.3 Cut and Paste ........................................... 5-24
   • Setting the Range ........................................ 5-25
   • Copying .................................................. 5-25
   • Cutting .................................................. 5-26
   • Pasting .................................................. 5-26
   • Reverse Pasting ......................................... 5-27

5.3 Other Editing ............................................ 5-28
5.3.1 Editing Play Speed ...................................... 5-28
   • Modification of Speed Type .............................. 5-28
   • Relative Modification ................................. 5-28
   • Modification by TRT (Traverse Time) ................. 5-30
5.3.2 Editing Motion Type .................................... 5-31
5.3.3 Editing Condition Files ................................ 5-32
5.3.4 Editing User Variables .................................. 5-32
   • Displaying Byte, Integer, Double-Precision, and Real
     Type Variables ........................................... 5-34
   • Setting Byte, Integer, Double-Precision, and Real
     Type Variables .......................................... 5-35
   • Registering Variable Name .............................. 5-36
   • Displaying Position Variables ......................... 5-37
   • Setting Position Variables ............................ 5-38
   • Setting Position Variables Using the Number Keys .. 5-39
   • Setting Position Variables Using the Axis Keys ... 5-41
   • Deleting Data Set of Position Variables ............. 5-42
   • Checking Positions by Position Variables .......... 5-42
   • Manipulator Types ..................................... 5-43
5.3.5 Editing Local Variables ............................... 5-47
   • Setting the Number of Local Variables ............... 5-48
5.3.6 Searching .............................................. 5-49
   • Line Search ............................................. 5-50
   • Step Search ............................................ 5-51
   • Label Search ........................................... 5-51
   • Instruction Search .................................... 5-52
   • Tag Search ............................................. 5-53

5.4 Setting the Edit Lock .................................... 5-56
5.4.1 Edit Lock For All Jobs (Option) ...................... 5-56

6 Convenient Functions
6.1 One-touch Operations .................................... 6-1
6.1.1 Direct Open .......................................... 6-1
6.1.2 Reserved Display Call ................................ 6-3
   • Registering Reserved Displays ....................... 6-4
   • Calling Reserved Displays ............................ 6-4
6.2 Parallel Shift Function ........................................ 6-5
  6.2.1 Parallel Shift Function .................................. 6-5
  6.2.2 Setting the Shift Value .................................. 6-7
    ■ Registering Position Variables ......................... 6-7
    ■ Coordinates ............................................. 6-7
    ■ Setting the Shift Value ................................ 6-8
  6.2.3 Registering Shift Instructions ........................ 6-9
    ■ SFTON Instruction ...................................... 6-10
    ■ SFTOF Instruction ...................................... 6-11
    ■ MSHIFT Instruction ..................................... 6-12
  6.2.4 Continuation of the Parallel Shift Function ........ 6-14
  6.2.5 Examples of Use ........................................ 6-15
    ■ Example of Use of Shift Addition/Subtraction ........ 6-15
    ■ Example of Use of MSHIFT Instruction ................. 6-16
6.3 Parallel Shift Job Conversion Function .................... 6-17
  6.3.1 Parallel Shift Job Conversion ........................ 6-17
    ■ Coordinates for Conversion .......................... 6-17
  6.3.2 Operating Methods ..................................... 6-22
    ■ Specifying the Conversion Items ....................... 6-22
    ■ Specifying the Shifting Amount ....................... 6-23
    ■ Executing Conversion ................................ 6-25
6.4 PAM Function .................................................. 6-26
  6.4.1 PAM Function ........................................... 6-26
    ■ Input Ranges for Adjustment Data ..................... 6-26
  6.4.2 Operating Methods ..................................... 6-27
    ■ Setting Adjustment Data ............................... 6-27
    ■ Executing the Adjustment .............................. 6-28
    ■ Editing Data ............................................ 6-29
6.5 Mirror Shift Function ........................................ 6-31
  6.5.1 Mirror Shift ............................................ 6-31
    ■ Object Job ............................................... 6-31
    ■ Group Axes Which Become Objects .................... 6-31
    ■ Position Variable ..................................... 6-32
    ■ Parameter ............................................... 6-32
  6.5.2 Operation Method ...................................... 6-32
    ■ Converting .............................................. 6-32

7 Controlling Peripheral Devices
  7.1 Floppy Disk Unit ............................................ 7-1
    7.1.1 Floppy Disk Unit .................................... 7-1
      ■ Notes on the Use of Floppy Disks and Disk Units .... 7-2
      ■ Connecting Cables .................................... 7-2
      ■ Inserting a Floppy Disk .............................. 7-4
    7.1.2 File Management ..................................... 7-5
      ■ Data That Can Be Saved and Save Destination File Names ... 7-6
      ■ Selecting a Memory Unit ............................. 7-9
      ■ Formatting a Floppy Disk ............................ 7-10
      ■ Loading ................................................. 7-11
8 Handling

8.1 Specific Keys ........................................... 8-1

8.2 Instructions and Signals ................................. 8-2
     8.2.1 HAND Instruction ................................ 8-2
          ■ Function ........................................ 8-2
          ■ Instruction and Additional Items ............... 8-2
     8.2.2 HSEN (Tool Sensor) Instruction ................... 8-3
          ■ Function ........................................ 8-3
          ■ Instruction and Additional Items ............... 8-3
     8.2.3 Handling Usage Diagnosis Display ................ 8-4
     8.2.4 Tool Shock Sensor Function ....................... 8-6
     8.2.5 Tool Shock Sensor Input Signal ................... 8-6
          ■ Function ........................................ 8-6
          ■ Signal Condition ............................... 8-6
          ■ How to use the signal .......................... 8-6
     8.2.6 Tool Shock Sensor Input Reset ..................... 8-6
          ■ Function ........................................ 8-6
     8.2.7 Low Air Pressure Input Signal .................... 8-7
          ■ Function ........................................ 8-7
          ■ Signal Condition ............................... 8-7
          ■ How to use the signal .......................... 8-7

9 Handling Instructions

9.1 Registering Operating Instructions ................... 9-1
     9.1.1 HAND Instruction ................................ 9-1
     9.1.2 HSEN Instruction ................................ 9-3

9.2 Table of Work Instructions .............................. 9-6

10 Table of Basic Instructions
1 An Introduction to XRC

1.1 Controller

The main power switch is located on the front of the XRC controller. The playback panel is installed in the upper right corner of the cabinet door and the programming pendant hangs on a hook below the playback panel.

<table>
<thead>
<tr>
<th>Components</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Power Switch</td>
<td>Turns the XRC power ON/OFF.</td>
</tr>
<tr>
<td>Door Lock</td>
<td>Locks the door.</td>
</tr>
<tr>
<td>Playback Panel</td>
<td>Equipped with the keys and buttons used for playback of the manipulator. For details, see &quot;1.2 Playback Panel&quot;.</td>
</tr>
<tr>
<td>Programming Pendant</td>
<td>Equipped with keys and buttons used for conducting manipulator teaching operations and editing jobs. For details, see &quot;1.3 Programming Pendant&quot;.</td>
</tr>
</tbody>
</table>
1.2 Playback Panel

1.2.1 Playback Panel Overview

The playback panel is equipped with the buttons used to play back the manipulator.

1.2.2 Button Description

Playback panel buttons are enclosed in brackets throughout this manual.

- **[TEACH] on the playback panel**
- **[START] on the playback panel**
1.2.3 Playback Panel Buttons

**EMERGENCY STOP**
- Turns off the servo power.

**SERVO ON READY**
- Enables the servo power ON.
- Use this button to turn servo power ON after and emergency stop or servo overrun condition.
- When this button is pressed,
  - The lamp will glow when all safety interlocks are closed in Play Mode.
  - The lamp will blink in Teach Mode, and the servo power is applied when the operator grips the deadman switch.

**PLAY**
- Selects the play mode, which allows playback of a job after teaching.
- Pressing this button places the XRC in Play Mode. The lamp will glow when in Play Mode.
- If Teach Lock is ON, the lamp will not light.

**TEACH**
- Selects the teach mode to enable manipulator operation and editing functions using the programming pendant.
- Pressing this button places the XRC in Teach Mode. The lamp will glow when in Teach Mode.
- If Edit Lock (option) is ON, the edition function is disabled and the lamp will not light.

**REMOTE**
- Selects the playback panel or external input signal to perform the start and mode switching operation.
- Operation by remote signal input is possible when lamp is lit.
- When lamp is lit, playback panel will not operate.

**ALARM**
- Lights to indicate that an alarm or error has occurred.
- To release the alarm, press [RESET] on the programming pendant.

**START**
- Starts the manipulator playback operation.
- This lamp lights during the playback operation.

**HOLD**
- Temporarily stops the manipulator playback operation.
- This button functions in any mode.
- This button lights only while the button is held down. Releasing the button turns the lamp off. Even though the lamp is not lit, the manipulator will not start unless the next start instruction is given.
- This lamp lights automatically in the following instances to indicate that the system is in the hold status.
  - While the hold signal is input from the HOLD key.
  - During a hold request from the external computer while in the remote mode.
  - Stop caused by job operation. (For example: wire sticking during the welding operation.)
- Start and axis functions will not operate while this lamp is lit.
1.3 Programming Pendant

1.3.1 Programming Pendant Overview

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

■ Character Keys

The keys which have characters printed on them are denoted with []. \[\text{ENTER}\] is shown as [ENTER] and \[\text{TEACH LOCK}\] is shown as [TEACH LOCK].

The number keys have additional functions along with their number values. Dual function keys are used in the context of the operation being performed. For example: \[\text{TIMER}\] 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
- Reserved Display key
- Direct Open key
- Page key
- Area key

■ Axis Keys and Number Keys

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

■ Keys Pressed Simultaneously

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

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.STOP Button</td>
<td>Turns off the servo power. When the servo power is turned off, the SERVO ON LED on the programming pendant and the SERVO ON READY lamp will light. An emergency stop message is displayed on the screen.</td>
</tr>
<tr>
<td>Deadman Switch</td>
<td>Turns on the servo power. Deadman switch is active only when the SERVO ON READY lamp is blinking and both the safety plug and Teach Lock are on.</td>
</tr>
<tr>
<td>[TEACH LOCK]</td>
<td>Sets to Teach Lock. The LED lights when the Teach Lock is set. When you set Teach Lock, Start is disabled and mode changes are locked out until Teach Lock is turned off. When Teach Lock is off, servo power cannot be turned on using the deadman switch.</td>
</tr>
<tr>
<td>Cursor</td>
<td>Moves the cursor in the direction of the arrow. The size of the cursor and the range/place where the cursor can move will vary dependent on the display. 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. When [SHIFT] is pressed simultaneously:</td>
</tr>
<tr>
<td>[SELECT]</td>
<td>Selects menu items such as top menu, pull down menu, etc.</td>
</tr>
<tr>
<td>[TOP MENU]</td>
<td>Displays the top menu.</td>
</tr>
</tbody>
</table>
### Area Key
- Moves the cursor between “Menu Area” and “General Purpose Display Area”.

### Page Key
- Displays the next page. When [SHIFT] is pressed simultaneously with [PAGE], the previous page is displayed.

### Direct Open Key
- Displays the content related to the current line.
  
  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.

  **Example:**
  - For a CALL instruction, the content of the called job will be displayed.
  - For an Operation instruction, the content of the condition file will be displayed.
  - For Input/output instructions, the in/output condition will be displayed.

### Reserved Display Key
- Displays the reserved display.
  During operation the display, which is registered because it is often seen, can be called up by pressing this key.

### [COORD]
- Select the operation coordinate system when the manipulator is operated manually.
  Five coordinate systems (joint, rectangular, cylinder, 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”
  The selected coordinate system is displayed on the status display area.

  When [SHIFT] is pressed simultaneously with [COORD], the coordinate number can be changed when the “TOOL” or “USER” coordinate system is selected.

### [MAN SPD]
- Sets the speed for manual operation.
  This speed is also valid for operations with [FWD] and [BWD].
  There are four speed levels (slow, medium, fast, and inching).
  Each time [FST] is pressed, manual speed changes in the following order: “INCH”→“SLOW”→“MED”→“FST”
  Each time [SLW] is pressed, manual speed changes in the following order: “FST”→“MED”→“SLOW”→“INCH”
  The selected speed is displayed on the status area.

### [HIGH SPD]
- Changes the speed of axis operation when and axis button is pressed.
  The speed of the manipulator will change to high regardless of the programmed speed.

  Note that only one axis can be operated at high speed. High-speed operation of multiple axes is not possible.
1.3 Programming Pendant

- **[MOTION TYPE]**
  Selects the motion type for playback operation. The selected motion type is shown in the status display area on the screen.

  Each time this key is pressed, the motion type changes in the following order:
  "MOVJ" → "MOVL" → "MOVC" → "MOVS"

  When [SHIFT] is pressed simultaneously with [MOTION TYPE], the motion mode changes in the following order:
  "STANDARD" → "EXTERNAL REFERENCE POINT"* → "CONVEYOR"*

  Motion Type can be changed in any mode.

  *: These modes are purchased options.

- **Axis Key**
  Moves specified axes on manipulator. 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.

  Axis type (robot or external) is changed as follows:

  The manipulator operates in the selected coordinate system.

- **[TEST START]**
  Moves the manipulator through taught steps in a continuous motion when [TEST START] and [INTERLOCK] are simultaneously pressed.

  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"

  If an operating speed exceeds the maximum teaching speed, the operation proceeds at the maximum teaching speed. Operation stops immediately when this key is released.

- **[FWD]**
  Moves the manipulator through the taught steps while this key is pressed. Only move instructions are executed (no weld commands). When [SHIFT] is pressed simultaneously with [FWD], all instructions except move instructions are executed.

  As for the operation of pressing [REF PNT] simultaneously, see the description of "TEST START".

- **[BWD]**
  Moves the manipulator through the taught steps in the reverse direction while this key is pressed. Only move instructions are executed (no weld commands).

- **[INFORM LIST]**
  Displays instruction lists of commands available for job editing.

- **[CANCEL]**
  Cancels data input and resets errors.
# 1.3 Programming Pendant

<table>
<thead>
<tr>
<th>Key</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>[DELETE]</strong></td>
<td>Deletes registered instructions and data. [DELETE] functions only when the key lamp is lit.</td>
</tr>
<tr>
<td><img src="delete.png" alt="DELETE" /></td>
<td></td>
</tr>
<tr>
<td><strong>[INSERT]</strong></td>
<td>Inserts new instructions or data. [INSERT] functions only when the key lamp is lit.</td>
</tr>
<tr>
<td><img src="insert.png" alt="INSERT" /></td>
<td></td>
</tr>
<tr>
<td><strong>[MODIFY]</strong></td>
<td>Modifies taught position data, instructions, and data. [MODIFY] functions only when the key lamp is lit.</td>
</tr>
<tr>
<td><img src="modify.png" alt="MODIFY" /></td>
<td></td>
</tr>
<tr>
<td><strong>[ENTER]</strong></td>
<td>Registers instructions, data, current position of the manipulator, etc. 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.</td>
</tr>
<tr>
<td><img src="enter.png" alt="ENTER" /></td>
<td></td>
</tr>
<tr>
<td><strong>[SHIFT]</strong></td>
<td>Changes the functions of the other keys. Used with [TOP MENU], [COORD], [MOTION TYPE], CURSOR, RESERVED DISPLAY KEY, NUMBER KEY, Page Key to access alternate functions. Refer to the description of each key for the alternate [SHIFT] functions.</td>
</tr>
<tr>
<td><img src="shift.png" alt="SHIFT" /></td>
<td></td>
</tr>
<tr>
<td><strong>Number Key</strong></td>
<td>Enters the number or symbol when the &quot;&gt;&quot; prompt appears on the input line. &quot;.&quot; is the decimal point. &quot;-&quot; is a minus sign or hyphen. The number keys are also used as function keys. Refer to the explanation of each key for details.</td>
</tr>
<tr>
<td><img src="number_key.png" alt="Number Key" /></td>
<td></td>
</tr>
</tbody>
</table>
1.3.4 Programming Pendant Display

- The Four Display Areas

The programming pendant display area is 40 columns by 12 lines. The display area is made up of three different sections.

Each display has its own individual title. The title is displayed in the upper left-hand part of the general purpose display area.

- Status Display Area

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

ØGROUP OPERATION AXIS
Displays the active group axis for systems equipped with station axes or several robot axes.
R1 to R3 : Robot Axes
B1 to B3 : Base Axes
S1 to S6 : Station Axes
1.3 Programming Pendant

**OPERATION COORDINATE SYSTEM**
Displays the selected coordinate system.
- Link Coordinate
- XYZ Coordinate
- Cylinder Coordinate
- Tool Coordinate
- User Coordinate

**MANUAL SPEED**
Displays the selected speed.
- Inching
- Low Speed
- Medium Speed
- High Speed

**OPERATION CYCLE**
Displays the present operation cycle.
- Step
- Cycle
- Continuous

**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

**PAGE**
Displays the screen where the page is switched.
1.3 Programming Pendant

- Human Interface Display Area

The human interface display area is used for display information such as the instruction being input, data, and error messages. The area is made up of three different lines.

1. **Input Buffer Line**
   Displays instructions as they are being entered.

2. **Input Line**
   Displays data values being entered (only when data input is required).

3. **Message Line**
   Displays error messages and dialogs for input. Error messages are given priority if errors occur during input. Messages longer than one line length will scroll off the screen as you continue entering data.

1.3.5 Screen Descriptions

- Denotation

The menu displayed in the programming pendant is denoted with { }. The above menu items are denoted with {JOB}, {EDIT}, {DISPLAY}, AND {UTILITY}.

Menu commands are denoted in the same manner.
Screen

The screen can be displayed according to the view desired.

- Full Screen View
- Upper Screen View
- Middle Screen View
- Lower Screen View
1.3.6 Character Input

[SELECT] : Insert a character at the cursor’s location on the input line.
[CANCEL] : Delete all characters on the input line.
   Cancels character input, even if no characters have been entered on the input line.

PAGE KEY : Change the data type for input; Letter → Symbol → User Word.
[ENTER] : Registers all characters on the input line.

CURSOR :
   • When the cursor is on the input line:
      [←] : Moves the cursor to the left.
      [→] : Moves the cursor to the right.
      [↑] : Deletes the character to the left of the cursor.
   • When the cursor is on the character input display:
      [←] : Moves the cursor to the left.
      [→] : Moves the cursor to the right.
      [↑] : Moves the cursor up.
      [↓] : Moves the cursor down.

■ Number Input

Number input is performed with the number key. Numbers include 0-9, the decimal point (.), and the minus sign/hyphen (-).
Note however, that the decimal character cannot be used in job names.

■ Letter Input

Press the page key to display the Letter Input screen. Move the cursor to the desired letter and press [SELECT] to enter the letter.

■ Symbol Input

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

The XRC has two modes:

- Operation Mode
- Operation Location Mode

Each mode is described in this section.

1.4.1 Operation Mode

The Operation Mode is the mode in which the manipulator is programmed and operated. The operation mode is indicated by the mode lamp on the playback panel.

- Teach Mode
  Used for teaching new jobs or modifying existing jobs.
- Play Mode
  Used to run programmed jobs.

1.4.2 Operation Location Mode

Specifies the control point for operations such as manipulator mode, cycle, servo power, and calling jobs.

The location mode is indicated by the REMOTE switch on the playback panel.

- Playback panel mode
  Remote operation is not possible.
  Playback panel / Programming Pendant input is available.
- Remote Mode
  Operation via remote input is possible.

The table below shows the modes and the capability within each mode.

The data transfer input function (optional) is available in the remote mode.
1.4 Modes

1.4.3 Teach Mode Priority

For safety reasons, Teach mode always takes priority in mode switching operations. It is not possible to switch to other modes via the playback panel or external input when TEACH LOCK is turned on.

The controller remembers which mode it was in when power was turned off so that when power is turned back on, the controller is in the same mode. However, if the mode has already been specified by the playback panel or the external input when power is turned on, the mode when power was turned off is not effective.

1.4.4 Edit Jobs and Active Jobs

The XRC can call a job stored in the memory at any time in order to edit or execute the job. Jobs set for editing are called “edit jobs.” The name of the edit job is displayed in the status display in teach mode. Jobs set for execution are called “active jobs”. The name of the active job is displayed in the status display area in play mode.

<table>
<thead>
<tr>
<th>Mode Operation</th>
<th>Local Mode (Remote lamp is OFF)</th>
<th>Remote Mode (Remote lamp is ON)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servo ON</td>
<td>Playback Panel / Programming Pendant</td>
<td>External signal</td>
</tr>
<tr>
<td>Start</td>
<td>Playback Panel</td>
<td>External signal</td>
</tr>
<tr>
<td>Mode change</td>
<td>Playback Panel</td>
<td>External signal</td>
</tr>
<tr>
<td>Cycle change</td>
<td>Programming Pendant</td>
<td>External signal</td>
</tr>
<tr>
<td>Call master job</td>
<td>Programming Pendant</td>
<td>External signal</td>
</tr>
</tbody>
</table>

When you change the operation mode, the current job changes according to the mode.

For example: If an edit job is open in Teach mode, it will become the active job when the controller is switched to Play mode.

The job type can be changed by switching modes in the following manner:
1.5 About the Security Mode

The XRC contains a security system known as the security mode. This is a method where only those operators with an appropriate level can perform operations or change settings. Be sure that the operator is at the appropriate level before operation.

1.5.1 Types of Security Modes

The following three types of security modes are available.

- **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.

- **Editing Mode**
  During the edit mode, teaching, robot jog operations, job editing, and editing of various operation files can be performed.
### 1.5 About the Security 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.

---

#### Menu & Security Mode

<table>
<thead>
<tr>
<th>Top Menu</th>
<th>Sub Menu</th>
<th>Security Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB</td>
<td>SELECT JOB</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>CREATE NEW JOB</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>MASTER JOB</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>JOB CAPACITY</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>RES. START(JOB)</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>RES. STATUS</td>
<td>Operation</td>
</tr>
<tr>
<td>VARIABLE</td>
<td>BYTE</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>INTEGER</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>DOUBLE</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>REAL</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>POSITION(ROBOT)</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>POSITION(BASE)</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>POSITION(ST)</td>
<td>Operation</td>
</tr>
<tr>
<td>IN/OUT</td>
<td>EXTERNAL INPUT</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>EXTERNAL OUTPUT</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>UNIVERSAL INPUT</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>UNIVERSAL OUTPUT</td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>SPECIFIC INPUT</td>
<td>Edit</td>
</tr>
<tr>
<td></td>
<td>SPECIFIC OUTPUT</td>
<td>Edit</td>
</tr>
<tr>
<td></td>
<td>RIN</td>
<td>Edit</td>
</tr>
<tr>
<td></td>
<td>REGISTER</td>
<td>Edit</td>
</tr>
<tr>
<td></td>
<td>AUXILIARY RELAY</td>
<td>Edit</td>
</tr>
<tr>
<td></td>
<td>CONTROL INPUT</td>
<td>Edit</td>
</tr>
<tr>
<td></td>
<td>PSEUDO INPUT SIG</td>
<td>Edit</td>
</tr>
<tr>
<td></td>
<td>ANALOG OUTPUT</td>
<td>Edit</td>
</tr>
<tr>
<td></td>
<td>LADDER PROGRAM</td>
<td>Management</td>
</tr>
<tr>
<td></td>
<td>I/O ALARM</td>
<td>Management</td>
</tr>
<tr>
<td></td>
<td>I/O MESSAGE</td>
<td>Management</td>
</tr>
</tbody>
</table>
## About the Security Mode

### Menu & Security Mode

<table>
<thead>
<tr>
<th>Top Menu</th>
<th>Sub Menu</th>
<th>Security Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ROBOT</strong></td>
<td><strong>CURRENT POSITION</strong></td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td><strong>COMMAND POSITION</strong></td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td><strong>SERVO MONITOR</strong></td>
<td>Management</td>
</tr>
<tr>
<td></td>
<td><strong>OPE ORIGIN POS</strong></td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td><strong>SECOND HOME POS</strong></td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td><strong>DROP AMOUNT</strong></td>
<td>Management</td>
</tr>
<tr>
<td></td>
<td><strong>POWER ON/OFF POS</strong></td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td><strong>TOOL</strong></td>
<td>Edit</td>
</tr>
<tr>
<td></td>
<td><strong>INTERFERENCE</strong></td>
<td>Management</td>
</tr>
<tr>
<td></td>
<td><strong>USER COORDINATE</strong></td>
<td>Edit</td>
</tr>
<tr>
<td></td>
<td><strong>HOME POSITION</strong></td>
<td>Management</td>
</tr>
<tr>
<td></td>
<td><strong>MANIPULATOR TYPE</strong></td>
<td>Management</td>
</tr>
<tr>
<td></td>
<td><strong>ROBOT CALIB</strong></td>
<td>Edit</td>
</tr>
<tr>
<td></td>
<td><strong>ANALOG MONITOR</strong></td>
<td>Management</td>
</tr>
<tr>
<td></td>
<td><strong>OVERRUN&amp;S-SENSOR</strong></td>
<td>Edit</td>
</tr>
<tr>
<td></td>
<td><strong>LIMIT RELEASE</strong></td>
<td>Edit</td>
</tr>
<tr>
<td><strong>SYSTEM INFO</strong></td>
<td><strong>MONITORING TIME</strong></td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td><strong>ALARM HISTORY</strong></td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td><strong>VERSION</strong></td>
<td>Operation</td>
</tr>
<tr>
<td><strong>FD/PC CARD</strong></td>
<td><strong>LOAD</strong></td>
<td>Edit</td>
</tr>
<tr>
<td></td>
<td><strong>SAVE</strong></td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td><strong>VERIFY</strong></td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td><strong>DELETE</strong></td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td><strong>FORMAT</strong></td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td><strong>DEVICE</strong></td>
<td>Operation</td>
</tr>
</tbody>
</table>
1.5.2 Modifying the Security Mode

**Operation**

From the Top Menu display, select {SECURITY} under the menu

1. Select the security mode to be modified
2. Input user ID
3. Press [ENTER]

**Explanation**

*1 The current security mode is displayed in the title of the top menu screen.
1.5 About the Security Mode

*2 When the selected security mode is higher than the currently set mode, the user ID input status display is shown.

At the factory, the user ID number below is preset.
- Edit Mode: [00000000]
- Management Mode: [99999999]

*3 The selected security mode’s input ID is checked. If the correct user ID is input, the security mode is modified.
2 Manipulator Coordinates

2.1 Robot Axes and Coordinates

Names for Robot System Axes
The external axes of the XRC 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.

Robot axis
This is the axis for the manipulator itself.

Base axis
This is the axis that moves the entire manipulator. It corresponds to the traveling axis. It controls the path of traveling manipulators.

Station axis
This is any axis other than the robot and base axes. It indicates the tilt or rotating axis of the fixture.
2.1 Robot Axes and Coordinates

2.1.1 Types of Coordinates

The following coordinates can be used to operate the manipulator:

- **Joint Coordinates**
  Each axis of the manipulator moves independently.

- **Rectangular Coordinates**
  The manipulator, regardless of its position, moves parallel to any of the X-, Y-, and Z-axes.

- **Cylinder Coordinates**
  The q 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 any coordinate system, it is possible to change only the wrist orientation at a fixed TCP (tool center point) position. This is called the TCP fixed function.
2.2 General Operations

2.2.1 Selecting a Coordinate System

Motion Type Key

Select a coordinate using the following procedure:
Press [MOTION TYPE]. Each time this key is pressed, the coordinate is switched in the following order:
Check the selection in the status area of the display.

Joint ➔ Rectangular(Cylinder) ➔ 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 SPD]. The manual speed set is also effective for [FWD] / [BWD] operations in addition to the axis operations.

Selecting with Manual Speed Keys

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

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

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

When the manipulator is operated with the programming pendant, the highest speed of the Tool Center Point is limited to 250 mm/sec.
### 2.2 General Operations

#### Using the High Speed Key

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

**NOTE**

[HIGH SPD] 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 (option function) with two or more axes, switches the group axis in the job content display by the following procedure:

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 the group axes key. 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 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.

<table>
<thead>
<tr>
<th>Axis Name</th>
<th>Axis Operation Key</th>
<th>Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Axes</td>
<td>S-Axis</td>
<td><img src="S-" alt="S-" /> <img src="S+" alt="S+" /></td>
</tr>
<tr>
<td></td>
<td>L-Axis</td>
<td><img src="L-" alt="L-" /> <img src="L+" alt="L+" /></td>
</tr>
<tr>
<td></td>
<td>U-Axis</td>
<td><img src="U-" alt="U-" /> <img src="U+" alt="U+" /></td>
</tr>
<tr>
<td>Wrist Axes</td>
<td>R-Axis</td>
<td><img src="R-" alt="R-" /> <img src="R+" alt="R+" /></td>
</tr>
<tr>
<td></td>
<td>B-Axis</td>
<td><img src="B-" alt="B-" /> <img src="B+" alt="B+" /></td>
</tr>
<tr>
<td></td>
<td>T-Axis</td>
<td><img src="T-" alt="T-" /> <img src="T+" alt="T+" /></td>
</tr>
</tbody>
</table>

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 [S-] + [S+]), none of the axes operate.
In the rectangular coordinates, the manipulator moves parallel to the X-, Y-, or Z- axes. The motion of each axis is described in the following table:

<table>
<thead>
<tr>
<th>Axis Name</th>
<th>Axis Operation Key</th>
<th>Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Axes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrist Axes</td>
<td>TCP Control Motion is executed. See Section &quot;2.8 Tool Tip Operations&quot;.</td>
<td></td>
</tr>
</tbody>
</table>
When two or more keys are pressed at the same time, the manipulator will perform compound moves. 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 Cylinder Coordinates

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

<table>
<thead>
<tr>
<th>Axis Name</th>
<th>Axis Operation Key</th>
<th>Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Axes</td>
<td>θ-Axis</td>
<td>Main unit rolls around S-axis.</td>
</tr>
<tr>
<td></td>
<td>r-Axis</td>
<td>Moves perpendicular to Z-axis.</td>
</tr>
<tr>
<td></td>
<td>Z-Axis</td>
<td>Moves parallel to Z-axis.</td>
</tr>
</tbody>
</table>

Wrist Axes TCP Control Motion is executed. See "2.8 Tool Tip Operations".

When two or more keys are pressed at the same time, the manipulator will perform compound moves. 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:

<table>
<thead>
<tr>
<th>Axis Name</th>
<th>Axis Operation Key</th>
<th>Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Axes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X- Axis</td>
<td>X</td>
<td>Moves parallel to X-axis.</td>
</tr>
<tr>
<td>Y- Axis</td>
<td>Y</td>
<td>Moves parallel to Y-axis.</td>
</tr>
<tr>
<td>Z- Axis</td>
<td>Z</td>
<td>Moves parallel to Z-axis.</td>
</tr>
<tr>
<td>Wrist Axes</td>
<td>TCP Control Motion is executed. See &quot;2.8 Tool Tip Operations &quot;.</td>
<td></td>
</tr>
</tbody>
</table>

When two or more keys are pressed at the same time, the manipulator will perform compound moves. 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.

For tool coordinates, the tool file should be registered in advance. For further details, refer to the “YASNAC XRC 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. See “YASNAC XRC INSTRUCTIONS” for details about the setting procedure.

**Operation**

Press [COORD] and set to [TOOL] \(^1\) \(\rightarrow\) Press [SHIFT] + [COORD] \(^2\) \(\rightarrow\) Select the desired tool number

**Explanation**

\(^1\) When [COORD] is pressed, the status area displays JOINT \(\rightarrow\) XYZ \(\rightarrow\) TOOL \(\rightarrow\) USER.

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB CONTENT</td>
<td>R</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

\(^2\) The Tool Number Select Display is shown.

```
<table>
<thead>
<tr>
<th>TOOL NO SELECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 : TORCH MT-3501</td>
</tr>
<tr>
<td>2 : TORCH MTY-3501</td>
</tr>
<tr>
<td>2 : TORCH MTY-3502</td>
</tr>
</tbody>
</table>
```
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.

<table>
<thead>
<tr>
<th>Axis Name</th>
<th>Axis Key</th>
<th>Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Axes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X- Axis</td>
<td><img src="image" alt="X- Axis Key" /></td>
<td>Moves parallel to X-axis.</td>
</tr>
<tr>
<td>Y- Axis</td>
<td><img src="image" alt="Y- Axis Key" /></td>
<td>Moves parallel to Y-axis.</td>
</tr>
<tr>
<td>Z- Axis</td>
<td><img src="image" alt="Z- Axis Key" /></td>
<td>Moves parallel to Z-axis.</td>
</tr>
</tbody>
</table>

Wrist axes TCP Control Motion is executed. See "2.8 Tool Tip Operations".

When two or more keys are pressed at the same time, the manipulator will perform compound moves. 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.
2.7 User Coordinates

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

2.7.3 Selecting a User Coordinate Number

Follow the procedure below to select the desired coordinate system from among the registered user coordinates.

**Operation**

Press [COORD] and set to [USER] → Press [SHIFT] + [COORD] → Select the desired user number

**Explanation**

*1 When [COORD] is pressed, the status area displays JOINT → XYZ → TOOL → USER.

*2 The User Coordinate Number Select Display appears.
2.8 Tool Tip Operations

2.8.1 TCP Fixed Operations

A TCP fixed operation can only change the wrist orientation at a fixed TCP position in all coordinate systems except the joint coordinates. The motion of each axis is described in the following table.

<table>
<thead>
<tr>
<th>Axis Name</th>
<th>Axis Key</th>
<th>Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Axes</td>
<td>🔄 X</td>
<td>Control points move. These movements differ depending on rectangular, cylinder, tool and user coordinates.</td>
</tr>
<tr>
<td></td>
<td>🔄 Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>🔄 Z</td>
<td></td>
</tr>
<tr>
<td>Wrist Axes</td>
<td>🔄 X</td>
<td>Wrist axes move by fixed control points. These movements differ depending on rectangular, cylinder, tool and user coordinates.</td>
</tr>
<tr>
<td></td>
<td>🔄 Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>🔄 Z</td>
<td></td>
</tr>
</tbody>
</table>

When two or more keys are pressed at the same time, the manipulator will perform compound moves. 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.
Turning of each wrist axis differs in each coordinate system.

- In the following case, 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 is registered in a tool file. The control point controls 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, and then manipulating the axes while changing the control point. This coordinate can be performed with all coordinates except the joint coordinates. The axis operation is the same as that of the TCP fixed operation.

<Example 1> TCP Change Operation with Multiple Tools
The control points for Tool 1 and Tool 2 are taken as P1 and P2, respectively. When Tool 1 is selected to perform axis operation, Tool 1 control point P1 controls 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, Tool 2 control point P2 controls axis operation. In this case, Tool 1 follows Tool 2.
<Example 2>TCP Change Operation with a Single Tool
The two angles of the workpiece that the tool is holding are taken as control points P1 and P2 respectively. By selecting two control points alternately, the workpieces can be moved as shown below:

For registration of the tool file, refer to “YASNAC XRC INSTRUCTIONS”.

3 Teaching

3.1 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 teach lock.
- Register a job.

3.1.1 Checking Emergency Stop Buttons

The Servo On buttons on both the playback panel and 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 are functioning correctly before operating the manipulator.

<table>
<thead>
<tr>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press E. STOP 🔴 ➔ Confirm the servo power is turned off*1 ➔ Press [SERVO ON READY]*2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>*1 The SERVO ON buttons on both the playback panel and the programming pendant light while servo supply is turned on. When the emergency stop button is pressed and the servo power is turned off, both SERVO ON button lamps will turn off.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SERVO ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirm the light is off on the programming pendant</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SERVO ON READY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirm the light is off on the playback panel</td>
</tr>
</tbody>
</table>

*2 After confirming correct operation, press [SERVO ON READY] on the playback panel to turn on the servo power.

3.1.2 Setting the Teach Lock

For safety purposes, always set the teach lock before beginning to teach. While the teach lock is set, the mode of operation is tied to the teach mode and cannot be switched using either the playback panel or external input. If the teach lock is not set, the power cannot be turned on using the deadman switch on the programming pendant.
3.1 Preparation for Teaching

Operation

Press [T-LOCK]*1

Explanation

*1 While the teach-lock is set, this key lamp lights.

3.1.3 Registering Job Names

Give your job a name and enter it.

Characters that Can Be Used in Job Names

Job names can use up to eight 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>

 JOB - 1
 WORK - A

Registering Job Names

Operation

Select {JOB} under the top menu ➔ Select {CREATE NEW JOB} ➔ Input job name*2 ➔ Press [ENTER] ➔ Press “EXEC”*3

Explanation

*1 The selection menu is displayed.

*2 Input job names using the character input operation. For information on character input operation, refer to “ 1.3.6 Character Input ”
3.2 Teaching

3.2.1 Teaching Display Screens

Teaching is conducted in the job content display. The job content display 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. **Step Numbers**
   Step numbers are automatically displayed at the move instruction line. Step numbers are automatically regenerated if steps are inserted or deleted.

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

   MOVJ
   
   VJ = 50.00
   
   Instruction
   
   Tag
   
   Numerical Data
   
   Additional Item
3.2 Teaching

3.2.2 Motion Type and Play Speed

Motion 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, motion type, and play speed are registered for the robot axes steps at one time. If the motion type or play speed settings are omitted during teaching, the data used from the previously taught step is automatically used.

## Joint Motion Type

The joint motion type is used when the manipulator does not need to move in a specific path toward the next step position (such as air cuts to and from the workpiece). When the joint motion type is used for teaching a robot axis, the move instruction is MOVJ. For safety purposes, use the joint motion type to teach the first step.

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

### Play Speed Setting Display

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

<table>
<thead>
<tr>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move the cursor to the play speed ➤ Press [SHIFT] + the cursor key simultaneously</td>
</tr>
</tbody>
</table>

**Explanation**

*1 The joint speed moves up and down.

<table>
<thead>
<tr>
<th>Fast</th>
<th>100.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.00</td>
<td></td>
</tr>
<tr>
<td>25.00</td>
<td></td>
</tr>
<tr>
<td>12.50</td>
<td></td>
</tr>
<tr>
<td>6.25</td>
<td></td>
</tr>
<tr>
<td>3.12</td>
<td></td>
</tr>
<tr>
<td>1.56</td>
<td></td>
</tr>
<tr>
<td>Slow</td>
<td>0.78 (%)</td>
</tr>
</tbody>
</table>

Instructions: These are instructions needed to process or perform an operation. In the case of MOVE instructions, the instruction corresponding to the motion 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.
3.2 Teaching

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

  ![Linear Motion Type Diagram]

  **Play Speed Setting Display (same for circular and spline motion type)**
  There are two types of displays, and they can be switched depending on the application. Setting method is same as link speed

  **Operation**
  Move the cursor to the play speed ➦ Press [SHIFT] + the cursor key simultaneously

  **Explanation**
  *1 The play speed moves up and down..

<table>
<thead>
<tr>
<th>Mode</th>
<th>Speed (mm/sec)</th>
<th>Mode</th>
<th>Speed (cm/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast</td>
<td>1500.0</td>
<td>Fast</td>
<td>9000</td>
</tr>
<tr>
<td></td>
<td>750.0</td>
<td></td>
<td>4500</td>
</tr>
<tr>
<td></td>
<td>375.0</td>
<td></td>
<td>2250</td>
</tr>
<tr>
<td></td>
<td>187.0</td>
<td></td>
<td>1122</td>
</tr>
<tr>
<td></td>
<td>93.0</td>
<td></td>
<td>558</td>
</tr>
<tr>
<td></td>
<td>46.0</td>
<td></td>
<td>276</td>
</tr>
<tr>
<td></td>
<td>23.0</td>
<td></td>
<td>138</td>
</tr>
<tr>
<td>Slow</td>
<td>11</td>
<td>Slow</td>
<td>66</td>
</tr>
</tbody>
</table>

- **Circular Motion Type**
  The manipulator moves in an arc that passes through three points. When circular motion is used for teaching a robot axis, the move instruction is MOVC.

  **Single circular**
  When a single circular movement is required, teach the circular motion for three points, P1 to P3, as shown in the figure below. If joint or linear motion type is taught at P0, the point before starting the circular operation, the manipulator moves from P0 to P1 in a straight line.
Continuous Circular
When continuous circular movements must be separated from each other by a joint or linear motion type 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.

Play Speed
The play speed set display is identical to that for the linear motion type. 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 Motion Type

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

Single Free Curve

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

<table>
<thead>
<tr>
<th>Point</th>
<th>Motion Type</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOVL</td>
</tr>
<tr>
<td>P1</td>
<td>Spline</td>
<td>MOVJ</td>
</tr>
<tr>
<td>P2</td>
<td></td>
<td>MOVS</td>
</tr>
<tr>
<td>P3</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOVL</td>
</tr>
</tbody>
</table>

Continuous Free Curves

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

<table>
<thead>
<tr>
<th>Point</th>
<th>Motion Type</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOVL</td>
</tr>
<tr>
<td>P1</td>
<td>Spline</td>
<td>MOVJ</td>
</tr>
<tr>
<td>P2</td>
<td></td>
<td>MOVS</td>
</tr>
<tr>
<td>P5</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOVL</td>
</tr>
</tbody>
</table>

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

Play Speed

The play speed set display is identical to that for the linear motion type. As with the circular motion type, the speed taught at P2 is applied from P1 to P2, and the speed taught at P3 is applied from P2 to P3.

3.2.3 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 "Fig. Registering Move Instructions ", or they can be done by inserting steps between already registered steps, as shown in "Fig. Inserting Move Instructions ". This paragraph explains the teaching of "Fig. Registering Move Instructions ", the operations involved in registering new steps.

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 0.75mm.

Registering Move Instructions

Inserting Move Instructions

Teaching of "Fig. Inserting Move Instructions " is called “Inserting move instruction," to distinguish it from the method shown in "Fig. Registering Move Instructions ". For more details on this operation, see "3.4.2 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, the instruction is always registered before the END instruction. Therefore, it is not necessary to press [INSERT]. For insertion ("Fig. Inserting Move Instructions "), [INSERT] must be pressed.
3.2 Teaching

### Position Data

**Operation**

1. Select {JOB} under the top menu
2. Move the cursor on the line immediately before the position where a move instruction to be registered
3. Grasp the deadman switch.
4. Move the manipulator to the desired position using the axis key

**Explanation**

*1  Grasp the deadman switch to turn the servo power on.

*2  Use the axis operation key to move the manipulator to the desired position.

### Selecting The Tool Number

**Operation**

1. Press [SHIFT] + [COORD]  
2. Select desired tool number
3. Press [SHIFT] + [COORD]

**Explanation**

*1  When selecting the “JOINT”, “XYZ/CYLINDER”, or “TOOL” coordinate, press [SHIFT] + [COORD] and the tool number selection display will be shown.

*2  Return to the job content display.
Using Multiple Tools with 1 Robot

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

### Motion Type

**Operation**

Press [MOTION TYPE] → Select the desired motion type

**Explanation**

*1 When [MOTION TYPE] is pressed, MOVJ → MOVL → MOVC → MOVS are displayed in order in the input buffer line.

#### Play Speed

**Operation**

Move the cursor to the play speed to be set → Press [SHIFT] + the cursor key simultaneously → Press [ENTER]

**Explanation**

*1 The joint speed moves up and down.

*2 The MOV instruction is registered.

Follow the above instructions when conducting teaching. (Tool number, motion type, and play speed do not need to be set to the same values as shown above.)
3.2 Teaching

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 motion type) and MOVL (linear motion type). 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. 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.

<table>
<thead>
<tr>
<th>Position levels</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Teaching Position</td>
</tr>
<tr>
<td>1 to 4</td>
<td>Fine Rough</td>
</tr>
</tbody>
</table>

Position Level

Operation

Select move instruction (MOVJ or MOVL) \(^1\) ➤ Select the position level “UNUSED”. \(^2\)

Select “PL=” \(^3\) ➤ Press [ENTER] ➤ Press [ENTER] \(^4\)

Explanation

\(^1\) The motion type is displayed in the input buffer line. When the motion type is selected, the detailed edit display is shown.

```
=> MOVJ VJ=50.00
```

```
JOB   EDIT   DISPLAY   UTILITY
DETAIL EDIT   R1
MOVJ
JOINT SPEED    VJ= 50.00
POS LEVEL      UNUSED
NWAIT         UNUSED
```

```
=>MOVJ VJ=50.00
!```
3.2 Teaching

*2 The selection dialog is displayed.

*3 The position level is displayed in the input buffer line. The position initial value is 1.

*4 To change the position level, select the level above the input buffer line, use the number key to input the value, and press [ENTER]. The position level's move instruction is registered.

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 4 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
```

### 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 the procedure below to register reference point instructions.

<table>
<thead>
<tr>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select {JOB} under the top menu ➔ Select {JOB} ➔ Move the cursor ➔ Grasp the deadman switch ➔ Press the axis operation key ➔ Press [REF PNT] ➔ Change the reference point number ➔ Press [INSERT] ➔ Press [ENTER]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>*1 Move the cursor to the line immediately before the position where the reference point to be registered.</td>
</tr>
</tbody>
</table>

```
PLACE BEFORE WHERE REFERENCE POINT IS TO BE REGISTERED

=> REFP 1
```

<table>
<thead>
<tr>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>*2 The servo power is turned on.</td>
</tr>
</tbody>
</table>

```

<table>
<thead>
<tr>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>*3 The reference point instruction is displayed in the input buffer line.</td>
</tr>
</tbody>
</table>

```
```
0003 MOVL V=558
0004 CALL JOB:TEST
0005 MOVL V=138
```

```
=> REFP 1
```

<table>
<thead>
<tr>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>*4 Move the cursor to the reference point number, and press [SHIFT] + the cursor key to change the reference point number.</td>
</tr>
</tbody>
</table>

```
=> REFP 2
```

If you use the number keys to input the reference point number, press [SELECT] when the cursor is on the reference point number. The data input line is displayed. Input the number and press [ENTER].
**3.2 Teaching**

*5  The [INSERT] key lamp lights. Registering before the END instruction, [INSERT] is not needed.

*6  The REFP instruction is registered.

---

### Registering Timer Instructions

The timer instruction stops the manipulator for a specified time. Follow the procedure below to register timer instructions.

#### Operation

Select {JOB} under the top menu  ➔  Select {JOB}  ➔  Move the cursor to inserted position

1. Press [TIMER]
2. Change the timer value
3. Press [INSERT]
4. Press [ENTER]

#### Explanation

1. **Move the cursor to the line immediately before the position where the timer instruction is to be registered.**

2. **The TIMER instruction is displayed on the input buffer line.**

3. **Move the cursor to the timer value and change it by pressing [SHIFT] + the cursor key.** The timer unit of adjustment is 0.01 minutes.

4. **The [INSERT] key lamp lights.** When registering before the END instruction, [INSERT] is not needed.
3.2 Teaching

*5 The TIMER instruction is registered.

Changing Timer Value

**Operation**


**Explanation**

*1 The TIMER instruction detail edit display is shown.

*2 When is selected, the items available to be changed are displayed in the dialog. Select the particular item to be changed.

When a number is to be changed, move the cursor to the number and press [SELECT]. The display changes to the number mode, and using the number keys, input the desired value, and press [ENTER].

*3 The details edit display is closed and the job content display is shown again. Modified content is displayed in the input buffer line.

---

0003 MOVJ VJ=50.00
0004 TIMER T=2.00
0005 MOVJ V=138

TIMRO INSTRUCTION REGISTERED

JOB EDIT DISPLAY UTILITY

DETAIL EDIT R1 C L

TIMER TIME T= 1.00

>> TIMER T=1.00

JOB EDIT DISPLAY UTILITY

DETAIL EDIT R1 C L

TIMER TIME CONSTANT I

I

I

>> TIMER T=I001

>> I=3

>> TIMER T=I003

---

3-15
3.2 Teaching

*4 The [INSERT] key lamp lights. When registering before the END instruction, [INSERT] is not needed.

*5 The TIMER instruction is registered.

3.2.4 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.

Step 6 after change II
Step 1

Step 6

Step 5

Step 6 is changed to overlap with step 1.

Operation

Move the cursor to the first step line ➔ Press [FWD]*1 ➔ Move the cursor to the last step line*2 ➔ Press [MODIFY]*3 ➔ Press [ENTER]*4

Explanation

*1 Move the cursor to the first step.

*2 The cursor starts blinking. When the cursor line position and the manipulator position are different in the job content display, the cursor blinks.

*3 The key lamp lights.

*4 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. Motion type and play speed do not change.
3.3 Checking Steps

3.3.1 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.

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

Operation

Move the cursor to the step to be confirmed ➔ Press [FWD] or [BWD]*1

Explanation

*1 If [FWD] / [BWD] are continuously pressed, the manipulator reaches the following / previous step and stops.

Even if [FWD] is pressed, the manipulator does not proceed to a step when an instruction other than the move instruction is registered. To proceed to a next step, perform either of the following operations:

When executing instructions other than the move instruction : Press [INTERLOCK] + [FWD].

When not executing instructions other than the move instruction : Press the cursor key, move the cursor to the next move instruction and press [FWD].

If you skip over a step, move the cursor to desired position and press [FWD]. The manipulator moves directly to the step where the cursor is currently positioned. Change the cursor position.

For safety, set manual speed at or below.

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].
3.3 Checking Steps

- 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 motion type.
- 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 motion step. Circular motion is restored from P2 and P3.
Free Curve Movements with FWD/BWD Operations

- The manipulator moves in a straight line to the first step of free curve motion.
- There must be three free curve motion steps in a row to perform a free 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 free curve motion step. Free curve motion is restored from P2 onward. However, the path followed between P2 and P3 is somewhat different from the path followed at playback.

![Diagram of Free Curve Movements]

- 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.

![Diagram of Free Curve Movements Example]

Selecting Manual Speed

When [FWD] or [BWD] is pressed, the manipulator moves at the manual speed selected at that time. The set manual speed can be checked by the MAN SPD lamp on the programming pendant.

![Utility Panel for Selecting Manual Speed]

Manual speed is set with [FST] and [SLW]. FWD operation can be performed at a high speed by pressing [HIGH SPD]. Follow the procedure below to select a manual speed.
3.3 Checking Steps

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

```
[INCH] ➔ [LOW] ➔ [MED] ➔ [FST]
```

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

```
[FST] ➔ [MED] ➔ [LOW] ➔ [INCH]
```

---

**NOTE**

- FWD/BWD operation is performed with SLW speed even if INCH is selected.
- [HIGH SPD] 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 the procedure below to move the manipulator to the reference point.

**Operation**

Move the cursor to the reference point instruction line to be checked ➔ Press [REF PNT] + [FWD]*1

**Explanation**

*1 Move the cursor to the reference point line to be checked. The manipulator moves to the reference point of the cursor line.

---

### 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.

**NOTE**

- Operation speeds greater than the maximum teaching speed are reduced to the maximum teaching speed.
- Machine lock is the only special operation available 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.
3.3 Checking Steps

**Operation**

Select {JOB} under the top menu ➔ Press {JOB} ➔ Press [INTERLOCK] + [TEST START]  

**Explanation**

*1 The test operation job content display is shown.

*2 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.

![Supplement]

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

- Begin move instruction insertion
  - Move cursor to location where you want to insert the instruction
  - Axis operations
  - Set motion type
  - Set play speed
  - Set position level when necessary
  - Press [INSERT]
  - Press [ENTER]
  - Insertion completed

- Begin move instruction deletion
  - Move cursor to location of instruction to be deleted
  - Press [DELETE]
  - Press [ENTER]
  - Deletion completed
It is not possible to change a move instruction to a reference point instruction and vice versa.
3.4 Modifying Steps

Begin REFP instruction modification

Deletions

Move cursor to the REFP instruction to be deleted, and move the manipulator to the position

Press [DELETE]

Press [ENTER]

Deletion completed

Modifications

Move cursor to the REFP instruction to be modified

Perform axis operations

Press [REF PNT]

Press [MODIFY]

Press [ENTER]

Modification completed
3.4.1 Displaying the Job Content Display for Editing

- **Currently Called Up Job**

  **Operation**
  
  Select {JOB} under the top menu. ➡️ Select {JOB}™

  **Explanation**
  
  *™ The job content display is shown.

- **Calling Up Other Jobs**

  **NOTE**
  
  In any other than the teach mode, press [TEACH] on the playback panel.
3.4 Modifying Steps

Operation

Select \( \text{JOB} \) under the top menu \( \Rightarrow \) Select \{SELECT JOB\} \(^1\) \( \Rightarrow \) Select the job name to be called

Explanation

\(^1\) The job list display is shown.

3.4.2 Inserting Move Instructions

NOTE Move instructions cannot be inserted when the servo power is not on.

Operation

Move the cursor to the line before the insert position \(^1\) \( \Rightarrow \) Press the axis operation key \(^2\) 
\( \Rightarrow \) Press [INSERT] \(^3\) \( \Rightarrow \) Press [ENTER] \(^4\)

Explanation

\(^1\)

\(^2\) Turn on the servo power, press the axis operation key, and move the manipulator to the position to be inserted.
3.4 Modifying Steps

**NOTE**
Confirm the move instruction on the input buffer line and set desired motion type and play speed.

*3  The key will light.

**NOTE**
When the inserting position is immediately before the END instruction, [INSERT] is not needed.

*4  The move instruction is inserted after the cursor line.

```
MOVE INSTRUCTION IS ADDED
```

```
0006 MOV V=276
0007 TIMER T=1.00
0008 DOUT OT#(1) ON
0009 MOV V=558
0010 MOV VJ=100.0
```

**NOTE**
Positions where the move instruction 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 performed in the “Move Instruction Register Method.”

<Examples of Inserting a Move Instruction>
When a move instruction is inserted in the job below, it is placed on different lines according to the setting the check drive condition display.

```
BEFORE ADDING
CURSOR LINE
```

```
0006 MOV V=276
0007 TIMER T=1.00
0008 DOUT OT#(1) ON
0009 MOV VJ=100.0
```

```
AFTER ADDING : WHEN INSERTING BEFORE THE NEXT STEP
```

```
0006 MOV V=276
0007 TIMER T=1.00
0008 DOUT OT#(1) ON
0009 MOV V=558
0010 MOV VJ=100.0
```

```
AFTER ADDING WHEN INSERTING BEFORE THE NEXT CURSOR LINE
```

```
0006 MOV V=276
0007 MOV V=558
0008 TIMER T=1.00
0009 DOUT OT#(1) ON
0010 MOV VJ=100.0
```
3.4 Modifying Steps

3.4.3 Deleting Move Instructions

Step where move instruction is to be deleted
Path before deletion
Path after deletion

Operation
Move the cursor to the move instruction to be deleted**1 ➔ Press [DELETE]**2 ➔ Press [ENTER]**3

Explanation
**1

MOVE INSTRUCTION TO BE DELETED
0003 MOVL V=138
0004 MOVL V=558
0005 MOVJ VJ=50.00

If the manipulator position differs from the cursor position on the display, the cursor blinks. Stop the blinking by either of the following procedures.
① Press [FWD] and move the manipulator to the position where the move instruction is to be deleted.
② Press [MODIFY] ➔ [ENTER] to change the position data of the blinking cursor position to the current manipulator position.

**2 The key will blink.

**3 The cursor line step is deleted.

NOTE

**2

MOVE INSTRUCTION TO BE DELETED
0003 MOVL V=138
0004 MOVJ VJ=50.00

3.4.4 Modifying Move Instructions

- Modifying Position Data

Operation
Move the cursor to the MOV instruction to be modified**1 ➔ Press the axis operation key**2 ➔ Press [MODIFY]**3 ➔ Press [ENTER]**4

Explanation
**1 Display the job content display and move the cursor to the move instruction to be changed.
3.4 Modifying Steps

*2 Turn on the servo power, press the axis operation key, and move the manipulator to the position after the changed instruction.

*3 The key will blink.

*4 The position data in the present position is changed.

*5 The values of the position variables are not changed. Even MOV instructions for which position variables have been set are not changed.

■ Modifying Motion Type

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

**Operation**

Move the cursor to the move instruction to be modified

1. Press [FWD]

2. Press [DELETE]

3. Press [ENTER]

4. Press [MOTION TYPE]

5. Press [INSERT]

6. Press [ENTER]

**Explanation**

*1 Display the job content display, and move the cursor to the move instruction motion type to be changed.

*2 Turn on the servo power, press [FWD], and move the manipulator to the cursor’s move instruction position.

*3 The key will blink.

*4 The cursor line step is deleted.

*5 When [MOTION TYPE] is pressed one time, the motion type after the change is selected. Each time [MOTION TYPE] is pressed, the input buffer line instruction alternates.

*6 The motion type and position data are changed at the same time.
3.4.5 Modifying Reference Point Instructions

- Deleting Reference Point Instructions

**Operation**

Move the cursor to the reference point to be deleted ➡ Press [DELETE]*1 ➡ Press [ENTER]*2

**Explanation**

- The key will blink.
- The reference point instruction at the cursor line is deleted.

- Modifying Reference Point Instructions

**Operation**

Move the cursor to the reference point instruction to be modified ➡ Press [REF PNT] ➡ Move the manipulator with the axis key*1 ➡ Press [MODIFY]*2 ➡ Press [ENTER]*3

**Explanation**

- Turn on the servo power and use the axis keys to move the manipulator to the position after the changed item.
- The key will light.
- The reference point instruction at the cursor line is changed.
3.4.6 Modifying Timer Instructions

- Deleting Timer Instructions

**Operation**

Move the cursor to the timer instruction to be deleted \(^1\) ➔ Press [DELETE] \(^2\) ➔ Press [ENTER] \(^3\)

**Explanation**

*1 The timer instruction at the cursor line is deleted.

*2 The key will light.

*3 Move the cursor to the timer instruction to be deleted ➔ Press [DELETE] ➔ Press [ENTER]

**Operation**

Move the cursor to the timer instruction to be modified ➔ Press [TIMER] ➔ Move the cursor to the input buffer line timer value \(^1\) ➔ Change the timer value \(^2\) ➔ Press [ENTER] \(^3\)

**Explanation**

*1 Line up the cursor with the input buffer line timer value and press [SHIFT] + the cursor key to set the data. To use the number keys to input data, move the cursor to the input buffer line timer value and press [SELECT]. The number value is then input.

*2 This key lamp lights.

*3 The timer instruction at the cursor line is changed.
3.5 Operations After Teaching

3.5.1 Releasing the teach lock

When the teaching operation is completed, release the teach lock using the programming pendant.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press [LOCK]</td>
<td>LED of the [TEACH LOCK] is turn off and the teach lock is released.</td>
</tr>
<tr>
<td></td>
<td>The message &quot;Caution! TEACH-LOCK mode released&quot; is displayed.</td>
</tr>
</tbody>
</table>
4 Playback

4.1 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**

Select {JOB} under the Top Menu ➔ Select {SELECT JOB} ➔ Select the desired job

**Explanation**

*1 The Job List Display is shown.

<table>
<thead>
<tr>
<th>JOB LIST</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB00002</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JOB00003</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAMPLE01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARC-JOB1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEST-1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*2 The selected job is called, and the job content display is shown.

<table>
<thead>
<tr>
<th>JOB CONTENT</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>J:TEST-1</td>
<td>S:000 R1</td>
<td>TOOL:*</td>
<td></td>
</tr>
<tr>
<td>0000 NOP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0001 MOVJ VJ=50.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0002 MOVL V=138</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003 END</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>=&gt;MOVJ Vj=0.78</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

■ Registering the Master Job

If a particular job is played back frequently, it is convenient to register that job as a master job (master registration). A job registered as the master job can be called more easily than the method described on the preceding page.
Follow the procedure below to register a job as a master job.

**Operation**

Select (JOB) under the Top Menu ➤ Select {SELECT JOB} ➤ Select the desired job

**Explanation**

*1 The master job display is shown.

```
JOB     EDIT     DISPLAY     UTILITY
MASTER JOB

MASTER JOB : ********
```

*2 The select dialog is displayed.

```
JOB     EDIT     DISPLAY     UTILITY
MASTER JOB

MASTER: CALL MASTER JOB
SETTING MASTER JOB
CANCEL MASTER JOB
```

*3 The job list display is shown.

```
JOB     EDIT     DISPLAY     UTILITY
MASTER JOB

TEST-1   JOB00002   JOB00003
ARC-JOB1  SAMPLE01
```
4.1 Preparation for Playback

*4 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 display, playback display, job select display, or the master job display.

Calling from the Job Content, Playback, Job Select Display

**Operation**

Select {JOB} under the Menu*1 ➔ Select {CALL MASTER JOB}*2

**Explanation**

*1 The Pull Down Menu is displayed.

*2 The master job is called, and the job content display is shown.
Calling from the Master Job Display

Operation

Select {JOB} under the Top Menu \textsuperscript{1} \Rightarrow Select {MASTER JOB} \textsuperscript{1} \Rightarrow Press [SELECT] \textsuperscript{2} 

\Rightarrow Select “CALL MASTER JOB” \textsuperscript{2}

Explanation

\textsuperscript{1} The master job display is shown.

\textsuperscript{2} The select dialog is displayed.

\textsuperscript{3} The master job is called, and the job content display (during the teach mode), or the playback display (during the play mode) is displayed.
4.2 Playback

4.2.1 The Playback Display

When [PLAY] on the playback panel is pressed while displaying the job content display, the playback display 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 working 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 ends when the manipulator stops and the start button lamp goes off.

5) Move Time
   Displays the moving 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.
4.2 Playback

4.2.1 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 display.

Operation

Select {DISPLAY} under the Menu ➔ Select {CYCLE TIME}**1

Explanation

**1 The cycle time is displayed. Doing the same operation one more time will delete the cycle time display.

4.2.2 Playback

Playback is the operation by which the taught job is played back. Follow the procedures below to start the playback operation.

NOTE After checking to be sure there is no one near the manipulator, start the playback operation by following the procedures below.

- Playback Panel (Start Button)
- Peripheral Device (External Start Input)

The procedure to be used to start playback is specified by pressing [REMOTE] on the playback panel.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Explanation</th>
</tr>
</thead>
</table>
| Turn off [REMOTE] on the playback panel**1 | The remote mode is disabled and the teach or play mode is enabled.

For playback using the playback panel, follow the procedures below.

- Selecting the start device

When [REMOTE] lamp is ON

<table>
<thead>
<tr>
<th>Operation</th>
<th>Start up by peripheral device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start up by playback panel</td>
<td></td>
</tr>
</tbody>
</table>

When [REMOTE] lamp is OFF

PLAYBACK PANEL [REMOTE]
4.2 Playback

- **Selecting Mode**

  **Operation**
  
  Press [PLAY] on the playback panel*1

  **Explanation**
  
  *1 The play mode is specified.

- **Start Operation**

  **Operation**
  
  Press [START] on the playback panel*1

  **Explanation**
  
  *1 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.
  - STEP: Executes one step (instruction) at a time.

  The operation cycle can be changed using the following:

  **Operation**
  
  Select {CYCLE} under the menu in the top menu display ➔ Select the operation cycle to be changed*1

  **Explanation**
  
  *1 The operation cycle is changed.
Operation Cycle Automatic Setting

The operation cycle is set to “1CYCLE” automatically when the following operation is done.

<table>
<thead>
<tr>
<th>Operation Cycle</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLAY mode</td>
<td>(Light ON)</td>
</tr>
<tr>
<td>TEACH mode</td>
<td>(Light ON)</td>
</tr>
<tr>
<td>REMOTE mode</td>
<td>(Light ON)</td>
</tr>
<tr>
<td>local mode</td>
<td>(Light OFF)</td>
</tr>
<tr>
<td>Main Power</td>
<td>(ON)</td>
</tr>
</tbody>
</table>

Automatic setting of the operation cycle can be changed by the following operation.

**Operation**

Select {SETUP} under the top menu ➔ Select {OPERATE COND}† ➔ Select desired operation ‡ ➔ Select desired cycle §

**Explanation**

† The operating condition display is shown. Use the cursor to scroll the screen.

‡ The selection dialog is displayed.
4.2 Playback

The operation cycle set automatically is changed.

“NONE” setting

The operation cycle is not changed when “NONE” is set. 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.

*3 The operation cycle set automatically is changed.
4.2 Playback

4.2.3 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 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 display. When displaying the playback screen, move the cursor to the menu area and select {UTILITY} → {SETUP SPECIAL RUN}. The special play screen appears.

### 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**

Select “LOW SPEED START” under the special play set display

Press [START] on the playback panel

**Explanation**

*1 The setting alternates between “VALID” and “INVALID”.

*2 Return to the playback display.

*3 Set to “VALID” and start the playback operation. Manipulator moves at a low speed for the first step and stops. After this, press [START] on the playback panel to execute each of the remaining steps. The manipulator moves at the speeds taught.
Limited Speed Operations

The manipulator operates within the limited speed in the teach mode. The limited speed is set at 250 mm/sec. Therefore, steps with speeds faster than 250 mm/sec are restricted to this speed limit. However, operation is performed at actual playback speeds for steps under this limit.

**Operation**

Select “SPEED LIMIT” under the special play set display

1. Select “COMPLETE”

2. Press [START] on the playback panel

**Explanation**

1. The setting alternates between “VALID” and “INVALID”.

2. Return to the playback display.

3. Set to “VALID” and start the playback operation. The manipulator moves 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.

**NOTE** Be careful of steps programmed at lower speeds than the dry run speed, because they are executed at greater speeds than programmed.

**Operation**

Select the “DRY-RUN SPEED” under the special play set display

1. Select “COMPLETE”

2. Press [START] on the playback panel

**Explanation**

1. The setting alternates between “VALID” and “INVALID”.

2. Return to the playback display.

3. Set to “VALID” and start the playback operation. The manipulator moves at dry-run speed.
4.2 Playback

In machine lock operation, a job is played back without moving the manipulator to check the status of input and output.

**Machine Lock Operation**

Select "MACHINE LOCK" under the special play set display→ Select "COMPLETE"→ Press [START] on the playback panel

**Operation**

- The setting alternates between “VALID” and “INVALID”.
- Return to the playback display.
- Set to “VALID” and start the playback operation. The manipulator starts machine lock operation.

**Check Operation**

During check operation, the machine runs without issuing work instructions, such as the arc instruction. It is used primarily to check the path of the program.

Select “CHECK-RUN” under the special play set display→ Select “COMPLETE”→ Press [START] on the playback panel

**Operation**

- The setting alternates between “VALID” and “INVALID”.
- Return to the playback display.
- Set to “VALID” and start the playback operation. The manipulator starts check operation.
4.2 Playback

- **Check Run and Weaving Prohibit**

  When the check run is executed, and weaving prohibit is specified, the weaving operation is not executed in the weaving position of the job.

  **Operation**
  
  Select “WEAV PROHIBIT IN CHK-RUN” under the special play set display → Select “COMPLETE” → Press [START] on the playback panel

  **Explanation**
  
  *1 The setting alternates between “VALID” and “INVALID”.
  
  *2 Return to the playback display.
  
  *3 Set to “VALID” to execute the start operation. The manipulator does not execute the weaving operation during check run execution.

- **Cancel All Special Operations**

  **Operation**
  
  Select {EDIT} from the menu → Select “CANCEL ALL SELECT”

  **Explanation**
  
  *1 The message “All special functions canceled” is displayed.

  **NOTE**

  Special operations are also automatically cancelled if the main power is shut off.
4.3 Stop and Restart

The manipulator stops in the following conditions:
- Hold
- Emergency Stop
- Stop By Alarm
- Others
- During Each Application

4.3.1 Hold

Pressing [HOLD] on the playback panel causes the manipulator to stop all motion. There are two ways to hold.

- Playback Panel
- External Input Signal (Specific)

Using the Playback Panel

Hold
When [HOLD] on the playback panel is pressed, the manipulator stops momentarily.

[Supplement]

[HOLD] lamp lights while it is held down. At the same time, [START] lamp goes OFF.

Release
Press [START] on the playback box. The manipulator restarts its operation, beginning at the position at which it was stopped.

Using an External Input Signal (Specific)

Hold

Operation

Turn on the hold signal from an external input*'1

Explanation

*1 The manipulator stops momentarily.

The external input signal [HOLD] lamp lights.
The playback panel [HOLD] lamp lights. At the same time [START] lamp lights.
4.3  Stop and Restart

Release

**Operation**

Turn off the hold signal from an external input*1

**Explanation**

*1 Hold is released. To continue the operation, press [START] on the playback panel, or the external input signal. The manipulator restarts its operation, beginning at the position at which it was stopped.

4.3.2 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 any of the following:

- Playback Panel
- Programming Pendant
- External Input Signal (Specific)

**Operation**

Press the emergency stop button *1

**Explanation**

*1 The servo power turns off and the manipulator stops immediately.

Using the playback panel:

Using the programming pendant:

Emergency Stop Using the Playback Panel

Robot stops by P.PANEL emergency stop

Emergency Stop Using the Programming Pendant

Robot stops by P.P. emergency stop

Emergency Stop Using External Input Signal

Robot stops by external emergency stop
4.3 Stop and Restart

Release

<table>
<thead>
<tr>
<th>Operation</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn the emergency stop button in the direction of the arrows <strong>1</strong></td>
<td></td>
</tr>
</tbody>
</table>

**1** Turn the emergency stop button in the direction of the arrows.

Using the playback panel:

Using the programming pendant:

Press [SERVO READY] on the playback panel or the deadman switch on the programming pendant to turn on the servo power supply again.

Using the playback panel:

Using the programming pendant:
4.3.3  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.

4.3.4  Stop by Alarm

If an alarm occurs during operation, the manipulator stops immediately, the alarm/error lamp on the playback panel lights and the alarm display appears on the programming pendant indicating that the machine was stopped by an alarm.

![Alarm Display Example]

If more than one alarm occurs simultaneously, the first four alarms are displayed. The fifth and subsequent alarms are not displayed, but they can be checked on the alarm history display. The following operations are available in the alarm status: display change, mode change, alarm reset, and emergency stop.

Release
Alarms are classified by minor and major alarms.

**Minor Alarms**

**Operation**

Press [SELECT]"1

**Explanation**

"1 Select [RESET] under the alarm display to release the alarm status. When using an external input signal, turn on the “ALARM RESET” setting.
4.4 Modifying Play Speed

4.3.5 Others

- Temporary Stop By Mode Change
  When the play mode is switched to the teach mode during playback, the manipulator stops immediately.

- Temporary Stop By the PAUSE Instruction
  When the PAUSE instruction is executed, the manipulator stops operating.

4.4 Modifying Play Speed

4.4.1 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.

The operation flow override of play speeds is as shown in the following:
4.4 Modifying Play Speed

Start speed override

Call job to perform speed override

Set speed override
(Speed data modify:OFF, specify the ratio)

Start playback

Adjust the ratio during playback if needed

YES

Reset and playback?

NO

Modify?

YES

Call job perform speed override

Set speed override
(Modify play:ON, specify the ratio)

Start playback
Modify play speed simultaneously

NO

(1 cycle completed)

Changes experimentally, without modifying registered speed

Modifies play speed

(1 cycle completed)
4.4 Modifying Play Speed

Setting Speed Overrides

Operation
Select {UTILITY} under Menu in the playback display ➔ Select {SPEED OVERRIDE}"1 ➔ Select “ON” or “OFF” under “MODIFY” "2 ➔ Set the override ratio "3

Explanation

"1 The playback display becomes the speed override condition.

"2 Each time [SELECT] is pressed when the cursor is on the data of the item “MODIFY”, “ON” and “OFF” alternate. 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”.

"3 Line up the cursor with the override ratio and move the cursor up and down to change the ratio. If you want to input the ratio number directly, move the cursor to the override ratio and press [SELECT]. The number input line is displayed. Input the override ratio using the number keys.

Modifying Play Speed

Operation
Set speed override ➔ Playback the robot "7

Explanation

"1 After the speed override is set, 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. When one cycle is completed by the END instruction, the speed override setting is released.
4.4 Modifying Play Speed

- 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 setting “MODIFY: ON”, the safety speed operation is performed at the same time. The manipulator operates at safety speed, however the play speed in memory is modified as the setting using speed override.
- Play speed set by the SPEED instruction is not modified.

### Modifying Speed Override Ratio

**Operation**

Select {UTILITY} under the Menu in the playback display ➨ Select {SPEED OVERRIDE} ➨ Set the desired speed override ratio with the cursor

**Explanation**

*1 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 value input status display will be shown. Use the number keys to input the new ratio. If [CANCEL] is pressed, the modified ratio is released.

### Releasing Speed Override Settings

**Operation**

Select {UTILITY} under the Menu in the playback display ➨ Select {SPEED OVERRIDE}

**Explanation**

*1 The setting of the speed override ratio is released. If it’s released, the speed ratio setting is not displayed on the playback display.

The speed override settings are automatically released in the following cases:

- When dry-run speed operation is set.
- When the mode is changed to any mode other than the play mode.
- When an alarm or error occurs.
- When 1 CYCLE operation is completed using the END instruction.
- When the power supply is turned off.
4.5 Playback With Reserved Start

4.5.1 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 display.
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 playback panel
- Start operation from external input signal (specific)

**NOTE**
Enabling reserved start can not be performed if the EDIT LOCK (option) setting is ON.

**Operation**

Select {SETUP} under the top menu ➔ Select {OPERATE COND}[*1] ➔ Select “RESERVED START”[*2]

**Explanation**

[*1] The operation condition display is shown. The screen is scrolled up/down by the cursor key when it locates at the top/bottom of the items.

<table>
<thead>
<tr>
<th>OPERATING CONDITION</th>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXTERNAL CYCLE SWITCH</td>
<td>PERMIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP CYCLE SWITCH</td>
<td>PERMIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXTERNAL SERVO ON</td>
<td>PERMIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPANEL SERVO ON</td>
<td>i PERMIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHECK/MACHINE LOCK</td>
<td>PERMIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MASTER CALLING UP</td>
<td>PERMIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MASTER JOB CHANGE</td>
<td>ii PERMIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESERVED START</td>
<td>i PROHIBIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESERVED START JOB CHANGE</td>
<td>PERMIT</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**
The operation condition display is shown only when the security mode is management mode.
4.5 Playback With Reserved Start

*2 Each time [SELECT] is pressed, “PERMIT” and “PROHIBIT” alternates. Select “PERMIT”.

The external start and the playback panel start are prohibited even if setting is “PERMIT” when reserved start is enabled. Regardless of the operation cycle selected, it is automatically set to 1CYCLE.

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

Select {SETUP} under the top menu ➔ Select {RES. START(CNCT)}*1 ➔ Select “START IN” or “START OUT” for each station*2 ➔ Input desired signal number ➔ Press [ENTER]

Explanation

*1 The reserved start connection display is shown.

*2 The input buffer line is displayed.
**4.5 Playback With Reserved Start**

The input/output signal number is registered.

### Registering Jobs to Stations

Register the starting job of each station.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESERVED START(CNCT)</td>
<td>[R1]</td>
<td>[E]</td>
<td>[D]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NO.</th>
<th>START IN</th>
<th>START OUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>2</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>3</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>4</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>5</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>6</td>
<td>***</td>
<td>***</td>
</tr>
</tbody>
</table>

*3 The input/output signal number is registered.

- **NOTE**
  - 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”.

#### Operation

1. Select (JOB) under the top menu
2. Select (RES. START(JOB))
3. Select job name for each station
4. Select “SETTING START JOB”
5. Select desired job

#### Explanation

- **1** The reserved start connection display is shown.
  - ● indicates that the input/output number is registered.
  - ○ indicates that the input/output number is not registered.
4.5 Playback With Reserved Start

The selection dialog is displayed.

The job list display is shown.

The starting job is registered.

---

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”.

---

**NOTE**
4.5 Playback With Reserved Start

**Operation**

Select {JOB} under the top menu ➔ Select {RES. START(JOB)} *1 ➔ Select job name for each station *2 ➔ Select "CANCEL START JOB" *3

**Explanation**

*1 The reserved start job display is shown.
*2 The selection dialog is displayed.

*3 Registered job is deleted.

<table>
<thead>
<tr>
<th>RESERVING START</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB NAME</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JOB NAME</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONNECTION</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESERVING START</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB NAME</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JOB NAME</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONNECTION</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.5.2 Playback from Reserved Start

**Start Operation**

**Operation**

Press [PLAY] on the playback panel *1 ➔ Press start button on the station *2
4.5 Playback With Reserved Start

- 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.

### Checking Job Reservation Status

The job reservation status during playback can be checked.

**Operation**

Select {JOB} under the top menu ➔ Select {RES. STATUS}†

**Explanation**

† The job reservation display is shown.

<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>STARTING</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>JOB2</td>
<td>RESERVE1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>JOB3</td>
<td>RESERVE2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>JOB4</td>
<td>RESERVE3</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

① **STATUS**

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. |
4.5 Playback With Reserved Start

- START IN
  Input signal status is displayed.
  “●”: Input signal ON
  “O”: Input signal OFF

- Resetting Job Reservation
The job reservation can be reset.

- NOTE
  If “STARTING” is displayed, the job cannot be reset.

**Operation**
Select {JOB} on the job reservation status display ➔ Select {RESET RESERVATION} or {RESET ALL} ➔ Select “YES”

**Explanation**
*1 The job reservation display is shown.
  When {RESET RESERVATION} is selected, job reservation stated to “RESERVE” is reset.
  When {RESET ALL} is selected, job reservation stated to “STOP” and “RESERVE” is reset.

- NOTE
  All job reservations are reset automatically in the following conditions:
  When the reserved start sets to “PROHIBIT”
  When another job is called or an edit operation is performed.
4.5.3 Hold Operation

Pressing [HOLD] on the playback panel causes the manipulator to stop all motion. Hold operation can be performed by the following buttons or signal.

- [HOLD] on the playback panel
- External Input Signal (Specific)
- Hold button for the station axis

■ [HOLD] on the Playback Panel

Hold
The manipulator stops temporarily when [HOLD] on the playback panel 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 at which it was stopped.

■ Hold by External Input Signal (Specific)

Hold

<table>
<thead>
<tr>
<th>Operation</th>
<th>Input ON signal to the external input (specific) specified for hold operation*1</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Explanation</th>
<th>The manipulator stops temporarily.</th>
</tr>
</thead>
<tbody>
<tr>
<td>*1</td>
<td>The hold lamp for the external output signal lights.</td>
</tr>
<tr>
<td></td>
<td>The [HOLD] lamp on the playback panel lights and the [START] lamp goes off.</td>
</tr>
</tbody>
</table>

Release

<table>
<thead>
<tr>
<th>Operation</th>
<th>Input OFF signal to the external input (specific) specified for hold operation*1</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Explanation</th>
<th>Hold is released.</th>
</tr>
</thead>
<tbody>
<tr>
<td>*1</td>
<td>To continue the operation, press the start button on the suspended station. The manipulator restarts its operation from the position at which it was stopped.</td>
</tr>
</tbody>
</table>
Hold at the Station

Hold

**Operation**

Press the hold button on the station

**Explanation**

*1 The manipulator stops temporarily.

---

Release

**Operation**

Press the hold button on the suspended station

**Explanation**

*1 Hold is released.

To continue the operation, press the start button on the station. The manipulator restarts its operation from the position at which it was stopped.
4.6 Displaying Job Stack

The following operation can display the job stack to check the level at which the series of jobs advance or return during execution of CALL or JUMP instructions.

**Operation**

Select {DISPLAY} under the Menu in the playback display → Select {JOB STACK}

**Explanation**

* The pull down menu is displayed.

---

Stack Level 1  Stack Level 2  Stack Level 3  Stack Level 4  ...

Job A  Job B  Job C  Job D  ...

Job calls can be used for up to 8 stack levels.
The job stack status dialog is displayed. To close the job stack status dialog display, select (DISPLAY) then (JOB STACK) under the menu once more.

For example, when the playback of Job C is executing, Job C is called from Job B. Also, Job B is called from Job A.
4.6 Displaying Job Stack
5 Editing

5.1 Editing Jobs

5.1.1 Displays Related to Job

There are three types of job displays. Jobs can be checked and edited in these displays.

- **Job Header Display**
  Comments, data and time of registration, edit prohibit status, and so on are displayed and edited.

- **Job Content Display**
  The content of the registered job can be displayed and edited. The taught position data is also displayed.

- **Command Position Display**
  The taught data is displayed.

- **Job Capacity Display**
  The number of registered jobs, amount of memory, number of steps used, etc. is shown.

- **Job List Display**
  The registered job is sorted alphabetically, then displayed, and the job is selected.

### JOB HEADER DISPLAY

**Operation**

Select {JOB} under the top menu ➔ Select {JOB} ➔ Select {DISPLAY} under the menu ➔ Select {JOB HEADER} *

**Explanation**

* The job header display is shown. Scroll the display using the cursor.

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB HEADER</td>
<td>R1</td>
<td>⚪</td>
<td>⚪</td>
</tr>
<tr>
<td>JOB NAME</td>
<td>TESTJOB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMM.</td>
<td>This job is test job</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DATE</td>
<td>998/05/27 12:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAPACITY</td>
<td>1024 BYTE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LINES</td>
<td>30 LINE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEPS</td>
<td>20 STEP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EDIT LOCK</td>
<td>OFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TO SAVE TO FD</td>
<td>NOT DONE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP SET</td>
<td>R1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

‖ Turn on servo power ‖
5.1 Editing Jobs

- **JOB NAME**
  Displays the name of the current job.

- **COMM**
  Displays the comments attached to the current job. This field can be edited in this display.

- **DATE**
  Displays the date and time of the last editing of the job.

- **CAPACITY**
  Displays the amount of memory that is being used to register this job.

- **LINES**
  Displays the total number of move instructions registered in this job.

- **STEPS**
  Displays the total number of move instructions registered in this job.

- **EDIT LOCK**
  Displays whether the edit prohibit setting for this job is at on or off. This field can be edited at this display.

- **TO SAVE TO FD**
  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”.

- **GROUP SET**
  Displays the setting status for the group axes that this job controls. If the master axis is specified, the master axis is highlighted. Nothing is displayed for a system with only one manipulator.

---

**Job Content Display**

**Operation**

Select {JOB} under the top menu ➤ Select {JOB}“†

**Explanation**

“†” 「 LEFT ) : The cursor is moved to the address area.

→ (RIGHT) : The cursor is moved to the instruction area.

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>J:TEST</td>
<td>S:003</td>
<td>R1</td>
<td>TOOL:00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>J:TEST</th>
<th>S:003</th>
<th>R1</th>
<th>TOOL:00</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>THIS JOB IS TEST JOB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0002</td>
<td>MOVJ VJ=50.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003</td>
<td>MOVJ VJ=12.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0004</td>
<td>MOVJ VJ=276</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0005</td>
<td>TIMER T=1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0006</td>
<td>DOUT OT#(1) ON</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

=>MOVJ VJ=100.00

! Turn on servo power
5.1 Editing Jobs

Address Area
This area displays line numbers and step numbers.

Instruction Area
This area displays instructions, additional items, and comments. Line editing is possible.

Command Pos Display

Operation
Select (ROBOT) under the top menu → Select {COMMAND POSITION} *1

Explanation
*1 Edit operations cannot be conducted from this display, but the taught play speed and position data can be viewed on this display.

Interpolation
Displays the motion type.

Speed
Displays the play speed.

Command Position
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 (*).

Current Data
Displays the current tool file number and position of the manipulator.

Job List Display

Operation
Select {JOB} under the top menu → Select {SELECT JOB}

Explanation

Interpolation
Displays the motion type.

Speed
Displays the play speed.

Command Position
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 (*).

Current Data
Displays the current tool file number and position of the manipulator.
5.1 Editing Jobs

- **Job Names**
  The registered job name is displayed.

**NOTE** If a job has an error in the content, its name blinks.

## Job Capacity Display

**Operation**

Select {JOB} under the top menu ➔ Select {JOB CAPACITY}

### JOB CAPACITY

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUMBER OF JOBS</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USED MEMORY</td>
<td>5932 BYTES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REST</td>
<td>34904 BYTES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROBOT AXIS</td>
<td>STEPS : 378 STEP</td>
<td>REMAIN STEPS : 220 STEP</td>
<td>EDITTING BUFFER : USED</td>
</tr>
</tbody>
</table>

1. **Number of Jobs**
   Displays the total number of jobs currently registered in the memory of XRC.
2. **Used Memory/Remaining Memory**
   Displays the total amount of memory used by the jobs, and the amount of remaining memory.
3. **Number of Used Steps/Number of Remaining Steps**
   Displays the total number of registered steps, and the number of remaining steps.

Turn on servo power
5.1.2 Editing Jobs

This section explains how to manage the jobs in the teach mode without moving the manipulator.

**NOTE**

Edit operations are restricted when the edit lock is applied.

**NOTE**

Editing Move Instructions

See "3 Teaching" for basic information on editing move instructions. It is not possible to add, delete, or modify move instructions which have position data. See "3.4 Modifying Steps" for details.

The following MOV instruction edit operations are explained in this section:

1. For move instructions:
   - Insertion or deletion of move instruction
   - Modification of motion 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

2. For move instructions using position variables:
   - Insertion and deletion of move instruction.

### 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 display or the job list display.

**On the Job Content Display**

On the job content display, the current edit job becomes the copy source job.

**Operation**

1. Select {JOB} under the top menu
2. Select {JOB} from the menu
3. Select {COPY JOB}
4. Input the new job name
5. Press [ENTER]
5.1 Editing Jobs

**Explanation**

*1 The job content display is shown.

```
JOB CONTENT
J:JOB-A S:000 R1 TOOL:*  
0000 NOP  
0001 THIS JOB IS TEST JOB  
0002 MOVJ VJ=50.00  
0003 MOVJ VJ=12.50  
0004 MOVL V=276
```

*2 The pull down menu is displayed.

```
SELECT JOB
CALL MASTER JOB
CREATE NEW JOB
RENAME JOB
Copy JOB
```

*3 The name of the copy source job is displayed on the input line. It’s possible to partially change this name to enter a new name.
If the copy source job name is not to be used, press [CANCEL] to delete the characters on the input line, then enter a new job name.

```
= JOB-B
```

See "1.3.6 Character Input" for information on letter input operations.

*4 The confirmation dialog is displayed.
If “YES” is selected, the job is copied and the new job is displayed.
If “NO” is selected, the job copy is not executed, and the process is cancelled.
On the Job List Display
The operation of selecting the copy source job from the registered jobs is executed using the job list display.

Operation
Select {JOB} under the top menu ➔ Select {SELECT JOB}**1 ➔ Use the cursor to move to the copy position ➔ Select {JOB} under the menu ➔ Select {COPY JOB}**2

Explanation
*1 The job list display is shown.
*2 Next operation for copying job is the same as the previous page “Job Content Display”.

Once the copy is completed, it returns to the job list display.

Deleting Jobs
This operation is used to delete jobs that are registered on the XRC. It can be performed in either the job content display or the job list display.

On the Job Content Display
On the job content display, the current edit job is deleted.

Operation
Select {JOB} under the top menu ➔ Select {JOB}**1 ➔ Select {JOB} under the menu**2 ➔ Select {DELETE JOB}**3

Explanation
*1 The job content display is shown.
5.1 Editing Jobs

*2 The pull down menu is displayed.

The pull down menu is displayed.

*3 The confirmation dialog is displayed.
When “YES” is selected, the edited job is deleted. When deletion is completed, the job content display is shown.
When “NO” is selected, the job deletion is cancelled.

On the Job List Display

On the job list display, select the job to be deleted from the list of job names.

Operation

Select {JOB} under the top menu ➔ Select {JOB SELECT} ➔ Move the cursor to the job to be deleted ➔ Select {JOB} under the menu ➔ Select {DELETE JOB}

Explanation

*1 The job list display is shown.

*2 The following operation is the same as those in the prior page’s “On the Job Content Display” section.

If “NO” is selected, the job deletion is stopped.

5.1 Editing Jobs

- 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 display or the job list display.

On the Job Content Display

**Operation**

Select {JOB} under the top menu  ➔  Select {JOB}¹  ➔  Select {JOB} under the menu  ➔  Select {RENAME JOB}²  ➔  Input the job name³  ➔  Press [ENTER]⁴

**Explanation**

*¹ The job content display is shown.

```
<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB CONTENT</td>
<td>R1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JOB-A</td>
<td>S:000</td>
<td>R1</td>
<td>TOOL:*</td>
</tr>
<tr>
<td>0000 NOP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0001 THIS JOB IS TEST JOB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0002 MOVJ VJ=50.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003 MOVJ VJ=12.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0004 MOVL V=276</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

*² The pull down menu is displayed.

```
<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SELECT JOB</td>
<td>R1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CALL MASTER JOB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CREATE NEW JOB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RENAME JOB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPY JOB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003 MOVJ VJ=12.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0004 MOVL V=276</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

*³ Input the new job name on the input line.

The name of the copy source job is displayed on the input line. It is possible to partially change this name to enter a new name.

If the copy source job name is not to be used at all, press [CANCEL] to delete the characters on the input line, then enter a new job name.

See "1.3.6 Character Input" for information on letter input operations.
5.1 Editing Jobs

*4 The confirmation dialog is displayed. 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.

![Image of confirmation dialog]

On the Job List Display

On the job list display, select the job whose name is to be modified from the list of job names.

**Operation**

Select {JOB} under the top menu ➤ Select {SELECT JOB} ➤ Move the cursor to the name to be changed ➤ Select {JOB} under the menu ➤ Select {RENAME JOB} ➤

**Explanation**

*1 The job list display is shown.

*2 Next operation for renaming job is the same as the previous page “Job Content Display”.

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 display. Editing comments are viewed with the job header display.

**Operation**

Select {JOB} under the top menu ➤ Select {JOB} ➤ Select {DISPLAY} under the menu ➤ Select {JOB HEADER} ➤ Select “COMM.” ➤ Input comments ➤ Press [ENTER]
5.1 Editing Jobs

**Explanation**

*1 The job header display is shown.

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB HEADER</td>
<td></td>
<td>R1 ▶</td>
<td></td>
</tr>
<tr>
<td>JOB NAME  : TESTJOB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMM.     : THIS JOB IS TEST JOB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DATE      : 1998/05/27 12:00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*2 For jobs that are already registered, comments are displayed on the input line. It is possible to partially change comments to enter new comments. If the comment is not to be used at all, press [CANCEL] to delete the characters on the input line, then enter a new comment.

> THIS JOB IS TEST JOB

See "1.3.6 Character Input " for information on letter input operations.

*3 The input line comment is registered and is displayed in the “COM” area on the job header display.

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB HEADER</td>
<td></td>
<td>R1 ▶</td>
<td></td>
</tr>
<tr>
<td>JOB NAME  : TESTJOB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMM.     : THIS JOB IS TEST JOB</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 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 in the job header display.

**Operation**

Select {JOB} under the top menu ➔ Select {JOB} ➔ Select {DISPLAY} under the menu ➔ Select {JOB HEADER} *1 ➔ Select “EDIT LOCK” and set the edit prohibit *2
5.1 Editing Jobs

**Explanation**

"1" The job header display is shown.

```
<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB NAME</td>
<td>TESTJOB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMM.:</td>
<td>THIS JOB IS TEST JOB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DATE</td>
<td>1998/05/27 12:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAPACITY</td>
<td>1024 BYTE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LINES</td>
<td>30 LINE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEPS</td>
<td>20 STEP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EDIT LOCK</td>
<td>OFF</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

"2" Each time [SELECT] is pressed, the setting alternates between “ON” (edit disabled) and “OFF” (edit enabled).

### Enabling Modification of Position Data Only

It is possible to set conditions which allow changes to position data in jobs which are locked.

**Operation**

Select {SETUP} under the top menu ➔ Select {TEACHING COND} ➔ Select “STEP ONLY CHANGING” and setting is permitted

**Explanation**

"1" Teaching condition display is shown.

```
<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEACHING CONDITION</td>
<td>RECT/CYLINDRICAL</td>
<td>RECT</td>
<td></td>
</tr>
<tr>
<td>LANGUAGE LEVEL</td>
<td>SUBSET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOVE INSTRUCTION SET</td>
<td>LINE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEP ONLY CHANGING</td>
<td>PROHIBIT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

Teaching condition display is shown only when the security mode is higher than the edit mode.

"2" Each time [SELECT] is pressed, the setting alternates between “PROHIBIT” and “PERMIT”.

---

5-12
The content of editing differs depending on where the cursor is in the address area or instruction area.

When the cursor is in the address area
Instructions can be inserted, deleted, or modified.

When the cursor is in the instruction area
Already-registered instructions can be modified, inserted, or deleted.

This section explains the following operations:

- Inserting instructions in jobs
- Deleting registered instructions
- Modifying registered instructions

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

The instructions are divided into the group by processing or each work.

<table>
<thead>
<tr>
<th>Group</th>
<th>Contents</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/O Instructions</td>
<td>Controls input and output</td>
<td>DOUT, WAIT</td>
</tr>
<tr>
<td>Control Instructions</td>
<td>Controls processing or each work</td>
<td>JUMP, TIMER</td>
</tr>
<tr>
<td>Operating Instructions</td>
<td>Performs arithmetic calculation</td>
<td>ADD, SET</td>
</tr>
<tr>
<td>Move Instructions</td>
<td>Moves the manipulator</td>
<td>MOVJ, REFP</td>
</tr>
<tr>
<td>Shift Instructions</td>
<td>Shifts the teaching point</td>
<td>SFTON, SFTOF</td>
</tr>
<tr>
<td>Work Instructions</td>
<td>Operates arc welding or handling, etc</td>
<td>ARCON, WVON</td>
</tr>
</tbody>
</table>

### Instruction List Dialog

By pressing [INFORM LIST]，the instruction group list dialog is displayed.

The instruction list dialog is displayed by selecting the group.

The instruction list dialog is returned to the instruction group list dialog if “..” is selected.
## Inserting Instructions

### Operation

Move the cursor to the address area in the job content display

- Press [INFORM LIST]

Select the instruction group

- Select the instruction

- Press [INSERT] and [ENTER]

### Explanation

**1** Move the cursor to the line just before where the instruction is to be inserted.

LINE BEFORE WHERE INSTRUCTION IS TO BE ADDED

0020 MOVL V=138
0021 MOVL V=138
0022 MOVJ VJ=100.00

**2** The INFORM command list is displayed, and an underline is displayed beneath the line number in the address area.

**3** The instruction list dialog is displayed. The instruction is displayed on the input buffer line with the same additional items as registered previously.

**4** The instruction displayed in the input buffer line is inserted.
5.2 Editing Instructions

Deleting Instructions

**Operation**

Move the cursor to the address area in the job content display "1 Move the cursor to the deleting line in the address area ➔ Press [DELETE] and [ENTER] "2

**Explanation**

"1 Move the cursor to the line just before where the instruction is to be deleted.

```
0020 MOVL V=138
0021 MOVL V=138
0022 MOVL V=138
```

"2 The instruction is deleted and the following lines move up.

```
0021 MOVL V=138
0022 MOVL V=100.00
0023 DOUT OT#(1) ON
```

Modifying Instructions

**Operation**

Move the cursor to the address area in the job content display "1 ➔ Press [INFORM LIST] "2 ➔ Select the new instruction group "3 ➔ Select the instruction ➔ Press [MODIFY] and [ENTER] "4

**Explanation**

"1

```
0021 MOVL V=138
0022 MOVL V=100.00
0023 DOUT OT#(1) ON
```

"2 The INFORM command list is displayed. Move the cursor to the instruction list dialog and the address area cursor becomes and under bar.

```
J:TEST     S:016
R1 S C
IN/OUT
CONTROL
DEVICE
MOTION
ARITH
SHIFT
```

5-16
5.2 Editing Instructions

*3 The instruction list dialog is displayed. The selected instruction is displayed on the input buffer line with the same additional items as registered previously.

*4 Current instruction is modified to the instruction displayed in the input buffer line.
5.2.2 Editing Additional Items (Line Edit)

The line edit function can be used to edit only the additional items of a registered instruction. This section explains the following operations:

- Modifying additional numeric data
- Modifying additional items
- Inserting additional items
- Deleting additional items

---

**Modification of Additional Numeric Data**

**Operation**

1. Move the cursor to the line where the number data is to be modified in the job content display.
2. Press [SELECT].
3. Move the cursor to the number data to be modified.
4. Select the numeric data by moving the cursor up/down.
5. Press [ENTER].

**Explanation**

*1 Selected line is displayed on the input buffer line.

---

This edit instruction is to be performed when the cursor is in the instruction area.
5.2 Editing Instructions

*2 If you want to input the number data directly, press [SELECT]. The input buffer line is displayed. Input the number data and press [ENTER]

```
=> PULSE OT#(2) T=1001
> Output_no.=1
```

*3 The number data is modified.

```
J:TEST  S:015  R1 TOOL:*  
0017 TIMER T=1.00
0018 MOVJ VJ=12.50
0019 MOVJ VJ=50.00
0020 MOVL V=138
0021 PULSE CT#(1) T=1001
0022 MOVJ VJ=100.00
0023 DOUT OT#(1) ON
=> PULSE OT#(1) T=1001
```

Modifying Additional Items

**Operation**

Move the cursor to the address area in the job content display"1" ➤ Press [SELECT]"2"

➤ Move the cursor to the INFORM command ➤ Press [SELECT]"3" ➤ Move the cursor to the additional item to be modified ➤ Press [SELECT]"4" ➤ Select new additional item"5" ➤ Press [ENTER]"6" ➤ Press [ENTER]"7"

**Explanation**

*1 Selected line is displayed on the input buffer line.

```
J:TEST  S:015  R1 TOOL:*  
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
=> WAIT IN#(1)=ON
```

The cursor moves to the input buffer line.

```
=> WAIT IN#(1)=ON
```
5.2 Editing Instructions

*2 The detail edit display is shown.

```plaintext
JOB  EDIT  DISPLAY  UTILITY
DETAIL EDIT
WAIT
WAIT TARGET  IN#(1)  1
CONDITION =
CONDITION  ON
TIME  UNUSED

=> WAIT IN#(1)=ON
```

*3 The selection dialog is displayed.

```plaintext
JOB  EDIT  DISPLAY  UTILITY
DETAIL EDIT  R1 S C L
WAIT
WAIT TARGET  OT#(1)  1
CONDITION =
CONDITION  ON
TIME  UNUSED
```

*4 The additional item is modified.

```plaintext
JOB  EDIT  DISPLAY  UTILITY
DETAIL EDIT  R1 S C L
WAIT
WAIT TARGET  OT#(1)  1
CONDITION =
CONDITION  ON
TIME  UNUSED
```

*5 The detail edit display is closed, and the job content display is shown.

*6 Contents of the input buffer line are registered on the cursor line of the instruction area.
5.2 Editing Instructions

Inserting Additional Items

**Operation**

- Move the cursor to the line where the additional item to be inserted
  - Press [SELECT]
- Move the cursor to the instruction
  - Press [SELECT]
- Move the cursor to the additional item to be inserted
  - Press [SELECT]
- Select inserting additional item
  - Press [ENTER]
  - Press [ENTER]

**Explanation**

*1* Selected line is displayed on the input buffer line.

*2* The cursor moves to the input buffer line.

*3* The detail edit display is shown.

*4* The selection dialog is displayed.
5.2 Editing Instructions

*5 The additional item is inserted.

When the additional item needs the number data, move the cursor to “NUMBER” and press [SELECT]. The input buffer line is displayed. Input the number data and press [ENTER].

*6 The detail edit display is closed, and the job content display is shown.

*7 Contents of the the input buffer line are registered on the cursor line of the instruction area.

Deleting Additional Items

NOTE This operation can not be used for the additional item which is locked.

Operation

Move the cursor to the line where the additional item to be deleted ➔ Press [SELECT]¹
Move the cursor to the instruction ➔ Press [SELECT]² ➔ Move the cursor to the additional item to be deleted ➔ Press [SELECT]³ ➔ Select “UNUSED”⁴ ➔ Press [ENTER]⁵ ➔ Press [ENTER]⁶
5.2 Editing Instructions

Explanation

*1 Selected line is displayed on the input buffer line.

The cursor moves to the input buffer line.

*2 The detail edit display is shown.

*3 The selection dialog is displayed.

*4 The additional item is deleted.

*5 The detail edit display closes, and the job content display is shown.
Contents of the input buffer line are registered on the cursor line of the instruction area.

5.2.3 Cut and Paste

Cut and paste is a function that allows the use of a buffer to edit a job. There are four operations associated with this function.

**Copy**: Copies a specified range to the buffer.

**Cut**: 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**: Reverses the order of the contents of the buffer, and inserts them into a job.

The buffer takes space from the job field. For this reason, if a copy, paste, or reverse operation is performed when there is very little memory left for a specific job, it is possible that there is not enough memory for the buffer, and an error will occur. If this happens, either eliminate unnecessary jobs in order to free more memory, or break the amount of data into smaller segments using multiple cut and paste operations.
5.2 Editing Instructions

■ Setting the Range

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

**Operation**

Move the cursor to the address area in the job content display

Press [SHIFT] + [SELECT]  
Move the cursor to the end line

**Explanation**

*1 The range specification begins, and the address is displayed in reverse.

*2 Moving the cursor effects to the range. Up to the line specified by the cursor is the range.

*3 Copying

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

**Operation**

Select {EDIT} under the menu  
Select {COPY}
5.2 Editing Instructions

Explanation

*1 The pull down menu is displayed.

*2 The specified range is copied to the buffer.

---

Cutting

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

Operation

Select {EDIT} under the menu*1 ➞ Select {CUT}*2

Explanation

*1 The pull down menu is displayed.

*2 The confirmation dialog is displayed. When “YES” is selected, the specified range is deleted and copied to the buffer.
When “NO” is selected, the cutting operation is cancelled.

---

Pasting

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

Operation

Move the cursor the line immediately before the desired position in the job content display ➞ Select {EDIT} under the menu*1 ➞ Select {PASTE} ➞ Select “YES”*2
5.2 Editing Instructions

**Explanation**

*1 The pull down menu is displayed.

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>END LINE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEARCH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PASTE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003 MOVJ VJ=12.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0004 MOVJ VJ=12.50</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*2 When “YES” is selected, the contents of the buffer are inserted to the job. When “NO” is selected, the pasting operation is cancelled.

Reverse Pasting

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

**Operation**

Move the cursor to the line immediately before the desired position in the job content display ➔ Select (EDIT) under the menu ➔ Select {REVERSE PASTE}*1 ➔ Select “YES”*2

**Explanation**

*1 The pull down menu is displayed.

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEARCH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PASTE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REVERSE PASTE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003 MOVJ VJ=12.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0004 MOVJ VJ=12.50</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*2 When “YES” is selected, the contents of the buffer are reverse pasted to the job. When the “NO” is selected, the pasting operation is cancelled.
5.3 Other Editing

5.3.1 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.).

<table>
<thead>
<tr>
<th>Type of Play Speed</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>VJ</td>
<td>Joint Speed Normal robot axes</td>
</tr>
<tr>
<td>V</td>
<td>Control Point Speed</td>
</tr>
<tr>
<td>VR</td>
<td>Posture Angle Speed</td>
</tr>
<tr>
<td>VE</td>
<td>Base Axis Speed</td>
</tr>
</tbody>
</table>

Relative Modification

All steps are selected regardless of the play speed type. This method is used to change all steps by a specified percentage. This is called relative modification.
The speed of the entire job or specified section can be changed.

#### Operation

Select \{JOB\} under the top menu ➔ Select \{JOB\} ➔ Move the cursor to the address area ➔ Press [SHIFT] + [SELECT] in the speed modify start line*1 ➔ Select \{EDIT\} under the menu ➔ Select \{CHANGE SPEED\} *2 ➔ Item setting operation ➔ Select "EXEC"*4

#### Explanation

*1 Specify the range as described in “Setting the Range” for Cut and Paste operation.

*2 The speed modification display is shown.

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPEED MODIFICATION</td>
<td>R1</td>
<td>C5</td>
<td>S3</td>
</tr>
<tr>
<td>START LINE NO.</td>
<td>0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>END LINE NO.</td>
<td>0002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MODIFICATION TYPE</td>
<td>CONFIRM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPEED KIND</td>
<td>VJ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPEED</td>
<td>50.00 %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

 EXEC | CANCEL

- **START NO.**
  Displays the first line number of the section to be modified.

- **END NO.**
  Displays the last line number of the section to be modified.

- **CHANGE MODE**
  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”.

- **SPEED TYPE**
  Selects the speed type.
  When [SELECT] is pressed when the cursor is on this item, selection dialog is displayed. Select the speed type to be changed.

- **SPEED VALUE**
  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].

*3 If “MODIFICATION TYPE” is set to “CONFIRM”, the confirmation dialog is displayed.
If “YES” is selected, the speed on the first line in the range is changed and the next speed is searched.
If “NO” is selected, the current speed is not changed and the next speed is searched.
If “MODIFICATION TYPE” is set to “NO CONFIRM”, all the speeds of the specified section are changed.
 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 this to 15 seconds, this function is used.

**Operation**

Select {JOB} under the top menu ➔ Select {JOB} ➔ Move the cursor to the address area ➔ Press [SHIFT] + [SELECT] in the move time measure start line*1 ➔ Select {EDIT} under the menu ➔ Select {TRT}*2 ➔ Item setting operation ➔ Select “EXEC”*3

**Explanation**

*1 Specify the range as described in “Setting the Range” for Cut and Paste operation.

*2 The TRT display is shown.

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>R1</td>
<td>R1</td>
<td>R1</td>
</tr>
</tbody>
</table>

①**START NO.**
Displays the first line number of the section to be measured and modified.

②**END NO.**
Displays the last line number of the section to be measured and modified.

③**MOVING**
The moving time needed to move from the first number to last number is measured and displayed.

④**SET**
Set the desired moving time.
When [SELECT] is pressed when the cursor is on this item, the input buffer line is displayed. Input the desired moving time and press [ENTER].

*3 The speed is changed according to the setting.
### 5.3.2 Editing Motion Type

**Operation**

Select {JOB} under the top menu ➔ Select {JOB} ➔ Move the cursor to the address area ➔ Select the line to be modified ➔ Press [SHIFT] + the cursor key simultaneously ➔ Press [ENTER]

**Explanation**

*1 The instruction on the cursor is displayed in the input buffer line.

*2 The motion type in the input buffer line changes. The modification of the speed according to the modification of the motion 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
The instruction on the cursor line is replaced with one on the input buffer line.

5.3.3 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 XRC Instructions for information regarding the contents and editing methods for the condition file.

5.3.4 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:

<table>
<thead>
<tr>
<th>Data Format</th>
<th>Variable No. (pcs)</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byte Type</td>
<td>B000 to B099 (100)</td>
<td>Range of storable values is from 0 to 255. Can store I/O status. Can perform logical operations (AND, OR, etc)</td>
</tr>
<tr>
<td>Integer Type</td>
<td>I000 to I099 (100)</td>
<td>Range of storable values is from -32768 to 32767.</td>
</tr>
<tr>
<td>Double-precision</td>
<td>D000 to D099 (100)</td>
<td>Range of storable values is from -2147483648 to 2147483647.</td>
</tr>
<tr>
<td>Real Type</td>
<td>R000 to R099 (100)</td>
<td>Range of storable values is from -3.4E+38 to 3.4E+38. Accuracy: 1.18E-38 &lt; x &lt;= 3.4E38</td>
</tr>
<tr>
<td>Position Type</td>
<td>Robot</td>
<td>Can store position data in pulse form or in XYZ form. XY type variable can be used as target position data for move instructions, and as incremental values for parallel shift instructions.</td>
</tr>
<tr>
<td></td>
<td>P000 to P127 (128)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Base</td>
<td>BP000 to BP127 (128)</td>
</tr>
<tr>
<td></td>
<td>Station</td>
<td>EX000 to EX127 (128)</td>
</tr>
</tbody>
</table>

**NOTE**

- **Play Speed V:**
  MOVL V=I000
  The variable IO00 is used for speed V with this move instruction.
  The unit for V is 0.1 mm per second.
  For example, if IO00 were set as 1000, the following would be true:
  I000=1000 \(\rightarrow\) unit for V is 0.1 mm/sec \(\rightarrow\) V=100.0 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 IO00 were set as 1000, the following would be true:
  I000=1000 \(\rightarrow\) 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 IO00 were set as 1000, the following would be true:
  I000=1000 \(\rightarrow\) unit for T is 0.01 seconds \(\rightarrow\) T=10.00 seconds.
5.3 Other Editing

Displaying Byte, Integer, Double-Precision, and Real Type Variables

**Operation**

Select {VARIABLE} under the top menu ➔ Select desired variable type ➔ Move the cursor to the desired variable no.

**Explanation**

*1 Select any variable among {BYTE}, {INTEGER}, {DOUBLE}, and {REAL} under the sub menu.
   The variable display is shown. (Following is a case that BYTE TYPE is selected.)

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BYTE VARIABLE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO.</td>
<td>CONTENTS</td>
<td>NAME</td>
<td></td>
</tr>
<tr>
<td>B000</td>
<td>2</td>
<td>0000_0010 WORK NUM</td>
<td></td>
</tr>
<tr>
<td>B001</td>
<td>0</td>
<td>0000_0000</td>
<td></td>
</tr>
<tr>
<td>B002</td>
<td>255</td>
<td>1111_1111</td>
<td></td>
</tr>
<tr>
<td>B003</td>
<td>0</td>
<td>0000_0000</td>
<td></td>
</tr>
<tr>
<td>B004</td>
<td>0</td>
<td>0000_0000</td>
<td></td>
</tr>
<tr>
<td>B005</td>
<td>10</td>
<td>0000_1010</td>
<td></td>
</tr>
<tr>
<td>B006</td>
<td>1</td>
<td>0000_0001</td>
<td></td>
</tr>
<tr>
<td>B007</td>
<td>1</td>
<td>0000_0001</td>
<td></td>
</tr>
</tbody>
</table>

*2 When the desired variable number is not displayed, move the cursor with either of the following operations.

(Operation 1)
Move the cursor on the variable no. and press [SELECT]. And then input the variable no. using the number key and press [ENTER].

(Operation 2)
Move the cursor to the menu area and select (EDIT) ➔ (SEARCH). And then input the variable no. with the number key and press [ENTER].

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MOVE CURSOR TO DESIRED VARIABLE NUMBER</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Setting Byte, Integer, Double-Precision, and Real Type Variables

**Operation**

Select {VARIABLE} under the top menu ➔ Select desired variable type*1 ➔ Move the cursor to the desired variable No.*2 ➔ Move the cursor to the data of the variable*3 ➔ Press [SELECT] ➔ Input the desired number ➔ Press [ENTER]*4

**Explanation**

*1 Select any variable among {BYTE}, {INTEGER}, {DOUBLE}, and {REAL} under the sub menu.

*2 When the desired variable number is not displayed, move the cursor with either of the following operations.

(Operation 1)
Move the cursor on the variable no. and press [SELECT]. Then input the variable no. using the number key and press [ENTER].

(Operation 2)
Move the cursor to the menu area and select {EDIT} ➔ {SEARCH}. Then input the variable no. with the number key and press [ENTER].

*3 The value input status display is shown.

*4 Input value is set to the variable on the cursor position.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BYTE VARIABLE</strong></td>
<td><strong>R1</strong></td>
<td><strong>R3</strong></td>
<td><strong>R2</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NO.</th>
<th>CONTENTS</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>B000</td>
<td>2  0000_0010</td>
<td>WORK NUM</td>
</tr>
<tr>
<td>B001</td>
<td>11  0000_1100</td>
<td>WORK NUM</td>
</tr>
<tr>
<td>B002</td>
<td>255  1111_1111</td>
<td>WORK NUM</td>
</tr>
</tbody>
</table>
Registering Variable Name

**Operation**

Select {VARIABLE} under the top menu ➔ Select desired variable

Move the cursor to desired variable number ➔ Select "NAME"

Input name ➔ Press [ENTER]

**Explanation**

*1 Select any variable type from among byte type, integer type, double precision type, real type, robot position type, base position type, and station position type.

*2 If desired variable number is not displayed, move the cursor by either of following operations.

- Select the variable number, input desired variable number and press [ENTER]

The cursor moves to the variable number to be input.

- 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.

*3 The input buffer line is displayed.

*4 The variable name is registered.

Refer to "1.3.6 Character Input" for the character input operation.

---

**Table: SUPPLEMENT BYTE VARIABLE**

<table>
<thead>
<tr>
<th>NO.</th>
<th>CONTENTS</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>B000</td>
<td>2 0000_0010</td>
<td>WORK NUM</td>
</tr>
<tr>
<td>B001</td>
<td>12 0000_1100</td>
<td>WORK2 NUM</td>
</tr>
<tr>
<td>B002</td>
<td>255 1111_1111</td>
<td>WORK3 NUM</td>
</tr>
</tbody>
</table>
5.3 Other Editing

Displaying Position Variables

**Operation**

Select **{VARIABLE}** under the top menu ➔ Select desired position variable type

Press the page key

**Explanation**

*1 The position variable display of desired type among robot type, base type, and station type is shown.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>#P000 [ROBOT] NAME: SHIFT DATA</td>
<td>R1</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>R1:X</td>
<td>330.000</td>
<td>TOOL: 01</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>-10.000</td>
<td>&lt;TYPE&gt;</td>
<td></td>
</tr>
<tr>
<td>Rx</td>
<td>0.00</td>
<td>FRONT</td>
<td>S&lt;180</td>
</tr>
<tr>
<td>Ry</td>
<td>0.00</td>
<td>UP</td>
<td>R&lt;180</td>
</tr>
<tr>
<td>Rz</td>
<td>0.00</td>
<td>FLIP</td>
<td>T&lt;180</td>
</tr>
</tbody>
</table>

*2 Select the desired number by pressing PAGE KEY

If [SHIFT] is pressed simultaneously, the display returns to previous page.

When the desired variable number is not displayed, move the cursor with either of the following operations.

(Operation 1)
Move the cursor to the variable no. and press [SELECT]. Then input the variable no. using the number key and press [ENTER].

(Operation 2)
Move the cursor to the menu area and select **{EDIT}** ➔ **{SEARCH}**. Then input the variable no. with the number key and press [ENTER].
### Setting Position Variables

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

**NOTE**

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

<table>
<thead>
<tr>
<th>TYPE</th>
<th>Pxxx (Robot Axes)</th>
<th>BPxxx (Base Axes)</th>
<th>EXxxx (Station Axes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pulse Type</td>
<td>XYZ Type</td>
<td>Pulse Type</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Setting Method</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using the number keys</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using the axis keys</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Select coordinates from base, robot, user, tool.
Setting Position Variables Using the Number Keys

Pulse Type

**Operation**

Select **{VARIABLE}** under the top menu ➤ Select desired position variable type**1** ➤
Select the variable data type**2** ➤ Select **{PULSE}** ➤ Move the cursor to desired data
to be input and press [SELECT] ➤ Input the value ➤ Press [ENTER]**3**

**Explanation**

*1 The desired variable display is shown (robot, base, or station).

*2 The selection dialog is displayed.

*3 If the position variable was set before, confirmation dialog is displayed for data clear. If
“YES” is selected, the data is cleared.
5.3 Other Editing

*3 Set the value in the cursor position.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>POSiTION VARIABLE</td>
<td>R1</td>
<td></td>
<td>3:</td>
</tr>
<tr>
<td>#P000 [PULSE]</td>
<td></td>
<td>NAME:</td>
<td>TOOL:00</td>
</tr>
<tr>
<td>R1:</td>
<td>L</td>
<td>45000</td>
<td></td>
</tr>
</tbody>
</table>

XYZ Type

**Operation**

Select {VARIABLE} under the top menu ➔ Select desired position variable type ➔ Select the variable data type *1 ➔ Select desired coordinates except PULSE ➔ Move the cursor to desired data to be input and press [SELECT] ➔ Input the value ➔ Press [ENTER] *2

**Explanation**

*1 The selection dialog is displayed.

<table>
<thead>
<tr>
<th>#P000</th>
<th><strong>NAME:</strong></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PULSE</th>
<th>BASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROBOT</td>
<td>USER</td>
</tr>
<tr>
<td>TOOL</td>
<td>MASTER TOOL</td>
</tr>
</tbody>
</table>

*2 Set the value in the cursor position.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>POSiTION VARIABLE</td>
<td>R1</td>
<td></td>
<td>3:</td>
</tr>
<tr>
<td>#P000 [ROBOT ]</td>
<td></td>
<td>NAME:</td>
<td>TOOL:01</td>
</tr>
<tr>
<td>R1:X</td>
<td>330.000</td>
<td>TOOL:01</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>-10.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rx</td>
<td>0.00</td>
<td>FRONT</td>
<td>S&lt;180</td>
</tr>
<tr>
<td>Ry</td>
<td>0.00</td>
<td>UP</td>
<td>R&lt;180</td>
</tr>
<tr>
<td>Rz</td>
<td>0.00</td>
<td>FLIP</td>
<td>T&lt;180</td>
</tr>
</tbody>
</table>

!Turn on servo power

Setting of “<TYPE>”
Each time [SELECT] is pressed when the cursor is on the setting data in the input buffer line, the settings alternate.
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".

Current Position Display (XYZ) shows the current setting of a type.

### Setting Position Variables Using the Axis Keys

#### Pulse Type

**Operation**

Select {VARIABLE} under the top menu ➔ Select desired position variable type ➔ Press [SHIFT] + [ROBOT] *1 ➔ Move the manipulator with the axis key *2 ➔ Press [MODIFY] ➔ Press [ENTER]

**Explanation**

*1 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.

- (Robot Axis)
  Each time [SHIFT] + [ROBOT] is pressed, the axis displayed on the status line changes:
  R1 ➔ R2 ➔ R3.
- (Base or Station Axis)
  Each time [SHIFT]+[EX.AXIS] is pressed, the axis displayed on the status line changes:
  B1 ➔ B2 ➔ B3 ➔ S1 ➔ S2 ➔ S3 ➔ S4 ➔ S5 ➔ S6

*2 Move the manipulator or the external axis to the desired position to be set to position variable.

#### XYZ Type

**Operation**

Select {VARIABLE} under the top menu ➔ Select desired position variable type *1 ➔ Move the manipulator with the axis key *2 ➔ Press [MODIFY] ➔ Press [ENTER]

**Explanation**

*1 Move the manipulator to the desired position to be set to position variable.

*2 Move the manipulator or the external axis to the desired position to be set to position variable.
5.3 Other Editing

Deleting Data Set of Position Variables

**Operation**

Select {VARIABLE} under the top menu ➔ Select desired position variable type ➔
Select {DATA} under the menu

**Explanation**

1. The pulldown menu is displayed.

2. The displayed page position variable data is deleted.

Checking Positions by Position Variables

**Operation**

Select {VARIABLE} under the top menu ➔ Select desired position variable type ➔
Press [FWD]

**Explanation**

1. Selected axis moves to the position specified by the variable.

2. Move to the variable position where the selected axis has been set.

**NOTE**

The selected axis (maipulator, base, or station) moves directly to the set variable position.
Before pressing [FWD], check that the surrounding area is safe.
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 the appropriate solution, it is necessary to specify the robot type. This robot is called “Type.” There are up to six types in XRC system. These types also vary according to the robot models.

- Flip/No Flip: R-Axis Position
- R-Axis Angle
- T-Axis Angle
- Front/Back: Relationship Between the S-Axis and Control Point
- Upper Arm/Lower Arm: Type Comprised of the L- and U-Axis
- 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 robot in which the R-axis can move more than ±180° even in position A. It is necessary to specify whether the R-axis is from -90° to 90°, or from 270° to 360°, or from -360° to -270°. The same is true for the B position. This is set at the following “R-Axis Angle”.

<table>
<thead>
<tr>
<th>Flip</th>
<th>No Flip</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>-90 &lt; ( \theta_R ) &lt;= 90</th>
<th>90 &lt; ( \theta_R ) &lt;= 270</th>
</tr>
</thead>
<tbody>
<tr>
<td>270 &lt; ( \theta_R ) &lt;= 360, -360 &lt; ( \theta_R ) &lt;= -270</td>
<td>-270 &lt; ( \theta_R ) &lt;= -90</td>
</tr>
</tbody>
</table>

\( \theta_R \) is the angle when the R-axis home position is 0°.

This configuration is required for SK, K, SV model robots. It is not required for the S model robot.
5.3 Other Editing

- **R-Axis Angle**
  This specifies whether the R-axis angle is less than ±180° or greater than ±180°.

<table>
<thead>
<tr>
<th>R &lt; 180°</th>
<th>R &gt;= 180°</th>
</tr>
</thead>
</table>

-180 < θ R <= 180

-180 < θ R < 180, -360 <= θ R < 180

**NOTE** θ R is the angle when the R-axis home position is 0°.

This configuration is required for SK, K, SV and S model robots.

- **T-Axis Angle**
  The T-axis is specified for manipulators which have three wrist axes. T-Axis Angle specifies whether the T-axis angle is less than ±180° or greater than ±180°.

<table>
<thead>
<tr>
<th>T &lt; 180°</th>
<th>T &gt;= 180°</th>
</tr>
</thead>
</table>

-180 < θ T <= 180

180 < θ T < 180, -360 <= θ T < -180

**NOTE** θ T is the angle when the T-axis home position is 0°.
These configurations specify positions of the R-, B-, and T-axis. This configuration is required for SK, K, and SV model robots. It is not required for the S model robot.

**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. This configuration is required for SK, K, SV and S model robots.

**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.
5.3 Other Editing

This configuration is required for SV and S model robots. It is not required for SK and K model robots.

- **S-Axis Angle**
  This specifies whether the S-axis angle is less than $\pm 180^\circ$ or greater than $\pm 180^\circ$.

<table>
<thead>
<tr>
<th>S$&lt; 180^\circ$</th>
<th>S $\geq 180^\circ$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-180° &lt; $\theta$ S &lt;= 80°</td>
<td>-180° &lt; $\theta$ S &lt;= 360°</td>
</tr>
<tr>
<td>0°</td>
<td>0°, 360°, -360°</td>
</tr>
</tbody>
</table>

$\theta$ S is the angle when the S-axis home position is 0°.

This configuration is required for the robots which have working envelopes greater than $\pm 180^\circ$. 
5.3.5 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 table below, the letter L is affixed to the variable number to indicate a local variable.

### Local Variables

<table>
<thead>
<tr>
<th>Data Format</th>
<th>Variable No.</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byte Type</td>
<td>LB000 to L8000</td>
<td>Range of storeable values is from 0 to 255. Can store I/O status. Can perform logical operations (AND, OR, etc.)</td>
</tr>
<tr>
<td>Integer Type</td>
<td>L1000 to L1000</td>
<td>Range of storeable values is from -32768 to 32767.</td>
</tr>
<tr>
<td>Double-Precision Type</td>
<td>LD000 to LD000</td>
<td>Range of storeable values is from -2147483648 to 2147483647.</td>
</tr>
<tr>
<td>Real Type</td>
<td>LR000 to LR000</td>
<td>Range of storeable values is from -1.70141E+38 to 1.70141E+38.</td>
</tr>
<tr>
<td>Position Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Robot Axes</td>
<td>LP000 to LP000</td>
<td>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.</td>
</tr>
<tr>
<td>Base Axes</td>
<td>LBP000 to LBP000</td>
<td></td>
</tr>
<tr>
<td>Station Axes</td>
<td>LEX000 to LEX000</td>
<td></td>
</tr>
</tbody>
</table>

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 display. When the number is set, the area for the value is saved in memory.

The memory area where local variables can be set is limited to 540 bytes.
• 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 display 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.

Setting the Number of Local Variables
To use any of the variables in a job, setting is done in the job header display. When setting the number of variables, only save it in that memory area.

Only when expanding the “LANGUAGE LEVEL” is it possible to use local variables. Refer to Instructions and Maintenance “3.13 Instruction Level Setting” for details on setting the language level.

Operation
Select {JOB} under the top menu ➔ Select {JOB} ➔ Select {DISPLAY} under the menu ➔ Select {JOB HEADER} ➔ Select the number of local variables to be set ➔ Input the number of variables ➔ Press {ENTER}
5.3 Other Editing

**Explanation**

*1 The job header display is shown. Scroll the display using the cursor.

*2 The number input status is displayed.

*3 The number of local variables are set.

**5.3.6 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 in the job content display.

**Operation**

Select {JOB} under the top menu ➔ Select {JOB} → Select {EDIT} under the menu ➔ Select {SEARCH} → Select the searching type

**Explanation**

*1 The job content display is displayed.
5.3 Other Editing

**2** The pull down menu is displayed.

![Pull Down Menu](image)

**3** The select dialog is displayed.

![Select Dialog](image)

Searching is an operation by which the cursor is moved to a specific step and instruction in the edit job. A target point can be instantaneously searched out without using the cursor.

### Line Search

This function moves the cursor to the desired line number.

**Operation**

Select “LINE SEARCH” *1 ➔ Input desired line number ➔ Press [ENTER] *2

**Explanation**

*1 The input buffer line is displayed.
5.3 Other Editing

Move the cursor to the line number and the display is shown.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select “STEP SEARCH” (^1) ➔ Input the step number ➔ Press [ENTER] (^2)</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) The input buffer line is displayed.

\(^2\) Move the cursor to the input step and the display is shown.

Step Search
This function moves the cursor to the desired step number (move instruction).

Label Search
This function moves the cursor to the desired label.

\(^1\) The input buffer line is displayed.

\(^2\) Move the cursor to the line number and the display is shown.

\(^3\) Use the cursor to continue searching.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select “LABEL SEARCH” (^1) ➔ Input desired label name (^2) ➔ Press [ENTER] (^3) ➔ Use the cursor to continue searching (^4)</td>
<td></td>
</tr>
</tbody>
</table>

Label Search
This function moves the cursor to the desired label.

Operation
Select “LABEL SEARCH” \(^1\) ➔ Input desired label name \(^2\) ➔ Press [ENTER] \(^3\) ➔ Use the cursor to continue searching \(^4\)
5.3 Other Editing

*2 At this time, search can be conducted by only inputting the first character of the label. For example, to search for the “START” label, by only inputting “S” the search can be done.

*3 The label is searched out and the cursor is on its line number.

*4 It is possible to continue searching by pressing the cursor key. To end searching, select (EDIT) \(\rightarrow\) {END SEARCH} on the menu and press [SELECT].

Instruction Search

This function moves the cursor to a desired instruction.

**Operation**

Select “INSTRUCTION SEARCH”**2**  \(\rightarrow\) Select desired instruction group  \(\rightarrow\) Select desired instruction**4**  \(\rightarrow\) Use the cursor to continue searching**3**
5.3 Other Editing

**Explanation**

*1* The INFORM command list is displayed.

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB CONTENT</td>
<td></td>
<td>R1</td>
<td></td>
</tr>
<tr>
<td>J:TEST</td>
<td>S:003</td>
<td>R1 TOOl:00</td>
<td></td>
</tr>
<tr>
<td>0000 NOP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0001 &quot;THIS JOB IS TEST JOB&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0002 MOVJ VJ=50.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003 MOVJ VJ=12.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0004 MOVL V=276</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0005 TIMER T=1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0006 DOUT OT#(1) ON</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0007 MOVL V=138</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*2* The instruction is searched out and the cursor is on its line number.

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB CONTENT</td>
<td></td>
<td>R1</td>
<td></td>
</tr>
<tr>
<td>J:TEST</td>
<td>S:005</td>
<td>R1 TOOl:*</td>
<td></td>
</tr>
<tr>
<td>0010 ARCON ASF#(1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0011 MOVJ VJ=100.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0012 TIMER T=1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0013 MOVL V=138</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0014 MOVL V=138</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0015 MOVJ VJ=50.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0016 MOVL V=100.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0017 DOUT OT#(1) ON</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*3* It is possible to continue searching by pressing the cursor key. To end searching, select (EDIT) → (END SEARCH) on the menu and press [SELECT].

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOP LINE</td>
<td>EDIT</td>
<td>R1</td>
<td>TOOl:00</td>
</tr>
<tr>
<td>END LINE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>END SEARCH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENABLE SPEED TAG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENABLE POS LVL TAG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0013 MOVL V=138</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0014 MOVL V=138</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0015 MOVJ VJ=50.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0016 MOVL V=100.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0017 DOUT OT#(1) ON</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tag Search**

This function moves the cursor to the desired tag.

**Operation**

Select “TAG SEARCH” → Select desired instruction group → Select desired tag → Press [SELECT] → Use the cursor to continue searching
### Explanation

**1** The instruction list dialog is displayed.

<table>
<thead>
<tr>
<th>JOB</th>
<th>CONTENT</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>J:TEST</td>
<td>S:003</td>
<td>R1</td>
<td>TOOL:00</td>
<td></td>
</tr>
<tr>
<td>0000 NOP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0001 'THIS JOB IS TEST JOB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0002 MOVJ VJ=50.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003 MOVJ VJ=12.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0004 MOVL V=276</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0005 TIMER T=1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0006 DOUT OT#(1) ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0007 MOVL V=138</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Turn on servo power

**2** The tag list dialog for selected instruction is displayed.

<table>
<thead>
<tr>
<th>JOB</th>
<th>CONTENT</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>J:TEST</td>
<td>S:003</td>
<td>R1</td>
<td>TOOL:00</td>
<td></td>
</tr>
<tr>
<td>0000 NOP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0001 'THIS JOB IS TEST JOB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0002 MOVJ VJ=50.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003 MOVJ VJ=12.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0004 MOVL V=276</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0005 TIMER T=1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0006 DOUT OT#(1) ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0007 MOVL V=138</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Turn on servo power

**3** Move the cursor to the selected tag and the display is shown.

<table>
<thead>
<tr>
<th>JOB</th>
<th>CONTENT</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>J:TEST</td>
<td>S:005</td>
<td>R1</td>
<td>TOOL:*</td>
<td></td>
</tr>
<tr>
<td>0010 DOUT OT#(1) ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0011 MOVJ VJ=100.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0012 TIMER T=1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0013 MOVL V=138</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0014 MOVL V=138</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0015 MOVJ VJ=50.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0016 MOVJ VJ=100.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0017 DOUT OT#(1) ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Turn on servo power
It is possible to continue searching by pressing the cursor key. To end searching, select {EDIT} → {END SEARCH} on the menu and press [SELECT].
5.4 Setting the Edit Lock

The edit lock function can be set to avoid problems with inadvertent changes in registered jobs or data. There are two types of edit lock features:

- Edit lock by individual job unit
- Edit lock for all jobs

See "Setting Edit Lock on Individual Job Units" for further information on the edit lock function for individual jobs.

The application of an edit lock for all jobs can be performed only with systems that are equipped with the optional EDIT LOCK switch on the playback panel.

### 5.4.1 Edit Lock For All Jobs (Option)

The application of an edit lock for all jobs can be performed only with systems that are equipped with the optional EDIT LOCK switch on the playback panel.

Turn the EDIT LOCK key to the ON position. The edit lock is set, and all editing operations are prohibited. The key can be removed at this time.

When the EDIT LOCK key is turned to the OFF position, the edit lock state is released.
6 Convenient Functions

6.1 One-touch Operations

6.1.1 Direct Open

The direct open function immediately shows the job content display or condition file contents of a job called with the CALL instruction. Move the cursor to the required job name or condition file name and simply press DIRECT OPEN KEY to display the contents of the file. Direct open can be used for the following displays:

- Job content display for a job name directly specified by a CALL instruction
- Condition file display for a file name directly specified by a work instruction
- Command position display for a move instruction
- I/O display with an I/O instruction (when I/O numbers are specified)
6.1 One-touch Operations

<Example> Example Using Direct Open

Move the cursor to the job name or condition file to be changed in the job content display

Press DIRECT OPEN KEY  

Operation

Explanation

*1 This key lamp lights and the job content display or the condition file display is shown.

When the DIRECT OPEN KEY  key is pressed once more, the key lamp turns off, and the former job content display is shown.
6.1 One-touch Operations

6.1.2 Reserved Display Call

When operating while referring to other displays, the operation can become complicated. The “Reserved Display Call” is a function which registers and shows the display during the operation by only pressing RESERVED DISPLAY CALL KEY .

The direct open function cannot be used again while a directly opened display is shown. If another display is selected while the direct open function is effective, the function is automatically cancelled and its lamp goes out.

• The reserved display call function can be used in the teach mode or display mode. However, a display which is only used in the teach mode cannot be shown in the display mode, and vice-versa.
• A display only used in the security mode cannot be shown in another mode.

<Example> Calling the Reserved Display

In this example, the position variable display for setting the parallel shift is registered as the reserved display. The movements in the parallel shift job are checked by confirming the shift data on the reserve screen while watching the movement sequence on the job content display. When the check is complete, the display returns to the job content display.
### Registering Reserved Displays

**Operation**

Call the display to be registered.  

*1 ➔ Press [SHIFT] + RESERVED DISPLAY CALL KEY

*2

**Explanation**

*1 For example, select \{VARIABLE\} → \{POSITION(ROBOT)\} under the top menu, and the position variable display is shown.

*2 The shown display (in this case, the position variable display) is registered as the reserved display.

### Calling Reserved Displays

**Operation**

Press RESERVED DISPLAY CALL KEY  

*1

**Explanation**

*1 This key lamp lights and the registered reserved display is shown. Press RESERVE DISPLAY CALL KEY  again. This key lamp turns off and the previous display is shown.

- If another display is selected while a reserved display is on the screen, the reserved display call is automatically cancelled and the [RESERVED DISPLAY CALL] lamp goes out.
- The reserved display call function cannot be used for some displays (for example, the character input temporary display, external storage screen, etc.).
6.2 Parallel Shift Function

6.2.1 Parallel Shift Function

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 12 (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 (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.
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.
6.2.2 Setting the Shift Value

- Registering Position Variables

The XRC 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 display is shown in the following.

![Position Variable Display]

- Coordinates

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 travel axes, 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 display.

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:
The shift value is calculated on the position data display for the coordinates in which the shift is performed. Since this is normally performed in the user coordinates, the position data display for the user coordinates is used.

### 6.2.3 Registering Shift Instructions

To register the instruction, move the cursor to the address area in the job content display during teach mode.

**Operation**

Select {JOB} under the top menu ➔ Select {JOB} ➔ Move the cursor to the address area

**Explanation**

<table>
<thead>
<tr>
<th>Address Area</th>
<th>Instruction Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB EDIT DISPLAY UTILITY</td>
<td>JOB EDIT DISPLAY UTILITY</td>
</tr>
<tr>
<td>JOB CONTENT</td>
<td>JOB CONTENT</td>
</tr>
<tr>
<td>J:TEST</td>
<td>J:TEST</td>
</tr>
<tr>
<td>S:003</td>
<td>S:003</td>
</tr>
<tr>
<td>R1</td>
<td>R1</td>
</tr>
<tr>
<td>TOOL:00</td>
<td>TOOL:00</td>
</tr>
<tr>
<td>0000 NOP</td>
<td>0000 NOP</td>
</tr>
<tr>
<td>0001 'THIS JOB IS TEST JOB</td>
<td>0001 'THIS JOB IS TEST JOB</td>
</tr>
<tr>
<td>0002 MOVJ VJ=50.00</td>
<td>0002 MOVJ VJ=50.00</td>
</tr>
<tr>
<td>0003 MOVJ VJ=12.50</td>
<td>0003 MOVJ VJ=12.50</td>
</tr>
<tr>
<td>0004 MOVJ VJ=276</td>
<td>0004 MOVJ VJ=276</td>
</tr>
<tr>
<td>0005 TIMER T=1.00</td>
<td>0005 TIMER T=1.00</td>
</tr>
<tr>
<td>0006 DOUT OT#(1) ON</td>
<td>0006 DOUT OT#(1) ON</td>
</tr>
<tr>
<td>=&gt;MOVJ VJ=100.00</td>
<td>=&gt;MOVJ VJ=100.00</td>
</tr>
<tr>
<td>ITurn on servo power</td>
<td>ITurn on servo power</td>
</tr>
</tbody>
</table>
6.2 Parallel Shift Function

### SFTON Instruction

This is the instruction that starts a parallel shift.

#### Operation

Move the cursor to the position before where the SFTON instruction is to be registered:

1. Press [INSTRUCTION LIST]
2. Select [SHIFT]
3. Select the SFTON instruction
4. Modify the additional items, number values
5. Press [INSERT] and then [ENTER]

#### Explanation

1. Line immediately before where SFTON instruction is to be registered

```
0020 MOVL V=138
0021 MOVL V=138
0022 MOVL V=138
```

2. The instruction list dialog is displayed.

3. The SFTON instruction is displayed in the input buffer line.

4. If additional items are needed to edit continuously, perform the operation of **5** Editing Additional Item**.

   (Adding or Modifying Additional Items)
   - When changing the position variable number, move the cursor to the position variable number and press [SHIFT] + [CURSOR] to increase and decrease the value.

```
=> SFTON P000
```

When using the number key, if [SELECT] is pressed, the input line is displayed.

```
=> SFTON P000
```

Input using the number key and press [ENTER] to modify the number value in the input buffer line.

- When inserting [SHIFT] + [COORD], move the cursor to the instruction at the top of the input buffer line, press [SELECT], and the detail edit display is shown.
Line up the cursor with "UNUSED" and press [SELECT]. The select dialog is displayed. Line up the cursor with the coordinate system to be added, and press [SELECT].

After the coordinate system addition is completed, press [ENTER]. The detail edit display closes and the job content display is shown.

The instruction displayed in the input buffer line is registered.

**SFTOF Instruction**
This is the instruction that ends a parallel shift.

**Operation**

Move cursor to inserting line **1** ➔ Press [INFORM LIST] ➔ Select “SFTOF” instruction **2** ➔ Select [SHIFT] ➔ Press [INSERT] and then [ENTER]**3**
6.2 Parallel Shift Function

**Explanation**

*1 Line immediately before where SFTOF instruction is to be registered

*2 The instruction list dialog is displayed.

*3 The SFTOF instruction is displayed in the input buffer line.

*4 The SFTOF instruction is registered.

**MSHIFT Instruction**

When a parallel shift of the wrist posture is attempted, the manipulator may not necessarily 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.

**Operation**

Move the cursor to inserting line → Press [INFORM LIST] → Select [SHIFT] → Select “MSHIFT” instruction → Change the number data or additional items → Press [INSERT] and then [ENTER]
6.2 Parallel Shift Function

**Explanation**

*1 Line immediately before where MSHIFT instruction is to be registered

*2 The instruction list dialog is displayed.

*3 The MSHIFT instruction is displayed in the input buffer line.

*4 If additional items are needed to edit continuously, perform the operation of “6.2.2 Editing Additional Item”.

(Adding or Modifying Additional Items)

When changing the position variable number, move the cursor to the position variable number and press [SHIFT] + CURSOR to increase and decrease the value.

Example:

0003 MOVJ VJ=10.00
0004 GETS PX001 $PX000
0005 END

Line immediately before where MSHIFT instruction is to be registered

IN/OUT

CONTROL

DEVICE

MOTION

ARITH

SHIFT

SFTON

SFTOF

MSHIFT

MSHIFT

P-VAR(RESULT) PX000
COORDINATE BF
P-VAR(BASE) PX001
P-VAR(DEST) PX002

When inserting [SHIFT] + [COORD], move the cursor to the instruction at the top of the input buffer line, press [SELECT], and the detail edit display is shown.

=> MSHIFT PX000 BF PX001 PX002

When using the number keys to input, press [SELECT] and the input line is displayed.

> P=

Input using the number key and press enter to modify the number value in the input buffer line.

When inserting [SHIFT] + [COORD], move the cursor to the instruction at the top of the input buffer line, press [SELECT], and the detail edit display is shown.
Line up the cursor with “BF” and press [SELECT]. The select dialog is displayed. Line up the cursor with the the coordinate system to be changed, and press [SELECT].

Once the coordinate system modification is complete, press [ENTER]. The detail edit display closes and the job content display is shown.

*5 The instruction displayed in the input buffer line is registered.

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)
- Cursor position change (step, line, etc.) in the job
- 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

---

**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.
The parallel shift function remains in effect even if the control power supply is turned off.

### 6.2.5 Examples of Use

- **Example of Use of Shift Addition/Subtraction**

#### Workpiece Stacking Operation

<table>
<thead>
<tr>
<th>Line</th>
<th>Instruction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>SET B00 0</td>
<td></td>
</tr>
<tr>
<td>0002</td>
<td>SUB P000 P000</td>
<td></td>
</tr>
<tr>
<td>0003</td>
<td>MOVJ</td>
<td>Step 1</td>
</tr>
<tr>
<td>0004</td>
<td>MOVL</td>
<td>Step 2</td>
</tr>
<tr>
<td>0005</td>
<td>MOVJ</td>
<td>Step 3</td>
</tr>
<tr>
<td>0006</td>
<td>MOVJ</td>
<td>Step 4</td>
</tr>
<tr>
<td>0007</td>
<td>SFTON P000 UF#(1)</td>
<td>Shift start</td>
</tr>
<tr>
<td>0008</td>
<td>MOVL</td>
<td>Shift position Step 5</td>
</tr>
<tr>
<td>0009</td>
<td>MOVJ</td>
<td>Releasing workpiece</td>
</tr>
<tr>
<td>0010</td>
<td>SFTOF</td>
<td>Shift end</td>
</tr>
<tr>
<td>0011</td>
<td>ADD P000 P001</td>
<td>Add the shift value for the next operation.</td>
</tr>
<tr>
<td>0012</td>
<td>MOVL</td>
<td>Step 6</td>
</tr>
<tr>
<td>0013</td>
<td>MOVL</td>
<td>Step 7</td>
</tr>
<tr>
<td>0014</td>
<td>INC B000</td>
<td></td>
</tr>
<tr>
<td>0015</td>
<td>JUMP *A IF B00&lt;6</td>
<td></td>
</tr>
<tr>
<td>0016</td>
<td>SFTON P000 UF#(1)</td>
<td>Since the shift data is retained in memory, the same data can be used (with subtraction instead of addition) to perform a workpiece unloading operation.</td>
</tr>
</tbody>
</table>

Since the shift data is retained in memory, the same data can be used (with subtraction instead of addition) to perform a workpiece unloading operation.
### Example of Use of MSHIFT Instruction

<table>
<thead>
<tr>
<th>Line</th>
<th>Instruction</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>MOVJ VJ=20.00</td>
<td>Move the manipulator to the reference position.</td>
</tr>
<tr>
<td>0002</td>
<td>GETS PX000 $PX000</td>
<td>Set the reference position as position variable P000.</td>
</tr>
<tr>
<td>0003</td>
<td>MOVJ VJ=20.00</td>
<td>Move the manipulator to the target position.</td>
</tr>
<tr>
<td>0004</td>
<td>GETS PX001 $X000</td>
<td>Set the target position as position variable P00.</td>
</tr>
<tr>
<td>0005</td>
<td>MSHIFT PX010 BF PX000 PX00</td>
<td>Set shift value, and set it as position variable P010.</td>
</tr>
<tr>
<td>0006</td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>
6.3 Parallel Shift Job Conversion Function

6.3.1 Parallel Shift Job Conversion

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 Motion Range**

/OV is displayed for steps which result in a position outside the working 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 can not be converted. If conversion is attempted, no operation is performed.

### Coordinates for Conversion

When performing parallel shift job conversion, it is necessary to specify the coordinates in which the conversion is to be performed. The shift coordinates 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 table as follow.
### Relationship Between Group Combinations and Coordinates at Conversion

<table>
<thead>
<tr>
<th>Group Combination in Job</th>
<th>Usable Coordinate System</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>R</strong></td>
<td>Base coordinates, robot coordinates, tool coordinates, user coordinates</td>
<td>Shift performed on basis of selected coordinates</td>
</tr>
<tr>
<td><strong>R(B)</strong></td>
<td>Base coordinates, robot coordinates, tool coordinates, user coordinates</td>
<td>Shift performed on basis of selected coordinates</td>
</tr>
<tr>
<td><strong>R</strong></td>
<td>Base coordinates, robot coordinates, tool coordinates, user coordinates</td>
<td>The base axis is shifted by the specified amount and the tool center point of the manipulator is shifted by the specified amount in the base coordinates.</td>
</tr>
<tr>
<td><strong>R(B)</strong></td>
<td>Base coordinates, robot coordinates, tool coordinates, user coordinates</td>
<td>The base axis is shifted by the specified amount. The tool center point of the manipulator is shifted by the specified amount in the robot coordinates. These shifts are carried out independently.</td>
</tr>
<tr>
<td><strong>R</strong></td>
<td>Base coordinates, robot coordinates, tool coordinates, user coordinates</td>
<td>The base axis is shifted by the specified amount. The tool center point of the manipulator is shifted by the specified amount in the tool coordinates. These shifts are carried out independently.</td>
</tr>
<tr>
<td><strong>R</strong></td>
<td>Base coordinates, robot coordinates, tool coordinates, user coordinates</td>
<td>The base axis is shifted by the specified amount and the tool center point of the manipulator is shifted by the specified amount in the user coordinates.</td>
</tr>
<tr>
<td><strong>S</strong></td>
<td>Base coordinates, robot coordinates, tool coordinates, user coordinates</td>
<td>Shift is performed on the basis of pulse values regardless of the coordinates.</td>
</tr>
<tr>
<td><strong>R+S</strong></td>
<td>Base coordinates, robot coordinates, tool coordinates, user coordinates</td>
<td>The manipulator is shifted in the selected coordinates. The station axis is shifted on the basis of pulse values regardless of the coordinates.</td>
</tr>
<tr>
<td><strong>R(B)+S</strong></td>
<td>Base coordinates, robot coordinates, tool coordinates, user coordinates</td>
<td>The manipulator is shifted in the selected coordinates, as in <strong>①-④</strong> above. The station axis is shifted on the basis of pulse values regardless of the coordinates.</td>
</tr>
<tr>
<td><strong>R+R</strong></td>
<td>Base coordinates, robot coordinates, tool coordinates, user coordinates, master tool coordinates*₁</td>
<td>Two manipulators are shifted in the selected coordinates.</td>
</tr>
<tr>
<td><strong>R(B)+R(B)</strong></td>
<td>Base coordinates, robot coordinates, tool coordinates, user coordinates, master tool coordinates*₁</td>
<td>Two manipulators are shifted in the selected coordinate system, as in <strong>①-④</strong> above. Two base axes are also shifted.</td>
</tr>
</tbody>
</table>

---

*₁ In the master tool coordinates, conversion only occurs at the “slave” from the standpoint of the SMOV instruction.
6.3 Parallel Shift Job Conversion Function

**Base Coordinates**
The base axis is shifted by B and the tool center point of the manipulator is shifted by A in the base coordinates.

**Robot Coordinates**
The base axis is shifted by B. The tool center point of the manipulator is shifted by A in the robot coordinates. These shifts are carried out independently.
6.3 Parallel Shift Job Conversion Function

**Tool Coordinates**
The base axis is shifted by B and the control point of the manipulator is shifted by A in the tool coordinates.

**User Coordinates**
The base axis is shifted by B and the tool center point of the manipulator is shifted by A in the user coordinates.
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.
6.3 Parallel Shift Job Conversion Function

6.3.2 Operating Methods

Specifying the Conversion Items

**Operation**

Select {JOB} under the top menu ➔ Select {JOB CONTENT}"1 ➔ Select {UTILITY} under the menu ➔ Select {PARALLEL SHIFT JOB}"2 ➔ Specify the conversion items"3

**Explanation**

"1 The job content display is shown.

"2 The parallel shift job conversion display is shown.

"3 Following items are specified.

1 Original job
   Selects the job before conversion. The job which is shown in the job content display is set initially. To change the job do the following things.
   Press [SELECT] when the cursor is on the original job name. The job list display is shown. Select the desired job.

2 Conversion Step Section (Start Step → End Step)
   Specifies the step section of the original job. All the steps are set initially. If there is no steps in the original job, "*****" is displayed. To change the section do the following things.
   Press [SELECT] when the cursor is on the section. The input buffer line is displayed. Input the step number and press [ENTER].

3 Converted Job
   Specifies the converted job. If this is not specified ( "********" is displayed), the original job is converted. To change the job do the following things.
   Press [SELECT] when the cursor is on the original job name. The job list display is shown. Select the desired job.

4 Conversion Coordinates
   Selects the conversion coordinates. Press [SELECT] when the cursor is on the coordinates. The selection dialog is displayed. Select the desired coordinates.
   When the user coordinates are selected, the input buffer line is displayed. Input the desired user coordinate number and press [ENTER].
### Specifying the Shifting Amount

There are two methods for specifying the shifting amount.

- Input the shifting amount by numerical value directly.
- Calculate the shifting amount by teaching the original base point and converted base point.

#### Numerical Value Input

**Operation**

Display the parallel shift job conversion display ➔ Select the shifting direction

Input the shifting amount ➔ Press [ENTER]

**Explanation**

*1 The input buffer line is displayed.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOURCE JOB</td>
<td>:JOB1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEP SECTION</td>
<td>:001 ➔ 010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESTINATION JOB</td>
<td>:JOB2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COORDINATES</td>
<td>:ROBOT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASE POINT</td>
<td>:TEACH SETTING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHIFT VALUE</td>
<td>R1: X</td>
<td>Y</td>
<td>Z</td>
</tr>
<tr>
<td></td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*2 The shift amount is set.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOURCE JOB</td>
<td>:JOB1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEP SECTION</td>
<td>:001 ➔ 010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESTINATION JOB</td>
<td>:JOB2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COORDINATES</td>
<td>:ROBOT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASE POINT</td>
<td>:TEACH SETTING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHIFT VALUE</td>
<td>R1: X</td>
<td>Y</td>
<td>Z</td>
</tr>
<tr>
<td></td>
<td>200.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>
6.3 Parallel Shift Job Conversion Function

Calculation by Teaching

**Operation**

Display the parallel shift job conversion display ➔ Select “TEACH SETTING” in the item of “BASE POINT” ➔ Select “BASE POINT(SRC)” ➔ Move the manipulator by the axis operation ➔ Press [MODIFY] and [ENTER] ➔ Select “BASE POINT(DEST)” ➔ Press [MODIFY] and [ENTER] ➔ Select “EXEC”

**Explanation**

*1 The conversion base point display is shown.

*2 The original base point is set.

*3 The conversion base point is set.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARA</td>
<td>LE</td>
<td>SHFT JOB</td>
<td>R1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>EDIT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>DATA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>UTIL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TY</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EXEC CANCEL

EXEC CANCEL

EXEC CANCEL
The difference is calculated by the two teaching points and set as a shifting amount.

### Executing Conversion

**Operation**

Display the parallel shift job conversion display ➔ Select “EXEC”*

**Explanation**

* The confirmation dialog is displayed when the converted job is not specified. Select “YES” then the conversion is executed. The job content display is shown when the conversion is completed.

At step outside the working envelope, /OV is displayed after the move instruction

If an alarm occurs during conversion, conversion is suspended.
6.4 PAM Function

6.4.1 PAM Function

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. The following data can be adjusted by key input at the programming pendant.

- Taught Point
- Operation Speed
- Positioning Level

## Input Ranges for Adjustment Data

The input ranges for adjustment data are indicated in the following table.

<table>
<thead>
<tr>
<th>Data</th>
<th>Input Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Steps for Adjustment</td>
<td>Up to 10 steps can be adjusted at the same time.</td>
</tr>
<tr>
<td>Position Adjustment Range (X, Y, Z)</td>
<td>Unit: mm, two decimal places valid, initial value ±10mm</td>
</tr>
<tr>
<td>Speed Adjustment Range (V)</td>
<td>Unit: %, two decimal places valid, maximum ±50%</td>
</tr>
<tr>
<td>PL Adjustment Range</td>
<td>0 to 4</td>
</tr>
<tr>
<td>Adjustment Coordinates</td>
<td>Robot coordinates, base coordinates, tool coordinates, user coordinates (Default coordinates: robot coordinates)</td>
</tr>
</tbody>
</table>

**NOTE**

- Base axis and station axis data cannot be adjusted.
- Adjustment when a TCP instruction is executed performed by adjusting the data of the taught 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.
6.4.2 Operating Methods

■ Setting Adjustment Data

**Operation**

Select {JOB} under the top menu ➔ Select {JOB} *1 ➔ Select {UTILITY} under the menu ➔ Select {PAM} *2 ➔ Set adjustment data *3

**Explanation**

*1 The job content display (teach mode or playback mode) is displayed.

*2 The PAM status display is shown.

*3 Set adjustment data.

**Adjustment Job**

Set the job name to be adjusted.

Line up the cursor, and press [SELECT] to show the job list display. Line up the cursor and press [SELECT] to set the adjusted job.

**Input Coordinates**

Set the desired coordinates.

Line up the cursor and press [SELECT] to display the select dialog. Line up the cursor with the desired coordinate system and press select to set the input coordinates.

**Step Number**

Set the step number to be adjusted.

Line up the cursor and press [SELECT] to show the number input status display. Input the step number and press [ENTER] to set the value.

**XYZ Coordinate Adjustment**

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 show the number input status display. Input the number data and press [ENTER] to set the adjusted data.
6.4 PAM Function

GV Coordinate Adjustment
Set the speed.
Line up the cursor and press [SELECT] to show the number input status display.
Input the number data and press [ENTER] to set the adjusted data.

PL
When the position level of the job to be adjusted for the step set in GV is already decided, 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].

NOTE
If editing of the job is prohibited ([EDIT LOCK] on the playback panel is turned on), an error occurs when the job is selected. An error also occurs on selection of jobs for station axes only or jobs without group axes.

■ Executing the Adjustment

Execute

Operation
Select “END”*1 ➔ Select “YES”*2

Explanation

*1 The confirmation dialog is displayed.

*2 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). When the job adjustment is completed, the set data shown in the PAM status display is cleared. However, if the step's adjusted position exceeds the soft limit, an error occurs in that step only, and the data on the display cannot be cleared.
Execution Cancel
In the play mode, during the adjustment wait status, “CANCEL” is displayed in the PAM status display. To cancel the adjustment process, line up the cursor and press [SELECT]. Also, if a problem occurs before executing, the process is automatically cancelled.
- If the mode is changed
- If an alarm or error occurs
- If the power is cut off

Editing Data
Clearing Data
If there is a mistake made when adjusting the data, or if the need to adjust the step becomes unnecessary, the data can be cleared.

Operation
Move the cursor to the line of the data to be cleared"¹ ➔ Select {EDIT} under the menu
Select {LINE CLEAR}"²
**Explanation**

**1** The pull down menu is displayed.

**2** The desired data is copied to the line. However, if the line where the data is to be copied does not have a PL value, it cannot be copied.

---

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JOB  : TEST</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INPUT COORD : ROBOT COORD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEP</td>
<td>X(mm)</td>
<td>Y(mm)</td>
<td>Z(mm)</td>
</tr>
<tr>
<td>001</td>
<td>10.00</td>
<td>00.00</td>
<td>00.00</td>
</tr>
<tr>
<td>002</td>
<td>00.00</td>
<td>8.00</td>
<td>10.00</td>
</tr>
<tr>
<td>003</td>
<td>10.00</td>
<td>00.00</td>
<td>00.00</td>
</tr>
<tr>
<td>005</td>
<td>00.00</td>
<td>12.00</td>
<td>00.00</td>
</tr>
<tr>
<td>000</td>
<td>00.00</td>
<td>00.00</td>
<td>00.00</td>
</tr>
<tr>
<td>000</td>
<td>00.00</td>
<td>00.00</td>
<td>00.00</td>
</tr>
</tbody>
</table>

---

**Operation**

Line up the cursor with the part to be copied. ➔ Select {EDIT} under the menu**1** ➔
Select {LINE COPY} ➔ Line up the cursor with the line where the item is to be copied ➔
Select {EDIT} under the menu ➔ Select {LINE PASTE}**2**
6.5 Mirror Shift Function

6.5.1 Mirror Shift

Two robots can be used to draw, etc. on a symmetric path. The job is taught to one of the robots and then mirror shift is executed, after which the other robot can also perform the job.

- **Object Job**
  Jobs and relative jobs without group axes cannot be converted.

- **Group Axes Which Become Objects**
  When the job group axes in the multiple group axis system are specified, the specified job conversion and origin job conversion group axes should be the same.
  - Robot Axis : Same model
  - Base Axis : Same model
  - Station Axis : Same model
6.5 Mirror Shift Function

- **Position Variable**
  The position variable does not become an object of the mirror shift.

- **Parameter**
  The axes which should be shifted (sign is reversed) are specified in the following parameter:

  S1CxG065 : Mirror shift sign reversing axis specification

  ![Mirror Shift Axes Diagram]

  1st Axis (0:No reverse, 1:Reverse)

  6th Axis

6.5.2 Operation Method

- **Converting**
  The job conversion job content display is shown.

  **Called Job**

  ![Operation]

  **Operation**

  Select {JOB} under the top menu ➔ Select {JOB}

  **Other Called Jobs**

  ![Operation]

  **Operation**

  Select {JOB} under the top menu ➔ Select {SELECT JOB} ➔ Select the job to be called

  **Explanation**

  *1 The job list display is shown.

- **Converting Execution**

  ![Operation]

  **Operation**

  Select {UTILITY} under the menu ➔ Select {MIRROR SHIFT}
**6.5 Mirror Shift Function**

**Conversion Origin Job**
The conversion origin job name is selected. Line up the cursor with the name and press [SELECT]. When the job list display is shown, select the job to be converted, and press [SELECT].

**Conversion Origin Control Group**
The conversion origin job control group is displayed.

**Converted Job**
Select the converted job name. Line up the cursor with the name and press [SELECT] to show the character input status display. The conversion origin job name is displayed in the input line. When not using the conversion origin job name, press [CANCEL] and input the new job name.

**New Job Control Group**
If the job name is set as the same as the origin job name, the control group is also the same. To change the control group of the new job, line up the cursor with the control group and press [SELECT] to display the select dialog. Select the control group and press [SELECT].

**Execute**
Line up the cursor and press [SELECT] to execute the conversion. When the specified job conversion name is set, that job is converted. When the specified job conversion name is not set, the origin job is converted.

---

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIRROR SHIFT</td>
<td>📊</td>
<td>📊</td>
<td>📊</td>
</tr>
<tr>
<td>SOURCE JOB</td>
<td>R1</td>
<td>R1</td>
<td>📊</td>
</tr>
<tr>
<td>SOURCE CTRL GROUP</td>
<td>S1</td>
<td>📊</td>
<td>📊</td>
</tr>
<tr>
<td>DESTINATION JOB</td>
<td>📊</td>
<td>📊</td>
<td>📊</td>
</tr>
<tr>
<td>DEST CTRL GROUP</td>
<td>📊</td>
<td>📊</td>
<td>📊</td>
</tr>
</tbody>
</table>

EXEC CANCEL
6.5 Mirror Shift Function
7 Controlling Peripheral Devices

7.1 Floppy Disk Unit

7.1.1 Floppy Disk Unit

The floppy disk unit YASNAC FC2, specially designed for the XRC, is available as an option. (The conventional floppy disk unit YASNAC FC1 can also be used.) The floppy disk unit is used to save various data and parameters on a 3.5-inch floppy disk. The floppy disk unit YASNAC FC2 is shown below.
Notes on the Use of Floppy Disks and Disk Units

The following are basic rules to be observed when using a floppy disk unit or floppy disks:

Floppy Disks

- Floppy disks should be handled very carefully to prevent loss of data recorded on them.

- Since data on floppy disks are recorded magnetically, keep them away from magnets or any magnetized object.

- A 3.5 inch floppy disk has a sliding protective cover that prevents the exposure of the recording disk coated in magnetic film. Do not manually open the sliding cover; the recording disk could be soiled or damaged if touched.

- A 3.5 inch floppy disk taken out of its plastic case should not be carried in a pocket or left on an instrument because it may gather dust. The use of a dirty floppy disk could result in a malfunction of the floppy disk unit. When not in use, a floppy disk should be kept inside the plastic case.

- Floppy disks kept inside plastic cases cannot be bent easily. However, store them in a box to further ensure they will not accidentally be broken or bent.

Floppy Disk Units

- The floppy disk unit is a precision mechanism and should be handled as such. Do not jar or shock the floppy disk unit.

- Do not expose the floppy disk unit to an environment that includes a large amount of iron particles or similar materials for any extended period of time. Failure to follow this instruction could badly affect the reliability of the unit because it uses a magnetic recording mechanism. When the unit is not in use, it should be stored in a location that is free from iron particles or similar materials.

Connecting Cables

Connect the floppy disk unit and the YASNAC XRC using the special connection cable.

Programming Pendant

A floppy connector and floppy power plug socket are installed on the inside of the sub-panel of the playback panel. Insert the power cable and RS-232C cable into the specified connector. The cable may be connected while the power to the controller is turned on.
### Floppy Disk Unit

A connector and power plug socket for the XRC are installed on the rear side of the floppy disk unit. Insert the power cable and RS-232C cable into the specified connector.

### Controller Selection

The YASNAC FC2 can be used with the XRC as well as with the YASNAC MRC and ERC. Select XRC using the MRC/ERC selector switch on the rear panel of the YASNAC FC2. When using the XRC flip the switch to the MRC side.

#### CAUTION

- The power supply receptacle must have a grounding. Ground it neatly.

Failure to ground equipment may result in injury from electric shock.

The YASNAC FC2 has a power switch on its front panel. Flip the switch to the on position to turn on the power. A lamp inside the switch lights when the power is supplied.
7.1 Floppy Disk Unit

**NOTE**

Confirm that there is no floppy disk inside the slot before turning the power on or off.

---

**Inserting a Floppy Disk**

The floppy disk insertion slot has an opening on the front panel of the floppy disk unit. The opening is protected by a cover. Gently press a knob on the cover to open the cover. A floppy disk should be inserted straight into the slot; never force it at an angle. Refer to the illustration below for the correct inserting direction. When the disk has been inserted correctly, it clicks into position. To remove the floppy disk, press the eject button at the upper right corner.

---

**NOTE**

A purchased floppy disk cannot be used before it is formatted. Refer to section 8.1.2 of “File Maintenance/Floppy disk initialization.”

**NOTE**

The access lamp lights during data transmission. Data can be destroyed if the eject button is pressed while the access lamp lights. Never press the eject button while the access lamp lights.
7.1.2 File Management

The flowchart below shows file transfer and file management. The operations are performed with the programming pendant.
7.1 Floppy Disk Unit

Data That Can Be Saved and Save Destination File Names

The floppy disk display is shown below. Data that can be saved are classified into eight
groups. The table on the next page lists the data of the seven 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 XRC. Data
belonging to the data groups marked with “n” on the FD/PC CARD display (shown below)
have restrictions which apply to reloading into memory because they include system-related
information.

Refer to “YASNAC XRC Instructions” for the method to reload into the memory any data
belonging to the data groups marked with “n” on the FD/PC CARD display,

The numbers ① through ⑧ in the above display correspond to the numbers ① through ⑧ in
the table on the next page.

• If the operator selects ③ “BATCH USER MEMORY”, all data belonging to groups ① and
  ② are saved as one file.

• When ② “BATCH USER MEMORY”, ④ “BATCH CMOS”, or ⑧ “ALL CMOS AREA” is
  selected, jobs are also saved, but the job headers of the saved jobs are not saved to an
  external memory unit. Saving of job headers is only completed if ① “JOB” is selected to
  save the data.

The numbers ① through ⑧ in the above display correspond to the numbers ① through ⑧ in
the table on the next page.

<table>
<thead>
<tr>
<th>Data That Can Be Saved</th>
<th>File Name (Saved Data)</th>
<th>Save</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>① JOB</td>
<td>Single job</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>JOBNAME.JBI</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Related job (Job+Condition)</td>
<td>JOBNAME.JBR</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>④ ALL CMOS AREA</td>
<td>ALLCMSxx.HEX</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>⑦ BATCH CMOS</td>
<td>CMOSxx.HEX</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>③ BATCH USER MEMORY</td>
<td>JOBxx.HEX</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

- marked data cannot be loaded

The numbers ① through ⑧ in the above display correspond to the numbers ① through ⑧ in
the table on the next page.
<table>
<thead>
<tr>
<th>Data That Can Be Saved</th>
<th>File Name (Saved Data)</th>
<th>Save OPER</th>
<th>Save EDIT</th>
<th>Load OPER</th>
<th>Load EDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tool data</td>
<td>TOOL.CND</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weaving data</td>
<td>WEAV.CND</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User coordinate data</td>
<td>UFRAME.CND</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Converted data</td>
<td>VAR.DAT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc start condition data</td>
<td>ARCSRT.CND</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc end condition data</td>
<td>ARCSRT.CND</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welder Condition Assist Data</td>
<td>ARCSUP.DAT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welder Characteristic Data</td>
<td>WELDER.DAT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welder Characteristic Definition Data</td>
<td>WELDUDEF.DAT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shock Detection Level Data</td>
<td>SHOCKLVL.CND</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Servo Gun Pressure Power Data</td>
<td>SPRESS.CND</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Servo Gun Dry Spot Pressure Data</td>
<td>SPRESSCL.CND</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spot Gun Characteristic Data</td>
<td>SGUN.DAT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spot Welder Characteristic Data</td>
<td>SWELDER.DAT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short/Full Open Position Data</td>
<td>STROKE.DAT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Robot matching parameter</td>
<td>RC.PRM</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System definition parameter</td>
<td>SD.PRM</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coordinate origin parameter</td>
<td>RO.PRM</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System matching parameter</td>
<td>SC.PRM</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIO parameter</td>
<td>CIO.PRM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function definition parameter</td>
<td>FD.PRM</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application parameter</td>
<td>AP.PRM</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmission(general) parameter</td>
<td>RS.PRM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor parameter</td>
<td>SE.PRM</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Servo parameter</td>
<td>SV.PRM</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Servo motor parameter</td>
<td>SVM.PRM</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation Control Parameter</td>
<td>AMC.PRM</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Servo Power Block Parameter</td>
<td>SVP.PRM</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motion Function Parameter</td>
<td>MF.PRM</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motion Transmission Parameter</td>
<td>RSM.PRM</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC Definition Parameter</td>
<td>PCD.PRM</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concurrent I/O program</td>
<td>CIOPRG.LST</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I/O name data</td>
<td>IONAME.DAT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7-7 Floppy Disk Unit
### 7.1 Floppy Disk Unit

<table>
<thead>
<tr>
<th>SYSTEM DATA</th>
<th>Data That Can Be Saved</th>
<th>File Name (Saved Data)</th>
<th>Save</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>User Word Registration</td>
<td>UWORD.DAT</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>SV monitor signals</td>
<td>SVMON.DAT</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Variable Name</td>
<td>VARNAME.DAT</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Second home position</td>
<td>HOME2.DAT</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Alarm history data</td>
<td>ALMHIST.DAT</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Home position calibrating data</td>
<td>ABSO.DAT</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>System Information</td>
<td>SYSTEM.SYS</td>
<td>O</td>
<td>X</td>
</tr>
</tbody>
</table>

**OPER** : Operation Mode  
**EDIT** : Edit Mode
# Selecting a Memory Unit

**Operation**

Select {FD/PC CARD} ➔ Select {DEVICE} *1 ➔ Select “DEVICE” *2 ➔ Select the device to be modified *3

**Explanation**

*1 The device select display is shown.

*2 The select dialog is displayed.

*3 The device is modified.
### Formatting a Floppy Disk

A floppy disk cannot be used before it has been formatted. A floppy disk that is formatted differently from the XRC recording format needs to be reformatted before it can be used. Follow the procedure below to format a floppy disk.

The YASNAC FC1, which accepts 2DD floppy disks only, always formats a floppy disk into the 720 KB format. The YASNAC FC2 accepts both 2DD and 2HD floppy disks.

#### NOTE
- Be aware that all preexisting data on a floppy disk are lost when it is formatted.
- Floppy disks that are used with the XRC should have the MS-DOS format. Other recording formats are unacceptable.

#### Operation

Select {FD/PC CARD} under the top menu → Select {FORMAT} → Select “FLOPPY TYPE” → Select “EXEC” → Select “YES”

#### Explanation

1. The floppy format display is shown.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLOPPY DISK/PC CARD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FC2 (FORMAT)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLOPPY TYPE</td>
<td>2DD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FORMAT SIZE</td>
<td>720KB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXEC</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Each time [SELECT] is pressed, the “2DD” and the “2HD” will be alternately displayed. At this time, the format size corresponding to the floppy type is automatically modified.
   - 2DD : 720K
   - 2HD : 1.2MB

2HD floppy disk format can be changed. To change, line up the cursor and press [SELECT]. Each time [SELECT] is pressed, the “1.2MB” and “1.4MB” will be alternately displayed.

When the format type is “2DD”, the format size is specified to 720KB.
*3 The confirmation dialog is displayed.

*4 The floppy disk starts formatting.

### Loading

To upload data from the external memory unit to the memory of the XRC, follow the procedure in the following.

#### Loading the Job

**Operation**

Select (FD/PC CARD) under the top menu ➔ Select {LOAD} ➔ Select “JOB” ➔ Select the job to be loaded ➔ Press [ENTER] ➔ Select “YES”

**Explanation**

*1 The floppy disk display is shown.
7.1 Floppy Disk Unit

*2 The job list display is shown.

*3 The selected job is marked with “★”.

*4 The confirmation dialog is displayed.

*5 The job starts loading, and the transmission display is shown.
Loading Files

**Operation**

Select {FD/PC CARD} under the top menu ➔ Select {LOAD}™ ➔ Select the file group to be loaded™ ➔ Select the file to be loaded™ ➔ Press [ENTER]™ ➔ Select “YES”™

**Explanation**

*1 The floppy disk display is shown.

*2 The file select display is shown.

*3 The selected data is marked with “★”. The “●” mark in the display shows the file which exists in the external memory unit (floppy disk).
7.1 Floppy Disk Unit

*4 The confirmation dialog is displayed.

*5 The data starts loading, and the transmission display is shown.

To cancel loading, press [SELECT].
Once loading is completed or cancelled, the file select display is shown.

Saving

To download data from the memory of the XRC to the external memory unit, perform the following procedure.

**Saving the Job**

**Operation**

Select {FD/PC CARD} under the top menu ➔ Select {SAVE}"1 ➔ Select “JOB”"2 ➔ Select the job to be saved"3 ➔ Press [ENTER]"4 ➔ Select “YES”"5
**7.1 Floppy Disk Unit**

**Explanation**

*1* The floppy disk display is shown.

```
<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLOPPY DISK/PC CARD</td>
<td>R1</td>
<td>R1</td>
<td>R1</td>
</tr>
<tr>
<td>FC2(SAVE)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UN-USED MEM :123.4 KB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JOB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FILE/GENERAL DATA</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BATCH USER MEMORY</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARAMETER</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I/O DATA</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYSTEM DATA</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BATCH CMOS</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALL CMOS AREA</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

*2* The job list display is shown.

```
<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLOPPY DISK/PC CARD</td>
<td>R1</td>
<td>R1</td>
<td>R1</td>
</tr>
<tr>
<td>FC2(SAVE)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SINGLE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO.:7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEST0001</td>
<td>TEST0002</td>
<td>TEST0003</td>
<td></td>
</tr>
<tr>
<td>TEST0004</td>
<td>TEST0005</td>
<td>TEST0006</td>
<td></td>
</tr>
<tr>
<td>TEST0007</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

*3* The selected job is marked with “★”.

```
<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLOPPY DISK/PC CARD</td>
<td>R1</td>
<td>R1</td>
<td>R1</td>
</tr>
<tr>
<td>FC2(SAVE)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SINGLE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO.:?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>★TEST0001</td>
<td>TEST0002</td>
<td>TEST0003</td>
<td></td>
</tr>
<tr>
<td>TEST0004</td>
<td>★TEST0005</td>
<td>TEST0006</td>
<td></td>
</tr>
<tr>
<td>TEST0007</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```
7.1 Floppy Disk Unit

*4 The confirmation dialog is displayed.

*5 The job starts saving, and the transmission display is shown.

File Saving

**Operation**

Select {FD/PC CARD} under the top menu ➔ Select {SAVE} ➔ Select the file group to be saved ➔ Select the file to be saved ➔ Press [ENTER] ➔ Select “YES”

**Explanation**

*1 The floppy disk display is shown.
The file select display is shown.

The selected data is marked with “★”. The “●” mark in the display shows the file which exists in the external memory unit (floppy disk).

The confirmation dialog is displayed.

The data starts saving and the transmission display is shown.
To cancel loading, press [SELECT].
If loading is completed or canceled, the file select display is shown.

**Saving the CMOS data**

To save all user’s programs (BATCH USER MEMORY), all data in the CMOS (BATCH CMOS), or all data in the CMOS area (ALL CMOS AREA), a single floppy disk may not be sufficient. In that case, the operator must provide another floppy disk when so instructed by a message on the display.

**Operation**

Select {FD/PC CARD} under the top menu ➤ Select {SAVE} ➤ Select “BATCH USER MEMORY” ➤ Select “EXEC” ➤ Select “YES” ➤ Insert the floppy disk.

**Explanation**

*1 The floppy disk display is shown.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLOPPY DISK/PC CARD</td>
<td>R1</td>
<td>3:</td>
<td></td>
</tr>
<tr>
<td>FC2(SAVE)</td>
<td>UN-USED MEM</td>
<td>123.4 KB</td>
<td></td>
</tr>
<tr>
<td>JOB</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FILE/GENERAL DATA</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BATCH USER MEMORY</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARAMETER</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I/O DATA</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYSTEM DATA</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BATCH CMOS</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALL CMOS AREA</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*2 The following display is shown. Please insert the first floppy disk in the external memory unit.

```
INSERT FLOPPY NO. 1

USABLE MEMORY: 100%

EXEC
```
**3** The confirmation dialog is shown.

![Confirmation Dialog]

**4** The file starts saving, and the transmission display is shown.

![Transmission Display]

To cancel the save operation, press [SELECT].

Files can be created as long as there is still space remaining on the floppy disk. Each file created on the floppy disk is given a file name that includes a serial number (in order of creation).

JOB: all user's programs (BATCH USER MEMORY)
CMOS: all data in CMOS (BATCH CMOS)
ALCMS: all CMOS area (ALL CMOS AREA)

An error will occur if the operator inserts a floppy disk having the unused area of 2KB or less. Replace it with another floppy disk.

*Not enough memory*

**5** If more data need to be saved when the first floppy disk is full, a message appears to prompt the operator to supply another floppy disk. Remove the current floppy disk, insert another one, and move the cursor to “EXEC” and press [SELECT].
After saving is completed, the floppy disk display is shown.

**Overwriting On Existing Files**

If the floppy disk contains a file with the same name as the one to be created by the saving process, the confirmation dialog is displayed.

When overwriting the file, move the cursor to “YES” and press [SELECT]. The file in the floppy disk is deleted and the forwarded data is saved. When not overwriting the file, move the cursor to “NO” and press [SELECT]. The save operation can be continued while replacing the new floppy disk.

### Verifying Data

Follow the procedure below to verify data in the memory of the XRC with similar data saved at the external memory unit.

- **NOTE**

  This function cannot be executed with “BATCH CMOS” or “ALL CMOS AREA” specified.
Verifying the Job

**Operation**

Select (FD/PC CARD) under the top menu ➔ Select (VERIFY) ➔ Select “JOB”

➔ Select the job to be verified ➔ Press [ENTER] ➔ Select “YES”

**Explanation**

*1 The floppy disk display is shown.

*2 The job list display is shown.

*3 The selected job is marked with “★”.

---

**Operation**

Select (FD/PC CARD) under the top menu ➔ Select (VERIFY) ➔ Select “JOB”

➔ Select the job to be verified ➔ Press [ENTER] ➔ Select “YES”

**Explanation**

*1 The floppy disk display is shown.

*2 The job list display is shown.

*3 The selected job is marked with “★”.

---

**Operation**

Select (FD/PC CARD) under the top menu ➔ Select (VERIFY) ➔ Select “JOB”

➔ Select the job to be verified ➔ Press [ENTER] ➔ Select “YES”

**Explanation**

*1 The floppy disk display is shown.

*2 The job list display is shown.

*3 The selected job is marked with “★”.

---

**Operation**

Select (FD/PC CARD) under the top menu ➔ Select (VERIFY) ➔ Select “JOB”

➔ Select the job to be verified ➔ Press [ENTER] ➔ Select “YES”

**Explanation**

*1 The floppy disk display is shown.

*2 The job list display is shown.

*3 The selected job is marked with “★”.

---

**Operation**

Select (FD/PC CARD) under the top menu ➔ Select (VERIFY) ➔ Select “JOB”

➔ Select the job to be verified ➔ Press [ENTER] ➔ Select “YES”

**Explanation**

*1 The floppy disk display is shown.

*2 The job list display is shown.

*3 The selected job is marked with “★”.

---
7.1 Floppy Disk Unit

*4 The confirmation dialog is displayed.

*5 The job starts verifying and the transmission display is shown.

To cancel the verifying operation, press [SELECT].
After verifying is completed or cancelled, the job list display is shown.

Verifying the Condition File / Universal Data

**Operation**

Select {FD/PC CARD} under the top menu  ➔  Select {VERIFY}^1  ➔  Select the file group to be verified^2  ➔  Select the file to be verified^3  ➔  Press [ENTER]^4 ➔  Select “YES”^5

**Explanation**

*1 The floppy disk display is shown.
The file select display is shown.

The selected data is marked with “★”.

The confirmation dialog is displayed.

The data starts verifying and the transmission display is shown.
To cancel the verifying operation, press [SELECT].
Once the verifying is completed or cancelled, the data list display is shown.

Deleting Files
Follow the procedure below to delete a file or files on a floppy disk in the floppy disk unit.

Delete the Job

Operation
Select {FD/PC CARD} under the top menu ➔ Select {DELETE} ➔ Select “JOB”
➔ Select the job to be deleted ➔ Press [ENTER] ➔ Select “YES”

Explanation

*1 The floppy disk display is shown.

*2 The job list display is shown.
The selected job is marked with "★".

The confirmation dialog is displayed.

Once deleting is completed, the floppy disk display is shown.

Delete the File

Operation

Select {FD/PC CARD} under the top menu ➔ Select {DELETE} ➔ Select the file group to be deleted ➔ Select the file to be deleted ➔ Press [ENTER] ➔

Select “YES”

Explanation

The floppy disk display is shown.
7.1 Floppy Disk Unit

*2 The file select display is shown.

*3 The selected data is marked with “★”. The “●” mark in the display shows the file which exists in the external memory unit (floppy disk).

*4 The confirmation dialog is displayed.

*5 Once deleting is completed, the floppy disk display is shown.

Job Selection Mode

The selection of jobs to be loaded, saved, compared, or deleted can be performed in different selection modes described below:

- Select SINGLE Mode
  Only the selected job can be loaded, saved, or verified.

- Select RELATED Mode
  The selected job and related jobs data and files can be loaded, saved, or verified.
7.1 Floppy Disk Unit

Switch select mode

Operation

Press the page key \( \text{\textbullet{}} \) in the floppy disk job list display*1

Explanation

*1 Each time the page key \( \text{\textbullet{}} \) is pressed the display switches back and forth between the “SINGLE SELECT MODE” and “RELATED SELECT MODE”.

For single selection mode

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB CONTENT</td>
<td>R1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J:TEST</td>
<td>S:000</td>
<td>R1</td>
<td>TOOL:</td>
</tr>
<tr>
<td>0000 NOP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0001 MOVJ VJ=50.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0002 MOVJ V=276</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003 WVON WEV#(1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0004 ARCON ASF#(1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0005 MOVJ V=138</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0006 MOVJ V=138</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Rightarrow ) MOVJ VJ=100.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Only the selected job is loaded, saved, and collated.

For relative selection mode

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB CONTENT</td>
<td>R1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J:JOB-11</td>
<td>S:000</td>
<td>R1</td>
<td>TOOL:</td>
</tr>
<tr>
<td>0000 NOP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0006 CALL JOB=JOB-11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0007 MOVJ VJ=50.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0008 MOVJ VJ=50.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0009 MOVJ VJ=50.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0010 MOVJ V=276</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0011 MOVJ V=276</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0012 WVON WEV#(1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0013 TIMER T=0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The selected job and the data file and related job are loaded, saved and collated.
How to Select Job and Data Files

The method of selecting a job and various data files when loading, saving, verifying, and deleting are described in the following:

- **Individual Select**
  Jobs and data files are selected individually one at a time.

- **Batch Select**
  Jobs and data files are selected all at one time.

Batch selection can be performed as in the following:

**Operation**

Select {EDIT} under the menu in either the floppy disk job list display or the file select display

*1 ➔ Select {SELECT ALL} *2

**Explanation**

*1  The pull down menu is displayed.

*2  All jobs are selected.

When {EDIT} ➔ {CANCEL SELECT} is selected, the selected item batch operation is cancelled.
### 8 Handling

#### 8.1 Specific Keys

<table>
<thead>
<tr>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>f·5</td>
<td>f·6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>f·3</td>
<td>f·4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>f·1</td>
<td>f·2</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>REFP</td>
<td>TOOL1 ON/OFF</td>
<td>TOOL2 ON/OFF</td>
</tr>
</tbody>
</table>

Switches the signal output of [f·1] and [f·2] ON and OFF when [INTERLOCK] is simultaneously pressed. “1” side tool valve signals (TOOL 1-1 to TOOL 4-1) can be allocated to [f·1] and “2” side tool valve signals (TOOL 1-2 to TOOL 4-2) can be allocated to [f·2]. Alternatively, general signals can be allocated to the keys. The key allocations can be changed from the handling display or by changing the AP parameters directly.

Switches tool 1 (TOOL 1-1/TOOL 1-2) output or the tool 2 (TOOL 2-1/TOOL 2-2) output ON and OFF when [INTERLOCK] is simultaneously pressed. The output signal is a double-solenoid-type signal. Also, press these keys during editing on the job content display in the teach mode to register the HAND instructions.

This is a function expansion key. Reserved for future use.
8.2 Instructions and Signals

8.2.1 HAND Instruction

**Function**

These instructions open and close the tools mounted to the manipulator. They correspond to single-, double-, and triple-position solenoids. Up to four tools can be controlled for each manipulator. The following sequences are available for solenoid signal control, according to the valve selected.

**SP (single-solenoid)**

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

**2P (double-solenoid)**

The HAND instruction turns ON/OFF the tool valve (x-1). 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.

<table>
<thead>
<tr>
<th>Instruction (x: Tool No)</th>
<th>SP (Valve x-1/x-2)</th>
<th>2P (Valve x-1/x-2)</th>
<th>3P (Valve x-1/x-2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAND x ON</td>
<td>ON/- (-/OFF)</td>
<td>ON/OFF</td>
<td>ON/OFF</td>
</tr>
<tr>
<td>HAND x OFF</td>
<td>OFF/- (-/OFF)</td>
<td>OFF/ON</td>
<td>OFF/ON</td>
</tr>
<tr>
<td>HAND x ON ALL</td>
<td>-</td>
<td>-</td>
<td>ON/ON</td>
</tr>
<tr>
<td>HAND x OFF ALL</td>
<td>-</td>
<td>-</td>
<td>OFF/OFF</td>
</tr>
</tbody>
</table>

**Instruction and Additional Items**

<table>
<thead>
<tr>
<th>HAND</th>
<th>#1</th>
<th>1</th>
<th>OFF</th>
<th>ALL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
</tr>
</tbody>
</table>

Device Number(#1 or #2)

Sets when two manipulators are used for handling
8.2 Instructions and Signals

8.2.2 HSEN (Tool Sensor) Instruction

- **Function**
  Confirm that the tool sensor is in the specified status. If the tool sensor is in the specified status, the result is $B06$ and the next instruction is executed. If a timer is specified, the instruction waits for the specified time (including infinity) to be input.

- **Instruction and Additional Items**

<table>
<thead>
<tr>
<th>HSEN</th>
<th>#1</th>
<th>1</th>
<th>OFF</th>
<th>T=10.00</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
</tr>
</tbody>
</table>

- **Device Number(#1 or #2)**
  Set when two manipulators are used for handling

- **Tool Sensor Number(1 to 8)**
  Required

- **Sensor Input Status(ON/OFF)**
  Required
  Select ON or OFF.

- **Signal waiting time(T=0.01 to 655.35sec)**
  FOREVER: Unlimited time
  If omitted, T=0.
  $B06$: Variable for execution result
  0: is set when the instruction is ended before the timer is over.
  1: is set when the instruction is ended when the timer is over.
8.2 Instructions and Signals

<Examples>

<table>
<thead>
<tr>
<th>Instruction Set</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSEN 1 ON FOREVER OFF FOREVER</td>
<td>Waits until sensor 1 turns ON (OFF). At completion, the result (0: tool sensor 1 is OFF, 1: tool sensor 1 is ON) is set in $B06.</td>
</tr>
<tr>
<td>HSEN 1 ON</td>
<td>Checks whether sensor 1 is turned ON at completion of HSEN instruction. The result (0: tool sensor 1 is OFF, 1: tool sensor 1 is ON) is set in $B06.</td>
</tr>
<tr>
<td>HSEN 1 ON T=10.00</td>
<td>Waits 10 seconds for tool sensor 1 to turn on. Sets the result 1 (tool sensor 1 is on) in $B06 if the sensor input turns ON. Sets the result 0 (tool sensor 1 is OFF) if the sensor does not turn ON after 10 seconds. To observe the $B06 contents with an IF statement, use the GETS instruction to read the contents to a B variable.</td>
</tr>
</tbody>
</table>

8.2.3 Handling Usage Diagnosis Display

**Operation**

Select {ROBOT} under the top menu ➔ Select (HANDLING DIAG) ➔ Select “F1 KEY ALLOCATION”, “F2 KEY ALLOCATION” and edit ➔ Select “TOOL SHOCK SENSOR FUNC”, “TOOL SHOCK SENSOR INPUT” and edit

**Explanation**

*1 The handling display is shown.
The selection dialog is displayed.

If a signal from {HAND1} to {HAND4} is selected, the key allocation to the corresponding tool valve signal can be modified. (In the following example, {HAND3} is selected in the “F2 KEY ALLOCATION”.)

When {GENERAL OUT} is selected, the input line is displayed.

Input desired number and press [ENTER]. (In the following example, 117 is entered.)

An error message is displayed if the input number lies outside the designated range. Press [CANCEL] to cancel the modification of the key allocation. If [f•1] or [f•2] and [INTERLOCK] are pressed simultaneously, the output of the designated signal is switched ON and OFF.
8.2 Instructions and Signals

8.2.4 Tool Shock Sensor Function

If “TOOL SHOCK SENSOR FUNC” is “USED” in the handling display, the tool shock sensor is enabled. When the tool shock sensor does not exist, set “NOT USED”.

8.2.5 Tool Shock Sensor Input Signal

- **Function**
  
  When this signal turns OFF, “TOOL SHOCK SENSOR WORKING” is displayed on the programming pendant and the system enters HOLD status.

- **Signal Condition**
  
  The signal is normally an ON (NC) signal.

- **How to use the signal**
  
  Input the tool shock sensor output signal to 2026 (CN13-B2 of XIU01). If this is not used, short circuit the signal.

8.2.6 Tool Shock Sensor Input Reset

- **Function**

  This function resets the HOLD status and enables the axis operation and [FWD]/[BWD] operations in order to allow the manipulator to be retracted after tool shock sensor operation. Set the function from the handling display. If “TOOL SHOCK SENSOR FUNC” is “USED” and “TOOL SHOCK SENSOR INPUT” is “INVALID” in the teach mode, “TOOL SHOCK SENSOR INP. RELEASING” is displayed and the input is disabled. The input is enabled if “TOOL SHOCK SENSOR INPUT” is “VALID”.

---

*3 If “TOOL SHOCK SENSOR FUNC” is selected, “USED” and “NOT USED” are alternately displayed.
If “TOOL SHOCK SENSOR INPUT” is selected, “VALID” and “INVALID” are alternately displayed.
The displayed state is the current setting.

**NOTE**

The “-1” tool valve signals can be allocated to [f•1] and the “-2” tool valve signals can be allocated to [f•2].
8.2.7 Low Air Pressure Input Signal

- **Function**
  If the air pressure drops, this input turns ON and triggers a user alarm (system section) in the play mode. In the teach mode the message “AIR PRESSURE LOWERING” is displayed.

- **Signal Condition**
  The signal is normally an OFF (NO) signal.

- **How to use the signal**
  Input the low air pressure signal to 2027 (CN13-A2 of XIU01). The alarm can be reset by turning OFF the signal and reset the alarm. To perform axis operations while the air pressure is low, set to teach mode and reset the alarm. The above message is displayed, but manipulator operations are possible.

Refer to the description of the handling display for details about using this function.
8.2 Instructions and Signals
9 Handling Instructions

9.1 Registering Operating Instructions

9.1.1 HAND Instruction

This instruction turns ON/OFF the hand valve signal and controls the hand.

**Operation**

Select (JOB) under the top menu ➔ Select (JOB CONTENT) ➔ Press [TOOL 1 ON/OFF] ➔ Select the tool number and edit ➔ Select the tool output status and edit ➔ Edit the valve simultaneous control ➔ Press [INSERT] ➔ Press [ENTER]

**Explanation**

*1 “HAND 1 ON” is displayed if [TOOL 1 ON/OFF] is pressed and “HAND 2 ON” is displayed if [TOOL 2 ON/OFF] is pressed in the input buffer line.
Or press [INFORM LIST] to display the instruction box and select the HAND instruction.

```
=> HAND 1 ON
```

*2 The input line is displayed.

```
=> HAND 1 ON
> Tool no.=
```

Input the tool number and press [ENTER].

```
=> HAND 1 ON
```

*3 When the cursor is pressed up/down while pressing [SHIFT], “ON” and “OFF” are alternately displayed.

```
=> HAND 1 OFF
```

*4 When inserting the valve simultaneous control (to make the hand valve 1 output same as the valve 2 output), move the cursor to “HAND”.

```
=> HAND 1 ON
```

9.1 Registering Operating Instructions

Press [SELECT]. The instruction detail display is displayed. Move the cursor to the data of “VALVE SIM CTRL”.

Press [SELECT]. The selection dialog is displayed. Move the cursor to (ALL).

Press [SELECT]. The data of “VALVE SIM CTRL” items change to the “ALL” and the “ALL” tag is added to the input buffer data.

Press [ENTER] to display the job content.
9.1.2 HSEN Instruction

This instruction monitors the various inputs used for handling and outputs the monitor result as a variable.

**Operation**

Select {JOB} under the top menu ➔ Select {JOB CONTENT} ➔ Press [INFORM LIST] ➔ Select the HSEN instruction*1 ➔ Select the sensor number and edit*2 ➔ Select the sensor input status and edit*3 ➔ Edit the signal waiting time*4 ➔ Press [INSERT] ➔ Press [ENTER]

**Explanation**

*1 The HSEN instruction is displayed in the input buffer line.

```
=> HSEN 8 ON
```

*2 The input line is displayed.

```
=> HSEN 8 ON
> Sensor_no: 
```

Input the sensor number and press [ENTER].

```
=> HSEN 1 ON
```

*3 When the cursor is pressed up/down while pressing [SHIFT], “ON” and “OFF” are alternately displayed.

```
=> HSEN 1 OFF
```

*4 When inserting the signal waiting time, move the cursor to “HSEN”.

```
=> HSEN 1 OFF
```

Press [SELECT]. The instruction detail display is displayed. Move the cursor to the data of “WAIT TIME”.

---

9-3
Press [SELECT]. The selection dialog is displayed. Move the cursor to \( T = \).

Press [SELECT]. The data of “WAIT TIME” item changes to the “T=” and the number item is displayed to the right of that. Move the cursor to the number item.

Press [SELECT]. The input line is displayed. Input the number.
Press [ENTER] to register the number value input into the input buffer line.

To make the (controller/hand/robot) to wait indefinitely, select “FOREVER” in the last selection dialog.

Press [ENTER] to display the job content.
## 9.2 Table of Work Instructions

Data variables are denoted with parentheses. In cases where multiple choices are possible, all choices are listed. Select one choice only.

### Handling Instructions

<table>
<thead>
<tr>
<th>Function</th>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAND</td>
<td># (Device number)</td>
<td>#1 or #2 Set when two manipulators are used for handling.</td>
</tr>
<tr>
<td></td>
<td>(Tool Number)</td>
<td>1 to 4 Required</td>
</tr>
<tr>
<td></td>
<td>(Tool Output Status)</td>
<td>ON or OFF Required</td>
</tr>
<tr>
<td></td>
<td>ALL</td>
<td>Valve simultaneous control Used to turn tool valves 1 and 2 ON or OFF simultaneously if a 3P solenoid is used.</td>
</tr>
<tr>
<td>Example</td>
<td>HAND 1 ON HAND #1 1 OFF ALL</td>
<td></td>
</tr>
</tbody>
</table>

### HSEN

<table>
<thead>
<tr>
<th>Function</th>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSEN</td>
<td>$B06</td>
<td>Result variable. Cannot be displayed on screen.</td>
</tr>
<tr>
<td></td>
<td># (Device number)</td>
<td>#1 or #2 Set when two manipulators are used for handling.</td>
</tr>
<tr>
<td></td>
<td>(Tool Sensor Number)</td>
<td>1 to 8 Required</td>
</tr>
<tr>
<td></td>
<td>(Sensor Input Status)</td>
<td>ON or OFF Required</td>
</tr>
<tr>
<td></td>
<td>T=(signal waiting time) or FOREVER</td>
<td>T:0.01 to 655.35 seconds FOREVER: Unlimited time. If omitted, T=0.</td>
</tr>
<tr>
<td>Example</td>
<td>HSEN 1 ON FOREVER HSEN #2 1 OFF HSEN 1 ON T=10.00</td>
<td></td>
</tr>
</tbody>
</table>
# 11 Table of Basic Instructions

- <> indicates numerical or alphabetical data.
- If multiple items are shown in one section, select one of the items.

## Move Instruction

<table>
<thead>
<tr>
<th></th>
<th>Function</th>
<th>Moves to the taught point with joint motion type.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MOVJ</strong></td>
<td>Format</td>
<td>Position data, Base axis position data, Station axis position data</td>
</tr>
<tr>
<td></td>
<td>VJ=&lt;play speed (%)&gt;</td>
<td>VJ: 0.01 to 100.00</td>
</tr>
<tr>
<td></td>
<td>PL=&lt;positioning level&gt;</td>
<td>PL: 0 to 4</td>
</tr>
<tr>
<td></td>
<td>NWAIT</td>
<td>UNTIL statement</td>
</tr>
<tr>
<td>Example</td>
<td>MOVJ VJ=50.00 PL=2 NWAIT UNTIL IN#(16)=ON</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Function</th>
<th>Moves to the taught point with linear motion type.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MOVL</strong></td>
<td>Format</td>
<td>Position data, Base axis position data, Station axis position data</td>
</tr>
<tr>
<td></td>
<td>V=&lt;play speed&gt;, VR=&lt;play speed of the posture&gt;, VE=&lt;play speed of external axis&gt;</td>
<td>V: 0.1 to 1500.0 mm/sec 0.6 to 9000.0 cm/min VR: 0.1 to 180.0 deg/sec VE: 0.01 to 100.00%</td>
</tr>
<tr>
<td></td>
<td>PL=&lt;positioning level&gt;</td>
<td>PL: 0 to 4</td>
</tr>
<tr>
<td></td>
<td>NWAIT</td>
<td>UNTIL statement</td>
</tr>
<tr>
<td>Example</td>
<td>MOVL V=138 PL=0 NWAIT UNTIL IN#(16)=ON</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Function</th>
<th>Moves to the taught point with circular motion type.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MOVC</strong></td>
<td>Format</td>
<td>Position data, Base axis position data, Station axis position data</td>
</tr>
<tr>
<td></td>
<td>V=&lt;play speed&gt;, VR=&lt;play speed of the posture&gt;, VE=&lt;play speed of external axis&gt;</td>
<td>Same with MOVL.</td>
</tr>
<tr>
<td></td>
<td>PL=&lt;positioning level&gt;</td>
<td>PL: 0 to 4</td>
</tr>
<tr>
<td></td>
<td>NWAIT</td>
<td></td>
</tr>
<tr>
<td>Example</td>
<td>MOVC V=138 PL=0 NWAIT</td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>Moves to the taught point with spline motion type.</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>MOVS</td>
<td><strong>Format</strong> Position data, Base axis position data, Station axis position data</td>
<td></td>
</tr>
<tr>
<td></td>
<td>These data do not appear on the display.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>V</strong>=&lt;play speed&gt;, <strong>VR</strong>=&lt;play speed of the posture&gt;, <strong>VE</strong>=&lt;play speed of external axis&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Same with MOVL.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>PL</strong>=&lt;positioning level&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PL:0 to 4</td>
<td></td>
</tr>
<tr>
<td>Example</td>
<td>MOVS <strong>V</strong>=120 <strong>PL</strong>=0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Moves the specified increment from the current position with linear motion type.</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMOV</td>
<td><strong>Format</strong> <strong>P</strong>&lt;variable number&gt;, <strong>BP</strong>&lt;variable number&gt;, <strong>EX</strong>&lt;variable number&gt;</td>
</tr>
<tr>
<td></td>
<td><strong>V</strong>=&lt;play speed&gt;, <strong>VR</strong>=&lt;play speed of the posture&gt;, <strong>VE</strong>=&lt;play speed of external axis&gt;</td>
</tr>
<tr>
<td></td>
<td>Same with MOVL.</td>
</tr>
<tr>
<td></td>
<td><strong>PL</strong>=&lt;positioning level&gt;</td>
</tr>
<tr>
<td></td>
<td>PL:0 to 4</td>
</tr>
<tr>
<td>Example</td>
<td>IMOV <strong>P</strong>000 <strong>V</strong>=138 <strong>PL</strong>=1 <strong>RF</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Defines a reference point(e.g. wall point for weaving).</th>
</tr>
</thead>
<tbody>
<tr>
<td>REFP</td>
<td><strong>Format</strong> Position data, Base axis position data, Station axis position data</td>
</tr>
<tr>
<td></td>
<td>These data do not appear on the display.</td>
</tr>
<tr>
<td></td>
<td><strong>&lt;reference point number&gt;</strong></td>
</tr>
<tr>
<td>Example</td>
<td>REFP 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Sets play speed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPEED</td>
<td><strong>Format</strong> <strong>VJ</strong>=&lt;play speed(%)&gt;, <strong>V</strong>=&lt;play speed&gt;, <strong>VR</strong>=&lt;play speed of the posture&gt;, <strong>VE</strong>=&lt;play speed of external axis&gt;</td>
</tr>
<tr>
<td></td>
<td><strong>VJ</strong>:Same with MOVJ. <strong>V</strong>, <strong>VR</strong>, <strong>VE</strong>: Same with MOVL.</td>
</tr>
<tr>
<td>Example</td>
<td>SPEED <strong>VJ</strong>=50.00</td>
</tr>
</tbody>
</table>
## I/O Instructions

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Format</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DOUT</strong></td>
<td>Turns the external output signals ON and OFF.</td>
<td>(\text{OT#} &lt;\text{output number}&gt;), (\text{OGH#} &lt;\text{output group number}&gt;), (\text{OG#} &lt;\text{output group number}&gt;)</td>
<td>DOUT OT#(12) ON</td>
</tr>
<tr>
<td></td>
<td>Number of addressed output signals: (\text{OT#}(xx)=1;\text{OGH#}(xx)=4) (per group); (\text{OG#}(xx)=8) (per group)</td>
<td>OGH#(xx) is not subject to parity check; only the binary specification is allowed.</td>
<td></td>
</tr>
<tr>
<td><strong>PULSE</strong></td>
<td>Outputs a pulse signal as an external output signal.</td>
<td>(\text{OT#} &lt;\text{output number}&gt;)</td>
<td>PULSE OT# (10) T=0.60</td>
</tr>
<tr>
<td></td>
<td>(\text{T}=&lt;\text{time(sec)}&gt;) 0.30 sec(default)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DIN</strong></td>
<td>Sets input signals in variables.</td>
<td>B&lt;variable number&gt;</td>
<td>DIN B016 IN#(16) DIN B002 IG#(2)</td>
</tr>
<tr>
<td></td>
<td>(\text{IN#} &lt;\text{input number}&gt;), (\text{IGH#} &lt;\text{input group number}&gt;), (\text{IG#} &lt;\text{input group number}&gt;), (\text{OT#} &lt;\text{output number}&gt;), (\text{OGH#} &lt;\text{output group number}&gt;), (\text{OG#} &lt;\text{output group number}&gt;), (\text{SIN#} &lt;\text{specific input number}&gt;), (\text{SOUT#} &lt;\text{specific output number}&gt;)</td>
<td>Number of addressed input signals: (\text{IN#}(xx)=1;\text{IGH#}(xx)=4) (per group); (\text{IG#}(xx)=8) (per group) Number of addressed output signals: (\text{OT#}(xx)=1;\text{OGH#}(xx)=4) (per group); (\text{OG#}(xx)=8) (per group) IGH#(xx) and OGH#(xx) are not subject to parity check; only the binary specification is allowed.</td>
<td></td>
</tr>
<tr>
<td><strong>WAIT</strong></td>
<td>Waits until the external input signal status matches the specified status.</td>
<td>(\text{IN#} &lt;\text{input number}&gt;), (\text{IG#} &lt;\text{input group number}&gt;) (&lt;\text{status}&gt;.\text{B&lt;variable number}&gt;) (\text{T}=&lt;\text{time(sec)}&gt;)</td>
<td>WAIT IN# (12)=ON T=10.00 WAIT IN# (12)=B002</td>
</tr>
</tbody>
</table>
### I/O Instructions

**AOUT**  
**Function**: Outputs the specified voltage to the general-purpose analog output port.  
**Format**: AO# (<output port number>)<output voltage(V)> -14.1 to +14.0  
**Example**: AOUT AO# (2) 12.7

**JUMP**  
**Function**: Jumps to the specified label or job.  
**Format**: <label number>, JOB:<job name>, IG# (<input group number>), B<variable number>, l<variable number>, D<variable number>  
**Example**: JUMP JOB:TEST1 IF IN#(14)=OFF

**CALL**  
**Function**: Calls the specified job.  
**Format**: JOB:<job name>, IG# (<input group number>), B<variable number>, l<variable number>, D<variable number>  
**Example**: CALL JOB:TEST1 IF IN#(24)=ON  
(The job is called by the patterns of input signal. In this example, Job 0 cannot be called.)

**RET**  
**Function**: Returns to the called job.  
**Format**: IF statement  
**Example**: RET IF IN#(12)=OFF

**END**  
**Function**: Declares the end of a job.  
**Format**:  
**Example**: END

**NOP**  
**Function**: No operation.  
**Format**:  
**Example**: NOP

**TIMER**  
**Function**: Stops for the specified time.  
**Format**: T=<time(sec)> T: 0.01 to 655.35  
**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>  
**Example**: JUMP *12 IF IN#(12)=OFF
### Control Instructions

<table>
<thead>
<tr>
<th>UNTIL statement</th>
<th>Function</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Format</td>
<td>IN# (&lt;input number&gt;) (\text{&lt;status&gt;})</td>
</tr>
<tr>
<td></td>
<td>Example</td>
<td>MOVL V=300 UNTIL IN#(10)=ON</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PAUSE</th>
<th>Function</th>
<th>Instructs a pause.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Format</td>
<td>IF statement</td>
</tr>
<tr>
<td></td>
<td>Example</td>
<td>PAUSE IF IN#(12)=OFF</td>
</tr>
</tbody>
</table>

### (comment)

<table>
<thead>
<tr>
<th>Function</th>
<th>Displays a comment entered on the job header display.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format</td>
<td>&lt;comment&gt;</td>
</tr>
<tr>
<td>Example</td>
<td>Draws 100mm size square.</td>
</tr>
</tbody>
</table>

### Shift Instructions

<table>
<thead>
<tr>
<th>SFTON</th>
<th>Starts a shift operation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format</td>
<td>P&lt;variable number&gt;, BF, RF, TF, UF#(&lt;user coordinate number&gt;), EX&lt;variable number&gt;</td>
</tr>
<tr>
<td>Example</td>
<td>SFTON P001 UF#(1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SFTOF</th>
<th>Stops a shift operation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format</td>
<td></td>
</tr>
<tr>
<td>Example</td>
<td>SFTOF</td>
</tr>
</tbody>
</table>
### Shift Instructions

**Function**
Obtains the parallel shift value between the reference position and the shift target position by the elements of the specified coordinate system and in consideration of the Cartesian displacements and postural change, and stores the obtained element values in the specified position variable.

*Format:* `MSHIFT <Data1><Coordinate><Data2><Data3>`

<table>
<thead>
<tr>
<th>data1</th>
<th>PX&lt;variable number&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>coordi-</td>
<td>BF, RF, TF, UF# (&lt;user coordinate number&gt;)</td>
</tr>
<tr>
<td>nate</td>
<td>BF: base coordinates</td>
</tr>
<tr>
<td></td>
<td>RF: robot coordinates</td>
</tr>
<tr>
<td></td>
<td>TF: tool coordinates</td>
</tr>
<tr>
<td></td>
<td>UF: user coordinates</td>
</tr>
<tr>
<td>data2</td>
<td>PX&lt;variable number&gt;</td>
</tr>
<tr>
<td>data3</td>
<td>PX&lt;variable number&gt;</td>
</tr>
</tbody>
</table>

**Example**
`MSHIFT PX000 RF PX001 PX002`

### Operating Instruction

**ADD**
Function
Adds `Data1` and `Data2`, and stores the result in `Data1`.

*Format:* `ADD<Data1><data2>`

<table>
<thead>
<tr>
<th>Data1</th>
<th>Data1 must always be a variable.</th>
</tr>
</thead>
<tbody>
<tr>
<td>data2</td>
<td></td>
</tr>
</tbody>
</table>

**Example**
`ADD I012 I013`

**SUB**
Function
Subtracts `Data2` from `Data1`, and stores the result in `Data1`.

*Format:* `SUB<Data1><data2>`

<table>
<thead>
<tr>
<th>Data1</th>
<th>Data1 must always be a variable.</th>
</tr>
</thead>
<tbody>
<tr>
<td>data2</td>
<td></td>
</tr>
</tbody>
</table>

**Example**
`SUB I012 I013`

**MUL**
Function
Multiplies `Data1` by `Data2`, and stores the result in `Data1`.

*Format:* `MUL<Data1><data2>`

<table>
<thead>
<tr>
<th>Data1</th>
<th>Data1 can be an element in a position variable.</th>
</tr>
</thead>
<tbody>
<tr>
<td>data2</td>
<td></td>
</tr>
</tbody>
</table>

**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:** \( \text{DIV<Data1><data2>} \)

- Data1 must always be a variable.
- Data2

**Example**
- \( \text{DIV I012 I013} \)
- \( \text{DIV P000 (3) 2} \) (Divide the Z-axis data by 2)

### INC

**Function**
Increments the value of the specified variable by 1.

**Format**
\( \text{B<variable number>,I<variable number>} \)

**Example**
- \( \text{INC I043} \)

### DEC

**Function**
Decrements the value of the specified variable by 1.

**Format**
\( \text{B<variable number>,I<variable number>} \)

**Example**
- \( \text{DEC I043} \)

### AND

**Function**
Obtains the AND of Data1 and Data2, and stores the result in Data1.

**Format:** \( \text{AND<Data1><data2>} \)

**Example**
- \( \text{AND B012 B020} \)

### OR

**Function**
Obtains the OR of Data1 and Data2, and stores the result in Data1.

**Format:** \( \text{OR<Data1><data2>} \)

**Example**
- \( \text{OR B012 B020} \)

### NOT

**Function**
Obtains the NOT of Data1 and Data2, and stores the result in Data1.

**Format:** \( \text{NOT<Data1><data2>} \)

**Example**
- \( \text{NOT B012 B020} \)

### XOR

**Function**
Obtains the exclusive OR of Data1 and Data2, and stores the result in Data1.

**Format:** \( \text{XOR<Data1><data2>} \)

**Example**
- \( \text{XOR B012 B020} \)
### Operating Instruction

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SET</strong></td>
<td>Sets Data2 to Data1. Format: SET&lt;Data1&gt;&lt;data2&gt;</td>
<td>Data1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data2</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>SET 1012 1020</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SETE</strong></td>
<td>Sets data to an element in a position variable.</td>
<td>P&lt;variable number&gt; (&lt;element number&gt;), BP&lt;variable number&gt; (&lt;element number&gt;), EX&lt;variable number&gt; (&lt;element number&gt;)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D&lt;variable number&gt;, &lt;double-precision integer type constant&gt;</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>SETE P012 (3) D005</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GETE</strong></td>
<td>Extracts an element in a position variable.</td>
<td>D&lt;variable number&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P&lt;variable number&gt; (&lt;element number&gt;), BP&lt;variable number&gt; (&lt;element number&gt;), EX&lt;variable number&gt; (&lt;element number&gt;)</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>GETE D006 P012 (4)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GETS</strong></td>
<td>Sets a status variable to the specified variable.</td>
<td>B&lt;variable number&gt;,I&lt;variable number&gt;, D&lt;variable number&gt;, R&lt;variable number&gt;, PX&lt;variable number&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$B&lt;variable number&gt;, $I&lt;variable number&gt;, $D&lt;variable number&gt;, $R&lt;variable number&gt;, $PX&lt;variable number&gt;</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>GETS B000 $B000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CNVRT</strong></td>
<td>Converts the position variable (Data2) into a position variable of the specified coordinate system, and stores the converted variable in Data1. Format: CNVRT&lt;Data1&gt;&lt;Data2&gt;&lt;coordinate&gt;</td>
<td>Data1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PX&lt;variable number&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BF, RF, UF# (&lt;user coordinate number&gt;), MTF</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>CNVRT PX000 PX001 BF</td>
<td></td>
</tr>
</tbody>
</table>

---

11-8
### Function

**CLEAR**

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>`

<table>
<thead>
<tr>
<th>Data1</th>
<th>B&lt;variable number&gt;, I&lt;variable number&gt;, D&lt;variable number&gt;, R&lt;variable number&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data2</td>
<td>&lt;number of variable&gt;, ALL, STACK</td>
</tr>
</tbody>
</table>

**Example**

- **CLEAR B000 ALL**
- **CLEAR STACK**

**SIN**

Obtains the sine of Data2, and stores the result in Data1.

**Format:** `SIN<Data1><Data2>`

<table>
<thead>
<tr>
<th>Data1</th>
<th>R&lt;variable number&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data2</td>
<td>&lt;constant&gt;, R&lt;variable number&gt;</td>
</tr>
</tbody>
</table>

**Example**

- **SIN R000 R001** (Sets the sine of R001 to R000)

**COS**

Obtains the cosine of Data2, and stores the result in Data1.

**Format:** `COS<Data1><Data2>`

<table>
<thead>
<tr>
<th>Data1</th>
<th>R&lt;variable number&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data2</td>
<td>&lt;constant&gt;, R&lt;variable number&gt;</td>
</tr>
</tbody>
</table>

**Example**

- **COS R000 R001** (Sets the cosine of R001 to R000)

**ATAN**

Obtains the arc tangent of Data2, and stores the result in Data1.

**Format:** `ATAN<Data1><Data2>`

<table>
<thead>
<tr>
<th>Data1</th>
<th>R&lt;variable number&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data2</td>
<td>&lt;constant&gt;, R&lt;variable number&gt;</td>
</tr>
</tbody>
</table>

**Example**

- **ATAN R000 R001** (Sets the arc tangent of R001 to R000)

**SQRT**

Obtains the square root of Data2, and stores the result in Data1.

**Format:** `SQRT<Data1><Data2>`

<table>
<thead>
<tr>
<th>Data1</th>
<th>R&lt;variable number&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data2</td>
<td>&lt;constant&gt;, R&lt;variable number&gt;</td>
</tr>
</tbody>
</table>

**Example**

- **SQRT R000 R001** (Sets the square root of R001 to R000)
YASNAC XRC OPERATOR’S MANUAL
FOR HANDLING

TOKYO OFFICE
New Pier Takashiba South Tower, 1-16-1, Kaigan, Minatoku, Tokyo 105-0022, Japan
Phone 81-3-5402-4511 Fax 81-3-5402-4580

MOTOMAN INC. HEADQUARTERS
805 Liberty Lane West Carrollton, OH 45449, U.S.A.
Phone 1-937-847-6200 Fax 1-937-847-6277

MOTOMAN INC. TROY FACILITY
1050 S. Dorset, Troy, OH 45373, U.S.A.
Phone 1-937-440-2600 Fax 1-937-440-2626

MOTOMAN INC. COLUMBUS OFFICE
Dublin Tech Mart 5000 Blazer Memorial Parkway Dublin, OH 43017-3359, U.S.A.
Phone 1-614-718-4200 Fax 1-614-718-4222

YASKAWA ELECTRIC EUROPE GmbH
Am Kronberger Hang 2, 65824 Schwalbach, Germany.
Phone 49 6196-689-300 Fax 49 6196-888-301

Motoman Robotics AB
Box 504 50852 Torsås, Sweden
Phone 46-486-48800 Fax 46-486-41410

Motoman Robotics GmbH
Kammertendieckstr. 85391 Allershausen, Germany
Phone 49 8166-900 Fax 49 8166-9039

YASKAWA ELECTRIC KOREA CORPORATION
Kipas Bld #1201, 36-4 Youido-dong, Yeongdeungpo-Ku, Seoul 150-010, Korea
Phone 82-2-784-7844 Fax 82-2-784-8496

YASKAWA ELECTRIC (SINGAPORE) PTE. LTD.
151 Lorong Chuan, #04-01, New Tech Park Singapore 556741, Singapore
Phone 65-282-3003 Fax 65-289-3003

YATEC ENGINEERING CORPORATION
Shen Hsiang Tang Sung Chiang Building 10F 146 Sung Chiang Road, Taipei, Taiwan
Phone 886-2-2563-0010 Fax 886-2-2567-4677

BEIJING OFFICE
Room No. 301 Office Building of Beijing International Club, 21 Jianguomenwai Avenue, Beijing 100020, China
Phone 86-10-6532-1850 Fax 86-10-6532-1851

SHANGHAI OFFICE
27 Hui He Road Shanghai 200437 China
Phone 86-21-6553-6600 Fax 86-21-6513-4242

YASKAWA JASON (HK) COMPANY LIMITED
Rm. 2909-10, Hong Kong Plaza, 186-191 Connaught Road West, Hong Kong
Phone 852-2803-2385 Fax 852-2547-5773

TAIPEI OFFICE
Shen Hsiang Tang Song Chiang Building 10F 146 Sung Chiang Road, Taipei, Taiwan
Phone 886-2-2563-0010 Fax 886-2-2567-4677

BEIJING YASKAWA BEIKE AUTOMATION ENGINEERING CO., LTD.
30 Xue Yuan Road, Haidian, Beijing, P.R. China Post Code: 100083
Phone 86-10-6233-2782 Fax 86-10-6232-1536

SHOUGANG MOTOMAN ROBOT CO., LTD.
7, Yongchang North Street, Beijing Economic Technological Investment & Development Area,
Beijing 100076, P.R. China
Phone 86-10-6788-0551 Fax 86-10-6788-2878

YASKAWA ELECTRIC CORPORATION

Specifications are subject to change without notice for ongoing product modifications and improvements.

MANUAL NO. RE-CSO-A014 © Printed in Japan April 1999 98-12