YASKAWA

DX100
OPERATOR'S MANUAL

FOR MATERIAL HANDLING, PRESS TENDING, CUTTING, AND OTHER APPLICATIONS

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

MOTOMAN INSTRUCTIONS

MOTOMAN-□□□ INSTRUCTIONS
DX100 INSTRUCTIONS
DX100 OPERATOR'S MANUAL
DX100 MAINTENANCE MANUAL

The DX100 operator's manuals above correspond to specific usage.
Be sure to use the appropriate manual.

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Revision: 7

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MANDATORY

- This manual explains the various components of the DX100 system and general operations. Read this manual carefully and be sure to understand its contents before handling the DX100.
- General items related to safety are listed in Section 1: Safety of the DX100 Instructions. To ensure correct and safe operation, carefully read the DX100 Instruction 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.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems (ANSI/RIA R15.06-2012). You can obtain this document from the Robotic Industries Association (RIA) at the following address:

Robotic Industries Association
900 Victors Way
P.O. Box 3724
Ann Arbor, Michigan 48106
TEL: (734) 994-6088
FAX: (734) 994-3338
www.roboticsonline.com

Ultimately, well-trained personnel are the best safeguard against accidents and damage that can result from improper operation of the equipment. The customer is responsible for providing adequately trained personnel to operate, program, and maintain the equipment. NEVER ALLOW UNTRAINED PERSONNEL TO OPERATE, PROGRAM, OR REPAIR THE EQUIPMENT!

We recommend approved Yaskawa training courses for all personnel involved with the operation, programming, or repair of the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the DX100.

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

DANGER	Indicates an imminent hazardous situation which, if not avoided, could result in death or serious injury to personnel.
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 “DANGER”, “CAUTION” and “WARNING.”

WARNING

- **Before operating the manipulator, check that servo power is turned off when the emergency stop buttons on the front door of the DX 100 and programing pendant are pressed.**
  When the servo power is turned off, the SERVO ON LED on the programing pendant is turned off.

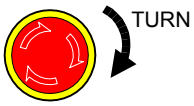
Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the emergency stop buttons do not function.

Figure 1: 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.

Figure 2: Release of EM



- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  - Be sure to use a lockout device to the safeguarding when going inside. Also, display the sign that the operation is being performed inside the safeguarding and make sure no one closes the safeguarding.
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Keep in mind the emergency response measures against the manipulator's unexpected motion toward you.
  - 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 person is present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
  - Turning on the power for the DX100.
  - Moving the manipulator with the programming pendant.
  - Running the system in the check mode.
  - 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 of the front door of the DX100 and programing 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 cabinet of the DX100 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 Warning Labels in the DX100 Instructions before operating the manipulator.

Definition of Terms Used In this Manual

The MOTOMAN is the YASKAWA industrial robot product.

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

In this manual, the equipment is designated as follows.

Equipment	Manual Designation
DX100 controller	DX100
DX100 programming pendant	Programming pendant
Cable between the manipulator and the controller	Manipulator cable

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

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

Description of the Operation Procedure

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

Registered Trademark

In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or brand names for each company or corporation. The indications of (R) and TM are omitted.

Safeguarding Tips

All operators, programmers, maintenance personnel, supervisors, and anyone working near the system 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 equipment, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this equipment.
- Improper connections can damage the equipment. All connections must be made within the standard voltage and current ratings of the equipment.
- The system must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06-2012, section 4.2.5, Sources of Energy, 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).

Mechanical Safety Devices

The safe operation of this equipment is ultimately the users 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 R15.06-2012 safety standards, and other local codes that may pertain to the installation and use of this equipment.

Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety equipment is provided as standard:

- Safety barriers
- Door interlocks
- Emergency stop palm buttons located on operator station

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

Programming, Operation, and Maintenance Safety

All operators, programmers, maintenance personnel, supervisors, and anyone working near the system must become familiar with the operation of this equipment. 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 equipment should be permitted to program, or maintain the system. All personnel involved with the operation of the equipment must understand potential dangers of operation.

- Inspect the equipment 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 all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Check the E-Stop button on the operator station for proper operation before programming. The equipment must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- Back up all programs and jobs onto suitable media before 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.
- Any modifications to the controller unit can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to the controller unit. Making any changes without the written permission from Yaskawa will void the warranty.
- Some operations require standard passwords and some require special passwords.
- The equipment allows modifications of the software for maximum performance. Care must be taken when making these modifications. All modifications made to the software will change the way the equipment operates and can cause severe personal injury or death, as well as damage parts of the system. Double check all modifications under every mode of operation to ensure that the changes have not created hazards or dangerous situations.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.
- Use proper replacement parts.
- Improper connections can damage the equipment. All connections must be made within the standard voltage and current ratings of the equipment.

Maintenance Safety

Turn the power OFF and disconnect and lockout/tagout all electrical circuits before making any modifications or connections.

Perform only the maintenance described in this manual. Maintenance other than specified in this manual should be performed only by Yaskawa-trained, qualified personnel.

Summary of Warning Information

This manual is provided to help users establish safe conditions for operating the equipment. Specific considerations and precautions are also described in the manual, but appear in the form of Dangers, Warnings, Cautions, and Notes.

It is important that users operate the equipment in accordance with this instruction manual and any additional information which may be provided by Yaskawa. Address any questions regarding the safe and proper operation of the equipment to Yaskawa Customer Support.

Customer Support Information

If you need assistance with any aspect of your DX100 system, please contact YASKAWA Customer Support at the following 24-hour telephone number:

(937) 847-3200

For **routine** technical inquiries, you can also contact YASKAWA Customer Support at the following e-mail address:

techsupport@motoman.com

When using e-mail to contact YASKAWA Customer Support, please provide a detailed description of your issue, along with complete contact information. Please allow approximately 24 to 36 hours for a response to your inquiry.

NOTE

Please use e-mail for **routine** inquiries only. If you have an urgent or emergency need for service, replacement parts, or information, you must contact YASKAWA Customer Support at the telephone number shown above.

Please have the following information ready before you call Customer Support:

• System	DX100
• Robots	_____
• Primary Application	_____
• Controller	DX100
• Software Version	Access this information on the Programming Pendant's LCD display screen by selecting {MAIN MENU} - {SYSTEM INFO} - {VERSION}
• Robot Serial Number	Located on the robot data plate
• Robot Sales Order Number	Located on the DX100 controller data plate

Table of Contents

1 Introduction 1-1
1.1 DX100 Overview 1-1
1.2 Programming Pendant 1-2
1.2.1 Programming Pendant Overview 1-2
1.2.2 Key Description 1-3
1.2.2.1 Character Keys 1-3
1.2.2.2 Symbol Keys 1-3
1.2.2.3 Axis Keys and Numeric Keys 1-3
1.2.2.4 Keys Pressed Simultaneously 1-3
1.2.3 Programming Pendant Keys 1-4
1.2.4 Programming Pendant Display 1-11
1.2.4.1 Five Display Areas 1-11
1.2.4.2 General-purpose Display Area 1-12
1.2.4.3 Main Menu Area 1-13
1.2.4.4 Status Display Area 1-13
1.2.4.5 Human Interface Display Area 1-16
1.2.4.6 Menu Area 1-16
1.2.5 Screen Descriptions 1-17
1.2.6 Character Input Operation 1-18
1.2.6.1 Character Input 1-18
1.2.6.2 Operation 1-18
1.2.6.3 Alphanumeric Input 1-19
1.2.6.4 Symbol Input 1-20
1.2.6.5 Register Word Function 1-21
1.3 Mode 1-29
1.3.1 Teach Mode 1-29
1.3.2 Play Mode 1-29
1.3.3 Remote Mode 1-29
1.3.4 Teach Mode Priority 1-29
1.4 Security Mode 1-30
1.4.1 Types of Security Modes 1-30
1.4.2 Changing Security Modes 1-35
2 Manipulator Coordinate Systems and Operations 2-1
2.1 Control Groups and Coordinate Systems 2-1
2.1.1 Control Group 2-1
2.1.2 Types of Coordinate Systems 2-2

2.2 General Operations 2-3
2.2.0.1 Check Safety 2-3
2.2.0.2 Select Teach Mode 2-3
2.2.0.3 Select Control Group 2-3
2.2.0.4 Select Coordinate System 2-3
2.2.0.5 Select Manual Speed 2-4
2.2.0.6 Servo ON 2-4
2.2.0.7 Axis Operation 2-4
2.2.0.8 HIGH SPEED 2-4
2.3 Coordinate Systems and Axis Operation 2-5
2.3.1 Joint Coordinates 2-5
2.3.2 Cartesian Coordinates 2-6
2.3.3 Cylindrical Coordinates 2-7
2.3.4 Tool Coordinates 2-9
2.3.4.1 Selecting Tool 2-11
2.3.5 User Coordinates 2-12
2.3.5.1 Selecting User Coordinates 2-13
2.3.5.2 Examples of User Coordinate Utilization 2-14
2.3.6 External Axis 2-14
2.3.7 Control Point Operation 2-15
2.3.7.1 Control Point Change 2-18
3 Teaching 3-1
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 a Job 3-2
3.1.3.1 Registering Job Names 3-2
3.1.3.2 Registering Jobs 3-2
3.1.3.3 Registering Comments 3-3
3.1.3.4 Registering Control Groups 3-3
3.1.3.5 Switching to the Teaching Window 3-4
3.2 Teaching Operation 3-5
3.2.1 Teaching Window 3-5
3.2.2 Interpolation Type and Play Speed 3-6
3.2.2.1 Joint Interpolation 3-6
3.2.2.2 Linear Interpolation 3-7
3.2.2.3 Circular Interpolation 3-8
3.2.2.4 Spline Interpolation 3-9

3.2.3 Teaching Steps 3-11
3.2.3.1 Registering Move Instructions 3-11
3.2.3.2 Registering Reference Point Instructions 3-18
3.2.3.3 Registering Timer Instructions 3-19
3.2.4 Overlapping the First and Last Steps 3-22
3.3 Checking Steps 3-23
3.3.1 FWD/BWD Key Operations 3-23
3.3.1.1 Precautions When Using FWD / BWD Operations 3-24
3.3.1.2 Selecting Manual Speed 3-26
3.3.1.3 Moving to Reference Point 3-27
3.3.1.4 Test Operations 3-27
3.3.1.5 Machine Lock Operation 3-28
3.4 Modifying Steps 3-29
3.4.1 Displaying the JOB CONTENT Window for Editing 3-33
3.4.1.1 Currently Called Up Job 3-33
3.4.1.2 Calling Up Other Jobs 3-33
3.4.2 Inserting Move Instructions 3-34
3.4.3 Deleting Move Instructions 3-36
3.4.4 Modifying Move Instructions 3-37
3.4.4.1 Modifying Position Data 3-37
3.4.4.2 Modifying Interpolation Type 3-37
3.4.5 Undo Operation 3-38
3.4.6 Modifying Reference Point Instructions 3-39
3.4.6.1 Deleting Reference Point Instructions 3-39
3.4.6.2 Modifying Reference Point Instructions 3-39
3.4.7 Modifying Timer Instructions 3-40
3.4.7.1 Deleting Timer Instructions 3-40
3.4.7.2 Modifying Timer Instructions 3-40
3.5 Modifying Jobs 3-41
3.5.1 Calling Up a Job 3-41
3.5.2 Windows Related to Job 3-41
3.5.3 JOB HEADER Window 3-42
3.5.4 JOB CONTENT Window 3-43
3.5.4.1 Switching the Address Area 3-44
3.5.5 COMMAND POSITION Window 3-48
3.5.6 JOB CAPACITY Window 3-49

3.6 Editing Instructions 3-50
3.6.1 Instruction Group 3-51
3.6.2 Inserting Instructions 3-52
3.6.3 Deleting Instructions 3-55
3.6.4 Modifying Instructions 3-55
3.6.5 Modifying Additional Numeric Data 3-59
3.6.6 Modifying Additional Items 3-60
3.6.7 Inserting Additional Items 3-61
3.6.8 Deleting Additional Items 3-63
3.7 Editing Jobs 3-64
3.7.1 Selecting the Range 3-66
3.7.2 Copying 3-67
3.7.3 Cutting 3-67
3.7.4 Pasting 3-68
3.7.5 Reverse Pasting 3-69
3.8 Test Operations 3-70
3.8.1 Test Operation Procedures 3-70
3.9 Other Job-editing Functions 3-71
3.9.1 Editing Play Speed 3-71
3.9.1.1 Modification of Speed Type 3-71
3.9.1.2 Relative Modification 3-71
3.9.1.3 Modification by TRT (Traverse Time) 3-73
3.9.2 Editing Interpolation Type 3-75
3.9.3 Editing Condition Files 3-76
3.9.4 User Variables 3-77
3.9.4.1 Setting Byte, Integer, Double Precision Integer, and Real Type Variables 3-78
3.9.4.2 Setting Character Type Variables 3-80
3.9.4.3 Registering Variable Name 3-82
3.9.4.4 Displaying Position Variables 3-83
3.9.4.5 Setting Position Variables 3-84
3.9.4.6 Setting Position Variables Using the Numeric Keys 3-85
3.9.4.7 Setting Position Variables Using the Axis Keys 3-87
3.9.4.8 Deleting Data Set of Position Variables 3-88
3.9.4.9 Checking Positions by Position Variables 3-88
3.9.4.10 Manipulator Types 3-89
3.9.5 Flip/No Flip 3-90
3.9.6 R-axis Angle 3-90
3.9.7 T-axis Angle 3-91

3.9.8 Front/Back 3-91
3.9.9 Upper Arm/Lower Arm 3-93
3.9.10 S-axis Angle 3-93
3.9.11 Editing Local Variables 3-94
3.9.11.1 Setting the Number of Local Variables 3-96
3.9.12 Search 3-98
3.9.12.1 Line Search 3-99
3.9.12.2 Step Search 3-100
3.9.12.3 Label Search 3-101
3.9.12.4 Instruction Search 3-103
3.9.12.5 Tag Search 3-105

4 Playback 4-1
4.1 Preparation for Playback 4-1
4.1.1 Selecting a Job 4-1
4.1.1.1 Calling a Job 4-1
4.1.1.2 Registering the Master Job 4-2
4.1.1.3 Calling the Master Job 4-4
4.1.2 The PLAYBACK Window 4-6
4.1.2.1 Display of Cycle Time 4-6
4.1.2.2 Operation Cycle 4-7
4.2 Playback 4-10
4.2.1 Playback Operation 4-10
4.2.1.1 Selecting the Start Device 4-10
4.2.1.2 Servo On 4-10
4.2.1.3 Start Operation 4-10
4.2.2 Special Playback Operations 4-11
4.2.2.1 Low Speed Operation 4-11
4.2.2.2 Limited Speed Operations 4-12
4.2.2.3 Dry-run Speed Operations 4-12
4.2.2.4 Machine Lock Operation 4-13
4.2.2.5 Check Mode Operation 4-13
4.2.2.6 Weaving Prohibit Setting during Check Mode Operation 4-13
4.2.2.7 Cancel All Special Operations 4-14
4.3 Stop and Restart 4-15
4.3.1 Hold 4-15
4.3.1.1 Using the Programming Pendant 4-15
4.3.1.2 Using an External Input Signal (System Input) 4-15
4.3.2 Emergency Stop 4-16
4.3.2.1 Restart After Emergency Stop 4-17
4.3.3 Stop by Alarm 4-18

4.3.4 Others 4-19
4.3.4.1 Temporary Stop by Mode Change 4-19
4.3.4.2 Temporary Stop by the PAUSE Instruction 4-19
4.4 Modifying Play Speed 4-20
4.4.1 Speed Override 4-20
4.4.1.1 Setting Speed Overrides 4-21
4.4.1.2 Modifying Play Speed 4-22
4.4.1.3 Canceling Speed Override Settings 4-22
4.5 Playback with Reserved Start 4-23
4.5.1 Preparation for Reserved Start 4-23
4.5.1.1 Enabling Reserved Start 4-24
4.5.1.2 Registering Reserved Start I/O Signal 4-26
4.5.1.3 Registering Jobs to Stations 4-28
4.5.1.4 Deleting Registered Jobs from Stations 4-30
4.5.2 Playback from Reserved Start 4-31
4.5.2.1 Start Operation 4-31
4.5.2.2 Checking Job Reservation Status 4-32
4.5.2.3 Resetting Job Reservation 4-33
4.5.3 Hold Operation 4-34
4.5.3.1 [HOLD] on the Programming Pendant 4-34
4.5.3.2 Hold by External Input Signal (System Input) 4-34
4.5.3.3 Hold at the Station 4-35
4.6 Displaying Job Stack 4-36
5 Editing Jobs 5-1
5.1 Copying Jobs 5-2
5.1.0.1 Copying Jobs on the JOB CONTENT Window 5-2
5.1.0.2 Copying Jobs on the JOB LIST Window 5-3
5.2 Deleting Jobs 5-5
5.2.0.1 Deleting Jobs on the JOB CONTENT Window 5-5
5.2.0.2 Deleting Jobs on the JOB LIST Window 5-6
5.3 Modifying Job Names 5-7
5.3.0.1 Modifying Job Names on the JOB CONTENT Window 5-7
5.3.0.2 Modifying Job Names on the JOB LIST Window 5-9
5.4 Editing Comments 5-11
5.5 Setting Edit Lock on Individual Job Units 5-13
5.6 Enabling the Modification of Position Data Only 5-14

6 Convenient Functions 6-1
6.1 One-touch Operation “Direct Open” 6-1
6.2 Job Edit Function During Playback 6-3
6.2.1 Function 6-3
6.2.2 Job Edit During Playback 6-3
6.2.2.1 Basic Operation 6-3
6.2.2.2 Editing 6-6
6.2.2.3 Editing Multiple Jobs 6-8
6.2.2.4 Canceling Write Request 6-11
6.3 Parallel Shift Function 6-13
6.3.1 Function Overview 6-13
6.3.1.1 Parallel Shift of Step 6-14
6.3.1.2 Parallel Shift of Job 6-14
6.3.2 Setting the Shift Value 6-15
6.3.2.1 Coordinate Systems 6-15
6.3.2.2 Setting the Shift Value 6-15
6.3.3 Registering Shift Instructions 6-17
6.3.3.1 SFTON Instruction 6-18
6.3.3.2 SFTOF Instruction 6-20
6.3.3.3 MSHIFT Instruction 6-21
6.3.4 Continuation of the Parallel Shift Function 6-23
6.3.5 Examples of Use 6-24
6.3.5.1 Example of Use of Shift Addition/Subtraction 6-24
6.3.5.2 Example of Use of MSHIFT Instruction 6-25
6.4 Parallel Shift Job Conversion Function 6-26
6.4.1 Function Overview 6-26
6.4.2 Coordinate Systems for Conversion 6-27
6.4.3 Executing the Parallel Shift Job Conversion 6-31
6.4.3.1 Window Display 6-31
6.4.3.2 Parallel Shift Job Conversion Operation 6-33
6.4.4 Specifying the Shift Value by Position Variables 6-39
6.4.4.1 Window Display 6-39
6.4.4.2 Jobs Targeted for Conversion 6-41
6.4.4.3 Conversion of Coordinated Jobs 6-42
6.4.4.4 Operation Procedure 6-45

6.5 PAM Function 6-47
6.5.1 Function Overview 6-47
6.5.1.1 Input Ranges for Adjustment Data 6-47
6.5.2 Operating Methods 6-49
6.5.2.1 Setting Adjustment Data 6-49
6.5.2.2 Executing the Adjustment 6-51
6.6 Mirror Shift Function 6-55
6.6.1 Function Overview 6-55
6.6.2 Pulse Mirror-shift Function 6-56
6.6.2.1 Parameter Setting 6-56
6.6.2.2 Object Job 6-56
6.6.2.3 Group Axes Specification 6-56
6.6.2.4 Position Variables 6-56
6.6.3 Robot-coordinates Mirror-shift Function 6-57
6.6.3.1 Object Job 6-57
6.6.3.2 Group Axes Specification 6-57
6.6.3.3 Position Variables 6-57
6.6.4 User-coordinates Mirror-shift Function 6-58
6.6.4.1 Object Job 6-58
6.6.4.2 Group Axes Specification 6-58
6.6.4.3 Position Variables 6-58
6.6.5 Notes on the Mirror Shift Function 6-59
6.6.6 Operation Procedures 6-60
6.6.6.1 Calling Up the JOB CONTENT Window 6-60
6.6.6.2 Mirror Shift Conversion 6-60
6.6.6.3 Explanation of the Mirror Shift Window 6-61
6.7 Multi Window Function 6-63
6.7.1 Function Overview 6-63
6.7.2 Setting the Dividing Pattern of the General-Purpose Display Area 6-63
6.7.2.1 Calling Up and Operating Methods of the Display Dividing Pattern Setting Window 6-64
6.7.3 Displaying the Multi Window 6-68
6.7.3.1 Multi Window Mode and Single Window Mode 6-68
6.7.3.2 Displaying the Status of Plural (more than two) Window Dividing Pattern Setting 6-68
6.7.3.3 Displaying of Active Window and Non-Active Window 6-69
6.7.3.4 Limited Matters in Multi Window Mode 6-69
6.7.4 Operation of Multi Window 6-70
6.7.4.1 Switching of Multi Window Mode and Single Window Mode 6-70
6.7.4.2 Switching of Active Window 6-72

6.7.5 Switching the Axis Operation Control Group 6-74
6.7.5.1 S2C540 “Choosing Method of Notifying the Change of Axis Operation Control Group when Switching the Active Window” 6-74

6.8 Simple Menu Function 6-76

6.8.1 Simple Menu 6-76

6.8.2 Registering the Layout Patters to User Definition Menu 6-77
6.8.2.1 Register with {REGIST} Button 6-77
6.8.2.2 Register by Key Operation 6-78
6.8.2.3 Conditions to Register the Layout 6-79
6.8.2.4 The Displayed Layout Name 6-79

6.8.3 Calling Up of the Registered Layout 6-80
6.8.3.1 Calling up 6-80
6.8.3.2 Conditions when Calling Up the Layout 6-81

6.8.4 Editing “USER DEFINITION” Menu 6-81
6.8.4.1 Displaying “UNSER DEFINITION” Window 6-81
6.8.4.2 Displaying “USER DEFINITION MENU” window Under Main Menu 6-82
6.8.4.3 Change the Name of Registered Layout Name 6-84
6.8.4.4 Deleting the Layout 6-86
6.8.4.5 Delete All Layout 6-88

6.8.5 Save/Load (to external memory devices) the User Definition Menu Data 6-90
6.8.5.1 Saving the Data 6-90
6.8.5.2 Loading the Data 6-92

6.9 Parameter Setting Function 6-94

6.9.1 Parameter Setting Function 6-94

6.9.2 Teaching Condition Setting 6-96

6.9.3 Operation Condition Setting 6-99

6.9.4 Operate Enable Setting 6-102

6.9.5 Function Enable Setting 6-104

6.9.6 Jog Condition Setting 6-106

6.9.7 Playback Condition Setting 6-107

6.9.8 Functional Condition Setting 6-109

6.10 Jog Key Allocation 6-110

6.10.1 Jog Key Allocation Function 6-110

6.10.2 Jog Key Allocation Setting 6-111
6.10.2.1 Allocation of the Jog Key 6-111
6.10.2.2 Cancellation of Jog Key Allocation 6-113
6.10.2.3 Operating Method of Allocated External Axis 6-114

6.11 Energy-Saving Function 6-115
6.11.1 Energy-Saving Function 6-115
6.11.2 Energy-Saving Setting Method 6-116
6.11.2.1 Valid/Invalid of Energy-Saving Setting 6-116
6.11.2.2 Accumulated Energy-Saving Time Clearance 6-118
6.11.3 Energy-Saving Status Confirmation Method 6-120
6.11.3.1 Confirmation by the accumulated energy-saving time 6-120
6.11.3.2 Confirmation by System Signal Output 6-120
6.12 Instruction Displaying Color Setting Function 6-121
6.12.1 Setting the Instruction Displaying Color on the Job Window 6-121
6.13 Present Manipulator Position Output Function 6-123
6.13.1 Outline 6-123
6.13.2 Parameters 6-123
6.14 Softlimit Setting Function 6-127
6.14.1 About the Softlimit Setting Function 6-127
6.14.2 The Softlimit Setting Screen 6-127
6.14.3 Setting the Softlimit by Numerical Value Input 6-128
6.14.4 Set the Current Value to the Softlimit 6-129
6.14.5 Set the Softlimit (+)/ the Softlimit (-) to the Initial Maker Value 6-131
6.14.6 Change the Coordinate Display of the Softlimit (+)/ the Softlimit (-) 6-132
6.15 Analog Output Function Corresponding to Speed 6-133
6.15.1 Overview 6-133
6.15.2 Instructions 6-134
6.15.2.1 Instructions for Analog Output Function Corresponding to Speed 6-134
6.15.2.2 Registration of Instructions 6-136
6.15.2.3 Analog Output Display 6-139
6.15.3 Examples 6-140
6.15.3.1 Examples of Output Characteristics 6-140
6.15.3.2 Example of Variation of Operating Speed and Analog Output Value 6-141
6.15.4 Filter Process 6-142
6.15.4.1 When Parameter is Set to “0” 6-142
6.15.4.2 When Parameter is Set to Values Other Than “0” 6-142
6.15.4.3 Parameter Setting 6-142
6.15.5 Precautions 6-146
6.15.5.1 When Analog Output Corresponding to Speed is Interrupted 6-146
6.15.5.2 When More than One Manipulator is Used 6-146

7 External Memory Devices 7-1
7.1 Memory Devices 7-1
7.1.1 Compact Flash (CF Cards) 7-2
7.1.1.1 Recommended Compact Flash Cards 7-2
7.1.1.2 Notes on handling Compact Flash 7-2
7.1.1.3 Inserting a Compact Flash 7-3
7.1.2 USB Memory Stick 7-4
7.1.2.1 Recommended USB Memory Stick 7-4
7.1.2.2 Notes on handling USB Memory Stick 7-4
7.1.2.3 Inserting a USB Memory Stick 7-5
7.2 Handling Data 7-6
7.2.1 Data Classification 7-6
7.2.2 File Existence 7-9
7.2.2.1 Saving by Overwriting 7-10
7.3 Operation Flow 7-11
7.3.0.1 Operating a Folder 7-12
7.3.0.2 Saving Data 7-16
7.3.0.3 Loading Data 7-28
7.3.0.4 Verifying Data 7-38
7.3.0.5 Deleting Data 7-41
7.3.0.6 Job Selection Mode 7-43

8 Parameter 8-1
8.1 Parameter Configuration 8-1
8.2 Motion Speed Setting Parameters 8-2
8.2.0.1 S1CxG000: IN-GUARD SAFE OPERATION MAX. SPEED 8-2
8.2.0.2 S1CxG001: DRY-RUN SPEED 8-2
8.2.0.3 S1CxG002 to S1CxG009: JOINT SPEED FOR REGISTRATION 8-2
8.2.0.4 S1CxG010 to S1CxG017: LINEAR SPEED FOR REGISTRATION 8-3
8.2.0.5 S1CxG018 to S1CxG025: POSITION ANGLE SPEED 8-3
8.2.0.6 S1CxG026 to S1CxG029: JOG OPERATION ABSOLUTE VALUE SPEED 8-3
8.2.0.7 S1CxG030 to S1CxG032: INCHING MOVE AMOUNT 8-4
8.2.0.8 S1CxG033 to S1CxG040: POSITIONING ZONE 8-4
8.2.0.9 S1CxG044: LOW-SPEED START 8-6
8.2.0.10 S1CxG045 to S1CxG048: JOG OPERATION LINK SPEED 8-6
8.2.0.11 S1CxG056: WORK HOME POSITION RETURN SPEED 8-6
8.2.0.12 S1CxG057: SEARCH MAX. SPEED 8-6
8.2.0.13 S2C201: POSTURE CONTROL AT CARTESIAN OPERATION OF JOG 8-6
8.2.0.14 S2C202: OPERATION IN USER COORDINATE SYSTEM (WHEN EXTERNAL REFERENCE POINT CONTROL FUNCTION USED) 8-6
8.2.0.15 S2C320: CONTROLLED GROUP JOB TEACHING POSITION CHANGE 8-7

8.2.0.16 S2C422: OPERATION AFTER RESET FROM PATH DEVIATION 8-7
8.2.0.17 S2C423: OPERATION AFTER JOB 8-7
8.2.0.18 S2C424: DEVIATED POSITION 8-8
8.2.0.19 S2C425: CIRCULAR INTERPOLATION TOOL POSITION CONTROL 8-9
8.2.0.20 S2C653: EMERGENCY STOP CURSOR ADVANCE CONTROL FUNCTION 8-9
8.2.0.21 S2C654: EMERGENCY STOP CURSOR ADVANCE CONTROL FUNCTION CONT PROCESS COMPLETION POSITION 8-10
8.2.0.22 S2C655: EMERGENCY STOP ADVANCE CONTROL FUNCTION WORK START INSTRUCTION STEP MOTION COMPLETION DELAY TIME 8-10
8.2.0.23 S2C698: BASE AXIS OPERATION KEY ALLOCATION SETTING 8-10
8.2.0.24 S3C1098 to S3C1102: POSITION CORRECTING FUNCTION DURING PLAYBACK 8-11

8.3 Mode Operation Setting Parameters 8-12
8.3.0.1 S2C195: SECURITY MODE WHEN CONTROL POWER SUPPLY IS TURNED ON 8-12
8.3.0.2 S2C196: SELECTION OF CARTESIAN/CYLINDRICAL 8-12
8.3.0.3 S2C197: COORDINATE SWITCHING PROHIBITED 8-12
8.3.0.4 S2C198: EXECUTION UNITS AT “FORWARD” OPERATION 8-12
8.3.0.5 S2C199: INSTRUCTION (EXCEPT FOR MOVE) EXECUTION AT “FORWARD” OPERATION 8-13
8.3.0.6 S2C203: CHANGING STEP ONLY 8-13
8.3.0.7 S2C204: MANUAL SPEED STORING FOR EACH COORDINATE 8-13
8.3.0.8 S2C206: ADDITIONAL STEP POSITION 8-13
8.3.0.9 S2C207: MASTER JOB CHANGING OPERATION 8-14
8.3.0.10 S2C208: CHECK AND MACHINE-LOCK KEY OPERATION IN PLAY MODE 8-14
8.3.0.11 S2C209: RESERVED WORK JOB CHANGING OPERATION 8-14
8.3.0.12 S2C210: MASTER OR SUBMASTER CALL OPERATION IN PLAY MODE 8-15
8.3.0.13 S2C211: LANGUAGE LEVEL 8-16
8.3.0.14 S2C214: INSTRUCTION INPUT LEARNING FUNCTION 8-16
8.3.0.15 S2C215: ADDRESS SETTING WHEN CONTROL POWER IS TURNED ON 8-16
8.3.0.16 S2C216: JOB LIST DISPLAY METHOD AT JOB SELECTION 8-16
8.3.0.17 S2C217: INITIAL OPERATION OF MANIPULATOR 8-17
8.3.0.18 S2C218: PLAYBACK EXECUTION AT CYCLE MODE “1- STEP” 8-17
8.3.0.19 S2C219: EXTERNAL START 8-17
8.3.0.20 S2C220: PROGRAMMING PENDANT START 8-17
8.3.0.21 S2C221: SPEED DATA INPUT FORM 8-18
8.3.0.22 S2C222: RESERVED START 8-18
8.3.0.23 S2C224: JOB SELECTION AT REMOTE FUNCTION (PLAY MODE) 8-18
8.3.0.24 S2C225: EXTERNAL MODE SWITCH 8-18
8.3.0.25 S2C227: EXTERNAL CYCLE SWITCHING 8-18
8.3.0.26 S2C228: PROGRAMMING PENDANT CYCLE SWITCHING 8-19
8.3.0.27 S2C229: SERVO ON FROM EXTERNAL PP PROHIBITION 8-19
8.3.0.28 S2C230: PROGRAMMING PENDANT OPERATION WHEN “IO” IS SELECTED FOR REMOTE MODE 8-19
8.3.0.29 S2C234: STEP REGISTRATION AT TOOL NO. CHANGE 8-20

8.3.0.30 S2C293: REMOTE FIRST CYCLE MODE 8-20
8.3.0.31 S2C294: LOCAL FIRST CYCLE MODE 8-20
8.3.0.32 S2C312: POWER ON FIRST CYCLE MODE 8-20
8.3.0.33 S2C313: TEACH MODE FIRST CYCLE MODE 8-21
8.3.0.34 S2C314: PLAY MODE FIRST CYCLE MODE 8-21
8.3.0.35 S2C316: START CONDITION AFTER ALARM-4107 (“OUT OF RANGE (ABSO DATA)”) 8-21
8.3.0.36 S2C395: SIGNAL NAME ALIAS FUNCTION 8-22
8.3.0.37 S2C396: VARIABLE NAME ALIAS FUNCTION 8-23
8.3.0.38 S2C397: I/O VARIABLE CUSTOMIZE FUNCTION 8-24
8.3.0.39 S2C410: WORD REGISTRATION FUNCTION / WORD EDITING FUNCTION SPECIFICATION 8-25
8.3.0.40 S2C413: JOB UNDELETE FUNCTION 8-25
8.3.0.41 S2C415 to S2C419: TIME RESET 8-27
8.3.0.42 S2C431: TOOL NO. SWITCHING 8-28
8.3.0.43 S2C433: POSITION TEACHING BUZZER 8-28
8.3.0.44 S2C434: JOB LINKING DESIGNATION (When Twin Synchronous Function Used) 8-28
8.3.0.45 S2C437: PLAYBACK OPERATION CONTINUATION FUNCTION 8-29
8.3.0.46 S2C544: I/O NAME DISPLAY FUNCTION FOR JOB 8-30
8.3.0.47 S2C684:ALL AXES ANGLE DISPLAY FUNCTION 8-30
8.3.0.48 S2C713: CONTROL POINT OPERATION SETTING ON THE SERVO TRACK 8-31

8.4 Parameters According to Interference Area 8-32
8.4.0.1 S1CxG400 to S1CxG415: PULSE SOFT LIMIT 8-32
8.4.0.2 S2C001: CUBE SOFT LIMIT CHECK 8-32
8.4.0.3 S2C002: S-AXIS INTERFERENCE CHECK 8-34
8.4.0.4 S2C003 to S2C066: CUBE/AXIS INTERFERENCE CHECK 8-35
8.4.0.5 S2C067 to S2C194: CUBE USING METHOD 8-37
8.4.0.6 S3C000 to S3C047: CUBE SOFT LIMIT 8-39
8.4.0.7 S3C048 to S3C063: S-AXIS INTERFERENCE AREA 8-39
8.4.0.8 S3C064 to S3C1087: CUBIC INTERFERENCE AREA 8-39
8.4.0.9 S3C1089 to S3C1096: ROBOT INTERFERENCE AREA 8-39
8.4.0.10 S3C1097: A SIDE LENGTH OF WORK-HOME-POSITION CUBE 8-39

8.5 Parameters according to Status I/O 8-40
8.5.0.1 S2C235: USER OUTPUT RELAY WHEN CONTROL POWER IS ON 8-40
8.5.0.2 S4C000 to S4C015: PARITY OF USER INPUT GROUPS 8-40
8.5.0.3 S4C016 to S4C031: PARITY OF USER OUTPUT GROUPS 8-41
8.5.0.4 S4C032 to S4C047: DATA OF USER INPUT GROUPS 8-42
8.5.0.5 S4C048 to S4C063: DATA OF USER OUTPUT GROUPS 8-43
8.5.0.6 S4C064 to S4C079: USER OUTPUT GROUP TO BE INITIALIZED AT SWITCHING MODE 8-44
8.5.0.7 S4C240: USER OUTPUT NO. WHEN MANIPULATOR DROP ALLOWABLE RANGE ERROR OCCURS 8-44

8.6 Parameters according to Coordinated or Synchronized Operation 8-45
8.6.0.1 S2C212: +MOV or +SMOV INSTRUCTION SPEED INPUT 8-45
8.6.0.2 S2C213: +MOV INSTRUCTION INTERPOLATION INPUT 8-45

8.6.0.3 S2C231: OPERATION METHOD AT FWD/BWD OPERATION OR TEST RUN BY INDEPENDENT CONTROL 8-45
8.6.0.4 S2C232: JOB AT CALLING MASTER OF SUBTASK BY INDEPENDENT CONTROL 8-46
8.6.0.5 S2C264: STATION AXIS CURRENT VALUE DISPLAY FUNCTION.... 8-46
8.6.0.6 S2C265 to S2C288: STATION AXIS DISPLAYED UNIT 8-46
8.6.0.7 S2C420: POSTURE CONTROL OF SYNCHRONIZED MANIPULATOR (When Twin Synchronous Function Used) 8-47
8.6.0.8 S2C421: POSTURE CONTROL OF MANIPULATOR IN MULTI-JOB (When Twin Synchronous Function Used) 8-47
8.6.0.9 S2C687: OPERATION OF JOB WITHOUT CONTROL GROUP SPECIFICATION 8-48
8.6.0.10 S2C688: EXECUTION OF “BWD” OPERATION..... 8-48
8.6.0.11 S3C1101: MAXIMUM DEVIATION ANGLE OF CURRENT STATION POSITION (When Twin Synchronous Function Used) 8-48

8.7 Parameters for Other Functions or Applications 8-49
8.7.0.1 S1CxG049 to S1CxG051: SMALL CIRCLE CUTTING 8-49
8.7.0.2 S1CxG052 to S1CxG053: SMALL CIRCLE CUTTING DIRECTION LIMIT VALUE 8-49
8.7.0.3 S1CxG054 to S1CxG055: SMALL CIRCLE CUTTING OVERLAP VALUE 8-49
8.7.0.4 S1CxG063, S1CxG064: PATTERN CUTTING DIMENSION 8-49
8.7.0.5 S1CxG065: MIRROR SHIFT SIGN INVERSION 8-49
8.7.0.6 S2C430: RELATIVE JOB OPERATION METHOD 8-49
8.7.0.7 S3C1111 to S3C1190: ANALOG OUTPUT FILTER CONSTANT (When analog output corresponding to speed function is used) 8-50
8.7.0.8 S3C1191: CUT WIDTH CORRECTION VALUE (When form cutting function is used) 8-50

8.8 Hardware Control Parameters 8-51
8.8.0.1 S2C646: ANTICIPATOR FUNCTION..... 8-51
8.8.0.2 S4C327 to S4C390: SETTING OF OPERATING RELAY NO..... 8-52
8.8.0.3 S4C391 to S4C454: OPERATING METHOD OF RELAYS..... 8-52
8.8.0.4 S2C786 to S2C788: COOLING FAN ALARM DETECTION..... 8-52
8.8.0.5 S2C789 to S2C792: COOLING FAN ALARM 1 OPERATION 8-53
8.8.0.6 S2C793 to S2C796: COOLING FAN ALARM 2 OPERATION 8-53
8.8.0.7 S2C797 to S2C800: COOLING FAN ALARM 3 OPERATION 8-53
8.8.0.8 S2C801 to S2C804: FAN ALARM 1 POWER SOURCE STATUS..... 8-53
8.8.0.9 S2C805 to S2C808: FAN ALARM 2 POWER SOURCE STATUS..... 8-53
8.8.0.10 S2C809 to S2C812: FAN ALARM 3 POWER SOURCE STATUS..... 8-54

8.9 TRANSMISSION PARAMETERS..... 8-55

8.10 Application Parameters..... 8-55

8.10.1 Arc Welding 8-55
8.10.1.1 AxP000: APPLICATION 8-55
8.10.1.2 AxP003: WELDING ASSIGNMENT OF WELDING START CONDITION FILE 8-55
8.10.1.3 AxP004: WELDING ASSIGNMENT OF WELDING END CONDITION FILES 8-55
8.10.1.4 AxP005: WELDING SPEED PRIORITY 8-55
8.10.1.5 AxP009: WORK CONTINUING 8-55

8.10.1.6 AxP010: WELDING INSTRUCTION OUTPUT 8-56
8.10.1.7 AxP011, AxP012: MANUAL WIRE OPERATION SPEED 8-56
8.10.1.8 AxP013, AxP014: WELDING CONTROL TIME 8-56
8.10.1.9 AxP015 to AxP017: NUMBER OF WELDING CONTROL 8-56
8.10.1.10 AxP026 to AxP029: TOOL ON/OFF USER OUTPUT NO. (Jigless system) 8-56

8.10.2 Handling Application 8-56
8.10.2.1 AxP002, AxP004: f1 KEY FUNCTION 8-56
8.10.2.2 AxP003, AxP005: f2 KEY FUNCTION 8-56

8.10.3 Spot Welding 8-56
8.10.3.1 AxP003: MAXIMUM NUMBER OF CONNECTED POWER SOURCES 8-56
8.10.3.2 AxP004: GUN FULL OPEN STROKE ON/OFF SIGNAL 8-57
8.10.3.3 AxP005: STROKE CHANGE ANSWER TIME LIMIT 8-57
8.10.3.4 AxP006: PARITY SPECIFICATION FOR WELDING CONDITIONS 8-57
8.10.3.5 AxP007: ANTICIPATE TIME 8-57
8.10.3.6 AxP015: WELDING ERROR RESET OUTPUT TIME 8-57
8.10.3.7 AxP016, AxP017: ELECTRODE WEAR AMOUNT ALARM VALUE 8-57

8.10.4 General-purpose Application 8-58
8.10.4.1 AxP009: WORK CONTINUE PROHIBIT 8-58

9 General Purpose Application 9-1

9.1 Simplified Teaching and Playback 9-1

9.1.1 Teaching 9-1
9.1.1.1 Preparation for Teaching 9-1
9.1.1.2 Teaching Procedure 9-4
9.1.1.3 Path Confirmation 9-13
9.1.1.4 Correcting a Job 9-14
9.1.1.5 Changing the Position Data 9-15

9.1.2 Playback 9-19
9.1.2.1 Preparation Before Playback 9-19
9.1.2.2 Playback Procedure 9-19

9.1.3 Example for General Purpose Application 9-20
9.1.3.1 Example Job 9-20
9.1.3.2 Teaching Procedure 9-21
9.1.3.3 Confirmation of Cutting Operation (Speed Limitation Drive) 9-24

9.2 Operation for Tool Control 9-25

9.2.1 Function Keys 9-25

9.2.2 Tool Control Settings 9-26

9.2.3 Work Instructions 9-27
9.2.3.1 TOOLON/TOOLOF Instructions 9-27
9.2.3.2 CALL Instruction 9-28
9.2.3.3 WVON Instruction 9-28
9.2.3.4 WVOF Instruction 9-29

9.3 Using Files 9-30
9.3.1 Weaving Basic Coordinate System 9-30
9.3.2 WEAVING CONDITION Window 9-31
9.3.3 Operation Method 9-34
9.3.3.1 Displaying a Weaving File 9-34
9.3.3.2 Editing Condition Data 9-34
9.3.3.3 Cases that Require the Registration of Reference Points 9-34
9.3.3.4 Prohibiting Weaving 9-35
9.3.3.5 Method to Prohibit Weaving in the Check Mode 9-35
9.3.3.6 Method to Prohibit Weaving During a “TEST RUN” or FWD Operation 9-36
9.3.3.7 Prohibiting Weaving By Means of a System Input Signal 9-36
9.4 Table of Work Instructions 9-37

10 Handling Application 10-1
10.1 Outlines 10-1
10.1.1 Function Keys 10-1
10.1.2 HAND Instruction 10-2
10.1.2.1 Function 10-2
10.1.2.2 Instruction and Additional Items 10-2
10.1.3 HSEN (Gripper Sensor) Instruction 10-3
10.1.3.1 Function 10-3
10.1.3.2 Instruction and Additional Items 10-3
10.1.3.3 Examples 10-4
10.1.4 Handling Window 10-4
10.1.5 Shock Sensor Function 10-6
10.1.6 Shock Sensor Input Signal 10-6
10.1.7 Shock Sensor Input Reset 10-6
10.1.8 Low Air Pressure Input Signal 10-6
10.2 Registering Instructions 10-7
10.2.1 HAND Instruction 10-7
10.2.2 HSEN Instruction 10-9
10.3 Table of Work Instructions 10-12

11 Table of Basic Instructions 11-1
11.1 Move Instructions 11-1
11.2 I/O Instructions 11-4
11.3 Control Instructions 11-6
11.4 Shift Instructions 11-8
11.5 Operating Instructions 11-9

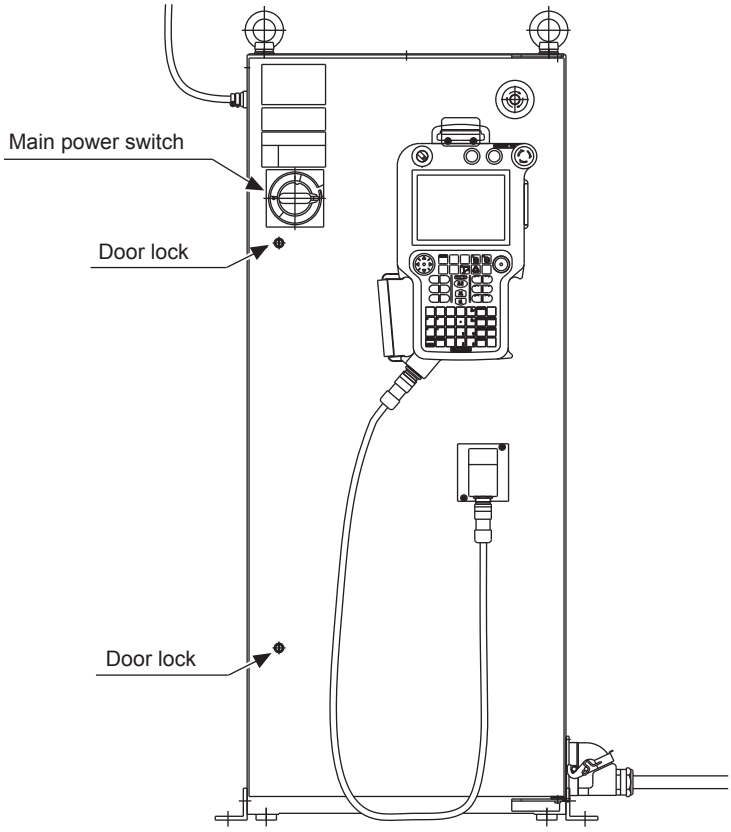
1 Introduction

1.1 DX100 Overview

The main power switch and the door lock are located on the front of the DX100 controller. The emergency stop button is installed in the upper right corner of the cabinet door and the programming pendant hangs from a hook below the button.

For information on setup, installation, and connection of the DX100 system, refer to the “DX100 INSTRUCTIONS”.

Fig. 1-1: DX100 Front View

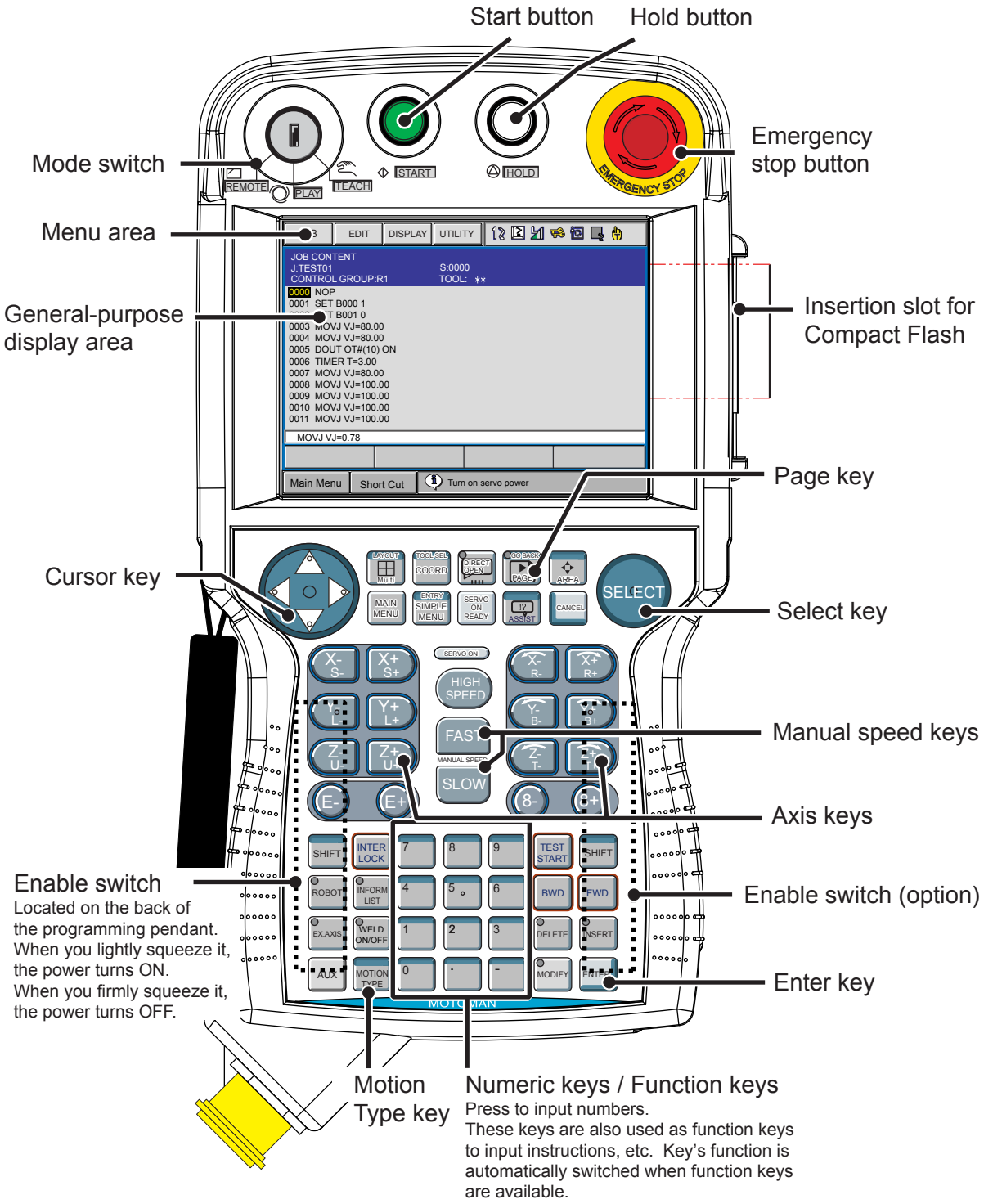


1.2 Programming Pendant

1.2.1 Programming Pendant Overview

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

Fig. 1-2: PP Overview



1.2.2 Key Description

1.2.2.1 Character Keys

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

is shown as [ENTER].

The Numeric keys have additional functions along with their number values. Dual function keys are used in the context of the operation being performed. For example:

may be described in the text as [1] or [TIMER].

1.2.2.2 Symbol Keys

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

Cursor

Emergency Stop button

Direct Open key

Page key

1.2.2.3 Axis Keys and Numeric Keys

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

Axis Keys Numeric Keys

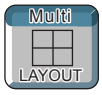
1.2.2.4 Keys Pressed Simultaneously

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

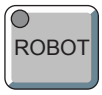
1.2.3 Programming Pendant Keys

[START]	**Starts the manipulator motion in playback operation.** • The lamp on this button is lit during the play operation. The lamp also lights when the playback operation is started by the system input START signal. The lamp turns OFF when the playback operation is stopped by alarm occurrence, HOLD signal, or mode change.
[HOLD]	**Holds the manipulator motion.** • This button is enabled in any mode. • The lamp on this button is lit only while the button is being pressed. Although the lamp turns OFF when the button is released, the manipulator stays stopped until a START command is input. • The HOLD lamp automatically lights in the following cases to indicate that the system is in HOLD status. The start and axis operations are disabled while the lamp is lit. 1. The HOLD signal of system input is ON. 2. The HOLD request is being sent from an external device in remote mode. 3. In the HOLD status caused by an error occurred in working process such as wire sticking at arc welding.
E.STOP Button	**Turns OFF the servo power.** • When the servo power is turned OFF, the SERVO ON LED on the programing pendant will extinguish. • An emergency stop message is displayed on the screen.
[MODE]	**Selects the Play mode, Teach mode, or Remote mode.**
	PLAY: Play Mode The playback of taught job is enabled. The START signal from an external device is disabled.
	TEACH: Teach Mode The axis operation and edition from the programming pendant are enabled. The START signal from an external device is disabled.
	REMOTE: Remote Mode The operation by external signals is enabled. [START] is invalid during the remote mode.

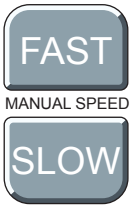
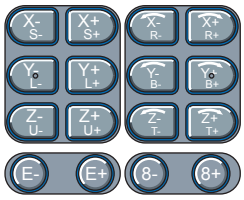
Enable Switch 	**Turns ON the servo power.** When the Enable switch is lightly squeezed while the SERVO ON LED is blinking and the Mode Switch is set to “TEACH”, the power is turned ON. And when this switch is released or firmly squeezed while the power is turned ON, the power turns OFF.
[SELECT] 	**Works as described below.** • Selects menu items in the main menu area and the pull-down menu area. • Makes the selected item ready to be set in the general-purpose display area. • Displays multiple messages in the message area.
Cursor 	**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 depending on the window. • If the UP cursor button is pressed when the cursor is on the first line, the cursor will move to the last line of the job. Conversely, if the cursor is on the last line of the job and the DOWN cursor button is pressed, the cursor will jump to the first line of the job. [SHIFT] + UP Scrolls the screen upward. [SHIFT] + DOWN Scrolls the screen downward. [SHIFT] + RIGHT Scrolls the screen to the right. [SHIFT] + LEFT Scrolls the screen to the left.
[MAIN MENU] 	**Displays the main menu.** If this button is pressed while the main menu is displayed, the main menu disappears. [MAIN MENU] + UP Increases the brightness of the screen. [MAIN MENU] + DOWN Decreases the brightness of the screen.
[SIMPLE MENU] 	**Displays the simple menu.** If this button is pressed while the simple menu is displayed, the simple menu disappears.

[SERVO ON READY] 	**Enables the servo power supply to be turned ON.** Press this button to enable the servo power supply to be turned ON if the servo power supply is shut OFF by the emergency stop or overrun signal. When this button is pressed: • In the play mode, the servo power supply is turned ON if the safeguarding is securely closed. • In the teach mode, the SERVO ON lamp flashes and the servo power supply is turned ON when the Enable switch is ON. • The SERVO ON lamp is lit while the servo power is ON.
[ASSIST] 	**Displays the menu to assist the operation for the currently displayed window.** Pressing this button with [SHIFT] or [INTERLOCK] displays the help guidance for the operation. • [SHIFT] + [ASSIST] The function list of key combinations with [SHIFT] appears. • [INTERLOCK] + [ASSIST] The function list of key combinations with [INTERLOCK] appears.
[CANCEL] 	**Cancels the current status.** • Deletes the sub menu in the main menu area and the pull-down menu area. • Cancels the input data or the input status in the general-purpose display area. • Cancels the multiple views in the message area. • Cancels the occurred error.
[MULTI]  	**Works for the multi mode.** If this button is pressed when the multi mode is ON, the active window switches. [SHIFT] + [MULTI] Switches between the multi-window display and the single-window display when the multi mode is ON.
[COORD] 	**Select the operation coordinate system when the manipulator is operated manually.** • Five coordinate systems (joint, cartesian, cylindrical, tool and user) can be used. Each time this key is pressed, the coordinate system is switched in the following order: "JOINT"→"WLD/CYL"→"TOOL"→"USER" • The selected coordinate system is displayed on the status display area. [SHIFT] + [COORD] The coordinate number can be changed when the "TOOL" or "USER" coordinate system is selected.

[DIRECT OPEN]	**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 a work instruction, the content of the condition file will be displayed. For Input/output instructions, the input/output condition will be displayed. • The lamp on this button is lit while the direct open is ON. Press this button while the lamp is lit to return to the previous window.
[PAGE]	**Displays the next page.** The page can be switched only when the lamp on this button is lit. [SHIFT] + [PAGE] Switches to the previous page.
[AREA]	**Moves the cursor in the following order : "Menu Area"→"General-Purpose Display Area"→"Message Area"→"Main Menu Area". If no item is displayed, the cursor does not move.** [SHIFT] + [AREA] The language can be switched when the bilingual function is valid. (Bilingual function is optional.) [AREA] + DOWN Moves the cursor from the general-purpose display area to the operation button when the operation button is displayed. [AREA] + UP Moves the cursor to the general-purpose display area when the cursor is on the operation button.
[SHIFT]	**Changes the functions of other keys by pressing together.** Can be used with [ASSIST], [COORD], [AREA], [MOTION TYPE], [ROBOT], [EX. AXIS], cursor key or Numeric key to access alternate functions. Refer to the description of each key for the alternate [SHIFT] functions.
[INTERLOCK]	**Changes the functions of other keys by pressing together.** Can be used with [ASSIST], [MULTI], [TEST START], [FWD], or Numeric key (Numeric key customize function), [ROBOT]. Refer to the description of each key for the alternate [INTERLOCK] functions.

[INFORM LIST] 	**Displays instruction lists of commands available for job editing.**
[ROBOT]  	**Enables the robot axis operation.** [ROBOT] is active for the system where multiple manipulators are controlled by one DX100 or the system with external axes. [SHIFT] + [ROBOT] The robot under axis operation can be switched to a robot axis which is not registered to the currently selected job. [**INTERLOCK**] + [ROBOT] Switches the application when several applications are set to a robot.
[EX. AXIS] 	**Enables the external axis (base axis or station axis) operation.** [EX.AXIS] is active for the system with external axes. [SHIFT] + [**EX. AXIS**] The external axis under axis operation can be switched to an external axis which is not registered to the currently selected job.
[MOTION TYPE] 	**Selects the interpolation type for playback operation.** The selected interpolation type is shown in the status display area on the screen. • Each time this key is pressed, the interpolation type changes in the following order: "MOVJ"→" MOVL"→"MOVC"→"MOVS" [SHIFT] + [MOTION TYPE] The interpolation mode changes in the following order: "STANDARD"→" EXTERNAL REFERENCE POINT"*→" CONVEYOR"* Interpolation type can be changed in any mode. *: These modes are purchased options.

[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. Operation stops immediately when this key is released. • The manipulator operates according to the currently selected operation cycle: "AUTO", "1CYCLE", or "STEP". • The manipulator operates at the taught speed. However, if the taught speed exceeds the maximum teaching speed, the operation proceeds at the maximum teaching speed.
[FWD] 	**Moves the manipulator through the taught steps while this key is pressed.** • Only move instructions are executed (one instruction at a time, no welding instructions). [INTERLOCK] + [FWD] All instructions are executed. [REFP] + [FWD] Moves to the reference point of the cursor line. See *section 3.3.1.3 “Moving to Reference Point” on page 3-27* . The manipulator operates at the selected manual speed. Make sure that the selected manual speed is the desired one before starting operation.
[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). The manipulator operates at the selected manual speed. Make sure that the selected manual speed is the desired one before starting operation.
[DELETE] 	**Deletes the registered instruction.** • Deletion completes when [ENTER] is pressed while this key lamp is lit.
[INSERT] 	**Inserts a new instruction.** • Insertion completes when [ENTER] is pressed while this key lamp is lit.
[MODIFY] 	**Modifies the taught position data or instruction.** • Modification completes when [ENTER] is pressed while this key lamp is lit.

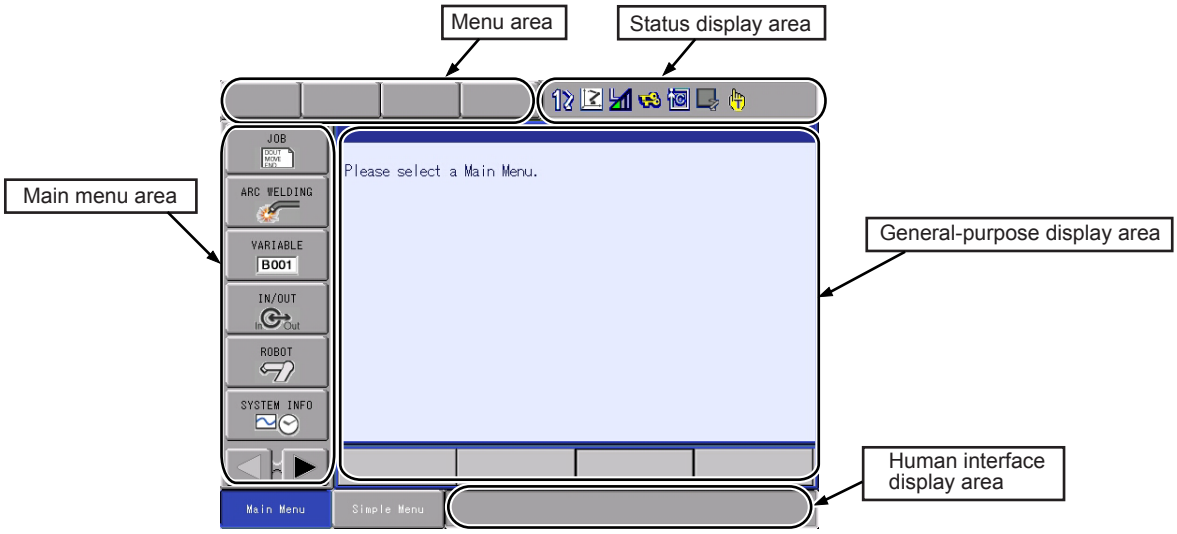
[ENTER] 	**Registers instructions, data, current position of the manipulator, etc.** • When [ENTER] is pressed, the instruction or data displayed in the input buffer line moves to the cursor position to complete a registration, insertion, or modification.
MANUAL SPEED keys  	**Sets the speed for manual operation. This speed is also valid for operations with [FWD] and [BWD].** • There are four speed levels (slow, medium, fast, and inching). The speed changes as described below. The selected speed is displayed on the status area. Each time [FAST] is pressed, manual speed changes in the following order: "INCH"→" SLOW"→"MED"→"FST". Each time [SLOW] is pressed, manual speed changes in the following order: "FST"→"MED"→"SLOW"→"INCH"
[HIGH SPEED] 	**Makes the manipulator move at high speed while this button and one of the axis keys are pressed simultaneously during manual operation. No need to change the setting of speed.** • The speed for [HIGH SPEED] is specified in advance.
Axis Keys  	**Moves specified axes on manipulator.** • The manipulator axes only move while the key is pressed. • Multiple axes can be operated simultaneously by pressing two or more keys at the same time. The manipulator operates in the selected coordinate system at the selected manual speed. Make sure that the selected coordinate system and the manual speed are the desired ones before starting the axis operation. It is possible to allocate any external axes to [E-] + [E+], [8-] + [8+] keys to operate them. Refer to *section 6.10 "Jog Key Allocation" on page 6-110*.
Numeric Keys 	**Enters the number or symbol when the ">" prompt appears on the input line.** • "." is the decimal point. "-" is a minus sign or hyphen. The Numeric keys are also used as function keys. Refer to the explanation of each function for details.

1.2.4 Programming Pendant Display

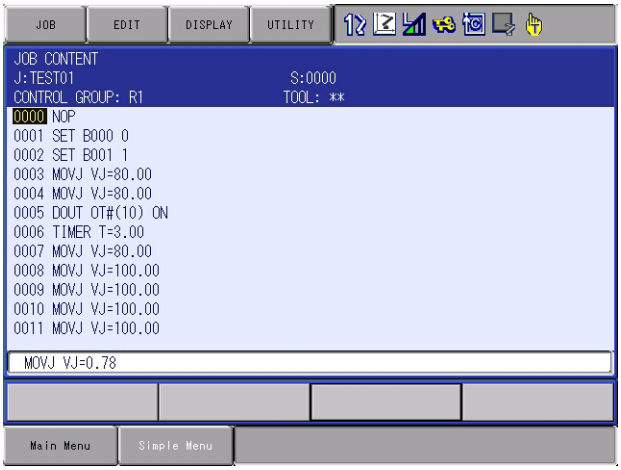
The programming pendant display is a 5.7 inch color display.
Alphanumeric characters can be used.

1.2.4.1 Five Display Areas

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



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



1.2.4.2 General-purpose Display Area

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

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

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

EXECUTE : Continues operation with the displayed contents.

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

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

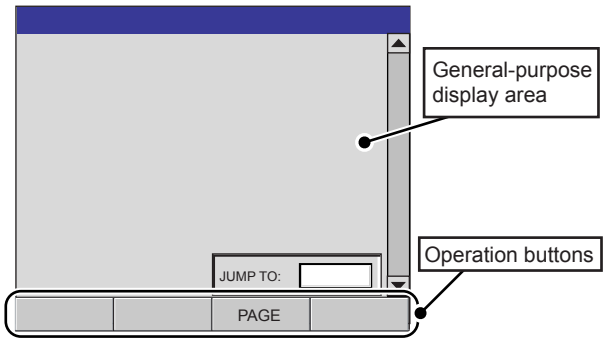
STOP : Stops operation when loading, saving, or verifying with an external memory device.

RELEASE : Releases the overrun and shock sensor function.

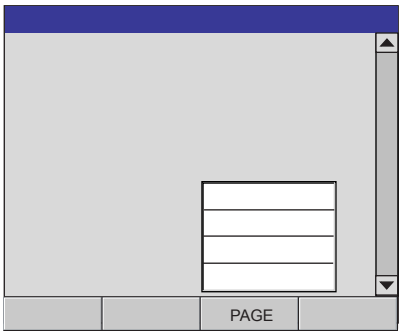
RESET : Resets an alarm. (Cannot reset major alarms.)

PAGE : Jumps to the appropriate page if the page can be switched.

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

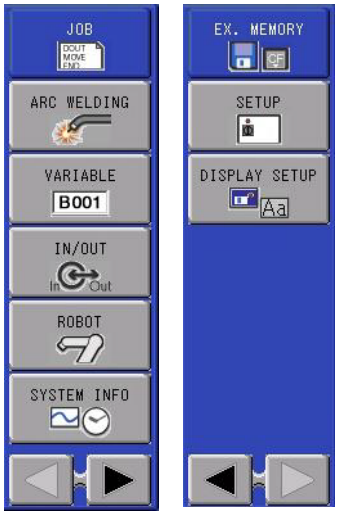


- When the page can be switched by selecting an item, the following selection list appears when “DIRECT PAGE” is selected. Select a desired item using the UP and DOWN cursor key and press [ENTER].



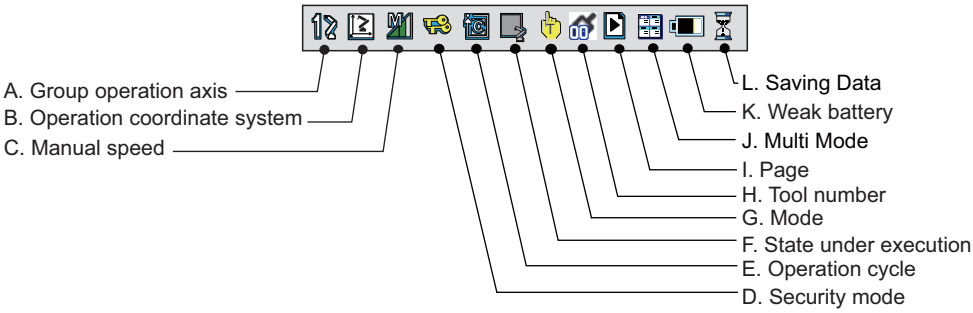
1.2.4.3 Main Menu Area

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



1.2.4.4 Status Display Area

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



A. Control Group

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

to : Robot Axes

to : Base Axes

to : Station Axes

B. Operation Coordinate System

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

: Joint Coordinates

: Cartesian Coordinates

: Cylindrical Coordinates

: Tool Coordinates

: User Coordinates

C. Manual Speed

Displays the selected speed. For details, refer to *section 2.2.0.5 “Select Manual Speed” on page 2-4*.

: Inching

: Low Speed

: Medium Speed

: High Speed

D. Security Mode

: Operation Mode

: Edit Mode

: Management Mode

E. Operation Cycle

Displays the present operation cycle.

: Step

: Cycle

: Continuous

F. 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

G. Mode

: Teach mode

: Play mode

H. Tool Number

From to : Displayed the tool No. which is chosen by a robot when the tool No. switch function is valid. (S2C431=1).

I. Page

: Displayed when the page can be switched.

J. Multi Mode

: Displayed when the multi window mode is set.

K. Weak Battery of Memory

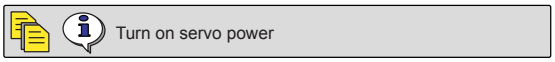
: Displayed when the battery of memory is weak.

L. Saving Data

: Displayed while saving the data.

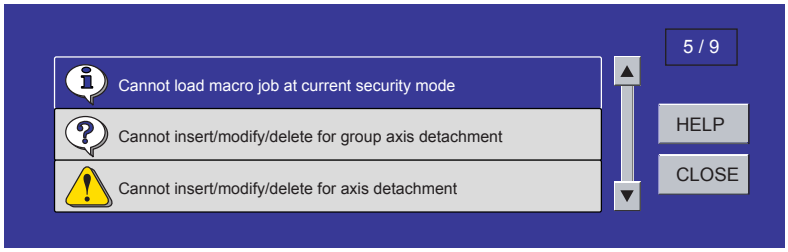
1.2.4.5 Human Interface Display Area

An error(s) or a message(s) is displayed in the human interface display area.



When an error is displayed, operations cannot be performed until the error is canceled. Press [CANCEL] to allow for operations.

When two or more errors occur, appears in the message display area. Activate the message display area and press [SELECT] to view the list of current errors.



To close the error list, select "CLOSE" or press [CANCEL].

1.2.4.6 Menu Area

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

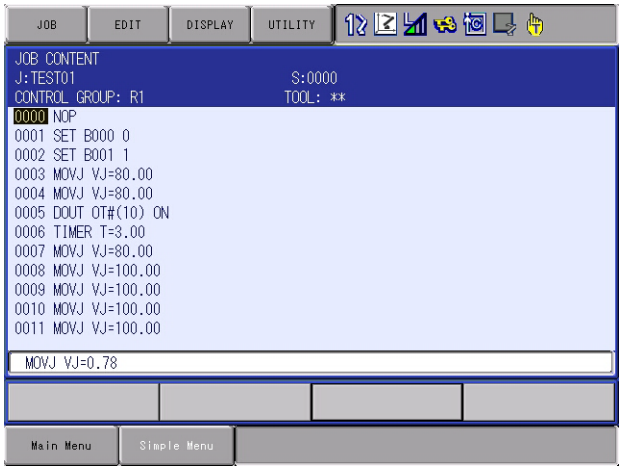
1.2.5 Screen Descriptions

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

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

- The window can be displayed according to the view desired.

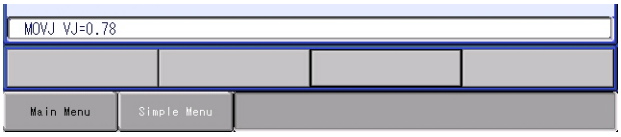
Full Window View



Upper Window View

Middle Window View

Lower Window View



1.2.6 Character Input Operation

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

1.2.6.1 Character Input

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

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

1.2.6.2 Operation

Keypad	Button on the Programming Pendant	Explanation
Cursor		Moves the cursor (focus).
[SELECT]		Selects a character.
[CANCEL]		Clears all the characters being typed. Pressing this second time cancels the software keypad.
[ENTER]		Enters the input characters.
Button Tab		Switches the keypads displayed on the programming pendant.
		Closes the software keypad.
Numeric Keys	 to 	Enters numbers.

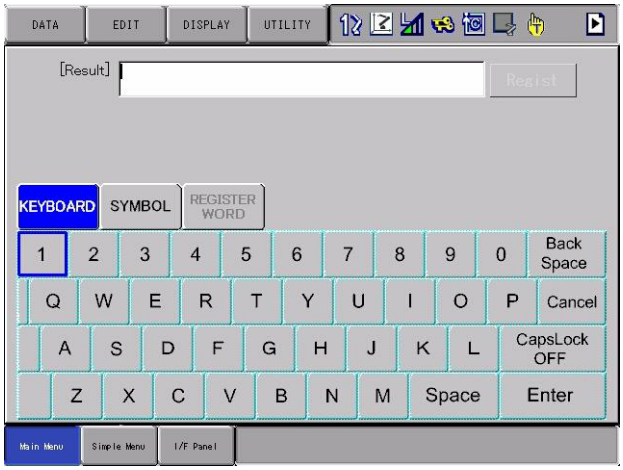
1.2.6.3 Alphanumeric Input

Number input is performed with the Numeric keys or on the following alphanumeric input window. Numbers include 0 to 9, the decimal point (.), and the minus sign/hyphen (-).

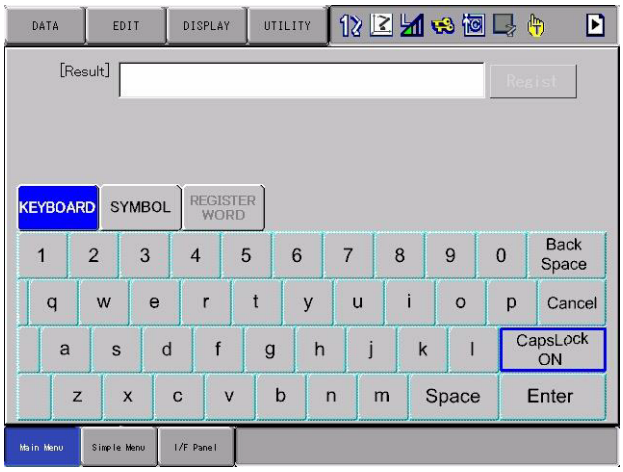
Note however, that the decimal point cannot be used in job names.

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

For Numbers and Upper-case Characters



For Numbers and Lower-case Characters



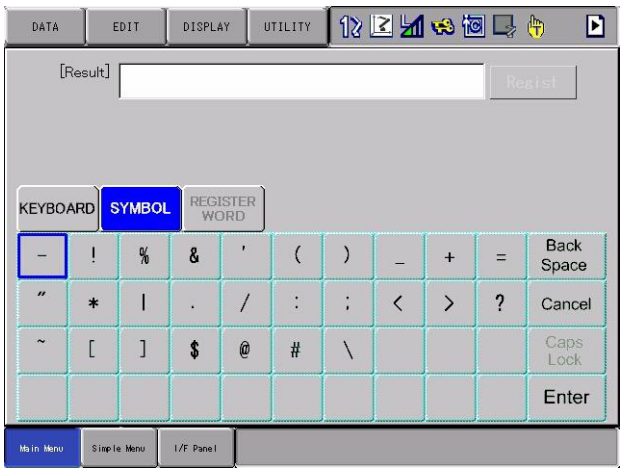
1.2.6.4 Symbol Input

Press the page key to display the symbol input window.

Move the cursor to the desired symbol and press [SELECT] to enter the symbol.

Note that only some symbols are available for naming jobs.

For Symbols



SUPPLE-MENT

When the focus is in a text field of [Result], it is able to move a cursor position by pressing [Shift]+[→] or [Shift]+[←].

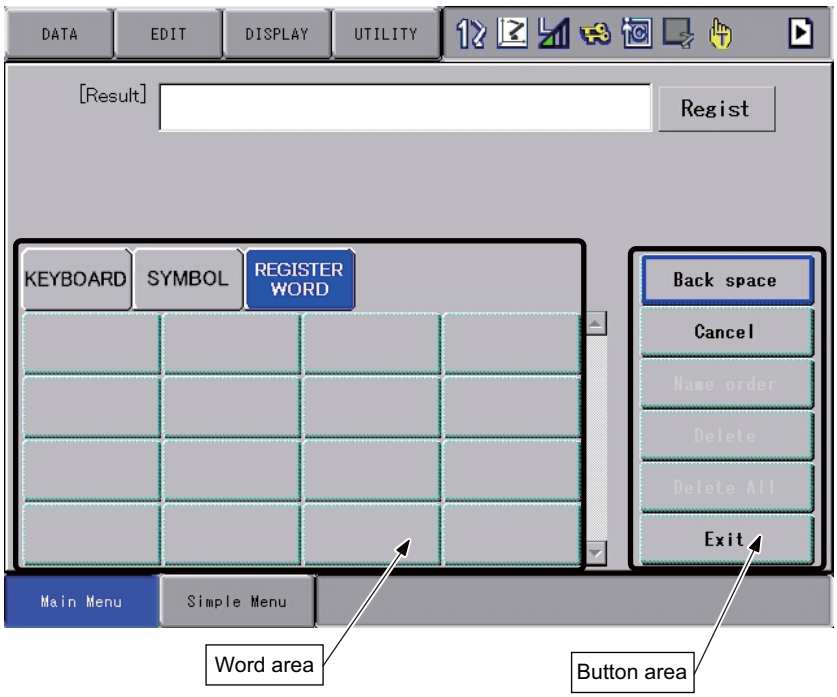
1.2.6.5 Register Word Function

This function enables to use the registered word when input a character by registering the word (character string) in advance.
To use this function simplifies to input the same character strings.
It is able to register the 32 words of eight characters.

> SUPPLE-MENT
> There is a limit to enter the character by input contents. If a registered word includes a limited character, it is unable to use the word.
> e.g. Unable to use the lower case characters, a decimal point and symbols to the job name.

Select {SET WORD} from {SETUP} in the main menu.

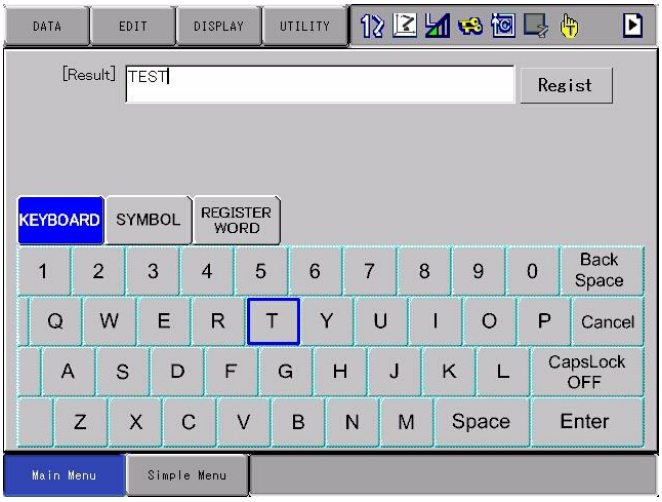
- Register word window is displayed
- The registered words are displayed in the word area.
- If there is not any registered word, unable to select [Name order], [Delete] and [Delete All] in the button area.



■ **Word Registration**

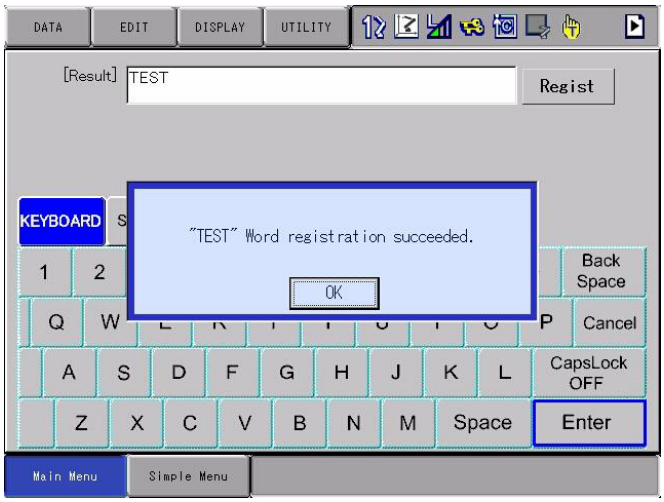
It is able to register the 32 words of eight characters.
Register a word by selecting [REGISTER WORD] button while the word editing is valid (S2C410=1) during using the keyboard, or register the word in the word register screen.

e.g. Register the word “TEST”.
Select [KEYBORD].



Enter [TEST] by using the keyboard, and select [Regist].

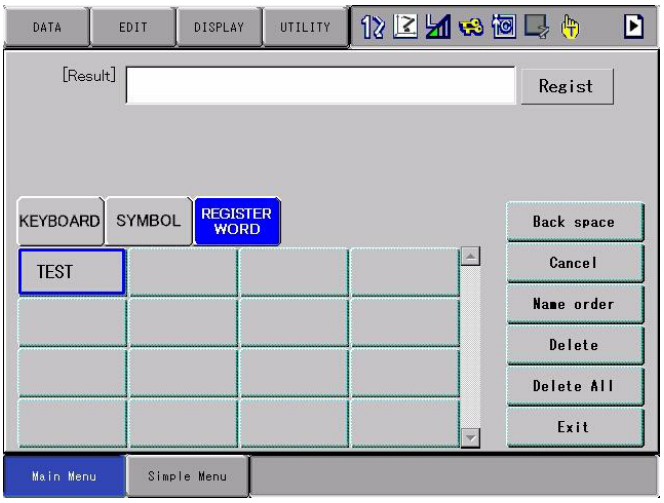
– The dial box appears.



Select [REGISTER WORD].

– The word area appears.

– Confirm that [TEST] is in the word area.



■ **Back Space**

Delete the last character of the input character string.

Select [Back space] in the word register screen.

– Delete the last character of the input character string.

■ **Cancel**

Cancel the input character string.

Select [Cancel] in the word register screen.

– Cancel the character string if there is a character string is input.

– End the word register screen if there is not any character string.

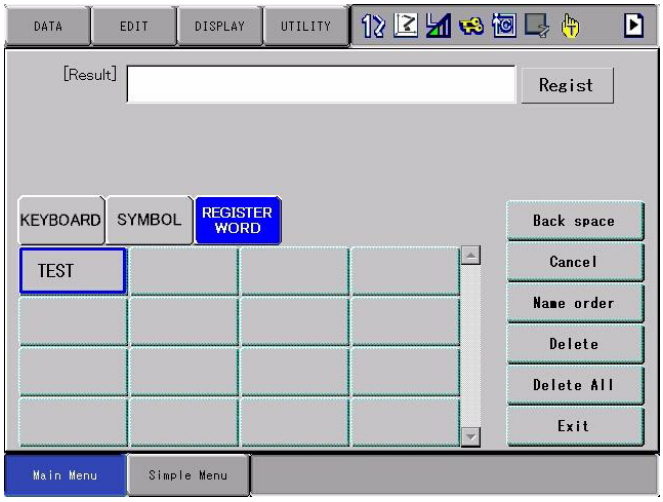
■ **Use of Words**

e.g. Use the registered word [TEST].

Select [REGISTER WORD].

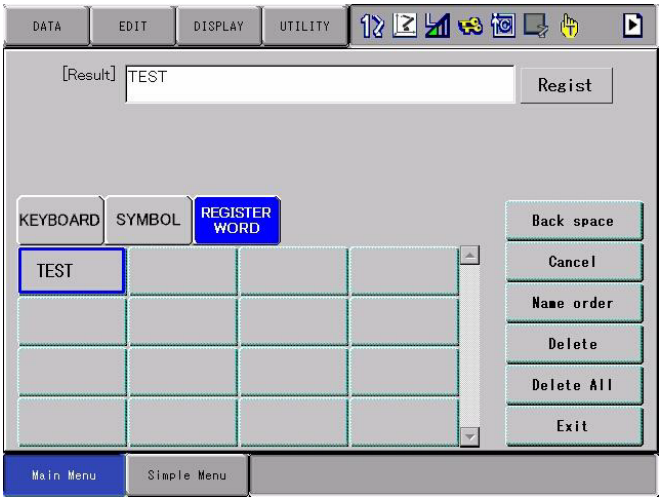
– The word area is displayed.

> SUPPLE-MENT
> There is a limit to enter the character by input contents. If a registered word includes a limited character, it is unable to use the word.
> e.g. Unable to use the lower case characters, a decimal point and symbols to the job name.



Select [TEST] in the word area.

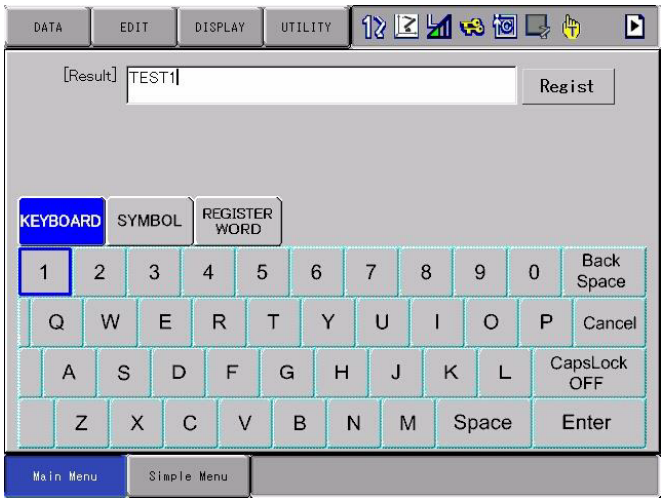
– The registered word [TEST] appears in the input area.



Select [KEYBORD].

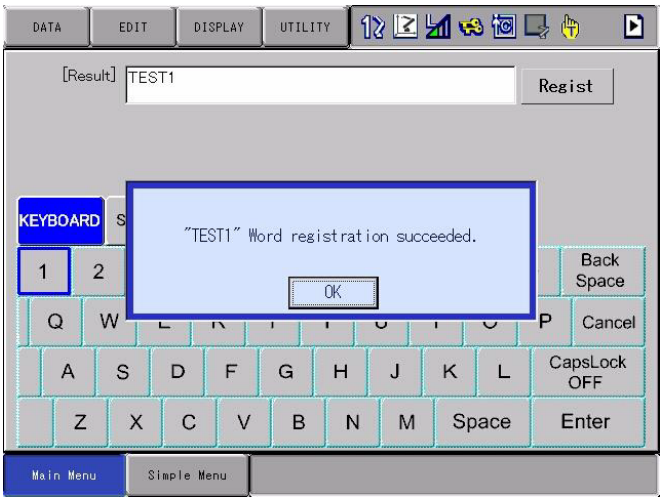
Move the focus to “1” by the programming pendant, and press [Select].

– The “1” is added after [TEST] in the [Result].



While [TEST1] is displayed in the [Result], select [Regist].

The dial box, which says {“TEST1” Word registration succeeded. } appears, and the registration is completed.



■ **Change the Arrangement of the Words to Display**

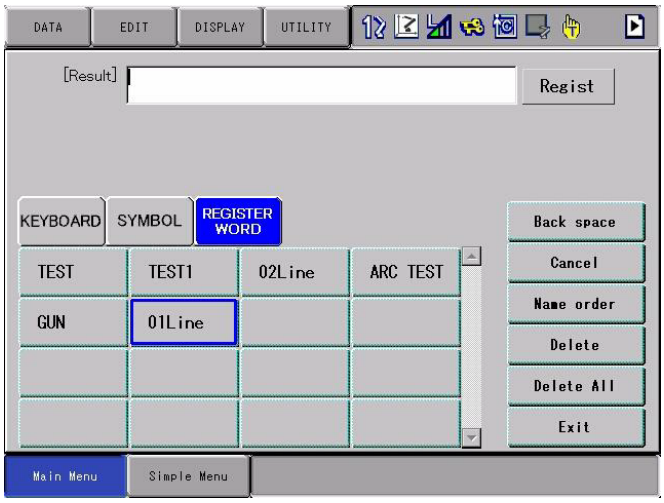
Able to change the arrangement of the words to display.

1. Name order display

Select [Name order] in the button area.

– Displayed by the name order of the words.

– [Name order] button changes to [Register order] button.

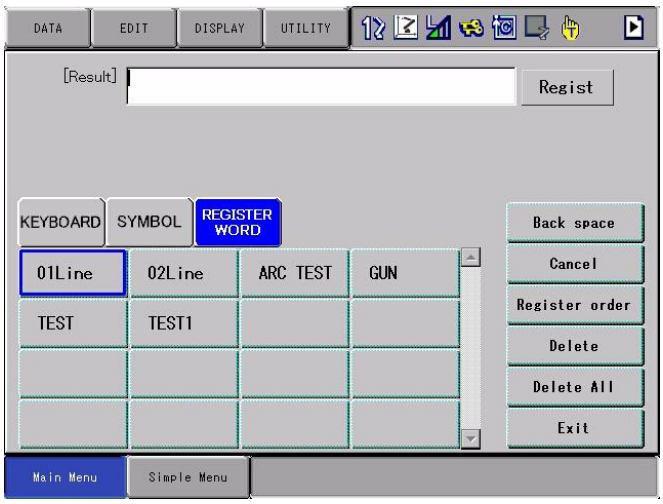


2. Register order display

Select [Register order] in the button area.

– Displayed by the register order of the words.

– [Register order] button changes to [Name order] button.

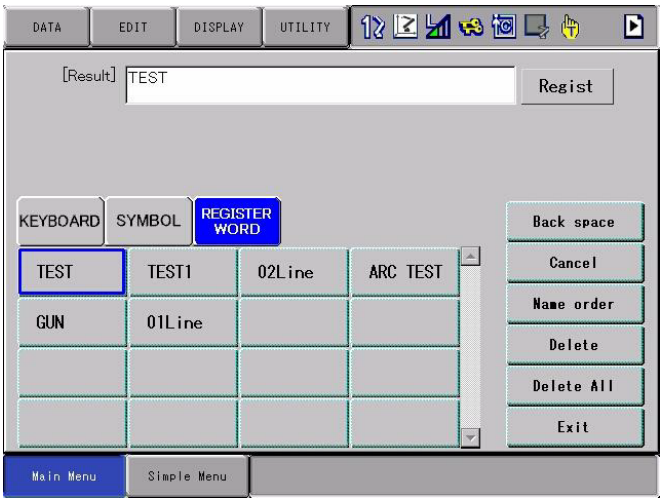


■ **Delete the Word**

Able to delete the registered words.

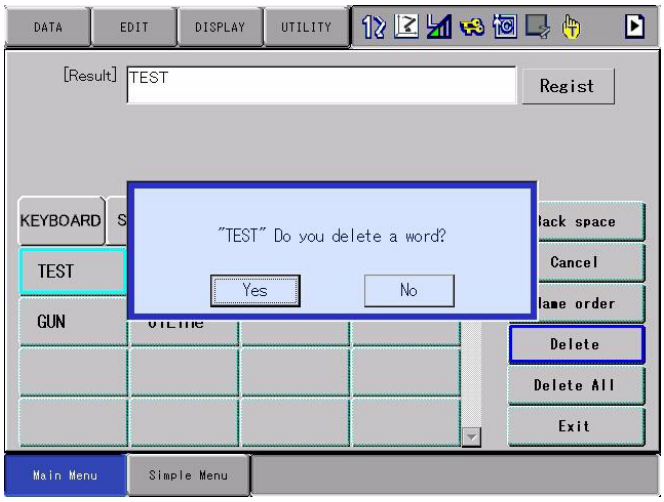
Delete the words while the word editing is valid (S2C410=1) during using the keyboard, or delete the word in the word register screen.

e.g. Delete registered word “TEST”.
Select [REGISTER WORD].
The word area appears.



Select [TEST] in the word area, and select [Delete] in the button area.

– The dialog box, which asks {“TEST” Do you delete a word?}, appears.



Select [Yes].

[TEST] in the word area is deleted.

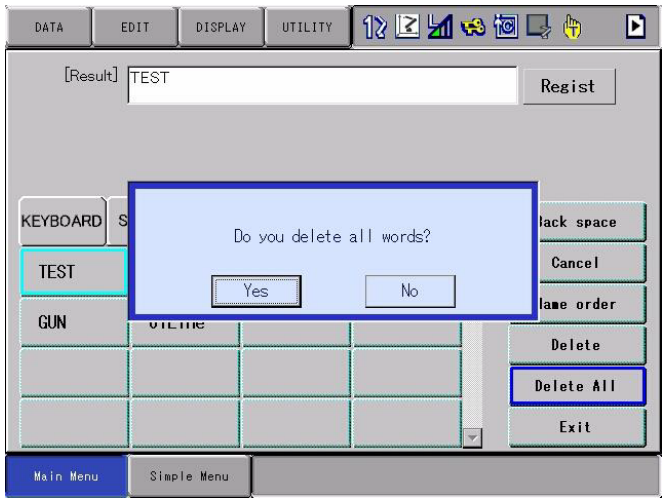
■ **Delete All Words**

Able to delete all registered words.

Delete while the word editing is valid (S2C410=1) during using the keyboard, or delete the word in the word register screen.

- Delete all registered words.
  Select [Delete All] in the button area.

– The dialog box, which asks {Do you delete all words?}, appears.



Select [Yes].

– The all words are deleted.

1.3 Mode

The following three modes are available for DX100.

- Teach Mode
- Play Mode
- Remote Mode

1.3.1 Teach Mode

In the teach mode, the following can be done.

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

1.3.2 Play Mode

In the play mode, the following can be done.

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

1.3.3 Remote Mode

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

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

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

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

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

Note: “PP” indicates the programming pendant.

1.3.4 Teach Mode Priority

In the teach mode, following operations are disabled:

1. Playback using [START].
2. Playback from external input signals.

1.4 Security Mode

1.4.1 Types of Security Modes

The following three types of security modes are available for DX100.

Any operation in the edit mode and the management mode requires a password. The password must contain between 4 and 8 letters, numbers, or symbols.

- Operation Mode
  The operator can monitor the line operation and start and stop the manipulator. Repairs, etc. can be performed if any abnormalities are detected.

- Edit Mode
  Teaching, robot jog operations, and editing of jobs and various condition files can be performed in addition to the operations enabled in the operation mode.

- Management Mode
  The operator who performs setup and maintenance for the system can set the machine control parameter, set the time, change the password, etc. in addition to the operations enabled in the edit mode.

Table 1-1: Menu & Security Mode (Sheet 1 of 4)

Main Menu	Sub Menu	Allowed Security Mode	
		DISPLAY	EDIT
JOB	JOB	Operation	Edit
	SELECT JOB	Operation	Operation
	CREATE NEW JOB[1)]	Edit	Edit
	MASTER JOB	Operation	Edit
	JOB CAPACITY	Operation	-
	RES. START (JOB)[1)]	Edit	Edit
	RES. STATUS[2)]	Operation	-
	CYCLE	Operation	Operation
VARIABLE	BYTE	Operation	Edit
	INTEGER	Operation	Edit
	DOUBLE	Operation	Edit
	REAL	Operation	Edit
	STRING	Operation	Edit
	POSITION (ROBOT)	Operation	Edit
	POSITION (BASE)	Operation	Edit
	POSITION (ST)	Operation	Edit
	LOCAL VARIABLE	Operation	-
IN/OUT	EXTERNAL INPUT	Operation	Edit
	EXTERNAL OUTPUT	Operation	Edit
	UNIVERSAL INPUT	Operation	Operation
	UNIVERSAL OUTPUT	Operation	Operation
	SPECIFIC INPUT	Operation	-
	SPECIFIC OUTPUT	Operation	-
	RIN	Operation	-
	CPRIN	Operation	-
	REGISTER	Operation	Management
	AUXILIARY RELAY	Operation	-
	CONTROL INPUT	Operation	-
	PSEUDO INPUT SIG	Operation	Management
	NETWORK INPUT	Operation	-
	NETWORK OUTPUT	Operation	-
	ANALOG OUTPUT	Operation	-
	SV POWER STATUS	Operation	-
	LADDER PROGRAM	Management	Management
	I/O ALARM	Management	Management
	I/O MESSAGE	Management	Management

Table 1-1: Menu & Security Mode (Sheet 2 of 4)

Main Menu	Sub Menu	Allowed Security Mode	
		DISPLAY	EDIT
ROBOT	CURRENT POSITION	Operation	-
	COMMAND POSITION	Operation	-
	SERVO MONITOR	Management	-
	WORK HOME POS	Operation	Edit
	SECOND HOME POS	Operation	Edit
	DROP AMOUNT	Management	Management
	POWER ON/OFF POS	Operation	-
	TOOL	Edit	Edit
	INTERFERENCE	Management	Management
	SHOCK SENS LEVEL	Operation	Edit
	USER COORDINATE	Edit	Edit
	HOME POSITION	Management	Management
	MANIPULATOR TYPE	Management	-
	ANALOG MONITOR	Management	Management
	OVERRUN&S-SENSOR[1)]	Edit	Edit
	LIMIT RELEASE[1)]	Edit	Edit
	ARM CONTROL[1)]	Management	Management
	SHIFT VALUE	Operation	-
SYSTEM INFO	VERSION	Operation	-
	MONITORING TIME	Operation	Management
	ALARM HISTORY	Operation	Management
	I/O MSG HISTORY	Operation	Management
	SECURITY	Operation	Operation
FD/CF	LOAD	Edit	-
	SAVE	Operation	-
	VERIFY	Operation	-
	DELETE	Operation	-
	DEVICE	Operation	Operation
	FOLDER	Edit	Management
	INITIALIZE[1)]	Operation	-

Table 1-1: Menu & Security Mode (Sheet 3 of 4)

Main Menu	Sub Menu	Allowed Security Mode	
		DISPLAY	EDIT
PARAMETER	S1CxG	Management	Management
	S2C	Management	Management
	S3C	Management	Management
	S4C	Management	Management
	A1P	Management	Management
	A2P	Management	Management
	A3P	Management	Management
	A4P	Management	Management
	A5P	Management	Management
	A6P	Management	Management
	A7P	Management	Management
	A8P	Management	Management
	RS	Management	Management
	S1E	Management	Management
	S2E	Management	Management
	S3E	Management	Management
	S4E	Management	Management
	S5E	Management	Management
	S6E	Management	Management
	S7E	Management	Management
	S8E	Management	Management
SETUP	TEACHING COND.	Edit	Edit
	OPERATE COND.	Management	Management
	OPERATE ENABLE	Management	Management
	FUNCTION ENABLE	Management	Management
	JOG COND.	Management	Management
	PLAYBACK COND.	Management	Management
	FUNCTION COND.	Management	Management
	DATE/TIME	Management	Management
	GRP COMBINATION[2)]	Management	Management
	RESERVE JOB NAME	Edit	Edit
	USER ID	Edit	Edit
	SET SPEED	Management	Management
	KEY ALLOCATION	Management	Management
	JOG KEY ALLOC.	Edit	Management
	RES. START (CNCT)	Management	Management
	AUTO BACK SET	Management	Management
	WRONG DATA LOG	Edit	Management
	ENERGY SAVING FUNCTION	Edit	Management
DISPLAY SETUP	CHANGE FONT	Operation	Operation
	CHANGE BUTTON	Operation	Operation
	INITIALIZE LAYOUT	Operation	Operation
	CHANGE WINDOW PATTERN	Operation	Operation

Table 1-1: Menu & Security Mode (Sheet 4 of 4)

Main Menu	Sub Menu	Allowed Security Mode	
		DISPLAY	EDIT
ARC WELDING	ARC START COND.	Operation	Edit
	ARC END COND.	Operation	Edit
	ARC AUX COND.	Operation	Edit
	POWER SOURCE COND.	Operation	Edit
	ARC WELD DIAG.	Operation	Edit
	WEAVING	Operation	Edit
	ARC MONITOR	Operation	Edit
	ARC MONITOR (SAMPL)	Operation	-
HANDLING	HANDLING DIAGNOSIS	Operation	Edit
SPOT WELDING	WELD DIAGNOSIS	Operation	Edit
	I/O ALLOCATION	Management	Management
	GUN CONDITION	Management	Management
	SPOT POWER SOURCE COND.	Management	Management
	APPLICATION CONDITION SETTING	Management	Management
SPOT WELDING (MOTOR GUN)	WELD DIAGNOSIS	Operation	Edit
	GUN PRESSURE	Edit	Edit
	PRESSURE	Edit	Edit
	I/O ALLOCATION	Management	Management
	GUN CONDITION	Management	Management
	CLEARANCE SETTING	Operation	Edit
	SPOT POWER SOURCE COND.	Management	Management
	TIP INSTALLATION	Operation	Management
	APPLICATION SETTING	Management	Management
GENERAL	WEAVING	Operation	Edit
	GENERAL DIAG.	Operation	Edit
COMMON TO ALL APPLICATIONS	I/O VARIABLE CUSTOMIZE	Operation	Operation

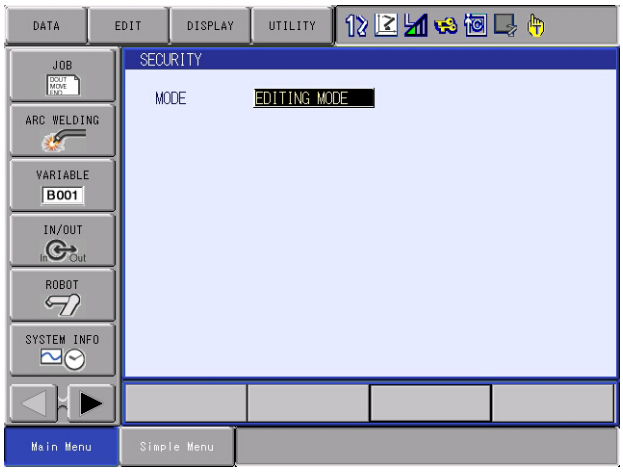
1 Displayed in the teach mode only.
2 Displayed in the play mode only.

1.4.2 Changing Security Modes

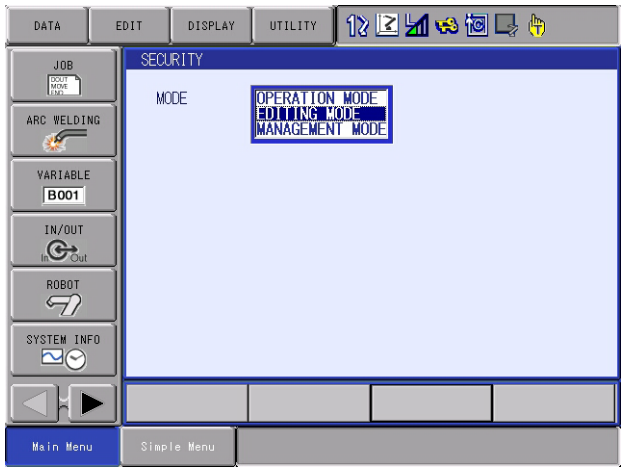
The security mode can be changed only when the main menu is displayed.

1. Select {SYSTEM INFO} under the main menu.
   – The sub menu appears.

2. Select {SECURITY}.
   – The security of the main menu is shown.



   – The security mode can be selected from operation mode, edit mode, or management mode.



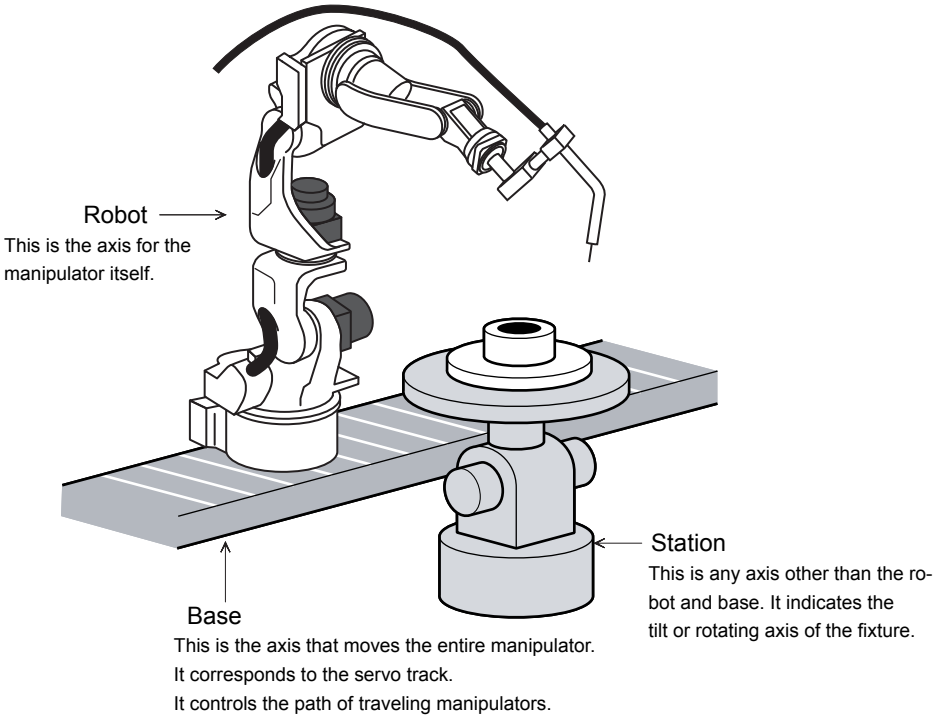
3. Select the desired security mode.
   – When the selected security mode is higher than the currently set mode, the user ID input status window appears.
4. Input the user ID as required.
   – At the factory, the user ID number is preset as follows:
     Edit Mode: [00000000]
     Management Mode: [99999999]
5. Press [ENTER].
   – The selected security mode's input ID is checked. If the correct user ID is input, the security mode is changed.

2 Manipulator Coordinate Systems and Operations

2.1 Control Groups and Coordinate Systems

2.1.1 Control Group

For the DX100, a group of axes to be controlled at a time is called “Control Group”, and the group is classified into three units: “ROBOT” as a manipulator itself, “BASE” that moves the manipulator in parallel, and “STATION” as jigs or tools other than “ROBOT” and “BASE”. BASE and STATION are also called external axes.



2.1.2 Types of Coordinate Systems

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

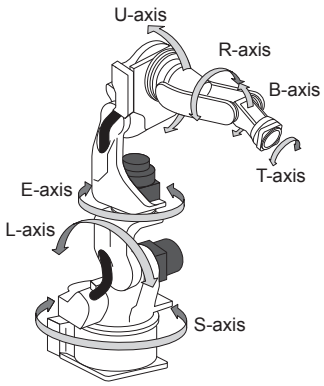
- Joint Coordinates
  Each axis of the manipulator moves independently.

- Cartesian Coordinates
  The tool tip of the manipulator moves parallel to any of the X-, Y-, and Z-axes.

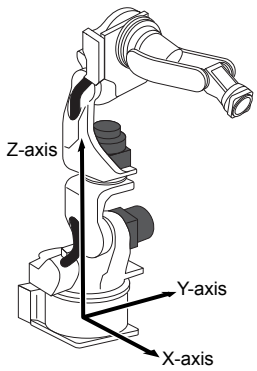
- Cylindrical Coordinates
  The θ axis moves around the S-axis. The R-axis moves parallel to the L-axis arm. For vertical motion, the tool tip of the manipulator moves parallel to the Z-axis.

- 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.

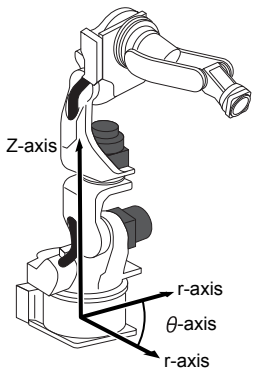
- User Coordinates
  The XYZ-cartesian coordinates are defined at any point and angle. The tool tip of the manipulator moves parallel to the axes of them.



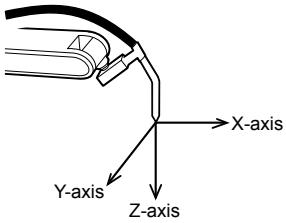
Joint Coordinates



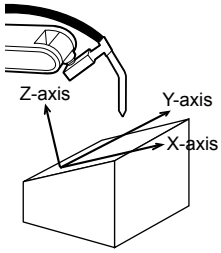
Cartesian Coordinates



Cylindrical Coordinates



Tool Coordinates



User Coordinates

2.2 General Operations

2.2.0.1 Check Safety

Before any operation of the DX100, read Section 1 “Safety” of “DX100 INSTRUCTIONS” again and keep safe around the robot system or peripherals.

2.2.0.2 Select Teach Mode

Set the mode switch on the programming pendant to “teach”.

2.2.0.3 Select Control Group

If the DX100 has several Control Groups or Coordinate Control Systems (optional function), select control group first.

If two or more ROBOT, BASE, STATION are registered, switch control group by pressing [SHIFT] + [ROBOT] or [SHIFT] + [EX. AXIS].

After selecting a job, the control group registered in the selected job is enabled. The control group registered in the edit job can be switched by pressing [ROBOT] or [EX. AXIS].

Check the selected control group at the status display area on the programming pendant.

2.2.0.4 Select Coordinate System

Select a coordinate system by pressing [COORD] key.

Each time [COORD] key is pressed, the coordinate system switches in the following order:

Joint→Cartesian (Cylindrical)→Tool→User.

Check the selected coordinate on the status display area on the programming pendant.

2.2.0.5 Select Manual Speed

Select manual speed of operation by pressing [FAST] or [SLOW]. The selected speed is effective not only for axis operation but [FWD] or [BWD] operation.

> **NOTE** In operating the manipulator manually by the programming pendant, the maximum speed of center point is limited at 250 mm/s.

- Each time [FAST] is pressed, the speed switches in the order of "INCH"→"SLOW"→"MED"→"FAST".

- Each time [SLOW] is pressed, the speed switches in the order of "FAST"→"MED"→"SLOW"→"INCH".

Check selected manual speed on the status area of Programming Pendant.

2.2.0.6 Servo ON

Press [SERVO ON READY], then SERVO ON LED starts blinking.

Squeeze the Enable switch, then SERVO ON LED starts lighting.

2.2.0.7 Axis Operation

Make sure of safety around the manipulator. Press axis key, then axis moves according to the selected control group, coordinates, and manual speed. See *section 2.3 "Coordinate Systems and Axis Operation" on page 2-5*.

2.2.0.8 HIGH SPEED

Press [HIGH SPEED] while pressing an axis key to make the manipulator move faster than the usual speed.

> **SUPPLEMENT** The [HIGH SPEED] key is disabled when "INCH" is selected for the manual speed.

2.3 Coordinate Systems and Axis Operation

2.3.1 Joint Coordinates

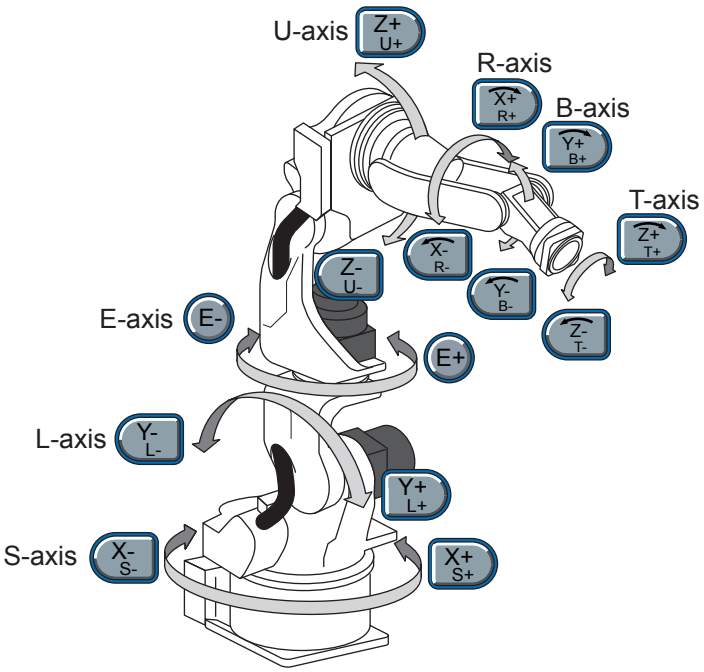
When operating in joint coordinates mode, the S, L, U, R, B, and T-axes of the manipulator move independently. The motion of each axis is described in the table below.

Table 2-1: Axis Motion in Joint Coordinates

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

SUPPLE-MENT

- When two or more axis keys are pressed at the same time, the manipulator will perform a compound movement. However, if two different directional keys (such as [S -] + [S +]) for the same axis are pressed at the same time, the axis will not operate.
  (When [S -] + [S +] + [L +] are pressed, only the axis corresponding to [L +] will operate.)



2.3.2 Cartesian Coordinates

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

Table 2-2: Axis Motion in Cartesian Coordinates

Axis Name		Axis Operation Key	Motion
Basic Axes	X-axis	X- S- / X+ S+	Moves parallel to X-axis.
	Y-axis	Y- L- / Y+ L+	Moves parallel to Y-axis.
	Z-axis	Z- U- / Z+ U+	Moves parallel to Z-axis.
Wrist Axes		Motion about TCP is executed. See *section 2.3.7 "Control Point Operation" on page 2-15*.	

SUPPLE-MENT

- When two or more axis keys are pressed at the same time, the manipulator will perform compound movement. However, if two different directional keys (such as [X -] + [X +]) for the same axis are pressed at the same time, the axis will not operate.
(When [X -] + [X +] + [Y +] are pressed, only the axis corresponding to [Y +] will operate.)

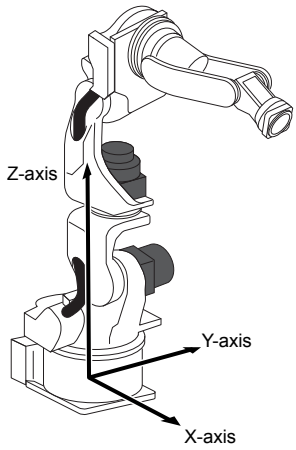


Fig. 2-1: Moves parallel to X- or Y-axis

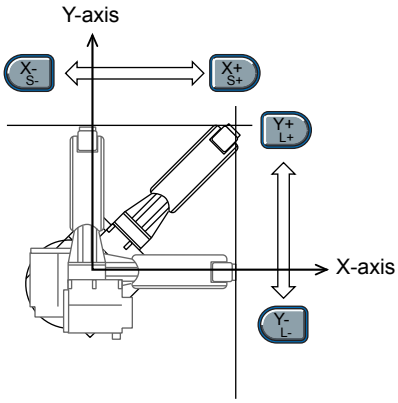
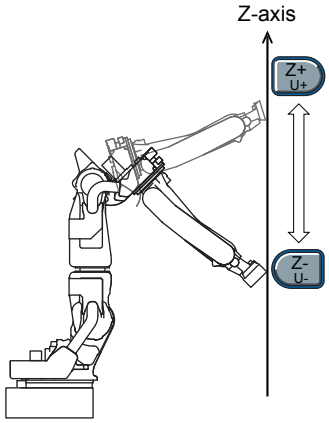


Fig. 2-2: Moves parallel to Z-axis



2.3.3 Cylindrical Coordinates

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

Table 2-3: Axis Motion in Cylindrical Coordinates

Axis Name		Axis Operation Key	Motion
Basic Axes	θ-axis	X- S- / X+ S+	Main unit rolls around S-axis.
	r-axis	Y- L- / Y+ L+	Moves perpendicular to Z-axis.
	Z-axis	Z- U- / Z+ U+	Moves parallel to Z-axis.
Wrist Axes		Motion about TCP is executed. See *section 2.3.7 "Control Point Operation" on page 2-15*.	

SUPPLE-MENT

- When two or more axis keys are pressed at the same time, the manipulator will perform compound movement. However, if two different directional keys (such as [Z -] + [Z +]) for the same axis are pressed at the same time, the axis will not operate.
  (When [Z -] + [Z +] + [Y +] are pressed, only the axis corresponding to [Y +] will operate.)

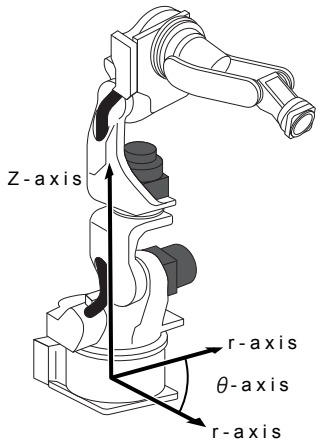


Fig. 2-3: Rolls around q-axis

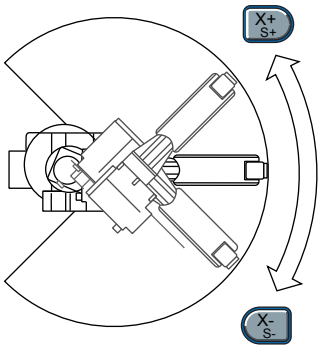
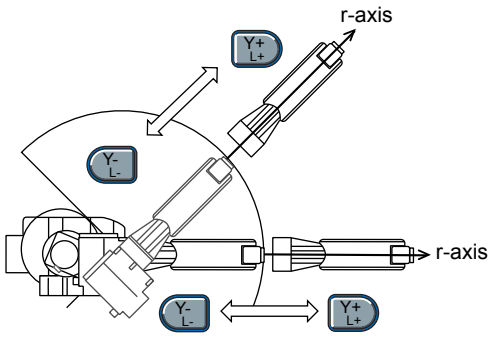


Fig. 2-4: Moves perpendicular to r-axis



2.3.4 Tool Coordinates

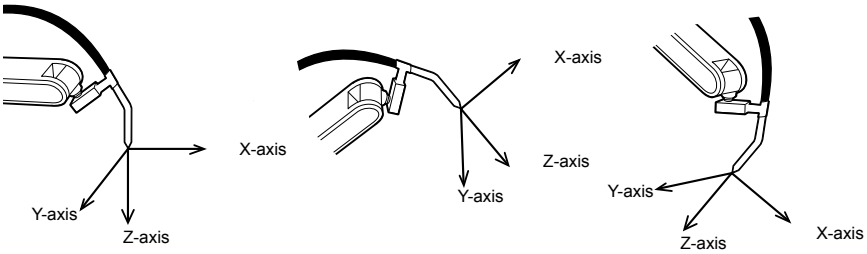
In the tool coordinates, the manipulator moves parallel to the X-, Y-, and Z-axes, which are defined at the tip of the tool. The motion of each axis is described in the table below.

Table 2-4: Axis Motion in Tool Coordinates

Axis Name		Axis Operation Key	Motion
Basic Axes	X-axis	X- S- / X+ S+	Moves parallel to X-axis.
	Y-axis	Y- L- / Y+ L+	Moves parallel to Y-axis.
	Z-axis	Z- U- / Z+ U+	Moves parallel to Z-axis.
Wrist Axes		Motion about TCP is executed. See *section 2.3.7 "Control Point Operation" on page 2-15*.	

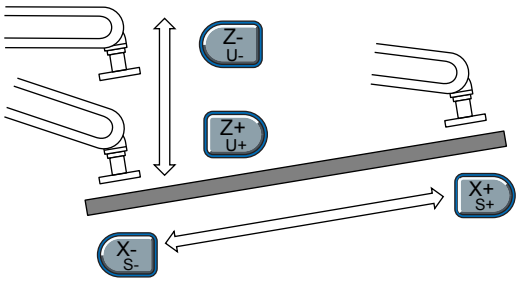
SUPPLE-MENT

- When two or more axis keys are pressed at the same time, the manipulator will perform compound movement. However, if two different directional keys (such as [X -] + [X +]) for the same axis are pressed at the same time, the axis will not operate.
  (When [X -] + [X +] + [Y +] are pressed, only the axis corresponding to [Y +] will 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 the 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.



SUPPLE-MENT

For tool coordinates, the tool file should be registered in advance. For further details, refer to section 8.3 “Tool Data Setting” of coordinates “DX100 INSTRUCTIONS” (RE-CTO-A215).

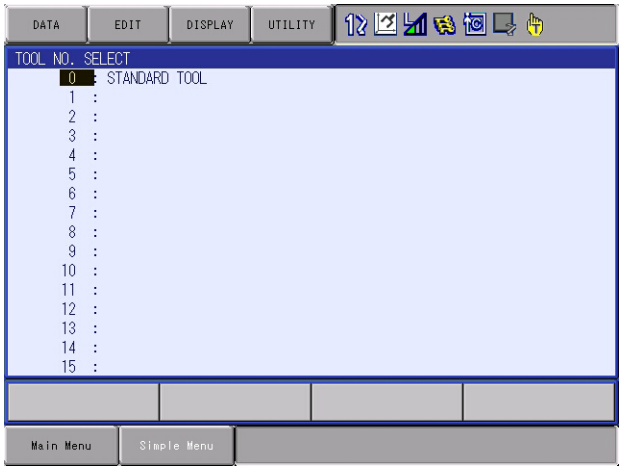
2.3.4.1 Selecting Tool

Tool numbers are used to specify a tool when more than one tool is used on the system.

You may select from the registered tool files when you switch tools on the manipulator.

> SUPPLE-MENT
>
> This operation can be performed only when the number of tool is more than one.
> To use several tool files with one manipulator, set the following parameter.
> S2C431: Tool number switch specifying parameter
> 1: Can be switched
> 0: Cannot be switched

1. Press the [COORD] key and select the tool coordinates .
   – Each time [COORD] key is pressed, the coordinate system switches in the following order:
   Joint→Cartesian (Cylindrical)→Tool→User.
   Check the change on the status display area.
2. Press [SHIFT] + [COORD].
   – The TOOL NO. SELECT window appears.



3. Move the cursor to the tool to use.
   – The TOOL NO. SELECT window above shows an example; “TOOL NO. 0 TORCH MT-3501” is selected.
4. Press [SHIFT] + [COORD].
   – The window goes back to the previous window.

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

Table 2-5: Axis Motion in User Coordinates

Axis Name		Axis Operation Key	Motion
Basic Axes	X-axis	X- S- / X+ S+	Moves parallel to X-axis.
	Y-axis	Y- L- / Y+ L+	Moves parallel to Y-axis.
	Z-axis	Z- U- / Z+ U+	Moves parallel to Z-axis.
Wrist Axes		Motion about TCP is executed. See *section 2.3.7 "Control Point Operation" on page 2-15*.	

SUPPLE-MENT

- When two or more axis keys are pressed at the same time, the manipulator will perform compound movement. However, if two different directional keys (such as [X -] + [X +]) for the same axis are pressed at the same time, the axis will not operate.
(When [X -] + [X +] + [Y +] are pressed, only the axis corresponding to [Y +] will operate.)

Fig. 2-5: Moves parallel to X or Y-axis

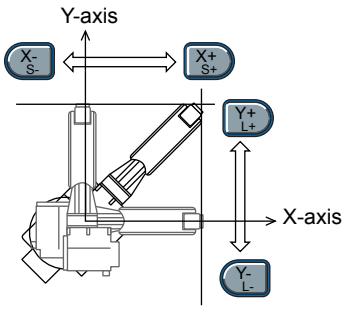
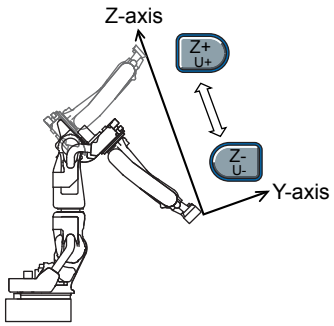
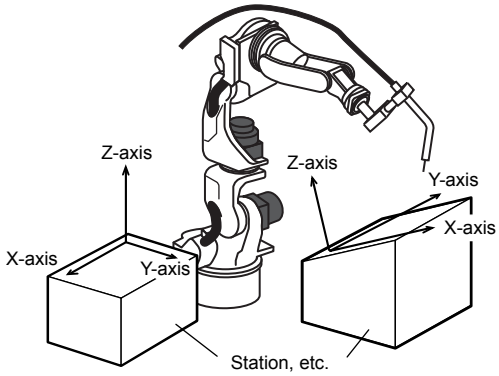


Fig. 2-6: Moves parallel to Z-axis

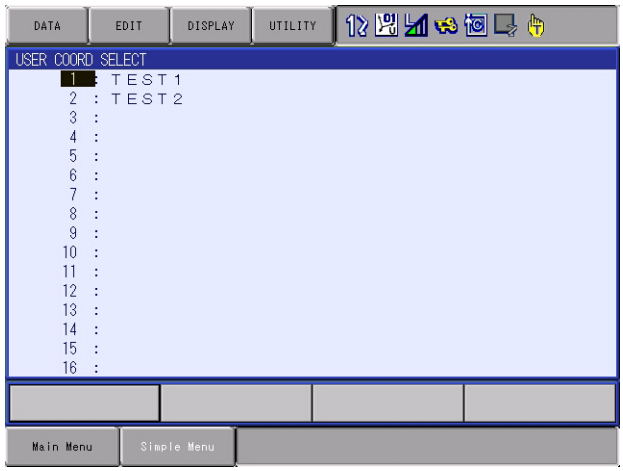




2.3.5.1 Selecting User Coordinates

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

1. Press [COORD] to select the user coordinates .
   – Each time [COORD] key is pressed, the coordinate system switches in the following order:
   Joint→Cartesian (Cylindrical)→Tool→User.
   Check the change on the status display area.
2. Press [SHIFT] + [COORD].
   – The USER COORD SELECT window appears.



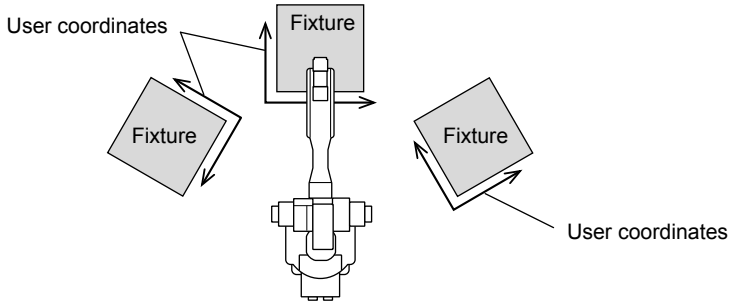
> SUPPLE-MENT
> For more information on registration of the user coordinates, refer to section 8.8 “User Coordinate Setting” of “DX100 INSTRUCTIONS” (RE-CTO-A215).

3. Select the desired user number.

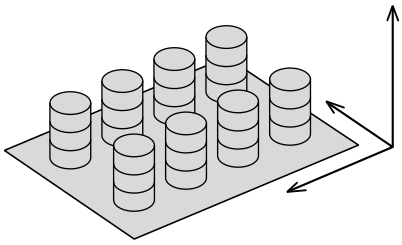
2.3.5.2 Examples of User Coordinate Utilization

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

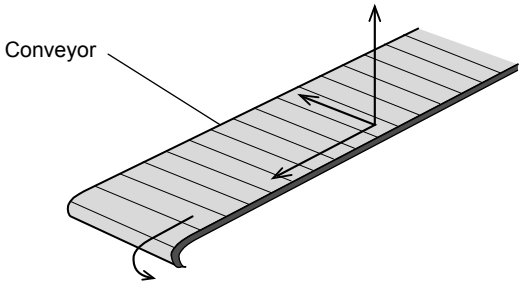
- When multiple positioners are used, manual operation can be simplified by setting the user coordinates for each fixture.



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



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



2.3.6 External Axis

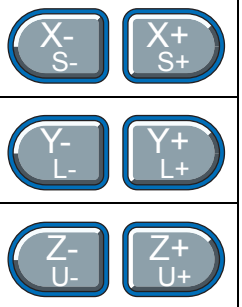
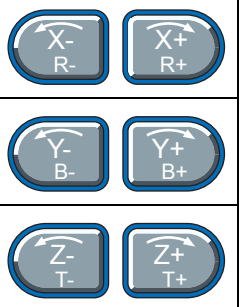
The external axis can be operated by selecting “BASE” or “STATION” for the control group. The motion of each axis is described in the table below.

Axis Name		Axis Operation Key	Motion
BASE or STATION	1st axis	X- S- / X+ S+	The 1st axis moves.
	2nd axis	Y- L- / Y+ L+	The 2nd axis moves.
	3rd axis	Z- U- / Z+ U+	The 3rd axis moves.

2.3.7 Control Point Operation

Motion about TCP (Tool Center Point) 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 table below.

Table 2-6: Axis Motion in Motion about TCP

Axis Name	Axis Operation Key	Motion
Major Axes		TCP moves. These movements differ depending on cartesian, cylindrical, tool and user coordinates.
Wrist Axes		Wrist axes move with the TCP fixed. These movements differ depending on cartesian, cylindrical, tool and user coordinates.
E-axis		* Available only for the manipulator with seven axes The posture of arm changes while the position and posture of the tool remain fixed. (The Re degree changes.)

SUPPLE-MENT

- When two or more axis keys are pressed at the same time, the manipulator will perform compound movement. However, if two different directional keys (such as [X -] + [X +]) for the same axis are pressed at the same time, the axis will not operate.
  (When [X -] + [X +] + [Y +] are pressed, only the axis corresponding to [Y +] will operate.)

SUPPLE-MENT

Re is an element to indicate the posture of the manipulator with seven axes and does not change by the specified coordinates.

The definition of Re is shown below.

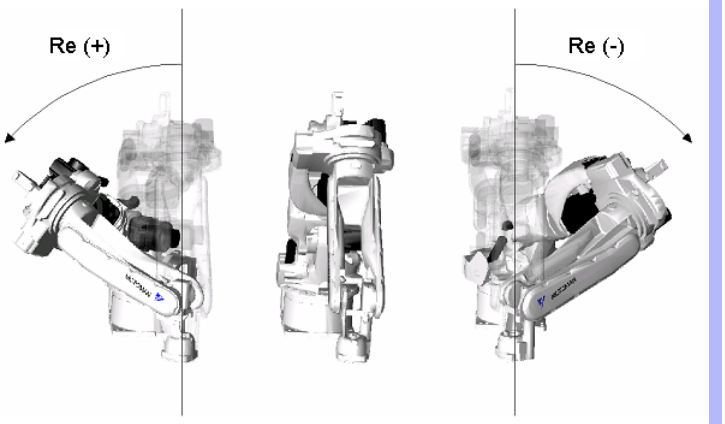


Fig. 2-7: Torch Welding

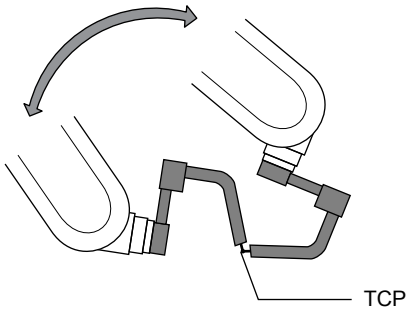
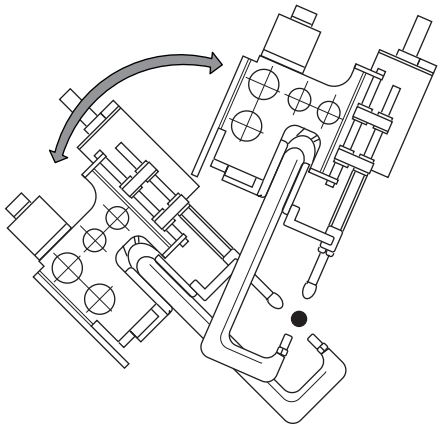
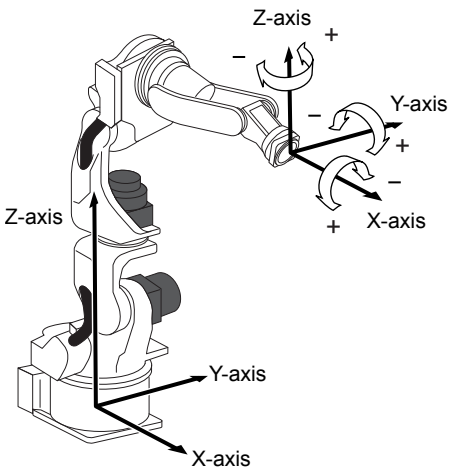


Fig. 2-8: Gun Spot Welding

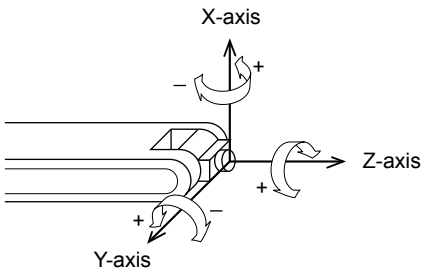


Turning of each wrist axis differs in each coordinate system.

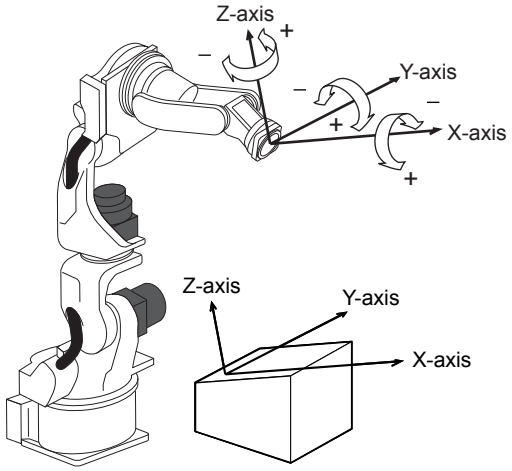
- In cartesian or cylindrical coordinates, wrist axis rotations are based on the X-, Y-, or Z-axis.



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



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



2.3.7.1 Control Point Change

The tool tip position (TCP) is the target point of axis operations and is set as the distance from the flange face. The control point change operation is an axis operation that involves selecting a tool from the list of registered tools (Refer to *section 2.3.4.1 "Selecting Tool" on page 2-11*), and then manipulating the axes while changing the TCP. This can be performed with all coordinates except the joint coordinates. The axis operation is the same as that of the motion about TCP.

<Example 1>TCP Change Operation with Multiple Tools

(1) Set the TCPs for Tool 1 and Tool 2 as P1 and P2, respectively.

(2) When Tool 1 is selected to perform an axis operation, P1 (Tool 1's TCP) is the target point of the operation. Tool 2 follows Tool 1 and is not controlled by the axis operation.

(3) On the other hand, When Tool 2 is selected to perform an axis operation, P2 (Tool 2's TCP) is the target point of the axis operation. In this case, Tool 1 just follows Tool 2.

Fig. 2-9: Selection of Tool 1 and axis operations with controlling P1

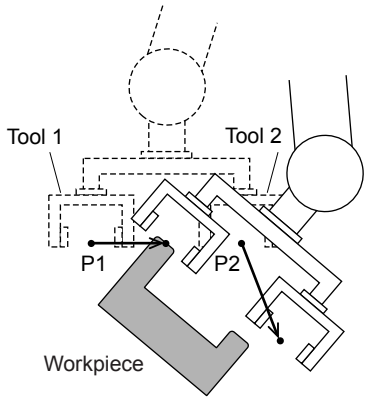
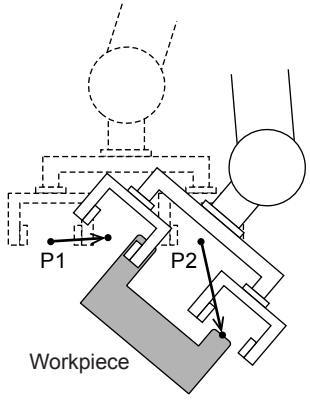


Fig. 2-10: Selection of Tool 2 and axis operations with controlling P2



<Example 2>TCP Change Operation with a Single Tool

(1) Set the two corners of the workpiece that the tool is holding as TCP P1 and P2 respectively.

(2) By selecting two TCPs alternately, the workpiece can be moved as shown below:

Fig. 2-11: Motion about TCP with P1 selected

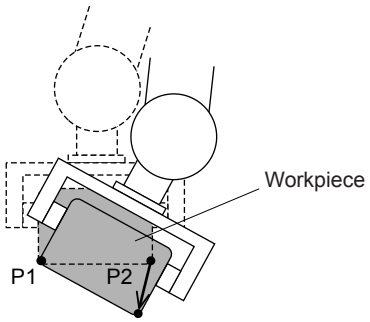
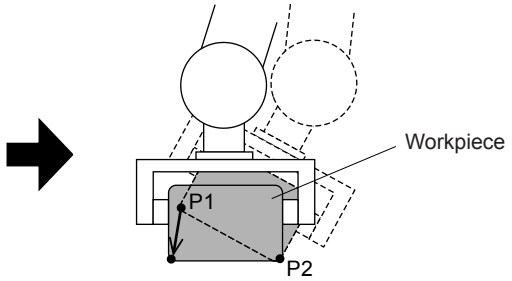


Fig. 2-12: Motion about TCP with P2 selected



SUPPLE-MENT For registration of the tool file, refer to section 8.3 “Tool Data Setting” of “DX100 INSTRUCTIONS” (RE-CTO-A215).

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 mode switch to “TEACH”.

Then,

- Register a job.

3.1.1 Checking Emergency Stop Buttons

The Servo ON button on the programming pendant should be lit while the power is ON for the servo system. Perform the following operation to ensure that the emergency stop buttons on both the DX100 and the programming pendant are functioning correctly before operating the manipulator.

1. Press E. STOP button.
   – Press the emergency stop button on the DX100 or the programming pendant.
2. Confirm the servo power is turned OFF.
   – The SERVO ON button on the programming pendant lights while servo supply is turned ON.
   – When the emergency stop button is pressed and the servo power is turned OFF, the SERVO ON lamp will turn OFF.
3. Press [SERVO ON READY] of the programming pendant.
   – After confirming correct operation, press [SERVO ON READY]. The servo power will be ready to turn ON.
   – The servo power can be turned ON while the SERVO ON button lamp blinks.

3.1.2 Setting the Teach Lock

For safety purposes, always set the mode switch to “TEACH” before beginning to teach.

While the teach lock is set, the mode of operation is tied to the teach mode and the machines cannot be played back using either [START] or external input.

3.1.3 Registering a Job

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

3.1.3.1 Registering Job Names

Job names can use up to 32 alphanumeric and symbol characters. These different types of characters can coexist within the same job name.

The following rules apply to the designation of job names:

- A maximum of 32 characters can be used for a job name.
- If the job name is already used, an input error is caused.

<Example>

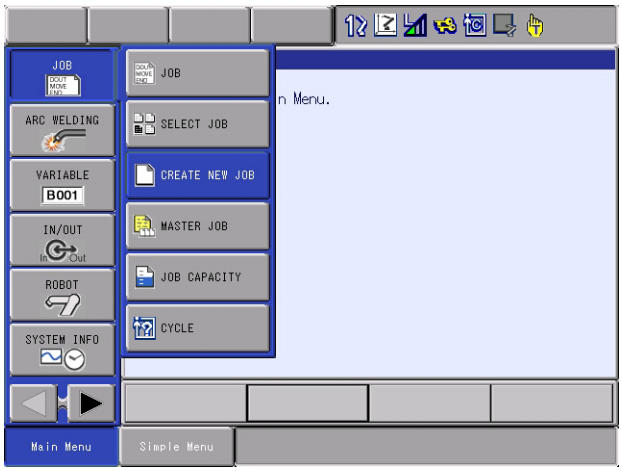
0	0	1					

J	O	B	-	1			

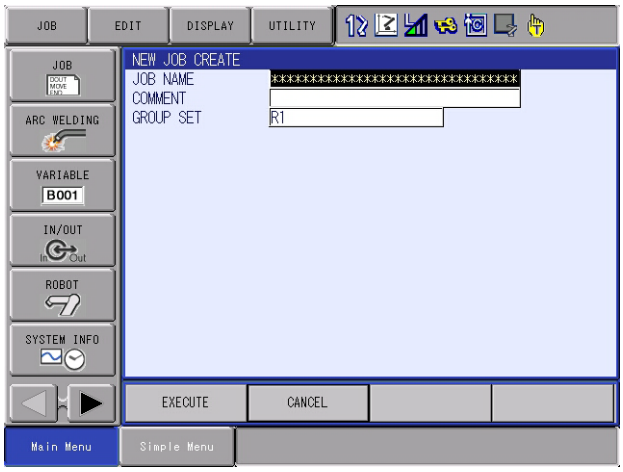
W	O	R	K	-	A		

3.1.3.2 Registering Jobs

1. Select {JOB} under the main menu.
   – The sub-menu appears.



2. Select {CREATE NEW JOB}.
   – The NEW JOB CREATE window appears.



3. Input job name.
   – Move the cursor to JOB NAME, and press [SELECT]. Input job names using the character input operation. For information on character input operation, refer to *section 1.2.6 “Character Input Operation” on page 1-18*.
4. Press [ENTER].

3.1.3.3 Registering Comments

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

1. Enter a comment.
   – In the NEW JOB CREATE window, move the cursor to the comment and press [SELECT]. For information on character input operation, refer to *section 1.2.6 “Character Input Operation” on page 1-18*.
2. Press [ENTER].

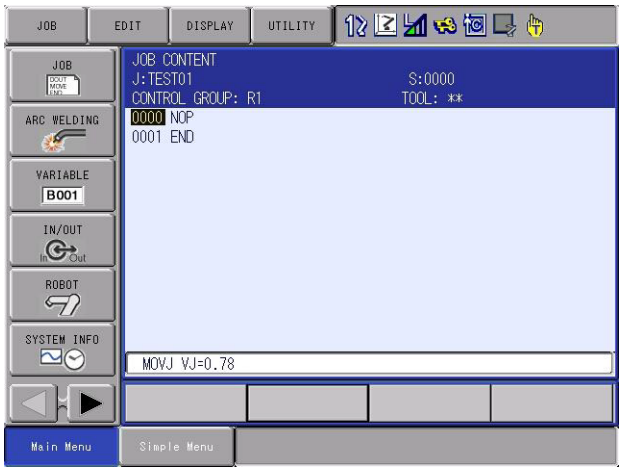
3.1.3.4 Registering Control Groups

Select the control group that has been registered in advance. If external axes (BASE or STATION) or multiple robot systems are not used, the registration of control groups is not required.

3.1.3.5 Switching to the Teaching Window

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

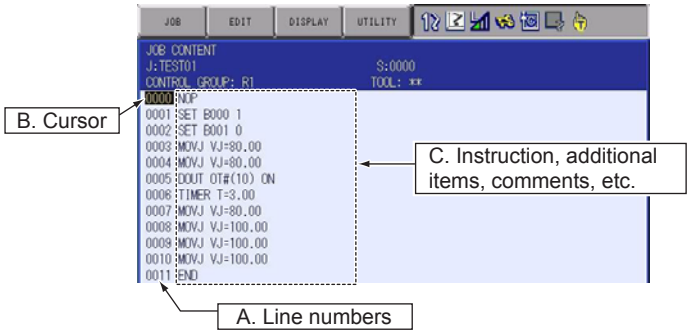
1. In the NEW JOB CREATE window, press [ENTER] or select “EXECUTE”.
   – Job name, comments, and control groups are all registered. Then, the JOB CONTENT window appears. NOP and END instructions are automatically registered.



3.2 Teaching Operation

3.2.1 Teaching Window

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



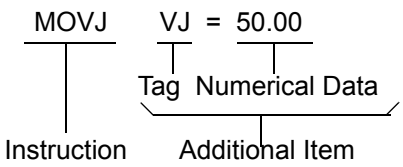
A. Line Numbers

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

B. Cursor

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

C. Instructions, Additional Items, Comments, Etc.



Instructions	:	These are instructions needed to process or perform an operation. In the case of MOVE instructions, the instruction corresponding to the interpolation type is automatically displayed at the time position is taught.
Additional items	:	Speed and time are set depending on the type of instruction. When needed, numerical or character data is added to the condition-setting tags.

3.2.2 Interpolation Type and Play Speed

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

Normally, the position data, interpolation type, and play speed are registered together for a robot axis step. If the interpolation type or play speed settings are omitted during teaching, the data used from the previously taught step is automatically used.

3.2.2.1 Joint Interpolation

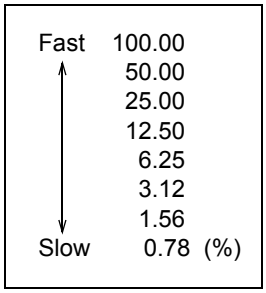
The joint interpolation is used when the manipulator does not need to move in a specific path toward the next step position. When the joint interpolation is used for teaching a robot axis, the move instruction is MOVJ. For safety purposes, use the joint interpolation to teach the first step.

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

<Play Speed Setting Window>

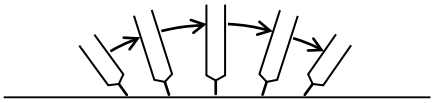
- Speeds are indicated as percentages of the maximum rate.
- Setting “0:Speed Omit” sets the same speed as the previous determination.

1. Move the cursor to the play speed.
2. Set the play speed by pressing [SHIFT] + the cursor key.
   – The joint speed value increases or decreases.



3.2.2.2 Linear Interpolation

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



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

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

1. Move the cursor to the play speed.
2. Set the play speed by pressing [SHIFT] + the cursor key.
   – The play speed value increases or decreases.

Fast 1500.0	
750.0	
375.0	
187.0	
93.0	
46.0	
23.0	
Slow 11 (mm/s)	

Fast 9000	
4500	
2250	
1122	
558	
276	
138	
Slow 66 (cm/min)	

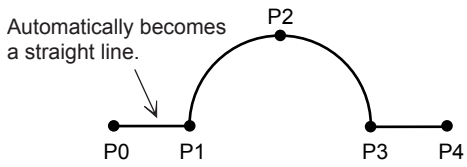
3.2.2.3 Circular Interpolation

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

■ **Single Circular Arc**

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

Table 3-1: Interpolation Type for Single Circular Arc

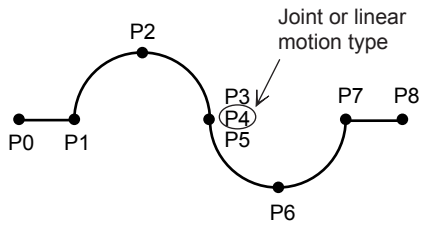


Point	Interpolation Type	Instruction
P0	Joint or Linear	MOVJ MOVL
P1 P2 P3	Circular	MOVC
P4	Joint or Linear	MOVJ MOVL

■ **Continuous Circular Arcs**

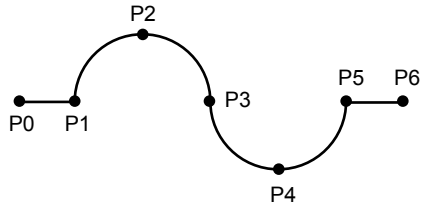
As shown below, when two or more successive circular movements with different curvatures are required, the movements must be separated from each other by a joint or linear interpolation step. This step must be inserted between the steps at an identical point. The step at the end point of the preceding circular movement must coincide with the beginning point of the following circular movement.

Table 3-2: Interpolation Type for Continuous Circular Arcs



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

Alternatively, to continue movements without adding an extra joint or linear interpolation step in between, add “FPT” tag to the step whose curvature is needed to be changed.



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

<Play Speed>

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

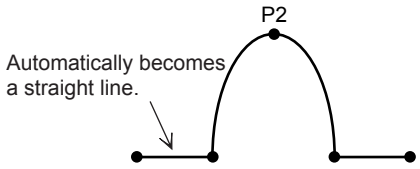
3.2.2.4 Spline Interpolation

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

■ **Single Spline Curve**

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

Table 3-3: Interpolation Type for Single Spline Curve

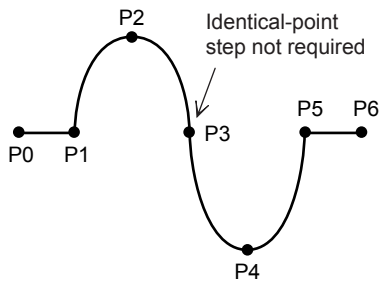


Point	Interpolation Type	Instruction
P0	Joint or Linear	MOVJ MOVL
P1 P2 P3	Spline	MOVS
P4	Joint or Linear	MOVJ MOVL

Continuous Spline Curves

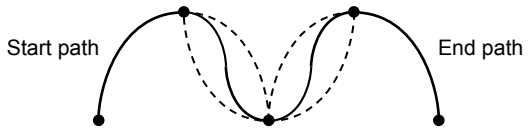
The manipulator moves through a path created by combining parabolic curves. This differs from the circular interpolation in that steps with identical points are not required at the junction between two spline curves.

Table 3-4: Interpolation Type for Continuous Spline Curves



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

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

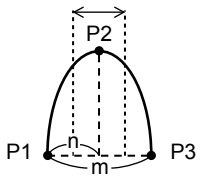


<Play Speed>

- The play speed setting window is identical to that for the linear interpolation.
- As with the circular interpolation, the speed taught at P2 is applied from P1 to P2, and the speed taught at P3 is applied from P2 to P3.

NOTE

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



3.2.3 Teaching Steps

3.2.3.1 Registering Move Instructions

Whenever one step is taught, one move instruction is registered. There are two ways to teach a step. Steps can be taught in sequence as shown in the following left figure *Fig. 3-1 "Registering Move Instructions"* or they can be done by inserting steps between already registered steps, as shown in the right figure *Fig. 3-2 "Inserting Move Instructions"*

This paragraph explains the teaching of *Fig. 3-1 "Registering Move Instructions"*, the operations involved in registering new steps.

Fig. 3-1: Registering Move Instructions

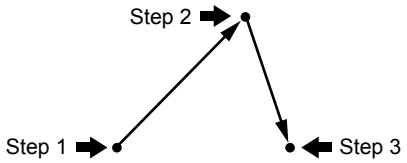
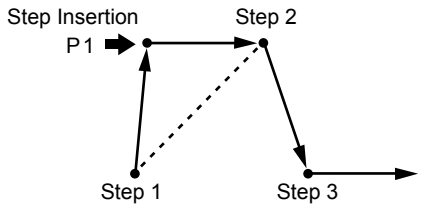


Fig. 3-2: Inserting Move Instructions

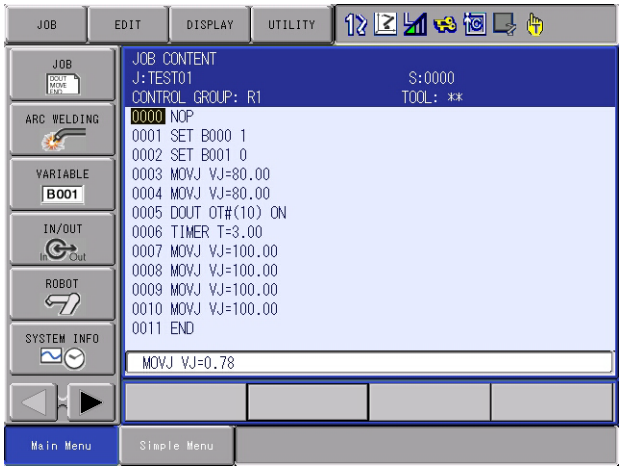


Teaching of *Fig. 3-2 "Inserting Move Instructions"* is called "Inserting move instruction", to distinguish it from the method shown in *Fig. 3-1 "Registering Move Instructions"*. For more details on this operation, see *section 3.4.2 "Inserting Move Instructions" on page 3-34*. The basic operations for registration and insertion are the same. The only difference is pressing [INSERT] in the case of insertion. For registration (*Fig. 3-1 "Registering Move Instructions"*), the instruction is always registered before the END instruction. Therefore, it is not necessary to press [INSERT]. For insertion (*Fig. 3-2 "Inserting Move Instructions"*), [INSERT] must be pressed.

■ **Setting the Position Data**

1. Select {JOB} under the main menu.
   – The sub-menu appears.

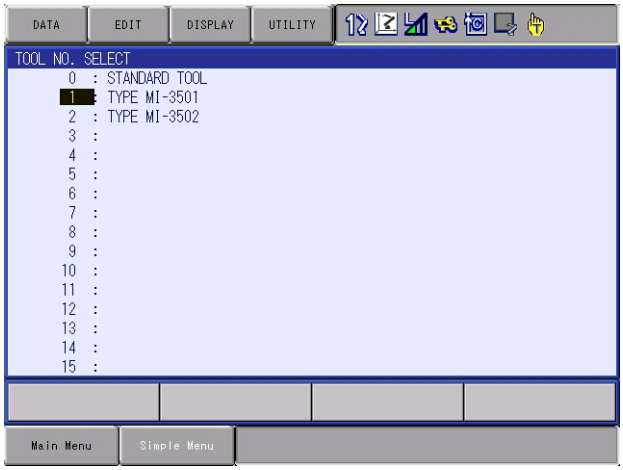
2. Select {JOB}.
   – The contents of the currently-selected job is displayed.



3. Move the cursor on the line immediately before the position where a move instruction to be registered.
4. Grip the Enable switch.
   – Grip the Enable switch to turn the servo power ON.
5. Move the manipulator to the desired position using the axis key.
   – Use the axis operation key to move the manipulator to the desired position.

Selecting the Tool Number

1. Press [SHIFT] + [COORD].
   - When selecting the “JOINT”, “XYZ/CYLINDRICAL”, or “TOOL” coordinates, press [SHIFT] + [COORD] and the TOOL NO. SELECT window will be shown.



2. Move the cursor to the desired tool number.
   - The currently-selected tool number by the cursor is displayed.
3. Press [SHIFT] + [COORD].
   - The JOB CONTENT window appears.

SUPPLE-MENT

Using Multiple Tools with One Manipulator

- When multiple tools are to be used with one manipulator, set parameter S2C431 to 1.
- See *section 2.3.4 “Tool Coordinates” on page 2-9* for details on this operation.

Setting the Interpolation Type

1. Press [MOTION TYPE].
2. Select the desired interpolation type.
   - When [MOTION TYPE] is pressed, MOVJ → MOVL → MOVC → MOVS are displayed in order in the input buffer line.

■ Setting the Play Speed

1. Move the cursor to the instruction.

```
0000 NOP
0001 MOVJ VJ=0.78
0002 END
```

2. Press [SELECT].
   – The cursor moves to the input buffer line.

```
MOVJ VJ=0.78
```

3. Move the cursor to the play speed to be set.

```
MOVJ VJ=0.78
```

4. Press [SHIFT] + the cursor key [↑] or [↓] simultaneously.
   – The joint speed moves up and down.

```
MOVJ VJ=50.00
```

5. Press [ENTER].
   – The MOV instruction is registered.

Move instruction is registered.

```
0000 NOP
0001 MOVJ VJ=50.00
0002 END
```

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

SUPPLE-MENT

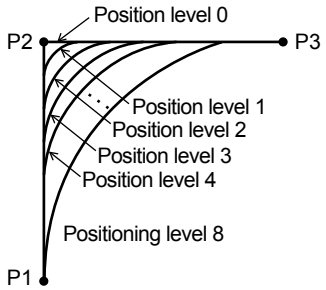
To make the setting so that the play speed tag is not displayed as a default, select {EDIT} from the menu and then select “ENABLE SPEED TAG” to delete “*”.

SUPPLE-MENT

- The position level can be set at the same time that the move instruction is registered.
- To display the position level tag as a default, select {EDIT} from the menu and then select “ENABLE POS LEVEL TAG”.

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

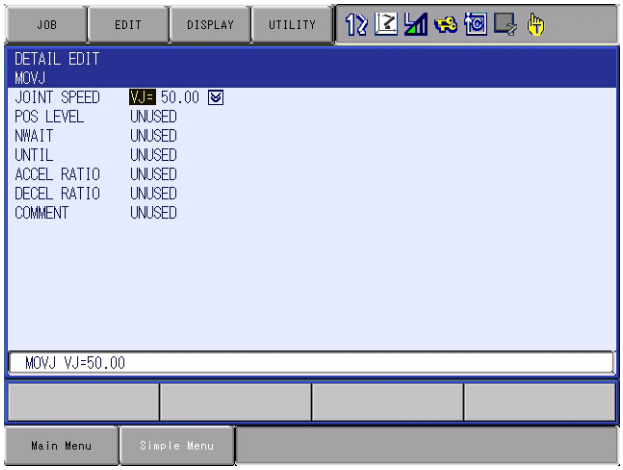
The relationship between path and accuracy for position levels is as follows.



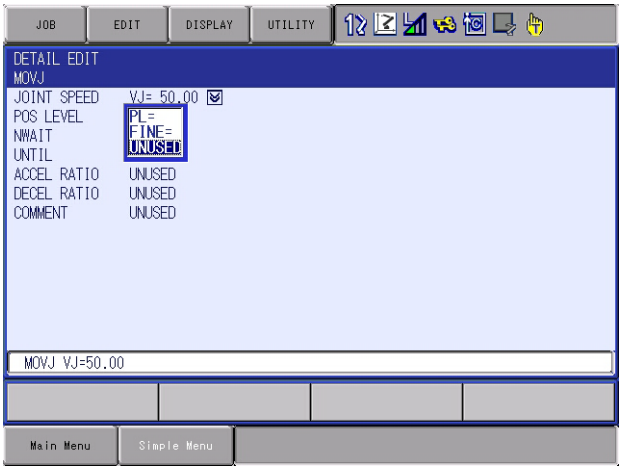
Position Levels	Accuracy
0	Teaching position
1 to 8	Fine | Rough

■ Setting the Position Level

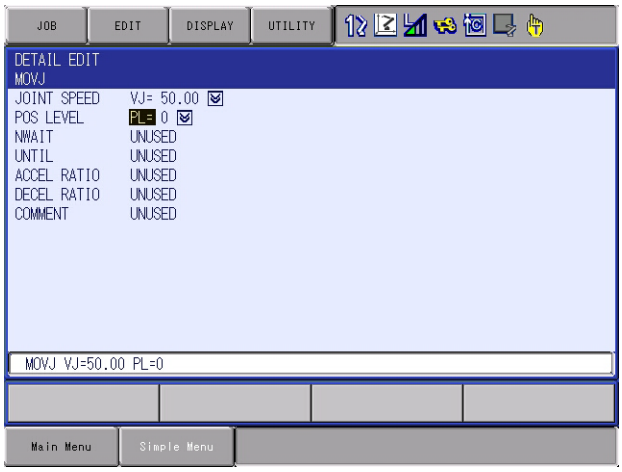
1. Select move instruction.
   – The DETAIL EDIT window appears.



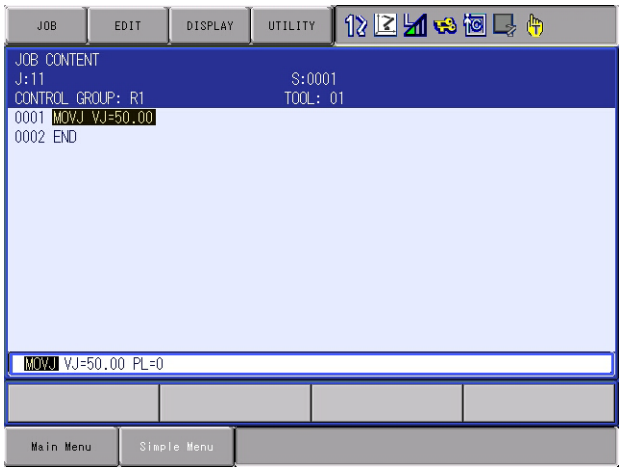
2. Select the position level “UNUSED”.
   – The selection dialog box appears.



3. Select “PL”.
   – The position level is displayed. The position initial value is 1.

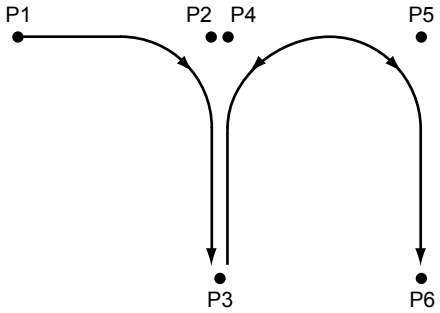


4. Press [ENTER].
   – To change the position level, select the level in the input buffer line, type the value using the Numeric keys, and press [ENTER]. The position level’s move instruction is registered.



5. Press [ENTER].

For example, to perform the movement steps shown below, set as follows:



Steps P2, P4, and P5 are simple passing points, and do not require accurate positioning. Adding PL=1 to 8 to the move instructions of these steps moves the manipulator around the inner corners, thereby reducing the cycle time.

If complete positioning is necessary as P3 or P6, add PL=0.

<EXAMPLE>

Passing points P2, P4, and P5:

```
MOVL  V=138   PL=3
```

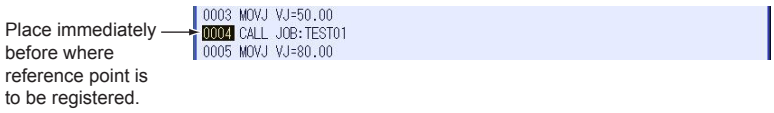
Positioning point P3 and P6:

```
MOVL  V=138   PL=0
```

3.2.3.2 Registering Reference Point Instructions

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

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Move the cursor.
   – Move the cursor to the line immediately before the position where the reference point to be registered.



4. Grip the Enable switch.
   – The servo power is turned ON.
5. Press the axis operation key.
   – Move the manipulator to the position to be registered as the reference point.
6. Press [REFP] or select “REFP” from the inform list.
   – The reference point instruction is displayed in the input buffer line.

7. Change the reference point number in one of the following ways.
   – Move the cursor to the reference point number, and press [SHIFT] + the cursor key to change the reference point number; or

   – Press [SELECT] when the cursor is on the reference point number. Then, the data input buffer line appears. Input the number and press [ENTER].

8. Press [INSERT].
   – The [INSERT] key lamp lights.
   When registering before the END instruction, pressing [INSERT] is not needed.
9. Press [ENTER].
   – The REFP instruction is registered.

SUPPLE-MENT

The programming pendant does not have the [REFP] key for the application of spot welding, motor gun, and of material handling, assembling, and cutting.

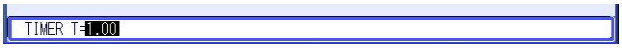
3.2.3.3 Registering Timer Instructions

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

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Move the cursor.
   – Move the cursor to one line before the position where the timer instruction is to be registered.

4. Press [TIMER].
   – The TIMER instruction is displayed on the input buffer line.

5. Change the timer value.
   – Move the cursor to the timer value and change it by pressing [SHIFT] + the cursor key. The timer unit of adjustment is 0.01 seconds.

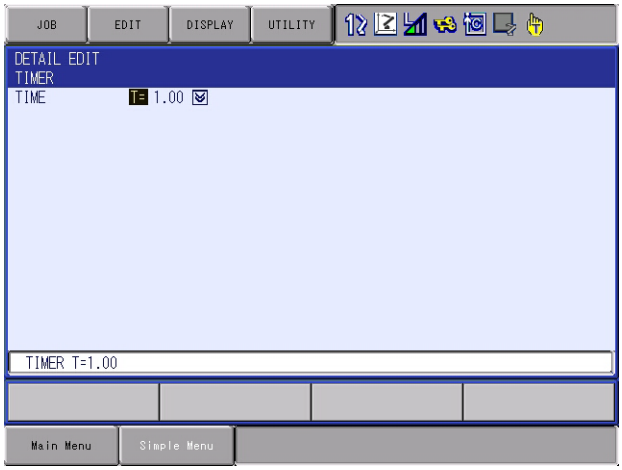


   – If you use the Numeric keys to input the timer value, press [SELECT] when the cursor is on the timer value. The data input line appears. Input the value and press [ENTER].

6. Press [INSERT].
   – The [INSERT] key lamp lights.
   – When registering before the END instruction, pressing [INSERT] is not needed.
7. Press [ENTER].
   – The TIMER instruction is registered.

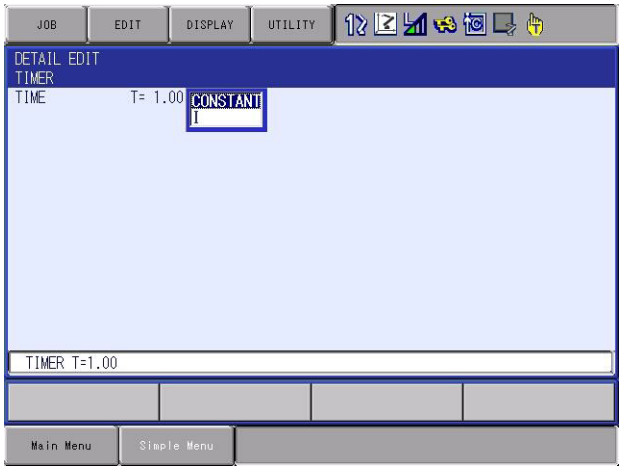
■ **Changing Timer Value**

1. Press [TIMER].
2. Press [SELECT].
   – The DETAIL EDIT window for the TIMER instruction appears.



3. Input the timer value on the instruction DETAIL EDIT window.

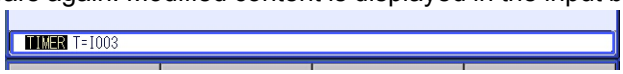
   (1) When is selected, the items available to be changed are displayed in the dialog box.



   (2) Select the particular item to be changed.

   – When a number is to be changed, move the cursor to the number and press [SELECT]. Input the desired value using the Numeric keys, and press [ENTER].

4. Press [ENTER].
   – The DETAIL EDIT window is closed and the JOB CONTENT window appears again. Modified content is displayed in the input buffer line.



5. Press [INSERT].
   - The [INSERT] key lamp lights.
   - When registering before the END instruction, pressing [INSERT] is not needed.
6. Press [ENTER].
   - The TIMER instruction is registered.

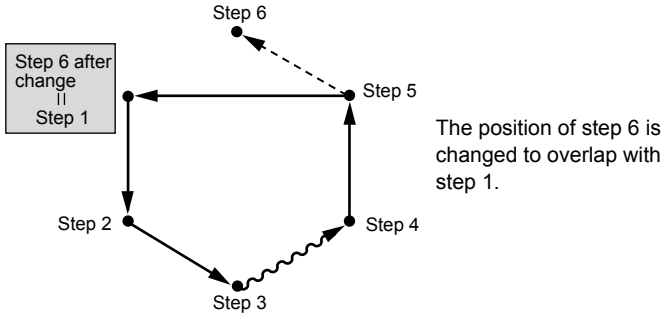
```
0003 MOVJ VJ=50.00
0004 TIMER T=I003
0005 MOVL V=138
```

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.

SUPPLE-MENT



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

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.
[INTERLOCK] + [FWD]: All instructions are executed alternately.

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

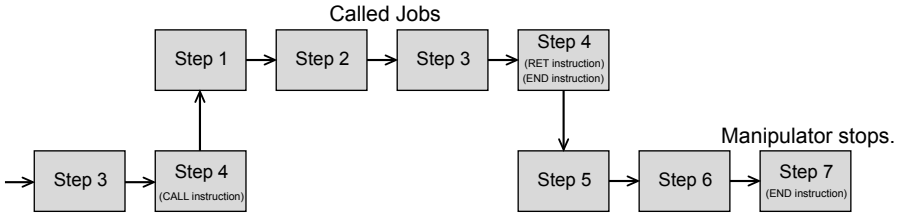
NOTE For safety, set manual speed at M1 or below.

1. Move the cursor to the step to be checked.
2. Press [FWD] or [BWD].
   – The manipulator reaches the following / previous step and stops.

3.3.1.1 Precautions When Using FWD / BWD Operations

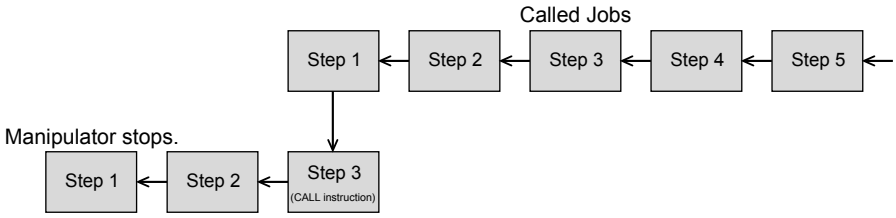
■ **FWD Movements**

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



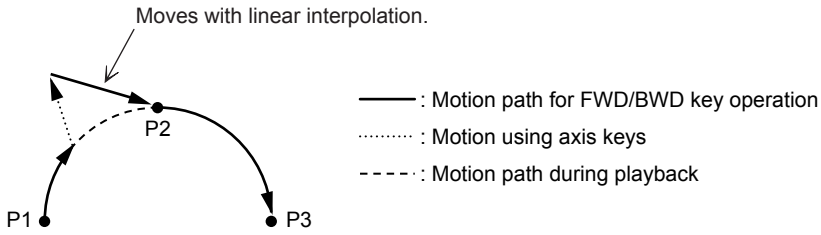
■ **BWD Movements**

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



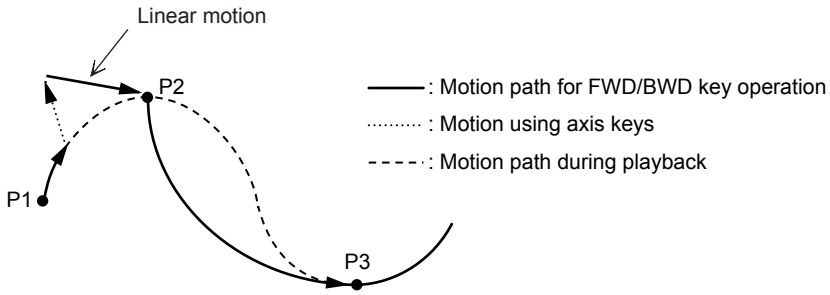
■ **Circular Movements with FWD/BWD Key Operations**

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

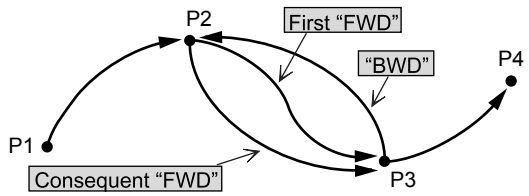


■ **Spline Curve Movements with FWD/BWD Operations**

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



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



3.3.1.2 Selecting Manual Speed

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

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

- Each time [FAST] is pressed, the speed switches in the order of "INCH"→"SLOW"→"MED"→"FAST".

- Each time [SLOW] is pressed, the speed switches in the order of "FAST"→"MED"→"SLOW"→"INCH".

NOTE

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

3.3.1.3 Moving to Reference Point

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

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

> SUPPLE-MENT
> The programming pendant does not have the [REFP] key for the application of spot welding, general purposes (= material handling, assembling, cutting) or motor gun.

3.3.1.4 Test Operations

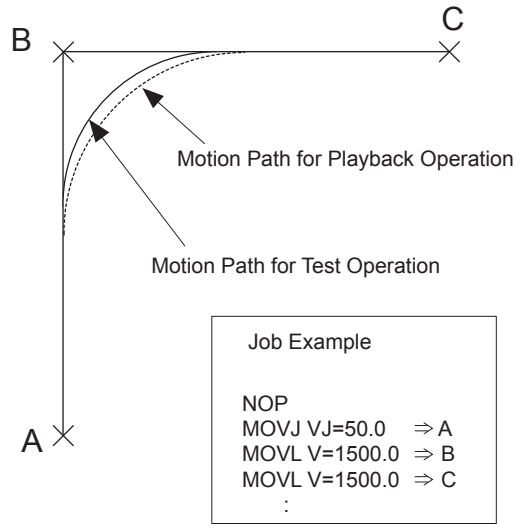
Playback operations can be simulated in the teach mode with test operations. This function is convenient for checking continuous paths and operation instructions.

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.
> • Work instruction output, such as arc output, is not executed.

Note that the motion path for the playback operation is replayed during the test operation. Therefore, make sure that there is no obstacle around the manipulator and great caution should be exercised when the test operation is performed.

Motion Path for Test Operation



> NOTE
> There may be a slight difference between the motion path for the test operation and the motion path for the playback operation due to a mechanical error or control delay, etc.

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

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

NOTE

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

3.3.1.5 Machine Lock Operation

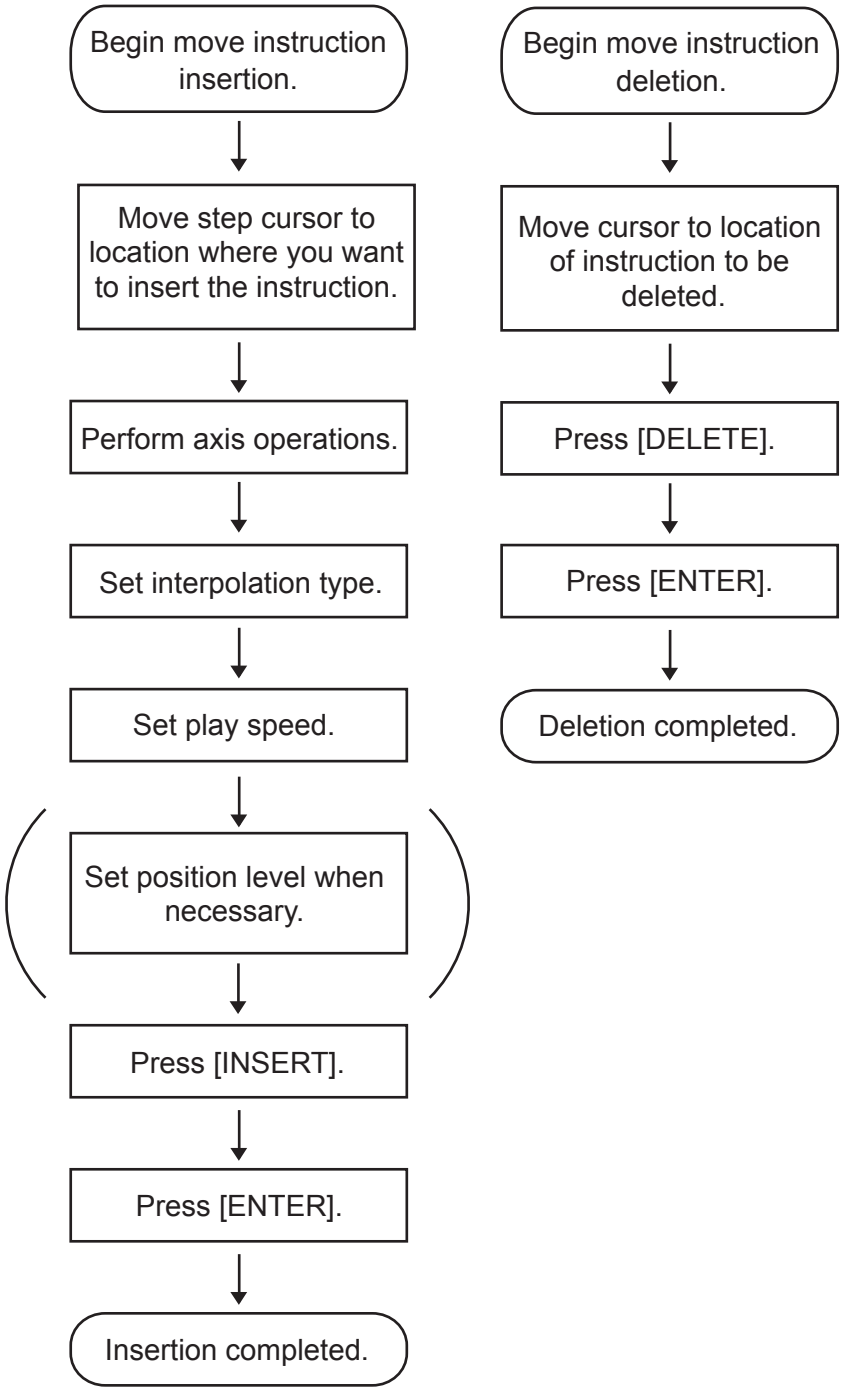
When “MACHINE LOCK” is enabled, the [FWD] / [BWD] operation or the test operation can be performed to check the status of input and output without moving the manipulator.

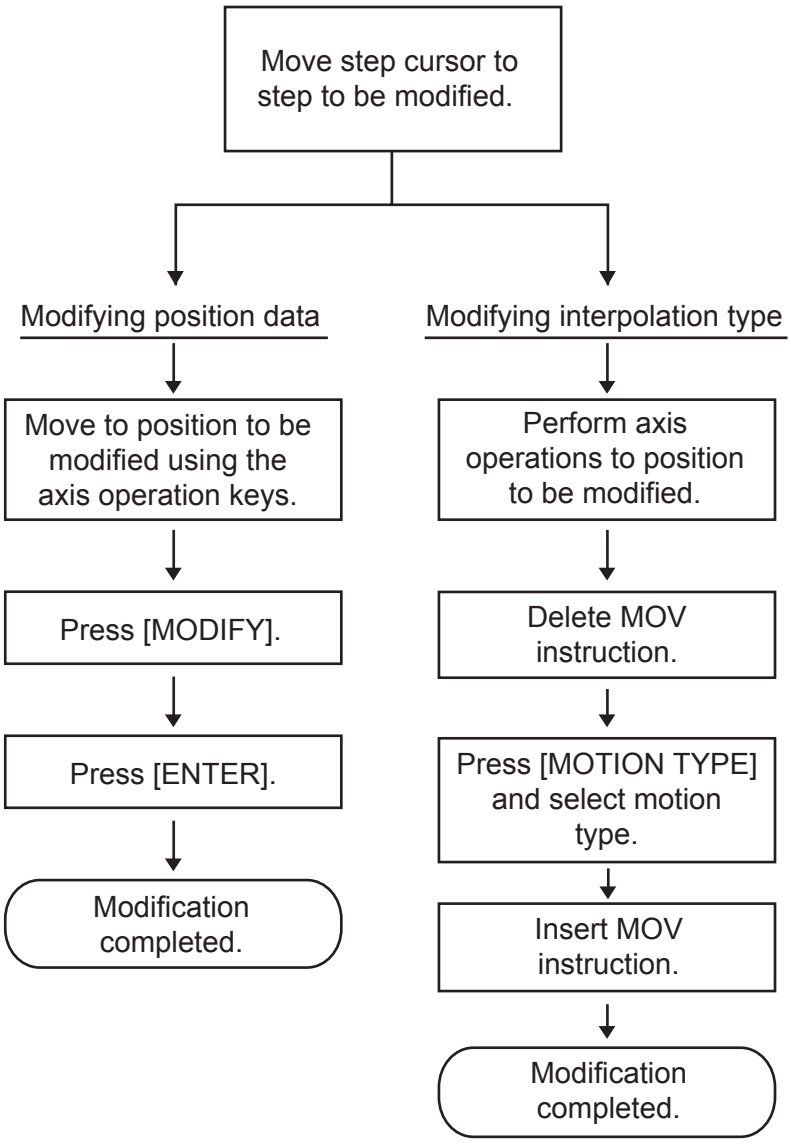
1. Press [AREA].
2. Select {UTILITY}.
3. Select {SETUP SPECIAL RUN}.
   – The SPECIAL TEACH window appears.
4. Select “MACHINE LOCK”.
   – Press [SELECT] to switch “VALID” and “INVALID”.

NOTE

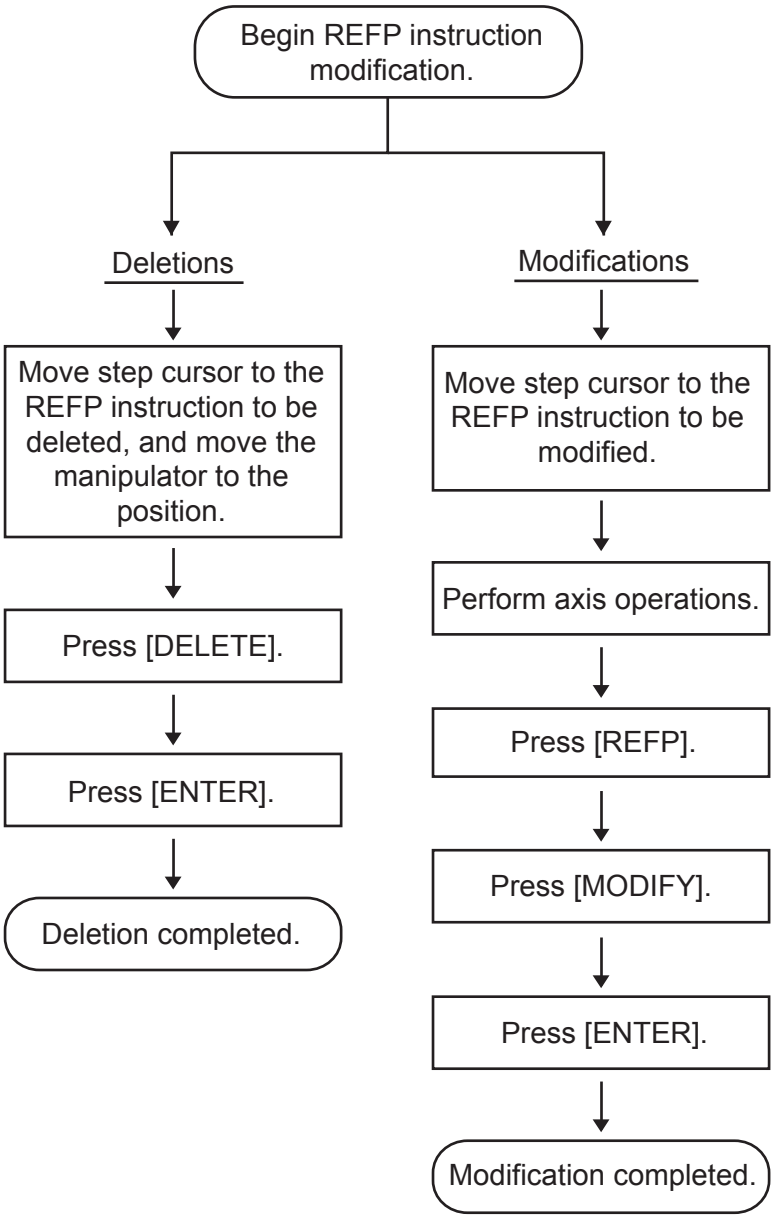
- The setting of “MACHINE LOCK” is maintained even after the mode is switched: If the machine lock is set to “VALID” in the teach mode, it is still “VALID” after switching to the play mode.
  The same applies when the mode is switched from the play mode to the teach mode.
- Note that the machine lock becomes “INVALID” if the following operation is performed.
  - Execution of “CANCEL ALL SELECT” in the SPECIAL PLAY window.
  - Turning off the main power.

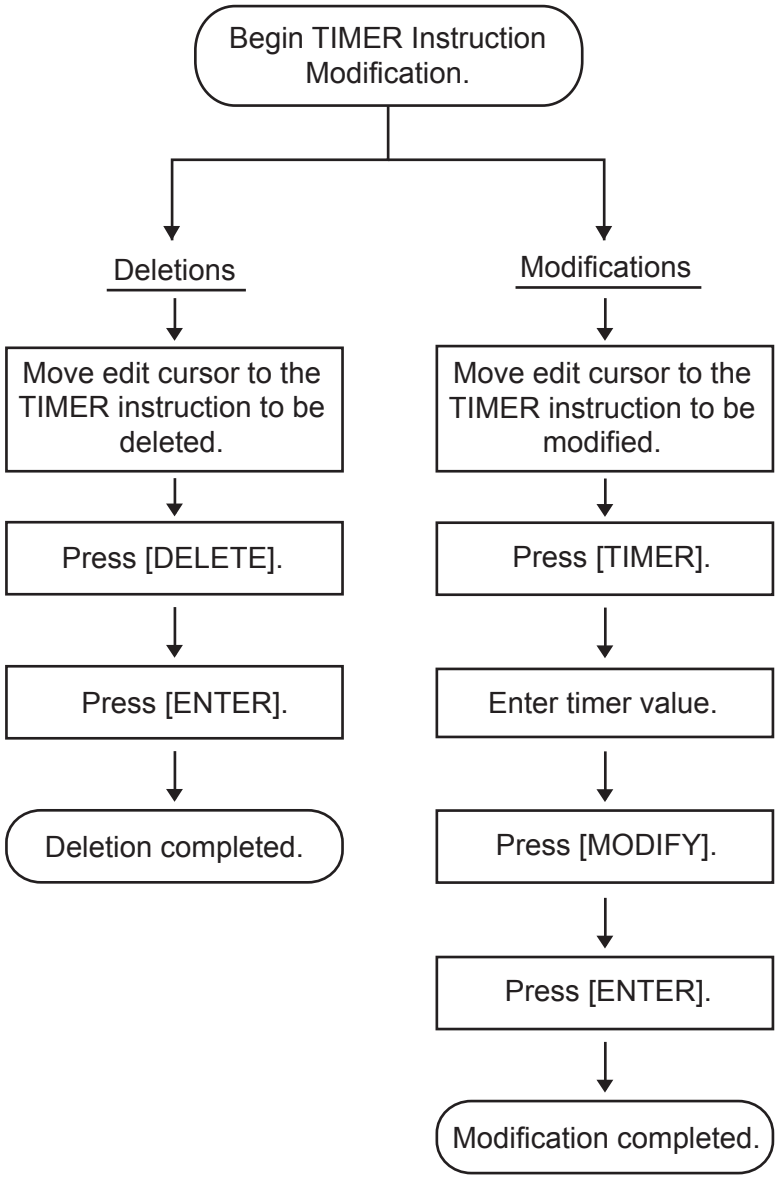
3.4 Modifying Steps





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


Begin REFP instruction modification.
Deletions
Move step cursor to the REFP instruction to be deleted, and move the manipulator to the position.
Press [DELETE].
Press [ENTER].
Deletion completed.
Modifications
Move step cursor to the REFP instruction to be modified.
Perform axis operations.
Press [REFP].
Press [MODIFY].
Press [ENTER].
Modification completed.


Begin TIMER Instruction Modification.
Deletions
Modifications
Move edit cursor to the TIMER instruction to be deleted.
Press [DELETE].
Press [ENTER].
Deletion completed.
Move edit cursor to the TIMER instruction to be modified.
Press [TIMER].
Enter timer value.
Press [MODIFY].
Press [ENTER].
Modification completed.

3.4.1 Displaying the JOB CONTENT Window for Editing

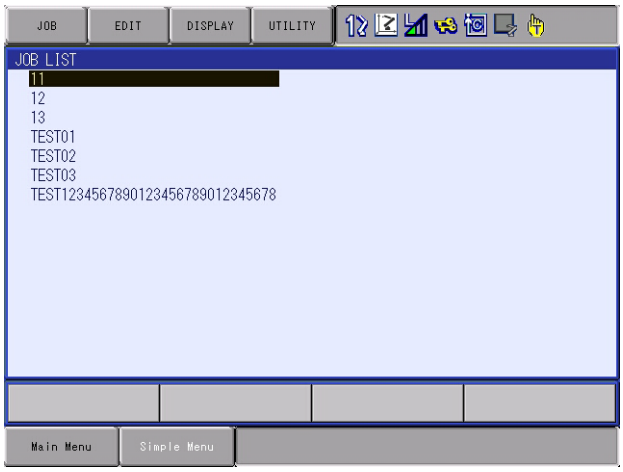
3.4.1.1 Currently Called Up Job

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

3.4.1.2 Calling Up Other Jobs

> **NOTE** In any other than the teach mode, set the mode switch to "TEACH".

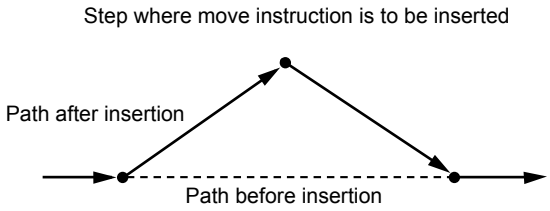
1. Select {JOB} under the main menu.
2. Select {SELECT JOB}.
   – The JOB LIST window appears.



3. Select the job name to be called.

3.4.2 Inserting Move Instructions

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



1. Move the cursor to the line immediately before the insert position.

The line immediately before where the move instruction is to be added.

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

2. Press the axis operation key.
   – Turn ON the servo power and press the axis operation key to move the manipulator to the position to be inserted.

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

3. Press [INSERT].
   – The key lamp will light.

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

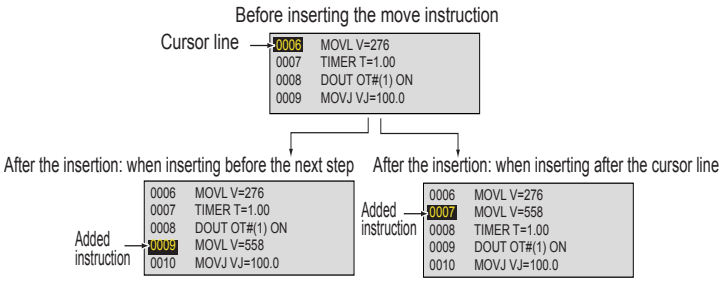
4. Press [ENTER].
   – The move instruction is inserted after the cursor line.

The move instruction is added.

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

5. Press [ENTER].
   – <Examples of Inserting a Move Instruction>
   • When a move instruction is inserted in the following job, it is placed on different lines according to the setting in the

TEACHING CONDITION window.

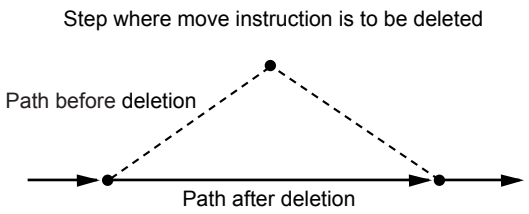


NOTE

Positions where the move instructions are inserted.

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

3.4.3 Deleting Move Instructions



1. Move the cursor to the move instruction to be deleted.

Move instruction to be deleted

```
0003    MOVL V=138
0004    MOVL V=558
0005    MOVJ VJ=50.00
```

> **NOTE**
>
> If the manipulator position differs from the cursor position on the window, 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. Press [DELETE].
   – The key lamp will blink.
3. Press [ENTER].
   – The step indicated by cursor line is deleted.

```
0003    MOVL V=138
0004    MOVJ VJ=50.00
```

3.4.4 Modifying Move Instructions

3.4.4.1 Modifying Position Data

1. Move the cursor to the MOV instruction to be modified.
   – Display the JOB CONTENT window and move the cursor to the move instruction to be changed.
2. Press the axis operation key.
   – Turn ON the servo power and press the axis operation key to move the manipulator to the desired position.
3. Press [MODIFY].
   – The key lamp will blink.
4. Press [ENTER].
   – The position data in the present position is registered.

> SUPPLE-MENT
> For MOV instructions for which position variables have been set, the position variables will not be changed.

3.4.4.2 Modifying Interpolation Type

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

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

3.4.5 Undo Operation

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

The UNDO operation becomes enabled by selecting {EDIT}→{ENABLE UNDO}, and becomes disabled by selecting {EDIT}→{*ENABLE UNDO} while editing a job.

NOTE

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

1. Press [ASSIST].
   – The assist menu appears.

2. Select {UNDO}.
   – The last operation is undone.
3. Select {REDO}.
   – The last UNDO operation is undone.

3.4.6 Modifying Reference Point Instructions

3.4.6.1 Deleting Reference Point Instructions

NOTE

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

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

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

3.4.6.2 Modifying Reference Point Instructions

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

3.4.7 Modifying Timer Instructions

3.4.7.1 Deleting Timer Instructions

1. Move the cursor to the timer instruction to be deleted.

Timer instruction to be deleted

```
0003    MOVJ VJ=50.00
0004    TIMER T=1.00
0005    MOVL V=138
```

2. Press [DELETE].
   – The key lamp will light.
3. Press [ENTER].
   – The timer instruction at the cursor line is deleted.

```
0003    MOVJ VJ=50.00
0004    MOVL V=138
```

3.4.7.2 Modifying Timer Instructions

1. Move the cursor to the timer instruction to be modified.

```
0003    MOVJ VJ=50.00
0004    TIMER T=1.00
0005    MOVL VJ=138
```

2. Press [SELECT].
3. Move the cursor to the input buffer line timer value.
   – Move the cursor to the input buffer line timer value and press [SHIFT] + the cursor key to set the data.
   – To use the Numeric keys to input data, move the cursor to the input buffer line timer value and press [SELECT].

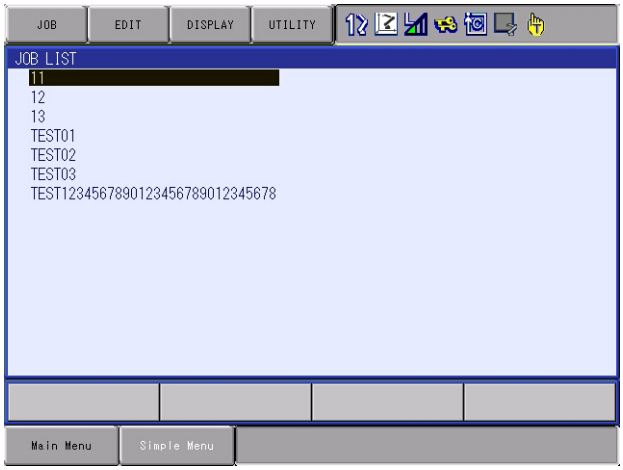
```
=> TIMER T=1.00
```

4. Change the timer value.
5. Press [MODIFY].
6. Press [ENTER].
   – This key lamp will light.

3.5 Modifying Jobs

3.5.1 Calling Up a Job

1. Select {JOB} under the main menu.
2. Select {SELECT JOB}.
   – The JOB LIST window appears.



3. Select the desired job.

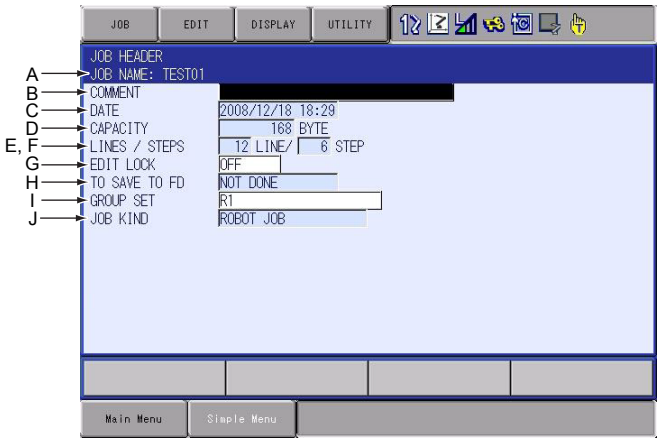
3.5.2 Windows Related to Job

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

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

3.5.3 JOB HEADER Window

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Select {DISPLAY} under the menu.
4. Select {JOB HEADER}.
   – The JOB HEADER window appears. Scroll the window using the cursor.



A. JOB NAME
Displays the name of the current job.

B. COMMENT
Displays the comments attached to the current job. This can be edited in this window.

C. DATE
Displays the date and time of the last editing of the job.

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

E. LINES
Displays the total number of instructions registered in this job.

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

G. EDIT LOCK
Displays whether the edit prohibit setting for this job is ON or OFF. This can be changed in this window.

H. TO SAVE TO FD
Displays “DONE” if the contents of the job have already been saved to an external memory after the date and time of the last editing operation, and displays “NOT DONE” if they have not been 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”.

I. GROUP SET
Displays the control group that this job controls. If the master axis is specified, the master axis is highlighted.

J. JOB KIND
Displays the kind of this job.

SUPPLE-MENT

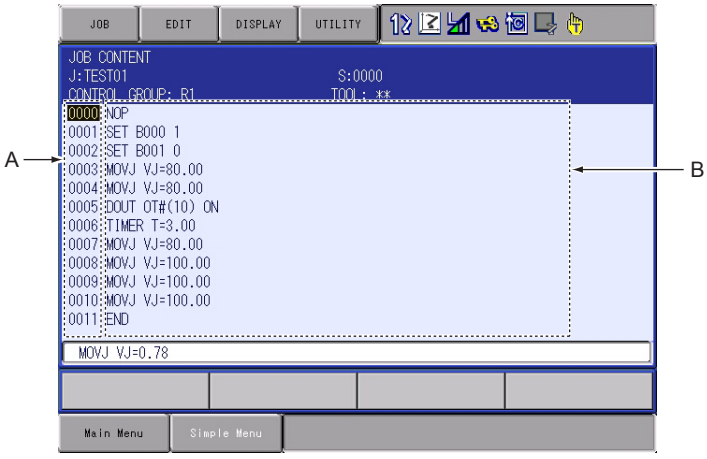
To return to the JOB CONTENT window from the JOB HEADER window, select {DISPLAY} from the menu and then select {JOB CONTENT}.

3.5.4 JOB CONTENT Window

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

– ← (Left) : The cursor is moved to the address area.

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



A. Address Area

Displays the line numbers, the step numbers and the tool numbers which are registered in the each step.

B. Instruction Area

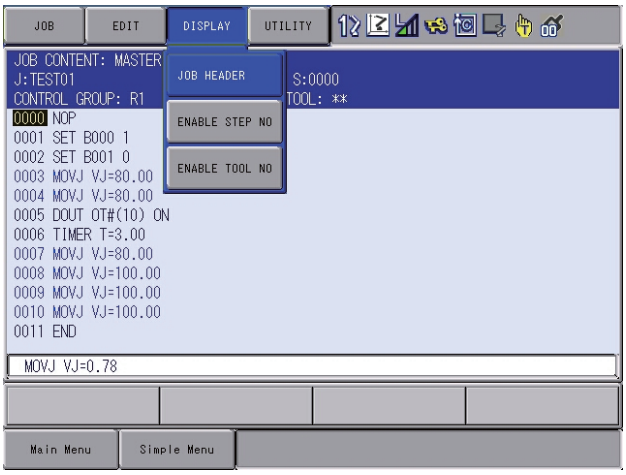
Displays instructions, additional items, and comments. Line editing is possible.

3.5.4.1 Switching the Address Area

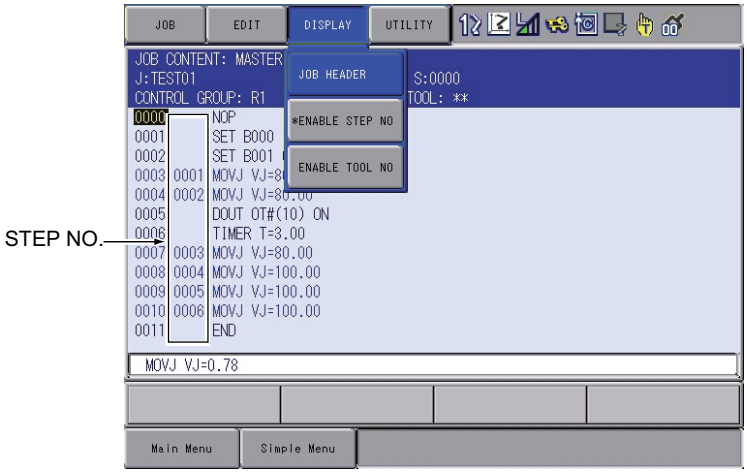
Able to switch a state of the display (to hide or show) of the following numbers in the address area.

- Step numbers
- Tool numbers in the each step

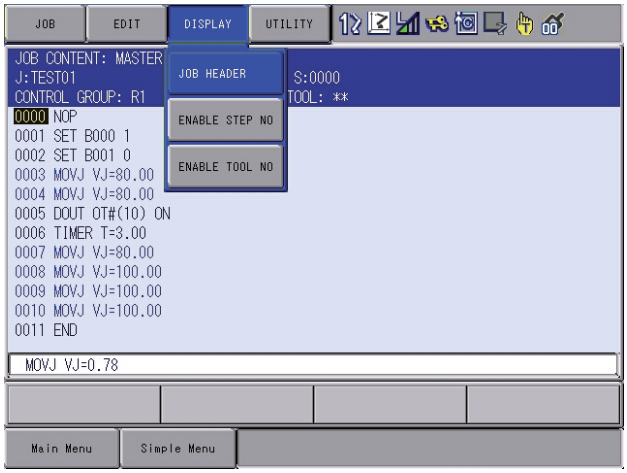
1. Select the {JOB} under the main menu.
2. Select {JOB CONTENT}.
   – Job content appears.
3. Select {DISPLAY} in the menu area.
   – A pull down menu appears.



4. Select {ENABLE STEP NO}.
   – Step numbers appear in the address area.
   – In the pull down menu, {ENABLE STEP NO} changes to {＊ENABLE STEP NO}.

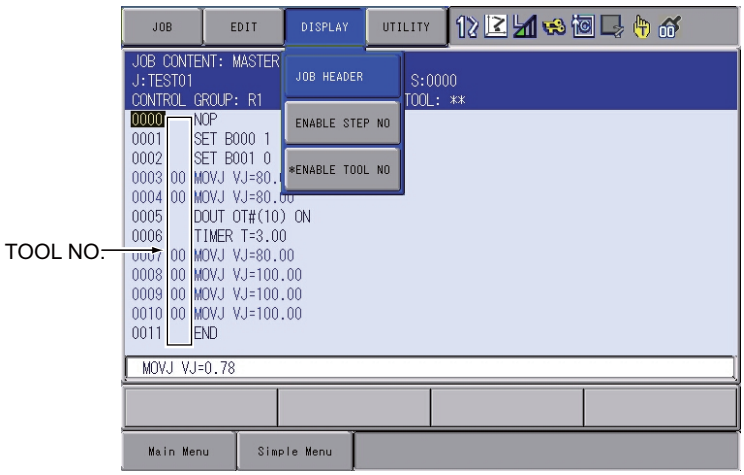


5. Select { ∗ ENABLE STEP NO}.
   - Step numbers in the address area disappear.
   - In the pull down menu, { ∗ ENABLE STEP NO} changes to {ENABLE STEP NO}.

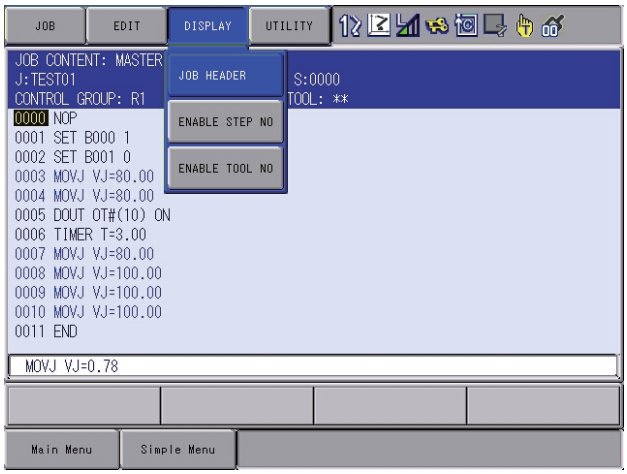


6. Select {ENABLE TOOL NO}.
   - Tool numbers appear in the address area.
   - In the pull down menu, {ENABLE TOOL NO} changes to { ∗ ENABLE TOOL NO}.

   Tool numbers only appear in the line during the move instruction and also appear under the teach mode.

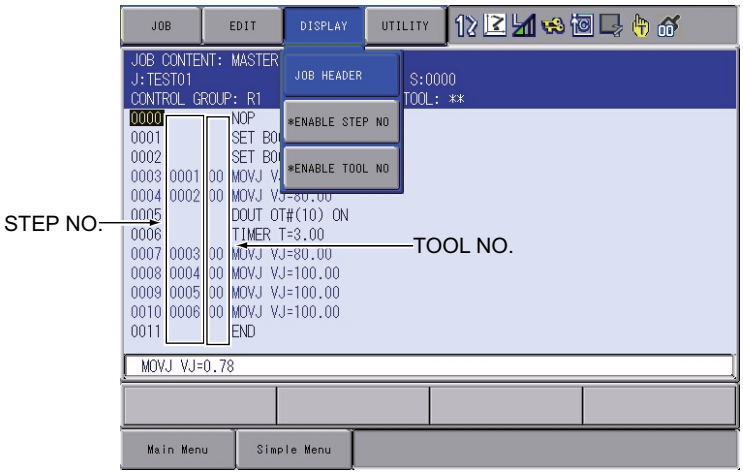


7. Select {∗ENABLE TOOL NO}.
   - Step numbers in the address area disappear.
   - In the pull down menu, {∗ENABLE TOOL NO} changes to {ENABLE TOOL NO}.

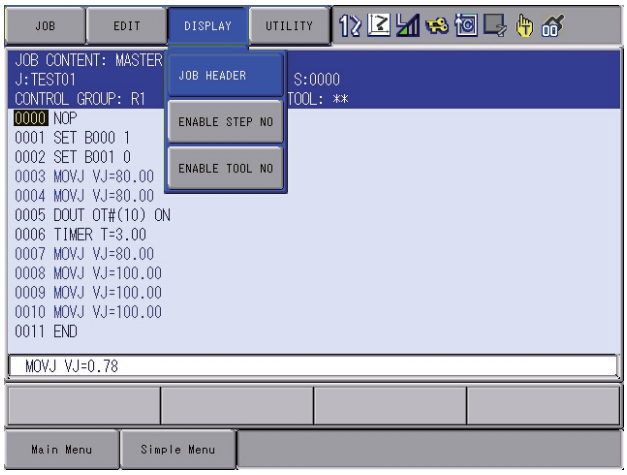


8. Select both {ENABLE STEP NO} and {ENABLE TOOL NO}.
   - The both step numbers and tool numbers appear in the address area.
   - In the pull down menu, {ENABLE STEP NO} changes to {∗ENABLE STEP NO}.
   - In the pull down menu, {ENABLE TOOL NO} changes to {∗ENABLE TOOL NO}.

   Tool numbers only appear in the line during the move instruction and also appear under the teach mode.

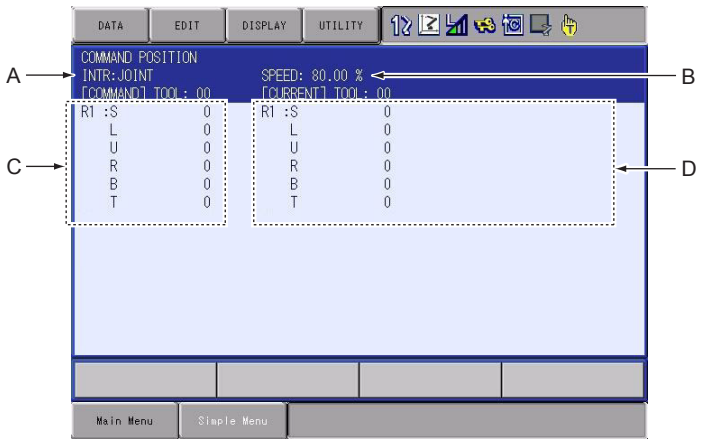


9. Select both {∗ENABLE STEP NO} and {∗ENABLE TOOL NO}.
   - The both step numbers and tool numbers disappear in the address area.
   - In the pull down menu, {∗ENABLE STEP NO} changes to {ENABLE STEP NO}.
   - In the pull down menu, {∗ENABLE TOOL NO} changes to {ENABLE TOOL NO}.



3.5.5 COMMAND POSITION Window

1. Select {ROBOT} under the main menu.
2. Select {COMMAND POSITION}.
   – Edit operations cannot be conducted on this window, but the taught play speed and position data can be viewed on this window.



A. Interpolation
Displays the interpolation type.

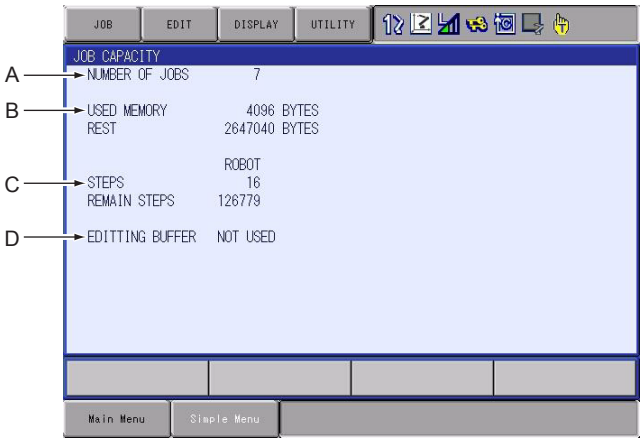
B. Speed
Displays the play speed.

C. 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 (*).

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

3.5.6 JOB CAPACITY Window

1. Select {JOB} under the main menu.
2. Select {JOB CAPACITY}.



A. NUMBER OF JOBS

Displays the total number of jobs currently registered in the memory of DX100.

B. USED MEMORY

Displays the total amount of memory used in the DX100.

C. STEPS

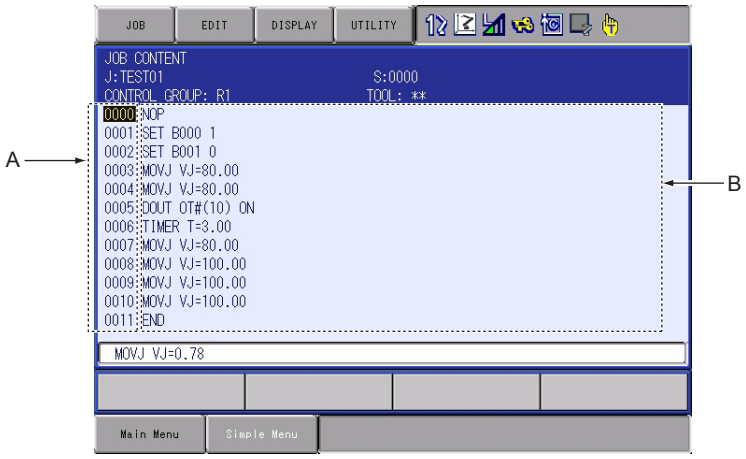
Displays the total number of used steps.

D. EDITING BUFFER

Displays editing buffer use.

3.6 Editing Instructions

The editable content differs depending on whether the cursor is in the address area or instruction area.



A. When the cursor is in the address area

Instructions can be inserted, deleted, or modified.

B. When the cursor is in the instruction area

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

Editing only additional items is called “line editing”.

When inserting or modifying instructions, input the instruction with the function keys such as [TIMER], etc. or by using the instruction list dialog box.

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

If the addition, deletion or modification of additional item is needed, edit on the instruction DETAIL EDIT window. If it is not needed, continue the registration process.

3.6.1 Instruction Group

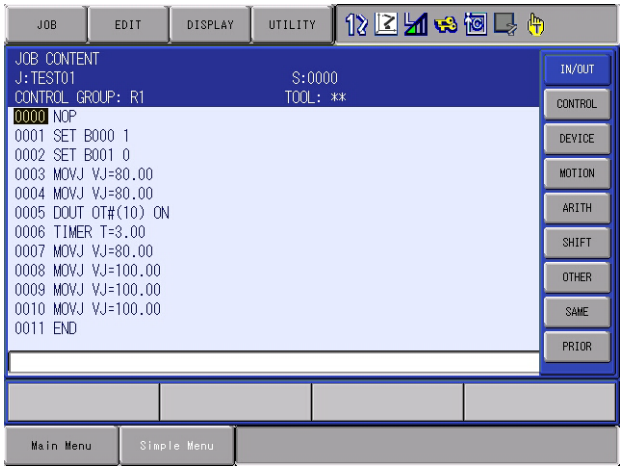
The instructions are divided into eight groups by processing or each work.

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

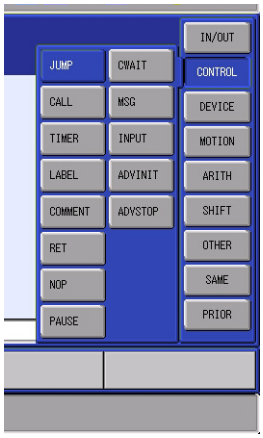
■ **Instruction List**

By pressing [INFORM LIST]

, the instruction group list dialog box appears.



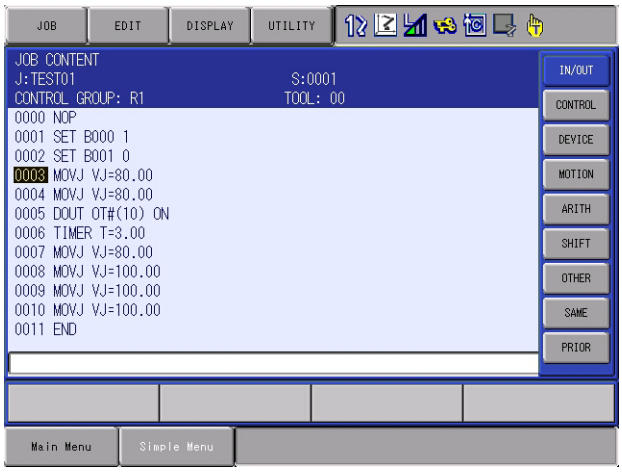
By selecting a group, the instruction list dialog box of the selected group appears.



3.6.2 Inserting Instructions

1. Move the cursor to the address area in the JOB CONTENT window.
   – Move the cursor to the line immediately before where the instruction is to be inserted, in the teach mode.

2. Press [INFORM LIST].
   – The INFORM command list appears, and an underline is displayed beneath the line number in the address area.



3. Select the instruction group.
   – The instruction list dialog box appears. The selected instruction is displayed on the input buffer line with the same additional items as registered previously.

4. Select the instruction.
5. Change the data of additional items or variables as required.
   – **<When Nothing is to be Changed>**
   (1) Proceed to Step 6.

– <When Additional Items are to be edited>

1. Changing numeric data

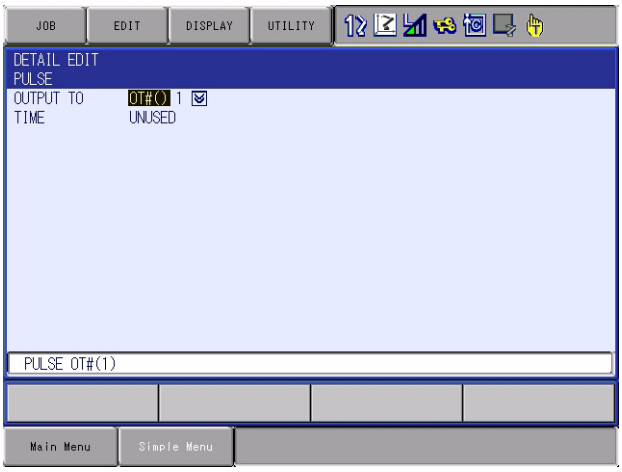
(1) Move the cursor to the desired item and press [SHIFT] + the cursor key to increase or decrease the value.

(2) To directly input the value using Numeric keys, press [SELECT] to display the input buffer line.

(3) Type the value and press [ENTER]. The value on the input buffer line is changed.

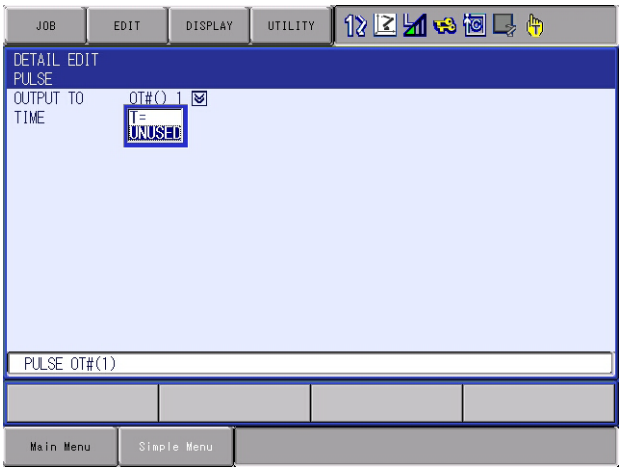
2. Adding, modifying, or deleting an additional item

(1) To add, modify, or delete an additional item, move the cursor to the instruction on the input buffer line and press [SELECT]. The DETAIL EDIT window appears.



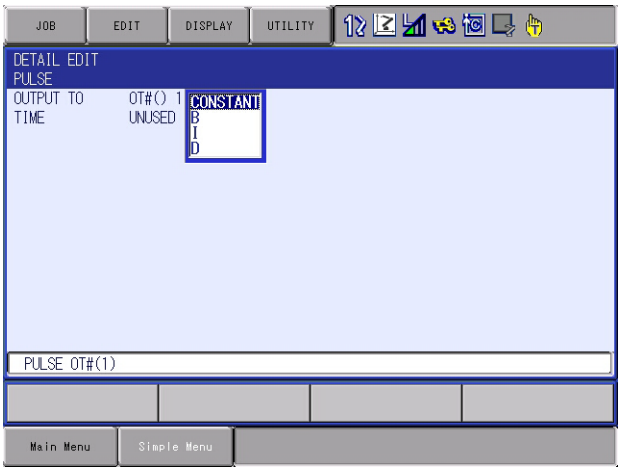
– To add an item, move the cursor to “UNUSED” and press [SELECT]. The selection dialog box appears.

(2) Move the cursor to the desired item and press [SELECT].
To delete an item, move the cursor to the item to be deleted and select “UNUSED”.



3. Changing the data type

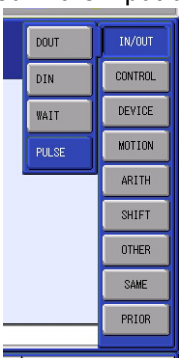
(1) To change the data type of an additional item, move the cursor to ☑ of the item and press [SELECT]. The data type list appears. Select the desired data type.



(2) After additional items have been added, modified or deleted as required, press [ENTER]. The DETAIL EDIT window closes and the JOB CONTENT window appears.

6. Press [INSERT] and [ENTER].

– The instruction displayed in the input buffer line is inserted.



3.6.3 Deleting Instructions

1. Move the cursor to the address area in the JOB CONTENT window.
   – Move the cursor to the instruction line to be deleted, in the teach mode.

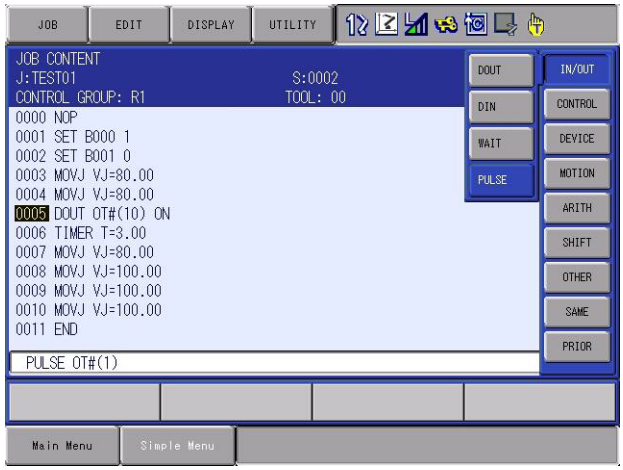
2. Move the cursor to the deleting line in the address area.
3. Press [DELETE] and [ENTER].
   – The instruction is deleted and the following lines move up.

3.6.4 Modifying Instructions

1. Move the cursor to the address area in the JOB CONTENT window.
   – Move the cursor to the instruction line to be modified, in the teach mode.

2. Press [INFORM LIST].
   – The INFORM command list appears and the cursor moves to the INFORM command list.

3. Select the instruction group.
   – The instruction list dialog box appears. The selected instruction is displayed on the input buffer line with the same additional items as registered previously.



4. Move the cursor key to the instruction to be modified and press [SELECT].
5. Change the data of additional items or variables as required.

– **<Editing Additional Items>**

1. Changing numeric data

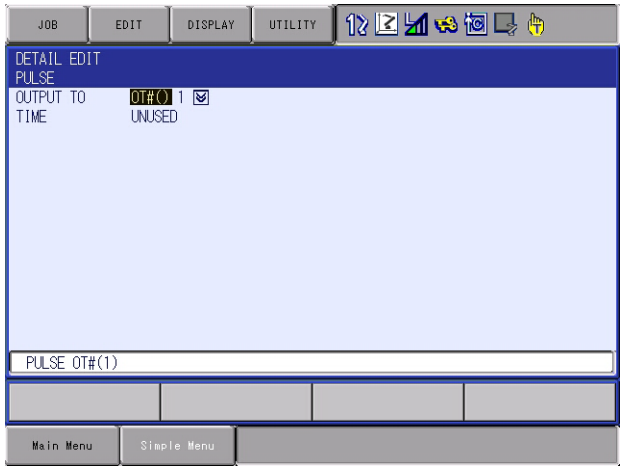
(1) Move the cursor to the desired item and press [SHIFT] + the cursor key to increase or decrease the value.

– To directly input the value using Numeric keys, press [SELECT] to display the input buffer line for the numeric values.

(2) Type the value and press [ENTER]. The value on the input buffer line is changed.

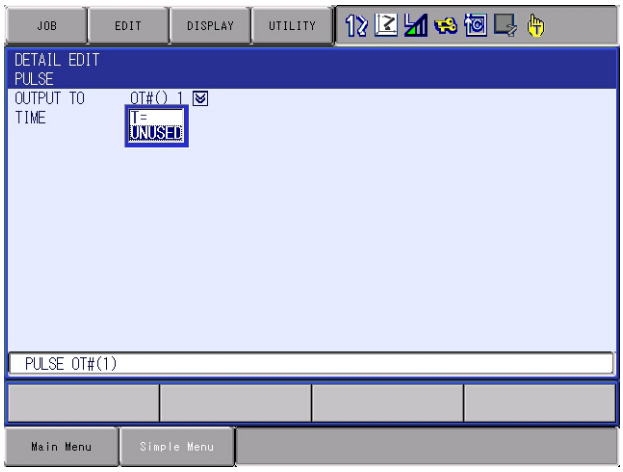
2. Adding, modifying, or deleting an item

(1) To add, modify or delete an additional item, move the cursor to the instruction on the input buffer line and press [SELECT]. The DETAIL EDIT window appears.



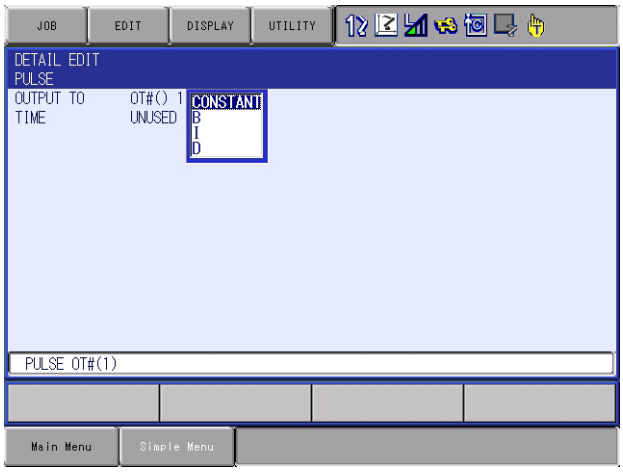
(2) To add an item, move the cursor to “UNUSED” and press [SELECT]. The selection dialog box appears.

(3) Move the cursor to the desired item and press [SELECT].
To delete an item, move the cursor to the item to be deleted and select “UNUSED”.



3. Changing the data type

(1) To change the data type of an additional item, move the cursor to ☒ of the item and press [SELECT]. The data type list appears. Select the desired data type.



(2) After additional items have been added, modified or deleted as required, press [ENTER]. The DETAIL EDIT window closes and the JOB CONTENT window appears.

6. Press [MODIFY] and [ENTER].

– The instruction is modified to the instruction displayed in the input buffer line.

3.6.5 Modifying Additional Numeric Data

1. Move the cursor to the instruction area in the JOB CONTENT window.
   - Move the cursor to the instruction area if it is in the address area.
   - Press [SELECT] to change the mode to line editing mode.
2. Select the line where the number data is to be modified.
   - The selected line can now be edited.

3. Move the cursor to the numeric data to be modified.
4. Input the desired number.
   - Press [SHIFT] + the cursor key to increase or decrease the value. To directly input the number, press [SELECT]. The input buffer line appears. Type the number and press [ENTER].

5. Press [ENTER].
   - The numeric data is modified.

3.6.6 Modifying Additional Items

1. Move the cursor to the instruction area in the JOB CONTENT window.
2. Select the instruction line for which the additional item is to be modified.
   - Move the cursor to the instruction area if it is in the address area
   - Press [SELECT] to change the mode to line editing mode.

Instruction line for which additional item is to be modified.

3. Select the instruction.
   - Move the cursor key to a instruction, the press [SELECT] to display DETAIL EDIT window.

4. Select the additional item to be modified.
   - The selection dialog box appears.

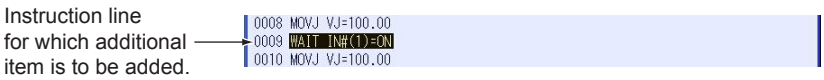
5. Select the desired additional item.
   - The modified additional item is displayed on the DETAIL EDIT window.

6. Press [ENTER].
   - The DETAIL EDIT window closes, and the JOB CONTENT window appears.
7. Press [ENTER].
   - Contents of the input buffer line are registered on the cursor line of the instruction area.

Instruction line for which additional item was modified.

3.6.7 Inserting Additional Items

1. Move the cursor to the instruction area in the JOB CONTENT window.
2. Select the instruction line for which the additional item is to be inserted.
   – The selected line can now be edited.



3. Select the instruction.
   – Move the cursor key to [SELECT] and press, then DETAIL EDIT window appears.

4. Select the additional item to be inserted on DETAIL EDIT window.
   – The selection dialog box appears.

5. Select inserting additional item.
   – The item to be added appears.

   – When the additional item needs the numeric data, move the cursor to the number and press [SELECT]. The input buffer line appears. Type the number and press [ENTER].

6. Press [ENTER].
   – DETAIL EDIT window closes and JOB CONTENT window appears.
7. Press [ENTER].
   – Contents of the input buffer line are registered on the cursor line of the instruction area.

Instruction line for which additional item was added.

```
0008 MOVJ VJ=100.00
0009 WAIT IN#(1)=ON T=0.50
0010 MOVJ VJ=100.00
```

3.6.8 Deleting Additional Items

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

1. Move the cursor to the instruction area in the JOB CONTENT window.
2. Select the line where the additional item is to be deleted.
   - Move the cursor to the instruction area when it is in the address area.
   - Press [SELECT] to change the mode to line editing mode.

Instruction line for which additional item is to be deleted.

```
0008 MOVJ VJ=100.00
0009 WAIT IN#(1)=ON T=0.50
0010 MOVJ VJ=100.00
```

3. Select the instruction.
   - Move the cursor to the instruction and press [SELECT], then DETAIL EDIT window appears.

4. Select the additional item to be deleted.
   - The selection dialog box appears.

5. Select “UNUSED”.
   - “UNUSED” is displayed ton the DETAIL EDIT window.

6. Press [ENTER].
   - The DETAIL EDIT window closes, and the JOB CONTENT window appears.
7. Press [ENTER].
   - Contents of the input buffer line are registered on the cursor line of the instruction area.

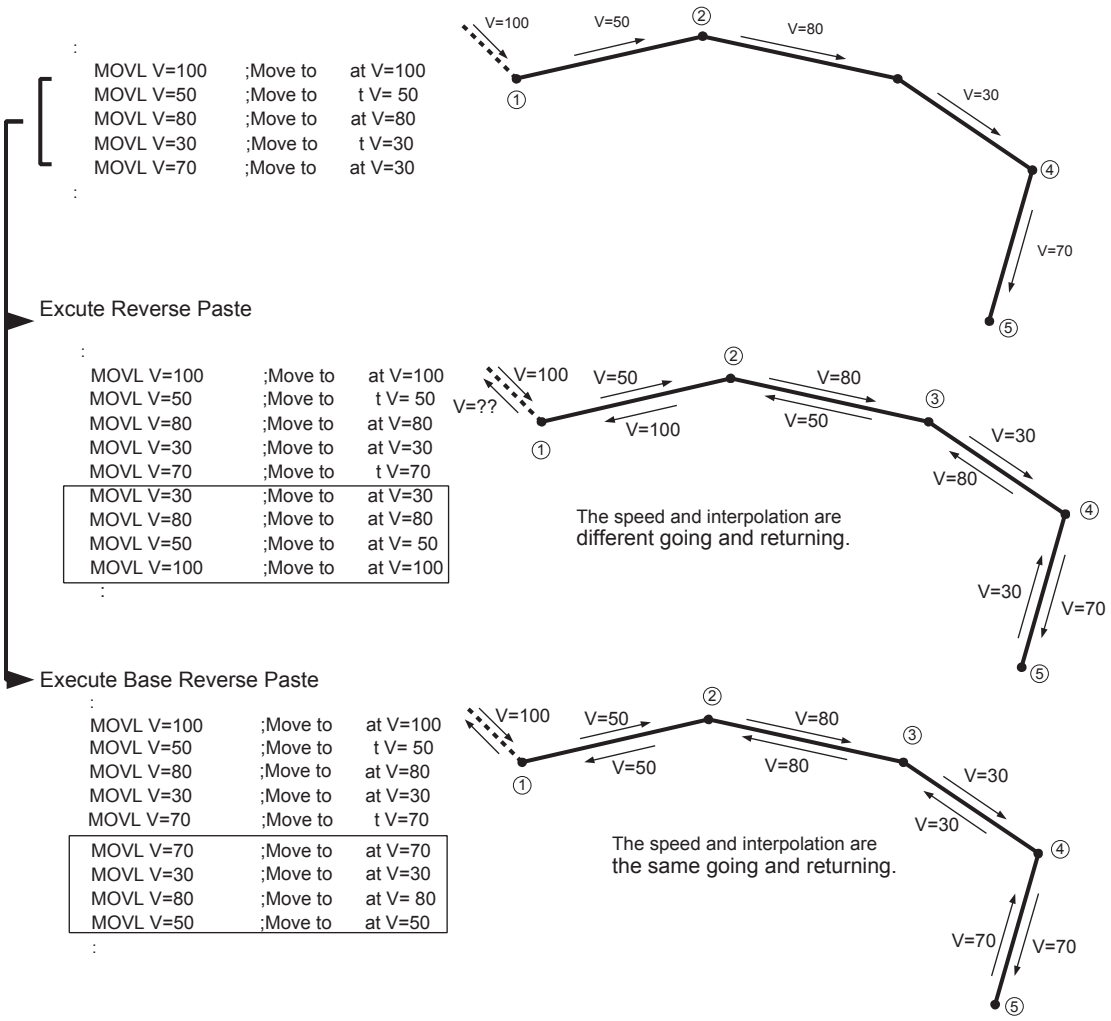
Instruction line for which the additional item was deleted.

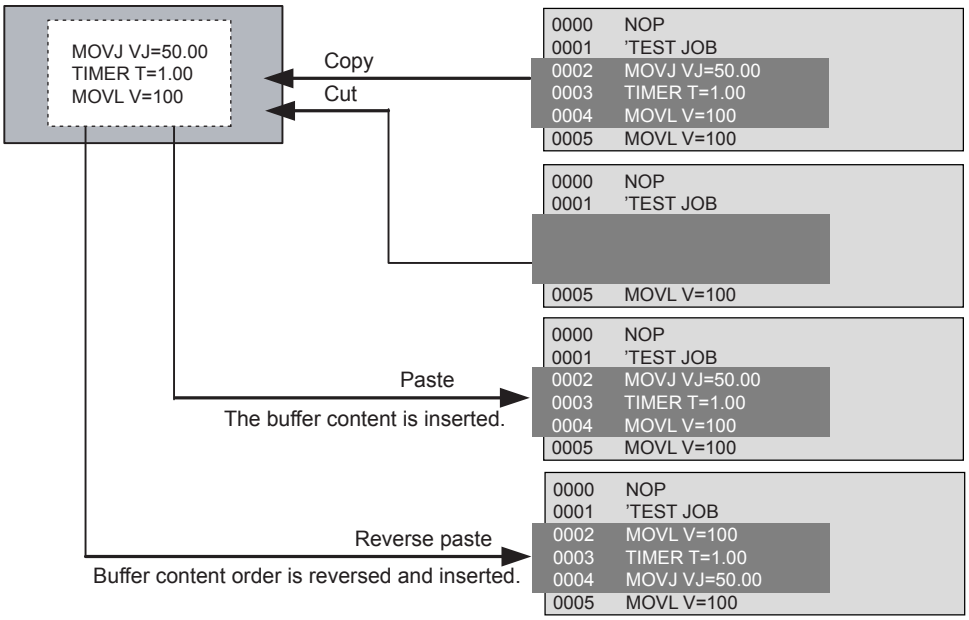
```
0008 MOVJ VJ=100.00
0009 WAIT IN#(1)=ON
0010 MOVJ VJ=100.00
```

3.7 Editing Jobs

The following five operations are to edit jobs.

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

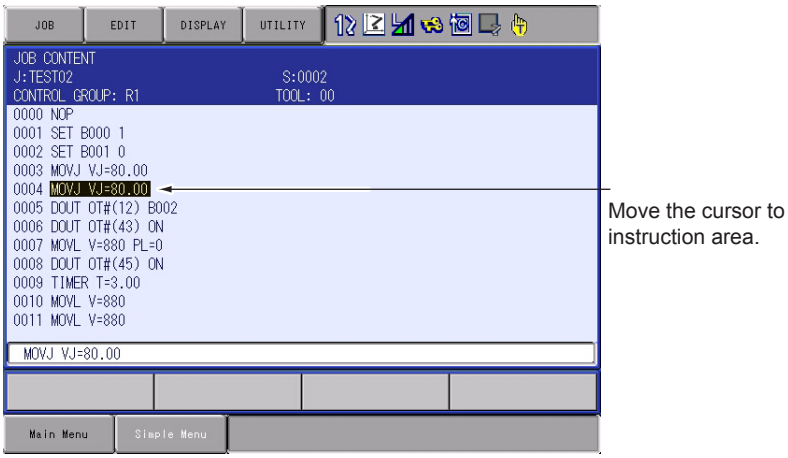



MOVJ VJ=50.00
TIMER T=1.00
MOVL V=100
Copy
Cut
0000 NOP
0001 'TEST JOB
0002 MOVJ VJ=50.00
0003 TIMER T=1.00
0004 MOVL V=100
0005 MOVL V=100
0000 NOP
0001 'TEST JOB
0005 MOVL V=100
Paste
The buffer content is inserted.
0000 NOP
0001 'TEST JOB
0002 MOVJ VJ=50.00
0003 TIMER T=1.00
0004 MOVL V=100
0005 MOVL V=100
Reverse paste
Buffer content order is reversed and inserted.
0000 NOP
0001 'TEST JOB
0002 MOVL V=100
0003 TIMER T=1.00
0004 MOVJ VJ=50.00
0005 MOVL V=100

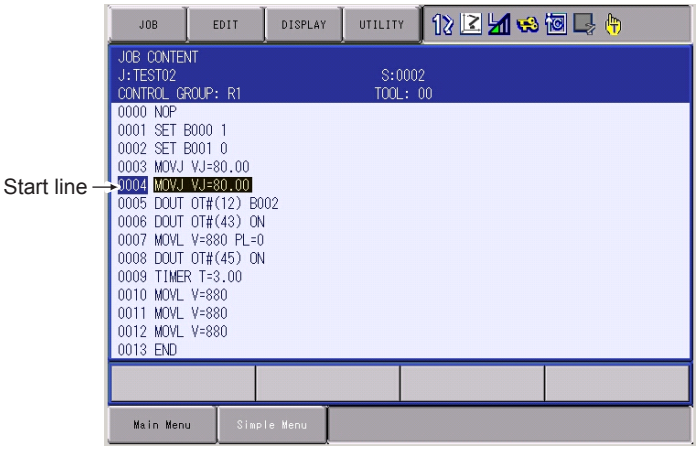
3.7.1 Selecting the Range

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

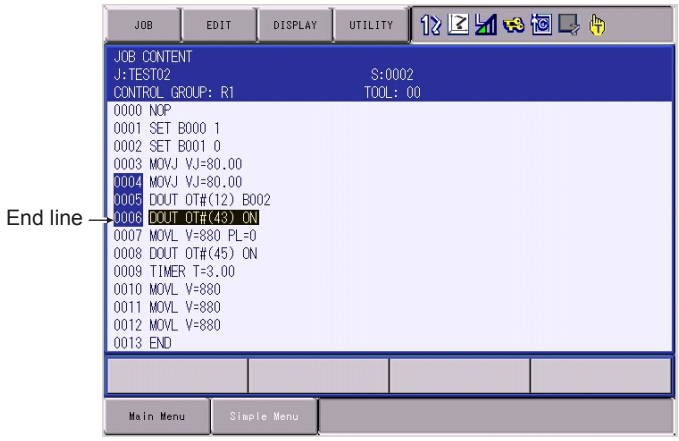
1. Move the cursor to the instruction area in the JOB CONTENT window.



2. Move the cursor to the start line and press [SHIFT] + [SELECT].
   – The range specification begins, and the address is displayed in reverse.



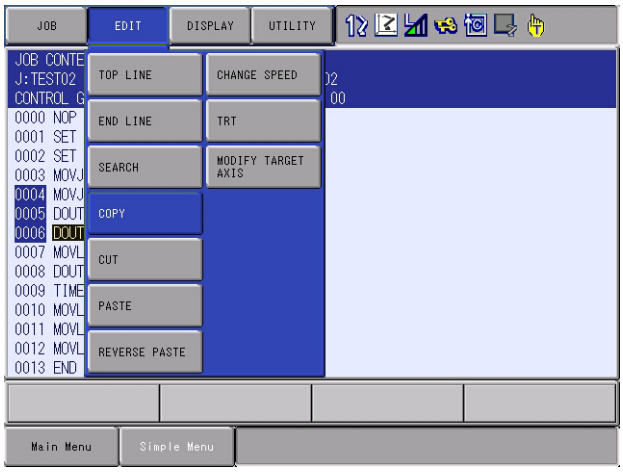
3. Move the cursor to the end line.
   – The range is varied by moving the cursor. Up to the line specified by the cursor is the range.



3.7.2 Copying

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

1. Select {EDIT} under the menu.
   – The pull-down menu appears.

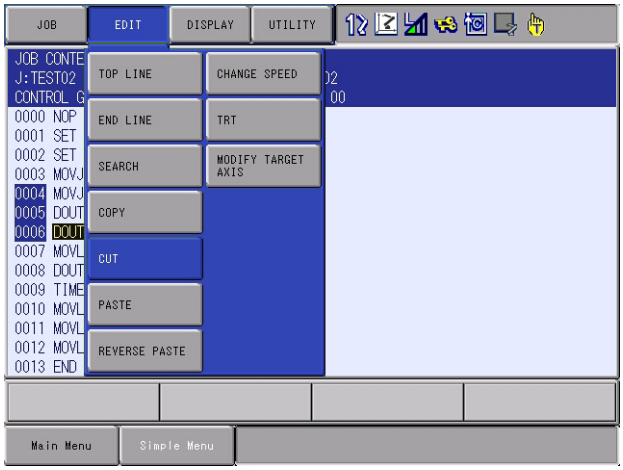


2. Select {COPY}.
   – The specified range is copied to the buffer.

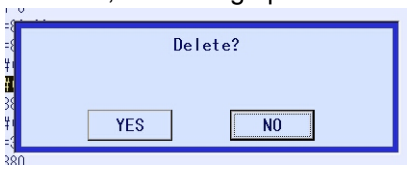
3.7.3 Cutting

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

1. Select {EDIT} under the menu.
   – The pull-down menu appears.



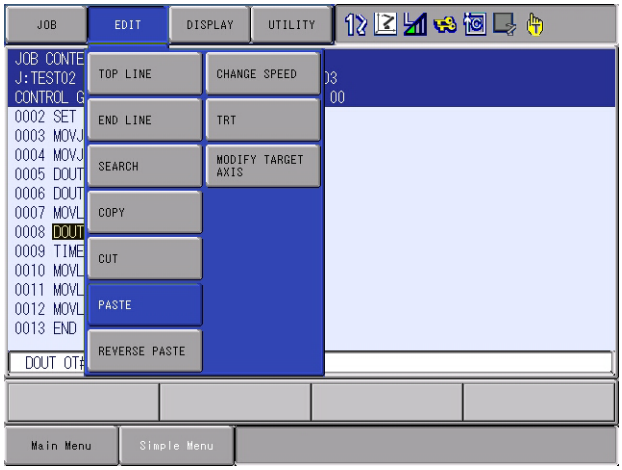
2. Select {CUT}.
   – The confirmation dialog box appears. When “YES” is selected, the specified range is deleted and copied to the buffer.
   – When “NO” is selected, the cutting operation is canceled.



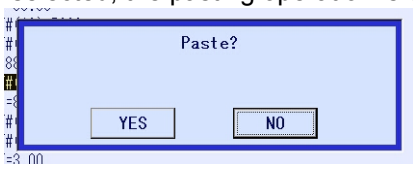
3.7.4 Pasting

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

1. Move the cursor to the line immediately before the desired position in the JOB CONTENT window.
   – The pull-down menu appears.



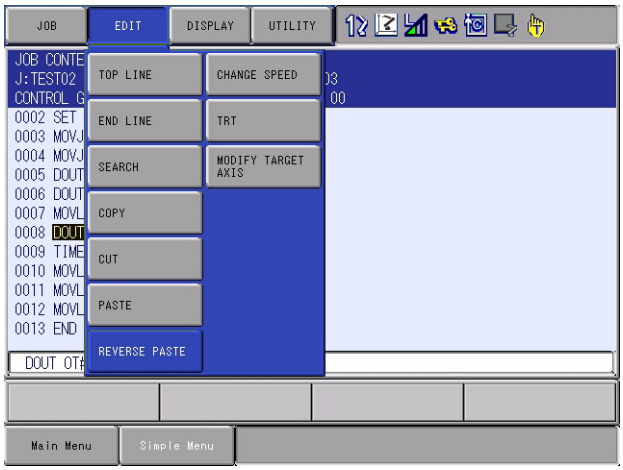
2. Select {EDIT} under the menu.
3. Select {PASTE}.
   – The confirmation dialog box appears.
   – When “YES” is selected, the contents of the buffer are inserted to the job.
   – When “NO” is selected, the pasting operation is canceled.



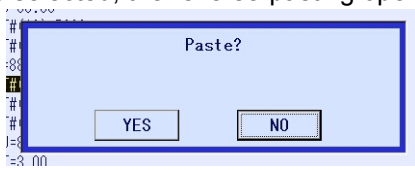
3.7.5 Reverse Pasting

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

1. Move the cursor to the line immediately before the desired position in the JOB CONTENT window.
2. Select {EDIT} under the menu.
   – The pull-down menu appears.



3. Select {REVERSE PASTE}.
   – The confirmation dialog box appears.
   – When “YES” is selected, the contents of the buffer are reverse pasted to the job.
   – When “NO” is selected, the reverse-pasting operation is canceled.



3.8 Test Operations

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

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

NOTE

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

3.8.1 Test Operation Procedures

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

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

NOTE

Always check safety conditions before starting the manipulator in motion.

3.9 Other Job-editing Functions

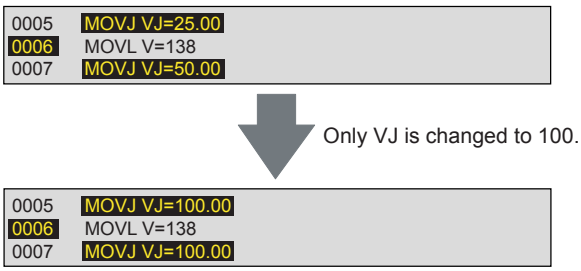
3.9.1 Editing Play Speed

There are two ways to modify play speed:

- Modification of Speed Type
- Relative Modification

3.9.1.1 Modification of Speed Type

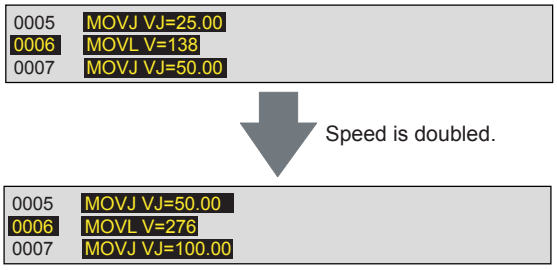
This method is used to modify the speed type (such as VJ, V, VR, etc.)



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

3.9.1.2 Relative Modification

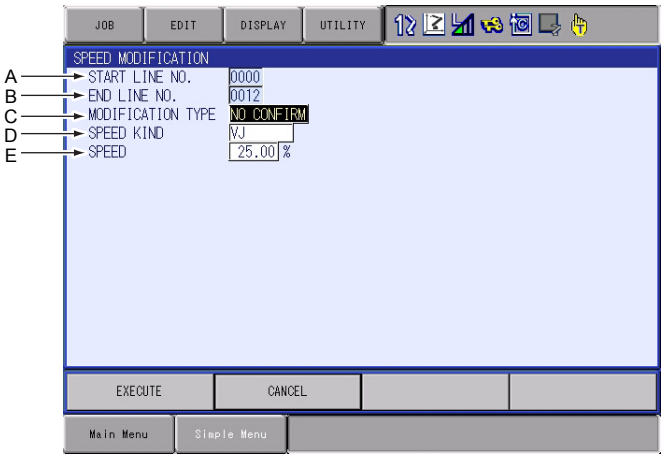
All steps are selected regardless of the play speed type. This method is used to change all steps by a specified percentage (1% to 200%). This is called relative modification.



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

1. Select {JOB} under the main menu.
2. Select {JOB}.
   – The JOB CONTENT window appears.
3. Move the cursor to the instruction area.
4. Press [SHIFT] + [SELECT] in the speed modify start line.
   – If the section is not specified, the speed of the entire job will be changed.
   – Move the cursor to the end line. The line numbers of the selected lines are highlighted.

5. Select {EDIT} under the menu.
6. Select {CHANGE SPEED}.
   – The SPEED MODIFICATION window appears.



7. Set desired items.

A. START LINE NO.
Displays the first line number of the section to be modified.

B. END LINE NO.
Displays the last line number of the section to be modified.

C. MODIFICATION TYPE
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”.

D. SPEED KIND
Selects the speed type.
When [SELECT] is pressed when the cursor is on this item, selection dialog box appears. Select the speed type to be changed.

E. SPEED
Specifies the speed value.
When [SELECT] is pressed when the cursor is on this item, the mode changes to the number input mode. Input the speed value and press [ENTER].

8. Select “EXECUTE”.
   – The speed begins to change.
   – If “MODIFICATION TYPE” is set to “CONFIRM”, the confirmation dialog box “Modifying speed” is displayed. Press [ENTER] to change the speed on the first line and search for the next speed. Press the UP/DOWN cursor button to keep the speed on the first line and search for the next speed. To cancel the speed modification, press [CANCEL].
   – If “MODIFICATION TYPE” is set to “NOT CONFIRM”, all the speeds of the specified section are changed.

3.9.1.3 Modification by TRT (Traverse Time)

Modifications made by TRT have the following characteristics:

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

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

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

7. Set the desired items.

A. START LINE NO.
Displays the first line number of the section to be measured and modified.

B. END LINE NO.
Displays the last line number of the section to be measured and modified.

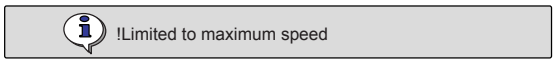
C. MOVING TIME
The weaving time needed to move from the first number to last number is measured and displayed.

D. SETTING TIME
Set the desired weaving time.
When [SELECT] is pressed when the cursor is on this item, the input buffer line appears. Input the desired weaving time and press [ENTER].

8. Select “EXECUTE”.
   – The speed is changed according to the setting.

NOTE

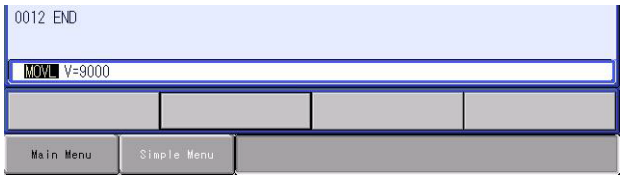
- If instructions that include specific speed data such as SPEED or ARCON instructions (including speed data of the welding condition file) exist in the specified section, the speed data for those steps are not changed. Therefore, in such cases, the set time and the actual time required are not same.
- If the speed data is limited by the maximum value, the following message is displayed.



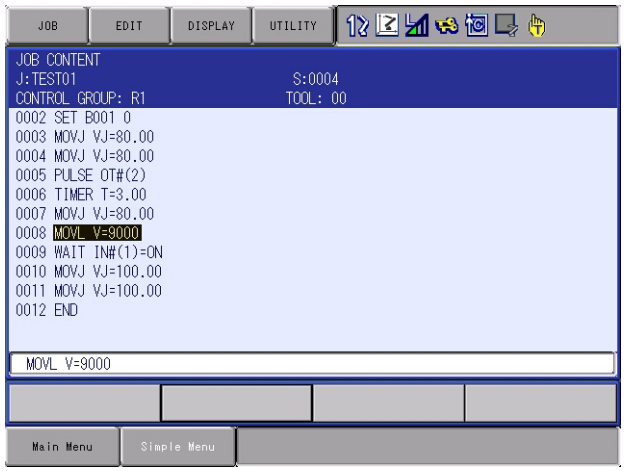
3.9.2 Editing Interpolation Type

1. Select {JOB} under the main menu.
2. Select {JOB}.
   – The JOB CONTENT window appears.
3. Move the cursor to the instruction area.
4. Select the line to be modified.
   – The instruction on the cursor is displayed in the input buffer line.

5. Press [SHIFT] + the cursor key simultaneously.
   – The interpolation type in the input buffer line changes.
   – The modification of the speed according to the modification of the interpolation type is calculated by the ratio to maximum speed at each speed.
   – Joint Speed: MAX=100.0%
     Linear Speed: MAX=9000cm/min
     (e.g.)
     Joint Speed: 50% = Linear Speed: 4500cm/min
     Linear Speed: 10% = Linear Speed: 900cm/min



6. Press [ENTER].
   – The instruction on the cursor line is replaced with one on the input buffer line.

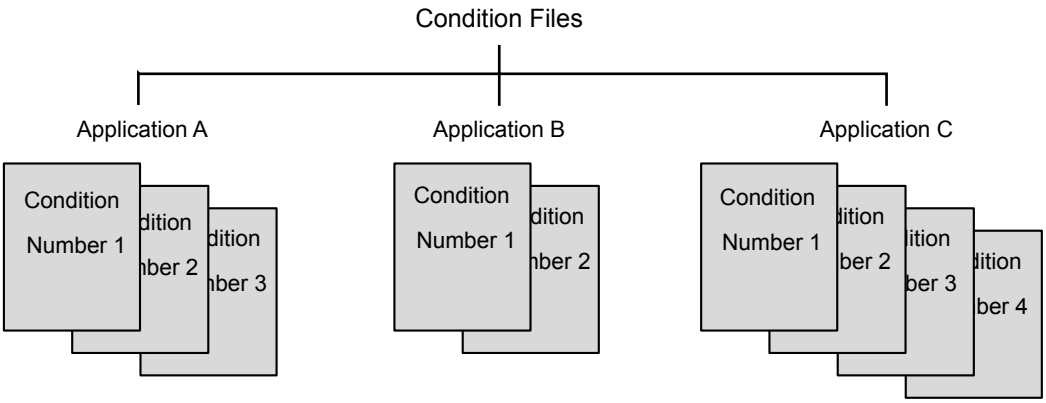


3.9.3 Editing Condition Files

Condition files are prepared in order to set the conditions for the manipulator to execute instructions.

Multiple condition files are provided for each application. More than one pattern can be set up in each condition file. The patterns are listed by “condition numbers”. This number is specified by the work instruction in a job.

> **NOTE** Refer to DX100 Operator’s Manual of each application for information regarding the contents and editing methods of the condition file.



3.9.4 User Variables

User variables are used for jobs to store counters, calculation results or input signals. Since the same user variable can be used in multiple jobs, save the numerical values as common references for the jobs and the user variables are maintained even when the power is turned OFF.

User variables have the following applications:

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

The data formats for user variables are described in the following table:

Table 3-5: User Variables

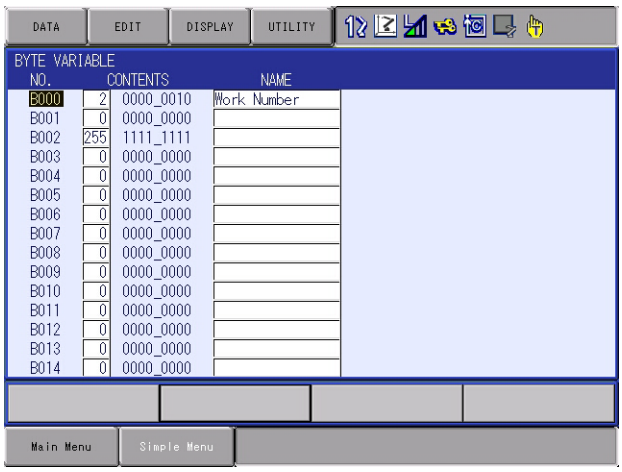
Data Format	Variable No. (pcs)	Functions
Byte Type	B000 to B099 (100)	Range of storable values is from 0 to 255. Can store I/O status. Can perform logical operations (AND, OR, etc.)
Integer Type	1000 to 1099 (100)	Range of storable values is from -32768 to 32767.
Double Precision Integer Type	D000 to D099 (100)	Range of storable values is from -2147483648 to 2147483647.
Real Type	R000 to R099 (100)	Range of storable values is from -3.4E+38 to 3.4E38. Accuracy: 1.18E-38 < x ≤ 3.4E38
Character Type	S000 to S099 (100)	Maximum storable number of characters is 16.
Position Type	P000 to P127 (128)	Can store position data in pulse form or in XYZ form. XYZ type variable can be used as target position data for move instructions, and as incremental values for parallel shift instructions.
	BP000 to BP127 (128)	
	EX000 to EX127 (128)	

NOTE

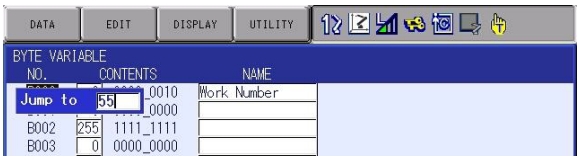
- **Play Speed V:**
  MOVL V=I000
  The variable I000 is used for speed V with this move instruction.
  The unit for V is 0.1mm per second.
  For example, if I000 were set as 1000, the following would be true:
  I000=1000 → unit for V is 0.1mm/s → V=100.0mm/s
  Note that, depending on the unit being used, the value of the variable and the value of the actual speed on occasion might not match.
- **Play Speed VJ:**
  MOVL VJ=I000
  The unit for VJ is 0.01%.
  For example, if I000 were set as 1000, the following would be true:
  I000=1000 → unit for VJ is 0.01% → VJ=10.00%.
- **Timer T:**
  TIMER T=I000
  The unit for T is 0.01 seconds.
  For example, if I000 were set as 1000, the following would be true:
  I000=1000 → unit for T is 0.01 seconds → T=10.00 seconds.

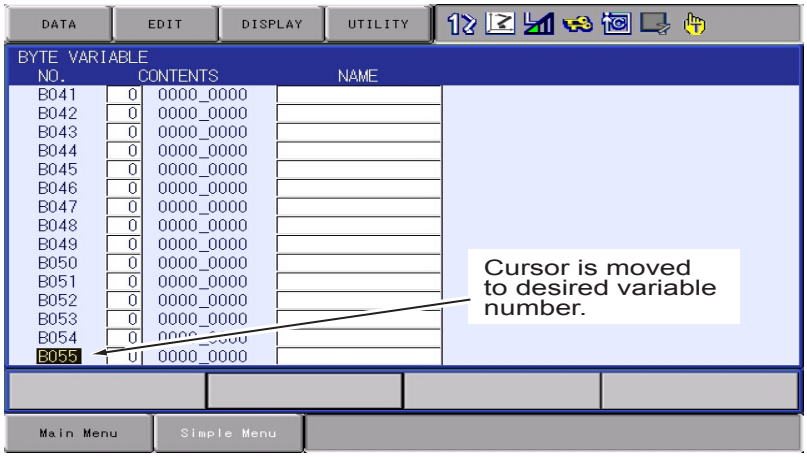
3.9.4.1 Setting Byte, Integer, Double Precision Integer, and Real Type Variables

1. Select {VARIABLE} under the main menu.
   – {BYTE}, {INTEGER}, {DOUBLE}, and {REAL} are displayed for the sub menu.
2. Select desired variable type.
   – The BYTE VARIABLE window appears. (Following is a case that {BYTE} is selected.)



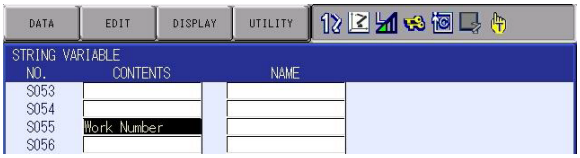
3. Move the cursor to the desired variable No.
   – When the desired variable number is not displayed, move the cursor with either of the following operations.
     • Move the cursor on the variable No. and press [SELECT]. Then input the variable No. using the Numeric keys and press [ENTER].
     • Move the cursor to the menu area and select {EDIT} → {SEARCH}. Then input the variable No. with the Numeric keys and press [ENTER]





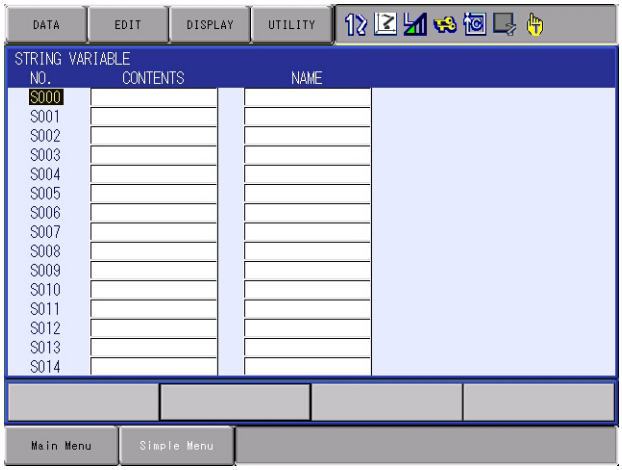
4. Move the cursor to the data of the variable.
   – The number can be directly typed.
5. Input the desired number.

6. Press [ENTER].
   – Input value is set to the variable on the cursor position.

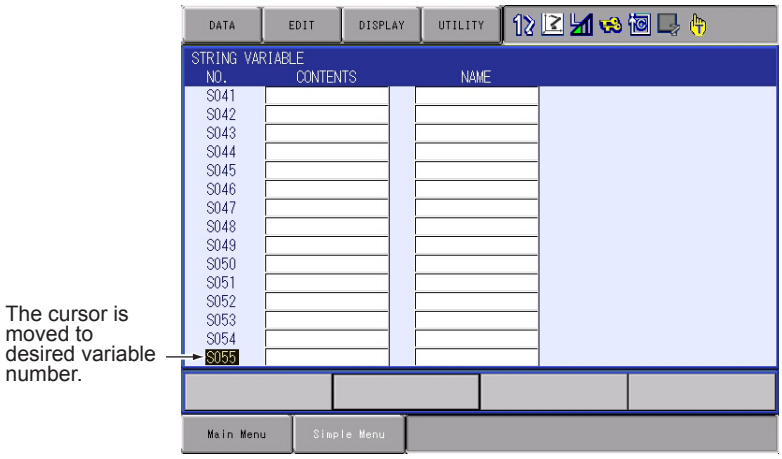


3.9.4.2 Setting Character Type Variables

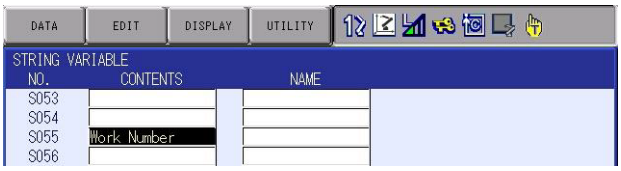
1. Select {VARIABLE} under the main menu.
2. Select {STRING}.
   – The STRING VARIABLE window appears.



3. Move the cursor to the desired variable No.
   – When the desired variable number is not displayed, move the cursor with either of the following operations.
   • Move the cursor on the variable No. and press [SELECT]. Then input the variable No. using the Numeric keys and press [ENTER].
   • Move the cursor to the menu area and select {EDIT} → {SEARCH}. Then input the variable No. with the Numeric keys and press [ENTER]



4. Move the cursor to the data of the variable.
   – The characters can be directly typed.
5. Input the desired characters.
   – For information on character input operation, refer to *section 1.2.6 “Character Input Operation” on page 1-18*.
6. Press [ENTER].
   – The input characters are set to the variable on the cursor position.



3.9.4.3 Registering Variable Name

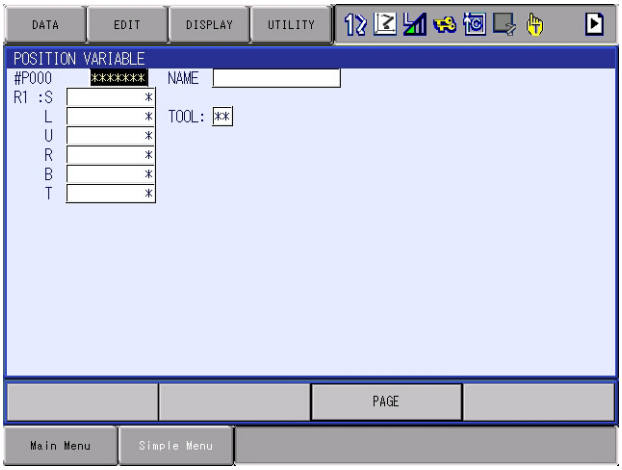
1. Select {VARIABLE} under the main menu.
2. Select desired variable.
   – Select any variable type from among byte type, integer type, double precision integer type, real type, robot position type, base position type, and station position type.
3. Move the cursor to desired variable number.
   – If 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.
4. Select “NAME”.
   – The input buffer line appears.

> SUPPLE-MENT
> Refer to *section 1.2.6 “Character Input Operation” on page 1-18* for the character input operation.

5. Input name.
6. Press [ENTER].
   – The variable name is registered.

3.9.4.4 Displaying Position Variables

1. Select {VARIABLE} under the main menu.
2. Select desired position variable type.
   – The POSITION VARIABLE window of desired type among robot type, base type, and station type appears.



3. Move to a page with the objective variable number.
   – When the desired variable number is not displayed, move the cursor with either of the following operations.
   • Press the page key or [SHIFT] + page key .
   • Press page button, then input the variable No. using the Numeric keys and press [ENTER].
   • Move the cursor to the menu area and select {EDIT} → {SEARCH}. Then input the variable No. with the Numeric keys and press [ENTER].

Move to desired variable number page.

3.9.4.5 Setting Position Variables

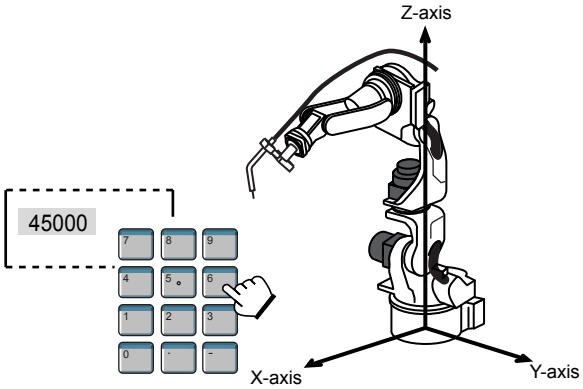
The following table shows the types of position variables and setting methods.

> **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.

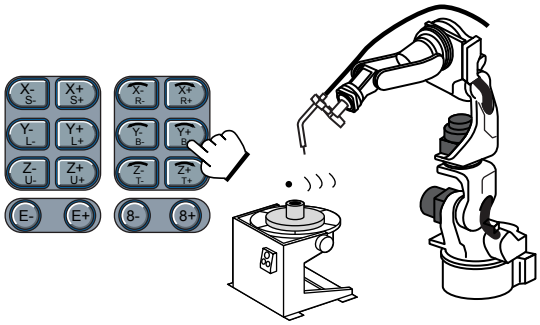
Table 3-6: Types of Position Variables and Setting Method

Type	Pxxx (Robot)		BPxxx (Base)		EXxxx (Station)
	Pulse Type	XYZ Type	Pulse Type	XYZ Type	Pulse Type
Setting Method		Select coordinates from base, robot, user, tool.			

Using the numeric keys



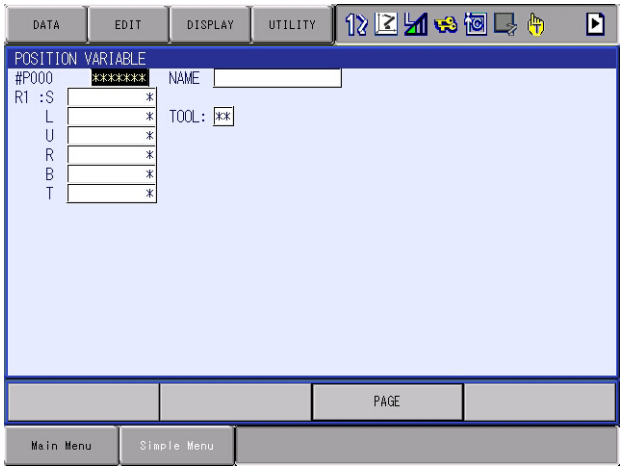
Using the axis keys



3.9.4.6 Setting Position Variables Using the Numeric Keys

■ **Pulse Type**

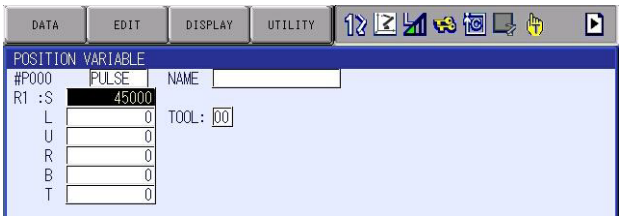
1. Select {VARIABLE} under the main menu.
2. Select desired position variable type.
   – The desired variable window appears (robot, base, or station). (The POSITION VARIABLE window is used for this example.)



3. Select the variable data type.
   – The selection dialog box appears.

   – If the position variable was set before, confirmation dialog box appears for data clear. If “YES” is selected, the data is cleared.

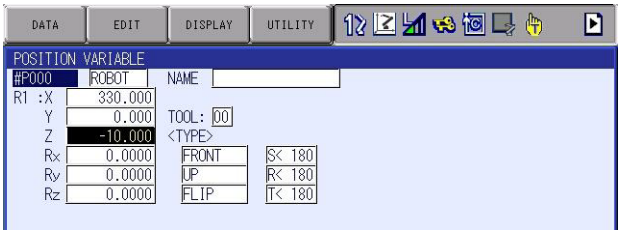
4. Select {PULSE}.
5. Move the cursor to desired data to be input and press [SELECT].
6. Input the value.
7. Press [ENTER].
   – The value is set in the cursor position.



■ XYZ Type

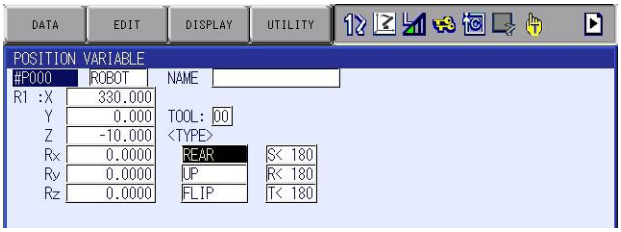
1. Select {VARIABLE} under the main menu.
2. Select desired position variable type.
3. Select the variable data type.
   – The selection dialog box appears.

4. Select desired coordinates except PULSE.
5. Move the cursor to desired data to be input and press [SELECT].
6. Input the value.
7. Press [ENTER].
   – The value is set in the cursor position.



(1) 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 *section 3.9.4.10 “Manipulator Types” on page 3-89*. Current Position Window (XYZ) shows the current setting of a type.

3.9.4.7 Setting Position Variables Using the Axis Keys

■ **Pulse Type**

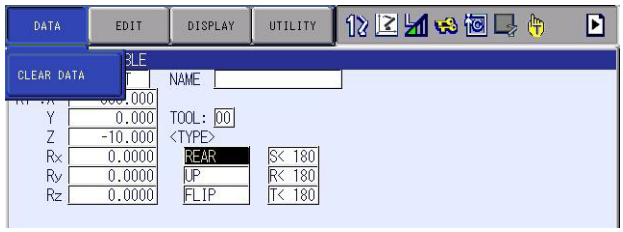
1. Select {VARIABLE} under the main menu.
2. Select desired position variable type.
   – The desired variable window appears (robot, base, or station).
3. Press [SHIFT] + [ROBOT]. When you need an external axis position, press [SHIFT]+[EX.AXIS].
   (1) When there are two or more robot, base, or a station, specify the axis with following operation.
   • **Robot**
   Each time [SHIFT] + [ROBOT] is pressed, the axis displayed on the status line changes:
   R1 → R2 → ... → R8.
   • **Base or Station**
   Each time [SHIFT]+[EX.AXIS] is pressed, the axis displayed on the status line changes:
   B1→ B2 → ... → B8 → S1 → S2 → ..... → S24.
   (2) Check the selected axis on the status line.
4. Move the manipulator with the axis keys.
   – Move the manipulator or the external axis to the desired position to be set to position variable.
5. Press [MODIFY].
6. Press [ENTER].

■ **XYZ Type**

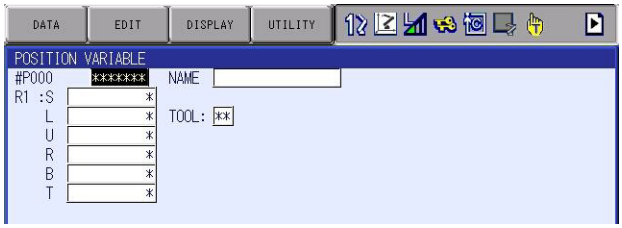
1. Select {VARIABLE} under the main menu.
2. Select desired position variable type.
   (1) When there are two or more robot, base, or a station, specify the axis with following operation.
   • **Robot**
   Each time [SHIFT] + [ROBOT] is pressed, the axis displayed on the status line changes:
   R1 → R2 → ... → R8.
   • **Base or Station**
   Each time [SHIFT]+[EX.AXIS] is pressed, the axis displayed on the status line changes:
   B1→ B2 → ... → B8 → S1 → S2 → ..... → S24.
   (2) Check the selected axis on the status line.
3. Move the manipulator with the axis keys.
   – Move the manipulator or the external axis to the desired position to be set to position variable.
4. Press [MODIFY].
5. Press [ENTER].

3.9.4.8 Deleting Data Set of Position Variables

1. Select {VARIABLE} under the main menu.
2. Select desired position variable type.
3. Select {DATA} under the menu.
   – The pull-down menu appears.



4. Select {CLEAR DATA}.
   – The position variable data on the displayed page are deleted.



3.9.4.9 Checking Positions by Position Variables

1. Select {VARIABLE} under the main menu.
2. Select desired position variable type.
   (1) When there are two or more robot, base, or a station, specify the axis with following operation.

   • **Robot**
   Each time [SHIFT] + [ROBOT] is pressed, the axis displayed on the status line changes:
   R1 → R2 → ... → R8.

   • **Base or Station**
   Each time [SHIFT]+[EX.AXIS] is pressed, the axis displayed on the status line changes:
   B1→ B2 → ... → B8 → S1 → S2 → ..... → S24.

   (2) Check the selected axis on the status line.
3. Press [FWD].
   – Selected axis moves to the position specified by the variable.

> **NOTE**
> The selected axis (manipulator, base, or station) moves directly to the set variable position.
> Before pressing [FWD], check that the surrounding area is safe.

3.9.4.10 Manipulator Types

When the position data of the job data are described using the XYZ format, several postures may be taken according to the manipulator's structure when moving it to the described position.

Although these postures have the same coordinates for TCP, they vary in pulse for each axis.

Thus, the manipulator's posture cannot be uniquely defined only by the coordinate value, and it is necessary to specify the data other than the coordinate value to define the manipulator's posture.

This is called "Type".

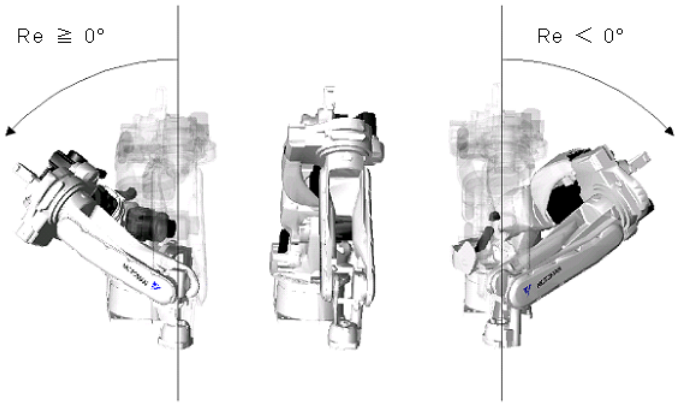
Type varies according to the manipulator model.

NOTE

For the manipulator with seven axes, X, Y, Z, Rx, Ry, Rz, Re and Type are used.

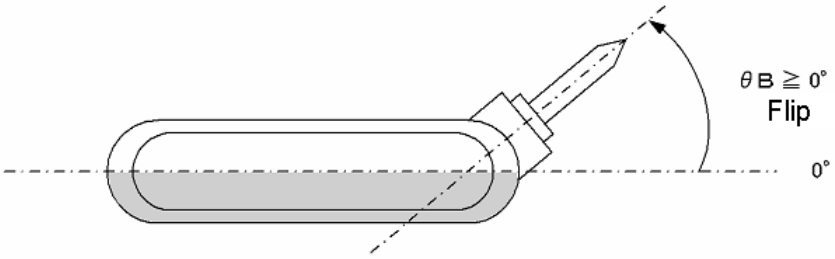
Re is an element to indicate the posture of the manipulator with seven axes and does not change by the specified coordinates.

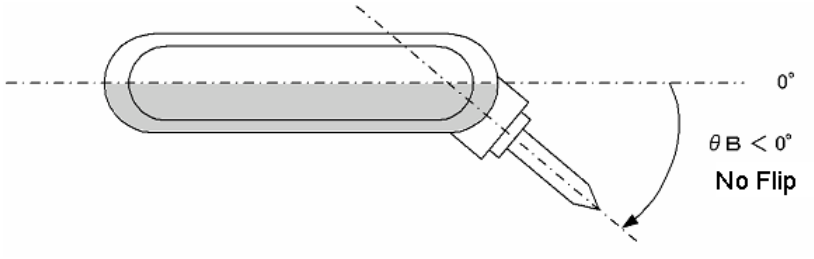
The definition of Re is shown below.



3.9.5 Flip/No Flip

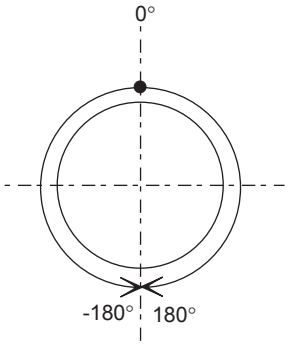
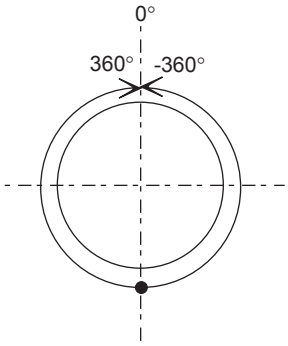
When the angle of B-axis is within (+) range (θB ≥ 0°), it is called “Flip”, and when within (-) range (θB < 0°), “No Flip”.





3.9.6 R-axis Angle

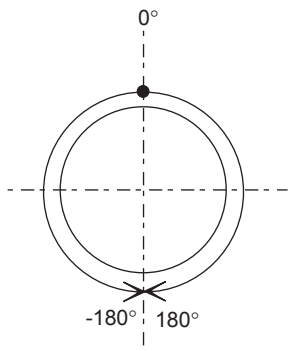
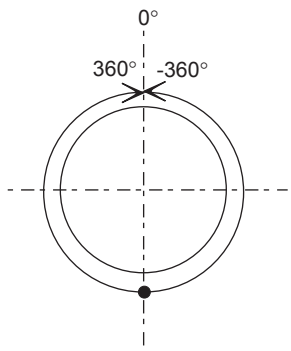
This specifies whether the R-axis angle is less than ±180° or greater than ±180°.

R < 180°	R ≥ 180°
	
-180° < θ R <= 180°	180° < θ R θ R <= -180°

NOTE θ R is the angle when the R-axis home position is 0 °.

3.9.7 T-axis Angle

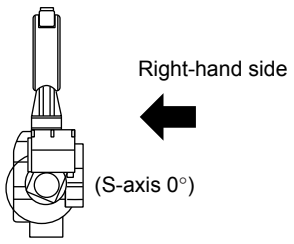
This specifies positions of the R-, B-, and T-axis.
For manipulators with wrist axes (three axes), this specifies whether the T-axis angle is less than ±180° or greater than ±180°.

T <180°	**T ≥ 180°**
 -180° < θ T <= 180°	 180° < θ T θ T <= -180°

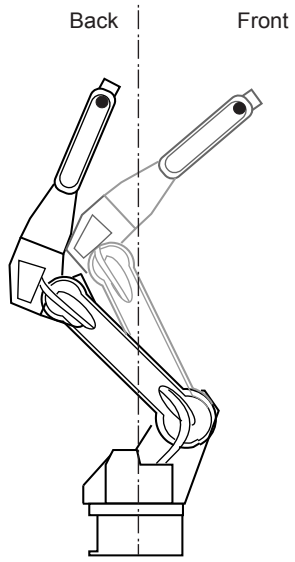
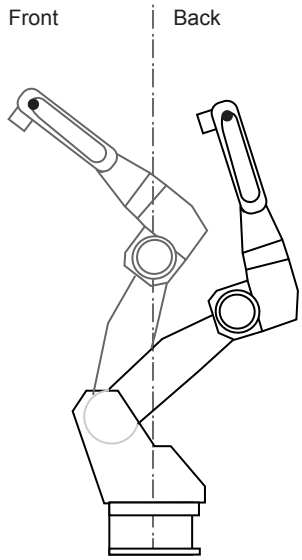
NOTE θ T is the angle when the T-axis home position is 0°.

3.9.8 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.

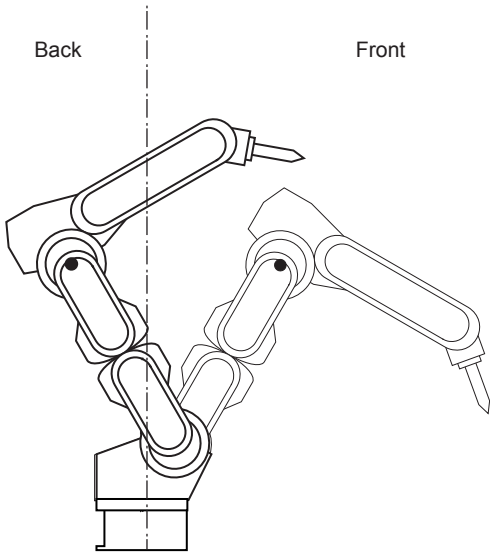


The diagram below shows the S-axis at 0° and at 180°. This is the configuration when the L-axis and the U-axis are viewed from the right-hand side.

S-axis 0°	S-axis 180°
	

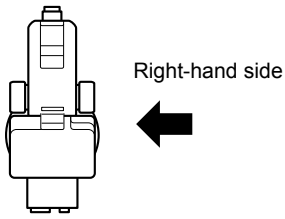
For the manipulator with seven axes, this specifies where in the S-axis rotation center the U-axis rotation center locates when viewing the L-axis and U-axis from the right-hand side.

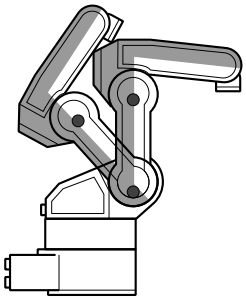
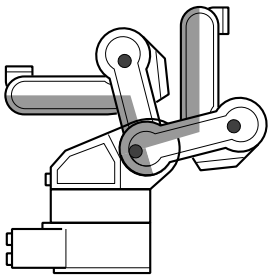
When viewed from the right-hand side, the right of the S-axis rotation center is called the front, and the left is called the back.



3.9.9 Upper Arm/Lower Arm

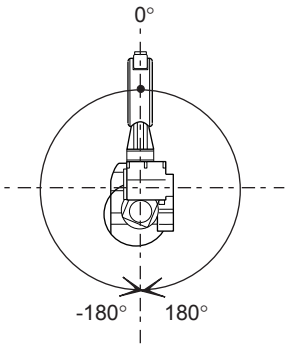
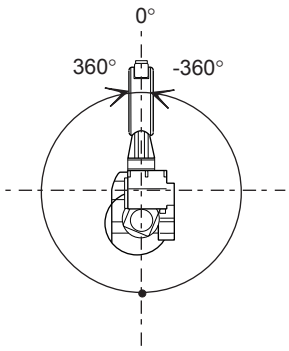
This specifies a type comprised of L-axis and U-axis when the L-axis and U-axis are viewed from the right-hand side.



Upper Arm	Lower Arm
	

3.9.10 S-axis Angle

This designation is required for the manipulators which have working envelopes greater than ±180°.
This specifies whether the S-axis angle is less than ±180° or greater than ±180°.

S<180°	S ≥ 180°
	
-180° < θ S <= 180°	180° < θ S θ S <= -180°

NOTE θ S is the angle when the S-axis home position is 0°.

3.9.11 Editing Local Variables

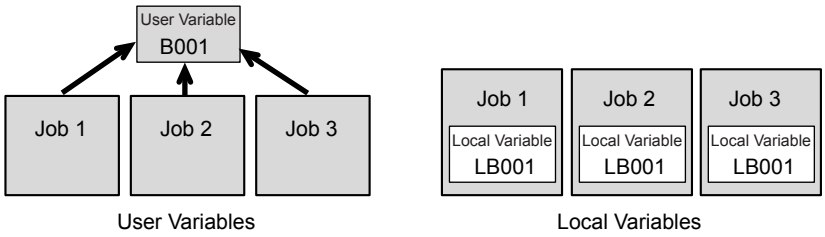
As well as user variables, local variables can be used for the storage of counters, calculations, and input signals. The data format is the same as that of user variables. As shown in the following table, the letter L is affixed to the variable number to indicate a local variable.

Table 3-7: Local Variables

Data Format		Variable No.	Functions
Byte Type		LB000 to LB□□□	Range of storable values is from 0 to 255. Can store I/O status. Can perform logical operations (AND, OR, etc.)
Integer Type		LI000 to LI□□□	Range of storable values is from -32768 to 32767.
Double Precision Integer Type		LD000 to LD□□□	Range of storable values is from -2147483648 to 2147483647.
Real Type		LR000 to LR□□□	Range of storable values is from -3.4E+38 to 3.4E+38 Accuracy: 1.18E-38 < x ≤ 3.4E+38
Character Type		LS000 to LS□□□	Maximum storable number of characters is 16.
Position Type	Robot Axes	LP000 to LP□□□	Can store position data in pulse form or in XYZ form. XYZ type variables can be used as target position data for move instructions, and as incremental values for parallel shift instructions.
	Base Axes	LBP000 to LBP□□□	
	Station Axes	LEX000 to LEX□□□	

Local variables differ from user variables in the following four ways:

- **Used in One Job Only**
  With user variables it is possible to define and use one variable in multiple jobs, but local variables are used only in the job in which they are defined, and cannot be read from other jobs.
  Accordingly, local variables do not affect other jobs, so it is possible to define a variable number (such as LB001) separately in different jobs, and use it in different ways in each of these jobs.



- **Able to Use Any Number of Variables**
  The number is set in the JOB HEADER window. When the number is set, the area for the value is saved in memory.

- **Not Able to Display the Variable Contents**
  To display the local variable contents, user variables are needed. For example, to view the contents of local variable LP000, save it temporarily as user variable P001. Then execute the instruction SET P001 LP000, and view the POSITION VARIABLE window for P001.

- **Enabled Only During the Execution of the Defined Job**
  The contents of the local variables are enabled only during the execution of the defined job.
  The local variable field is assured when the defined job is called (when the job is executed by a CALL or JUMP instruction, or the job is selected by the menu). Once the job is completed by the execution of a RET, END, or JUMP instruction, the local variable data that was set is disabled. However, if a job which uses local variables itself calls a separate job, then is returned by use of a RET instruction, the data that was present prior to the CALL instruction remains in effect and can be used.

NOTE

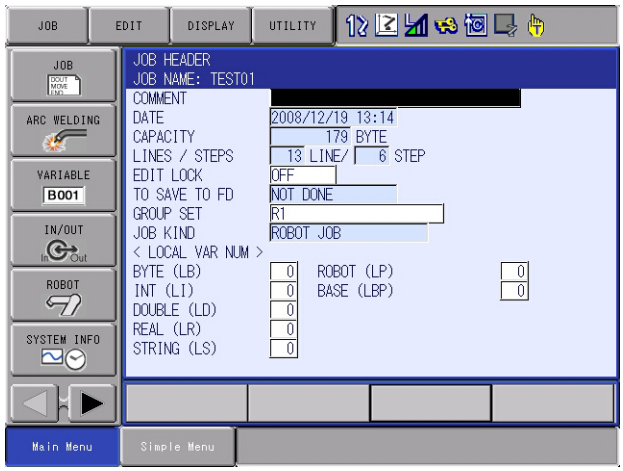
Precautions for Variables and Units
As was the case with user variables, note that, depending on the value of the unit being used, the value of the variable and the value of the actual speed or time an occasion might not match. Refer to *section 3.9.4 “User Variables” on page 3-77*.

3.9.11.1 Setting the Number of Local Variables

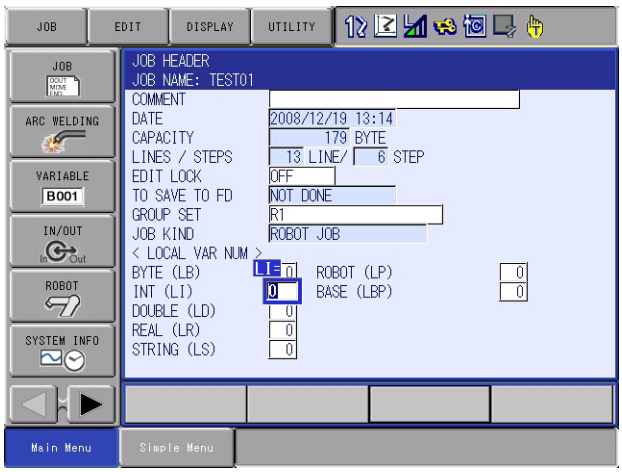
The number of local variables used in a job is set in the JOB HEADER window. When the number of local variables is set, memory is allocated for those variables.

> **NOTE** Only when expanding the “INSTRUCTION LEVEL”, it is possible to use local variables. Refer to section 8.12 “Instruction Level Setting” of “DX100 INSTRUCTIONS” (RE-CTO-A215) for details on setting the language level.

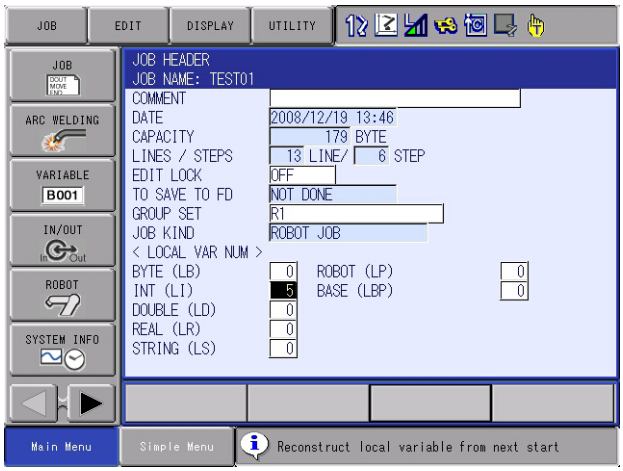
1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Select {DISPLAY} under the menu.
4. Select {JOB HEADER}.
   – The JOB HEADER window appears. Scroll the window using the cursor.



5. Select the number of local variables to be set.
   – The input buffer line appears.



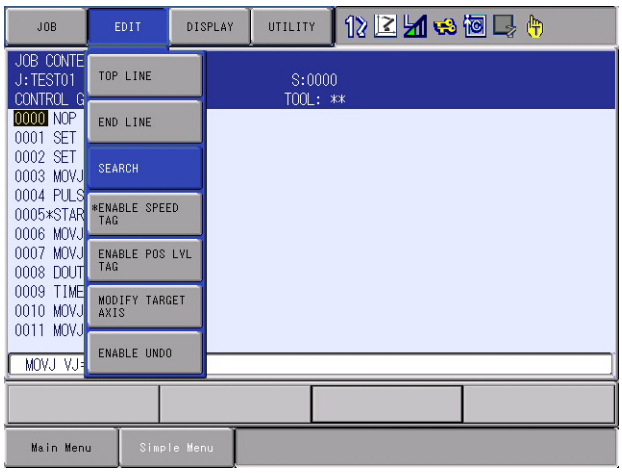
6. Input the number of variables.
7. Press [ENTER].
   – The number of local variables are set.



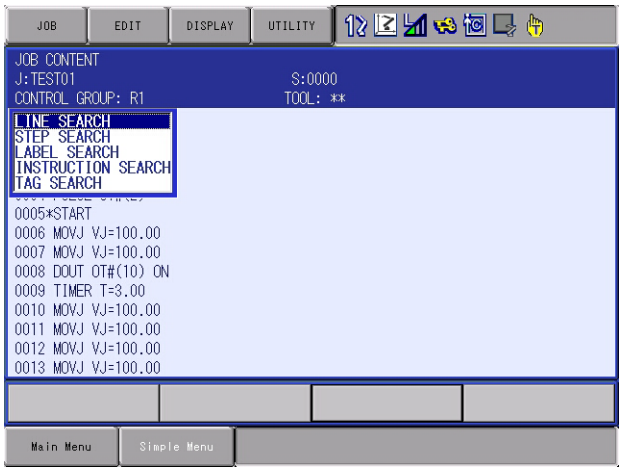
3.9.12 Search

When editing or checking, jobs and steps can be searched for. Search can be done when the cursor is in either the address or instruction area on the JOB CONTENT window.

1. Select {JOB} under the main menu.
2. Select {JOB}.
   – The JOB CONTENT window appears.
3. Select {EDIT} under the menu.
   – The pull-down menu appears.



4. Select {SEARCH}.
   – The selection dialog box appears.



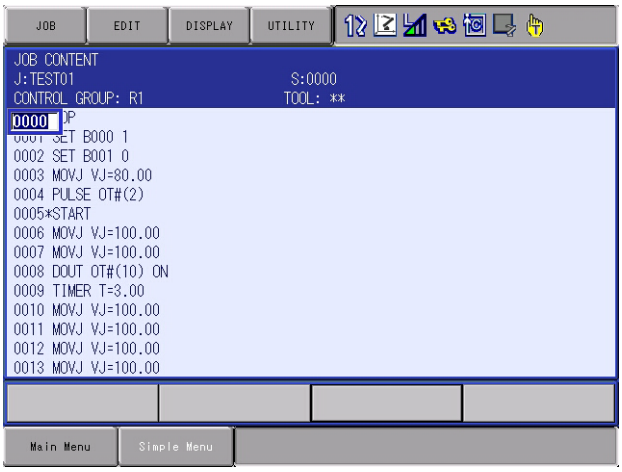
5. Select the search type.

Search is an operation by which the cursor is moved to a specific step or instruction in the edit job. The desired item can be instantly searched for without using the cursor.

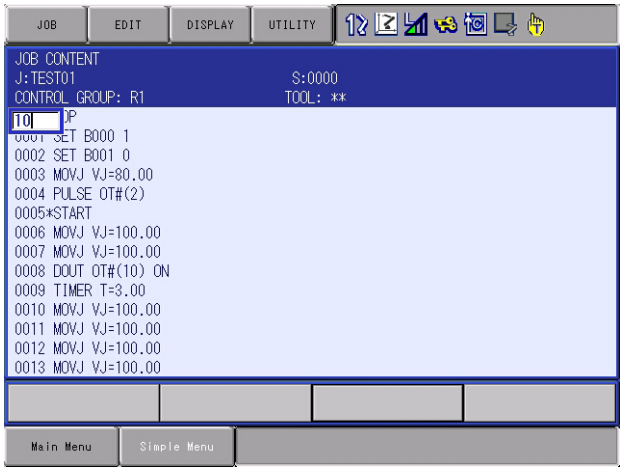
3.9.12.1 Line Search

This function moves the cursor to the desired line number.

1. Select {EDIT], {SEARCH} and “LINE SEARCH”.
   – The number can be entered.



2. Input desired line number.

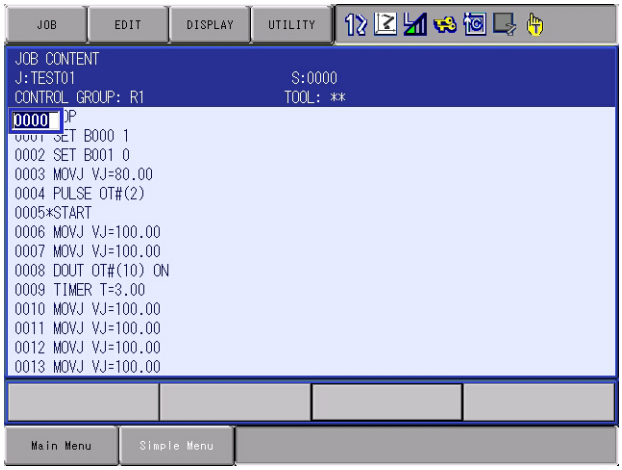


3. Press [ENTER].
   – The cursor is moved to the line number and the window appears.

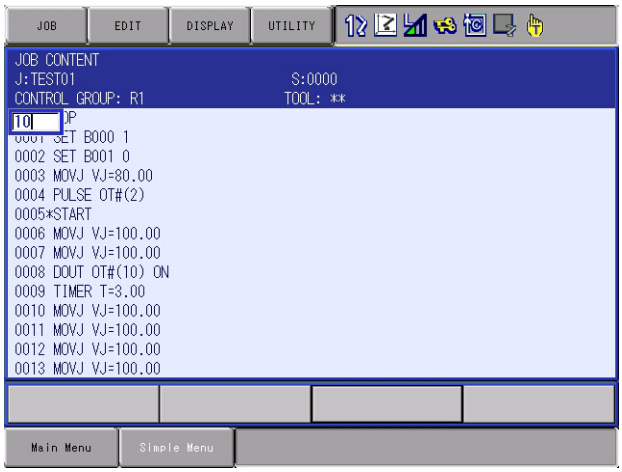
3.9.12.2 Step Search

This function moves the cursor to the desired step number (move instruction).

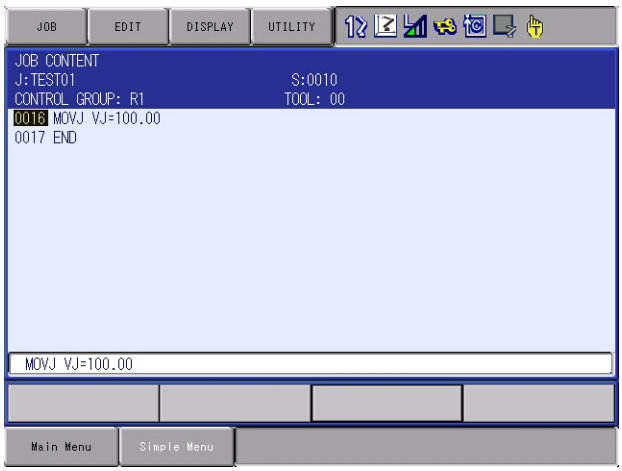
1. Select {EDIT], {SEARCH} and “STEP SEARCH”.
   – The number can be entered.



2. Input desired step number.



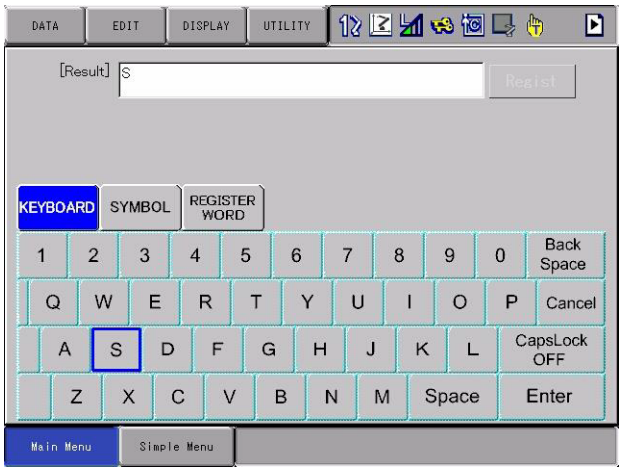
3. Press [ENTER].
   – The cursor is moved to the input step and the window appears.



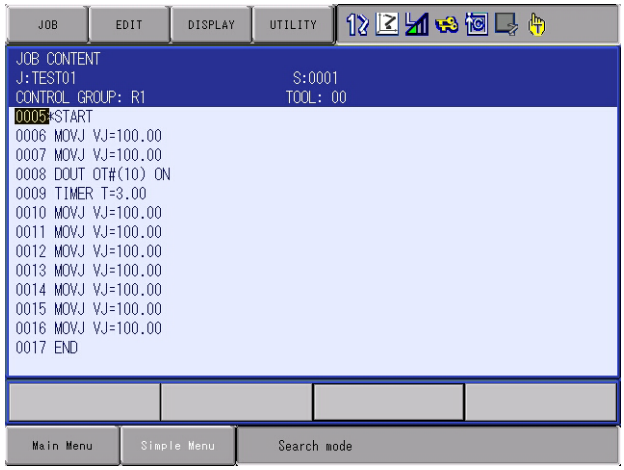
3.9.12.3 Label Search

This function searches for the desired label and the instruction using that label.

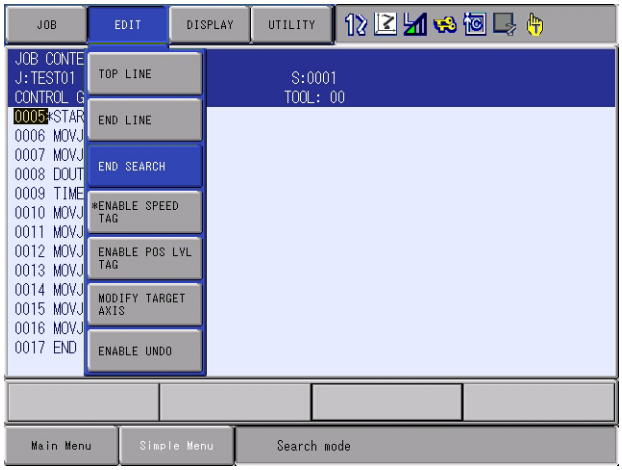
1. Select {EDIT}, {SEARCH} and “LABEL SEARCH”.
   – The characters can be entered.
2. Input desired label name.
   – For information on character input operation, refer to *section 1.2.6 “Character Input Operation” on page 1-18*.
   – At this time, search can be conducted by entering any one character of the label. For example, to search for the “START” label, enter only “S”, and the search can be done.



3. Press [ENTER].
   – The cursor is moved to the desired label and the window appears.



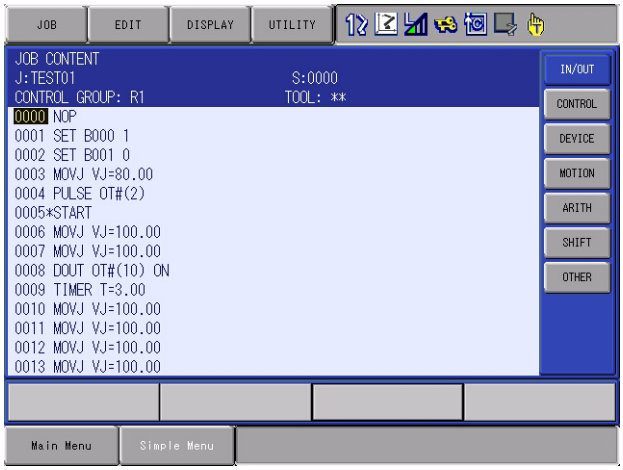
4. Use the cursor to continue search.
   - While searching, forward search and backward search are possible by pressing the cursor key.
   - To end search, select {EDIT} → {END SEARCH} on the menu and press [SELECT].



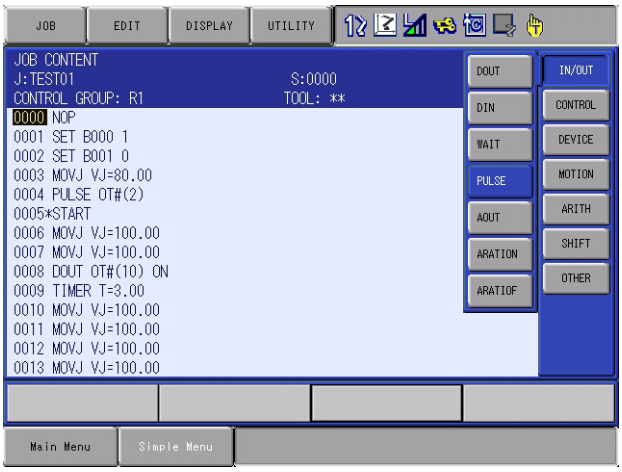
3.9.12.4 Instruction Search

This function moves the cursor to a desired instruction.

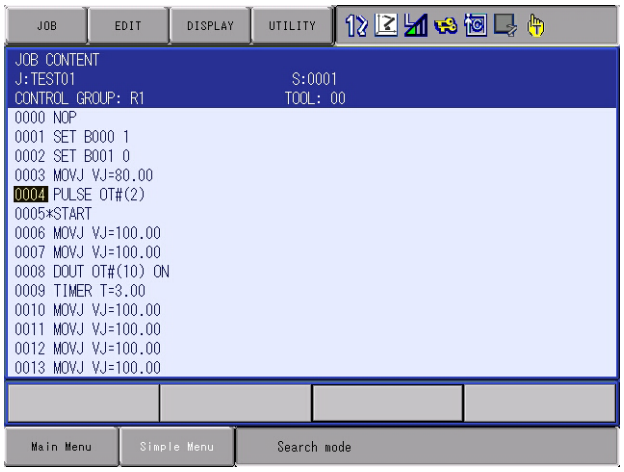
1. Select {EDIT}, {SEARCH} and “INSTRUCTION SEARCH”.
   – The INFORM command list appears.



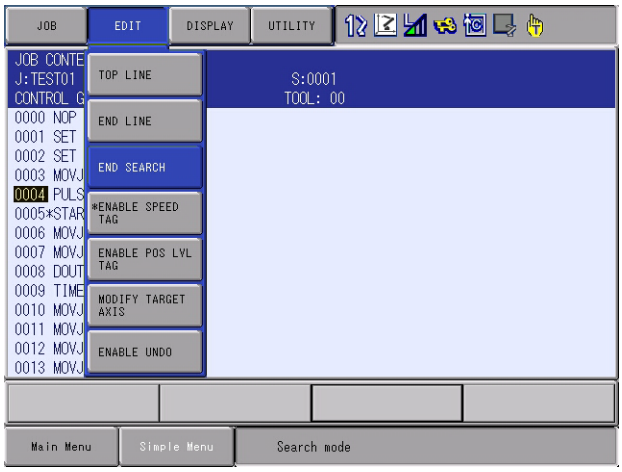
2. Select desired instruction group.
3. Select desired instruction.



   – The cursor is moved to the selected instruction and the window appears.



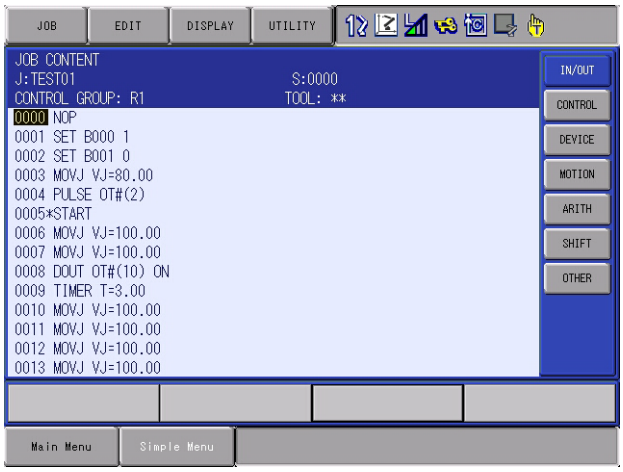
4. Use the cursor to continue search.
   - While searching, forward search and backward search are possible by pressing the cursor key.
   - To end search, select {EDIT} → {END SEARCH} on the menu and press [SELECT], or press [CANCEL].



3.9.12.5 Tag Search

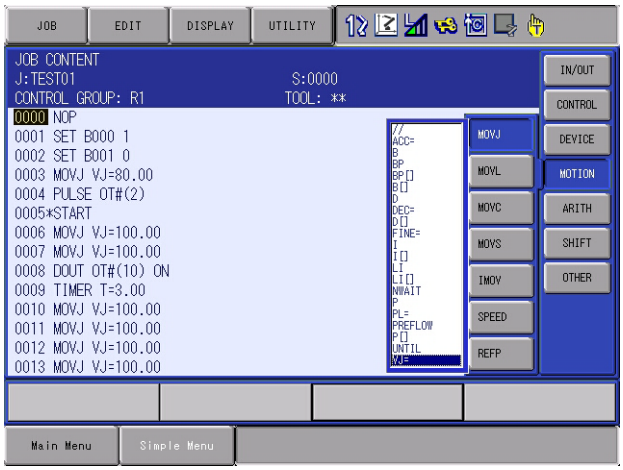
This function moves the cursor to the desired tag.

1. Select {EDIT}, {SEARCH} and “TAG SEARCH”.
   – The instruction list dialog box appears.

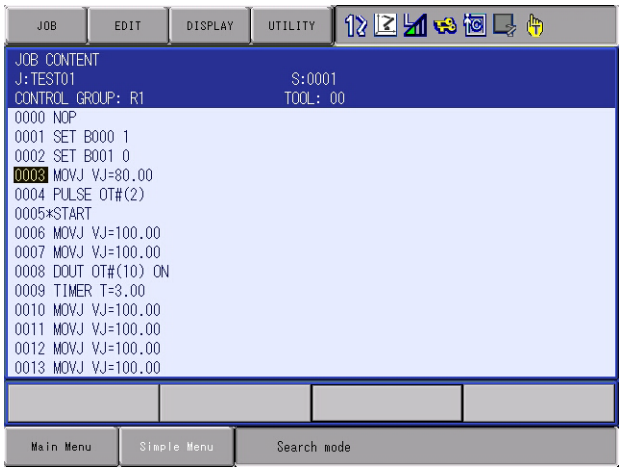


2. Select desired instruction group.
3. Select desired instruction for which the tag is to be searched.

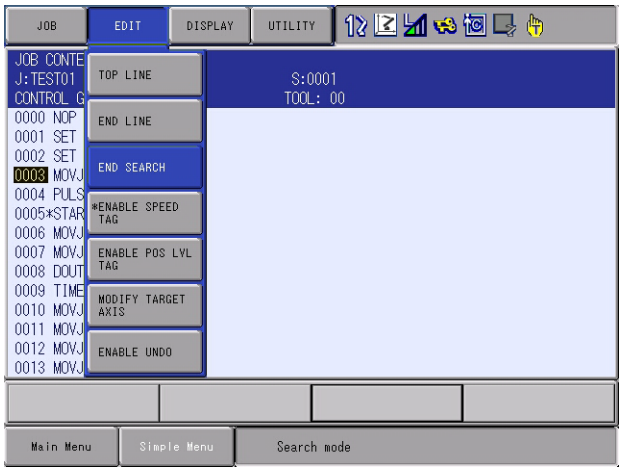
   – The tag list dialog box for selected instruction appears.



4. Select the desired tag.
   – The cursor is moved to the selected tag and the window appears.



5. Use the cursor to continue search.
   – While searching, forward search and backward search are possible by pressing the cursor key.
   – To end search, select {EDIT} → {END SEARCH} on the menu and press [SELECT], or press [CANCEL].



4 Playback

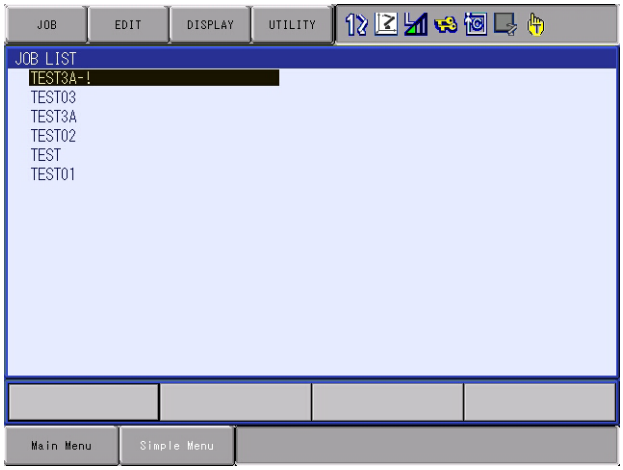
4.1 Preparation for Playback

4.1.1 Selecting a Job

Playback is the act of executing a taught job. Before playback operation, first call the job to be executed.

4.1.1.1 Calling a Job

1. Select {JOB} under the main menu.
2. Select {SELECT JOB}.
   – The JOB LIST window appears.



3. Select the desired job.

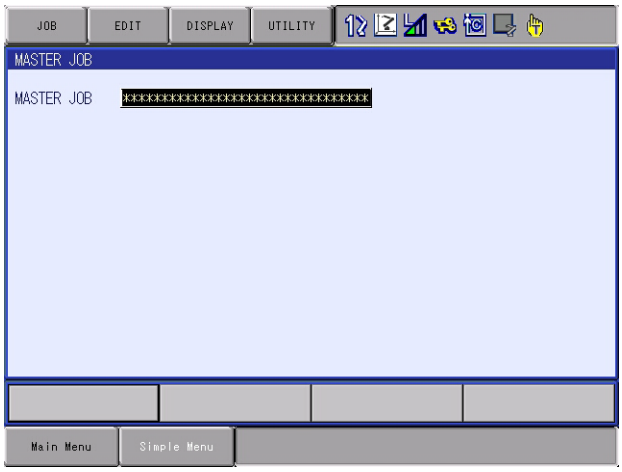
4.1.1.2 Registering the Master Job

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.

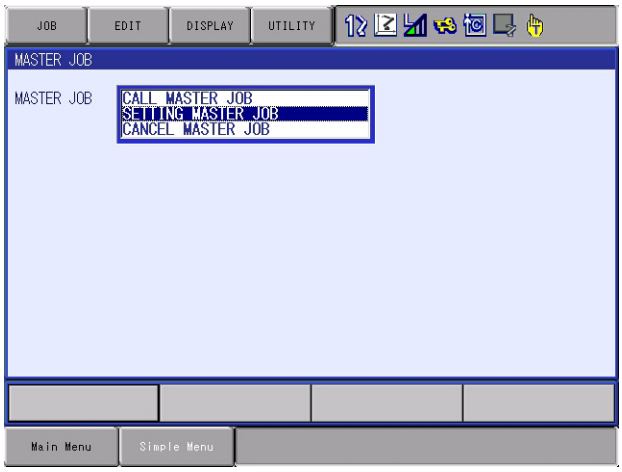
> **NOTE** Only one job can be registered as the master job. Registering a master job automatically cancels the previously registered master job.

Be sure to register a master job in the teach mode.

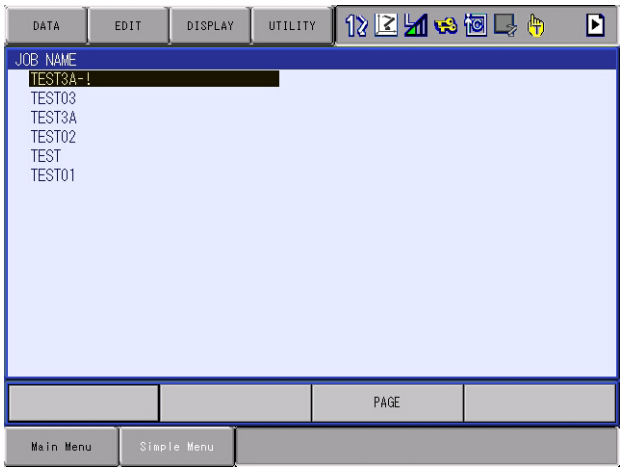
1. Select {JOB} under the main menu.
2. Select {MASTER JOB}.
   – The MASTER JOB window appears.



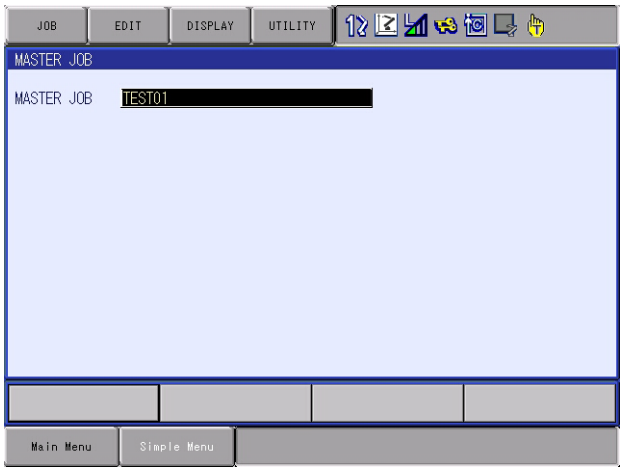
3. Press [SELECT].
   – The selection dialog box appears.



4. Select {CALL MASTER JOB}.
   – The JOB LIST window appears.



5. Select a job to be registered as a master job.
   – The selected job is registered as the master job.

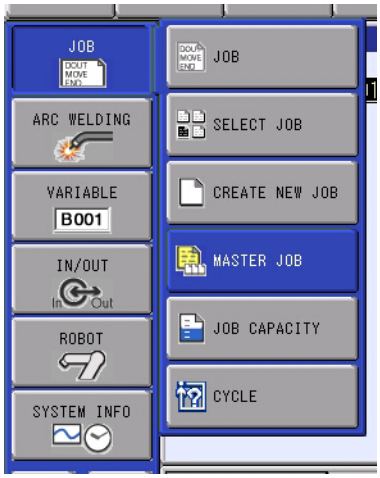


4.1.1.3 Calling the Master Job

This operation is to call a master job. The job can be called in the JOB CONTENT window, PLAYBACK window, JOB SELECT window, or the MASTER JOB window.

■ Calling from the JOB CONTENT, PLAYBACK, JOB SELECT Window

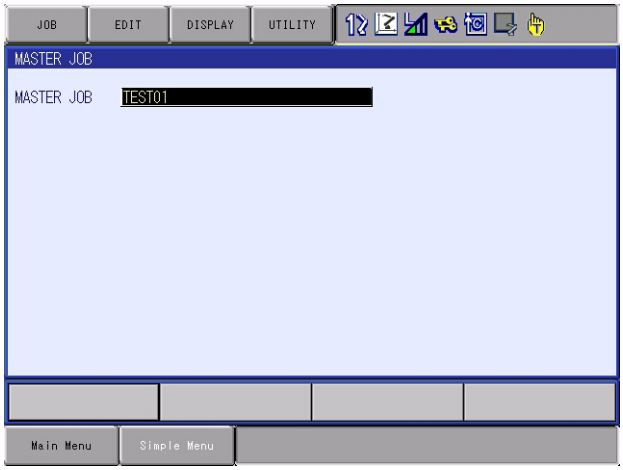
1. Select {JOB} under the menu.



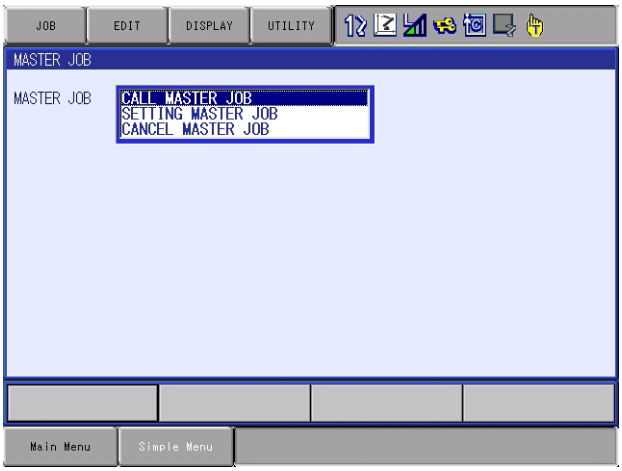
2. Select {MASTER JOB}.
   – The master job is called, and the JOB CONTENT window appears.

■ Calling from the MASTER JOB Window

1. Select {JOB} under the main menu.
2. Select {MASTER JOB}.
   – The MASTER JOB window appears.



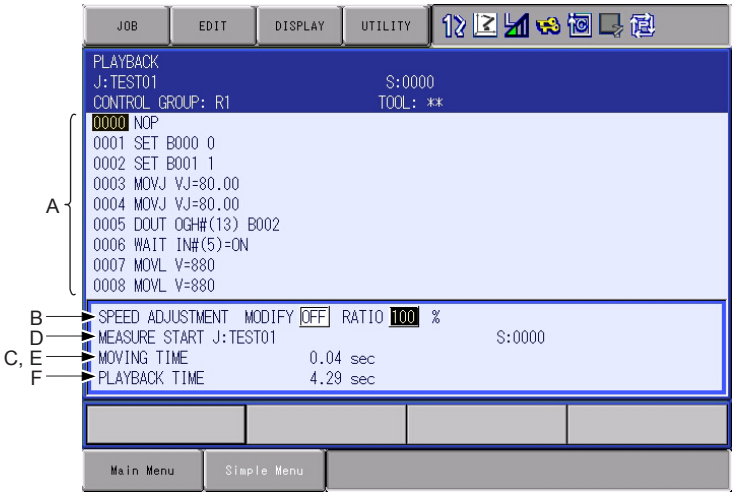
3. Press [SELECT].
   – The selection dialog box appears.



4. Select {CALL MASTER JOB}.
   – The master job is called, and the JOB CONTENT window (during the teach mode), or the PLAYBACK window (during the play mode) appears.

4.1.2 The PLAYBACK Window

When the mode switch on the programming pendant is switched to “PLAY” while displaying the JOB CONTENT window, the PLAYBACK window appears.



A. Job Content

The cursor moves according to the playback operation. The contents are automatically scrolled as needed.

B. Override Speed Settings

Displayed when override speed setting is performed.

C.Cycle Time

Displays the operating time of the manipulator. Each time the manipulator is started, the previous cycle time is reset, and a new measurement begins. Either showing or hiding the cycle time display is selectable.

D. Start No.

First step in the measurement. Measurement starts when the start button lamp lights and the playback starts.

E. Motion Time

Displays the weaving time of the manipulator.

F. Playback Time

Displays the time from the beginning to the end of the measurement. Measurement ends when the manipulator stops and the start button lamp goes off.

4.1.2.1 Display of Cycle Time

Follow the procedure below to set whether or not to display the cycle time on the PLAYBACK window.

1. Select {DISPLAY} under the menu.
2. Select {CYCLE TIME}.
   - The cycle time is displayed.
   - Repeat the same operation to hide the cycle time display.

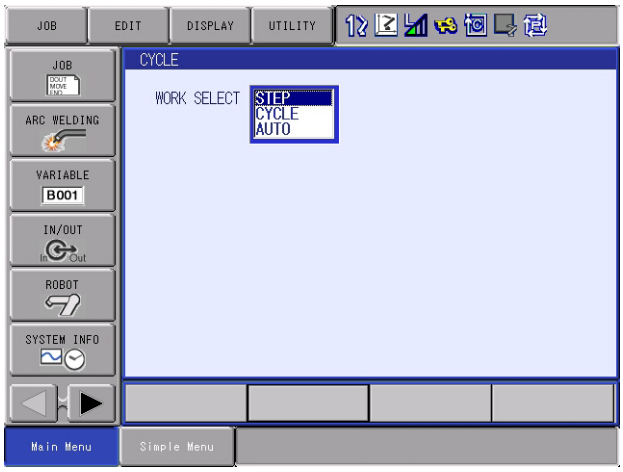
4.1.2.2 Operation Cycle

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 execution processing returns to the original job.
- 1 STEP : Executes one step (instruction) at a time.

The operation cycle can be changed as follows:

1. Select {JOB} under the main menu, and then select {CYCLE}.
2. Select the operation cycle to be changed.
   – The operation cycle is changed.

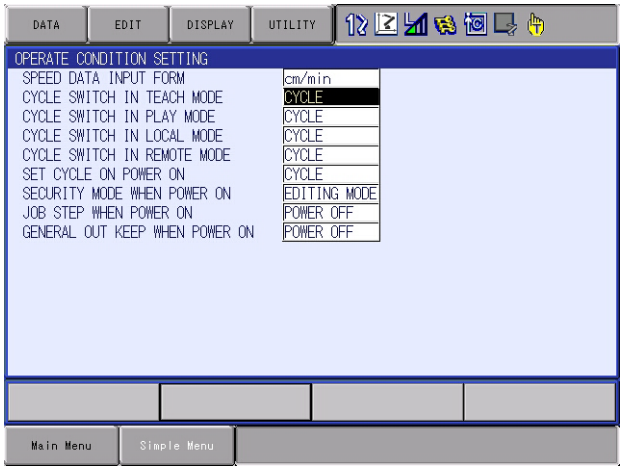


■ Automatic Setting for Operation Cycle

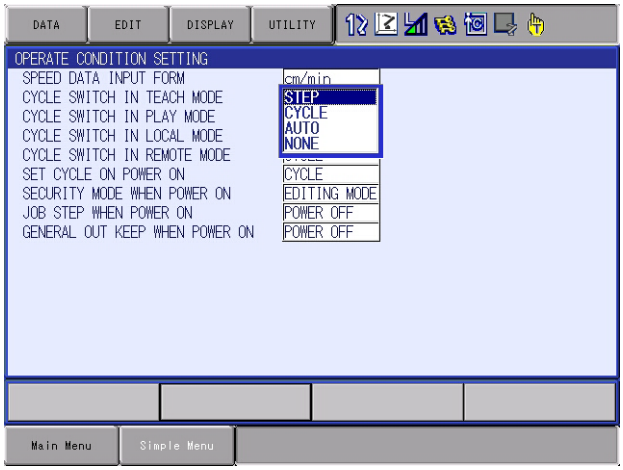
Automatic setting of the operation cycle can be changed by the following operation.

This can be done in the management mode only.

1. Select {SETUP} under the main menu.
2. Select {OPERATE COND}.
   – The OPERATING CONDITION window appears. Use the cursor to scroll the screen.



3. Select the desired operation.
   – The selection dialog box appears.

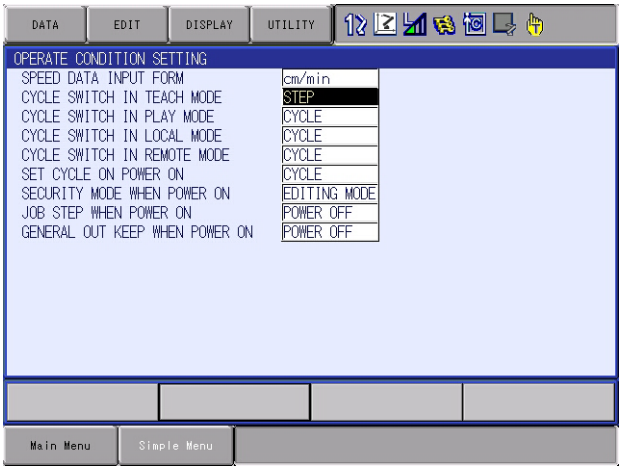


SUPPLE-MENT

“NONE” setting

The operation cycle is not changed when “NONE” is set. For example, if the setting is “CYCLE SWITCH IN PLAY MODE = NONE”, the operation cycle is maintained even after switching to the play mode.

4. Select a cycle.
   – The operation cycle when switching modes is set.



4.2 Playback

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

- Programming pendant (start button)
- Peripheral device (external start input)

Which is used to start playback is specified by the mode switch on the programming pendant.

Mode Switch on Programming Pendant	Job is started up by
[PLAY]	[START] button on programming pendant
[REMOTE]	Peripheral device

For playback using the programming pendant, follow the procedures below.

4.2.1.1 Selecting the Start Device

1. Set the mode switch on the programming pendant to “PLAY”.
   – The remote mode is disabled and the play mode is enabled so the machines are to be started up by the programming pendant.

4.2.1.2 Servo On

1. Press [Servo ON Ready].
   – DX100 servo power is ON and the Servo ON lamp on the programming pendant lights.

4.2.1.3 Start Operation

1. Press [START].
   – The start button lamp lights and the manipulator begins operation.

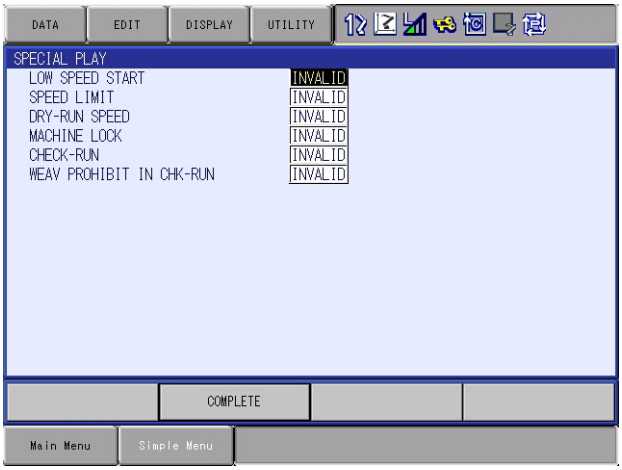
4.2.2 Special Playback Operations

The following special operations can be performed during playback:

- Low speed operation
- Limited speed operation
- Dry run speed operation
- Machine lock operation
- Check mode operation

Two or more special operations can be performed at the same time. If multiple operations are selected, the speed during playback is limited to the speed of the slowest operation. Settings for special operations are done in the SPECIAL PLAY window.

When the PLAYBACK window is displayed, move the cursor to the menu area and select {UTILITY} → {SETUP SPECIAL RUN}. The SPECIAL PLAY window appears.



4.2.2.1 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 and then low speed operation is canceled.

Even if the manipulator is stopped its motion during the low speed operation, the low speed status would not be canceled before it reaches the first step.

After one step operation, pressing [START] allows the manipulator to move at the taught speed.

1. Select “LOW SPEED START” on the SPECIAL PLAY window.
   – The setting alternates between “VALID” and “INVALID”.
2. Select “COMPLETE”.
   – The window returns to the PLAYBACK window.

4.2.2.2 Limited Speed Operations

The manipulator operates within the limited speed for the teach mode. Usually, the limited speed is set to 250mm/s. However, operation is performed at actual playback speeds for steps in which the set speed is under this limit.

1. Select “SPEED LIMIT” under the SPECIAL PLAY window.
   – The setting alternates between “VALID” and “INVALID”.
2. Select “COMPLETE”.
   – The window returns to the PLAYBACK window.

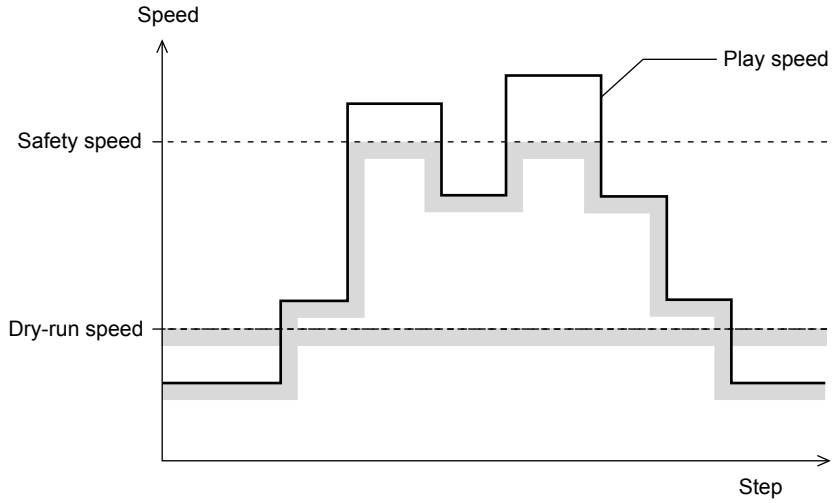
4.2.2.3 Dry-run Speed Operations

The dry-run speed is a constant speed that is independent of the teaching speeds. The manipulator executes all the steps at a constant speed, which 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.

1. Select the “DRY-RUN SPEED” under the SPECIAL PLAY window.
   – The setting alternates between “VALID” and “INVALID”.
2. Select “COMPLETE”.
   – The window returns to the PLAYBACK window.

Fig. 4-1: Safety Speed and Dry-run Speed



4.2.2.4 Machine Lock Operation

A job is played back without moving the manipulator to check the status of input and output.

1. Select “MACHINE LOCK” under the SPECIAL PLAY window.
   – The setting alternates between “VALID” and “INVALID”.
2. Select “COMPLETE”.
   – The window returns to the PLAYBACK window.

NOTE

- The setting of “MACHINE LOCK” is maintained even after the mode is switched: If the machine lock is set to “VALID” in the teach mode, it is still “VALID” after switching to the play mode.
  The same applies when the mode is switched from the play mode to the teach mode.
- Note that the machine lock becomes “INVALID” if the following operation is performed.
  - Execution of “CANCEL ALL SELECT” in the SPECIAL PLAY window.
- Turning off the main power.

4.2.2.5 Check Mode Operation

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

1. Select “CHECK-RUN” under the SPECIAL PLAY window.
   – The setting alternates between “VALID” and “INVALID”.
2. Select “COMPLETE”.
   – The window returns to the PLAYBACK window.

4.2.2.6 Weaving Prohibit Setting during Check Mode Operation

The weaving operation is not executed in the weaving section of the job.

1. Select “WEAV PROHIBIT IN CHK-RUN” under the SPECIAL PLAY window.
   – The setting alternates between “VALID” and “INVALID”.
2. Select “COMPLETE”.
   – The window returns to the PLAYBACK window.

4.2.2.7 Cancel All Special Operations

All special operations are disabled by the following operation.

1. Select {EDIT} from the menu.
2. Select “CANCEL ALL SELECT”.
   – The message “All special functions canceled” appears.

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

4.3.1 Hold

Hold operation causes the manipulator to stop all motion.

SUPPLE-MENT

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

4.3.1.1 Using the Programming Pendant

■ **Hold**

1. Press [HOLD] on the programming pendant.
2. The manipulator stops. The [HOLD] lamp lights while the [HOLD] button is held down.

■ **Release**

1. Press [START] on the programming pendant.
2. The manipulator restarts its operation from the position where it was stopped.

4.3.1.2 Using an External Input Signal (System Input)

■ **Hold**

1. Turn ON the hold signal from an external input (system input).
   – The manipulator stops temporarily.

   External holding

   – The output signal “HOLD” turns ON.
   – The programming pendant [HOLD] lamp lights.

■ **Release**

1. Turn off the hold signal from an external input (system input).
   – Hold is released.
   – To continue the operation, press [START] or turn ON the external input signal (system input). The manipulator restarts its operation, beginning from the position where it was stopped.

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 either of the following:

- Button on the Front Door of the DX100
- Programming pendant
- External input signal (system input)

■ Emergency Stop

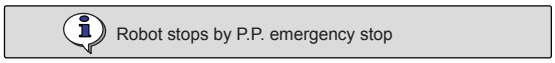
1. Press the emergency stop button .

   – The servo power turns OFF and the manipulator stops immediately.

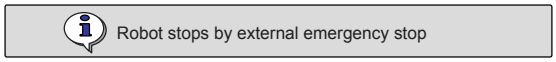
   – On the front door of the DX100:

   – On the programming pendant:

Using the Emergency Stop Button on the Programming Pendant



Using the External Input Signal (System Input)



■ Release

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

   – On the front door of the DX100:

   – On the programming pendant:

   – To turn ON the servo power supply again, press [SERVO ON READY] and then grip the Enable switch of the programming pendant.

4.3.2.1 Restart After Emergency Stop

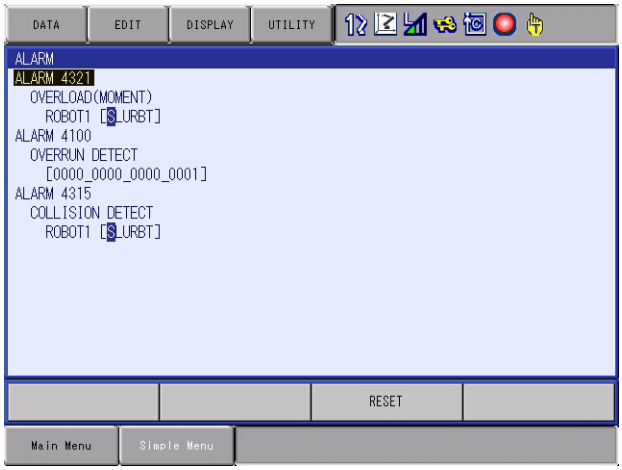
CAUTION

- 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.

4.3.3 Stop by Alarm

If an alarm occurs during operation, the manipulator stops immediately and the ALARM window appears on the programming pendant indicating that the machine was stopped by an alarm.

– If more than one alarm occurs simultaneously, all alarms can be viewed on the window. Scroll down the viewing area of the window when necessary.



The following operations are available in the alarm status:
window change, mode change, alarm reset, and emergency stop.
To display the ALARM window again when the window is changed during alarm occurrence, select {SYSTEM INFO} and then {ALARM HISTORY}.

■ Releasing Alarms

<Minor Alarms>

1. Press [SELECT].
   – Select “RESET” under the ALARM window to release the alarm status.
   – When using an external input signal (system input), turn ON the “ALARM RESET” setting.

<Major Alarms>

1. Turn OFF the main power supply and remove the cause of the alarm.
   – If a severe alarm such as hardware failure alarm occurs, the servo power is automatically shut off and the manipulator stops. If releasing does not work, turn OFF the main power and correct the cause of the alarm.

4.3.4 Others

4.3.4.1 Temporary Stop by Mode Change

When the play mode is switched to the teach mode during playback, the manipulator stops immediately.

!Stopped by switching mode

To restart the operation, return to the play mode and perform a start operation.

4.3.4.2 Temporary Stop by the PAUSE Instruction

When the PAUSE instruction is executed, the manipulator stops operating.

!Robot stops by execution PAUSE command

To restart the operation, perform a start operation. The manipulator restarts from the next instruction.

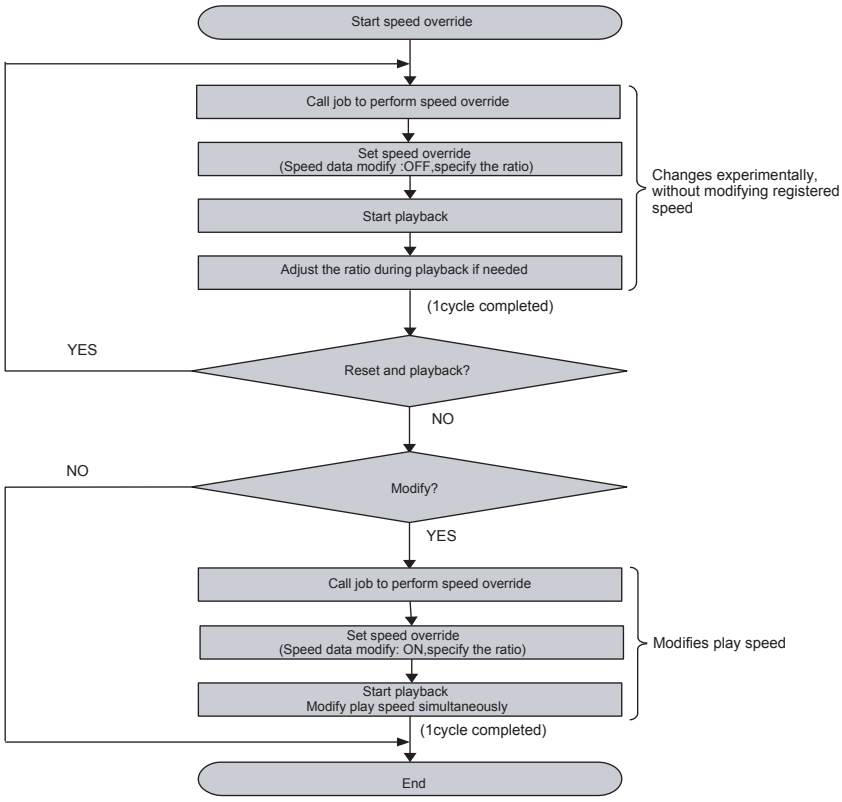
4.4 Modifying Play Speed

4.4.1 Speed Override

Speed modifications using the speed override have the following features:

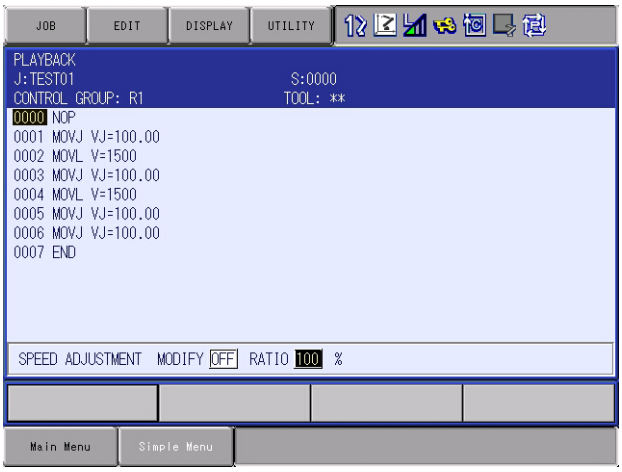
- Speed can be modified during playback.
  The job can be played back at various speeds until the play speed is properly adjusted.
- Speed can be increased or decreased by a ratio of the current play speed.
  The ratio settings range from 10% to 150% in increments of 1%.
  Therefore, it is convenient when, for example, all play speed settings are to be increased by 150% at the same time.

The operation flow is shown below.



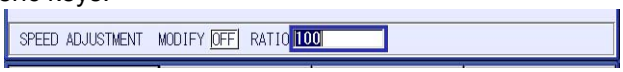
4.4.1.1 Setting Speed Overrides

1. Select {UTILITY} under the menu in the PLAYBACK window.
2. Select {SPEED OVERRIDE}.
   – The PLAYBACK window shows the speed override status.



3. Select “ON” or “OFF”.
   – Each time [SELECT] is pressed, “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”.

4. 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 appears. Input the override ratio using the Numeric keys.



4.4.1.2 Modifying Play Speed

1. Set speed override.
2. Playback the manipulator.
   - 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 canceled.

NOTE

- Assuming that the manipulator moves from step 1 to step 2, the play speed of step 2 is not modified if the speed override is canceled before reaching step 2.
- The play speed after the modification by the speed override is limited by the maximum and the minimum speed of manipulator.
- When the safety speed operation is commanded with the setting of “MODIFY: ON”, the manipulator operates at the safety speed. However, the play speed in memory is modified as set by the speed override.
- Play speed set by the SPEED instruction is not modified.

4.4.1.3 Canceling Speed Override Settings

1. Select {UTILITY} under the menu in the PLAYBACK window.
2. Select {SPEED OVERRIDE}.
   - The setting of the speed override ratio is canceled.
   - If canceled, the speed ratio setting is not displayed on the PLAYBACK window.

NOTE

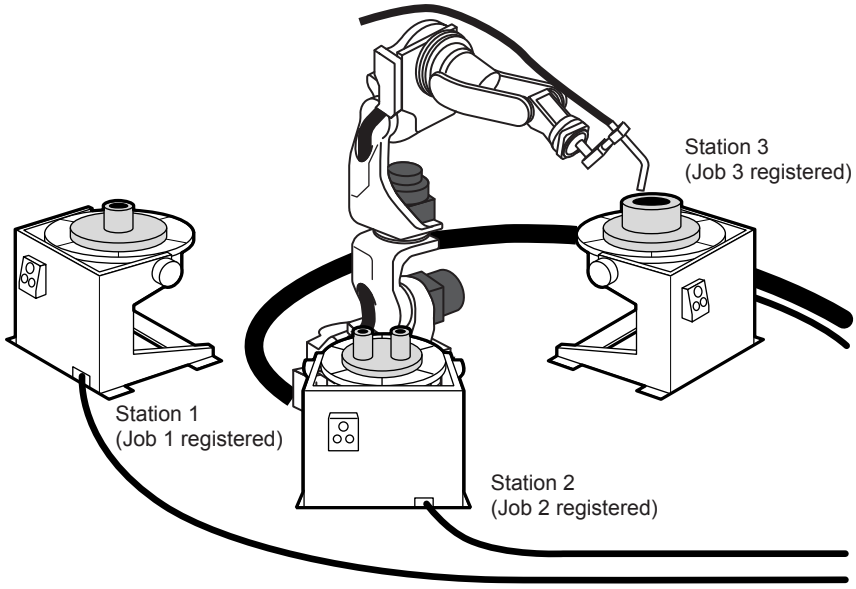
The speed override settings are automatically canceled in the following cases:

- 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 one cycle operation is completed with 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 the 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 have been pressed, and will be executed in that order.
During playback, the status of the reservation can be checked on the start reservation window.

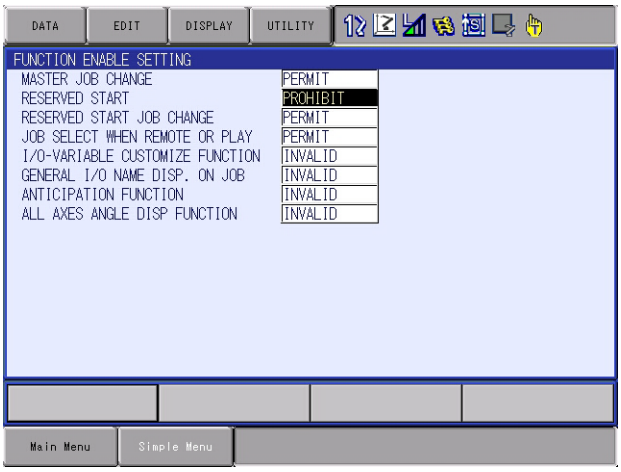
4.5.1.1 Enabling Reserved Start

The start button on the station is operative when the reserved start function is enabled, and the following start operations are disabled.

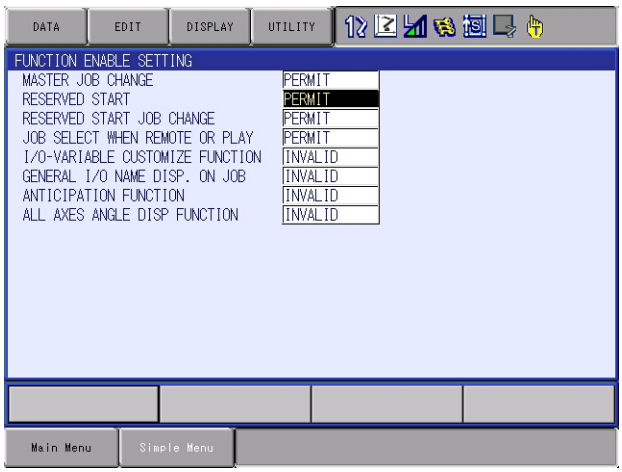
- [START] on the programming pendant
- Start operation from external input signal (system input)

> **NOTE** The OPERATING CONDITION window is shown only when the security mode is management mode.

1. Select {SETUP} under the main menu.
2. Select {OPERATE COND}.
   - The OPERATING CONDITION window appears.
   - The screen is scrolled up/down by the cursor key when it locates at the top/bottom of the items.



3. Select “RESERVED START”.
   - Each time [SELECT] is pressed, “PERMIT” and “PROHIBIT” alternate. Select “PERMIT”.



NOTE

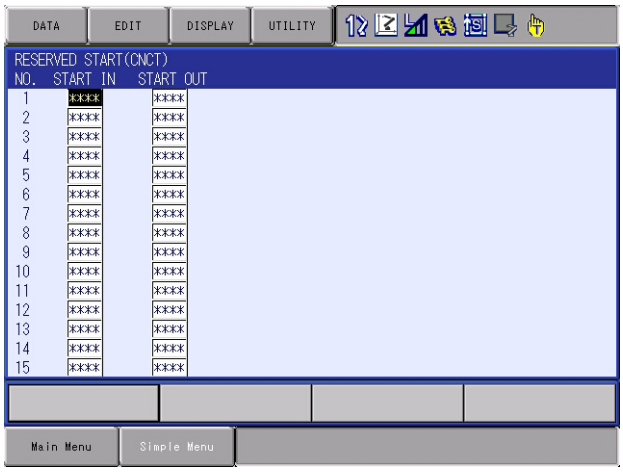
When the reserved start is enabled, the external start and the programming pendant start are prohibited even if setting is “PERMIT”.
Regardless of the operation cycle selected, it is automatically set to 1 CYCLE.

4.5.1.2 Registering Reserved Start I/O Signal

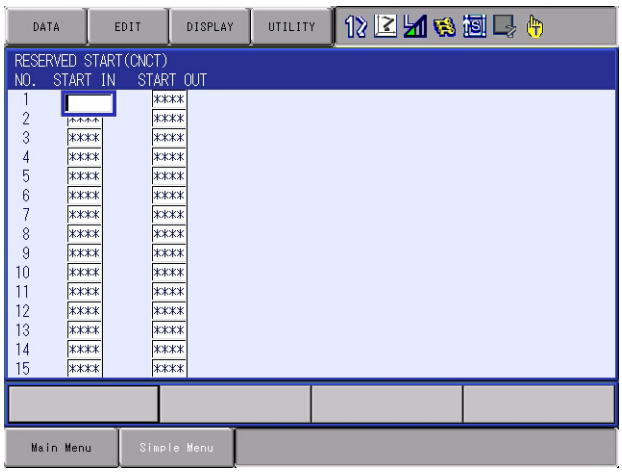
Register the start I/O signal as a preparation to perform the start operation from the station.

> **NOTE**
> This operation can be done only when the operation mode is the teach mode and the security mode is the management mode, and only when the setting of “RESERVED START JOB CHANGE” is “PERMIT” in the OPERATING CONDITION window.

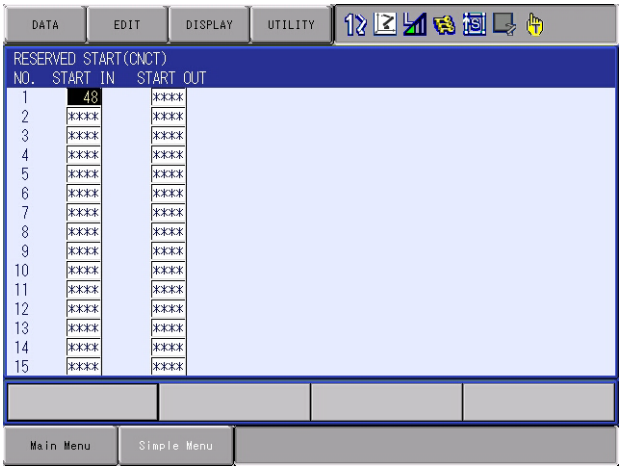
1. Select {SETUP} under the main menu.
2. Select {RES. START(CNCT)}.
   – The RESERVED START (CNCT) window appears.



3. Select “START IN” or “START OUT” for each station.
   – The number can now be entered.



4. Input signal number and press [ENTER].
   – The input/output signal number is registered.

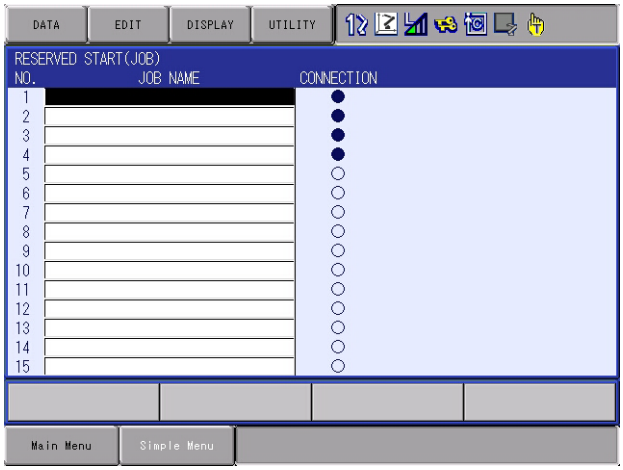


4.5.1.3 Registering Jobs to Stations

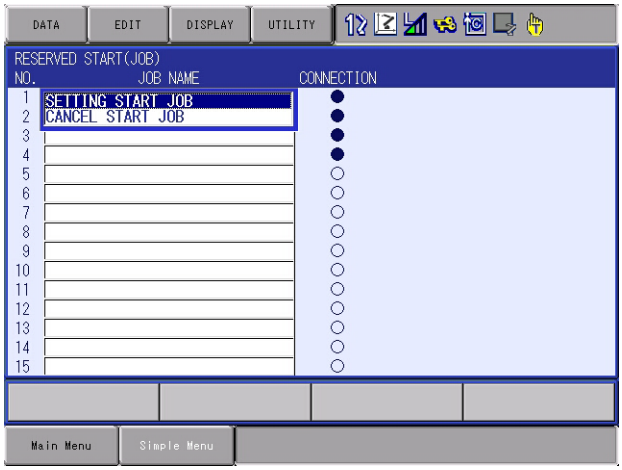
Register the starting job of each station.

> **NOTE**
> This operation can be done only when the operation mode is the teach mode and the setting of “RESERVED START JOB CHANGE” is “PERMIT” in the OPERATING CONDITION window.

1. Select {JOB} under the main menu.
2. Select {RES. START(JOB)}.
   – The RESERVED START (JOB) window appears.
   – ● indicates that the input/output number is registered.
   – ○ indicates that the input/output number is not registered.



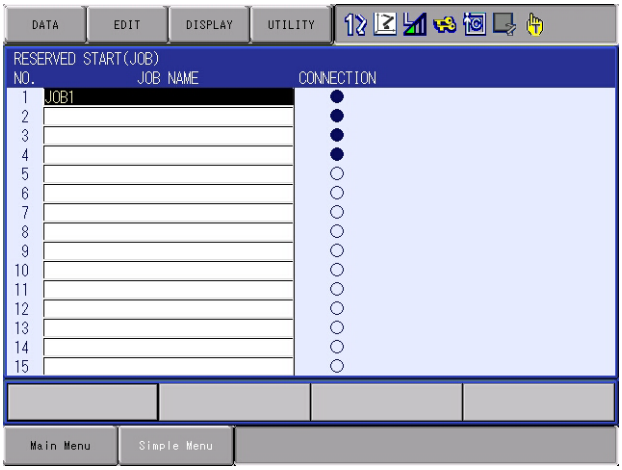
3. Select the job name for each station.
   – The selection dialog box appears.



4. Select “SETTING START JOB”.
   – The JOB LIST window appears.

5. Select a job.

– The starting job is registered.

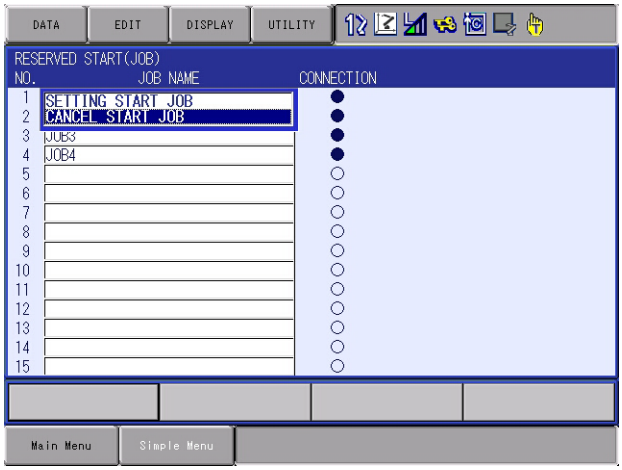


4.5.1.4 Deleting Registered Jobs from Stations

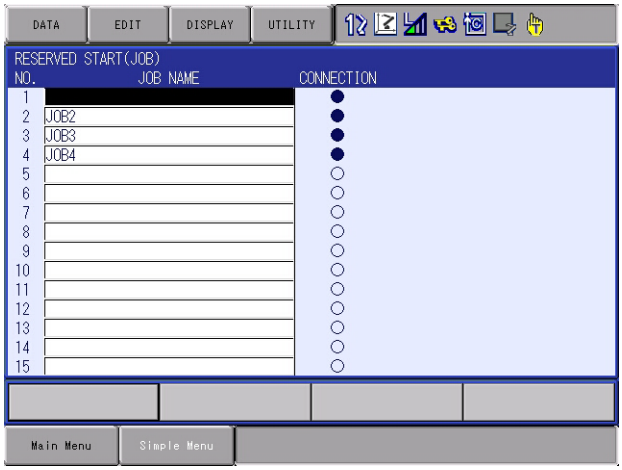
Delete the registered job of each station.

> **NOTE** This operation can be done only when the operation mode is the teach mode and the setting of “RESERVED START JOB CHANGE” is “PERMIT” in the operation condition display.

1. Select {JOB} under the main menu.
2. Select {RES. START(JOB)}.
   – The RESERVED START (JOB) window appears.
3. Select the job name of the station to be deleted.
   – The selection dialog box appears.



4. Select “CANCEL START JOB”.
   – The registered job is deleted.



4.5.2 Playback from Reserved Start

4.5.2.1 Start Operation

1. Set the mode switch to “PLAY”.
2. Press start button on the station.
   – The job registered for the station starts up and the manipulator performs one cycle operation.

NOTE

- 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.
- During the execution of a job for one station, if the start button of another station is pressed, the job of the latter station is reserved and prepared to start. Jobs are reserved and executed in the order that the start buttons have been 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.

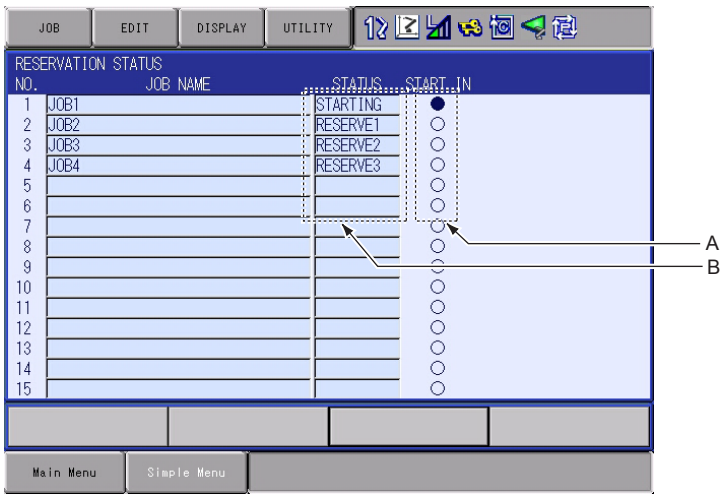
SUPPLE-MENT

Reservations are canceled when the start button is pressed again during the job reservation operation.

4.5.2.2 Checking Job Reservation Status

The job reservation status during playback can be checked.

1. Select {JOB} under the main menu.
2. Select {RES. STATUS}.
   – The RESERVATION STATUS window appears.



A. 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.

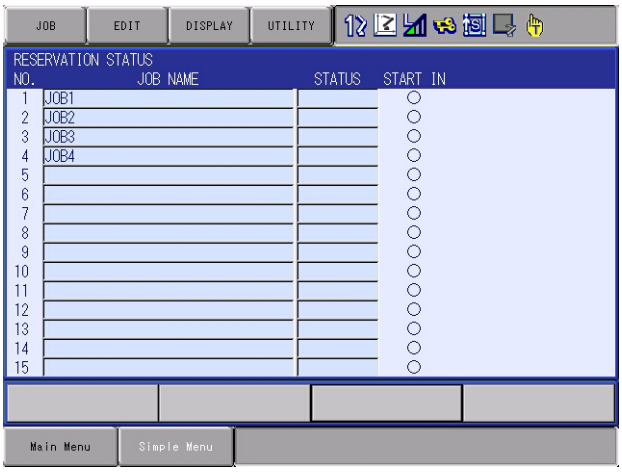
B.START IN

Input signal status is displayed.
"●": Input signal ON
"○": Input signal OFF

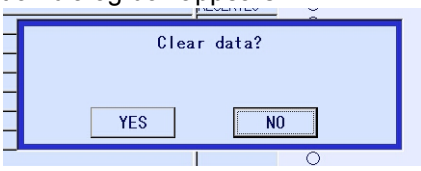
4.5.2.3 Resetting Job Reservation

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

1. Select {JOB} on the RESERVATION STATUS window.
2. Select {RESET RESERVATION} or {RESET ALL}.
   – 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.



   – The confirmation dialog box appears.



3. Select “YES”.

> **NOTE**
> All job reservations are reset automatically in the following conditions:
> • When the reserved start sets to “PROHIBIT”. (When “RESERVED START” is set to “PROHIBIT” on the OPERATING CONDITION window.)
> • When another job is called or an edit operation is performed.

4.5.3 Hold Operation

Hold operation causes the manipulator to stop all motion. It can be performed by the following buttons or signal.

- [HOLD] on the programming pendant
- External Input Signal (system input)
- Hold button for the station axis

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

4.5.3.1 [HOLD] on the Programming Pendant

■ **Hold**

1. Press [HOLD] on the programming pendant.
   – The manipulator stops temporarily.
   – The [HOLD] lamp lights while the [HOLD] button is held down.

■ **Release**

1. Press the start button on the suspended station.
   – The manipulator restarts its operation from the position where it was stopped.

4.5.3.2 Hold by External Input Signal (System Input)

■ **Hold**

1. Input ON signal to the external input (system input) specified for the hold operation.
   – The manipulator stops temporarily.

   External holding

   – The hold lamp for the external output signal lights.
   – The [HOLD] lamp on the programming pendant lights and the [START] lamp turns OFF.

■ **Release**

1. Input OFF signal to the external input (system input) specified for the hold operation.
   – Hold is released.
2. To continue the operation, press the start button on the suspended station.
   – The manipulator restarts its operation from the position where it was stopped.

4.5.3.3 Hold at the Station

■ **Hold**

1. Press the hold button on the station.
   – The manipulator stops temporarily.

External holding

■ **Release**

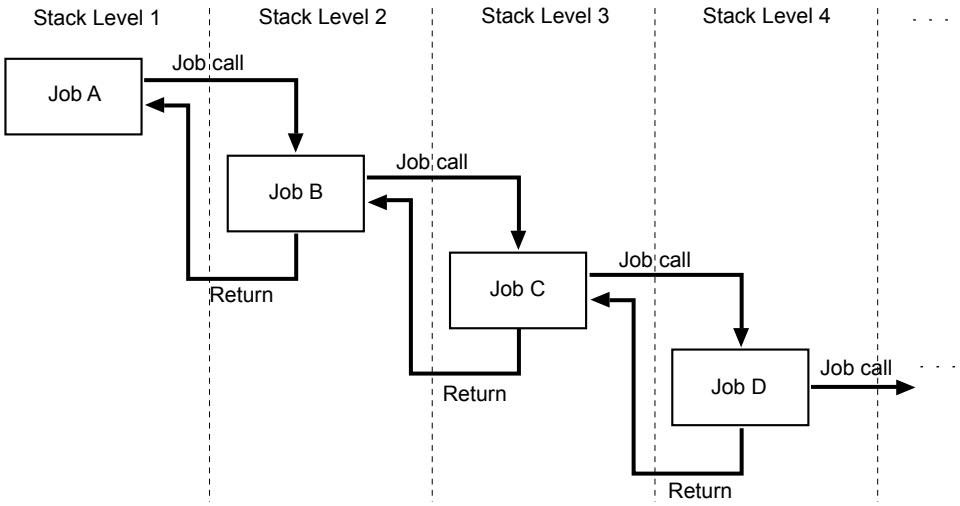
1. Press the hold button on the suspended station.
   – Hold is released.
   – Press the start button on the station, then the manipulator restarts its operation from the position where it was stopped.

SUPPLE-MENT

Pressing the start button on a station that is not in the Hold status does not start manipulator operation. The job registered for the station is reserved or the reservation, if it has been made, is canceled.

4.6 Displaying Job Stack

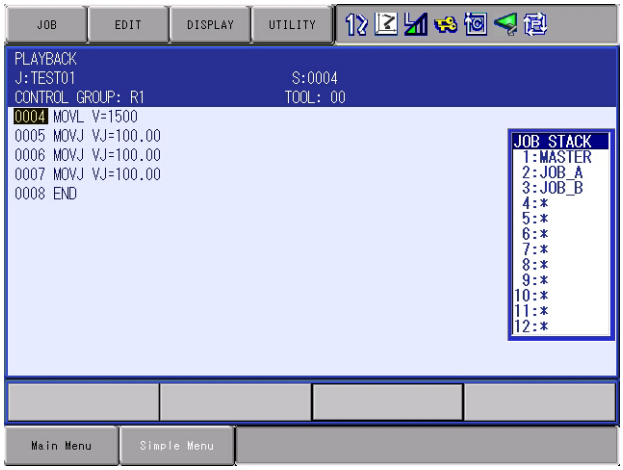
During the execution of the series of jobs that combined with CALL or JUMP instructions, the job stack can be displayed to check where the current job is and how many jobs are left.



SUPPLE-MENT Job calls can be used for up to 12 stack levels.

1. Select {DISPLAY} under the menu on the PLAYBACK window.
   – The pull-down menu appears.

2. Select {JOB STACK}.
   - The job stack status dialog box appears.
   - To close the job stack status dialog box, select {DISPLAY} and then {JOB STACK} under the menu again.



   - For above example, the playback of Job C is being executed and the Job C is called from Job B. Also, the Job B is called from Job A.

5 Editing Jobs

This section explains how to manage the jobs without moving the manipulator. Copying, deleting, and modifying of the jobs can be done only in the teach mode. Other operations can be done in any mode.

NOTE

Edit operations are restricted when the edit lock is applied.

NOTE

Editing Move Instructions

See *chapter 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 *section 3.4 “Modifying Steps” on page 3-29* for details.
- The following MOV instruction edit operations are explained in this section:

  For move instructions:

  - Insertion, deletion, or modification of additional items
  - Modification of interpolation type or play speed for move instructions
  - Setting, modification, or deletion of UNTIL statements (interruption conditions based on input signals)
  - Setting and deletion of NWAIT instructions

  For move instructions using position variables:

  - Insertion and deletion of move instruction.

SUPPLE-MENT

Refer to *section 1.2.6 “Character Input Operation” on page 1-18* for the character input operation.

5.1 Copying Jobs

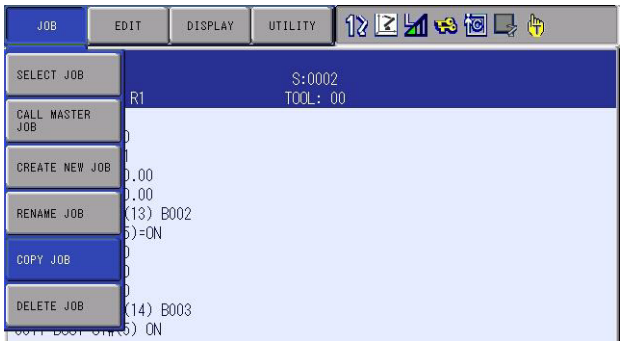
This operation is used to copy registered jobs and use them to create new jobs. It can be done using either the JOB CONTENT window or the JOB LIST window.

5.1.0.1 Copying Jobs on the JOB CONTENT Window

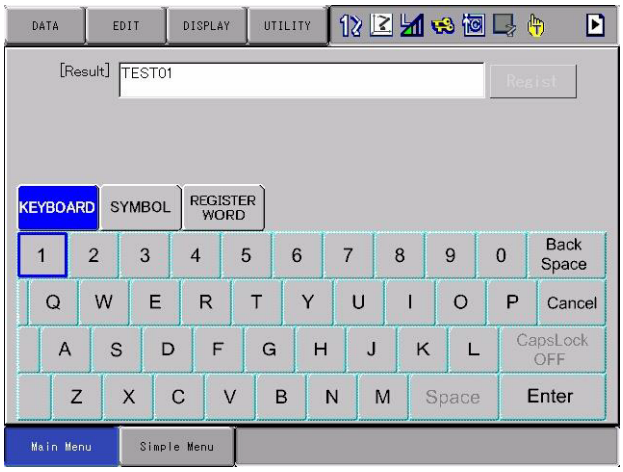
On the JOB CONTENT window, the current edit job becomes the copy source job.

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

3. Select {JOB} → {COPY JOB} under the pull-down menu.



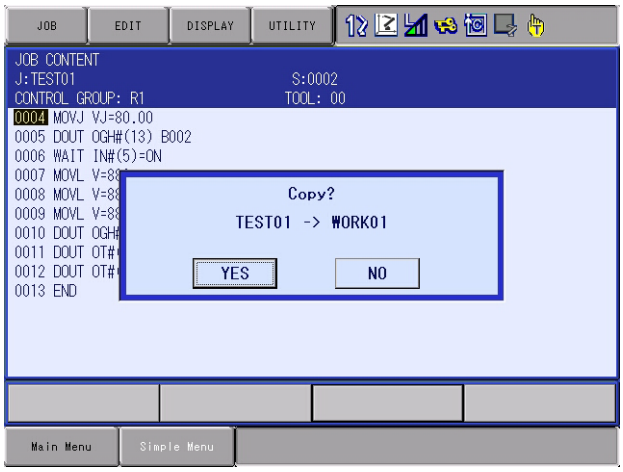
4. Input the job name.
   – Input the new job name.
   – The name of the copy source job is displayed on the input area. It is possible to partially change this name to enter a new name.



SUPPLE-MENT

See *section 1.2.6 “Character Input Operation” on page 1-18* for information on letter input operations.

5. Press [ENTER].
   – The confirmation dialog box appears.
   – If “YES” is selected, the job is copied and the new job appears.
   – If “NO” is selected, the job copy is not executed, and the process is canceled.



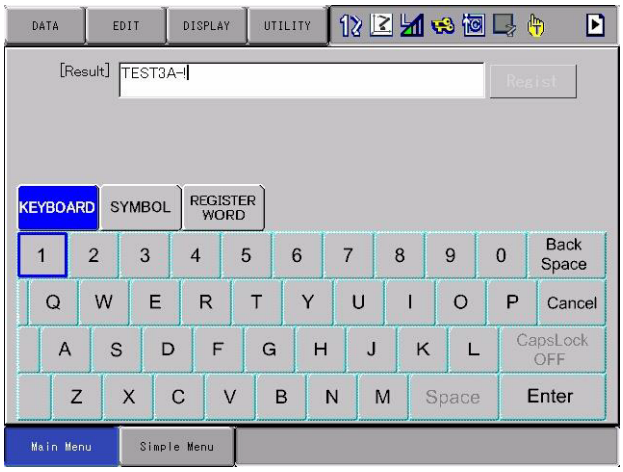
5.1.0.2 Copying Jobs on the JOB LIST Window

On the JOB LIST window, select the copy source job from the registered jobs and specify the copy destination directory.

1. Select {JOB} → {SELECT JOB} under the main menu.
   – The JOB LIST window appears.

2. Move the cursor to the copy source job.
3. Select {JOB} → {COPY JOB} under the pull-down menu.

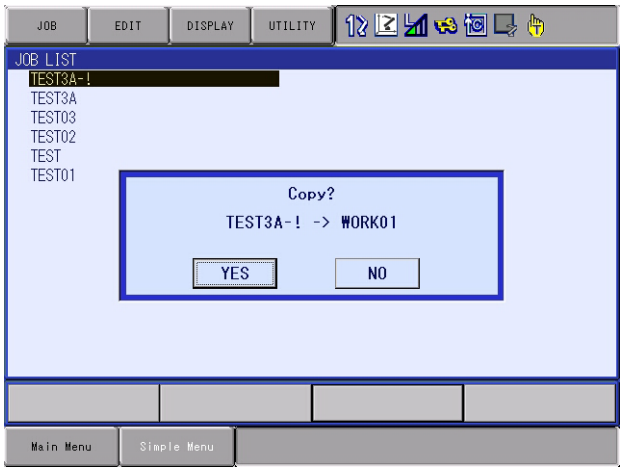
4. Input the job name.
   - Input the new job name.
   - The name of the copy source job is displayed on the input area. It is possible to partially change this name to enter a new name.



SUPPLE-MENT

See *section 1.2.6 "Character Input Operation" on page 1-18* for information on letter input operations.

5. Press [ENTER].
   - The confirmation dialog box appears.
   - If "YES" is selected, the job is copied and the new job appears.
   - If "NO" is selected, the job copy is not executed, and the process is canceled.



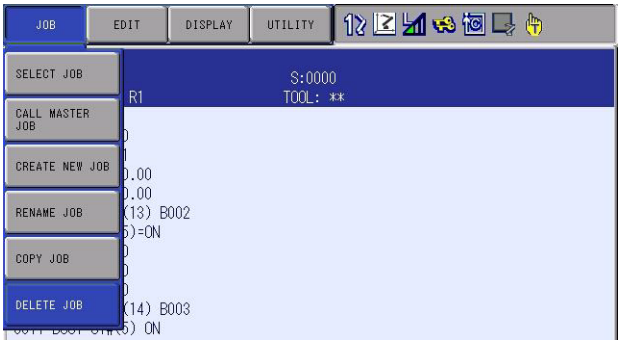
5.2 Deleting Jobs

This operation is used to delete jobs that are registered on the DX100. It can be performed in either the JOB CONTENT window or the JOB LIST window.

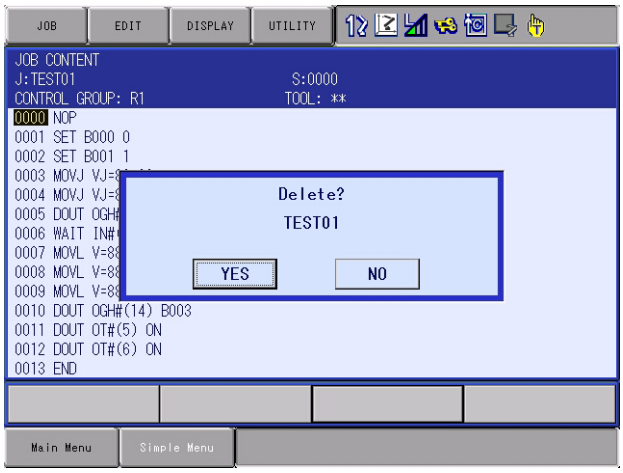
5.2.0.1 Deleting Jobs on the JOB CONTENT Window

On the JOB CONTENT window, the current edit job is deleted.

1. Select {JOB} under the main menu.
2. Select {JOB}.
   – The JOB CONTENT window appears.
3. Select {JOB} → {DELETE JOB} under the pull-down menu.



4. Press “YES”.
   – The confirmation dialog box appears.
   – When “YES” is selected, the edit job is deleted. When deletion is completed, the JOB LIST window appears.
   – When “NO” is selected, the job deletion is canceled.

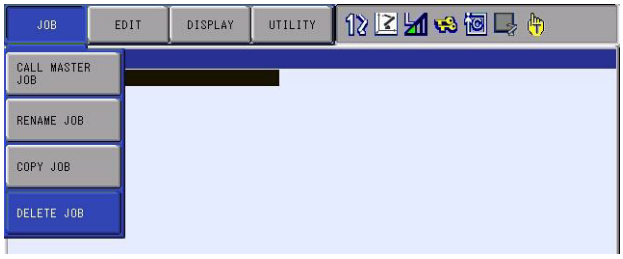


5.2.0.2 Deleting Jobs on the JOB LIST Window

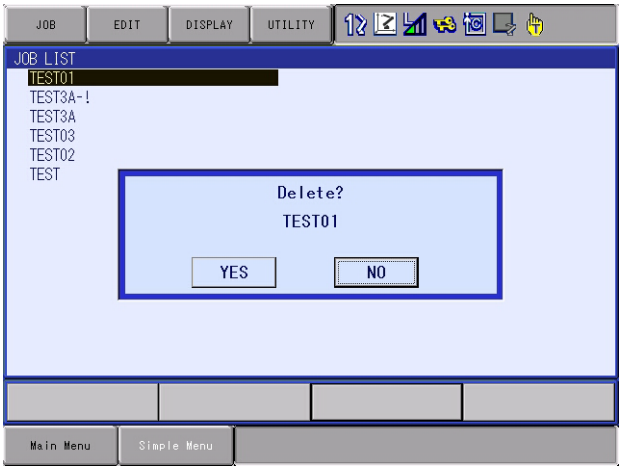
On the JOB LIST window, select the job to be deleted from the list of the registered jobs.

1. Select {JOB} → {SELECT JOB} under the main menu.
   – The JOB LIST window appears.

2. Move the cursor to the job to be deleted.
3. Select {JOB} → {DELETE JOB} under the pull-down menu.



4. Press “YES”.
   – The confirmation dialog box appears.
   – When “YES” is selected, the selected job is deleted. When deletion is completed, the JOB LIST window appears.
   – If “NO” or [CANCEL] is selected, the job deletion is canceled and the JOB LIST window appears.



SUPPLE-MENT

To select all the registered jobs at a time, select {EDIT} from the menu and then select “SELECT ALL”.

5.3 Modifying Job Names

This operation is used to modify the name of a job that is registered. The operation can be performed in either the JOB CONTENT window or the JOB LIST window.

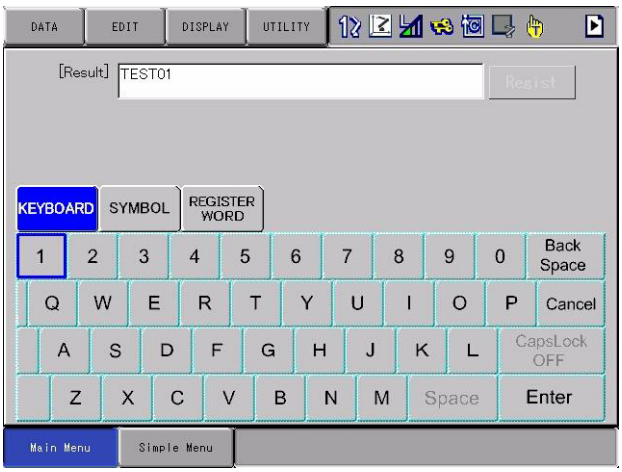
5.3.0.1 Modifying Job Names on the JOB CONTENT Window

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

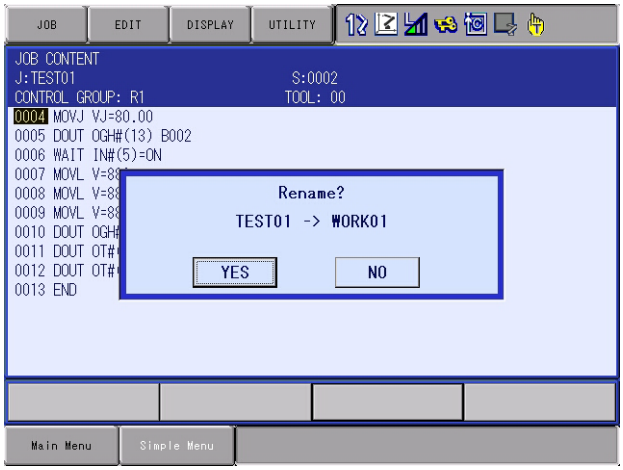
3. Select {JOB} → {RENAME JOB} under the pull-down menu.

4. Input the job name.
   – Input the new job name.
   – The name of the source job is displayed on the input area. It is possible to partially change this name to enter a new name.

> SUPPLE-MENT
> See *section 1.2.6 "Character Input Operation" on page 1-18* for information on letter input operations.



5. Press [ENTER].
   - The confirmation dialog box appears.
   - When “YES” is selected, the job name is changed and a new job name is displayed.
   - When “NO” is selected, the job name is not changed, and the process is canceled.



5.3.0.2 Modifying Job Names on the JOB LIST Window

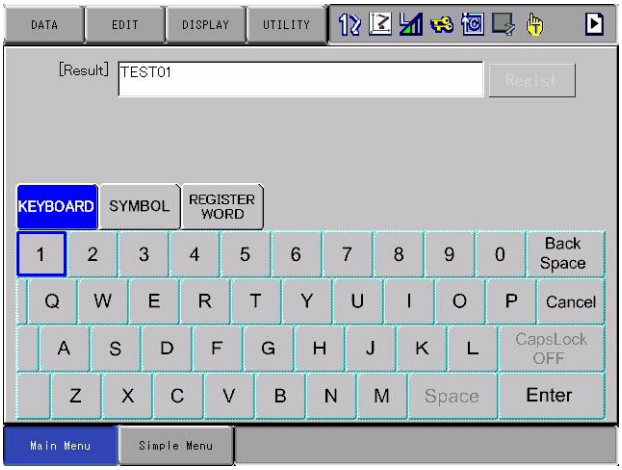
On the JOB LIST window, select the job whose name is to be modified from the list of the registered jobs.

1. Select {JOB} → {SELECT JOB} under the main menu.
   – The JOB LIST window appears.

2. Move the cursor to the name to be changed.
3. Select {JOB} → {RENAME JOB} under the pull-down menu.

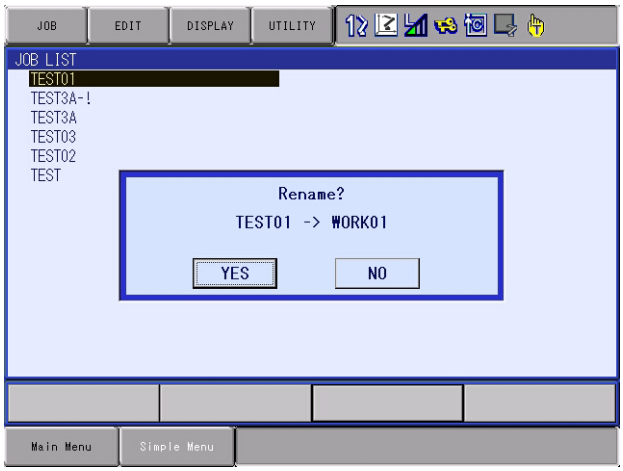
4. Input the job name.
   – Input the new job name.
   – The name of the source job is displayed on the input area. It is possible to partially change this name to enter a new name.

> SUPPLE-MENT
> See *section 1.2.6 "Character Input Operation" on page 1-18* for information on letter input operations.



5. Press [ENTER].
   – The confirmation dialog box appears.
   – When "YES" is selected, the job name is changed and a new job name is displayed.

– When “NO” is selected, the job name is not changed, and the process is canceled.



5.4 Editing Comments

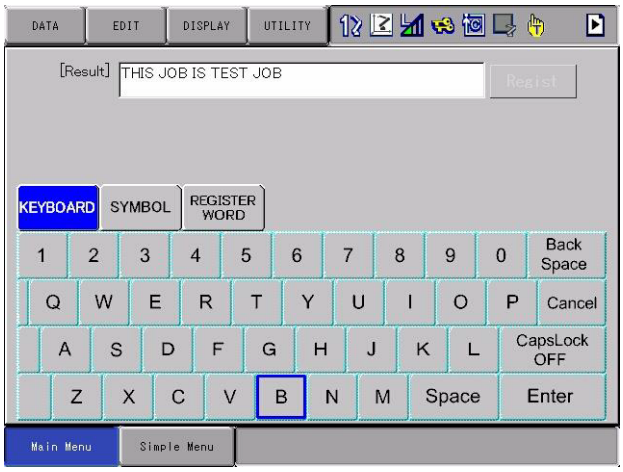
Comments of up to 32 characters can be added to each job to identify each job more specifically. Comments are displayed and edited on the JOB HEADER window.

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Select {DISPLAY} under the pull-down menu.
4. Select {JOB HEADER}.
   – The JOB HEADER window appears.

5. Select “COMMENT”.
   – The window for character input appears.
6. Input comments.
   – Input comments.
   – For the jobs that are already registered, comments are displayed on the input area. It is possible to partially change comments to enter new comments.

SUPPLE-MENT

See *section 1.2.6 “Character Input Operation” on page 1-18* for information on letter input operations.



7. Press [ENTER].
   – The comment on the input area is registered and is displayed on the “COMMENT” area in the JOB HEADER window.

5.5 Setting Edit Lock on Individual Job Units

In order to prevent inadvertent changes in the registered jobs or data, it is possible to set the edit lock to each job. When the edit lock is ON, the job cannot be edited or deleted.

The edit lock can be set and canceled on the JOB HEADER window.

> SUPPLE-MENT
> Setting of the edit lock can be changed only when the security mode is management mode.

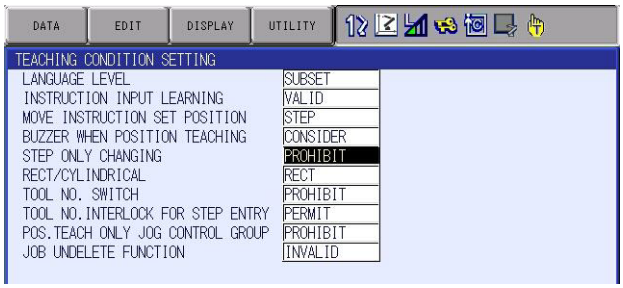
1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Select {DISPLAY} under the pull-down menu.
4. Select {JOB HEADER}.
   – The JOB HEADER window appears.

5. Select “EDIT LOCK” and set the edit prohibit.
   – Each time [SELECT] is pressed, the setting alternates between “ON” (edit disabled) and “OFF” (edit enabled).

5.6 Enabling the Modification of Position Data Only

Even in the edit-locked job, the position data can be modified.

1. Select {SETUP} under the main menu.
2. Select {TEACHING CONDITION SETTING}.
   – The TEACHING CONDITION SETTING window appears.



SUPPLE-MENT

TEACHING CONDITION SETTING window is shown only when the security mode is edit mode or management mode.

3. Select “STEP ONLY CHANGING” and press [SELECT].
   – Each time [SELECT] is pressed, the setting alternates between “PROHIBIT” and “PERMIT”.

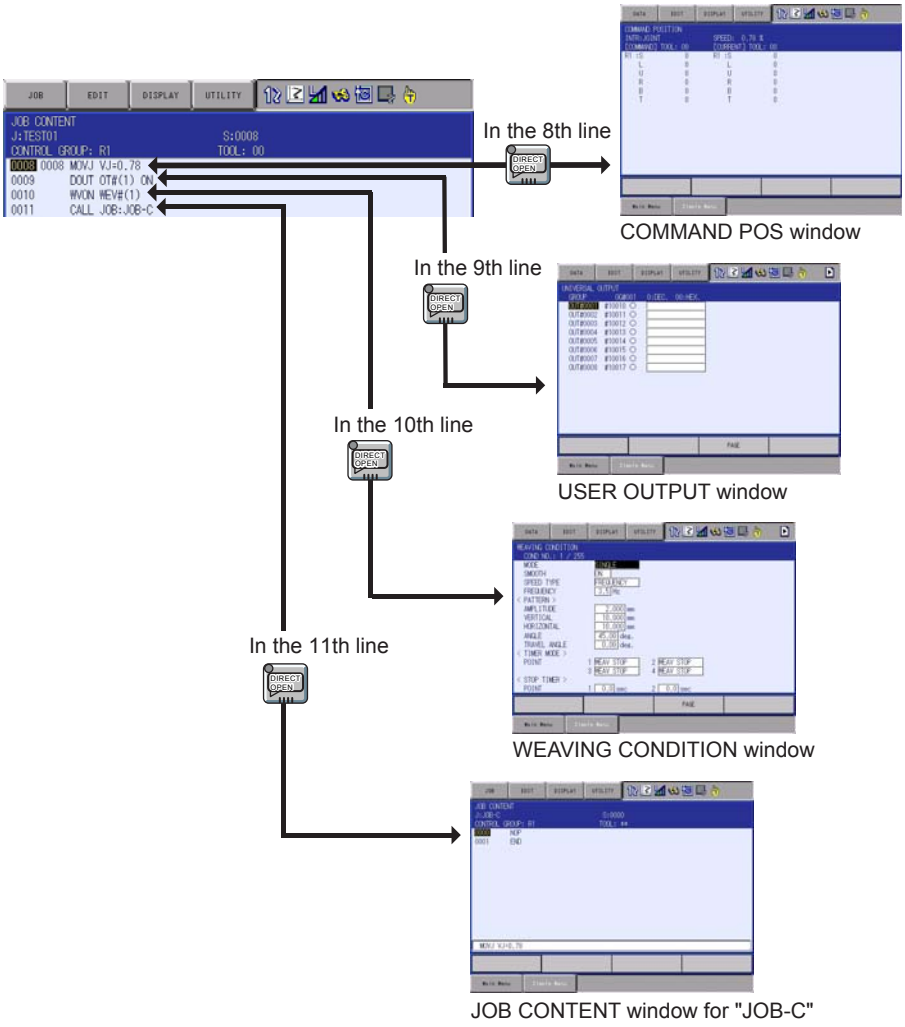
6 Convenient Functions

6.1 One-touch Operation “Direct Open”

The direct open function immediately shows the JOB CONTENT window or condition file contents of a job called by the CALL instruction. Move the cursor to the desired job name or condition file name and simply press the direct open key to display the contents of the file. This function can be used for the following window:

- JOB CONTENT window for a job name directly specified by a CALL instruction
- CONDITION FILE window for a file name directly specified by a work instruction
- COMMAND POS window for a move instruction
- I/O window with an I/O instruction (when I/O numbers are specified)

<Example> Example Using Direct Open



1. In the JOB CONTENT window, move the cursor to the job name or the condition file for which the window is to be displayed.

2. Press the direct open key .
   – This key lamp lights and the JOB CONTENT window or the condition file window appears.
   – When the direct open key is pressed once again, the key lamp turns OFF, and the window returns to the former JOB CONTENT window.

NOTE

- The direct open function cannot be used again while a directly opened window is shown.
- If another window is selected while the direct open function is effective, the function is automatically cancelled and the lamp on the direct open key goes out.
- Once another JOB CONTENT window is opened by the direct open function, the former job cannot be continuously operated. (Stopped until the opened JOB CONTENT window is closed.)

6.2 Job Edit Function During Playback

6.2.1 Function

Jobs can be edited during playback, including during the play mode.

<Editable> user job

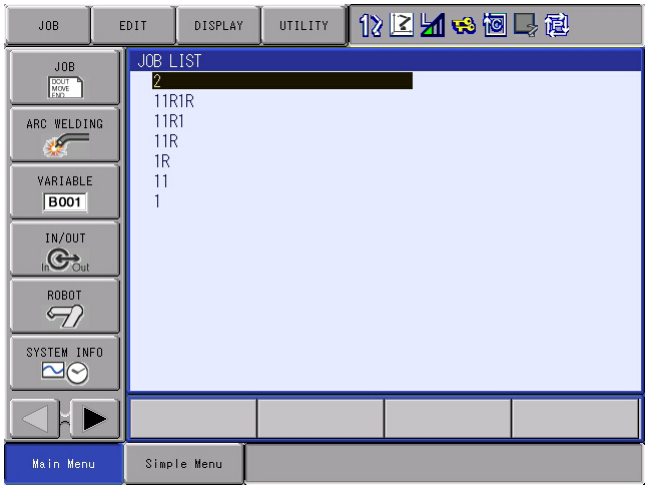
<Not Editable> macro job and system job

6.2.2 Job Edit During Playback

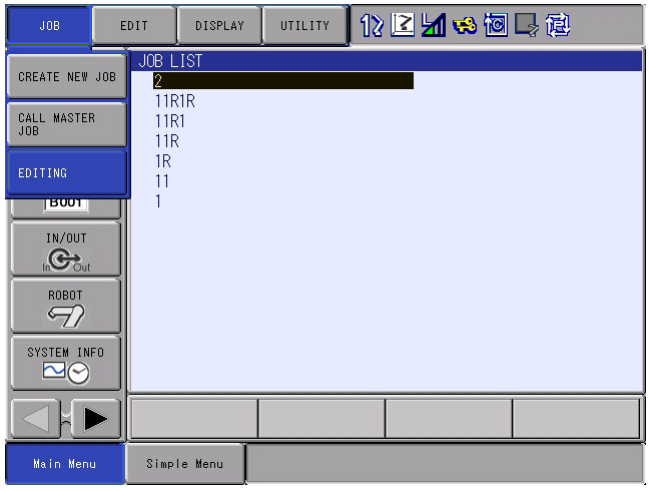
6.2.2.1 Basic Operation

The job edit operation during playback is described below.

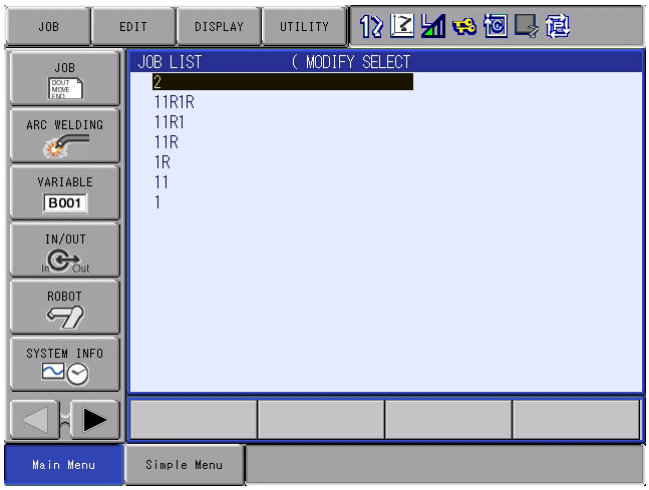
1. During playback, select the main menu {JOB}, then select the submenu {SELECT JOB}.
   – JOB LIST display appears.



2. Select {EDITING} under the pull-down menu {JOB}.



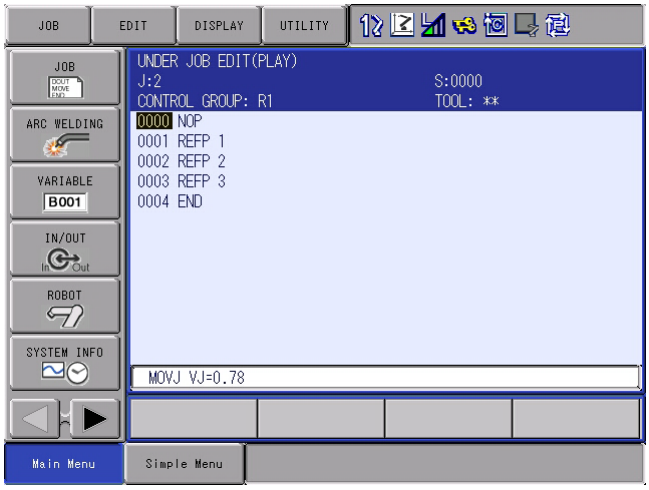
3. Select the job to be edited from JOB LIST.



– The selected job will be registered in the display of the submenu "PLAY EDIT JOB LIST".

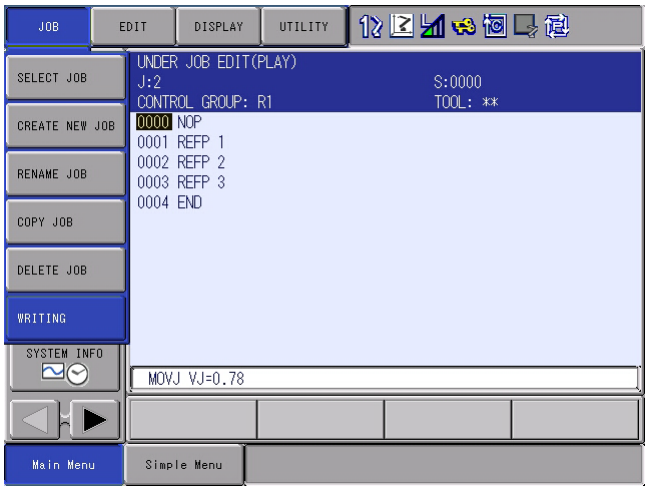
4. Edit the selected job.

– Edit the job selected in the above step in the same manner as the teach mode.

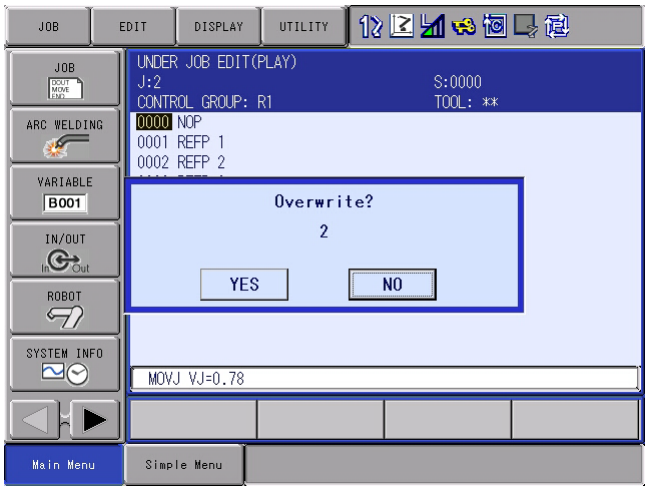


– Regarding restrictions on editing, refer to *section 6.2.2.2 "Editing" on page 6-6*.

5. Select {WRITING} under the pull-down menu {JOB} to reflect the edited data.



– If the job to be written to is listed in “JOB LIST”, a confirmation dialog “Overwrite?” appears. Select “YES” to reflect the edited data. Refer to the “SUPPLEMENT” on the next page.



– If the job with the same name is not listed in “JOB LIST”, the job to be written to will be added to “JOB LIST”. Refer to the “SUPPLEMENT” on the next page.

SUPPLE-MENT

If data is reflected during playback, the message “Requesting playback edit JOB writing” appears, and the status becomes a write request. To write the job, execute the instruction “LATESTJOB” in the write request status or end playback. If data is reflected in the play mode but not during playback, the job will be written immediately.

However, if the job to be written to is being executed (including jobs in the call stack),
“Error 5240: Cannot write in the JOB in execution.”
appears, and the edited data will not be reflected.

If a job in the call stack is written to in the play mode but not during playback,
“Error 5241: Cannot write in the JOB in JOB STACK.”
appears, and the edited data will not be reflected.

If data is reflected during teaching, the job will be written immediately.

6.2.2.2 Editing

The data of the selected job (see *the step 4 of section 6.2.2.1 “Basic Operation” on page 6-3*) can be edited in the same manner as the normal teach mode.
However, the functions that affect the manipulator motion are restricted as follows:

- Position teaching cannot be edited.
- The pull-down menu during editing is restricted as shown in *Fig. 6-1 “Pull-down Menu (EDIT) * Cursor Is on Line No.”* to *Fig. 6-4 “Pull-down Menu (UTILITY)” on page 6-7*.

*Fig. 6-1: Pull-down Menu (EDIT) * Cursor Is on Line No.*

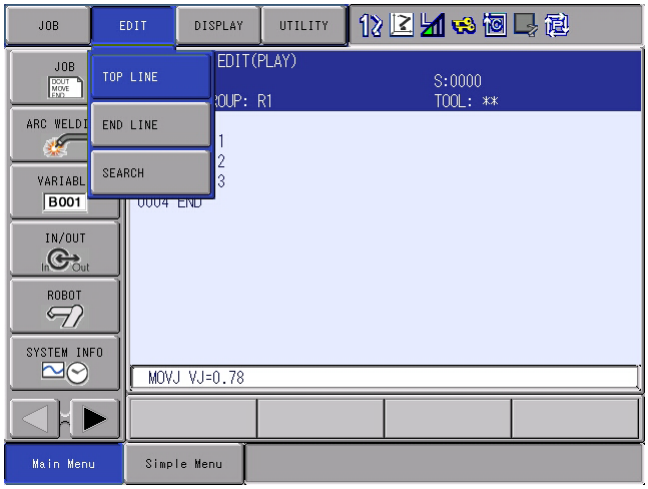


*Fig. 6-2: Pull-down Menu (EDIT) * Cursor Is on Instruction*

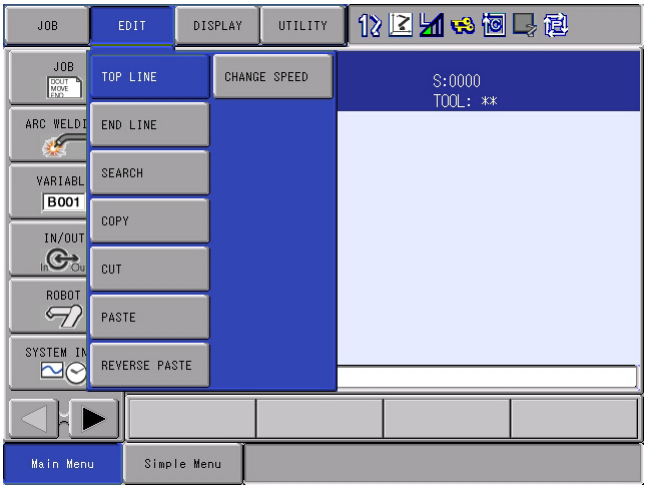


Fig. 6-3: Pull-down Menu (DISPLAY)

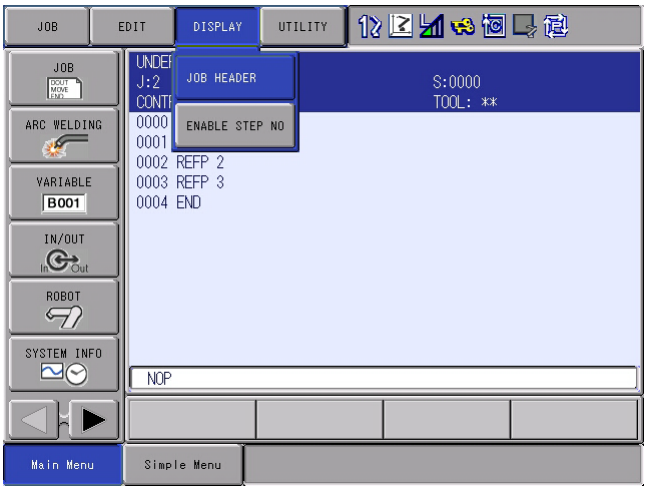
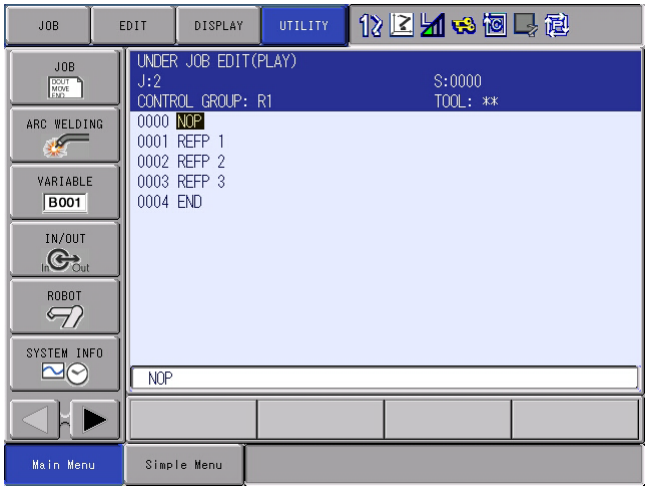


Fig. 6-4: Pull-down Menu (UTILITY)



In addition to the job edit operation described above, {CREATE NEW JOB}, {RENAME JOB}, {COPY JOB}, and {DELETE JOB} under the pull-down menu {JOB} are also available.

All of the above operations are performed for the jobs listed in “PLAY EDIT JOB LIST”.

To reflect the edited data in the job listed in JOB LIST, {WRITING} must be done.

Regarding {DELETE JOB}, only the jobs listed in “PLAY EDIT JOB LIST” can be deleted. The jobs in “JOB LIST” will not be deleted.

SUPPLE-MENT

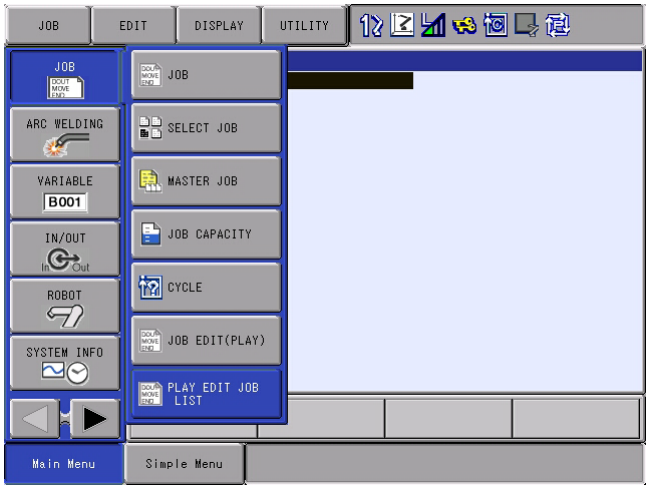
The above {WRITING}, {DELETE JOB}, {RENAME JOB}, and {COPY JOB} can be done in the same manner on the “PLAY EDIT JOB LIST” display.

6.2.2.3 Editing Multiple Jobs

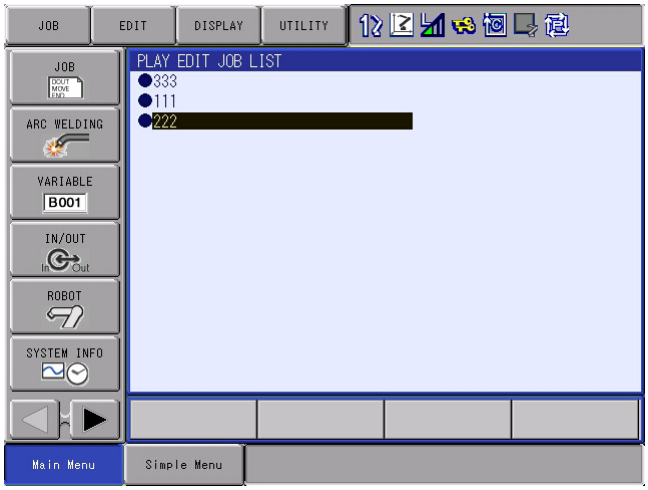
The procedure to delete or write multiple jobs at once on the PLAY EDIT JOB LIST display is described below.

■ **Deleting Multiple Jobs**

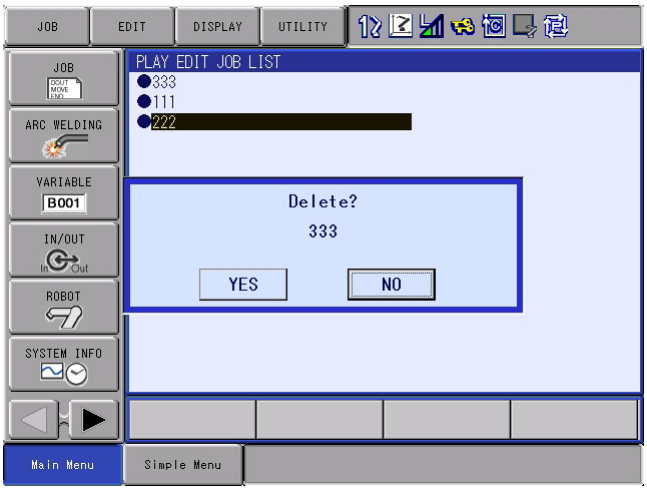
1. Select the main menu {JOB}, then select the submenu {PLAY EDIT JOB LIST}.



2. Select the job to be deleted by [SHIFT] + [SELECT].
   – “●“ appears on the left of the selected job.

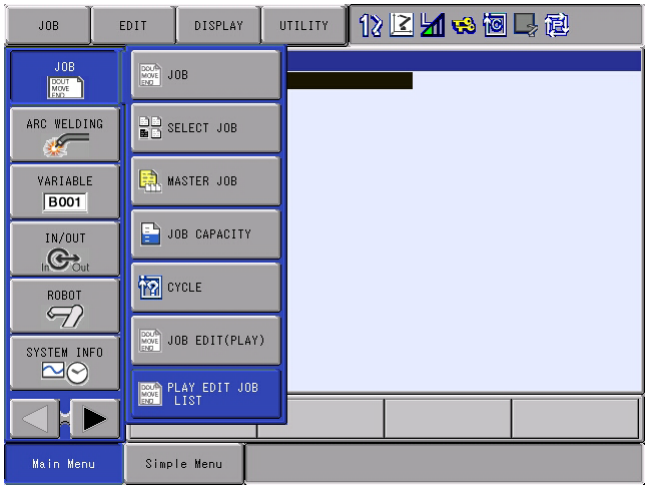


3. Select {DELETE JOB} under the pull-down menu {JOB}.
   – A confirmation dialog box appears for each selected job. Select "YES" to delete the job from the PLAY EDIT JOB LIST display.

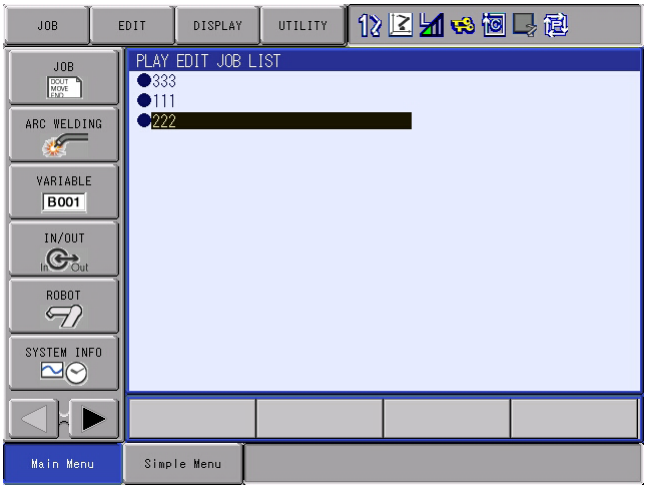


■ Writing to Multiple Jobs

1. Select the main menu {JOB}, then select the submenu {PLAY EDIT JOB LIST}.



2. Select the job to be written to by [SHIFT] + [SELECT].
   – "●" appears on the left of the selected job.



3. Select {WRITING} under the pull-down menu {JOB}.
   – If the job to be written to is listed in JOB LIST, a confirmation dialog "Overwrite?" appears. Select "YES" to reflect the edited data. If "NO" is selected, the edited data will not be reflected. To cancel writing, press [CANCEL] while the confirmation dialog appears.
   If the job with the same name is not listed in "JOB LIST", the job to be written to will be added to "JOB LIST". Refer to the "SUPPLEMENT" below.

SUPPLE-MENT

If data is reflected during playback, the message "Requesting playback edit JOB writing" appears, and the status becomes a write request. To write the job, execute the instruction "LATESTJOB" in the write request status or end playback. If data is reflected in the play mode but not during playback, the job will be written immediately.

However, if the job to be written to is being executed (including jobs in the call stack),
"Error 5240: Cannot write in the JOB in execution."
appears, and the edited data will not be reflected.

If a job in the call stack is written to in the play mode but not during playback,
"Error 5241: Cannot write in the JOB in JOB STACK."
appears, and the edited data will not be reflected.

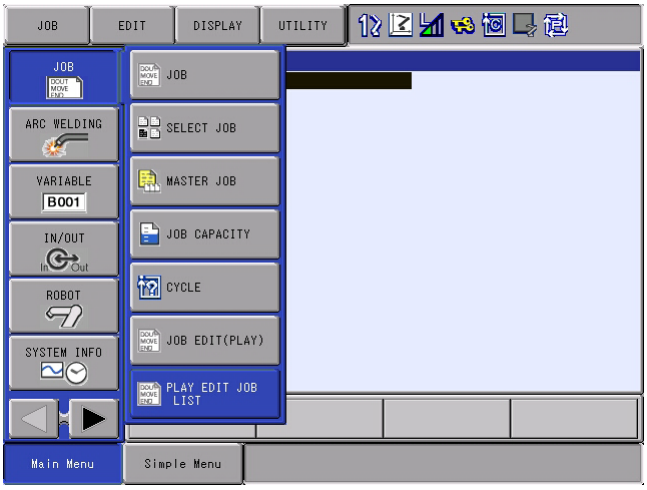
If data is reflected during teaching, the job will be written immediately.

6.2.2.4 Canceling Write Request

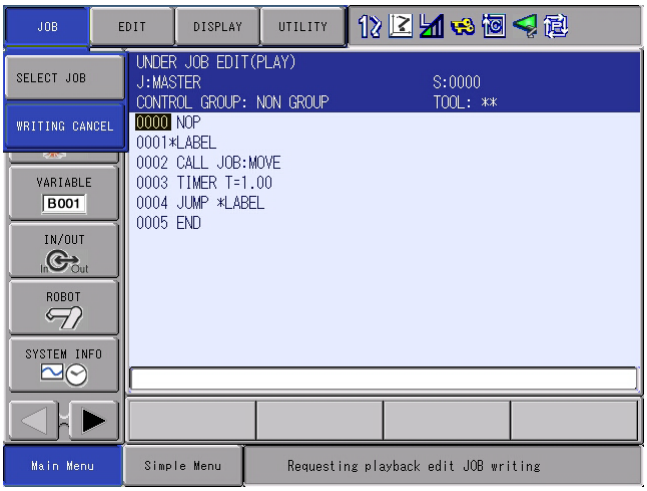
The procedure to cancel a write request is described below.

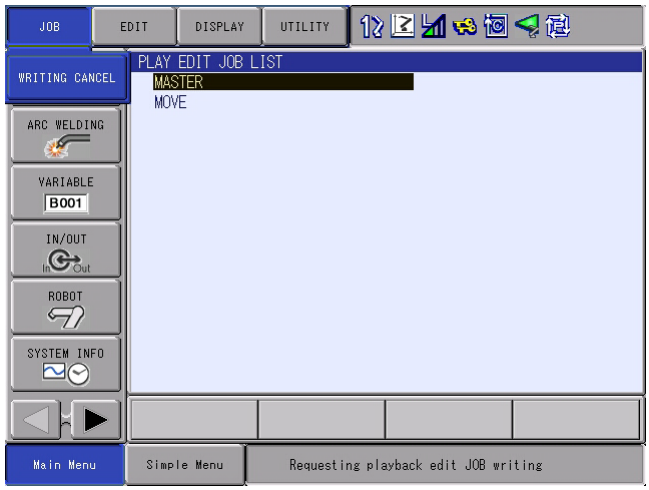
■ **Canceling Write Request**

1. Select the main menu {JOB}, then select the submenu {PLAY EDIT JOB LIST},
   or
   select the main menu {JOB}, then select the submenu {JOB EDIT (PLAY)}.



2. Select {WRITING CANCEL} under the pull-down menu {JOB}.





CAUTION

- When the mode switch is changed to the teach mode during job editing

Even if the mode switch is changed to the teach mode without reflecting or canceling the edited data, the changed data will be saved. In this case, select the main menu {JOB}, then select the submenu {SELECT JOB} or {PLAY EDIT JOB LIST} to edit data in the same manner as in the play mode. However, position teaching cannot be done.

SUPPLE-MENT

Regarding the job edited in the play mode, even after the mode is changed to the teach mode, the edited data will not be reflected if {WRITING} is not done.

- Writing a job

{WRITING} operates differently depending on the status of the robot.

Select {JOB}, then select {WRITING} to reflect the edited data in the job. The data is reflected as described below depending on whether the job is being executed or not.

1. When the job is NOT being executed: The data is reflected immediately.
2. When the job is being executed: The data is reflected when the instruction “LATESTJOB” is executed or when the job execution is completed.

“Requesting playback edit JOB writing” appears while waiting for reflect operation (during a write request).

SUPPLE-MENT

- The executing job cannot be written to even by the instruction “LATESTJOB”.
- If a power failure occurs during a write request, the write request will be canceled upon restarting, and the job will not be reflected.

- During a file transfer

{WRITING} cannot be done during file transfer (i.e. external memory operation or data transmission).

In addition, a file cannot be transferred during a write request.

- During a write request

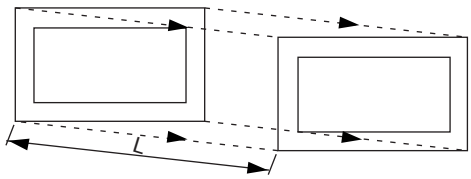
Editing is inhibited during a write request (while “Requesting playback edit JOB writing” appears).

To edit data, wait for the writing to be completed or cancel the write request.

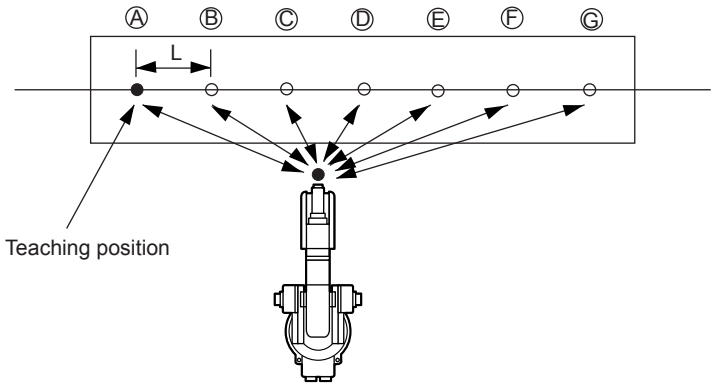
6.3 Parallel Shift Function

6.3.1 Function Overview

Parallel shift refers to the shifting of an object from a fixed position in such a way that all points within the object move an equal distance. In the model for parallel shift shown in the following, the shift value can be defined as the distance L (three-dimensional coordinate displacement). The parallel shift function is relevant to the actual operation of the manipulator because it can be used to reduce the amount of work involved in teaching by shifting a taught path (or position).



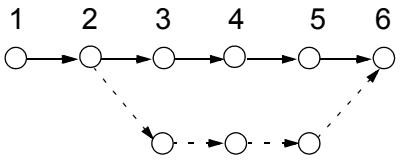
In the example in the figure below, the taught position A is shifted in increments of the distance L (this is actually a three-dimensional XYZ displacement that can be recognized by the robot) in order to enable the operation that was taught at position A to also be performed at positions B through G.



6.3.1.1 Parallel Shift of Step

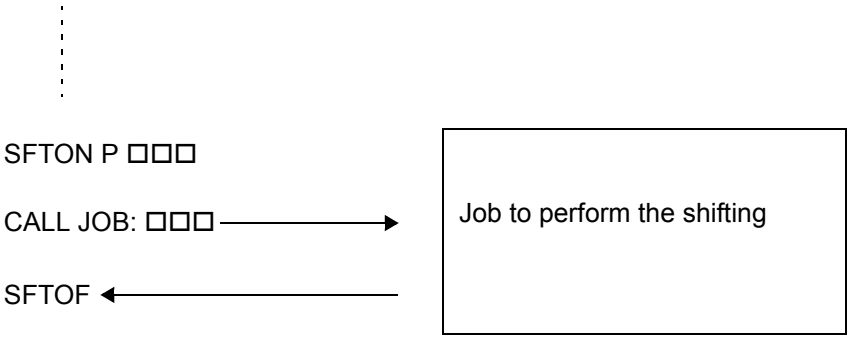
The block from the SFTON to the SFTOF instructions is subject to the shift operation.

Line (Step)	Instruction	
0000	NOP	
0001(001)	MOVJ VJ=50.00	Shifted block
0002(002)	MOVL V=138	
0003	SFTON P□□□UF# (1)	
0004(003)	MOVL V=138	
0005(004)	MOVL V=138	



6.3.1.2 Parallel Shift of Job

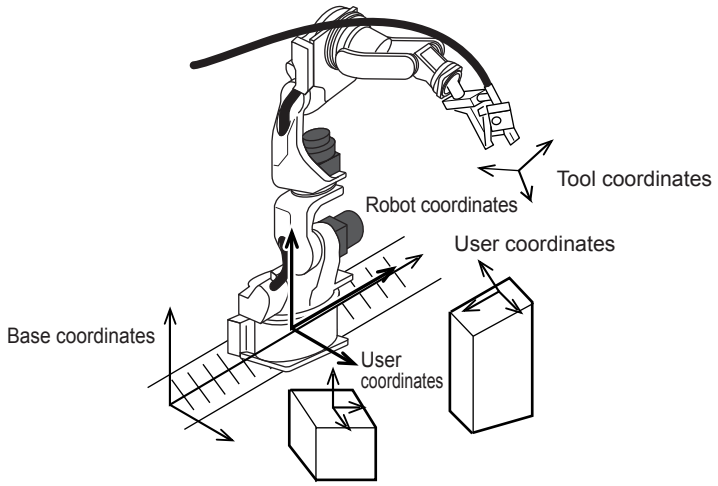
When shifting an entire series of operations, the range to be shifted by the shift instruction can be set using the method indicated above, but the method shown in the following, in which just the part to be shifted is made into a separate job, can also be used.



6.3.2 Setting the Shift Value

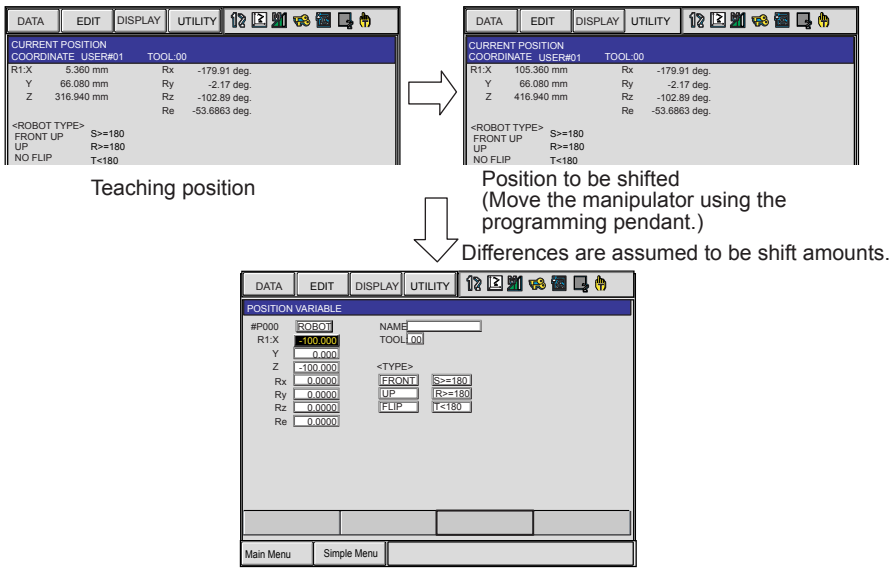
6.3.2.1 Coordinate Systems

The shift value for parallel shift is X, Y, and Z increment in each coordinates. There are four coordinates: base coordinates, robot coordinates, tool coordinates, and user coordinates. In systems with no servo track, the base coordinates and robot coordinates are the same.

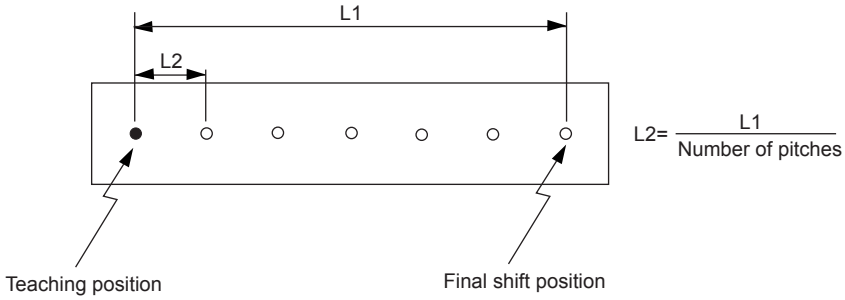


6.3.2.2 Setting the Shift Value

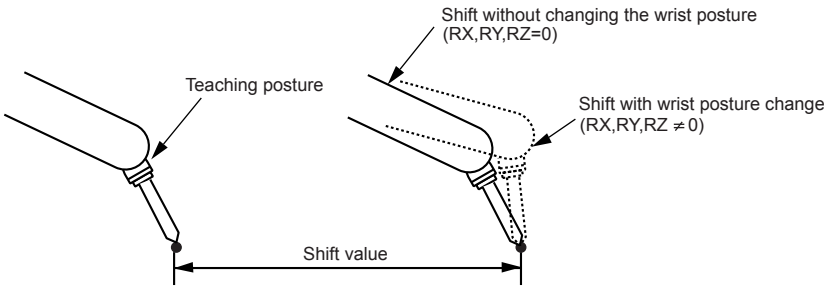
When setting the shift value for the position variables, use the current position (coordinates) of the manipulator in the window.



The shift value is the X, Y, and Z difference between the shift position and teaching position and the difference in angular displacement RX, RY, And RZ (normally set at “0”). If shifting is executed at equal pitch intervals, for example for palletizing, find the difference between the teaching position and the final shift position, then divide by the number of pitch intervals (number of divisions) to calculate the shift value per pitch.



The posture of the wrist is defined by the angular displacement of the coordinates of the wrist axes. Consequently, if the shift value is specified with X, Y, and Z only (RX, RY, RZ=0), the wrist is shifted while maintaining the same posture as at the teaching point. Since shifting is normally performed without changing the posture, there is no need to specify an angular displacement for the wrist. The motion when a parallel shift is performed is shown in the following:

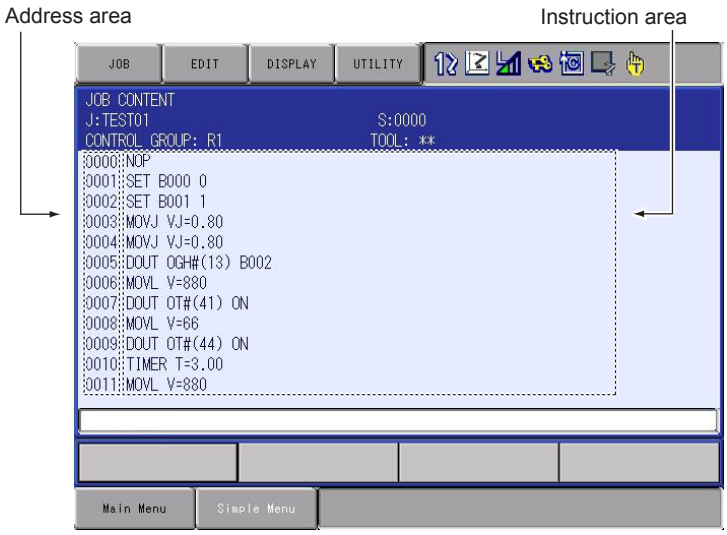


The shift value is calculated on the position data window for the coordinates in which the shift is performed. Since this is normally performed in the user coordinates, the position data window for the user coordinates is used.

6.3.3 Registering Shift Instructions

To register the instruction, move the cursor to the address area in the JOB CONTENT window during teach mode as follows:

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

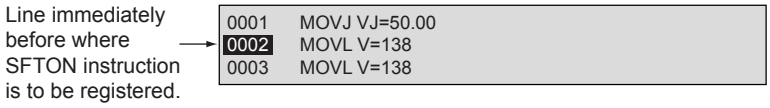


3. Move the cursor to the address area.

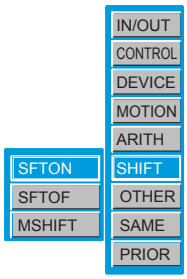
6.3.3.1 SFTON Instruction

This is the instruction that starts a parallel shift.

1. Move the cursor to the line immediately before where the SFTON instruction is to be registered.



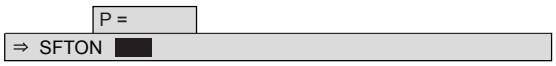
2. Press [INFORM LIST].
   – The instruction list dialog box appears.



3. Select {SHIFT}.
4. Select the SFTON instruction.
   – The SFTON instruction is displayed in the input buffer line.
5. Modify the additional items or number values as required.
   – **<When Nothing is to be Changed>**
   Proceed to Step 6.
   – **<When Editing Additional Items>**

• Adding or modifying additional items
To change the position variable number, move the cursor to the position variable number and press [SHIFT] + the cursor key to increase or decrease the value.

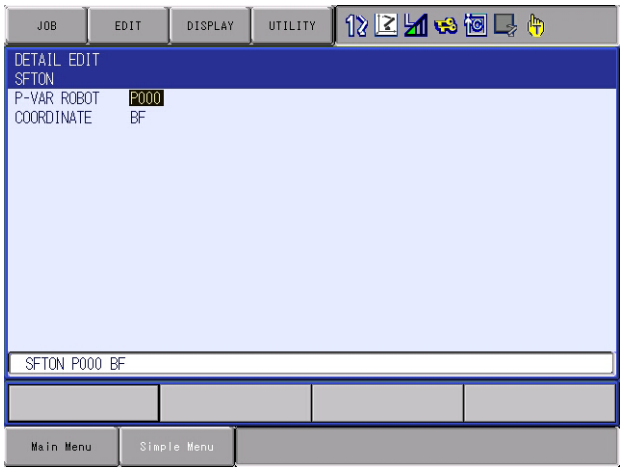
To directly input the value using the Numeric keys, press [SELECT] to display the input buffer line.



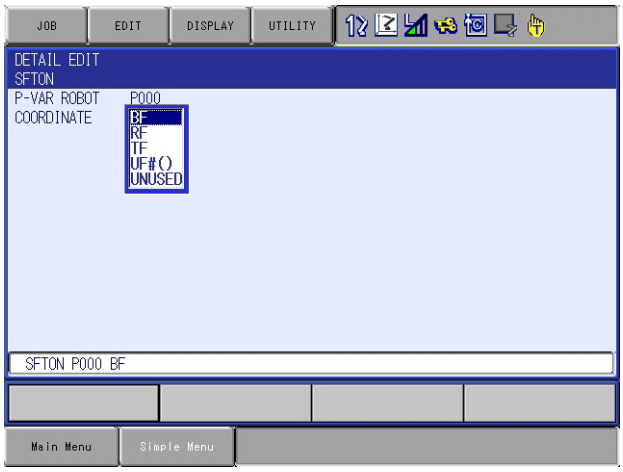
After the number is input, press [ENTER] to modify the number value in the input buffer line.

• Adding the coordinate system in which the shift is performed
Move the cursor to the instruction in the input buffer line and press [SELECT]. The DETAIL EDIT window appears.

```
⇒ SFTON P001
```



– Line up the cursor with ”UNUSED” and press [SELECT]. The selection dialog box appears. Line up the cursor with the coordinate system to be added, and press [SELECT].



– After the coordinate system addition is completed, press [ENTER]. The DETAIL EDIT window closes and the JOB CONTENT window appears.

6. Press [INSERT] and then [ENTER].

– The instruction displayed in the input buffer line is registered.

Line where SFTON instruction is registered. →

```
0002   MOVL V=138
0003   SFTON P000 BF
0004   MOVL V=138
```

6.3.3.2 SFTOF Instruction

This is the instruction that ends a parallel shift.

1. Move the cursor to the line immediately before where the SFTOF instruction is to be registered.

Line immediately before where SFTOF instruction is to be registered.

```
0006    MOVL V=138
0007    DOUT OT#(1) ON
0008    TIMER T=1.00
```

2. Press [INFORM LIST].
   – The instruction list dialog box appears.
3. Select {SHIFT}.
4. Select the SFTOF instruction.
   – The SFTOF instruction is displayed in the input buffer line.

```
⇒ SFTOF
```

5. Press [INSERT] and then [ENTER].
   – The SFTOF instruction is registered.

```
0006    MOVL V=138
0007    SFTOF
0008    DOUT OT#(1) ON
```

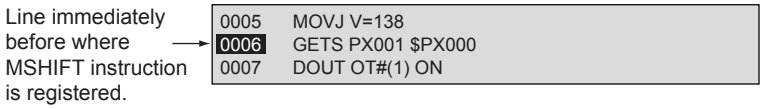
6.3.3.3 MSHIFT Instruction

When a parallel shift of the wrist posture is attempted, the manipulator may not be shifted to the target posture in the following cases.

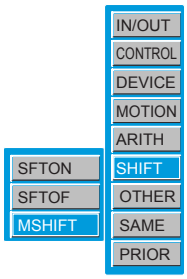
- Posture displacement (Rx, Ry, Rz) is specified to the shift value set by the user.
- When a displacement between two points is calculated using an INFORM operating instruction (ADD instruction, SUB instruction, etc.), and a posture displacement (Rx, Ry, Rz) is specified in the shift value.

In such cases, the MSHIFT instruction can be used to automatically calculate the optimum shift value for an operation to reach the target shift position and posture. With an MSHIFT instruction, the shift value between the reference position and the target position (shift position) when the parallel shift is performed is determined in the specified coordinate system, and set as the specified position variable.

1. Move the cursor to the line immediately before where the MSHIFT instruction is to be registered.



2. Press [INFORM LIST].
   – The instruction list dialog box appears.



3. Select {SHIFT}.
4. Select the MSHIFT instruction.
   – The MSHIFT instruction is displayed in the input buffer line.
5. Change the number data or additional items as required.
   – **<When Nothing is to be Changed>**
   Proceed to Step 6.
   – **<When Editing Additional Items>**
   – Adding or modifying additional items
   To change the position variable number, move the cursor to the position variable number and press [SHIFT] + the cursor key to increase or decrease the value.

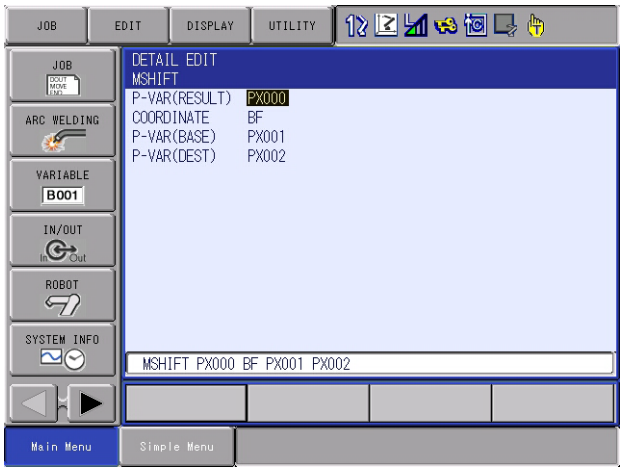
– To directly input the value using the Numeric keys, press [SELECT] to display the input buffer line.

```
PX =
⇒ MSHIFT  BF PX001 PX002
```

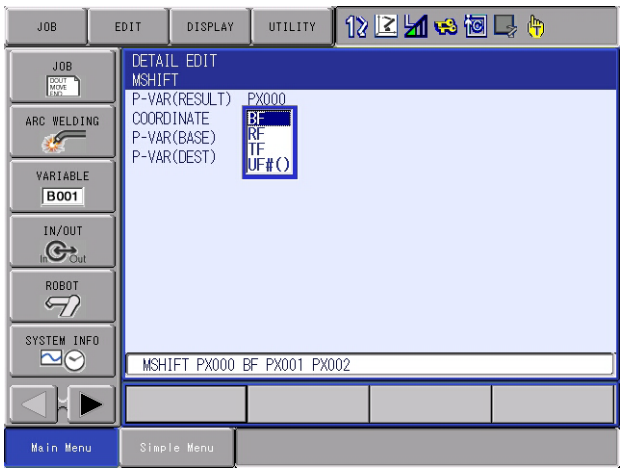
– After the number is input, press [ENTER] to modify the number value in the input buffer line.

– Changing the coordinate system in which the shift is performed Move the cursor to the instruction in the input buffer line and press [SELECT]. The DETAIL EDIT window appears.

```
⇒ MSHIFT PX000 BF PX001 PX002
```



– Line up the cursor with “BF” and press [SELECT]. The selection dialog box appears. Line up the cursor with the coordinate system to be changed, and press [SELECT].



– After the coordinate system modification is complete, press [ENTER]. The DETAIL EDIT window closes and the JOB CONTENT window appears.

6. Press [INSERT] and then [ENTER].

– The instruction displayed in the input buffer line is registered.

Line where MSHIFT is registered. →

```
0006   GETS PX000 $PX000
0007   MSHIFT PX000 RF PX001 PX002
0008   DOUT OT#(1) ON
```

6.3.4 Continuation of the Parallel Shift Function

CAUTION

- If the shift function is cancelled through a job editing operation after the execution of a parallel shift instruction, the job must be started again from the beginning.
- Because no shift is performed when the operation is restarted, there is a possibility of interference between the workpiece and fixture.

If any of the following operations are performed after executing a parallel shift instruction, the shift function is cancelled.

- Job editing operation (changing, deleting, adding)
- Job copy, job name change
- Registering a new job, deleting a job, or modifying a selected job
- Restart after the alarm occurs
- When control power is turned OFF

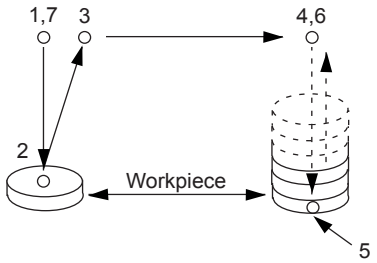
NOTE With any operation other than those listed above, the parallel shift function remains in effect.

6.3.5 Examples of Use

6.3.5.1 Example of Use of Shift Addition/Subtraction

Table 6-1: Workpiece Stacking Operation

Line	Instruction	
0000	NOP	
0001	SET B000 0	
0002	SUB P000 P000	Make the first shift value zero.
0003	*A	
0004	MOVJ	Step 1
0005	MOVL	Step 2
0006	’Gripping workpiece	
0007	MOVL	Step 3
0008	MOVL	Step 4
0009	SFTON P000 UF#(1)	Shift start
0010	MOVL	Shift position Step 5
0011	’Releasing workpiece	
0012	SFTOF	Shift end
0013	ADD P000 P001	Add the shift value for the next operation.
0014	MOVL	Step 6
0015	MOVL	Step 7
0016	INC B000	
0017	JUMP *A IF B00<6	
0018	↓	
	SFTON P000 UF#(1) SFTOF SUB P000 P001	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.
	↓	



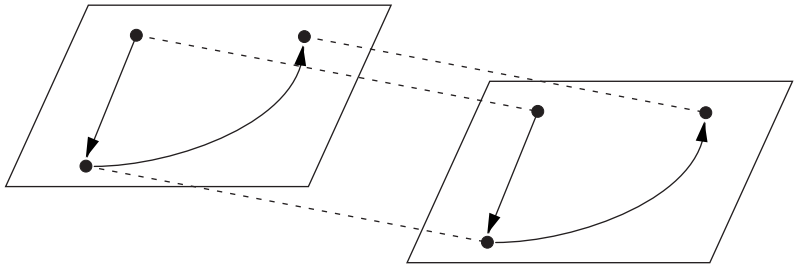
6.3.5.2 Example of Use of MSHIFT Instruction

Line	Instruction	Explanation
0000	NOP	
0001	MOVJ VJ=20.00	Move the manipulator to the reference position.
0002	GETS PX000 $PX000	Set the reference position as position variable P000.
0003	MOVJ VJ=20.00	Move the manipulator to the target position.
0004	GETS PX001 $PX000	Set the target position as position variable P001.
0005	MSHIFT PX010 BF PX000 PX001	Set shift value and set it as position variable P010.
0006	END	

6.4 Parallel Shift Job Conversion Function

6.4.1 Function Overview

If the manipulator and base positions are moved after a job has been taught, the entire job has to be modified. The parallel shift conversion function shortens the modification time required in cases like this by shifting all steps of the job by the same value to create a new job.



When the parallel shift conversion is performed, all job steps are shifted by the same value.

NOTE

Steps Outside the P-point Maximum Envelope

- "/OV" is displayed for the steps which result in a position outside the P-point maximum envelope of the manipulator. When the position is corrected, "/OV" display disappears.

Position Variable

- Position variables are not subject to the parallel shift job conversion.

Not Converted Job

- The following jobs cannot be converted. If conversion is attempted, no operation is performed.
  - Jobs without any group axes
  - Concurrent jobs (optional)

CAUTION

- If a job name after conversion is not specified when executing the parallel shift job conversion, the position data of the job is shifted and converted, then the data is overwritten with a new position data after the shift. Be sure to save the job in the external memory device or create the same job by copying before executing conversion.

6.4.2 Coordinate Systems for Conversion

When performing the parallel shift job conversion, it is necessary to specify the coordinate systems in which the conversion is to be performed. The coordinate system can be selected from the following:

- Base coordinates
- Robot coordinates
- Tool coordinates
- User coordinates (64 types)
- Master tool coordinates (R*+R* job)
- Pulse coordinates

In the case of an ordinary job for which group axes are registered, shift conversion is performed in accordance with the selected coordinate system. The relationship between group combinations and coordinates are shown in the following table.

1 to 4 in the table are followed by their explanations.

Table 6-2: Relationship Between Group Combinations and Coordinates at Conversion

Group Combination in Job	Explanation		
		Usable Coordinate System	
R	Shift is performed on the basis of selected coordinates.		
		Base coordinates, robot coordinates, tool coordinates, user coordinates, pulse coordinates	
R(B)	Shift is performed on the basis of selected coordinates.		
		1. Base Coordinates	The base axis is shifted by the specified amount and the TCP of the manipulator is shifted by the specified amount in the base coordinates.
		2. Robot Coordinates	The base axis is shifted by the specified amount. The TCP of the manipulator is shifted by the specified amount in the robot coordinates. These shifts are carried out independently.
		3. Tool Coordinates	The base axis is shifted by the specified amount. The TCP of the manipulator is shifted by the specified amount in the tool coordinates. These shifts are carried out independently.
		4. User Coordinates	The base axis is shifted by the specified amount and the TCP of the manipulator is shifted by the specified amount in the user coordinates.
		5. Pulse Coordinates	The taught position of each axis is shifted by the specified amount on the basis of pulse values.
S	Shift is performed on the basis of pulse values regardless of the coordinates.		

Table 6-2: Relationship Between Group Combinations and Coordinates at Conversion

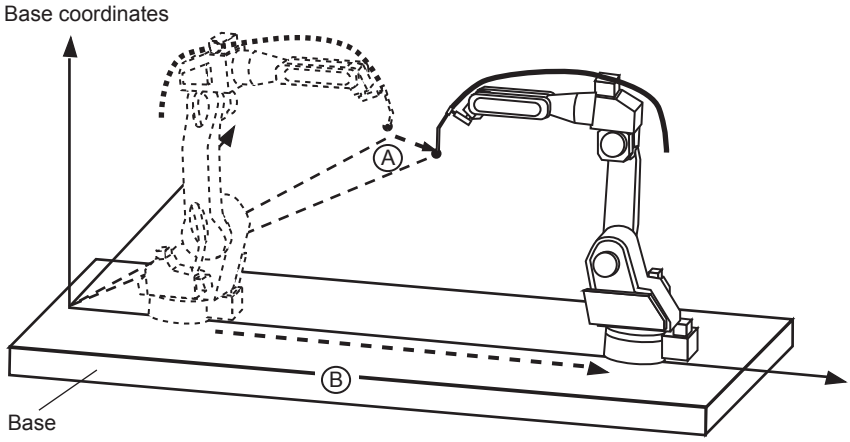
R+S	The manipulator is shifted in the selected coordinates. The station axis is shifted on the basis of pulse values regardless of the coordinates.
	Base coordinates, robot coordinates, tool coordinates, user coordinates, pulse coordinates
R(B)+S	The manipulator is shifted in the selected coordinates, as in 1 to 5 above. The station axis is shifted on the basis of pulse values regardless of the coordinates.
R+R	Two manipulators are shifted in the selected coordinates.
	Base coordinates, robot coordinates, tool coordinates, user coordinates, master tool coordinates [1)], pulse coordinates
R(B)+R(B)	Two manipulators are shifted in the selected coordinate system, as in 1 to 5 above. Two base axes are also shifted.

1 In the master tool coordinates, conversion only occurs at the “slave” from the standpoint of the SMOV instruction.

■ About 1 to 4 in the Table

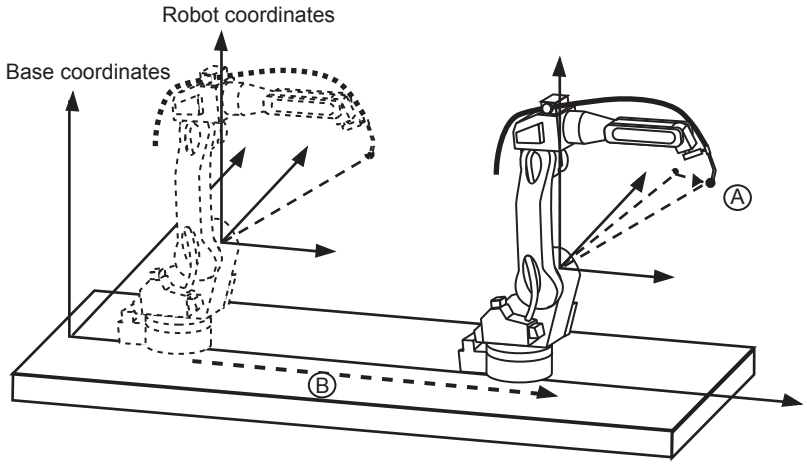
1. Base Coordinates

The base axis is shifted by B and the TCP of the manipulator is shifted by A in the base coordinates.



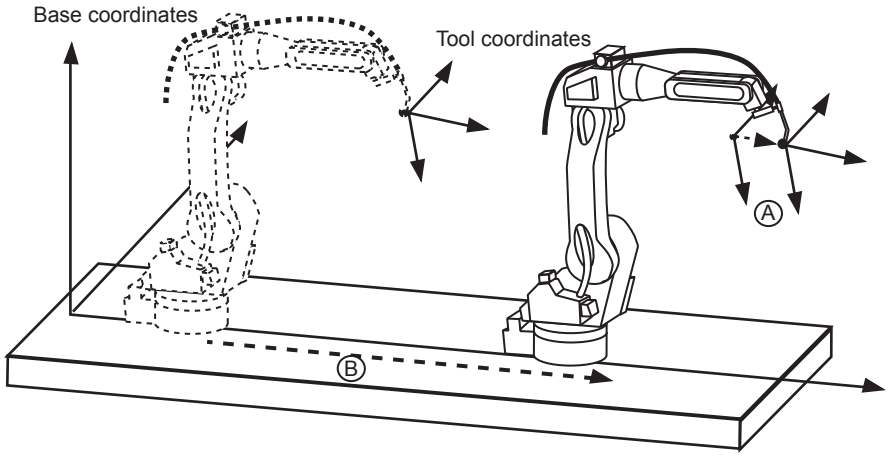
2. Robot Coordinates

The base axis is shifted by B. The TCP of the manipulator is shifted by A in the robot coordinates. These shifts are carried out independently.



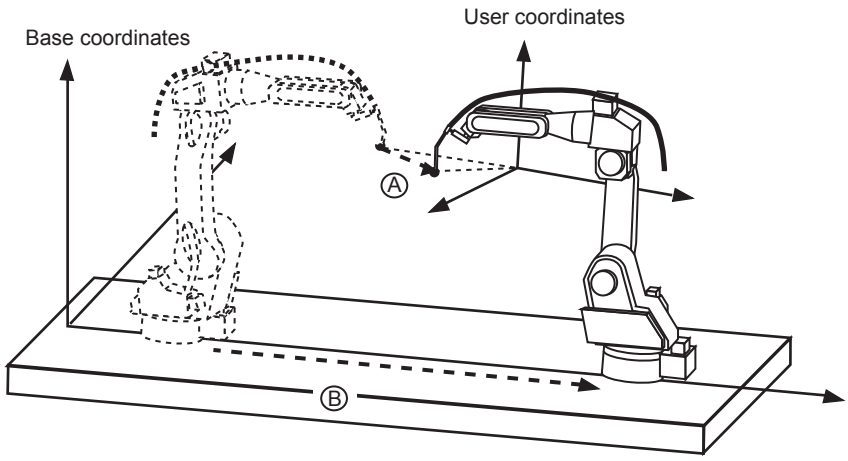
3. Tool Coordinates

The base axis is shifted by B and the TCP of the manipulator is shifted by A in the tool coordinates. These shifts are carried out independently.



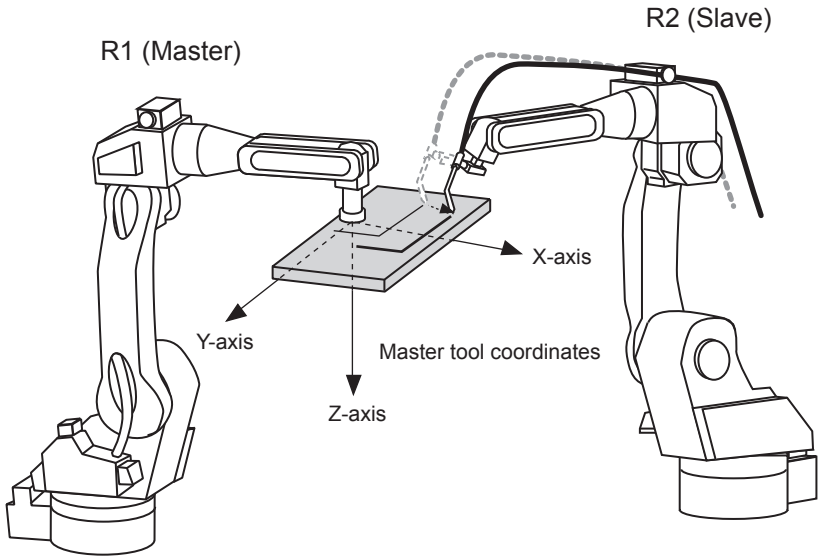
4. User Coordinates

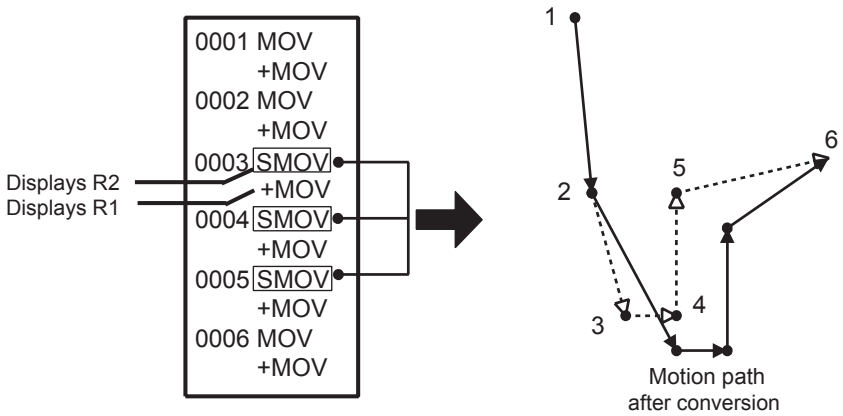
The base axis is shifted by B and the TCP of the manipulator is shifted by A in the user coordinates. These shifts are carried out independently.



■ Converting R*+R* Jobs with Master Tool Coordinates

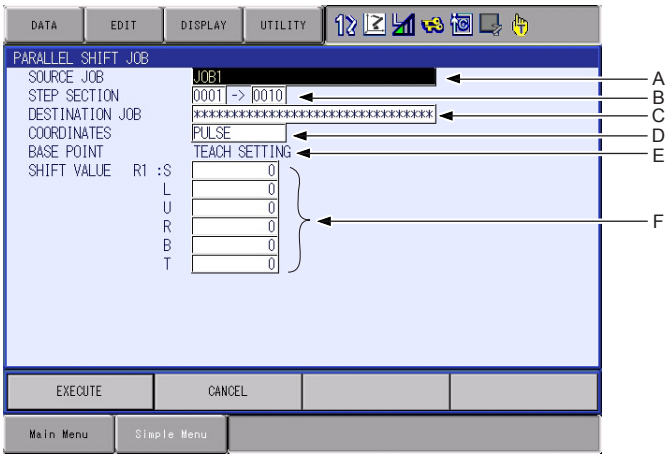
R*+R* coordinated jobs can be subjected to the parallel shift job conversion in the master tool coordinates. Only the steps taken at the “slave” from the standpoint of the SMOV instruction are subject to conversion (i.e. the steps of R2 in the figure below).





6.4.3 Executing the Parallel Shift Job Conversion

6.4.3.1 Window Display



A. SOURCE JOB

Selects the job before conversion. The job which is shown in the JOB CONTENT window is set initially. To change the job, perform the following procedure.
Move the cursor to the job name and press [SELECT]. The JOB LIST window appears. Select the desired job.

B. STEP SECTION (Start Step → End Step)

Specifies the step section of the source job. All the steps are set initially. If there is no step in the source job, "***" is displayed. To change the section, perform the following procedure.
Move the cursor to the step section indication and press [SELECT]. The input buffer line appears. Input the step number and press [ENTER].

C. DESTINATION JOB

Specifies the converted job. If this is not specified ("********" is displayed), the source job is overwritten with a job after conversion. If the converted job is specified, the source job is copied and converted. To change the job, perform the following procedure.
Move the cursor to the converted job name indication and press [SELECT]. The character input line appears. The source job name is displayed in the input line. To enter a job name without using the source job name, press [CANCEL] and then input a job name.

D. COORDINATES

Selects the conversion coordinates. Move the cursor to the coordinates name and press [SELECT]. The selection dialog box appears. Select the desired coordinates.
When the user coordinates are selected, the input buffer line appears. Input the desired user coordinate number and press [ENTER].

E. BASE POINT

Calculates the difference by the two teaching points as a shift value.

F. SHIFT VALUE

The axis shown is varied according to the setting of “4. coordinates” above.

Move the cursor to the input box and press [SELECT] to directly input the shift value.

If the shift value is calculated by the two teaching points, the difference is shown as a shift value.

6.4.3.2 Parallel Shift Job Conversion Operation

There are two methods for specifying the shift value.

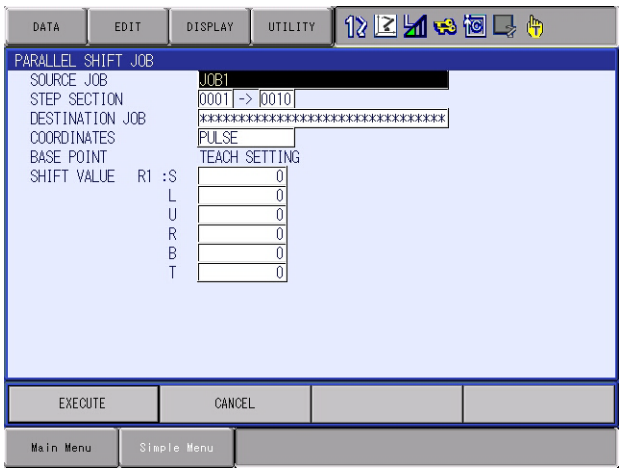
- Directly input the shift value by numerical value.
- Calculate the shift value by teaching the original base point and converted base point.

> SUPPLE-MENT
> The method using position variables by parameter setting is described in *section 6.4.4 "Specifying the Shift Value by Position Variables" on page 6-39* other than above two methods.

The following are the operation procedures by each setting of shift value for parallel shift job conversion.

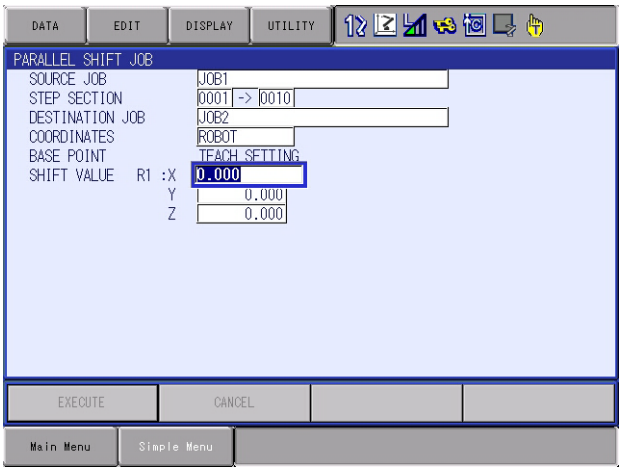
■ Numerical Value Input

1. Select {JOB} under the main menu.
2. Select {JOB}.
   – The JOB CONTENT window appears.
3. Select {UTILITY} under the pull-down menu.
4. Select {PARALLEL SHIFT JOB}.
   – The PARALLEL SHIFT JOB window appears.

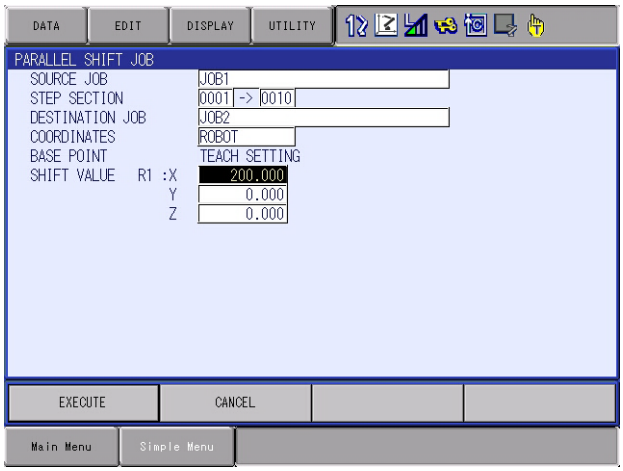


5. Specify the conversion items.
   – Specify each item.

6. Select the shift value to be set.
   – The number can be entered.

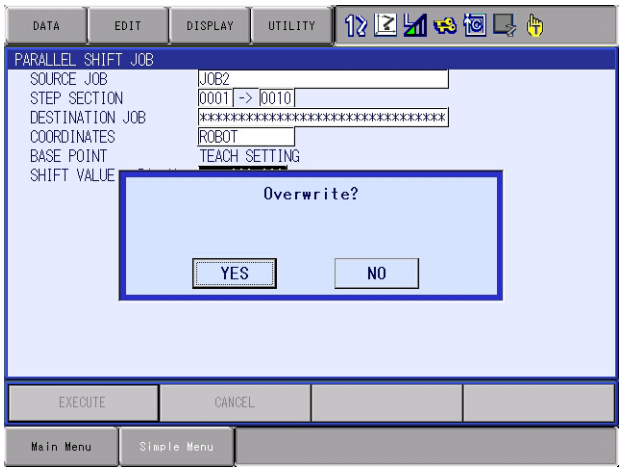


7. Type the shift value using the Numeric keys.
8. Press [ENTER].
   – The shift value is set.



9. Display the PARALLEL SHIFT JOB window. Select “EXECUTE”.
   – The confirmation dialog box appears when the converted job is not specified. Select “YES” then the conversion is executed.
   – The JOB CONTENT window appears when the conversion is completed.

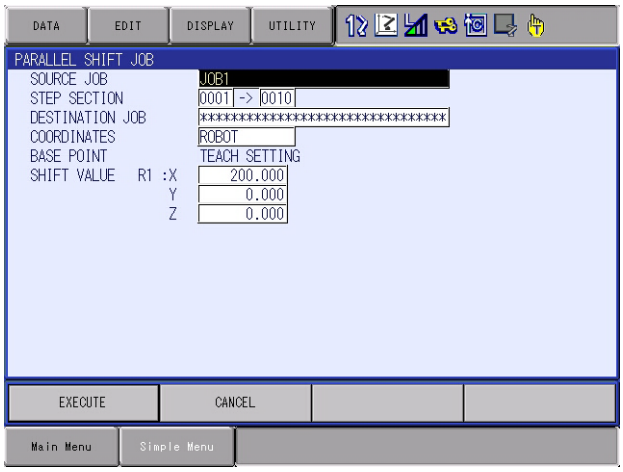
– When “CANCEL“ is selected, the display goes back to the JOB CONTENT window without executing conversion.



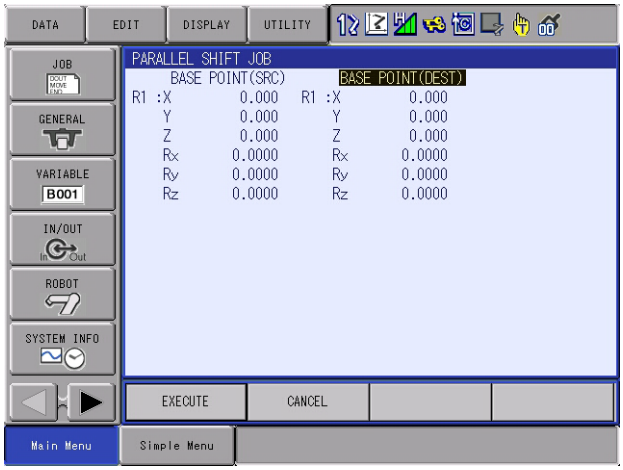
NOTE If an alarm occurs during conversion, conversion is suspended.

■ Calculation by Teaching

1. Select {JOB} under the main menu.
2. Select {JOB}.
   – The JOB CONTENT window appears.
3. Select {UTILITY} under the pull-down menu.
4. Select {PARALLEL SHIFT JOB}.
   – The PARALLEL SHIFT JOB window appears.

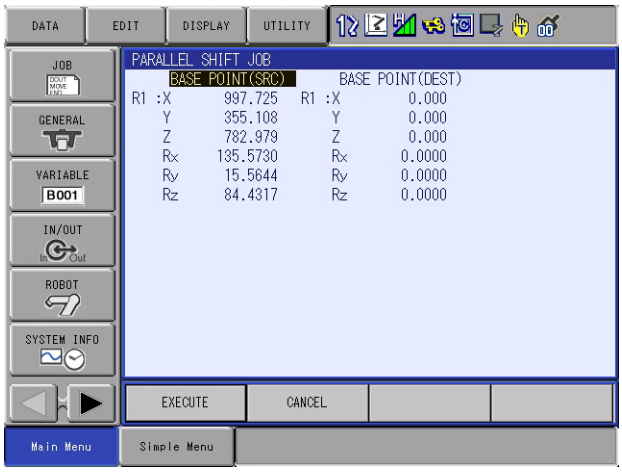


5. Specify the conversion items.
   – Specify each item.
6. Display the PARALLEL SHIFT JOB window. Select “TEACH SETTING” in the item of “BASE POINT”.
   – The BASE POINT window appears.

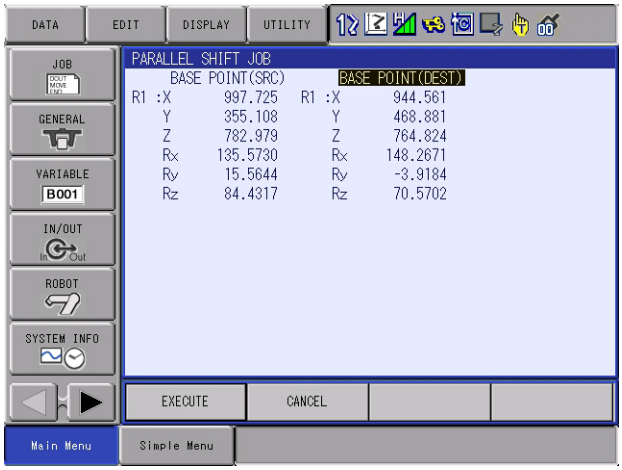


7. Select “BASE POINT(SRC)”.
8. Move the manipulator to the original base point by the axis keys.

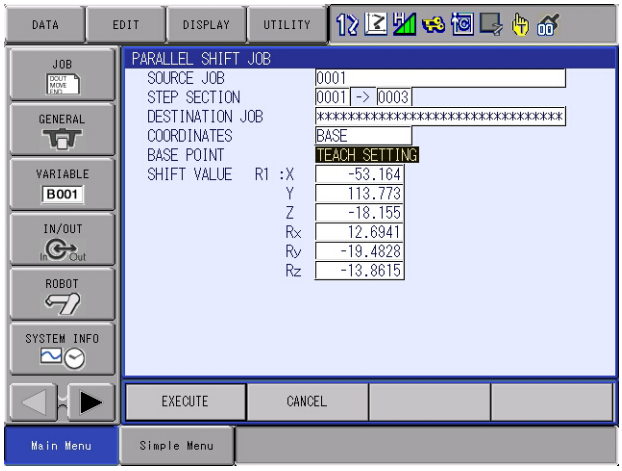
9. Press [MODIFY] and [ENTER].
   – The original base point is set.



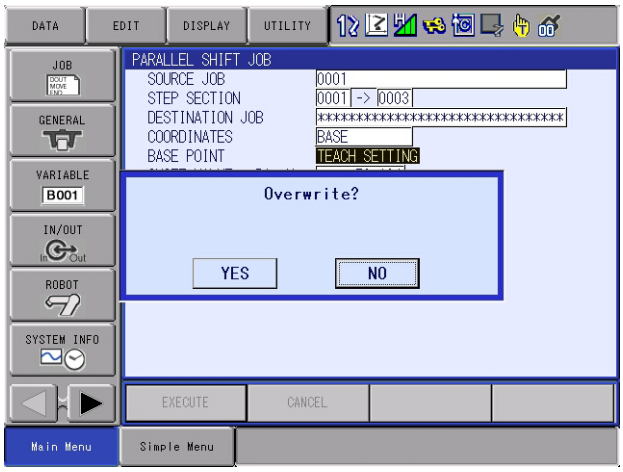
10. Select “BASE POINT(DEST)”.
11. Move the manipulator to the converted base point by the axis keys.
12. Press [MODIFY] and [ENTER].
   – The conversion base point is set.



13. Touch “EXECUTE”.
   – The difference is calculated by the two teaching points and set as a shift value.



14. Display the PARALLEL SHIFT JOB window. Select “EXECUTE”.
    - The confirmation dialog box appears when the converted job is not specified. Select “YES” then the conversion is executed.
    - The JOB CONTENT window appears when the conversion is completed.
    - When “CANCEL“ is selected, the display goes back to the JOB CONTENT window without executing conversion.



If an alarm occurs during conversion, conversion is suspended.

6.4.4 Specifying the Shift Value by Position Variables

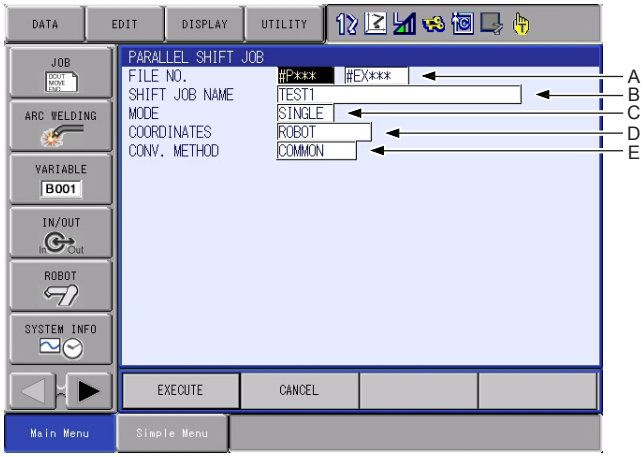
The shift value can be specified using position variables by parameter settings.

Parameter S2C652: SHIFT VALUE FOR PARALLEL SHIFT JOB CONVERSION

0: Shift value by numeral/teaching (Initial setting)

1: Position variable shift value

6.4.4.1 Window Display



A. FILE NO.

Specifies position variables.

B. SHIFT JOB NAME

The job which was shown in the JOB CONTENT window is set initially. To change the job, perform the following procedure.
Move the cursor to the conversion job name and press [SELECT]. The JOB LIST window appears. Move the cursor to the desired job and press [SELECT]. The PARALLEL SHIFT JOB window reappears, and the job name which was selected is shown.

C. MODE

Specifies the conversion mode.
SINGLE (INDEPENDENT JOB CONVERSION)
Only the selected job is converted even if the selected job includes the jobs called by JUMP or CALL instructions. Related jobs are not converted.
RELATIVE (RELATIVE JOB CONVERSION)
Both the selected job and all the related jobs (the jobs called by JUMP or CALL instructions) are converted.
For details of each conversion mode, refer to *section 6.4.4.2 “Jobs Targeted for Conversion”* .

D. COORDINATES

Selects the conversion coordinates.
Move the cursor to the coordinates name and press [SELECT]. The selection dialog box appears. Select the desired coordinates.
When the user coordinates are selected, the input buffer line appears. Input the desired user coordinate number and press [ENTER].

E. CONV. METHOD

Specifies the conversion methods of related jobs such as a coordinated job with two manipulators or the system with multiple stations.

COMMON (COMMON SHIFT)

All the manipulators (or all the bases, or all the stations) are converted by the same shift value.

EACH (INDIVIDUAL SHIFT)

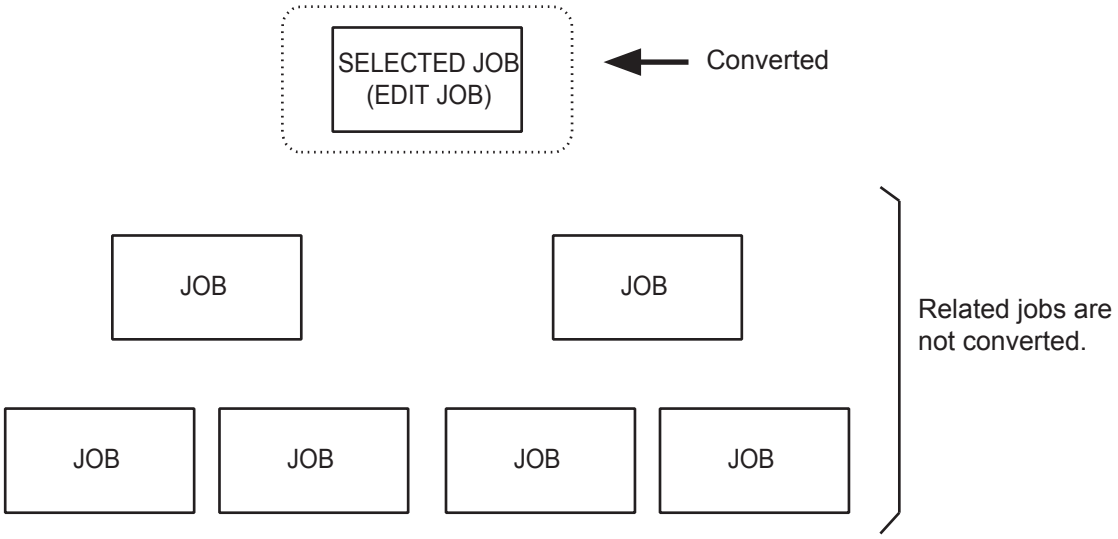
Each manipulator (or each base, or each station) is converted separately by different shift values.

For details of each conversion method, refer to *section 6.4.4.3 “Conversion of Coordinated Jobs” on page 6-42*.

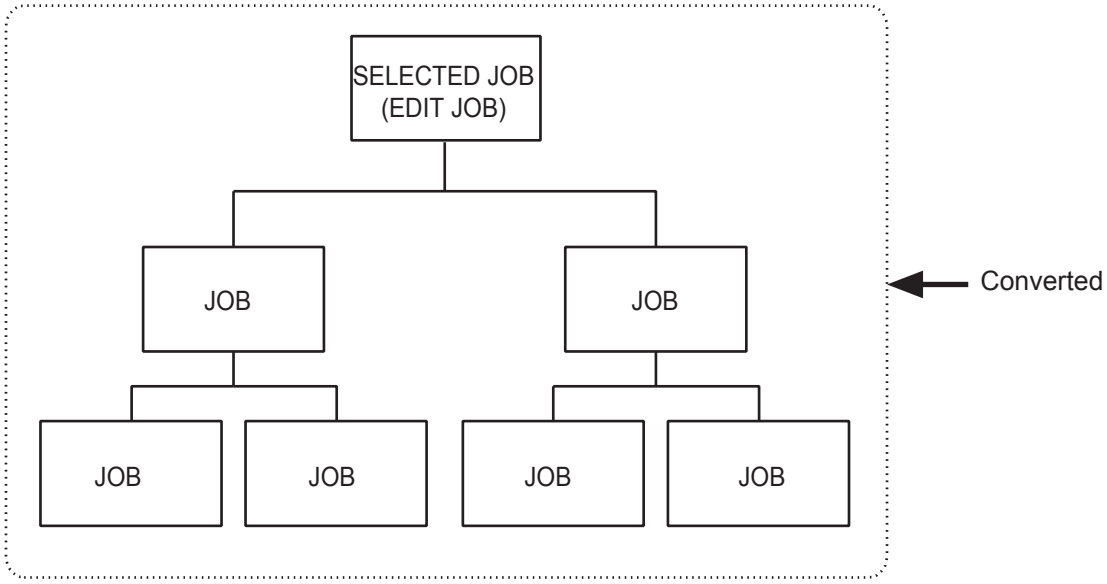
6.4.4.2 Jobs Targeted for Conversion

There are two ways to specify the job to be converted as described in the following:

- Independent Job Conversion
  Only the selected job is converted even if the selected job includes the jobs called by JUMP or CALL instructions. Related jobs are not converted.



- Related Job Conversion
  Both the selected job and all the related jobs (the jobs called by JUMP or CALL instructions) are converted.

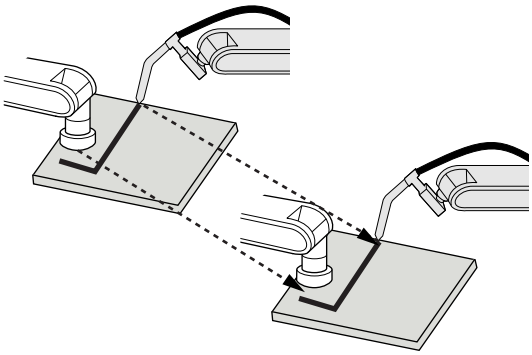


6.4.4.3 Conversion of Coordinated Jobs

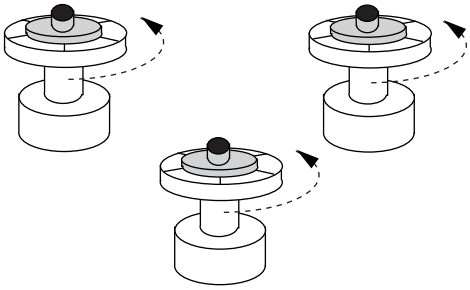
There are two ways to convert a related job such as a coordinated job with two manipulators or the system with multiple stations as described in the following:

- **Common Shift**
  All the manipulators (or all the bases, or all the stations) are converted by the same shift value.

Coordinated job with R1+R2

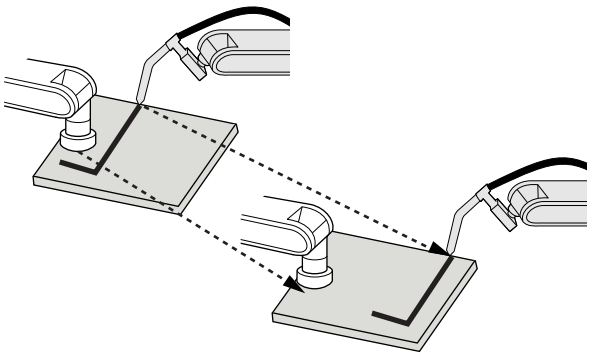


The system with multiple stations

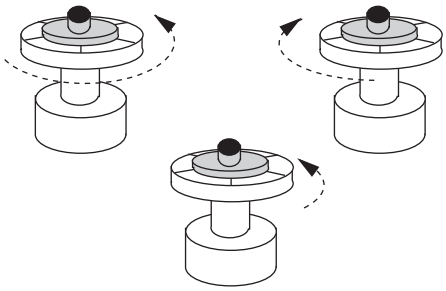


- **Individual Shift**
  Each manipulator (or each base, or each station) is converted separately by different shift values.

Coordinated job with R1+R2



The system with multiple stations



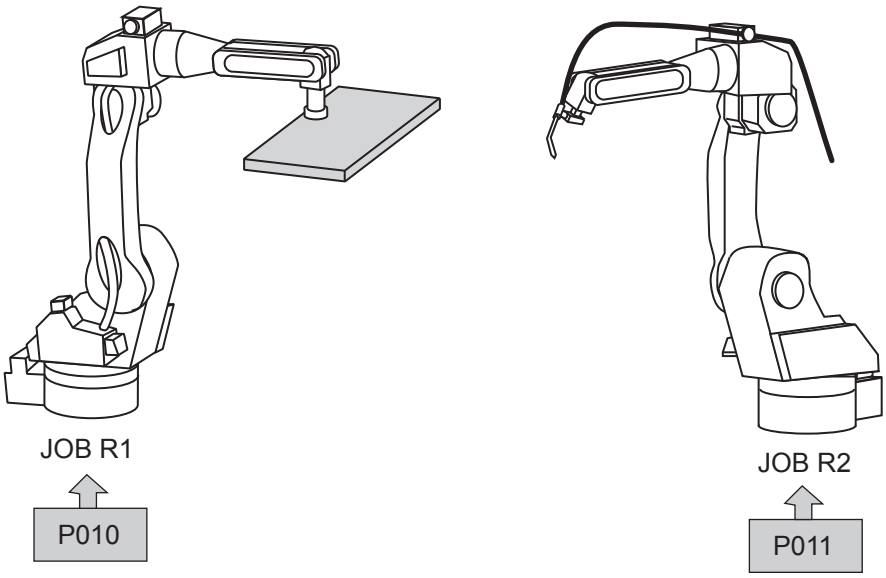
■ **Variables used in an individual shift**

> **NOTE** Be sure to use the variables of which numbers are consecutive after the selected number. The variables of which numbers are not consecutive are unable to be selected.

Example 1) When selecting P010 for a coordinated job with R1 + R2:

Use P010 for R1.

Use P011 for R2.



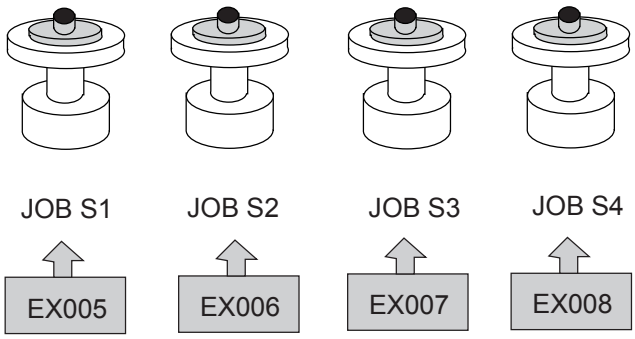
Example 2) When selecting EX005 for multiple jobs with four stations:

Use EX005 for S1.

Use EX006 for S2.

Use EX007 for S3.

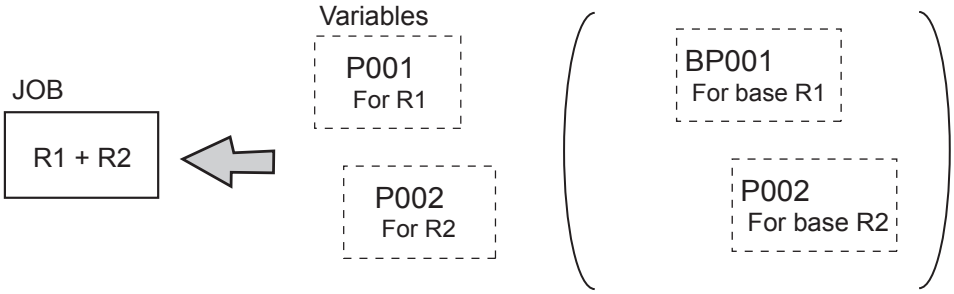
Use EX008 for S4.



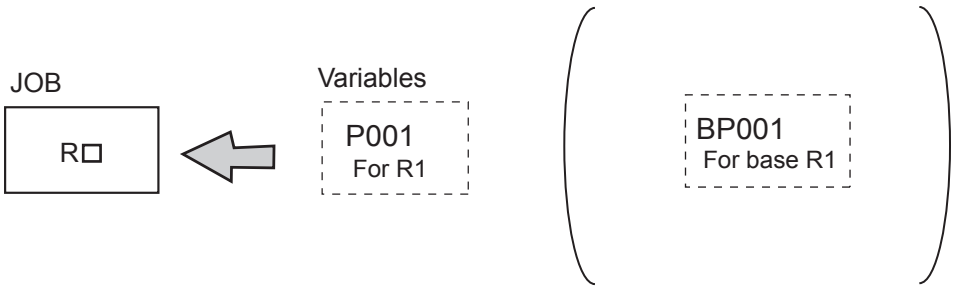
■ **Relation between variables and jobs for conversion in an individual shift**

■ **In the case of independent job conversion:**

- Coordinated job with R1 + R2
  Different shift values can be set for each manipulator and base.

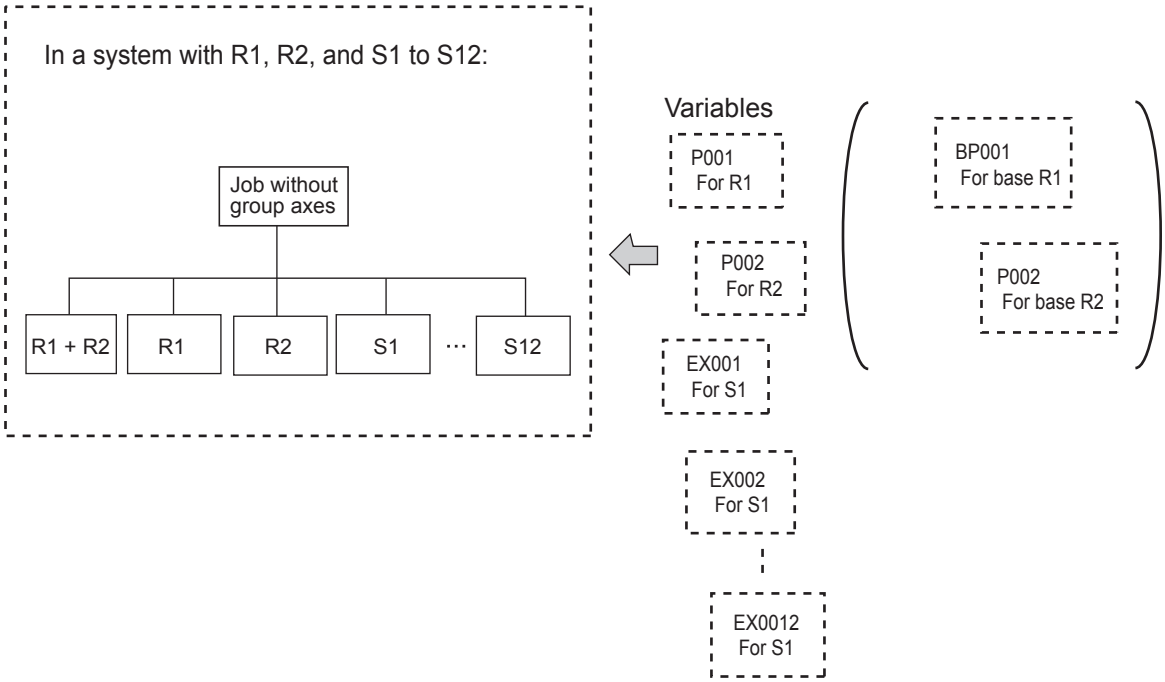


- Job with R□ (+ S□)
  Use one variable for a job with one manipulator.



■ **In the case of related job conversion:**

- Different shift values can be set for each manipulator, base, and station.

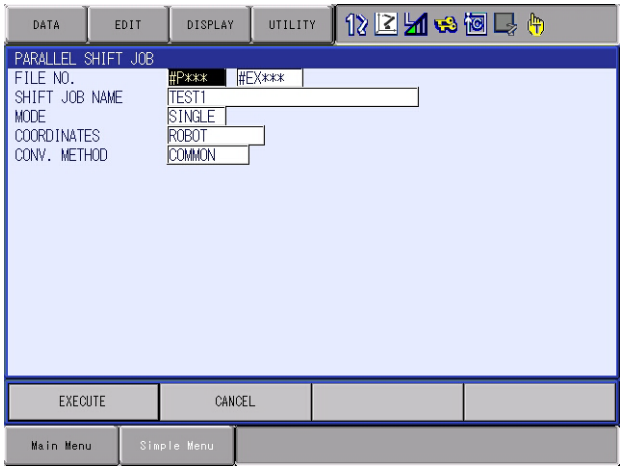


6.4.4.4 Operation Procedure

The following is the operation procedure for the parallel shift job conversion using position variables.

1. Set the parameter.
   - Set the parameter S2C652 (SHIFT VALUE FOR PARALLEL SHIFT JOB CONVERSION) to 1 (Position variable shift value).
2. Set the position variable.
   - Specify a position variable in advance when setting a shift value by position variables.
   - For the setting of position variables, refer to *section 3.9.4 “User Variables” on page 3-77*.
3. Select {JOB} under the main menu.
4. Select {JOB}.
   - The JOB CONTENT window appears.
5. Select {UTILITY} under the pull-down menu.

6. Select {PARALLEL SHIFT JOB}.
   – The PARALLEL SHIFT JOB window appears.



7. Specify the conversion items.
   – Specify each item.
8. Select “EXECUTE”.
   – Select “EXECUTE” then the parallel shift job conversion is executed. The JOB CONTENT window appears when the conversion is completed.
   – When “CANCEL“ is selected, the display goes back to the JOB CONTENT window without executing conversion.

NOTE If an alarm occurs during conversion, conversion is suspended.

NOTE Specify the position variable in advance when using the setting value as a shift value.

6.5 PAM Function

6.5.1 Function Overview

The function for position adjustment during playback (PAM: Position Adjustment by Manual) allows position adjustment by simple operations while observing the motion of the manipulator and without stopping the manipulator. Positions can be adjusted in both teach mode and play mode.

The following data can be adjusted by key input from the programming pendant.

- Teaching Point (Position)
- Teaching Point (Posture angle)
- Operation Speed
- Position Level

6.5.1.1 Input Ranges for Adjustment Data

The input ranges for adjustment data are indicated in the following table.

Data	Input Range
Number of Steps for Adjustment	Up to 10 steps can be adjusted at the same time.
Position Adjustment Range (X, Y, Z)	Unit: mm, valid to two decimal places, maximum ±10 mm
Posture Angle Adjustment Range (Rx, Ry, Rz)	Unit: deg, valid to two decimal places, maximum ±10 deg
Speed Adjustment Range (V)	Unit: %, valid to two decimal places, maximum ±50%
PL Adjustment Range	0 to 8
Adjustment Coordinates	Robot coordinates, base coordinates, tool coordinates, user coordinates (Default coordinates: robot coordinates)

SUPPLE-MENT

The input ranges for adjustment data can be changed by the following parameters:

- S3C1098: Position adjustment range (unit: 0.001 mm)
- S3C1099: Speed adjustment range (unit: 0.01%)
- S3C1100: Adjustment coordinate specification
- S3C1102: Posture angle adjustment range (unit: 0.01 deg)

For details, refer to *chapter 8 "Parameter"*.

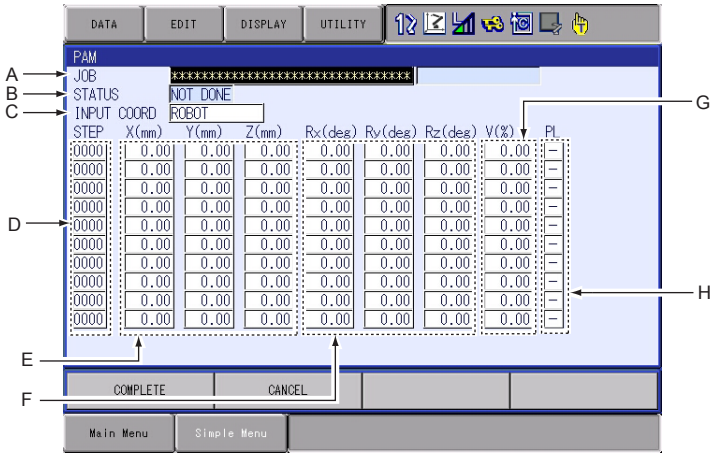
NOTE

- Base axis and station axis data cannot be adjusted.
- Adjustment when a TCP instruction is executed is performed by adjusting the data of the selected tool.
- When the coordinates for adjustment are user coordinates, an error occurs if teaching has not been performed in the user coordinates.
- If an attempt is made to adjust “PL” when there is no “PL” in the step subject to the adjustment, an error occurs.
- Position variable and reference point steps cannot be adjusted. An error occurs if adjustment is attempted.
- An attempt to adjust the speed at the step that has no speed tag causes an error.

6.5.2 Operating Methods

6.5.2.1 Setting Adjustment Data

1. Select {JOB} under the main menu.
2. Select {JOB}.
   – The JOB CONTENT window (in the teach mode) or the PLAYBACK window (in the playback mode) appears.
3. Select {UTILITY} under the pull-down menu.
4. Select {PAM}.
   – The PAM window appears.



5. Set adjustment data.
   – Set adjustment data.
   – **A. Job**
     Set the job name to be adjusted.
     Line up the cursor and press [SELECT] to display the JOB LIST window.
     Move the cursor to the desired job and press [SELECT] to set the adjusted job.
   – **B. Status**
     Shows the status of adjustment in the PAM function.
     “NOT DONE” appears when adjustment is not executed. “DONE” appears when the execution of adjustment is completed.
   – **C. Input Coord**
     Set the desired coordinates.
     Line up the cursor and press [SELECT] to display the selection dialog box.
     Move the cursor to the desired coordinate system and press [SELECT] to set the input coordinates.
   – **D. Step Number**
     Set the step number to be adjusted.
     Line up the cursor and press [SELECT] to display the number input buffer line.
     Input the step number and press [ENTER] to set the value.
   – **E. 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 display the number input buffer line.
Input the number data and press [ENTER] to set the adjusted data.

– **F. Rx, Ry, Rz Coordinate Adjustment**
Set the direction and amount of the Rx, Ry and Rz posture angles.
Line up the cursor with the data to be adjusted and press [SELECT] to display the number input buffer line.
Input the number data and press [ENTER] to set the adjusted data.

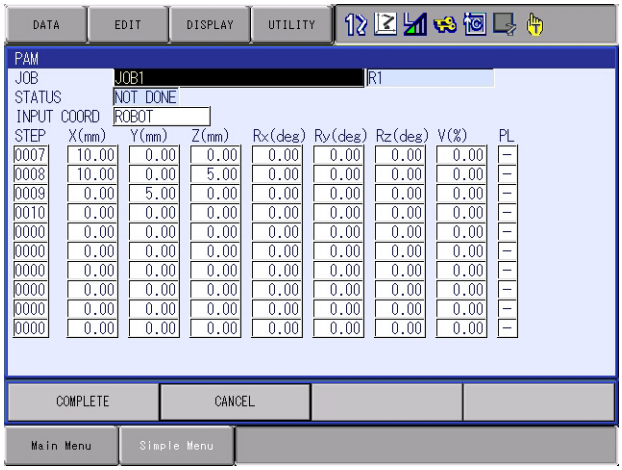
– **G. V Coordinate Adjustment**
Set the speed.
Line up the cursor and press [SELECT] to display the number input buffer line.
Input the number data and press [ENTER] to set the adjusted data.

– **H. PL**
The position level of the job to be adjusted for the step set in “4. Step Number” is displayed, and the data can be modified.
When the position level is not decided, [-] is displayed, and cannot be set.
To modify the position level, line up the cursor, press [SELECT], input the number value and press [ENTER].

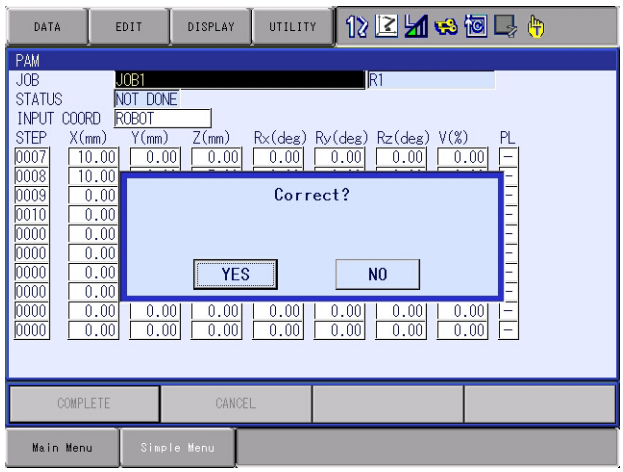
6.5.2.2 Executing the Adjustment

■ Executing the Adjustment

1. Touch “COMPLETE” on the screen.
   – The confirmation dialog box appears.



2. Select “YES”.
   – 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 window is cleared. However, if the step’s adjusted position exceeds the software limit, an error occurs, and the data in only that step cannot be cleared on the window.



■ Cancelling the Execution

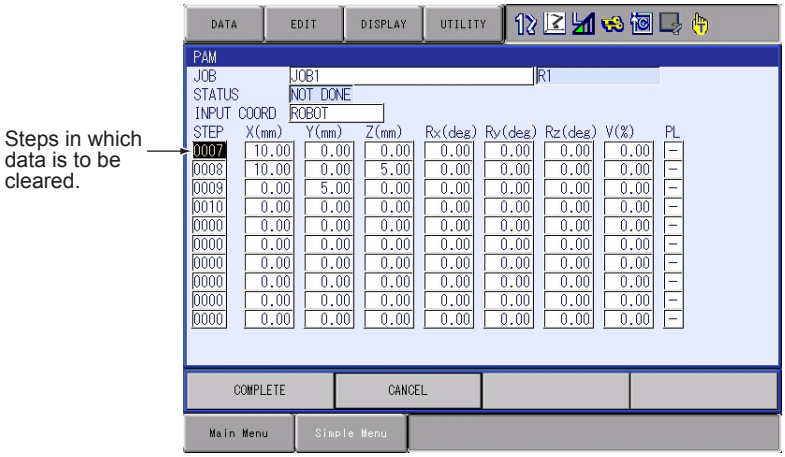
In the play mode, during the adjustment wait status, “STOP” is displayed in the PAM window. To cancel the adjustment process, touch “STOP” on the screen. Also, if the following occurs before executing, the process is automatically cancelled.

- If the mode is changed
- If an alarm occurs
- If the power is turned OFF

■ Clearing Data

If there is a mistake made when adjusting the data, or if the adjustment of the step becomes unnecessary, the data can be cleared.

1. Move the cursor to the step of the data to be cleared.

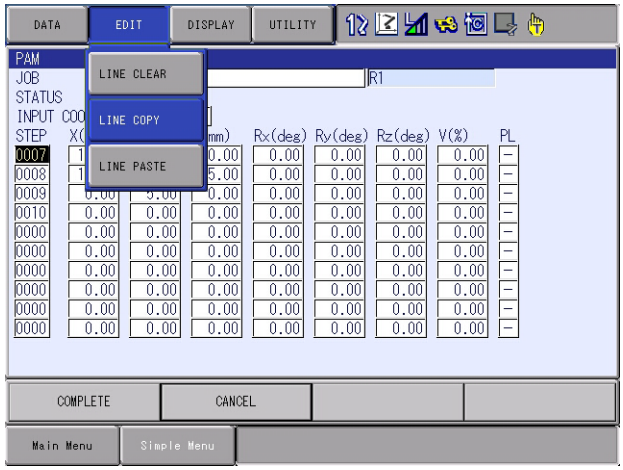


2. Select {EDIT} under the pull-down menu.
3. Select {LINE CLEAR}.
   – The line data is cleared.

■ Copying Data

To input the same data as those set previously, perform the following operation.

1. Move the cursor to the line to be copied.
2. Select {EDIT} under the menu.
   – The pull-down menu appears.



3. Select {LINE COPY}.
4. Move the cursor to the line where the item is to be copied.
5. Select {EDIT} under the menu.
6. Select {LINE PASTE}.
   – The desired data is copied to the line.
   – However, if the line where the data is to be copied does not have a speed value or PL value, it cannot be copied.

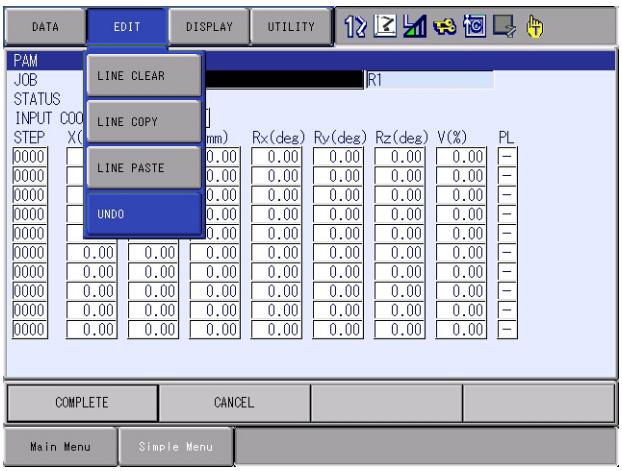
■ Canceling the Adjustment

After the position adjustment in the PAM function, the job can be returned to the status before adjustment only during teaching. In this case, follow the procedures below.

Note that the job cannot be undone during playback.

1. Move the cursor to the line to be copied.
   – After the position adjustment, the status shows “DONE”.

2. Select {EDIT} under the menu.
   – The pull-down menu appears.



3. Select {UNDO} under the pull-down menu.
   – The confirmation dialog box appears.

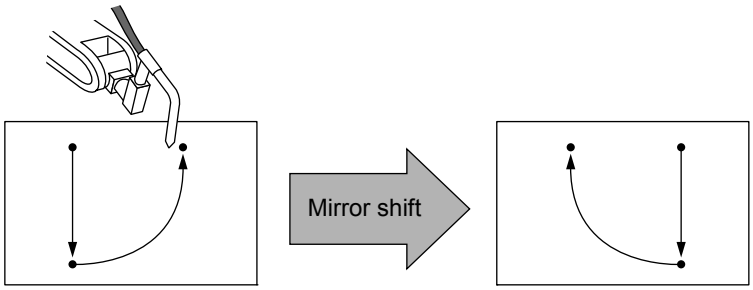
4. Select “YES“
   – The status turns “NOT DONE“ and the job is undone when selecting “YES“. The status does not change and the job is not undone when selecting “NO”.

6.6 Mirror Shift Function

6.6.1 Function Overview

With the mirror shift function, a job is converted to the job in which the path is symmetrical to that of the original job. This conversion can be performed for the specified coordinate among the X-Y, X-Z, or Y-Z coordinate of the robot coordinates and the user coordinates.

The mirror shift function is classified into the following three: the pulse mirror-shift function, the robot-coordinates mirror-shift function, and the user-coordinates mirror-shift function.

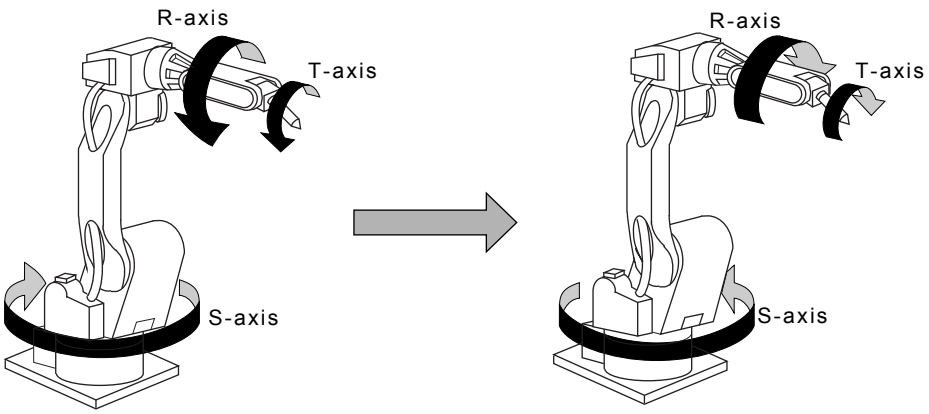


The original path before the mirror shift

The converted path after the mirror shift

6.6.2 Pulse Mirror-shift Function

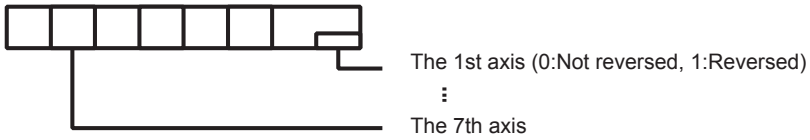
With the pulse mirror-shift function, the mirror shift is performed by reversing the sign (+/-) for the axes which are specified with the parameter in advance.



6.6.2.1 Parameter Setting

Using the following parameter, specify the axes for which the sign is to be reversed.

S1CxG065: Mirror Shift Sign Reversing Axis Specification



6.6.2.2 Object Job

Jobs without group axes and relative jobs cannot be converted.

6.6.2.3 Group Axes Specification

When specifying the group axes for the converted job in a multiple group axes system, the group axes specified in the original and converted jobs must be the same.

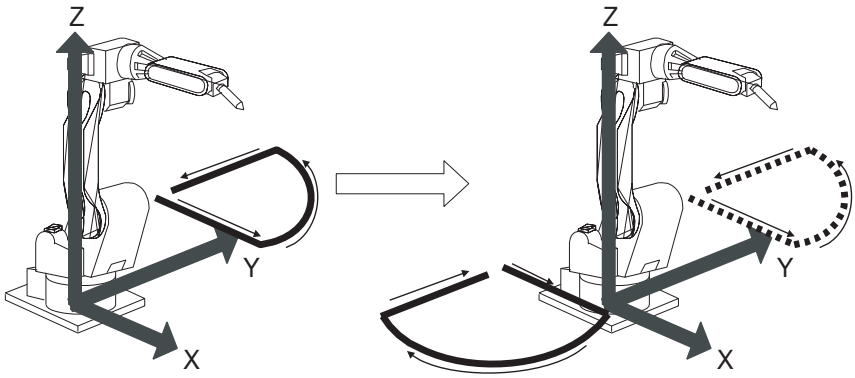
- Robot Axis: Same model
- Base Axis: Same configuration
- Station Axis: Same configuration

6.6.2.4 Position Variables

Position variables are not converted by the mirror shift function.

6.6.3 Robot-coordinates Mirror-shift Function

With the robot-coordinates mirror-shift function, the mirror shift is performed on the X-Z coordinate of the robot coordinates.



6.6.3.1 Object Job

Jobs without group axes cannot be converted.

6.6.3.2 Group Axes Specification

When specifying the group axes for the converted job in a multiple group axes system, the group axes specified in the original and converted jobs must be the same.

- Robot Axis: Same model
- Base Axis: Same configuration
- Station Axis: Same configuration

6.6.3.3 Position Variables

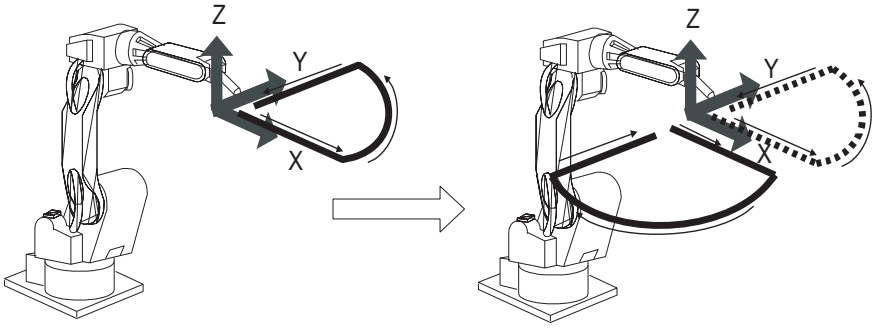
Position variables are not converted by the mirror shift function.

NOTE

- Mirror shift conversion for the base axis is not performed with the robot-coordinates mirror shift function.
- With the robot-coordinates mirror shift function, mirror shift conversion for the station axis is performed by reversing the sign for the axes specified with the parameter S1CxG065 "Mirror Shift Sign Reversing Axis Specification" .

6.6.4 User-coordinates Mirror-shift Function

With the user-coordinates mirror-shift function, the mirror shift is performed on the X-Z, X-Y, or Y-Z coordinate of the specified user coordinates.



6.6.4.1 Object Job

Jobs without group axes cannot be converted.

6.6.4.2 Group Axes Specification

When specifying the group axes for the converted job in a multiple group axes system, the group axes specified in the original and converted jobs must be the same.

- Robot Axis: Same model
- Base Axis: Same configuration
- Station Axis: Same configuration

6.6.4.3 Position Variables

Position variables are not converted by the mirror shift function.

NOTE

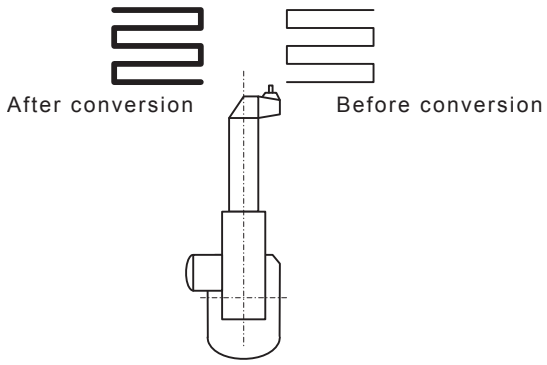
With the user-coordinates mirror shift function, mirror shift conversion for the station axis is performed by reversing the sign for the axes specified with the parameter S1CxG065 "Mirror Shift Sign Reversing Axis Specification".

6.6.5 Notes on the Mirror Shift Function

For manipulators, such as a polishing wrist, whose center of S-axis rotation and T-axis rotation are offset in the X-coordinate direction, the mirror shift cannot correctly be performed by the pulse mirror-shift function. Be sure to use the robot-coordinates mirror-shift function or use the user-coordinates mirror-shift function with the user coordinates specified on the center of the T-axis rotation.

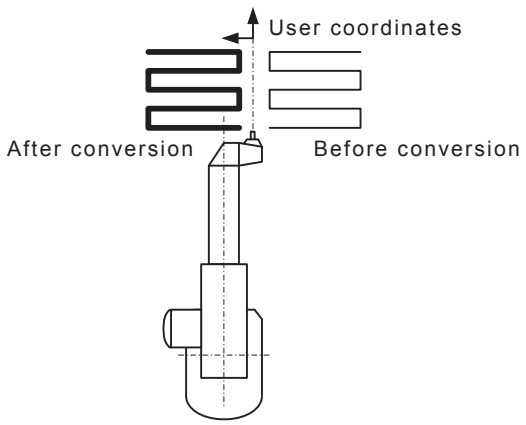
(1) Using the Robot-coordinates Mirror-shift Function
When the robot-coordinates mirror-shift function is performed, the mirror shift is performed on the X-Z coordinate of the robot coordinates. The path of the converted job is as follows:

Robot-coordinates Mirror-shift Conversion



(2) Using the User-coordinates Mirror-shift Function
To use the user-coordinates mirror-shift function, specify the user coordinates on the center of T-axis rotation in advance.

User-coordinates Mirror-shift Conversion



6.6.6 Operation Procedures

6.6.6.1 Calling Up the JOB CONTENT Window

Call up the JOB CONTENT window of the job to be converted as follows:

■ **For Current Job**

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

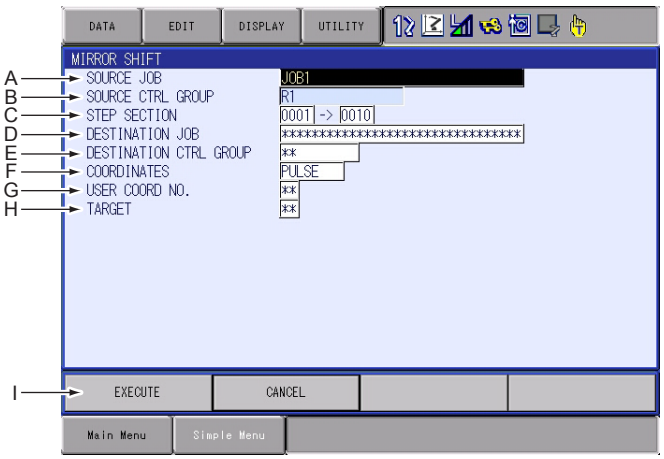
■ **For Another Job**

1. Select {JOB} under the main menu.
2. Select {SELECT JOB}.
   – The JOB LIST window appears.
3. Select the desired job.

6.6.6.2 Mirror Shift Conversion

1. Display the JOB CONTENT window.
2. Select {UTILITY} under the pull-down menu.
   – The MIRROR SHIFT window appears.
3. Select {MIRROR SHIFT}.
   – The MIRROR SHIFT window appears.

6.6.6.3 Explanation of the Mirror Shift Window



A. SOURCE JOB

Selects the conversion source job.
To select another job to be converted, move the cursor to the name and press [SELECT] to call up the list of jobs. Select the desired job and press [SELECT].

B. SOURCE CTRL GROUP

Displays the control group of the conversion source job.

C. STEP SELECTION

Specifies the steps to be converted. From the first step to the last step of the selected job are specified as initial value.

D. DESTINATION JOB

Specifies the converted job name. To enter the name, move the cursor to the name and press [SELECT]. The name of the conversion source job is displayed in the input line as initial value. When "***" is displayed, the name for the converted job is to be the same as that of the conversion source job.

E. DEST CTRL GROUP

Selects the control group for the converted job. When the destination job name is entered, the same control group as the conversion source job is automatically set. To change it, move the cursor to the control group and press [SELECT] to call up the selection dialog box.

F. COORDINATES

Specifies the coordinates used for conversion.
"PULSE": Executes the pulse mirror-shift conversion.
"ROBOT": Executes the mirror-shift conversion on the basis of the cartesian coordinates.
"USER": Executes the mirror-shift conversion on the basis of the specified user coordinates.

G. USER COORD NO.

Specifies the user coordinates number when "USER" is selected in “6. COORDINATES”.
This item cannot be set when "PULSE" or "ROBOT" is selected in “6. COORDINATES”.

H. TARGET

Specifies the coordinate where conversion is to be done when "ROBOT" or "USER" is selected in “6. COORDINATES”. "XY", "XZ", or "YZ" can be selected. Always specify "XZ" for "ROBOT".

I. EXECUTE

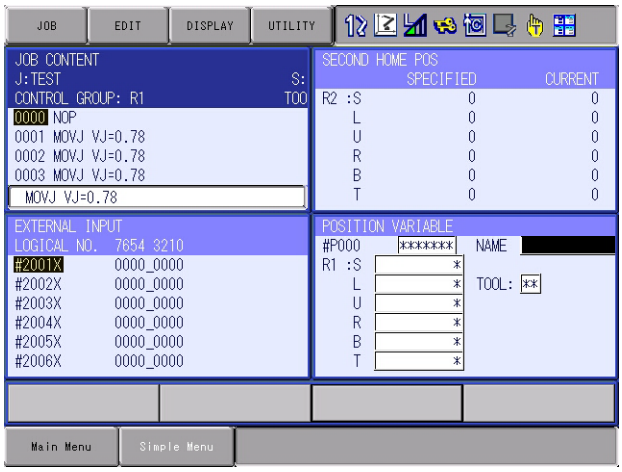
Mirror shift conversion is executed when pressing “EXECUTE” or [ENTER]. A job is created with the name of conversion source job when a job after conversion is not entered.

6.7 Multi Window Function

6.7.1 Function Overview

Multi window function divides the general-purpose display area up to 4 windows and shows them simultaneously.

There are seven dividing patterns to be optionally choose as necessary.



6.7.2 Setting the Dividing Pattern of the General-Purpose Display Area

The dividing pattern of the general purpose display area can be changed in the window exclusive for setting.

Table 6-3: Display the dividing Pattern (Sheet 1 of 2)

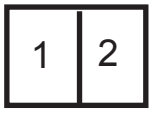
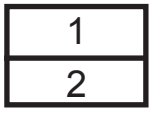
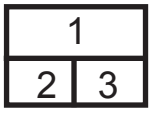
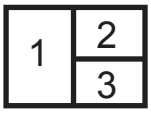
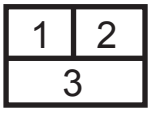
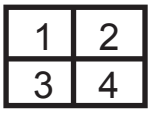
	Number of the window	Dividing Pattern
1	1 window	
2	2 windows	
3	2 windows	
4	3 windows	

Table 6-3: Display the dividing Pattern (Sheet 2 of 2)

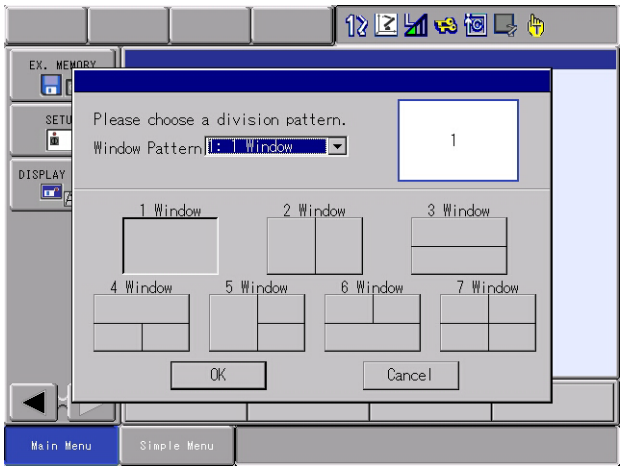
	Number of the window	Dividing Pattern
5	3 windows	
6	3 windows	
7	4 windows	

6.7.2.1 Calling Up and Operating Methods of the Display Dividing Pattern Setting Window

Call up the dividing pattern setting window.

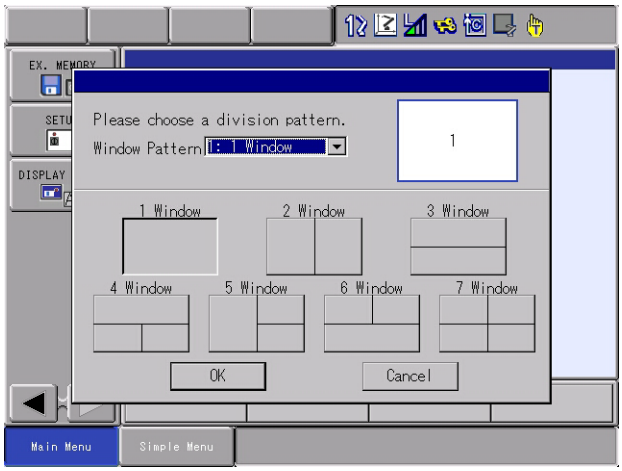
1. Select [DEIPLAY SETUP] -[CHANGE WINDOW PATTERN] under the main menu.

2. Dividing pattern setting window appears in the center of the display.

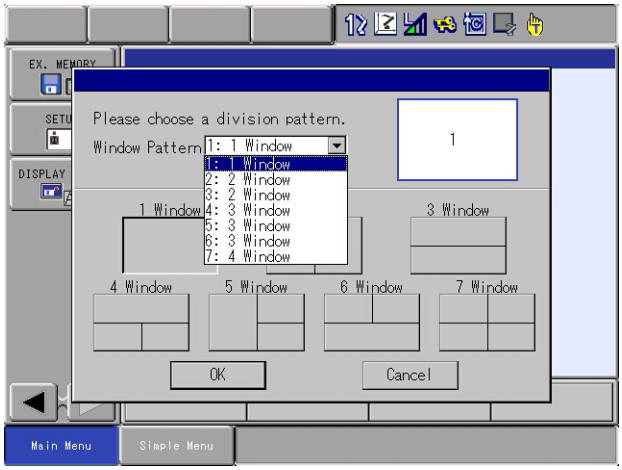


In the dividing pattern setting window, set the dividing pattern of the general-purpose display area.

1. Key operation 1:
   When “Window Pattern” is focused in the window, the option of the dividing pattern shifts as cursor moves upper or lower.
   – Choose the desired dividing patter from the “Window Pattern”.

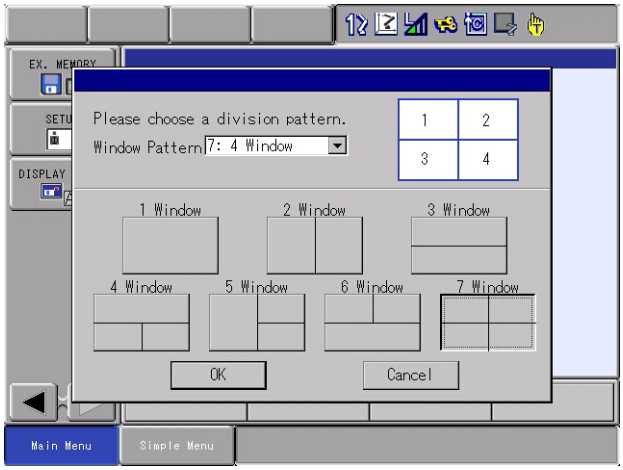


2. Key operation 2:
   Press Select key when “Window Pattern” is focused. The list of the dividing patterns appears. The list closes and a pattern is set after choosing the desired pattern and press “Select” key.



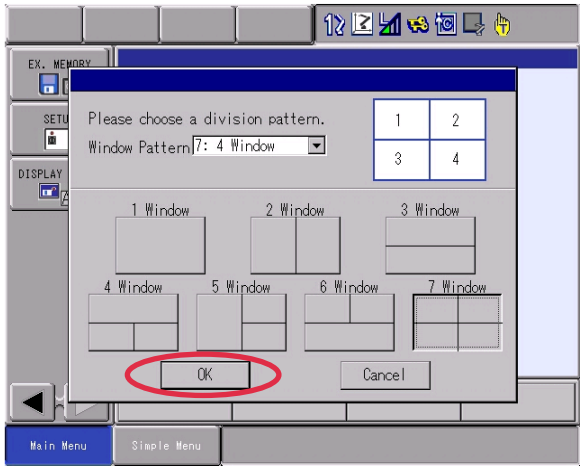
3. Touching operation:
   The desired pattern can be chosen by touching a pattern in the window.

   – Choose a pattern from the dividing pattern buttons.



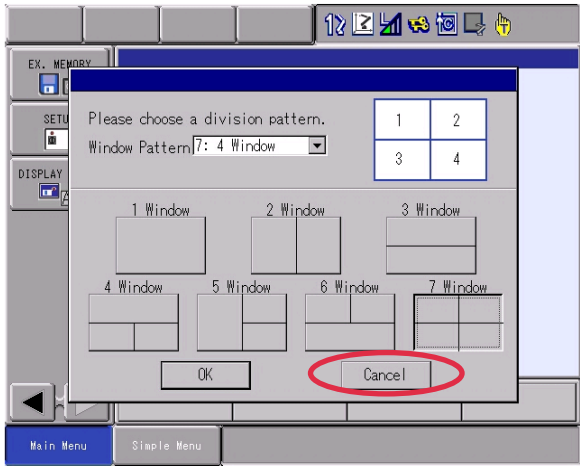
4. Touch [OK] button or move the cursor to it and press [SELECT] key.

   – The dividing pattern setting window closes and the chosen pattern (chosen with the procedure either 1, 2 or 3) appears.



Cancel the setting

1. Touch [CANCEL] button or move the cursor to it and press [SELECT] key.
   – Dividing pattern setting window closes. The dividing pattern in the general-purpose display area doesn't change.



SUPPLE-MENT

The cursor moves by pressing [AREA] key in the dividing pattern setting window.

6.7.3 Displaying the Multi Window

6.7.3.1 Multi Window Mode and Single Window Mode

Specifying more than two-window pattern in the dividing pattern setting window shows plural windows simultaneously in the general-purpose display area.

This is called multi window mode.

On the other hand, a single active window can be displayed with pressing [SHIFT] + [MULTI] key operation.

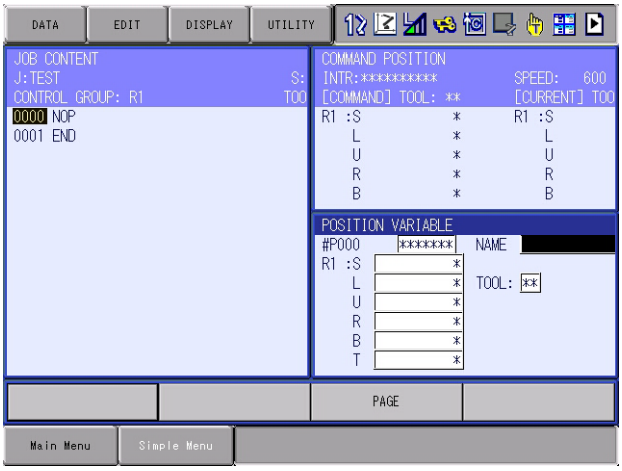
This is called single window mode.

Pressing [SHIFT] + [MULTI] key operation switches the display from single window mode to multi window mode. The mode can be changed as necessary.

6.7.3.2 Displaying the Status of Plural (more than two) Window Dividing Pattern Setting

When more than two windows are displayed as a desired pattern,

appears on the upper part of the window whereas it doesn't appear when a single window is displayed.



6.7.3.3 Displaying of Active Window and Non-Active Window

When a display is in the multi window mode, one window should be active and the rest is (are) non-active. The title of the active window is displayed in deep blue and non-active window is in light blue.

The active window is the subject of key operation.
Also, the menu area or the operational buttons under the general-purpose displaying area are displayed for the operation of the active window.

6.7.3.4 Limited Matters in Multi Window Mode

The content of window when it is in multi window mode can be different from the same window when it is in single window mode because of its limited size. The content becomes normal when the window is displayed in the single window mode.

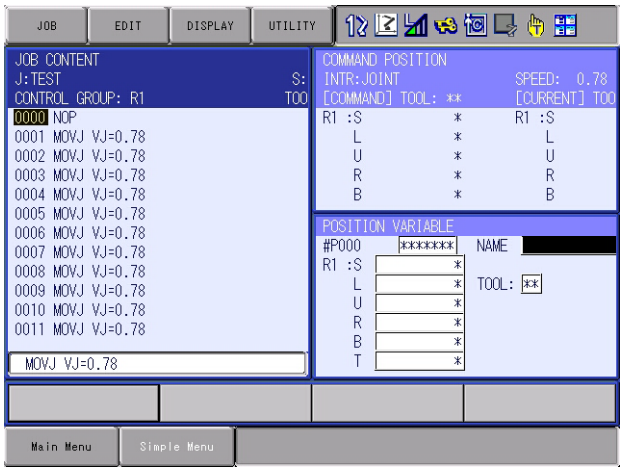
- The input buffer in the JOB window is displayed only when the window is active.
- No auxiliary window appears.

6.7.4 Operation of Multi Window

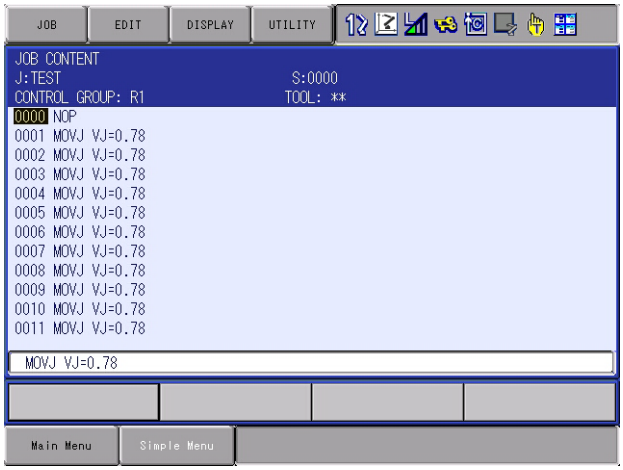
6.7.4.1 Switching of Multi Window Mode and Single Window Mode

When more than two windows are displayed as a dividing pattern of the multi window, it is possible to switch multi window mode to single window mode.

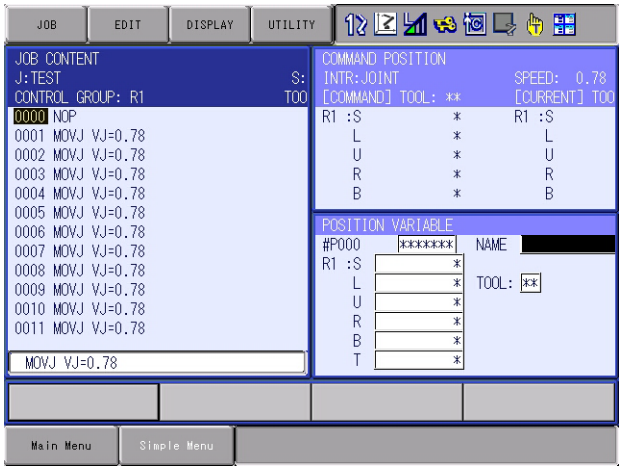
1. Set the mode of the general-purpose displaying area to multi window mode.



2. Press [SHIFT]+[MULTI] keys.
   – Active window is displayed under single window mode in the general-purpose window displaying area.



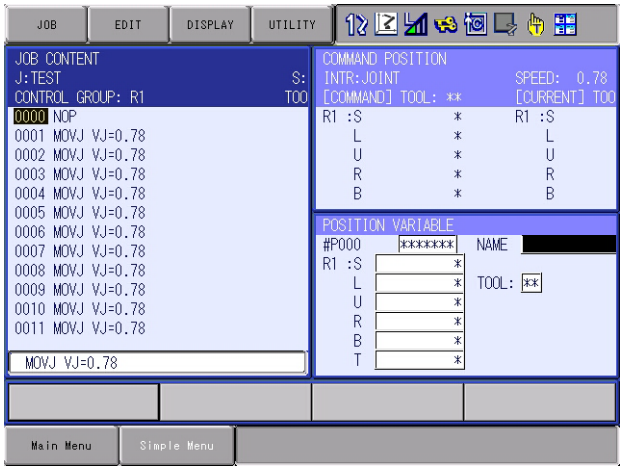
3. Press [SHIFT]+[MULTI] keys in step 2 status.
   – The general-purpose display area changes to already set pattern in multi window mode.



6.7.4.2 Switching of Active Window

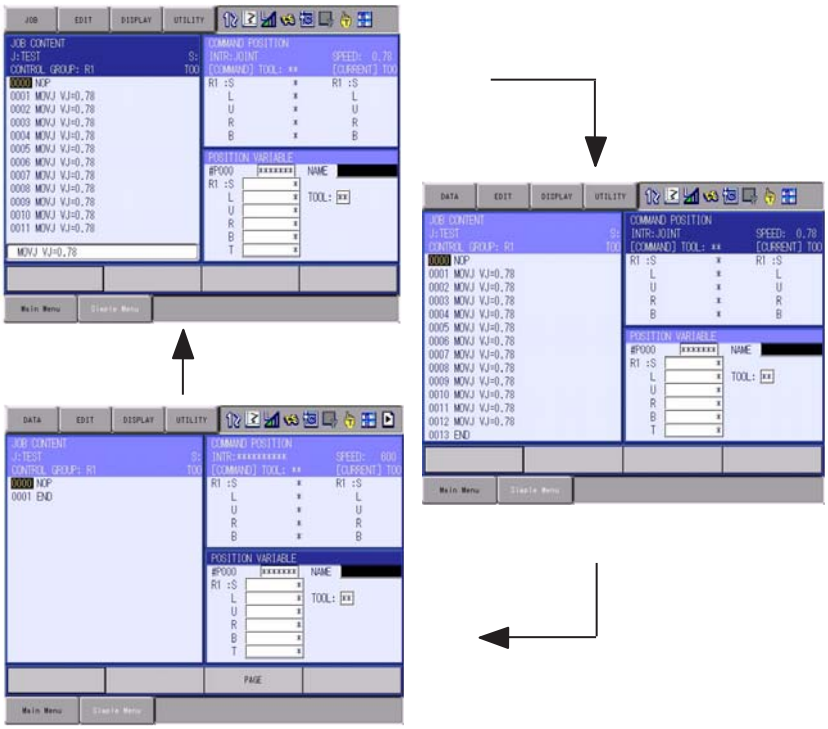
Switch the active window in the multi window displaying mode.

1. Set the mode of the general-purpose displaying area to multi window mode.



2. Key Operation:
   Press [MULT] key

   – The window to be active shifts. The active window shifts in the order mentioned in *section 6.7.2 "Setting the Dividing Pattern of the General-Purpose Display Area" on page 6-63*.
   (1→2→3→4→1……)

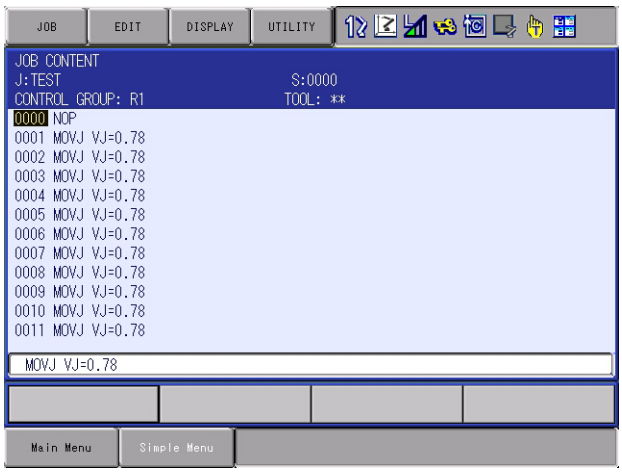


3. Touching Operation:
   Touch the window to be active.

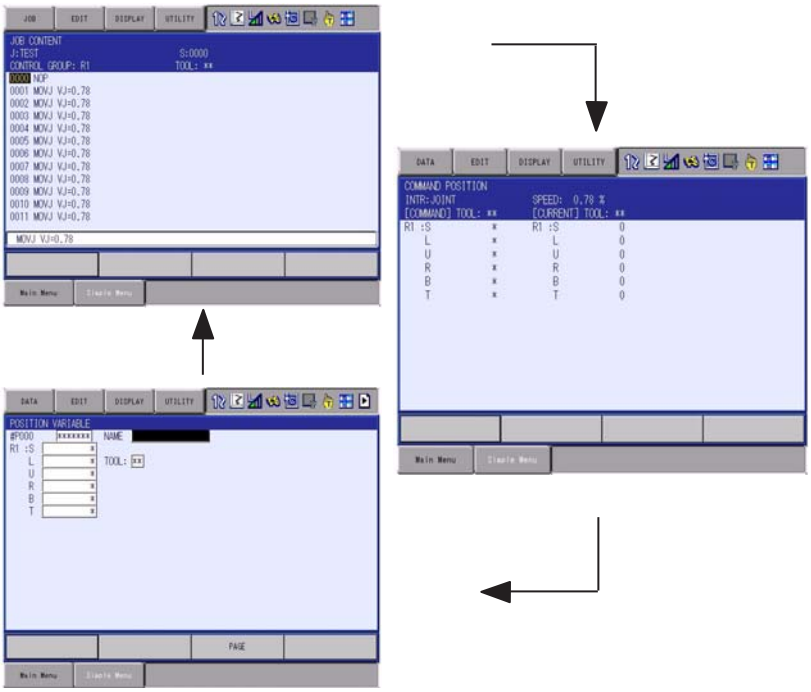
   – The touched window becomes active.

Switch the active window in the single window mode.

1. Set the mode of the general-purpose displaying area to single window mode.



2. Press [MULT] key
   – The following windows are displayed in the order mentioned in *section 6.7.2 “Setting the Dividing Pattern of the General-Purpose Display Area” on page 6-63*. (1→2→3→4→1……)



NOTE

During the period before menu is selected when alarm occurred, the active window cannot be switched if alarm window is displayed, direct open is ON or a window is displayed by key allocation operation.

6.7.5 Switching the Axis Operation Control Group

The appropriate control group for axis operation is automatically selected in accordance with the window status or its operation in the active window. Due to this function, when the general-purpose display area is in multi window mode, the control group for axis operation can vary depending on the window which is active at the time.

To avoid unexpected control group to function and for the better safeness, the change of the control group with the [MULTI] key operation or touching operation when switching the active window is notified to the user.

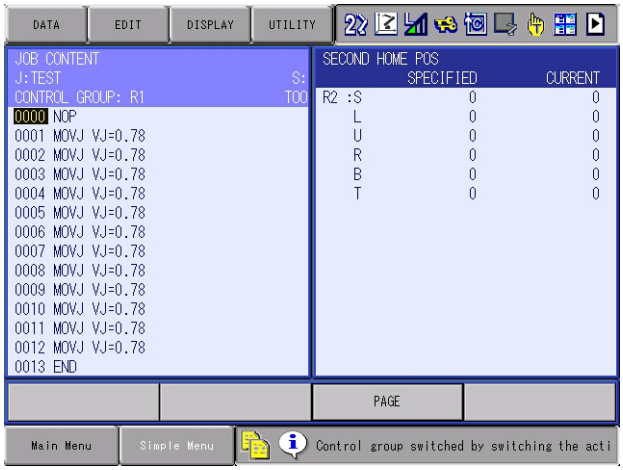
SUPPLE-MENT

The change of the control group for axis operation due to other than [MULTI] key operation or touching operation; due to the switch of the window by selecting main menu, is not notified to the user.

6.7.5.1 S2C540 “Choosing Method of Notifying the Change of Axis Operation Control Group when Switching the Active Window”

The method to notify the change of control group for axis operation due to the switch of active window can be changed with parameter.

- Setting Value:0
  - Keep displaying the message in the human interface display area for three seconds.
  - Message “Control group switched by switching the active window” is displayed.



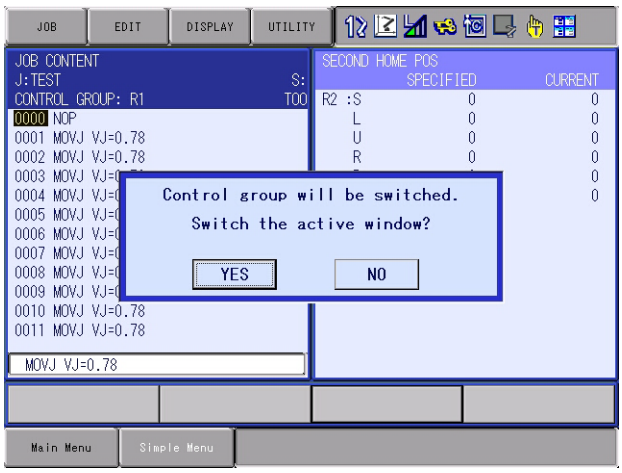
• Setting Value:1

– Call up the confirmation dialog box to confirm the switch of the active window.

– Message “Control group will be changed. Switch the active window?” is displayed

– “Yes” ····· After switching the window to be active, a message appears in the human interface display area.

– “No” ····· Cancel the window to be active.



• Setting Value:2

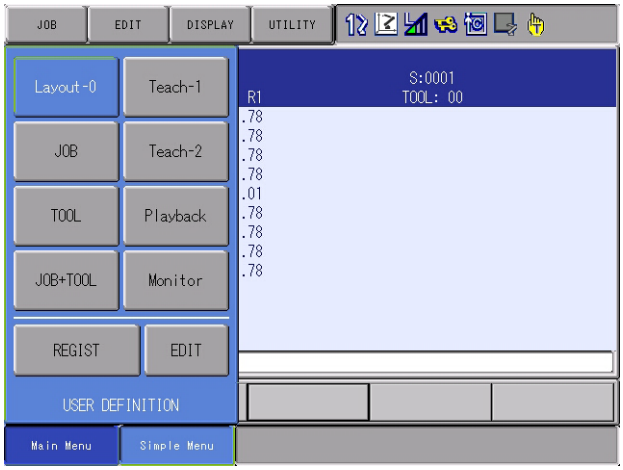
– Do not notify the control group change.

6.8 Simple Menu Function [1)]

6.8.1 Simple Menu

This function enables users to create “USER DEFINITION” menu by registering the layouts (screen dividing patterns and screen to be displayed) on the general-purpose display area.

Eight layout patterns can be registered to the user definition menu at maximum.
The registered layout patterns can be easily called up with the buttons of simple menu.



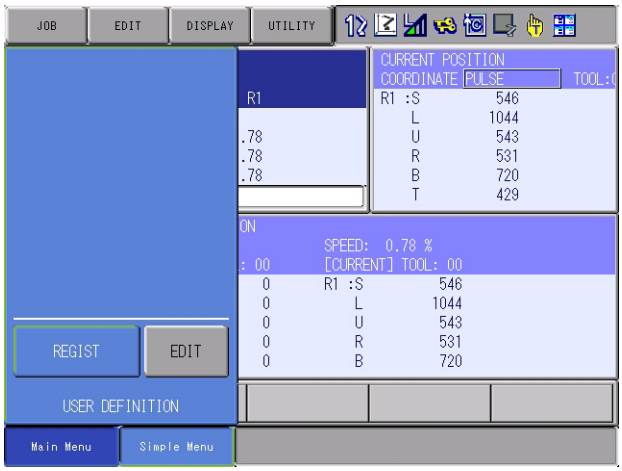
1 Simple menu function is available in DS1.50-00 version or later.

6.8.2 Registering the Layout Patters to User Definition Menu

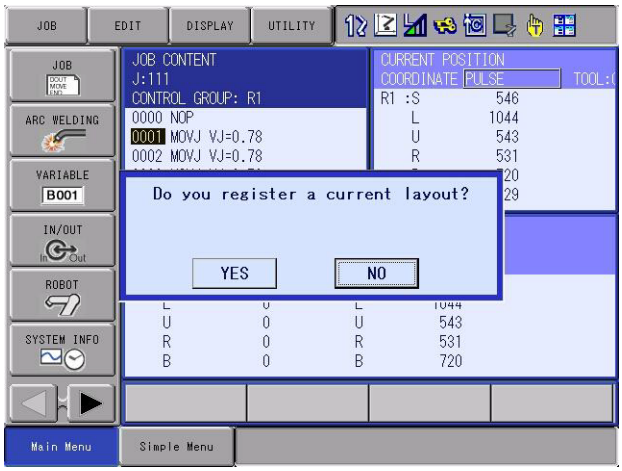
6.8.2.1 Register with {REGIST} Button

Register the layout patterns by using {RESIST} button which is in “USER DEFINITION” menu.

1. Press [SIMPLE MENU] key or select {Simple Menu} button on the display while the layout pattern to be registered is on the general-purpose display area.
   – “USER DEFINITION” menu appears.



2. Press {REGIST} button.
   – “USER DEFINITION” menu closes.
   – The message “Do you register a current layout?” appears in the confirmation dialog box.



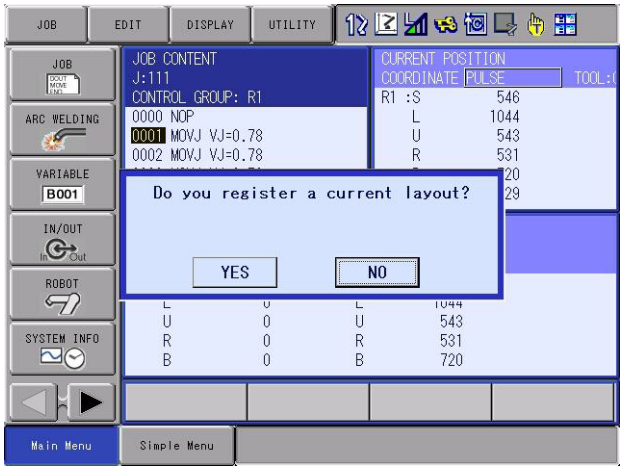
3. Select {YES}.
   – The layout is registered and the dialog box closes.

   *It will not be registered when {NO} is selected.

6.8.2.2 Register by Key Operation

Use the programming pendant keys to register the layout patterns to “USER DEFINITION” menu.

1. Press [SHIFT] + [SIMPLE MENU] keys while the layout pattern to be registered is on the general-purpose display area.
   – The message “Do you register a current layout?” appears in the confirmation dialog box.



2. Select {YES}.
   – The layout is registered and the dialog box closes.

   *It will not be registered when {NO} is selected.

6.8.2.3 Conditions to Register the Layout

There are some cases that the layout patterns cannot be registered to “USER DEFINITION” menu.

Followings are the conditions and the messages that the layout is refused to register.

	Condition	Message
1	when the layout is already registered.	This layout is already registered. This layout is already registered
2	when eight layouts are already registered.	There is not an undefined domain. There is not an undefined domain
3	When the registering layout includes the window which cannot be started up from the main menu.	The screen which I cannot register is included [W1W2W3W4] The screen which I cannot register is included [W1 (The number W1 to W4 indicates the windows which are actually displayed on the general-purpose display area, however, the highlighted numbered window cannot be registered. *For the layout of 1 to 4,refer to *Table 6-3 "Display the dividing Pattern" on page 6-63*.
4	When a single window is displayed under the multi window mode.	Cannot register at current operation mode. Cannot register at current operation mode

SUPPLE-MENT

The screens which cannot be started up from the main menu are impossible to register.
Also, the layout of the screens that are called up from {FD/PC CARD} or ladder editor (optional function) cannot be registered.

6.8.2.4 The Displayed Layout Name

After a layout pattern is registered to “USER DEFINITION” menu, it is named in accordance with the status of the general-purpose display area when the layout pattern is created.
Refer to the followings for the details.

	Status of general-purpose display area	Name registered to “USER DEFINITION” Menu
1	Single window mode	(Same as the sub menu in main menu)
2	Multi window mode	Layout -n (“n” should be a number from 0 to 7)

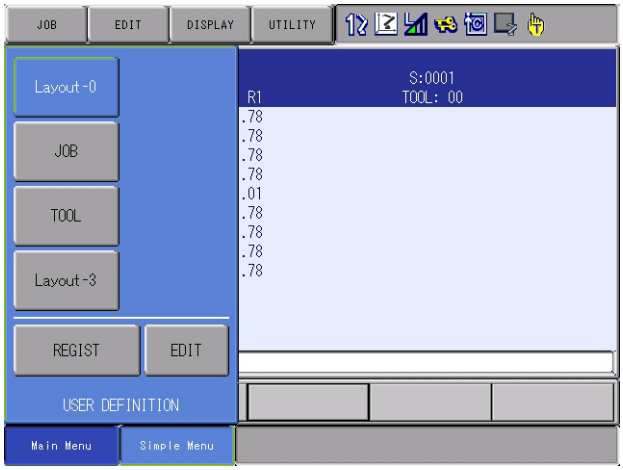
It is possible to change the name even after the name is registered. Refer to *section 6.8.4.3 “Change the Name of Registered Layout Name” on page 6-84*.

6.8.3 Calling Up of the Registered Layout

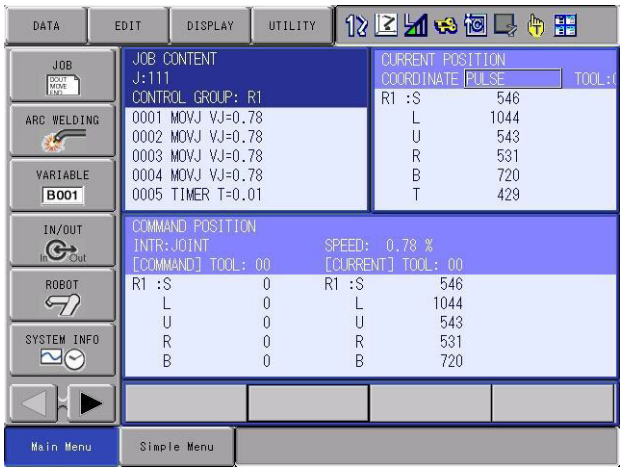
6.8.3.1 Calling up

Call up the registered layout with the following procedures.

1. Press [SIMPLE MENU] key or select {Simple Menu} button at the lower-left on the display.
   – “USER DEFINITION” menu appears.



2. Select and press a button on “USER DEFINITION” menu to display a layout to be called up.
   – “USER DEFINITION” menu closes.
   – The selected layout appears on the general-purpose display area.



6.8.3.2 Conditions when Calling Up the Layout

There are some cases where the layout cannot be called up depending on the conditions when calling up.
Followings are the conditions and the messages that the layout is refused to be called up.

	Condition	Message
1	When all the registered layout windows cannot be displayed due to security mode or its purpose of use.	There are no windows to display within the chosen layout.

When undisplayed screen is included in the layout to be called up due to above mentioned reasons, the message, “Please selected a Main Menu” appears to the said screen.

6.8.4 Editing “USER DEFINITION” Menu

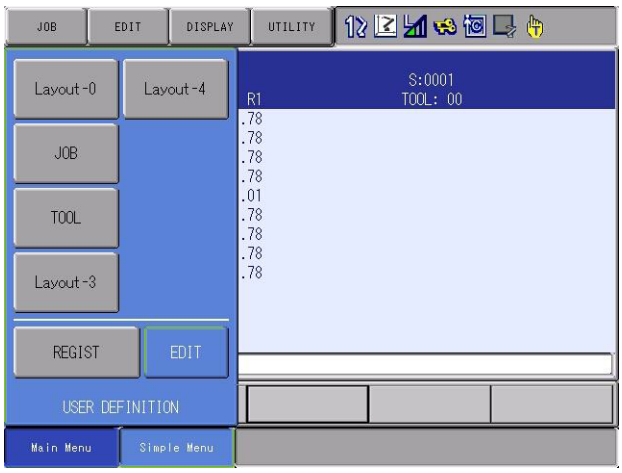
Editing procedures of “changing the registered name” and “deleting the registered item” are possible to the items registered to “USER DEFINITION MENU” window.

Those editions are executed on “USER DEFINITION MENU” window. Displaying of “USER DEFINITION MENU” window is possible in the operation mode or more and editing of this menu is possible in the editing mode or more.

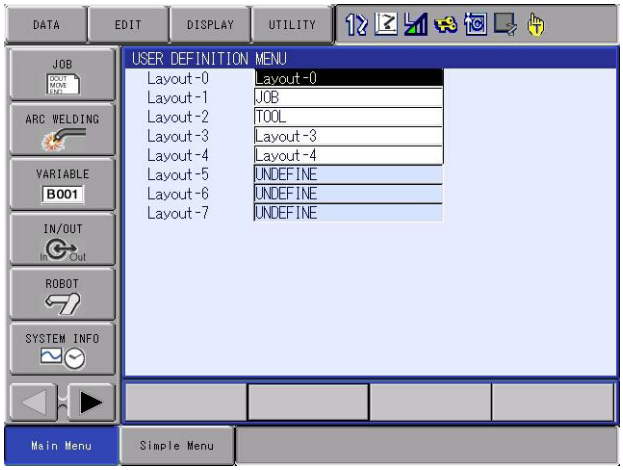
6.8.4.1 Displaying “UNSER DEFINITION” Window

Displays “UNSER DEFINITION MENU” Window with {EDIT} button.

1. Press [SIMPLE MENU] key or select {Simple Menu} button at the lower-left on the display.
   – “USER DEFINITION MENU” menu appears.



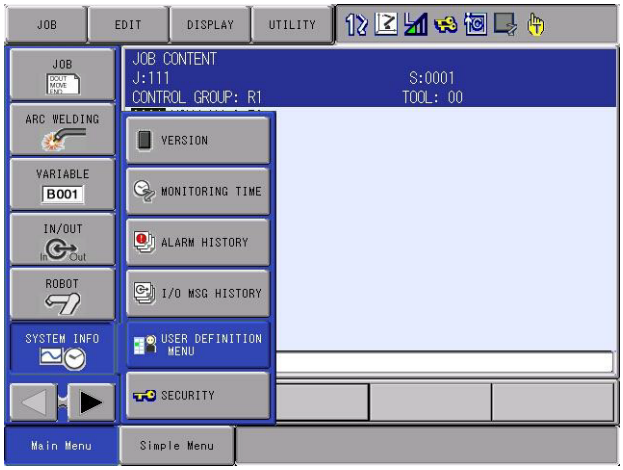
2. Press {EDIT} button.
   – “USER DEFINITION” menu closes.
   – “USER DEFINITION MENU” window appears on the active window in the general-purpose display area.



6.8.4.2 Displaying “USER DEFINITION MENU” window Under Main Menu

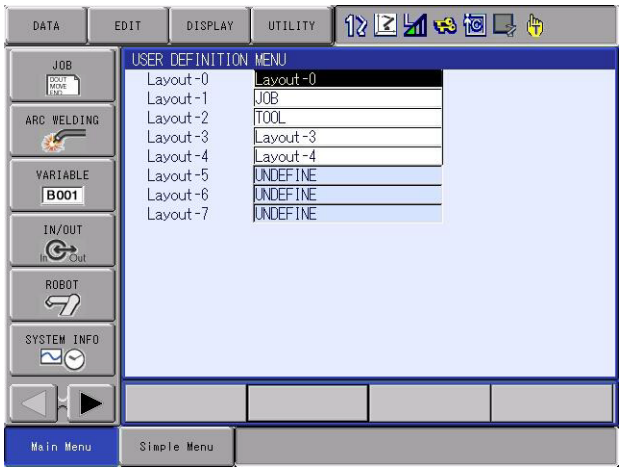
Displays “USER DEFINITION MENU” window under main menu.

1. Select {SYSTEM INFO} under the main menu.
   – {SYSTEM INFO} sub menu appears.



2. Select {USER DEFINITION}.

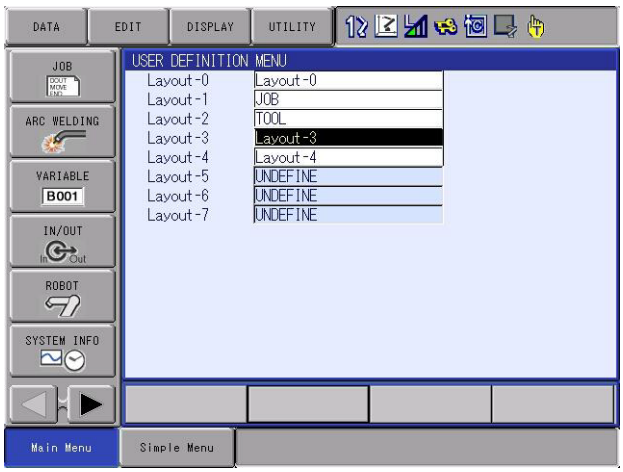
– “USER DEFINITION MENU” window appears on the active window in the general-purpose display area.



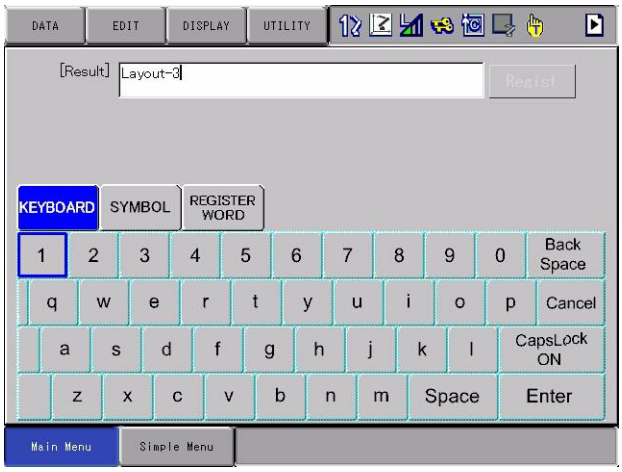
6.8.4.3 Change the Name of Registered Layout Name

The registered layout names can be changed.

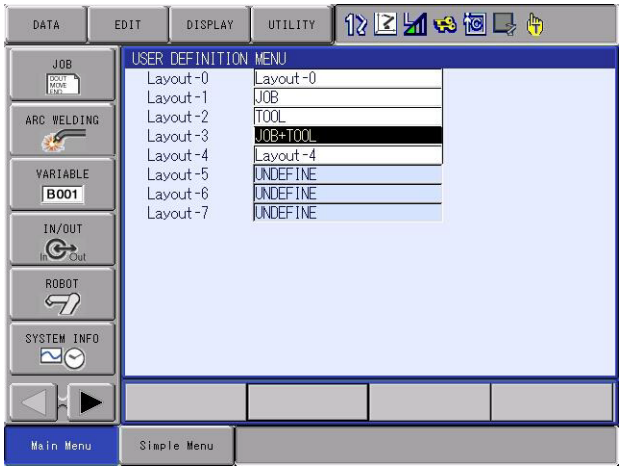
1. Display “USER DEFINITION MENU” window.



2. Move the cursor key to the layout name to be changed and press [SELECT] key.
   – The software key pad for inputting letters appears.



3. Input the layout name, then press [ENTER] key or {ENTER} button.
   – The software key pad closes.
   – The name changes.



* If complete the software key pad operation with [CANCEL] key or {CANCEL} button, the name editing operation is also canceled.

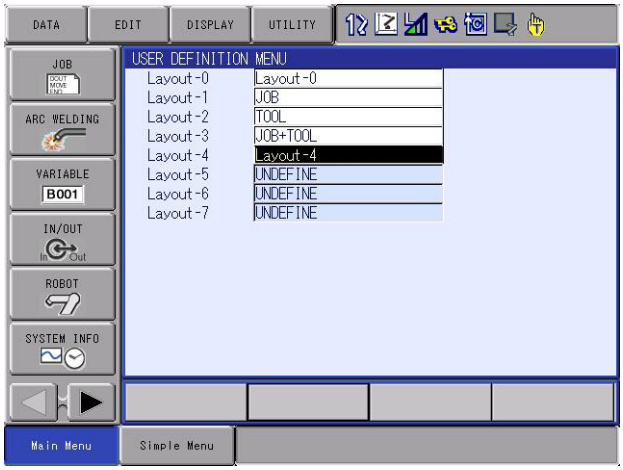
SUPPLE-MENT

When the bilingual function is valid, name in each language can be set.

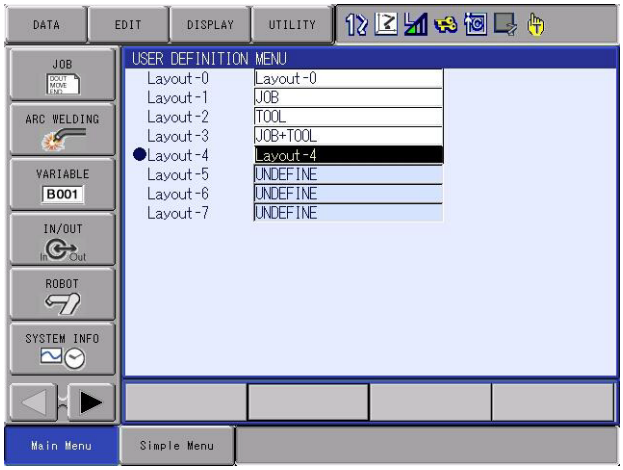
6.8.4.4 Deleting the Layout

The layout registered to “USER DEFINITION” menu can be deleted.

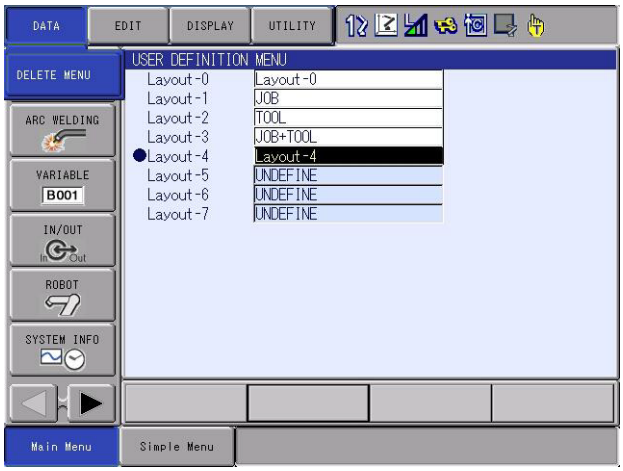
1. Display “USER DEFINITION MENU” window.



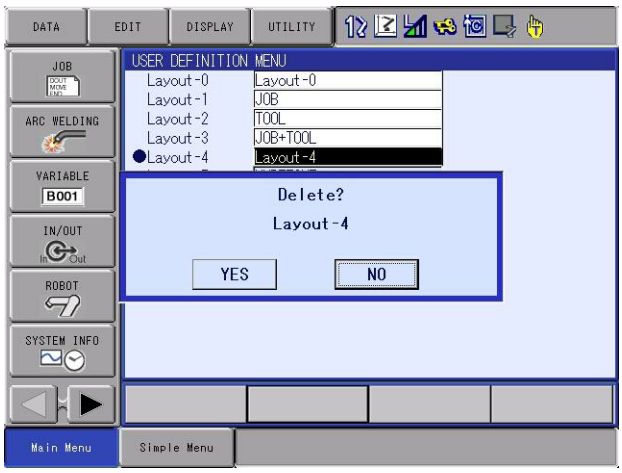
2. Move the cursor key to the layout to be deleted and press [SHIFT] + [SELECT] keys. (multiple selection possible)
   – “●” mark is indicated at the head of the selected line.



3. Select {DATA} in the menu.
   – A pull down menu appears.



4. Select {DELETE MENU}.
   – The confirmation dialog box with a message “Delete? Layout -4 (layout name)” appears to the line marked with “●”.



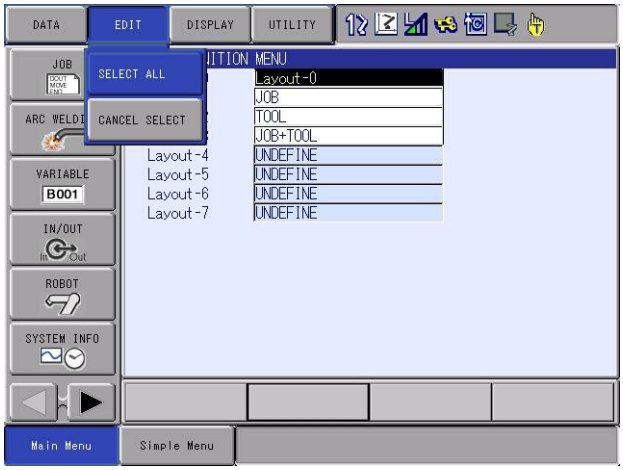
5. Select {YES} in the dialog box.
   – The marked layout is deleted.

   * The layout will not be deleted if {NO} in the dialog box is selected.

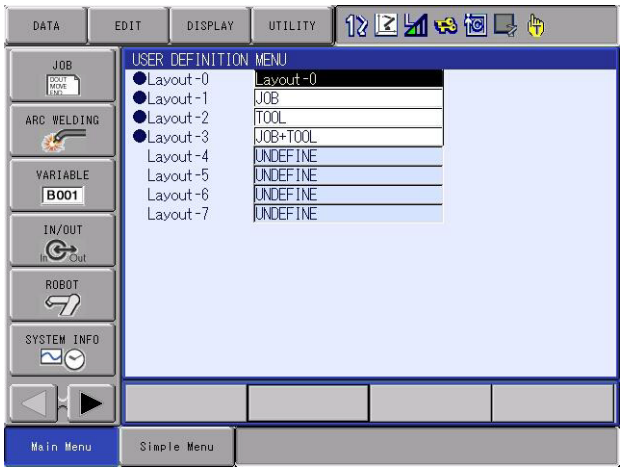
6.8.4.5 Delete All Layout

All layouts registered to “USER DEFINITION” menu can be deleted at a time.

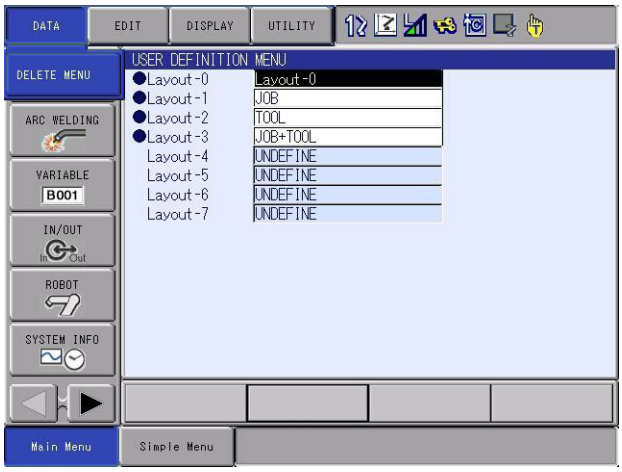
1. Display “USER DEFINITION MENU” window.
2. Select {EDIT} in the menu.
   – A pull down menu appears.



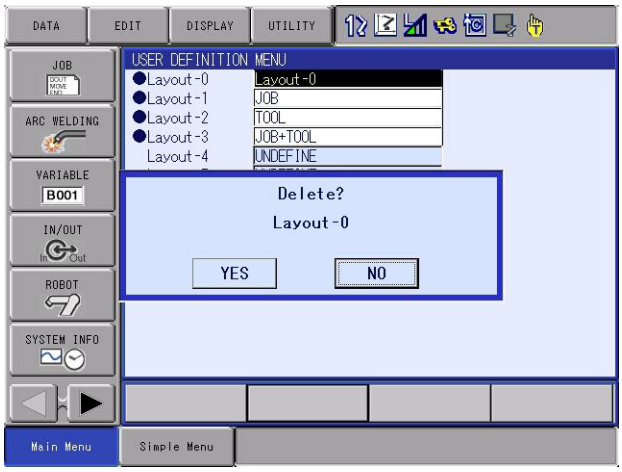
3. Select {SELECT ALL}.
   – “●” mark is indicated to all the registered layouts.



4. Select {DATA} in the menu.
   – A pull down menu appears.



5. Select {DELETE MENU}.
   – The confirmation dialog box with a message “Delete? Layout -0 (layout name)” appears to the lines marked with “●”.



6. Select {YES} in the dialog box.
   – The marked layouts are deleted.

   * The layout will not be deleted if {NO} in the dialog box is selected.

SUPPLE-MENT

Move the cursor to the line with “●” mark, and press [SHIFT] + [SELECT] keys to disappear “●” mark.
When select {EDIT} - {CANCEL SELECT} under the pull down menu to cancel select and “●” marks disappear.

6.8.5 Save/Load (to external memory devices) the User Definition Menu Data

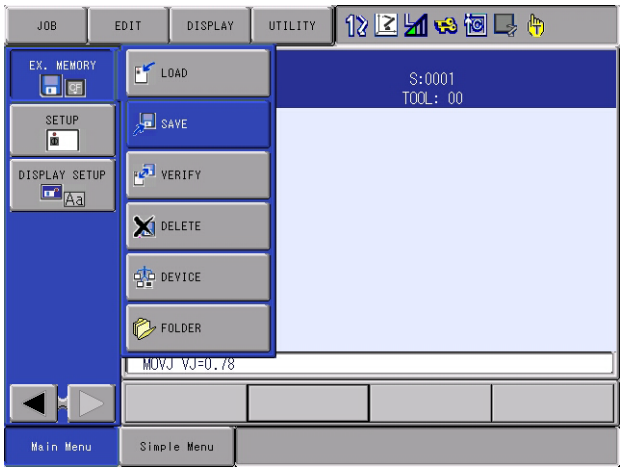
The data registered to “USER DEFINITION” menu (user menu data) can be saved to and loaded from the external memory device.

In this case, the name of the file is “USERMENU.DAT”.

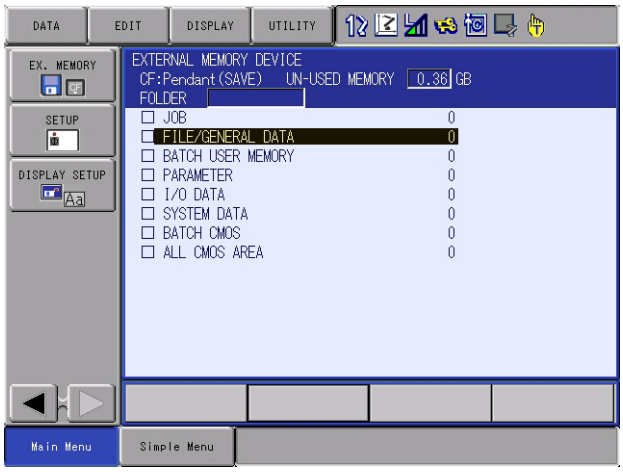
6.8.5.1 Saving the Data

User menu data can be saved at the security level of operation mode or more.

1. Select {EX. MOMORY} under the main menu.
   – {EX. MOMORY} sub menu appears.

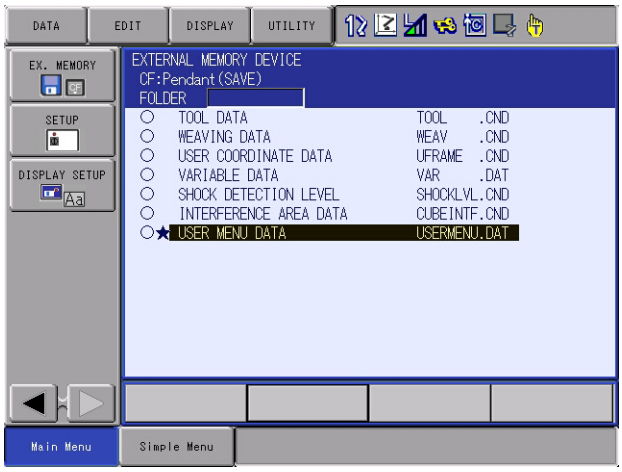


2. Select {SAVE}.
   – {SAVE} window of external memory device appears.

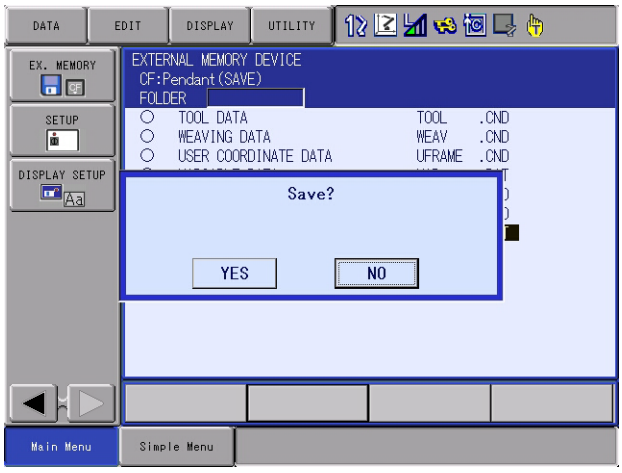


3. Select {FILE/GENERAL DATA}.
   – {FILE/GENERAL DATA} window of external memory device appears.

4. Select {USER MENU DATA}.
   – "★" mark is indicated at the head of {USER MENU DATA}.



5. Press [ENTER].
   – The confirmation dialog box with a message "SAVE" appears.



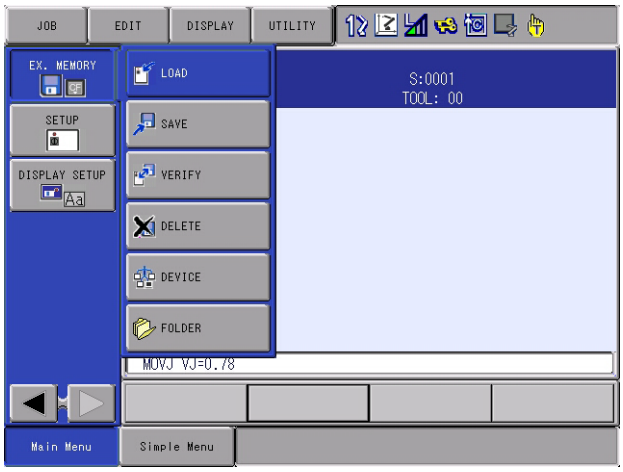
6. Select {YES} in the dialog box.
   – {USER MENU DATA} is saved.

   * It will not be saved if {NO} in the dialog box is selected.

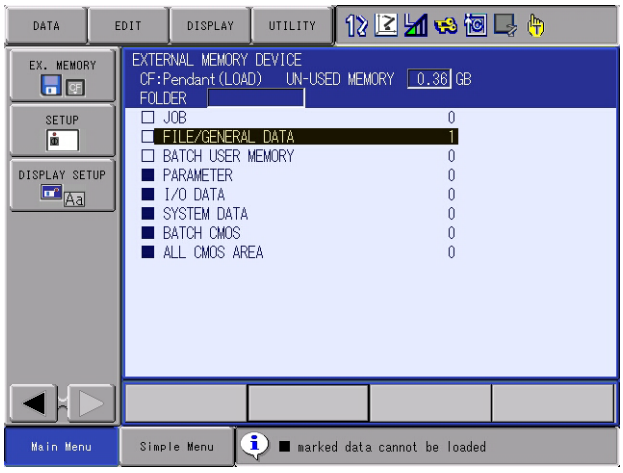
6.8.5.2 Loading the Data

User menu data can be loaded at the security level of editing mode or more.

1. Select {EX. MOMORY} under the main menu.
   – {EX. MOMORY} sub menu appears.

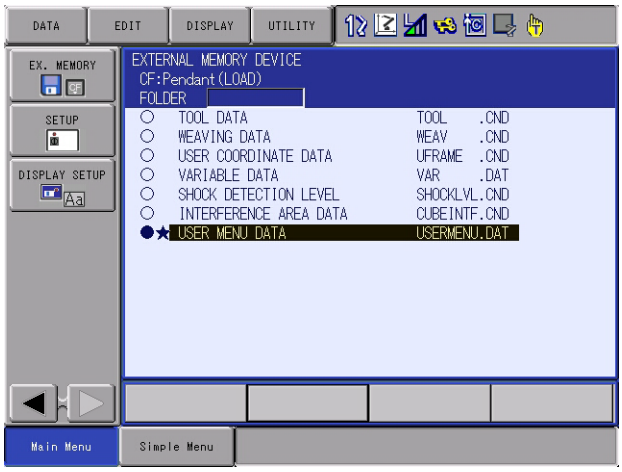


2. Select {LOAD}.
   – {LOAD} window of external memory device appears.

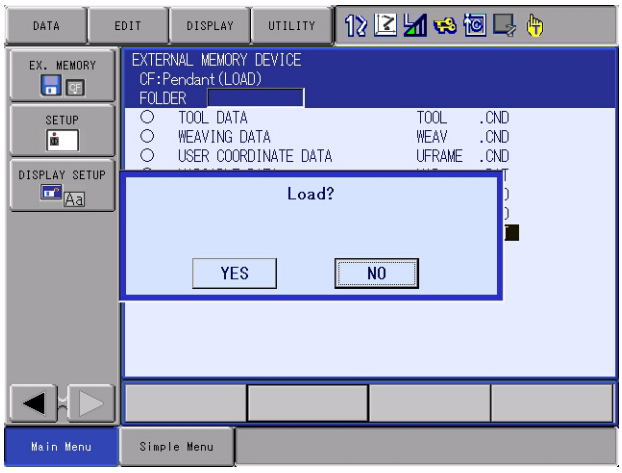


3. Select {FILE/GENERAL DATA}.
   – {FILE/GENERAL DATA} window of external memory device appears.

4. Select {USER MENU DATA}.
   – "★" mark is indicated at the head of {USER MENU DATA}.



5. Press [ENTER].
   – The confirmation dialog box with a message "LOAD?" appears.



6. Select {YES} in the dialog box.
   – {USER MENU DATA} is loaded.
   * It will not be loaded if {NO} in the dialog box is selected.

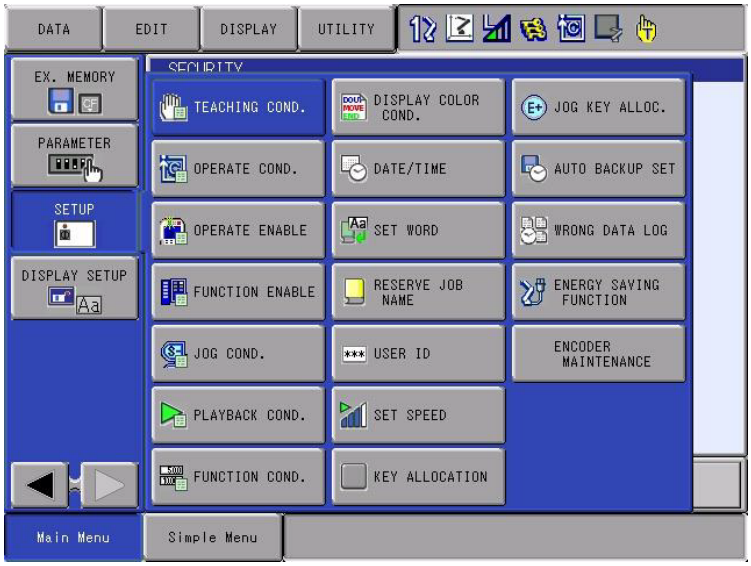
6.9 Parameter Setting Function

6.9.1 Parameter Setting Function

Among the parameters explained in *chapter 8 "Parameter"*, frequently used parameters' settings can be changed from the exclusive windows. Those windows are sorted out depending on the parameters' function as shown below.

- TEACHING CONDITION SETTING
  Teaching-relevant parameters are displayed.
- OPERATE CONDITION SETTING
  Mode switching/power-relevant parameters are displayed.
- OEPRATE ENABLE SETTING
  ON/OFF of the manipulator-relevant parameters are displayed.
- FUNCTION ENABLE SETTING
  Enable/unable of optional function-relevant parameters settings are displayed.
- JOG CONDITION SETTING
  Operation of the jog-relevant parameters are displayed.
- PLAYBACK CONDITION SETTING
  Playback operation-relevant parameters are displayed.
- FUNCTIONAL CONDITION SETTING
  Execution of each function-relevant parameters are displayed.

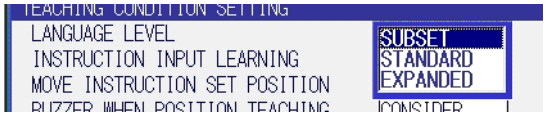
Select above mentioned menu from {SETUP} window under main menu.



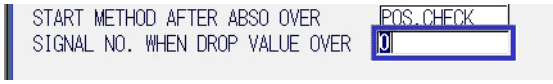
Move the cursor key to select a menu, then the settings of the desired parameters can be changed by one of the following three methods according to its content.

- When there are two options.
  The options alternate every time the select key is pressed.

- When there are three or more options.
  A dialog box with the options appears. Select one to change the settings.

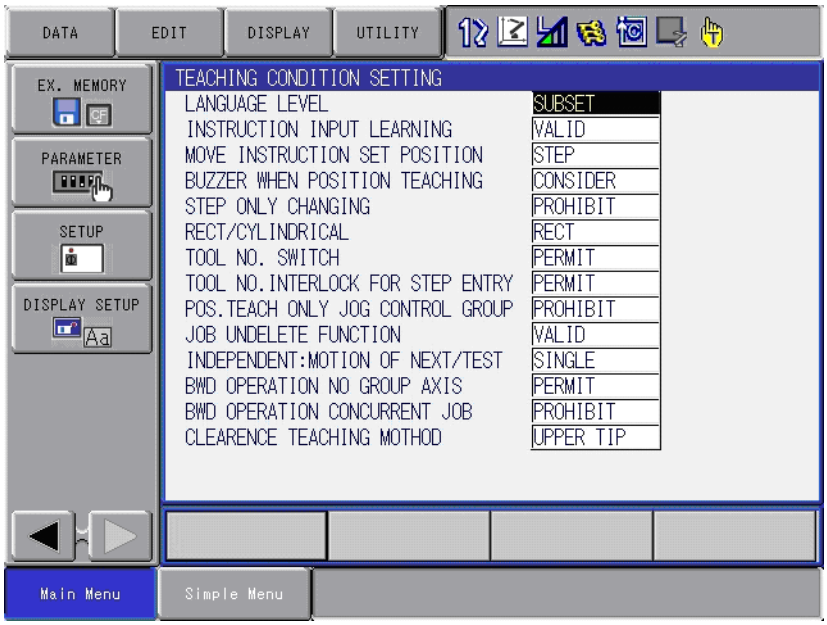


- When it requires to input a value.
  Input a value using the Numeric keys and press [ENTER] to change the settings.



6.9.2 Teaching Condition Setting

Select {SETUP} → {TEACHING CONDITION SETTING} to display the following window.



- LANGUAGE LEVEL (S2C211)
  Refer to *section 8.3.0.13 “S2C211: LANGUAGE LEVEL” on page 8-16*.

Setting	Parameter Value
Subset	0
Standard	1
Expanded	2

- INSTRUCTION INPUT LEARING (S2C214)
  Refer to *section 8.3.0.14 “S2C214: INSTRUCTION INPUT LEARNING FUNCTION” on page 8-16*.

Setting	Parameter Value
Valid	0
Invalid	1

- MOVE INSTRUCTION SET POSITION (S2C206)
  Refer to *section 8.3.0.8 “S2C206: ADDITIONAL STEP POSITION” on page 8-13*.

Setting	Parameter Value
Step	0
Line	1

- BUZZER WHEN POSITION TEACHING (S2C433)
  Refer to *section 8.3.0.43 “S2C433: POSITION TEACHING BUZZER” on page 8-28*.

Setting	Parameter Value
Consider	0
Not Consider	1

- STEP ONLY CHANGING (S2C203)
  Refer to *section 8.3.0.6 “S2C203: CHANGING STEP ONLY” on page 8-13*.

Setting	Parameter Value
Permit	0
Prohibit	1

- RECT/CYL INDRICAL (S2C196)
  Refer to *section 8.3.0.2 “S2C196: SELECTION OF CARTESIAN/ CYLINDRICAL” on page 8-12*.

Setting	Parameter Value
Cyl.	0
Rectangle	1

- TOOL NO. SWITCH (S2C431)
  Refer to *section 8.3.0.42 “S2C431: TOOL NO. SWITCHING” on page 8-28*.

Setting	Parameter Value
Prohibit	0
Permit	1

- TOOL NO. INTERLOCK FOR STEP ENTRY(S2C234)
  Refer to *section 8.3.0.29 “S2C234: STEP REGISTRATION AT TOOL NO. CHANGE” on page 8-20*.

Setting	Parameter Value
Permit	0
Prohibit	1

- POS. TEACH ONLY JOG CONTROL GROUP (S2C320)
  Refer to *section 8.2.0.15 “S2C320: CONTROLLED GROUP JOB TEACHING POSITION CHANGE” on page 8-7*.

Setting	Parameter Value
Prohibit	0
Permit	1

- JOB UNDELETE FUNCTION(S2C413)
  Refer to *section 8.3.0.39 “S2C410: WORD REGISTRATION FUNCTION / WORD EDITING FUNCTION SPECIFICATION” on page 8-25*.

Setting	Parameter Value
Invalid	0
Valid	1

- INDEPENDENT :MOTION OF NEXT/TEST(S2C231)
  Refer to *section 8.6.0.3 “S2C231: OPERATION METHOD AT FWD/ BWD OPERATION OR TEST RUN BY INDEPENDENT CONTROL” on page 8-45*.
  →This appears only when the independent control is valid.

Setting	Parameter Value
Single	0
All	1

- BWD OPERATION NO GROUP AXIS (S2C688 d0 bit)
- BWD OPERATION CONCURRENT JOB (S2C688 d1 bit)
  Refer to *section 8.6.0.10 “S2C688: EXECUTION OF “BWD” OPERATION” on page 8-48*.
  →This appears only when the independent control is valid.

Setting	Bit Status
Permit	0
Prohibit	1

- STATION TWIN (S2C434)
  Refer to *section 8.3.0.44 “S2C434: JOB LINKING DESIGNATION (When Twin Synchronous Function Used)” on page 8-28*.
  →This appears only when the STATION TWIN SYNCHRONOUS JOB is valid.

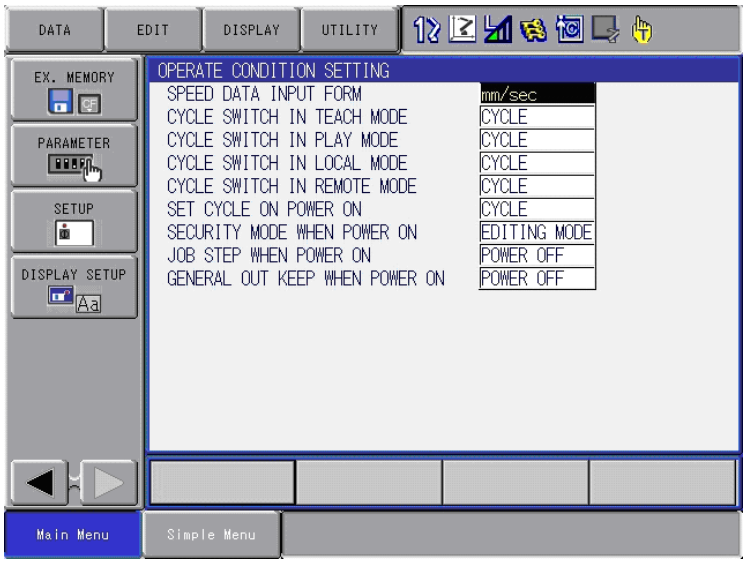
Setting	Parameter Value
Invalid	0
Valid	1

- CLEARANCE TEACHING METHOD (S2C612)
  →This appears only when it is for motor gun use.

Setting	Parameter Value
Upper Tip	0
Lower Tip	1
Gun Close	2

6.9.3 Operation Condition Setting

Select {SETUP} → {OPERATE CONDITION SETTING} to display the following window.



- SPEED DATA INPUT FORM (S2C221)
  Refer to *section 8.3.0.21 “S2C221: SPEED DATA INPUT FORM” on page 8-18*.

Setting	Parameter Value
mm/sec	0
cm/min	1
inch/min	2
mm/min	3

- CYCLE SWITCH IN TEACH MODE (S2C313)
  Refer to *section 8.3.0.33 “S2C313: TEACH MODE FIRST CYCLE MODE” on page 8-21*.

Setting	Parameter Value
Step	0
Cycle	1
Auto	2
None	3

- CYCLE SWITCH IN PLAY MODE (S2C314)
  Refer to *section 8.3.0.34 “S2C314: PLAY MODE FIRST CYCLE MODE” on page 8-21*.

Setting	Parameter Value
Step	0
Cycle	1
Auto	2
None	3

- CYCLE SWITCH IN LOCAL MODE (S2C294)
  Refer to *section 8.3.0.31 “S2C294: LOCAL FIRST CYCLE MODE” on page 8-20*.

Setting	Parameter Value
Step	0
Cycle	1
Auto	2
None	3

- CYCLE SWITCH IN REMOTE MODE (S2C293)
  Refer to *section 8.3.0.30 “S2C293: REMOTE FIRST CYCLE MODE” on page 8-20*.

Setting	Parameter Value
Step	0
Cycle	1
Auto	2
None	3

- SET SYCLE ON POWER ON (S2C312)
  Refer to *section 8.3.0.32 “S2C312: POWER ON FIRST CYCLE MODE” on page 8-20*.

Setting	Parameter Value
Step	0
Cycle	1
Auto	2
None	3

- SECURITY MODE WHEN POWER ON (S2C195)
  Refer to *section 8.3.0.1 “S2C195: SECURITY MODE WHEN CONTROL POWER SUPPLY IS TURNED ON” on page 8-12*.

Setting	Parameter Value
Operation Mode	0
Editing Mode	1
Management Mode	2

- JOB STEP WHEN POWER ON (S2C215)
  Refer to *section 8.3.0.15 “S2C215: ADDRESS SETTING WHEN CONTROL POWER IS TURNED ON” on page 8-16*.

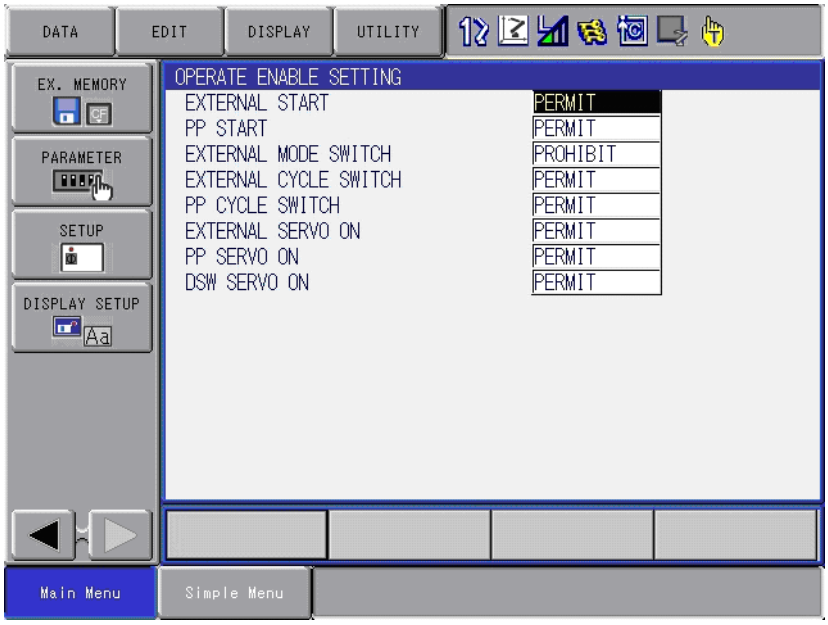
Setting	Parameter Value
Power OFF	0
Initial	1

- GENERAL OUT KEEP WHEN POWER ON (S2C235)
  Refer to *section 8.5.0.1 “S2C235: USER OUTPUT RELAY WHEN CONTROL POWER IS ON” on page 8-40*.

Setting	Parameter Value
Power OFF	0
Initial	1

6.9.4 Operate Enable Setting

Select {SETUP} → {OPERATE ENABLE SETTING} to display the following window.



- EXTERNAL START (S2C219)
  Refer to *section 8.3.0.19 “S2C219: EXTERNAL START” on page 8-17*.

Setting	Parameter Status
Permit	0
Prohibit	1

- PP START (S2C220)
  Refer to *section 8.3.0.20 “S2C220: PROGRAMMING PENDANT START” on page 8-17*.

Setting	Parameter Status
Permit	0
Prohibit	1

- EXTERNAL MODE SWITCH (S2C225)
  Refer to *section 8.3.0.24 “S2C225: EXTERNAL MODE SWITCH” on page 8-18*.

Setting	Parameter Status
Permit	0
Prohibit	1

- EXTERNAL CYCLE SWITCH (S2C227)
  Refer to *section 8.3.0.25 “S2C227: EXTERNAL CYCLE SWITCHING” on page 8-18*.

Setting	Parameter Status
Permit	0
Prohibit	1

- PP CYCLE SWITCH (S2C228)
  Refer to *section 8.3.0.26 “S2C228: PROGRAMMING PENDANT CYCLE SWITCHING” on page 8-19*.

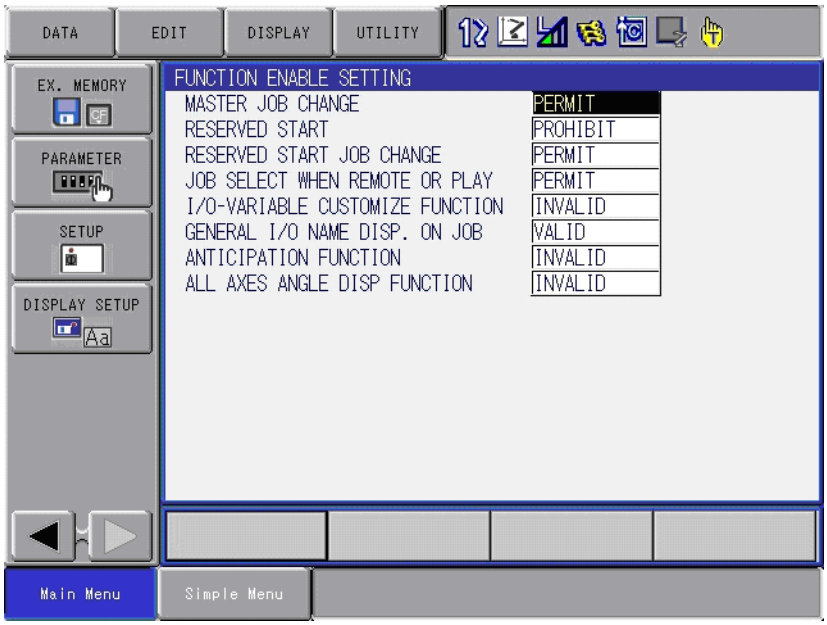
Setting	Parameter Status
Permit	0
Prohibit	1

- EXTERNAL SERVO ON (S2C229 d0 bit)
- PP SERVO ON (S2C229 d1 bit)
- DSW SERVO ON (S2C229 d2 bit)
  Refer to *section 8.3.0.27 “S2C229: SERVO ON FROM EXTERNAL PP PROHIBITION” on page 8-19*.

Setting	Bit Status
Permit	0
Prohibit	1

6.9.5 Function Enable Setting

Select {SETUP} → {FUNCTION ENABLE SETTING} to display the following window.



- MASTER JOB CHANGE (S2C207)
  Refer to *section 8.3.0.9 “S2C207: MASTER JOB CHANGING OPERATION” on page 8-14*.

Setting	Parameter Status
Permit	0
Prohibit	1

- RESERVED START (S2C222)
  Refer to *section 8.3.0.22 “S2C222: RESERVED START” on page 8-18*.

Setting	Parameter Status
Permit	0
Prohibit	1

- RESERVED START JOB CHANGE (S2C209)
  Refer to *section 8.3.0.11 “S2C209: RESERVED WORK JOB CHANGING OPERATION” on page 8-14*.

Setting	Parameter Status
Permit	0
Prohibit	1

- JOB SELECT WHEN REMOTE OR PLAY (S2C224)
  Refer to *section 8.3.0.23 “S2C224: JOB SELECTION AT REMOTE FUNCTION (PLAY MODE)” on page 8-18*.

Setting	Parameter Status
Permit	0
Prohibit	1

- I/O-VARIABLE CUSTOMIZE FUNCTION (S2C397)
  Refer to *section 8.3.0.38 “S2C397: I/O VARIABLE CUSTOMIZE FUNCTION” on page 8-24*.

Setting	Parameter Status
Invalid	0
Valid	1

- GENERAO I/O NAME DISP. ON JOB (S2C544)
  Refer to *section 8.3.0.46 “S2C544: I/O NAME DISPLAY FUNCTION FOR JOB” on page 8-30*.

Setting	Parameter Status
Invalid	0
Valid	1

- ANTICIPATION FUNCTION (S2C646)
  Refer to *section 8.8.0.1 “S2C646: ANTICIPATOR FUNCTION” on page 8-51*.

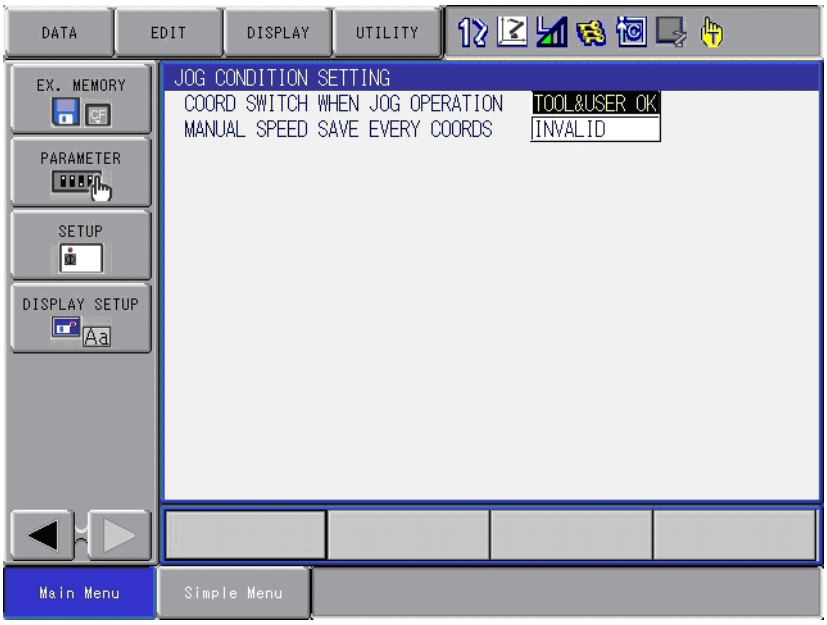
Setting	Parameter Status
Invalid	0
Valid	1

- ALL AXES ANGLE DISP FUNCTION (S2C684 d0 bit)
  Refer to *section 8.3.0.47 “S2C684:ALL AXES ANGLE DISPLAY FUNCTION” on page 8-30*.

Setting	Parameter Status
Invalid	0
Valid	1

6.9.6 Jog Condition Setting

Select {SETUP} → {JOG CONDITION SETTING} to display the following window.



- COORD SWITCH WHEN JOG OPERATION (S2C197)
  Refer to *section 8.3.0.3 "S2C197: COORDINATE SWITCHING PROHIBITED" on page 8-12*.

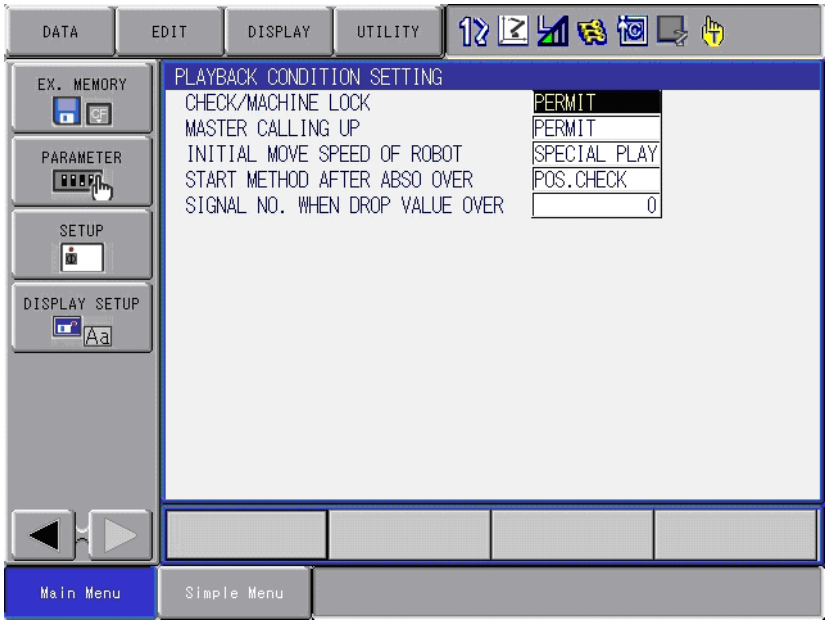
Setting	Parameter Status
Tool & User OK	0
Tool NG	1
User NG	2
Tool & User NG	3

- MANUAL SPEED SAVE EVERY COORDS (S2C204)
  Refer to *section 8.3.0.7 "S2C204: MANUAL SPEED STORING FOR EACH COORDINATE" on page 8-13*.

Setting	Parameter Status
Invalid	0
Valid	1

6.9.7 Playback Condition Setting

Select {SETUP} → {PLAYBACK CONDITION SETTING} to display the following window.



- CHECK/MACHINE LOCK (S2C208)
  Refer to *section 8.3.0.10 "S2C208: CHECK AND MACHINE-LOCK KEY OPERATION IN PLAY MODE" on page 8-14*.

Setting	Parameter Status
Permit	0
Prohibit	1

- MASTER CALLING UP (S2C210)
  Refer to *section 8.3.0.12 "S2C210: MASTER OR SUBMASTER CALL OPERATION IN PLAY MODE" on page 8-15*.

Setting	Parameter Status
Permit	0
Prohibit	1

- INITIAL MOVE SPEED OF ROBOT (S2C217)
  Refer to *section 8.3.0.17 "S2C217: INITIAL OPERATION OF MANIPULATOR" on page 8-17*.

Setting	Parameter Status
Special Play	0
Low Speed	1

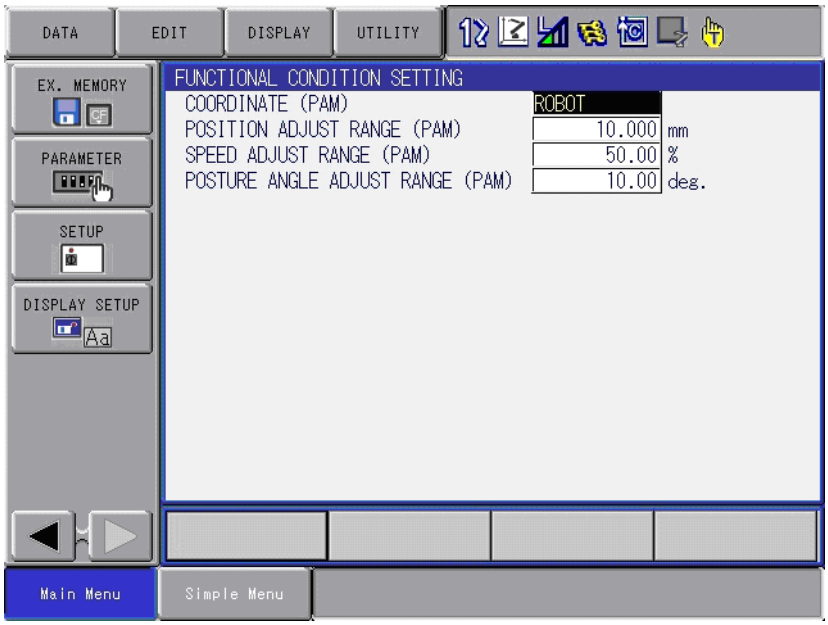
- START METHOD AFTER ABSO OVER (S2C316)
  Refer to *section 8.3.0.35 “S2C316: START CONDITION AFTER ALARM-4107 (“OUT OF RANGE (ABSO DATA)”)” on page 8-21*.

Setting	Parameter Status
Pos. Check	0
Low Speed	1

- SIGNAL NO. WHEN DROP VALUE OVER (S2C240)
  Refer to *section 8.5.0.7 “S4C240: USER OUTPUT NO. WHEN MANIPULATOR DROP ALLOWABLE RANGE ERROR OCCURS” on page 8-44*.

6.9.8 Functional Condition Setting

Select {SETUP} → {FUNCTIONAL CONDITION SETTING} to display the following window.



- COORDINATE (PAM) (S2C1100)
  Refer to *section 8.2.0.24 "S3C1098 to S3C1102: POSITION CORRECTING FUNCTION DURING PLAYBACK" on page 8-11*.

Setting	Parameter Status
Base	0
Robot	1
Tool	2
User #1	3
:	
User #63	65

- POSITION ADJUST RANGE (PAM) (S2C1098)
- SPEED ADJUST RANGE (PAM) (S2C1099)
- POSTURE ANGLE ADJUST RANGE (PAM) (S2C1102)
  Refer to *section 8.2.0.24 "S3C1098 to S3C1102: POSITION CORRECTING FUNCTION DURING PLAYBACK" on page 8-11*.

6.10 Jog Key Allocation

6.10.1 Jog Key Allocation Function

This function enables to operate external axis without switching control groups by using operation keys of 7th-axis (E+, E-) and 8th-axis (8+,8-) on the programing pendant after setting any external axis to them.

CAUTION

- Operation of external axis by using the allocated operation keys of 7th-axis and 8th-axis are valid only when operating a robot.
  In the case where operating external axes, operate them by using keys from the key for 1st -axis.
  Furthermore, when the robot is equipped with 7th and 8th axes, keys on the pendant are used to operate existing axes on a priority basis.
  For example, when the robot is equipped with 7 axes, E-axis will move even if the external axis operation is allocated to 7th-axis (E+, E-) operational key.

NOTE

This function can operate other control group than displayed in the upper part of the programming pendant (Status display area or the LED of [ROBOT] or [EX.AXIS] keys).

Also, the simultaneous operation of the robot and the external axes is possible by pressing several axis operational keys at a time. Please be careful to the axes movements when pressing them.

6.10.2 Jog Key Allocation Setting

6.10.2.1 Allocation of the Jog Key

CAUTION

- Allocation of the jog keys is valid only in the management mode while only confirmation of allocated axes is valid in the operation mode and edit mode.

NOTE

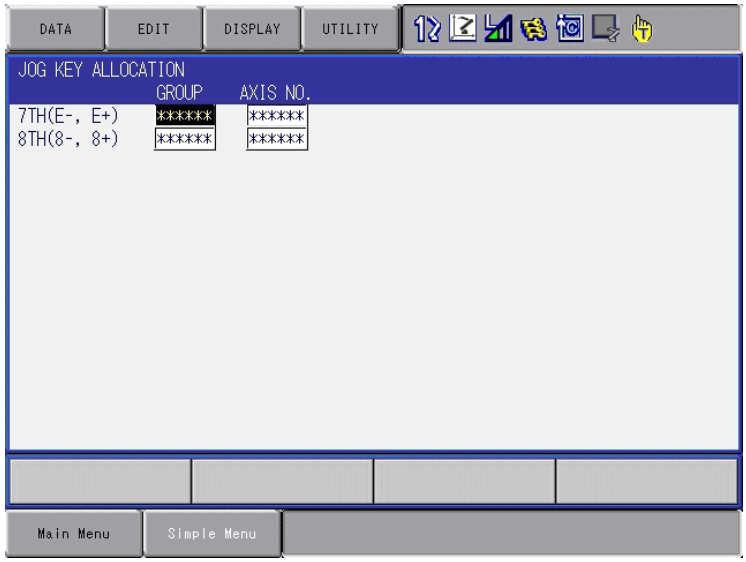
The setup conditions are saved in the following parameters. Even if the same numbered external axes are allocated to a key (example:S1 for the 1st-axis), the value of the parameter to be saved varies depending on the composition of the control group of the system. In this consequence, when loading the parameter file (ALL.PRM or AC.PRM), please make sure to confirm the allocating status before executing the function.

Parameters for saving the setup conditions of jog key allocation.

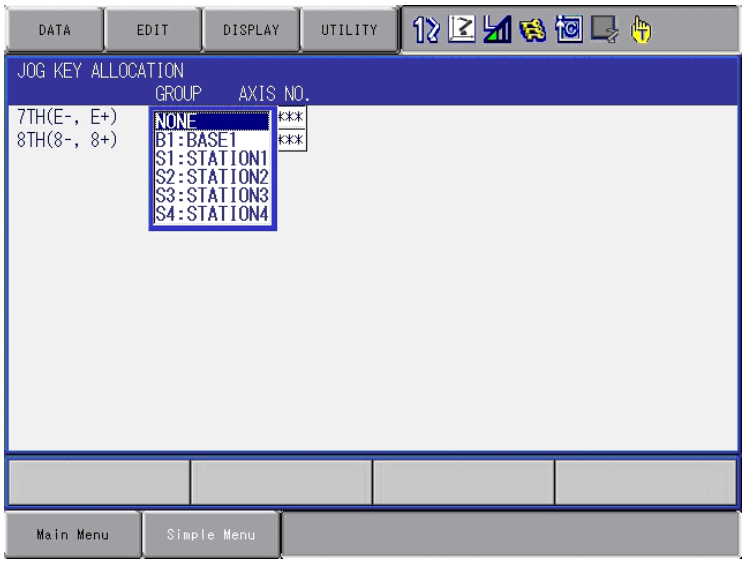
S2C739 7th-axis

S2C740 8th-axis

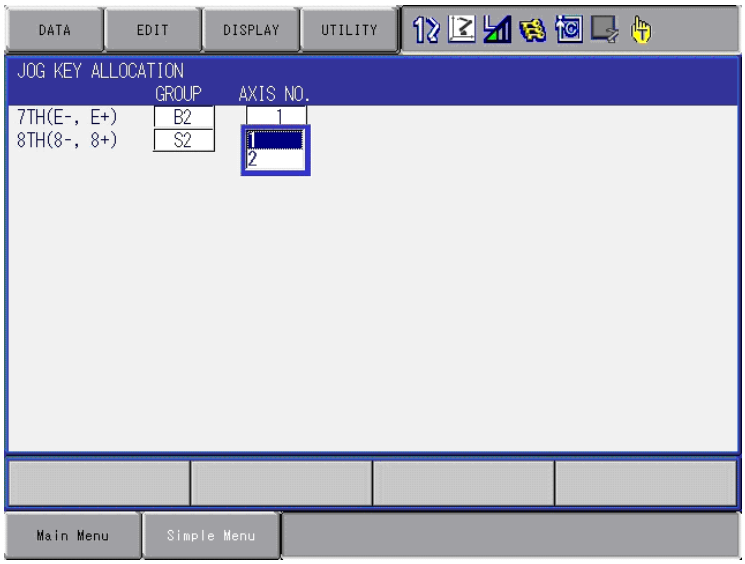
1. Select {SETUP} under main menu.
2. Select {JOG KEY ALLOCATION}.
   – Jog key allocation window appears.



3. Move the cursor key to “GROUP” and press down [SELECT] key.
   – The list of allocatable external axes appears.



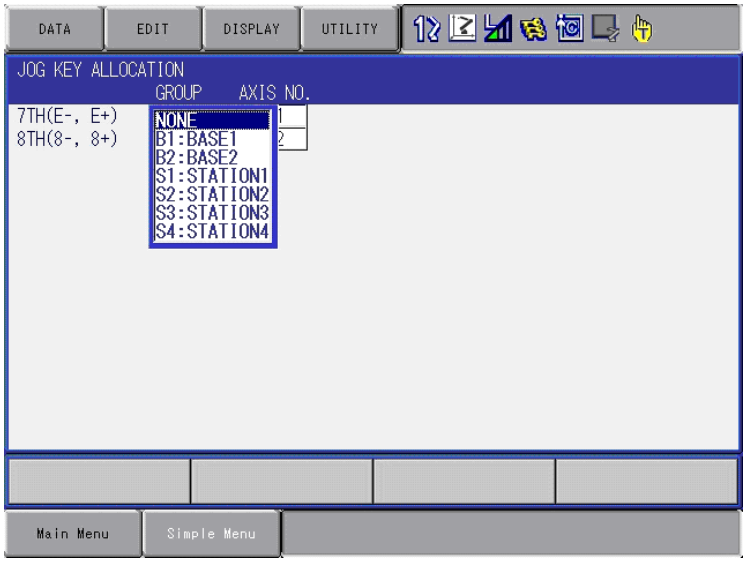
4. Select an external axis to be allocated.
   – The selected external axis is indicated in “GROUP” and “1” is indicated in “AXIS NO”.
5. (In the cases where the external axis is composed of more than two axes and the axis from the 2nd-axis are operated)
   Move the cursor key to “AXIS NO”. and press down [SELECT] key.
   – The list of selected external axes appears.



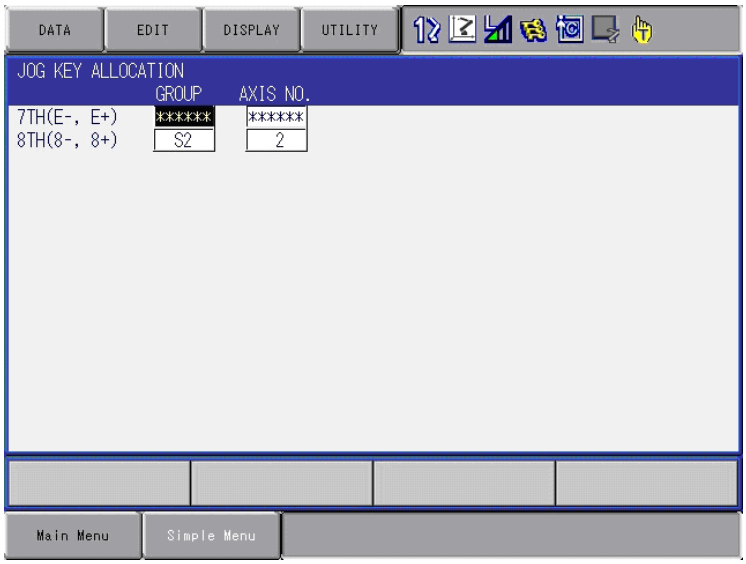
6. Select a desired axis number.
   – The selected axis is indicated in “AXIS NO”.

6.10.2.2 Cancellation of Jog Key Allocation

1. Select {SETUP} under main menu.
2. Select {JOG KEY ALLOCATION}.
   – Jog key allocation window appears.
3. Move the cursor key to “GROUP” and press down [SELECT] key.
   – The list of allocatable external axes appears.



4. Select “NONE”.
   – “******” is indicated in “GROUP” and “AXIS NO”.



6.10.2.3 Operating Method of Allocated External Axis

CAUTION

- When the same external axis (same group and axis number) is allocated to 7th- and 8th-axis keys, it won't move even both keys are pressed individually. In the case like this, the message "Check the setting of JOG KEY ALLOCATION(7th and 8th)" is indicated to alarm that the same external axis is allocated to two different keys. Please cancel the allocation setting or allocate another external axis to either of the key.

1. Press [ROBOT] key.
   – A mark of robot is indicated at the left side of the status area on the programming pendant, and this expresses that the robot is selected to be the object of operation.
   Also, the LED of [ROBOT] key lights.
2. Press 7th(E+,E-)-axis or 8th(8+,8-)-axis operation key.
   – The allocated external axes moves if there are no 7th- and 8th-axes and the allocation setting was done properly.

6.11 Energy-Saving Function

6.11.1 Energy-Saving Function

Energy-saving function is a function to save power by halting the power to the robot after applying brake to the motor when robot's all axes won't move for a designated period of time while servo is turned ON in play mode. The initial designated period of time is 10 minutes.

This energy-saving function is valid when all the following condition met.

1. Energy-saving function is valid.
2. The system input signal (signal to prohibit on energy-saving mode #40580) is turned OFF.

Followings are the status of the robot while this function is valid.

1. The message "On energy saving mode" is indicated on the programming pendant.
2. The servo is turned ON.
3. The jobs under execution are continuously executed.
4. The system output signal (ENERGY-SAVING:SOUT#0576(#50727))to indicate that it is in energy-saving status is turned ON while other signals won't change.

CAUTION

This function is cancelled in the following cases.

- When the programming pendant mode is switched to teach mode.
- When the system input signal of external servo OFF(1,2,3) is input.
- When the axis, which belongs to the subject control group of the executing job, is about to move while energy-saving function is valid.
- In the cases where emergency stop or servo OFF is executed when alarming.

NOTE

This function will not be cancelled if the system input signal (signal to prohibit energy-saving #40580) is turned ON. This signal merely prohibits to shift the status to energy-saving status.

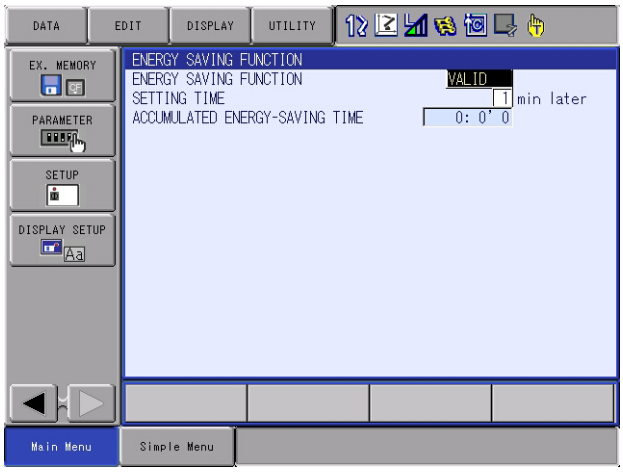
6.11.2 Energy-Saving Setting Method

6.11.2.1 Valid/Invalid of Energy-Saving Setting

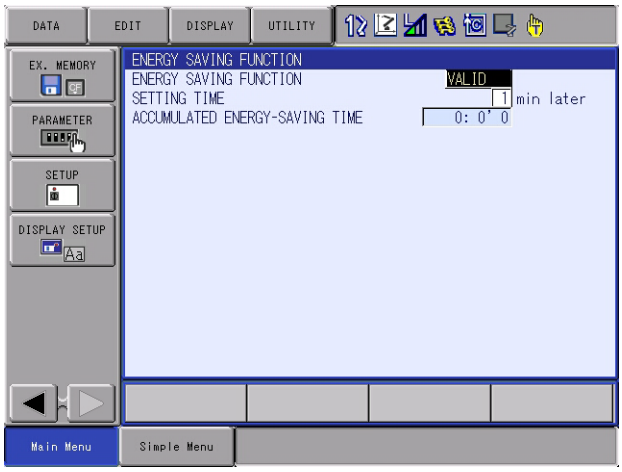
CAUTION

- Valid/invalid of the energy-saving function is available only in the management mode while only confirmation of this function is available in the operation mode and edit mode.

1. Select {SETUP} under main menu.
2. Select {ENERGY SAVING FUNCTION}.
   – Energy-saving function window appears.



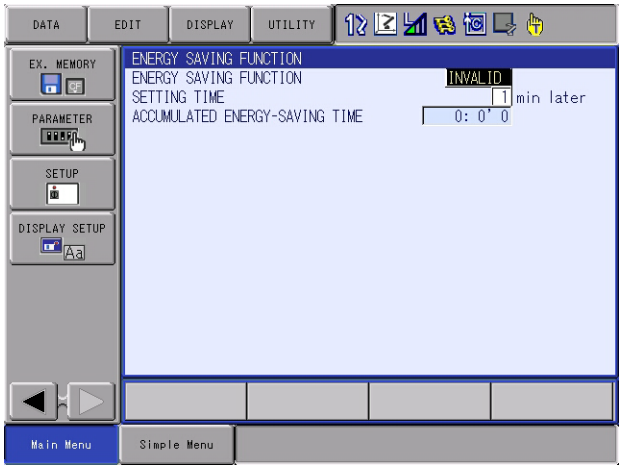
3. Move the cursor key to “ENERGY SAVING FUNCTION” and press [SELECT].
   – Valid and invalid alternate at each press of select key.



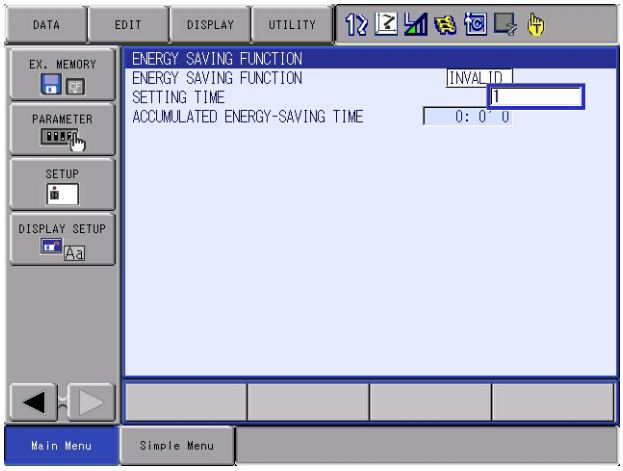
↑

Press [SELECT] key

↓

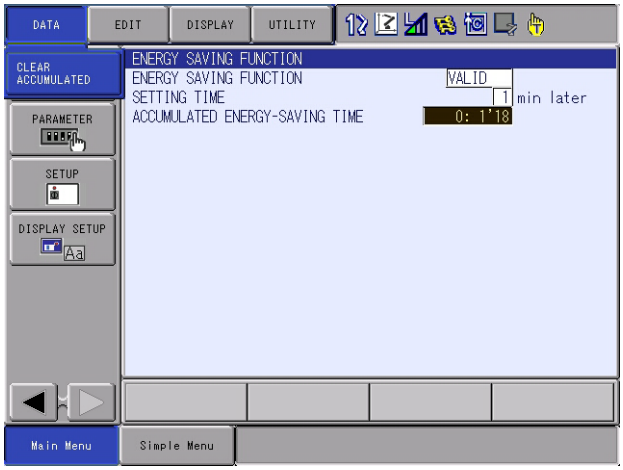


4. Move the cursor key to {SETTING TIME} and press [SELECT] key.
   – Input the time you want to start energy-saving after the robot is stopped into {SETTING TIME} section (unit: min.). The initial value is set to 10 min. and the range of the inputting value is from 1 to 60.

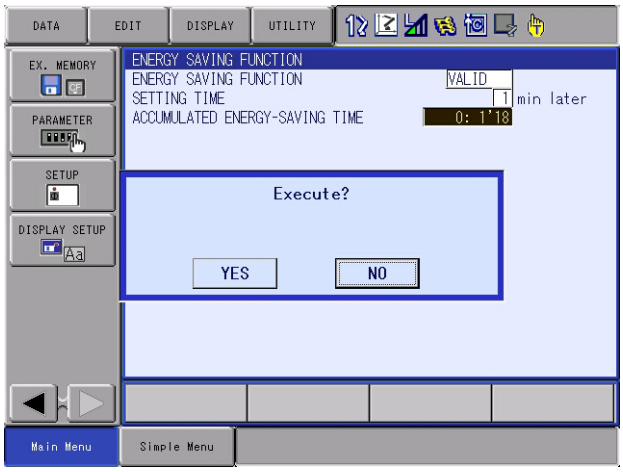


6.11.2.2 Accumulated Energy-Saving Time Clearance

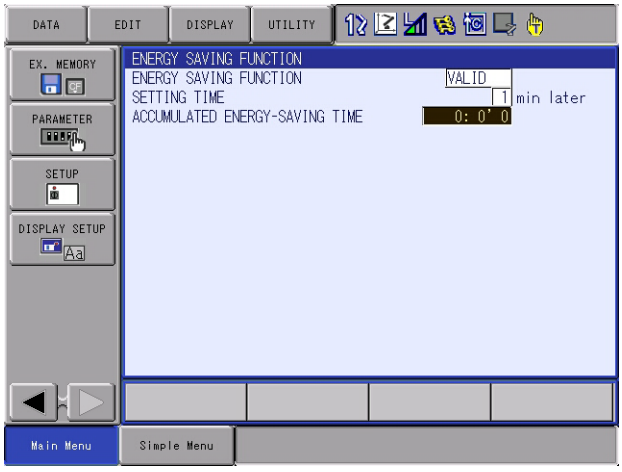
1. Select {SETUP} under main menu.
2. Select {ENERGY SAVING FUNCTION}.
   – Energy-saving function window appears.
3. Move the cursor key to {ACCUMULTED ENERGY-SAVING TIME}.
4. Move the cursor key to {DATA} and press [SELECT] key.
   – “CLEAR ACCUMULTED” appears in the pull-down menu.



5. Select {CLEAR ACCUMULTED}
   – The confirmation dialog box appears.



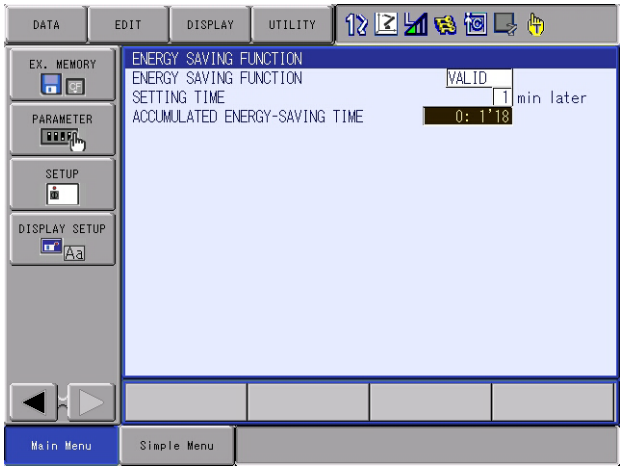
6. Select “YES” on the dialog box,
   – The accumulated energy-saving time is cleared.



6.11.3 Energy-Saving Status Confirmation Method

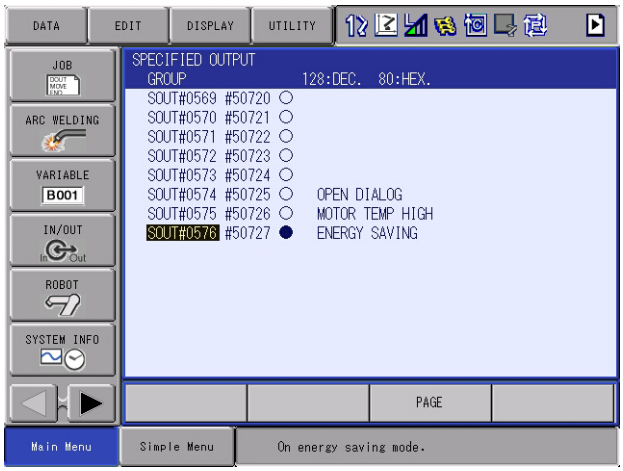
6.11.3.1 Confirmation by the accumulated energy-saving time

1. Select {SETUP} under main menu.
2. Select {ENERGY SAVING FUNCTION}.
   – Energy-saving function window appears.
   The accumulated energy-saving time is being counted up while the status is in the energy-saving mode.



6.11.3.2 Confirmation by System Signal Output

1. Select {IN/OUT} under main menu.
2. Select {SPECIFIC OUTPUT}.
   – The specific output window appears.
3. Press [PAGE] or [SELECT] key to display SOUT#0576 (#50727).
   – The system output status during the energy-saving status is indicated.
   This signal is turned ON while in the energy-saving mode.



   – This signal is turned OFF after the energy-saving mode is released.

6.12 Instruction Displaying Color Setting Function

6.12.1 Setting the Instruction Displaying Color on the Job Window[1)]

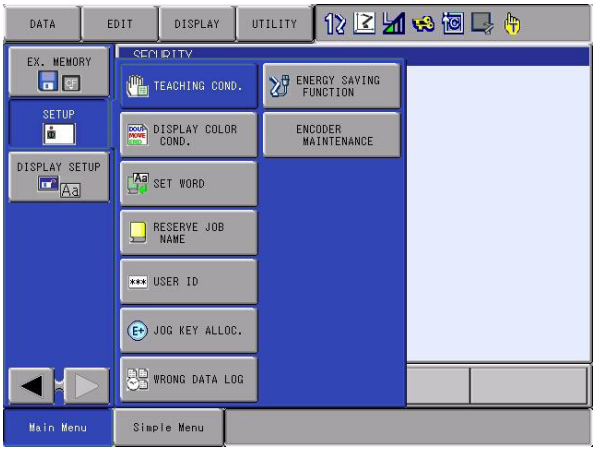
With this function, each instruction can be displayed on a color to color basis on the job window.

The following instructions are the subject of this function.

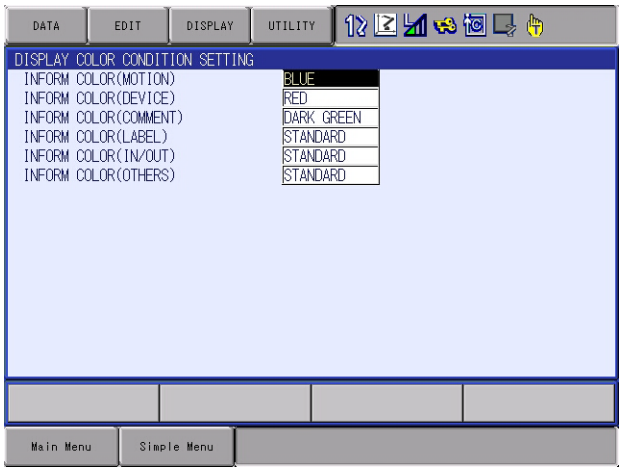
- Move instruction
- DEVICE instruction
- Comment instruction
- Label instruction
- Macro instruction (when the macro function is effective)
- I/O instruction
- All the instructions other than listed above

The color of each instruction in the job window can be set on the DISPLAY COLOR CONDITION SETTING window.

1. Select {SETUP} under the main menu.

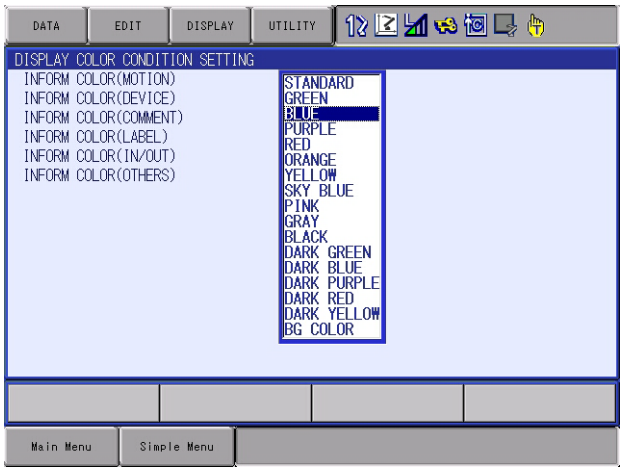


2. Select {DISPLAY COLOR CONDITION SETTING}.
   – The display color condition setting window appears.

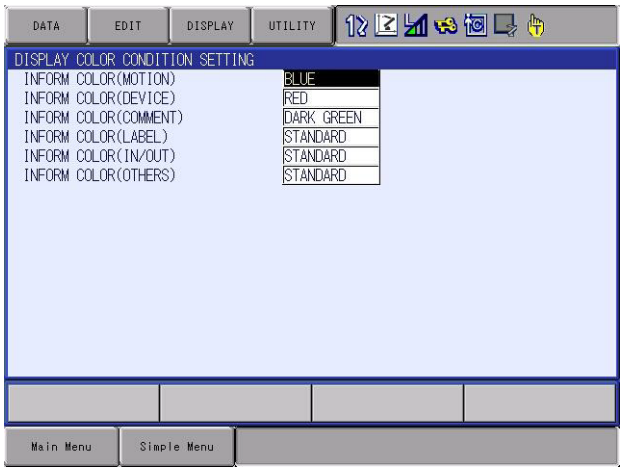


1 Instruction displaying color setting function on the job window is available from version DS2.00-00.

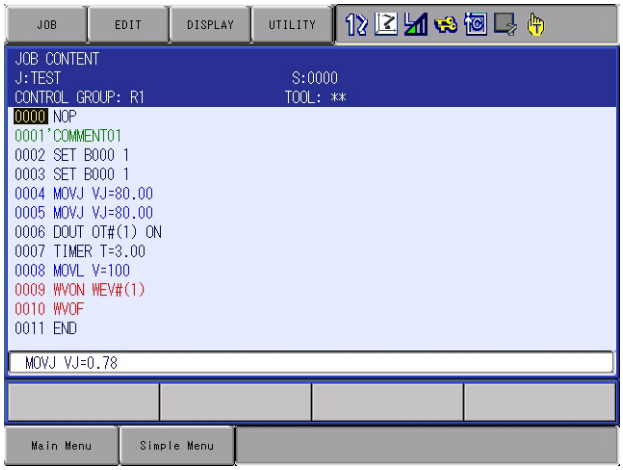
3. Move the cursor to the instruction to be changed and press [SELECT].
   – The list of the candidate colors for the instruction is displayed.



4. Select a color.
   – The color of each instruction is fixed.



5. Select JOB window.
   – Each instruction is displayed in the selected colors on the job window.



6.13 Present Manipulator Position Output Function

6.13.1 Outline

Output the present manipulator's cartesian position (base coordinate) to the specified register.

6.13.2 Parameters

The following parameters specify the function and output register number.

S1CxG	Meaning
208	Specify a function which outputs a specified value of the present cartesian position (base coordinate) to the register 0: invalid 1: Valid
209	Specify the output size to the register 0: 2 bytes output 1: 4 bytes output
210	Cartesian position (command value) X register number of output destination
211	Cartesian position (command value) Y register number of output destination
212	Cartesian position (command value) Z register number of output destination
213	Cartesian position (command value) Rx register number of output destination
214	Cartesian position (command value) Ry register number of output destination
215	Cartesian position (command value) Rz register number of output destination
216	Cartesian position (command value) Re register number of output destination
217	Specify a function which outputs a FB value of the present cartesian position (base coordinate) to the register 0: invalid 1: Valid
218	Specify the output size to the register 0: 2 bytes output 1: 4 bytes output
219	Cartesian position (FB value) X register number of output destination
220	Cartesian position (FB value) Y register number of output destination
221	Cartesian position (FB value) Z register number of output destination
222	Cartesian position (FB value) Rx register number of output destination
223	Cartesian position (FB value) Ry register number of output destination
224	Cartesian position (FB value) Rz register number of output destination
224	Cartesian position (FB value) Re register number of output destination

(Example 1)

S1C1G	Setting value
208	1
209	0
210	10
211	11
212	12
213	13
214	14
215	15
216	16

When setting the parameter as above, the manipulator's present cartesian position is output to the registers as follows.

M010 = Manipulator's present cartesian position (command value) X [unit: mm]

M011 = Manipulator's present cartesian position (command value) Y [unit: mm]

M012 = Manipulator's present cartesian position (command value) Z [unit: mm]

M013 = Manipulator's present cartesian position (command value) Rx [unit: deg]

M014 = Manipulator's present cartesian position (command value) Ry [unit: deg]

M015 = Manipulator's present cartesian position (command value) Rz [unit: deg]

M016 = Manipulator's present cartesian position (command value) Re [unit: deg]

(Example 2)

S1C1G	Setting value
217	1
218	1
219	10
220	12
221	14
222	16
223	18
224	20
225	22

When setting the parameter as above, the manipulator's present cartesian position is output to the registers as follows

M010=	Lower 2 bytes of the	manipulator's present cartesian position (FB value)	X	[unit: μmm]
M011=	Upper 2 bytes of the	manipulator's present cartesian position (FB value)	X	[unit: μmm]
M012=	Lower 2 bytes of the	manipulator's present cartesian position (FB value)	Y	[unit: μmm]
M013=	Upper 2 bytes of the	manipulator's present cartesian position (FB value)	Y	[unit: μmm]
M014=	Lower 2 bytes of the	manipulator's present cartesian position (FB value)	Z	[unit: μmm]
M015=	Upper 2 bytes of the	manipulator's present cartesian position (FB value)	Z	[unit: μmm]
M016=	Lower 2 bytes of the	manipulator's present cartesian position (FB value)	Rx	[unit: 0.001deg]
M017=	Upper 2 bytes of the	manipulator's present cartesian position (FB value)	Rx	[unit: 0.001deg]
M018=	Lower 2 bytes of the	manipulator's present cartesian position (FB value)	Ry	[unit: 0.001deg]
M019=	Upper 2 bytes of the	manipulator's present cartesian position (FB value)	Ry	[unit: 0.001deg]
M020=	Lower 2 bytes of the	manipulator's present cartesian position (FB value)	Rz	[unit: 0.001deg]
M021=	Upper 2 bytes of the	manipulator's present cartesian position (FB value)	Rz	[unit: 0.001deg]
M022=	Lower 2 bytes of the	manipulator's present cartesian position (FB value)	Re	[unit: 0.001deg]
M023=	Upper 2 bytes of the	manipulator's present cartesian position (FB value)	Re	[unit: 0.001deg]

NOTE

- When validating the command value register output function (S1CxG208=1), never fail to set the output register number (S1CxG210 to 216) of each coordinate value.
- When validating the FB value register output function (S1CxG217=1), never fail to set the output register number (S1CxG219 to 225) of each coordinate value.
- In case 2 bytes is set as the register output size (S1CxG209=1 or S1CxG218=1), the unit of X,Y and Z-axes coordinate value becomes “mm” and that of Rx, Ry, Rz and Re coordinate value becomes “deg”. In both cases, only the lower 2 bytes are output.
- When setting 4 bytes to the register output size (S1CxG209=1 or S1CxG218=1), the unit of X,Y and Z-axes coordinate value becomes “µmm” and that of Rx, Ry, Rz and Re coordinate value becomes “0.0001deg”.
- When setting 4 bytes to the register output size (S1CxG209=1 or S1CxG218=1), upper byte of the coordinate value is output to the following register number to the specified output register number. In this consequence, confirm the register’s status of use before setting the output size to the register.

6.14 Softlimit Setting Function

6.14.1 About the Softlimit Setting Function

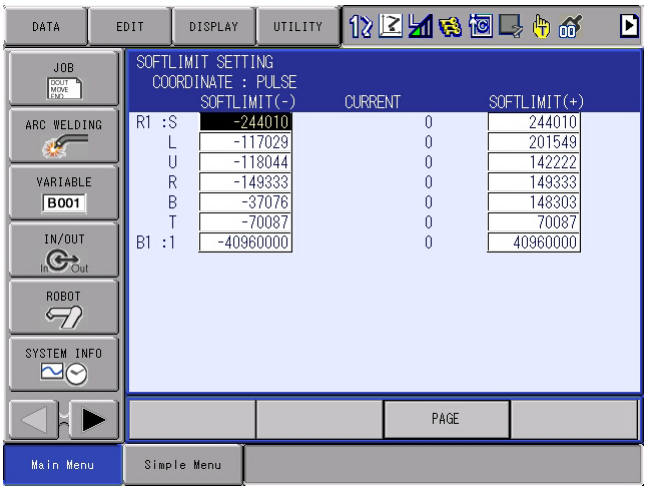
The softlimit setting function is a function to set the softlimit to limit the range of the manipulator motion in software.

6.14.2 The Softlimit Setting Screen

CAUTION

- The softlimit setting screen is displayed at the teach mode and the management mode.

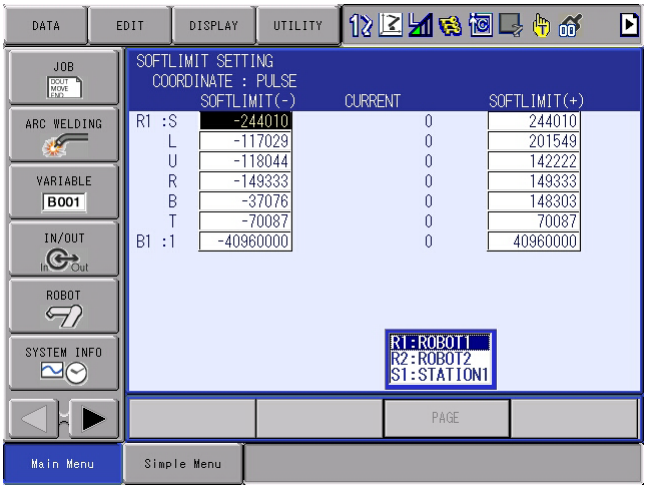
1. Select {ROBOT} in the main menu.
2. Select {SOFTLIMIT SETTING}.
   – The softlimit setting screen is displayed.



3. Set the control group as desired.

   – Switch to the desired control group by the page key or the selection dialog.

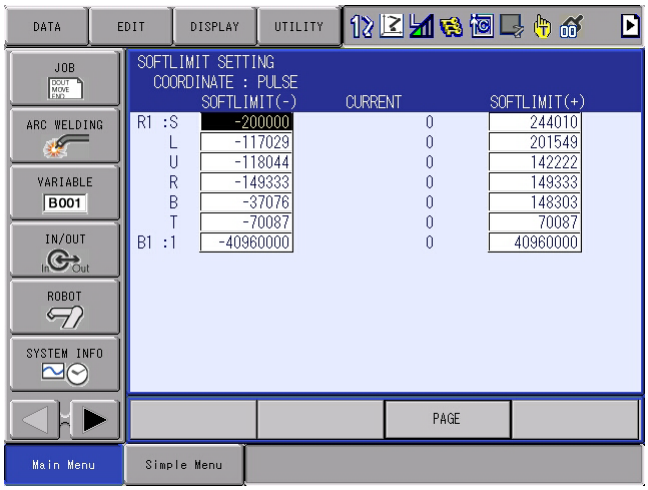
   – As for the selection dialog, select [PAGE] on the screen and move the cursor to desired control group. Press [SELECT].



6.14.3 Setting the Softlimit by Numerical Value Input

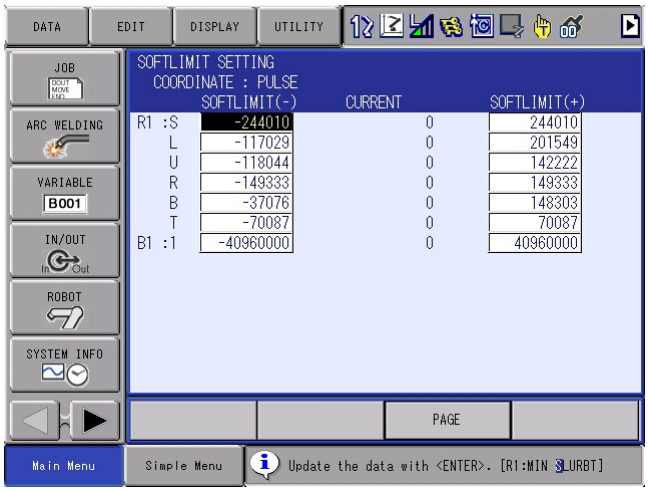
1. Move the cursor to the desired axis of the softlimit (+) or the softlimit (-), and press [SELECT].
2. Enter the values of the softlimit (+)/ the softlimit (-), and press [ENTER].

   – The softlimit is set.



6.14.4 Set the Current Value to the Softlimit

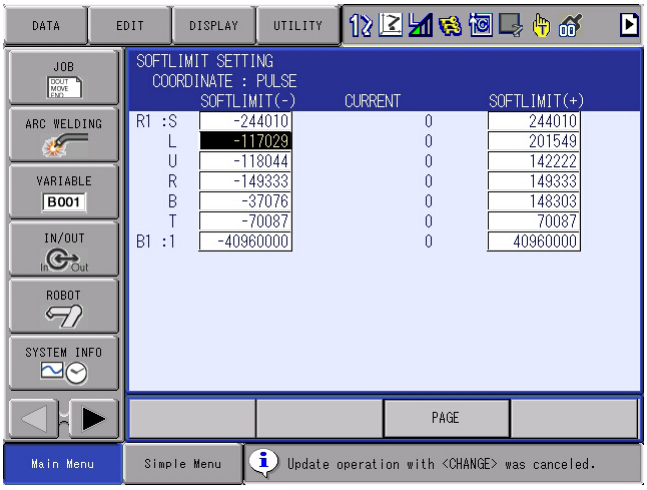
1. Move the manipulator by the axis key.
   – Move the manipulator to the position of which value is maximum number or minimum number of the softlimit by the axis key.
2. Move the cursor to the desired axis of the softlimit (+) or the softlimit (-).
   – When change the maximum number of the first softlimit, move the cursor to the first axis of the softlimit (+).
   – When change the minimum number of the first softlimit, move the cursor to the first axis of the softlimit (-).
3. Press [MODIFY].
   – The message [Update the data with <ENTER>.] appears.



   – If perform the one of the following operations, the modify operation will be canceled.

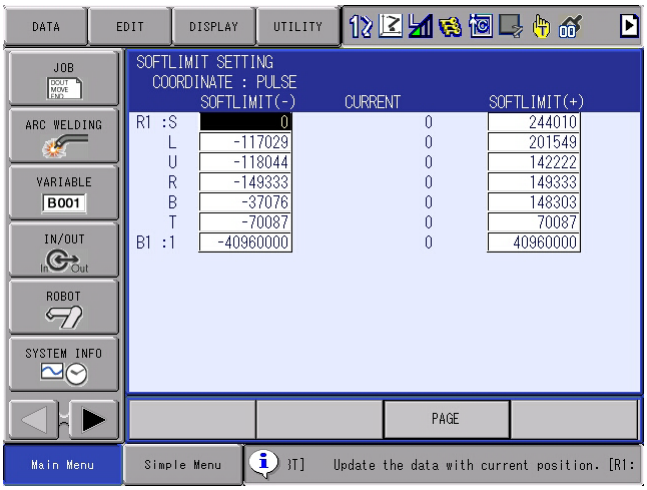
   • Press [MODIFY] key.
   • Press [SELECT] key.
   • Press the one of [↑] [↓] [←] [→] keys.
   • Press [PAGE] key.
   • Press [DIRECT OPEN] key.
   • Press a ten key.
   • Select the reserved display.
   • Switch the screen.
   • Switch the mode.

– The message [Update operation with <CHANGE> was canceled.] appears.



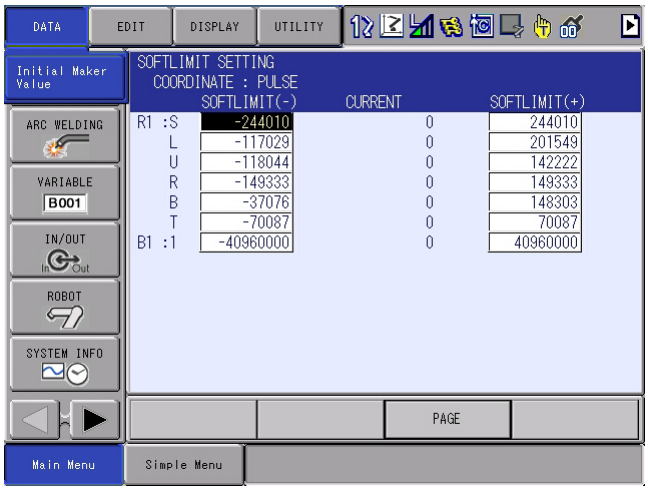
4. Press [ENTER].

– The current position is set as the softlimit.

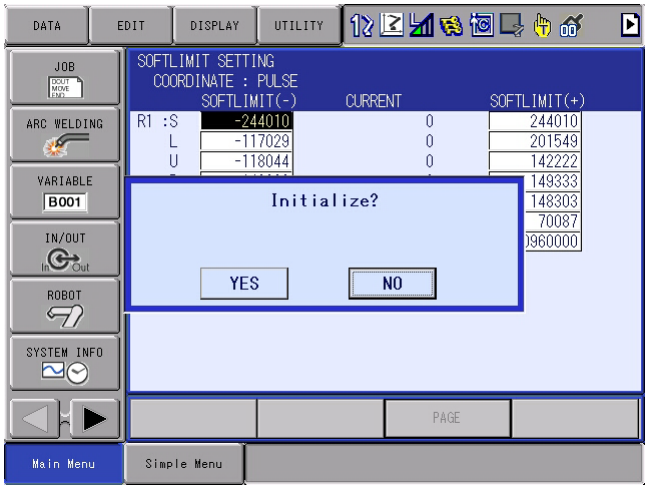


6.14.5 Set the Softlimit (+)/ the Softlimit (-) to the Initial Maker Value

1. Select {DATA} in the pull-down menu.
   – {Initial Maker Value} appears.



2. Select {Initial Maker Value}.
   – The confirmation dialog appears.

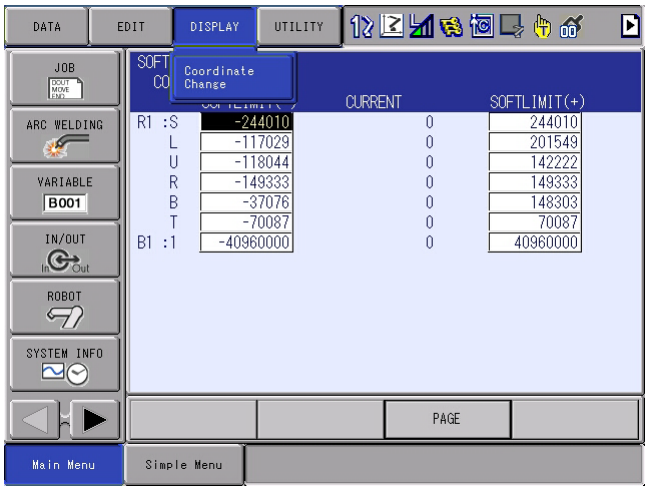


3. Select [YES].
   – The initial maker value is set for all displayed axes.
   The operation is canceled when select [NO].

> **NOTE**
>
> The initial maker value limits the range of the mechanical motion of the manipulator, and it varies according to the model of the robot.
>
> It is different from the motion range which was set to add the base station axis.

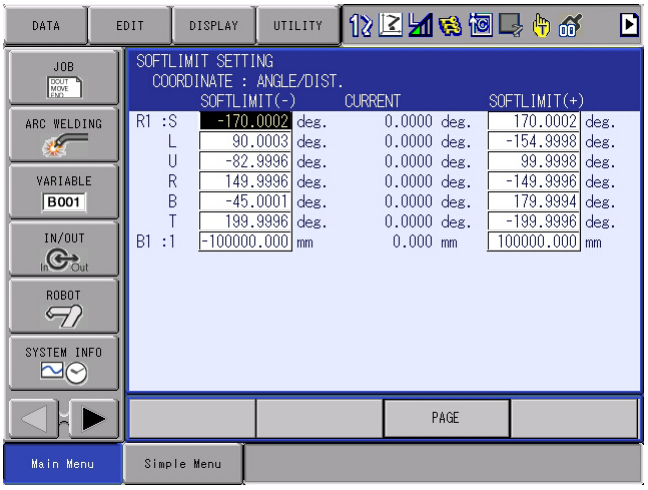
6.14.6 Change the Coordinate Display of the Softlimit (+)/ the Softlimit (-)

1. Select {DISPLAY} in the pull-down menu.
   – {Coordinate Change} appears.



2. Select {Coordinate Change}.
   – When the displaying coordinate is a pulse,
   the robot axis is changed to the angle display;
   the base axis is changed to the distance display; and
   the station axes is changed for each axis by the value of the station axis display parameter (S2C265 to 288).

   When the first bit is OFF, the first axis is changed to the angle display.
   When the second bit is ON, the second axis is changed to the distance display.
   When the display coordinate is angle/distance, the all axes are changed to the pulse display.



NOTE

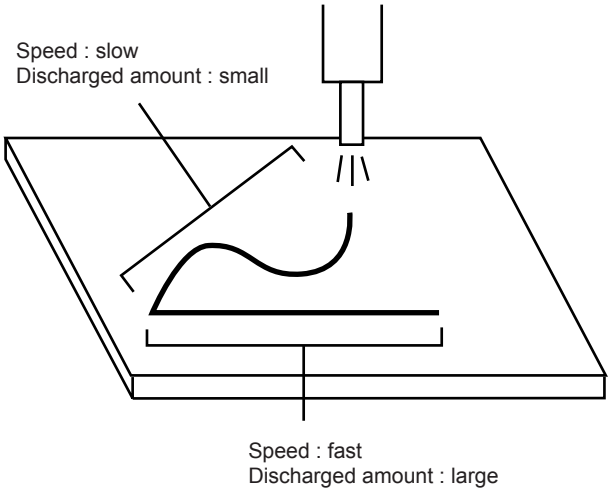
- When the display of the softlimit value is the angle display, the pulse display and the sign may be different.
- Be sure to confirm the motion range by the jog operation after changing the softlimit value.

6.15 Analog Output Function Corresponding to Speed

6.15.1 Overview

The analog output function corresponding to speed changes the analog output value automatically, according to the manipulator operating speed. This function does not need resetting of the analog output value according to the operating speed, so that the time required for job teaching can be reduced.

For example, when the thickness of sealing or painting should be constant, the discharged amount of seals or paints can be controlled by the manipulator operating speed.



NOTE

For the analog output function corresponding to speed, the following board is needed.

- Analog output expansion board: JANCD-YEW02-E

6.15.2 Instructions

6.15.2.1 Instructions for Analog Output Function Corresponding to Speed

The instructions, ARATION and ARATIOF, are used for the analog output function corresponding to speed.

■ **ARATION**

The analog output function corresponding to speed is performed after executing ARATION instruction. This instruction is valid during circular interpolation, linear interpolation or spline interpolation. It is executed only at playback or FWD key operation; it is not executed during axis operation.

This instruction is also used when each set value for the analog output function corresponding to speed is to be changed.

ARATION AO#(1) BV=10.00 V=200.0 OFV=2.00

① ② ③ ④

①**Output port number**
General analog output port to execute the analog output corresponding to speed
Setting range : 1 to 40

②**Basic voltage**
Voltage to be output at the speed set with the basic speed.
Setting range : -14.00 to +14.00V

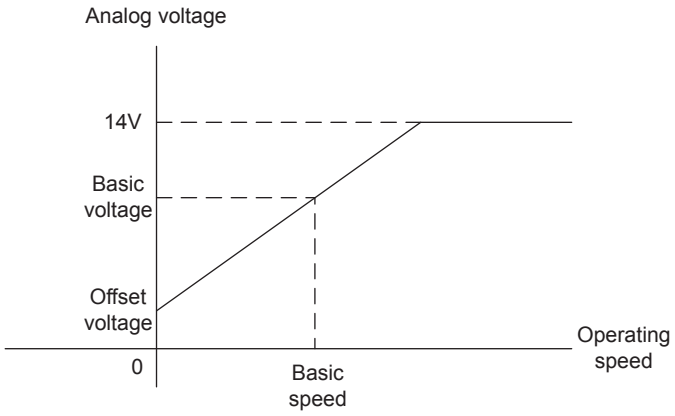
③**Basic speed**
Operating speed which becomes the basis for when the set voltage is output.
Setting range : 0.1 to 1500.0mm/sec
1 to 9000cm/min

④**Offset voltage**
Analog voltage when the operating speed is 0.
Setting range : -14.00 to +14.00V

According to the set value of the ARATION instruction, the output characteristics for the relation between the operating speed and the analog voltage are calculated. The analog output function corresponding to speed is executed depending on these output characteristics.

The following graph shows the output characteristics.

Fig. 6-5: Output Characteristics When Analog Output Function Corresponding to Speed is Used



NOTE When the analog output value exceeds ± 14.00 V because of the operating speed, the value is limited within ± 14.00 V.

■ **ARATIOF**

When the ARATIOF instruction is executed, the analog output corresponding to speed is completed, and the set offset voltage becomes the fixed output.

ARATIOF AO#(1)

①

①**Output port number**

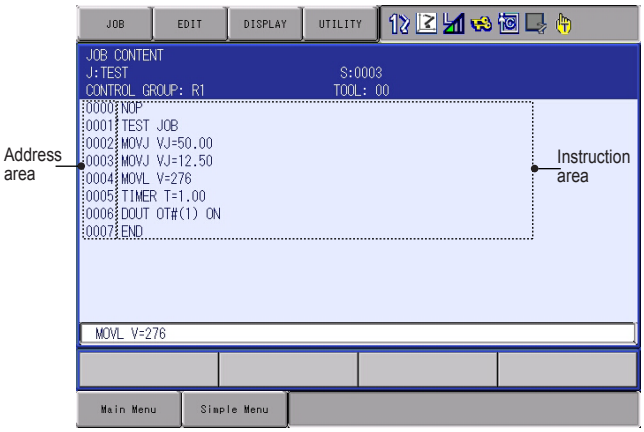
General analog output port to end the analog output corresponding to speed

Setting range : 1 to 40

6.15.2.2 Registration of Instructions

The instructions can be registered when the cursor is in the address area on the job content display in teach mode. Perform the following operations before registering an instruction.

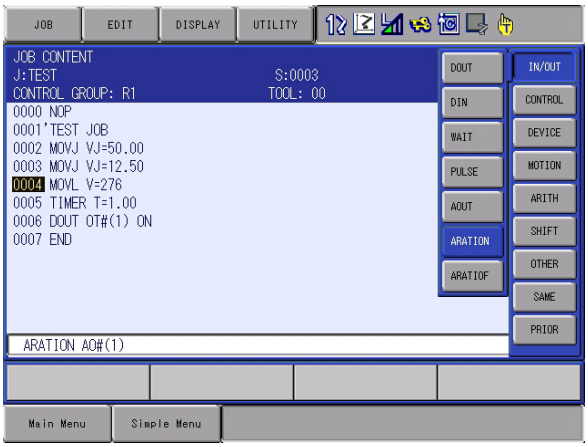
1. Select {JOB} under the main menu
2. Select {JOB CONTENT}
3. Move the cursor to the address area



■ **ARATION**

1. Move the cursor to one line above the place to register the ARATION instruction

2. Press [INFORM LIST]
3. Select [IN/OUT]
   – The instruction list dialog appears.

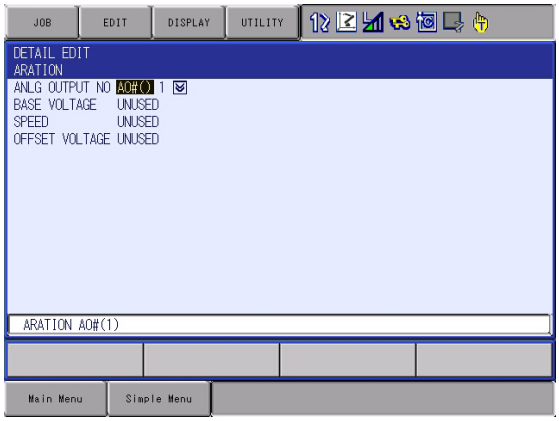


4. Select “ARATION”
   – The ARATION instruction is indicated in the input buffer line.

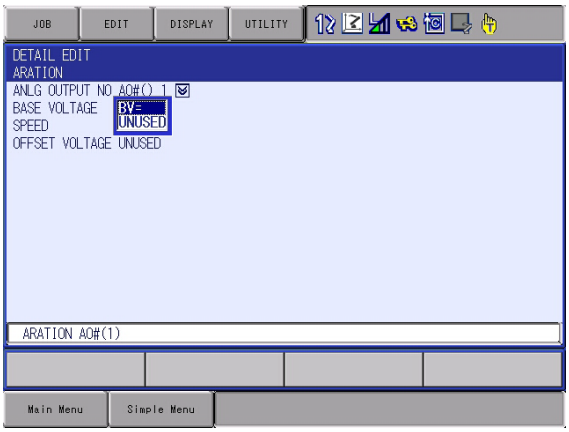
5. Change any additional items and numerical values
   - <Register without changes>
     To register without changes, perform operation of step 6.
   - <Register with addition or change of the additional items>
     - To change the output port number
       In case of using [SHIFT] and the cursor key, move the cursor to the output port number, and then press [SHIFT] and the cursor key simultaneously, to change the output port number.

In case of using the number keys, move the cursor to the output port number, and press [SELECT] to display an input buffer line. Enter the number, and then press [ENTER] to change the number displayed.

- To change the basic voltage, the speed, and the offset voltage
  Move the cursor to the instruction in the input buffer line, and then press [SELECT]. The detail edit display is shown.



Move the cursor to “UNUSED” of the additional item to be changed, and then press [SELECT]. The selection dialog is displayed.
Move the cursor to the additional item to be changed, and press [SELECT].



When the additional item is changed, press [ENTER]. The detail

edit window closes, and the job content window appears.

6. Press [INSERT] and [ENTER]
   – The instruction indicated in the input buffer line is registered.

The line where ARATION instruction is registered.

```
0020 MOVL V=138
0021 ARATION AO#(1) BV=10.00
0022 MOVL V=138
```

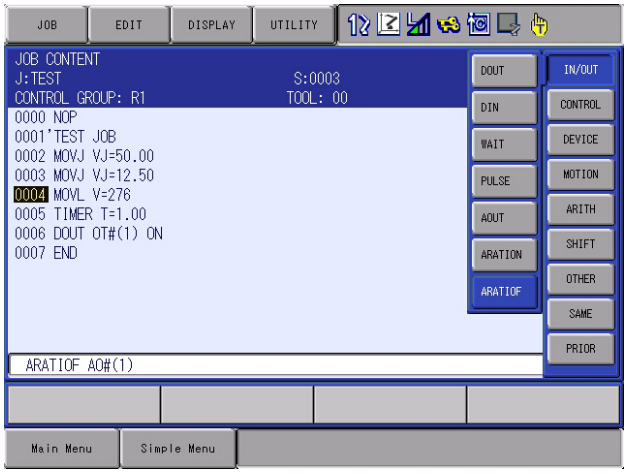
■ **ARATIOF**

1. Move the cursor to one line above the place to register ARATIOF instruction

The line above the place to register ARATIOF instruction.

```
0030 MOVL V=138
0031 MOVL V=138
0032 MOVL V=138
```

2. Press [INFORM LIST]
3. Select [IN/OUT]
   – The instruction list dialog appears.



4. Select “ARATIOF”
   – The ARATIOF instruction is indicated in the input buffer line.

```
ARATIOF AO#(1)
```

5. Press [INSERT] and [ENTER]
   – The ARATIOF instruction is registered.

```
0030 MOVL V=138
0031 ARATIOF AO#(1)
0032 MOVL V=138
```

6.15.2.3 Analog Output Display

The current settings can be confirmed on the analog output window.

①**Terminal**
General analog output port

②**OUTPUT (V)**
Indicates the voltage which is currently output.

③**BASIC (V)**
Indicates the basic voltage used for the analog output corresponding to speed.
This value is used until a new value is set by ARATION instruction.

④**TRAIT**
Indicates the current output characteristics of the output port.
SP RAT : during execution of the analog output corresponding to speed
STATIC : fixed output status

⑤**OFFSET (V)**
Indicates the offset voltage used for the analog output corresponding to speed.
This value is used until a new value is set by ARATION instruction.

⑥**BASIC SPD**
Indicates the basic speed used for the analog output corresponding to speed.
This value is used until a new value is set by ARATION instruction.

⑦**ROBOT**
Indicates the manipulator number for the analog output corresponding to speed.

1. Select {IN/OUT} from the main menu
2. Select {ANALOG OUTPUT}
   – The analog output window appears.

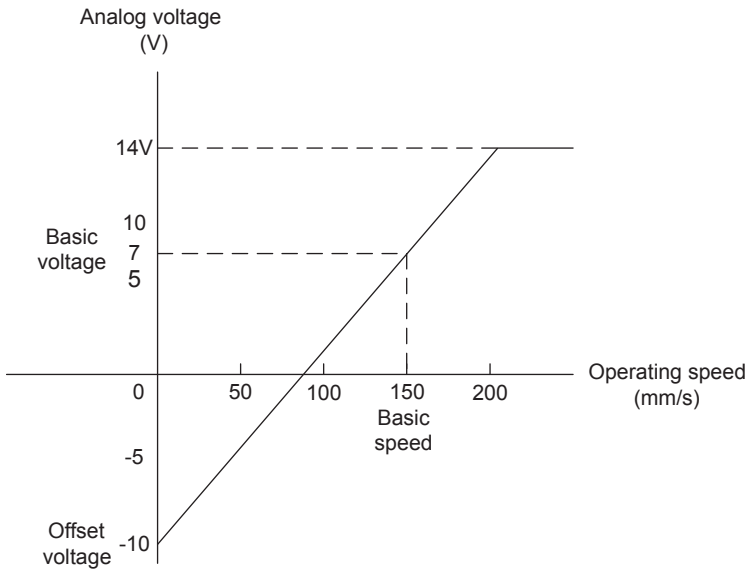
The output terminal numbers which follow the AOUT4 can be switched and displayed by pressing the page key.

6.15.3 Examples

6.15.3.1 Examples of Output Characteristics

The graph below shows the change in the output characteristics when the following job is done.

	Output Voltage (V)
MOVJ VJ=50.00	
ARATION AO#(1) BV=7.00 V=150.0 OFV=-10.00	7.00
MOVL V=50.0	-4.33
MOVC V=100.0	1.33
MOVC V=100.0	1.33
MOVC V=100.0	1.33
MOVL V=200.0	12.67



6.15.3.2 Example of Variation of Operating Speed and Analog Output Value

The following graph shows the change of the analog output according to the speed variation.

MOVL V=200.0····①

ARATION AO#(1) BV=10.00 V=200.0 OFV=-2.00

MOVC V=150.0····②

MOVC VR=20.0····③ (When the tool center point speed is 100 mm/s)

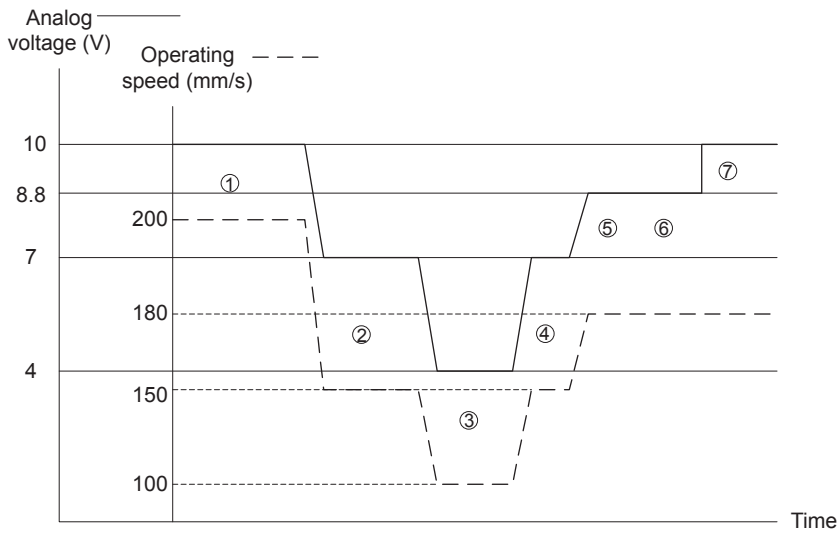
MOVC V=150.0····④

MOVL V=180.0····⑤

MOVL····⑥ (When the tool center point speed is 180 mm/s)

AOUT AO#(1) 10.00····⑦

Fig. 6-6: Analog Voltage according to Speed



NOTE

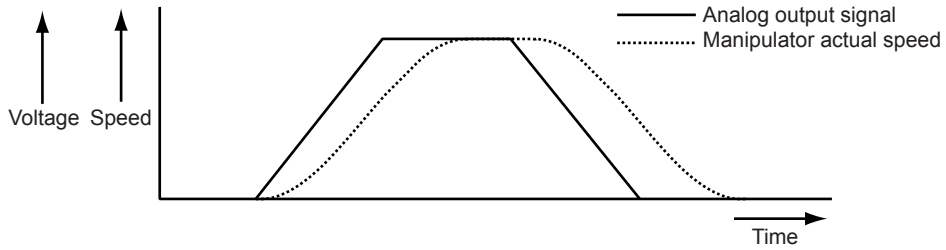
- Since the analog output corresponding to speed is made for the calculated speed, there may be little difference from the actual operating speed of the manipulator.
- When a posture speed is specified, the analog output corresponding to speed is made for the operating speed at the tool center point with the posture speed.

6.15.4 Filter Process

In the analog output function corresponding to speed, the output analog signal can be filtered by setting a filter constant at the parameters.

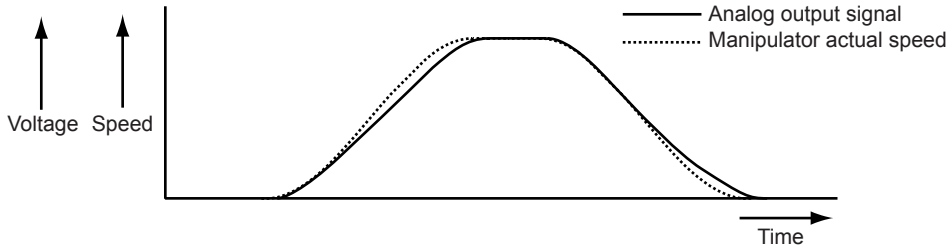
6.15.4.1 When Parameter is Set to “0”

The analog signal according to the speed reference (the speed determined by a path operation) is output.



6.15.4.2 When Parameter is Set to Values Other Than “0”

The analog signal according to the speed of filtered speed reference is output. By the filter process, the output signal can be close to the manipulator’s actual speed.



6.15.4.3 Parameter Setting

Adjust the settings of parameters during actual operations.

Table 6-4: Parameter (Sheet 1 of 3)

Parameter Number	Analog Output	Content	Unit
S3C1111 S3C1112	Analog output No.1 Analog output No.1	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1113 S3C1114	Analog output No.2 Analog output No.2	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1115 S3C1116	Analog output No.3 Analog output No.3	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1117 S3C1118	Analog output No.4 Analog output No.4	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1119 S3C1120	Analog output No.5 Analog output No.5	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1121 S3C1122	Analog output No.6 Analog output No.6	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1123 S3C1124	Analog output No.7 Analog output No.7	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1125 S3C1126	Analog output No.8 Analog output No.8	Primary filter constant Secondary filter constant	[msec] [msec]

Table 6-4: Parameter (Sheet 2 of 3)

Parameter Number	Analog Output	Content	Unit
S3C1127 S3C1128	Analog output No.9 Analog output No.9	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1129 S3C1130	Analog output No.10 Analog output No.10	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1131 S3C1132	Analog output No.11 Analog output No.11	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1133 S3C1134	Analog output No.12 Analog output No.12	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1135 S3C1136	Analog output No.13 Analog output No.13	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1137 S3C1138	Analog output No.14 Analog output No.14	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1139 S3C1140	Analog output No.15 Analog output No.15	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1141 S3C1142	Analog output No.16 Analog output No.16	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1143 S3C1144	Analog output No.17 Analog output No.17	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1145 S3C1146	Analog output No.18 Analog output No.18	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1147 S3C1148	Analog output No.19 Analog output No.19	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1149 S3C1150	Analog output No.20 Analog output No.20	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1151 S3C1152	Analog output No.21 Analog output No.21	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1153 S3C1154	Analog output No.22 Analog output No.22	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1155 S3C1156	Analog output No.23 Analog output No.23	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1157 S3C1158	Analog output No.24 Analog output No.24	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1159 S3C1160	Analog output No.25 Analog output No.25	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1161 S3C1162	Analog output No.26 Analog output No.26	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1163 S3C1164	Analog output No.27 Analog output No.27	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1165 S3C1166	Analog output No.28 Analog output No.28	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1167 S3C1168	Analog output No.29 Analog output No.29	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1169 S3C1170	Analog output No.30 Analog output No.30	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1171 S3C1172	Analog output No.31 Analog output No.31	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1173 S3C1174	Analog output No.32 Analog output No.32	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1175 S3C1176	Analog output No.33 Analog output No.33	Primary filter constant Secondary filter constant	[msec] [msec]

Table 6-4: Parameter (Sheet 3 of 3)

Parameter Number	Analog Output	Content	Unit
S3C1177 S3C1178	Analog output No.34 Analog output No.34	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1179 S3C1180	Analog output No.35 Analog output No.35	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1181 S3C1182	Analog output No.36 Analog output No.36	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1183 S3C1184	Analog output No.37 Analog output No.37	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1185 S3C1186	Analog output No.38 Analog output No.38	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1187 S3C1188	Analog output No.39 Analog output No.39	Primary filter constant Secondary filter constant	[msec] [msec]
S3C1189 S3C1190	Analog output No.40 Analog output No.40	Primary filter constant Secondary filter constant	[msec] [msec]

The standard parameter settings are as follows.

- For small capacity robot with a payload 6 kg and 16 kg
  Primary filter constant : 50 msec
  Secondary filter constant : 50 msec
- For large capacity robot with a payload 60 kg and 130 kg
  Primary filter constant : 100 msec
  Secondary filter constant : 100 msec

6.15.5 Precautions

6.15.5.1 When Analog Output Corresponding to Speed is Interrupted

If the manipulator is stopped for some reason and the editing operation is performed, the analog output corresponding to speed is interrupted. This interruption is performed in all output terminals, and the analog voltage fixed immediately before the interruption is output to each output terminal.

The analog output corresponding to speed is not interrupted in any other cases.

6.15.5.2 When More than One Manipulator is Used

The attribute of the job where the instruction is executed determines the manipulator where the analog output corresponding to speed is performed.

For a coordinated job, the analog output corresponding to speed is performed at the operating speed of the manipulator at the slave side.

7 External Memory Devices

7.1 Memory Devices

The following memory devices can be used in the DX100 to save and load data such as jobs and parameters.

Device	Function	Media (destination of saved/ loaded data)	Optional function requirement
CF: Pendant	Standard	Compact Flash Card (CF card)	No requirement. Programming pendant is equipped with a slot.
USB: Pendant	Standard	USB Memory Stick	No requirement. Programming pendant is equipped with a slot.
FC1	Optional[1)]	2DD floppy disk, personal computer (FC1 emulator)	“FC1“or personal computer with “FC1 emulator”
FC1 (DX)	Optional[1)]	Personal computer (FC1 emulator)	Personal computer with “FC1 emulator”
FC2	Optional[1)]	2DD floppy disk, 2HD floppy disk	“FC2”
PC	Optional[1)]	Personal computer (MOTOCOM32 host)	Via RS-232C: “Data transmission function “and “MOTOCOM32” Via Ethernet: “Ethernet function” plus above two requirements
FTP	Optional[1)]	FTP server such as personal computer	“Data transmission function”, “MOTOCOM32”, and “FTP function”

1 For the operation, refer to instruction manuals for each optional function.

7.1.1 Compact Flash (CF Cards)

The programming pendant is equipped with CF card slot. Use the FAT16 or FAT32 formatted Compact Flash.

7.1.1.1 Recommended Compact Flash Cards

Refer to section 9.1.2 “Device” in “DX100 INSTRUCTIONS (RE-CTO-A215)” for the recommended products used for external memory of DX100. Model numbers are subject to be updated due to termination of product and new addition. Contact Yaskawa representative when necessary.

7.1.1.2 Notes on handling Compact Flash

- Do not drop or bend exerting any shock or strong force to the Compact Flash.
- Keep away from water, oil, organic solvent, dust, and dirt.
- Do not use or keep the Compact Flash in places where strong static electricity or electronic noise may occur.
- Do not insert or remove the Compact Flash or turn OFF the power when accessing the Compact Flash (writing-in or reading-out the Compact Flash data).
- To protect the data, back up the data regularly on other media. Damages or loss of data due to operation errors or accidents can be minimized.

*Compact Flash has a limited life span.

The life span differs depending on products or status of use. However, normal use of Compact Flash as an external memory device for the DX100 does not adversely affect the Compact Flash. For details, refer to instruction manuals for each medium.

7.1.1.3 Inserting a Compact Flash

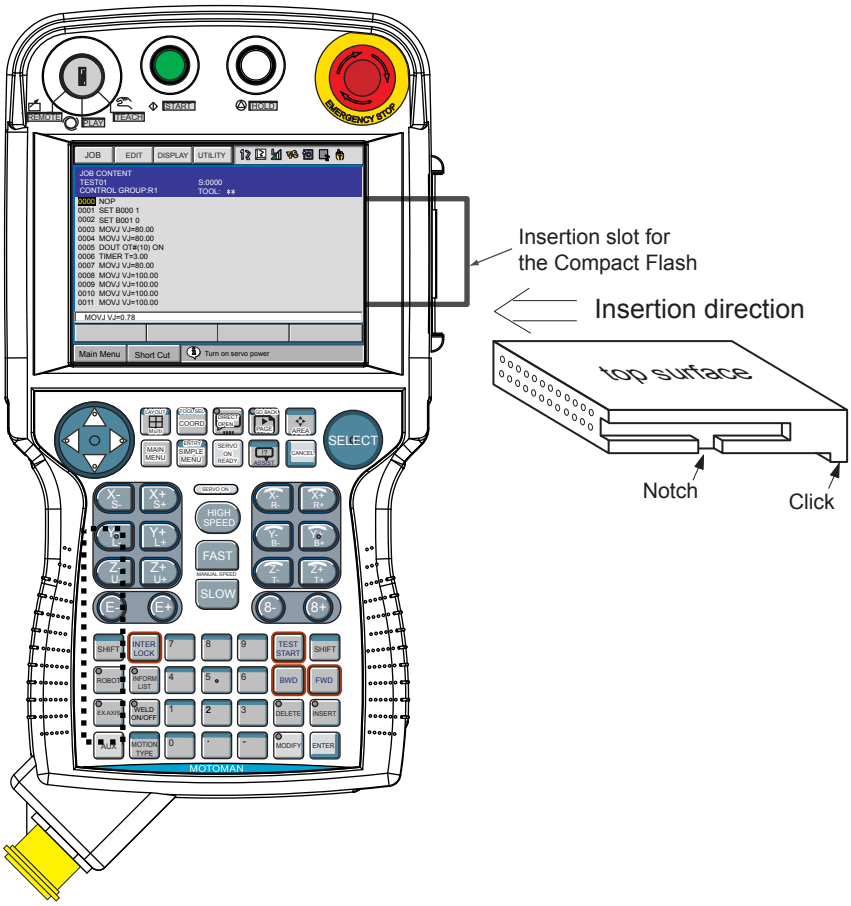
When inserting a Compact Flash, take note of insertion direction.

With the notch and clip of the Compact Flash downward, insert the Compact Flash slowly into the slot of the programming pendant of which display faces up.

Forcible insertion may result in damage to the Compact Flash or CF card slot.

After inserting the card, be sure to close the cover of the slot before starting operation.

Fig. 7-1: Using a Compact Flash Card



7.1.2 USB Memory Stick

The programming pendant is equipped with a USB connector. Use the FAT16 or FAT32 formatted USB memory stick.

7.1.2.1 Recommended USB Memory Stick

Refer to section 9.1.2 “Device” in “DX100 INSTRUCTIONS (RE-CTO-A215)” for the recommended products used for external memory of DX100. Model numbers are subject to be updated due to termination of product and new addition. Contact Yaskawa representative when necessary.

7.1.2.2 Notes on handling USB Memory Stick

- Do not drop or bend exerting any shock or strong force to the Compact Flash.
- Keep away from water, oil, organic solvent, dust, and dirt.
- Do not use or keep the Compact Flash in places where strong static electricity or electronic noise may occur.
- Do not insert or remove the Compact Flash or turn OFF the power when accessing the Compact Flash (writing-in or reading-out the Compact Flash data).
- To protect the data, back up the data regularly on other media. Damages or loss of data due to operation errors or accidents can be minimized.

*USB memory stick has a limited life span.

The life span differs depending on products or status of use. However, normal use of USB memory stick as an external memory device for the DX100 does not adversely affect the USB memory stick. For details, refer to instruction manuals for each medium.

7.1.2.3 Inserting a USB Memory Stick

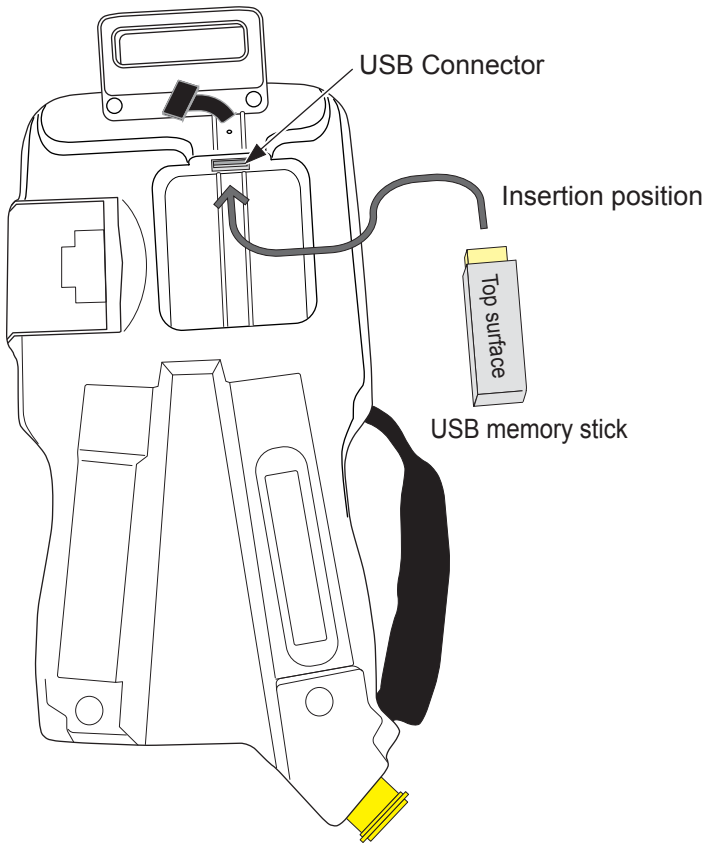
When inserting a USB memory stick, take note of insertion direction.

With the USB memory stick face-up and the connector upwards, insert the stick slowly into the slot of the programming pendant of which display face-down.

Forcible insertion may result in damage to the USB memory stick or USB connector.

After inserting the stick, be sure to close the cover of the connector before starting operation.

Fig. 7-2: Using a USB Memory Stick



NOTE

When a USB memory stick is used, the waterproofing of programming pendant cannot be maintained.

If the USB memory stick is always set in the programming pendant, the stick may fall out of the pendant.

If it is impossible to maintain the waterproofing of programming pendant or to prevent the USB memory stick from falling out of the programming pendant, use a Compact Flash card instead.

7.2 Handling Data

7.2.1 Data Classification

For the DX100, data that can be saved online are classified into eight categories.

1. JOB
2. FILE/GENERAL DATA
3. BATCH USER MEMORY*1
4. PARAMETER*2
5. SYSTEM DATA
6. I/O DATA
7. BATCH CMOS*3
8. ALL CMOS AREA*4

Data saved on the external memory device can be loaded again into the DX100.

Each data in the eight categories varies depending on applications or options.

When the device is set to “PC” and “FTP”, data cannot be handled other than “1. JOB” and “2. FILE/GENERAL DATA”.

Also, the “1. JOB” whose name consists of more than nine letters cannot be handled at “FC1” and “FC2”.

*1: “3. BATCH USER MEMORY” includes “1. JOB” and “2. FILE/GENERAL DATA”.

*2: “PARAMETER BATCH” includes all “P4. PARAMETER”.

*3: “7. BATCH CMOS” includes “3. BATCH USER MEMORY”, “4. PARAMETER”, “5. SYSTEM DATA”, and “6. I/O DATA”.

*4:“ALL CMOS AREA” data cannot be loaded in edit mode and management mode.

NOTE

PARAMETER, I/O DATA, SYSTEM DATA, PARAMETER BATCH, BATCH CMOS, and ALL CMOS AREA are used for backup.

If those data are loaded by other controllers, unintended data overwriting, unexpected operation, or abnormal system startup may occur.

Do not load those backup data into other controllers.

If two controllers are loaded with the same job, paths of the two manipulators are different due to the home positions or mechanical error of the component parts.

Be sure to check the operation instruction before operation.

The data such as variable data, user coordinate data, job data, parameter data and each condition file data should not be changed during saving the ALL CMOS AREA, SYSTME DATA and BATCH USER MEMORY.

Changing the those data may cause incorrect saving as well as during the playback.

Table 7-1: Data List (Sheet 1 of 2)

Data Classification			File Name (Saved Data)	Save			Load		
				OPN	EDIT	MAN	OPN	EDIT	MAN
8. ALL CMOS AREA			ALCMSxx.HEX	○	○	○	X	X	X
7. BATCH CMOS			CMOSxx.HEX	○	○	○	X	X	○
3. BATCH USER MEMORY			JOBxx.HEX	○	○	○	X	○	○
1. JOB	Single job		JOBNAME.JBI	○	○	○	X	○	○
	Related job (Job+Condition)		JOBNAME.JBR	○	○	○	X	○	○
2 FILE/ GENERAL DATA	Tool data		TOOL.CND	○	○	○	X	○	○
	Weaving data		WEAV.CND	○	○	○	X	○	○
	User coordinate data		UFRAME.CND	○	○	○	X	○	○
	Variable data		VAR.DAT	○	○	○	X	○	○
	Arc start condition data		ARCSRT.CND	○	○	○	X	○	○
	Arc end condition data		ARCEND.CND	○	○	○	X	○	○
	Welding condition auxiliary data		ARCSUP.DAT	○	○	○	X	○	○
	Power source characteristic data		WELDER.DAT	○	○	○	X	○	○
	Power source characteristic definition data		WELDUDEF.DAT	○	○	○	X	○	○
	Shock detection level data		SHOCKLVL.CND	○	○	○	X	○	○
	Motor gun pressure power data		SPRESS.CND	○	○	○	X	○	○
	Motor gun dry spot pressure data		SPRESSCL.CND	○	○	○	X	○	○
	Spot gun characteristic data		SGUN.DAT	○	○	○	X	○	○
	Spot welding power source characteristic data		SWELDER.DAT	○	○	○	X	○	○
	Short/Full open position data		STROKE.DAT	○	○	○	X	○	○
	Spot I/O allocation data		SPOTIO.DAT	○	○	○	X	○	○
	Airgun condition data		AIRGUN.DAT	○	○	○	X	○	○
	Spot welding condition data		SPOTWELD.DAT	○	○	○	X	○	○
	Clearance data		CLEARANCE.DAT	○	○	○	X	○	○
	Interference area file		CUBEINTF.CND	○	○	○	X	○	○
4. PARAMETER BATCH			ALL.PRM	○	○	○	X	X	○
4. PARA-METER	Robot matching parameter		RC.PRM	○	○	○	X	X	○
	System definition parameter		SD.PRM	○	○	○	X	X	○

Table 7-1: Data List (Sheet 2 of 2)

Data Classification					File Name (Saved Data)	Save			Load		
						OPN	EDIT	MAN	OPN	EDIT	MAN
8.	7.	4.	4. PARA-METER	Coordinate home position parameter	RO.PRM	○	○	○	X	X	○
				System matching parameter	SC.PRM	○	○	○	X	X	○
				CIO parameter	CIO.PRM	○	○	○	X	X	○
				Function definition parameter	FD.PRM	○	○	○	X	X	○
				Application parameter	AP.PRM	○	○	○	X	X	○
				Transmission (general) parameter	RS.PRM	○	○	○	X	X	○
				Sensor parameter	SE.PRM	○	○	○	X	X	○
				Servo parameter	SV.PRM	○	○	○	X	X	○
				Servomotor parameter	SVM.PRM	○	○	○	X	X	○
				Operation control parameter	AMC.PRM	○	○	○	X	X	○
				Servo power block parameter	SVP.PRM	○	○	○	X	X	○
				Motion function parameter	MF.PRM	○	○	○	X	X	○
				SERVOPACK parameter	SVS.PRM	○	○	○	X	X	○
				Converter parameter	SVC.PRM	○	○	○	X	X	○
				Robot control expand parameter	RE.PRM	○	○	○	X	X	○
		5. I/O DATA		CIO program	CIOPRG.LST	○	○	○	X	X	○
				I/O name data	IONAME.DAT	○	○	○	X	X	○
				Pseudo input signals	PSEUDOIN.DAT	○	○	○	X	X	○
				External I/O name data	EXIONAME.DAT	○	○	○	X	X	○
				Register name data	IOMNAME.DAT	○	○	○	X	X	○
		6. SYSTEM DATA		User word register name	UWORD.DAT	○	○	○	X	X	○
				SV monitor signals	SVMON.DAT	○	○	○	X	X	○
				Variable name	VARNAME.DAT	○	○	○	X	X	○
				Second home position	HOME2.DAT	○	○	○	X	X	○
				Alarm history data	ALMHIST.DAT	○	○	○	X	X	X
				Home position calibrating data	ABSO.DAT	○	○	○	X	X	○
				System information	SYSTEM.SYS	○	○	○	X	X	X
				Work home position data	OPEORG.DAT	○	○	○	X	X	○
				I/O message history data	IOMSGHST.DAT	○	○	○	X	X	X
				Function key allocation data	KEYALLOC.DAT	○	○	○	X	X	○
				Arc monitor data	ARCMON.DAT	○	○	○	X	X	X

* OPN: Operation Mode, EDIT: Edit Mode, MAN: Management Mode
○ : Can be done, X : Cannot be done

7.2.2 File Existence

The following data categories show whether the same file name as a file that is going to be saved is in the external memory device or not.

- JOB
  No mark appears when the selected folder has the file of the same name.
  The asterisk (*) appears when the folder does not have the same name file.
- FILE/GENERAL DATA, PARAMETER, SYSTEM DATA, I/O DATA
  Black circle (●) appears when the selected folder has the file of the same name.
  White circle (○) appears when the folder does not have the same name file.

SUPPLE-MENT

Whether the job after editing is saved or not can be judged by checking “TO SAVE TO FD” in the JOB HEADER window. However, the status of “TO SAVE TO FD” does not change after saving “3. BATCH USER MEMORY” and “7. BATCH CMOS”.

Fig. 7-3: Example of JOB

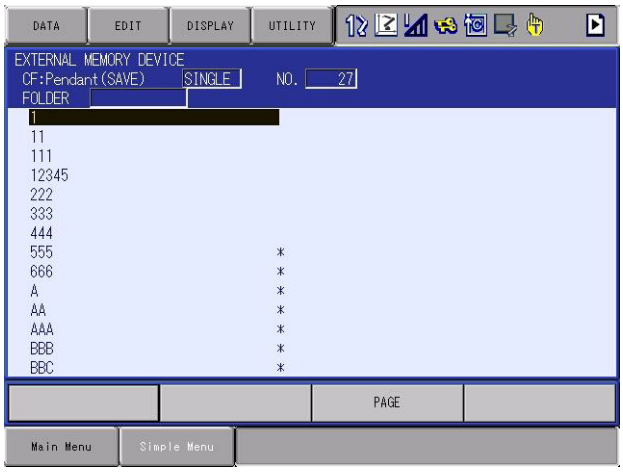
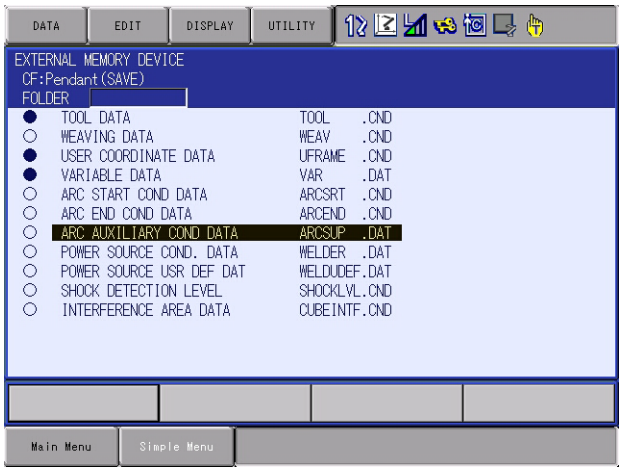


Fig. 7-4: Example of FILE/GENERAL DATA



7.2.2.1 Saving by Overwriting

“3. BATCH USER MEMORY”, “7. BATCH CMOS”, and “8. ALL CMOS AREA” can be overwritten.

As for “1. JOB”, “2. FILE/GENERAL DATA”, “4. PARAMETER”, “5. SYSTEM DATA”, and “6. I/O DATA”, those data cannot be overwritten. Delete the target file in the device before the saving operation. If Compact Flash is used as the device, the file does not need to be deleted because another folder can be created to save the data.

7.3 Operation Flow

The following description is the operation flow for external memory devices.

- SELECT DEVICE
  Select {FD/PC CARD} --> {DEVICE}, and the destination device for saving.
  The device selected is valid after turning the power supply ON again.
  *1: Sub menu {FORMAT} appears when selecting FC1 or FC2.

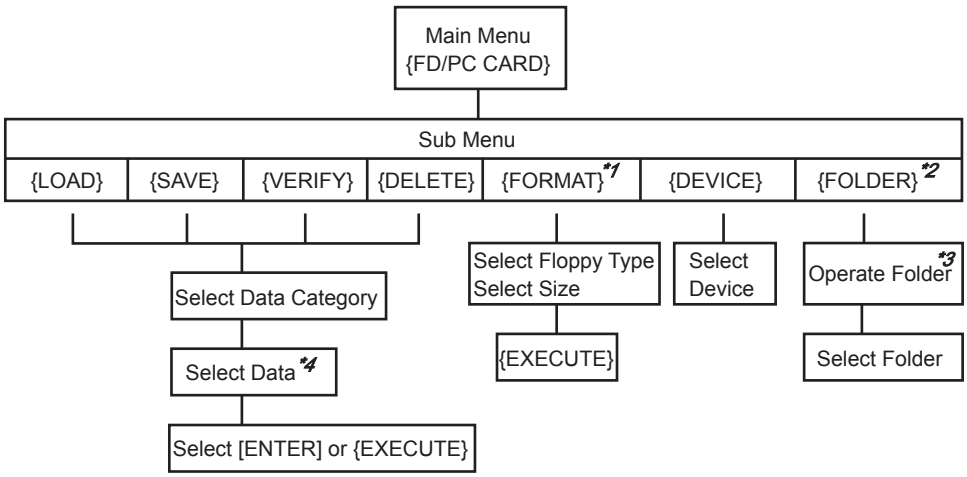
- SELECT FOLDER
  Select {FD/PC CARD} --> {DEVICE}, and the destination folder for saving.
  The folder selected is invalid after turning the power supply ON again.
  *2: {FOLDER} appears when using the Compact Flash as a device.
  *3 The settings of {CREATE NEW FOLDER}, {DELETE FOLDER}, and {ROOT FOLDER} can be set.

- SELECT SUB MENU
  Select an operation to be performed from {LOAD}, {SAVE}, {VERIFY}, and {DELETE}.

- SELECT DATA CATEGORY
  Select the target data category.

- SELECT DATA
  Select the target data.
  “3. BATCH USER MEMORY”, “7. BATCH CMOS”, and “8. ALL CMOS AREA” do not require this operation.
  *4 Individual selection, batch selection, marker (*) selection, and canceling selection can be performed.

- EXECUTE
  Select [ENTER] or {EXECUTE}.



7.3.0.1 Operating a Folder

Folders can be used in order to classify and sort out the data such as jobs and condition files when using the Compact Flash. The folders can be created in hierarchical structure positioning a root folder at the top.

■ **Restrictions**

Folder name: Up to 8 one-byte characters + 3 characters for extension

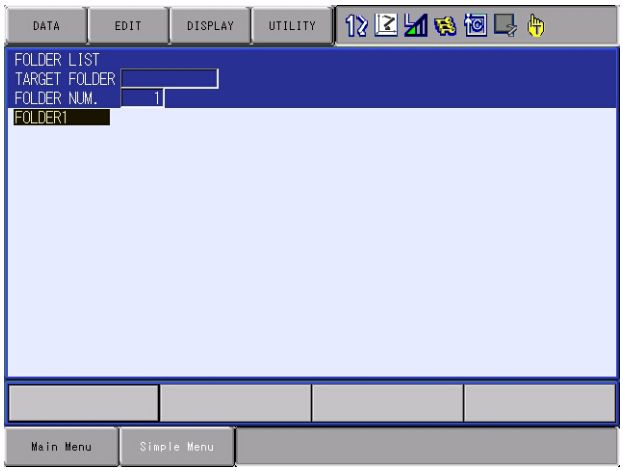
*Long folder names cannot be used such as the name that exceeds the restricted number of characters mentioned above as created in PC, etc.

Maximum path length: 42 one-byte characters

*“ERROR 3360: INVALID FOLDER” appears when selecting the folder of which name exceeds the maximum path length.

■ **Selecting a Folder**

1. Select {FD/PC CARD} under the main menu.
2. Select {FOLDER}.
   – The FOLDER LIST window appears.
3. Move the cursor to a folder and press [SELECT].
   – A folder can be selected.
4. To move the hierarchy from a child folder to a parent folder, move the cursor to [..] and press [SELECT].



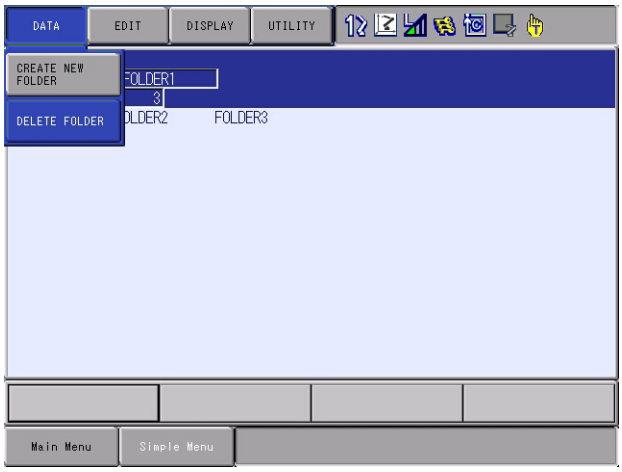
■ Creating a Folder

1. Change the security to management mode. Select {FD/PC CARD} under the main menu.
2. Select {FOLDER}.
   – The FOLDER LIST window appears.
3. Move the cursor to a folder and press [SELECT].
   – Select the higher-level folder where a new folder to be created should be contained.
   – When creating a folder in top-level, this step is unnecessary.
4. Select {DATA} --> {CREATE NEW FOLDER} under the pull-down menu. Input folder name using the keyboard on the screen and press [ENTER].
   – A folder is created.

■ Deleting a Folder

1. Change the security to management mode. Select {FD/PC CARD} under the main menu.
2. Select {FOLDER}.
   – The FOLDER LIST window appears.
3. Move the cursor to a folder and press [SELECT].
   – Select the higher-level folder where a folder to be deleted is contained.
   – When deleting a folder in top-level, this step is unnecessary.
4. Delete the files and subfolders beforehand inside the folder that is to be deleted.
   – A folder cannot be deleted if the folder contains files or subfolders inside.

Move the cursor to the folder to be deleted.
5. Select {DATA} --> {DELETE FOLDER} under the pull-down menu.

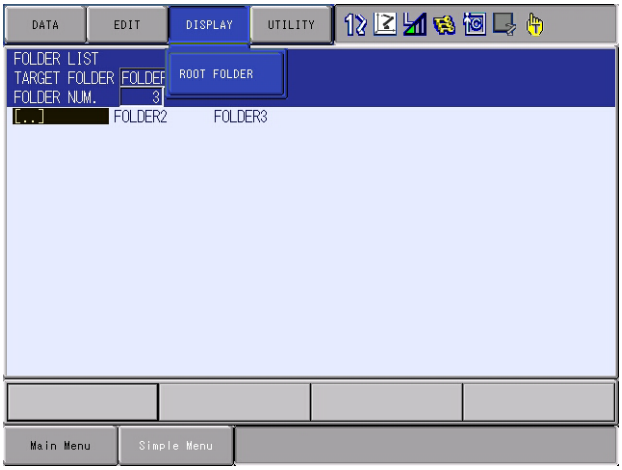


■ **Initial Folder Setting**

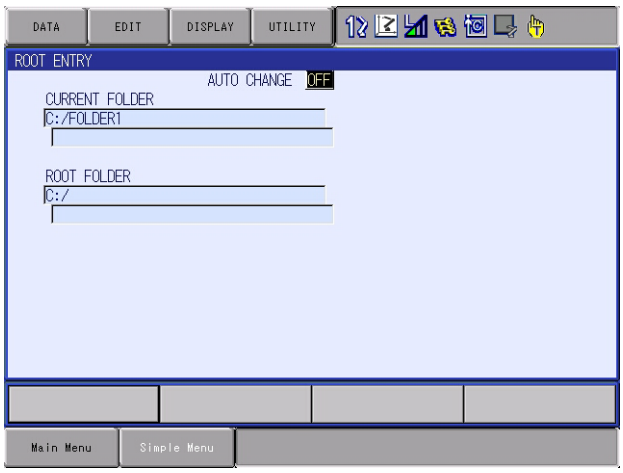
The folder that is contained in a deep hierarchy can be selected in a shortened operation.

When selecting {LOAD}, {SAVE}, {VERIFY}, or {DELETE} from the sub menu of {FD/PC CARD}, the folder that has been set as an initial folder becomes a current folder.

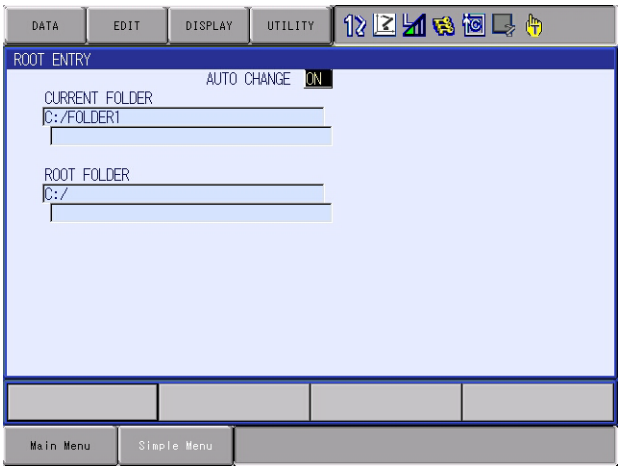
1. Change the security to management mode. Select {FD/PC CARD} under the main menu.
2. Select {FOLDER}.
   – The FOLDER LIST window appears.
3. Move the cursor to a folder and press [SELECT].
   – Select a folder that is to be set as a root folder.
4. Select {DISPLAY} --> {ROOT FOLDER} under the pull-down menu.
   – The INITIAL FOLDER SETTING window appears.



   – A folder currently selected appears in “CURRENT FOLDER” and the initial folder appears in “ROOT FOLDER”.



5. Select {EDIT} --> {SETUP FOLDER} under the pull-down menu. Move the cursor to “AUTO CHANGE” and press [SELECT].
   – The initial folder is set in “ROOT FOLDER”.



   – “AUTO CHANGE” shows “ON” and the initial folder setting becomes valid. Subsequently, every time {FD/PC CARD} --> {FOLDER} is selected, the initial folder that has been set becomes a current folder.

SUPPLE-MENT

When the initial folder is missing due to exchange of the Compact Flash, etc., “ERROR 3360: INVALID FOLDER” appears when selecting {LOAD}, {SAVE}, {VERIFY}, {DELETE} or {FOLDER} menu from {FD/PC CARD}, and simultaneously the initial folder becomes invalid. Set “ON” in “AUTO CHANGE” when the initial folder setting needs to be valid.

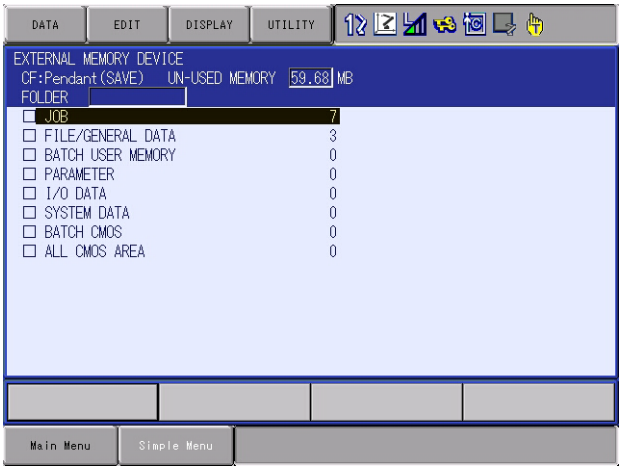
7.3.0.2 Saving Data

To download data from the memory of the DX100 to the external memory device, perform the following procedure.

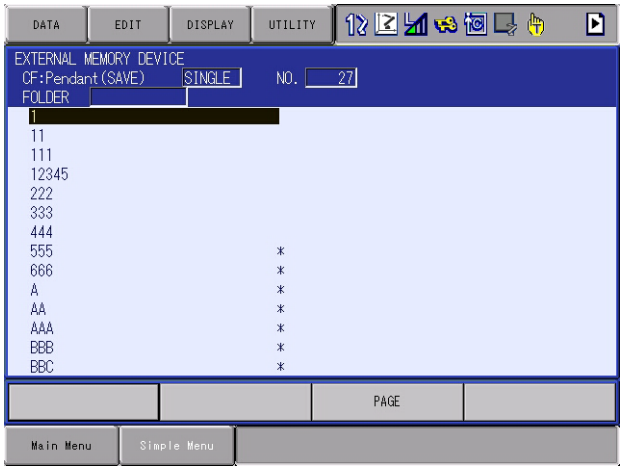
> **NOTE**
>
> Data such as PARAMETER, SYSTEM DATA, I/O DATA, and the batch data such as PARAMETER BATCH, BATCH CMOS, ALL CMOS AREA, that include PARAMETER, SYSTEM DATA, I/O DATA, contain the information specific to each robot controller.
>
> Those data are prepared as backup data for reloading into the controller used for saving.
>
> Loading the data from other controller may result in destruction or loss of critical system information.
>
> Take extra care for the saved data.

■ **Saving a Job**

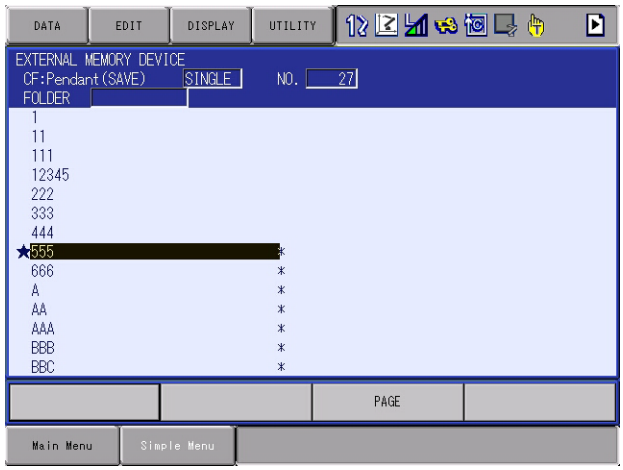
1. Select {FD/PC CARD} under the main menu.
2. Select {SAVE}.
   – The following window appears.



3. Select {JOB}.
   – The JOB LIST window appears.



4. Select a job to be saved.
   – The selected job is marked with “★”.

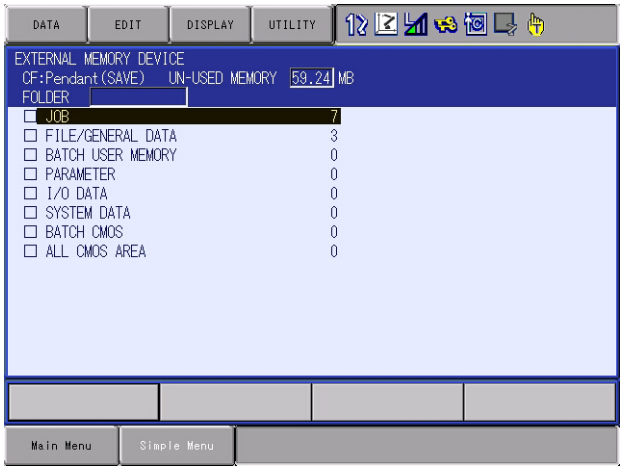


5. Press [ENTER].
   – The confirmation dialog box appears.

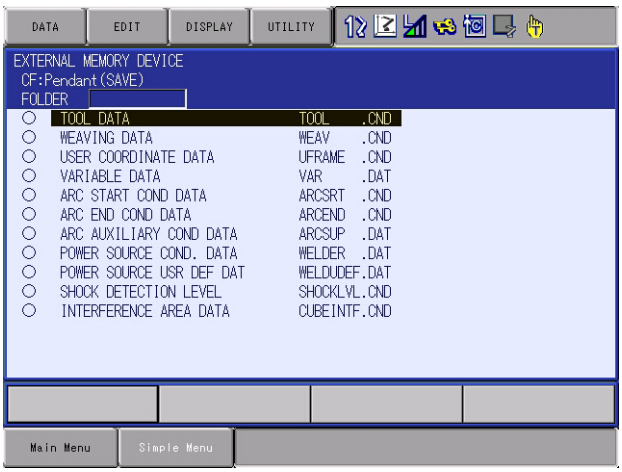
6. Select “YES”.
   – The selected job is saved.

■ Saving a Condition File or General Data

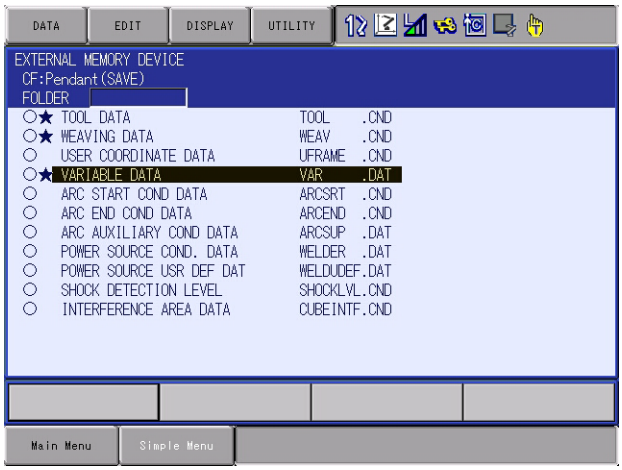
1. Select {FD/PC CARD} under the main menu.
2. Select {SAVE}.
   – The following window appears.



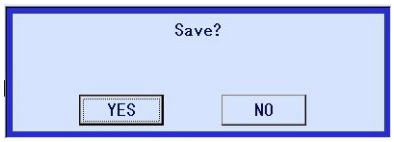
3. Move the cursor to {FILE/GENERAL DATA} and select.
   – The selection window appears.
   – The content of the display varies in accordance with applications and options.



4. Select condition files or general data to be saved.
   – The selected files are marked with “★”.



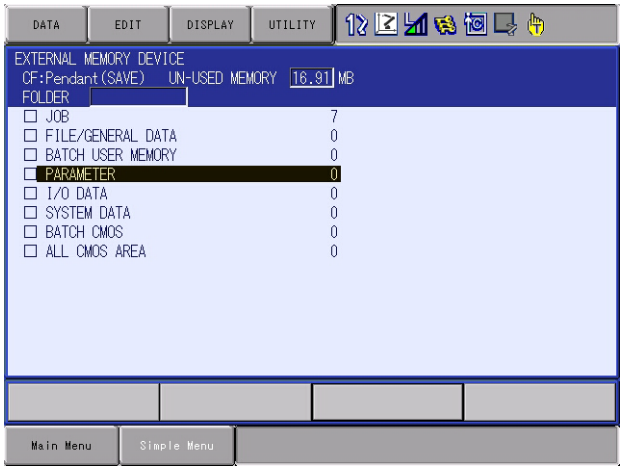
5. Press [ENTER].
   – The confirmation dialog box appears.



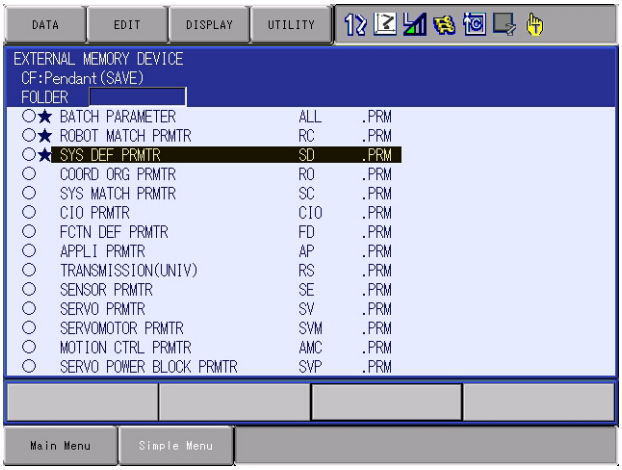
6. Select “YES”.
   – The selected files are saved.

■ Saving a Parameter

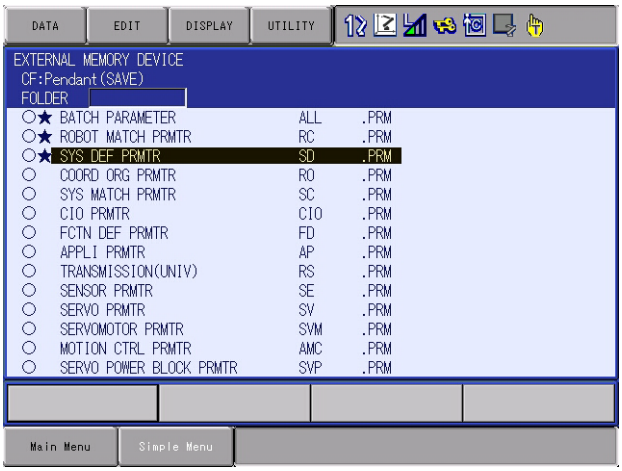
1. Select {FD/PC CARD} under the main menu.
2. Select {SAVE}.
   – The following window appears.



3. Move the cursor to {PARAMETER} and select.
   – The selection window for parameters appears.



4. Select parameters to be saved.
   – The selected parameters are marked with “★”.



5. Press [ENTER].
   – The confirmation dialog box appears.

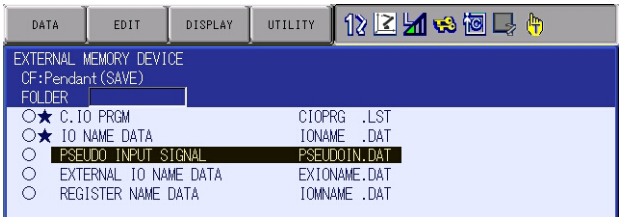
6. Select “YES”.
   – The selected parameters are saved.

■ Saving I/O Data

1. Select {FD/PC CARD} under the main menu.
2. Select {SAVE}.
   – The following window appears.

3. Move the cursor to {I/O DATA} and select.
   – The selection window for I/O data appears.

4. Select I/O data to be saved.
   – The selected I/O data are marked with "★".

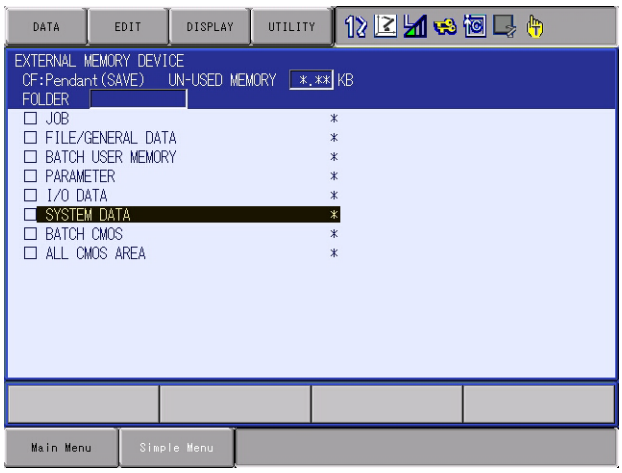


5. Press [ENTER].
   – The confirmation dialog box appears.

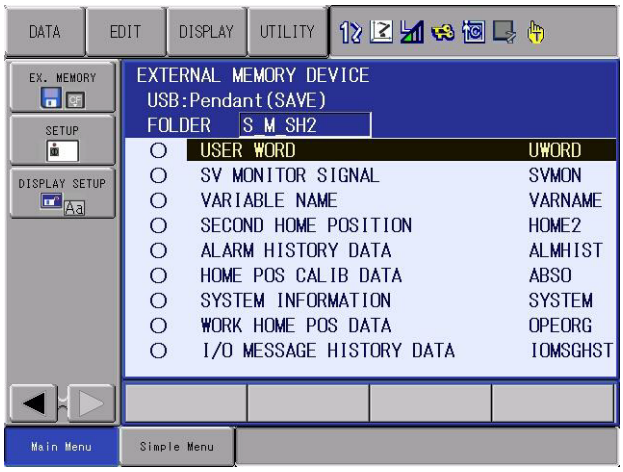
6. Select "YES".
   – The selected I/O data are saved.

■ Saving System Data

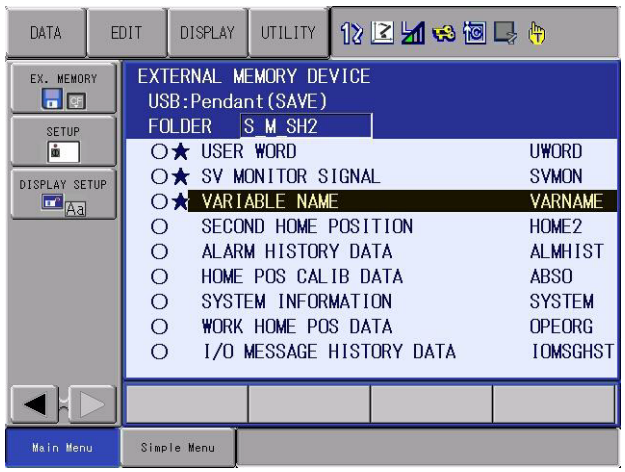
1. Select {FD/PC CARD} under the main menu.
2. Select {SAVE}.
   – The following window appears.



3. Move the cursor to {SYSTEM DATA} and select.
   – The selection window for system data appears.



4. Select system data to be saved.
   – The selected system data are marked with "★".



5. Press [ENTER].
   – The confirmation dialog box appears.

6. Select "YES".
   – The selected system data are saved.

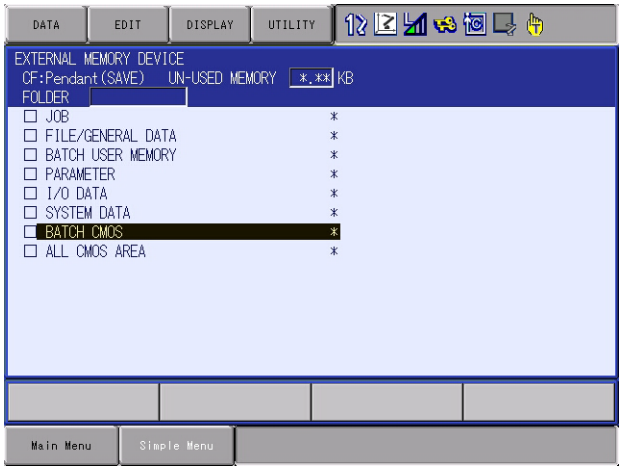
SUPPLE-MENT

"BATCH USER MEMORY", "BATCH CMOS", and "ALL CMOS AREA" can be overwritten.

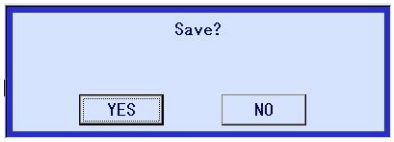
As for "JOB", "FILE/GENERAL DATA", "PARAMETER", "SYSTEM DATA", and "I/O DATA", the data cannot be overwritten. In this case, delete the file of the same name in the folder beforehand or create a new folder so that the data can be stored inside.

■ Saving All User's Programs

1. Select {FD/PC CARD} under the main menu.
2. Select {SAVE}.
   – The following window appears.



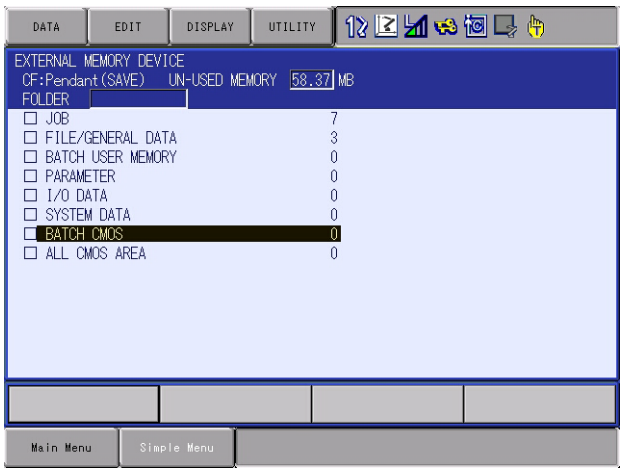
3. Move the cursor to {BATCH USER MEMORY} and select.
4. Select "EXECUTE".
   – The confirmation dialog box appears.



5. Select "YES".
   – All user's programs are saved.

■ Saving All CMOS Data

1. Select {FD/PC CARD} under the main menu.
2. Select {SAVE}.
   – The following window appears.

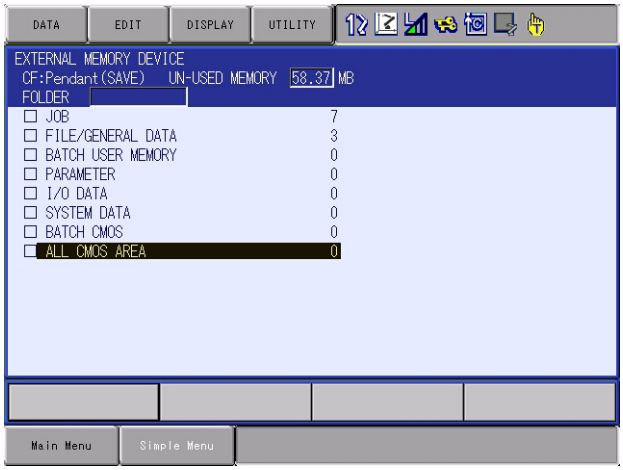


3. Move the cursor to {BATCH CMOS} and select.
4. Select “EXECUTE”.
   – The confirmation dialog box appears.

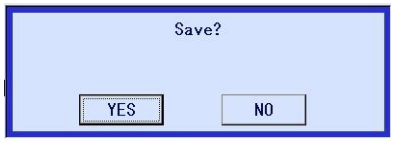
5. Select “YES”.
   – All CMOS data are saved.

■ Saving All Data in CMOS Area

1. Select {FD/PC CARD} under the main menu.
2. Select {SAVE}.
   – The following window appears.



3. Move the cursor to {ALL CMOS AREA} and select.
4. Select “EXECUTE”.
   – The confirmation dialog box appears.



5. Select “YES”.
   – All data in CMOS area are saved.

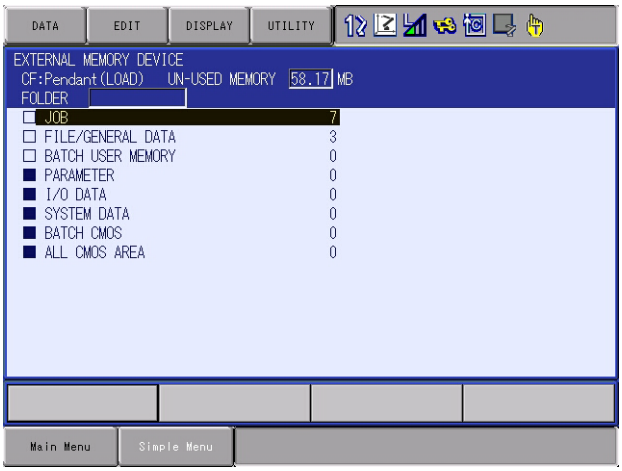
7.3.0.3 Loading Data

To upload data from the external memory device to the memory of the DX100, follow the procedure in the following.

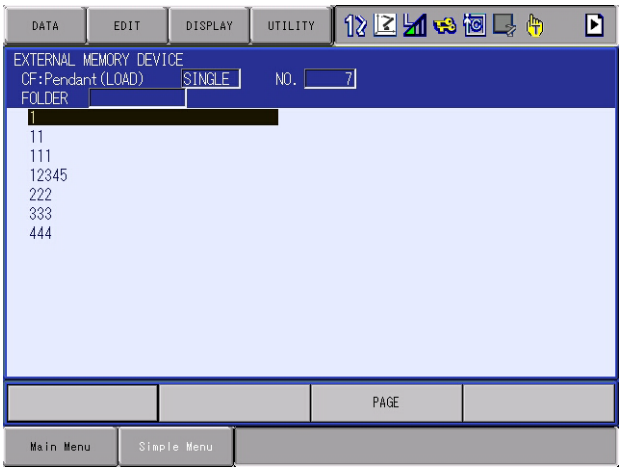
> **NOTE**
>
> Data such as PARAMETER, SYSTEM DATA, I/O DATA, and the batch data such as PARAMETER BATCH, BATCH CMOS, ALL CMOS AREA, that include PARAMETER, SYSTEM DATA, I/O DATA, contain the information specific to each robot controller.
>
> Those data are prepared as backup data for reloading into the controller used for saving.
>
> Loading the data from other controller may result in destruction or loss of critical system information.
>
> Take extra care for the saved data.

■ **Loading a Job**

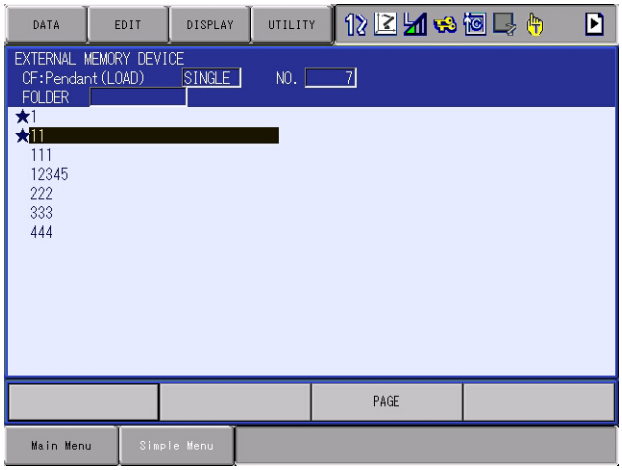
1. Select {FD/PC CARD} under the main menu.
2. Select {LOAD}.
   – The following window appears.



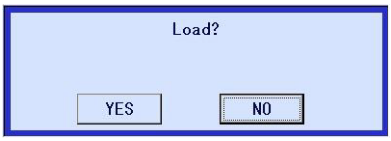
3. Select {JOB}.
   – The job selection window appears.



4. Select a job to be loaded.
   – The selected jobs are marked with “★”.



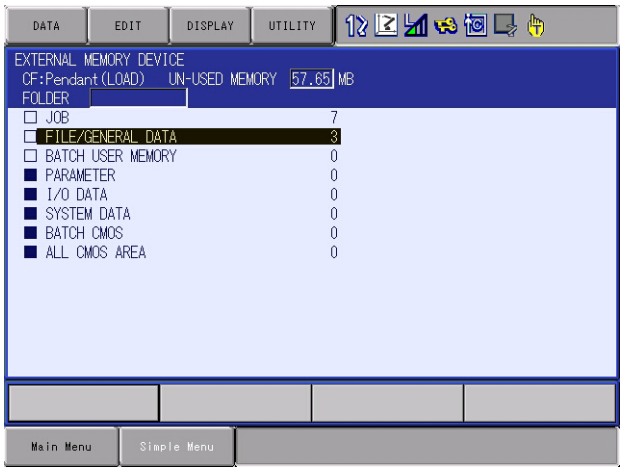
5. Press [ENTER].
   – The confirmation dialog box appears.



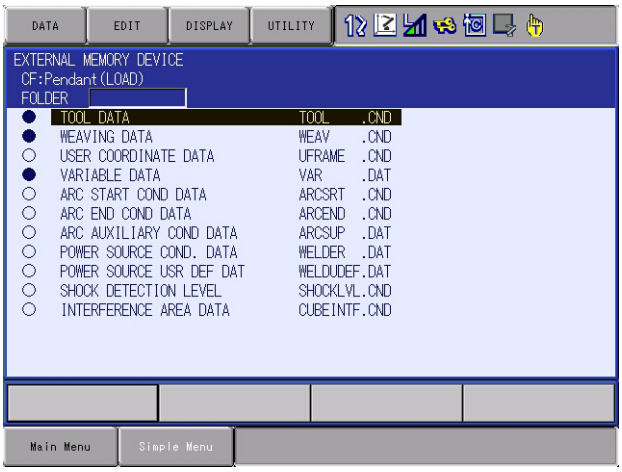
6. Select “YES”.
   – The selected jobs are loaded.

■ Loading a Condition File or General Data

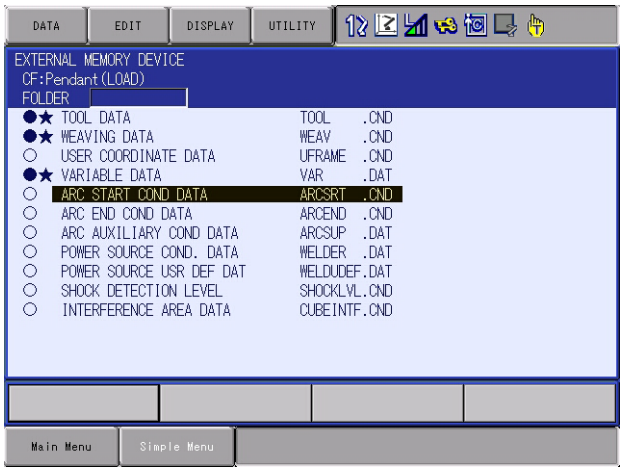
1. Select {FD/PC CARD} under the main menu.
2. Select {LOAD}.
   – The following window appears.



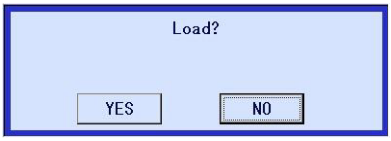
3. Move the cursor to {FILE/GENERAL DATA} and select.
   – The selection window for condition file or general data appears.



4. Select a condition file or general data to be loaded.
   – The selected files are marked with "★".



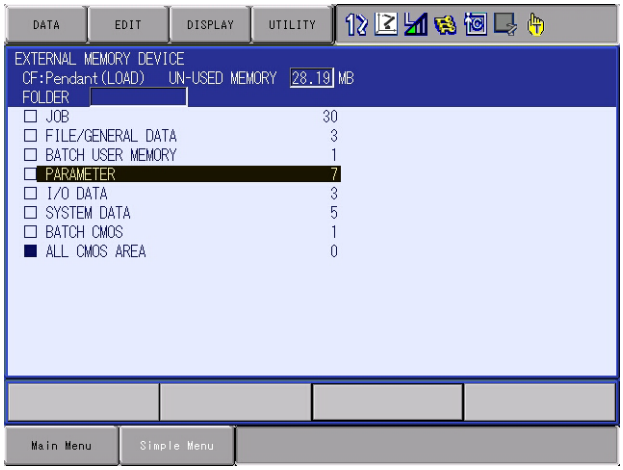
5. Press [ENTER].
   – The confirmation dialog box appears.



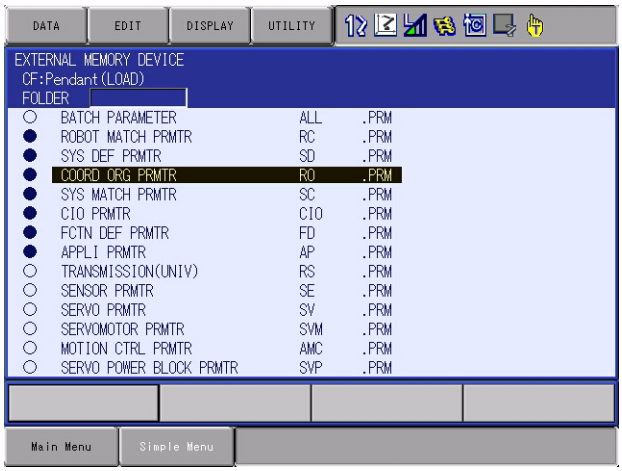
6. Select “YES”.
   – The selected files are loaded.

■ Loading a Parameter

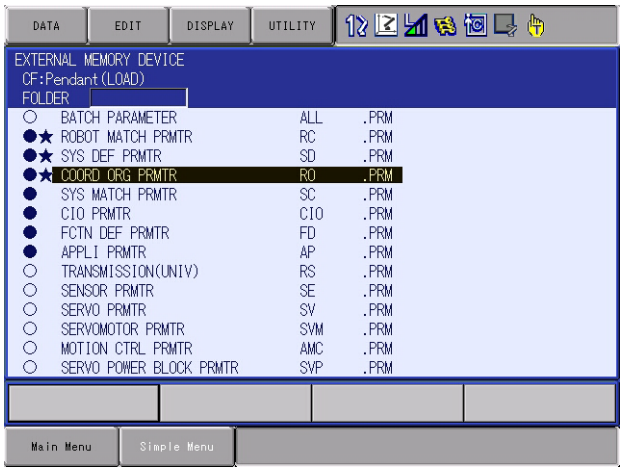
1. Select {FD/PC CARD} under the main menu.
2. Select {LOAD}.
   – The following window appears.



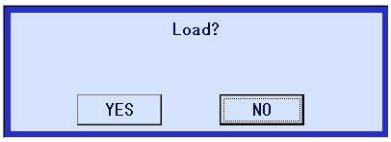
3. Move the cursor to {PARAMETER} and select.
   – The selection window for parameters appears.



4. Select parameters to be loaded.
   – The selected parameters are marked with “★”.



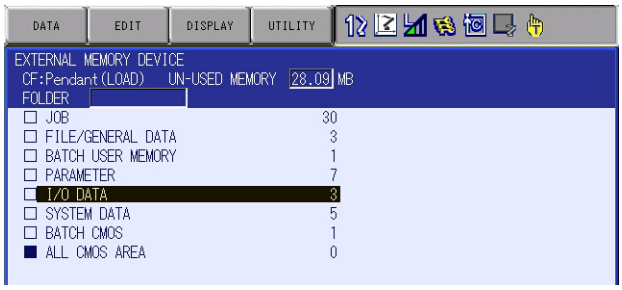
5. Press [ENTER].
   – The confirmation dialog box appears.



6. Select “YES”.
   – The selected parameters are loaded.

■ Loading I/O Data

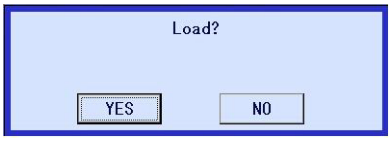
1. Select {FD/PC CARD} under the main menu.
2. Select {LOAD}.
   – The following window appears.



3. Move the cursor to {I/O DATA} and select.
   – The selection window for I/O data appears.

4. Select I/O data to be loaded.
   – The selected I/O data are marked with “★”.

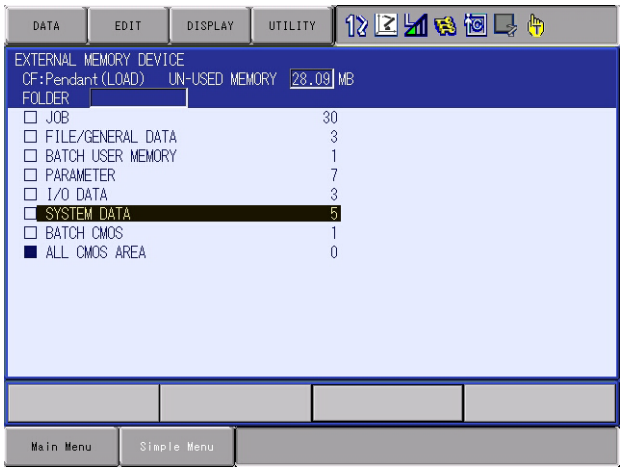
5. Press [ENTER].
   – The confirmation dialog box appears.



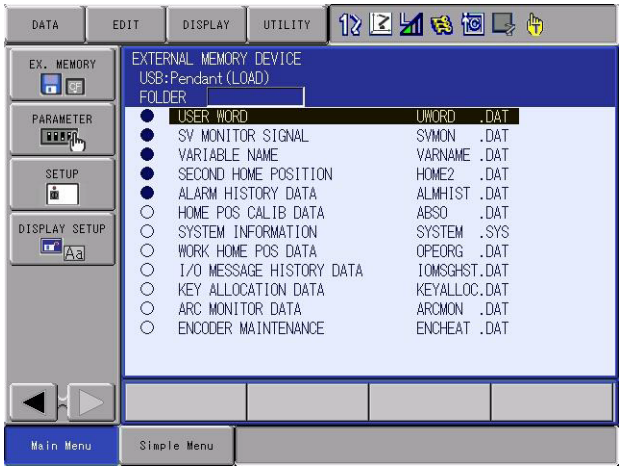
6. Select “YES”.
   – The selected I/O data are loaded.

■ Loading System Data

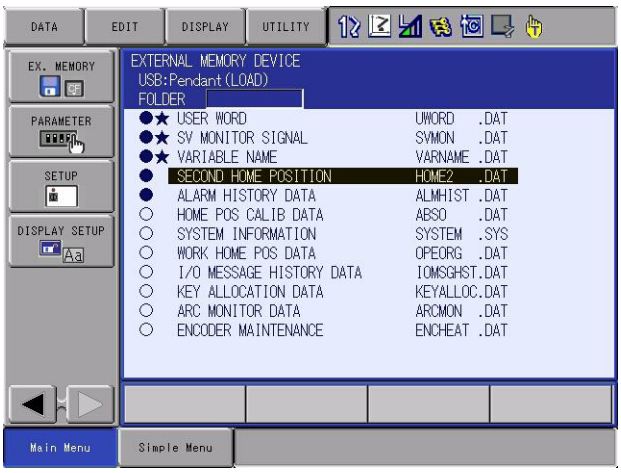
1. Select {FD/PC CARD} under the main menu.
2. Select {LOAD}.
   – The following window appears.



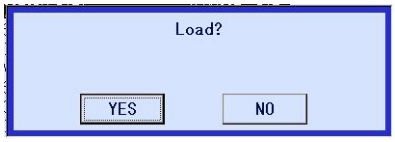
3. Move the cursor to {SYSTEM DATA} and select.
   – The selection window for system data appears.



4. Select system data to be loaded.
   – The selected system data are marked with "★".



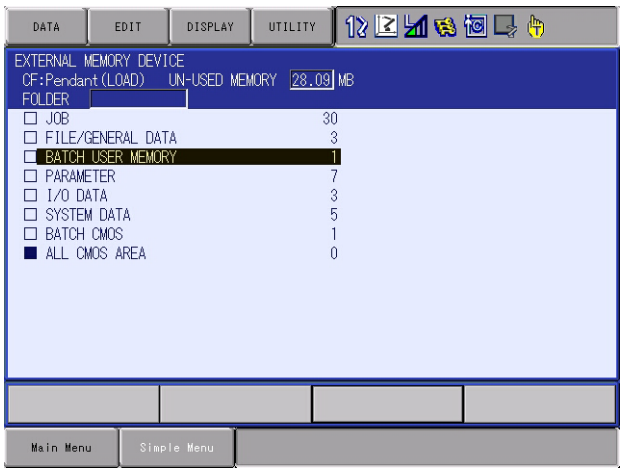
5. Press [ENTER].
   – The confirmation dialog box appears.



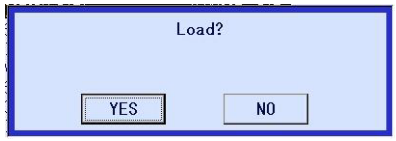
6. Select “YES”.
   – The selected system data are loaded.

■ Loading All User's Programs

1. Select {FD/PC CARD} under the main menu.
2. Select {LOAD}.
   – The following window appears.



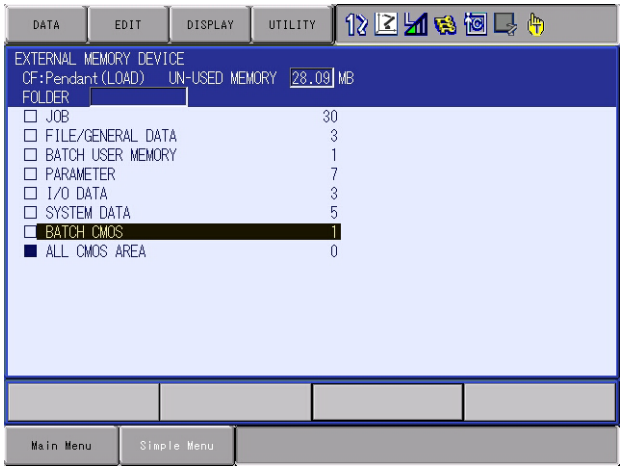
3. Move the cursor to {BATCH USER MEMORY} and select.
4. Select "EXECUTE".
   – The confirmation dialog box appears.



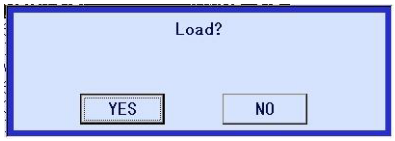
5. Select "YES".
   – All user's programs are loaded.

■ Loading All CMOS Data

1. Select {FD/PC CARD} under the main menu.
2. Select {LOAD}.
   – The following window appears.



3. Move the cursor to {BATCH CMOS} and select.
4. The confirmation dialog box appears.



5. Select “YES”.
   – All CMOS data are loaded.

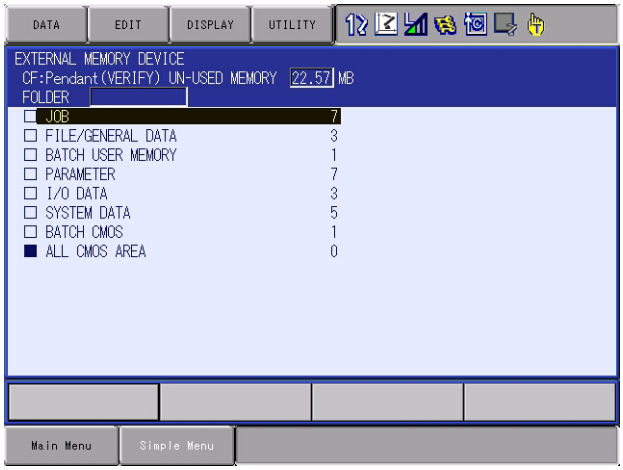
7.3.0.4 Verifying Data

Follow the procedure below to verify data in the memory of the DX100 with data saved in the external memory device.

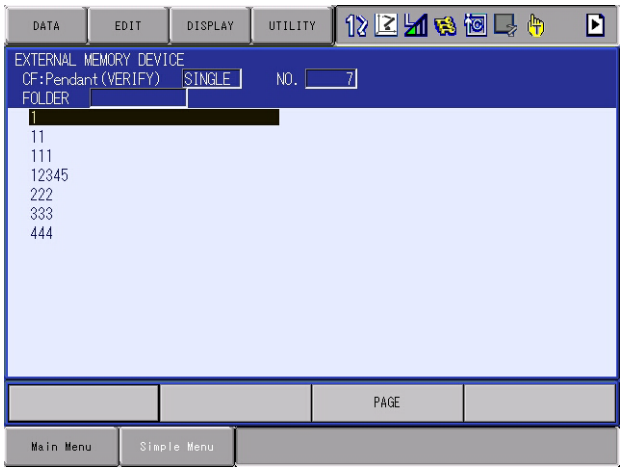
> **NOTE** This function cannot be executed with “BATCH USER MEMORY”, “BATCH CMOS”, or “ALL CMOS AREA” specified.

■ **Verifying a Job**

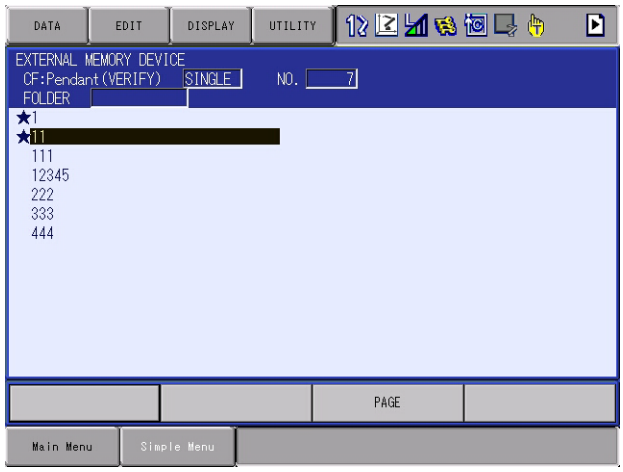
1. Select {FD/PC CARD} under the main menu.
2. Select {VERIFY}.
   – The following window appears.



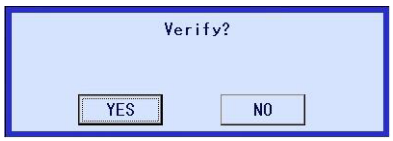
3. Select {JOB}.
   – The job selection window appears.



4. Select a job to be verified.
   – The selected jobs are marked with “★”.



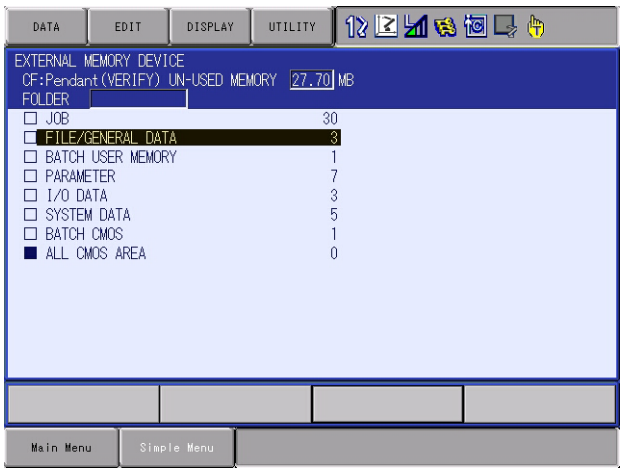
5. Press [ENTER].
   – The confirmation dialog box appears.



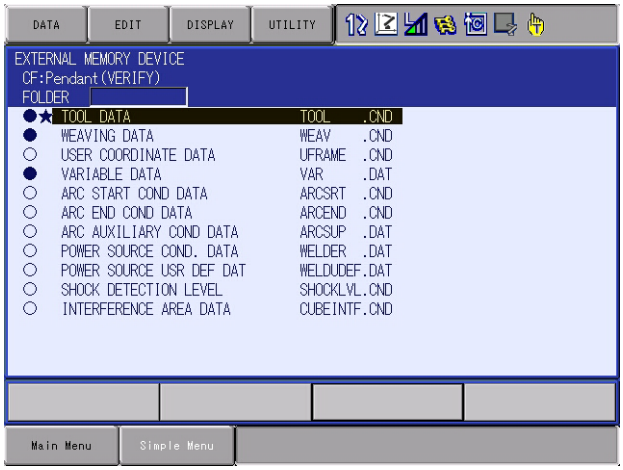
6. Select “YES”.
   – The selected jobs are verified.

■ Verifying a File

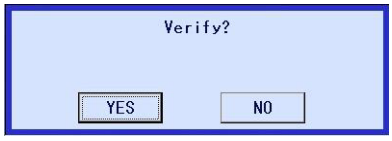
1. Select {FD/PC CARD} under the main menu.
2. Select {VERIFY}.
   – The following window appears.



3. Select the group of the file to be verified.
4. Select a file to be verified.
   – The selected files are marked with “★”.



5. Press [ENTER].
   – The confirmation dialog box appears.



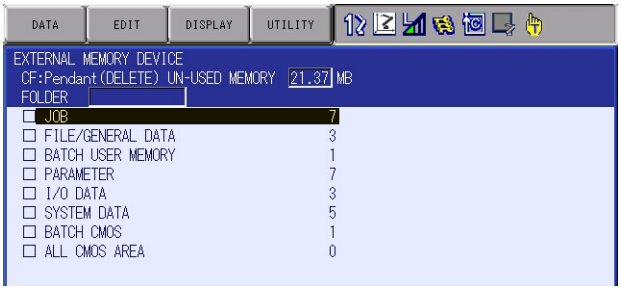
6. Select “YES”.
   – The selected files are verified.

7.3.0.5 Deleting Data

Follow the procedure below to delete a file or files on an external memory device.

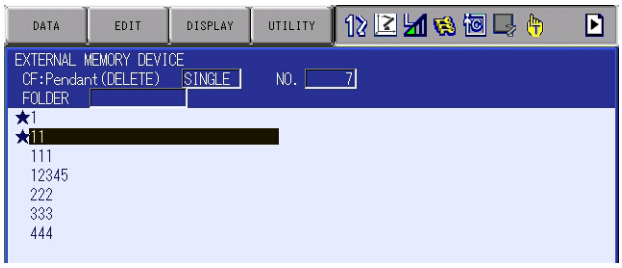
■ Deleting a Job

1. Select {FD/PC CARD} under the main menu.
2. Select {DELETE}.
   – The following window appears.



3. Select {JOB}.
   – The job selection window appears.

4. Select a job to be deleted.
   – The selected jobs are marked with "★".

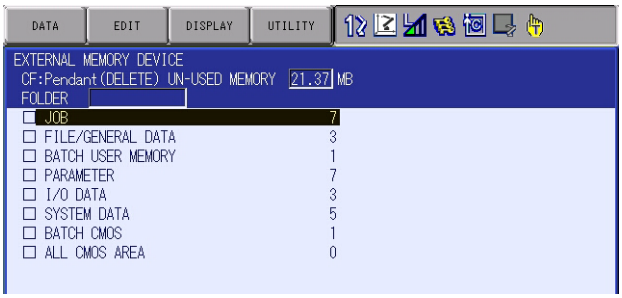


5. Press [ENTER].
   – The confirmation dialog box appears.

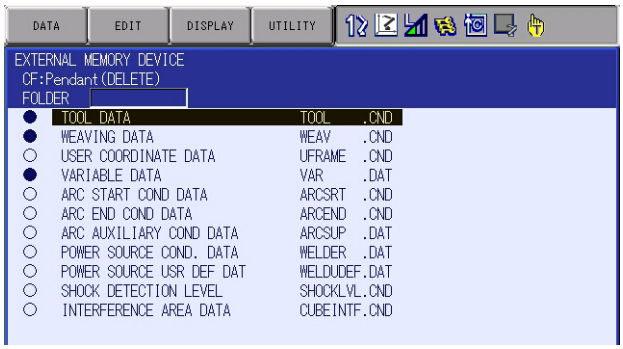
6. Select "YES".
   – The selected jobs are deleted.

■ Deleting a File

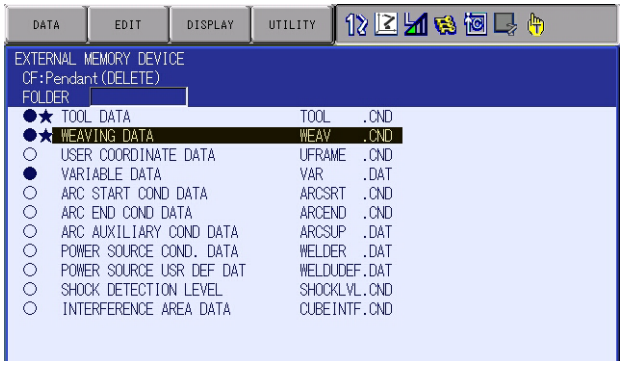
1. Select {FD/PC CARD} under the main menu.
2. Select {DELETE}.
   – The following window appears.



3. Select the group of the file to be deleted.



4. Select a file to be deleted.
   – The selected files are marked with “★”.



5. Press [ENTER].
   – The confirmation dialog box appears.

6. Select “YES”.
   – The selected files are deleted.

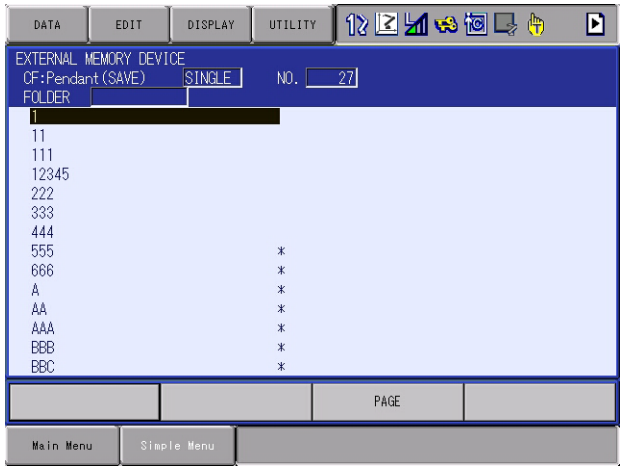
7.3.0.6 Job Selection Mode

The method of selecting a job and various data files when loading, saving, verifying, and deleting are described in the following:

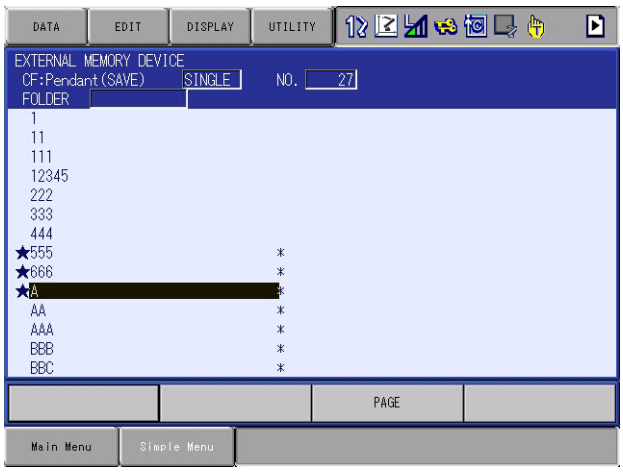
- Individual Selection
  Jobs and data files are selected individually one at a time.
- Batch Selection
  Jobs and data files are selected all at one time.
- Marker (*) Selection
  Loading: selects the files in the external memory device.
  Saving: selects the files in the memory of the DX100.
  Verifying: selects both the files in the external memory device and in the memory of the DX100.

■ Using Individual Selection

1. In either the external memory JOB LIST window or the file selection window, move the cursor to a job or a file to be selected.



2. Press [SELECT].
   Move the cursor to a file needed and press [SELECT] again.
   *To cancel the selected items, select {EDIT} and then {CANCEL SELECT}.
   – The selected jobs are marked with "★".



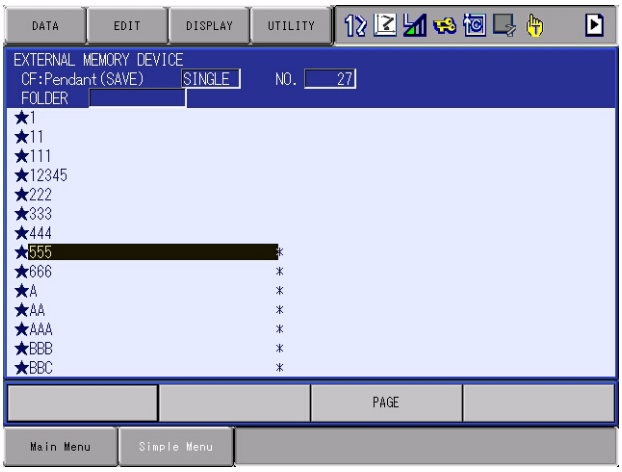
■ Using Batch Selection

1. In either the external memory JOB LIST window or the file selection window, select {EDIT} under the menu.

   – The pull-down menu appears.

2. Select {SELECT ALL}.
   *To cancel the selected items, select {EDIT} and then {CANCEL SELECT}.

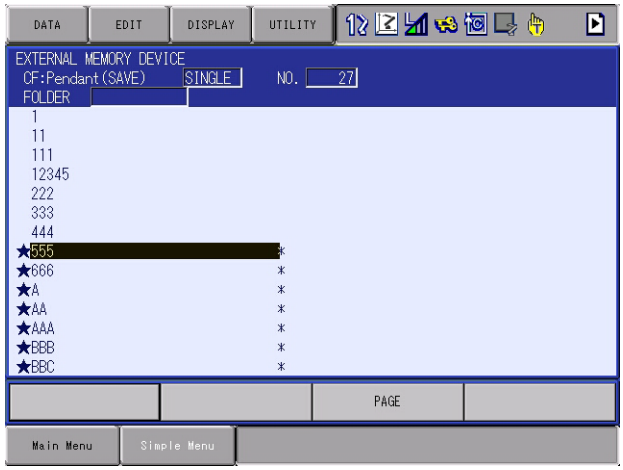
   – All jobs are selected.



■ Using Marker (*) Selection

1. In either the external memory JOB LIST window or the file selection window, select {EDIT} under the menu.
   – The pull-down menu appears.

2. Select {SELECT MARKER (*)}.
   *To cancel the selected items, select {EDIT} and then {CANCEL SELECT}.



8 Parameter

8.1 Parameter Configuration

The parameters of DX100 can be classified into the following seven:

Motion Speed Setting Parameter

Determines the manipulator motion speed for jog operation at teaching, test operation, or playback operation.

Mode Operation Setting Parameter

Makes the setting for various operations in the teach mode or remote mode.

Parameter according to Interference Area

Limits the P-point maximum envelope of the manipulator or sets the interference area for axis interference or cubic interference.

Parameter according to Status I/O

Sets the parity check or I/O setting for user input/output signals.

Parameter according to Coordinated or Synchronized Operation

Makes the settings for coordinated or synchronized operations between manipulators or between manipulators and stations.

Parameter for Other Functions or Applications

Makes the settings for other functions or applications.

Hardware Control Parameter

Makes the hardware settings for fan alarm or relay operation, etc.

SUPPLE-MENT

S1CxG Parameters

The initial setting of S1CxG parameters depends on the manipulator model.

For a system in which two manipulators are controlled, the following two types of parameters are used: S1C1G type and S1C2G type.

8.2 Motion Speed Setting Parameters

These parameters set the manipulator motion speed for jog operation at teaching, test operation, or playback operation.

8.2.0.1 S1CxG000: IN-GUARD SAFE OPERATION MAX. SPEED

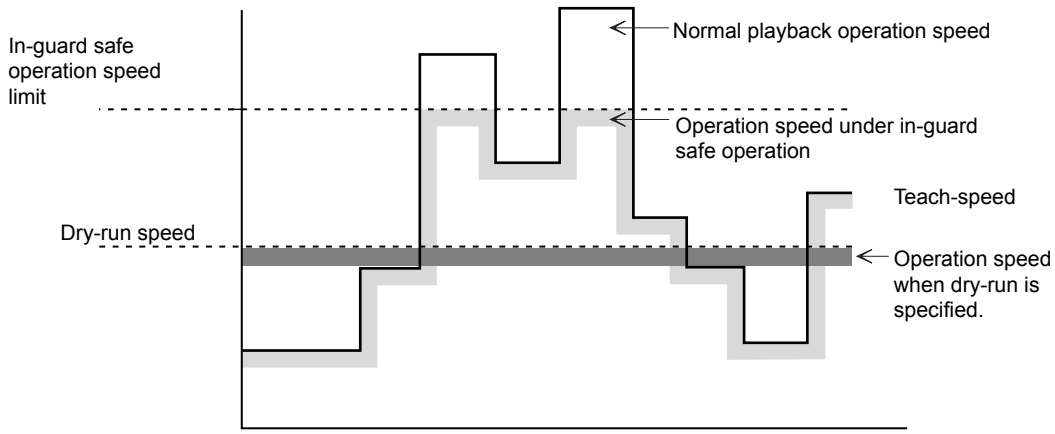
Units: 0.01%

The upper speed limit is set for in-guard safe operation. While the in-guard safe operation command signal is being input, the TCP speed is limited to the TCPmax speed.

8.2.0.2 S1CxG001: DRY-RUN SPEED

Units: 0.01%

This is a dry-run operation speed setting value used when checking the path. Take safety into consideration when setting changes are unnecessary.



8.2.0.3 S1CxG002 to S1CxG009: JOINT SPEED FOR REGISTRATION

Units: 0.01%

The value set in these parameters is registered as the joint speed for each speed level when teaching the position data with the programming pendant. The percentage corresponding to the set value at each level is registered as 100% of the value set in the playback speed limit. Values greater than those set as speed limit values cannot be set.

S1CxG002: Level 1
S1CxG003: Level 2
.
.
.
S1CxG009: Level 8

8.2.0.4 S1CxG010 to S1CxG017: LINEAR SPEED FOR REGISTRATION

Units: 0.1mm/s

The value set in these parameters is registered as the linear speed for each speed level when teaching the position data with the programming pendant. Values greater than those set as playback speed limit values cannot be set.

S1CxG010: Level 1
S1CxG011: Level 2
.
.
.
S1CxG017: Level 8

8.2.0.5 S1CxG018 to S1CxG025: POSITION ANGLE SPEED

Units: 0.1°/s

The value set in these parameters is registered as the position angle speed for each speed level when teaching the position data with the programming pendant. Values greater than those set as playback speed limit cannot be set.

S1CxG018: Level 1
S1CxG019: Level 2
.
.
.
S1CxG025: Level 8

8.2.0.6 S1CxG026 to S1CxG029: JOG OPERATION ABSOLUTE VALUE SPEED

Units: 0.1mm/s

These are setting values of jog operation speed set by the programming pendant. Values greater than those set as jog operation speed limit value cannot be set.

S1CxG026	Low level	:	Jog operation speed when “LOW” manual speed is specified.
S1CxG027	Medium level	:	Jog operation speed when “MEDIUM” manual speed is specified.
S1CxG028	High level	:	Jog operation speed when “HIGH” manual speed is specified.
S1CxG029	High-speed-level	:	Jog operation speed when [HIGH SPEED] is pressed.

8.2.0.7 S1CxG030 to S1CxG032: INCHING MOVE AMOUNT

These parameters specify the amount per move at inching operation by the programming pendant. The referenced parameter differs according to the operation mode at inching operation.

S1CxG030	:	Joint Operation (Unit: 1 pulse)
S1CxG031	:	Cartesian/cylindrical (Unit: 0.001 mm)
S1CxG032	:	Motion about TCP (Unit: 0.001 degree)

SUPPLE-MENT

If the value set for S1CxG031 or S1CxG032 is too small, the inching operation does not proceed.

NOTE

Note that the units of S1CxG031 and S1CxG032 are smaller than those for the NX100.

8.2.0.8 S1CxG033 to S1CxG040: POSITIONING ZONE

This parameter value will be referenced when positioning is specified with the “MOVE” instruction: MOVJ (joint movement) or MOVL (linear movement).

<Example> MOVL V=100.0 PL=1

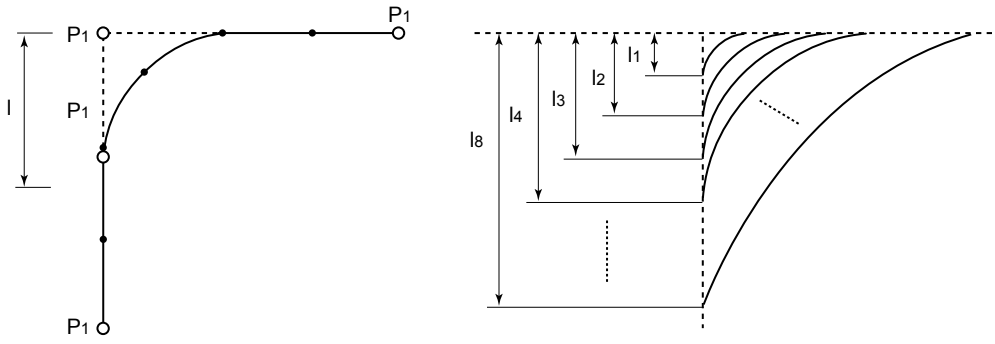
Positioning level

Positioning specification

The value set in this parameter specifies the range to enter in relation to the teaching point for that step positioning. After entering the specified positioning zone, the manipulator starts moving to the next step. The system is also set up so inward turning operation is carried out in the moving section when moving to the next path; speed changeover is smooth.

S1CxG033: Positioning level 1
S1CxG034: Positioning level 2
.
.
.
S1CxG040: Positioning level 8

Since operation will be turning inward during playback, as shown in the following diagram, use setting values taking safety aspects into consideration.



NOTE This process becomes effective when change in direction of steps is between 25° and 155°.

SUPPLE-MENT

Position Level

Position levels are divided into nine stages of 0 to 8 with the "MOV" instruction.
e.g. MOVL V=500 PL=1 (PL:Position Level)
The functions at each level are as follows:
0: Complete positioning to the target point
1 to 8: Inward turning operation
Following are explanations of the respective processing details and their relations with the parameter.

- Level 0
  Determines positioning completion when the amount of deviation (number of pulses) to the target point of each axis comes within the position set zone specified by the parameter.
  After the positioning completes, the instruction system starts instruction to the next target point.
- Level 1 to 8
  Recognizes virtual positioning before the target point. The distance of the virtual target position from the target point is specified at the positioning level.
  Distance data corresponding to each level are set in the parameter. Determination of the virtual target position is carried out in the instruction system.
  Set zone: The zone of each positioning level set in the parameter. (μm)

8.2.0.9 S1CxG044: LOW-SPEED START

Units: 0.01%

This parameter specifies max. speed at low speed start. Specify the starting method for “initial operation speed of manipulator” (S2C217).

8.2.0.10 S1CxG045 to S1CxG048: JOG OPERATION LINK SPEED

Units: 0.01%

These parameters prescribe the link speed at jog operation by the programming pendant. Specify the percentage (%) for the jog operation speed limit, the joint max. speed.

S1CxG045: Jog operation link speed at level “LOW”

S1CxG046: Jog operation link speed at level “MEDIUM”

S1CxG047: Jog operation link speed at level “HIGH”

S1CxG048: Jog operation link speed at level “HIGH SPEED”

8.2.0.11 S1CxG056: WORK HOME POSITION RETURN SPEED

Units: 0.01%

This parameter specifies the speed for returning to work home position against the maximum speed.

8.2.0.12 S1CxG057: SEARCH MAX. SPEED

Units: 0.1mm/s

This parameter specifies the max. speed for searching.

8.2.0.13 S2C201: POSTURE CONTROL AT CARTESIAN OPERATION OF JOG

This parameter specifies whether or not posture control is performed at cartesian operation of “JOG” by the programming pendant. Use posture control unless a special manipulator model is used.

0 : With posture control

1 : Without posture control

8.2.0.14 S2C202: OPERATION IN USER COORDINATE SYSTEM (WHEN EXTERNAL REFERENCE POINT CONTROL FUNCTION USED)

This parameter specifies the TCP or reference point of motion about TCP when the external reference point control function is used and the user coordinate system is selected by the programming pendant.

Fig. 8-1: 0: When manipulator TCP is selected

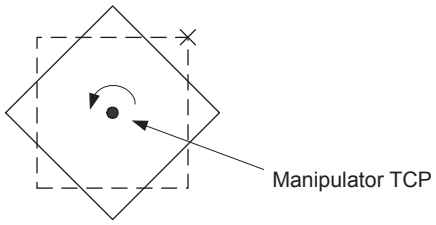
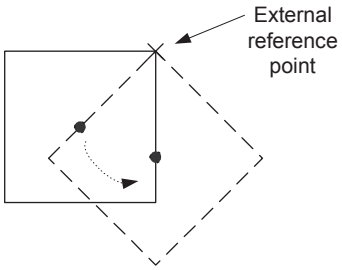


Fig. 8-2: 1: When external reference point is selected



8.2.0.15 S2C320: CONTROLLED GROUP JOB TEACHING POSITION CHANGE

This parameter is used to change only the job teaching position of controlled group axis.

0 : Not changed
1 : Changed

8.2.0.16 S2C422: OPERATION AFTER RESET FROM PATH DEVIATION

8.2.0.17 S2C423: OPERATION AFTER JOB

These parameters specify the method of restarting the manipulator that has deviated from the normal path such as an emergency stop or jog operation.

0 : Move to the indicated step (initial setting).
1 : After moving back to the deviated position, move to the indicated step.
2 : Move back to the deviated position and stop.

Table 8-1: S2C422

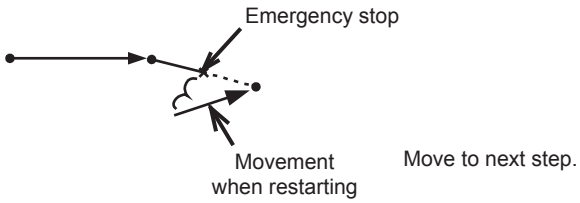
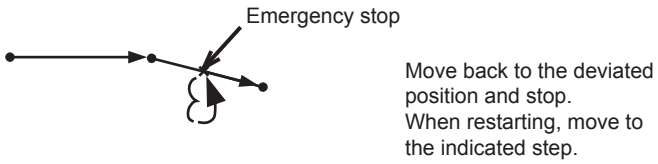
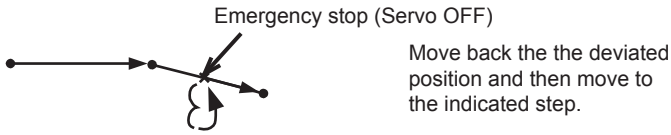
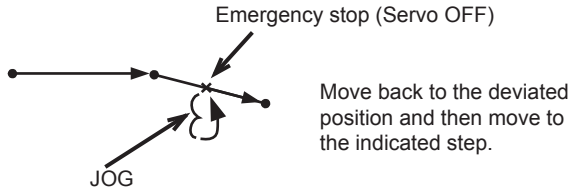
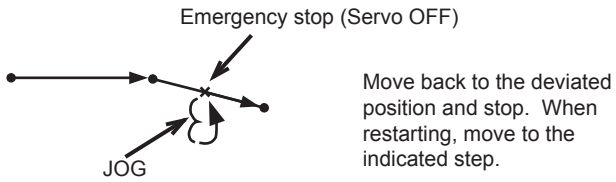
Parameter Setting Value	Movement When Restarting
0	Move to next step. 
1	After moving back to the deviated position, move to the indicated step. 
2	

Table 8-2: S2C423

Parameter Setting Value	Movement When Restarting
0	Move to the next step.
1	After moving back to the deviated position, move to the indicated step. 
2	

NOTE

- To the path deviated position, the manipulator moves in a straight line at low speed operation (SICxG044).
  It is linear movement. After resetting from deviation, the speed becomes the same as taught speed.
- The initial setting (prior to shipping) is 0: The manipulator moves in a straight line from the present position to the indicated step.

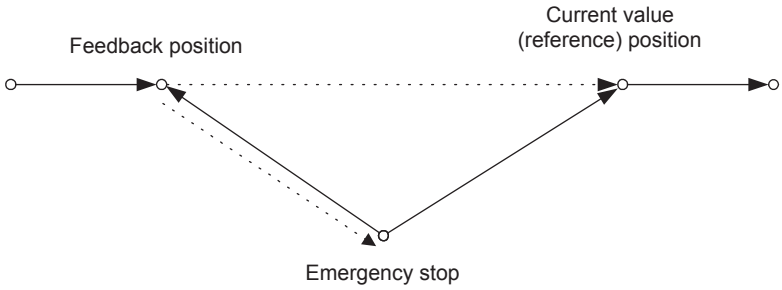
8.2.0.18 S2C424: DEVIATED POSITION

This parameter specifies whether deviated position is to be robot current (reference) position or feedback position.

0 : Return to the feedback position.

1 : Return to the current value (reference) position.

When emergency stop is applied during high-speed motion, the deviated position differs from the robot current value (reference) position and feedback position as shown in the following.



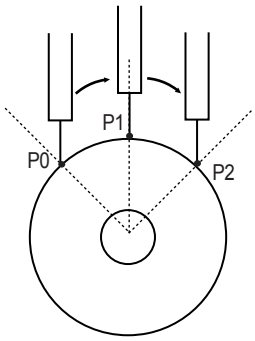
8.2.0.19 S2C425: CIRCULAR INTERPOLATION TOOL POSITION CONTROL

This parameter selects tool position control methods at circular interpolation operation.

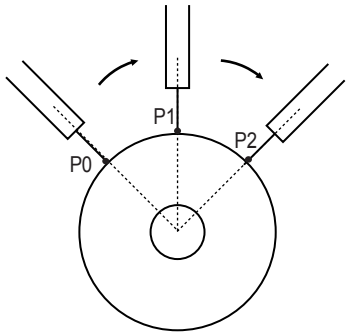
0 : Fixed angle position
Interpolation is performed depending on the position change viewed from the base coordinate.
As the figure below (left) shows, when tool position viewed from outside is not significantly changed and that position is mainly taught at teaching, this setting is required.

1 : Rotating position by circular arc path
Interpolation is performed depending on the position change corresponding to circular arc path.
As the figure below (right) shows, when tool position corresponding to circular arc path (tool position viewed from the center of the circular arc) is not significantly changed, and that position is mainly taught at teaching, this setting is required.

0: Fixed angle position



1: Rotating position by circular arc path



8.2.0.20 S2C653: EMERGENCY STOP CURSOR ADVANCE CONTROL FUNCTION

This parameter specifies whether to use the cursor advance control function or not.

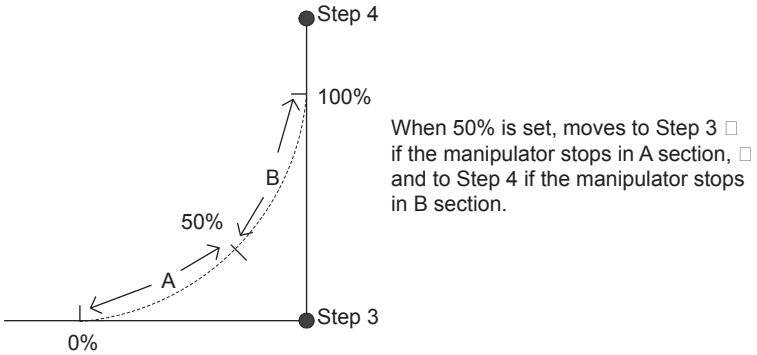
0: Not use

1: Use

8.2.0.21 S2C654: EMERGENCY STOP CURSOR ADVANCE CONTROL FUNCTION CONT PROCESS COMPLETION POSITION

Units: %

When the manipulator stops during moving inner corner by CONT process, this parameter specifies which position of the inner corner should be considered as the end of step.



8.2.0.22 S2C655: EMERGENCY STOP ADVANCE CONTROL FUNCTION WORK START INSTRUCTION STEP MOTION COMPLETION DELAY TIME

Units: ms

In order to recognize securely the completion of motion to the step of work start instruction (such as ARCON instruction), this parameter specifies the delay time for motion completion of the work start instruction step only.

8.2.0.23 S2C698: BASE AXIS OPERATION KEY ALLOCATION SETTING

Table 8-3: Parameter Setting and Jog Operation Key Allocation

Coordinates/Parameter	S2C698= “0”	S2C698= “1”
Joint	Axis number order	Specified
Cylindrical	Axis number order	Specified
Cartesian	Specified	Specified
Tool	Specified	Specified
User	Specified	Specified

Axis number order: X: First axis, Y: Second axis, Z: Third axis

Specified: X: X-direction (RECT-X), Y: Y-direction (RECT-Y), Z: Z-direction (RECT-Z)

8.2.0.24 S3C1098 to S3C1102: POSITION CORRECTING FUNCTION DURING PLAYBACK

These parameters specify the necessary data for position correcting function (PAM) during playback operation.

S3C1098	Specifies the limit of position correcting range (Units: μm)
S3C1099	Specifies the limit of speed correcting range (Units: 0.01%)
S3C1100	Specifies the correcting coordinates 0 : Base 1 : Robot 2 : Tool 3 : User 1 to 26:User 24
S3C1102	Specifies the limit of posture angle adjustment range (Units: 0.01°)

8.3 Mode Operation Setting Parameters

These parameters set various operations in the teach mode or remote mode.
Some parameters can be set through {SETUP} → {TEACHING COND} or {OPERATE COND}.

8.3.0.1 S2C195: SECURITY MODE WHEN CONTROL POWER SUPPLY IS TURNED ON

The operation level when the control power supply is turned ON is set.

0 : Operation Mode
1 : Editing Mode
2 : Management Mode

8.3.0.2 S2C196: SELECTION OF CARTESIAN/CYLINDRICAL

This parameter specifies whether the cartesian mode or cylindrical mode is affected when cartesian/cylindrical mode is selected by operation (coordinate) mode selection at axis operation of programming pendant. This specification can be done on the TEACHING CONDITION window.

0 : Cylindrical mode
1 : Cartesian mode

8.3.0.3 S2C197: COORDINATE SWITCHING PROHIBITED

This parameter prohibits switching coordinates during JOG operation by the programming pendant.

0 : Switching permitted for tool coordinates and user coordinates
1 : Switching prohibited for tool coordinates
2 : Switching prohibited for user coordinates
3 : Switching prohibited for tool coordinates and user coordinates

8.3.0.4 S2C198: EXECUTION UNITS AT “FORWARD” OPERATION

This parameter specifies the execution units at step mode of “FORWARD” operation by the programming pendant.

Parameter Setting Value	Operation Units	
0	MOVL DOUT TIMER DOUT MOVL	Stops at every instruction
1	MOVL DOUT TIMER DOUT MOVL	Stops at move instruction

8.3.0.5 S2C199: INSTRUCTION (EXCEPT FOR MOVE) EXECUTION AT "FORWARD" OPERATION

This parameter specifies the method of instruction (except for move) execution at "FORWARD" operation by the programming pendant.

0 : Executed by pressing [FWD] + [INTERLOCK]
1 : Executed by pressing [FWD] only
2 : Instruction not executed

8.3.0.6 S2C203: CHANGING STEP ONLY

This parameter specifies whether to permit only step changes in an editing-prohibited job. When permitted, only position data can be changed but additional data such as speed cannot be changed. This specification can be done on the TEACHING CONDITION window.

0 : Permitted
1 : Prohibited

8.3.0.7 S2C204: MANUAL SPEED STORING FOR EACH COORDINATE

This parameter specifies whether to assign different manual speeds for the joint coordinates and other coordinates. If "NOT STORED" is selected, manual speed is not affected by changing the coordinates. If "STORED" is selected, manual speeds can be selected separately for the joint coordinates and other coordinates.

0 : Not stored
1 : Stored

8.3.0.8 S2C206: ADDITIONAL STEP POSITION

This parameter designates either "before next step" or "after the cursor position (between instructions)" as additional step position. This specification can be done on the TEACHING CONDITION window.

Fig. 8-3: <Example>

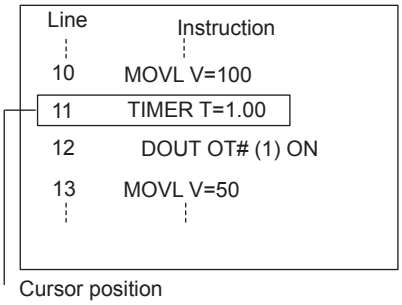


Fig. 8-4: S2C206-0 (Before the Next Step)

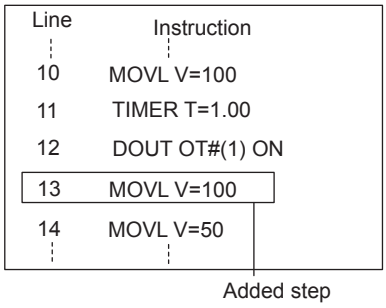
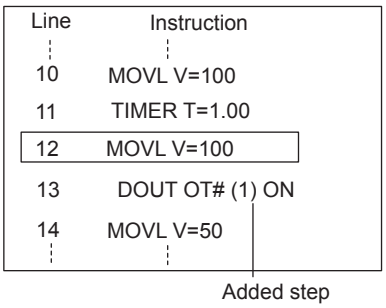


Fig. 8-5: S2C206-1 (Between Instructions)



8.3.0.9 S2C207: MASTER JOB CHANGING OPERATION

This parameter specifies whether to permit or prohibit master job changing operation. If “PROHIBIT” is specified, the master job cannot be changed (or registered) easily. The specification can be done on the OPERATING CONDITION window.

0 : Permitted

1 : Prohibited

8.3.0.10 S2C208: CHECK AND MACHINE-LOCK KEY OPERATION IN PLAY MODE

This parameter specifies whether to permit or prohibit in play mode to change the operation that changes the operation condition. Even if an error occurs because of the operation with the keys, the manipulator does not stop. The specification can be done on the OPERATING CONDITION window.

0 : Permitted

1 : Prohibited

8.3.0.11 S2C209: RESERVED WORK JOB CHANGING OPERATION

This parameter specifies whether to permit reserved work job changing operation.

The designation can be done on the OPERATING CONDITION window.

0 : Permitted

1 : Prohibited

8.3.0.12 S2C210: MASTER OR SUBMASTER CALL OPERATION IN PLAY MODE

This parameter specifies whether the master or submaster call operation in play mode is permitted or not. When the independent control function is valid, the master job for sub-task is specified at the same time. The specification can be done on the OPERATING CONDITION window.

0 : Permitted

1 : Prohibited

8.3.0.13 S2C211: LANGUAGE LEVEL

This parameter specifies the level of the robot language (INFORM III). The levels simplify the instruction registering operation. With the DX100, all robot instructions can be executed regardless of specification of instruction sets. The specification can be done on the TEACHING CONDITION window.

0: Contracted Level
Only frequently used robot instructions are selected to reduce the number of instructions to be registered. Robot instructions displayed on the instruction dialog box are also reduced so that specification is simplified.

1: Standard Level

2: Expanded Level
All the robot instructions are available in standard and expanded levels. The two levels are distinguished by the number of additional information items (tags) that can be used with robot instructions. At the expanded level, the flowing functions are available.

- Local Variables and Array Variables
- Use of Variables for Tags (Example: MOVJ VJ=I000)
  The above functions are not available at the standard level, however, which reduces the number of data required to register instructions, thereby simplifying the operation.

8.3.0.14 S2C214: INSTRUCTION INPUT LEARNING FUNCTION

This parameter specifies whether to set a line of instructions that has been input on the input buffer line when pressing the first soft key for each instruction. If “PROVIDED” is selected, the instructions are set.

0 : Without learning function
1 : With learning function

8.3.0.15 S2C215: ADDRESS SETTING WHEN CONTROL POWER IS TURNED ON

This parameter specifies the processing of the job name, step No., and line No. that are set when the control power supply is turned ON.

0 : Reproduces the address when power supply is turned ON.
1 : Lead address (Line”0”) of the master job.

8.3.0.16 S2C216: JOB LIST DISPLAY METHOD AT JOB SELECTION

These parameters specify the displaying method on the JOB LIST window at job selection.

0 : Order of Names
1 : Order of Date

8.3.0.17 S2C217: INITIAL OPERATION OF MANIPULATOR

This parameter specifies the operation speed level of the first section when starting. Specify the operation speed with the low-speed start (S1CxG044). When starting at low-speed, the manipulator stops after reaching the indicated step regardless of the cycle setting. Once the manipulator is paused during the low-speed operation, it moves at teaching speed when restarted.

0 : Specified on the SPECIAL PLAY window. Operates at low speed only when low speed start is set. Operates at taught speed when not instructed.

1 : Starts at low speed after editing regardless of soft key instructions.

8.3.0.18 S2C218: PLAYBACK EXECUTION AT CYCLE MODE “1- STEP”

Parameter Setting Value	Operation Units	
0	MOVL DOUT TIMER DOUT MOVL	Stops at every instruction
1	MOVL DOUT TIMER DOUT MOVL	Stops at move instruction

NOTE

When operating “FORWARD” by the programming pendant, the units for execution are set in another parameter (S2C198).

8.3.0.19 S2C219: EXTERNAL START

This parameter specifies whether a start instruction from external input is accepted or not. The specification can be done on the OPERATING CONDITION window.

0 : Permitted

1 : Prohibited

8.3.0.20 S2C220: PROGRAMMING PENDANT START

This parameter specifies whether a start instruction from the programming pendant is accepted or not.

0 : Permitted

1 : Prohibited

8.3.0.21 S2C221: SPEED DATA INPUT FORM

This parameter specifies the units for speed data input and display.

mm/s : in units of 0.1 mm/s

cm/min : in units of 1cm/min

inch/min : in units of 1 inch/min

mm/min : in units of 1 mm/min

The specification can be done on the OPERATING CONDITION window.

0 : mm/sec
1 : cm/min
2 : inch/min
3 : mm/min

8.3.0.22 S2C222: RESERVED START

This parameter specifies whether a reserved start instruction from the programming pendant is accepted or not. The specification can be done on the OPERATING CONDITION window.

0 : Permitted
1 : Prohibited

8.3.0.23 S2C224: JOB SELECTION AT REMOTE FUNCTION (PLAY MODE)

This parameter specifies whether a job selection in play mode at remote function is prohibited or not.

0 : Permitted
1 : Prohibited

8.3.0.24 S2C225: EXTERNAL MODE SWITCH

This parameter specifies whether mode switching from the outside is accepted or not. The specification can be done on the OPERATING CONDITION window.

0 : Permitted
1 : Prohibited

8.3.0.25 S2C227: EXTERNAL CYCLE SWITCHING

This parameter specifies whether cycle switching from the outside is accepted or not. The specification can be done on the OPERATING CONDITION window.

0 : Permitted
1 : Prohibited

8.3.0.26 S2C228: PROGRAMMING PENDANT CYCLE SWITCHING

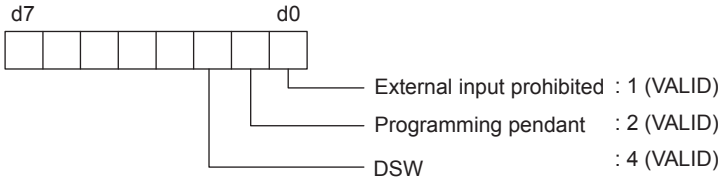
This parameter specifies whether cycle switching from the programming pendant is accepted or not. The specification can be done on the OPERATING CONDITION window.

0 : Permitted

1 : Prohibited

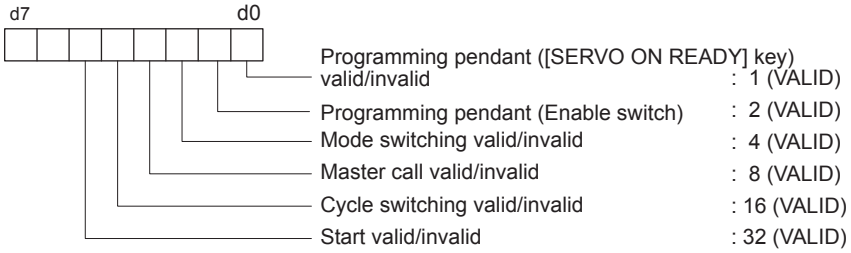
8.3.0.27 S2C229: SERVO ON FROM EXTERNAL PP PROHIBITION

This parameter specifies whether a servo ON instruction is accepted or not. More than one instruction can be specified. For example, to permit the servo ON instruction from an external input only, set “2”. In this case, servo ON instruction from the programming pendant is not accepted. The specification can be done on the OPERATING CONDITION window.



8.3.0.28 S2C230: PROGRAMMING PENDANT OPERATION WHEN “IO” IS SELECTED FOR REMOTE MODE

This parameter specifies whether each operation of the following is valid when “IO” is selected for remote function selection. IO and command are available for remote function selection: “IO” is set prior to shipping. “Command” is valid when transmission function (optional) is specified.



8.3.0.29 S2C234: STEP REGISTRATION AT TOOL NO. CHANGE

The registration of the step when the tool number is changed allows the setting to be made as prohibited.

If this parameter is set to “1” (prohibited), the following operations are prohibited.

0 : Permitted
1 : Prohibited

- Modification of a step
  When the tool number of the teaching step differs from the currently-selected tool number, the step cannot be modified.
- Deletion of a step
  Even if the teaching step position coincides with the current position, the step cannot be deleted when the tool number of the teaching step differs from the currently-selected tool number.
- Addition of a step
  When the tool number of the teaching step indicated by the cursor differs from the currently-selected tool number, the step cannot be added.

8.3.0.30 S2C293: REMOTE FIRST CYCLE MODE

This parameter sets the cycle that changes from the local mode to the remote mode.

The setting can be made on the OPERATING CONDITION window.

0 : Step
1 : 1 cycle
2 : Continuous
3 : Setting retained

8.3.0.31 S2C294: LOCAL FIRST CYCLE MODE

This parameter sets the cycle that changes from the remote mode to the local mode.

The setting can be made on the OPERATING CONDITION window.

0 : Step
1 : 1 cycle
2 : Continuous
3 : Setting retained

8.3.0.32 S2C312: POWER ON FIRST CYCLE MODE

This parameter sets the first cycle mode for when the power is turned ON.

The setting can be made on the OPERATING CONDITION window.

0 : Step
1 : 1 cycle
2 : Continuous
3 : Setting retained

8.3.0.33 S2C313: TEACH MODE FIRST CYCLE MODE

This parameter sets the cycle that changes from the play mode to the teach mode.

The setting can be made on the OPERATING CONDITION window.

0 : Step
1 : 1 cycle
2 : Continuous
3 : Setting retained

8.3.0.34 S2C314: PLAY MODE FIRST CYCLE MODE

This parameter sets the cycle that changes from the teach mode to the play mode.

The setting can be made on the OPERATING CONDITION window.

0 : Step
1 : 1 cycle
2 : Continuous
3 : Setting retained

8.3.0.35 S2C316: START CONDITION AFTER ALARM-4107 (“OUT OF RANGE (ABSO DATA)”)

This parameter specifies the activating method after the alarm 4107 (“OUT OF RANGE (ABSO DATA)”) occurs.

0 : Position check operation required
1 : Low-speed start up

8.3.0.36 S2C395: SIGNAL NAME ALIAS FUNCTION

On the JOB CONTENT window, the name registered to the user input/output signal number can be displayed as alias instead of the signal number itself.

Table 8-4: S2C395

Parameter Setting Value	Valid/Invalid
0	Function invalid
1	Function valid

1. With this function valid, the confirmation dialog box “Register by name (alias)?” is displayed when a signal (IN#(), OT#(), IG#(), OG#(), IGH#(), OGH#()) is selected on the DETAIL EDIT window.
2. Select “YES” and the signal select window appears. Then select the target signal of number and press [ENTER], and the registered name is displayed instead of the signal number. However, if the signal number’s name is not yet registered, it is displayed by number as usual.

<Example> Registration of the name of user output OUT#0001 as “OUTPUT 1”

In the case of DOUT instruction:

S2C395=0 : DOUT OT#(1) ON

S2C395=1 : DOUT OT#(OUTPUT 1) ON

SUPPLE-MENT

Select {IN/OUT} → {UNIVERSAL INPUT/OUTPUT} to edit signal names on the window. Up to 16 characters can be entered as a signal name. However, when this function is valid, if the content below is entered, the error message shows and the name cannot be registered.

- The name already registered
- Letters beginning with a number
- Letters including the signs below:
  (,) , [,] , = , < , > , space, comma
- Letters beginning with “alphabets representing variables” + “number”
  <Example> B0..., I0..., BP1..., LEX2...
  Alphabets representing variables: B, I, D, R, S, P, BP, EX, PX, LB, LI LD, LR, LS, LP, LBP, LEX, LPX

When the name begins with “ ‘ ”, it is regarded as a comment and the same comment can be registered for two or more signals. In this case, although this function is valid, the number is displayed on the JOB CONTENT window instead of the name.

<Example> Registration of the name of user output OUT#0002 as “ ‘OUTPUT 2”
S2C395=0 : DOUT OT#(2) ON
S2C395=1 : DOUT OT#(2) ON

8.3.0.37 S2C396: VARIABLE NAME ALIAS FUNCTION

On the JOB CONTENT window, the name registered to the variable (including local variables) can be displayed as alias instead of the variable number.

Table 8-5: S2C396

Parameter Setting Value	Valid/Invalid
0	Function invalid
1	Function valid

1. With this function valid, the confirmation dialog box “Register by name (alias) ?” is displayed when you select the variable on the DETAIL EDIT window.
2. Select “YES” and the variable select window appears. Then select the target variable of number and press [ENTER], and the registered name is displayed instead of the variable number. However, if the variable number’s name is not yet registered, it is displayed by number as usual.

<Example> Registration of the byte type variable B000 as “WORK KIND”
In the case of SET instruction
S2C396=0 : SET B000 128
S2C396=1 : SET WORK KIND 128

SUPPLE-MENT

Select {VARIABLE} from the menu to select each variable and edit the variable name. Up to 16 characters can be entered as a variable name. However, when this function is valid, if the content below is entered, the error message shows and the name cannot be registered.

- The name already registered
- Letters beginning with a number
- Letters including the signs below:
  (,) , [,] , = , < , > , space, comma
- Letters beginning with “alphabets representing variables” + “number”
  <Example> B0..., I0..., BP1..., LEX2...
  Alphabets representing variables: B, I, D, R, S, P, BP, EX, PX, LB, LI LD, LR, LS, LP, LBP, LEX, LPX

When the name begins with “ ‘ ”, it is regarded as a comment and the same comment can be registered for two or more variables. In this case, although this function is valid, the number is displayed on the JOB CONTENT window instead of the name.

<Example> Registration of the byte type variable B001 as “WORKNUM”
S2C396=0 : SET B001 10
S2C396=1 : SET B001 10

8.3.0.38 S2C397: I/O VARIABLE CUSTOMIZE FUNCTION

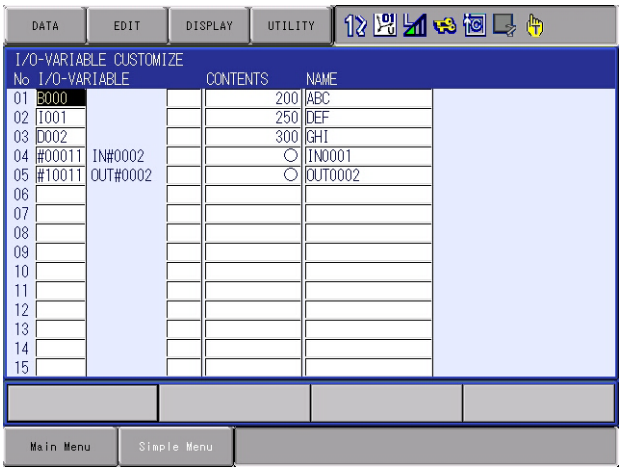
This function enables registration of any particular input/output signal/ variable. Reference and editing of signals/variables are possible on the same window.

Table 8-6: S2C397

Parameter Setting Value	Valid/Invalid
0	Function Invalid
1	Function Valid

With this function valid, the sub-menu {I/O-VARIABLE CUSTOMIZE} opens under the main menu {ARC WELDING}, {SPOT WELDING}, {GENERAL}, {HANDLING} (differs by application). Select {I/O-VARIABLE CUSTOMIZE}, and the I/O-VARIABLE CUSTOMIZE window appears as follows.

Fig. 8-6: I/O VARIABLE CUSTOMIZE Window



On the I/O-VARIABLE CUSTOMIZE window, any of the input/output signals/variables can be selected and registered (up to 32 items). Registrable signals/variables are as follows:

Table 8-7: Registrable Items on the I/O-VARIABLE CUSTOMIZE Window

Input/Output Signals	USER INPUT SIGNAL USER OUTPUT SIGNAL PSEUDO INPUT SIGNAL
Variables	BYTE TYPE VARIABLE (B VARIABLE) INTEGER TYPE VARIABLE (I VARIABLE) DOUBLE-PRECISION INTEGER TYPE VARIABLE (D VARIABLE)

The contents and names of the registered signals/variables can be checked and edited on this window.
In addition, the data list of registered signals/variables can be loaded, saved, verified or deleted with an external memory unit.
Only when this function is valid, “I/O-VARIABLE CUSTOMIZE (file name: USRIOVAR.DAT)” is displayed and can be selected. To display the “I/O-VARIABLE CUSTOMIZE (file name: USRIOVAR.DAT)”, select {FD/CF} → {LOAD} {SAVE} {VERIFY} {DELETE} → {SYSTEM DATA}.

8.3.0.39 S2C410: WORD REGISTRATION FUNCTION / WORD EDITING FUNCTION SPECIFICATION

Specifies the valid or invalid to edit the words while inputting the characters.

0 : Invalid

1 : Vaild

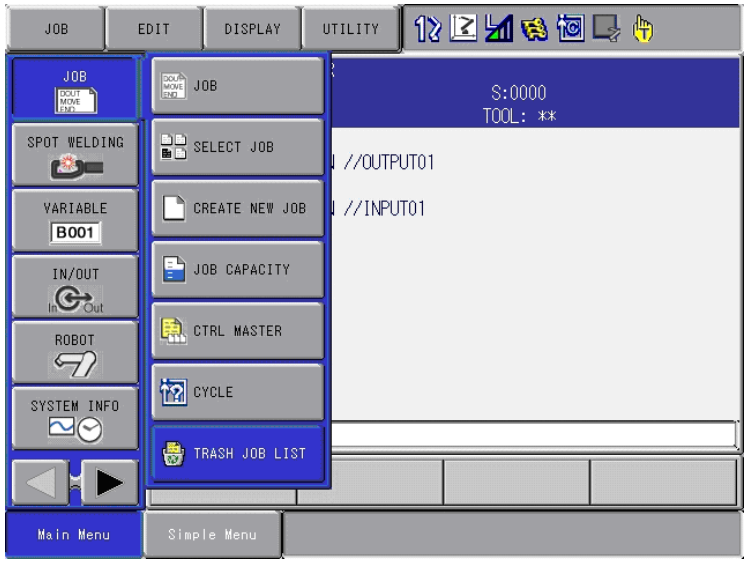
*It is able to edit the words when the security mode is the edit mode or the management mode.

8.3.0.40 S2C413: JOB UNDELETE FUNCTION

This function doesn't completely delete a job from its memory when deleting the job, but saves the data so that the job can be restored as needed.

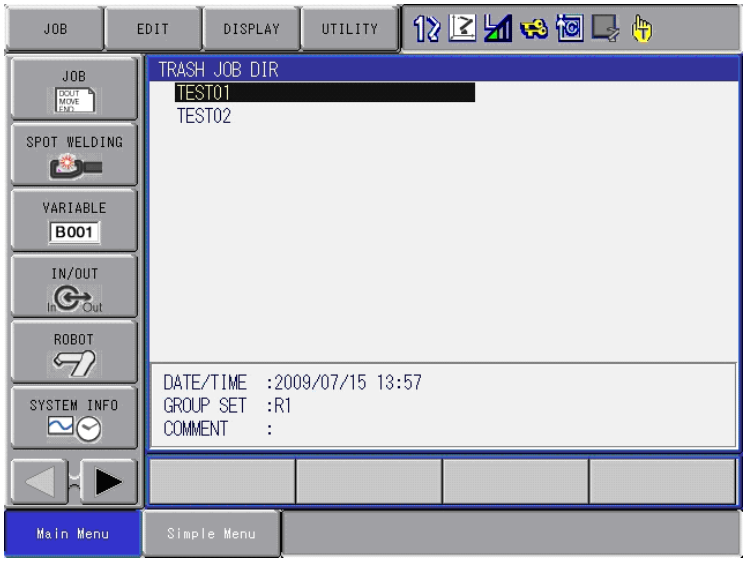
This parameter can be set on {TEACHING CONDITION} window.

If a job is deleted while this function is valid, the job disappears from the JOB LIST window. In this case, {TRASH JOB LIST} is newly displayed to {JOB} on the main menu and the deleted job is listed on it.



NOTE The job will not be listed on the trash job list and will not be restored if it is deleted when this function is invalid.

On the trash job list, the deleted jobs are displayed.



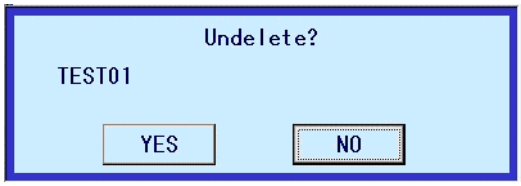
On this window, the following operations are available with the same operations as job list window.

- Batch selection / canceling selection of the jobs ({EDIT} →{SELECT ALL} →{CANCEL SELECT})
- Job search ({EDIT} →{JOB SEARCH COND})
- Rearrange of the jobs in the order of date / order of name ({DISPLAY} →{DATE} {NAME})
- Job detailed information display ({DISPLAY} →{DETAIL})

■ **Restoring the Job**

Choose a job to be restored and select {UNDELETE JOB} from {JOB} on the pull down menu.

A dialog box to confirm restoring the selected job.



Select

[YES] to restore the job. The restored job is deleted from the trash job list and newly listed to the job list.

[NO} to cancel restoring the job.

■ **Deleting the Job Completely**

Delete a job from the memory. The job will not be restored after this operation.
Choose a job to be completely deleted, then select {DELETE JOB} from {JOB} on the pull down menu.

A dialog box to confirm deleting the selected job.

Select

[YES] to delete the job completely. The deleted job is deleted from the trash job list.

[NO} to cancel deleting the job.

NOTE

The job data remains until it is completely deleted and the capacity of the memory becomes less as long as this function is valid. Delete unnecessary data to keep enough job capacity.

8.3.0.41 S2C415 to S2C419: TIME RESET

These parameters specify whether resetting operation of the specified times is permitted or not.

S2C415	:	CONTROL POWER ON TIME
S2C416	:	SERVO POWER ON TIME
S2C417	:	PLAYBACK TIME
S2C418	:	WORK TIME
S2C419	:	WEAVING TIME

0 : Prohibit Resetting
1 : Permit Resetting

“PERMIT” is set as the initial value for the work time and motion time.

8.3.0.42 S2C431: TOOL NO. SWITCHING

This parameter specifies whether tool number switching is permitted or not.

0 : Prohibited (Only number “0” can be used.)

1 : Permitted (64 type of tools from number “0” to “63” can be used.)

8.3.0.43 S2C433: POSITION TEACHING BUZZER

This parameter specifies whether the buzzer sound at position teaching is used or not.

0 : With buzzer

1 : Without buzzer

8.3.0.44 S2C434: JOB LINKING DESIGNATION (When Twin Synchronous Function Used)

This parameter specifies whether the manipulator at the synchronizing side is to be linked when the manipulator and the station at the synchronized side are performing FWD/BWD or test run, by using the twin synchronous function.

0 : Not operating

1 : Linking

Fig. 8-7: 0 : Does not operate the synchronizing side while teaching the synchronized side.

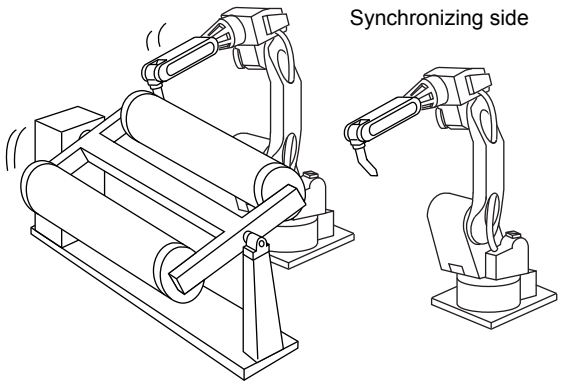
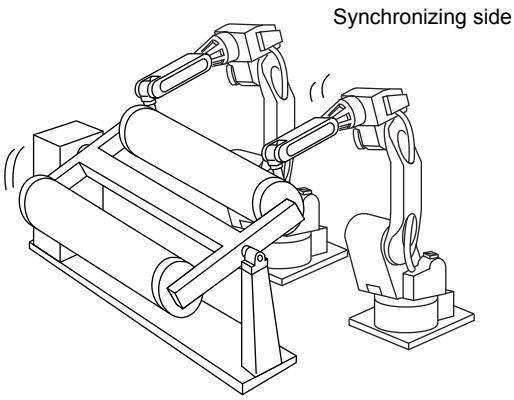


Fig. 8-8: 1 : Links the synchronizing side while teaching the synchronized side.



8.3.0.45 S2C437: PLAYBACK OPERATION CONTINUATION FUNCTION

This function is used to decide where to resume the playback on the start operation after suspending the playback and moving the cursor or selecting other jobs.

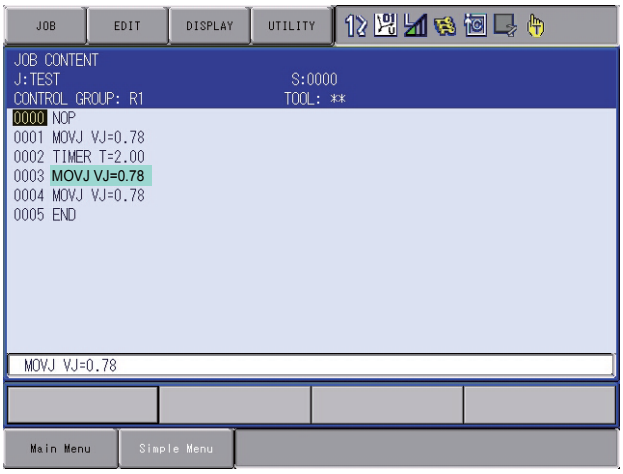
0: Starts operation where the cursor is located in the job displayed at the moment.

1: The playback continuation window appears. Select “YES” and the playback resumes where the cursor has been located when the playback suspended. If “NO” is selected, the playback resumes where the cursor is located in the job displayed at the moment.

Table 8-8: S2C437

Parameter Setting Value	Where the Playback Resumes
0	Resumes where the cursor is located in the job displayed at the moment.
1	Resumes where the cursor has been located when the playback suspended OR where the cursor is located in the job displayed at the moment. **<Example>** Suspended at step 0003 during the playback of job A ↓ Displays job B ↓ Starts operation ↓ On the playback operation continuation window • When “YES” selected, the playback resumes from step 0003 of job A • When “NO” selected, the playback resumes from the current position in job B

* When this function is valid (S2C437=1), a light blue cursor is displayed at the instruction section of step where the playback has been stopped. When “YES” is selected, the playback resumes where this cursor is located.



NOTE

If a job has been edited or FWD/BWD/TEST RUN operation(s) have been executed, the playback cannot resume where it has suspended. Also this function is invalid if the reserved start function is set valid (S2C222=0).

8.3.0.46 S2C544: I/O NAME DISPLAY FUNCTION FOR JOB

When a user input/output signal, whose name is already set, is used as a job, this function displays the signal name in the form of a comment.

```
JOB CONTENT: MASTER
J:SAMPLE01
CONTROL GROUP: R1
0000 NOP
0001 DOUT OT#(1) ON //OUTPUT01
0002 MOVJ VJ=0.78
0003 WAIT IN#(1)=ON //INPUT01
0004 MOVJ VJ=0.78
0005 END
```

> **NOTE**
> When the specification of the signal is group specification (IG#, IGH#, OG#, OGH#), the name will not be displayed. Also, the name will not be displayed when the job is saved at external memory devices.

This parameter can be set on {FUNCTION ENABLE}.window.

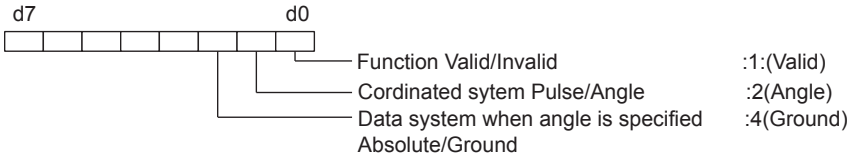
0 : Invalid
1 : Valid

8.3.0.47 S2C684:ALL AXES ANGLE DISPLAY FUNCTION

This function enables to change the display of manipulator position from pulse-formed to angle-formed on the specific window.

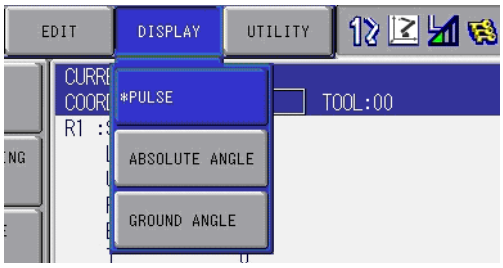
This function is valid in the following windows.

- Current value (however, it is invalid if the present displayed coordinate systems are “base”, “robot” or “user”.)
- Command position
- Work home position
- Second work home position



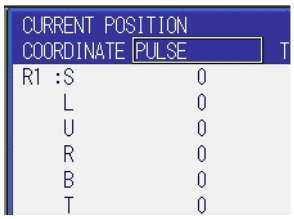
This function can be valid/invalid on {FUNCTION ENABLE} window.

Select {DISPLAY} on the pull down menu while this function is valid, then {PUSLE}, {ABSOLUTE ANGLE} and {GROUND ANGLE} appear. Select one so that the presently displayed data can be changed to the selected data type.



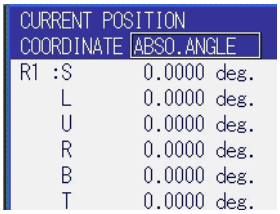
PULSE

Indicates the pulse data of each axis.



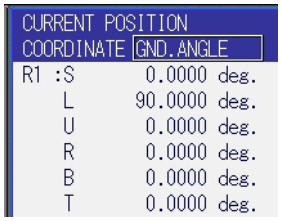
ABSOLUTE ANGLE

Indicates the independent angle at every axes on the basis that the absolute value is 0[deg] when the pulse is 0.



GROUND ANGLE

Indicates the L- and U-axes angle according to the manipulator installation direction. The value of unoperated axes may vary depending on the manipulator's posture.



NOTE As for the servo track, angle is not indicated but distance (unit [mm]).

8.3.0.48 S2C713: CONTROL POINT OPERATION SETTING ON THE SERVO TRACK

This parameter specifies a motion system by which the manipulator's control point is fixed while the servo track is in operation.

However, it is valid only when the selected control group is specified as a servo track and the servo track is operated by jog keys in the cartesian coordinates.

0 : Normal operation

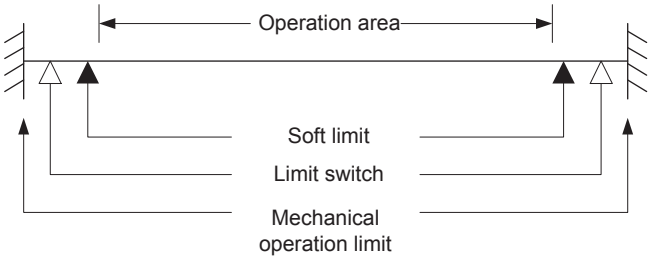
1 : Control point operation setting on the servo track

8.4 Parameters According to Interference Area

These parameters limit the P-point maximum envelope of the manipulator or set the interference area for axis interference or cubic interference.

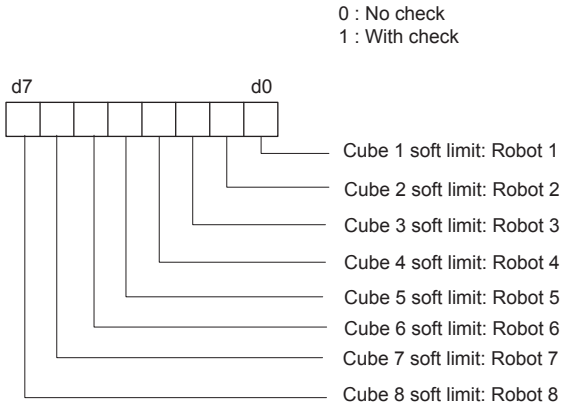
8.4.0.1 S1CxG400 to S1CxG415: PULSE SOFT LIMIT

Soft limit is set independently for each axis by pulse value setting. Set current value (pulse value) of the axis at the soft limit set up position.



8.4.0.2 S2C001: CUBE SOFT LIMIT CHECK

This parameter specifies whether to check the cube soft limit. More than one soft limit can be specified.



If “WITH CHECK” is selected, set up the following parameters.

Units: μm

Cube Soft Limit (Base Coordinates of Robot TCP)

S3C000: Robot 1: + side: X

S3C001: Robot 1: + side: Y

S3C002: Robot 1: + side: Z

S3C003: Robot 1: - side: X

S3C004: Robot 1: - side: Y

S3C005: Robot 1: - side: Z

S3C007: Robot 2: + side: X

S3C008: Robot 2: + side: Y

S3C009: Robot 2: + side: Z

S3C010: Robot 2: - side: X

S3C011: Robot 2: - side: Y

S3C012: Robot 2: - side: Z

•

•

•

S3C042: Robot 8: + side: X

S3C043: Robot 8: + side: Y

S3C044: Robot 8: + side: Z

S3C045: Robot 8: - side: X

S3C046: Robot 8: - side: Y

S3C047: Robot 8: - side: Z

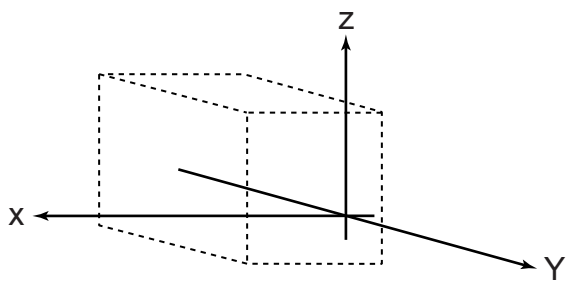
SUPPLE-MENT

Soft Limit

Soft limit is a software-type function to limit the range of movement of the manipulator.

If the TCP reaches the soft limit during operation, the manipulator automatically stops and no longer moves in that same direction. An alarm occurs if this soft limit is exceeded during playback. This soft limit is classified into two types.

- Cube Soft Limit
  Soft limit is set with the absolute value on the base coordinates.



- Pulse Soft Limit (Independent Axis Soft Limit)
  Refer to *section 8.4.0.1 “S1CxG400 to S1CxG415: PULSE SOFT LIMIT” on page 8-32*.

8.4.0.3 S2C002: S-AXIS INTERFERENCE CHECK

This parameter specifies whether to check for interference with each manipulator. If “WITH CHECK” is selected, set up the following parameters.

Units: Pulse

S3C048: S-axis Interference Area Robot 1 (+)

S3C049: S-axis Interference Area Robot 1 (-)

S3C050: S-axis Interference Area Robot 2 (+)

S3C051: S-axis Interference Area Robot 2 (-)

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.
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S3C063: S-axis Interference Area Robot 8 (-)

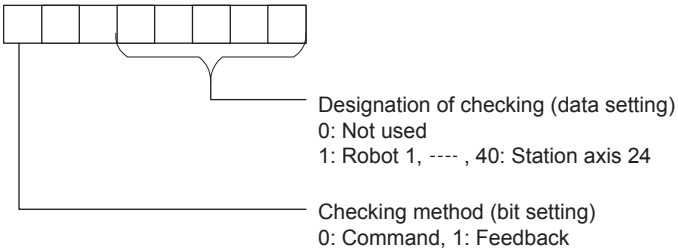
8.4.0.4 S2C003 to S2C066: CUBE/AXIS INTERFERENCE CHECK

1. Designation of checking
   These parameters specify the cube/axis interference to be used by bit.

0	:	Cube Interference/Axis Interference Not Used
1	:	Robot 1
2	:	Robot 2
.....		
8	:	Robot 8
9	:	Base Axis 1
10	:	Base Axis 2
.....		
16	:	Base Axis 8
17	:	Station Axis 1
18	:	Station Axis 2
.....		
40	:	Station Axis 24

2. Checking method

   Designates whether checking is performed by command or feedback.



Checking method

The checking method differs according to ON/OFF status of servo power supply.

SUPPLE-MENT

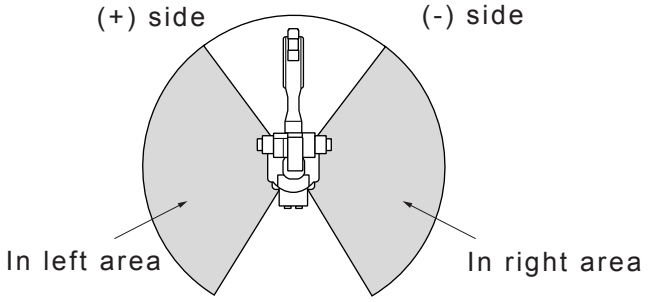
Checking Method Designation	Servo Power Supply ON	Servo Power Supply OFF
Command	Command	Feedback
Feedback	Feedback	Feedback

During the servo float function operation, checking is performed by feedback regardless of the checking method designation.

Interference Area

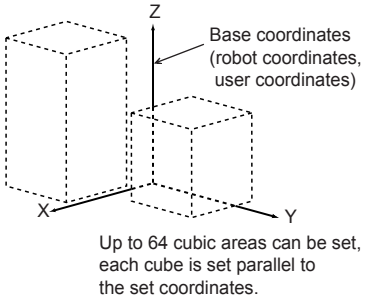
It is possible to output whether the TCP during operation is inside or outside as a status signal, and to set the area to control the position by parameters S2C003 to S2C194. When the manipulator attempts to enter this area, the corresponding input signal (e.g. an “entrance prohibit signal”) is detected. The manipulator stops immediately if there is an input signal and goes into waiting status until this signal is cleared. This signal is processed in the I/O section. Three methods of interference area settings are prepared for manipulators and stations. For a system with one manipulator, use robot 1.

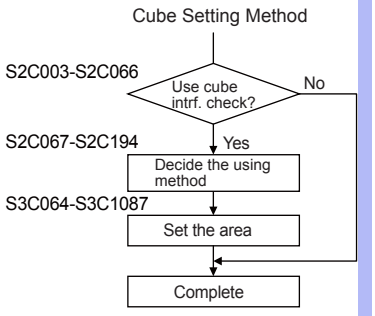
- S-axis Interference Area
  Position is controlled by the pulse value of the S-axis.



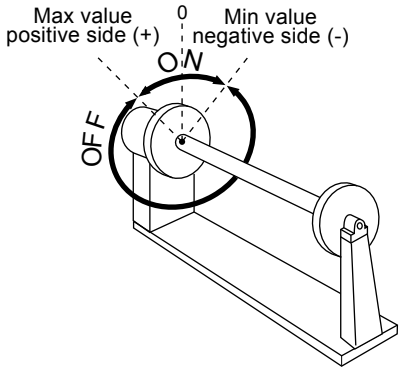
SUPPLE-MENT

- Cubic Interference Area
  Up to 64 cubic areas can be set. The edges of the cubes are set parallel to the robot coordinates or the user coordinates.





- Axis Interference Area
  Up to 64 areas can be set. Each operation area maximum and minimum value are set for the robot, base axis, and station axis plus and minus side.



8.4.0.5 S2C067 to S2C194: CUBE USING METHOD

These parameters specify the coordinates for defining the cube. If the user coordinates are selected, also specify the user coordinate system numbers. Set cubic area referring to the cubic interference areas shown below.

Coordinate specification

0 : Pulse (axis interference)

1 : Base coordinates

2 : Robot coordinates

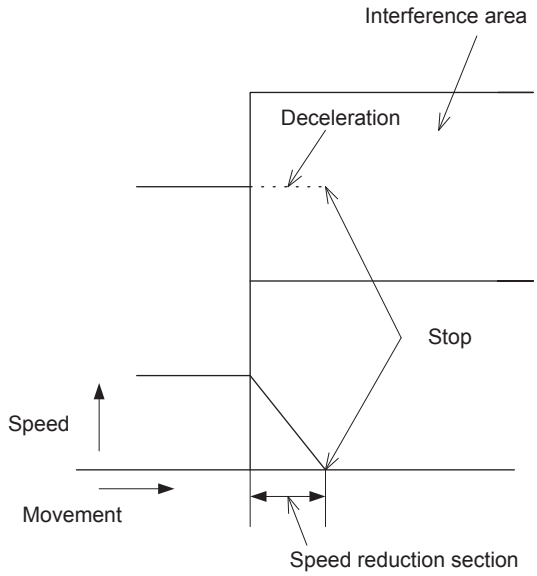
3 : User coordinates

Coordinate No.: Specify the user coordinate number when selecting “3: User Coordinates”.
Units: 1μm

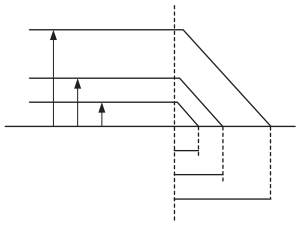
Precaution When Setting the Interference Area

It will be necessary to consider the following when setting the cubic interference and S-axis interference areas. The manipulator is processed to decelerate to stop from the point where it enters in the area. Therefore, set the areas in consideration of the amount of the manipulator movement in the deceleration section shown in the figure below.

SUPPLE-MENT



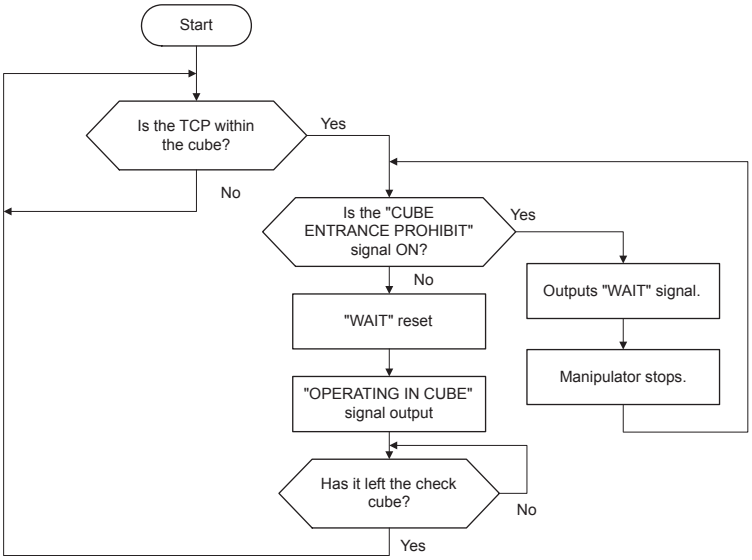
The move amount in the speed reduction section is dependent on the moving speed of the manipulator at that time:



V = 1500mm/s → approx. 300mm (Max.)
V = 1000mm/s → approx. 160mm
V = 30mm/s → approx. 3 to 4 mm
V = 20mm/s → approx. 2mm

Interference Prevention in Interference Area

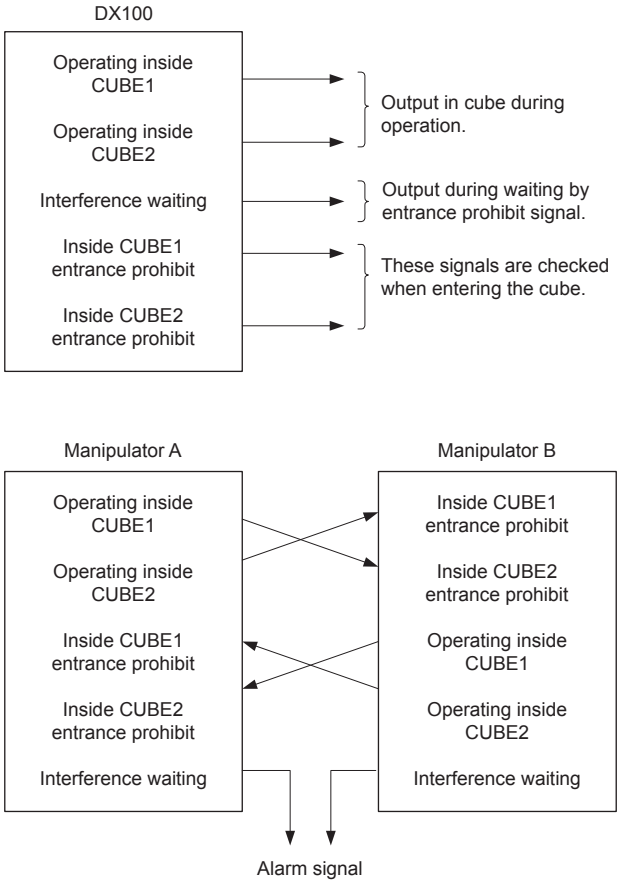
Processing to prevent interference is executed in the I/O processing section. The relation between the DX100 I/O signal and manipulator operation is shown below.



In wait status with the entrance prohibit signal, the manipulator just barely enters the area for speed reduction processing and then stops.

SUPPLE-MENT

Fig. 8-9: Connection Example Where Two Manipulators are Operated in the Same Area



8.4.0.6 S3C000 to S3C047: CUBE SOFT LIMIT

These parameters specify auxiliary functions of S2C001 parameter. For details, see *section 8.4.0.2 “S2C001: CUBE SOFT LIMIT CHECK” on page 8-32*.

8.4.0.7 S3C048 to S3C063: S-AXIS INTERFERENCE AREA

These parameters specify auxiliary functions of S2C002 parameter. For details, see *section 8.4.0.3 “S2C002: S-AXIS INTERFERENCE CHECK” on page 8-34*.

8.4.0.8 S3C064 to S3C1087: CUBIC INTERFERENCE AREA

These parameters specify auxiliary functions of S2C003 to S2C066 parameters. For details, see *section 8.4.0.4 “S2C003 to S2C066: CUBE/ AXIS INTERFERENCE CHECK” on page 8-35*.

8.4.0.9 S3C1089 to S3C1096: ROBOT INTERFERENCE AREA

These parameters specify auxiliary functions of S2C236 to S2C263 parameters. For details, see *section 8.4.0.6 “S3C000 to S3C047: CUBE SOFT LIMIT” on page 8-39*.

8.4.0.10 S3C1097: A SIDE LENGTH OF WORK-HOME-POSITION CUBE

Units: 1μm

This parameter specifies a side length of the cube for the work home position.

8.5 Parameters according to Status I/O

These parameters set the parity check or I/O setting for user input/output signals.

8.5.0.1 S2C235: USER OUTPUT RELAY WHEN CONTROL POWER IS ON

This parameter specifies the state of the user output relays when the control power is turned ON. Since the power OFF state, including peripheral devices, cannot be completely reproduced, take note when restarting.

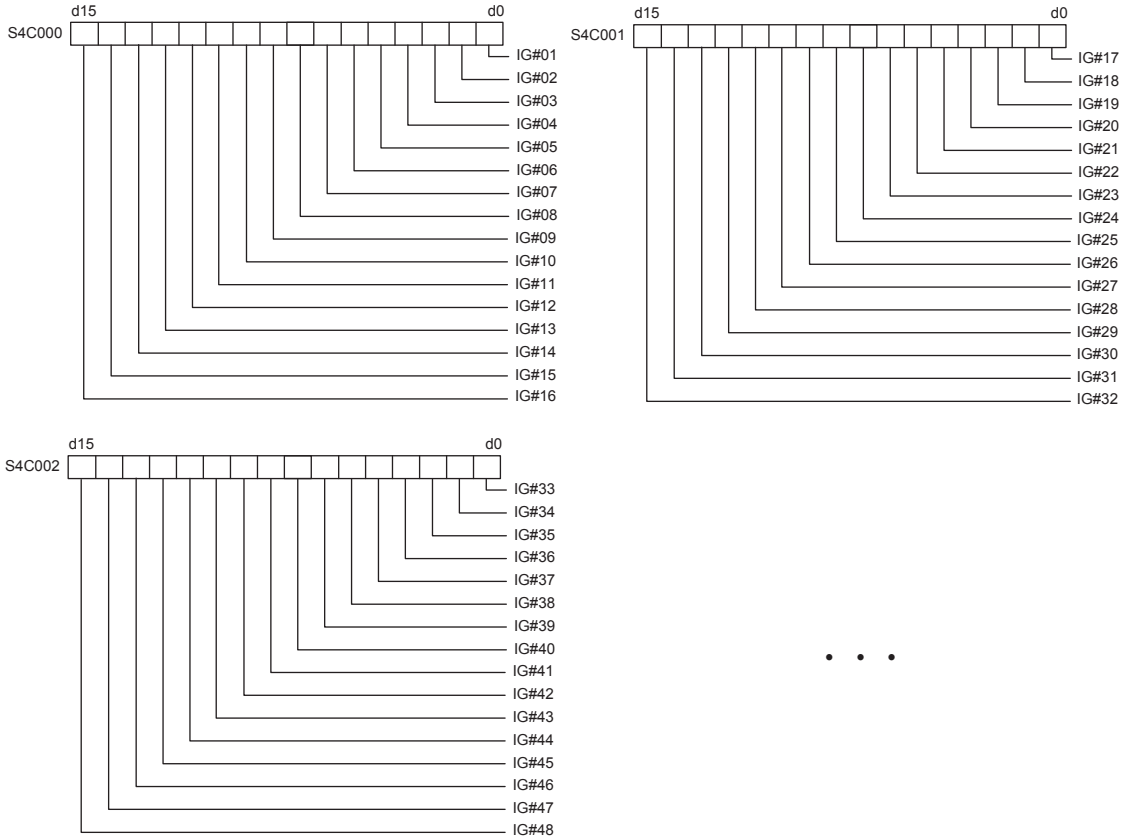
0 : Reset to the power OFF state

1 : Initialized (all user relays OFF)

8.5.0.2 S4C000 to S4C015: PARITY OF USER INPUT GROUPS

These parameters specify whether to execute priority checks with parameters when instructions covering the input group (1G#) are executed. The instructions covering the input groups are as shown below.

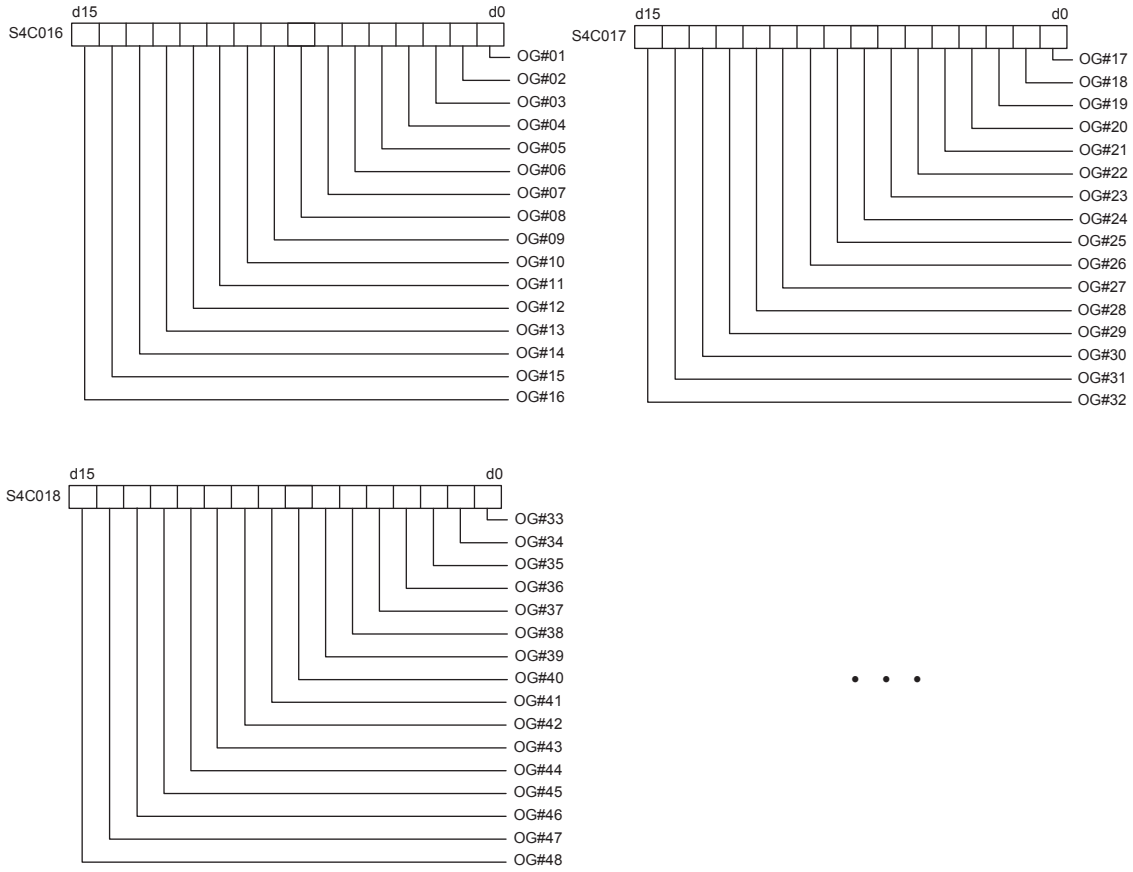
- IF Sentence (JUMP, CALL, RET, PAUSE)
- Pattern Jump, Pattern Job Call
- DIN
- WAIT



Parity bits are set as the highest level bits of each input group and are written in even parity. If an error is detected during parity check, an alarm occurs and the manipulator stops. Remains unchanged if no parity check is specified.

8.5.0.3 S4C016 to S4C031: PARITY OF USER OUTPUT GROUPS

These parameters specify whether the output group instruction is executed with parity check (even parity).



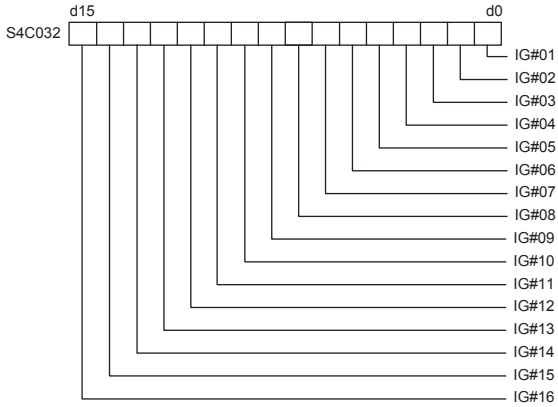
Parity bits are set as the highest level bits of each output group. For example, if OG#01 is specified with parity and DOUT OG# (1) 2 is executed, the result will be 00000010 if 2 is binary converted. Since there will be only one bit (odd) ON at this time, the parity bit (highest level bit) will be set to ON and 10000010 (130) will be output to OG# (1).

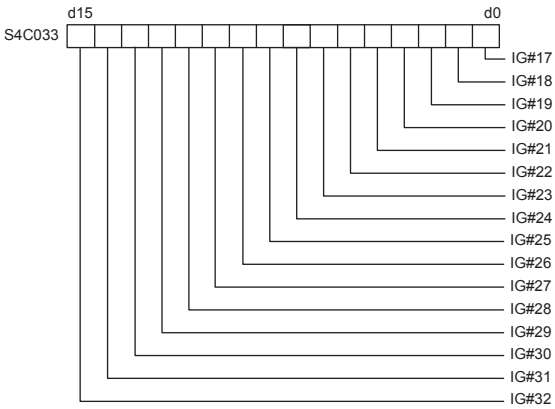
As in the case of a variable such as DOUT OG# (1) B003 parity bits are added to the contents of the variable data. However, if the contents of the variable exceed 127, as in the case of DOUT OG# (1) 128, an alarm will occur. Remains unchanged if no parity check is specified.

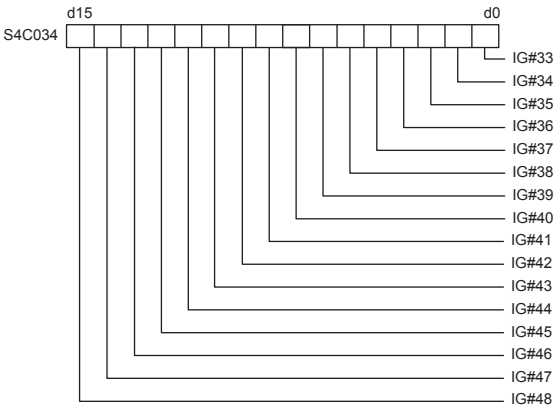
8.5.0.4 S4C032 to S4C047: DATA OF USER INPUT GROUPS

These parameters specify whether to handle the input group data as binary data or as BCD data when an instruction for the input group (1G#) is executed. The instructions covering the input groups are as shown below.

- IF Sentence (JUMP, CALL, RET, PAUSE)
- Pattern Jump, Pattern Job Call
- DIN
- WAIT



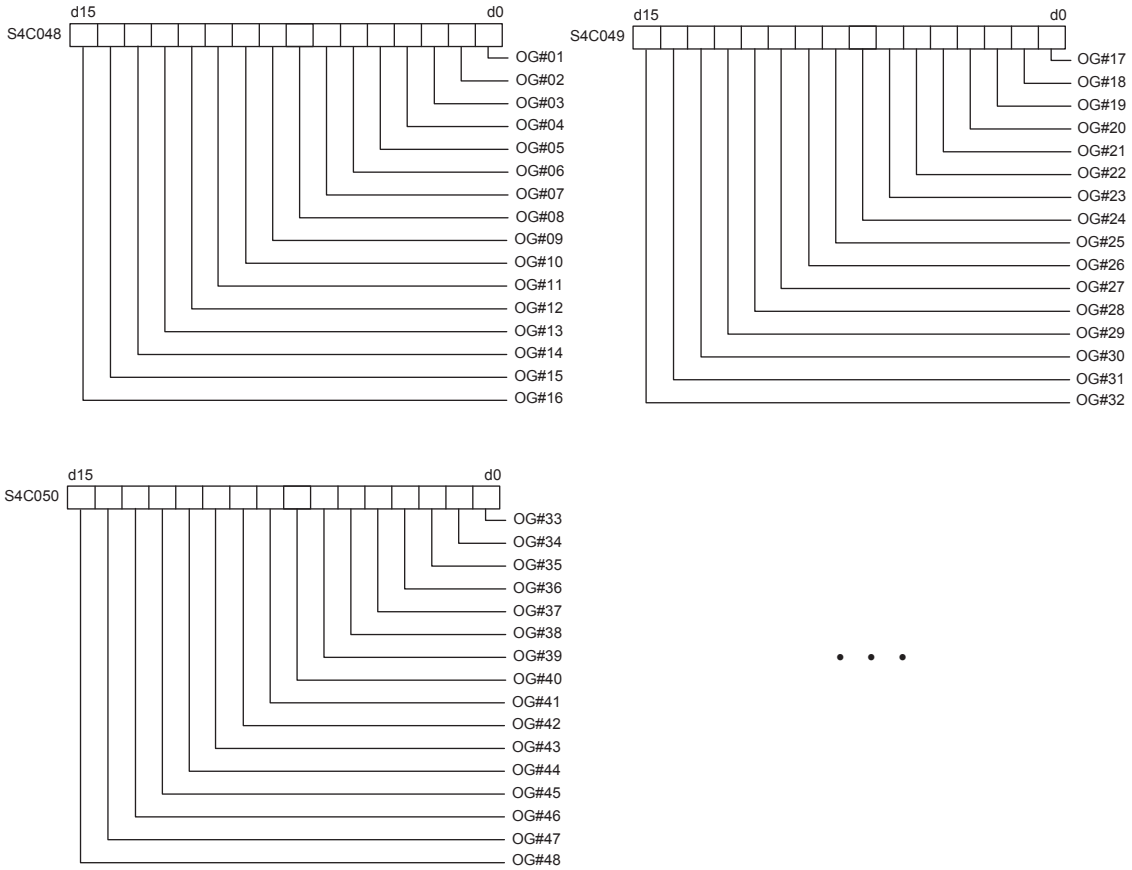




• • •

8.5.0.5 S4C048 to S4C063: DATA OF USER OUTPUT GROUPS

These parameters specify whether the output group instruction is executed with binary data or BCD data.

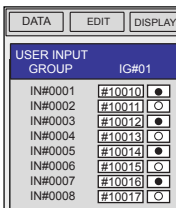


Differences Between Binary Data and BCD Data

For the input group and output group, the result will depend on whether the binary or BCD formula is used.

<Example> When the input function is [01010101]

SUPPLE-MENT

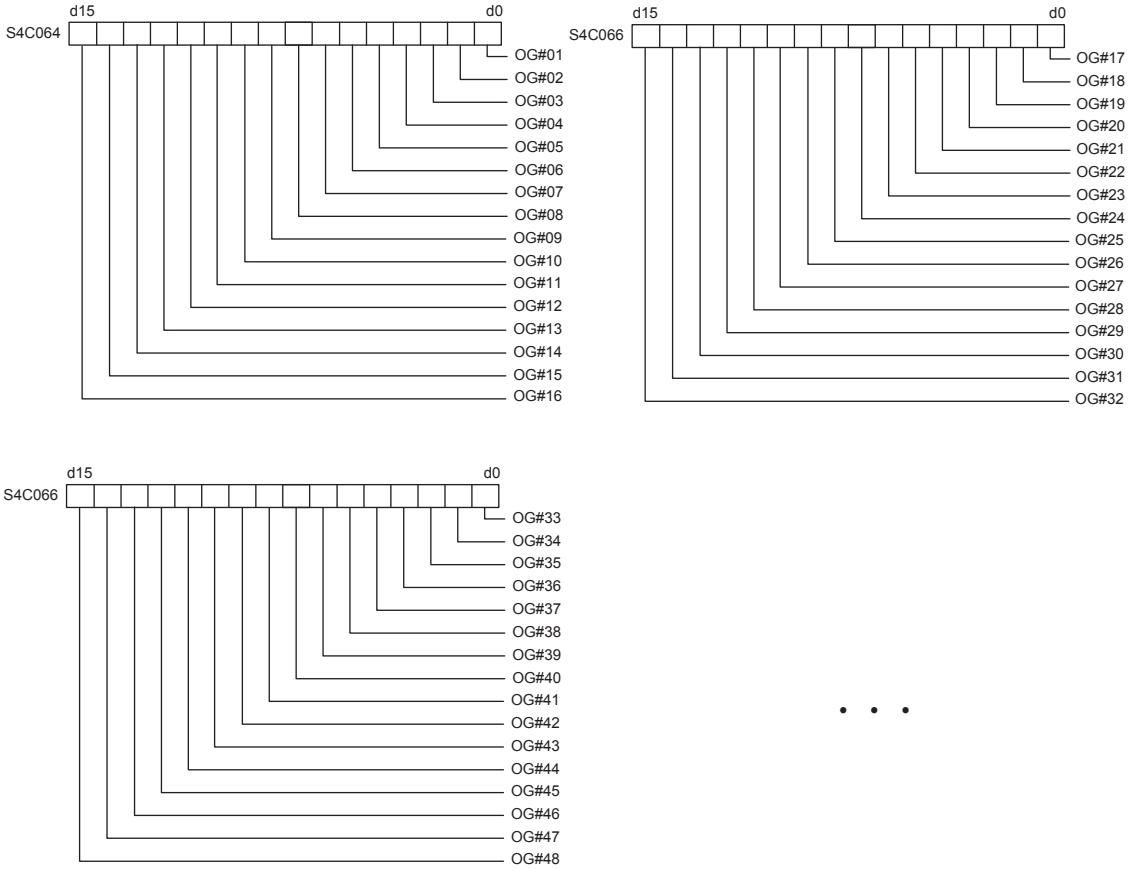


State	Binary	Case	BCD		Case	
1	$2^0 = 1$	1	$2^0 = 1$	Total is in ones.	1	5
0	$2^1 = 2$	0	$2^1 = 2$		0	
1	$2^2 = 4$	4	$2^2 = 4$		4	
0	$2^3 = 8$	0	$2^3 = 8$		0	
1	$2^4 = 16$	16	$2^0 = 1$	Total is in tens.	1	5
0	$2^5 = 32$	0	$2^1 = 2$		0	
1	$2^6 = 64$	64	$2^2 = 4$		4	
0	$2^7 = 128$	0	$2^3 = 8$		0	
		85			55	
		Binary data value			BCD data value	

However, in the case of BCD data, because the upper bound value is 99, it is not possible to use any value which exceeds nine in the one or ten digit place.

8.5.0.6 S4C064 to S4C079: USER OUTPUT GROUP TO BE INITIALIZED AT SWITCHING MODE

Set the user output group with bit to be initialized at switching mode. Use these parameters when using user output signals as work instructions for peripheral devices.



8.5.0.7 S4C240: USER OUTPUT NO. WHEN MANIPULATOR DROP ALLOWABLE RANGE ERROR OCCURS

This parameter specifies the user output number to output the manipulator drop allowable range error alarm occurrence externally.

When this function is not used, set “0”.

8.6 Parameters according to Coordinated or Synchronized Operation

These parameters make the settings for coordinated or synchronized operations between manipulators or between manipulators and stations.

8.6.0.1 S2C212: +MOV or +SMOV INSTRUCTION SPEED INPUT

This parameter specifies whether the speed inputting for move instructions of the master robot in a coordinated job is permitted or not.

<Example> 0: Not Provided

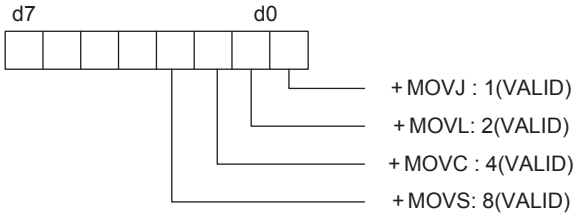
```
SMOVL      V=100
+MOVL                    ← Master side
                         Speed specification not
                         provided
```

<Example> 1: Provided

```
SMOV L     V=100
+MOV L     V=100         ← Master side
                         Speed specification
                         provided
```

8.6.0.2 S2C213: +MOV INSTRUCTION INTERPOLATION INPUT

This parameter specifies which interpolation is permitted for move instructions for the master robot in a coordinated job. More than one instruction can be specified.

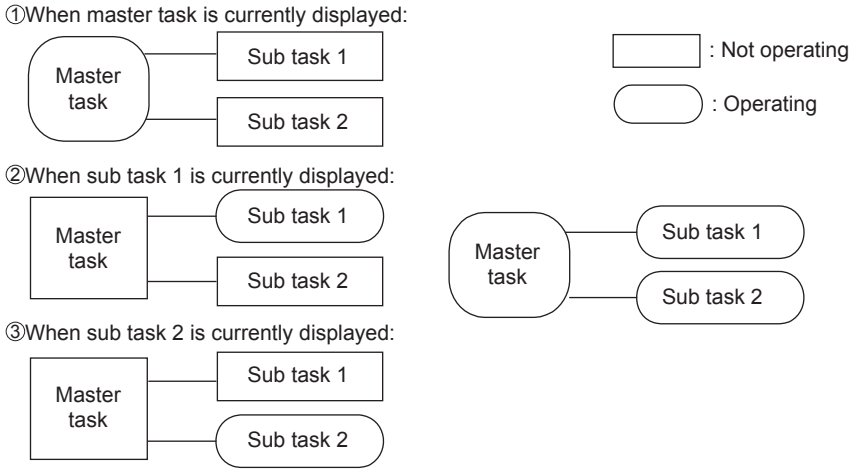


8.6.0.3 S2C231: OPERATION METHOD AT FWD/BWD OPERATION OR TEST RUN BY INDEPENDENT CONTROL

This parameter specifies the operation method at FWD/BWD operation or test run by independent control.

0 : The job of the task that is currently displayed operates.

1 : Jobs of all the tasks operate.



0: One of the task jobs that are currently displayed operates.

1: All task jobs operate.

8.6.0.4 S2C232: JOB AT CALLING MASTER OF SUBTASK BY INDEPENDENT CONTROL

This parameter specifies the job which is called up when the master of the subtask is called up by independent control.

0 : Master job
1 : Root job

Master Job: Job registered in the master control window

Root Job: Job activated by PSTART instruction

8.6.0.5 S2C264: STATION AXIS CURRENT VALUE DISPLAY FUNCTION

This parameter specifies whether the function to display the current value of the station axis in the following units is valid/invalid.

0 : Invalid
1 : Valid

Rotary axis : Angle (deg)
Servo track : Distance (mm)

Regarding whether to specify the rotary axis or the servo track, refer to *section 8.6.0.6 “S2C265 to S2C288: STATION AXIS DISPLAYED UNIT”*.

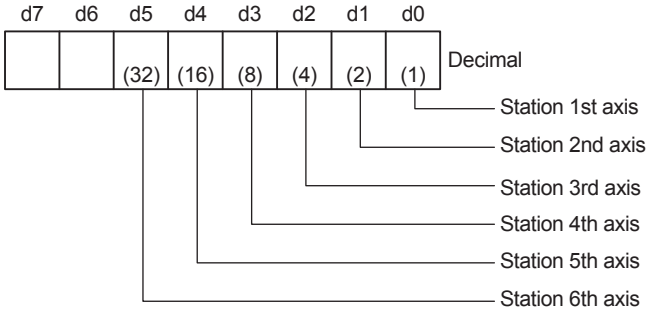
8.6.0.6 S2C265 to S2C288: STATION AXIS DISPLAYED UNIT

This parameter specifies the station axis displayed unit (bit specification).

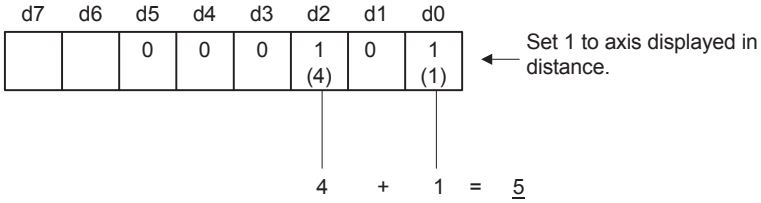
0 : Display angle (deg)
1 : Display in distance (mm)

■ **Setting Method**

Set a numerical value (decimal) where the bit of the axis to be displayed in the units of distance becomes 1.



<Example> When 1st and 3rd axes of station 1 are displayed in the units of distance:



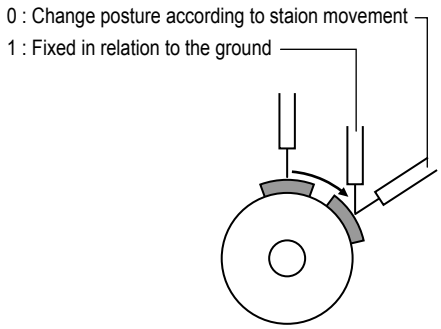
Therefore, set parameter S2C265 of station 1 to 5.

8.6.0.7 S2C420: POSTURE CONTROL OF SYNCHRONIZED MANIPULATOR (When Twin Synchronous Function Used)

This parameter specifies the posture control method for synchronized manipulator performing compensation during playback by using the twin synchronous function.

0 : Change posture according to station movement

1 : Fixed in relation to the ground



8.6.0.8 S2C421: POSTURE CONTROL OF MANIPULATOR IN MULTI-JOB (When Twin Synchronous Function Used)

This parameter specifies the posture control method for manipulator executing compensation at the linking side when job linking is performed during FWD/BWD operation by the twin synchronous function.

0 : Change posture according to station movement

1 : Fixed in relation to the ground

8.6.0.9 S2C687: OPERATION OF JOB WITHOUT CONTROL GROUP SPECIFICATION

When the servo power supply is individually turned OFF where jobs in multiple number of tasks are operated using the independent control function, the job execution of the control group whose servo power supply is turned OFF is interrupted. The jobs of other control groups continue their execution.

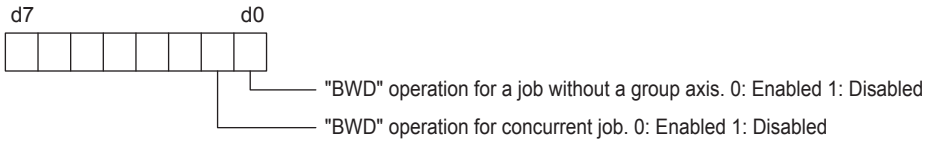
For the jobs without control group specification such as master job, the conditions for execution can be set by the parameter.

0 : Execution possible only when servo power supply to all the axes have been turned ON.

1 : Execution possible when servo power supply to any axis is turned ON.

8.6.0.10 S2C688: EXECUTION OF “BWD” OPERATION

This parameter prohibits step-back operation of a job without a step.

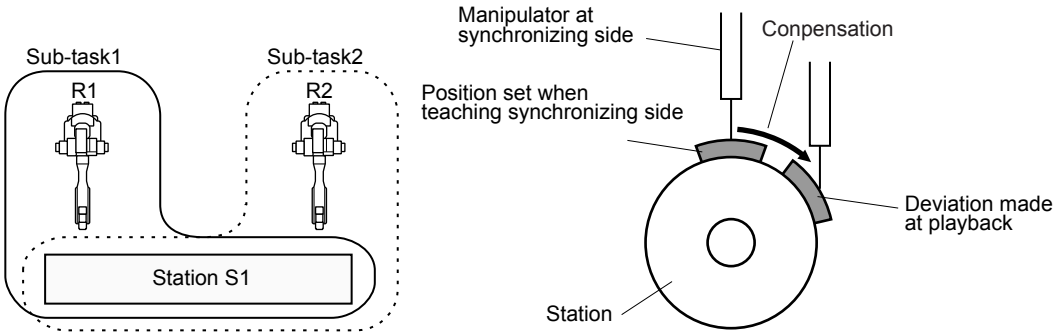


8.6.0.11 S3C1101: MAXIMUM DEVIATION ANGLE OF CURRENT STATION POSITION (When Twin Synchronous Function Used)

Used when the twin synchronous function is used. This parameter specifies the maximum deviation between the teaching position and the current station position.

0 : No deviation check

Other than 0 : Deviation angle (units : 0.1°)



In the above figure on the left, the follower R2 executes the job of subtask 2 in synchronization with the motion of the station axis which is moved by the R1 job. In this procedure, the job of subtask 2 controls only the R2 robot axis.

If the teaching position of the station in the subtask 2 differs from the station current position (controlled by the subtask 1 job), the difference is automatically offset so that R2 keeps the taught position in relation to the station.

Difference between the taught and the station current positions is always monitored. If the difference exceeds a set value of the parameter, the message “PULSE LIMIT (TWIN COORDINATED)” appears.

8.7 Parameters for Other Functions or Applications

These parameters make the settings for other functions or applications.

8.7.0.1 S1CxG049 to S1CxG051: SMALL CIRCLE CUTTING

These parameters prescribe cutting operation at small circle cutting.

S1CxG049 (Minimum diameter)	:	Set the minimum diameter of a figure in the units of μm that can be processed by small-circle cutting machine.
S1CxG050 (Maximum diameter)	:	Set the maximum diameter of a figure in the units of μm that can be processed by small-circle cutting machine.
S1CxG051 (Maximum speed)	:	Set the maximum cutting speed at operation by CUT instruction in the units of 0.1mm/s.

8.7.0.2 S1CxG052 to S1CxG053: SMALL CIRCLE CUTTING DIRECTION LIMIT VALUE

These parameters set the cutting direction limits at small circle cutting.

S1CxG052 (+ direction)	:	Set the limit value in the positive direction of cutting angle DIR set by CUT instruction, in the units of 0.01°.
S1CxG053 (- direction)	:	Set the limit value in the negative direction of cutting angle DIR set by CUT instruction, in the units of 0.01°.

8.7.0.3 S1CxG054 to S1CxG055: SMALL CIRCLE CUTTING OVERLAP VALUE

These parameters set the overlapped value at small circle cutting.

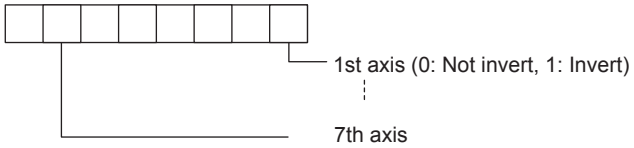
S1CxG054 (Operation radius)	:	Set the operation radius at inner rotation in the units of 1 μm after overlapping by CUT instruction.
S1CxG055 (Rotation angle)	:	Set the rotation angle at inner rotation in the units of 0.1° after overlapping by CUT instruction.

8.7.0.4 S1CxG063, S1CxG064: PATTERN CUTTING DIMENSION

These parameters set the minimum diameter (S1CxG063) and the maximum diameter (S1CxG064) for the pattern cutting in units of μm.

8.7.0.5 S1CxG065: MIRROR SHIFT SIGN INVERSION

This parameter sets which axis to be shifted (mirror-shift: invert the sign).



8.7.0.6 S2C430: RELATIVE JOB OPERATION METHOD

This parameter specifies how to operate a relative job. A method to convert a relative job into a standard job (pulse), and a conversion method to calculate the aimed position (pulse position) when a relative job is operated can be specified.

0 : Previous step with priority (B-axis moving distance minimized.)
1 : Form with priority
2 Previous step with priority (R-axis moving distance minimized.)

8.7.0.7 S3C1111 to S3C1190: ANALOG OUTPUT FILTER CONSTANT (When analog output corresponding to speed function is used)

By setting a constant to filter, a filter processing can be performed for the output analog signal.

8.7.0.8 S3C1191: CUT WIDTH CORRECTION VALUE (When form cutting function is used)

This parameter specifies the path correction value for pattern cutting operation. A value 1/2 of the cut width is set in units of μm.

8.8 Hardware Control Parameters

These parameters make the hardware settings for fan alarm or relay operation, etc.

8.8.0.1 S2C646: ANTICIPATOR FUNCTION

This parameter specifies anticipation output.

0 : Invalid
1 : Valid

The anticipator function is a function to quicken or slow the ON/OFF timing of four user output signals and two user output groups. Using this function, signal output can be carried out before or after the step is reached. As a result, timing deviation due to delayed motion of peripheral devices and robot motion can be adjusted.

Setting the time to a negative value (-) advances the signal output.

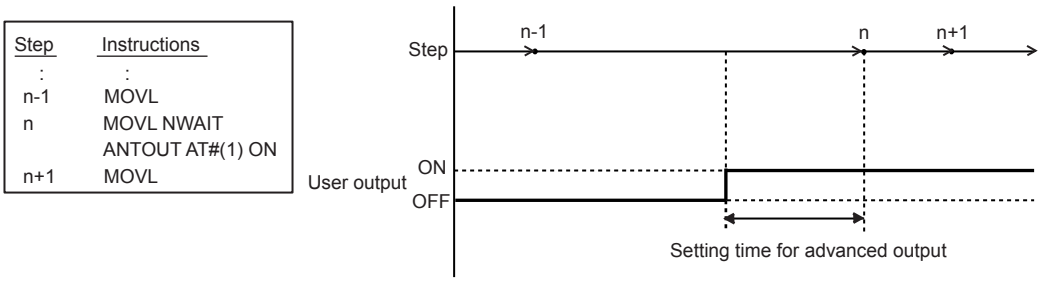
This setting is effective when adjusting timing deviation due to delayed motion of peripheral devices.

Setting the time to a positive value (+) delays the signal output.

This setting is effective when adjusting timing deviation due to delayed robot motion.

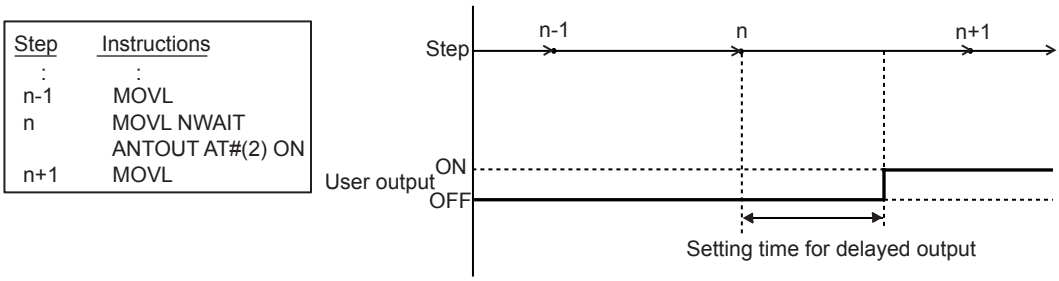
<Advanced Signal Output>

Signal output is carried out before the step is reached.



<Delayed Signal Output>

Signal output is carried out after the step is reached.



8.8.0.2 S4C327 to S4C390: SETTING OF OPERATING RELAY NO.

Up to 64 output signals can be turned ON/OFF with the programming pendant. The object relay No. is set in these parameters. Although it is possible to set optional values for output No. 1 to 1024 in the parameters, the following must be taken into consideration.

- Avoid setting duplicate numbers.
- The signal turned ON or OFF with the programming pendant is operated again or remains unchanged until the instruction is executed.

8.8.0.3 S4C391 to S4C454: OPERATING METHOD OF RELAYS

These parameters specify the operating method of output signals by the programming pendant. The operating method can be specified for each output signal.

Parameter Setting Value	Operation of Output Signal
0	+ON ON -OFF OFF
1	+ON ON/OFF with the key ON while the key is pressed OFF if the key is not pressed ON OFF

8.8.0.4 S2C786 to S2C788: COOLING FAN ALARM DETECTION

This parameter specifies a detection for cooling fan 1 to 3 with alarm sensor, connected to power ON unit.

0 : No detection
1 : Detected with message display
2 : Detected with message and alarm display

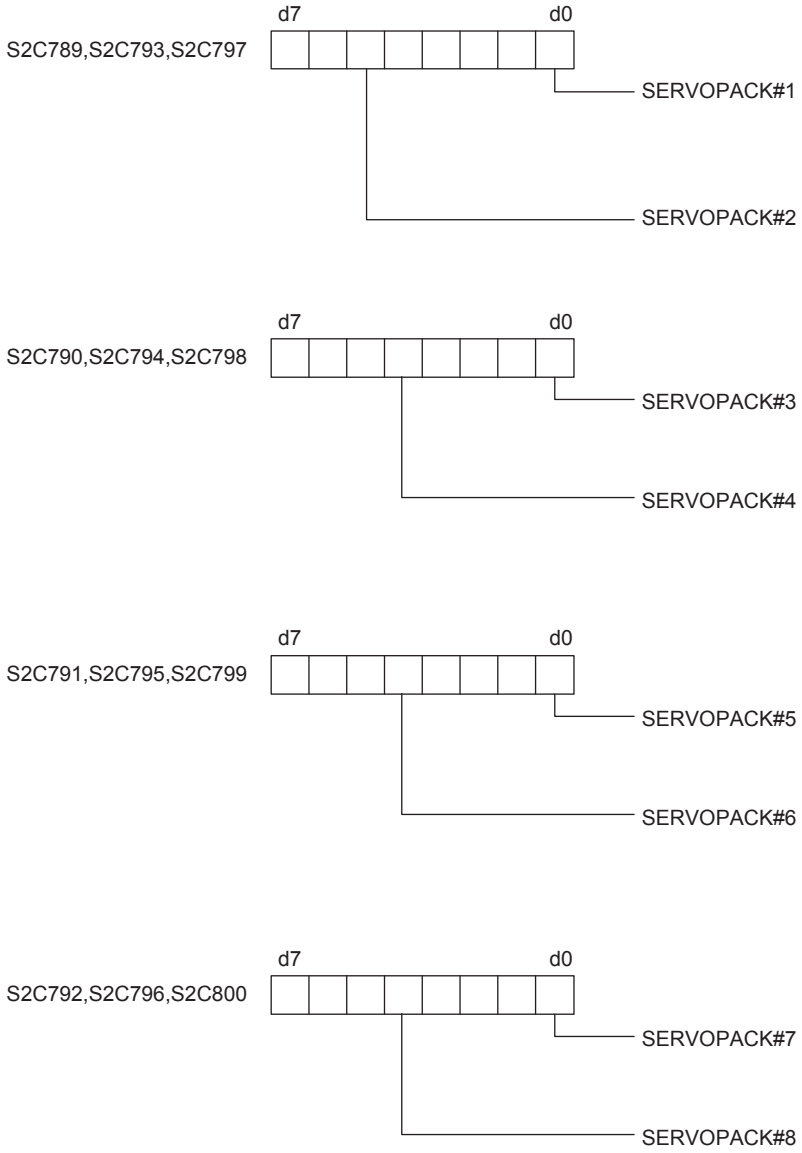
8.8.0.5 S2C789 to S2C792: COOLING FAN ALARM 1 OPERATION

8.8.0.6 S2C793 to S2C796: COOLING FAN ALARM 2 OPERATION

8.8.0.7 S2C797 to S2C800: COOLING FAN ALARM 3 OPERATION

These parameters specify the operation of cooling fan 1 to 3 with alarm sensor, connected to power ON unit.

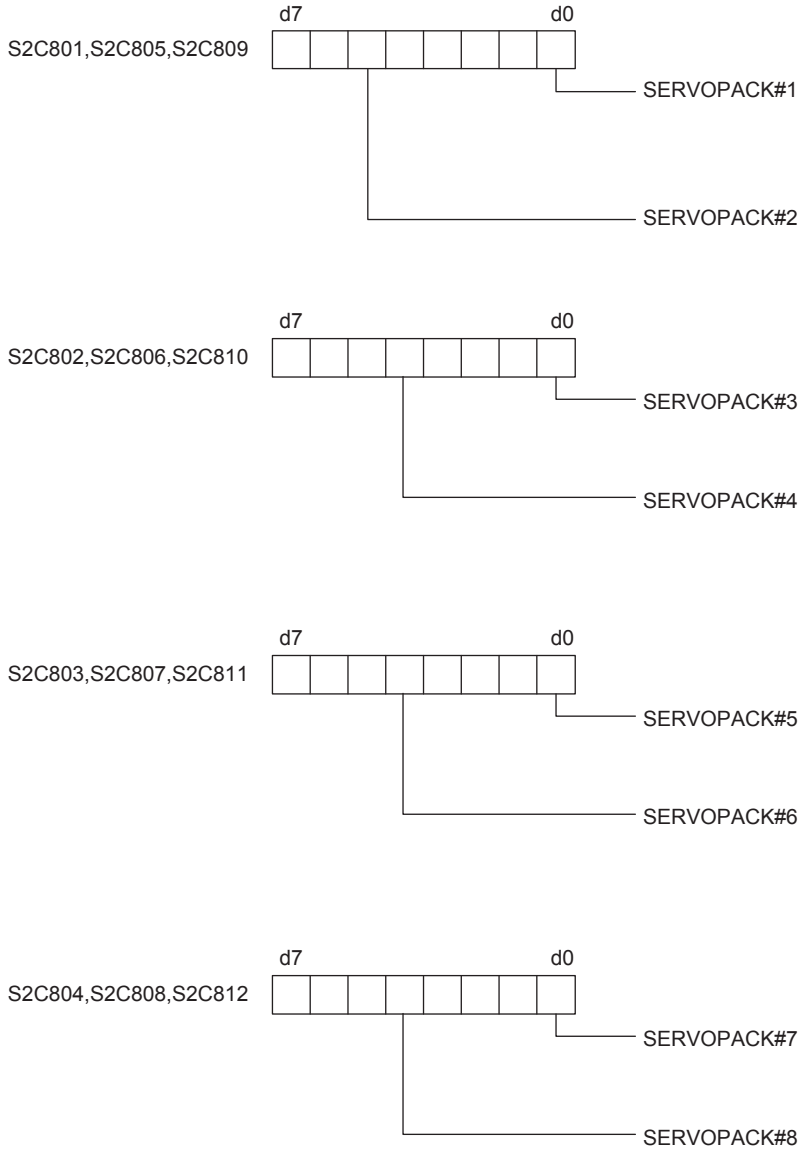
Each bit specifies the power ON unit to which the detecting sensor is connected.



8.8.0.8 S2C801 to S2C804: FAN ALARM 1 POWER SOURCE STATUS

8.8.0.9 S2C805 to S2C808: FAN ALARM 2 POWER SOURCE STATUS

8.8.0.10 S2C809 to S2C812: FAN ALARM 3 POWER SOURCE STATUS



8.9 TRANSMISSION PARAMETERS

These parameters are used when the optional FC1, FC2, or data transmission function is used.

For details, refer to the optional manual “DX100 DATA TRANSMISSION FUNCTION”.

8.10 Application Parameters

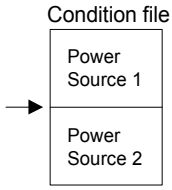
8.10.1 Arc Welding

8.10.1.1 AxP000: APPLICATION

This parameter specifies the application. Set “0” for arc welding.

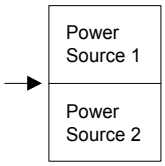
8.10.1.2 AxP003: WELDING ASSIGNMENT OF WELDING START CONDITION FILE

This parameter specifies the beginning condition number in the welding start condition file to be assigned to Power Source 2. Condition files of a lower number are automatically assigned to Power Source 1. For a system with one Power Source, set “49” (maximum value).



8.10.1.3 AxP004: WELDING ASSIGNMENT OF WELDING END CONDITION FILES

This parameter specifies the beginning condition number in the welding END condition file to be assigned to Power Source 2. Condition files of a lower number are automatically assigned to Power Source 1. For a system with one Power Source, set “13” (maximum value).



8.10.1.4 AxP005: WELDING SPEED PRIORITY

This parameter specifies whether the welding speed is specified by the “ARCON” instruction, by the welding start condition file, or by the additional times of the “MOV” instruction.

8.10.1.5 AxP009: WORK CONTINUING

This parameter specifies whether to output an “ARCON” instruction to restart after the manipulator stopped while the “ARCON” instruction is being output.

8.10.1.6 AxP010: WELDING INSTRUCTION OUTPUT

This parameter specifies the beginning number (0 to 12) of the analog output channel to the Power Source. “0” indicates that no Power Source exists.

8.10.1.7 AxP011, AxP012: MANUAL WIRE OPERATION SPEED

These parameters specify the manual wire operation speed as a percentage of the maximum instruction value. Instruction polarity is determined by the current instruction in the Power Source characteristic file. The setting range is from 0 to 100.

8.10.1.8 AxP013, AxP014: WELDING CONTROL TIME

These parameters specify the welding control time in units of minutes. The setting range is from 0 to 999.

8.10.1.9 AxP015 to AxP017: NUMBER OF WELDING CONTROL

These parameters specify the number of welding controls. The setting range is from 0 to 99.

8.10.1.10 AxP026 to AxP029: TOOL ON/OFF USER OUTPUT NO. (Jigless system)

These parameters specify the user output number for the tool open/close operation by specific keys.

8.10.2 Handling Application

8.10.2.1 AxP002, AxP004: f1 KEY FUNCTION

These parameters set the output signal to assign for f1 key.

0: Not specified

1 to 4: Specific outputs for HAND-1 to HAND4-1

5: User output (No. is specified by AxP004).

8.10.2.2 AxP003, AxP005: f2 KEY FUNCTION

These parameters set the output signal to assign for f2 key.

0: Not specified

1 to 4: Specific outputs for HAND-2 to HAND4-2

5: User output (No. is specified by AxP005)

8.10.3 Spot Welding

8.10.3.1 AxP003: MAXIMUM NUMBER OF CONNECTED POWER SOURCES

This parameter specify the maximum number of power sources which are to be used. The value is automatically set at start-up. No modification is needed.

8.10.3.2 AxP004: GUN FULL OPEN STROKE ON/OFF SIGNAL

This parameter specifies which stroke switching signal is output ON or OFF to make the gun fully-opened for each gun.

Bit specification (1 for 01) for 8 guns. The initial setting is “0”.

```
0 0 0 0 0 0 0 0
| | | | | | | |
8 7 6 5 4 3 2 1     Gun number
```

8.10.3.3 AxP005: STROKE CHANGE ANSWER TIME LIMIT

When using the X2 gear mechanical stopper gun and switching gun stroke, this parameter sets the time from the stroke-switching-sequence start until the pressure instruction end.

The initial setting is “0”, with which the switching signal is output for the “stopper-type stroke switching time” set in the file, and then the gun pressure instruction is turned OFF.

8.10.3.4 AxP006: PARITY SPECIFICATION FOR WELDING CONDITIONS

When adding the parity signal to the welding condition signal with the Power Source connected to each welding gun, this parameter specifies odd or even parity.

Bit specification for 4 Power Sources. (0 : odd number, 1 : even number) The initial setting is “0”.

```
0 0 0 0 0 0 0 0
        | | | |
        4 3 2 1     Power Source number
```

8.10.3.5 AxP007: ANTICIPATE TIME

When executing the GUNCL or SPOT instruction with NWAIT specified in the previous move instruction but the time is not specified by ATT in the GUNCL or SPOT instruction, this parameter specifies the anticipate condition (time). The initial setting is “0”, with which the each instruction is executed as soon as the taught position of the previous move instruction is reached, as normal operation.

8.10.3.6 AxP015: WELDING ERROR RESET OUTPUT TIME

This parameter sets the output time of the welding error reset signal to the Power Source when the alarm reset signal is input.

If the setting is "0", the welding error reset signal is not output to the Power Source even if the alarm reset signal is input.

8.10.3.7 AxP016, AxP017: ELECTRODE WEAR AMOUNT ALARM VALUE

These parameters set the electrode wear amount alarm values (AxP016: movable side, AxP017: fixed side) at the wear detection.

8.10.4 General-purpose Application

8.10.4.1 AxP009: WORK CONTINUE PROHIBIT

This parameter specifies whether to output TOOLON instruction or not at restarting when the work is stopped for some reasons during the output of TOOLON instruction.

9 General Purpose Application

9.1 Simplified Teaching and Playback

9.1.1 Teaching

9.1.1.1 Preparation for Teaching

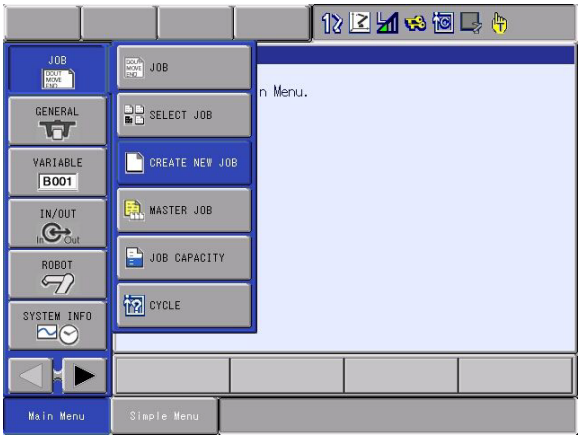
Perform the following tasks before starting to teach.

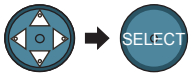
- Set the operation mode to teach mode.
- Enter the job name.

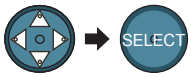
1. Confirm that the mode switch on the programming pendant is set to “TEACH.” If not, set the switch to “TEACH.”

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

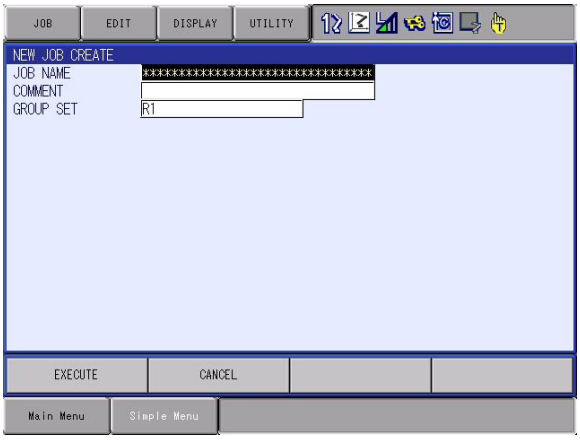
3. Select {JOB} under the main menu, and select {CREATE NEW JOB} in the sub menu.



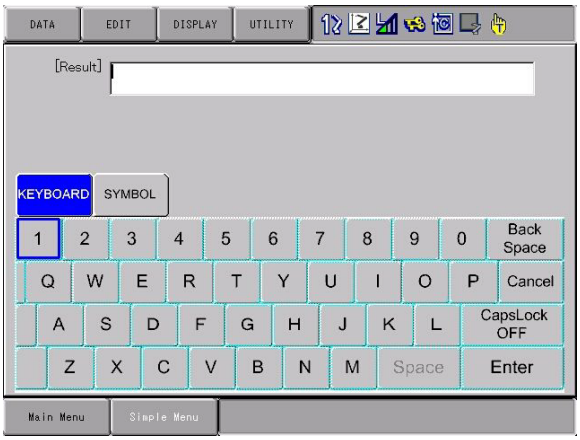




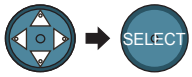
4. After the NEW JOB CREATE window appears, press [SELECT].

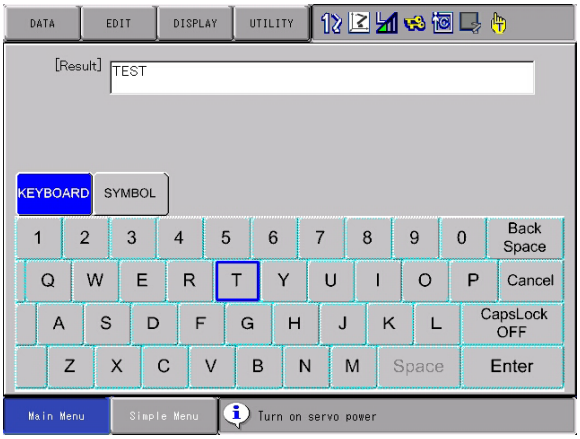


5. After the following window appears, input the job name. The word “TEST” is used in this example job name.

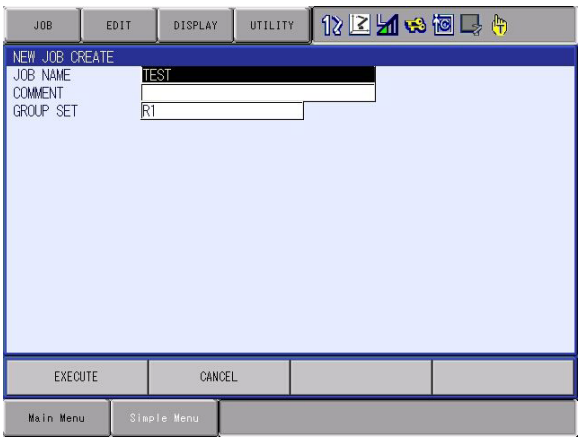


6. Move the active window to software keypad by pressing the [AREA] key. Move the cursor to “T” and press [SELECT]. Enter “E,” “S,” and “T” in the same manner. The characters can also be entered by directly touching each character on the screen.

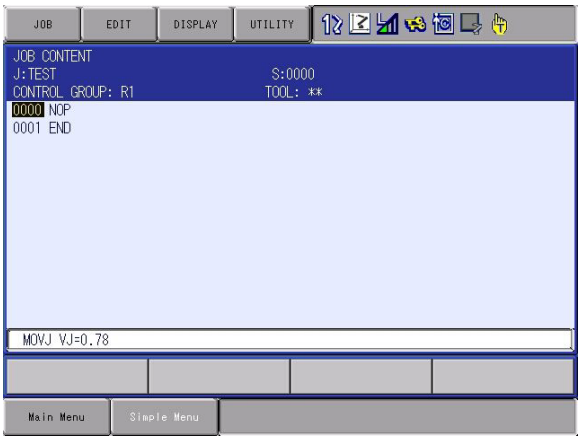




7. Press [ENTER] to register.



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



Characters which can be Used for Job Names

SUPPLE-MENT

Job names can be created from numbers and the alphabetical letters. The input display can be switched between upper-case characters, lower-case characters, and symbols by pressing the page key PAGE during the operation 5. Up to 32 characters can be used.

9.1.1.2 Teaching Procedure

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

Main move instructions begin with “MOV” in the INFORM III language used by the DX100.

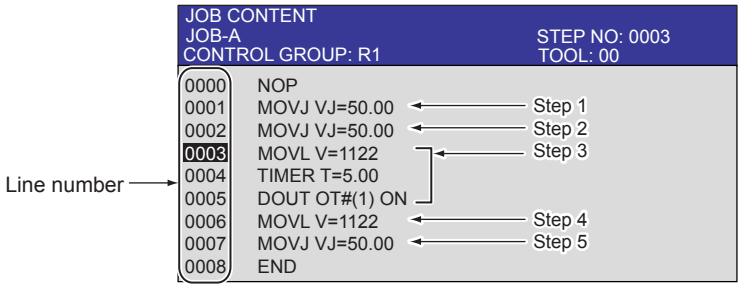
<Example>

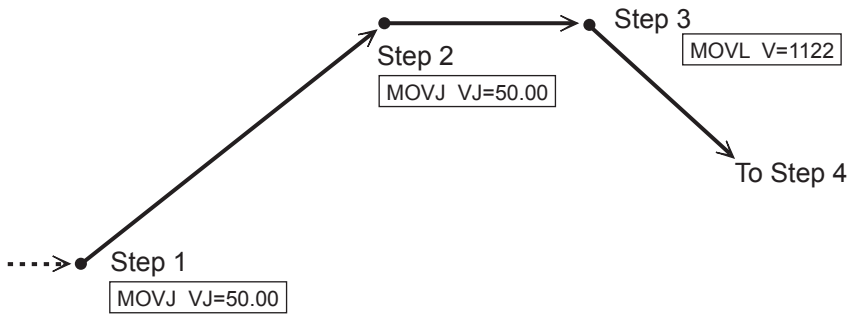
MOVJ VJ=50.00

MOVL V=1122 PL=1

<Example>

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



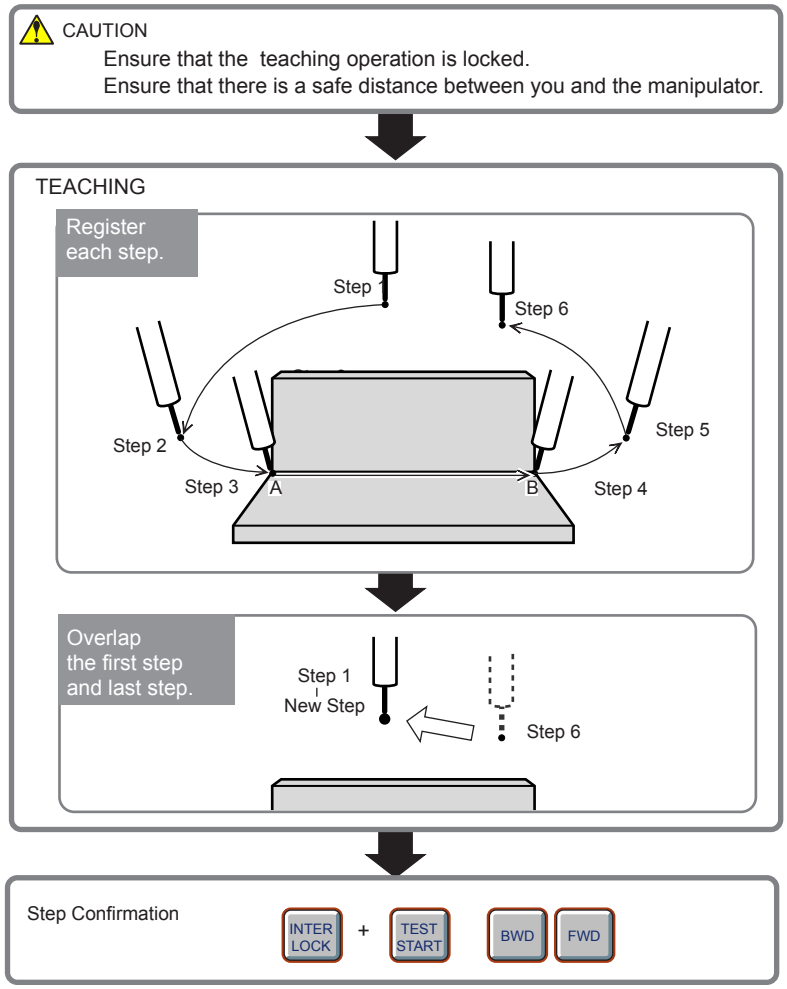


Teaching a Job

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

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

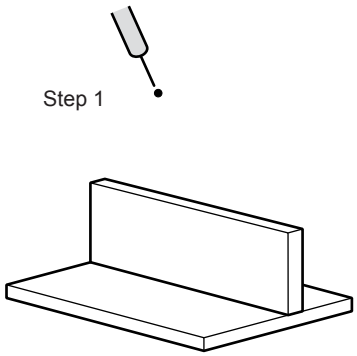
Fig. 9-1: Teaching a Job



Actual work is not performed here.

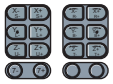
■ Step 1 -- Standby Position

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



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

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



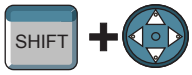
3. Select joint interpolation by pressing [MOTION TYPE]. Joint instruction “MOVJ...” will be displayed in the input buffer line.

```
=> MOVJ VJ=0.78
```

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

```
0000  NOP
0001  END
```

5. The input buffer line appears. Move the cursor to the right to VJ=*.**, which shows the speed. While pressing [SHIFT] simultaneously, move the cursor up and down (to higher and lower play speeds) until the desired speed is specified.
Set the speed to 50%.



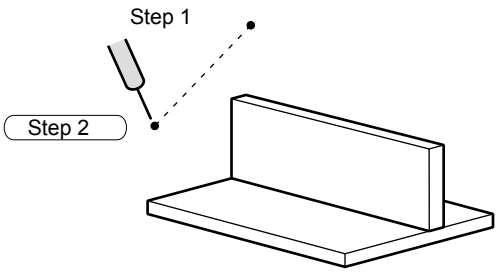

```
=> MOVJ VJ=50.00
```

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

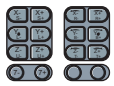
```
0000  NOP
0001  MOVJ VJ=50.00
0002  END
```

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

Define the manipulator work pose.



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

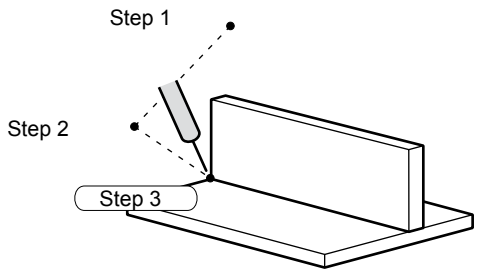


2. Press [ENTER]. Step 2 (Line 0002) is registered.

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

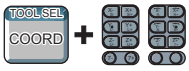
■ **Step 3 -- Work Start Position**

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



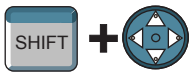
1. Change to medium speed by pressing [FAST] or [SLOW] until is displayed in the status area.

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



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

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

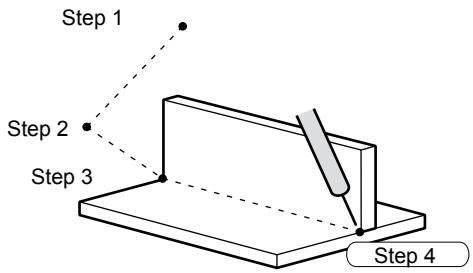


5. Press [ENTER]. Step 3 (Line 0003) is registered.

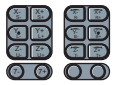
```
0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  END
```

■ 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.



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

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

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

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

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

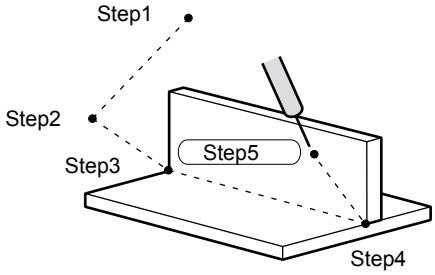
```
=> MOVL V=138
```

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

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

■ Step 5 -- Clear Position

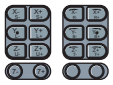
Move the manipulator to a position where it will not strike the workpiece or fixture.



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

> **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 interpolation type (MOVJ).

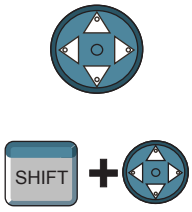
```
=> MOVJ V=12.50
```

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

```
=> MOVJ VJ=12.50
```

5. The input buffer line appears. Move the cursor to the right to VJ=12.50, which shows the speed. While pressing [SHIFT] simultaneously, move the cursor up and down (to higher and lower play speeds) until the desired speed is specified.
   Set the speed to 50%.

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

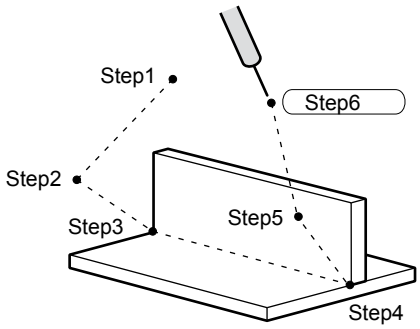


6. Press [ENTER]. Step5 (Line 0005) is registered.

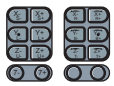
```
0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVL V=138
0005  MOVJ VJ=50.00
0006  END
```

■ **Step 6 -- Near the Standby Position**

Move the manipulator near the standby position.



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



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

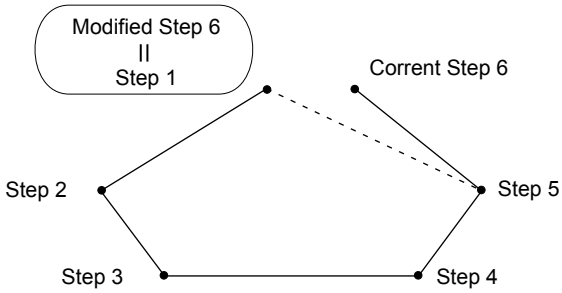
```
0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVL V=138
0005  MOVJ VJ=50.00
0006  MOVJ VJ=50.00
0007  END
```

Ensuring the First and Last Step are Identical

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

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

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



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

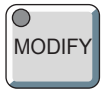
```
0000  NOP
0001  MOVJ VJ=50.00
0002  MOVJ VJ=50.00
0003  MOVJ VJ=12.50
0004  MOVL V=138
0005  MOVJ VJ=50.00
0006  MOVJ VJ=50.00
0007  END
```

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

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

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

4. Press [MODIFY].



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

9.1.1.3 Path Confirmation

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

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

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

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

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

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

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

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

9.1.1.4 Correcting a Job

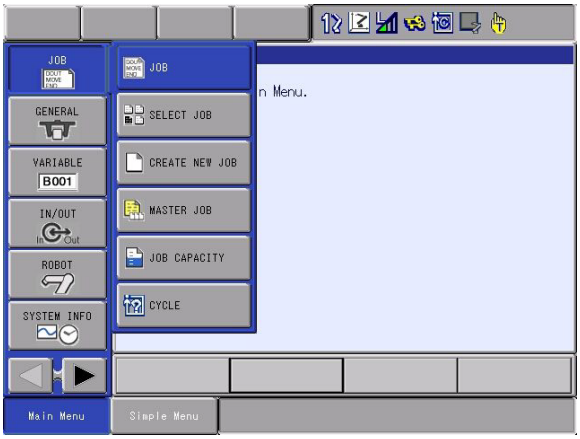
CAUTION

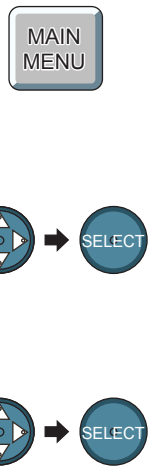
- **After the job is corrected, be sure to confirm the path.**

■ **Before Correcting a Job**

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

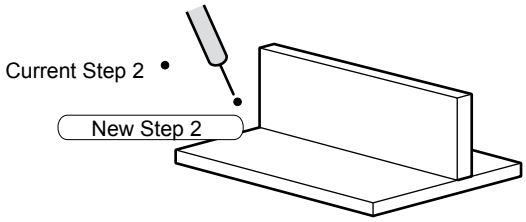
1. Select {JOB} under the main menu and {JOB} under the sub menu to display the JOB CONTENT window.





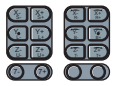
9.1.1.5 Changing the Position Data

Change the position registered in Step 2.

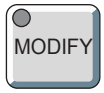


1. Move the manipulator to Step 2 (Line 0002) by pressing [FWD].

2. Move the manipulator to the modified position with the axis operation keys.



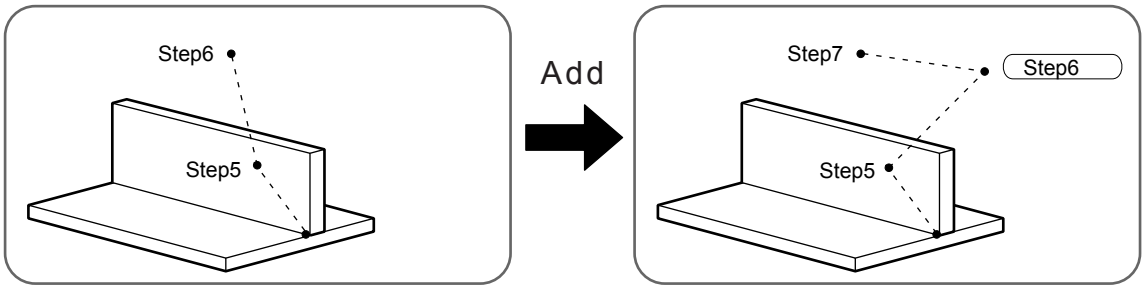
3. Press [MODIFY].



4. Press [ENTER]. The step's position data is changed.

■ Adding a Step

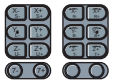
Add a new step between Step 5 and Step 6.



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

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

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



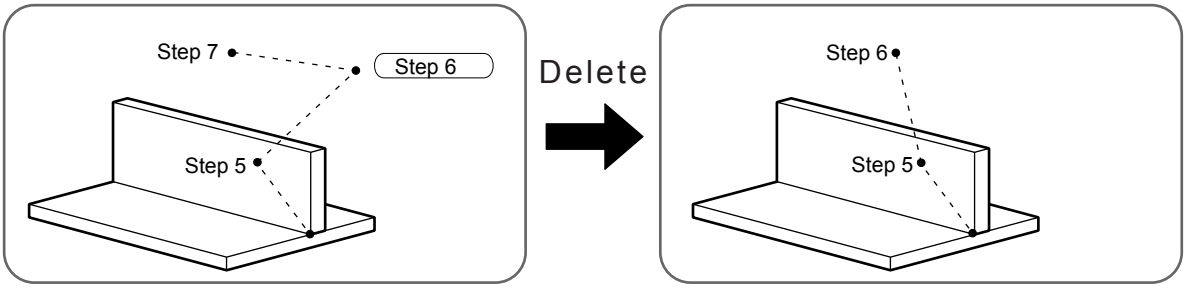
3. Press [INSERT].

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

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

■ Deleting a Step

Delete the step you just added.



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

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

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

3. Press [ENTER]. The step is deleted. When a step is deleted, the numbering of step is automatically adjusted corresponding to the deletion.

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

SUPPLE-MENT

When “Error 2070: Set Robot Exactly to Taught Position” Occurs

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

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

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

■ Changing the Speed between Steps

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

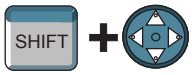
1. Move the cursor to Step 4.

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

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

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

3. The input buffer line appears. Move the cursor to the right to “V=138,” which shows the speed. While pressing [SHIFT] simultaneously, move the cursor up and down (to higher and lower play speeds) until the desired speed is specified.
   Set the speed to 66cm/min.




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

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

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

SUPPLE-MENT

The unit for speed can be verified and modified by “SPEED DATA INPUT FORM” from {SETUP} → {OPERATE COND}.

9.1.2 Playback

9.1.2.1 Preparation Before Playback

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 started, the manipulator begins to move from the Step 1.

9.1.2.2 Playback Procedure

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

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

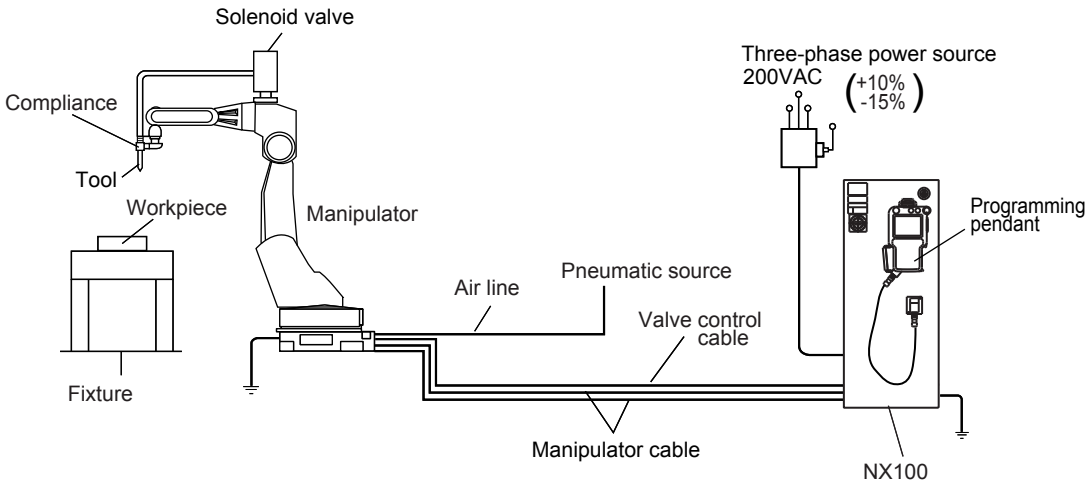
2. Press [SERVO ON READY] to turn ON the servo power.

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

9.1.3 Example for General Purpose Application

9.1.3.1 Example Job

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



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

9.1.3.2 Teaching Procedure

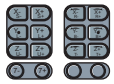
The teaching procedure of Step 2 which specifies the cutting pose and Step 3 and 4 (cutting section) are explained.

NOTE

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

■ **Step 2 -- Near cutting position**
Define the cutting pose.

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



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

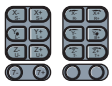
```
0000    NOP
0001    MOVJ VJ=25.00
0002    MOVJ VJ=25.00
0003    END
```

■ **Step 3 -- Cutting Start Position**

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

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

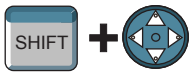
2. Move the manipulator to the cutting start position with the axis operation keys. At this time, do not release the pose input in Step 2.



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

=> MOVJ VJ=25.00

4. The input buffer line appears. Move the cursor to the right to “VJ=25.00,” which shows the speed. While pressing [SHIFT] simultaneously, move the cursor up and down (to higher and lower play speeds) until the desired speed is specified.
Set the speed to 12.50%.



=> MOVJ VJ=12.50

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

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

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

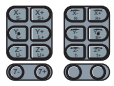
=> TOOLON

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

■ Step 4 -- Cutting End Position

Define the cutting end position.

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



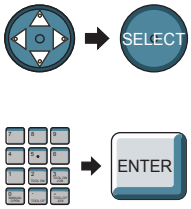
2. Set linear interpolation (MOVL) by pressing [MOTION TYPE].

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

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

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

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



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

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

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

```
=> TOOLOF
```

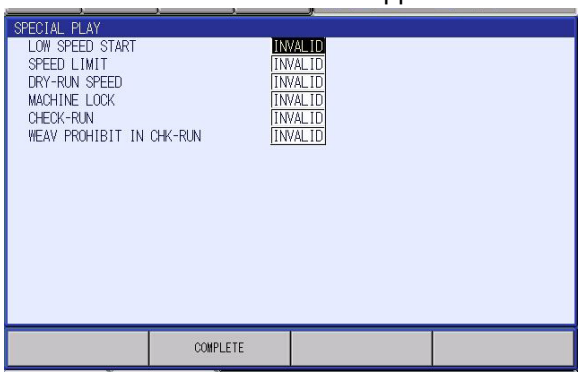
7. Press [ENTER]. The TOOLOF instruction is registered.

9.1.3.3 Confirmation of Cutting Operation (Speed Limitation Drive)

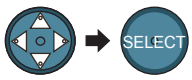
The speed limitation drive is executed to confirm the taught path. All the operations operate below the limitation speed during teach mode (250mm/s usually) in the speed limitation drive. If the taught speed is below the limitation speed, the operation is executed at the same speed as the teaching procedure.

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

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



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



■ **Cutting Execution**

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

9.2 Operation for Tool Control

9.2.1 Function Keys

The function keys for tool control are assigned to the Numeric keys as described below.

	Registers the TOOLON instruction. If [INTERLOCK] is pressed simultaneously, the TOOLON operation is executed.
	Registers the TOOLOF instruction. If [INTERLOCK] is pressed simultaneously, the TOOLOFF operation is executed.
	Registers the CALL instruction for the reserved job TOOLONxx.
	Registers the CALL instruction for the reserved job TOOLOFxx.

9.2.2 Tool Control Settings

The following setting can be performed on the GENERAL DIAGNOSIS window.

1. Select {GENERAL} under the main menu.
2. Select {GENERAL DIAGNOSIS}.
   – The GENERAL DIAGNOSIS window appears.

   – Select "CONT" to continue the work operation when the manipulator is restarted after it abort for any reason during the work operation. Select "STOP" to abort the work operation if the manipulator stops. When the manipulator is restarted, it moves without doing any work. Use the work start command to restart the work instruction.
3. Select the setting data of "WORKING ABORT PROCESS."
   – Each time [SELECT] is pressed, "CONT" and "STOP" is alternately displayed. The displaying state is the current setting.

9.2.3 Work Instructions

9.2.3.1 TOOLON/TOOLOF Instructions

1. These instructions are to perform TOOLON/TOOLOFF. The function keys are [TOOLON] and [TOOLOF].

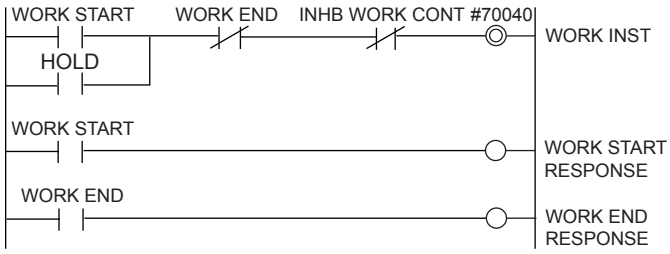
TOOLON TOOLOF

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Press [TOOLON] or [TOOLOF].
   – The TOOLON or TOOLOF instruction is displayed in the input buffer line. Or press [INFORM LIST] to display the instruction box and select the TOOLON/TOOLOF instruction.

   ⇒ TOOLON

   – **TOOLON**
   Turns ON the work instruction.
   Turns ON the work start command (system output relay #51530) and waits for the work start response (system input relay #41130).
   The next instruction is executed when the work response turns ON.
   The work start response relay turns ON immediately after the work start command is output.

   – **TOOLOF**
   Turns OFF the work instruction.
   Turns ON the work end command (system output relay #51531) and waits for the work end response (system input relay #41131).
   The next instruction is executed when the work end response turns ON.
   The work end response relay turns ON immediately after the work end command is output. The work instruction is programmed to hold after the work start command turns ON and to turn OFF when the work end command turns ON.
   When the manipulator stops during the work operation, the work instruction turns OFF.
   When restarting, turn ON the work instruction when "WORKING ABORT PROCESS" is set to "CONT." Do not turn OFF the work instruction when "STOP" is set.



4. Press [INSERT].
5. Press [ENTER].

9.2.3.2 CALL Instruction

This instruction calls a reserved job TOOLONxx or TOOLOFxx. The function keys for registration are [TOOLON JOB] and [TOOLOF JOB].

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Press [TOOLON JOB] or [TOOLOF JOB].
   – The CALL instruction is displayed in the input buffer line.

```
⇒ CALL JOB:TOOLON
```

4. Select the job name.
   – The JOB LIST window appears.
5. Press [SELECT].
   – The window for character input appears.
   The job name can now be changed. Modify the job name and press [ENTER].
6. Press [INSERT].
7. Press [ENTER].

9.2.3.3 WVON Instruction

This instruction starts the weaving motion. Specify conditions in the weaving condition file when registering the WVON instruction.

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Press [INFORM LIST].
4. Select the WVON instruction.
   – The WVON instruction is displayed in the input buffer line.

```
⇒ WVON WEV#(1)
```

   – To register the instruction displayed in the input buffer line without editing, press [INSERT] and then press [ENTER].
5. Select the file number and edit.
   – The input line is displayed.

```
Weaving_file_no.=
⇒ WVON WEV#( ) ON
```

   – Input weaving file number using the Numeric keys and press [ENTER]. (In the following example, 2 is entered.)

```
⇒ WVON WEV#(2)
```

6. Press [INSERT].
7. Press [ENTER].

9.2.3.4 WVOF Instruction

This instruction ends the weaving motion.

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Press [INFORM LIST].
4. Select the WVOF instruction.
   – The WVOF instruction is displayed in the input buffer line.

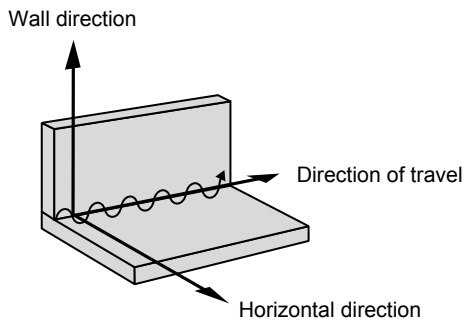
   ⇒ WVOF

5. Press [INSERT].
6. Press [ENTER].

9.3 Using Files

9.3.1 Weaving Basic Coordinate System

Weaving is performed based on the following coordinate system. This coordinate system is automatically generated according to the conditions described in a weaving condition file.



Weaving Basic Coordinate System

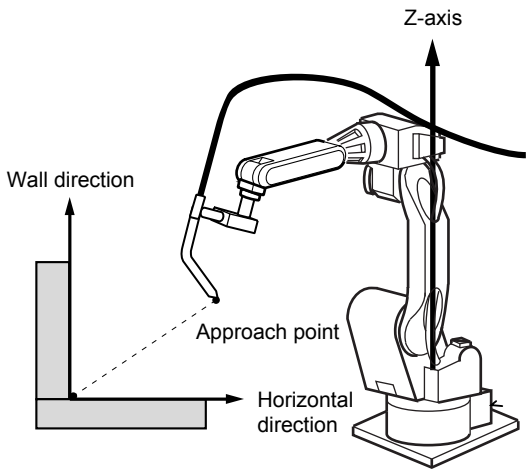
Wall Direction: Z-direction of the robot axis

Horizontal Direction: The direction of approach point from the wall

Direction of Travel: The direction in which the manipulator moves from the weaving start point to the end point

SUPPLE-MENT

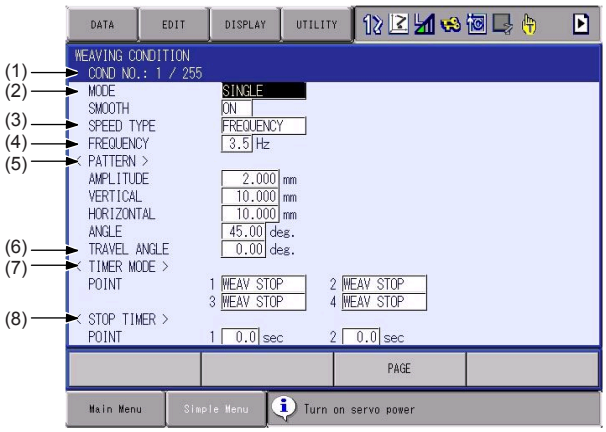
The approach point is a point indicated by a step immediately before the step where weaving starts.



NOTE

Depending on the mounting and shape of the workpiece, a definition of the above coordinate system may not be sufficient to generate a weaving pattern. In that case, register the reference point REFP1 or REFP2. For details, refer to *section 9.3.3.3 "Cases that Require the Registration of Reference Points" on page 9-34* ".

9.3.2 WEAVING CONDITION Window



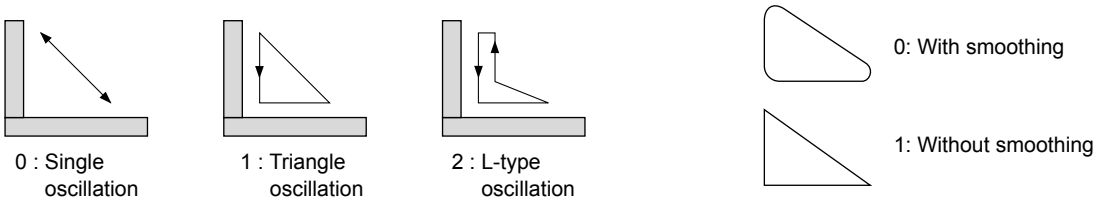
WEAVING CONDITION Window

(1) WEAVING COND NO. (1 to 255)

– Displays a weaving condition file number.

(2) MODE (Weave type)

– There are three weave type: single oscillation, triangle oscillation, and L-type oscillation. Each type can be specified with or without smoothing.



Weave Type

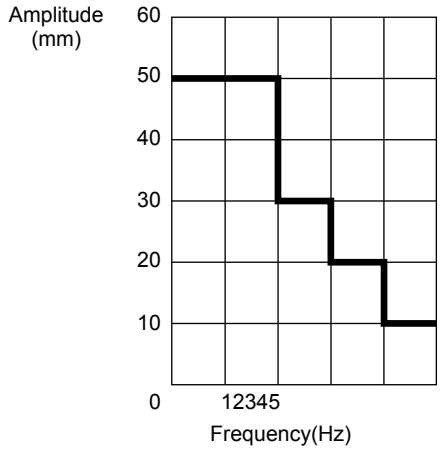
Smoothing

(3) SPEED

– Specifies how the oscillation speed is defined.
0: Defined by the frequency.
1: Defined by the weaving time for each weaving section.

(4) FREQUENCY

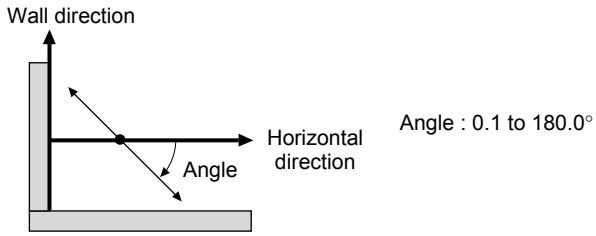
– Specifies the weaving frequency if “SPEED (3)” is set to “0: FREQ.” Note that the maximum frequency is determined by the amplitude as illustrated in the graph below. Specify a frequency within the allowable range. Note that the graph only indicates tentative values.



Maximum Frequencies for Different Amplitudes

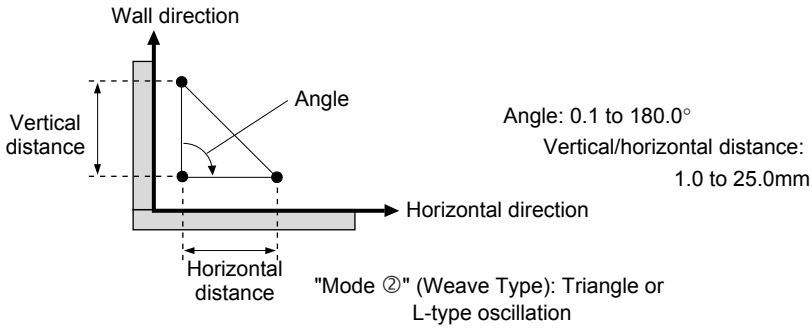
(5) PATTERN

– If “MODE (2)” is set to “0: SINGL,” the angle must be specified.



"Mode ②" (Weave Type): Single oscillation

– If “MODE (2)” is set to “1: TRI” or “2: L”, the following information on the triangle must be specified: vertical distance, horizontal distance, and angle.

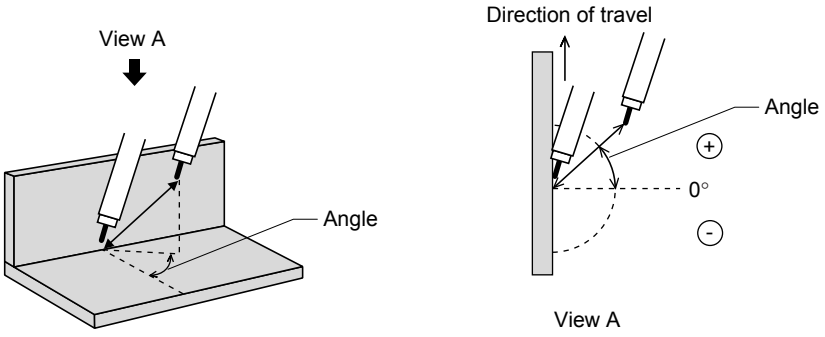


"Mode ②" (Weave Type): Triangle or L-type oscillation

(6) ANGLE

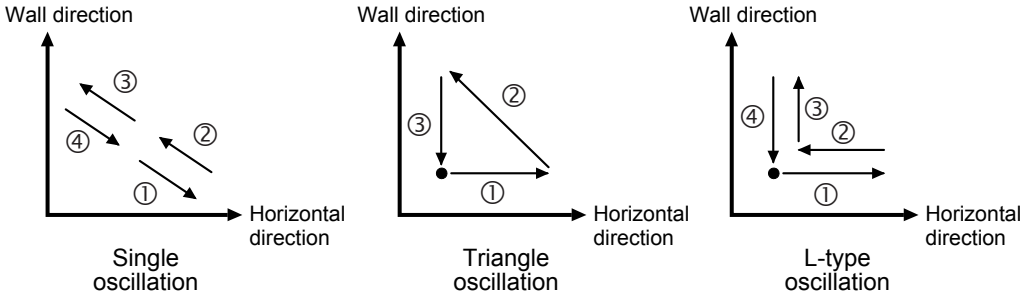
– The oscillation angle as measured from the weld line.

– Range: from - 90(deg.) to + 90(deg)



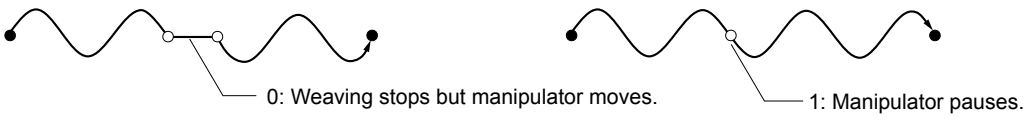
(7) TIMER (Timer mode)

– As shown below, a single weaving period is divided into three or four sections. A timer count can be specified for pauses at a point (node) between sections. (The circled number indicates section number.)



Set one of the following timer modes:

0 : Weaving stops but manipulator moves. 1 : Manipulator pauses.



(8) TIMER (Timer count)

– If “Speed (3) is set to “1: MOVING TIME,” a timer count specified here determines the duration of a pause (weaving stop or manipulator pause) at a mode between two sections of (8).

9.3.3 Operation Method

9.3.3.1 Displaying a Weaving File

1. Select {ARC WELDING} under the main menu.
2. Select {WEAVING}.
3. Display the desired file number.
   – The weaving condition file can be displayed using the page key .

   Press the page key to call the next file number.

   Press [SHIFT]+ page key to call the previous file number.

   Press the page key to input the desired file number, then press enter key.

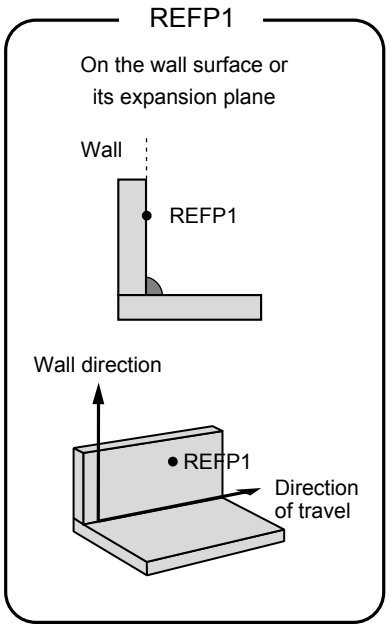
9.3.3.2 Editing Condition Data

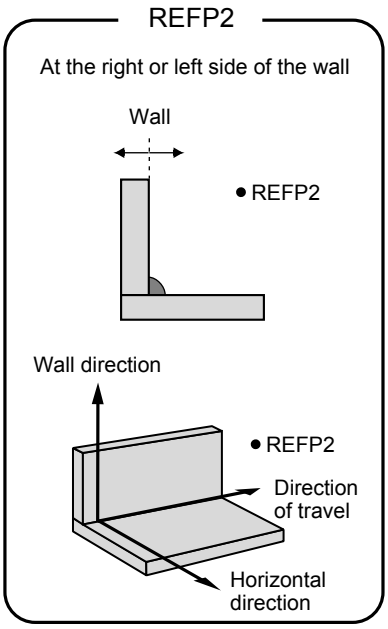
1. Select the item to be edited.
2. Input the value using the Numeric keys.

9.3.3.3 Cases that Require the Registration of Reference Points

The registration of the reference point REFP1 or REFP2 is not usually required. They are required only with a special workpiece condition, etc.

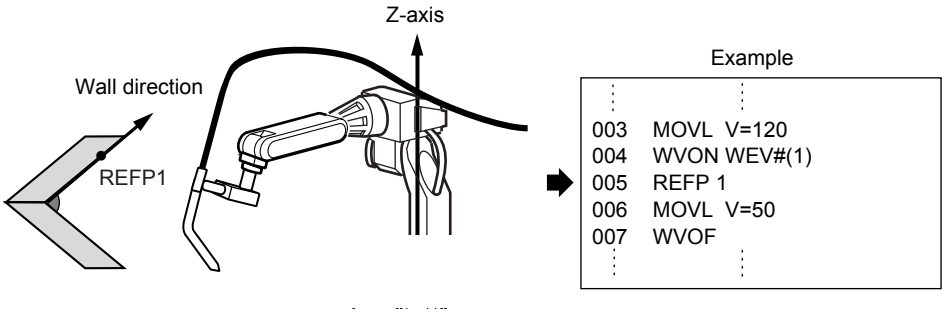
The REFP1, which defines the wall direction, is a point on the wall surface or its expansion plane. The REFP2, which defines the horizontal direction, is a point at the right or left side of the wall.



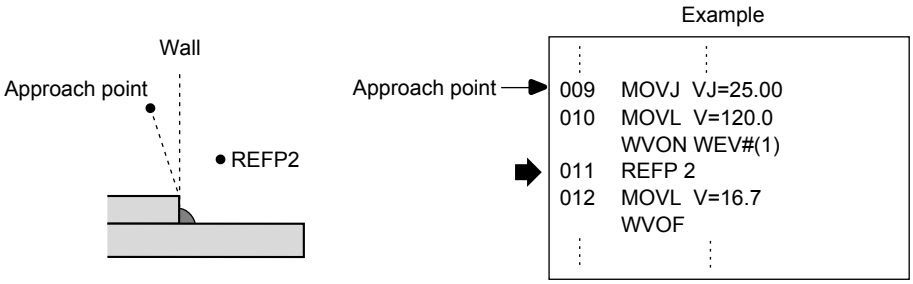


SUPPLE-MENT For information on registering REFP, refer to *section 3.2.3.2 "Registering Reference Point Instructions" on page 3-18*.

< Example 1 > REFP1 is registered because the wall direction is not parallel to the Z-axis of the robot coordinate.



< Example 2 > REFP2 is registered because the approach point is at another side of the wall.

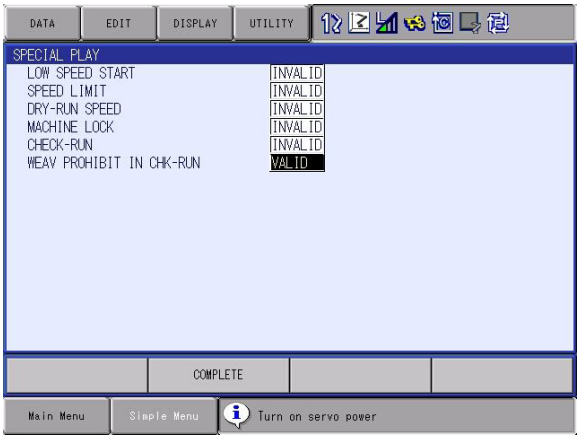


9.3.3.4 Prohibiting Weaving

If the weaving instruction is registered during the check mode of the play mode or “TEST RUN” or FWD operation in the teach mode, weaving is executed as well as other move instructions. However, in some cases when weaving is not wanted because of a workpiece collides, etc., follow the procedure below to prohibit weaving.

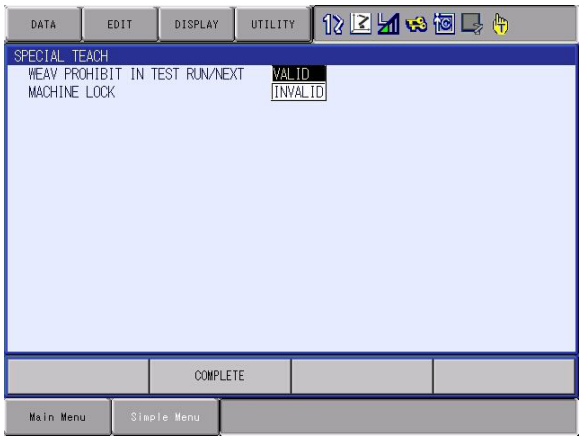
9.3.3.5 Method to Prohibit Weaving in the Check Mode

1. Press [AREA].
2. Select {UTILITY}.
3. Select {SPECIAL PLAY}.
4. Select prohibit weaving during the check mode.
   – The SPECIAL PLAY window appears.



9.3.3.6 Method to Prohibit Weaving During a “TEST RUN” or FWD Operation

1. Press [AREA].
2. Select {UTILITY}.
3. Select {SPECIAL TEACH}.
4. Select prohibit weaving during the FWD/TEST RUN operation.
   – The SPECIAL TEACH window appears.



9.3.3.7 Prohibiting Weaving By Means of a System Input Signal

The system input signal #40047 is used.

The system input signal can prohibit weaving at any time during a play operation, regardless of whether or not it is in a check mode.

9.4 Table of Work Instructions

- < > indicates alpha-numerical data.
- If multiple items are shown in one additional item section, select one.

Table 9-1: General-purpose Instructions

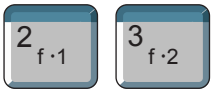
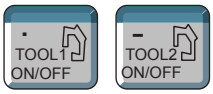
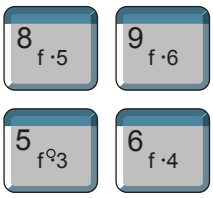
TOOLON	Function	Turns ON work tools (work instructions).	
	Additional Item	TOOL1, TOOL2	Displayed only when using multiple manipulators.
	Example	TOOLON	
TOOLOF	Function	Turns OFF work tools (work instructions).	
	Additional Item	TOOL1, TOOL2	Displayed only when using multiple manipulators.
	Example	TOOLOF	
WVON	Function	Starts weaving.	
	Additional Item	RB1, RB2	Displayed only when using multiple manipulators.
		WEV#(<weaving condition file number>)	1 to 255
	Example	WVON WEV# (1)	
WVOF	Function	Ends weaving.	
	Additional Item	RB1, RB2	Displayed only when using multiple manipulators.
		None	
	Example	WVOF	

10 Handling Application

10.1 Outlines

10.1.1 Function Keys

Table 10-1: Key Function

	Switches the signal output of [f•1] and [f•2] ON and OFF when [INTERLOCK] is simultaneously pressed. "1" side gripper valve signals (HAND 1-1 to HAND 4-1) can be allocated to [f•1] and "2" side gripper valve signals (HAND 1-2 to HAND 4-2) can be allocated to [f•2]. Alternatively, user signals can be allocated to the keys. The key allocations can be changed from the HANDLING window or by changing the AP parameters directly.
	Switches gripper 1 (HAND 1-1/HAND 1-2) output or the gripper 2 (HAND 2-1/HAND 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 window in the teach mode to register the HAND instructions.
	Not used.

10.1.2 HAND Instruction

10.1.2.1 Function

The following instructions open and close the grippers mounted on the manipulator. They correspond to single-, double-, and triple-position solenoids. Up to four grippers 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 gripper valve (x-1). The inverse signal is output to the gripper 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 gripper valve (x-1). The inverse signal is output to the gripper valve (x-2).

- **3P (triple-position solenoid)**
  Adding ALL to the HAND instruction allows both gripper valve (x-1) and gripper valve (x-2) to be turned ON/OFF simultaneously. Functions as a double-solenoid if ALL is not added to the HAND instruction.

Table 10-2: Valve ON/OFF Condition of Each Solenoid

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

10.1.2.2 Instruction and Additional Items

HAND	#1	1	OFF	ALL
	(1)	(2)	(3)	(4)

(1) Device Number(#1 or #2)
Sets when two manipulators are used for handling.

(2) Gripper Number(1 to 4)
Required.

(3) Gripper Output Status (ON/OFF)
Required.
Select ON or OFF.

(4) Valve Simultaneous Control (ALL)
Adds to turn valves 1 and 2 ON or OFF simultaneously.

10.1.3 HSEN (Gripper Sensor) Instruction

10.1.3.1 Function

Confirm that the gripper sensor is in the specified status. If the gripper sensor is in the specified status, the result is $B014* and the next instruction is executed. If a timer is specified, the instruction waits for the specified time (including infinity) to be input.

10.1.3.2 Instruction and Additional Items

HSEN	#1	1	OFF	T=10.00
	(1)	(2)	(3)	(4)

(1) Device Number(#1 or #2)
Set when two manipulators are used for handling.

(2) Sensor Number(1 to 8)
Required.

(3) Sensor Input Status (ON/OFF)
Required.
Select ON or OFF.

(4) Signal waiting time (T=0.01 to 655.35sec)
FOREVER: Unlimited time
If omitted, T=0.
$B014: Variable for execution result
Sets the 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.

10.1.3.3 Examples

```
HSEN 1 ON FOREVER
       OFF FOREVER
```

Waits until sensor 1 turns ON (OFF). At completion, the result (1: gripper sensor 1 is ON (OFF)) is set in $B014.

```
HSEN 1 ON
```

Checks whether sensor 1 is turned ON at completion of HSEN instruction. The result (0: gripper sensor 1 is OFF, 1: gripper sensor 1 is ON) is set in $B014.

```
HSEN 1 ON T=10.00
```

Waits 10 seconds for gripper sensor 1 to turn ON. Sets the result 1 (gripper sensor 1 is ON) in $B014 if the sensor input turns ON. Sets the result 0 (gripper sensor 1 is OFF) if the sensor does not turn ON after 10 seconds.
To observe the $B014 contents with an IF statement, use the GETS instruction to read the contents to a B variable.

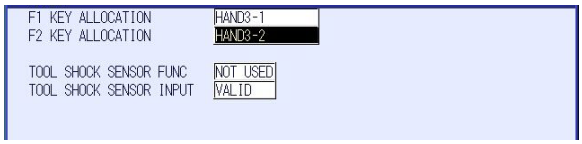
10.1.4 Handling Window

1. Select {ROBOT} under the main menu.
2. Select {HANDLING DIAG}.
   – The HANDLING window appears.

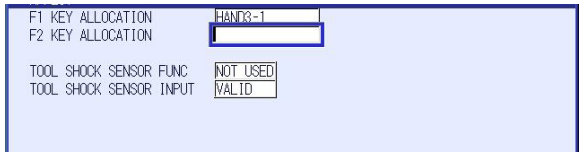
3. Select “F1 KEY ALLOCATION” or “F2 KEY ALLOCATION,” and then edit.
   – The selection dialog box appears.

   – If a signal from {HAND1} to {HAND4} is selected, the key allocation to the corresponding gripper valve signal can be modified. (In the following example, {HAND3} is selected in the “F2 KEY

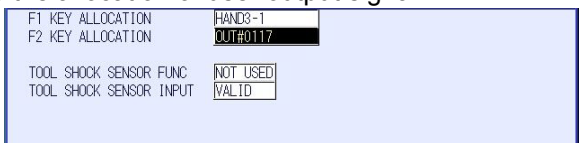
ALLOCATION.”)
When HAND3 is set for the “F2 KEY ALLOCATION”



– When {USER OUT} is selected, the output number of user signal is asked.



– Input desired number with Numeric keys and press [ENTER] to change the allocation of user output signal.



SUPPLE-MENT

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.

NOTE

The “-1” gripper valve signals can be allocated to [f•1] and the “-2” gripper valve signals can be allocated to [f•2].

4. Select “SHOCK SENSOR FUNC” or “SHOCK SENSOR INPUT,” and then edit.

– If “SHOCK SENSOR FUNC” is selected, “USED” and “NOT USED” are alternately displayed.
If “SHOCK SENSOR INPUT” is selected, “VALID” and “INVALID” are alternately displayed.
The displayed state is the current setting.

10.1.5 Shock Sensor Function

If “SHOCK SENSOR FUNC” is “USED” in the HANDLING window, the shock sensor is enabled. When the shock sensor does not exist, set “NOT USED.”

10.1.6 Shock Sensor Input Signal

- Function
  When this signal turns OFF, “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 shock sensor output signal to #20026 (CN309-B2 of YIU01).

10.1.7 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 shock sensor operation.
  Set the function on the HANDLING window. If “SHOCK SENSOR FUNC” is “USED” and “SHOCK SENSOR INPUT” is “INVALID” in the teach mode, “SHOCK SENSOR INP. RELEASING” is displayed and the input is disabled. The input is enabled if “SHOCK SENSOR INPUT” is “VALID.”

SUPPLE-MENT

Refer to *section 10.1.4 “Handling Window” on page 10-4* for details about using this function.

10.1.8 Low Air Pressure Input Signal

- Function
  If the air pressure drops, this signal 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 #20027 (CN309-A2 of YIU01).
  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.

10.2 Registering Instructions

10.2.1 HAND Instruction

This instruction turns ON/OFF the gripper valve signal and controls the tool.

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Press [TOOL 1 ON/OFF] or [TOOL 2 ON/OFF].
   – “HAND 1 ON” is displayed if [TOOL 1 ON/OFF] is pressed; “HAND 2 ON” is displayed if [TOOL 2 ON/OFF] is pressed in the input buffer line.
   If “HAND” is selected after pressing [INFORM LIST], “HAND 1 ON” is displayed.

   ⇒ HAND 1 ON

   – To register the instruction shown in the input buffer line without editing, press [INSERT] and then press [ENTER].
4. Select the gripper number and edit.
   – The input line is displayed.

   Tool_no=
   ⇒ HAND ▌ ON

   – Input the gripper number with the Numeric keys, and press [ENTER].

   ⇒ HAND 1 ON

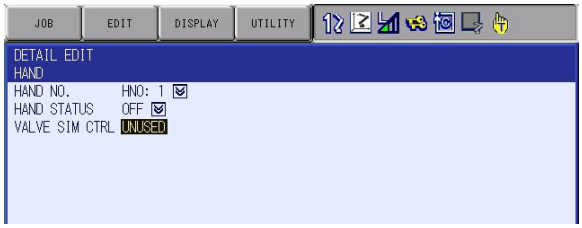
5. Select the gripper output status and edit.
   – If the UP or DOWN ARROW cursor is pressed together with [SHIFT], “ON” and “OFF” are alternately displayed.

   ⇒ HAND 1 OFF

   – If no settings are to be made for other additional items, press [INSERT] and then press [ENTER]. The HAND instruction is registered.

6. Edit the valve simultaneous control.
   – If inserting a valve simultaneous control (to make the gripper valve 1 output same as the valve 2 output), select “HAND.”

   – The DETAIL EDIT window appears.
     Select “VALVE SIM CTRL.”



   – The selection dialog box appears.

   – Select “ALL.”
     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 window.
7. Press [INSERT].
8. Press [ENTER].

10.2.2 HSEN Instruction

This instruction monitors the various inputs used for handling and outputs the monitor result as a variable.

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Press [INFORM LIST].
4. Select the HSEN instruction.
   – The HSEN instruction is displayed in the input buffer line.

   ⇒ HSEN 8 ON

   – To register the instruction shown in input buffer line without editing, press [INSERT] and then press [ENTER].
5. Select the sensor number and edit.
   – The input line is displayed.

   Sensor_no.=
   ⇒ HSEN ON

   – Input the sensor number with the Numeric keys, and press [ENTER].

   ⇒ HSEN 1 ON

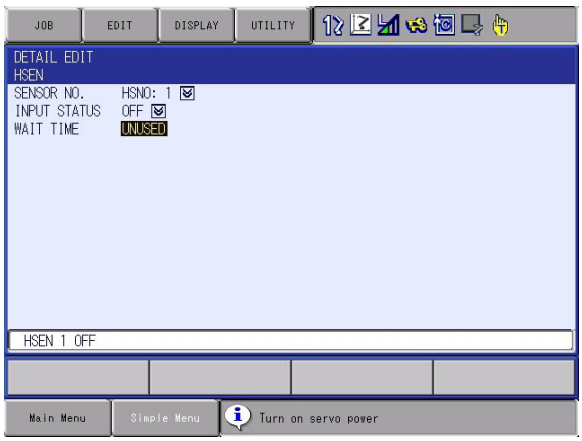
6. Select the sensor input status and edit.
   – If the UP or DOWN ARROW cursor is pressed together with [SHIFT], “ON” and “OFF” are alternately displayed.

   ⇒ HSEN 1 OFF

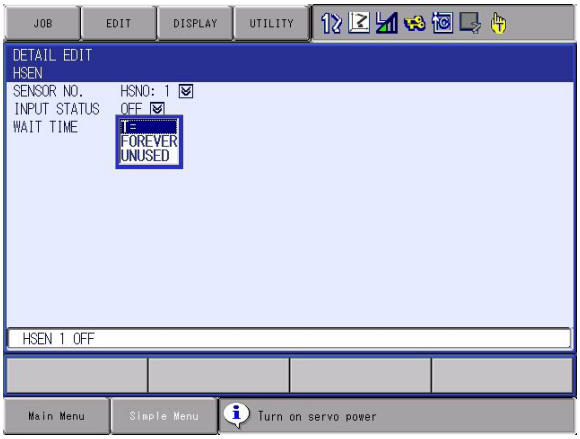
   – If no settings are to be made for other additional items, press [INSERT] and then press [ENTER]. The HSEN instruction is registered.
7. Edit the signal waiting time.
   – If inserting a signal waiting time, select “HSEN.”

   ⇒ HSEN 1 OFF

   The DETAIL EDIT window appears.



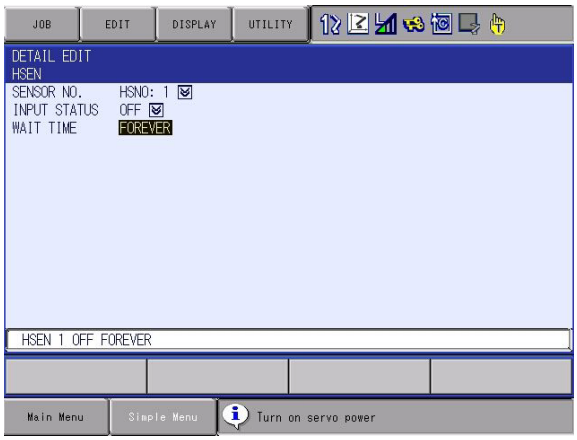
– Select “UNUSED.”
The selection dialog box appears.



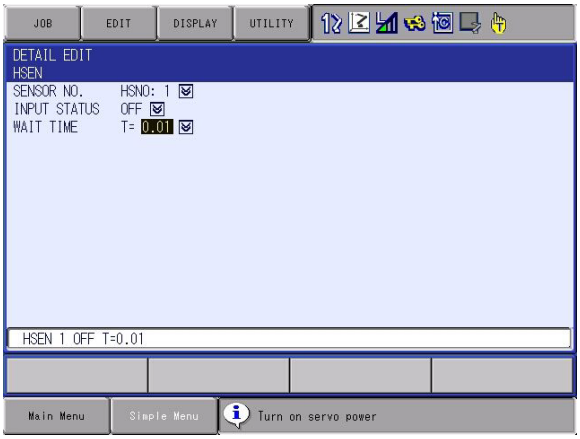
– Select “T=.”

SUPPLE-MENT

To make the (controller/hand/robot) to wait indefinitely, select “FOREVER.”

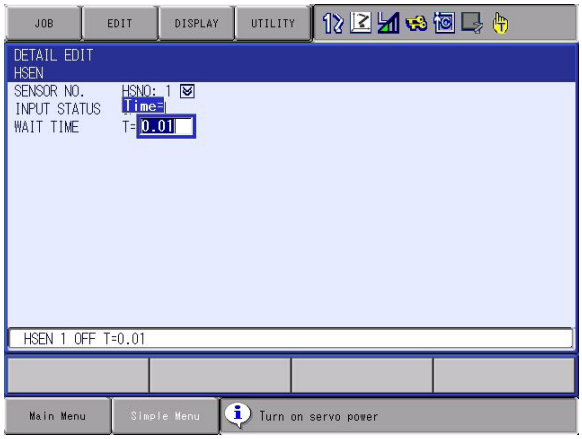


– The data of “WAIT TIME” item changes to the “T=” and the number item is displayed to the right of that.

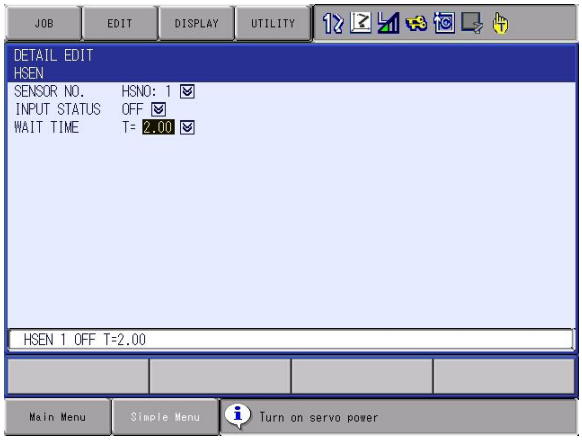


– Select the number item.

– The input line appears. Type the number with the Numeric keys.



– Press [ENTER] to display the number value input into the input buffer line.



– Press [ENTER] to display the JOB CONTENT window.

8. Press [INSERT].
9. Press [ENTER].

10.3 Table of Work Instructions

- <> indicates alpha-numerical data.
- If multiple items are shown in one additional item section, select one.

Table 10-3: Handling Instructions

HAND	Function	Turns ON/OFF signals to the gripper valves to open and close grippers.	
	Additional Item	# <Device number>	#1 or #2 Set when two manipulators are used for handling.
		<Gripper Number>	1 to 4 Required.
		<Gripper Output Status>	ON or OFF Required.
		ALL	Valve simultaneous control Used to turn gripper valves 1 and 2 ON or OFF simultaneously if a 3P solenoid is used.
	Example	HAND 1 ON HAND #1 1 OFF ALL	
HSEN	Function	Monitors the sensor inputs used for handling applications and outputs the monitored results to variable $B014.	
	Additional Item	$B014	Result variable. Cannot be displayed on screen.
		# <Device number>	#1 or #2 Set when two manipulators are used for handling.
		<Gripper Sensor Number>	1 to 8 Required.
		<Sensor Input Status>	ON or OFF Required.
		T=<signal waiting time> or FOREVER	T:0.01 to 655.35 seconds FOREVER: Unlimited time. If omitted, T=0.
	Example	HSEN 1 ON FOREVER HSEN #2 1 OFF HSEN 1 ON T=10.00	

11 Table of Basic Instructions

- <> indicates numerical or alphabetical data.
- If multiple items are shown in one section, select one of the items.

11.1 Move Instructions

MOVJ	**Function**	Moves to a taught point with joint interpolation type.	
	Additional Item	Position data, Base axis position data, Station axis position data	These data do not appear on the screen.
		VJ=<play speed>	VJ: 0.01 to 100.00%
		PL=<position level>	PL:0 to 8
		NWAIT	
		UNTIL statement	
		ACC=(acceleration adjustment ratio)	ACC: 20 to 100%
		DEC=(deceleration adjustment ratio)	DEC: 20 to 100%
	Example	MOVJ VJ=50.00 PL=2 NWAIT UNTIL IN#(16)=ON	
MOVL	**Function**	Moves to a taught point with linear interpolation type.	
	Additional Item	Position data, Base axis position data, Station axis position data	These data do not appear on the screen.
		V=<play speed>, VR=<play speed of the posture>, VE=<play speed of external axis>	V:0.1 to 1500.0 mm/s 1 to 9000.0 cm/min VR:0.1 to 180.0 deg/s VE:0.01 to 100.00%
		PL=<position level>	PL:0 to 8
		CR=(corner radius)	CR: 1.0 to 6553.5mm
		NWAIT	
		UNTIL statement	
		ACC=(acceleration adjustment ratio)	ACC: 20 to 100%
		DEC=(deceleration adjustment ratio)	DEC: 20 to 100%
	Example	MOVL V=138 PL=0 NWAIT UNTIL IN#(16)=ON	
MOVC	**Function**	Moves to a taught point with circular interpolation type.	
	Additional Item	Position data, Base axis position data, Station axis position data	These data do not appear on the screen.
		V=<play speed>, VR=<play speed of the posture>, VE=<play speed of external axis>	Same as MOVL.
		PL=<position level>	PL:0 to 8
		NWAIT	
		ACC=(acceleration adjustment ratio)	ACC: 20 to 100%
		DEC=(deceleration adjustment ratio)	DEC: 20 to 100%
	Example	MOVC V=138 PL=0 NWAIT	

MOVS	**Function**	Moves to a taught point with spline interpolation type.	
	Additional Item	Position data, Base axis position data, Station axis position data	These data do not appear on the screen.
		V=<play speed>, VR=<play speed of the posture>, VE=<play speed of external axis>	Same as MOVL.
		PL=<position level>	PL:0 to 8
		NWAIT	
		ACC=(acceleration adjustment ratio)	ACC: 20 to 100%
		DEC=(deceleration adjustment ratio)	DEC: 20 to 100%
	Example	MOVS V=120 PL=0	
IMOV	**Function**	Moves the specified increment from the current position with linear interpolation type.	
	Additional Item	P<variable number>, BP<variable number>, EX<variable number>	
		V=<play speed>, VR=<play speed of the posture>, VE=<play speed of external axis>	Same as MOVL.
		PL=<position level>	PL:0 to 8
		NWAIT	
		BF,RF,TF,UF# (<user coordinate number>)	BF: base coordinates RF: robot coordinates TF: tool coordinates UF: user coordinates
		UNTIL statement	
		ACC=(acceleration adjustment ratio)	ACC: 20 to 100%
		DEC=(deceleration adjustment ratio)	DEC: 20 to 100%
	Example	IMOV P000 V=138 PL=1 RF	
REFP	**Function**	Defines a reference point (e.g. wall point for weaving).	
	Additional Item	<reference point number>	wall point 1 for weaving :1 wall point 2 for weaving :2
		Position data, Base axis position data, Station axis position data	These data do not appear on the screen.
	Example	REFP 1	
SPEED	**Function**	Sets play speed.	
	Additional Item	VJ=<joint speed>, V=<TCP speed>, VR=<play speed of the posture>, VE=<play speed of external axis>	VJ:Same as MOVJ. V,VR,VE: Same as MOVL.
	Example	SPEED VJ=50.00	

CAUTION

When start IMOV instruction again after IMOV instruction was aborted due to execute the following operations, the manipulator moves the added values, which is set anew from the aborted position, in the linear interpolation. The values become greater than the set added value. Please do not execute the IMOV instruction when changing move distance by the abort causes a problem.

- External servo OFF signal 2 (#40066)
- Turning OFF the servo power due to alarm occurring
- Enable signal
- Mode switch
- Enable switch

11.2 I/O Instructions

DOUT	**Function**	Turns the external output signals ON and OFF.	
	Additional Item	OT# (<output number>), OGH# (<output group number>), OG# (<output group number>) Number of addressed output signals: OT#(xx)=1;OGH#(xx)=4(per group); OG#(xx)=8(per group) OGH#(xx) is not subject to parity check; only the binary specification is allowed.	
		FINE	With a high degree of accuracy
	Example	DOUT OT#(12) ON	
PULSE	**Function**	Outputs a pulse signal as an external output signal.	
	Additional Item	OT# (<output number>), OGH# (<output group number>), OG# (<output group number>)	
		T=<time (seconds)>	0.01 to 655.35 s 0.30 s unless otherwise specified
	Example	PULSE OT# (10) T=0.60	
DIN	**Function**	Sets input signals in variables.	
	Additional Item	B<variable number>	
		IN# (<input number>), IGH# (<input group number>), IG# (<input group number>), OT# (<output number>), OGH# (<output group number>), OG# (<output group number>), SIN# (<system input number>), SOUT# (<system output number>) Number of addressed input signals: IN#(xx)=1;IGH#(xx)=4(per group); IG#(xx)=8(per group) Number of addressed output signals: OT#(xx)=1;OGH#(xx)=4(per group); OG#(xx)=8(per group) IGH#(xx) and OGH#(xx) are not subject to parity check; only the binary specification is allowed.	
	Example	DIN B016 IN#(16) DIN B002 IG#(2)	

WAIT	**Function**	Waits until the external input signal status matches the specified status.	
	Additional Item	IN# (<input number>), IGH# (<input group number>), IG# (<input group number>), OT# (<user output number>), OGH# (<output group number>), SIN# (<system input number>), SOUT# (<system output number>)	
		<status>,B<variable number>	
		T=<time (seconds)>	0.01 to 655.35 s
	Example	WAIT IN# (12)=ON T=10.00 WAIT IN# (12)=B002	
AOUT	**Function**	Outputs the specified voltage to the general-purpose analog output port.	
	Additional Item	AO# (<output port number>)	1 to 40
		<output voltage(V)>	-14.0 to 14.0
	Example	AOUT AO# (2) 12.7	
ARATION	**Function**	Starts the analog output corresponding to the speed.	
	Additional Item	AO#(<output port number>)	1 to 40
		BV = <basic voltage>	-14.00 to 14.00
		V = <basic speed>	0.1 to 150.0 mm/s 1 to 9000 cm/min
		OFV = <offset voltage>	-14.00 to 14.00
	Example	ARATION AO#(1) BV=10.00 V=200.0 OFV=2.00	
ARATIOF	**Function**	Ends the analog output corresponding to the speed.	
	Additional Item	AO#(<output port number>)	1 to 40
	Example	ARATIOF AO#(1)	

11.3 Control Instructions

JUMP	**Function**	Jumps to the specified label or job.	
	Additional Item	* <label character string>, JOB:<job name>, IG# (<input group number>), B<variable number>, I<variable number>, D<variable number>	
		UF# (user coordinates number)	
		IF statement	
	Example	JUMP JOB:TEST1 IF IN#(14)=OFF	
***** **(label)**	**Function**	Indicates a jump destination.	
	Additional Item	<jump destination>	8 characters or less
	Example	*123	
CALL	**Function**	Calls the specified job.	
	Additional Item	JOB:<job name>, IG# (<input group number>), B<variable number>, I<variable number>, D<variable number>	
		UF# (user coordinates number)	
		IF statement	
	Example	CALL JOB:TEST1 IF IN# (24)=ON CALL IG#(2) (The job is called by the patterns of input signal. In this example, Job 0 cannot be called.)	
RET	**Function**	Returns to the call source job.	
	Additional Item	IF statement	
	Example	RET IF IN#(12)=OFF	
END	**Function**	Declares the end of a job.	
	Additional Item		
	Example	END	
NOP	**Function**	No operation.	
	Additional Item		
	Example	NOP	
TIMER	**Function**	Stops for the specified time.	
	Additional Item	T=<time (seconds)>	0.01 to 655.35 s
	Example	TIMER T=12.50	
IF **statement**	**Function**	Evaluates the specified condition and makes a judgment accordingly. Described after an instruction that specifies a certain action. Format:<Item1>=,<>,<=,>=,<,><Item2>	
	Additional Item	<Item1>	
		<Item2>	
	Example	JUMP *12 IF IN#(12)=OFF	

UNTIL statement	**Function**	Monitors the specified input signal during an action and stops the action when the specified signal status is observed. Described after an instruction that specifies a certain action.	
	Additional Item	IN# (<input number>)	
		<status>	
	Example	MOVL V=300 UNTIL IN#(10)=ON	
PAUSE	**Function**	Instructs a pause.	
	Additional Item	IF statement	
	Example	PAUSE IF IN#(12)=OFF	
’ (comment)	**Function**	Dispalys a comment.	
	Additional Item	<comment>	32 characters or less
	Example	’Draws 100mm size square.	
CWAIT	**Function**	Waits for execution of the instruction on the next line. Used with the NWAIT tag which is an additional item of a move instruction.	
	Additional Item		
	Example	MOVL V=100 NWAIT DOUT OT#(1) ON CWAIT DOUT OT#(1) OFF MOVL V=100	
ADVINIT	**Function**	Initializes the prereading instruction processing. Used to adjust the access timing for variable data.	
	Additional Item		
	Example	ADVINIT	
ADVSTOP	**Function**	Stops the prereading instruction processing. Used to adjust the access timing for variable data.	
	Additional Item		
	Example	ADVINIT	

11.4 Shift Instructions

SFTON	**Function**	Starts a shift operation.		
	Additional Item	P<variable number>, BP<variable number>, EX<variable number>, BF,RF,TF, UF#(<user coordinate number>)		BF: base coordinates RF: robot coordi-nates TF: tool coordinates UF: user coordinates
	Example	SFTON P001 UF#(1)		
SFTOF	**Function**	Stops a shift operation.		
	Additional Item			
	Example	SFTOF		
MSHIFT	**Function**	Obtains the shift value in the specified coordinate system from Data 2 and 3, and stores the obtained element values in Data 1. Format:MSHIFT <Data1><Coordinate><Data2><Data3>		
	Additional Item	Data1	PX<variable number>	
		Coordinate	BF,RF,TF, UF# (<user coordinate number>), MTF	BF: base coordinates RF: robot coordi-nates TF: tool coordinates UF: user coordinates MTF: tool coordinates for the master
		Data2	PX<variable number>	
		Data3	PX<variable number>	
	Example	MSHIFT PX000 RF PX001 PX002		

11.5 Operating Instructions

ADD	**Function**	Adds Data1 and Data2, and stores the result in Data1. Format:ADD<Data1><Data2>		
	Additional Item	Data1	B<variable number>, I<variable number>, D<variable number>, R<variable number>, P<variable number>, BP<variable number>, EX<variable number>	Data1 must always be a variable.
		Data2	Constant, B<variable number>, I<variable number>, D<variable number>, R<variable number>, P<variable number>, BP<variable number>, EX<variable number>	
	Example	ADD I012 I013		
SUB	**Function**	Subtracts Data2 from Data1, and stores the result in Data1. Format:SUB<Data1><Data2>		
	Additional Item	Data1	B<variable number>, I<variable number>, D<variable number>, R<variable number>, P<variable number>, BP<variable number>, EX<variable number>	Data1 must always be a variable.
		Data2	Constant, B<variable number>, I<variable number>, D<variable number>, R<variable number>, P<variable number>, BP<variable number>, EX<variable number>	
	Example	SUB I012 I013		

MUL	**Function**	Multiplies Data1 by Data2, and stores the result in Data1. Format:MUL<Data1><Data2> Data1 can be an element in a position variable. Pxxx(0):all axis data, Pxxx(1):X-axis data, Pxxx(2):Y-axis data, Pxxx(3):Z-axis data, Pxxx(4):Tx-axis data, Pxxx(5):Ty-axis data, Pxxx(6):Tz-axis data		
	Additional Item	Data1	B<variable number>, I<variable number>, D<variable number>, R<variable number>, P<variable number> (<element number>), BP<variable number> (<element number>), EX<variable number> (<element number>)	Data1 must always be a variable.
		Data2	Constant, B<variable number>, I<variable number>, D<variable number>, R<variable number>	
	Example	MUL I012 I013 MUL P000 (3) 2 (Multiply the Z-axis data by 2.)		
DIV	**Function**	Divides Data1 by Data2, and stores the result in Data1. Format:DIV<Data1><Data2> Data1 can be an element in a position variable. Pxxx(0):all axis data, Pxxx(1):X-axis data, Pxxx(2):Y-axis data, Pxxx(3):Z-axis data, Pxxx(4):Tx-axis data, Pxxx(5):Ty-axis data, Pxxx(6):Tz-axis data		
	Additional Item	Data1	B<variable number>, I<variable number>, D<variable number>, R<variable number>, P<variable number> (<element number>), BP<variable number> (<element number>), EX<variable number> (<element number>)	Data1 must always be a variable.
		Data2	Constant, B<variable number>, I<variable number>, D<variable number>, R<variable number>	
	Example	DIV I012 I013 DIV P000 (3) 2 (Divide the Z-axis data by 2.)		
INC	**Function**	Increments the value of the specified variable by 1.		
	Additional Item	B<variable number>,I<variable number>, D<variable number>		
	Example	INC I043		
DEC	**Function**	Decrements the value of the specified variable by 1.		
	Additional Item	B<variable number>,I<variable number>, D<variable number>		
	Example	DEC I043		

AND	**Function**	Obtains the AND of Data1 and Data2, and stores the result in Data1. Format:AND<Data1><Data2>		
	Additional Item	Data1	B<variable number>	
		Data2	B<variable number>, Constant	
	Example	AND B012 B020		
OR	**Function**	Obtains the OR of Data1 and Data2, and stores the result in Data1. Format:OR<Data1><Data2>		
	Additional Item	Data1	B<variable number>	
		Data2	B<variable number>, Constant	
	Example	OR B012 B020		
NOT	**Function**	Obtains the NOT of Data2, and stores the result in Data1. Format:NOT<Data1><Data2>		
	Additional Item	Data1	B<variable number>	
		Data2	B<variable number>, Constant	
	Example	NOT B012 B020		
XOR	**Function**	Obtains the exclusive OR of Data1 and Data2, and stores the result in Data1. Format:XOR<Data1><Data2>		
	Additional Item	Data1	B<variable number>	
		Data2	B<variable number>, Constant	
	Example	XOR B012 B020		
SET	**Function**	Sets Data2 to Data1. Format:SET<Data1><Data2>		
	Additional Item	Data1	B<variable number>, I<variable number>, D<variable number>, R<variable number>, P<variable number>, S<variable number>, BP<variable number>, EX<variable number>	Data1 must always be a variable.
		Data2	Constant, B<variable number>, I<variable number>, D<variable number>, R<variable number>, S<variable number>, EXPRESS	
	Example	SET I012 I020		
SETE	**Function**	Sets data to an element in a position variable.		
	Additional Item	Data 1	P<variable number> (<element number>), BP<variable number> (<element number>), EX<variable number> (<element number>)	
		Data 2	D<variable number>, <double-precision integer type constant>	
	Example	SETE P012 (3) D005		

GETE	**Function**	Extracts an element in a position variable.		
	Additional Item	D<variable number>		
		P<variable number> (<element number>), BP<variable number> (<element number>), EX<variable number> (<element number>)		
	Example	GETE D006 P012 (4)		
GETS	**Function**	Sets a system variable to the specified variable.		
	Additional Item	B<variable number>, I<variable number>, D<variable number>, R<variable number>, PX<variable number>		
		$B<variable number>, $I<variable number>, $D<variable number>, $R<variable number>, $PX<variable number>, $ERRNO, Constant, B<variable number>		System variable
	Example	GETS B000 $B000 GETS I001 $I[1] GETS PX003 $PX001		
CNVRT	**Function**	Converts the position variable (Data2) into a position variable of the specified coordinate system, and stores the converted variable in Data1. Format:CNVRT<Data1><Data2><coordinate>		
	Additional Item	Data1	PX<variable number>	
		Data2	PX<variable number>	
		BF,RF,TF,UF# (<user coordinate number>),MTF		BF: base coordinates RF: robot coordinates TF: tool coordinates UF: user coordinates MTF:tool coordinates for the master
	Example	CNVRT PX000 PX001 BF		

CLEAR	**Function**	Starting with the variable number in Data1, clears (sets to zero) as many variables as specified by a number in Data2. Format:CLEAR<Data1><Data2>		
	Additional Item	Data1	B<variable number>, I<variable number>, D<variable number>, R<variable number>, $B<variable number>, $I<variable number>, $D<variable number>, $R<variable number>,	
		Data2	<number of variables>, ALL,STACK	ALL:Clears variables of the variable number in Data1 and of all the variable numbers that follow. STACK:Clears all variables in the job call stack.
	Example	CLEAR B000 ALL CLEAR STACK		
SIN	**Function**	Obtains the sine of Data2, and stores the result in Data1. Format:SIN<Data1><Data2>		
	Additional Item	Data1	R<variable number>	Data1 must always be a real type variable.
		Data2	<constant>, R<variable number>	
	Example	SIN R000 R001 (Sets the sine of R001 to R000.)		
COS	**Function**	Obtains the cosine of Data2, and stores the result in Data1. Format:COS<Data1><Data2>		
	Additional Item	Data1	R<variable number>	Data1 must always be a real type variable.
		Data2	<constant>, R<variable number>	
	Example	COS R000 R001 (Sets the cosine of R001 to R000.)		
ATAN	**Function**	Obtains the arc tangent of Data2, and stores the result in Data1. Format:ATAN<Data1><Data2>		
	Additional Item	Data1	R<variable number>	Data1 must always be a real type variable.
		Data2	<constant>, R<variable number>	
	Example	ATAN R000 R001 (Sets the arc tangent of R001 to R000.)		
SQRT	**Function**	Obtains the square root of Data2, and stores the result in Data1. Format:SQRT<Data1><Data2>		
	Additional Item	Data1	R<variable number>	Data1 must always be a real type variable.
		Data2	<constant>, R<variable number>	
	Example	SQRT R000 R001 (Sets the square root of R001 to R000.)		

MFRAME	**Function**	Creates a user coordinate using the position data for the given three points as definition points. <Data1> indicates the definition point ORG position data, <Data2> the definition point XX position data, and <Data3> the definition point XY position data. Format: MFRAME <user coordinate> <Data1> <Data2> <Data3>		
	Additional Item	UF#(<user coordinate number>)		1 to 24
		Data1	PX <variable number>	
		Data2	PX <variable number>	
		Data3	PX <variable number>	
	Example	MFRAME UF#(1) PX000 PX001 PX002		
MULMAT	**Function**	Obtains the matrix product of Data2 and Data3, and stores the result in Data1. Format: MULMAT <Data1> <Data2> <Data3>		
	Additional Item	Data1	P <variable number>	
		Data2	P <variable number>	
		Data3	P <variable number>	
	Example	MULMAT P000 P001 P002		
INVMAT	**Function**	Obtains the inverse matrix of Data2, and stores the result in Data1. Format: INVMAT <Data1> <Data2>		
	Additional Item	Data1	P <variable number>	
		Data2	P <variable number>	
	Example	INVMAT P000 P001		
SETFILE	**Function**	Changes the contents data of a condition file into the numeric data of Data1. The contents data of a condition file to be changed is specified by the element number.		
	Additional Item	Contents data of a condition file	WEV#(<condition file number>)(<element number>)	
		Data1	Constant, D<variable number>	
	Example	SETFILE WEV#(1)(1) D000		
GETFILE	**Function**	Stores the contents data of a condition file in Data1. The contents data of a condition file to be obtained is specified by the element number.		
	Additional Item	Data1	D <variable number>	
		Contents data of a condition file	WEV#(<condition file number>)(<element number>)	
	Example	GETFILE D000 WEV#(1)(1)		
GETPOS	**Function**	Stores the position data of Data2 (step number) in Data1.		
	Additional Item	Data1	PX <variable number>	
		Data2	STEP# (<step number>)	
	Example	GETPOS PX000 STEP#(1)		
VAL	**Function**	Converts the numeric value of the character string (ASCII) of Data2 into the real number, and stores the result in Data1. Format: VAL <Data1> <Data2>		
	Additional Item	Data1	B <variable number>, I <variable number>, D <variable number>, R <variable number>	
		Data2	Character string, S <variable number>	
	Example	VAL B000 “123”		

ASC	**Function**	Obtains the character code of the first letter of the character string (ASCII) of Data2, and stores the result in Data1. Format:ASC<Data1><Data2>		
	Additional Item	Data1	B <variable number>, I <variable number>, D <variable number>	
		Data2	Character string, S <variable number>	
	Example	ASC B000 “ABC”		
CHR$	**Function**	Obtains the character (ASCII) with the character code of Data2, and stores the result in Data1. Format:CHR$<Data1><Data2>		
	Additional Item	Data1	S <variable number>	
		Data2	Constant, B <variable number>	
	Example	CHR$ S000 65		
MID$	**Function**	Obtains the character string (ASCII) of any length (Data 3, 4) from the character string (ASCII) of Data2, and stores the result in Data1. Format:MID$<Data1><Data2><Data3><Data4>		
	Additional Item	Data1	S <variable number>	
		Data2	Character string, S <variable number>	
		Data3	Constant, B <variable number>, I <variable number>, D <variable number>	
		Data4	Constant, B <variable number>, I <variable number>, D <variable number>	
	Example	MID$ S000 “123ABC456” 4 3		
LEN	**Function**	Obtains the total number of bytes of the character string (ASCII) of Data2, and stores the result in Data1. Format:LEN<Data1><Data2>		
	Additional Item	Data1	B <variable number>, I <variable number>, D <variable number>	
		Data2	Character string, S <variable number>	
	Example	LEN B000 “ABCDEF”		
CAT$	**Function**	Combines the character string (ASCII) of Data2 and Data3, and stores the result in Data1. Format:CAT$<Data1><Data2><Data3>		
	Additional Item	Data1	S <variable number>	
		Data2	Character string, S <variable number>	
		Data3	Character string, S <variable number>	
	Example	CAT$ S000 “ABC” “DEF”		

DX100
OPERATOR'S MANUAL

FOR MATERIAL HANDLING, PRESS TENDING, CUTTING, AND OTHER APPLICATIONS

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