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

MOTOMAN INSTRUCTIONS

MOTOMAN ROBOTIC ARC WELDING 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.

Part Number: 158051-1CD
Revision: 5
### 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.
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 “WARNING,” “CAUTION,” “MANDATORY,” or “PROHIBITED.”

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

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

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

🚫 PROHIBITED
Must never be performed.

Even items described as “CAUTION” may result in a serious accident in some situations.

At any rate, be sure to follow these important items.

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

• Before operating the manipulator, check that servo power is turned off when the emergency stop buttons on the front door of the 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:
  – View the manipulator from the front whenever possible.
  – Always follow the predetermined operating procedure.
  – Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

• Confirm that no 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 DX 100 and programing pendant.
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.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX100 controller</td>
<td>DX100</td>
</tr>
<tr>
<td>DX100 programming pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator cable</td>
</tr>
</tbody>
</table>
Descriptions of the programming pendant keys, buttons, and displays are shown as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Pendant</td>
<td>Character Keys: The keys which have characters printed on them are denoted with [ ]. ex. [ENTER]</td>
</tr>
<tr>
<td>Symbol Keys</td>
<td>The keys which have a symbol printed on them are not denoted with [ ] but depicted with a small picture. ex. page key</td>
</tr>
<tr>
<td>Axis Keys</td>
<td>&quot;Axis Keys&quot; and &quot;Numeric Keys&quot; are generic names for the keys for axis operation and number input.</td>
</tr>
<tr>
<td>Numeric Keys</td>
<td>Keys pressed simultaneously: When two keys are to be pressed simultaneously, the keys are shown with a &quot;+&quot; sign between them, ex. [SHIFT]+[COORD]</td>
</tr>
<tr>
<td>Displays</td>
<td>The menu displayed in the programming pendant is denoted with { }. ex. {JOB}</td>
</tr>
</tbody>
</table>

**Description of the Operation Procedure**

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

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Lincoln ARCLINK XT

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<td>Appendix A</td>
<td>Revision History</td>
<td>A-1</td>
</tr>
</tbody>
</table>
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, [ENTER] 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: [1] 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.

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

<table>
<thead>
<tr>
<th>Key</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>[START]</strong></td>
<td>Starts the manipulator motion in playback operation.</td>
</tr>
<tr>
<td></td>
<td>• The lamp on this button is lit during the playback operation.</td>
</tr>
<tr>
<td></td>
<td>• The lamp also lights when the playback operation is started by the system input START signal.</td>
</tr>
<tr>
<td></td>
<td>• The lamp turns OFF when the playback operation is stopped by alarm occurrence, HOLD signal, or mode change.</td>
</tr>
<tr>
<td><strong>[HOLD]</strong></td>
<td>Holds the manipulator motion.</td>
</tr>
<tr>
<td></td>
<td>• This button is enabled in any mode.</td>
</tr>
<tr>
<td></td>
<td>• The lamp on this button is lit only while the button is being pressed.</td>
</tr>
<tr>
<td></td>
<td>• Although the lamp turns OFF when the button is released, the manipulator stays stopped until a START command is input.</td>
</tr>
<tr>
<td></td>
<td>• 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.</td>
</tr>
<tr>
<td></td>
<td>1. The HOLD signal of system input is ON.</td>
</tr>
<tr>
<td></td>
<td>2. The HOLD request is being sent from an external device in remote mode.</td>
</tr>
<tr>
<td></td>
<td>3. In the HOLD status caused by an error occurred in working process such as wire sticking at arc welding.</td>
</tr>
<tr>
<td><strong>E.STOP Button</strong></td>
<td>Turns OFF the servo power.</td>
</tr>
<tr>
<td></td>
<td>• When the servo power is turned OFF, the SERVO ON LED on the programming pendant will extinguish.</td>
</tr>
<tr>
<td></td>
<td>• An emergency stop message is displayed on the screen.</td>
</tr>
<tr>
<td><strong>[MODE]</strong></td>
<td>Selects the Play mode, Teach mode, or Remote mode.</td>
</tr>
<tr>
<td></td>
<td>PLAY: Play Mode</td>
</tr>
<tr>
<td></td>
<td>The playback of taught job is enabled.</td>
</tr>
<tr>
<td></td>
<td>The START signal from an external device is disabled.</td>
</tr>
<tr>
<td></td>
<td>TEACH: Teach Mode</td>
</tr>
<tr>
<td></td>
<td>The axis operation and edition from the programming pendant are enabled.</td>
</tr>
<tr>
<td></td>
<td>The START signal from an external device is disabled.</td>
</tr>
<tr>
<td></td>
<td>REMOTE: Remote Mode</td>
</tr>
<tr>
<td></td>
<td>The operation by external signals is enabled.</td>
</tr>
<tr>
<td></td>
<td>[START] is invalid during the remote mode.</td>
</tr>
</tbody>
</table>
Enable Switch | Turns ON the servo power.
The Enable switch is active only when the SERVO ON LED is blinking, the safety plug is ON, and the Mode Switch is set to “TEACH.” When this switch is lightly squeezed, the power turns ON. When firmly squeezed, the power turns OFF.

[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.
1 Introduction

1.2 Programming Pendant

[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 Play mode, the servo power supply is turned ON if the safeguarding is securely closed.
• In 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.
<table>
<thead>
<tr>
<th>Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[DIRECT OPEN]</td>
<td>Displays the content related to the current line.</td>
</tr>
<tr>
<td></td>
<td>• To display the content of a CALL job or condition file, move the cursor</td>
</tr>
<tr>
<td></td>
<td>to the next line and press [DIRECT OPEN]. The file will be displayed for</td>
</tr>
<tr>
<td></td>
<td>the selected line. Display content will vary depending on the type of</td>
</tr>
<tr>
<td></td>
<td>instruction used in the job.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>For a CALL instruction, the content of the called job will be displayed.</td>
</tr>
<tr>
<td></td>
<td>For a work instruction, the content of the condition file will be displayed.</td>
</tr>
<tr>
<td></td>
<td>For Input/output instructions, the input/output condition will be displayed.</td>
</tr>
<tr>
<td></td>
<td>• The lamp on this button is lit while the direct open is ON. Press this</td>
</tr>
<tr>
<td></td>
<td>button while the lamp is lit to return to the previous window.</td>
</tr>
<tr>
<td>[PAGE]</td>
<td>Displays the next page.</td>
</tr>
<tr>
<td></td>
<td>The page can be switched only when the lamp on this button is lit.</td>
</tr>
<tr>
<td></td>
<td>[SHIFT] + [PAGE]</td>
</tr>
<tr>
<td></td>
<td>Switches to the previous page.</td>
</tr>
<tr>
<td>[AREA]</td>
<td>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.</td>
</tr>
<tr>
<td>[SHIFT] + [AREA]</td>
<td>The language can be switched when the bilingual function is valid. (Bilingual function is optional.)</td>
</tr>
<tr>
<td>[AREA] + DOWN</td>
<td>Moves the cursor from the general-purpose display area to the operation button when the operation button is displayed.</td>
</tr>
<tr>
<td>[AREA] + UP</td>
<td>Moves the cursor to the general-purpose display area when the cursor is on the operation button.</td>
</tr>
<tr>
<td>[SHIFT]</td>
<td>Changes the functions of other keys by pressing together.</td>
</tr>
<tr>
<td>[INTERLOCK]</td>
<td>Changes the functions of other keys by pressing together.</td>
</tr>
<tr>
<td></td>
<td>Can be used with [MAIN MENU], [ASSIST], [COORD], [AREA], [MOTION TYPE],</td>
</tr>
<tr>
<td></td>
<td>cursor key or Numeric key to access alternate functions.</td>
</tr>
<tr>
<td></td>
<td>Refer to the description of each key for the alternate [SHIFT] functions.</td>
</tr>
<tr>
<td></td>
<td>Can be used with [ASSIST], [MULTI], [TEST START], [FWD], or Numeric key</td>
</tr>
<tr>
<td></td>
<td>(Numeric key customize function). Refer to the description of each key for the alternate [INTERLOCK] functions.</td>
</tr>
</tbody>
</table>
# Introduction

## 1.2 Programming Pendant

<table>
<thead>
<tr>
<th>Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[INFORM LIST]</td>
<td>Displays instruction lists of commands available for job editing.</td>
</tr>
<tr>
<td>[ROBOT]</td>
<td>Enables the robot axis operation.</td>
</tr>
<tr>
<td>[EX. AXIS]</td>
<td>Enables the external axis (base axis or station axis) operation.</td>
</tr>
<tr>
<td>[MOTION TYPE]</td>
<td>Selects the interpolation type for playback operation.</td>
</tr>
<tr>
<td>[TEST START]</td>
<td>Moves the manipulator through taught steps in a continuous motion when [TEST START] and [INTERLOCK] are simultaneously pressed.</td>
</tr>
</tbody>
</table>

**[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.

**[EX. AXIS]**

Enables the external axis (base axis or station axis) operation.

[EX.AXIS] is active for the system with external axes.

**[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.
## 1.2 Programming Pendant

<table>
<thead>
<tr>
<th>Button</th>
<th>Function</th>
</tr>
</thead>
</table>
| **[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 3-24.  
  The manipulator operates at the selected manual speed. Make sure that the selected manual speed is the desired one before starting operation. |
| ![FWD](image) | ![INTERLOCK](image) ![FWD](image) ![REFP](image) ![FWD](image) |
| **[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. |
| ![BWD](image) | ![DELETE](image) ![INSERT](image) ![MODIFY](image) ![ENTER](image) |
| **[DELETE]** | Deletes the registered instruction.  
- Deletion completes when **[ENTER]** is pressed while this key lamp is lit. |
| ![DELETE](image) | ![INSERT](image) ![MODIFY](image) ![ENTER](image) |
| **[INSERT]** | Inserts a new instruction.  
- Insertion completes when **[ENTER]** is pressed while this key lamp is lit. |
| ![DELETE](image) ![INSERT](image) ![MODIFY](image) ![ENTER](image) |
| **[MODIFY]** | Modifies the taught position data or instruction.  
- Modification completes when **[ENTER]** is pressed while this key lamp is lit. |
| ![DELETE](image) ![INSERT](image) ![MODIFY](image) ![ENTER](image) |
| **[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. |
| ![DELETE](image) ![INSERT](image) ![MODIFY](image) ![ENTER](image) |
1.2 Programming Pendant

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.

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].
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1.2 Programming Pendant

- 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.

![Main Menu Area Diagram]

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).

![Status Display Area Diagram]

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
Introduction

1.2 Programming Pendant

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 2-3.

- 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
1.2 Programming Pendant

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. Page
   - : Displayed when the page can be switched.

I. Multi Mode
   - : Displayed when the multi window mode is set.

J. Weak Battery of Memory
   - : Displayed when the battery of memory is weak.

K. 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.

**Fig. 1-3: Full Window View**

![Full Window View](image)

**Fig. 1-4: Upper Window View**

![Upper Window View](image)

**Fig. 1-5: Middle Window View**

![Middle Window View](image)

**Fig. 1-6: Lower Window View**

![Lower Window View](image)
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 “Caps Lock OFF” or “Caps Lock ON.”

1.2.6.2 Operation

<table>
<thead>
<tr>
<th>Keypad</th>
<th>Button on the Programming Pendant</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cursor</td>
<td>![Cursor Icon]</td>
<td>Moves the cursor (focus).</td>
</tr>
<tr>
<td>[SELECT]</td>
<td>![Select Icon]</td>
<td>Selects a character.</td>
</tr>
<tr>
<td>[CANCEL]</td>
<td>![Cancel Icon]</td>
<td>Clears all the characters being typed. Pressing this second time cancels the software keypad.</td>
</tr>
<tr>
<td>[ENTER]</td>
<td>![Enter Icon]</td>
<td>Enters the input characters.</td>
</tr>
<tr>
<td>Button Tab</td>
<td>![Page Icon]</td>
<td>Switches the keypads displayed on the programming pendant.</td>
</tr>
<tr>
<td>Numeric Keys</td>
<td>![Number Icons]</td>
<td>Enters numbers.</td>
</tr>
</tbody>
</table>

Button Tab

Closes the software keypad.
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 \( \text{[PAGE]} \) to display the alphanumeric input window. Move the cursor to the desired letter and press [SELECT] to enter the letter.

*Fig. 1-7: For Numbers and Upper-case Characters*

![Alphanumeric Input Window](image)

*Fig. 1-8: For Numbers and Lower-case Characters*

![Alphanumeric Input Window](image)

1.2.6.4 Symbol Input

Press the page key \( \text{[PAGE]} \) 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.
1 Introduction
1.2 Programming Pendant

Fig. 1-9: For Symbols
1.3 Mode

The following three modes are available for DX100.

- Teach Mode
- Play Mode
- Remote Mode

1.3.1 Teach Mode

In 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 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.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Mode</th>
<th>Teach Mode</th>
<th>Play Mode</th>
<th>Remote Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servo ON Ready</td>
<td>PP</td>
<td>PP</td>
<td>External input signal</td>
<td></td>
</tr>
<tr>
<td>Start</td>
<td>Invalid</td>
<td>PP</td>
<td>External input signal</td>
<td></td>
</tr>
<tr>
<td>Cycle Change</td>
<td>PP</td>
<td>PP</td>
<td>External input signal</td>
<td></td>
</tr>
<tr>
<td>Call Master Job</td>
<td>PP</td>
<td>PP</td>
<td>External input signal</td>
<td></td>
</tr>
</tbody>
</table>

Note: “PP” indicates the programming pendant.

1.3.4 Teach Mode Priority

In 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

<table>
<thead>
<tr>
<th>Main Menu</th>
<th>Sub Menu</th>
<th>Security Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>I/O MESSAGE</td>
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¹) Requires movement to RS-232 or RS-422 interface.
²) Requires movement to RS-422 interface.
### Table 1-1: Menu & Security Mode (Continued)

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<thead>
<tr>
<th>Main Menu</th>
<th>Sub Menu</th>
<th>Security Mode</th>
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<td>SERVO MONITOR</td>
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<tr>
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<td>WORK HOME POS</td>
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<td>SECOND HOME POS</td>
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<td>DROP AMOUNT</td>
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<td>POWER ON/OFF POS</td>
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<td>HOME POSITION</td>
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<td>OVERRUN&amp;S-SENSOR 1)</td>
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### Table 1-1: Menu & Security Mode (Continued)

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<td>GUN CONDITION</td>
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<td>GENERAL DIAGNOSIS</td>
<td>Operation</td>
<td>Edit</td>
</tr>
<tr>
<td>ALL COMMON APPLICATION</td>
<td>I/O-VARIABLE CUSTOMIZE</td>
<td>Operation</td>
<td>Operation</td>
</tr>
</tbody>
</table>

1. Displayed in Teach mode only.
2. Displayed in 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.

Robot
This is the axis for the manipulator itself.

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

Station
This is any axis other than the robot and base. It indicates the tilt or rotating axis of the fixture.
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 $\theta$ 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.
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  $\rightarrow$ Cartesian (Cylindrical)  $\rightarrow$ Tool  $\rightarrow$ 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.

• Each time [FAST] is pressed, the speed switches in the order of “INCH” $\rightarrow$ “SLOW” $\rightarrow$ “MED” $\rightarrow$ “FAST”.

• Each time [SLOW] is pressed, the speed switches in the order of “FAST” $\rightarrow$ “MED” $\rightarrow$ “SLOW” $\rightarrow$ “INCH”.

In operating the manipulator manually by the programming pendant, the maximum speed of center point is limited at 250 mm/s.
2.2 General Operations

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.

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

<table>
<thead>
<tr>
<th>Axis Name</th>
<th>Axis Operation Key</th>
<th>Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Axes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-axis</td>
<td>![S-]  ![S+]</td>
<td>Main unit rotates right and left.</td>
</tr>
<tr>
<td>L-axis</td>
<td>![Y-]  ![Y+]</td>
<td>Lower arm moves forward and backward.</td>
</tr>
<tr>
<td>U-axis</td>
<td>![Z-]  ![Z+]</td>
<td>Upper arm moves up and down.</td>
</tr>
<tr>
<td>Wrist Axes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-axis</td>
<td>![X-]  ![X+]</td>
<td>Wrist rolls right and left.</td>
</tr>
<tr>
<td>B-axis</td>
<td>![Y-]  ![Y+]</td>
<td>Wrist moves up and down.</td>
</tr>
<tr>
<td>T-axis</td>
<td>![Z-]  ![Z+]</td>
<td>Wrist turns right and left.</td>
</tr>
<tr>
<td>E-axis</td>
<td>![E-]  ![E+]</td>
<td>Lower arm turns right and left.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Axis Name</th>
<th>Axis Operation Key</th>
<th>Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Axes</td>
<td>X-axis</td>
<td>X- S- X+ S+</td>
</tr>
<tr>
<td></td>
<td>Z-axis</td>
<td>Z- U- Z+ U+</td>
</tr>
</tbody>
</table>

Wrist Axes Motion about TCP is executed. See Section 2.3.7 “Control Point Operation” on page 2-14.

• When two or more axis keys are pressed at the same time, the manipulator will perform compound movement. However, if two different directional keys for the same axis are pressed at the same time (such as [X-] + [X+]), none of the axes operate.
### 2.3.3 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*

<table>
<thead>
<tr>
<th>Axis Name</th>
<th>Axis Operation Key</th>
<th>Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Axes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \theta )-axis</td>
<td>( X_- ) ( X_+ ) ( S_- ) ( S_+ )</td>
<td>Main unit rolls around ( S )-axis.</td>
</tr>
<tr>
<td>r-axis</td>
<td>( Y_- ) ( Y_+ ) ( L_- ) ( L_+ )</td>
<td>Moves perpendicular to ( Z )-axis.</td>
</tr>
<tr>
<td>Z-axis</td>
<td>( Z_- ) ( Z_+ ) ( U_- ) ( U_+ )</td>
<td>Moves parallel to ( Z )-axis.</td>
</tr>
</tbody>
</table>

Wrist Axes | Motion about TCP is executed. See Section 2.3.7 “Control Point Operation” on page 2-14.
• When two or more axis keys are pressed at the same time, the manipulator will perform compound movement. However, if two different directional keys for the same axis are pressed at the same time (such as [Z-] + [Z+]), none of the axes operate.

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*

<table>
<thead>
<tr>
<th>Axis Name</th>
<th>Axis Operation Key</th>
<th>Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Axes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X-axis</td>
<td>S-</td>
<td>Moves parallel to X-axis.</td>
</tr>
<tr>
<td></td>
<td>S+</td>
<td></td>
</tr>
<tr>
<td>Y-axis</td>
<td>L-</td>
<td>Moves parallel to Y-axis.</td>
</tr>
<tr>
<td></td>
<td>L+</td>
<td></td>
</tr>
<tr>
<td>Z-axis</td>
<td>U-</td>
<td>Moves parallel to Z-axis.</td>
</tr>
<tr>
<td></td>
<td>U+</td>
<td></td>
</tr>
<tr>
<td>Wrist Axes</td>
<td>Motion about TCP is executed. See Section 2.3.7 &quot;Control Point Operation&quot; on page 2-14.</td>
<td></td>
</tr>
</tbody>
</table>

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

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

In 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 work pieces.
2.3 Coordinate Systems and Axis Operation

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.

For tool coordinates, the tool file should be registered in advance. For further details, refer to “8.3 Tool Data Setting” of coordinates “DX100 INSTRUCTIONS” (162536-1CD).

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].
2.3 Coordinate Systems and Axis Operation

– The TOOL NO. SELECT window appears.

![Tool No. Select Window]

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**

<table>
<thead>
<tr>
<th>Axis Name</th>
<th>Axis Operation Key</th>
<th>Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Axes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X-axis</td>
<td><img src="X-" alt="X-" /> <img src="X+" alt="X+" /></td>
<td>Moves parallel to X-axis.</td>
</tr>
<tr>
<td>Y-axis</td>
<td><img src="Y-" alt="Y-" /> <img src="Y+" alt="Y+" /></td>
<td>Moves parallel to Y-axis.</td>
</tr>
<tr>
<td>Z-axis</td>
<td><img src="Z-" alt="Z-" /> <img src="Z+" alt="Z+" /></td>
<td>Moves parallel to Z-axis.</td>
</tr>
<tr>
<td>Wrist Axes</td>
<td>Motion about TCP is executed. See Section 2.3.7 “Control Point Operation” on page 2-14.</td>
<td></td>
</tr>
</tbody>
</table>

**SUPPLEMENT**

• When two or more axis keys are pressed at the same time, the manipulator will perform compound movement. However, if two different directional keys for the same axis are pressed at the same time (such as [X-] + [X+]), none of the axes operate.
2.3.5.1 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.
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.

<table>
<thead>
<tr>
<th>Axis Name</th>
<th>Axis Operation Key</th>
<th>Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASE or STATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st axis</td>
<td>X- S- X+ S+</td>
<td>The 1st axis moves.</td>
</tr>
<tr>
<td>2nd axis</td>
<td>Y- L- Y+ L+</td>
<td>The 2nd axis moves.</td>
</tr>
<tr>
<td>3rd axis</td>
<td>Z- U- Z+ U+</td>
<td>The 3rd axis moves.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Axis Name</th>
<th>Axis Operation Key</th>
<th>Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Axes</td>
<td></td>
<td>TCP moves. These movements differ depending on cartesian, cylindrical, tool and user coordinates.</td>
</tr>
<tr>
<td>Wrist Axes</td>
<td></td>
<td>Wrist axes move with the TCP fixed. These movements differ depending on cartesian, cylindrical, tool and user coordinates.</td>
</tr>
<tr>
<td>E-axis</td>
<td></td>
<td>* 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.)</td>
</tr>
</tbody>
</table>

• When two or more axis keys are pressed at the same time, the manipulator will perform compound movement. However, if two different directional keys for the same axis are pressed at the same time (such as [X-] + [X+]), none of the axes operate.
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 2-10), 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:

For registration of the tool file, refer to Section 8.3 “Tool Data Setting” of “DX100 INSTRUCTIONS” (162536-1CD).
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.

   - 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 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>

001 JOB-1 WORK-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 Teaching

3.1 Preparation for Teaching

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.

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Additional Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOVJ</td>
<td>VJ = 50.00</td>
</tr>
</tbody>
</table>

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

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

- The manipulator moves in a linear path from one taught step to the next.
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.

  \[ \text{Table 3-1: Interpolation Type for Single Circular Arc} \]

<table>
<thead>
<tr>
<th>Point</th>
<th>Interpolation Type</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td>P1</td>
<td>Circular</td>
<td>MOVC</td>
</tr>
<tr>
<td>P2</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td>P3</td>
<td></td>
<td>MOVL</td>
</tr>
<tr>
<td>P4</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td></td>
<td>Automatically becomes a straight line.</td>
<td></td>
</tr>
</tbody>
</table>

- **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.

  \[ \text{Table 3-2: Interpolation Type for Continuous Circular Arcs} \]

<table>
<thead>
<tr>
<th>Point</th>
<th>Interpolation Type</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td>P1</td>
<td>Circular</td>
<td>MOVC</td>
</tr>
<tr>
<td>P2</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td>P3</td>
<td></td>
<td>MOVL</td>
</tr>
<tr>
<td>P4</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td>P5</td>
<td>Circular</td>
<td>MOVC</td>
</tr>
<tr>
<td>P6</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td>P7</td>
<td></td>
<td>MOVL</td>
</tr>
<tr>
<td>P8</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td></td>
<td>Joint or linear motion type</td>
<td></td>
</tr>
</tbody>
</table>
3 Teaching

3.2 Teaching Operation

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.

<table>
<thead>
<tr>
<th>Point</th>
<th>Interpolation Type</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOVVL</td>
</tr>
<tr>
<td>P1</td>
<td>Circular</td>
<td>MOVC</td>
</tr>
<tr>
<td>P2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P3</td>
<td>Circular</td>
<td>MOVC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FPT</td>
</tr>
<tr>
<td>P4</td>
<td>Circular</td>
<td>MOVC</td>
</tr>
<tr>
<td>P5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P6</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOVVL</td>
</tr>
</tbody>
</table>

<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**

<table>
<thead>
<tr>
<th>Point</th>
<th>Interpolation Type</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOVVL</td>
</tr>
<tr>
<td>P1</td>
<td>Spline</td>
<td>MOVS</td>
</tr>
<tr>
<td>P2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P4</td>
<td>Joint or Linear</td>
<td>MOVJ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOVVL</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Point Interpolation Type</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0 Joint or Linear</td>
<td>MOVJ MOVL</td>
</tr>
<tr>
<td>P1 to P5 Spline</td>
<td>MOVS</td>
</tr>
<tr>
<td>P6 Joint or Linear</td>
<td>MOVJ MOVL</td>
</tr>
</tbody>
</table>

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.

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 Fig.3-1 "Registering Move Instructions" or they can be done by inserting steps between already registered steps, as shown in 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.

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 3-31. 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.
3.2 Teaching Operation

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. Select the desired tool number.

– The contents of the currently-selected job is displayed.
3. Press [SHIFT] + [COORD].
   – The JOB CONTENT window appears.

Using Multiple Tools with One Manipulator

- When multiple tools are to be used with one manipulator, set parameter 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.
2. Press [SELECT].
   – The cursor moves to the input buffer line.
3. Move the cursor to the play speed to be set.
   – The joint speed moves up and down.
4. Press [SHIFT] + the cursor key [↑] or [↓] simultaneously.
5. Press [ENTER].
   – The MOV instruction is registered.

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

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 “*.”

- 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.”
3 Teaching

3.2 Teaching Operation

**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.

<table>
<thead>
<tr>
<th>Position Levels</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Teaching position</td>
</tr>
<tr>
<td>1 to 8</td>
<td>Fine, Rough</td>
</tr>
</tbody>
</table>

### Setting the Position Level

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

![DETAIL EDIT window](image)
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 Teaching Operation

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.

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.

   ![Timer Detail Edit Window](image)

   (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.
3. Teaching
3.2 Teaching Operation

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.

| 000.0 | MOV L Y1=102.00 |
| 000.2 | TIMER T=0005 |
| 000.5 | MXL X=130 |
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.

![Diagram showing the process of overlapping steps]

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, but when [INTERLOCK] + [FWD] are pressed, all instructions are executed.

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

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.

---

**NOTE**

For safety, set manual speed at or below.
3 Teaching
3.3 Checking Steps

- **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.
3 Teaching

3.3 Checking Steps

- 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”.
  \[
  \text{INCH} \quad \text{SLW} \quad \text{MED} \quad \text{FST}
  \]

- Each time [SLOW] is pressed, the speed switches in the order of “FAST”→“MED”→“SLOW”→“INCH”.
  \[
  \text{FST} \quad \text{MED} \quad \text{SLW} \quad \text{INCH}
  \]

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

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.

3.3.1.4 Test Operations

Playback operations can be simulated in 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 Play mode.

- 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**

**Job Example**

- NOP
- MOVL V=1500.0 \(\Rightarrow A\)
- MOVL V=1500.0 \(\Rightarrow B\)
- MOVL V=1500.0 \(\Rightarrow C\)

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.
3 Teaching
3.3 Checking Steps

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”.

- The setting of “MACHINE LOCK” is maintained even after the mode is switched: If the machine lock is set to “VALID” in Teach mode, it is still “VALID” after switching to Play mode.
  The same applies when the mode is switched from Play mode to 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

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

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

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

Move edit cursor to the TIMER instruction to be deleted.

Press [DELETE].

Press [ENTER].

Deletion completed.

Modifications

Move edit cursor to the TIMER instruction to be modified.

Press [TIMER].

Enter timer value.

Press [MODIFY].

Press [ENTER].

Modification completed.
3.4 Modifying Steps

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

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.
   - 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.
   - 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 inserted after the cursor line.
3.4 Modifying Steps

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.

    - **Before inserting the move instruction**
      
      | Step | Instruction |
      |------|-------------|
      | 0006 | MOV L V=276 |
      | 0007 | TIMER T=1.00 |
      | 0008 | DOUT OT#(1) ON |
      | 0009 | MOV J V=100.0 |

    - **After the insertion: when inserting before the next step**
      
      | Step | Instruction |
      |------|-------------|
      | 0006 | MOV L V=276 |
      | 0007 | MOV L V=558 |
      | 0008 | TIMER T=1.00 |
      | 0009 | DOUT OT#(1) ON |
      | 0010 | MOV J V=100.0 |

    - **After the insertion: when inserting after the cursor line**
      
      | Step | Instruction |
      |------|-------------|
      | 0006 | MOV L V=276 |
      | 0007 | MOV L V=558 |
      | 0008 | TIMER T=1.00 |
      | 0009 | DOUT OT#(1) ON |
      | 0010 | MOV J V=100.0 |

**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**
     
     | Step | Instruction |
     |------|-------------|
     | 0003 | MOV L V=138 |
     | 0004 | MOV L V=558 |
     | 0005 | MOV J V=50.00 |

   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.
Robotic Arc Welding  
Lincoln ARCLINK XT

3  Teaching  
3.4  Modifying Steps  

3. Press [ENTER].  
– The step indicated by cursor line is deleted.  

<table>
<thead>
<tr>
<th>Line</th>
<th>Instruction</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>0003</td>
<td>MOV L V=138</td>
<td></td>
</tr>
<tr>
<td>0004</td>
<td>MOV J VJ=50.00</td>
<td></td>
</tr>
</tbody>
</table>

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.  

*Supplement*

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} → {DISABLE UNDO} while editing a job.

- 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 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

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

**NOTE**
- 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.

2. Press [DELETE].
   - The key lamp will light.

3. Press [ENTER].
   - The timer instruction at the cursor line is deleted.

3.4.7.2 Modifying Timer Instructions

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

2. Press [TIMER].

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].

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 Modifying Jobs

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.

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 Arrow](Left) : The cursor is moved to the address area.
   - ![Right Arrow](Right): The cursor is moved to the instruction area.

### A. Address Area
Displays line numbers.

### B. Instruction Area
Displays instructions, additional items, and comments. Line editing is possible.
3.5 Modifying Jobs

3.5.4.1 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.
3.5.5 JOB CAPACITY Window

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

![Image of JOB CAPACITY window]

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.

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

### 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 Teach mode.

   ![Line before where instruction is to be added.]

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.
3-45

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3 Teaching
3.6 Editing Instructions

– <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.

![Data Type List](image)

(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 Teach mode.

   ![Image of instruction lines]

   The line to be deleted
   0024 MNOU V=00.00
   0025 MNOU V=00.00
   0026 MNOU T=010.00 ON

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.

   ![Image of lines moving up]

   The following lines move up.
   0024 MNOU V=00.00
   0025 MNOU V=100.00
   0026 MNOU T=010.00 ON

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 Teach mode.

   ![Image of instruction lines]

   Instruction line to be changed
   0024 MNOU V=00.00
   0025 MNOU V=00.00
   0026 MNOU T=010.00 ON
   0026 TIMER T=2.00

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

   ![Image of 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. Select the instruction to be modified.

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 cur-
sor key to increase or decrease the value.

        ![Image of cursor and numeric keys]

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

        (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 the selected 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.
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.
   - The selected line can now be edited.

3. Select the instruction.
   - The DETAIL EDIT window appears.

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.
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.
   – The selection dialog box appears.

4. Select the additional item to be inserted.
   – The additional item is inserted.
   – 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].

5. Select inserting additional item.
   – The DETAIL EDIT window closes, and the JOB CONTENT window appears.

6. Press [ENTER].
   – Contents of the input buffer line are registered on the cursor line of the instruction area.
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.
   - The selected line can be now be edited.

3. Select the instruction.
   - The DETAIL EDIT window appears.

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

5. Select "UNUSED."
   - "UNUSED" 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.
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.)

```
MOVL V=100 ;Move to at V=100
MOVL V=50 ;Move to at V=50
MOVL V=80 ;Move to at V=80
MOVL V=30 ;Move to at V=30
MOVL V=70 ;Move to at V=70
```

The speed and interpolation are different going and returning.

```
MOVL V=10 ;Move to at V=10
MOVL V=50 ;Move to at V=50
MOVL V=80 ;Move to at V=80
MOVL V=30 ;Move to at V=30
MOVL V=70 ;Move to at V=70
```

The speed and interpolation are the same going and returning.
3 Teaching
3.7 Editing Jobs

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Copy
Cut
Paste
Reverse paste

The buffer content is inserted.
Buffer content order is reversed and inserted.

MOVJ VJ=50.00
TIMER T=1.00
MOVL V=100

0000 NOP
0001 TEST JOB
0002 MOVJ VJ=50.00
0003 TIMER T=1.00
0004 MOVL V=100
0005 MOVL V=100

Copy
Cut
Paste
Reverse paste

The buffer content is inserted.
Buffer content order is reversed and inserted.

MOVJ VJ=50.00
TIMER T=1.00
MOVL V=100

0000 NOP
0001 TEST JOB
0002 MOVJ VJ=50.00
0003 TIMER T=1.00
0004 MOVL V=100
0005 MOVL V=100

Copy
Cut
Paste
Reverse paste

The buffer content is inserted.
Buffer content order is reversed and inserted.

MOVJ VJ=50.00
TIMER T=1.00
MOVL V=100

0000 NOP
0001 TEST JOB
0002 MOVJ VJ=50.00
0003 TIMER T=1.00
0004 MOVL V=100
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 cancelled.
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 cancelled.
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 cancelled.
3.8 Test Operations

Playback operations can be simulated in 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 Play mode:

- Operation speeds greater than the maximum teaching speed are reduced to the maximum teaching speed.
- Only machine lock is available among special operations for playback in 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.

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.)

```
0005 MOVJ VJ=25.00
0006 MOVL V=138
0007 MOVJ VJ=50.00
```

![Example of VJ change](image)

Only VJ is changed to 100.

```
0005 MOVJ VJ=100.00
0006 MOVL V=138
0007 MOVJ VJ=100.00
```

<table>
<thead>
<tr>
<th>Type of Play Speed</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>VJ</td>
<td>Joint Speed</td>
</tr>
<tr>
<td>V</td>
<td>TCP Speed</td>
</tr>
<tr>
<td>VR</td>
<td>Posture Angle Speed</td>
</tr>
<tr>
<td>VE</td>
<td>Base Axis Speed</td>
</tr>
</tbody>
</table>

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.

```
0005 MOVJ VJ=125.00
0006 MOVL V=138
0007 MOVJ VJ=150.00
```

![Example of relative modification](image)

Speed is doubled.

```
0005 MOVJ VJ=50.00
0006 MOVL V=276
0007 MOVJ VJ=100.00
```

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.

   • 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.

      ![Limited to maximum speed message]

   ![NOTE]

   ![Limited to maximum speed message]
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=9000 cm/min
     (e.g.)
     Joint Speed: 50% = Linear Speed: 4500 cm/min
     Linear Speed: 10% = Linear Speed: 900 cm/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.

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>
<thead>
<tr>
<th>Data Format</th>
<th>Variable No. (pcs)</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byte Type</td>
<td>B000 to B099 (100)</td>
<td>Range of storable values is from 0 to 255. Can store I/O status. Can perform logical operations (AND, OR, etc.)</td>
</tr>
<tr>
<td>Integer Type</td>
<td>1000 to 1099 (100)</td>
<td>Range of storable values is from -32768 to 32767.</td>
</tr>
<tr>
<td>Double Precision Integer Type</td>
<td>D000 to D099 (100)</td>
<td>Range of storable values is from -2147483648 to 2147483647.</td>
</tr>
<tr>
<td>Real Type</td>
<td>R000 to R099 (100)</td>
<td>Range of storable values is from -3.4E+38 to 3.4E38. Accuracy: 1.18E-38 &lt; x ≤ 3.4E38</td>
</tr>
<tr>
<td>Character Type</td>
<td>S000 to S079 (80)</td>
<td>Maximum storable number of characters is 16.</td>
</tr>
<tr>
<td>Position Type</td>
<td>P000 to P127 (128)</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>BP000 to BP127 (128)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EX000 to EX127 (128)</td>
<td></td>
</tr>
</tbody>
</table>

1 B080 - B083 are reserved for Lincoln Arclink interface. They are labeled on the pendant as "Rx FEEDER SELECT"
2 S080 - S099 are reserved for system applications. These are labeled on the pendant.
3.9 Other Job-editing Functions

### 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.)

#### Play Speed V:

MOV L V=I000
The variable 1000 is used for speed V with this move instruction.
The unit for V is 0.1 mm per second.
For example, if I000 were set as 1000, the following would be true:
I000=1000 \( \rightarrow \) unit for V is 0.1 mm/s \( \rightarrow \) V=100.0 mm/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:

MOV L VJ=I000
The unit for VJ is 0.01%.
For example, if I000 were set as 1000, the following would be true:
I000=1000 \( \rightarrow \) unit for VJ is 0.01% \( \rightarrow \) VJ=10.00%.

#### Timer T:

TIMER T=I000
The unit for T is 0.01 seconds.
For example, if I000 were set as 1000, the following would be true:
I000=1000 \( \rightarrow \) unit for T is 0.01 seconds \( \rightarrow \) T=10.00 seconds.
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} \(\rightarrow\) {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.

5. Input name.

6. Press [ENTER].
   - The variable name is registered.

Refer to Section 1.2.6 “Character Input Operation” on page 1-18 for the character input operation.
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. Press the page key \(\text{PAGE}\) or \([\text{SHIFT}] + \text{page key}\) .
   - When the desired variable number is not displayed, move the cursor with either of the following operations.
     - Press \[\text{DIRECT PAGE}\]. Then input the variable No. using the Numeric keys and press \[\text{ENTER}\].
     - Move the cursor to the menu area and select \{}EDIT\} 
       \(\rightarrow\) \{SEARCH\}. Then input the variable No. with the Numeric keys and press \[\text{ENTER}\].

Move to desired variable number page.
### Setting Position Variables

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

- The setting of position variables is done in 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**

<table>
<thead>
<tr>
<th>Type</th>
<th>Pxxx (Robot)</th>
<th>BPxxx (Base)</th>
<th>EXxxx (Station)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pulse Type</td>
<td>XYZ Type</td>
<td>Pulse Type</td>
</tr>
<tr>
<td>Setting Method</td>
<td>Select coordinates from base, robot, user, tool.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Using the numeric keys</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Using the axis keys</td>
</tr>
</tbody>
</table>

---

3.9.4.5 Setting Position Variables
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.)

![Position Variable Window](image)

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.
3.9 Other Job-editing Functions

**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 3-79. 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 Teaching

3.9 Other Job-editing Functions

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.
3. Press [FWD].
   – Selected axis moves to the position specified by the variable.
(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.

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.

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 Teaching
3.9.5 Flip/No Flip

When the angle of B-axis is within (+) range ($\theta_B \geq 0^\circ$), it is called "Flip", and when within (-) range ($\theta_B < 0^\circ$), "No Flip."

\[ \theta_B \geq 0^\circ \quad \text{Flip} \]
\[ \theta_B < 0^\circ \quad \text{No Flip} \]

3.9.6 R-axis Angle

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

<table>
<thead>
<tr>
<th>$R &lt; 180^\circ$</th>
<th>$R \geq 180^\circ$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0^\circ$</td>
<td>$0^\circ$</td>
</tr>
<tr>
<td>$-180^\circ$</td>
<td>$360^\circ$</td>
</tr>
<tr>
<td>$180^\circ$</td>
<td>$-360^\circ$</td>
</tr>
</tbody>
</table>

$-180 < \theta R \leq 180 \quad 180 < \theta R \leq 360, -360 < \theta R \leq -180$

**Note:** $0^\circ$ R is the angle when the R-axis home position is $0^\circ$. 
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°.

<table>
<thead>
<tr>
<th>T &lt; 180°</th>
<th>T ≥ 180°</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
<td>0°</td>
</tr>
<tr>
<td>-180° ≤ T ≤ 180°</td>
<td>180° ≤ T ≤ 360°, -360° ≤ T ≤ -180°</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>S-axis 0°</th>
<th>S-axis 180°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back</td>
<td>Front</td>
</tr>
<tr>
<td>Front</td>
<td>Back</td>
</tr>
</tbody>
</table>

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.

Right-hand side

<table>
<thead>
<tr>
<th>Upper Arm</th>
<th>Lower Arm</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Upper Arm Diagram" /></td>
<td><img src="image2.png" alt="Lower Arm Diagram" /></td>
</tr>
</tbody>
</table>

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°.

<table>
<thead>
<tr>
<th>S &lt; 180°</th>
<th>S ≥ 180°</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="S-angle Diagram" /></td>
<td><img src="image4.png" alt="S-angle Diagram" /></td>
</tr>
</tbody>
</table>

-180° < θ S ≤ 180°  
180° < θ S ≤ 360°  
-360° < 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

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

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

• **Used in One Job Only**
  
  With user variables it is possible to define and use one variable in multiple jobs, but local variables are used only in the 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.
3 Teaching
3.9 Other Job-editing Functions

- **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.

---

**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 3-6B.
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.

Only when expanding the "INSTRUCTION LEVEL," it is possible to use local variables. Refer to section "8.12 Instruction Level Setting" of "DX100 INSTRUCTIONS" (162536-1CD) 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.

   ![Image 1]

   2. Input desired line number.

   ![Image 2]

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

   ![Image 3]
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} \(\rightarrow\) {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} \rightarrow {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.

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 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.

  ![Image 1](image1)

  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.

![Image 2](image2)
3. Press [SELECT].
   – The selection dialog box appears.

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

![Image of operation cycle selection process]

- **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}.
4.1 Preparation for Playback

– The OPERATING CONDITION window appears. Use the cursor to scroll the screen.

3. Select the desired operation.

– The selection dialog box appears.

“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 Play mode.
4  Playback
4.1 Preparation for Playback

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

4.2.1 Playback Operation

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.

<table>
<thead>
<tr>
<th>Mode Switch on Programming Pendant</th>
<th>Job is started up by</th>
</tr>
</thead>
<tbody>
<tr>
<td>[PLAY]</td>
<td>[START] button on programming pendant</td>
</tr>
<tr>
<td>[REMOTE]</td>
<td>Peripheral device</td>
</tr>
</tbody>
</table>

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 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. Low speed operation is also cancelled if the manipulator is manually stopped during the low speed operation.

After one step operation or any stop of manipulator during low speed 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 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.

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.

---

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.

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.
    - 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

Robot stops by P.P. emergency stop

#### Using the External Input Signal (System Input)

Robot stops by external emergency stop

### 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 Play mode is switched to Teach mode during playback, the manipulator stops immediately.

To restart the operation, return to 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.

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 Modifying Play Speed

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 cancelled.

   **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 cancelled 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 Cancelling 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 cancelled.
   - If cancelled, the speed ratio setting is not displayed on the PLAYBACK window.

   **NOTE**
   The speed override settings are automatically cancelled in the following cases:
   - When dry-run speed operation is set.
   - When the mode is changed to any mode other than 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."
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.

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.

This operation can be performed while in Teach mode and security mode is 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. Playback

4.5 Playback with Reserved Start

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

   ![Image of RESERVE START (JOB) window]

4.5.1.3 Registering Jobs to Stations

Register the starting job of each station.

This operation can be done only when the operation mode is Teach mode and the setting of "RESERVED START JOB CHANGE" is "PERMIT" in the OPERATING CONDITION window.

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 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.

   **SUPPLEMENT**
   Reservations are cancelled 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.

   ![Reservation Status Window]

   **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.

3. Select “YES.”

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

[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.
   - 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.

■ 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.

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.

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.

**Job calls can be used for up to 12 stack levels.**
4 Playback
4.6 Displaying Job Stack

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

**NOTE** Edit operations are restricted when the edit lock is applied.

### Editing Move Instructions

See Chapter 3 "Teaching" on page 3-1 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 3-26 for details.

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

  **NOTE**

  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.

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.
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 cancelled.

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.
5. Editing Jobs

5.1 Copying Jobs

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.

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 cancelled.

See Section 1.2.6 “Character Input Operation” on page 1-18 for information on letter input operations.
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 cancelled.
5.2 Deleting Jobs

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\} \(\rightarrow\) \{SELECT JOB\} under the main menu.
   - The JOB LIST window appears.

2. Move the cursor to the job to be deleted.

3. Select \{JOB\} \(\rightarrow\) \{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 cancelled and the JOB LIST window appears.

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.

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 cancelled.

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.
5. Editing Jobs

5.3 Modifying Job Names

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.

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 cancelled.
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.

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 cancelled 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 “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 COND}.
   - The TEACHING CONDITION SETTING window appears.

   ![TEACHING CONDITION SETTING window]

   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
6 Convenient Functions
6.1 One-touch Operation “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 Parallel Shift Function

6.2.1 Function Overview

Parallel shift refers to the shifting of an object from a fixed position in such a way that all points within the object move an equal distance. In the model for parallel shift shown in the following, the shift value can be defined as the distance L (three-dimensional coordinate displacement). The parallel shift function is relevant to the actual operation of the manipulator because it can be used to reduce the amount of work involved in teaching by shifting a taught path (or position.)

In the example in the figure below, the taught position A is shifted in increments of the distance L (this is actually a three-dimensional XYZ displacement that can be recognized by the robot) in order to enable the operation that was taught at position A to also be performed at positions B through G.

6.2.1.1 Parallel Shift of Step

The block from the SFTON to the SFTOF instructions is subject to the shift operation.
6.2.1.2 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.
6.2.2 Setting the Shift Value

6.2.2.1 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.

6.2.2.2 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.
6.2.3 Registering Shift Instructions

To register the instruction, move the cursor to the address area in the JOB CONTENT window during teach mode as follows:

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

– The JOB CONTENT window appears.

3. Move the cursor to the address area.

6.2.3.1 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.

   Line immediately before where SFTON instruction is to be registered.

   |   |   |   |   |   |
   |   |   |   |   |   |
   |   |   |   |   |   |
   |   |   |   |   |   |
   | 0020 | MOV V=138 |
   | 0021 | MOV V=138 |
   | 0022 | MOV V=138 |

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.
6 Convenient Functions
6.2 Parallel Shift Function

- **<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.

  ![Image](image1.png)

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

  ![Image](image2.png)

  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.

  ![Image](image3.png)

  - 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].

  ![Image](image4.png)
6 Convenient Functions

6.2 Parallel Shift Function

- 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.

---

6.2.3.2 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.

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.

5. Press [INSERT] and then [ENTER].
- The SFTOF instruction is registered.

---

6.2.3.3 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.

```
0003 MOVJ VJ=10.00
0004 GETS PX001 $PX000
0005 END
```

Line immediately before where MSHIFT instruction is 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 posi-
     tion 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.
     • 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.
6. Convenient Functions

6.2 Parallel Shift Function

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.

<table>
<thead>
<tr>
<th>Line where MSHIFT is registered.</th>
<th>0003 MOVJ VJ=10.00</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0004 GETS PX001 $PX000</td>
</tr>
<tr>
<td></td>
<td>0005 MSHIFT PX000 RF PX001 PX002</td>
</tr>
</tbody>
</table>
6.2.4 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.
6.2.5 Examples of Use

6.2.5.1 Example of Use of Shift Addition/Subtraction

Table 6-1: Workpiece Stacking Operation

<table>
<thead>
<tr>
<th>Line</th>
<th>Instruction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>SET B000 0</td>
<td>Make the first shift value zero.</td>
</tr>
<tr>
<td>0002</td>
<td>SUB P000 P000</td>
<td></td>
</tr>
<tr>
<td>0003</td>
<td>*A</td>
<td></td>
</tr>
<tr>
<td>0004</td>
<td>MOVJ</td>
<td>Step 1</td>
</tr>
<tr>
<td>0005</td>
<td>MOVL</td>
<td>Step 2</td>
</tr>
<tr>
<td>0006</td>
<td>'Gripping workpiece</td>
<td></td>
</tr>
<tr>
<td>0007</td>
<td>MOVL</td>
<td>Step 3</td>
</tr>
<tr>
<td>0008</td>
<td>MOVL</td>
<td>Step 4</td>
</tr>
<tr>
<td>0009</td>
<td>SFTON P000 UF#(1)</td>
<td>Shift start</td>
</tr>
<tr>
<td>0010</td>
<td>MOVL</td>
<td>Shift position Step 5</td>
</tr>
<tr>
<td>0011</td>
<td>'Releasing workpiece</td>
<td></td>
</tr>
<tr>
<td>0012</td>
<td>SFTOF</td>
<td>Shift end</td>
</tr>
<tr>
<td>0013</td>
<td>ADD P000 P001</td>
<td>Add the shift value for the next operation.</td>
</tr>
<tr>
<td>0014</td>
<td>MOVL</td>
<td>Step 6</td>
</tr>
<tr>
<td>0015</td>
<td>MOVL</td>
<td>Step 7</td>
</tr>
<tr>
<td>0016</td>
<td>INC B000</td>
<td></td>
</tr>
<tr>
<td>0017</td>
<td>JUMP *A IF B00&lt;6</td>
<td></td>
</tr>
<tr>
<td>0018</td>
<td>SFTON P000 UF#(1)</td>
<td>Since the shift data is retained in memory, the same data can be used (with subtraction instead of addition) to perform a workpiece unloading operation.</td>
</tr>
</tbody>
</table>

Since the shift data is retained in memory, the same data can be used (with subtraction instead of addition) to perform a workpiece unloading operation.
6.2.5.2 Example of Use of MSHIFT Instruction

<table>
<thead>
<tr>
<th>Line</th>
<th>Instruction</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>MOVJ VJ=20.00</td>
<td>Move the manipulator to the reference position.</td>
</tr>
<tr>
<td>0002</td>
<td>GETS PX000 $PX000</td>
<td>Set the reference position as position variable P000.</td>
</tr>
<tr>
<td>0003</td>
<td>MOVJ VJ=20.00</td>
<td>Move the manipulator to the target position.</td>
</tr>
<tr>
<td>0004</td>
<td>GETS PX001 $PX000</td>
<td>Set the target position as position variable P001.</td>
</tr>
<tr>
<td>0005</td>
<td>MSHIFT PX010 BF PX000 PX001</td>
<td>Set shift value and set it as position variable P010.</td>
</tr>
<tr>
<td>0006</td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>
6.3 Parallel Shift Job Conversion Function

6.3.1 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.

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.
6.3.2 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.

Table 6-2: Relationship Between Group Combinations and Coordinates at Conversion

<table>
<thead>
<tr>
<th>Group Combination in Job</th>
<th>Explanation</th>
<th>Usable Coordinate System</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>Shift is performed on the basis of selected coordinates.</td>
<td>Base coordinates, robot coordinates, tool coordinates, user coordinates, pulse coordinates</td>
</tr>
<tr>
<td>R(B)</td>
<td>Shift is performed on the basis of selected coordinates.</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Pulse Coordinates: The taught position of each axis is shifted by the specified amount on the basis of pulse values.</td>
</tr>
<tr>
<td>S</td>
<td>Shift is performed on the basis of pulse values regardless of the coordinates.</td>
<td></td>
</tr>
</tbody>
</table>
### 6.3 Parallel Shift Job Conversion Function

#### Table 6-2: Relationship Between Group Combinations and Coordinates at Conversion

<table>
<thead>
<tr>
<th>Combination</th>
<th>Description</th>
<th>Coordinates</th>
</tr>
</thead>
<tbody>
<tr>
<td>R+S</td>
<td>The manipulator is shifted in the selected coordinates. The station axis is shifted on the basis of pulse values regardless of the coordinates.</td>
<td>Base coordinates, robot coordinates, tool coordinates, user coordinates, pulse coordinates</td>
</tr>
<tr>
<td>R(B)+S</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>R+R</td>
<td>Two manipulators are shifted in the selected coordinates.</td>
<td>Base coordinates, robot coordinates, tool coordinates, user coordinates, master tool coordinates ¹, pulse coordinates</td>
</tr>
<tr>
<td>R(B)+R(B)</td>
<td>Two manipulators are shifted in the selected coordinate system, as in 1 to 5 above. Two base axes are also shifted.</td>
<td></td>
</tr>
</tbody>
</table>

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.

![Diagram](image_url)
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).
6.3.3 Executing the Parallel Shift Job Conversion

6.3.3.1 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 \(\rightarrow\) 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.

6.3.3.2 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.

The method using position variables by parameter setting is described in Section 6.3.4 “Specifying the Shift Value by Position Variables” on page 6-28 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.

   ![Image of PARALLEL SHIFT JOB window]

7. Type the shift value using the Numeric keys.

8. Press [ENTER].
   – The shift value is set.

   ![Image of PARALLEL SHIFT JOB window]

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.
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6.3 Parallel Shift Job Conversion Function

12. Press [MODIFY] and [ENTER].

– The conversion base point is set.

![Base Point Input Screen]

13. Touch “EXECUTE.”

– The difference is calculated by the two teaching points and set as a shift value.

![Parallel Shift Job Conversion Screen]
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.

NOTE
6.3.4 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

6.3.4.1 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 con-
   verted.
   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 6.3.4.2 “Jobs Tar-
   geted for Conversion”.
6 Convenient Functions

6.3 Parallel Shift Job Conversion Function

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 6.3.4.3 “Conversion of Coordinated Jobs” on page 6-30.

6.3.4.2 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 JOBS

\[\text{SELECTED JOB (EDIT JOB)}\] Converted

Related jobs are not converted.
6.3 Parallel Shift Job Conversion Function

- Related Job Conversion
  Both the selected job and all the related jobs (the jobs called by JUMP or CALL instructions) are converted.

6.3.4.3 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](image-url)
6 Convenient Functions

6.3 Parallel Shift Job Conversion Function

**Individual Shift**
Each manipulator (or each base, or each station) is converted separately by different shift values.

Coordinated job with R1+R2
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6.3 Parallel Shift Job Conversion Function

**Variables used in an individual shift**

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.
6. Convenient Functions

6.3 Parallel Shift Job Conversion Function

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.

   ![Diagram of variables and jobs for conversion in an individual shift]

• Job with \( R \square (+ S\square) \)
  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.

6.3.4.4 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 3-68.

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.
6.3 Parallel Shift Job Conversion Function

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.
6.4 PAM Function

6.4.1 Function Overview

The function for position adjustment during playback (PAM: Position Adjustment by Manual) allows position adjustment by simple operations while observing the motion of the manipulator and without stopping the manipulator. Positions can be adjusted in both teach mode and play mode.

The following data can be adjusted by key input from the programming pendant.

- Teaching Point (Position)
- Teaching Point (Posture angle)
- Operation Speed
- Position Level

6.4.1.1 Input Ranges for Adjustment Data

The input ranges for adjustment data are indicated in the following table.

<table>
<thead>
<tr>
<th>Data</th>
<th>Input Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Steps for Adjustment</td>
<td>Up to 10 steps can be adjusted at the same time.</td>
</tr>
<tr>
<td>Position Adjustment Range (X, Y, Z)</td>
<td>Unit: mm, valid to two decimal places, maximum ±10 mm</td>
</tr>
<tr>
<td>Posture Angle Adjustment Range (Rx, Ry, Rz)</td>
<td>Unit: deg, valid to two decimal places, maximum ±10 deg</td>
</tr>
<tr>
<td>Speed Adjustment Range (V)</td>
<td>Unit: %, valid to two decimal places, maximum ±50%</td>
</tr>
<tr>
<td>PL Adjustment Range</td>
<td>0 to 8</td>
</tr>
<tr>
<td>Adjustment Coordinates</td>
<td>Robot coordinates, base coordinates, tool coordinates, user coordinates (Default coordinates: robot coordinates)</td>
</tr>
</tbody>
</table>

The input ranges for adjustment data can be changed by the following parameters:

- S3C1098: Position adjustment range (unit: 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" on page 8-1.
6.4.2 Operating Methods

6.4.2.1 Setting Adjustment Data

1. Select {JOB} under the main menu.

2. Select {JOB}.
   - The JOB CONTENT window (in 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.

   • 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.
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6.4 PAM Function

- **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].
6.4.2.2 Executing the Adjustment

- Executing the Adjustment

1. Touch “COMPLETE” on the screen.
   - The confirmation dialog box appears.

2. Select “YES.”
   - In Teach mode, the job adjustment can be immediately executed. In 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 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.
6 Convenient Functions
6.4 PAM Function

■ 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.

![Pull-down menu image]

3. Select {UNDO} under the pull-down menu.
   – The confirmation dialog box appears.

![Confirmation dialog box]

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.”
6.5 Mirror Shift Function

6.5.1 Function Overview

With the mirror shift function, a job is converted to the job in which the path is symmetrical to that of the original job. This conversion can be performed for the specified coordinate among the X-Y, X-Z, or Y-Z coordinate of the robot coordinates and the user coordinates.

The mirror shift function is classified into the following three: the pulse mirror-shift function, the robot-coordinates mirror-shift function, and the user-coordinates mirror-shift function.

![Mirror Shift Diagram]

The original path before the mirror shift

The converted path after the mirror shift

6.5.2 Pulse Mirror-shift Function

With the pulse mirror-shift function, the mirror shift is performed by reversing the sign (+/-) for the axes which are specified with the parameter in advance.

![Pulse Mirror-shift Diagram]
6.5 Mirror Shift Function

6.5.2.1 Parameter Setting

Using the following parameter, specify the axes for which the sign is to be reversed.

S1CxG065: Mirror Shift Sign Reversing Axis Specification

The 1st axis (0: Not reversed, 1: Reversed)

The 6th axis

6.5.2.2 Object Job

Jobs without group axes and relative jobs cannot be converted.

6.5.2.3 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

6.5.2.4 Position Variables

Position variables are not converted by the mirror shift function.
## 6.5.3 Robot-coordinates Mirror-shift Function

With the robot-coordinates mirror-shift function, the mirror shift is performed on the X-Z coordinate of the robot coordinates.

### 6.5.3.1 Object Job

Jobs without group axes cannot be converted.

### 6.5.3.2 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

### 6.5.3.3 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."
6.5.4 User-coordinates Mirror-shift Function

With the user-coordinates mirror-shift function, the mirror shift is performed on the X-Z, X-Y, or Y-Z coordinate of the specified user coordinates.

6.5.4.1 Object Job

Jobs without group axes cannot be converted.

6.5.4.2 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

6.5.4.3 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."
6.5.5 Notes on the Mirror Shift Function

For manipulators, such as a polishing wrist, whose center of S-axis rotation and T-axis rotation are offset in the X-coordinate direction, the mirror shift cannot correctly be performed by the pulse mirror-shift function. Be sure to use the robot-coordinates mirror-shift function or use the user-coordinates mirror-shift function with the user coordinates specified on the center of the T-axis rotation.

(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
6.5.6 Operation Procedures

6.5.6.1 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.

6.5.6.2 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.

6.5.6.3 Explanation of the Mirror Shift Window

![Mirror Shift Window Diagram]

- **A** SOURCE JOB
- **B** SOURCE CTRL GROUP
- **C** STEP SECTION
- **D** DESTINATION JOB
- **E** DESTINATION CTRL GROUP
- **F** COORDINATES
- **G** USER LAMP NO.
- **H** TARGET
- **I** EXECUTE CANCEL

[Diagram of Mirror Shift Window with labels and options]
6 Convenient Functions
6.5 Mirror Shift Function

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.
6.6 Multi Window Function

6.6.1 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.

![Image of multi window function]

6.6.2 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.

![Image of dividing patterns]

<table>
<thead>
<tr>
<th>Number of the window</th>
<th>Dividing Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 window</td>
</tr>
<tr>
<td>2</td>
<td>2 windows</td>
</tr>
<tr>
<td>3</td>
<td>2 windows</td>
</tr>
<tr>
<td>4</td>
<td>3 windows</td>
</tr>
</tbody>
</table>
### 6.6. Multi Window Function

**Table 6-3: Display the dividing Pattern (Sheet 2 of 2)**

<table>
<thead>
<tr>
<th>Number of the window</th>
<th>Dividing Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 3 windows</td>
<td>![Pattern 1]</td>
</tr>
<tr>
<td>6 3 windows</td>
<td>![Pattern 2]</td>
</tr>
<tr>
<td>7 4 windows</td>
<td>![Pattern 3]</td>
</tr>
</tbody>
</table>

**6.6.2.1 Calling Up and Operating Methods of the Display Dividing Pattern Setting Window**

Call up the dividing pattern setting window.

1. Select [DISPLAY SETUP] - [CHANGE WINDOW PATTERN] under the main menu.

   ![Display Setup Menu]

2. Dividing pattern setting window appears in the center of the display.

   ![Dividing Pattern Setting Window]

---

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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 pattern 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.

The cursor moves by pressing [AREA] key in the dividing pattern setting window.
6.6.3 Displaying the Multi Window

6.6.3.1 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.

6.6.3.2 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.

6.6.3.3 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.
6.6.3.4 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.

6.6.4 Operation of Multi Window

6.6.4.1 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.
6. Convenient Functions

6.6 Multi Window Function

   - The general-purpose display area changes to already set pattern in multi window mode.

6.6.4.2 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.
6 Convenient Functions

6.6 Multi Window Function

2. Key Operation:
Press [MULT] key

– The window to be active shifts. The active window shifts in the order mentioned in Section 6.6.2 "Setting the Dividing Pattern of the General-Purpose Display Area" on page 6-50.

1\rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 1 \cdots \cdots)

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 6.6.2 “Setting the Dividing Pattern of the General-Purpose Display Area” on page 6-50. (1→2→3→4→1······)

6.6.5 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 [MULT] key operation or touching operation when switching the active window is notified to the user.

The change of the control group for axis operation due to other than [MULT] key operation or touching operation; due to the switch of the window by selecting main menu, is not notified to the user.
6.6.5.1 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.
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.

<table>
<thead>
<tr>
<th>Device</th>
<th>Function</th>
<th>Media (destination of saved/ loaded data)</th>
<th>Optional function requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF: Pendant</td>
<td>Standard</td>
<td>Compact Flash Card (CF card)</td>
<td>No requirement. Programming pendant is equipped with a slot.</td>
</tr>
<tr>
<td>USB: Pendant</td>
<td>Standard</td>
<td>USB Memory Stick</td>
<td>No requirement. Programming pendant is equipped with a slot.</td>
</tr>
<tr>
<td>FC1</td>
<td>Option 1)</td>
<td>2DD floppy disk, personal computer (FC1 emulator)</td>
<td>&quot;FC1&quot; or personal computer with &quot;FC1 emulator&quot;</td>
</tr>
<tr>
<td>FC2</td>
<td>Option 1)</td>
<td>2DD floppy disk, 2HD floppy disk</td>
<td>&quot;FC2&quot;</td>
</tr>
<tr>
<td>PC</td>
<td>Option 1)</td>
<td>Personal computer (MOTOCOM32 host)</td>
<td>Via RS-232C: &quot;Data transmission function&quot; and &quot;MOTOCOM32&quot; Via Ethernet: &quot;Ethernet function&quot; plus above two requirements</td>
</tr>
<tr>
<td>FTP</td>
<td>Option 1)</td>
<td>FTP server such as personal computer</td>
<td>&quot;Data transmission function&quot;, &quot;MOTOCOM32&quot;, and &quot;FTP function&quot;</td>
</tr>
</tbody>
</table>

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

Recommended products used for external memory of DX100 are listed below. Model numbers are subject to be updated due to termination of product and new addition. Contact Yaskawa representative when necessary.

<table>
<thead>
<tr>
<th>No.</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hagiwara Sys-Com</td>
<td>MCF10P-256MS (IOOA II-YE2)</td>
<td>256MB</td>
</tr>
<tr>
<td>2</td>
<td>Hagiwara Sys-Com</td>
<td>MCF10P-512MS</td>
<td>(512MB)</td>
</tr>
<tr>
<td>3</td>
<td>Hagiwara Sys-Com</td>
<td>MCF10P-A01GS</td>
<td>(1GB)</td>
</tr>
<tr>
<td>4</td>
<td>Hagiwara Sys-Com</td>
<td>MCF10P-A02GS</td>
<td>(2GB)</td>
</tr>
<tr>
<td>5</td>
<td>AiliconSystem</td>
<td>SSD-C25M3512</td>
<td>&quot;xxMB&quot; denotes memory size (up to 2GB).</td>
</tr>
</tbody>
</table>
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.
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7 External Memory Devices
7.1 Memory Devices

*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

Recommended products used for external memory of DX100 are listed below. Model numbers are subject to be updated due to termination of product and new addition. Contact Yaskawa Motoman representative when necessary.

<table>
<thead>
<tr>
<th>No.</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hagiwara Sys-Com</td>
<td>UDG3-GA Series</td>
<td>1GB or 2GB</td>
</tr>
</tbody>
</table>

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.
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.”

*1: “3. BATCH USER MEMORY” includes “1. JOB” and “2. FILE/GENERAL DATA.”

*2: “PARAMETER BATCH” includes all “4. PARAMETER.”


*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.
### Table 7-1: Data List (Sheet 1 of 2)

<table>
<thead>
<tr>
<th>Data Classification</th>
<th>File Name (Saved Data)</th>
<th>Save OPN</th>
<th>Save EDIT</th>
<th>Save MAN</th>
<th>Load OPN</th>
<th>Load EDIT</th>
<th>Load MAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. ALL CMOS AREA</td>
<td>ALCMSxx.HEX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. BATCH CMOS</td>
<td>CMOSxx.HEX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. BATCH USER MEMORY</td>
<td>JOBxx.HEX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. JOB</td>
<td>Single job</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Related job</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Job+Condition)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 FILE/GENERAL DATA</td>
<td>Tool data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Weaving data</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>User coordinate data</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Variable data</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Arc start condition data</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Arc end condition data</td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Welding condition</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>auxiliary data</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Power source</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>characteristic data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power source</td>
<td></td>
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</tbody>
</table>

* 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.

Fig. 7-3: Example of JOB

![Example of JOB](image1)

Fig. 7-4: Example of FILE/GENERAL DATA

![Example of FILE/GENERAL DATA](image2)

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”
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 Operation Flow

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: 64 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.”

7.3.0.2 Saving Data

To download data from the memory of the DX100 to the external memory device, perform the following procedure.

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.
7 External Memory Devices

7.3 Operation Flow

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.
7.3 Operation Flow

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.

Supplement

“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.
7. External Memory Devices

7.3 Operation Flow

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.
7 External Memory Devices

7.3 Operation Flow

Saving All Data in CMOS Area

1. Select {FD/PC CARD} under the main menu.
2. Select {SAVE}.
   - The following window appears.
   ![External Memory Device Menu]
3. Move the cursor to {ALL CMOS AREA} and select.
4. Select "EXECUTE."
   - The confirmation dialog box appears.
   ![Confirmation Dialog]
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.

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.

**NOTE**

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.
7 External Memory Devices

7.3 Operation Flow

### 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.
7.3 Operation Flow

**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 "★.

```
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<tr>
<td>MOTION CTRL PRMTR</td>
<td>AMR</td>
</tr>
<tr>
<td>SERVO POWER BLOCK PRMTR</td>
<td>SVP</td>
</tr>
</tbody>
</table>
```

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.

```
<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/O DATA</td>
<td>50</td>
</tr>
<tr>
<td>FILE/GENERAL DATA</td>
<td>5</td>
</tr>
<tr>
<td>BATCH USER MEMORY</td>
<td>1</td>
</tr>
<tr>
<td>PARAMETER</td>
<td>7</td>
</tr>
</tbody>
</table>
```

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.
7 External Memory Devices

7.3 Operation Flow

- Loading All User’s Programs

1. Select (FD/IPC 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.

This function cannot be executed with “BATCH USER MEMORY,” “BATCH CMOS,” or “ALL CMOS AREA” specified.
7.3 Operation Flow

### Verifying a Job

1. Select {FD/PC CARD} under the main menu.
2. Select {VERIFY}.
   - The following window appears.

   ![Verifying a Job Window]

3. Select {JOB}.
   - The job selection window appears.

   ![Job Selection Window]
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.
7.3 Operation Flow

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.
7-39

7  External Memory Devices
7.3  Operation Flow

■ 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.

   ![External Memory Device Screen](image1)

   *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 Teach mode or remote mode.

Parameter according to Interference Area
Limits the P-point maximum envelope of the manipulator or sets the interference area for axis interference or cubic interference.

Parameter according to Status I/O
Sets the parity check or I/O setting for user input/output signals.

Parameter according to Coordinated or Synchronized Operation
Makes the settings for coordinated or synchronized operations between manipulators or between manipulators and stations.

Parameter for Other Functions or Applications
Makes the settings for other functions or applications.

Hardware Control Parameter
Makes the hardware settings for fan alarm or relay operation, etc.

S1CxG Parameters
The initial setting of S1CxG parameters depends on the manipulator model.
For a system in which two manipulators are controlled, the following two types of parameters are used: S1C1G type and S1C2G type.
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 Parameter

8.2 Motion Speed Setting Parameters

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 Motion Speed Setting Parameters

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)

If the value set for S1CxG031 or S1CxG032 is too small, the inching operation does not proceed.

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

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.

This process becomes effective when change in direction of steps is between 25° and 155°.

Position Level

Position levels are divided into nine stages of 0 to 8 with the “MOV” instruction.

\[ \text{e.g. MOVL V=500 PL=1 (PL: Position Level)} \]

The functions at each level are as follows:

0: Complete positioning to the target point
1 to 8: Inward turning operation

Following are explanations of the respective processing details and their relations with the parameter.

- **Level 0**
  
  Determines positioning completion when the amount of deviation (number of pulses) to the target point of each axis comes within the position set zone specified by the parameter.
  
  After the positioning completes, the instruction system starts instruction to the next target point.

- **Level 1 to 8**
  
  Recognizes virtual positioning before the target point. The distance of the virtual target position from the target point is specified at the positioning level.
  
  Distance data corresponding to each level are set in the parameter. Determination of the virtual target position is carried out in the instruction system.
  
  Set zone: The zone of each positioning level set in the parameter. (\(\mu\text{m}\))
8.2 Motion Speed Setting Parameters

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*
8 Parameter
8.2 Motion Speed Setting Parameters

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

<table>
<thead>
<tr>
<th>Parameter Setting Value</th>
<th>Movement When Restarting</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Move to next step.</td>
</tr>
<tr>
<td></td>
<td>Emergency stop</td>
</tr>
<tr>
<td></td>
<td>Movement when restarting</td>
</tr>
<tr>
<td>1</td>
<td>After moving back to the deviated position, move to the indicated step.</td>
</tr>
<tr>
<td></td>
<td>Emergency stop</td>
</tr>
<tr>
<td></td>
<td>Move back to the deviated position and stop. When restarting, move to the indicated step.</td>
</tr>
<tr>
<td>2</td>
<td>Emergency stop (Servo OFF)</td>
</tr>
<tr>
<td></td>
<td>Move back the deviated position and then move to the indicated step.</td>
</tr>
</tbody>
</table>

### Table 8-2: S2C423

<table>
<thead>
<tr>
<th>Parameter Setting Value</th>
<th>Movement When Restarting</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Move to the next step.</td>
</tr>
<tr>
<td></td>
<td>JOG</td>
</tr>
<tr>
<td></td>
<td>Movement when restarting</td>
</tr>
<tr>
<td>1</td>
<td>After moving back to the deviated position, move to the indicated step.</td>
</tr>
<tr>
<td></td>
<td>Emergency stop (Servo OFF)</td>
</tr>
<tr>
<td></td>
<td>Move back to the deviated position and then move to the indicated step.</td>
</tr>
<tr>
<td>2</td>
<td>Emergency stop (Servo OFF)</td>
</tr>
<tr>
<td></td>
<td>Move back to the deviated position and stop. When restarting, move to the indicated step.</td>
</tr>
</tbody>
</table>
8.2 Motion Speed Setting Parameters

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.

![Diagram showing deviation in position]

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.
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 Parameter
8.2 Motion Speed Setting Parameters

8.2.0.23 S2C698: BASE AXIS OPERATION KEY ALLOCATION SETTING

Table 8-3: Parameter Setting and Jog Operation Key Allocation

<table>
<thead>
<tr>
<th>Coordinates/Parameter</th>
<th>S2C698= &quot;0&quot;</th>
<th>S2C698= &quot;1&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint</td>
<td>Axis number order</td>
<td>Specified</td>
</tr>
<tr>
<td>Cylindrical</td>
<td>Axis number order</td>
<td>Specified</td>
</tr>
<tr>
<td>Cartesian</td>
<td>Specified</td>
<td>Specified</td>
</tr>
<tr>
<td>Tool</td>
<td>Specified</td>
<td>Specified</td>
</tr>
<tr>
<td>User</td>
<td>Specified</td>
<td>Specified</td>
</tr>
</tbody>
</table>

Axis number order: X: First axis, Y: Second axis, Z: Third axis

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 Teach mode or remote mode. Some parameters can be set through `{SETUP} \rightarrow \{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.

<table>
<thead>
<tr>
<th>Parameter Setting Value</th>
<th>Operation Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>MOVL DOUT TIMER DOUT MOVL</td>
</tr>
<tr>
<td>1</td>
<td>MOVL DOUT TIMER DOUT MOVL</td>
</tr>
</tbody>
</table>
8 Parameter
8.3 Mode Operation Setting Parameters

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>
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 following 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”

<table>
<thead>
<tr>
<th>Parameter Setting Value</th>
<th>Operation Units</th>
</tr>
</thead>
</table>
| 0 | MOVL  
DOUT  
TIMER  
DOUT  
MOVL  | Stops at every instruction |
| 1 | MOVL  
DOUT  
TIMER  
DOUT  
MOVL  | Stops at move instruction |

When operating “FORWARD” by the programming pendant, the units for execution are set in another parameter (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 1 cm/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.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Permitted</td>
</tr>
<tr>
<td>1</td>
<td>Prohibited</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Permitted</td>
</tr>
<tr>
<td>1</td>
<td>Prohibited</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Permitted</td>
</tr>
<tr>
<td>1</td>
<td>Prohibited</td>
</tr>
</tbody>
</table>
8 Parameter

8.3 Mode Operation Setting Parameters

- 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 Play mode to Teach mode.

The setting can be made on the OPERATING CONDITION window.

- 0: Step
8.3.0.34 S2C314: PLAY MODE FIRST CYCLE MODE
This parameter sets the cycle that changes from Teach mode to 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

<table>
<thead>
<tr>
<th>Parameter Setting Value</th>
<th>Valid/Invalid</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Function invalid</td>
</tr>
<tr>
<td>1</td>
<td>Function valid</td>
</tr>
</tbody>
</table>

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
Select \{IN/OUT\} \rightarrow \{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...


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**

<table>
<thead>
<tr>
<th>Parameter Setting Value</th>
<th>Valid/Invalid</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Function invalid</td>
</tr>
<tr>
<td>1</td>
<td>Function valid</td>
</tr>
</tbody>
</table>

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
8.3 Mode Operation Setting Parameters

S2C396=0 : SET B000 128  
S2C396=1 : SET WORK KIND 128

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...


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"

<table>
<thead>
<tr>
<th>Parameter Setting Value</th>
<th>Valid/Invalid</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Function Invalid</td>
</tr>
<tr>
<td>1</td>
<td>Function Valid</td>
</tr>
</tbody>
</table>

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.
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**

<table>
<thead>
<tr>
<th>Input/Output Signals</th>
<th>USER INPUT SIGNAL</th>
<th>USER OUTPUT SIGNAL</th>
<th>PSEUDO INPUT SIGNAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>BYTE TYPE VARIABLE (B VARIABLE)</td>
<td>INTEGER TYPE VARIABLE (I VARIABLE)</td>
<td>DOUBLE-PRECISION INTEGER TYPE VARIABLE (D VARIABLE)</td>
</tr>
</tbody>
</table>

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 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

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Prohibit Resetting</td>
</tr>
<tr>
<td>1</td>
<td>Permit Resetting</td>
</tr>
</tbody>
</table>

"PERMIT" is set as the initial value for the work time and motion time.
Robotic Arc Welding
Lincoln ARCLINK XT

8 Parameter
8.3 Mode Operation Setting Parameters

8.3.0.40 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.)

8.3.0.41 S2C433: POSITION TEACHING BUZZER
This parameter specifies whether the buzzer sound at position teaching is used or not.
0 : With buzzer
1 : Without buzzer

8.3.0.42 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: Does not operate the synchronizing side while teaching the synchronized side.

Fig. 8-8: 1: Links the synchronizing side while teaching the synchronized side.
8.3.0.43 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

<table>
<thead>
<tr>
<th>Parameter Setting Value</th>
<th>Where the Playback Resumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Resumes where the cursor is located in the job displayed at the moment.</td>
</tr>
</tbody>
</table>
| 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.

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).
8.4 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
- S3C006: Robot 2: + side: X
8.4 Parameters according to Interference Area

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 (-)
- S3C052: S-axis Interference Area Robot 3 (+)
- S3C053: S-axis Interference Area Robot 3 (-)
- S3C054: S-axis Interference Area Robot 4 (+)
- S3C055: S-axis Interference Area Robot 4 (-)

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 8-26.
8 Parameter
8.4 Parameters according to Interference Area

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.

<table>
<thead>
<tr>
<th>Checking Method Designation</th>
<th>Servo Power Supply ON</th>
<th>Servo Power Supply OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command</td>
<td>Command</td>
<td>Feedback</td>
</tr>
<tr>
<td>Feedback</td>
<td>Feedback</td>
<td>Feedback</td>
</tr>
</tbody>
</table>

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.

• 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 Parameters according to Interference Area

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.

The move amount in the speed reduction section is dependent on the moving speed of the manipulator at that time:

- \( V = 1500\text{mm/s} \rightarrow \text{approx. 300mm (Max.)} \)
- \( V = 1000\text{mm/s} \rightarrow \text{approx. 160mm} \)
- \( V = 30\text{mm/s} \rightarrow \text{approx. 3 to 4 mm} \)
- \( V = 20\text{mm/s} \rightarrow \text{approx. 2mm} \)
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.

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 8-26.

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 8-27.

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 8-28.

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 8-32.

8.4.0.10 S3C1097: A SIDE LENGTH OF WORK-HOME-POSITION CUBE
Units: 1 µm
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 Parameters according to Status I/O

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.

### BCD DATA SPECIFICATION AT BIT-ON (1)

**S4C049**

<table>
<thead>
<tr>
<th>d15</th>
<th>d0</th>
<th>OG#17</th>
<th>OG#18</th>
<th>OG#19</th>
<th>OG#20</th>
<th>OG#21</th>
<th>OG#22</th>
<th>OG#23</th>
<th>OG#24</th>
<th>OG#25</th>
<th>OG#26</th>
<th>OG#27</th>
<th>OG#28</th>
<th>OG#29</th>
<th>OG#30</th>
<th>OG#31</th>
<th>OG#32</th>
</tr>
</thead>
</table>

**S4C050**

<table>
<thead>
<tr>
<th>d15</th>
<th>d0</th>
<th>OG#33</th>
<th>OG#34</th>
<th>OG#35</th>
<th>OG#36</th>
<th>OG#37</th>
<th>OG#38</th>
<th>OG#39</th>
<th>OG#40</th>
<th>OG#41</th>
<th>OG#42</th>
<th>OG#43</th>
<th>OG#44</th>
<th>OG#45</th>
<th>OG#46</th>
<th>OG#47</th>
<th>OG#48</th>
</tr>
</thead>
</table>

**S4C048**

<table>
<thead>
<tr>
<th>d15</th>
<th>d0</th>
<th>OG#01</th>
<th>OG#02</th>
<th>OG#03</th>
<th>OG#04</th>
<th>OG#05</th>
<th>OG#06</th>
<th>OG#07</th>
<th>OG#08</th>
<th>OG#09</th>
<th>OG#10</th>
<th>OG#11</th>
<th>OG#12</th>
<th>OG#13</th>
<th>OG#14</th>
<th>OG#15</th>
<th>OG#16</th>
</tr>
</thead>
</table>

### 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]

<table>
<thead>
<tr>
<th>State</th>
<th>Binary</th>
<th>Case</th>
<th>BCD</th>
<th>Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2^0 = 1</td>
<td>1</td>
<td>2^0 = 1</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>2^1 = 2</td>
<td>0</td>
<td>2^1 = 2</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2^2 = 4</td>
<td>4</td>
<td>2^2 = 4</td>
<td>4</td>
</tr>
<tr>
<td>0</td>
<td>2^3 = 8</td>
<td>0</td>
<td>2^3 = 8</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2^4 = 16</td>
<td>16</td>
<td>2^4 = 16</td>
<td>16</td>
</tr>
<tr>
<td>0</td>
<td>2^5 = 32</td>
<td>0</td>
<td>2^5 = 32</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2^6 = 64</td>
<td>64</td>
<td>2^6 = 64</td>
<td>64</td>
</tr>
<tr>
<td>0</td>
<td>2^7 = 128</td>
<td>0</td>
<td>2^7 = 128</td>
<td>0</td>
</tr>
</tbody>
</table>

| Total is in ones. | 1 | 0 |
| Total is in tens. | 5 | 4 |

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

<table>
<thead>
<tr>
<th>Instruction</th>
<th>V=100</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMOVL</td>
<td></td>
</tr>
<tr>
<td>+MOVL</td>
<td>← Master side</td>
</tr>
<tr>
<td></td>
<td>Speed specification not provided</td>
</tr>
</tbody>
</table>

1: Provided

<table>
<thead>
<tr>
<th>Instruction</th>
<th>V=100</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMOV L</td>
<td></td>
</tr>
<tr>
<td>+MOV L</td>
<td>← Master side</td>
</tr>
<tr>
<td></td>
<td>Speed specification provided</td>
</tr>
</tbody>
</table>

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.
8.6 Parameters according to Coordinated or Synchronized Operation

8.6.0.4 S2C232: JOB AT CALLING MASTER OF SUBTASK 1, 2, 3, 4, 5, 6, and 7 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)
8 Parameter

8.6 Parameters according to Coordinated or Synchronized Operation

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:

<table>
<thead>
<tr>
<th>d7</th>
<th>d6</th>
<th>d5</th>
<th>d4</th>
<th>d3</th>
<th>d2</th>
<th>d1</th>
<th>d0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

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 Parameters according to Coordinated or Synchronized Operation

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.
8.6 Parameters according to Coordinated or Synchronized Operation

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.
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).

- 0: Previous step with priority (B-axis moving distance minimized.)
- 1: Form with priority
- 2: Previous step with priority (R-axis moving distance minimized.)

8.7.0.6 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.
8.7 Parameters for Other Functions or Applications

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.

```
<table>
<thead>
<tr>
<th>Step</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>n-1</td>
<td>MOVL</td>
</tr>
<tr>
<td>n</td>
<td>MOVL NWAIT</td>
</tr>
<tr>
<td></td>
<td>ANTOUT AT#(1) ON</td>
</tr>
<tr>
<td>n+1</td>
<td>MOVL</td>
</tr>
</tbody>
</table>
```

<Delayed Signal Output>

Signal output is carried out after the step is reached.

```
<table>
<thead>
<tr>
<th>Step</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>n-1</td>
<td>MOVL</td>
</tr>
<tr>
<td>n</td>
<td>MOVL NWAIT</td>
</tr>
<tr>
<td></td>
<td>ANTOUT AT#(2) ON</td>
</tr>
<tr>
<td>n+1</td>
<td>MOVL</td>
</tr>
</tbody>
</table>
```
8 Parameter
8.8 Hardware Control Parameters

8.8.0.2 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

8.8.0.3 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.

8.8.0.4 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.

<table>
<thead>
<tr>
<th>Parameter Setting Value</th>
<th>Operation of Output Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>ON/OFF with the key ON while the key is pressed ON/OFF if the key is not pressed ON OFF</td>
</tr>
<tr>
<td>1</td>
<td>ON/OFF with the key ON while the key is pressed OFF if the key is not pressed ON OFF</td>
</tr>
</tbody>
</table>

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.
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 Application Parameters

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. For the Lincoln ArcLink/XT interface, this parameter should be configured as follows:

- Welder #1: A1P010 = 1
- Welder #2: A2P010 = 5 (set only when 2 or more welders per system)
- Welder #3: A3P010 = 9 (set only when 3 or more welders per system)
- Welder #4: A4P010 = 13 (set only when 4 or more welders per system)

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 Arc Welding Application

9.1 System Structure Example of Arc Welding System

Fig. 9-1: System Structure of Welding Robot

9.2 General Descriptions of Instructions and Functions

9.2.1 Setup

Connect the welder, robot, wirefeeder, and gas lines as shown in the connection diagram provided with your system.

**Setup the Power Source**

See Section 9.5 “Power Source Condition File” on page 9-12.

Connect CAT5 (or greater) Ethernet cable from the power source to the DX100 controller. If using more than one power source (or connecting a PC for remote monitoring) use a standard Ethernet switch to connect all devices.

**Welder Network Addressing**

Each welder in the robot cell must be mapped to a particular welder index.

For example: a Lincoln power source with an IP address of 192.168.255.66 may be referred to as “Welder 1” in the Motoman controller. Up to four welders can be mapped per a single controller.
Open the Lincoln Setup screen. From the pendant main menu, touch [Arc Welding] > [Lincoln Setup].

The network will automatically be scanned when opening this screen. By touching the [Refresh Scan...] button, you can manually re-scan the network for any new welders.

Simply touch the welder you want from the list of Available Welders. Upon selecting a particular welder in the list, the LED's on the front of the power source should begin to rapidly blink, as a visual indication of which welder has been selected. Then, touch the [Assign Rx] button to assign the selected welder to a particular index in the Motoman controller.

You must also specify what type of wire feeder is connected to this welder. Use the [Change Feeder] drop down menu to select the correct feeder.

**NOTE:** The feeder selection and welder IP addresses are stored in robot variables B080-B083 and S080-S083. These variables should not be used by any robot job!

These variables are labeled on the pendant display screen.
9.2 General Descriptions of Instructions and Functions

9.2.2 Global Weld Settings

The "Global" tab settings apply to all 999 Arc Start files. These settings will replace some of the options contained in the Arc Auxiliary File.

A. Arc Loss Timeout
The amount of time to allow an arc to reestablish itself before beginning the Arc Restart function. This overrides the value in the Arc Auxiliary file.

B. Restart Arc At
When the Arc Restart function is being performed, the weld control parameters are scaled to this percentage. This overrides the Current and Voltage fields in the Arc Auxiliary file.

C. Workpoint in Amps
On Lincoln welders, the primary weld parameter is called Workpoint. By checking this option, the welder will change weld parameters so that you can specify the desired amperage for the selected process. Please note that this amperage is based on a lookup table internal to the welder. To achieve the desired amperage, a specific wire stick-out must be maintained that is specific to the selected weld process.

D. Trim in Volts
On Lincoln welders, the secondary weld parameter is called Trim. By checking this option, the welder will change weld parameters so that you can specify the desired voltage for the selected process. Please note that this voltage is based on a lookup table internal to the welder. To achieve the desired voltage, a specific wire stick-out must be maintained that is specific to the selected weld process.

Not all welders support converting Workpoint in Amps and Trim in Volts. If your welder does not support this feature, these check boxes will have no effect. Please consult your Lincoln Electric representative for more information.
E. Automatic stick-check if not using AEF

When a weld ends with an Arc End File, the user is able to specify whether to perform a stick-check after the weld. However, when an AEF is not used, the weld will abruptly end. By checking this box, a stick-check will automatically be performed after each arc. In the event of a stick-detection, an alarm will be raised on the pendant.

Please note that the stick-check operation can increase cycle time on short, rapid welds with minimal time between arcs.

9.2.3 Teaching Operation

Teach a welding line.

```
000  NOP
001  MOVJ VJ=10.00 Standby position
002  MOVJ VJ=80.00 Approach position
003  MOVL V=800 Welding start point
004  MOVL V=50 Welding start
005  MOVL V=50 Welding condition change
006  ARCSET ASF#(3) Welding end point
007  MOVL V=50 Welding end
008  ARCOF AEF#(1) Retract position
009  MOVL V=800 Standby position
010  MOVJ VJ=50.00
011  END
```

Register work instructions.

- **ARCON** Section 9.6.1 “ARCON” on page 9-20
- **ARCOF** Section 9.6.2 “ARCOF” on page 9-26
- **ARCSET** Section 9.6.3 “ARCSET” on page 9-32
9 Arc Welding Application

9.2 General Descriptions of Instructions and Functions

Set welding conditions.
- Arc welding start condition Section 9.6.1 “ARCON” on page 9-20
- Arc welding end condition Section 9.6.2 “ARCOF” on page 9-26

```
000  NOP
001  MOVJ VJ=10.00
002  MOVJ VJ=80.00
003  MOVL V=800
004  ARCON ASF#(1)
005  MOVL V=50
006  ARCSET ASF#(3)
007  MOVL V=50
008  ARCOF AEF#(1)
009  MOVL V=800
010  MOVJ VJ=50.00
011  END
```

Set other welding functions.
- Weaving Section 9.12 “Weaving Condition File” on page 9-71
- Arc retry function Section 9.7 “Arc Retry Function” on page 9-51
- Arc restart function Section 9.8 “Arc Restart Function” on page 9-53
- Wire-stick check function Section 9.9 “Wire-stick Check Function” on page 9-57
- Automatic wire-stick release function Section 9.9 “Wire-stick Check Function” on page 9-57
- Slope up/down function Section 9.11 “Slope Up/Down Function” on page 9-60
9 Arc Welding Application
9.2 General Descriptions of Instructions and Functions

Check operation.

- Test operation (See Section 3.8 “Test Operations” on page 3-61.)
- Welding execution function during Teach mode Section 9.6.7 “Welding Execution Function During Teach Mode” on page 9-50

<table>
<thead>
<tr>
<th>000</th>
<th>NOP</th>
<th>Standby position</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>MOVJ VJ=10.00</td>
<td>Approach position</td>
</tr>
<tr>
<td>002</td>
<td>MOVJ VJ=80.00</td>
<td>Welding start point</td>
</tr>
<tr>
<td>003</td>
<td>MOVL V=800</td>
<td>Weaving start</td>
</tr>
<tr>
<td>004</td>
<td>WVON WEV#(1)</td>
<td>Welding start</td>
</tr>
<tr>
<td>005</td>
<td>ARCON ASF#(1)</td>
<td>Welding condition change</td>
</tr>
<tr>
<td>006</td>
<td>MOVL V=50</td>
<td>Welding end point</td>
</tr>
<tr>
<td>007</td>
<td>ARCSET ASF#(3)</td>
<td>Welding end</td>
</tr>
<tr>
<td>008</td>
<td>MOVL V=50</td>
<td>Weaving end</td>
</tr>
<tr>
<td>009</td>
<td>ARCOF AEF#(1)</td>
<td>Retract position</td>
</tr>
<tr>
<td>010</td>
<td>WVOF</td>
<td>Standby position</td>
</tr>
<tr>
<td>011</td>
<td>MOVL V=800</td>
<td></td>
</tr>
<tr>
<td>012</td>
<td>MOVJ VJ=50.00</td>
<td></td>
</tr>
<tr>
<td>013</td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>
9.3 Function Keys

Each function used for arc welding is allocated on the numeric keys of the programming pendant.

- **1 TIMER**
  - Registers a timer instruction “TIMER” in a job.

- **0 REFP**
  - Registers a reference point “REFP” in a job, or modifies a registered reference point.
  - \[REFP] + [FWD]
    - Moves the manipulator to the registered reference point.

- **8 ARCON**
  - Registers a welding start instruction “ARCON.”

- **5 ARCOFF**
  - Registers a welding end instruction “ARCOFF.”

- **2 GAS**
  - Use this key to control the gas flow.
  - Gas is fed only while [GAS] is pressed.
  - (Refer to Section 9.3.2 “Gas Flow Control Function” on page 9-9.)
<table>
<thead>
<tr>
<th><strong>[DIRECT OPEN]</strong></th>
<th>Displays the content related to the current line.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• 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.</td>
</tr>
<tr>
<td>Example:</td>
<td>For a CALL instruction, the content of the called job will be displayed.</td>
</tr>
<tr>
<td></td>
<td>For a work instruction, the content of the condition file will be displayed.</td>
</tr>
<tr>
<td></td>
<td>For Input/output instructions, the input/output condition will be displayed.</td>
</tr>
<tr>
<td></td>
<td>• 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.</td>
</tr>
</tbody>
</table>

| **[FEED]** | **[RETRACT]** | Used for wire inching. Press [FEED] to feed the wire, and [RETRACT] to retract the wire. While these keys are pressed, the wire feed motor operates. Wire feeder speed gradually increases when the [FEED] or [RETRACT] key is held. (Refer to Section 9.3.1 “Wire Inching Function” on page 9-9.) |

| **[CUR/VOL]** | **[CUR/VOL]** | Modifies the weld settings for the active Lincoln process while welding in Play mode. Press [3/CUR/VOL] to increase the current/voltage value, and press [-/CUR/VOL] to decrease the current/voltage value. (Refer to Section 9.13 “Changing Welding Conditions During Playback” on page 9-91.) |

| **[WELD ON/OFF]** | When Security mode is set to management mode, press this key to light the LED and welding can be performed during the test run. This can be used to weld while in Teach mode. *When [WELD ON/OFF] is pressed and the LED is lit, a beep is sounded. |
9.3 Function Keys

9.3.1 Wire Inching Function

**Wire Inching**

The term wire inching refers to gradually feeding or retracting the welding wire through the torch. [FEED] and [RETRACT] are used to perform wire inching. The wire inching simply feeds or retracts the wire, it has nothing to do with the job procedure being taught. The wire inching is performed only in Teach mode when the arc does not occur.

**Wire Feeding**

The wire is fed only while [FEED] is pressed.

The speed gradually increases when the [FEED] button is held.

**Wire Retraction**

The wire is retracted only while [RETRACT] is pressed.

The speed gradually increases when the [RETRACT] button is held.

9.3.2 Gas Flow Control Function

**Gas Flow Control**

The Gas Flow Control function is used to enable and disable shielding gas by opening or closing the solenoid valve. Pressing [GAS] opens and closes the solenoid valve. This operation does not cause any changes in the job contents. The Gas Flow Control function is enabled in Teach mode only.
9.4 Enhanced Welding Condition File Function

The Lincoln ArcLink XT interface requires the Enhanced Welding Condition File function be enabled.

When the file type changes, the welding Start/End Condition file is initialized.

When loading welding condition files that have been saved on an external memory device, only Enhanced Welding Condition files can be loaded. Weld files used with non-Lincoln XT welders cannot be loaded without modification to the individual ArcStart and ArcEnd files. ArcStart and ArcEnd files are specific to ArcLink XT interfaced welders.

9.4.1 Function Setting

To change the type of the welding condition file, proceed as follows:

1. While pressing [MAIN MENU], turn power ON. Then change the security mode to the management mode.
2. Select {SYSTEM} from the main menu and select { SETUP}.

The system should ship with Enhanced Welding by default. This procedure is only needed if the system is set back to Standard Welding.

- The SETUP window appears.
3. Select “OPTION FUNCTION.”
   – The OPTION FUNCTION window appears.

![OPTION FUNCTION window]

4. Select “ARC WELDING,” then select “ENHANCED.”
   – The selection dialog box appears.

![Selection dialog box]

   – The confirmation dialog box appears. Selecting “YES” changes the file type and initializes the related files (welding Start/End condition files).

![Confirmation dialog box]

5. Reboot the DX100 controller.
9.5 Power Source Condition File

9.5.1 About Power Source Condition File

The power source condition file sets the power source characteristics that determine the scaling interaction between the robot controller and power source. It sets up a very specific scaling which ensures the values requested from the teach pendant are accurately sent to the power source.

For precise control, the control signals sent from the controller to the power source must be properly adjusted.

The Lincoln ArcLink XT interface ensures that the requested value is output with the least amount of error as possible. The Lincoln ArcLink XT interface requires linear scaling of the welder condition file. The scaling shown below must be used when connecting to a Lincoln ArcLinkXT machine.
Fig. 9-2: Welding Current Output Characteristics (Example)

![Welding Current Output Characteristics](image)

![Welding Voltage Output Characteristics](image)
9.5.2 POWER SOURCE CONDITION File

9.5.2.1 Reading a Power Source Condition File

1. Select (DATA) from the menu.

2. Select (READING).

3. Select the Power Source condition file number of the data to be read.

- Each time the page key is pressed, the window alternates between the MAKER INITIAL VALUE window and the USER INITIAL VALUE window.

- In the MAKER INITIAL VALUE window, the registered initial value file list (1 to 24) is shown.

<table>
<thead>
<tr>
<th>NO.</th>
<th>NAME</th>
<th>POWER</th>
<th>DIA.</th>
<th>GAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>MOTOWELD-E350</td>
<td>2</td>
<td>1.2</td>
<td>MAG</td>
</tr>
<tr>
<td>02</td>
<td>MOTOWELD-E350</td>
<td>2</td>
<td>1.2</td>
<td>MAG</td>
</tr>
<tr>
<td>03</td>
<td>MOTOWELD-E350</td>
<td>2</td>
<td>1.2</td>
<td>CO2</td>
</tr>
<tr>
<td>04</td>
<td>MOTOWELD-E350</td>
<td>2</td>
<td>1.2</td>
<td>MAG</td>
</tr>
<tr>
<td>05</td>
<td>MOTOWELD-E350</td>
<td>2</td>
<td>1.2</td>
<td>CO2</td>
</tr>
<tr>
<td>06</td>
<td>MOTOWELD-E350</td>
<td>2</td>
<td>1.2</td>
<td>MAG</td>
</tr>
<tr>
<td>07</td>
<td>MOTOWELD-E350</td>
<td>2</td>
<td>0.9</td>
<td>CO2</td>
</tr>
<tr>
<td>08</td>
<td>MOTOWELD-E350</td>
<td>2</td>
<td>0.9</td>
<td>MAG</td>
</tr>
<tr>
<td>09</td>
<td>MOTOWELD-E350</td>
<td>2</td>
<td>0.9</td>
<td>CO2</td>
</tr>
<tr>
<td>10</td>
<td>MOTOWELD-E350</td>
<td>2</td>
<td>0.9</td>
<td>MAG</td>
</tr>
<tr>
<td>11</td>
<td>MOTOWELD-E350</td>
<td>2</td>
<td>0.9</td>
<td>CO2</td>
</tr>
<tr>
<td>12</td>
<td>MOTOWELD-E350</td>
<td>2</td>
<td>0.9</td>
<td>CO2</td>
</tr>
<tr>
<td>13</td>
<td>MOTOWELD-E350</td>
<td>2</td>
<td>0.9</td>
<td>CO2</td>
</tr>
<tr>
<td>14</td>
<td>MOTOWELD-E350</td>
<td>2</td>
<td>1.2</td>
<td>CO2</td>
</tr>
</tbody>
</table>

- In the USER INITIAL VALUE window, the registered user registration file list (1 to 4) is shown.

<table>
<thead>
<tr>
<th>NO.</th>
<th>NAME</th>
<th>POWER</th>
<th>DIA.</th>
<th>GAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>LINCOLN I400</td>
<td>A/V</td>
<td>1.2</td>
<td>CO2</td>
</tr>
<tr>
<td>02</td>
<td>USER-2</td>
<td>A/V</td>
<td>1.2</td>
<td>MAG</td>
</tr>
<tr>
<td>03</td>
<td>USER-3</td>
<td>A/V</td>
<td>1.2</td>
<td>CO2</td>
</tr>
<tr>
<td>04</td>
<td>USER-4</td>
<td>A/V</td>
<td>1.2</td>
<td>MAG</td>
</tr>
</tbody>
</table>
4. Select “YES.”

   - The confirmation dialog box appears. Select “NO” to return to the POWER SOURCE CONDITION window without reading the file.

---

**9.5.2.2 POWER SOURCE CONDITION Window**

A. **POWER SOURCE NO. (1 to 4)**

Displays a Power Source number between 1 and 4 (for each welder.)

B. **SETTING**

If this file is modified, the Setting status automatically changes to “NONE,” indicating that the modification is not saved yet. To save the modification to the file, move the cursor to “SETTING” and press [SELECT]. The Setting status changes to “DONE.”

C. **POWER SOURCE NAME**

Displays a Power Source name of 16 characters or less.

D. **COMM. (COMMENT)**

Displays a comment of 32 characters or less.
E. POWER SUPPLY (A/V, A/%)

- When “A/%” is displayed: Measured values of voltage can be input as a percentage “%” for “D. MEASURE” in the POWER SOURCE CONDITION window for the current/voltage output as shown on the next page.

- When “A/V” is displayed: Measured values of voltage can be input in Volts “V” for “D. MEASURE” in the POWER SOURCE CONDITION window for current/voltage output as shown on the next page. Always select “A/V” when using the Lincoln ArcLink XT interface.

*To switch between “A/%” and “A/V”, select [DATA] -> [READING] to read the initial value file (maker offer) or user registered file.

F. SHIELDING GAS (CO2,MAG)

Specifies the shielding gas type.

G. WIRE DIA. (0 to 9.9mm)

Specifies the wire diameter.

H. WIRE STICKOUT (0 to 99mm)

Specifies the length of the welding wire protruding from the torch tip.

I. WIRE ANTI-STICKING (0 to 9.9 seconds)

Specifies the duration of the wire anti-stick process at the end of welding.

J. ARC FAILURE STOP (0 to 2.55 seconds)

Specifies the time between the detection of arc failure and the stopping of manipulator movement.

9.5.2.3 POWER SOURCE CONDITION Window for Current/Voltage Output

A. RANGE

Indicates the polarity of the reference value for the welding current and voltage. If the range is positive(+), the reference value is in the range between 0 and 14.00V. If the range is negative(-), the reference value is in the range between 0 and -14.00V. Always select positive (+) for the Lincoln ArcLink XT.
B. ADJUST (0.80 to 1.20)
A correction value to adjust the welding current/voltage output. Set to “1.00.” for Lincoln ArcLink XT.

C. REF. (V) (0 to 14.00V)
Welding current/voltage reference values. See supporting chart. Do not modify the settings provided or power source control will be disrupted.

D. MEASURE (0 to 999A, 0 to 50.0V, or 50 to 150%)
The welding current/voltage output values measured at the reference values as given under C. See supporting chart.

9.5.3 Editing the Power Source Condition Files

When the Power Source condition file is modified or the file is read in, the SETTING status in the POWER SOURCE CONDITION window changes from “DONE” to “NONE.” After editing, move the cursor to SETTING and press [SELECT] to save the modification. The SETTING status changes from “NONE” to “DONE.”

9.5.3.1 Displaying a Power Source Condition File
1. Select {ARC WELDING} under the main menu.
2. Select {POWER SOURCE CONDITION}.
   – The POWER SOURCE CONDITION window appears.
9.5.3.2 Editing a Power Source Condition File

- Editing the “WELDER NAME” or “COMMENT”
  1. Select “POWER SOURCE NAME” or “COMMENT.”
  2. Input characters.

- Editing Other Items
  1. Select the item to be edited.
  2. Input the number using the Numeric keys.

9.5.3.3 Saving the Power Source Condition File Data

In addition to the 24 types of initial value data that Yaskawa has provided, 4 types of Power Source condition files can also be registered. Data that has been partially modified using the initial value file can also be registered.

1. Select {ARC WELDING} under the main menu.
2. Select {POWER SOURCE COND.}.

3. Select {WRITING} from {DATA} in the menu.
   - The user registered file list appears.

4. Select the Power Source condition file number of the data to be written.
   - The confirmation dialog box appears.

5. Select “YES.”
   - Select “YES” to register the Power Source condition file data. Select “NO” to return to the POWER SOURCE CONDITION window.
9.6 Basic Functions

9.6.1 ARCON

9.6.1.1 Function

This instruction outputs an Arc Start command and is used to begin a weld. The [ARCON] function key can be used for registration.

![Function key to register the welding start instruction (ARCON)](image)

9.6.1.2 Syntax

```
ARCON  WELDn  ASF#  END
```

9.6.1.3 Explanation

- **WELD1/WELD2/WELD3/WELD4**
  Choose one of the following tags.

  These tags are enabled only when the robot controller has been configured to use two or more power sources. When there is only one power source, these tags are not displayed.

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WELD1</td>
<td>Selects the Power Source 1.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>WELD2</td>
<td>Selects the Power Source 2.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>WELD3</td>
<td>Selects the Power Source 3.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>WELD4</td>
<td>Selects the Power Source 4.</td>
<td></td>
</tr>
</tbody>
</table>

- **ASF# (Arc welding start condition file number)**

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ASF# (Arc welding start condition file number)</td>
<td>Specifies the arc welding start condition file number. Conditions to start welding are registered in the arc welding start condition file.</td>
<td>No. 1 to 999. The number can be specified by direct entry or by using a B/I/D/LB/LI/LD variable.</td>
</tr>
</tbody>
</table>
9.6.1.4 Registering the ARCON Instruction
1. Press [ARCON].
2. Press [ENTER].

9.6.1.5 Setting Welding Start Conditions
The ARCON instruction must only be registered using an Arc Start File.

- Example:
  ARCON ASF# (1)
  (Refer to Section 9.6.4 “Arc Start Condition File” on page 9-35).

- Arc Welding Start Condition File
  1. Select the ARCON instruction in the instruction area.
     - The ARCON instruction appears in the input buffer line.
     
        | JOB CONTENT |
        | @ JOB NAME: WORK A |
        | CONTROL GROUP: R1 |
        | STEP NO: 0003 |
        | TOOL: 00 |

        | 0000   | NOP |
        | 0001   | MOVJ VJ=80.00 |
        | 0002   | MOVL V=890 |
        | 0003   | END |

  2. Press [SELECT].
     - The DETAIL EDIT window appears.
  3. Place the cursor on “UNUSED.”
4. Press [SELECT] and select “ASF#( )” from the selection dialog.

```
<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

```

The ARCON command must use an ASF#. Setting the voltage and current with the “AC=” command does not work with the Lincoln ArcLink XT interface.

- If the welding conditions have already been set in the ARCON instruction additional items, the DETAIL EDIT window appears.

```
<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

5. Place the cursor on “AC=” and press [SELECT], then select “ASF#( )” from the selection dialog.

```
<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

6. Set the file number.
- Specify the file number (1 to 999).
(1) Move the cursor to the file number and press [SELECT].

(2) Type the file number using the numeric keys and press [ENTER].

7. Press [ENTER].
   – The set contents are displayed in the input buffer line.

8. Press [ENTER].
   – The set contents are registered in the job.
9.6 Basic Functions

– Press [CANCEL] to return to the JOB CONTENT window if the set contents are not to be registered.

Without Additional Items

When an additional item is not provided for the ARCON instruction, set the welding conditions in advance with the welding condition setting instruction (ARCSET) before executing the ARCON instruction. (Refer to Section 9.6.3 “ARCSET” on page 9-32.)

1. Select the ARCON instruction in the instruction area.
   – The ARCON instruction appears in the input buffer line.

2. Press [SELECT].
   – The DETAIL EDIT window appears.
3. Place the cursor on “ASF#( )” or “AC=”.
4. Press [SELECT] and select “UNUSED” from the selection dialog.

5. Press [ENTER].
   - The set contents are displayed in the input buffer line.

6. Press [ENTER].
   - The set contents are registered in the job.

   – Press [CANCEL] to return to the JOB CONTENT window if the set contents are not to be registered.
9.6.2 ARCOF

9.6.2.1 Function
This instruction outputs an arc end command and is used to end a weld. The function key [ARCOF] can be used for registration.

Function key to register the welding end instruction (ARCOF)

9.6.2.2 Syntax

9.6.2.3 Explanation

**WELD1/WELD2/WELD3/WELD4**
Choose one of the following tags. These tags are enabled only when multiple applications are in use and two or more applications are set as arc welding application. When there is only one application, these tags are not displayed.

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WELD1</td>
<td>Selects the Power Source 1.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>WELD2</td>
<td>Selects the Power Source 2.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>WELD3</td>
<td>Selects the Power Source 3.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>WELD4</td>
<td>Selects the Power Source 4.</td>
<td></td>
</tr>
</tbody>
</table>

**AEF# (Arc welding end condition file number)**

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>AEF# (Arc welding end condition file number)</td>
<td>Specifies the arc welding end condition file number. Conditions to end welding are registered in the arc welding end condition file.</td>
<td>No. 1 to 999. The number can be specified by direct entry or by using a B/I/D/LB/LI/LD variable.</td>
</tr>
</tbody>
</table>
9.6.2.4 Registering the ARCOF Instruction

1. Press [ARCOF].

2. Press [ENTER].

9.6.2.5 Setting Arc Welding End Conditions (Crater Processing)

The ARCOF instruction can be registered in either of the following ways:

- With an arc welding end condition file
  ARCOF AEF#(1)
  In this case, the welding condition is set using the arc welding end condition file. (Refer to Section 9.6.5 “Arc End Condition File” on page 9-42).
- Without additional items
  ARCOF
  This turns off the arc without performing any crater process, burn-back, or anti-stick procedures.
## With an Arc Welding End Condition File

1. Select the ARCOF instruction in the instruction area.
   
   – The ARCOF instruction appears in the input buffer line.

2. Press [SELECT].
   
   – The DETAIL EDIT window appears.

3. Place the cursor on “UNUSED”.

4. Press [SELECT] and select “AEF#( )” from the selection dialog.

### NOTE

The ARCOF command must use an “AEF#” or “UNUSED” Set Method. Setting the voltage/current with the “AC=” command will not work with the Lincoln ArcLink XT interface.
If the welding conditions have already been set in the ARCOF instruction additional items, the DETAIL EDIT window appears.

5. Place the cursor on "AC=" and press [SELECT], then select "AEF#()" from the selection dialog.

6. Set the file number.
   – Specify the file number (1 to 999).
   (1) Move the cursor to the file number and press [SELECT].
   (2) Type the file number using the numeric keys and press [ENTER].

7. Press [ENTER].
   – The set contents are displayed in the input buffer line.

8. Press [ENTER].
9.6 Basic Functions

- The set contents are registered in the job.

1. Select the ARCOF instruction in the instruction area.
   - The ARCOF instruction appears in the input buffer line.
2. Press [SELECT].
   - The DETAIL EDIT window appears.

Without Additional Items

1. Select the ARCOF instruction in the instruction area.
   - The ARCOF instruction appears in the input buffer line.
2. Press [SELECT].
   - The DETAIL EDIT window appears.
3. Place the cursor on “AEF#()” or “AC=”.

4. Press [SELECT] and select “UNUSED” from the selection dialog.

5. Press [SELECT].
   – The set contents are displayed in the input buffer line.

6. Press [ENTER].
   – The set contents are registered in the job.
   – Press [CANCEL] to return to the JOB CONTENT window if the set contents are not to be registered.
9.6.3 ARCSET

9.6.3.1 Function

The ARCSET instruction can be used to set the weld control parameters prior to the start of a weld or during welding.

The ARCSET instruction must be registered in the following way:

- With an arc welding start condition file
  ARCSET ASF# (1)
  In this case, the welding condition is set using the arc start condition file.
  (Refer to Section 9.6.4 “Arc Start Condition File” on page 9-35.)

9.6.3.2 Syntax

9.6.3.3 Explanation

- **WELD1/WELD2/WELD3/WELD4**
  Choose one of the following tags.

  These tags are enabled only when multiple applications are in use and two or more applications are set as arc welding application. When there is only one application, these tags are not displayed.

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WELD1</td>
<td>Selects the Power Source 1.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>WELD2</td>
<td>Selects the Power Source 2.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>WELD3</td>
<td>Selects the Power Source 3.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>WELD4</td>
<td>Selects the Power Source 4.</td>
<td></td>
</tr>
</tbody>
</table>

9.6.3.4 Registering the ARCSET Instruction

- **With an Arc Start Condition File**
  1. Select the ARCSET instruction in the instruction area.
     - The ARCSET instruction appears in the input buffer line.
2. Press [SELECT].
   – The DETAIL EDIT window appears.
   (1) Place the cursor on “UNUSED.”

   ![DATA EDIT DISPLAY UTILITY](image)
   DETAIL EDIT
   ARCSET
   WELDING CURR: UNUSED
   WELDING VOLT: UNUSED
   SPEED: UNUSED
   ANALOG OUTPUT3: UNUSED
   ANALOG OUTPUT4: UNUSED

   (2) Press [SELECT] and select “ASF#()” from the selection dialog.

   ![DATA EDIT DISPLAY UTILITY](image)
   DETAIL EDIT
   ARCSET
   WELDING CURR: AC=
   WELDING VOLT: ASF#()
   SPEED: UNUSED
   ANALOG OUTPUT3: UNUSED
   ANALOG OUTPUT4: UNUSED

3. Set the file number.
   – Specify the file number (1 to 999).
   (1) Move the cursor to the file number and press [SELECT].

   ![DATA EDIT DISPLAY UTILITY](image)
   DETAIL EDIT
   ARCSET
   SET METHOD: ASF#()
   CONDITION SET: ACOND=0

   (2) Type the file number using the numeric keys and press [ENTER].

   ![DATA EDIT DISPLAY UTILITY](image)
   DETAIL EDIT
   ARCSET
   SET METHOD: ASF#()
   CONDITION SET: ACOND=0
4. Specify the condition set.
   - Specify the number for the condition set (0 or 1).
   
   (1) Move the cursor to the ACOND number at the condition set, and press [SELECT].

   ![Data Edit Display Utility](image1)

   - Setting the condition-set number will specify whether to use settings from the Start Condition or Main Condition in the Arc Start File.
   - ACOND=0: Sets the weld settings in the “start condition.”
   - ACOND=1: Sets the weld settings in the “main condition.”

5. Press [ENTER].
   - The set contents are displayed in the input buffer line.

   ![Data Edit Display Utility](image2)

6. Press [ENTER].
   - Press [ENTER]. The set contents are registered in the job.

   ![Job Edit Display Utility](image3)
9.6.4 Arc Start Condition File

Up to 999 Arc Start Condition files can be defined. Each of these files is related to a specifically defined welder (1-4) based on the mapping created in the Lincoln Setup screen.

A welding procedure is made up of seven components: process, material type, wire diameter, program, wire feed speed, voltage or arc length trim, and wave control. Selecting a welding mode determines the output characteristics of the power source.

The Lincoln ArcLink XT interface has been designed to step you through the process of defining your welding procedure. If you make selections out of order, the interface will prompt you to make a new selection for any settings that do not apply.

The standard process modes shipped with the system encompass a wide range of common processes and will meet most needs.

Many fields in the Arc Start Condition file editor are disabled based on the active security level of the pendant.

Users with Operator level security access are not able to modify any of the settings.

Users with Editing level access are only be able to modify the Weld Control Parameters of files that have already been configured, but cannot change the selected mode or modify fields that affect robot motion during the weld.

Users with Management level access are able to modify and create new files.

9.6.4.1 Arc Start Condition File Editor

The Arc Start condition file editor can be opened from the main menu or by clicking on the direct open key while highlighting an ARCON command in a job file.
9.6.4.2 Tabs

Conditions of the arc start condition file are divided into the tabs: “Process,” “Preflow,” “Start Condition,” “Main Condition,” and “Other.”

To switch between tabs, use the cursor key (left and right) or simply touch the desired tab on the pendant screen or use the arrow left/right button when in the application.

**“Process” Tab Window**

The Process tab helps determine the output characteristics of the power source. The Search field allows you to view the available process modes by process type, wire type, and wire size. Selecting a setting for one component narrows your choice of available mode numbers in the table. If the process mode number is known, it can be entered directly into the field next to the [Set Process] button.

Process mode selection directly impacts what values and parameters are available in each subsequent tab and how they determine the output characteristics of the power source.

**A. Process Type:**
Select the welding process. Multiple selections are available including; SMAW, SSFCAW, GTAW, Gouge, PAW, and SAW.

**B. Wire Type**
Select from the wire material types available. Multiple selections are available including; Aluminum, Copper, Stainless, Metal Core, and many others.

**C. Wire Size**
Select from the wire diameters available.

**D. Process Selection**
Once the available modes have been narrowed down using the Search fields, select a specific process mode from the listed programs available for the selected process, wire type, and wire size. A specific process must be selected before clicking the [Set Process] button.

**E. Set Process**
Click the [Set Process] button to select the desired process mode. If any settings are outside accepted values, they will be highlighted in red and must be corrected before the process is set.
“Preflow” Tab Window
Allows shielding-gas output prior to the beginning of welding.

A. Gas: Preflow Time
After the manipulator moves to the welding start point, the shielding gas can be started before the manipulator begins welding. The manipulator is stationary during Preflow.

Use the check box to enable / disable Preflow. Then, enter a length of time (in seconds) to hold with the gas on. Enter a value of “0” to prevent preflow.

“Start Condition” Tab Window
A “Start Condition” allows for a brief period of different weld parameters at the start of the weld. This is often used to deposit extra material at the start of the weld or to ramp from a low setting to a higher setting. Check the “Enable Starting Condition” and “Enable Slope” boxes to specify whether the conditions set in “Start Condition” tab step or gradually ramp to the conditions set in “Main Condition” tab when starting welding.

The available parameters change based on what options are enabled, as shown in the following:

Fig. 9-3: With “Enable Starting Condition” Unchecked
A. Strike Wirefeed Speed
The wirefeed speed from the time of ArcOn until the wire contacts the part and an arc is detected.

B. Delay After Strike
The length of time when the manipulator pauses between detecting the arc and beginning motion.

**Fig. 9-4: With “Enable Starting Condition” Checked**

C. Enable Starting Condition
Allows different weld settings at the beginning of the weld before applying the Main Condition settings.

The Robot Move Distance controls how long the Starting condition is applied before switching to the Main condition.

D. Robot Move Distance
Specifies the travel distance over which the Starting conditions are applied before switching to the Main condition.

E. Weld Control Parameters
The process mode selection directly impacts what values and parameters appear in the weld control parameters area. These control parameters vary depending on the process mode selection. Some of the more common parameters include:

- WFS (Wire Feed Speed)
  In synergic welding modes (synergic CV, pulse GMAW) WFS is the dominant control parameter, controlling all other variables. The user adjusts WFS according to factors such as weld size, penetration requirements, heat input, etc. The WFS setting is used to adjust output characteristics (output voltage, output current) according to pre-programmed settings.
  In non-synergic modes, the WFS control behaves more like a conventional CV power source where WFS and voltage are independent adjustments. Therefore, to maintain the arc characteristics, voltage must be adjusted to compensate for any changes made to the WFS.
- **Voltage**
  Welding voltage output value. In constant voltage modes (synergic CV, standard CV) this control adjusts the welding voltage. In pulse synergic welding modes (pulse GMAW only) the user can change the Trim setting to adjust the arc length. It is adjustable from 0.50 to 1.50. A Trim setting of 1.00 is a good starting point for most conditions.

Refer to the Lincoln power source documentation included with your system for more information regarding these weld control parameters.

_Fig. 9-5: With “Enable Slope” Checked_

**F. Enable Slope**
Allows a gradual transition between the conditions set in “Start Condition” tab and those specified in the “Main Condition” tab. Stepping causes the weld parameters to immediately transition to the Main condition. Sloping causes the weld parameters to gradually ramp up/down to the Main condition.

**G. Slope Distance**
Displayed only when the Enable Slope box is checked. The robot travel distance where the conditions are gradually changed from the ones set in the “Start Condition” tab to the ones set in the “Main Condition” tab.

**H. Robot Speed**
Displayed only when the Enable Slope box is checked. The speed which the manipulator moves along the welding line as it transitions between the conditions set in “Start Condition” tab and those specified in the “Main Condition.” This value can be overridden by the speed value specified in the INFORM job. The speed value that is given precedence is controlled by robot parameter AxP005. See Section 9.6.6 “Welding Speed Specifications” on page 9-50.
A. Robot Speed

Travel speed of the robot until an ARCOF command is reached or a new speed is requested. This value can be overridden by the speed value specified in the INFORM job. The speed value that is given precedence is controlled by robot parameter AxP005. See Section 9.6.6 “Welding Speed Specifications” on page 9-50.

B. Weld Control Parameters

Process mode selection directly impacts what values and parameters appear in the weld control parameters area. These control parameters vary depending on the process mode selection. Some of the more common parameters include:

- **WFS (Wire Feed Speed)**
  In synergic welding modes (synergic CV, pulse GMAW) WFS is the dominant control parameter, controlling all other variables. The user adjusts WFS according to factors such as weld size, penetration requirements, heat input, etc. The WFS setting is used to adjust output characteristics (output voltage, output current) according to pre-programmed settings.
  In non-synergic modes, the WFS control behaves more like a conventional CV power source where WFS and voltage are independent adjustments. Therefore, to maintain the arc characteristics, voltage must be adjusted to compensate for any changes made to the WFS.

- **Voltage**
  Welding voltage output value. In constant voltage modes (synergic CV, standard CV) this control adjusts the welding voltage. In pulse synergic welding modes (pulse GMAW only) the user can change the Trim setting to adjust the arc length. It is adjustable from 0.50 to 1.50. A Trim setting of 1.00 is a good starting point for most conditions.

Refer to the Lincoln power source documentation included with your system for more information regarding these and other weld control parameters.
“Other” Tab Window

The Other tab provides settings for Position Set Zone, Arc Retry, and others.

Fig. 9-7: Other Tab

A. Position Set Zone

Specifies the distance from the actual position of the manipulator (the position fed back from the encoder of each axis of the manipulator) to the welding start point, where the manipulator is regarded to have reached the welding start point. When the position set zone is set to “Unused”, the welding start signal is output to the Power Source immediately after the move instruction to the welding start point is output. When the position set zone is set to 1, the welding start signal is output to the Power Source after the manipulator completely reaches the welding start point and stops. When a bigger number is selected (2, 3, or 4), the timing of the output of the welding start signal becomes earlier, i.e., the time from the output of the welding start signal to the welding start point becomes longer.

B. Enable Retry

Turns retry function ON or OFF. This allows the robot to retry an ARCON command if the arc fails to start at the beginning of the weld. Check this box to turn the retry function ON. See Section 9.6.7 “Welding Execution Function During Teach Mode” on page 9-51 for information about the Arc Retry Function.

C. Arc Failure Restart

Specifies whether the Arc Restart function is used. If this function is used, the settings are specified in both the Global tab and the Arc Auxiliary file. See Section 9.8.2 “Arc Auxiliary Condition File” on page 9-55 for more information.

D. Production Monitoring Profile Number

Specifies the profile (1-32) that will be used to record statistics for this weld. See Chapter 10 “Production Monitoring” for more information.
E. Burnback
When the weld is stopped without using an Arc End File (such as HOLD, EStop, or ARCOF command without AEF tag), it is common for the wire to end stuck to the workpiece. By checking this option, an automatic burnback can be applied at the end of the weld by stopping the wire-drive for the specified amount of time. The weld controller stays on during this time, with the currently active weld parameters, to burnback the wire.

F. Disable Last-Weld data collection on robot
At the end of each arc, the welder automatically calculates statistics about the weld. Normally, the robot will retrieve this data and save it to global l-variables for use by the robot programmer. (See Chapter 10 for more information).

By checking this option, the robot controller will not retrieve the data from the welder. This can help improve cycle time when performing rapid, short welds with minimal time between arcs. Please note that this option does not disable the statistics within the welder. So any Production Monitoring applications run from a PC or central server will not be affected.

G. Copy
Allows the user to copy all settings from another Arc Start file. The active file number is the destination of the copy. Input the file number of the source file and touch the [Copy From] button.

H. Display Units
This determines whether the weld control parameters are displayed with metric or imperial units. This setting does not apply to any Robot Speed fields. The unit for Robot Speed is based on the speed used for programming robot jobs. This can be changed from the main menu under Setup -> Operate Condition.

9.6.5 Arc End Condition File
Up to 999 Arc End Condition files can be defined. Each of these files is related to a specifically defined welder (1-4) based on the mapping created in the LWeld Mapper screen.

A welding procedure is made up of seven components: process, material type, wire diameter, program, wire feed speed, voltage or arc length trim, and wave control. Selecting a welding mode determines the output characteristics of the power source.

The Lincoln ArcLink XT interface has been designed to step you through the process of defining your welding procedure. If you make selections out of order, the interface will prompt you to make a new selection for any settings that do not apply.

The standard process modes shipped with the system encompass a wide range of common processes and will meet most needs.
Many fields in the Arc End Condition file editor are disabled based on the active security level of the pendant.

Users with Operator level security access are not able to modify any of the settings.

Users with Editing level access are only able to modify the Weld Control Parameters of files that have already been configured, but cannot change the selected mode or modify fields that affect robot motion during the weld.

Users with Management level access are able to modify and create new files.

9.6.5.1 Arc End Condition File Editor

The Arc End condition file editor can be opened from the main menu or by clicking on the direct open key while highlighting an ARCOF command in a job file.

9.6.5.2 Tabs

Conditions of the arc end condition file are divided into the tabs: “Process,” “Crater,” “Burnback,” “Postflow,” and “Misc.”

To switch between tabs, use the cursor key (left and right) or simply touch the desired tab on the pendant screen.
“Process” Tab Window

The Process tab helps determine the output characteristics of the power source. The Search field allows you to view the available process modes by process type, wire type, and wire size. Selecting a setting for one component narrows your choice of available mode numbers in the table. If the process mode number is known, it can be entered directly into the window next to the [Set Process] button.

Process mode selection directly impacts what values and parameters are available in each subsequent tab and how they determine the output characteristics of the power source.

Fig. 9-8: Process Tab

A. Process Type:
Select the welding process. Multiple selections are available including; SMAW, SSFCAW, GTAW, Gouge, PAW, and SAW.

B. Wire Type
Select from the wire material types available for the selected process. Multiple selections are available including; Aluminum, Copper, Stainless, Metal Core, and many others.

C. Wire Size
Select from the wire diameters available for the selected process and material type.

D. Process Selection
Once the selection has been narrowed down using the Search field, select a specific process mode from the listed programs available for the selected process, wire type, and wire size. Only once a process has been selected and highlighted can the [Set Process] button be pressed.

E. Set Process
Click the [Set Process] button to select the desired process mode. If any settings are outside accepted values, they will be highlighted in red and must be corrected before the process is set.
“Crater” Tab Window

The Crater condition is used to fill in the end of the weld. This can be used to create a “puddle” for a smooth and consistent finish or to taper up/down from a main weld condition resulting in a narrower or wider weld approaching the end of the weld.

Fig. 9-9: Crater Tab

A. Slope down from Main Condition

Allows a gradual transition between the conditions set in the “Main Condition” tab of the Arc Start condition file and those specified in the “Crater” tab. If this is not selected, the weld control parameters immediately switch to those specified in the “Crater” tab.

B. Robot Speed

Displayed only when the “Slope down” box is checked. The speed which the manipulator moves along the welding line as it transitions between the conditions set in “Main Condition” tab and those specified in the “Crater” tab. This value can be overridden by the speed value specified in the INFORM job. The speed value that is given precedence is controlled by robot parameter AxP005. See Section 9.6.6 “Welding Speed Specifications” on page 9-50.

C. Slope Distance

Displayed only when the Enable Slope box is checked. The robot’s travel distance over which the conditions are gradually changed from the ones set in the “Start Condition” tab to the ones set in the “Main Condition” tab.

D. Crater Duration

The amount of time the Crater setting are applied.

The Crater condition is always used when an Arc End file is used. If the crater condition is not wanted but an Arc End file must be used, the duration can be set to “0.0” or the weld control parameters can be set to be the same as the Main condition.
E. Weld Control Parameters

Process mode selection directly impacts what values and parameters appear in the weld control parameters area. These control parameters vary depending on the process mode selection. Some of the more common parameters include:

- **WFS (Wire Feed Speed)**
  
  In synergic welding modes (synergic CV, pulse GMAW) WFS is the dominant control parameter, controlling all other variables. The user adjusts WFS according to factors such as weld size, penetration requirements, heat input, etc. The WFS setting is used to adjust output characteristics (output voltage, output current) according to pre-programmed settings.

  In non-synergic modes, the WFS control behaves more like a conventional CV power source where WFS and voltage are independent adjustments. Therefore, to maintain the arc characteristics, voltage must be adjusted to compensate for any changes made to the WFS.

- **Voltage**
  
  Welding voltage output value. In constant voltage modes (synergic CV, standard CV) this control adjusts the welding voltage. In pulse synergic welding modes (pulse GMAW only) the user can change the Trim setting to adjust the arc length. It is adjustable from 0.50 to 1.50. A Trim setting of 1.00 is a good starting point for most conditions.

Refer to the Lincoln power source documentation included with your system for more information regarding these and other weld control parameters.
“Burnback” Tab Window

The burnback function is setup to use a wire feed speed of zero while setting the welding voltage (trim) to higher level. This is often used to ensure the wire is cleared from the workpiece at the end of the weld.

Although WFS is a parameter for the burnback procedure, the wire feeder is disabled. For synergic weld modes, the WFS is used to determine the voltage of the weld.

Fig. 9-10: Burnback Tab

A. Burnback Duration
The amount of time the burnback setting are applied.

B. Weld Control Parameters
Process mode selection directly impacts what values and parameters appear in the weld control parameters area. These control parameters vary depending on the process mode selection. Some of the more common parameters include:

- WFS (Wire Feed Speed)
  The wire feeder is always disabled during the burnback process. However, in synergic welding modes (synergic CV, pulse GMAW) WFS is the dominant control parameter, controlling all other variables. The user adjusts WFS according to factors such as weld size, penetration requirements, heat input, etc. The WFS setting is used to adjust output characteristics (output voltage, output current) according to pre-programmed settings.

- Voltage
  Welding voltage output value. In constant voltage modes (synergic CV, standard CV) this control adjusts the welding voltage. In pulse synergic welding modes (pulse GMAW only) the user can change the Trim setting to adjust the arc length. It is adjustable from 0.50 to 1.50. A Trim setting of 1.00 is a good starting point for most conditions.

Refer to the Lincoln power source documentation included with your system for more information regarding these and other weld control parameters.
9.6 Basic Functions

**“Postflow” Tab Window**
Enables postflow of shielding gas as the manipulator holds over the end of the weld.

*Fig. 9-11: Postflow Tab*

- **A. Postflow Time**
  Specifies with the length of time to feed the shielding gas while the manipulator remains stationary at the end of the weld line.

**“Misc” Tab Window**

*Fig. 9-12: Miscellaneous Tab*

- **A. Position Set Zone**
  Specifies the distance from the actual position of the manipulator (the position fed back from the encoder of each axis of the manipulator) to the welding start point, where the manipulator is regarded to have reached the welding start point.
  When the position set zone is set to “Unused”, the welding start signal is output to the Power Source immediately after the move instruction to the welding start point is output.
  When the position set zone is set to 1, the welding start signal is output to the Power Source after the manipulator completely reaches the welding start point and stops.
  When a bigger number is selected (2, 3, or 4), the timing of the output of the welding start signal becomes earlier, i.e., the time from the output of the welding start signal to the welding start point becomes longer.
Crater at the end of the weld bead

If the timing between the manipulator’s stop and the switch of the crater condition are not right, there may be rare occasions when the crater becomes longer as shown below.

In this case, it is effective to set the position set zone to 0 in order to precisely synchronize the timing between the manipulator’s stop and the switch of the crater condition.

When the position set zone is set to 1, the cycle time extends by 0.1 to 0.2 seconds, because the judgment that the manipulator has reached the welding end point is delayed, compared with when the position set zone is set to other than 0.

Set the appropriate position set zone depending on the shape of crater.

B. Enable Stick Check
Specifies whether the stick check function is ON or OFF. This allows the robot to ensure that the wire is free from the workpiece prior to moving to the next programmed point.

These settings override those in the Arc Auxiliary Condition file.

C. Automatically Clear Stuck Wire
If wire stick is detected the power source reenergizes with the settings from the burnback tab in an attempt to clear the stuck wire.

D. Check Duration
Amount of time that the wire stick check is performed. The robot determines if the wire is stuck at the end of this time period.

E. Clear Attempts
Determines the number of times to repeat the auto clear process. If the wire is still stuck after this number of repeated attempts, an alarm appears instructing you to manually cut the wire and reset the alarm.

F. Copy
Allows the user to copy all settings from another Arc End file. The active file number is the destination of the copy. Input the file number of the source file and touch the [Copy From] button.

G. Display Units
Determines if the weld control parameters are displayed in metric or imperial units. This setting does not apply to any Robot Speed fields. The unit for Robot Speed is based on the speed used for programming robot jobs. This can be changed from the main menu under Setup -> Operate Condition.
9.6.6 Welding Speed Specifications

The welding speed is determined by one of the following:

- Welding speed specified by the play speed of the move instruction
- Welding speed specified by the arc start condition file

When the move instruction does not specify a speed

Welding is performed at the welding speed of the ArcStart instruction.

When the move instruction and ArcStart instruction specify different speeds

Priority is given to one according to the parameter values described below. To switch the priorities, change the parameter setting.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Contents</th>
<th>Initial Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AxP005 x: Application number</td>
<td>Move instruction speed is priority: 0</td>
<td>0</td>
</tr>
<tr>
<td>AxP005</td>
<td>ARCON instruction speed is priority: 1</td>
<td></td>
</tr>
</tbody>
</table>

9.6.7 Welding Execution Function During Teach Mode

When the [INTERLOCK] + [WELD ON/OFF] keys are pressed simultaneously, the LED is lit with a beep sound, turning ON the system output signal "#50065: PERMISSIBLE WORK IN TEST RUN."

When pressing these keys once again, the LED goes out and the beep sound stops, then the system output signal "#50065: PERMISSIBLE WORK IN TEST RUN" turns OFF.

This signal allows welding while in Teach mode.

*Welding can be performed during a test run only when the security mode is the management mode.

*Welding cannot be performed during a test run even while the LED is lit unless the security mode is management mode.

During a test run in Teach mode, the manipulator may not move at the actual welding speed due to the speed limit. (e.g. at a welding position/point where the manipulator significantly changes its posture during a coordinated motion with a station)

In these cases, the weld bead may be thicker compared with the bead that is formed during the playback operation, or burn through may occur as the speed of the welding is different from the speed that is appropriate for the welding conditions (current and voltage).
9.7 Arc Retry Function

Non-conductive materials, such as rust, soot, and oil, may cause an arc failure during arc start. An arc failure stops the manipulator and interrupts work. This is prevented by using the arc retry function.

When an arc start failure occurs and the arc retry function is performed, the ARCON process is repeated according to the retry condition defined in the Arc Auxiliary Condition File. The manipulator repeats the ARCON procedure as it slightly shifts its position near the arc starting point. After that, the manipulator returns to the starting point when an arc starts and continues working.

*Fig. 9-13: Retry Function Example*

1. Arc Start Failure
2. The Retry Procedure
   - Returns toward the previous step and performs a retract inching, then returns to the teaching starting point and repeats the ARCON procedure.
3. After a successful arc start, the manipulator continues to weld.
9.7 Arc Retry Function

9.7.1 Arc Retry Function Setting

A. NO. (0 to 9 times)
Maximum repetition count for the arc retry process.

B. RETRACT TIME (0 to 2.50 seconds)
Wire retracting time in the arc retry process.

C. REPLAY DISTANCE (0 to 99.9 mm)
Manipulator moving distance for an arc retry process in replay mode.

D. SPEED (1 to 600 cm/min)
Speed of the manipulator when it returns to the welding start point at arc retry.

E. CURRENT
This option is not used for the Lincoln ArcLink XT interface. The weld settings stored in the arc start file are used when retrying.

F. VOLTAGE
This option is not used for the Lincoln ArcLink XT interface. The weld settings stored in the arc start file are used when retrying.

When the twin synchronous function, etc. is used, the arc retry function cannot be used.
9.8 Arc Restart Function

9.8.1 Notes on Restarting

If the manipulator stops during welding, the arc is automatically turned OFF. When restarted, operation depends on the Restart function settings specified in the ArcAux file. Based on these settings, the robot may perform a lap weld or continue welding in the direction it was traveling prior to the fault. Refer to “Other Tab Window” at page 9-42 for additional information.

When the manipulator stops because of an arc failure, a simple start would leave a break in the welding line. This is prevented by using the arc restart function. When the arc restart function is executed, the manipulator is restarted using the method specified in the Arc Auxiliary Condition File.

DANGER!

If the manipulator is moved from the stopped position using the axis keys, return the manipulator to the stopped position before restarting for safe operation.

It is possible to move the manipulator to the stopped position automatically at restarting and start welding again by the parameter setting (S2C422, S2C423).

[FWD] or [BWD] can be used for moving to the stopped position.

S2C422: Restart Operation after E-Stop (Set 2).
S2C423: Restart Operation after Jog Operation (Set 2).

Refer to "DX100 Concurrent IO Parameter" for details of the parameter setting.
There are three methods to restart the manipulator after an arc failure:

- With the arc OFF, the controller outputs an error signal and the message “RESTARTING FOR ARC,” but continues manipulator movement. After exiting the arc section, the controller outputs the message “END OF ARC RESTARTING,” and continues operation.

- With the arc ON trial, the manipulator automatically returns for the specified overlap length $^{*2}$, and then continues welding.

- The manipulator stops and waits for a manual intervention. After intervention (A), the operator should return the manipulator to the original stop position (B). And then press [START] again. The manipulator returns for the specified overlap length $^{*2}$ (C) and continues the work.

$^{*1}$ The arc auxiliary condition file defines the number of restart attempts, the distance to overlap, and the robot speed. The power output is controlled by the Global Settings in the arc start editor.

$^{*2}$ The overlap length (the length of the section where welding is repeated after a restart) can be set as desired (0 to 99.9mm).

Modifying the job cursor resets the “restarting” status. Therefore, the arc restart function cannot be executed after the cursor is moved.
9.8.2 Arc Auxiliary Condition File

9.8.2.1 Arc Restart Function Setting

A. NO. (0 to 9 times)
Maximum repetition count for the arc restart process regarding the same welding section.

B. LAP DISTANCE (0 to 99.9mm)
Overlapped welding distance in a restart process.

C. SPEED (1 to 600 cm/min)
Speed of the manipulator as it moves backward in an arc restart process.

D. CURRENT
Not applicable for ArcLink XT systems. Refer to the “Other” Tab Window at page 9-42. The weld settings stored in the arc start file are used when restarting. The settings are scaled by the value specified in the Global Settings of the arc start editor.

E. VOLTAGE
Not applicable for ArcLink XT systems. Refer to the “Other” Tab Window at page 9-42. The weld settings stored in the arc start file are used when restarting. The settings are scaled by the value specified in the Global Settings of the arc start editor.
F. RESTART MODE

1. ARC FAILURE

(1) NO RESTART:
   – Arc restart function is not used. The manipulator stops with the arc
     failure alarm.

(2) ARCOF CONTINUE:
   – With the arc OFF, the controller outputs the “Restarting for Arc”
     message and the manipulator keeps moving.
   – After moving through the arc section, the controller outputs the “End
     of Arc Restarting” message and resumes normal welding operation.
   – The message is reset when OUT #2045 is turned ON and OFF.

(3) AUTO RESTART:
   – The manipulator automatically restarts.

(4) SEMI-AUTO RESTART:
   – The manipulator stops and waits for manual intervention.
   – The manipulator restarts when the operator presses [START] again.
   – The restart status is reset when OUT #2046 is turned ON and OFF.

2. GAS FAILURE

(1) NO RESTART:
   – Arc restart function is not used. The manipulator moves with the gas
     shortage alarm.

(2) ALARM AT ARC END:
   – The manipulator continues the welding operation until it reaches the
     welding end point, where it stops with an alarm.

(3) SEMI-AUTO RESTART:
   – The manipulator stops and waits for manual intervention.
   – The manipulator restarts as the operator presses [START] again.
   – The restart status is reset when OUT #2046 is turned ON and OFF.

3. WIRE FAILURE

(1) NO RESTART:
   – Arc restart function is not used. The manipulator moves with the wire
     shortage alarm.

(2) ALARM AT ARC END:
   – The manipulator continues the welding operation until it reaches the
     welding end point, where it stops with an alarm.

(3) SEMI-AUTO RESTART:
   – The manipulator stops and waits for manual intervention.
   – The manipulator restarts as the operator presses [START] again.
   – The restart status is reset when OUT #2046 is turned ON and OFF.

When the complete synchronization of the twin synchronous
function is used, the arc restart function cannot be used.
9.9 Wire-stick Check Function

- **Anti-Stick Function**
  
  The wire may stick to the workpiece after welding is completed (1.)
  
  As an anti-stick process, the Power Source temporarily reapply the voltage at the end of welding (2.)
  
  After the anti-stick process, a wire stick check is performed (3.)
  
  If the anti-stick process failed and a wire stick is detected, the manipulator enters a hold status or performs the automatic sticking release process, depending on the anti-stick condition specified.
  
  Time required for the anti-stick process is configured in the arc end condition editor.
  
  The wire check is performed after the anti-stick process time has elapsed.

**Wire stick**

“Wire stick” refers to the contact of the wire to the workpiece as observed after the arc-OFF.

1. Welding End (Wire Stick Occurrence)

2. Anti-stick Process

3. Wire Stick Check
   - Wire stick check is performed after elapsing of the anti-stick process time defined in the Power Source characteristic file.
9.10 Automatic Wire-stick Release Function

Refer to the “Misc” Tab Window at page 9-48 for wire-stick release settings.

- **Automatic Wire-stick Release Function**
  
The automatic wire-stick release function is only used when the Arc End file specifies at least one “Auto Clear Attempt.”

  When this function is used, the manipulator does not immediately output the wire sticking signal upon detecting a wire stick, but automatically attempts to release the wire by re-energizing the welding power supply.

  When the stick release process has failed for a specified number of times, the manipulator stops and outputs the wire stick signal.

  This function is specified in the arc end condition file. When it is used, the number of attempts are set in the end condition editor.

- **Manipulator Stopped by Wire Stick**
  
  If a wire stick occurs at the end of welding, the manipulator immediately stops in the hold status. While the manipulator remains in the hold status, the [HOLD] lamp lights and the external system output signal “Wire Sticking” is output. A message on the pendant instructs the user to manually cut the wire before pressing the RESET button.

  Once the wire has been cut and the [Reset] button pressed, the power source applies a 50v touchsense signal to confirm that the wire has been cleared.
9.10 Automatic Wire-stick Release Function

9.10.1 Arc Auxiliary Condition File

### 9.10.1.1 Automatic Wire Anti-stick Function Setting

The Arc Auxiliary File is not used for anti-stick with the Lincoln ArcLink XT interface. Refer to the “Misc Tab Window” at page 9-48 for correct settings for anti-stick.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARC AUXILIARY COND</td>
<td>COND NO:</td>
<td>&lt;WIRE ANTI-STICKING FUNCTION SET&gt;</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>NO.</td>
<td>1 times</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>CURRENT</td>
<td>110 A</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>VOLTAGE</td>
<td>120 %</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>CLOCK</td>
<td>0.30 sec</td>
<td></td>
</tr>
</tbody>
</table>

**A. NO. (0 to 9 times)**

Not applicable for ArcLink XT systems. Refer to the “Misc Tab Window” at page 9-48 for correct settings for wire anti-stick function settings.

**B. CURRENT (1 to 999A)**

Not applicable for ArcLink XT systems. Refer to the “Misc Tab Window” at page 9-48 for correct settings for wire anti-stick function settings.

**C. VOLTAGE (0 to 50.0V, 50 to 150%)**

Not applicable for ArcLink XT systems. Refer to the “Misc Tab Window” at page 9-48 for correct settings for wire anti-stick function settings.

**D. CLOCK (0 to 2.00 seconds)**

Not applicable for ArcLink XT systems. Refer to the “Misc Tab Window” at page 9-48 for correct settings for wire anti-stick function settings.
9.11 Slope Up/Down Function

The slope up/down function is used during welding to gradually change the welding condition.

This function is extremely effective in conducting heat for such operations on work pieces such as the one shown below.

During the welding of a workpiece as shown below, especially during the period before the end of welding, the tearing or dropping of metal can occur quite frequently due to heat conduction.

However, even in this example, if the welding condition is gradually decreased before the end of welding, tearing and dropping of metal can be prevented.

<table>
<thead>
<tr>
<th>Reference Job</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>MOVL V=500</td>
<td>Moves to welding start point P1. Arc starts.</td>
</tr>
<tr>
<td>ARCON ASF#(1)</td>
<td></td>
</tr>
<tr>
<td>MOV C V=80</td>
<td></td>
</tr>
<tr>
<td>MOV C V=80</td>
<td></td>
</tr>
<tr>
<td>MOV C V=80</td>
<td></td>
</tr>
<tr>
<td>MOV C V=80</td>
<td></td>
</tr>
<tr>
<td>ARCCTE ASF#(4)</td>
<td></td>
</tr>
<tr>
<td>MOV C V=80</td>
<td></td>
</tr>
<tr>
<td>ARCOF AEF#(2)</td>
<td></td>
</tr>
<tr>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>

![Diagram showing welding start point (P1) and welding end point (Pn) must be the same.](image)

![Graph showing current vs. position with main condition and end condition.](graph)
9.11.1 ARCCTS

9.11.1.1 Function

The ARCCTS instruction is used with a move instruction to gradually change the weld settings during welding.

A gradual change in the power output is specified by an aimed value and the length of the slope up/down section. The length of the slope up/down section is set from the move start point.

If no length is specified, the entire section of the move instruction is used.

9.11.1.2 Syntax

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WELD1</td>
<td>Selects the Power Source 1.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>WELD2</td>
<td>Selects the Power Source 2.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>WELD3</td>
<td>Selects the Power Source 3.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>WELD4</td>
<td>Selects the Power Source 4.</td>
<td></td>
</tr>
</tbody>
</table>
9 Arc Welding Application
9.11 Slope Up/Down Function

AVP = Percentage against the proper voltage output value

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
</table>
| 7   | AVP = Percentage against the proper voltage output value | Specifies the target value of welding voltage by the percentage against the proper output value of welding voltage. | Percentage: 50 to 150%
The voltage output value can be specified by B/I/D/B[ ][I][D][LB/LD/LB][ ][I][LD[ ] variable. |

DIS = Slope up/down section length
This tag can be added or omitted.

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
</table>
| 10  | DIS = Slope up/down section length       | Specifies the slope up/down section length where the current and voltage are gradually changed. The length is set as the distance from the move start point. If no length is specified, the entire section of the move instruction is used. | Length: 0.1 to 6553.5 mm
The slope up/down section length can be specified by B/I/D/B[ ][I][D][LB/LD/LB][ ][I][LD[ ] variable. (Unit: 0.1 mm) |

Gradually Decreasing Current or Voltage

Gradually Increasing Current or Voltage
9.11.1.4 Registering the ARCCTS Instruction

1. Press [INFORM LIST].
   - The instruction list dialog box appears.

   ![Instruction List Dialog Box]

2. Select the ARCCTS instruction.
   - The ARCCTS instruction appears in the input buffer line.

3. Press [SELECT] and set the welding condition in the DETAIL EDIT window.

**NOTE**

- The ARCCTS or ARCCTE instruction is valid for only one step.
- If the move section specified by the move instruction is shorter than the distance specified by the slope up/down section length (DIS=XXX), the change is performed equally in the entire section of the move instruction.
- If the ARCCTS or ARCCTE instruction specifies the distance as zero (DIS=0.00), the change is performed equally in the entire section of the move instruction.
- A pair of ARCCTS and ARCCTE instructions can be used on one move instruction. In this case, the ARCCTS instruction is executed first, then the ARCCTE instruction is executed in the remaining part of the move section. If the remaining part of the move section is 0mm, the value instantly changes to the value specified in the ARCCTE instruction.
9.11 Slope Up/Down Function

- The DETAIL EDIT window appears.

1. Move the cursor to the item to be set and press [SELECT].
2. Type the welding conditions using the numeric keys and press [ENTER].
3. To add the additional items, place the cursor on the item with the “UNUSED” condition and press [SELECT]. The selection dialog box appears. To delete the additional items, line up the cursor with the additional items and select “UNUSED.”
9.11 Slope Up/Down Function

4. Press [ENTER].
   – The set contents are displayed in the input buffer line.

   ![JOB CONTENT display](image)

5. Press [ENTER].
   – The set contents are registered in the job.

   ![JOB CONTENT display](image)

   – Press [CANCEL] to return to the JOB CONTENT window when the set contents are not to be registered.

   ![JOB CONTENT display](image)
9.11.2 **ARCCTE**

9.11.2.1 **Function**

The ARCCTE instruction is used with a move instruction to gradually change the welding current and voltage during welding.

A gradual change in the current or voltage is specified by an aimed value and the length of the slope up/down section. The length of the slope up/down section is measured from the move end point (DIS).

If no length is specified, the entire section of the move instruction is used.

9.11.2.2 **Syntax**

![Diagram of ARCCTE function](image)

9.11.2.3 **Explanation**

**WELD1/WELD2/WELD3/WELD4**

Choose one of the following tags.

These tags are enabled only when multiple applications are in use and two or more applications are set as arc welding application.

When there is only one application, these tags are not displayed.

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WELD1</td>
<td>Selects the Power Source 1.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>WELD2</td>
<td>Selects the Power Source 2.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>WELD3</td>
<td>Selects the Power Source 3.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>WELD4</td>
<td>Selects the Power Source 4.</td>
<td></td>
</tr>
</tbody>
</table>
Robotic Arc Welding
Lincoln ARCLINK XT

9.11 Slope Up/Down Function

AVP = Percentage against the proper voltage output value
Be sure to choose either of the following.

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>AV = Voltage output value</td>
<td>Specifies the target value of welding voltage.</td>
<td>Voltage value: 0.1 to 50.0 V The voltage output value can be specified by B/I/D/B/IB/L/DB/LB/LI/LZ/LB/LI/LZ variable. (Unit: 0.1 V)</td>
</tr>
</tbody>
</table>

DIS = Slope up/down section length
This tag can be added or omitted.

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>DIS = Slope up/down section length</td>
<td>Specifies the slope up/down section length where the current and voltage are gradually changed. The length is set as the distance from the move start point. If no length is specified, the entire section of the move instruction is used.</td>
<td>Length: 0.1 to 6553.5 mm The slope up/down section length can be specified by B/I/D/B/IB/L/DB/LB/LI/LZ/LB/LI/LZ variable. (Unit: 0.1 mm)</td>
</tr>
</tbody>
</table>

Gradually Decreasing Weld Settings

Gradually Increasing Weld Settings
9 Arc Welding Application

9.11 Slope Up/Down Function

9.11.2.4 Registering the ARCCTE Instruction

1. Press [INFORM LIST].
   - The instruction list dialog box appears.

   ![INFORM LIST Dialog Box]

2. Select the ARCCTE instruction.
   - The ARCCTE instruction appears in the input buffer line.

![Input Buffer Line]

NOTE

- The ARCCTS or ARCCTE instruction is valid for only one step.
- If the move section specified by the move instruction is shorter than the distance specified by the slope up/down section length (DIS=XXX), the change is performed equally in the entire section of the move instruction.
- If the ARCCTS or ARCCTE instruction specifies the distance as zero (DIS=0.00), the change is performed equally in the entire section of the move instruction.
- A pair of ARCCTS and ARCCTE instructions can be used on one move instruction. In this case, the ARCCTS instruction is executed first, then the ARCCTE instruction is executed in the remaining part of the move section. If the remaining part of the move section is 0mm, the value instantly changes to the value specified in the ARCCTE instruction.
3. Press [SELECT] and set the welding condition in the DETAIL EDIT window.

- The DETAIL EDIT window appears.

(1) Move the cursor to the item to be set and press [SELECT].

(2) Type the welding conditions using the numeric keys and press [ENTER].

(3) To add the additional items, place the cursor on the item with the “UNUSED” condition and press [SELECT]. The selection dialog box appears. To delete the additional items, line up the cursor with the additional items and select “UNUSED.”
4. Press [ENTER].

- The set contents are displayed in the input buffer line.

![Image of input buffer line]

5. Press [ENTER].

- The set contents are registered in the job.

![Image of registered job content]

- Press [CANCEL] to return to the JOB CONTENT window when the set contents are not to be registered.

![Image of job content window with [CANCEL] button]
9.12 Weaving Condition File

9.12.1 Weaving Basic Coordinate System

Weaving is performed based on the following coordinate system. This coordinate system is automatically generated when weaving is executed.

Wall Direction: Z-direction of the robot axis
Horizontal Direction: The direction to the approach point from the wall
Direction of Travel: The direction in which the manipulator moves from the weaving start point to the end point

The approach point is a point indicated by a step immediately before the step where weaving starts.

Depending on the mounting status and shape of the workpiece, a definition of the above coordinate system may not be sufficient to generate a weaving pattern. In this case, register the reference point REFP 1 or REFP 2.

For details, refer to Section 9.12.4.2 “Editing the Condition Data” on page 9-88.
9.12.1.1 Cases that Require the Registration of Reference Points

Registration of the reference point REFP1 or REFP2 is not usually required. They are required only with a special workpiece condition, etc.

The REFP1, that 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.

**Example 1**
REFP1 is registered because the wall direction is not parallel to the Z-axis of the robot coordinates.

**Example 2**
REFP2 is registered because the approach point is at another side of the wall.

For information on registering REFP, refer to Section 3.2.3.2 "Registering Reference Point Instructions" on page 3-16.
9.12.2 WVON

9.12.2.1 Function
This is the weaving start operation.

9.12.2.2 Syntax
The tag to be used varies according to the control group of job.

Table 9-1: Job Type and Control Group

<table>
<thead>
<tr>
<th>No.</th>
<th>Type</th>
<th>Control Group of Job</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Independent</td>
<td>Job with one manipulator (Standard)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Coordinated</td>
<td>Job with two manipulators</td>
<td>Option</td>
</tr>
</tbody>
</table>

Table 9-2: Tag Usage Limitation

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Control Group of Job</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RB1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>RB2</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>RB3</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>WEV#()</td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>5</td>
<td>AMP=</td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>6</td>
<td>FREQ=</td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>7</td>
<td>ANGL=</td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>8</td>
<td>DIR=</td>
<td></td>
<td>O</td>
</tr>
</tbody>
</table>

O: Available
X: Not available
9.12.2.3 Explanation

Be sure to choose one of the following tags.

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RB1</td>
<td>Specifies the weaving motion of robot 1.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>RB2</td>
<td>Specifies the weaving motion of robot 2.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>RB3</td>
<td>Specifies the weaving motion of robot 3.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>RB4</td>
<td>Specifies the weaving motion of robot 4.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>RB5</td>
<td>Specifies the weaving motion of robot 5.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>RB6</td>
<td>Specifies the weaving motion of robot 6.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>RB7</td>
<td>Specifies the weaving motion of robot 7.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>RB8</td>
<td>Specifies the weaving motion or robot 8.</td>
<td></td>
</tr>
</tbody>
</table>

**WEV# (Weaving condition file number) AMP = Weaving half-amplitude**
Be sure to choose one of the following tags.

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>WEV# (Weaving condition file number)</td>
<td>Specifies the weaving condition file number. Conditions for the weaving motion are registered in the weaving condition file.</td>
<td>No. 1 to 16 The number can be specified by B/I/D/LB/LI/LD variable.</td>
</tr>
<tr>
<td>10</td>
<td>AMP = Weaving half-amplitude</td>
<td>Specifies the half-amplitude of weaving.</td>
<td>Half-amplitude: 0.1 to 99.9 mm The half-amplitude can be specified by B/I/D/LB/LI/LD/LB/LI/LD/LI variable. (Unit: 0.1 mm)</td>
</tr>
</tbody>
</table>

**FREQ = Weaving frequency**
Only when “AMP = Weaving half-amplitude” is selected in the above “WEV# (Weaving condition file number) AMP = Weaving half-amplitude” at page 9-74, be sure to add the following tag.

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>FREQ = Weaving</td>
<td>Specifies the weaving frequency.</td>
<td>Frequency: 1.0 to 5.0 Hz The frequency can be specified by B/I/D/LB/LI/LD/LB/LI/LD/LI variable. (Unit: 0.1 Hz)</td>
</tr>
<tr>
<td></td>
<td>frequency</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### ANGL = Weaving angle

Only when “AMP = Weaving half-amplitude” is selected in the above “WEV# (Weaving condition file number)/AMP = Weaving half-amplitude” at page 9-74, this tag is added or omitted after “FREQ = Weaving frequency” at page 9-74.

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
</table>
| 12  | ANGL = Weaving angle | Specifies the weaving angle.     | Angle: 0.1 to 180.0 degree
The degree can be specified by B/I/D/B[ ]/I[ ]/D[ ]/LB/LI/LD/LB[ ]/LI[ ]/LD[ ] variable.
(Unit: 0.1) |

### DIR = Starting direction of weaving

This tag can be added or omitted.

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
</table>
| 13  | DIR = Starting direction of weaving | Specifies the starting direction of weaving. | Direction: 0 to 1
0: Forward
1: Backward
The direction can be specified by B/I/D/B[ ]/I[ ]/D[ ]/LB/LI/LD/LB[ ]/LI[ ]/LD[ ] variable. |
Setting conditions for weaving

• Weaving half-amplitude
  Specifies the amplitude size of weaving motion.

• Weaving angle
  Specifies the angle of weaving motion.

• Starting direction of weaving
  Specifies the starting direction of weaving motion.
9.12.2.4 Registering the WVON instruction

This is the instruction to start the weaving operation.

1. Move the cursor to the address area.
2. Press [INFORM LIST].
   – The instruction list dialog box appears.

3. Select “DEVICE.”

4. Select the WVON instruction.
   – The “WVON” instruction appears in the input buffer line.

5. Press [SELECT], and set the file number in the DETAIL EDIT window.
   – Select the file number (1 to 16.)
     (1) Move the cursor to the file number and press [SELECT].
(2) Input the file number using the numeric keys and press [ENTER].

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>WVON</td>
<td>WVON</td>
<td>WVON WEV#(1)</td>
<td>WVON WEV#(1)</td>
</tr>
</tbody>
</table>

6. Press [ENTER].
   - The set contents are displayed in the input buffer line.

   - The set contents are registered in the job.

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB CONTENT</td>
<td>JOB NAME: WORK A</td>
<td>CONTROL GROUP: R1</td>
<td></td>
</tr>
<tr>
<td>0000</td>
<td>NOP</td>
<td>ARCON</td>
<td>ARCTE</td>
</tr>
<tr>
<td>0001</td>
<td>MOV J=80.00</td>
<td>VWELD</td>
<td>DEVICE</td>
</tr>
<tr>
<td>0002</td>
<td>MOV L=800</td>
<td>ARWELD</td>
<td>MCTK</td>
</tr>
<tr>
<td>0003</td>
<td>ARCON</td>
<td>ARSET</td>
<td>ARTH</td>
</tr>
<tr>
<td>0004</td>
<td>WVON WEV#(1)</td>
<td>WVON</td>
<td>SRFL</td>
</tr>
<tr>
<td>0005</td>
<td>MOV J=50</td>
<td>MOV</td>
<td>OTHER</td>
</tr>
<tr>
<td>0006</td>
<td>MOV L=50</td>
<td>MOV</td>
<td>OTHER</td>
</tr>
<tr>
<td>0007</td>
<td>ARCON</td>
<td>ARCON</td>
<td>SAME</td>
</tr>
<tr>
<td>0008</td>
<td>END</td>
<td>ARCTE</td>
<td>PRIOR</td>
</tr>
</tbody>
</table>

- When the set contents are not to be registered, press [CANCEL] to return to the JOB CONTENT window.
9.12.3 WVOF Instruction

9.12.3.1 Function
This is the weaving end instruction.

9.12.3.2 Syntax
The control group of job limits the tag usage.

```
WVOF → END
    1
    RBn
```

Table 9-3: Job Type and Control Group

<table>
<thead>
<tr>
<th>No.</th>
<th>Type</th>
<th>Control Group of Job</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Independent</td>
<td>Job with one manipulator (Standard)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Coordinated</td>
<td>Job with two manipulators</td>
<td>Option</td>
</tr>
</tbody>
</table>

Table 9-4: Tag Usage Limitation

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Control Group of Job</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RB1</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>2</td>
<td>RB2</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>3</td>
<td>RB3</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>4</td>
<td>RB4</td>
<td>X</td>
<td>O</td>
</tr>
</tbody>
</table>

O: Available
X: Not available
9.12.3.3 Explanation


Be sure to choose one of the following tags.

<table>
<thead>
<tr>
<th>No.</th>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RB1</td>
<td>Specifies the weaving motion of robot 1.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>RB2</td>
<td>Specifies the weaving motion of robot 2.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>RB3</td>
<td>Specifies the weaving motion of robot 3.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>RB4</td>
<td>Specifies the weaving motion of robot 4.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>RB5</td>
<td>Specifies the weaving motion of robot 5.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>RB6</td>
<td>Specifies the weaving motion of robot 6.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>RB7</td>
<td>Specifies the weaving motion of robot 7.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>RB8</td>
<td>Specifies the weaving motion of robot 8.</td>
<td></td>
</tr>
</tbody>
</table>

*Example*

```
NOP
MOVJ VJ=50.00
MOVL V=220
MOVL V=200
WVON WEV#(2)
ARCON AC=220 AVP=100 T=0.50
MOVL V=138
ARCOF AC=160 AVP=90 T=0.50
WVOF
MOVL V=200
MOVJ VJ=50.00
END
```

![Diagram of robotic arc welding process]
9.12.3.4 Registering WVOF instruction

This is the instruction to end the weaving operation.

1. Move the cursor to the address area.
2. Press [INFORM LIST].
   - The instruction list dialog box appears.
3. Select “DEVICE.”
4. Select the “WVOF” instruction.
5. Press [ENTER].
   - The set contents are registered in the job.
9.12.4 WEAVING CONDITION Window

A. COND NO. (1 to 255)
Displays a weaving condition file number between 1 and 255.

B. MODE, C. SMOOTH
There are three weaving modes: single, triangle, and L-type. Each mode can be specified with or without smoothing.

D. SPEED TYPE (FREQUENCY, MOTION TIME)
Specifies the setting type of the weaving motion speed.
Two types are available: setting by frequency and setting by the weaving time in each weaving section.
E. FREQUENCY
Specifies the weaving frequency if “SPEED TYPE” is set to “FREQUENCY.” Note that the maximum frequency is determined by the amplitude as illustrated in the graph below. Specify a frequency within the allowable range.

F. PATTERN
• AMPLITUDE
  Specifies the amplitude size at weaving when “MODE” is set to “SINGLE.”

• VERTICAL, HORIZONTAL
  If “MODE” is set to “TRIANGLE” or “L-TYPE,” the data for the triangle must be set to define the weaving pattern.
• **ANGLE**
  Specifies the angle of weaving motion.

  **MODE: SINGLE**

  ![Diagram of Angle in Mode SINGLE]

  Angle: 0.1 to 180.0°

• **TRAVEL ANGLE**
  Specifies the travel angle of weaving motion.

  **MODE: TRIANGLE, L-TYPE**

  ![Diagram of Travel Angle in Mode TRIANGLE, L-TYPE]
Robotic Arc Welding
Lincoln ARCLINK XT

9 Arc Welding Application
9.12 Weaving Condition File

G. TIMER (MODE)
As shown below, a single weaving cycle is divided into three or four sections. The timer mode can be specified for each section.

Set one of the following timer modes:
WEAV STOP: Weaving stops but manipulator moves.
ROBOT STOP: Manipulator stops.

H. MOTION TIME
If “SPEED TYPE” is set to “MOTION TIME,” the weaving time specified here determines the moving speed in each of the weaving sections (explained in “TIMER (MODE)” above).

I. STOP TIMER
Specifies the timer to determine weaving stop or manipulator stop for each section (explained in “TIMER (MODE)” above).

J. HOVER WEAVING COND. (option)
• SET (ON/OFF)
  Specifies whether hover weaving is used or not.

• TIMER
  Finishes hover weaving when the time specified here ends.

• INPUT SIGNAL
  Finishes hover weaving when the input signal specified here is input.

<table>
<thead>
<tr>
<th>Reference Job</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOP</td>
</tr>
<tr>
<td>MOVJ VJ=10.00</td>
</tr>
<tr>
<td>MOVJ VJ=25.00</td>
</tr>
<tr>
<td>REFP 3</td>
</tr>
<tr>
<td>ARCON ASF#(1)</td>
</tr>
<tr>
<td>WVON WEV#(1)</td>
</tr>
<tr>
<td>MOVL V=60</td>
</tr>
<tr>
<td>WVOF</td>
</tr>
<tr>
<td>ARCOF</td>
</tr>
<tr>
<td>MOVJ VJ=25.00</td>
</tr>
<tr>
<td>MOVJ VJ=25.00</td>
</tr>
<tr>
<td>END</td>
</tr>
</tbody>
</table>

Welding start point.
Reference point for defining the direction of travel.
*Teaching by interpolation instruction, not by joint interpolation.
The same point with the welding start point.
In hover weaving, the start and end points are the same. Therefore, the weaving direction cannot be determined. For this reason, the user needs to register a reference point (REFP 3) to define the direction of travel.

**NOTE**

In hover weaving, the start and end points are the same. Therefore, the arc retry function and arc restart function are not available.

**Wall Direction:** Robot axis Z+ direction  
**Horizontal Direction:** Direction from the wall to approach point  
**Direction of Travel:** Direction from weaving start point to REFP3
9.12.4.1 Displaying a Weaving File

1. Select {ARC WELDING} under the main menu.

![Main Menu Screen]

2. Select {WEAVING}.

![Weaving Condition File Screen]

3. Display the desired file number.

   (1) The desired file can be called up by using the page key .

   (2) Press the page key to call the next file.

   (3) Press [SHIFT]+ page key to call the previous file.
9.12.4.2 Editing the Condition Data

1. Select the item to be edited.

2. Input the value using the numeric keys.
9.12.5 Prohibiting Weaving

If the weaving instruction is registered during the “CHECK” operation in Play mode or “TEST RUN” or [FWD] key operation in Teach mode, weaving is performed as well as other move instructions.

However, in the cases when weaving should not be performed because the manipulator collides with a workpiece, etc., follow the procedure below to prohibit weaving.

9.12.5.1 Method to Prohibit Weaving During a “CHECK” operation

2. Select {UTILITY}.
3. Select {SETUP SPECIAL RUN}.
   – The SPECIAL PLAY window appears.
4. Select “WEAV PROHIBIT IN CHK-RUN.”
   – Each time [SELECT] is pressed, “VALID” and “INVALID” alternate.
9.12.5.2 Method to Prohibit Weaving During the “TEST RUN” or FWD Operation

1. Press [AREA] on the JOB CONTENT window in the Teach mode.

2. Select {UTILITY}.

3. Select {SETUP SPECIAL RUN}.
   - The SPECIAL TEACH window appears.

4. Select “WEAV PROHIBIT IN TEST RUN/NEXT.”

9.12.5.3 Method to Prohibit 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 a check operation.
9.13 Changing Welding Conditions During Playback

9.13.1 ARC COND ADJUSTMENT Window

The welding workpoint and trim can be modified in the ARC COND ADJUSTMENT window while in Play mode. Typically current modifies the workpoint and voltage modifies the trim settings. The selection of which parameter is modified depends on the welding mode selected within the welder.

Great care must be taken when making changes using the Arc Condition Adjustment screen as the units displayed are not accurate and should only be used as a rough estimate of where the current settings fall within the operating range of the power source.

10<Current<999 = range for workpoint
10<Voltage<50 = range for trim

A. CURR (A)/VOLT (%)

Depending on the selected weld mode:
CURRENT: This control adjusts the workpoint for the process; typically wirefeed speed. For non-synergic weld modes, this adjusts voltage.
VOLTAGE: This control typically adjusts the Arc Voltage by either increasing the CV voltage command or the pulse welding parameters resulting in increased voltage and arc length. for non-synergic weld modes, this adjusts the wire feed speed.

B. DATA (Change data or No change data)

Specifies whether or not to rewrite the condition file data or additional item.
The data is rewritten when the execution of the instruction which includes the changed condition data ends.

C. INST

The last instruction that sets the welding current or voltage is displayed.
The instruction includes the following:
• ARCON
• ARCSET
9.13 Changing Welding Conditions During Playback

9.13.1.1 Displaying the ARC COND ADJUSTMENT Window

1. Press [AREA] on the PLAYBACK window while in Play mode and in a job screen.
2. Select {UTILITY}.
3. Select {WELD COND. ADJUST.}.

Changing the Welding Conditions

1. Cursor to the current or voltage condition to be adjusted.
   – The Workpoint (typically wirefeed speed) and trim (typically arc length) can be independently changed.
   – Press the key [CURR/VOL] to increase the Workpoint (WFS) and Trim (arc length).
   – Press the key [CURR/VOL] to decrease the Workpoint (WFS) and Trim (arc length).
   – Each time the key is pressed, the current value changes in increments of 1A, and the voltage value changes in increments of 1% or 0.1V.
Editing “DATA”

1. Select “DATA.”

   – Each time [SELECT] is pressed, the setting alternates between “No change data” and “Change data.”
9.13.2 Notes on Modification of Welding Conditions

9.13.2.1 When Condition Data cannot be Modified

In the following cases, the window returns to the previous window of the ARC COND ADJUSTMENT window. Current and voltage cannot be modified, regardless of whether function keys are pressed.

- When the mode is switched (to the Teach mode, etc.)
- When the emergency stop is activated.

9.13.2.2 ARCON Instruction

The ARCON instruction without an additional item is not subject to arc condition rewriting.

- ARCON ASF#(1) : Current and voltage values can be rewritten.
- ARCON ASF#(6) : Conditions cannot be rewritten.

9.13.2.3 ARCOF Instruction

The conditions of the ARCOF instruction cannot be rewritten.

9.13.2.4 ARCCTS and ARCCTE Instructions

The arc condition adjustment operation is invalid while the slope up/down instruction ARCCTS or ARCCTE is executed.

Even if "Change data" is set on the ARC COND ADJUSTMENT window, rewriting cannot be done after the ARCCTS or ARCCTE instruction.

Refer to Section 9.10.1 “Arc Auxiliary Condition File” on page 9-59 for details regarding the ARCCTS and ARCCTE instructions.
9.14 Displaying Welding Alarm History

Historical records of welding-related alarms can be viewed on the user alarm (system section) window.

To view the detailed information about alarm occurrence, use the alarm detailed window.

9.14.1 Alarm History Windows

There are 5 types of alarm history windows:

- MAJOR ALARM
- MINOR ALARM
- USER ALARM (SYSTEM)
- USER ALARM (USER)
- OFF-LINE ALARM

In each window, the alarm code, occurrence date, time, and detailed information are displayed.

1. Select {SYSTEM INFO} under the main menu.
   - The sub-menu for the system information appears.

2. Select {ALARM HISTORY}.
   - The alarm history window appears.
3. Using the page key to change the window.

– Each time the page key is pressed, the window alternates between “MAJOR ALARM,” “MINOR ALARM,” “USER ALARM (SYSTEM),” “USER ALARM (USER),” and “OFF-LINE ALARM.”

9.15 Arc Welding Management and Maintenance

9.15.1 ARC WELD DIAGNOSIS Window

Optimum arc welding requires timely contact-tip replacement and nozzle cleaning.

It is also recommended that the user check how often such functions as arc retry, arc restart, and automatic anti-stick have been used and adjust the operating environment and work conditions accordingly.

The use of the above-mentioned functions can be controlled or confirmed in the ARC WELD DIAGNOSIS window.

For example, contact-tip replacement is initially set at 180 minutes. When the welding time reaches 180 minutes, an external output signal (system output) is output. The operator can then replace the tip or adjust as necessary.

9.15.2 ARC WELD DIAGNOSIS Window

A. WORK CONTINUE (CONT, STOP)

When the manipulator is restarted after it stops in the middle of a work section, the manipulator either performs welding over the remaining part of the section or moves without performing welding.
B. TIP REPLACE, NOZZLE CLEAN (0 to 999 minutes)

In the “SETTING” fields, specify the timings for contact-tip replacement and nozzle cleaning. The initial values are 180 minutes for contact-tip replacement; 30 minutes for nozzle cleaning. The “ACCUM.” fields display an accumulated service duration.

C. RETRY, RESTART (ARC), ANTI-STICK

In each of the “SETTING” fields, specify a reference value for the number of times each function is used. As an initial setting, 10 is specified for each function. Each of the “ACCUM.” fields displays the accumulated count, showing how many times the function has been used.

ARC RETRY, ARC RESTART, and ANTI-STICK counts:

These counts are different from the maximum repetition counts specified in the arc auxiliary condition file. These counts show how many times these functions have actually been used.

9.15.2 Editing the ARC WELD DIAGNOSIS Window

1. Select {ARC WELDING} under the main menu.

2. Select {ARC WELD DIAG}.

3. Line up the cursor with each set item and press [SELECT] to edit it.
4. Set the work continue specification.
   – Each time [SELECT] is pressed, the setting alternates between “CONT” and “STOP.”

5. Set the control value.
   – Move the cursor to the setting value to be changed and press [SELECT].

6. Input the desired value using the numeric keys and press [ENTER].

The accumulated value can be cleared by either of the following:
• ARC WELD DIAGNOSIS window
• External input signal (system input signal)
## 9.16 Appendix 1

### 9.16.1 Table of Work Instructions

- < > indicates alpha-numerical data.
- If multiple items are shown in one additional item section, select one.

**Table 9-5: Arc Welding Instructions**

<table>
<thead>
<tr>
<th>ARCON Function</th>
<th>Outputs arc start conditions and an arc start instruction for the Power Source.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>WELD1, WELD2, WELD3, WELD4 Displayed only when using multiple manipulators.</td>
</tr>
<tr>
<td>Example</td>
<td>ARCON ASF#(1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ARCOF Function</th>
<th>Outputs arc end conditions and an arc end instruction for the Power Source.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>WELD1, WELD2, WELD3, WELD4 Displayed only when using multiple manipulators.</td>
</tr>
<tr>
<td>Example</td>
<td>ARCOF AEF#(1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ARCSET Function</th>
<th>Changes the welding conditions individually.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>WELD1, WELD2, WELD3, WELD4 Displayed only when using multiple manipulators.</td>
</tr>
<tr>
<td>Example</td>
<td>ARCSET ASF#(16)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ARCCTS Function</th>
<th>Changes the welding conditions gradually during execution of welding.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>WELD1, WELD2, WELD3, WELD4 Displayed only when using multiple manipulators.</td>
</tr>
<tr>
<td>Example</td>
<td>ARCCS ASF#(16)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ARCCTE Function</th>
<th>Changes the welding conditions gradually during execution of welding.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>WELD1, WELD2, WELD3, WELD4 Displayed only when using multiple manipulators.</td>
</tr>
<tr>
<td>Example</td>
<td>ARCCTE ASF#(16)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WVON Function</th>
<th>Starts weaving.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>RB1, RB2, RB3, RB4 Displayed only when using multiple manipulators.</td>
</tr>
<tr>
<td>Example</td>
<td>WVON WEV#(1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WVOF Function</th>
<th>Ends weaving.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>RB1, RB2, RB3, RB4 Displayed only when using multiple manipulators.</td>
</tr>
<tr>
<td>Example</td>
<td>WVOF</td>
</tr>
</tbody>
</table>
## Appendix 2

### 9.17.1 Power Source Condition File Initial Value

The initial value data for 24 Power Sources are prepared as follows:

<table>
<thead>
<tr>
<th>Power Source No.</th>
<th>Power Source Name</th>
<th>Power Supply</th>
<th>Shielding Gas</th>
<th>Wire Diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MOTOWELD-E series 350A class</td>
<td>Synergic</td>
<td>MAG (or CO2)</td>
<td>1.2 (or any)</td>
</tr>
<tr>
<td>2</td>
<td>MOTOWELD-E series 350A class</td>
<td>Independent</td>
<td>MAG (or CO2)</td>
<td>1.2 (or any)</td>
</tr>
<tr>
<td>3</td>
<td>MOTOWELD-E series 500A class</td>
<td>Synergic</td>
<td>MAG (or CO2)</td>
<td>1.2 (or any)</td>
</tr>
<tr>
<td>4</td>
<td>MOTOWELD-E series 500A class</td>
<td>Independent</td>
<td>MAG (or CO2)</td>
<td>1.2 (or any)</td>
</tr>
<tr>
<td>5</td>
<td>MOTOWELD-S350-AJ2/3 (without STC)</td>
<td>Synergic</td>
<td>CO2</td>
<td>1.2</td>
</tr>
<tr>
<td>6</td>
<td>MOTOWELD-S350-AJ2/3 (without STC)</td>
<td>Synergic</td>
<td>MAG</td>
<td>1.2</td>
</tr>
<tr>
<td>7</td>
<td>MOTOWELD-S350-AJ2/3 (without STC)</td>
<td>Independent</td>
<td>CO2</td>
<td>1.2</td>
</tr>
<tr>
<td>8</td>
<td>MOTOWELD-S350-AJ2/3 (without STC)</td>
<td>Independent</td>
<td>MAG</td>
<td>1.2</td>
</tr>
<tr>
<td>9</td>
<td>MOTOWELD-S350-AJ2/3 (without STC)</td>
<td>Synergic</td>
<td>CO2</td>
<td>0.9 (or 1.0)</td>
</tr>
<tr>
<td>10</td>
<td>MOTOWELD-S350-AJ2/3 (without STC)</td>
<td>Synergic</td>
<td>MAG</td>
<td>0.9 (or 1.0)</td>
</tr>
<tr>
<td>11</td>
<td>MOTOWELD-S350-AJ2/3 (without STC)</td>
<td>Independent</td>
<td>CO2</td>
<td>0.9 (or 1.0)</td>
</tr>
<tr>
<td>12</td>
<td>MOTOWELD-S350-AJ2/3 (without STC)</td>
<td>Independent</td>
<td>MAG</td>
<td>0.9 (or 1.0)</td>
</tr>
<tr>
<td>13</td>
<td>MOTOWELD-S350-AJ2/3 (with STC)</td>
<td>Synergic</td>
<td>CO2</td>
<td>1.2</td>
</tr>
<tr>
<td>14</td>
<td>MOTOWELD-S350-AJ2/3 (with STC)</td>
<td>Synergic</td>
<td>MAG</td>
<td>1.2</td>
</tr>
<tr>
<td>15</td>
<td>MOTOWELD-S350-AJ2/3 (with STC)</td>
<td>Independent</td>
<td>CO2</td>
<td>1.2</td>
</tr>
<tr>
<td>16</td>
<td>MOTOWELD-S350-AJ2/3 (with STC)</td>
<td>Independent</td>
<td>MAG</td>
<td>1.2</td>
</tr>
<tr>
<td>17</td>
<td>MOTOWELD-S350-AJ2/3 (with STC)</td>
<td>Synergic</td>
<td>CO2</td>
<td>0.9 (or 1.0)</td>
</tr>
<tr>
<td>18</td>
<td>MOTOWELD-S350-AJ2/3 (with STC)</td>
<td>Synergic</td>
<td>MAG</td>
<td>0.9 (or 1.0)</td>
</tr>
<tr>
<td>19</td>
<td>MOTOWELD-S350-AJ2/3 (with STC)</td>
<td>Independent</td>
<td>CO2</td>
<td>0.9 (or 1.0)</td>
</tr>
<tr>
<td>20</td>
<td>MOTOWELD-S350-AJ2/3 (with STC)</td>
<td>Independent</td>
<td>MAG</td>
<td>0.9 (or 1.0)</td>
</tr>
<tr>
<td>21</td>
<td>SHINKO ES 350</td>
<td>Synergic</td>
<td>CO2</td>
<td>1.2</td>
</tr>
<tr>
<td>22</td>
<td>DAIHEN CPV 350</td>
<td>Synergic</td>
<td>CO2</td>
<td>1.2</td>
</tr>
<tr>
<td>23</td>
<td>MOTOWELD-S500 (without STC)</td>
<td>Synergic</td>
<td>CO2</td>
<td>1.2</td>
</tr>
<tr>
<td>24</td>
<td>MOTOWELD-S500 (without STC)</td>
<td>Synergic</td>
<td>MAG</td>
<td>1.2</td>
</tr>
</tbody>
</table>
10 Production Monitoring

The Yaskawa ArcLink XT interface supports integration with the Lincoln Production Monitoring 2.2 software. Full feature support and setup must be performed using the Powerwave Manager PC software (available as a free download from www.powerwavesoftware.com). However, the ArcLink XT pendant interface provides a convenient portal for performing setup changes and monitoring.

The Lincoln Production Monitoring 2.2 software enables the following:

- Monitoring of weld data during weld
- Gathering of weld statistics and averages for previous welds
- Setting empirical limits to determine if a weld is "good"
- Control of robot/welder actions for "bad" welds
- User notification when welder needs attention/service

10.1 Setup/Installation

The DX100 ArcLink XT interface is preconfigured for use with the Lincoln Production Monitoring 2.2 software. No additional robot setup is required.

Full setup and configuration of all available settings must be performed using the Powerwave Manager PC software provided by Lincoln Electric. Optionally, you can also setup a central webserver database to manage data for all Lincoln welders in your plant. Please refer to your Lincoln documentation for additional information.

10.2 Operation

When using the Production Monitoring 2.2 software, weld data for each weld is gathered into one of 32 profiles. Averages and statistics are calculated for all welds in a particular profile. It is common practice to "categorize" welds and select different profiles for each of the different welds on a part.

Each Arc Start Condition file is associated with a particular production monitoring profile number. This is set under the "Other" tab of the Arc Start file. See Section 9.6.4 "Arc Start Condition File" for additional information.

Some welders can be configured for up to 200 profiles. This will be detected by the robot and is fully supported. Please consult your Lincoln Electric representative for more information about your welder.
10.2 Operation

Fig. 10-1: Production Monitoring Profile Number

10.2.1 Startup

The Production Monitoring application can be started from the main menu. Press the {Arc Welding} button and select {Production Monitor} from the dropdown list.

Fig. 10-2: Production Monitor

You must be in MANAGEMENT security level to access Production Monitoring. See Section 1.4 “Security Mode” for information on changing security levels.
“Control” Tab Window

All data and settings are loaded/saved from the welder number selected at the top of the application. If a particular welder does not appear in the dropdown list, check that it is powered ON and properly connected to the DX100. You may need to close and restart the application after connecting a welder.

The Control tab allows you to select settings that apply to all profiles in the welder.

Fig. 10-3: Control Tab

A. Out of Limit Actions

Production Monitoring allows you to set upper and lower limits for the attributes of a particular weld (See Profile Config tab). If a particular attribute goes outside of the pre-programmed limit, you can determine what response action is performed.

Press the {Edit} button to modify these actions. Then press [Save] to accept the changes.

- **No Action**: Even if limits for this attribute are enabled, no action is taken when the weld goes out of limit.
- **Log Event**: The event is logged into the Production Monitoring database. The pass/fail signal indicates that the weld failed. The weld is not interrupted and no alarm occurs.
- **Fault System**: The event is logged into the Production Monitoring database. The pass/fail signal indicates that the weld failed. The weld stops immediately. The robot displays a PM Limit alarm that must be reset before continuing to weld.

**NOTE** Limits must be set for each individual profile number. However, these actions are global to all profiles.
• Alarm Latch: The event is logged into the Production Monitoring database. The pass/fail signal indicates that the weld failed. The weld continues to finish. At the end of the weld, the robot controller displays a PM Limit alarm that must be reset before the next weld. A latch event can also be reset from this screen. Please note that the main weld condition does finish.

B. Reset Alarm Latch
In the event of an Alarm Latch action, the latch must be cleared before you can weld again. Resetting the robot alarm will clear the latch. You can also use this button to clear the latch.

C. Enter Custom Weight
When using a custom or partial wire spool, it is generally not desirable to use the [Reset Wire Weight] button. This button will allow you to manually type in a custom weight for the new spool. After typing in the desired weight, you must touch the button again to save your value.

D. Reset Wire Weight
The weight of the wire spool is estimated by the Lincoln power source. When replacing an empty spool, you must reset the weight to notify the welder there is a new spool.

Click this button to reset the weight back to the initial weight of a new spool (touch a second time to confirm). The initial weight is set using Lincoln’s Powerwave Manager.

E. Wire Weight Warning
The power source notifies the user when the wire spool gets below a certain limit. To change this limit, click the textbox, and type the new value into the textbox and click [Save].

When the warning weight level is reached, a message is displayed on the bottom of the pendant as a reminder that the wire is low. This message is cleared after touching [Reset Wire Weight]. Additionally, you can configure the power source to send an email notification when the wire is low. Please see Lincoln Powerwave Manager for more details.
“Profile Config” Tab Window

Each of the profiles can be configured to ensure individual weld attributes remain within certain upper and lower bounds. These bounds are "trained" using the Powerwave Manager. However, the Profile Config tab allows you to manually enter the limits and/or tweak the values that have been trained.

**Fig. 10-4: Profile Config Tab**

Press {Edit} to modify the values for the selected profile. If the Enable checkbox is not checked for a particular attribute, the limits will not be monitored during the weld.

**NOTE**

With the 455m/655m power source, you cannot enable/disable individual attributes. Plus, Weld Score is not available.

**A. Start Delay (seconds)**

Set the time from the start of the arc before beginning to monitor the limits. This is useful when ramping the weld settings at the start of a weld.

**B. Duration Limits (seconds)**

Sets the limits for the time length of the weld.

**C. Current Limits (Amps)**

Sets the limits for the amperage of the weld.

**D. Voltage Limits (Volts)**

Sets the limits for the voltage of the weld.

**E. Wirefeed Speed Limits (inches per minute)**

Sets the limits for the WFS of the weld.

**F. Discard welds shorter than...**

If the length of a weld is shorter than the Start Delay plus the End Delay, it can be excluded from the Production Monitoring history.

**G. End Delay (seconds)**

When an out-of-limit event occurs, the power source will wait for this amount of time before taking action. If the weld ends prior to this action, it will be ignored.
“Last Weld Data” Tab Window

The Last Weld Data tab provides statistics for the last weld performed by the selected welder number.

Fig. 10-5: Last Weld Data

A. Weld Profile Totals
This displays the totals for the profile number used in the last weld. This may be different than the selected profile for the next weld.

B. Last Weld...
This displays various statistics about the weld attributes for the last weld.

C. Overall Pass/Fail
This indicates if the weld stayed within the programmed limits of the profile. This will indicate failure in the event of a Log Event, Fault Event, or Alarm Latch. If No Action was selected on the Control tab, then this will indicate "Pass" even if the weld went outside the programmed limits.
10.2 Operation

“Last PM Alarm” Tab Window
In the event of a failed weld, this tab displays the attribute(s) that were out of limit. If a Fault Event or Alarm Latch occurs, the alarm is displayed on the programming pendant. However, the alarm does not contain specific information on what failed. Use this tab for more detail.

Fig. 10-6: Last PM Alarm

“Live Monitor” Tab Window
The Live Monitor tab monitors weld data in real time. It can be used as a handy reference to monitor the weld. The display shows a 10 second scrolling window into the weld.

Fig. 10-7: Live Monitor
10.3 Part Numbers

Each time an arc is established, the weld data is saved in the weld history with a unique weld ID number. To view weld data for an entire part comprised of multiple welds, you can assign a part number that is associated with each weld ID. This allows you to keep the same part number until you have completed all welds.

The part number is stored in the robot D-Variables.

In the INFORM robot job, simply set/increment the appropriate variable when you weld a new part. See Section 3.9.4 “User Variables” for more information on setting variables.

- Welder 1: D100
- Welder 2: D110
- Welder 3: D120
- Welder 4: D130

10.4 Accessing Data

The Production Monitoring data collected by the DX100 is stored in user variables for easy reference by external devices. Using an HMI or PLC, this data can be stored, displayed, or used for other calculations. The following table shows the user variables where the data is stored.

<table>
<thead>
<tr>
<th>I Variables</th>
<th>Welder 1</th>
<th>Welder 2</th>
<th>Welder 3</th>
<th>Welder 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Weld Profile #</td>
<td>100</td>
<td>125</td>
<td>150</td>
<td>175</td>
</tr>
<tr>
<td>Last Weld Limit Code **</td>
<td>101</td>
<td>126</td>
<td>151</td>
<td>176</td>
</tr>
<tr>
<td>Last Weld Max Amps</td>
<td>102</td>
<td>127</td>
<td>152</td>
<td>177</td>
</tr>
<tr>
<td>Last Weld Avg Amps</td>
<td>103</td>
<td>128</td>
<td>153</td>
<td>178</td>
</tr>
<tr>
<td>Last Weld Min Amps</td>
<td>104</td>
<td>129</td>
<td>154</td>
<td>179</td>
</tr>
<tr>
<td>Last Weld Max Volts</td>
<td>105</td>
<td>130</td>
<td>155</td>
<td>180</td>
</tr>
<tr>
<td>Last Weld Avg Volts</td>
<td>106</td>
<td>131</td>
<td>156</td>
<td>181</td>
</tr>
<tr>
<td>Last Weld Min Volts</td>
<td>107</td>
<td>132</td>
<td>157</td>
<td>182</td>
</tr>
<tr>
<td>Last Weld Max WFS</td>
<td>108</td>
<td>133</td>
<td>158</td>
<td>183</td>
</tr>
<tr>
<td>Last Weld Avg WFS</td>
<td>109</td>
<td>134</td>
<td>159</td>
<td>184</td>
</tr>
<tr>
<td>Last Weld Min WFS</td>
<td>110</td>
<td>135</td>
<td>160</td>
<td>185</td>
</tr>
<tr>
<td>Last Weld Max WeldScore</td>
<td>111</td>
<td>136</td>
<td>161</td>
<td>186</td>
</tr>
<tr>
<td>Last Weld Avg WeldScore</td>
<td>112</td>
<td>137</td>
<td>162</td>
<td>187</td>
</tr>
<tr>
<td>Last Weld Min WeldScore</td>
<td>113</td>
<td>138</td>
<td>163</td>
<td>188</td>
</tr>
<tr>
<td>Profile Weld Count</td>
<td>117</td>
<td>142</td>
<td>167</td>
<td>192</td>
</tr>
<tr>
<td>Profile Current Limit Count</td>
<td>118</td>
<td>143</td>
<td>168</td>
<td>193</td>
</tr>
<tr>
<td>Profile Voltage Limit Count</td>
<td>119</td>
<td>144</td>
<td>169</td>
<td>194</td>
</tr>
<tr>
<td>Profile WFS Limit Count</td>
<td>120</td>
<td>145</td>
<td>170</td>
<td>195</td>
</tr>
<tr>
<td>Profile Time Limit Count</td>
<td>121</td>
<td>146</td>
<td>171</td>
<td>196</td>
</tr>
<tr>
<td>Profile Score Limit Count</td>
<td>122</td>
<td>147</td>
<td>172</td>
<td>197</td>
</tr>
</tbody>
</table>
**Limit code is a binary encoded field**

<table>
<thead>
<tr>
<th>Bit 15</th>
<th>Bit 14</th>
<th>Bit 13</th>
<th>Bit 12</th>
<th>Bit 11</th>
<th>Bit 10</th>
<th>Bit 9</th>
<th>Bit 8</th>
<th>Bit 7</th>
<th>Bit 6</th>
<th>Bit 5</th>
<th>Bit 4</th>
<th>Bit 3</th>
<th>Bit 2</th>
<th>Bit 1</th>
<th>Bit 0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>T\text{high}</td>
<td>T\text{low}</td>
<td>S\text{high}</td>
<td>S\text{low}</td>
<td>W\text{high}</td>
<td>W\text{low}</td>
<td>V\text{high}</td>
<td>V\text{low}</td>
<td>I\text{high}</td>
<td>I\text{low}</td>
</tr>
</tbody>
</table>
10  Production Monitoring
10.4  Accessing Data
# 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.

<table>
<thead>
<tr>
<th>Additional Item</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position data, Base axis position data, Station axis position data</td>
<td>These data do not appear on the screen.</td>
<td></td>
</tr>
</tbody>
</table>

VJ=<play speed>  
PL=<position level>  
NWAIT  
UNTIL statement  
ACC=(acceleration adjustment ratio)  
DEC=(deceleration adjustment ratio)

**Example**

```
MOVJ VJ=50.00 PL=2 NWAIT UNTIL IN#(16)=ON
```

### MOVL Function
Moves to a taught point with linear interpolation type.

<table>
<thead>
<tr>
<th>Additional Item</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position data, Base axis position data, Station axis position data</td>
<td>These data do not appear on the screen.</td>
<td></td>
</tr>
</tbody>
</table>

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>  
CR=(corner radius)  
NWAIT  
UNTIL statement  
ACC=(acceleration adjustment ratio)  
DEC=(deceleration adjustment ratio)

**Example**

```
MOVL V=138 PL=0 NWAIT UNTIL IN#(16)=ON
```

### MOVC Function
Moves to a taught point with circular interpolation type.

<table>
<thead>
<tr>
<th>Additional Item</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position data, Base axis position data, Station axis position data</td>
<td>These data do not appear on the screen.</td>
<td></td>
</tr>
</tbody>
</table>

V=<play speed>,  
VR=<play speed of the posture>,  
VE=<play speed of external axis>  
Same as MOVL.

PL=<position level>  
NWAIT  
ACC=(acceleration adjustment ratio)  
DEC=(deceleration adjustment ratio)

**Example**

```
MOVC V=138 PL=0 NWAIT
```
<table>
<thead>
<tr>
<th>Function</th>
<th>MOVS</th>
<th>Moves to a taught point with spline interpolation type.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>Position data, Base axis position data, Station axis position data</td>
<td>These data do not appear on the screen.</td>
</tr>
<tr>
<td>V = &lt;play speed&gt;, VR = &lt;play speed of the posture&gt;, VE = &lt;play speed of external axis&gt;</td>
<td>Same as MOVL.</td>
<td></td>
</tr>
<tr>
<td>PL = &lt;position level&gt;</td>
<td>PL: 0 to 8</td>
<td></td>
</tr>
<tr>
<td>NWAIT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACC = (acceleration adjustment ratio)</td>
<td>ACC: 20 to 100%</td>
<td></td>
</tr>
<tr>
<td>DEC = (deceleration adjustment ratio)</td>
<td>DEC: 20 to 100%</td>
<td></td>
</tr>
<tr>
<td>Example</td>
<td>MOVS V=120 PL=0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>IMOV</th>
<th>Moves the specified increment from the current position with linear interpolation type.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>P&lt;variable number&gt;, BP&lt;variable number&gt;, EX&lt;variable number&gt;</td>
<td></td>
</tr>
<tr>
<td>V = &lt;play speed&gt;, VR = &lt;play speed of the posture&gt;, VE = &lt;play speed of external axis&gt;</td>
<td>Same as MOVL.</td>
<td></td>
</tr>
<tr>
<td>PL = &lt;position level&gt;</td>
<td>PL: 0 to 8</td>
<td></td>
</tr>
<tr>
<td>NWAIT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BF, RF, TF, UF# (&lt;user coordinate number&gt;)</td>
<td>BF: base coordinates RF: robot coordinates TF: tool coordinates UF: user coordinates</td>
<td></td>
</tr>
<tr>
<td>UNTIL statement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACC = (acceleration adjustment ratio)</td>
<td>ACC: 20 to 100%</td>
<td></td>
</tr>
<tr>
<td>DEC = (deceleration adjustment ratio)</td>
<td>DEC: 20 to 100%</td>
<td></td>
</tr>
<tr>
<td>Example</td>
<td>IMOV P000 V=138 PL=1 RF</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>REFP</th>
<th>Defines a reference point (e.g. wall point for weaving).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>&lt;reference point number&gt;</td>
<td>wall point 1 for weaving : 1 wall point 2 for weaving : 2</td>
</tr>
<tr>
<td>Position data, Base axis position data, Station axis position data</td>
<td>These data do not appear on the screen.</td>
<td></td>
</tr>
<tr>
<td>Example</td>
<td>REFP 1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>SPEED</th>
<th>Sets play speed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>VJ = &lt;joint speed&gt;, V = &lt;TCP speed&gt;, VR = &lt;play speed of the posture&gt;, VE = &lt;play speed of external axis&gt;</td>
<td>VJ: Same as MOVJ. V, VR, VE: Same as MOVL.</td>
</tr>
<tr>
<td>Example</td>
<td>SPEED VJ = 50.00</td>
<td></td>
</tr>
</tbody>
</table>
## 11.2 I/O Instructions

<table>
<thead>
<tr>
<th>Function</th>
<th>DOUT</th>
<th>Turns the external output signals ON and OFF.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>OT# (&lt;output number&gt;), OGH# (&lt;output group number&gt;), OG# (&lt;output group number&gt;)</td>
<td>Number of addressed output signals: OT#(xx)=1; OGH#(xx)=4(per group); OG#(xx)=8(per group)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OGH#(xx) is not subject to parity check; only the binary specification is allowed.</td>
</tr>
<tr>
<td>Example</td>
<td>DOUT OT#(12) ON</td>
<td>FINE With a high degree of accuracy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>PULSE</th>
<th>Outputs a pulse signal as an external output signal.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>OT# (&lt;output number&gt;), OGH# (&lt;output group number&gt;), OG# (&lt;output group number&gt;)</td>
<td>T=&lt;time (seconds)&gt; 0.01 to 655.35 s 0.30 s unless otherwise specified</td>
</tr>
<tr>
<td>Example</td>
<td>PULSE OT# (10) T=0.60</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>DIN</th>
<th>Sets input signals in variables.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>B&lt;variable number&gt;</td>
<td>IN# (&lt;input number&gt;), IGH# (&lt;input group number&gt;), IG# (&lt;input group number&gt;), OT# (&lt;output number&gt;), OGH# (&lt;output group number&gt;), OG# (&lt;output group number&gt;), SIN# (&lt;system input number&gt;), SOUT# (&lt;system output number&gt;)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of addressed input signals: IN#(xx)=1; IGH#(xx)=4(per group); IG#(xx)=8(per group)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of addressed output signals: OT#(xx)=1; OGH#(xx)=4(per group); OG#(xx)=8(per group)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IGH#(xx) and OGH#(xx) are not subject to parity check; only the binary specification is allowed.</td>
</tr>
<tr>
<td>Example</td>
<td>DIN B016 IN#(16) DIN B002 IG#(2)</td>
<td></td>
</tr>
</tbody>
</table>
## Robotic Arc Welding
### Lincoln ARCLINK XT

#### 11.2 I/O Instructions

### Table of Basic Instructions

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WAIT</strong></td>
<td>Waits until the external input signal status matches the specified status.</td>
</tr>
<tr>
<td><strong>Additional Item</strong></td>
<td><strong>IN# (&lt;input number&gt;), IGH# (&lt;input group number&gt;), IG# (&lt;input group number&gt;), OT# (&lt;user output number&gt;), OGH# (&lt;output group number&gt;), SIN# (&lt;system input number&gt;), SOUT# (&lt;system output number&gt;)</strong></td>
</tr>
<tr>
<td><strong>&lt;status&gt;, B&lt;variable number&gt;</strong></td>
<td></td>
</tr>
<tr>
<td><strong>T= (time (seconds))</strong></td>
<td>0.01 to 655.35 s</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td><strong>WAIT IN# (12)=ON T=10.00</strong>&lt;br&gt;<strong>WAIT IN# (12)=B002</strong></td>
</tr>
</tbody>
</table>

| **AOUT** | Outputs the specified voltage to the general-purpose analog output port. |
| **Additional Item** | **AO# (<output port number>)** 1 to 40<br>**<output voltage(V)>** -14.0 to 14.0 |
| **Example** | **AOUT AO# (2) 12.7** |

| **ARATION** | Starts the analog output corresponding to the speed. |
| **Additional Item** | **AO# (<output port number>)** 1 to 40<br>**BV = <basic voltage>** -14.00 to 14.00<br>**V = <basic speed>** 0.1 to 150.0 mm/s 1 to 9000 cm/min<br>**OFV = <offset voltage>** -14.00 to 14.00 |
| **Example** | **ARATION AO#(1) BV=10.00 V=200.0 OFV=2.00** |

| **ARATIOF** | 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

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Additional Item</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>JUMP</strong></td>
<td>Jumps to the specified label or job.</td>
<td>* &lt;label character string&gt;, JOB:&lt;job name&gt;, IG# (&lt;input group number&gt;), B&lt;variable number&gt;, I&lt;variable number&gt;, D&lt;variable number&gt;, UF# (user coordinates number)</td>
<td>JUMP JOB:TEST1 IF IN#(14)=OFF</td>
</tr>
<tr>
<td>*** (label)**</td>
<td>Indicates a jump destination.</td>
<td>&lt;jump destination&gt; 8 characters or less</td>
<td>*123</td>
</tr>
<tr>
<td><strong>CALL</strong></td>
<td>Calls the specified job.</td>
<td>JOB:&lt;job name&gt;, IG# (&lt;input group number&gt;), B&lt;variable number&gt;, I&lt;variable number&gt;, D&lt;variable number&gt;, UF# (user coordinates number)</td>
<td>CALL JOB:TEST1 IF IN#(24)=ON CALL IG#(2)</td>
</tr>
<tr>
<td><strong>RET</strong></td>
<td>Returns to the call source job.</td>
<td>IF statement</td>
<td>RET IF IN#(12)=OFF</td>
</tr>
<tr>
<td><strong>END</strong></td>
<td>Declares the end of a job.</td>
<td></td>
<td>END</td>
</tr>
<tr>
<td><strong>NOP</strong></td>
<td>No operation.</td>
<td></td>
<td>NOP</td>
</tr>
<tr>
<td><strong>TIMER</strong></td>
<td>Stops for the specified time.</td>
<td>T=&lt;time (seconds)&gt; 0.01 to 655.35 s</td>
<td>TIMER T=12.50</td>
</tr>
<tr>
<td><strong>IF statement</strong></td>
<td>Evaluates the specified condition and makes a judgment accordingly. Described after an instruction that specifies a certain action.</td>
<td>Format:&lt;item1&gt;=,&lt;&gt;,&lt;=,&gt;=,&lt;,&gt;&lt;item2&gt;</td>
<td>JUMP *12 IF IN#(12)=OFF</td>
</tr>
</tbody>
</table>
### UNTIL statement

**Function**: Monitors the specified input signal during an action and stops the action when the specified signal status is observed. Described after an instruction that specifies a certain action.

**Additional Item**
- IN# (<input number>)
- <status>

**Example**

```
MOVL V=300 UNTIL IN#(10)=ON
```

### PAUSE

**Function**: Instructs a pause.

**Additional Item**
- IF statement

**Example**

```
PAUSE IF IN#(12)=OFF
```

### ' (comment)

**Function**: Displays a comment.

**Additional Item**
- <comment> 32 characters or less

**Example**

```
'Draws 100mm size square.'
```

### 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

<table>
<thead>
<tr>
<th>Function</th>
<th>Function Description</th>
<th>Additional Item</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SFTON</strong></td>
<td>Starts a shift operation.</td>
<td>P&lt;variable number&gt;, BP&lt;variable number&gt;, EX&lt;variable number&gt;, BF, RF, TF, UF#(&lt;user coordinate number&gt;)</td>
</tr>
<tr>
<td>Additional Item</td>
<td></td>
<td>BF: base coordinates, RF: robot coordinates, TF: tool coordinates, UF: user coordinates</td>
</tr>
<tr>
<td>Example</td>
<td>SFTON P001 UF#(1)</td>
<td></td>
</tr>
<tr>
<td><strong>SFTOF</strong></td>
<td>Stops a shift operation.</td>
<td></td>
</tr>
<tr>
<td>Example</td>
<td>SFTOF</td>
<td></td>
</tr>
<tr>
<td><strong>MSHIFT</strong></td>
<td>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 &lt;Data1&gt;&lt;Coordinate&gt;&lt;Data2&gt;&lt;Data3&gt;</td>
<td></td>
</tr>
<tr>
<td>Additional Item</td>
<td>Data1 PX&lt;variable number&gt;</td>
<td>BF: base coordinates, RF: robot coordinates, TF: tool coordinates, UF: user coordinates, MTF: tool coordinates for the master</td>
</tr>
<tr>
<td>Coordinate</td>
<td>BF, RF, TF, UF#(&lt;user coordinate number&gt;), MTF</td>
<td></td>
</tr>
<tr>
<td>Data2</td>
<td>PX&lt;variable number&gt;</td>
<td></td>
</tr>
<tr>
<td>Data3</td>
<td>PX&lt;variable number&gt;</td>
<td></td>
</tr>
<tr>
<td>Example</td>
<td>MSHIFT PX000 RF PX001 PX002</td>
<td></td>
</tr>
</tbody>
</table>
### 11.5 Operating Instructions

**ADD**  
**Function:** Adds Data1 and Data2, and stores the result in Data1.  
Format: `ADD<Data1><Data2>`

<table>
<thead>
<tr>
<th>Additional Item</th>
<th>Data1</th>
<th>Data2</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B&lt;variable number&gt;,</td>
<td>Constant,</td>
<td><strong>ADD I012 I013</strong></td>
</tr>
<tr>
<td></td>
<td>I&lt;variable number&gt;,</td>
<td>B&lt;variable number&gt;,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D&lt;variable number&gt;,</td>
<td>I&lt;variable number&gt;,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R&lt;variable number&gt;,</td>
<td>D&lt;variable number&gt;,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P&lt;variable number&gt;,</td>
<td>R&lt;variable number&gt;,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BP&lt;variable number&gt;,</td>
<td>P&lt;variable number&gt;,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EX&lt;variable number&gt;</td>
<td>BP&lt;variable number&gt;,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>EX&lt;variable number&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Data1 must always be a variable.</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SUB**  
**Function:** Subtracts Data2 from Data1, and stores the result in Data1.  
Format: `SUB<Data1><Data2>`

<table>
<thead>
<tr>
<th>Additional Item</th>
<th>Data1</th>
<th>Data2</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B&lt;variable number&gt;,</td>
<td>Constant,</td>
<td><strong>SUB I012 I013</strong></td>
</tr>
<tr>
<td></td>
<td>I&lt;variable number&gt;,</td>
<td>B&lt;variable number&gt;,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D&lt;variable number&gt;,</td>
<td>I&lt;variable number&gt;,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R&lt;variable number&gt;,</td>
<td>D&lt;variable number&gt;,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P&lt;variable number&gt;,</td>
<td>R&lt;variable number&gt;,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BP&lt;variable number&gt;,</td>
<td>P&lt;variable number&gt;,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EX&lt;variable number&gt;</td>
<td>BP&lt;variable number&gt;,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>EX&lt;variable number&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Data1 must always be a variable.</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 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.

**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.

**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
### Table of Basic Instructions

#### 11.5 Operating Instructions

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Format</th>
<th>Additional Item</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>AND</td>
<td>Obtains the AND of Data1 and Data2, and stores the result in Data1.</td>
<td>AND&lt;Data1&gt;&lt;Data2&gt;</td>
<td>Data1: B&lt;variable number&gt;, Data2: B&lt;variable number&gt;, Constant</td>
<td>AND B012 B020</td>
</tr>
<tr>
<td>OR</td>
<td>Obtains the OR of Data1 and Data2, and stores the result in Data1.</td>
<td>OR&lt;Data1&gt;&lt;Data2&gt;</td>
<td>Data1: B&lt;variable number&gt;, Data2: B&lt;variable number&gt;, Constant</td>
<td>OR B012 B020</td>
</tr>
<tr>
<td>NOT</td>
<td>Obtains the NOT of Data2, and stores the result in Data1.</td>
<td>NOT&lt;Data1&gt;&lt;Data2&gt;</td>
<td>Data1: B&lt;variable number&gt;, Data2: B&lt;variable number&gt;, Constant</td>
<td>NOT B012 B020</td>
</tr>
<tr>
<td>XOR</td>
<td>Obtains the exclusive OR of Data1 and Data2, and stores the result in Data1.</td>
<td>XOR&lt;Data1&gt;&lt;Data2&gt;</td>
<td>Data1: B&lt;variable number&gt;, Data2: B&lt;variable number&gt;, Constant</td>
<td>XOR B012 B020</td>
</tr>
<tr>
<td>SET</td>
<td>Sets Data2 to Data1.</td>
<td>SET&lt;Data1&gt;&lt;Data2&gt;</td>
<td>Data1: B&lt;variable number&gt;, I&lt;variable number&gt;, D&lt;variable number&gt;, R&lt;variable number&gt;, P&lt;variable number&gt;, S&lt;variable number&gt;, BP&lt;variable number&gt;, EX&lt;variable number&gt;, Data2: Constant, B&lt;variable number&gt;, I&lt;variable number&gt;, D&lt;variable number&gt;, R&lt;variable number&gt;, S&lt;variable number&gt;, EXPRESS</td>
<td>SET I012 I020</td>
</tr>
<tr>
<td>SETE</td>
<td>Sets data to an element in a position variable.</td>
<td>SETE P&lt;variable number&gt; (&lt;element number&gt;), BP&lt;variable number&gt; (&lt;element number&gt;), EX&lt;variable number&gt; (&lt;element number&gt;)</td>
<td>Data1: B&lt;variable number&gt;, D&lt;variable number&gt;, &lt;double-precision integer type constant&gt;</td>
<td>SETE P012 (3) D005</td>
</tr>
</tbody>
</table>
### GETE Function
Extracts an element in a position variable.

<table>
<thead>
<tr>
<th>Additional Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D&lt;variable number&gt;</td>
<td></td>
</tr>
<tr>
<td>P&lt;variable number&gt; (element number), BP&lt;variable number&gt; (element number), EX&lt;variable number&gt; (element number)</td>
<td></td>
</tr>
</tbody>
</table>

**Example**
```
GETE D006 P012 (4)
```

### GETS Function
Sets a system variable to the specified variable.

<table>
<thead>
<tr>
<th>Additional Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B&lt;variable number&gt;, I&lt;variable number&gt;, D&lt;variable number&gt;, R&lt;variable number&gt;, PX&lt;variable number&gt;, $B&lt;variable number&gt;, $I&lt;variable number&gt;, $D&lt;variable number&gt;, $R&lt;variable number&gt;, $PX&lt;variable number&gt;, $ERRNO, Constant, B&lt;variable number&gt;</td>
<td></td>
</tr>
</tbody>
</table>

**Example**
```
GETS B000 $B000
GETS I001 $[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>
```

<table>
<thead>
<tr>
<th>Additional Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data1 PX&lt;variable number&gt;, Data2 PX&lt;variable number&gt;</td>
<td></td>
</tr>
<tr>
<td>BF, RF, TF, UF# (&lt;user coordinate number&gt;), MTF</td>
<td></td>
</tr>
</tbody>
</table>

**Example**
```
CNVRT PX000 PX001 BF
```

BF: base coordinates  
RF: robot coordinates  
TF: tool coordinates  
UF: user coordinates  
MTF: tool coordinates for the master
### 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<sup>1</sup>, STACK

All<sup>1</sup>: 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 D000 ALL
- CLEAR STACK

1) NOTE: CLEAR B000 ALL should not be used. B080-B083 are reserved for system use.

### 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.)
<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Additional Item</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQRT</td>
<td>Obtains the square root of Data2, and stores the result in Data1. Format: SQRT&lt;Data1&gt;&lt;Data2&gt;</td>
<td>Data1 R&lt;variable number&gt; Data2 &lt;constant&gt;, R&lt;variable number&gt;</td>
<td>SQRT R000 R001 (Sets the square root of R001 to R000.)</td>
</tr>
<tr>
<td>MFRAME</td>
<td>Creates a user coordinate using the position data for the given three points as definition points. &lt;Data1&gt; indicates the definition point ORG position data, &lt;Data2&gt; the definition point XX position data, and &lt;Data3&gt; the definition point XY position data. Format: MFRAME &lt;user coordinate&gt; &lt;Data1&gt; &lt;Data2&gt; &lt;Data3&gt;</td>
<td>UF#(&lt;user coordinate number&gt;) 1 to 24 Data1 PX &lt;variable number&gt; Data2 PX &lt;variable number&gt; Data3 PX &lt;variable number&gt;</td>
<td>MFRAME UF#(1) PX000 PX001 PX002</td>
</tr>
<tr>
<td>MULMAT</td>
<td>Obtains the matrix product of Data2 and Data3, and stores the result in Data1. Format: MULMAT &lt;Data1&gt; &lt;Data2&gt; &lt;Data3&gt;</td>
<td>Data1 P &lt;variable number&gt; Data2 P &lt;variable number&gt; Data3 P &lt;variable number&gt;</td>
<td>MULMAT P000 P001 P002</td>
</tr>
<tr>
<td>INVMAT</td>
<td>Obtains the inverse matrix of Data2, and stores the result in Data1. Format: INVMAT &lt;Data1&gt; &lt;Data2&gt;</td>
<td>Data1 P &lt;variable number&gt; Data2 P &lt;variable number&gt;</td>
<td>INVMAT P000 P001</td>
</tr>
<tr>
<td>SETFILE</td>
<td>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.</td>
<td>Contents data of a condition file WEV#(&lt;condition file number&gt;)(&lt;element number&gt;) Data1 Constant, D&lt;variable number&gt;</td>
<td>SETFILE WEV#(1)(1) D000</td>
</tr>
<tr>
<td>GETFILE</td>
<td>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.</td>
<td>Data1 D &lt;variable number&gt; Contents data of a condition file WEV#(&lt;condition file number&gt;)(&lt;element number&gt;)</td>
<td>GETFILE D000 WEV#(1)(1)</td>
</tr>
<tr>
<td>GETPOS</td>
<td>Stores the position data of Data2 (step number) in Data1.</td>
<td>Data1 PX &lt;variable number&gt; Data2 STEP# (&lt;step number&gt;)</td>
<td>GETPOS PX000 STEP#(1)</td>
</tr>
</tbody>
</table>
### Table of Basic Instructions

#### 11.5 Operating Instructions

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Format</th>
<th>Additional Item</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VAL</strong></td>
<td>Converts the numeric value of the character string (ASCII) of Data2 into the real number, and stores the result in Data1.</td>
<td>VAL &lt;Data1&gt; &lt;Data2&gt;</td>
<td>Data1: B &lt;variable number&gt;, I &lt;variable number&gt;, D &lt;variable number&gt;, R &lt;variable number&gt;</td>
<td>VAL B000 &quot;123&quot;</td>
</tr>
<tr>
<td><strong>ASC</strong></td>
<td>Obtains the character code of the first letter of the character string (ASCII) of Data2, and stores the result in Data1.</td>
<td>ASC &lt;Data1&gt; &lt;Data2&gt;</td>
<td>Data1: B &lt;variable number&gt;, I &lt;variable number&gt;, D &lt;variable number&gt;</td>
<td>ASC B000 &quot;ABC&quot;</td>
</tr>
<tr>
<td><strong>CHR$</strong></td>
<td>Obtains the character (ASCII) with the character code of Data2, and stores the result in Data1.</td>
<td>CHR$ &lt;Data1&gt; &lt;Data2&gt;</td>
<td>Data1: S &lt;variable number&gt;</td>
<td>CHR$ S000 65</td>
</tr>
<tr>
<td><strong>MID$</strong></td>
<td>Obtains the character string (ASCII) of any length (Data3, 4) from the character string (ASCII) of Data2, and stores the result in Data1.</td>
<td>MID$ &lt;Data1&gt; &lt;Data2&gt; &lt;Data3&gt; &lt;Data4&gt;</td>
<td>Data1: S &lt;variable number&gt;</td>
<td>MID$ S000 &quot;123ABC456&quot; 4 3</td>
</tr>
<tr>
<td><strong>LEN</strong></td>
<td>Obtains the total number of bytes of the character string (ASCII) of Data2, and stores the result in Data1.</td>
<td>LEN &lt;Data1&gt; &lt;Data2&gt;</td>
<td>Data1: B &lt;variable number&gt;, I &lt;variable number&gt;, D &lt;variable number&gt;</td>
<td>LEN B000 &quot;ABCDEF&quot;</td>
</tr>
</tbody>
</table>
### Table of Basic Instructions

#### 11.5 Operating Instructions

<table>
<thead>
<tr>
<th>CAT$</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Combines the character string (ASCII) of Data2 and Data3, and stores the result in Data1. Format: \texttt{CAT$&lt;Data1&gt;&lt;Data2&gt;&lt;Data3&gt;}</td>
<td></td>
</tr>
</tbody>
</table>

#### Additional Item

<table>
<thead>
<tr>
<th>Data1</th>
<th>S \textless variable number\textgreater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data2</td>
<td>Character string, S \textless variable number\textgreater</td>
</tr>
<tr>
<td>Data3</td>
<td>Character string, S \textless variable number\textgreater</td>
</tr>
</tbody>
</table>

#### Example

\texttt{CAT$ S000 "ABC" "DEF"}
### Appendix A  Revision History

<table>
<thead>
<tr>
<th>Date</th>
<th>CEN / ECN</th>
<th>Revision No.</th>
<th>Reason For Revision</th>
<th>Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/11/2014</td>
<td>14-0202M</td>
<td>4</td>
<td>1. In the System Structure Example of Arc Welding System updated power source to Lincoln R350. 2. Replace Welder Mapper with Lincoln Setup screen 3. Add specifying type of wire feeder and add screen shot. 4. Add Global Weld Setting Section 5. Function Setting section change supplement to &quot;The system should ship with Enhanced Welding by default. This procedure is only needed if the system is set back to Standard Welding.&quot; 6. Remove Global Setting Tab from &quot;Process Tab Window&quot; 7. Remove Global Tab Window section 8. Change Production Monitoring to 2.2 software 9. Under the Profile Config Tab Window update the note to say 455m/655m</td>
<td>JFC</td>
</tr>
<tr>
<td>4/10/2014</td>
<td>14-0446M</td>
<td>5</td>
<td>Add information about B080 - B083 and S080 - S099.</td>
<td>JFC</td>
</tr>
</tbody>
</table>
Specifications are subject to change without notice
for ongoing product modifications and improvements.