NX100
OPERATOR＇S MANUAL
FOR MATERIAL HANDLING，ASSEMBLING，AND CUTTING APPLICATIONS

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

## MOTOMAN INSTRUCTIONS

MOTOMAN－Dロロ INSTRUCTIONS
NX100 INSTRUCTIONS
NX100 OPERATOR＇S MANUAL
NX100 MAINTENANCE MANUAL

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

## (! MANDATORY

- This manual explains the various components of the NX100 system and general operations. Read this manual carefully and be sure to understand its contents before handling the NX100.
- General items related to safety are listed in Section 1: Safety of the NX100 Instructions. To ensure correct and safe operation, carefully read the NX100 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 NX100.
In this manual, the Notes for Safe Operation are classified as "WARNING," "CAUTION," "MANDATORY," or "PROHIBITED."


WARNING
 CAUTION
©prOHIBITED

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

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.

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

Must never be performed.

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

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

## ! WARNING

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

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


- 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.


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

Improper or unintended manipulator operation may result in injury.

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

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

## $!$ <br> CAUTION

- Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately, and be sure that all other necessary processing has been performed.
-Check for problems in manipulator movement.
-Check for damage to insulation and sheathing of external wires.
- Always return the programming pendant to the hook on the NX100 cabinet after use.

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

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


## Definition of Terms Used Often in This Manual

The MOTOMAN is the YASKAWA industrial robot product.
The MOTOMAN usually consists of the manipulator, the controller, the programming pendant, and the manipulator cables.
In this manual, the equipment is designated as follows:

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

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

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

## Description of the Operation Procedure

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

## Registered Trademark

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## 1 Introduction

### 1.1 NX100 Overview

The main power switch and the door lock are located on the front of the NX100 controller. The emergency stop button is installed in the upper right corner of the cabinet door and the programming pendant hangs from a hook below the button.
For information on setup, installation, and connection of the NX100 system, refer to the "NX100 INSTRUCTIONS."


### 1.2 Programming Pendant

### 1.2.1 Programming Pendant Overview

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


### 1.2.2 Key Description

## - Character Keys

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

## - Symbol Keys

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


## - Axis Keys and Numeric Keys

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


## ■ Keys Pressed Simultaneously

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

### 1.2.3 Programming Pendant Keys

Turns OFF the servo power.
When the servo power is turned OFF, the SERVO ON LED on the pro-
graming pendant will extinguish.
An emergency stop message is displayed on the screen.

| [AREA] <br> AREA | Moves the cursor between "Menu Area" and "General Purpose Display Area." <br> When [SHIFT] is pressed simultaneously: <br> - [SHIFT] + [AREA] <br> The language can be switched when the bilingual function is valid. (Bilingual function is optional.) <br> - DOWN cursor button + [AREA] <br> Moves the cursor to the operation button on the screen if displayed. <br> - UP cursor button + [AREA] <br> Moves the cursor to the general-purpose display area when the cursor is on the operation button. |
| :---: | :---: |
|  | Displays the next page. <br> [SHIFT] + [PAGE] <br> The previous page is displayed. <br> The page can be changed when $\square$ appears in the status area on the screen. |
| [DIRECT OPEN] | Displays the content related to the current line. <br> 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. <br> Example: <br> For a CALL instruction, the content of the called job will be displayed. For a work instruction, the content of the condition file will be displayed. For Input/output instructions, the input/output condition will be displayed. |
| [COORD] <br> TOOL SEL <br> COORD | Select the operation coordinate system when the manipulator is operated manually. <br> 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" $\rightarrow$ "WLD/CYL" $\rightarrow$ "TOOL" $\rightarrow$ "USER" <br> The selected coordinate system is displayed on the status display area. <br> [SHIFT] + [COORD] <br> The coordinate number can be changed when the "TOOL" or "USER" coordinate system is selected. |
| MANUAL SPEED keys <br> FAST <br> SLOW | Sets the speed for manual operation. <br> This speed is also valid for operations with [FWD] and [BWD]. <br> There are four speed levels (slow, medium, fast, and inching). <br> Each time [FAST] is pressed, manual speed changes in the following <br> order: "INCH" $\rightarrow$ " SLOW" $\rightarrow$ "MED" $\rightarrow$ "FST" <br> Each time [SLOW] is pressed, manual speed changes in the following order: "FST" $\rightarrow$ " MED" $\rightarrow$ "SLOW" $\rightarrow$ "INCH" <br> The selected speed is displayed on the status area. |
| [HIGH SPEED] | Changes the speed of axis operation when the axis button is pressed. <br> The speed of the manipulator will change to high regardless of the programmed speed while this key is pressed. <br> The speed for [HIGH SPEED] is specified in advance. |


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


| [FWD] <br> FWD | Moves the manipulator through the taught steps while this key is pressed. <br> Only move instructions are executed (one instruction at a time, no welding instructions). <br> [INTERLOCK] + [FWD] <br> All instructions are executed. <br> [REFP] + [FWD] <br> Moves to the reference point of the cursor line. See "■ Moving to Reference Point" in " 3.3.1 FWD/BWD Key Operations ". <br> The manipulator operates at the selected manual speed. Make sure that the selected manual speed is the desired one before starting operation. |
| :---: | :---: |
| [BWD] <br> BWD | Moves the manipulator through the taught steps in the reverse direction while this key is pressed. Only move instructions are executed (no weld commands). |
| [INFORM LIST] | Displays instruction lists of commands available for job editing. |
| [CANCEL] <br> CANCEL | Cancels data input and resets errors. |
| [DELETE] <br> DELETE | Deletes registered instructions and data. <br> Deletion completes when [ENTER] is pressed while this key lamp is lit. |
| [INSERT] <br> INSERT | Inserts new instructions or data. Insertion completes when [ENTER] is pressed while this key lamp is lit. |
| [MODIFY] | Modifies taught position data, instructions, and data. Modification completes when [ENTER] is pressed while this key lamp is lit. |
| [ENTER] <br> ENTER | Registers instructions, data, current position of the manipulator, etc. <br> 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. |


| [SHIFT] | Changes the functions of other keys by pressing together. <br> Can be used with [MAIN MENU], [COORD], [MOTION TYPE], cursor key, <br> Numeric key, page key <br> Refer to the description of each key for the alternate [SHIFT] functions. |
| :--- | :--- | | Changes the functions of other keys by pressing together. |
| :--- |
| Can be used with [TEST START], [FWD], Numeric key (Numeric key cus- |
| tomize function). |
| Refer to the description of each key for the alternate [INTERLOCK] func- |
| tions. |

1.2 Programming Pendant

| [MAIN MENU] <br> MAIN <br> MENU | Displays the main menu. <br> If this button is pressed while the main menu is displayed, the main menu disappears. <br> [SHIFT] + [MAIN MENU] <br> While a window opens, the window is switched in the following order: <br> Window $\rightarrow$ Sub-menu $\rightarrow$ Main menu |
| :---: | :---: |
| [SERVO ON READY] | Enables the servo power supply to be turned ON. <br> 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: <br> - In the play mode, the servo power supply is turned ON if the safeguarding is securely closed. <br> - In the teach mode, the SERVO ON lamp flashes and the servo power supply is turned ON when the Enable switch is ON. <br> - 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. <br> Pressing this button with [SHIFT] or [INTERLOCK] displays the help guidance for the operation. <br> - [SHIFT] + [ASSIST] <br> The function list of key combinations with [SHIFT] appears. <br> - [INTERLOCK] + [ASSIST] <br> The function list of key combinations with [INTERLOCK] appears. |
| [BACK SPACE] <br> BACK <br> SPACE | Deletes the last character while typing characters. |

### 1.2.4 Programming Pendant Display

## - The Five Display Areas

The programming pendant display is a 6.5 inch color display. Alphanumeric characters can be used.
The general display area, menu area, human interface display area, and main menu area among the following five areas can be moved by pressing [AREA], or can be selected by directly touching the screen.


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

| JOB | EDIT | DISPLAY | UTILITY | 188 |
| :---: | :---: | :---: | :---: | :---: |
| JOB CONTENT  <br> JOB NAME:TEST01 STEP NO. : 0003 <br> CONTROL GROUP: R1 TOOL : 00 |  |  |  |  |
| ```0000 NOP 0001 SET B000 0 0002 SET B001 1 0003 MOVJ VJ=80.00 0004 MOVJ VJ=80.00 0005 DOUT OGH\#(13) BOO2 0006 DOUT OT\#(41) ON 0007 MOVL C00002 V=880.0 CV\#(1) CTP=0.662 0008 DOUT OT\#(44) ON 0009 TIMER T=3.0 0010 MOVL V=880.0 0011 MOVL V=880.0 0012 MOVL V=880.0 0013 MOVL V=880.0``` |  |  |  |  |
| Main Menu |  |  | Turn on se | o power |

## - General-purpose Display Area

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

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

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

EXECUTE: Continues operation with the displayed contents.
CANCEL: Cancels the displayed contents and returns to the previous window.
COMPLETE: Completes the setting operation displayed on the general-purpose display area.
STOP: Stops operation when loading, saving, or verifying with an external memory device.
RELEASE: Releases the overrun and shock sensor function.
RESET: Resets an alarm. (Cannot reset major alarms.)
DIRECT PAGE: Jumps to the 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].



## - 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.


- Status Display Area

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


## (1)Control Group

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



## (2)Operation Coordinate System

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

: Cartesian Coordinates
$\xrightarrow{(1)}$ : Cylindrical Coordinates
: Tool Coordinates
U User Coordinates
(3Manual Speed
Displays the selected speed. For details, refer to "■ Select Manual Speed."

: Inching
4: Low Speed

: Medium Speed
[
High Speed
(4)Security Mode

: Operation Mode

: Edit Mode

: Management Mode
(5)Operation Cycle

Displays the present operation cycle.

: Step

: Cycle

: Continuous
© 6 State Under Execution
Displays the present system status (STOP, HOLD, ESTOP, ALARM, or RUN).

: Hold Status

: Emergency Stop Status

: Alarm Status


Operating Status
(7)Mode (NS3.00 or Iater)

: Teach mode

: Play mode
(8Page
$\square$ : Displayed when the page can be switched.
©Weak Battery of Memory
$\square$ : Displayed when the battery of memory is weak.

## - Human Interface Display Area

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

## Turn on servo power

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

When two or more errors occur, 屋 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].

- Menu Area

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

| DATA | EDIT | DISPLAY | UTILITY |
| :--- | :--- | :--- | :--- |

### 1.2.5 Screen Descriptions

## - Denotation

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

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


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

- Screen

The window can be displayed according to the view desired.


Lower Window View

### 1.2.6 Character Input

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

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

- Operation

| Keypad | Button on the Programming Pendant | Explanation |
| :---: | :---: | :---: |
| Cursor |  | Moves the cursor (focus). |
| [SELECT] |  | Selects a character. |
| [CANCEL] | CANCEL | Clears all the characters being typed. <br> Pressing this second time cancels the software keypad. |
| [BACK SPACE] | BACK SPACE | Deletes the last one character. |
| [ENTER] | ENTER | Enters the input characters. |
| Button Tab |  | Switches the keypads displayed on the programming pendant. |
|  | MAIN MENU | Closes the software keypad. |
| Numeric Keys |  | Enters numbers. |

## - Alphanumeric Input

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

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

For Numbers and Upper-case Characters


For Numbers and Lower-case Characters


## Symbol Input

Press the page key to display the symbol input window.
Move the cursor to the desired symbol and press [SELECT] to enter the symbol. Note that only some symbols are available for naming jobs.

| Јов | EDIT |  | DISPLAY |  | UTILITY |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| [RESULT] |  |  |  |  |  |  |  |  |  |  |  |
| KEYBOARD SYMBOL |  |  |  |  |  |  |  |  |  |  |  |
| - | ! | \% | \& |  |  | ( | ) | - | + | = | Back Space |
| " | * | , |  | 1 |  | : | ; | < | > | ? | Cancel |
| \$ | @ | SP |  |  |  |  |  |  |  |  | Caps Lock |
|  |  |  |  |  |  |  |  |  |  |  | Enter |
| Main Menu |  | Short | t Cut |  |  |  |  |  |  |  |  |

SP: Space

### 1.3 Modes

The following three modes are available for NX100.

- Teach Mode
- Play Mode
- Remote Mode


### 1.3.1 Teach Mode

In the teach mode, the following can be done.

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


### 1.3.2 Play Mode

In the play mode, the following can be done.

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


### 1.3.3 Remote Mode

In the remote mode, the operations such as Servo ON Ready, Start, Cycle Change, Call Master Job can be commanded by external input signals.
The operations by external input signals become enabled in the remote mode, while [START] on the programming pendant becomes disabled.
The data transmission function (optional function) is also available in the remote mode.
The following table shows how each operation is input in each mode.
Note: "PP" indicates the programming pendant.

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

### 1.3.4 Teach Mode Priority

In the teach mode, following operations are disabled:

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

### 1.4 About the Security Mode

### 1.4.1 Types of Security Modes

The following three types of security modes are available for NX100.
Any operations in the edit mode and the management mode require 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.

Menu \& Security Mode

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

*1 Displayed in the teach mode only.
*2 Displayed in the play mode only.
1.4 About the Security Mode

Menu \& Security Mode

| Main Menu | Sub Menu | Security Mode |  |
| :---: | :---: | :---: | :---: |
|  |  | DISPLAY | EDIT |
| ROBOT | CURRENT POSITION | Operation | - |
|  | COMMAND POSITION | Operation | - |
|  | SERVO MONITOR | Management | - |
|  | WORK HOME POS | Operation | Edit |
|  | SECOND HOME POS | Operation | Edit |
|  | DROP AMOUNT | Management | Management |
|  | POWER ON/OFF POS | Operation | - |
|  | TOOL | Edit | Edit |
|  | INTERFERENCE | Management | Management |
|  | SHOCK SENS LEVEL | Operation | Management |
|  | USER COORDINATE | Edit | Edit |
|  | HOME POSITION | Management | Management |
|  | MANIPULATOR TYPE | Management | - |
|  | ROBOT CALIB | Edit | Edit |
|  | ANALOG MONITOR | Management | Management |
|  | OVERRUN\&S-SENSOR*1 | Edit | Edit |
|  | LIMIT RELEASE*1 | Edit | Management |
|  | ARM CONTROL* | Management | Management |
|  | SHIFT VALUE | Operation | - |
| SYSTEM INFO | VERSION | Operation | - |
|  | MONITORING TIME | Operation | Management |
|  | ALARM HISTORY | Operation | Management |
|  | I/O MSG HISTORY | Operation | Management |
|  | SECURITY | Operation | Operation |
| FD/CF | LOAD | Edit | - |
|  | SAVE | Operation | - |
|  | VERIFY | Operation | - |
|  | DELETE | Operation | - |
|  | DEVICE | Operation | Operation |
|  | FOLDER | Edit | Edit |
|  | FORMAT*5 | Operation | Operation |

*1 Displayed in the teach mode only.
*5 For FC1/FC2 Floppy disk
1.4 About the Security Mode

| Menu \& Security Mode |  |  |  |
| :---: | :---: | :---: | :---: |
| Main Menu | Sub Menu | Security Mode |  |
|  |  | DISPLAY | EDIT |
| PARAMETER | S1CxG | Management | Management |
|  | S2C | Management | Management |
|  | S3C | Management | Management |
|  | S4C | Management | Management |
|  | A1P | Management | Management |
|  | A2P | Management | Management |
|  | A3P | Management | Management |
|  | A4P | Management | Management |
|  | RS | Management | Management |
|  | S1E | Management | Management |
|  | S2E | Management | Management |
|  | S3E | Management | Management |
|  | S4E | Management | Management |
| SETUP | TEACHING COND | Edit | Edit |
|  | OPERATE COND | Management | Management |
|  | DATE/TIME | Management | Management |
|  | GRP COMBINATION | Management | Management |
|  | RESERVE JOB NAME | Edit | Edit |
|  | USER ID | Edit | Edit |
|  | SET SPEED | Management | Management |
|  | KEY ALLOCATION*1 | Management | Management |
|  | RES. START(CNCT) | Management | Management |
|  | AUTO BACKUP SET*3 | Management | Management |
|  | WRONG DATA LOG*4 | Operation | Management |
| ARC WELDING | ARC START COND. | Operation | Edit |
|  | ARC END COND. | Operation | Edit |
|  | ARC AUX COND. | Operation | Edit |
|  | POWER SOURCE COND. | Operation | Edit |
|  | ARC WELD DIAG. | Operation | Edit |
|  | WEAVING | Operation | Edit |
|  | ARC MONITOR | Operation | - |
| HANDLING | HANDLING DIAG. | Operation | Edit |
| SPOT WELDING | WELD DIAGNOSIS | Operation | Edit |
|  | I/O ALLOCATION | Management | Management |
|  | GUN CONDITION | Management | Management |
|  | SPOT POWER SOURCE COND. | Management | Management |

*1 Displayed in the teach mode only.
*3 From NS3. 20
*4 From NS3.21
1.4 About the Security Mode

Menu \& Security Mode

| Main Menu |  | Sub Menu |  |
| :--- | :--- | :---: | :---: |
|  |  | Security Mode |  |
| SPOT WELDING <br> (MOTOR GUN) | WELD DIAGNOSIS | Operation | Edit |
|  | GUN PRESSURE | Edit | Edit |
|  | PRESSURE | Edit | Edit |
|  | I/O ALLOCATION | Management | Management |
|  | GUN CONDITION | Management | Management |
|  | CLEARANCE SETTING | Operation | Edit |
|  | SPOT POWER SOURCE COND. | Management | Management |
| GENERAL | WEAVING | Operation | Edit |
|  | GENERAL DIAGNOSIS | Operation | Edit |
| ALL COMMON | I/O-VARIABLE CUSTOMIZE | Operation | Operation |

### 1.4.2 Switching Security Modes



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


Security Mode Selection Dialog Box
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.
1.4 About the Security Mode

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 4 | Input user ID as required. | At the factory, the user ID number is preset as follows: <br> • Edit Mode: [00000000] <br> - Management Mode: [99999999] |
| 5 | Press [ENTER]. | The selected security mode's input ID is checked. If the correct <br> 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 NX100, a group of axes to be controlled at a time is called "Control Group", and the group is classified into three units: "ROBOT" as a manipulator itself, "BASE" that moves the manipulator in parallel, and "STATION" as jigs or tools other than "ROBOT" and "BASE". BASE and STATION are also called external axes.


### 2.1.2 Types of Coordinate Systems

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

## - Joint Coordinates

Each axis of the manipulator moves independently.

- Cartesian Coordinates

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

## - Cylindrical Coordinates

The $\theta$ 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.


Cartesian Coordinates


Tool Coordinates


Cylindrical Coordinates


User Coordinates

### 2.2 General Operations

## ■ Check Safety

Before any operation of NX100, read Section 1 "Safety" of "NX100 INSTRUCTIONS" again and keep safe around robot system or peripherals.

## ■ Select Teach Mode

Set the mode switch on the programming pendant to "teach".

## - Select Control Group

If NX100 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, a control group registered in the selected job is enabled. A control group registered in the edit job can be switched by pressing [ROBOT] or [EX. AXIS].
Check selected control group at status display area on the programming pendant.

## - Select Coordinate System

Select coordinate system by pressing [COORD] button.
It switches; Joint $\rightarrow$ Cartesian (Cylindrical) $\rightarrow$ Tool $\rightarrow$ User in every pressing. Check the selected coordinate on the status display area on the programming pendant.

## - Select Manual Speed

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

NOTE In operating the manipulator manually by the programming pendant, the maximum speed of center point is limited at $250 \mathrm{~mm} / \mathrm{s}$.

- Every press of [FAST] switches; "INCH" $\rightarrow$ "SLOW" $\rightarrow$ "MED" $\rightarrow$ "FAST".

-Every press of [SLOW] switches; "FAST" $\rightarrow$ "MED" $\rightarrow$ "SLOW" $\rightarrow$ "INCH".

MANUAL SPEED


FST $\rightarrow$ MED SLW INCH

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

- Servo ON

Press [SERVO ON READY], then SERVO ON LED starts blinking.
Squeeze the Enable switch, then SERVO ON LED starts lighting.

## - 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 " 2.3 Coordinate Systems and Axis Operation " for details.

■ HIGH SPEED
Pressing of [HIGH SPEED] with axis keys pressed allows the manipulator to move faster than usual speed.

### 2.3 Coordinate Systems and Axis Operation

### 2.3.1 Joint Coordinates

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

Axis Motion in Joint Coordinates

| Axis Name |  | Axis Operation Key | Motion |
| :---: | :---: | :---: | :---: |
| Major Axes | S-axis | $\mathrm{X}-$ $\mathrm{X}+$  <br> $\mathrm{S}-$ S <br> $\mathrm{S}+$  | Main unit rotates right and left. |
|  | L-axis |  | Lower arm moves forward and backward. |
|  | U-axis | $\mathrm{Z}-$ $\mathrm{Z}+$ <br> $\mathrm{U}-$  <br>   | Upper arm moves up and down. |
| Wrist Axes | R-axis |  | Wrist rolls right and left. |
|  | B-axis |  | Wrist moves up and down. |
|  | T-axis |  | Wrist turns right and left. |

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



### 2.3.2 Cartesian Coordinates

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

Axis Motion in Cartesian Coordinates

| Axis Name |  | Axis Operation Key | Motion |
| :---: | :---: | :---: | :---: |
| Basic Axes | X-axis | $\mathrm{X}-1$ $\mathrm{X}+$ <br> $\mathrm{S}-$ S | Moves parallel to X-axis. |
|  | Y-axis | $\mathrm{Y}-$ $\mathrm{Y}+$ <br> $\mathrm{L-}$ $\mathrm{~L}+$ | Moves parallel to Y-axis. |
|  | Z-axis | $\mathrm{Z}-1$ $\mathrm{Z}+$ <br> $\mathrm{U}-$  <br>   | Moves parallel to Z-axis. |
| Wrist Axes |  | Motion about TCP is executed. See " 2.3.7 Control Point Operation " and " 2.3.8 Control Point Change. " |  |

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 $[\mathrm{X}-]+[\mathrm{X}+]$ ), none of the axes operate.



Moves parallel to X - or Y -axis


Moves parallel to Z-axis

### 2.3.3 Cylindrical Coordinates

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

Axis Motion in Cylindrical Coordinates

| Axis Name |  | Axis Operation Key | Motion |
| :---: | :---: | :---: | :---: |
| Basic Axes | $\theta$-axis | $\mathrm{X}-$ $\mathrm{X}+$ <br> $\mathrm{S}-$ S+ | Main unit rolls around S-axis. |
|  | r-axis | $\mathrm{Y}-$ $\left.\begin{array}{c}\mathrm{Y}+ \\ \mathrm{L}+ \\ \hline\end{array}\right)$ | Moves perpendicular to Z-axis. |
|  | Z-axis | $\mathrm{Z}-$ $\mathrm{Z}+$ <br> $\mathrm{U}-$  | Moves parallel to Z-axis. |
| Wrist Axes |  | Motion about TCP is executed. See " 2.3.7 Control Point Operation " and " 2.3.8 Control Point Change ". |  |

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.



Rolls around $\theta$-axis


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 shown in the following table:

| Axis Name |  | Axis Operation Key | Motion |
| :---: | :---: | :---: | :---: |
| Basic <br> Axes | X-axis |  | Moves parallel to X-axis. |
|  | Y- axis |  | Moves parallel to Y-axis. |
|  | Z- axis | $\mathrm{Z}-$ $\mathrm{Z}+$  <br> $\mathrm{U}-$   | Moves parallel to Z-axis. |
| Wrist Axes |  | Motion about TCP is executed. See " 2.3.7 Control Point Operation " and " 2.3.8 Control Point Change ". |  |

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 $[\mathrm{X}-]+[\mathrm{X}+]$ ), none of the axes operate.


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

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


For tool coordinates, the tool file should be registered in advance. For further details, refer to "8.3 Tool Data Setting" ofcoordinates "NX100 INSTRUCTIONS" (RE-CTO-A211).

## - Selecting the Tool

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

This operation can be performed only when numbers of the tool is more than one.
To use several tool files with one manipulator, set the following parameter.
S2C333: Tool number switch specifying parameter
1: Can be switched
0: Cannot be switched

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Press the [COORD] key and select the tool coordi- | Every pressing of the [COORD] key changes coordinate system; Joint $\rightarrow$ Cartesian (Cylindrical) $\rightarrow$ Tool $\rightarrow$ User. Check the change on the status display area. |
| 2 | Press [SHIFT] + [COORD]. | The TOOL NO. SELECT window appears. |
|  |  |  |
|  |  |  |
| 3 | Move the cursor to the tool to use. | The TOOL NO. SELECT window above shows an example; "TOOL NO. 0 TORCH MT-3501" is selected. |
| 4 | Press [SHIFT] + [COORD]. | The window goes back to the previous window. |

### 2.3.5 User Coordinates

In the user coordinates, the manipulator moves parallel to each axis of the coordinates which are set by the user. Up to 24 coordinate types can be registered. Each coordinate has a user number and is called a user coordinate file. The motion of each axis is described in the following table:
The figure and the table below describe the motion of each axis when the axis key is pressed.
Axis Motion in User Coordinates

| Axis Name |  | Axis Key | Motion |
| :---: | :---: | :---: | :---: |
| Basic <br> Axes | X-axis | $\mathrm{X}-$ $\mathrm{X}+$ <br> $\mathrm{S}-$ S+ | Moves parallel to X-axis. |
|  | Y- axis | $\mathrm{Y}-$ $\mathrm{Y}+$ <br> $\mathrm{L}-$ $\mathrm{L}+$ | Moves parallel to Y-axis. |
|  | Z- axis | $\mathrm{Z}-$  <br> $\mathrm{U}-$ $\mathrm{Z}+$ <br> $\mathrm{U}+$  | Moves parallel to Z-axis. |
| Wrist Axes |  | Motion about TCP is executed. See " 2.3.7 Control Point Operation " and " 2.3.8 Control Point Change ". |  |

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 $[\mathrm{X}-]+[\mathrm{X}+]$ ), none of the axes operate.


## - Selecting User Coordinates

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


## - Examples of User Coordinate Utilization

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

- 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

External axis is enabled to operate in selecting "BASE" or "STATION" for control group.

| Axis Name |  | Axis Operation Key | Motion |
| :---: | :---: | :---: | :---: |
| BASE or STATION | 1st axis | $\mathrm{X}-$ $\mathrm{X}+$ <br> $\mathrm{S}-$ S+ | The 1st axis moves. |
|  | 2nd axis | $\mathrm{Y}-$ $\mathrm{Y}+$ <br> L $\mathrm{L}+$ | The 2nd axis moves. |
|  | 3rd axis | $\mathrm{Z}-$ $\mathrm{Z}+$ <br> $\mathrm{U}-$ $\mathrm{U}+$ | The 3rd axis moves. |

### 2.3.7 Control Point Operation

Motion about TCP (Tool Center Point) can only change the wrist orientaion at a fixed TCP position in all coordinate systems except the joint coordinates. The motion of each axis is described in the following table.

Axis Motion in Motion about TCP

| Axis Name | Axis Key | Motion |
| :---: | :---: | :---: |
| Basic Axes | $\mathrm{X}-$ $\mathrm{X}+$ <br> $\mathrm{s}-$ <br> $\mathrm{S}+$ | TCP moves. These movements differ depending on cartesian, cylindrical, tool and user coordinates. |
|  | $\mathrm{Y}-$ $\mathrm{Y}+$ <br> $\mathrm{L-}$  |  |
|  | $\mathrm{Z}-\mathrm{Z}+$  <br> $\mathrm{U}-$ $\mathrm{U}+$ |  |
| Wrist Axes |  | Wrist axes move with the TCP fixed. These movements differ depending on cartesian, cylindrical, tool and user coordinates. |
|  |  |  |
|  |  |  |

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


Torch Welding


Turning of each wrist axis differs in each coordinate system.

- In cartesian or cylindrical coordinates, wrist axis rotations are based on the $\mathrm{X}-$, $\mathrm{Y}-$, 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.



### 2.3.8 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 the tool from a list of registered tools (Refer to "■ Selecting the Tool" in " 2.3.4 Tool Coordinates "), and then manipulating the axes while changing the TCP. This can be performed with all coordinates except the joint coordinates. The axis operation is the same as that of the motion about TCP.

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

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


Selection of Tool 1 and axis operations with controlling P1


Selection of Tool 2 and axis operations with controlling P2
$<$ Example $2>$ TCP Change Operation with a Single Tool
The two corners of the workpiece that the tool is holding are taken as TCPs P1 and P2 respectively. By selecting two TCPs alternately, the workpieces can be moved as shown below:


Motion about TCP with P1 selected


Motion about TCP with P2 selected

For registration of the tool file, refer to "8.3 Tool Data Setting" of "NX100 INSTRUCTIONS" (RE-CTO-A211).

## 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 NX100 and the programming pendant are functioning correctly before operating the manipulator.

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

### 3.1.2 Setting the Teach Lock

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

### 3.1.3 Registering a Job

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

- Registering Job Names

Job names can use up to 8 alphanumeric and symbol characters. These different types of characters can coexist within the same job name.
The following rules apply to the designation of names for reserved jobs:
A maximum of six characters can be used for a reserved job name.
When a reserved job name is used, additional characters are added by the system.
<Example>

$$
\begin{array}{|l|l|}
\hline 001 & \text { JOB-1 } \quad \text { WORK-A } \\
\hline
\end{array}
$$



## - Registering Comments

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

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | In the NEW JOB CREATE win- <br> dow, move the cursor to the <br> comment and press <br> [SELECT]. |  |
| 2 | Enter the comment. | For information on character input operation, refer to "1.2.6 Char- <br> acter Input." |
| 3 | Press [ENTER]. |  |

- 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.

## - 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:


### 3.2 Teaching Operation

### 3.2.1 The Teaching Window

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


## (1)Line Numbers

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

## (2)Cursor

The cursor for manipulator control. For the FWD, BWD, and test operation, the manipulator motion starts from the line this cursor points.
(3)Instructions, Additional Items, Comments, Etc.


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

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

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

## ■ Joint Interpolation

The joint interpolation is used when the manipulator does not need to move in a specific path toward the next step position. When the joint interpolation is used for teaching a robot axis, the move instruction is MOVJ. For safety purposes, use the joint interpolation to teach the first step.
When [MOTION TYPE] is pressed, the move instruction on the input buffer line changes.

## Play Speed Setting Window

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

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Move the cursor to the play speed. |  |
| 2 | Set the play speed by pressing [SHIFT] + the cursor key. | The joint speed value increases or decreases. <br> $\Rightarrow$ MOVJVJ=0.78 |

## ■ Linear Interpolation

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


Play Speed Setting Window (same for circular and spline interpolation)
There are two types of displays, and they can be switched depending on the application.

|  | Operation | Explanation |  |
| :---: | :---: | :---: | :---: |
| 1 | Move the cursor to the play speed. |  |  |
| 2 | Set the play speed by pressing [SHIFT] + the cursor key. | The play speed value inc | es or decreases. |

## - 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.


Interpolation Type for Single Circular Arc

|  | Interpolation Type | Instruction |
| :--- | :--- | :--- |
| P0 | Joint or Linear | MOVJ |
|  |  | MOVL |
| P1 | Circular | MOVC |
| P2 |  |  |
| P3 |  | MOVJ |
| P4 | Joint or Linear |  |

## Continuous Circular Arcs

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


## Play Speed

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

## ■ Spline Interpolation

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

## Single Spline Curve

When a single spline curve movement is required, teach the spline interpolation for three points, P 1 to P 3 , as shown in the figure below. If joint or linear interpolation is taught at point P 0 , the point before starting the spline interpolation, the manipulator moves from P0 to P 1 in a straight line.


Interpolation Type for a Single Spline Curve

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

## Continuous Spline Curves

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


Interpolation Type for Continuous Spline Curves

| Point | Interpolation Type | Instruction |
| :--- | :--- | :--- |
| P0 | Joint or Linear | MOVJ <br> MOVL |
| P1 <br> to <br> P5 | Spline | MOVS |
| P6 | Joint or Linear | MOVJ |

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


## Play Speed

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

## NOTE

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


### 3.2.3 Teaching Steps

## - Registering Move Instructions

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


Registering Move Instructions


Inserting Move Instructions

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

Setting the Position Data


## Selecting the Tool Number



Using Multiple Tools with One Manipulator

## SUPPLE

When multiple tools are to be used with one manipulator, set parameter S2C333 to 1.
See " 2.3.4 Tool Coordinates " for details on this operation.

## Setting the Interpolation Type

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Press [MOTION TYPE]. | When [MOTION TYPE] is pressed, MOVJ $\rightarrow$ MOVL $\rightarrow$ MOVC $\rightarrow$ <br> MOVS are displayed in order in the input buffer line. |
| 2 | Select the desired interpola- <br> tion type. |  |

## Setting the Play Speed

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Move the cursor to the instruction. | 0001 LOVV $=50.00$ |
| 2 | Press [SELECT]. | The cursor moves to the input buffer line. |
| 3 | Move the cursor to the play speed to be set. |  |
| 4 | Press [SHIFT] + the cursor key [ $\uparrow$ ] or [ $\downarrow$ ] simultaneously. | The joint speed moves up and down. |
| 5 | Press [ENTER]. | The MOV instruction is registered. |

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

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


## Setting Position Level

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

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


| Position Levels | Accuracy |
| :---: | :---: |
| 0 | Teaching position |
| 1 | Fine |
| to |  |
| 10 | Rough |

$\qquad$

3.2 Teaching Operation


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

## - Registering Reference Point Instructions

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

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{\mathrm{JOB}\}$ 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. reference point is 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. $\square$ REFP |
| 7 | Change the reference point number in one of the following ways. <br> 1: Move the cursor to the reference point number, and press [SHIFT] + the cursor key to change the reference point number; or <br> 2: Press [SELECT] when the cursor is on the reference point number. Then, the data input buffer line appears. Input the number and press [ENTER]. | $\square$ |
| 8 | Press [INSERT]. | The [INSERT] key lamp lights. <br> When registering before the END instruction, pressing [INSERT] is not needed. |
| 9 | Press [ENTER]. | The REFP instruction is registered. |

[^0]
## - Registering Timer Instructions

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

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{\mathrm{JOB}\}$ 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 $0.01 \mathrm{sec}-$ onds. <br> $\Rightarrow$ TIMER T=2.00 <br> 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. <br> When registering before the END instruction, pressing [INSERT] is not needed. |
| 7 | Press [ENTER]. | The TIMER instruction is registered. |

Changing Timer Value


### 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.


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

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Move the cursor to the first <br> step line. |  |
| 2 | Press [FWD]. | The manipulator moves to the first step position. |
| 3 | Move the cursor to the last <br> step line. | The cursor starts blinking. When the cursor line position and the <br> manipulator position are different in the JOB CONTENT window, <br> 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 <br> last step. At this time, only the position data can be changed in <br> 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.

NOTE
For safety, set manual speed at or below.

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Move the cursor to the step to <br> be checked. |  |
| 2 | Press [FWD] or [BWD]. | The manipulator reaches the following / previous step and stops. |

- Precautions When Using FWD / BWD Operations


## FWD Movements

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



## BWD Movements

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



## Circular Movements with FWD/BWD Key Operations

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



## Spline Curve Movements with FWD/BWD Operations

- The manipulator moves in a straight line to the first step of spline interpolation.
- There must be three spline curve motion steps in a row to perform a spline curve operation.
- Depending on the position where the [FWD] / [BWD] operation is performed, the alarm "IRREGULAR DISTANCES BETWEEN TEACHING POINTS" may occur. Note that FWD/ BWD inching operations change the path of the manipulator and caution is therefore required. Performing these operations also increases the likelihood that the "IRREGULAR DISTANCES BETWEEN TEACHING POINTS" will occur.
- If the [FWD] or [BWD] operation is restarted after being stopped to move the cursor or perform a search, the manipulator moves in a straight line to the next step.
- If the [FWD] or [BWD] operation is restarted after being stopped to move the axis as shown in the following, the manipulator moves in a straight line to P 2 , the next spline curve motion step. Spline curve motion is restored from P2 onward. However, the path followed between P2 and P3 is somewhat different from the path followed at playback.

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



## - Selecting Manual Speed

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

| DATA | EDIT | DISPLAY | UTILITY |  |
| :---: | :---: | :---: | :---: | :---: |
| JOB CONTENT |  |  |  |  |

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

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

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

MANUAL SPEED


[^1]- [HIGH SPEED] is available only for the FWD operation but not for BWD operation.


## - Moving to Reference Point

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

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Move the cursor to the refer- <br> ence point instruction line to <br> be checked. |  |
| 2 | Press [REFP] + [FWD]. | The manipulator moves to the reference point of the cursor line. |

## - Test Operations

Playback operations can be simulated in the teach mode with test operations. This function is convenient for checking continuous paths and operation instructions.
Test operation differs in the following ways from actual playback in the play mode.

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

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

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

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

### 3.4 Modifying Steps




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



### 3.4.1 Displaying the JOB CONTENT Window for Editing

■ Currently Called Up Job

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select $\{\mathrm{JOB}\}$ under the main <br> menu. |  |
| 2 | Select $\{\mathrm{JOB}\}$. | The JOB CONTENT window appears. |

- Calling Up Other Jobs

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


### 3.4 Modifying Steps

### 3.4.2 Inserting Move Instructions

## NOTE

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

Step where move instruction is to be inserted


|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Move the cursor to the line immediately before the insert position. | The line immediately before where the move instruction is to be added. $\quad \begin{cases}0006 & \text { MOVL V }=276 \\ 0007 & \text { TIMER T }=1.00 \\ 0008 & \text { DOUT OT\#(1) ON } \\ 0009 & \text { MOVJ VJ }=100.0\end{cases}$ |
| 2 | Press the axis operation key. | Turn ON the servo power and press the axis operation key to move the manipulator to the position to be inserted. |
|  |  | NOTE Confirm the move instruction on the input buffer line and set desired interpolation type and play speed. |
| 3 | Press [INSERT]. | The key lamp will light. |
|  |  | NOTE <br> 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. |
|  |  |   <br> The move instruction <br> is added. 0006 MOVL V=276 <br> 0007 TIMER T $=1.00$ <br> 0008 DOUT OT\#(1) ON <br> 0009 MOVLV $=558$ <br> 0010 MOVJ VJ $=100.0$ |
|  |  | <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. |
|  |  |  |

## Positions where the move instructions are inserted.

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

### 3.4.3 Deleting Move Instructions

Step where move instruction is to be deleted


|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Move the cursor to the move instruction to be deleted. |   <br> Move instruction  <br> Mo be deleted $\quad$0003 MOVL V=138 <br> 0004 <br> MOVL V $=558$  <br> 0005 MOVJ VJ=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. <br> - Press [FWD] and move the manipulator to the position where the move instruction is to be deleted. <br> - Press [MODIFY] $\rightarrow$ [ENTER] to change the position data of the blinking cursor position to the current manipulator position. |
| 2 | Press [DELETE]. | The key lamp will blink. |
| 3 | Press [ENTER]. | The step indicated by cursor line is deleted. |

### 3.4 Modifying Steps

### 3.4.4 Modifying Move Instructions

## - Modifying Position Data

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Move the cursor to the MOV <br> instruction to be modified. | Display the JOB CONTENT window and move the cursor to the <br> move instruction to be changed. |
| 2 | Press the axis operation key. | Turn ON the servo power and press the axis operation key to <br> 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. <br> SUPPLE- <br> MENT |
| For MOV instructions for which position variables <br> have been set, the position variables will not be <br> changed. |  |  |

■ Modifying Interpolation Type

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

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Move the cursor to the move <br> instruction to be modified. | Display the JOB CONTENT window, and move the cursor to the <br> move instruction for which interpolation type is to be changed. |
| 2 | Press [FWD]. | Turn ON the servo power and press [FWD] to move the manipula- <br> tor 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 <br> time [MOTION TYPE] is pressed, the input buffer line instruction <br> alternates. |
| 6 | Press [INSERT]. | The interpolation type and position data are changed at the same <br> time. |
| 7 | Press [ENTER]. |  |

### 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\} $\rightarrow\{$ ENABLE UNDO\}, and becomes disabled by selecting $\{E D I T\} \rightarrow\{* E N A B L E$ 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 the play mode after editing the move instruction. The undo operation works only for the last five edited instructions only.

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 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

## ■ Deleting Reference Point Instructions

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

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

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Move the cursor to the refer- <br> ence point instruction to be <br> deleted. |  |
| 2 | Press [DELETE]. | The key lamp will blink. |
| 3 | Press [ENTER]. | The reference point instruction at the cursor line is deleted. |

### 3.4 Modifying Steps

- Modifying Reference Point Instructions

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Move the cursor to the refer- <br> ence point instruction to be <br> modified. |  |
| 2 | Move the manipulator with the <br> axis operation keys. | Turn ON the servo power and use the axis operation keys to <br> 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

- Deleting Timer Instructions

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Move the cursor to the timer instruction to be deleted. |   <br> Timer instruction  <br> to be deleted 0003 MOVJ VJ=50.00 <br> 0004 TIMER T $=0.50$ <br> 0005 MOVL V $=138$ |
| 2 | Press [DELETE]. | The key lamp will light. |
| 3 | Press [ENTER]. | The timer instruction at the cursor line is deleted. |

- Modifying Timer Instructions

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Move the cursor to the timer instruction to be modified. | 0003 MOVJ VJ $=50.00$ <br> 0004 TIMER T=0.50 <br> 0005 MOVLVJ=138 <br> 0006 MOVL VJ $=138$ |
| 2 | Press [TIMER]. | 0003 MOVJ VJ=50.00 <br> 0004 TIMERT $=0.50$ <br> 0005 MOVLVJ <br> 0006 MOVL VJ $=138$ |
| 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]. | This key lamp will light. |
| 6 | Press [ENTER]. | The timer instruction at the cursor line is changed. |

### 3.5 Modifying Jobs

### 3.5.1 Calling Up a 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.

## - JOB HEADER Window

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select $\{\mathrm{JOB}\}$ under the main <br> menu. |  |
| 2 | Select $\{\mathrm{JOB}\}$. |  |


|  | Operation | Explanation |
| :---: | :---: | :---: |
| 3 | Select \{DISPLAY\} under the menu. |  |
| 4 | Select \{JOB HEADER\}. | The JOB HEADER window appears. Scroll the window using the cursor. |
|  |  |  |
|  |  |  |
|  |  | Main Menu Short Cut |

(1) OB NAME

Displays the name of the current job.

## (2)COMMENT

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

## (3)DATE

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

## (4)CAPACITY

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

## (5)LINES

Displays the total number of instructions registered in this
job.
© ${ }^{\text {CTEPS }}$
Displays the total number of move instructions registered in this job.
(7)EDIT LOCK

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

## (8)TO SAVE TO FD

Displays "DONE" if the contents of the job are saved to a floppy disk since the date and time of the last editing operation, and displays "NOT DONE" if they are not saved.
The job is marked as "DONE" only if it is saved as an independent job or as a related job. If it is saved in a CMOS batch operation, it is not marked as "DONE."

## (9)CONTROL GROUP

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\}.

- JOB CONTENT Window

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{JOB\} under the main menu. |  |
| 2 | Select $\{\mathrm{JOB}\}$. | The JOB CONTENT window appears. <br> $\leftarrow$ (Left) : The cursor is moved to the address area. <br> $\rightarrow$ (Right): The cursor is moved to the instruction area. |
|  |  |  |
|  |  | (1)Address Area <br> Displays line numbers. <br> (2)Instruction Area <br> Displays instructions, additional items, and comments. Line editing is possible. |

- COMMAND POSITION Window

- JOB CAPACITY Window

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{\mathrm{JOB}\}$ under the main menu. |  |
| 2 | Select \{JOB CAPACITY\}. | © 1 NUMBER OF J OBS <br> Displays the total number of jobs currently registered in the memory of NX100. <br> (2)USED MEMORY <br> Displays the total amount of memory used in the NX100. <br> (3)STEPS <br> Displays the total number of used steps. <br> (4)EDITING BUFFER <br> Displays editing buffer use. |

### 3.6 Editing Instructions

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

(1)When the cursor is in the address area

Instructions can be inserted, deleted, or modified.
(2)When the cursor is in the instruction area

Date of additional items of already-registered instructions can be modified, inserted, or deleted.
Editing additional items only is called "line editing."
When inserting or modifying instructions, input the instruction with the function keys such as [TIMER], etc. or using the instruction list dialog box. The selected instruction is displayed on the input buffer line with the same additional items as registered previously.

### 3.6.1 Instruction Group

The instructions are divided into eight groups by processing or each work.
By pressing [INFORM LIST] $\begin{gathered}\substack{\text { Neoram } \\ \text { List }}\end{gathered}$, the instruction group list dialog box appears.

| JOB | EDIT | DISPLAY | UTILITY |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| JOB CONTENT  <br> JOB NAME : TEST01 STEP NO. <br> CONTROL GROUP : R1 TOOL: 00 |  |  |  |  | IN/OUT <br> CONTROL |
| ```0000 NOP 0001 MOVJ VJ=25.00 PL=0 NWAIT ACC=20 DCC=20 0002 MOVJ VJ=25.00 0003 MOVJ VJ=12.50 0004 ARCON ASF#(1) 0005 END``` |  |  |  |  | DEVICE <br> MOTION <br> ARITH <br> SHIFT <br> OTHER <br> SAME <br> PRIOR |
| $\Rightarrow$ MOVJ VJ=50 |  |  |  |  |  |
| Main Menu | Short Cut |  |  |  |  |

3.6 Editing Instructions

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

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

| JUMP | INIOUT |
| :---: | :---: |
| CONTROL |  |
| CALL | OEVICE |
| TIMER | MOTION |
| LABEL | ARITH |
| COMMENT | SHIFT |
| RET | OTHER |
|  | SAME |
|  |  |

### 3.6.2 Inserting Instructions


3.6 Editing Instructions

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 5 | Change the data of additional items or variables as required. | <When Nothing is to be Changed> Proceed to Step 6. <br> <When Additional Items are to be edited> <br> - Changing numeric data <br> Move the cursor to the desired item and press [SHIFT] + the cursor key to increase or decrease the value. $\square$ <br> => PULSE OT\#( $\mathbf{2}$ ) <br> To directly input the value using Numeric keys, press [SELECT] to display the input buffer line. $\square$ <br> Type the value and press [ENTER]. The value on the input buffer line is changed. <br> - Adding, modifying, or deleting an item <br> 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. Move the cursor to the desired item and press [SELECT]. <br> To delete an item, move the cursor to the item to be deleted and select "UNUSED." |
|  |  |  |
|  |  |  |



### 3.6 Editing Instructions

### 3.6.3 Deleting Instructions

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Move the cursor to the address area in the JOB CONTENT window. | Move the cursor to the instruction line to be deleted, in the teach mode. |
| 2 | Move the cursor to the deleting line in the address area. | The line desiredto be deleted $\rightarrow$0020 MOVL V=138 <br> 0021 PULSE OT\#\#(2) T=1001 <br> MOVJ VJ $=100.00$  |
| 3 | Press [DELETE] and [ENTER]. | The instruction is deleted and the following lines move up. |

### 3.6.4 Modifying Instructions

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Move the cursor to the address area in the JOB CONTENT window. | Move the cursor to the instruction line to be modified, in the teach mode. |
| 2 | Press [INFORM LIST]. | The INFORM command list appears, and an underline is displayed beneath the line number in the address area. |
| 3 | Select the instruction group. | The instruction list dialog box appears. The selected instruction is displayed on the input buffer line with the same additional items as registered previously. |
| 4 | Select the instruction to be modified. |  |


3.6 Editing Instructions


### 3.6.5 Modifying Additional Numeric Data

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Mote the cursor to the instruction area in the JOB CONTENT window. |  |
| 2 | Select the line where the number data is to be modified. | 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]. <br> $\Rightarrow$ PULSE OT\#(2) T=1001 |
| 5 | Press [ENTER]. | The numeric data is modified. |

3.6.6 Modifying Additional Items


### 3.6.7 Inserting Additional Items

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

### 3.6.8 Deleting Additional Items

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

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Move the cursor to the instruction area in the JOB CONTENT window. |  |
| 2 | Select the line where the additional item is to be deleted. | 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 |
| :---: | :---: |
| 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. <br> (Refer to the following figure.) |




### 3.7.1 Selecting the Range

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

|  | Operation | Explanation |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Move the cursor to the instruction area in the JOB CONTENT window. |  |  |  |  | Move the cursor to instruction area. |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  | Main Menu | Short Cut | (ii) Tum on sevo power |  |  |
| 2 | Move the cursor to the start line and press [SHIFT] + [SELECT]. |  |  |  |  |  |
|  |  | reverse. |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  | Main Menu | Short Cut | (i) Tum on seno oower |  |
| 3 | Move the cursor to the end line. | Moving the cursor effects to the range. Up to the line specified by the cursor is the range. |  |  |  |  |

### 3.7 Editing Jobs

### 3.7.2 Copying

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


### 3.7.3 Cutting

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


### 3.7.4 Pasting

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

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Move the cursor to the line immediately before the desired position in the JOB CONTENT window. |  |
| 2 | Select \{EDIT $\}$ under the menu. | The pull-down menu appears. |
|  |  | Main Menu ${ }^{\text {S }}$ Short Cut |
| 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 Editing Jobs

### 3.7.5 Reverse Pasting

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


### 3.8 Test Operations

Playback operations can be simulated in the teach mode with test operations. This function is convenient for checking continuous paths and operation instructions.
Test operation differs in the following ways from actual playback in the play mode.
NOTE - Operation speeds greater than the maximum teaching speed are reduced to the maxi-
mum teaching speed.

- Only machine lock is available among special operations for playback in the play mode.
- Work instruction output, such as arc output, is not executed.

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

NOTE Always check safety conditions before starting the manipulator in motion.

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

### 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
- Modification of Speed Type

This method is used to modify the speed type (such as $\mathrm{VJ}, \mathrm{V}, \mathrm{VR}$, etc.).


| Type of <br> Play Speed | Explanation |  |
| :---: | :--- | :--- |
| VJ | Joint Speed | Normal robot axes |
| $V$ | TCP Speed |  |
| VR | Posture Angle Speed |  |
| VE | Base Axis Speed |  |

## - Relative Modification

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


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

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select $\{\mathrm{JOB}\}$ under the main <br> menu. |  |
| 2 | Select \{JOB\}. | The JOB CONTENT window appears. |


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

## - Modification by TRT (Traverse Time)

Modifications made by TRT have the following characteristics:

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

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



### 3.9.2 Editing Interpolation Type

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{\mathrm{JOB}\}$ under the main menu. |  |
| 2 | Select $\{\mathrm{JOB}\}$. | 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. <br> The modification of the speed according to the modification of the interpolation type is calculated by the ratio to maximum speed at each speed. <br> Joint Speed: MAX=100.0\% <br> Linear Speed: MAX $=9000 \mathrm{~cm} / \mathrm{min}$ <br> (e.g.) <br> Joint Speed: 50\% = Linear Speed: $4500 \mathrm{~cm} / \mathrm{min}$ <br> Linear Speed: 10\% = Linear Speed: $900 \mathrm{~cm} / \mathrm{min}$ |
| 6 | Press [ENTER]. | The instruction on the cursor line is replaced with one on the input buffer line. |

### 3.9.3 Editing Condition Files

Condition files are prepared in order to set the conditions for the manipulator to execute instructions.
Multiple condition files are provided for each application. More than one pattern can be set up in each condition file. The patterns are listed by "condition numbers." This number is specified by the work instruction in a job.

NOTE Refer to NX100 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:

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

- Play Speed V:

MOVL 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 1000 were set as 1000 , the following would be true:
$1000=1000 \rightarrow$ unit for $V$ is $0.1 \mathrm{~mm} / \mathrm{s} \rightarrow V=100.0 \mathrm{~mm} / \mathrm{s}$
Note that, depending on the unit being used, the value of the variable and the value of the actual speed on occasion might not match.

- Play Speed VJ :

MOVL VJ=I000
The unit for VJ is $0.01 \%$.
For example, if 1000 were set as 1000, the following would be true:
IOOO=1000 $\rightarrow$ unit for VJ is $0.01 \% \rightarrow \mathrm{VJ}=10.00 \%$.

- Timer T:

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

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


- Setting Character Type Variables

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 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. <br> - Move the cursor on the variable No. and press [SELECT]. Then input the variable No. using the Numeric keys and press [ENTER]. <br> - 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. |  |
| 5 | Press [SELECT]. | The characters can be directly typed. |
| 6 | Input the desired characters. | For information on character input operation, refer to "1.2.6 Character Input." |
| 7 | Press [ENTER]. | The input characters are set to the variable on the cursor position. |

- Registering Variable Name

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{VARIABLE\} under the main menu. |  |
| 2 | Select desired variable. | Select any variable type from among byte type, integer type, double precision integer type, real type, robot position type, base position type, and station position type. |
| 3 | Move the cursor to desired variable number. | If desired variable number is not displayed, move the cursor by either of following operations. <br> - Select the variable number, input desired variable number and press [ENTER] <br> The cursor moves to the variable number to be input. <br> - Move the cursor to the menu area and select $\{E D I T\} \rightarrow\{$ SEARCH $\}$. Input desired variable number and press [ENTER]. <br> The cursor moves to the variable number to be input. |
| 4 | Select "NAME." | The input buffer line appears. |
|  |  | Refer to " 1.2.6 Character Input " for the character input operation. |
| 5 | Input name. |  |
| 6 | Press [ENTER]. | The variable name is registered. |
|  |  |  |
|  |  |  |

- Displaying Position Variables

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 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 or [SHIFT] + page key . | Select the desired number by pressing the page key <br> If [SHIFT] is pressed simultaneously, the window returns to previous page. <br> When the desired variable number is not displayed, move the cursor with either of the following operations. <br> - Press [DIRECT PAGE]. Then input the variable No. using the Numeric keys and press [ENTER]. <br> - Move the cursor to the menu area and select \{EDIT\} $\rightarrow$ \{SEARCH\}. Then input the variable No. with the Numeric keys |
|  |  |  |

## - Setting Position Variables

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

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

Types of Position Variables and Setting Methods

| Type | Pxxx (Robot) |  | BPxxx(Base) |  | EXxxx <br> (Station) |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Pulse Type | XYZ Type | Pulse <br> Type | $\begin{aligned} & \text { XYZ } \\ & \text { Type } \end{aligned}$ | Pulse Type |
|  |  | Select coordinates from base, robot, user, tool. |  |  |  |



Using the axis keys


■ Setting Position Variables Using the Numeric Keys

## Pulse Type


3.9 Other Job-editing Functions

## XYZ Type

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

## About "<TYPE>"

- It is not necessary to set a type if the position variable is to be used for parallel shift operations.
- When the position variable is used with a move instruction such as "MOVJ P001," it is necessary to set a type. For details on types, refer to "Manipulator Types " on the page 3-76.
Current Position Window (XYZ) shows the current setting of a type.
- Setting Position Variables Using the Axis Keys


## Pulse Type

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | $\begin{array}{l}\text { Select }\{\text { VARIABLE\} under the } \\ \text { main menu. }\end{array}$ |  |
| 2 | $\begin{array}{l}\text { Select desired position vari- } \\ \text { able type. }\end{array}$ | The desired variable window appears (robot, base, or station). |
| 3 | Press [SHIFT] + [ROBOT]. | $\begin{array}{l}\text { When you need an external axis position, press } \\ \text { [SHIFT]+[EX.AXIS]. } \\ \text { When there are two or more robot, base, or a station, specify the } \\ \text { axis with following operation. } \\ - \text { Robot } \\ \text { Each time [SHIFT] + [ROBOT] is pressed, the axis displayed on } \\ \text { the status line changes: } \\ \text { R1 } \rightarrow \text { R2 } \rightarrow \text { R3 } \rightarrow \text { R4. }\end{array}$ |
| Base or Station |  |  |
| Each time [SHIFT]+[EX.AXIS] is pressed, the axis displayed on |  |  |
| the status line changes: |  |  |
| B1 $\rightarrow$ B2 $\rightarrow$ B3 $\rightarrow$ B4 $\rightarrow$ S1 $\rightarrow$ S2 $\rightarrow$ S3 $\rightarrow \cdots \rightarrow$ S12 |  |  |$]$

## XYZ Type

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select \{VARIABLE\} under the <br> main menu. | Select desired position vari- <br> able type. |
| When there are two or more robot, base, or a station, specify the <br> axis with following operation. <br> - Robot <br> Each time [SHIFT] + [ROBOT] is pressed, the axis displayed on <br> the status line changes: <br> R1 $\rightarrow$ R2 $\rightarrow$ R3 $\rightarrow$ R4. <br> Base or Station <br> Each time [SHIFT]+[EX.AXIS] is pressed, the axis displayed on <br> the status line changes: <br> B1 $\rightarrow$ B2 $\rightarrow$ B3 $\rightarrow$ B4 $\rightarrow$ S1 $\rightarrow$ S2 $\rightarrow$ S3 $\rightarrow \cdots \rightarrow$ S12 |  |  |
| 3 | Move the manipulator with the <br> axis keys. | Move the manipulator or the external axis to the desired position <br> to be set to position variable. |
| 4 | Press [MODIFY]. |  |
| 5 | Press [ENTER]. |  |

3.9 Other Job-editing Functions

- Deleting Data Set of Position Variables

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

- Checking Positions by Position Variables

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{VARIABLE\} under the main menu. |  |
| 2 | Select desired position variable type. | When there are two or more robot, base, or a station, specify the axis with following operation. <br> - Robot <br> Each time [SHIFT] + [ROBOT] is pressed, the axis displayed on the status line changes: $\mathrm{R} 1 \rightarrow \mathrm{R} 2 \rightarrow \mathrm{R} 3 \rightarrow \mathrm{R} 4 .$ <br> - Base or Station <br> Each time [SHIFT]+[EX.AXIS] is pressed, the axis displayed on the status line changes: $\mathrm{B} 1 \rightarrow \mathrm{~B} 2 \rightarrow \mathrm{~B} 3 \rightarrow \mathrm{~B} 4 \rightarrow \mathrm{~S} 1 \rightarrow \mathrm{~S} 2 \rightarrow \mathrm{~S} 3 \rightarrow \cdots \rightarrow \mathrm{~S} 12$ |
| 3 | Press [FWD]. | Selected axis moves to the position specified by the variable. |
|  |  | NOTE <br> The selected axis (manipulator, base, or station) moves directly to the set variable position. Before pressing [FWD], check that the surrounding area is safe. |

## ■ Manipulator Types

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

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

These six types are described in the following:

- Flip/No Flip

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

| Flip | No Flip |
| :---: | :---: |
|  |  |
| $\begin{gathered} -90<\theta R \leq 90 \\ 270<\theta R \leq 360,-360<\theta R \leq-270 \end{gathered}$ | $\begin{gathered} 90<\theta R \leq 270 \\ -270<\theta R \leq-90 \end{gathered}$ | $\theta R$ is the angle when the $R$-axis home position is $0^{\circ}$.

- R-axis Angle

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

| $R<180^{\circ}$ | $R \geq 180^{\circ}$ |
| :---: | :---: |
| $-180<\theta R \leq 180$ | $180<\theta R \leq 360,-360<\theta R \leq-180$ |

NOTE $\theta \mathrm{R}$ is the angle when the R -axis home position is $0^{\circ}$.
-T-axis Angle
This specifies positions of the R-, B-, and T-axis.
For manipulators with wrist axes (three axes), this specifies whether the T -axis angle is less than $\pm 180^{\circ}$ or greater than $\pm 180^{\circ}$.

| T < 180 ${ }^{\circ}$ | $\mathrm{T} \geq 180^{\circ}$ |
| :---: | :---: |
|  |  |
| $-180<\theta$ T $\leq 180$ | $180<\theta \mathrm{T} \leq 360,-360<\theta \mathrm{T} \leq-180$ |

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

## - Front/Back

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


The diagram above shows the S -axis at $0^{\circ}$ and at $180^{\circ}$. This is the configuration when the L-axis and the U-axis are viewed from the right-hand side.

## - Upper Arm/Low er Arm

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


- S-axis Angle

This designation is required for the manipulators which have working envelopes greater than $\pm 180^{\circ}$.

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

| $\mathrm{S}<180^{\circ}$ | $\mathrm{S} \geq 180^{\circ}$ |
| :---: | :---: |
| $-180^{\circ}<\theta \mathrm{S} \leq 180^{\circ}$ |  |

## 3．9．5 Editing Local Variables

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

Local Variables

| Data Format |  | Variable No． | Functions |
| :---: | :---: | :---: | :---: |
| Byte Type |  | LBOOO to LBDOD | Range of storable values is from 0 to 255 ． <br> Can store I／O status． <br> Can perform logical operations（AND，OR，etc．）． |
| Integer Type |  | LIOOO to <br>  | Range of storable values is from－32768 to 32767. |
| Double Precision Integer Type |  | LD000 to LDㅁㅁ | Range of storable values is from -2147483648 to 2147483647. |
| Real Type |  | LR000 to LRロロロ | Range of storable values is from $-3.4 \mathrm{E}+38$ to $3.4 \mathrm{E}+38$ Accuracy： $1.18 \mathrm{E}-38<\mathrm{x} \leq 3.4 \mathrm{E}+38$ |
| Character Type |  | LSOOO to <br> LSD日ロ | Maximum storable number of characters is 16 ． |
| Position Type | Robot <br> Axes | LP000 to LPロロロ | Can store position data in pulse form or in $X Y Z$ form．$X Y Z$ type variables can be used as target position data for move instructions，and as incremental values for parallel shift instructions． |
|  | Base <br> Axes | LBP000 to LBPロロロ |  |
|  | Station <br> Axes | LEX000 to LEXロロロ |  |

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


User Variables


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

- Not Able to Display the Variable Contents

To display the local variable contents, user variables are needed.
For example, to view the contents of local variable LPOOO, 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 J ob

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

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

## - Setting the Number of Local Variables

How many local variables are to be used in a job is set in the JOB HEADER window. When setting the number of variables, the memory area needed for those variables is saved.

Only when expanding the "INSTRUCTION LEVEL," it is possible to use local variables.
Refer to "8.12 Instruction Level Setting" of "NX100 INSTRUCTIONS" (RE-CTO-A211) for details on setting the language level.

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{\mathrm{JOB}\}$ 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. |
|  |  | Job EDIT DISPLAY UTILTY 退 [ \% M |
|  |  |  |
|  |  |  |

### 3.9.6 Searching

When performing editing or confirmation, a search for the job or step can be done. The search can be done when the cursor is in either the address or instruction area on the JOB CONTENT window.


Searching is an operation by which the cursor is moved to a specific step or instruction in the edit job. A target point can be instantaneously searched out without using the cursor.

### 3.9 Other Job-editing Functions

- Line Search

This function moves the cursor to the desired line number.

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{EDIT], \{SEARCH\} and "LINE SEARCH." | The input buffer line appears. |
| 2 | Input desired line number. |  |
| 3 | Press [ENTER]. | The cursor is moved to the line number and the window appears. |
|  |  |  |

- Step Search

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

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select "STEP SEARCH." | The input buffer line appears. |
| 2 | Input desired step number. |  |
| 3 | Press [ENTER]. | The cursor is moved to the input step and the window appears. |
|  |  | Main Menu Short Cut |

## Label Search

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


### 3.9 Other Job-editing Functions

## Instruction Search

This function moves the cursor to a desired instruction.


- Tag Search

This function moves the cursor to the desired tag.

3.9 Other Job-editing Functions


## 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.

- Calling a Job



## - Registering the Master Job

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

NOTE
Only one job can be registered as the master job. Registering a master job automatically releases the previously registered master job.

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

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{J O B\}$ under the main menu. |  |
| 2 | Select \{MASTER JOB\}. | The MASTER JOB window appears. |
|  |  |  |
|  |  |  |
|  |  | mastie jos |
|  |  | MASTER Job: ${ }^{\text {mam }}$ |
|  |  | Main Menu ${ }_{\text {L }}$ Short Cut |
| 3 | Press [SELECT]. | The selection dialog box appears. |
|  |  | Job [EIT DISPLAY UTLITY 18 [ |
|  |  | master job |
|  |  |  |
|  |  | Main Menu ${ }^{\text {a }}$ Short Cut |



- 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 J OB CONTENT, PLAYBACK, J OB SELECT Window

4.1 Preparation for Playback

Calling from the MASTER J OB Window


### 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.


## (1) ob Content

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

## (2) Override Speed Settings

Displayed when override speed setting is performed.

## (3) Cycle Time

Displays the operating time of the manipulator. Each time the manipulator is started, the previous cycle time is reset, and a new measurement begins. The setting can be made for display or no display.

## (4)Start No.

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

## (5) Motion Time

Displays the weaving time of the manipulator.

## © Playback Time

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

## - Display of Cycle Time

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

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select $\{$ DISPLAY $\}$ under the <br> menu. |  |
| 2 | Select \{CYCLE TIME\}. | The cycle time is displayed. Doing the same operation one more <br> time will delete the cycle time display. |

- Operation Cycle

There are three types of manipulator operation cycles:

- AUTO: Repeats a job continuously.
- 1 CYCLE : Executes a job once. If there is a called job during execution, it is performed, after which the manipulator returns to the original job.
- 1 STEP : Executes one step (instruction) at a time.

The operation cycle can be changed using the following:


## Automatic Setting for Operation Cycle

Automatic setting of the operation cycle can be changed by the following operation. This can be done in the management mode only.

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{SETUP\} under the main menu. |  |
| 2 | Select \{OPERATE COND\}. | The OPERATING CONDITION window appears. Use the cursor to scroll the screen. |
|  |  |  |
|  |  |  |
|  |  | Main menu Short Cut |
| 3 | Select desired operation. | The selection dialog box appears. |
|  |  | DATA EDIT DISPLAY [UTLITY [18 [ |
|  |  |  |
|  |  | Main Menu ${ }^{\text {S }}$ Short Cut |
|  |  | "NONE" setting <br> The operation cycle is not changed when "NONE" is set. <br> For example, if the setting is "CYCLE SWITCH IN TEACH MODE = NONE," the operation cycle after selecting the teach mode is the same as the one before. |

### 4.2 Playback



### 4.2 Playback

### 4.2.1 Playback Operation

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

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

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

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

| Mode Switch on <br> Programming Pendant | Job is started up by peripheral device |
| :--- | :--- |
| [PLAY] | [START] button on programming pen- <br> dant |
| $[$ REMOTE $]$ | Peripheral device |

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

- Selecting the Start Device

|  | Operation | Explanation |
| :---: | :--- | :--- |
| 1 | Set the mode switch on the <br> programming pendant to <br> "PLAY." | The remote mode is disabled and the play mode is enabled so <br> the machines are to be started up by the programming pendant. |

- Servo On

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Press [Servo ON Ready]. | NX100 servo power is ON and the Servo ON lamp on the pro- <br> gramming pendant lights. |

- Start Operation

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 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 of the operations.
Settings for special operations are done in the SPECIAL PLAY window.
When displaying the PLAYBACK window, move the cursor to the menu area and select $\{$ UTILITY\} $\rightarrow$ \{SETUP SPECIAL RUN\}. The SPECIAL PLAY window appears.

| DATA | EDIT | DISPLAY | UTILITY 亿 |  |
| :---: | :---: | :---: | :---: | :---: |
| SPECIAL PLAY |  |  |  |  |
|  |  |  |  |  |
|  |  | COMPLETE |  |  |
| Main Menu |  | Cut |  |  |

### 4.2 Playback

## - Low Speed Operation

The manipulator moves at low speed during the first step after starting. After the operation of this step, the manipulator stops regardless of the selection of the operation cycle and when low speed operation is canceled. Even if the manipulator is manually stopped during low speed operation, the low speed is cancelled.
After one step operation or any stop of manipulator during low speed operation, pressing [START] allows the manipulator to move at the taught speed.

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select "LOW SPEED START" <br> on the SPECIAL PLAY win- <br> dow. | The setting alternates between "VALID" and "INVALID." |
| 2 | Select "COMPLETE." | The window returns to the PLAYBACK window. |

## ■ Limited Speed Operations

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

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select "SPEED LIMIT" under <br> the SPECIAL PLAY window. | The setting alternates between "VALID" and "INVALID." |
| 2 | Select "COMPLETE." | The window returns to the PLAYBACK window. |

## - Dry-run Speed Operations

The dry-run speed is a constant speed that is independent of the teaching speeds. The manipulator executes all the steps at a constant speed, which is convenient for quick check of a job consisting of slow operations. The dry-run speed is $10 \%$ of maximum speed.

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

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select the "DRY-RUN <br> SPEED" under the SPE- <br> CIAL PLAY window. | The setting alternates between "VALID" and "INVALID." |
| 2 | Select "COMPLETE." | The window returns to the PLAYBACK window. |



## - Machine Lock Operation

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

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select "MACHINE LOCK" <br> under the SPECIAL PLAY win- <br> dow. | The setting alternates between "VALID" and "INVALID." |
| 2 | Select "COMPLETE." | The window returns to the PLAYBACK window. |

### 4.2 Playback

## - Check Mode Operation

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

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select "CHECK-RUN" under <br> the SPECIAL PLAY window. | The setting alternates between "VALID" and "INVALID." |
| 2 | Select "COMPLETE." | The window returns to the PLAYBACK window. |

## ■ Weaving Prohibit Setting during Check Mode Operation

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

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select "WEAV PROHIBIT IN <br> CHK-RUN" under the SPE- <br> CIAL PLAY window. | The setting alternates between "VALID" and "INVALID." |
| 2 | Select "COMPLETE." | The window returns to the PLAYBACK window. |

## - Cancel All Special Operations

All special operations are disabled by the following operation

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select \{EDIT\} from the menu. |  |
| 2 | Select "CANCEL ALL <br> 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
- During each application


### 4.3.1 Hold

Hold operation causes the manipulator to stop all motion.

|  | [HOLD] lamp lights while it is held down. At the same time, [START] lamp goes OFF. |  |
| :---: | :---: | :---: |
| Using the Programming Pendant |  |  |
| Hold |  |  |
|  | Operation | Explanation |
| 1 | Press [HOLD] on the programming pendant. | The manipulator stops. <br> The [HOLD] lamp lights while the [HOLD] button is held down. |

## Release

|  | Operation | Explanation |
| :---: | :--- | :--- |
| 1 | Press [START] on the pro- <br> gramming pendant. | The manipulator restarts its operation from the position where it <br> was stopped. |

■ Using an External Input Signal (System Input)
Hold

|  | Operation | Explanation |
| :--- | :--- | :---: |
| 1 | Turn ON the hold signal from <br> an external input (system <br> input). | The manipulator stops momentarily. |

Release

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Turn off the hold signal from <br> an external input (system <br> input). | Hold is released. To continue the operation, press [START] or turn <br> ON the external input signal (system input). The manipulator <br> restarts its operation, beginning from the position where it was <br> 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:

- Programming pendant
- External input signal (system input)


## Emergency Stop

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Press the emergency stop button | The servo power turns OFF and the manipulator stops immediately. <br> EMERGENCY STOP |
|  |  | On the front door of the NX100: |
|  |  | On the programming pendant: |
|  |  | Using the Emergency Stop Button on the Programming Pendant |
|  |  | (i) Robot stops by P.P. emergency stop |
|  |  | Using the External Input Signal (System Input) |
|  |  | (i) Robot stops by external emergency stop |



## - Restart After Emergency Stop

## ! <br> 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

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Press [SELECT]. | Select "RESET" under the ALARM window to release the alarm <br> status. When using an external input signal (system input), turn <br> ON the "ALARM RESET" setting. |

- Major Alarms

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Turn OFF the main power sup- <br> ply and remove the cause of <br> the alarm. | If a severe alarm, such as hardware failure occurs, servo power is <br> automatically shut off and the manipulator stops. If releasing <br> does not work, turn OFF the main power and correct the cause of <br> the alarm. |

### 4.3.4 Others

## ■ Temporary Stop by Mode Change

When the play mode is switched to the teach mode during playback, the manipulator stops immediately.
!Stopped by switching mode

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

## - Temporary Stop by the PAUSE Instruction

When the PAUSE instruction is executed, the manipulator stops operating.
!Robot stops by execution PAUSE command

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

### 4.4 Modifying Play Speed

### 4.4.1 Speed Override

Speed modifications using the speed override have the following features:

- Speed can be modified during playback.

The job can be played back at various speeds until the play speed is properly adjusted.

- Speed can be increased or decreased by a ratio of the current play speed.

The ratio settings range from $10 \%$ to $150 \%$ in increments of $1 \%$.

Therefore, it is convenient when, for example, all play speed settings are to be increased by $150 \%$ at the same time.

The operation flow override of play speeds is as shown in the following:


- Setting Speed Overrides

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{UTILITY\} under the menu in the PLAYBACK window. |  |
| 2 | Select \{SPEED OVERRIDE\}. | The PLAYBACK window becomes the speed override condition. |
|  |  |  |
| 3 | Select "ON" or "OFF" under "MODIFY." | Each time [SELECT] is pressed when the cursor is on the data of the item "MODIFY," "ON" and "OFF" alternate. <br> 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." $\square$ |
| 4 | Line up the cursor with the override ratio and move the cursor up and down to change the ratio. <br> 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. $\square$ |

- Modifying Play Speed

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Set speed override. |  |
| 2 | Playback the manipulator. | The play speed is increased or decreased in the set ratio. When <br> setting "MODIFY" to "ON," the step's play speed is modified when <br> each step is reached. <br> When one cycle is completed by the END instruction, the speed <br> override setting is released. |

NOTE

- Assuming that the manipulator moves from step 1 to step 2, the play speed of step 2 is not modified if the speed override is released before reaching step 2.
- When the play speed is changed by speed override, the maximum and minimum speed is limited by the manipulator.
- When the safety speed operation is commanded with the setting of "MODIFY: ON," the manipulator operates at safety speed. However, the play speed in memory is modified as set using speed override.
- Play speed set by the SPEED instruction is not modified.
- Releasing Speed Override Settings

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select \{UTILITY\} under the <br> menu in the PLAYBACK win- <br> dow. |  |
| 2 | Select \{SPEED OVERRIDE\}. | The setting of the speed override ratio is released. If it is <br> released, the speed ratio setting is not displayed on the PLAY- <br> BACK window. |

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

- When dry-run speed operation is set.
- When the mode is changed to any mode other than the play mode.
- When an alarm or error occurs.
- When one cycle operation is completed with the END instruction.
- When the power supply is turned OFF.


### 4.5 Playback with Reserved Start

### 4.5.1 Preparation for Reserved Start

In the reserved start function, jobs registered at different stations are played back in the reserved order using the start buttons on the stations.


For example, in a case where three stations handle three different workpieces, as shown in the illustration above, the jobs would be registered as follows:

- Job 1 is registered to process workpiece 1 at Station 1
- Job 2 is registered to process workpiece 2 at Station 2
- Job 3 is registered to process workpiece 3 at Station 3

To play back the jobs, prepare workpiece 1 and press the start button on Station 1. The manipulator executes Job 1. Prepare workpieces 2 and 3 while Job 1 is being executed, and press the start buttons on Stations 2 and 3. Even if Job 1 is being executed at that time, jobs on different stations are reserved in the order that the start buttons were pressed, and will be executed in that order. During playback, the status of the reservation can be checked on the start reservation window.

## - Enabling Reserved Start

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

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

The OPERATING CONDITION window is shown only when the security mode is management mode


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

## - Registering Reserved Start I/O Signal

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

NOTE
This operation can be done only when the operation mode is teach mode and the security mode is management mode.

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{SETUP\} under the main menu. |  |
| 2 | Select \{RES. START(CNCT) \}. | The RESERVED START (CNCT) window appears. |
| 3 | Select "START IN" or "START OUT" for each station. | The number can now be entered. |
| 4 | Input signal number and press [ENTER]. | The input/output signal number is registered. |

- 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.

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{\mathrm{JOB}\}$ under the main menu. |  |
| 2 | Select \{RES. START(JOB)\}. | The RESERVED START (JOB) window appears. <br> indicates that the input/output number is registered. <br> O indicates that the input/output number is not registered |
|  |  |  |
|  |  | 11   <br> 2  $\vdots$ <br> 3   <br> 4  $\vdots$ <br> 5  0 <br> 6  0 |
|  |  | Main Menu Short Cut |
| 3 | Select 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. |
|  |  |  |
|  |  |  |

- 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.

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{J O B\}$ under the main menu. |  |
| 2 | Select \{RES. START(JOB)\}. | The RESERVED START (JOB) window appears. |
| 3 | Select job name for each station. | The selection dialog box appears. |
|  |  |  |
|  |  |  |
|  |  | RESERVED START (JOB) NO. JOB NAME CONNECTION |
|  |  |  |
|  |  | Main Menu ${ }^{\text {a }}$ Shor Cut |
| 4 | Select "CANCEL START | Registered job is deleted. |
|  |  |  |
|  |  |  |
|  |  |  |

### 4.5.2 Playback from Reserved Start

- Start Operation

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Set the mode switch to "PLAY." |  |
| 2 | Press start button on the sta- <br> tion. | The job registered for the station starts up and the manipulator <br> performs one cycle operation. |

- While the job is being executed, the start button lamp on the station lamps.
- If the workpiece must be prepared at the station, prepare it before pressing the start button.
- If the start button of another station is pressed during execution of a job at one station, the job on the station is reserved and prepares to start. Jobs are reserved and executed in the order that the start buttons are pressed.
- When a job is reserved, the start button lamp on the station blinks.
- No station job is reserved when it is being executed even if its start button is pressed.
- To suspend a job being executed, perform the Hold operation.

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

- Checking Job Reservation Status

The job reservation status during playback can be checked.

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{\mathrm{JOB}\}$ under the main menu. |  |
| 2 | Select \{RES. STATUS\}. | The RESERVATION STATUS window appears. |
|  |  | DATA EDIT DISPLAY UTLITY |
|  |  | RESERVATION STATUS NO. JOB NAME STATUS START IN |
|  |  |  |
|  |  | Main Menu Short Cut |
|  |  | (1) STATUS <br> Reservation status is displayed. <br> STARTING: Indicates the station currently working. <br> STOP: Indicates any station where work has been temporarily stopped by a hold operation. <br> RESERVE1,RESERVE2,...: Indicates the order in which jobs have been reserved for start. <br> (2) START IN <br> Input signal status is displayed. <br> "•": Input signal ON <br> " $O$ ": Input signal OFF |

- Resetting Job Reservation

NOTE If "STARTING" is displayed, the job cannot be reset.


All job reservations are reset automatically in the following conditions:
NOTE

- 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] on the Programming Pendant

Hold

|  | Operation | Explanation |
| :---: | :--- | :--- |
| 1 | Press [HOLD] on the program- <br> ming pendant. | The manipulator stops temporarily. <br> The [HOLD] lamp lights while the [HOLD] button is held down. |

## Release

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Press the start button on the <br> suspended station. | The manipulator restarts its operation from the position where it <br> was stopped,. |

## ■ Hold by External Input Signal (System Input)

Hold

|  | Operation | Explanation |
| :--- | :--- | :---: |
| 1 | Input ON signal to the external <br> input (system input) specified <br> for hold operation. | The manipulator stops temporarily. <br> The hold lamp for the external output signal lights. |

## Release

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Input OFF signal to the exter- <br> nal input (system input) speci- <br> fied for hold operation. | Hold is released. <br> To continue the operation, press the start button on the sus- <br> pended station. The manipulator restarts its operation from the <br> position where it was stopped. |

- Hold at the Station


## Hold

|  | Operation | Explanation |
| :--- | :--- | :---: |
| 1 | Press the hold button on the <br> station. | The manipulator stops temporarily. |

## Release

|  | Operation | Explanation |
| :---: | :--- | :--- |
| 1 | Press the hold button on the <br> suspended station. | Hold is released. <br> Press the start button on the station, then the manipulator restarts <br> its operation from the position where it was stopped. |

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

### 4.6 Displaying Job Stack

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


Job calls can be used for up to 8 stack levels. (Up to 10 from NS3.00)

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{DISPLAY\} under the menu on the PLAYBACK window. | The pull-down menu appears. |
|  |  |  |
|  |  |  |
|  |  |  |
| 2 | Select \{JOB STACK\}. | The job stack status dialog box appears. To close the job stack status dialog box, select \{DISPLAY\} and then \{JOB STACK\} under the menu again. |
|  |  | DATA EDIT DISPLAY UTILTY 䢒 |
|  |  | PLAYBACK  <br> JOB NAME: TEST01 STEP NO. :0003 <br> CONTROL GROUP: R1 TOOL:00 |
|  |  |  |
|  |  | For above example, the playback of Job C is being executed and the Job C is called from Job B. Also, the Job B is called from Job A. |

## 5 Editing Jobs

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

Edit operations are restricted when the edit lock is applied.

## Editing Move Instructions

## NOTE

See " 3 Teaching " for basic information on editing move instructions.
It is not possible to add, delete, or modify move instructions which have position data. See
" 3.4 Modifying Steps " for details.
The following MOV instruction edit operations are explained in this section:
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.


### 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.

### 5.1.1 Copying Jobs on the JOB CONTENT Window

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

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{\mathrm{JOB}\}$ under the main menu. |  |
| 2 | Select $\{\mathrm{JOB}\}$. | The JOB CONTENT window appears. |
| 3 | Select $\{\mathrm{JOB}\}$ under the menu. | The pull-down menu appears. |
| 4 | Select \{COPY JOB\} under the pull-down menu. |  |
| 5 | 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. $\square$ <br> $>$ JOB-B |
|  |  | SUPPLE See " 1.2.6 Character Input " for information on letter input operations. |



### 5.1.2 Copying Jobs on the JOB LIST Window

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



### 5.2 Deleting Jobs

This operation is used to delete jobs that are registered on the NX100. It can be performed in either the JOB CONTENT window or the JOB LIST window.

### 5.2.1 Deleting Jobs on the JOB CONTENT Window

On the JOB CONTENT window, the current edit job is deleted.

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{\mathrm{JOB}\}$ under the main menu. |  |
| 2 | Select \{JOB\}. | The JOB CONTENT window appears. |
| 3 | Select $\{\mathrm{JOB}\}$ from the menu. | The pull-down menu appears. |
| 4 | Select \{DELETE JOB\} under the pull-down menu. | The confirmation dialog box appears. When "YES" is selected, the edit job is deleted. When deletion is completed, the JOB LIST window appears. <br> When "NO" is selected, the job deletion is cancelled. |
|  |  |  |
|  |  |  |
|  |  | Main Menu ShorrCut |

### 5.2.2 Deleting Jobs on the JOB LIST Window

On the JOB LIST window, select the job to be deleted from the list of the registered jobs.


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.
5.3.1 Modifying Job Names on the JOB CONTENT Window

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{\mathrm{JOB}\}$ under the main menu. |  |
| 2 | Select $\{\mathrm{JOB}\}$. | The JOB CONTENT window appears. |
| 3 | Select $\{\mathrm{JOB}\}$ from the menu. | The pull-down menu appears. |
| 4 | Select \{RENAME JOB\} under the pull-down menu. |  |



### 5.3.2 Modifying Job Names on the JOB LIST Window

On the JOB LIST window, select the job whose name is to be modified from the list of the registered jobs.


### 5.4 Editing Comments

Comments of up to 32 characters can be affixed to jobs to identify them more specifically. Comments are displayed and edited on the JOB HEADER window.

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{\mathrm{JOB}\}$ 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 "COMM." | The window for character input appears. |
| 6 | Input comments. | For jobs that are already registered, comments are displayed on the input area. It is possible to partially change comments to enter new comments. <br> $\Rightarrow$ THIS JOB IS TEST JOB |
|  |  | See "1.2.6 Character Input " for information on character input operations. |
| 7 | Press [ENTER]. | The input area comment is registered and is displayed in the "COMM." area on the JOB HEADER window. |
|  |  | Lar |
|  |  | Job HeADER |
|  |  |  |

### 5.5 Setting Edit Lock on Individual Job Units

In order to prevent inadvertent changes in registered jobs or data, it is possible to apply an edit lock to individual jobs. When a job is protected from editing, the job cannot be edited or deleted. Edit lock is set and cancelled on the JOB HEADER window.

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{\mathrm{JOB}\}$ under the main menu. |  |
| 2 | Select $\{\mathrm{JOB}\}$. |  |
| 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

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


## 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 with the CALL instruction. Move the cursor to the desired job name or condition file name and simply press the direct open key $\square$ to display the contents of the file. This function can be used for the following window:

- JOB CONTENT window for a job name directly specified by a CALL instruction
- CONDITION FILE window for a file name directly specified by a work instruction
- COMMAND POS window for a move instruction
- I/O window with an I/O instruction (when I/O numbers are specified)
<Example> Example Using Direct Open


|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | In the JOB CONTENT win- <br> dow, move the cursor to the <br> job name or condition file <br> for which the window is to <br> be displayed. |  |
| 2 | Press the direct open key <br>  | This key lamp lights and the JOB CONTENT window or the condi- <br> tion file window appears. When the direct open key |
| pressed once more, the key lamp turns OFF, and the window |  |  |
| returns to the former JOB CONTENT window. |  |  |

[^2]
### 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.


The block from the SFTON to the SFTOF instructions is subject to the shift operation．

| Line（Step） | $\quad$ Instruction |
| :--- | :--- |
| 0000 | NOP |
| $0001(001)$ | MOVJ VJ＝50．00 |
| $0002(002)$ | MOVL V＝138 |
| 0003 | SFTON PロロロUF\＃（1） |
| $0004(003)$ | MOVL V＝138 |
| $0005(004)$ | MOVL V＝138 |
| $0006(005)$ | MOVL V＝138 |
| 0007 | SFTOF |
| $0008(006)$ | MOVL V＝138 |



When shifting an entire series of operations，the range to be shifted by the shift instruction can be set using the method indicated above，but the method shown in the following，in which just the part to be shifted is made into a separate job，can also be used．


### 6.2.2 Setting the Shift Value

## ■ Registering Position Variables

The NX100 has 128 position variables (P000 to P127); these can be used to define parallel shift values. When using the parallel shift function, it is necessary to measure the distance between the teaching point and the shift destination position (XYZ displacement of each coordinate) and then register this in advance as a position variable.
When the shift instruction is executed in playback, the operation is performed at a location shifted from the taught position by the amount registered for the specified position variable. The POSITION VARIABLE window is shown in the following.

$\Rightarrow$ SFTON POOO

## ■ Coordinate Systems

The shift value for parallel shift is $\mathrm{X}, \mathrm{Y}$, and Z increment in each coordinates. There are four coordinates: base coordinates, robot coordinates, tool coordinates, and user coordinates. In systems with no servo track, the base coordinates and robot coordinates are the same.


## - Setting the Shift Value

When setting the shift value for the position variables, use the current position (coordinates) of the manipulator in the window.


The shift value is the $\mathrm{X}, \mathrm{Y}$, 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 ( $R X, R Y, R Z=0$ ), 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:

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{\mathrm{JOB}\}$ under the main menu. |  |
| 2 | Select \{JOB\}. | The JOB CONTENT window appears. |
|  |  |  |
| 3 | Move the cursor to the address area. |  |

- SFTON Instruction

This is the instruction that starts a parallel shift.

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Move the cursor to the line immediately before where the SFTON instruction is to be registered. | Line immediately $\longrightarrow$Lefore where <br> beto instruction <br> SFTON <br> is to be registered.0020 MOVL V $=138$ <br> 0021 <br> MOVL V $=138$ <br> MOVL V $=138$ <br> 0022  |
| 2 | Press [INFORM LIST]. | The instruction list dialog box appears. |
| 3 | Select \{SHIFT\}. |  |
| 4 | Select the SFTON instruction. | The SFTON instruction is displayed in the input buffer line. |
| 5 | Modify the additional items or number values as required. | <When Nothing is to be Changed> Proceed to Step 6. <br> <When Editing Additional Items> <br> - Adding or modifying additional items <br> 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. $\Rightarrow \text { SFTON P000 }$ <br> To directly input the value using the Numeric keys, press [SELECT] to display the input buffer line. <br> $P=$ <br> After the number is input, press [ENTER] to modify the number value in the input buffer line. |

6.2 Parallel Shift Function


- SFTOF Instruction

This is the instruction that ends a parallel shift

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Move the cursor to the line immediately before where the SFTOF instruction is to be registered. | Line immediately $\longrightarrow$Lefore where <br> ler <br> SFTOF instruction <br> is to be registered. <br> 0030MOVL V=138 <br> MOVL V $=138$ |
| 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. $\Rightarrow \text { SFTOF }$ |
| 5 | Press [INSERT] and then [ENTER]. | The SFTOF instruction is registered. |

## - 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 ( $\mathrm{Rx}, \mathrm{Ry}, \mathrm{Rz}$ ) 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, $R z$ ) is specified in the shift value.

In such cases, the MSHIFT instruction can be used to automatically calculate the optimum shift value for an operation to reach the target shift position and posture. With an MSHIFT instruction, the shift value between the reference position and target position (shift position) when parallel shift is performed is determined in the specified coordinate system, and set as the specified position variable.
6.2 Parallel Shift Function

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Move the cursor to the line immediately before where the MSHIFT instruction is to be registered. | Line immediately <br> before where <br> MSHITT instruction <br> 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. <br> <When Editing Additional Items> <br> - 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. <br> $\Rightarrow$ MSHIFTPX000 BF PX001 PX002 <br> To directly input the value using the Numeric keys, press [SELECT] to display the input buffer line. <br> After the number is input, press [ENTER] to modify the number value in the input buffer line. |



### 6.2.4 Continuation of the Parallel Shift Function

## A CAUTION

- If the shift function is cancelled through a job editing operation after execution of a parallel shift instruction, the job must be started again from the beginning.

Because no shift is performed when the operation is restarted, there is a possibility of interference between the workpiece and fixture.

If any of the following operations are performed after executing a parallel shift instruction, the shift function is cancelled.

- Job editing operation (changing, deleting, adding)
- Job copy, job name change
- Registering a new job, deleting a job, or modifying a selected job
- Restart after the alarm occurs
- When control power is turned OFF


### 6.2.5 Examples of Use

- Example of Use of Shift Addition/Subtraction

Workpiece Stacking Operation

Line Instruction

0000
0001
0002
0003
0004
0005
0006
0007
0008
0009
0010
0011
0012
0013
0014
0015
0016
0017
0018

| Instruction |  |
| :---: | :---: |
| NOP |  |
| SET B000 0 | Make the first shift value zero. |
| SUB P000 P000 |  |
| $\rightarrow$ * |  |
| MOVJ | Step 1 |
| MOVL | Step 2 |
| 'Gripping workpiece |  |
| MOVL | Step 3 |
| MOVL | Step 4 |
| SFTON P000 UF\#(1) | Shift start |
| MOVL | Shift position Step 5 |
| 'Releasing workpiece |  |
| SFTOF | Shift end |
| ADD P000 P001 | Add the shift value for the next operation. |
| MOVL | Step 6 |
| MOVL | Step 7 |
| INC B000 |  |
| -JUMP *A IF B00<6 |  |
| $\checkmark$ |  |
| SFTON P000 UF\#(1) |  |
| SFTOF | Since the shift data is retained in memory, the same data can be used (with subtraction |
| SUB P000 P001 | instead of addition) to perform a workpiece unloading operation. |
| $\downarrow$ |  |



## - Example of Use of MSHIFT Instruction

| Line | Instruction |
| :--- | :--- |
| 0000 NOP |  |
| 0001 MOVJ VJ=20.00 | Move the manipulator to the reference position. |
| 0002 GETS PX000 \$PX000 | Set the reference position as position variable P000. |
| 0003 MOVJ VJ=20.00 | Move the manipulator to the target position. |
| 0004 GETS PX001 \$PX000 | Set the target position as position variable P001. |
| 0005 MSHIFT PX010 BF PX000 PX001 | Set shift value and set it as position variable P010. |
| 0006 END |  |

### 6.3 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 parallel shift conversion is performed, all job steps are shifted by the same value.

Steps Outside the P-point Maximum Envelope
"/OV" is displayed for steps which result in a position outside the P-point maximum envelope of the manipulator. When the position is corrected, "/OV" display disappears.

Position Variable
Position variables are not subject to parallel shift job conversion.
Not Converted J ob
The following jobs cannot be converted. If conversion is attempted, no operation is performed.

- Jobs without any group axes
- Concurrent jobs (optional)

If a job name after conversion is not specified when executing 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 parallel shift job conversion, it is necessary to specify the coordinate systems in which the conversion is to be performed. The coordinate system can be selected from the following:

- Base coordinates
- Robot coordinates
- Tool coordinates
- User coordinates (24 types)
- Master tool coordinates ( $\mathrm{R}^{*}+\mathrm{R}^{*}$ job)
- Joint coordinates

In the case of an ordinary job for which group axes are registered, shift conversion is performed in accordance with the selected coordinate system. The relationship between group combinations and coordinates are shown in the following table.
(1) to $(4)$ in the table are followed by their explanations.

Relationship Between Group Combinations and Coordinates at Conversion

| Group | Explanation |  |
| :---: | :---: | :---: |
| in Job | Usable Coordinate System |  |
| R | Shift is performed on basis of selected coordinates. |  |
|  | Base coordinates, robot coordinates, tool coordinates, user coordinates, pulse coordinates |  |
| R (B) | Shift is performed on basis of selected coordinates. |  |
|  | (1)Base Coordinates | The base axis is shifted by the specified amount and the TCP of the manipulator is shifted by the specified amount in the base coordinates. |
|  | (2) Robot Coordinates | The base axis is shifted by the specified amount. The TCP of the manipulator is shifted by the specified amount in the robot coordinates. These shifts are carried out independently. |
|  | (3) Tool Coordinates | The base axis is shifted by the specified amount. The TCP of the manipulator is shifted by the specified amount in the tool coordinates. These shifts are carried out independently. |
|  | (4)User Coordinates | The base axis is shifted by the specified amount and the TCP of the manipulator is shifted by the specified amount in the user coordinates. |
|  | (5) Pulse Coordinates | The taught position of each axis is shifted by the specified amount on the basis of pulse values. |
| S | Shift is performed on the basis of pulse values regardless of the coordinates. |  |

Relationship Between Group Combinations and Coordinates at Conversion

| Group Combination in Job | Explanation |
| :---: | :---: |
|  | Usable Coordinate System |
| R+S | The manipulator is shifted in the selected coordinates. The station axis is shifted on the basis of pulse values regardless of the coordinates. |
|  | Base coordinates, robot coordinates, tool coordinates, user coordinates, pulse coordinates |
| $\mathrm{R}(\mathrm{B})+\mathrm{S}$ | The manipulator is shifted in the selected coordinates, as in (1) to (5) above. The station axis is shifted on the basis of pulse values regardless of the coordinates. |
| R+R | Two manipulators are shifted in the selected coordinates. |
|  | Base coordinates, robot coordinates, tool coordinates, user coordinates, master tool coordinates ${ }^{* 1}$, pulse coordinates |
| $\mathrm{R}(\mathrm{B})+\mathrm{R}(\mathrm{B})$ | Two manipulators are shifted in the selected coordinate system, as in (1) to (5) above. Two base axes are also shifted. |

*1 In the master tool coordinates, conversion only occurs at the "slave" from the standpoint of the SMOV instruction.

## (1) Base Coordinates

The base axis is shifted by B and the TCP of the manipulator is shifted by A in the base coordinates.


2 Robot Coordinates
The base axis is shifted by B. The TCP of the manipulator is shifted by A in the robot coordinates. These shifts are carried out independently.


## (3) Tool Coordinates

The base axis is shifted by B and the TCP of the manipulator is shifted by $A$ in the tool coordinates. These shifts are carried out independently.


## (4) User Coordinates

The base axis is shifted by $B$ and the TCP of the manipulator is shifted by $A$ in the user coordinates. These shifts are carried out independently.

6.3 Parallel Shift Job Conversion Function

## Converting R*+R* Jobs with Master Tool Coordinates

$R^{*}+R^{*}$ coordinated jobs can be subjected to parallel shift job conversion in the master tool coordinates. Only steps taken at the "slave" from the standpoint of the SMOV instruction are subject to conversion (i.e. the steps of R2 in the figure below).


### 6.3.3 Executing the Parallel Shift Job Conversion

## ■ Window Display



## © 1 SOURCE J OB

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.

## (2)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 steps in the source job, "***" is displayed. To change the section, perform the following procedure.
Move the cursor to the step section indication and press [SELECT]. The input buffer line appears. Input the step number and press [ENTER].

## (3)DESTINATION J OB

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 job name without using the source job name, press [CANCEL] and then input a job name.

## (4)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].

## (5)BASE POINT

Calculates the difference by the two teaching points as a shift value.

## (6)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.

## - 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 " 6.3.4 Specifying the Shift Value by Position Variables " 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



|  | Operation | Explanation |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 6 | Select the shift value to be set. | The number can be entered. |  |  |  |  |  |  |
|  |  |  | DATA |  | DISPLAY | UTLITY | 28 [8] | 76 |
|  |  |  | Parallel | SHIFT JO |  |  |  |  |
|  |  |  | SOUCE Jo STEP SEC DESIINA COORDIN BASE PO SSHIFT VAL |  |  | (eB1 |  |  |
|  |  |  | EXECUT | I | CANCEL |  |  |  |
|  |  |  | Main Menu | Shortc |  |  |  |  |
| 7 | Type the shift value using the Numeric keys. |  |  |  |  |  |  |  |
| 8 | Press [ENTER]. | The shift val | value is |  |  |  |  |  |
|  |  |  | DATA | EDIT | DISPLAY | UTLLTY | 28 [8] | 76 |
|  |  |  | Parallel | SHIFT JO |  |  |  |  |
|  |  |  | SOURCE | OB OTON TION JOB TES T, UE> |  | OB1 |  |  |
|  |  |  | EXECUT |  | CANCEL |  |  |  |
|  |  |  | Main Menu | Shortc |  |  |  |  |



Calculation by Teaching



|  | Operation | Explanation |
| :---: | :---: | :---: |
| 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. <br> When "CANCEL" is selected, the display goes back to the JOB |
|  |  |  |
|  |  | PARALLEL SHIFT Job |
|  |  | (e) |
|  |  | EXECUTE ${ }^{\text {a }}$ CANCEL 1 |
|  |  | Main Menu Shorctut |
|  |  | NOTE If an alarm occurs during conversion, conversion is suspended. |

### 6.3.4 Specifying the Shift Value by Position Variables

The shift value can be specified using position variables by parameter settings.
Parameter S2C514: SHIFT VALUE FOR PARALLEL SHIFT JOB CONVERSION
0 : Shift value by numeral/teaching (Initial setting)
1: Position variable shift value

- Window DIsplay

(1)FILE NO.

Specifies position variables.

## (2)SHIFT J OB 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.

## (3)MODE

Specifies the conversion mode.
SINGLE (INDEPENDENT J OB CONVERSION)
Only the selected job is converted even if the selected job includes jobs called by JUMP or CALL instructions. Related jobs are not converted.
RELATIVE (RELATIVE J OB 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 " Jobs Targeted for Conversion ".

## (4)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].

## (5)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 " Conversion of Coordinated Jobs ".

## - Jobs Targeted for Conversion

There are two ways to specify the job to be converted as described in the following:

Independent J ob Conversion
Only the selected job is converted even if the selected job includes jobs called by JUMP or CALL instructions. Related jobs are not converted.


## Related J ob Conversion

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


## - Conversion of Coordinated Jobs

There are two ways to convert a related job such as a coordinated job with two manipulators or the system with multiple stations as described in the following:

## Common Shift

All the manipulators (or all the bases, or all the stations) are converted by the same shift value.

Coordinated job with R1+R2


The system with multiple stations


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

Coordinated job with R1+R2


The system with multiple stations


Variables used in an individual shift

NOTE Be sure to use the variables of which numbers are consecutive after the selected number. The variables of which numbers are not consecutive are unable to be selected.

Example 1) When selecting P010 for a coordinated job with R1 + R2:
Use P010 for R1.
Use P011 for R2.


Example 2) When selecting EX005 for multiple jobs with four stations:
Use EX005 for S1.
Use EX006 for S2.
Use EX007 for S3.
Use EX008 for S4.


## Relation between variables and jobs for conversion in an individual shift

## In case of independent job conversion:

- Coordinated job with R1 + R2

Different shift values can be set for each manipulator and base.


- Job with R $\square$ (+ S $\square$ )

Use one variable for a job with one manipulator.


In case of related job conversion:

- Different shift values can be set for each manipulator, base, and station.

In a system with R1, R2, and S1 to S12:



## - Operation Procedure

The following is the operation procedure for parallel shift job conversion using position variables.

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Set the parameter. | Set the parameter S2C514 (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. <br> For the setting of position variables, refer to " 3.9.4 User Variables ". |
| 3 | Select $\{\mathrm{JOB}\}$ 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. |
|  |  |  |
|  |  | parallel shift job |
|  |  |  |
|  |  | EXECUTE ${ }^{\text {a }}$ CANCEL |
|  |  |  |
| 7 | Specify the conversion items. | Specify each item. |
| 8 | Select "EXECUTE." | Select "EXECUTE" then the parallel shift job conversion is executed. The JOB CONTENT window appears when the conversion is completed. <br> 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. |

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 at the programming pendant.

- Teaching Point (Position)
- Teaching Point (Posture angle): Valid from NS3.00
- Operation Speed
- Position Level


## - Input Ranges for Adjustment Data

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

| Data | Input Range |  |
| :--- | :--- | :--- |
| Number of Steps for Adjustment | Up to 10 steps can be adjusted at the same time. |  |
| Position Adjustment Range (X, Y, Z) | Unit: mm, valid to two decimal places, maximum <br> $\pm 10 \mathrm{~mm}$ |  |
| Posture Angle Adjustment Range <br> (Rx, Ry, Rz) | Unit: deg, valid to two decimal places, maximum <br> $\pm 10$ deg | Valid from <br> NS3.00 |
| Speed Adjustment Range (V) | Unit: \%, valid to two decimal places, maximum <br> $\pm 50 \%$ |  |
| PL Adjustment Range | 0 to 8 |  |
| Adjustment Coordinates | Robot coordinates, base coordinates, tool coordi- <br> nates, user coordinates (Default coordinates: <br> robot coordinates) |  |

The input ranges for adjustment data can be changed by the following parameters:
S3C806: Position adjustment range (unit: mm)
S3C807: Speed adjustment range (unit: 0.01\%)
S3C808: Adjustment coordinate specification
S3C810: Posture angle adjustment range (unit: 0.01 deg) [Valid from NS3.00]
For details, refer to "8 Parameter Description."

- Base axis and station axis data cannot be adjusted.
- Adjustment when a TCP instruction is executed is performed by adjusting the data of the selected tool.
- When the coordinates for adjustment are user coordinates, an error occurs if teaching has not been performed in the user coordinates.
- If an attempt is made to adjust "PL" when there is no "PL" in the step subject to the adjustment, an error occurs.
- Position variable and reference point steps cannot be adjusted. An error occurs if adjustment is attempted.
- An attempt to adjust the speed at a step that has no speed tag will cause an error.


### 6.4.2 Operating Methods

- Setting Adjustment Data

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{JOB\} under the main menu. |  |
| 2 | Select \{JOB\}. | The JOB CONTENT window (in the teach mode) or the 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. <br> (1)J OB <br> Set the job name to be adjusted. <br> Line up the cursor and press [SELECT] to display the JOB <br> LIST window. Move the cursor to the desired job and press <br> [SELECT] to set the adjusted job. <br> (2)STATUS <br> Shows the status of adjustment in the PAM function. <br> "NOT DONE" appears when adjustment is not executed. <br> "DONE" appears when the execution of adjustment is completed. <br> (3INPUT COORD <br> Set the desired coordinates. <br> 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. |


| Operation |  | Explanation |
| :--- | :--- | :--- |
| 5 | (cont'd) | (4)Step Number <br> Set the step number to be adjusted. <br> Line up the cursor and press [SELECT] to display the num- <br> ber input buffer line. Input the step number and press <br> [ENTER] to set the value. <br> (®XYZ Coordinate Adjustment <br> Set the direction and amount of the X, Y, and Z coordinates. <br> Line up the cursor with the data to be adjusted and press <br> [SELECT] to display the number input buffer line. Input the <br> number data and press [ENTER] to set the adjusted data. |
| ©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. |  |  |
| ©V Coordinate Adjustment |  |  |

## Executing the Adjustment

## Executing the Adjustment



## Cancelling the Execution

In the play mode, during the adjustment wait status, "STOP" is displayed in the PAM window. To cancel the adjustment process, touch "STOP" on the screen. Also, if the following occurs before executing, the process is automatically cancelled.

- If the mode is changed
- If an alarm occurs
- If the power is turned OFF



## Editing Data

## Clearing Data

If there is a mistake made when adjusting the data, or if the adjustment of the step becomes unnecessary, the data can be cleared.


## Copying Data

To input the same data as those set previously, perform the following operation.


## Canceling the Adjustment [Valid from NS3.00]

After the position adjustment in the PAM function, the job can be undone to the status before adjustment only during teaching. To undo the job, perform the following operation. However, the job cannot be undone during playback.


### 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 $\mathrm{X}-\mathrm{Y}, \mathrm{X}-\mathrm{Z}$, or $\mathrm{Y}-\mathrm{Z}$ coordinate of the robot coordinates and the user coordinates.
The mirror shift function is classified into the following three: the pulse mirror-shift function, the robot-coordinates mirror-shift function, and the user-coordinates mirror-shift function.


The original path
before the mirror shift



The converted path after the mirror shift

### 6.5.2 Pulse Mirror-shift Function

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


## - Parameter Setting

Using the following parameter, specify the axes for which the sign is to be reversed.
S1CxG065: Mirror Shift Sign Reversing Axis Specification


## - Object Job

Jobs without group axes and relative jobs cannot be converted.

## - Group Axes Specification

When specifying the group axes for the converted job in a multiple group axes system, the group axes specified in the original and converted jobs must be the same.

- Robot Axis: Same model
- Base Axis: Same configuration
- Station Axis: Same configuration


## - Position Variables

Position variables are not converted by the mirror shift function.

### 6.5.3 Robot-coordinates Mirror-shift Function

With the robot-coordinates mirror-shift function, the mirror shift is performed on the $\mathrm{X}-\mathrm{Z}$ coordinate of the robot coordinates.


- Object Job

Jobs without group axes cannot be converted.

## - Group Axes Specification

When specifying the group axes for the converted job in a multiple group axes system, the group axes specified in the original and converted jobs must be the same.

- Robot Axis: Same model
- Base Axis: Same configuration
- Station Axis: Same configuration


## - Position Variables

Position variables are not converted by the mirror shift function.

[^3]
### 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 $\mathrm{Y}-\mathrm{Z}$ coordinate of the specified user coordinates.


## ■ Object Job

Jobs without group axes cannot be converted.

## - Group Axes Specification

When specifying the group axes for the converted job in a multiple group axes system, the group axes specified in the original and converted jobs must be the same.

- Robot Axis: Same model
- Base Axis: Same configuration
- Station Axis: Same configuration


## ■ Position Variables

Position variables are not converted by the mirror shift function.

With the user-coordinates mirror shift function, mirror shift conversion for the station axis is performed by reversing the sign for the axes specified with the parameter S1CxG065 "Mirror Shift Sign Reversing Axis Specification."

### 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.

- Using the Robot-coordinates Mirror-shift Function

When the robot-coordinates mirror-shift function is performed, the mirror shift is performed on the $\mathrm{X}-\mathrm{Z}$ coordinate of the robot coordinates. The path of the converted job is as follows:

Robot-coordinates Mirror-shift Conversion


- 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.


### 6.5.6 Operation Procedures

- Calling Up the JOB CONTENT Window

Call up the JOB CONTENT window of the job to be converted as follows:
For Current J ob

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select $\{\mathrm{JOB}\}$ under the main <br> menu. |  |
| 2 | Select $\{\mathrm{JOB}\}$. |  |

For Another J ob

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select $\{\mathrm{JOB}\}$ <br> menu. |  |
| 2 | Select $\{$ SELECT JOB $\}$. | The JOB LIST window appears. |
| 3 | Select desired job. |  |

- Mirror Shift Conversion

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Display the JOB CONTENT <br> window. |  |
| 2 | Select \{UTILITY\} under the <br> pull-down menu. | The MIRROR SHIFT window appears. |
| 3 | Select \{MIRROR SHIFT\}. | The MIRROR SHIFT window appears. |

## - Explanation of the Mirror Shift Window


(1)SOURCE J OB

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].

## (2)SOURCE CTRL GROUP

Displays the control group of the conversion source job.

## (3)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.

## (4)DESTINATION J OB

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.

## (5)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.

## © 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.

## (7)USER COORD NO.

Specifies the user coordinates number when "USER" is selected in ©
This item cannot be set when "PULSE" or "ROBOT" is selected in © .
(8)TARGET

Specifies the coordinate where conversion is to be done when "ROBOT" or "USER" is selected in ©. "XY," "XZ," or "YZ" can be selected. Always specify "XZ" for "ROBOT."

## © 9 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.

## 7 External Memory Devices

### 7.1 Memory Devices

The following memory devices can be used in the NX100 to save and load data such as jobs and parameters.

| Device | Function | Media (destination of saved/ <br> loaded data) | Optional function requirement |
| :--- | :--- | :--- | :--- |
| Compact Flash | Standard | Compact Flash (CF card) | No requirement. <br> Programming pendant is <br> equipped with a slot. |
| FC1 | Option"1 | 2DD floppy disk, personal <br> computer (FC1 emulator) | "FC1" or personal computer <br> with "FC1 emulator" |
| FC2 | Option*1 | 2DD floppy disk, <br> 2HD floppy disk | "FC2" |
| PC | Option |  | Personal computer <br> (MOTOCOM32 host) |
| OTP | Option*1 | FTP server such as personal <br> mission function" and <br> "MOTOCOM32" |  |
| Via Ethernet: "Ethernet func- <br> tion" plus above two require- <br> ments |  |  |  |

[^4]
### 7.1.1 Compact Flash (CF Cards)

The programming pendant is equipped with CF card slot. Use the FAT16 or FAT32 formatted Compact Flash.

## - Recommended Compact Flash Cards

Recommended products used for external memory of NX100 are listed below. Model numbers are subject to be updated due to termination of product and new addition. Contact Yaskawa representative when necessary.
<Currently Recommended Compact Flash Cards>

| No. | Manufacturer | Model | Remarks |
| :---: | :--- | :--- | :--- |
| 1 | Hagiwara Sys-Com | MCF10P-128MS <br> (A00A II-YE | $(128 \mathrm{MB})$ |
| 2 | Hagiwara Sys-Com | MCF10P-256MS-YE2 | $(256 \mathrm{MB})$ |
| 3 | Hagiwara Sys-Com | MCF10P-512MS | $(512 \mathrm{MB})$ |
| 4 | Hagiwara Sys-Com | MCF10P-A01GS | $(1 \mathrm{~GB})$ |
| 5 | Hagiwara Sys-Com | MCF10P-A02GS | $(2 \mathrm{~GB})$ |

<Previously Recommended Compact Flash Cards>

| No. | Manufacturer | Model | Remarks |
| :---: | :--- | :--- | :--- |
| 1 | Hagiwara Sys-Com | CFI-128MDG | $(128 \mathrm{MB})$ |
| 2 | Hagiwara Sys-Com | CFI-256MDG | $(64 \mathrm{MB})$ |
| 3 | Hagiwara Sys-Com | CFC-064MBA <br> (HOOAA) | $(64 \mathrm{MB})$ |
| 4 | Hagiwara Sys-Com | CFI-064MBA <br> (HOOAA) | $(64 \mathrm{MB})$ |
| 5 | SanDisk | SDCFBI-64-EXPP-80 |  |

*512 MB (or more) CF cards in the same series can be used as external memory devices. However, FAT32 formatted CF cards such as high-capacity CF cards cannot be used for upgrading Pendant OS version.

## - 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.
- 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 NX100 does not adversely affect the Compact Flash. For details, refer to instruction manuals for each medium.

[^5]
## - 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.


### 7.2 Handling Data

### 7.2.1 Normal Mode Data Classification

For the NX100, data that can be saved in the normal mode 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 NX100.
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."
*3 "(7) BATCH CMOS" includes "(3) BATCH USER MEMORY", "(4) PARAMETER", "⑤ SYSTEM DATA", and "® I/O DATA."
*4 "ALL CMOS AREA" data cannot be loaded in edit mode and management mode.

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.

| Data classification |  |  | File Name (Saved Data) | Save |  | Load |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | EDIT | MAN | EDIT | MAN |
| (8) ALL CMOS AREA |  |  |  | ALCMSxx.HEX | $\bigcirc$ | $\bigcirc$ | X | X |
| (7) BATCH CMOS |  |  | CMOSxx.HEX | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
| (3) BATCH USER MEMORY |  |  | JOBxx. HEX | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
| (1) JOB |  | Single job | JOBNAME.JBI | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Related job (Job+Condition) | JOBNAME.JBR | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
| (2) FILE/ GENERAL DATA |  | Tool data | TOOL.CND | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Weaving data | WEAV.CND | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | User coordinate data | UFRAME.CND | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Variable data | VAR.DAT | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Arc start condition data | ARCSRT.CND | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Arc end condition data | ARCEND.CND | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Welding condition auxiliary data | ARCSUP.DAT | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Power Source characteristic data | WELDER.DAT | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Power Source characteristic definition data | WELDUDEF.DAT | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Shock detection level data | SHOCKLVL.CND | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Motor gun pressure power data | SPRESS.CND | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Motor gun dry spot pressure data | SPRESSCL.CND | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Spot gun characteristic data | SGUN.DAT | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Spot gun condition auxiliary data | SGUNSUP.DAT | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Spot welding Power Source characteristic data | SWELDER.DAT | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Spot I/O allocation data | SPOTIO.DAT | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Spot welding condition data | SPOTWELD.DAT | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
|  |  | Short/Full open position data | STROKE.DAT | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |


| Data classification |  |  | File Name (Saved Data) | Save |  | Load |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | EDIT | MAN | EDIT | MAN |
| (8) 7 | (4) PARAMETER BATCH |  |  | ALL.PRM | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  | (4) PARAMETER | Robot matching parameter | RC.PRM | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | System definition parameter | SD.PRM | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | Coordinate home position parameter | RO.PRM | O | O | X | $\bigcirc$ |
|  |  | System matching parameter | SC.PRM | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | CIO parameter | CIO.PRM | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | Function definition parameter | FD.PRM | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | Application parameter | AP.PRM | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | Transmission(general) parameter | RS.PRM | $\bigcirc$ | $\bigcirc$ | X | O |
|  |  | Sensor parameter | SE.PRM | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | Servo parameter | SV.PRM | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | Servomotor parameter | SVM.PRM | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | Operation control parameter | AMC.PRM | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | Servo power block parameter | SVP.PRM | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | Motion function parameter | MF.PRM | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | SERVOPACK parameter | SVS.PRM | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | Converter parameter | SVC.PRM | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  | (5) I/O DATA | Concurrent I/O program | CIOPRG.LST | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | I/O name data | IONAME.DAT | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | Pseudo input signals | PSEUDOIN.DAT | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  | © ${ }^{6}$ SYSTEM DATA | User word registration | UWORD.DAT | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | SV monitor signals | SVMON.DAT | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | Variable name | VARNAME.DAT | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | Second home position | HOME2.DAT | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | Alarm history data | ALMHIST.DAT | $\bigcirc$ | $\bigcirc$ | X | X |
|  |  | Home position calibrating data | ABSO.DAT | 0 | $\bigcirc$ | X | $\bigcirc$ |
|  |  | System information | SYSTEM.SYS | $\bigcirc$ | $\bigcirc$ | X | X |
|  |  | Work home position data | OPEORG.DAT | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |
|  |  | I/O message history data | IOMSGHST.DAT | $\bigcirc$ | $\bigcirc$ | X | X |
|  |  | Function key allocation data | KEYALLOC.DAT | $\bigcirc$ | $\bigcirc$ | X | $\bigcirc$ |

EDIT : Edit Mode, MAN: Management Mode $O$ : Can be done, $X$ : Cannot be done

### 7.2.2 Collective Backup

For the NX100, four types of collective backup are available: CMOS.BIN, CMOSBK.BIN, ALCMSxx.HEX, and CMOSxx.HEX.

## - CMOS.BIN

For the normal backup, use this data.
Save: Perform in the maintenance mode (the editing mode or higher.)
Load: Perform in the maintenance mode (the management mode.)
As for the load/save procedures, refer to "NX100 INSTRUCTIONS (RE-CTO-A211)".
Target Area: All areas of the internally-stored data. (Note that the monitoring time is not loaded.)

## - CMOSBK.BIN

This data is used in the automatic backup function.
Save: In the normal mode, saves with the preset conditions.
Load: Perform for the system restoration in the maintenance mode (the management mode.)
For details, refer to "NX100 INSTRUCTIONS (RE-CTO-A211)".
Target Area: All areas of the internally-stored data. (Note that the monitoring time is not loaded.)

## ■ CMOSxx.HEX

This data is loaded/saved in the FD/CF menu of the normal mode.
Save: Perform in the normal mode (the editing mode or higher.)
Load: Perform in the normal mode (the management mode.)
For details, refer to the following pages.
Target Area: The collected data including "Job File", "Data File", "Parameter File", "System Data", and "I/O Data" which can be individually loaded/saved in the FD/CF menu. Because the setting information of robot etc. are not included in the collected data, the system cannot be completely restored.

## ■ ALCMSxx.HEX

This data is for the manufacturer only. Users can save but cannot load this data.

In order to save the batch data, the following free space per file is needed in the Compact Flash card.
JZNC-NIF01-1: (The number of stored file + 1) x 7.5 MByte
JZNC-NIF01-2: (The number of stored file + 1) $\times 11.0$ MByte
Note that the free space for one working file is needed in addition to the abovementioned space when using the automatic backup function.
Besides, it is recommended to store the backup data in two or more Compact Flash cards to minimize problems if the Compact Flash card is damaged.

### 7.2.3 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 ( $\bullet$ ) appears when the selected folder has the file of the same name.
White circle ( $\circ$ ) appears when the folder does not have the same name file. 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 "® BATCH CMOS"


Example of JOB


Example of FILE/GENERAL DATA

## - 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\}.


## - 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


## Creating a Folder

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Change the security to man- <br> agement mode. <br> Select \{FD/PC CARD\} under <br> the main menu. |  |
| 2 | Select \{FOLDER\}. | The FOLDER LIST window appears. |
| 3 | Move the cursor to a folder <br> and press [SELECT]. | Select the higher-level folder where a new folder to be created <br> should be contained. When creating a folder in top-level, this <br> step is unnecessary. |
| 4 | Select \{DATA\} --> \{CREATE <br> NEW FOLDER\} under the pull- <br> down menu. <br> Input folder name using the <br> keyboard on the screen and <br> press [ENTER]. | A folder is created. |

## Deleting a Folder

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Change the security to management mode. <br> 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. |
| 5 | Move the cursor to the folder to be deleted. <br> 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.



When the initial folder is missing due to exchange of the Compact Flash, etc., "ERROR 3360: INVALID FOLDER" appears when selecting \{LOAD\}, \{SAVE\}, \{VERIFY\}, \{DELETE\} or \{FOLDER\} menu from \{FD/PC CARD\}, and simultaneously the initial folder becomes invalid. Set "ON" in "AUTO CHANGE" when the initial folder setting needs to be valid.

## - Saving Data

To download data from the memory of the NX100 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

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{FD/PC CARD\} under the main menu. |  |
| 2 | Select \{SAVE\}. | The following window appears. |
| 3 | Select \{JOB\}. | The JOB LIST window appears. |



Saving a Condition File or General Data


|  | Operation | Explanation |
| :--- | :--- | :--- |
| 5 | Press [ENTER]. | The confirmation dialog box appears. |
|  |  |  |
|  |  | Save? |
|  |  | YES $\quad$ NO |
| 6 | Select "YES." | The selected files are saved. |

Saving a Parameter

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 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 " $\star$." |


|  | Operation | Explanation |
| :--- | :--- | :--- |
| 5 | Press [ENTER]. | The confirmation dialog box appears. |
|  |  |  |
|  |  | Save? |
|  |  | YES $\quad$ NO |
| 6 | Select "YES." | The selected parameters are saved. |

Saving I/O Data

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 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 " $\star$." |
| 5 | Press [ENTER]. | The confirmation dialog box appears. |
| 6 | Select "YES." | The selected I/O data are saved. |

## Saving System Data


7.3 Operation Flow

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 5 | Press [ENTER]. | The confirmation dialog box appears. |
|  |  |  |
|  |  | Save? |
| 6 | Select "YES." | The selected system data are saved. |

"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", those data cannot be overwritten. In that 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

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{FD/PC CARD\} under the main menu. |  |
| 2 | Select \{SAVE\}. | The following window appears. |
| 3 | Move the cursor to \{BATCH USER MEMORY\} and select. |  |
| 4 | Select "EXECUTE." | The confirmation dialog box appears. |
| 5 | Select "YES." | All user's programs are saved. |

7.3 Operation Flow

Saving All CMOS Data

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{FD/PC CARD\} under the main menu. |  |
| 2 | Select \{SAVE\}. | The following window appears. |
| 3 | Move the cursor to $\{\mathrm{BATCH}$ CMOS\} and select. |  |
| 4 | Select "EXECUTE." | The confirmation dialog box appears. |
| 5 | Select "YES." | All CMOS data are saved. |

Saving All Data in CMOS Area

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{FD/PC CARD under the main menu. |  |
| 2 | Select \{SAVE\}. | The following window appears. |
| 3 | Move the cursor to \{ALL CMOS AREA\} and select. |  |
| 4 | Select "EXECUTE." | The confirmation dialog box appears. |
| 5 | Select "YES." | All data in CMOS area are saved. |

## Loading Data

To upload data from the external memory device to the memory of the NX100, 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. Those data are prepared as backup data for reloading into the controller used for saving. Loading the data from other controller may result in destruction or loss of critical system information.
Take extra care for the saved data.

## Loading a Job




## Loading a Condition File or General Data



|  | Operation | Explanation |
| :---: | :---: | :---: |
| 5 | Press [ENTER]. | The confirmation dialog box appears. |
|  |  | Load? |
|  |  | YES NO |
| 6 | Select "YES." | The selected files are loaded. |

## Loading a Parameter



|  | Operation | Explanation |
| :--- | :--- | :--- |
| 5 | Press [ENTER]. | The confirmation dialog box appears. |
|  |  |  |
|  |  | Load? |
| 6 | Select "YES." | YES $\quad$ NO |

## Loading I/O Data

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{FD/PC CARD $\}$ under the main menu. |  |
| 2 | Select \{LOAD\}. | The following window appears. |
| 3 | Move the cursor to \{I/O DATA\} and select. | The selection window for I/O data appears. |
| 4 | Select I/O data to be loaded. | The selected I/O data are marked with " $\star$." |
| 5 | Press [ENTER]. | The confirmation dialog box appears. |
| 6 | Select "YES." | The selected I/O data are loaded. |

## Loading System Data


7.3 Operation Flow

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 5 | Press [ENTER]. | The confirmation dialog box appears. |
|  |  | Load? <br>  <br>  <br>  <br>  <br> 6 Select "YES." |

## Loading All User's Programs

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{FD/PC CARD under the main menu. |  |
| 2 | Select \{LOAD\}. | The following window appears. |
| 3 | Move the cursor to \{BATCH USER MEMORY\} and select. |  |
| 4 | Select "EXECUTE." | The confirmation dialog box appears. |
| 5 | Select "YES." | All user's programs are loaded. |

7.3 Operation Flow

## Loading All CMOS Data



- Verifying Data

Follow the procedure below to verify data in the memory of the NX100 with data saved in the external memory device.

This function cannot be executed with "BATCH USER MEMORY," "BATCH CMOS," or "ALL CMOS AREA" specified.

## Verifying a Job


7.3 Operation Flow


## Verifying a File

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 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 " $\star$." |
| 5 | Press [ENTER]. | The confirmation dialog box appears. |
|  |  | Verify? <br> YES <br> NO |
| 6 | Select "YES." | The selected files are verified. |

## - Deleting Data

Follow the procedure below to delete a file or files on an external memory device.

Deleting a Job

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{FD/PC CARD $\}$ under the main menu. |  |
| 2 | Select \{DELETE\}. | The following window appears. |
| 3 | Select \{JOB\} | The job selection window appears. |
| 4 | Select a job to be deleted. | The selected jobs are marked with " $\star$." |
| 5 | Press [ENTER]. | The confirmation dialog box appears. |
| 6 | Select "YES." | The selected jobs are deleted. |

## Deleting a File

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 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 " $\star$." |
| 5 | Press [ENTER]. | The confirmation dialog box appears. <br> Delete? |
| 6 | Select "YES." | The selected files are deleted. |

## 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 NX100.
Verifying: selects both the files in the external memory device and in the memory of the NX100.

## Using Individual Selection



## Using Batch Selection

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | In either the external memory JOB LIST window or the file selection window, select $\{E D I T\}$ under the menu. | The pull-down menu appears. |
| 2 | Select \{SELECT ALL\}. <br> *To cancel the selected items, select \{EDIT\} and then \{CANCEL SELECT $\}$. | All jobs are selected. |

Using Marker (*) Selection

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | In either the external memory JOB LIST window or the file selection window, select $\{E D I T\}$ under the menu. | The pull-down menu appears. |
|  |  | Folier |
|  |  |  |
|  |  |  |
|  |  |  |
| 2 | Select \{SELECT MARKER $\left(^{*}\right)$ \}. <br> *To cancel the selected items, select \{EDIT\} and then \{CANCEL SELECT\}. |  |
|  |  |  |
|  |  | FLOPPY DISK/Compact Flash CF (LOAD) SINGLE NO. 33 FOLDER |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  | Main Menu |

## 8 Parameter

### 8.1 Parameter Configuration

The parameters of NX100 can be classified into the following seven:

## Motion Speed Setting Parameter

Determines the manipulator motion speed for jog operation at teaching, test operation, or playback operation.

## Mode Operation Setting Parameter

Makes the setting for various operations in the teach mode or remote mode.

## Parameter according to Interference Area

Limits the P -point maximum envelope of the manipulator or sets the interference area for axis interference or cubic interference.

## Parameter according to Status I/O

Sets the parity check or I/O setting for user input/output signals.

## Parameter according to Coordinated or Synchronized Operation

Makes the settings for coordinated or synchronized operations between manipulators or between manipulators and stations.

## Parameter for Other Functions or Applications

Makes the settings for other functions or applications.

## Hardware Control Parameter

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

## S1CxG Parameters

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

### 8.2 Motion Speed Setting Parameters

These parameters set the manipulator motion speed for jog operation at teaching, test operation, or playback operation.

## ■ S1CxG000: IN-GUARD SAFE OPERATION MAX. SPEED

Units: 0.01\%
The upper speed limit is set for in-guard safe operation. While the in-guard safe operation command signal is being input, the TCP speed is limited to the TCPmax speed.

## - S1CxG001: DRY-RUN SPEED

Units: 0.01\%
This is a dry-run operation speed setting value used when checking the path. Take safety into consideration when setting changes are unnecessary.


## - S1CxG002 to S1CxG009: JOINT SPEED FOR REGISTRATION

Units: 0.01\%
The value set in these parameters is registered as the joint speed for each speed level when teaching the position data with the programming pendant. The percentage corresponding to the set value at each level is registered as $100 \%$ of the value set in the playback speed limit. Values greater than those set as speed limit values cannot be set.

## - S1CxG010 to S1CxG017: LINEAR SPEED FOR REGISTRATION

Units: $0.1 \mathrm{~mm} / \mathrm{s}$
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.

## ■ S1CxG018 to S1CxG025: POSITION ANGLE SPEED

Units: $0.1 \%$
The value set in these parameters is registered as the position angle speed for each speed level when teaching the position data with the programming pendant. Values greater than those set as playback speed limit cannot be set.

## ■ S1CxG026 to S1CxG029: JOG OPERATION ABSOLUTE VALUE SPEED

Units: $0.1 \mathrm{~mm} / \mathrm{s}$
These are setting values of jog operation speed set by the programming pendant. Values greater than those set as jog operation speed limit value cannot be set.

Low level : Jog operation speed when "LOW" manual speed is specified.
Medium level : Jog operation speed when "MEDIUM" manual speed is specified.
High level : Jog operation speed when "HIGH" manual speed is specified.
High-speed-level : Jog operation speed when [HIGH SPEED] is pressed.

## ■ S1CxG030 to S1CxG032: INCHING MOVE AMOUNT

These parameters specify the amount per move at inching operation by the programming pendant. The referenced parameter differs according to the operation mode at inching operation.

Joint Operation : 1 to 10 pulses in units of 1 pulse
Cartesian/cylindrical, user, tool : 0.01 to 2.55 mm in units of 0.01 mm
Motion about TCP : 0.1 to $1.0^{\circ}$ in units of $0.1^{\circ}$

## - S1CxG033 to S1CxG040: POSITIONING ZONE

This parameter value will be referenced when positioning is specified with the "MOVE" instruction: MOVJ (joint movement) or MOVL (linear movement).

```
<Example>MOVL V=100.0 PL=1
Positioning level
Positioning specification
```

The value set in this parameter specifies the range to enter in relation to the teaching point for that step positioning. After entering the specified positioning zone, the manipulator starts moving to the next step. The system is also set up so inward turning operation is carried out in the moving section when moving to the next path; speed changeover is smooth.
Since operation will be turning inward during playback, as shown in the following diagram, use setting values taking safety aspects into consideration.


NOTE
This process becomes effective when change in direction of steps is between $250^{\circ}$ and $155^{\circ}$.

Position Level

Position levels are divided into nine stages of 0 to 8 with the "MOV" instruction.
e.g. MOVL V=500 PL=1 (PL:Position Level)

The functions at each level are as follows:
0 : Complete positioning to the target point
1 to 8: Inward turning operation
Following are explanations of the respective processing details and their relations with the parameter.

- Level 0

Determines positioning completion when the amount of deviation (number of pulses) to the target point of each axis comes within the position set zone specified by the parameter.

After the positioning completes, the instruction system starts instruction to the next target point.

- Level 1 to 8

Recognizes virtual positioning before the target point. The distance of the virtual target position from the target point is specified at the positioning level.
Distance data corresponding to each level are set in the parameter. Determination of the virtual target position is carried out in the instruction system.
Set zone: The zone of each positioning level set in the parameter. ( $\mu \mathrm{m}$ )

## - S1CxG044: LOW-SPEED START

Units: 0.01\%
This parameter specifies max. speed at low speed start. Specify the starting method for "initial operation speed of manipulator" (S2C169).

## ■ S1CxG045 to S1CxG048: JOG OPERATION LINK SPEED

Units: 0.01\%
These parameters prescribe the link speed at jog operation by the programming pendant. Specify the percentage (\%) for the jog operation speed limit, the joint max. speed.

S1CxG045: Jog operation link speed at level "LOW"
S1CxG046: Jog operation link speed at level "MEDIUM"
S1CxG047: Jog operation link speed at level "HIGH"
S1CxG048: Jog operation link speed at level "HIGH SPEED"

## - S1CxG056: WORK HOME POSITION RETURN SPEED

Units: 0.01\%
This parameter specifies the speed for returning to work home position against the maximum speed.

## - S1CxG057: SEARCH MAX. SPEED

Units: $0.1 \mathrm{~mm} / \mathrm{s}$
This parameter specifies the max. speed for searching.

## - S2C153: POSTURE CONTROL AT CARTESIAN OPERATION OF JOG

This parameter specifies whether or not posture control is performed at cartesian operation of "JOG" by the programming pendant. Use posture control unless a special manipulator model is used.

0 : With posture control
1: Without posture control

## ■ S2C154: OPERATION IN USER COORDINATE SYSTEM (WHEN EXTERNAL REFERENCE POINT CONTROL FUNCTION USED)

This parameter specifies the TCP or reference point of motion about TCP when the external reference point control function is used and the user coordinate system is selected by the programming pendant.

0: When manipulator TCP is selected


1: When external reference point is selected


## ■ S2C238: CONTROLLED GROUP JOB TEACHING POSITION CHANGE

This parameter is used to change only the job teaching position of controlled group axis.
0 : Not changed
1: Changed

## ■ S2C324, S2C325: OPERATION AFTER RESET FROM PATH DEVIATION

These parameters specify the method of restarting the manipulator that has deviated from the normal path such as an emergency stop or jog operation.

0 : Move to the indicated step (initial setting).
1: After moving back to the deviated position, move to the indicated step.
2: Move back to the deviated position and stop.
S2C324

| Parameter Setting <br> Value | Move to next step. |
| :--- | :--- |
|  | After moving back to the deviated position, move to the indicated <br> step. |
|  |  |

S2C324

| Parameter Setting <br> Value |  |
| :---: | :---: |
| 2 | Movement When Restarting |
| Move to the path deviated <br> position and stop. <br> When restarting, move to <br> the indicated step. |  |

S2C325

| Parameter Setting <br> Value | Move to the next step. |
| :--- | :--- |
| After moving back to the deviated position, move to the indicated |  |
| step. |  |

- To the path deviated position, the manipulator moves in a straight line at low speed oper- ation (SICxG044).
It is linear movement. After resetting from deviation, the speed becomes the same as taught speed.
- The initial setting (prior to shipping) is 0: The manipulator moves in a straight line from the present position to the indicated step.


## ■ S2C326: DEVIATED POSITION

This parameter specifies whether deviated position is to be robot current (reference) position or feedback position.

0 : Return to the feedback position.
1: Return to the current value (reference) position.
When emergency stop is applied during high-speed motion, the deviated position differs from the robot current value (reference) position and feedback position as shown in the following.


## - S2C327: 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.


1: Rotating position by circular arc path


## - S2C515: EMERGENCY STOP CURSOR ADVANCE CONTROL FUNCTION

This parameter specifies whether to use the cursor advance control function or not.
0 : Not use
1: Use
■ S2C516: EMERGENCY STOP CURSOR ADVANCE CONTROL FUNCTION CONT PROCESS COMPLETION POSITION

Units: \%
When the manipulator stops during moving inner corner by CONT process, this parameter specifies which position of the inner corner should be considered as the end of step.


When $50 \%$ is set, moves to Step 3 if the manipulator stops in A section, and to Step 4 if the manipulator stops in B section.

■ S2C517: EMERGENCY STOP ADVANCE CONTROL FUNCTION WORK START INSTRUCTION STEP MOTION COMPLETION DELAY TIME

Units: ms
In order to recognize securely the completion of motion to the step of work start instruction (such as ARCON instruction), this parameter specifies the delay time for motion completion of the work start instruction step only.

■ S2C560: BASE AXIS OPERATION KEY ALLOCATION SETTING
Parameter Setting and Jog Operation Key Allocation

| Coordinates/Parameter | S2C560 " "0" | S2C560 $=$ "1" |
| :--- | :--- | :--- |
| Joint | Axis number order | Specified |
| Cylindrical | Axis number order | Specified |
| Cartesian | Specified | Specified |
| Tool | Specified | Specified |
| User | Specified | Specified |

Axis number order: X : First axis, Y : Second axis, Z : Third axis
Specified: X: X-direction (RECT-X), Y: Y-direction (RECT-Y), Z: Z-direction (RECT-Z)

## ■ S3C806 to S3C808: POSITION CORRECTING FUNCTION DURING PLAYBACK

These parameters specify the necessary data for position correcting function (PAM) during playback operation.

S3C806 Specifies the limit of position correcting range (Units: $\mu \mathrm{m}$ )
S3C807 Specifies the limit of speed correcting range (Units: 0.01\%)
S3C808 Specifies the correcting coordinates
0 : Base
1 : Robot
2 : Tool
3 : User 1
to
26:User 24

### 8.3 Mode Operation Setting Parameters

These parameters set various operations in the teach mode or remote mode.

## - S2C147: SECURITY MODE WHEN CONTROL POWER SUPPLY IS TURNED ON

The operation level when the control power supply is turned ON is set.
0: Operation Mode
1: Editing Mode
2: Management Mode

## ■ S2C148: SELECTION OF CARTESIAN/CYLINDRICAL

This parameter specifies whether the cartesian mode or cylindrical mode is affected when cartesian/cylindrical mode is selected by operation (coordinate) mode selection at axis operation of programming pendant. This specification can be done on the TEACHING CONDITION window.

0 : Cylindrical mode
1: Cartesian mode

## - S2C149: COORDINATE SWITCHING PROHIBITED

This parameter prohibits switching coordinates during JOG operation by the programming pendant.

0: Switching permitted for tool coordinates and user coordinates
1: Switching prohibited for tool coordinates
2: Switching prohibited for user coordinates
3: Switching prohibited for tool coordinates and user coordinates

## ■ S2C150: EXECUTION UNITS AT "FORWARD" OPERATION

This parameter specifies the execution units at step mode of "FORWARD" operation by the programming pendant.

| Parameter Setting Value | Operation Units |  |
| :---: | :---: | :---: |
| 0 | MOVL DOUT TIMER DOUT MOVL | Stops at every instruction |
| 1 | MOVL DOUT TIMER DOUT MOVL | Stops at move instruction |

## S2C151: INSTRUCTION (EXCEPT FOR MOVE) EXECUTION AT "FORWARD" OPERATION

This parameter specifies the method of instruction (except for move) execution at "FORWARD" operation by the programming pendant.

0: Executed by pressing [FWD] + [INTERLOCK]
1: Executed by pressing [FWD] only
2: Instruction not executed

## ■ S2C155: CHANGING STEP ONLY

This parameter specifies whether to permit only step changes in an editing-prohibited job. When permitted, only position data can be changed but additional data such as speed cannot be changed. This specification can be done on the TEACHING CONDITION window.

0: Permitted
1: Prohibited

## S2C156: MANUAL SPEED STORING FOR EACH COORDINATE

This parameter specifies whether to assign different manual speeds for the joint coordinates and other coordinates. If "NOT STORED" is selected, manual speed is not affected by changing the coordinates. If "STORED" is selected, manual speeds can be selected separately for the joint coordinates and other coordinates.

0 : Not stored
1: Stored

## - S2C158: ADDITIONAL STEP POSITION

This parameter designates either "before next step" or "after the cursor position (between instructions)" as additional step position. This specification can be done on the TEACHING CONDITION window.
<Example>


S2C158-0 (Before the Next Step)

| Line | Instruction |
| :---: | :---: |
| $\vdots$ | $\vdots$ |
| 10 | MOVL V=100 |
| 11 | TIMER T=1.00 |
| 12 | DOUT OT\#(1) ON |
| 13 | MOVL V=100 |
| 14 | MOVL V=50 |
| $\vdots$ | $\vdots$ |
| Added step |  |

S2C158-1 (Between Instructions)

| Line | Instruction |
| :---: | :---: |
| $\vdots$ | $\vdots$ |
| 10 | MOVL V=100 |
| 11 | TIMER T=1.00 |
| 12 | MOVL V $=100$ |
| 13 | DOUT OT\# (1) ON |
| 14 | MOVL V=50 |
| $\vdots$ | $\vdots$ |
| Added step |  |

■ S2C159: MASTER JOB CHANGING OPERATION
This parameter specifies whether to permit or prohibit master job changing operation. If "PROHIBIT" is specified, the master job cannot be changed (or registered) easily. The specification can be done on the OPERATING CONDITION window.

0 : Permitted
1: Prohibited

## - S2C160: CHECK AND MACHINE-LOCK KEY OPERATION IN PLAY MODE

This parameter specifies whether to permit or prohibit in play mode to change the operation that changes the operation condition. Even if an error occurs because of the operation with the keys, the manipulator does not stop. The specification can be done on the OPERATING CONDITION window.

0: Permitted
1: Prohibited

## ■ S2C161: RESERVED WORK JOB CHANGING OPERATION

This parameter specifies whether to permit reserved work job changing operation. The designation can be done on the OPERATING CONDITION window.

0 : Permitted
1: Prohibited

## ■ S2C162: MASTER OR SUBMASTER CALL OPERATION IN PLAY MODE

This parameter specifies whether the master or submaster call operation in play mode is permitted or not. When the independent control function is valid, the master job for sub-task is specified at the same time. The specification can be done on the OPERATING CONDITION window.

0: Permitted
1: Prohibited

## - S2C163: LANGUAGE LEVEL

This parameter specifies the level of the robot language (INFORM III). The levels simplify the instruction registering operation. With NX100, all robot instructions can be executed regardless of specification of instruction sets. The specification can be done on the TEACHING CONDITION window.

## 0 : Contracted Level

Only frequently used robot instructions are selected to reduce the number of instructions to be registered. Robot instructions displayed on the instruction dialog box are also reduced so that specification is simplified.

1: Standard Level
2: Expanded Level
All the robot instructions are available in standard and expanded levels. The two levels are distinguished by the number of additional information items (tags) that can be used with robot instructions. At the expanded level, the flowing functions are available.

- Local Variables and Array Variables
- Use of Variables for Tags (Example: MOVJ VJ=I000) The above functions are not available at the standard level, however, which reduces the number of data required to register instructions, thereby simplifying the operation.


## - S2C166: INSTRUCTION INPUT LEARNING FUNCTION

This parameter specifies whether to set a line of instructions that has been input on the input buffer line when pressing the first soft key for each instruction. If "PROVIDED" is selected, the instructions are set.

0 : Without learning function
1: With learning function

## ■ S2C167: ADDRESS SETTING WHEN CONTROL POWER IS TURNED ON

This parameter specifies the processing of the job name, step No., and line No. that are set when the control power supply is turned ON.

0 : Reproduces the address when power supply is turned ON.
1: Lead address (Line"0") of the master job.

## - S2C168: JOB LIST DISPLAY METHOD AT JOB SELECTION

These parameters specify the displaying method on the JOB LIST window at job selection.
0 : Order of Names
1: Order of Date

## - S2C169: INITIAL OPERATION OF MANIPULATOR

This parameter specifies the operation speed level of the first section when starting. Specify the operation speed with the low-speed start (S1CxG044). When starting at low-speed, the manipulator stops after reaching the indicated step regardless of the cycle setting. Once the manipulator is paused during the low-speed operation, it moves at teaching speed when restarted.

0: Specified on the SPECIAL PLAY window. Operates at low speed only when low speed start is set. Operates at taught speed when not instructed.
1: Starts at low speed after editing regardless of soft key instructions.

■ S2C170: PLAYBACK EXECUTION AT CYCLE MODE "1- STEP"

| Parameter Setting Value | Operation Units |  |
| :---: | :---: | :---: |
| 0 | MOVL DOUT TIMER DOUT MOVL | Stops at every instruction |
| 1 | MOVL DOUT TIMER DOUT MOVL | Stops at move instruction. |

NOTE
When operating "FORWARD" by the programming pendant, the units for execution are set in another parameter (S2C150).

## ■ S2C171: EXTERNAL START

This parameter specifies whether a start instruction from external input is accepted or not. The specification can be done on the OPERATING CONDITION window.

0: Permitted
1: Prohibited

## ■ S2C172: PROGRAMMING PENDANT START

This parameter specifies whether a start instruction from the programming pendant is accepted or not.

0: Permitted
1: Prohibited

## - S2C173: SPEED DATA INPUT FORM

This parameter specifies the units for speed data input and display.
$\mathrm{mm} / \mathrm{s}$ : in units of $0.1 \mathrm{~mm} / \mathrm{s}$
$\mathrm{cm} / \mathrm{min}$ : in units of $1 \mathrm{~cm} / \mathrm{min}$
inch $/ \mathrm{min}$ : in units of $1 \mathrm{inch} / \mathrm{min}$
$\mathrm{mm} / \mathrm{min}$ : in units of $1 \mathrm{~mm} / \mathrm{min}$
The specification can be done on the OPERATING CONDITION window.
0 : mm/sec
1: $\mathrm{cm} / \mathrm{min}$
2: inch/min
3: mm/min

## ■ S2C174: RESERVED START

This parameter specifies whether a reserved start instruction from the programming pendant is accepted or not. The specification can be done on the OPERATING CONDITION window.

0 : Permitted
1: Prohibited

## - S2C176: JOB SELECTION AT REMOTE FUNCTION (PLAY MODE)

This parameter specifies whether a job selection in play mode at remote function is prohibited or not.

0: Permitted
1: Prohibited

## - S2C177: EXTERNAL MODE SWITCH

This parameter specifies whether mode switching from the outside is accepted or not. The specification can be done on the OPERATING CONDITION window.

0 : Permitted
1: Prohibited

## ■ S2C179: EXTERNAL CYCLE SWITCHING

This parameter specifies whether cycle switching from the outside is accepted or not. The specification can be done on the OPERATING CONDITION window.

0: Permitted
1: Prohibited

## ■ S2C180: PROGRAMMING PENDANT CYCLE SWITCHING

This parameter specifies whether cycle switching from the programming pendant is accepted or not. The specification can be done on the OPERATING CONDITION window.

0 : Permitted
1: Prohibited

## ■ S2C181: 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 " 6 ." In this case, servo ON instruction from the programming pendant is not accepted. The specification can be done on the OPERATING CONDITION window.


## S2C182: PROGRAMMING PENDANT OPERATION WHEN "IO" IS SELECTED FOR REMOTE MODE

This parameter specifies whether each operation of the following is valid when "IO" is selected for remote function selection. IO and command are available for remote function selection: "IO" is set prior to shipping. "Command" is valid when transmission function (optional) is specified.


## ■ S2C186: STEP REGISTRATION AT TOOL NO. CHANGE

The registration of the step when the tool number is changed allows the setting to be made as prohibited.
If this parameter is set to " 1 " (prohibited), the following operations are prohibited.
0: Permitted
1: Prohibited

- Modification of a step

When the tool number of the teaching step differs from the currently-selected tool number, the step cannot be modified.

- Deletion of a step

Even if the teaching step position coincides with the current position, the step cannot be deleted when the tool number of the teaching step differs from the currently-selected tool number.

- Addition of a step

When the tool number of the teaching step indicated by the cursor differs from the cur-rently-selected tool number, the step cannot be added.

## - S2C211: REMOTE FIRST CYCLE MODE

This parameter sets the cycle that changes from the local mode to the remote mode.
The setting can be made on the OPERATING CONDITION window.
0: Step
1: 1 cycle
2: Continuous
3: Setting retained

## - S2C212: LOCAL FIRST CYCLE MODE

This parameter sets the cycle that changes from the remote mode to the local mode.
The setting can be made on the OPERATING CONDITION window.
0: Step
1: 1 cycle
2: Continuous
3: Setting retained

## - S2C230: POWER ON FIRST CYCLE MODE

This parameter sets the first cycle mode for when the power is turned ON.
The setting can be made on the OPERATING CONDITION window.
0: Step
1: 1 cycle
2: Continuous
3: Setting retained

## - S2C231: TEACH MODE FIRST CYCLE MODE

This parameter sets the cycle that changes from the play mode to the teach mode.
The setting can be made on the OPERATING CONDITION window.
0: Step
1: 1 cycle
2: Continuous
3: Setting retained

## - S2C232: PLAY MODE FIRST CYCLE MODE

This parameter sets the cycle that changes from the teach mode to the play mode.
The setting can be made on the OPERATING CONDITION window.
0: Step
1: 1 cycle
2: Continuous
3: Setting retained

## - S2C297: 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.

S2C297

| Parameter Setting Value | Valid/Invalid |
| :---: | :--- |
| 0 | Function invalid |
| 1 | Function valid |

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. 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" <br> In the case of DOUT instruction:

> S2C297=0 : DOUT OT\#(1) ON
> S2C297=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..., IO..., BP1..., LEX2...

Alphabets representing variables: $\mathrm{B}, \mathrm{I}, \mathrm{D}, \mathrm{R}, \mathrm{S}, \mathrm{P}, \mathrm{BP}, \mathrm{EX}, \mathrm{PX}$, LB, LI LD, LR, LS, LP, LBP, LEX, LPX

When the name begins with " ' ", it is regarded as a comment and the same comment can be registered for two or more signals. In this case, although this function is valid, the number is displayed on the JOB CONTENT window instead of the name.
<Example> Registration of the name of user output OUT\#0002 as "'OUTPUT 2"
S2C297=0 : DOUT OT\#(2) ON
S2C297=1 : DOUT OT\#(2) ON

## - S2C298: 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.

| S2C298 |  |
| :---: | :--- |
| Parameter Setting Value | Valid/Invalid |
| 0 | Function invalid |
| 1 | Function valid |

With this function valid, the confirmation dialog box "Register by name (alias) ?" is displayed when you select the variable on the DETAIL EDIT window. 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" <br> In the case of SET instruction <br> S2C298=0 : SET B000 128 <br> S2C298=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..., IO..., BP1..., LEX2...

Alphabets representing variables: $B, I, D, R, S, P, B P, E X, P X$, LB, LI LD, LR, LS, LP, LBP, LEX, LPX

When the name begins with " " ", it is regarded as a comment and the same comment can be registered for two or more variables. In this case, although this function is valid, the number is displayed on the JOB CONTENT window instead of the name.
$<$ Example> Registration of the byte type variable B001 as "WORKNUM"
S2C298=0: SET B001 10
S2C298=1 : SET B001 10

## ■ S2C299: I/O VARIABLE CUSTOMIZE FUNCTION

This function enables registration of any particular input/output signal/variable. Reference and editing of signals/variables are possible on the same window.

S2C299

| Parameter Setting Value | Valid/Invalid |
| :---: | :--- |
| 0 | Function Invalid |
| 1 | Function Valid |

With this function valid, the sub-menu \{I/O-VARIABLE CUSTOMIZE\} opens under the main menu \{ARC WELDING\}, \{SPOT WELDING\}, \{GENERAL\}, \{HANDLING\} (differs by application). Select \{I/O-VARIABLE CUSTOMIZE\}, and the I/O-VARIABLE CUSTOMIZE window appears as shown below.


I/O-VARIABLE CUSTOMIZE Window
On the I/O-VARIABLE CUSTOMIZE window, any of the input/output signals/variables can be selected and registered (up to 32 items). Registrable signals/variables are as follows:

Registrable Items on the I/O-VARIABLE CUSTOMIZE Window

| Input/Output Signals | USER INPUT SIGNAL |
| :---: | :--- |
|  | USER OUTPUT SIGNAL |
|  | PSEUDO INPUT SIGNAL |
| Variables | BYTE TYPE VARIABLE (B VARIABLE) |
|  | INTEGER TYPE VARIABLE (I VARIABLE) |
|  | DOUBLE-PRECISION INTEGER TYPE VARIABLE (D VARIABLE) |

The contents and names of the registered signals/variables can be checked and edited on this window.
In addition, the data list of registered signals/variables can be loaded, saved, verified or deleted with an external memory unit.
Only when this function is valid, "I/O-VARIABLE CUSTOMIZE (file name: USRIOVAR.DAT)" is displayed and can be selected. To display the "I/O-VARIABLE CUSTOMIZE (file name: USRIOVAR.DAT)", select \{FD/CF\} $\rightarrow$ \{LOAD $\}\{$ SAVE $\}\{V E R I F Y\}\{$ DELETE $\} \rightarrow\{S Y S T E M$ DATA\}

## - S2C317 to S2C321: TIME RESET

These parameters specify whether resetting operation of the specified times is permitted or not.

S2C317 : CONTROL POWER ON TIME
S2C318 : SERVO POWER ON TIME
S2C319 : PLAYBACK TIME
S2C320 : WORK TIME
S2C321 : WEAVING TIME

0 : Prohibit Resetting
1: Permit Resetting
"PERMIT" is set as the initial value for the work time and motion time.

- S2C333: TOOL NO. SWITCHING

This parameter specifies whether tool number switching is permitted or not. If "PERMIT" is selected, 24 types of tools from number 0 to 23 can be switched. If "NOT PERMIT" is selected, only number "0" can be used.

0: Prohibited
1: Permitted

## ■ S2C335: POSITION TEACHING BUZZER

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

■ S2C336: JOB LINKING DESIGNATION (When Twin Synchronous Function Used)

This parameter specifies whether the manipulator at the synchronizing side is to be linked when the manipulator and the station at the synchronized side are performing FWD/BWD or test run, by using the twin synchronous function.

0 : Not operating
1: Linking

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


1 : Links the synchronizing side while teaching the synchronized side.


## - S2C339: 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.

> S2C339

| Parameter Setting Value | Where the Playback Resumes |
| :---: | :---: |
| 0 | Resumes where the cursor is located in the job displayed at the moment. |
| 1 | Resumes where the cursor has been located when the playback suspended OR where the cursor is located in the job displayed at the moment. <br> <Example> <br> Suspended at step 0003 during the playback of job A <br> Displays job B $\downarrow$ <br> Starts operation <br> On the playback operation continuation window <br> - When "YES" selected, the playback resumes from step 0003 of job A <br> - When "NO" selected, the playback resumes from the current position in job B |

* When this function is valid (S2C339=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 (S2C174=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.

■ S1CxG200 to S1CxG215: PULSE SOFT LIMIT
Soft limit is set independently for each axis by pulse value setting. Set current value (pulse value) of the axis at the soft limit set up position.


## - S2C001: CUBE SOFT LIMIT CHECK

This parameter specifies whether to check the cube soft limit. More than one soft limit can be specified.
$0:$ No check
$1:$ With check


Cube 1 soft limit (base coordinates value of robot 1 TCP)
Cube 2 soft limit (base coordinates value of robot 2 TCP)
Cube 3 soft limit (base coordinates value of robot 3 TCP)
Cube 4 soft limit (base coordinates value of robot 4 TCP)

If "WITH CHECK" is selected, set up the following parameters. S3C000 to S3C023: Cube Soft Limit

## Soft Limit

Soft limit is a software-type function to limit the range of movement of the manipulator. If the TCP reaches the soft limit during operation, the manipulator automatically stops and no longer moves in that same direction. An alarm occurs if this soft limit is exceeded during playback. This soft limit is classified into two types.

## - Cube Soft Limit

Soft limit is set with the absolute value on the base coordinates.


- Pulse Soft Limit (Independent Axis Soft Limit)

Refer to " S1CxG200 to S1CxG215: PULSE SOFT LIMIT. "

## - S2C002: S-AXIS INTERFERENCE CHECK

This parameter specifies whether to check for interference with each manipulator. If "WITH CHECK" is selected, set up the following parameters.
S3C024 to S3C031: S-axis Interference Area

■ S2C003 to S2C050: CUBE/AXIS INTERFERENCE CHECK

1. Designation of checking

These parameters specify the cube/axis interference to be used by bit.
0 : Cube Interference/Axis Interference Not Used

| 1: Robot 1 | 2 : Robot 2 | $3:$ Robot 3 | 4: Robot 4 |
| :---: | :--- | :--- | :--- |
| 5 : Base Axis 1 | 6: Base Axis 2 | 7 : Base Axis 3 | 8: Base Axis 4 |
| 9: Station Axis 1 | 10: Station Axis 2 | 11: Station Axis 3 | 12: Station Axis 4 |
| 13: Station Axis 5 | 14: Station Axis 6 | 15: Station Axis 7 | 16: Station Axis 8 |
| 17: Station Axis 9 | 18: Station Axis 10 | 19: Station Axis 11 | 20: Station Axis 12 |

2. Checking method

Designates whether checking is performed by command or feedback.


## Checking method

MENT
The checking method differs according to ON/OFF status of servo power supply.

| Checking Method Designation | Servo Power Supply ON | Servo Power Supply OFF |
| :--- | :---: | :---: |
| Command | Command | Feedback |
| Feedback | Feedback | Feedback |

During the servo float function operation, checking is performed by feedback regardless of the checking method designation.

## Interference Area

It is possible to output whether the TCP during operation is inside or outside as a status signal, and to set the area to control the position by parameters S2C003 to S2C114. When the manipulator attempts to enter this area, the corresponding input signal (e.g. an "entrance prohibit signal") is detected. The manipulator stops immediately if there is an input signal and goes into waiting status until this signal is cleared. This signal is procensed in the I/O section. Three methods of interference area settings are prepared for manipulators and stations. For a system with one manipulator, use robot 1.

- S-axis Interference Area

Position is controlled by the pulse value of the S -axis.


- Cubic Interference Area

Up to 32 cubic areas can be set. The edges of the cubes are set parallel to the robot coordinates or the user coordinates.


- Axis Interference Area

Up to 32 areas can be set. Each operation area maximum and minimum value are set for the robot, base axis, and station axis plus and minus side.


## ■ S2C051 to S2C114: CUBE USING METHOD

These parameters specify the coordinates for defining the cube. If the user coordinates are selected, also specify the user coordinate system numbers. Set cubic area referring to the cubic interference areas shown below.

Coordinate specification
0 : Pulse (axis interference)
1 : Base coordinates
2 : Robot coordinates
3 : User coordinates
Coordinate No.: Specify the user coordinate number when selecting " 3 : User Coordinates." Units: $1 \mu \mathrm{~m}$

Precaution When Setting the Interference Area
It will be necessary to consider the following when setting the cubic interference and S-axis interference areas. The manipulator is processed to decelerate to stop from the point where it enters in the area. Therefore, set the areas in consideration of the amount of the manipulator movement in the deceleration section shown in the figure below.


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

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

## Interference Prevention in Interference Area

Processing to prevent interference is executed in the I/O processing section. The relation between the NX100 I/O signal and manipulator operation is shown below.


In wait status with the entrance prohibit signal, the manipulator just barely enters the area for speed reduction processing and then stops.


Connection Example Where Two Manipulators are Operated in the Same Area

## S2C188 to S2C193: ROBOT INTERFERENCE CHECK

This parameter specifies whether to check interference between robots 1, 2, 3, and 4. Interference check is executed in the spherical range having the TCP in the center. If "provided" is selected, also select the following parameters.

ROBOT INTERFERENCE CHECK (units: $\mu \mathrm{m}$ )
S3C801 : ROBOT1 SPHERE RADIUS
S3C802 : ROBOT2SPHERERADIUS
S3C803 : ROBOT3 SPHERE RADIUS
S3C804 : ROBOT4 SPHERE RADIUS

## - S3C000 to S3C023: CUBE SOFT LIMIT

These parameters specify auxiliary functions of S2C001 parameter. For details, see the explanation of the S2C001 parameter.

## ■ S3C024 to S3C031: S-AXIS INTERFERENCE AREA

These parameters specify auxiliary functions of S2C002 parameter. For details, see the explanation of the S2C002 parameter.

## ■ S3C032 to S3C543: CUBIC INTERFERENCE AREA

These parameters specify auxiliary functions of S2C003 to S2C034 parameters. For details, see the explanation of the S2C003 to S2C050 parameters.

## ■ S3C801 to S3C804: ROBOT INTERFERENCE AREA

These parameters specify auxiliary functions of S2C188 to S2C193 parameters. For details, see the explanation of the S2C188 to S2C193 parameters.

## - S3C805: A SIDE LENGTH OF WORK-HOME-POSITION CUBE

Units: $1 \mu \mathrm{~m}$
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.

## - S2C187: USER OUTPUT RELAY WHEN CONTROL POWER IS ON

This parameter specifies the state of the user output relays when the control power is turned ON. Since the power OFF state, including peripheral devices, cannot be completely reproduced, take note when restarting.

0 : Reset to the power OFF state
1: Initialized (all user relays OFF)

## ■ S4C000 to S4C007: PARITY OF USER INPUT GROUPS

These parameters specify whether to execute priority checks with parameters when instructions covering the input group (1G\#) are executed. The instructions covering the input groups are as shown below.

- IF Sentence (JUMP, CALL, RET, PAUSE)
- Pattern Jump, Pattern Job Call
- DIN
- WAIT


Parity bits are set as the highest level bits of each input group and are written in even parity. If an error is detected during parity check, an alarm occurs and the manipulator stops. Remains unchanged if no parity check is specified.

## ■ S4C008 to S4C015: PARITY OF USER OUTPUT GROUPS

These parameters specify whether the output group instruction is executed with parity check (even parity).


PARITY CHECK AT BIT-ON (1)


PARITY CHECK AT BIT-ON (1)


PARITY CHECK AT BIT-ON (1)

Parity bits are set as the highest level bits of each output group. For example, if OG\#01 is specified with parity and DOUT OG\# (1) 2 is executed, the result will be 00000010 if 2 is binary converted. Since there will be only one bit (odd) ON at this time, the parity bit (highest level bit) will be set to ON and 10000010 (130) will be output to OG\# (1).
As in the case of a variable such as DOUT OG\# (1) B003 parity bits are added to the contents of the variable data. However, if the contents of the variable exceed 127, as in the case of DOUT OG\# (1) 128 , an alarm will occur. Remains unchanged if no parity check is specified.

- S4C016 to S4C023: DATA OF USER INPUT GROUPS

These parameters specify whether to handle the input group data as binary data or as BCD data when an instruction for the input group (1G\#) is executed. The instructions covering the input groups are as shown below.

- IF Sentence (JUMP, CALL, RET, PAUSE)
- Pattern Jump, Pattern Job Call
- DIN
- WAIT


BCD DATA SPECIFICATION AT BIT-ON (1)

BCD DATA SPECIFICATION AT BIT-ON (1)



BCD DATA SPECIFICATION AT BIT-ON (1)

- S4C024 to S4C031: DATA OF USER OUTPUT GROUPS

These parameters specify whether the output group instruction is executed with binary data or $B C D$ data.


## Differences Between Binary Data and BCD Data

For the input group and output group, the result will depend on whether the binary or BCD formula is used.
$<$ Example $>$ When the input function is [10101010]


However, in the case of BCD data, because the upper bound value is 99, it is not possible to use any value which exceeds nine in the one or ten digit place.

■ S4C032 to S4C039: USER OUTPUT GROUP TO BE INITIALIZED AT SWITCHING MODE

Set the user output group with bit to be initialized at switching mode. Use these parameters when using user output signals as work instructions for peripheral devices.


INITIAL VALUE SPECIFICATION AT BIT-ON (1)


INITIAL VALUE SPECIFICATION AT BIT-ON (1)


INITIAL VALUE SPECIFICATION AT BIT-ON (1)

## - S4C126: USER OUTPUT NO. WHEN MANIPULATOR DROP ALLOWABLE RANGE ERROR OCCURS

This parameter specifies the user output number to output the manipulator drop allowable range error alarm occurrence externally. When this function is not used, set " 0 ."

### 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.

## - S2C164: +MOV or +SMOV INSTRUCTION SPEED INPUT

This parameter specifies whether the speed inputting for move instructions of the master robot in a coordinated job is permitted or not.
<Example> 0: Not Provided


## - S2C165: +MOV INSTRUCTION INTERPOLATION INPUT

This parameter specifies which interpolation is permitted for move instructions for the master robot in a coordinated job. More than one instruction can be specified.


## ■ S2C183: OPERATION METHOD AT FWD/BWD OPERATION OR TEST RUN BY INDEPENDENT CONTROL

This parameter specifies the operation method at FWD/BWD operation or test run by independent control.

0 : The job of the task that is currently displayed operates.
1: Jobs of all the tasks operate.
(1) When master task is currently displayed:

(3) When sub task 2 is currently displayed:


0: One of the task jobs that are currently displayed operates.

1: All task jobs operate.

## ■ S2C184: JOB AT CALLING MASTER OF SUBTASK 1, 2, 3, 4, 5, 6, 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

## ■ S2C194: STATION AXIS CURRENT VALUE DISPLAY FUNCTION

This parameter specifies whether the function to display the current value of the station axis in the following units is valid/invalid.

- Rotary axis : Angle (deg)
- Servo track : Distance (mm)

0: Invalid
1: Valid

## - S2C195 to S2C206: STATION AXIS DISPLAYED UNIT

This parameter specifies the station axis displayed unit (bit specification).
0: Display angle (deg)
1: Display in distance (mm)

## Setting Method

Set a numerical value (decimal) where the bit of the axis to be displayed in the units of distance becomes 1.

$<$ Example $>$ When 1st and 3rd axes of station 1 are displayed in the units of distance:


Therefore, set parameter S2C195 of station 1 to 5 .

## ■ S2C322: POSTURE CONTROL OF SYNCHRONIZED MANIPULATOR (When Twin Synchronous Function Used)

This parameter specifies the posture control method for synchronized manipulator performing compensation during playback by using the twin synchronous function.

0 : Change posture according to station movement
1: Fixed in relation to the ground


■ S2C323: POSTURE CONTROL OF MANIPULATOR IN MULTIJOB (When Twin Synchronous Function Used)

This parameter specifies the posture control method for manipulator executing compensation at the linking side when job linking is performed during FWD/BWD operation by the twin synchronous function.

0 : Change posture according to station movement
1: Fixed in relation to the ground

## ■ S2C549: OPERATION OF JOB WITHOUT CONTROL GROUP SPECIFICATION

When the servo power supply is individually turned OFF where jobs in multiple number of tasks are operated using the independent control function, the job execution of the control group whose servo power supply is turned OFF is interrupted. The jobs of other control groups continue their execution.
For the jobs without control group specification such as master job, the conditions for execution can be set by the parameter.

0: Execution possible only when servo power supply to all the axes have been turned ON.
1: Execution possible when servo power supply to any axis is turned ON.

## ■ S2C550: EXECUTION OF "BWD" OPERATION

This parameter prohibits step-back operation of a job without a step.


## ■ S3C809: MAXIMUM DEVIATION ANGLE OF CURRENT STATION POSITION (When Twin Synchronous Function Used)

Used when the twin synchronous function is used. This parameter specifies the maximum deviation between the teaching position and the current station position.

0 : No deviation check
Other than 0: Deviation angle (units : $0.1^{\circ}$ )


In the above figure on the left, the follower R2 executes the job of subtask 2 in synchronization with the motion of the station axis which is moved by the R1 job. In this procedure, the job of subtask 2 controls only the R2 robot axis.
If the teaching position of the station in the subtask 2 differs from the station current position (controlled by the subtask 1 job), the difference is automatically offset so that R2 keeps the taught position in relation to the station.

Difference between the taught and the station current positions is always monitored. If the difference exceeds a set value of the parameter, the message "PULSE LIMIT (TWIN COORDINATED)" appears.

### 8.7 Parameters for Other Functions or Applications

These parameters make the settings for other functions or applications.

## ■ S1CxG049 to S1CxG051: SMALL CIRCLE CUTTING

These parameters prescribe cutting operation at small circle cutting.
S1CxG049: Set the minimum diameter of a figure in the units of $\mu \mathrm{m}$ that can
(Minimum diameter) be processed by small-circle cutting machine.
S1CxG050 : Set the maximum diameter of a figure in the units of $\mu \mathrm{m}$ that can
(Maximum diameter) be processed by small-circle cutting machine.
S1CxG051 : Set the maximum cutting speed at operation by CUT instruction
(Maximum speed) in the units of $0.1 \mathrm{~mm} / \mathrm{s}$.

## - S1CxG052 to S1CxG053: SMALL CIRCLE CUTTING DIRECTION LIMIT VALUE

These parameters set the cutting direction limits at small circle cutting.
S1CxG052 : Set the limit value in the positive direction of cutting angle DIR
(+ direction)
S1CxG053
(- direction)
set by CUT instruction, in the units of $0.01^{\circ}$.
: Set the limit value in the negative direction of cutting angle DIR set by CUT instruction, in the units of $0.01^{\circ}$.

■ S1CxG054 to S1CxG055: SMALL CIRCLE CUTTING OVERLAP VALUE

These parameters set the overlapped value at small circle cutting.
S1CxG054 : Set the operation radius at inner rotation in the units of $1 \mu \mathrm{~m}$ after
(Operation radius) overlapping by CUT instruction.
S1CxG055 : Set the rotation angle at inner rotation in the units of $0.1^{\circ}$ after (Rotation angle) overlapping by CUT instruction.

## - S1CxG063, S1CxG064: PATTERN CUTTING DIMENSION

These parameters set the minimum diameter (S1CxG063) and the maximum diameter (S1CxG064) for the pattern cutting in units of $\mu \mathrm{m}$.

## ■ S1CxG065: MIRROR SHIFT SIGN INVERSION

This parameter sets which axis to be shifted (mirror-shift: invert the sign).


## ■ S2C332: RELATIVE JOB OPERATION METHOD

This parameter specifies how to operate a relative job. A method to convert a relative job into a standard job (pulse), and a conversion method to calculate the aimed position (pulse position) when a relative job is operated can be specified.

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

## ■ S3C819 to S3C898: ANALOG OUTPUT FILTER CONSTANT (When analog output corresponding to speed function is used)

By setting a constant to filter, a filter processing can be performed for the output analog signal.

## - S3C899: CUT WIDTH CORRECTION VALUE (When form cutting function is used)

This parameter specifies the path correction value for pattern cutting operation. A value $1 / 2$ of the cut width is set in units of $\mu \mathrm{m}$.

### 8.8 Hardware Control Parameters

These parameters make the hardware settings for fan alarm or relay operation, etc.

## - S2C508: ANTICIPATOR FUNCTION

This parameter specifies anticipation output.
0: Invalid
1: Valid

The anticipator function is a function to quicken or slow the ON/OFF timing of four user output signals and two user output groups. Using this function, signal output can be carried out before or after the step is reached. As a result, timing deviation due to delayed motion of peripheral devices and robot motion can be adjusted.

Setting the time to a negative value (-) advances the signal output.
This setting is effective when adjusting timing deviation due to delayed motion of peripheral devices.
Setting the time to a positive value (+) delays the signal output.
This setting is effective when adjusting timing deviation due to delayed robot motion.

## <Advanced Signal Output>

Signal output is carried out before the step is reached.

<Delayed Signal Output>
Signal output is carried out after the step is reached.

| $\frac{\text { Step }}{:}$ |  |
| :--- | :--- |
| Instructions  <br> $n-1$  <br> $n$ MOVL <br>  MOVL NWAIT <br> $n+1$ ANTOUT AT\#(2) ON <br> MOVL  |  |



## - S2C646 to S2C648: COOLING FAN ALARM DETECTION

This parameter specifies a detection for cooling fan 1 to 3 with alarm sensor, connected to power ON unit.

0 : No detection
1: Detected with message display
2: Detected with message and alarm display

## - S4C181 to S4C212: SETTING OF OPERATING RELAY NO.

Up to 32 output signals can be turned ON/OFF with the programming pendant. The 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.


## ■ S4C213 to S4C244: OPERATING METHOD OF RELAYS

These parameters specify the operating method of output signals by the programming pendant. The operating method can be specified for each output signal.

| Parameter Setting Value | Operation of Output Signal |
| :---: | :---: |
| 0 | $+{ }^{+} \mathrm{ON}-O \mathrm{O}-\mathrm{ON}$ $-\mathrm{OFF}-\overline{\mathrm{O}}$ - OFF |
| 1 | + ON ON/OFF with the key <br> ON while the key  <br> is pressed  <br> OFF if the key is $-O$ O- ON <br> not pressed  |

■ S2C649 to S2C651: COOLING FAN ALARM 1 OPERATION
■ S2C652 to S2C654: COOLING FAN ALARM 2 OPERATION

## - S2C655 to S2C657: COOLING FAN ALARM 3 OPERATION

These parameters specify the operation of cooling fan 1 to 3 with alarm sensor, connected to power ON unit.
Each bit specifies the power ON unit to which the detecting sensor is connected.


- S2C658 to S2C660: FAN ALARM 1 POWER SOURCE STATUS

■ S2C661 to S2C663: FAN ALARM 2 POWER SOURCE STATUS
■ S2C664 to S2C666: FAN ALARM 3 POWER SOURCE STATUS

### 8.9 TRANSMISSION PARAMETERS

■ RSOOO: COMMUNICATION PROTOCOL
The protocol of the serial port of the NCP01 circuit board is specified.
0: No protocol
2: Basic protocol
3: FC1 protocol

### 8.9.1 Basic Protocol

Specify when using Yaskawa data transmission functions.

- RS030: NUMBER OF DATA BITS

This parameter specifies the number of data bits.
■ RS031: NUMBER OF STOP BITS
This parameter specifies the number of stop bits.
■ RS032: PARITY
This parameter specifies the parity bits.
■ RS033: TRANSMISSION SPEED
This parameter specifies the transmission speed in units of bauds.

- RS034: RESPONSE WAITING TIMER (TIMER A)

Units: 0.1 seconds
This timer monitors the sequence. It specifies the response waiting time for invalid or missing responses.

■ RS035: TEXT TERMINATION MONITORING TIMER (TIMER B)
This timer monitors text reception. Specify the monitoring time to wait for text termination character.

## ■ RS036: NUMBER OF ENQ RE-TRANSMISSION RETRIES

This parameter specifies the number of re-transmission attempts of the control characters for invalid or missing responses.

## ■ RS037: NUMBER OF DATA RE-TRANSMISSION RETRIES

This parameter specifies the number of re-transmission attempts of text for block check error (NAK reception).

## ■ RS038: BLOCK CHECK METHOD

This parameter specifies the checking method for text transmission errors. Set "0" for this protocol.

### 8.9.2 FC1 Protocol

The following protocols naturally correspond to the external memory unit, YASNAC FC1 or FC2.

- RS050: NUMBER OF DATA BITS

This parameter specifies the number of data bits.

## ■ RS051: NUMBER OF STOP BITS

This parameter specifies the number of stop bits.

- RS052: PARITY

This parameter specifies the parity bits.

## ■ RS053: TRANSMISSION SPEED

This parameter specifies the transmission speed in units of bauds.
■ RS054: RESPONSE WAITING TIMER (TIMER A)
Units: 0.1 seconds
This timer monitors the sequence. It specifies the response waiting time for invalid or missing responses.

■ RS055: TEXT TERMINATION MONITORING TIMER (TIMER B)
This timer monitors text reception. Specify the monitoring time to wait for text termination character.

## ■ RS056: NUMBER OF ENQ RE-TRANSMISSION RETRIES

This parameter specifies the number of re-transmission attempts of the control characters for invalid or missing responses.

## - RS057: NUMBER OF DATA RE-TRANSMISSION RETRIES

This parameter specifies the number of re-transmission attempts of text for block check error (NAK reception).

## - RS058: FC2 FORMAT SPECIFICATION

Specify the format type of the floppy disk used with external memory (YASNAC FC2).

## NOTE 720 kilobytes are unconditionally specified for YASNAC FC2 (2DD floppy disk exclusive use).

■ RS059: EXTERNAL MEMORY FILE OVERWRITE SPECIFICATION

Specify whether to accept the file overwrite of the external memory (YASNAC FC2 or FC1).

### 8.10 Application Parameters

### 8.10.1 Arc Welding

## - AxP000: APPLICATION

This parameter specifies the application. Set " 0 " for arc welding.

## ■ AxP003: WELDING ASSIGNMENT OF WELDING START CONDITION FILE

This parameter specifies the beginning condition number in the welding start condition file to be assigned to Power Source 2. Condition files of a lower number are automatically assigned to Power Source 1. For a system with one Power Source, set "49" (maximum value).


## - AxP004: WELDING ASSIGNMENT OF WELDING END CONDITION FILES

This parameter specifies the beginning condition number in the welding END condition file to be assigned to Power Source 2. Condition files of a lower number are automatically assigned to Power Source 1. For a system with one Power Source, set "13" (maximum value).


## ■ AxP005: WELDING SPEED PRIORITY

This parameter specifies whether the welding speed is specified by the "ARCON" instruction, by the welding start condition file, or by the additional times of the "MOV" instruction.

## ■ AxP009: WORK CONTINUING

This parameter specifies whether to output an "ARCON" instruction to restart after the manipulator stopped while the "ARCON" instruction is being output.

## ■ AxP010: WELDING INSTRUCTION OUTPUT

This parameter specifies the beginning number ( 0 to 12 ) of the analog output channel to the Power Source. "0" indicates that no Power Source exists.

## ■ AxP011, AxP012: MANUAL WIRE OPERATION SPEED

These parameters specify the manual wire operation speed as a percentage of the maximum instruction value. Instruction polarity is determined by the current instruction in the Power Source characteristic file. The setting range is from 0 to 100.

## ■ AxP013, AxP014: WELDING CONTROL TIME

These parameters specify the welding control time in units of minutes. The setting range is from 0 to 999.

## ■ AxP015 to AxP017: NUMBER OF WELDING CONTROL

These parameters specify the number of welding controls. The setting range is from 0 to 99 .

## ■ AxP026 to AxP029: TOOL ON/OFF USER OUTPUT NO. (Jigless system)

These parameters specify the user output number for the tool open/close operation by specific keys.

### 8.10.2 Handling Application

## - AxP002, AxP004: f1 KEY FUNCTION

These parameters set the output signal to assign for f1 key.
0 : Not specified
1 to 4: Specific outputs for HAND-1 to HAND4-1
5: User output (No. is specified by AxP004).

## - AxP003, AxP005: f2 KEY FUNCTION

These parameters set the output signal to assign for f 2 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

## - AxP003: MAXIMUM NUMBERS OF CONNECTED POWER SOURCES

The initial value is set to 4 . The value is automatically set at start-up. No modification is needed.

## ■ AxP004: GUN FULL OPEN STROKE ON/OFF SIGNAL

This parameter specifies which stroke switching signal is output ON or OFF to make the gun fully-opened for each gun.
Bit specification (1 for 01 ) for 8 guns. The initial setting is " 0 ."

```
00000000
| | | | | | | |
87654321 Gun number
```


## ■ AxP005: STROKE CHANGE ANSWER TIME LIMIT

When using the X2 gear mechanical stopper gun and switching gun stroke, this parameter sets the time from the stroke-switching-sequence start until the pressure instruction end. Setting range: 0.0 to 9.9 sec .
The initial setting is " 0 ," with which the switching signal is output for the "stopper-type stroke switching time" set in the file, and then the gun pressure instruction is turned OFF.

## - AxP006: PARITY SPECIFICATION FOR WELDING CONDITIONS

When adding the parity signal to the welding condition signal with the Power Source connected to each welding gun, this parameter specifies odd or even parity.
Bit specification for 4 Power Sources. ( 0 : odd number, 1 : even number) The initial setting is "0."

```
00000000
    | | | |
    4321 Power Source number
```


## ■ AxP007: ANTICIPATE TIME

When executing the GUNCL or SPOT instruction with NWAIT specified in the previous move instruction but the time is not specified by ATT in the GUNCL or SPOT instruction, this parameter specifies the anticipate condition (time). The initial setting is " 0 ," with which the each instruction is executed as soon as the taught position of the previous move instruction is reached, as normal operation.

## ■ AxP015: WELDING ERROR RESET OUTPUT TIME

This parameter sets the output time of the welding error reset signal to the Power Source when the alarm reset signal is input.
If the setting is " 0 ," the welding error reset signal is not output to the Power Source even if the alarm reset signal is input.

## ■ AxP016, AxP017: ELECTRODE WEAR AMOUNT ALARM VALUE

These parameters set the electrode wear amount alarm values (AxP016: movable side, AxP017: fixed side) at the wear detection.

### 8.10.4 General-purpose Application

## ■ AxP009: WORK CONTINUE PROHIBIT

This parameter specifies whether to output TOOLON instruction or not at restarting when the work is stopped for some reasons during the output of TOOLON instruction.

## 9 General Purpose Application

### 9.1 Simplified Teaching and Playback

### 9.1.1 Teaching

- Preparation for Teaching

Perform the following tasks before starting to teach.

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

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

2. Press [SERVO ON READY].

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

SERVO
READY the Enable switch.
3. Select $\{\mathrm{JOB}\}$ under the main menu, and select $\{$ CREATE NEW JOB $\}$ in the sub menu.

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

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

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


## 7. Press [ENTER] to register.



## ENTER

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



Characters which can be Used for Job Names

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

## - Teaching Procedure

To playback the manipulator, the instruction to move the manipulator must be written in a job. This instruction is called a move instruction. The destination position, the interpolation method, the play speed, etc. are registered in the move instruction.
Main move instructions begin with "MOV" in the INFORM III language used by the NX100.

## <Example>

MOVJ VJ=50.00
MOVL V=1122 PL=1

## <Example>

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


## Teaching a Job

A job is a work program that describes the tasks that the manipulator will execute. Jobs are created using a robot programming language called INFORM III.
The following example will instruct you how to teach the manipulator all of the steps from Point A to Point B of the following workpiece. This job can be completed in 6 steps.

## Safety Check

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


Actual work is not performed here.

## Step 1 -- Standby Position

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


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

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

3. Select joint interpolation by pressing [MOTION TYPE]. Joint instruction "MOVJ..." will be displayed in the input buffer line.
4. Move the cursor to the line number 0000 and press [SELECT].

| 0000 | NOP |
| :--- | :--- |
| 0001 | END |

5. The input buffer line appears. Move the cursor to the right to VJ=*.**, which shows the speed. While pressing [SHIFT] simultaneously, move the cursor $\square$ up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed to $50 \%$.

$\Rightarrow>$ MOVJ VJ $=50.00$
6. Press [ENTER]. Step 1 (Line 0001) is registered.

| 0000 | NOP |
| :--- | :--- |
| 0001 | MOVJ VJ =50.00 |
| 0002 | END |

## Step 2 -- Near the Work Start Position

Define the manipulator work pose.


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

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

| 0000 | NOP |
| :--- | :--- |
| 0001 | MOVJ VJ $=50.00$ |
| 0002 | MOVJ VJ $=50.00$ |
| 0003 | END |

## Step 3 -- Work Start Position

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


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

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

3. With the cursor located on the line number 0002, press [SELECT].
4. The input buffer line appears. Move the cursor to the right to VJ=*.**, which shows the speed. While pressing [SHIFT] simultaneously, move the cursor up and down (to higher and lower play speeds) until the desired speed is specified.

```
0 0 0 0 ~ N O P
0001 MOVJ VJ=50.00
0 0 0 2 ~ M O V J ~ V J = 5 0 . 0 0 ~
0003 MOVJ VJ=12.50
0004 END
```


## Step 4 -- Work End Position

Specify the work end position.


1. Move the manipulator to the work end position with the axis operation keys. While the manipulator is moving, keep a wide enough distance to ensure it will not strike the workpiece.
 There is no need to follow the work line too closely.
2. Press [MOTION TYPE] to select linear interpolation (MOVL).

$$
\Rightarrow \text { MOVL V }=66
$$

## MOTION TYPE

3. With the cursor located on the line number 0003, press [SELECT].
$>$ MOVLV=66
4. The input buffer line appears. Move the cursor to the right to V=*.**, which shows the speed. While pressing [SHIFT] simultaneously, move the cursor up and down (to higher and lower play speeds) until the desired speed is specified.
Set the speed to $138 \mathrm{~cm} / \mathrm{min}$.


## $\Rightarrow$ MOVL V=138

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

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

## Step 5 -- Clear Position

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


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

| JОB | EDIT | DISPLAY | UTILITY |  |
| :---: | :---: | :---: | :---: | :---: |

## FAST

MANUAL SPEED

NOTE This button only affects teaching speed. When the job is played, the job will execute at the speed defined in Step 4.
2. Move the manipulator with the axis operation keys to a position where it will not strike the fixture.
3. Press [MOTION TYPE] to set to the joint interpolation type
(MOVJ).

## MOTION

TYPE

$$
\Rightarrow \text { MOVJ V }=12.50
$$

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


## MOVJ VJ=12.50

5. The input buffer line appears. Move the cursor to the right to $\mathrm{VJ}=12.50$, which shows the speed. While pressing [SHIFT] simultaneously, move the cursor up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed to $50 \%$.


## $\Rightarrow$ MOVJ VJ=50.00

6. Press [ENTER]. Step5 (Line 0005) is registered.
```
0 0 0 0 ~ N O P
0 0 0 1 ~ M O V J ~ V J = 5 0 . 0 0 ~
0 0 0 2 ~ M O V J ~ V J = 5 0 . 0 0
0 0 0 3 ~ M O V J ~ V J = 1 2 . 5 0
0 0 0 4 ~ M O V L ~ V = 1 3 8 ~
0 0 0 5 ~ M O V J ~ V J = 5 0 . 0 0 ~
0006 END
```


## Step 6 -- Near the Standby Position

Move the manipulator near the standby position.


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

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

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

9.1 Simplified Teaching and Playback

## Ensuring the First and Last Step are Identical

The manipulator has stopped at Step 6, which should be very close to Step1.
It is possible to move directly from the welding end position of Step 5 to Step1, so the manipulator can begin the next welding job quickly and efficiently.
The following operation will make Step 6 (end position) and Step1 (standby position) identical.


1. Move the cursor to Step1 (Line 0001).
```
0 0 0 0 ~ N O P
0001 MOVJ VJ=50.00
0 0 0 2 ~ M O V J ~ V J = 5 0 . 0 0 ~
0 0 0 3 ~ M O V J ~ V J = 1 2 . 5 0
0 0 0 4 ~ M O V L ~ V = 1 3 8 ~
0 0 0 5 ~ M O V J ~ V J = 5 0 . 0 0
0 0 0 6 ~ M O V J ~ V J = 5 0 . 0 0 ~
0 0 0 7 \text { END}
```

2. Press [FWD]. The manipulator will move to Step1.
3. Move the cursor to Step 6 (Line 0006).
```
0 0 0 0 ~ N O P
0 0 0 1 ~ M O V J ~ V J = 5 0 . 0 0 ~
0 0 0 2 ~ M O V J ~ V J = 5 0 . 0 0 ~
0 0 0 3 ~ M O V J ~ V J = 1 2 . 5 0 ~
0 0 0 4 ~ M O V L ~ V = 1 3 8 ~
0005 MOVJ VJ=50.00
0 0 0 6 \text { MOVJ VJ=50.00}
0007 END
```

4. Press [MODIFY].

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

## - Path Confirmation

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

1. Move the cursor to Step 1 (Line 0001).
```
0000 NOP
0001 MOVJ VJ=50.00
0 0 0 2 ~ M O V J ~ V J = 5 0 . 0 0 ~
0003 MOVJ VJ=12.50
0 0 0 4 ~ M O V L ~ V = 1 3 8 ~
0 0 0 5 ~ M O V J ~ V J = 5 0 . 0 0 ~
0 0 0 6 ~ M O V J ~ V J = 5 0 . 0 0 ~
0007 END
```

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

| JOB | EDIT | DISPLAY | UTLITY |  |
| :---: | :---: | :---: | :---: | :---: |

FAST

SLow
3. Press [FWD] to confirm each step executed by the manipulator. Each time [FWD] is pressed, the manipulator moves one
 step.
4. When you finish step confirmation, move the cursor to the beginning of the job.

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


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

- Correcting a Job


## CAUTION

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


## Before Correcting a Job

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

1. Select $\{J O B\}$ under the main menu and $\{J O B\}$ under the sub menu to display the JOB CONTENT window.

MAIN MENU

| JOB | EDIT | DISPLAY | UTILITY | 18 |
| :---: | :---: | :---: | :---: | :---: |
|  | 通 |  |  |  |
| $\stackrel{\text { ARC WELDING }}{ }$ |  |  |  |  |
| VARIABLE B001 | $\square$ CREATE new job |  |  |  |
| $\begin{aligned} & \text { In/out } \\ & { }_{\text {In }} \end{aligned}$ | 㘧 | STER JOB |  |  |
| ROBOT <br> $\Rightarrow$ | EA Job Capacity |  |  |  |
| SYSTEM INFO ~ $\odot$ |  |  |  |  |
| Main Menu | Short Cut |  | (i) Turn on servo power |  |



- Changing the Position Data

Change the position registered in Step 2.


1. Move the manipulator to Step 2 (Line 0002) by pressing [FWD].
```
FWD
```

2. Move the manipulator to the modified position with the axis operation keys.

3. Press [MODIFY].

MODIFY
4. Press [ENTER]. The step's position data is changed.

## Adding a Step

Add a new step between Step 5 and Step 6.


1. Move the manipulator to Step 5 (Line 0005) by pressing [FWD].
```
0000 NOP
0 0 0 1 ~ M O V J ~ V J = 5 0 . 0 0 ~
0 0 0 2 ~ M O V J ~ V J = 5 0 . 0 0 ~
0 0 0 3 ~ M O V J ~ V J = 1 2 . 5 0 ~
0 0 0 4 ~ M O V L ~ V = 1 3 8 ~
0005 MOVJ VJ=50.00
0006 MOVJ VJ=50.00
0007 END
```

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

3. Press [INSERT].

4. Press [ENTER]. The step is added. When a step is added, the numbering is automatically adjusted to count the new step.
```
0 0 0 0 ~ N O P
0001 MOVJ VJ=50.00
0 0 0 2 ~ M O V J ~ V J = 5 0 . 0 0 ~
0 0 0 3 ~ M O V J ~ V J = 1 2 . 5 0
0 0 0 4 ~ M O V L ~ V = 1 3 8 ~
0005 MOVJ VJ=50.00
0006 MOVJ VJ=50.00
0007 MOVJ VJ=50.00
0008 END
```


## Deleting a Step

Delete the step you just added.


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

0000 NOP
0001 MOVJ VJ=50.00
0002 MOVJ VJ=50.00
0003 MOVJ VJ=12.50
0004 MOVL V=138
0005 MOVJ VJ=50.00
0006 MOVJ VJ=50.00
0007 MOVJ VJ=50.00
0008 END
2. Make sure the cursor is on the step you wish to delete, and press [DELETE].

3. Press [ENTER]. The step is deleted. When a step is deleted, the numbering of step is automatically adjusted corresponding to the deletion.

```
0000 NOP
0 0 0 1 ~ M O V J ~ V J = 5 0 . 0 0 ~
0 0 0 2 ~ M O V J ~ V J = 5 0 . 0 0 ~
0003 MOVJ VJ=12.50
0 0 0 4 ~ M O V L ~ V = 1 3 8 ~
0 0 0 5 ~ M O V J ~ V J = 5 0 . 0 0 ~
0006 MOVJ VJ=50.00
0007 END
```

When "Error 2070: Set Robot Exactly to Taught Position" Occurs
When the operator presses [ENTER] during the previous operation, an error can occur in some cases. The error occurs because the manipulator has not been moved exactly to the taught position. Cancel the error with either of the following two procedures:

- Press [CANCEL] and press [FWD] to move the manipulator to the position of the step.
- Press [MODIFY] and press [ENTER] to change the position data of the step, then press [DELETE] and press [ENTER].
If the cursor in the window is blinking, the manipulator is not in the taught position.


## Changing the Speed between Steps

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

1. Move the cursor to Step 4.
```
0 0 0 0 ~ N O P
0 0 0 1 ~ M O V J ~ V J = 5 0 . 0 0 ~
0 0 0 2 ~ M O V J ~ V J = 5 0 . 0 0 ~
0 0 0 3 ~ M O V J ~ V J = 1 2 . 5 0 ~
0004 MOVL V=138
0005 MOVJ VJ=50.00
0 0 0 6 ~ M O V J ~ V J = 5 0 . 0 0 ~
0007 END
```

2. Move the cursor to the instruction and press [SELECT].
```
0 0 0 0 ~ N O P
0001 MOVJ VJ=50.00
0 0 0 2 ~ M O V J ~ V J = 5 0 . 0 0 ~
0 0 0 3 ~ M O V J ~ V J = 1 2 . 5 0
0 0 0 4 ~ M O V L ~ V = 1 3 8 ~
0005 MOVJ VJ=50.00
0 0 0 6 ~ M O V J ~ V J = 5 0 . 0 0 ~
0007 END
```


3. The input buffer line appears. Move the cursor to the right to " $V=138$," which shows the speed. While pressing [SHIFT] simultaneously, move the cursor up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed to $66 \mathrm{~cm} / \mathrm{min}$.


```
0 0 0 0 ~ N O P
0001 MOVJ VJ=50.00
0 0 0 2 ~ M O V J ~ V J = 5 0 . 0 0
0 0 0 3 ~ M O V J ~ V J = 1 2 . 5 0
0 0 0 4 ~ M O V L ~ V = 6 6 ~
0 0 0 5 ~ M O V J ~ V J = 5 0 . 0 0 ~
0 0 0 6 ~ M O V J ~ V J = 5 0 . 0 0
0007 END
```

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

| 0000 | NOP |
| :--- | :--- |
| 0001 | MOVJ VJ $=50.00$ |
| 0002 | MOVJ VJ $=50.00$ |
| 0003 | MOVJ VJ $=12.50$ |
| 0004 | MOVL V=66 |
| 0005 | MOVJ VJ $=50.00$ |
| 0006 | MOVJ VJ $=50.00$ |
| 0007 | END |

0001 MOVJ VJ=50.00
0002 MOVJ VJ=50.00
VJ=12.50
0004 MOVL V=66
0006 MOVJ VJ=50.00
0007 END

The unit for speed can be verified and modified by "SPEED DATA INPUT FORM" from \{SETUP\} $\rightarrow$ \{OPERATE COND\}.

### 9.1.2 Playback

## - Preparation Before Playback

```
To run the program from the beginning of the job, perform the following operation.
- Move the cursor to the beginning of the job.
- Move the manipulator close to Step 1 with the axis operation keys.
When playback is started, the manipulator begins to move from the Step 1.
```

- Playback Procedure

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

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

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

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


### 9.1.3 Example for General Purpose Application

## - Example Job

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


| Line | Instruction | Explanation |  |
| :--- | :--- | :--- | :--- |
| 0000 | NOP |  |  |
| 0001 | MOVJ VJ=25.00 | Moves manipulator to the standby position. | (Step 1) |
| 0002 | MOVJ VJ=25.00 | Moves manipulator near the cutting start position. | (Step 2) |
| 0003 | MOVJ VJ=12.50 | Moves manipulator to the cutting start position. | (Step 3) |
| 0004 | TOOLON | Starts cutting. |  |
| 0005 | MOVL V=50.0 | Moves manipulator to the cutting end position. | (Step 4) |
| 0006 | TOOLOF | Ends cutting. |  |
| 0007 | MOVJ VJ=25.00 | Moves manipulator to the position where the tools and (Step 5) |  |
| 0008 | MOVJ VJ=25.00 | Moves manipulator to the standby position. | (Step 6) |
| 0009 | END |  |  |

## - Teaching Procedure

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

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

## Step 2 -- Near cutting position

Define the cutting pose.

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

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

| 0000 | NOP |
| :--- | :--- |
| 0001 | MOVJ VJ $=25.00$ |
| 0002 | MOVJ VJ $=25.00$ |
| 0003 | END |

ENTER
0001 MOVJ VJ=25.00
0002 MOVJ VJ=25.00
0003 END

## Step 3 -- Cutting Start Position

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

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

Medium speed: 四 is displayed in the status area.

| Joı | EDIt | DISPLAY | UTLITY | 18 [1] [190) |
| :---: | :---: | :---: | :---: | :---: |

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

3. With the cursor located on the line number, press [SELECT].
4. The input buffer line appears. Move the cursor to the right to " $\mathrm{VJ}=25.00$," which shows the speed. While pressing [SHIFT] simultaneously, move the cursor up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed to $12.50 \%$.

```
=>> MOVJ VJ=12.50
```

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

| 0000 | NOP |
| :--- | :--- |
| 0001 | MOVJ VJ $=25.00$ |
| 0002 | MOVJ VJ $=25.00$ |
| 0003 | MOVJ VJ $=12.50$ |
| 0004 | END |

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

## TOOLON

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

## Step 4 -- Cutting End Position

Define the cutting end position.

1. Move the manipulator to the cutting end position with the axis operation keys. It is necessary to choose a direction in which the treatment device and the tools do not interfere when the manipulator moves, and teach that position.
2. Set linear interpolation (MOVL) by pressing [MOTION TYPE].
3. With the cursor located on the line number, press [SELECT].
```
=>MOVLV=11.0
```

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

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

| 0000 | NOP |
| :--- | :--- |
| 0001 | MOVJ VJ $=25.00$ |
| 0002 | MOVJ VJ $=25.00$ |
| 0003 | MOVJ VJ $=12.50$ |
| 0004 | TOOLON |
| 0005 | MOVL V $=50.0$ |
| 0006 | END |

6. Press [./TOOL OF]. "TOOLOF" is displayed in the input buffer line.
$\Rightarrow$ TOOLOF
7. Press [ENTER]. The TOOLOF instruction is registered.
9.1 Simplified Teaching and Playback

## - Cutting Test

## Speed Limitation Drive

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

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

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

| SPECIAL PLAY |  |  |  |  |
| :--- | :--- | :---: | :---: | :---: |
| SLOW SPEED START |  |  |  | INVALID |
| SPEED LIMIT | INVALID |  |  |  |
| DRY-RUN SPEED | INVALID |  |  |  |
| MACHINE LOCK | INVALID |  |  |  |
| CHECK-RUN | INVALID |  |  |  |
| WEAV PROHIBIT IN CHK-RUN | INVALID |  |  |  |

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


| SPECIAL PLAY |  |  |  |  |
| :--- | :--- | :---: | :---: | :---: |
| SLOW SPEED START | INVALID |  |  |  |
| SPEED LIMIT | VALID |  |  |  |
| DRY-RUN SPEED | INVALID |  |  |  |
| MACHINE LOCK | INVALID |  |  |  |
| CHECK-RUN | INVALID |  |  |  |
| WEAV PROHIBIT IN CHK-RUN | INVALID |  |  |  |

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

## Cutting Execution

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

### 9.2 Operation for Tool Control

### 9.2.1 Function Keys

The function keys for tool control are assigned to the Numeric keys as described below.


Registers the TOOLON instruction.
If [INTERLOCK] is pressed simultaneously, the TOOLON operation is executed.

Registers the TOOLOF instruction.
If [INTERLOCK] is pressed simultaneously, the TOOLOFF operation is executed.
TOOLOF

Registers the CALL instruction for the reserved job TOOLONxx.
$\qquad$
Registers the CALL instruction for the reserved job TOOLOFxx.

TOOLOF
10B

### 9.2.2 Tool Control Settings

The following setting can be performed on the GENERAL DIAGNOSIS window.

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select \{GENERAL\} under the main menu. |  |
| 2 | Select \{GENERAL DIAGNOSIS\}. | The GENERAL DIAGNOSIS window appears. <br> Select "CONT" to continue the work operation when the manipulator is restarted after it abort for any reason during the work operation. <br> Select "STOP" to abort the work operation if the manipulator stops. When the manipulator is restarted, it moves without doing any work. Use the work start command to restart the work instruction. |
| 3 | Select the setting data of "WORKING ABORT PROCESS." | Each time [SELECT] is pressed, "CONT" and "STOP" is alternately displayed. The displaying state is the current setting. |

### 9.2.3 Work Instructions

## ■ TOOLON/TOOLOF Instructions

These instructions are to perform TOOLON/TOOLOFF. The function keys are [TOOLON] and [TOOLOF].

|  |  | $\begin{aligned} & \text { TOOLON } \\ & \hline \begin{array}{l} 2 \\ \text { TOOLON } \end{array} \end{aligned}$ | TOOLOF |
| :---: | :---: | :---: | :---: |
|  | Operation | Explanation |  |
| 1 | Select $\{\mathrm{JOB}\}$ under the main menu. |  |  |
| 2 | Select \{JOB\}. |  |  |
| 3 | Press [TOOLON] or [TOOLOF]. | The TOOLON or TOOLOF instruction is displayed in the input buffer line. Or press [INFORM LIST] to display the instruction box and select the TOOLON/TOOLOF instrcution. <br> $\Rightarrow$ TOOLON <br> TOOLON <br> Turns ON the work instruction. <br> Turns ON the work start command (system output relay \#50770) and waits for the work start response (system input relay \#40570). The next instruction is executed when the work response turns ON. The work start response relay turns ON immediately after the work start command is output. <br> TOOLOF <br> Turns OFF the work instruction. <br> Turns ON the work end command (system output relay \#50771) and waits for the work end response (system input relay \#40571). The next instruction is executed when the work end response turns ON. <br> The work end response relay turns ON immediately after the work end command is output. The work instruction is programmed to hold after the work start command turns ON and to turn OFF when the work end command turns ON. <br> When the manipulator stops during the work operation, the work instruction turns OFF. <br> When restarting, turn ON the work instruction when "WORKING ABORT PROCESS" is set to "CONT." Do not turn OFF the work instruction when "STOP" is set. |  |
| 4 | Press [INSERT]. |  |  |
| 5 | Press [ENTER]. |  |  |

- CALL Instruction

This instruction calls a reserved job TOOLONxx or TOOLOFxx. The function keys for registration are [TOOLON JOB] and [TOOLOF JOB].


|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select $\{\mathrm{JOB}\}$ <br> mender the main |  |
| 2 | Select \{JOB\}. | The CALL instruction is displayed in the input buffer line. <br> $\rightarrow$ CALLI JoB:TOOLON |
| 3 | Press [TOOLON JOB] or <br> [TOOLOF JOB]. | The JOB LIST window appears. |
| 4 | Select the job name. | The window for character input appears. <br> The job name can now be changed. Modify the job name and <br> press [ENTER]. |
| 5 | Press [SELECT]. |  |
| 6 | Press [INSERT]. |  |
| 7 | Press [ENTER]. |  |

## - WVON Instruction

This instruction starts the weaving motion. Specify conditions in the weaving condition file when registering the WVON instruction.

|  | Operation | Explanation |
| :---: | :---: | :---: |
| 1 | Select $\{\mathrm{JOB}\}$ under the main menu. |  |
| 2 | Select \{JOB\}. |  |
| 3 | Press [INFORM LIST]. |  |
| 4 | Select the WVON instruction. | The WVON instruction is displayed in the input buffer line. $\qquad$ <br> WVON WEV\#(1) <br> To register the instruction displayed in the input buffer line without editing, press [INSERT] and then press [ENTER]. |
| 5 | Select the file number and edit. | The input line is displayed. <br> Weaving_file_no.= <br> $\Rightarrow$ WVON WEV\#(П) ON <br> Input weaving file number using the Numeric keys and press [ENTER]. (In the following example, 2 is entered.) $\square$ <br> $\Rightarrow$ WVON WEV\#(2) |
| 6 | Press [INSERT]. |  |
| 7 | Press [ENTER]. |  |

- WVOF Instruction

This instruction ends the weaving motion.

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select $\{J O B\}$ <br> menu. |  |
| 2 | Select $\{J O B\}$. |  |
| 3 | Press [INFORM LIST]. |  |
| 4 | Select the WVOF instruction. | The WVOF instruction is displayed in the input buffer line. <br> $\Rightarrow$ WVOF |
| 5 | Press [INSERT]. |  |
| 6 | Press [ENTER]. |  |

### 9.3 Using Files

### 9.3.1 Weaving Basic Coordinate System

Weaving is performed based on the following coordinate system. This coordinate system is automatically generated according to the conditions described in a weaving condition file.


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

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


Depending on the mounting and shape of the workpiece, a definition of the above coordinate system may not be sufficient to generate a weaving pattern. In that case, register the reference point REFP1 or REFP2. For details, refer to "Cases that Require the Registration of Reference Points" in "9.3.3 Operation Method."

### 9.3.2 WEAVING CONDITION Window



WEAVING CONDITION Window
(1)WEAVING COND NO. (1 to 16)

Displays a weaving condition file number.

## (2)MODE (Weave type)

There are three weave type: single oscillation, triangle oscillation, and L-type oscillation.
Each type can be specified with or without smoothing.

0 : Single oscillation

1 : Triangle oscillation
Weave Type
2 : L-type oscillation


Smoothing

## (3)SPEED

Specifies how the oscillation speed is defined.
0 : Defined by the frequency.
1: Defined by the weaving time for each weaving section.

## (4)FREQUENCY

Specifies the weaving frequency if "SPEED (3)" is set to " 0 : FREQ." Note that the maximum frequency is determined by the amplitude as illustrated in the graph below. Specify a frequency within the allowable range. Note that the graph only indicates tentative values.


Maximum Frequencies for Different Amplitudes

## © 5 PATTERN

If "MODE (2" is set to " 0 : SINGL ," the angle must be specified.


If "MODE (2)" is set to " 1 : TRI" or " 2 : L", the following information on the triangle must be specified: vertical distance, horizontal distance, and angle.


## ©ANGLE

The oscillation angle as measured from the weld line. Range: from -90 (deg.) to $+90(\mathrm{deg})$



View A

## © TIMER (Timer mode)

As shown below, a single weaving period is divided into three or four sections. A timer count can be specified for pauses at a point (node) between sections. (The circled number indicates section number.)


Set one of the following timer modes:

0 : Weaving stops but manipulator moves.
1 : Manipulator pauses.

(8)TIMER (Timer count)

If "Speed (3") is set to " 1 : MOVING TIME," a timer count specified here determines the duration of a pause (weaving stop or manipulator pause) at a node between two sections of $\mathbb{( 7 )}$.

### 9.3.3 Operation Method

- Displaying a Weaving File

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select \{ARC WELDING\} under <br> the main menu. |  |
| 2 | Select \{WEAVING\}. |  |
| 3 | Display the desired file <br> number. | The weaving condition file can be displayed using the page key <br> The |
|  |  | Press the page key <br> Press [SHIFT]+ page key |

- Editing Condition Data

|  | Operation | Explanation |
| :--- | :--- | :--- |
| 1 | Select the item to be edited. |  |
| 2 | Input the value using the <br> Numeric keys. |  |

## - Cases that Require the Registration of Reference Points

The registration of the reference point REFP1 or REFP2 is not usually required. They are required only with a special workpiece condition, etc.
The REFP1, which defines the wall direction, is a point on the wall surface or its expansion plane. The REFP2, which defines the horizontal direction, is a point at the right or left side of the wall.


SUPPLEMENT

For information on registering REFP, refer to "■ Registering Reference Point Instructions" of "3.2.3 Teaching Steps."
<Example $1>$ REFP1 is registered because the wall direction is not parallel to the Z-axis of the robot coordinate.

$<$ Example $2>$ REFP2 is registered because the approach point is at another side of the wall.


## - Prohibiting Weaving

If the weaving instruction is registered during the check mode of the play mode or "TEST RUN" or FWD operation in the teach mode, weaving is executed as well as other move instructions. However, in some cases when weaving is not wanted because of a workpiece collides, etc., follow the procedure below to prohibit weaving.

- Method to Prohibit Weaving in the Check Mode

- Method to Prohibit Weaving During a "TEST RUN" or FWD Operation



## ■ Prohibiting Weaving By Means of a System Input Signal

The system input signal 40047 is used.
The system input signal can prohibit weaving at any time during a play operation, regardless of whether or not it is in a check mode.

### 9.4 Table of Work Instructions

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

General-purpose Instructions

| TOOLON | Function | Turns ON work tools (work instructions). |  |
| :---: | :---: | :---: | :---: |
|  | Additional Item | TOOL1, TOOL2 | Displayed only when using multiple manipulators. |
|  | Example | TOOLON |  |
| TOOLOF | Function | Turns OFF work tools (work instructions). |  |
|  | Additional Item | TOOL1, TOOL2 | Displayed only when using multiple manipulators. |
|  | Example | TOOLOF |  |
| WVON | Function | Starts weaving. |  |
|  | Additional Item | RB1, RB2 | Displayed only when using multiple manipulators. |
|  |  | WEV\#(<weaving condition file number>) | 1 to 16 |
|  | Example | WVON WEV\# (1) |  |
| WVOF | Function | Ends weaving. |  |
|  | Additional Item | RB1, RB2 | Displayed only when using multiple manipulators. |
|  |  | None |  |
|  | Example | WVOF |  |

## 10 Table of Basic Instructions

- <> indicates numerical or alphabetical data.
- If multiple items are shown in one section, select one of the items.


### 10.1 Move Instructions

| MOVJ | Function | Moves to a taught point with joint interpolation type. |  |
| :---: | :---: | :---: | :---: |
|  | Additional Item | Position data, Base axis position data, Station axis position data | These data do not appear on the screen. |
|  |  | VJ=<play speed> | VJ: 0.01 to 100.00\% |
|  |  | PL=<position level> | PL:0 to 8 |
|  |  | NWAIT |  |
|  |  | UNTIL statement |  |
|  |  | ACC=(acceleration adjustment ratio) | $\begin{aligned} & \text { ACC: } 20 \text { to } \\ & 100 \% \end{aligned}$ |
|  |  | DEC=(deceleration adjustment ratio) | $\begin{aligned} & \text { DEC: } 20 \text { to } \\ & 100 \% \end{aligned}$ |
|  | Example | MOVJ VJ=50.00 PL=2 NWAIT UNTIL IN\#(16)=ON |  |


| MOVL | Function | Moves to a taught point with linear interpolation type. |  |
| :---: | :---: | :---: | :---: |
|  | Additional Item | Position data, Base axis position data, Station axis position data | These data do not appear on the screen. |
|  |  | $\mathrm{V}=<$ play speed>, <br> $\mathrm{VR}=<$ play speed of the posture>, VE=<play speed of external axis> | $\mathrm{V}: 0.1$ to 1500.0 <br> $\mathrm{mm} / \mathrm{s}$ <br> 1 to 9000.0 $\mathrm{cm} / \mathrm{min}$ VR:0.1 to 180.0 deg/s VE:0.01 to 100.00\% |
|  |  | PL=<position level> | PL:0 to 8 |
|  |  | CR=(corner radius) | $\begin{aligned} & \text { CR: } 1.0 \text { to } \\ & 6553.5 \mathrm{~mm} \end{aligned}$ |
|  |  | NWAIT |  |
|  |  | UNTIL statement |  |
|  |  | ACC=(acceleration adjustment ratio) | $\begin{aligned} & \text { ACC: } 20 \text { to } \\ & 100 \% \end{aligned}$ |
|  |  | DEC=(deceleration adjustment ratio) | $\begin{aligned} & \text { DEC: } 20 \text { to } \\ & 100 \% \end{aligned}$ |
|  | Example | MOVL V=138 PL=0 NWAIT UNTIL IN\#(16)=ON |  |
| MOVC | Function | Moves to a taught point with circular interpolation type. |  |
|  | Additional Item | Position data, Base axis position data, Station axis position data | These data do not appear on the screen. |
|  |  | $\mathrm{V}=<$ play speed>, <br> $\mathrm{VR}=<$ play speed of the posture>, <br> VE=<play speed of external axis> | Same as MOVL. |
|  |  | PL=<position level> | PL:0 to 8 |
|  |  | NWAIT |  |
|  |  | ACC=(acceleration adjustment ratio) | $\begin{aligned} & \text { ACC: } 20 \text { to } \\ & 100 \% \end{aligned}$ |
|  |  | DEC=(deceleration adjustment ratio) | $\begin{aligned} & \text { DEC: } 20 \text { to } \\ & 100 \% \end{aligned}$ |
|  | Example | MOVC V=138 PL=0 NWAIT |  |


| MOVS | Function | Moves to a taught point with spline interpolation type. |  |
| :---: | :---: | :---: | :---: |
|  | Additional Item | Position data, Base axis position data, Station axis position data | These data do not appear on the screen. |
|  |  | $\mathrm{V}=<$ play speed>, <br> $\mathrm{VR}=<$ play speed of the posture>, <br> VE=<play speed of external axis> | Same as MOVL. |
|  |  | PL=<position level> | PL:0 to 8 |
|  |  | NWAIT |  |
|  |  | ACC=(acceleration adjustment ratio) | ACC: 20 to 100\% |
|  |  | DEC=(deceleration adjustment ratio) | $\begin{aligned} & \text { DEC: } 20 \text { to } \\ & 100 \% \end{aligned}$ |
|  | Example | MOVS V=120 PL=0 |  |
| IMOV | Function | Moves the specified increment from the current position with linear interpolation type. |  |
|  | Additional Item | $\mathrm{P}<$ variable number>, $\mathrm{BP}<$ variable number>, <br> EX<variable number> |  |
|  |  | $\begin{aligned} & \text { V=<play speed>, } \\ & \text { VR=<play speed of the posture>, } \\ & \text { VE=<play speed of external axis> } \end{aligned}$ | Same as MOVL. |
|  |  | PL=<position level> | PL:0 to 8 |
|  |  | NWAIT |  |
|  |  | BF,RF,TF,UF\# (<user coordinate number>) | BF: <br> base coordi- <br> nates <br> RF: <br> robot coordi- <br> nates <br> TF: <br> tool coordinates <br> UF: <br> user coordinates |
|  |  | UNTIL statement |  |
|  |  | ACC=(acceleration adjustment ratio) | $\begin{aligned} & \text { ACC: } 20 \text { to } \\ & 100 \% \end{aligned}$ |
|  |  | DEC=(deceleration adjustment ratio) | $\begin{aligned} & \text { DEC: } 20 \text { to } \\ & 100 \% \end{aligned}$ |
|  | Example | IMOV P000 V=138 PL=1 RF |  |

10.1 Move Instructions

| REFP | Function | Defines a reference point (e.g. wall point for weaving). |  |
| :---: | :---: | :---: | :---: |
|  | Additional Item | <reference point number> | wall point 1 for weaving :1 wall point 2 for weaving :2 |
|  |  | Position data, Base axis position data, Station axis position data | These data do not appear on the screen. |
|  | Example | REFP 1 |  |
| SPEED | Function | Sets play speed. |  |
|  | Additional Item | $\begin{aligned} & \text { VJ=<joint speed>, } \\ & \text { V=<TCP speed>, } \\ & \text { VR=<play speed of the posture>, } \\ & \text { VE=<play speed of external axis> } \end{aligned}$ | VJ:Same as MOVJ. V,VR,VE: Same as MOVL. |
|  | Example | SPEED VJ=50.00 |  |

10.2 I/O Instructions

| DOUT | Function | Turns the external output signals ON and OFF. |  |
| :---: | :---: | :---: | :---: |
|  | Additional Item | OT\# (<output number>), <br> OGH\# (<output group number>), <br> OG\# (<output group number>) <br> Number of addressed output signals: $\begin{aligned} & \text { OT\# }(x x)=1 ; \text { OGH\#( } x x \text { )=4(per group); } \\ & \text { OG\#(xx)=8(per group) } \end{aligned}$ <br> OGH\#(xx) is not subject to parity check; only the binary specification is allowed. |  |
|  |  | FINE | With a high degree of accuracy |
|  | Example | DOUT OT\#(12) ON |  |
| PULSE | Function | Outputs a pulse signal as an external output signal. |  |
|  | Additional Item | $\begin{aligned} & \text { OT\# (<output number>), } \\ & \text { OGH\# (<output group number>), } \\ & \text { OG\# (<output group number>) } \end{aligned}$ |  |
|  |  | T=<time (seconds)> | $\begin{aligned} & 0.01 \text { to } \\ & 655.35 \mathrm{~s} \\ & 0.30 \mathrm{~s} \text { unless } \\ & \text { otherwise spec- } \\ & \text { ified } \end{aligned}$ |
|  | Example | PULSE OT\# (10) T=0.60 |  |


| DIN | Function | Sets input signals in variables. |  |
| :---: | :---: | :---: | :---: |
|  | Additional Item | $\mathrm{B}<$ variable number> |  |
|  |  | IN\# (<input number>), <br> IGH\# (<input group number>), <br> IG\# (<input group number>), <br> OT\# (<output number>), <br> OGH\# (<output group number>), <br> OG\# (<output group number>), <br> SIN\# (<system input number>), <br> SOUT\# (<system output number>) <br> Number of addressed input signals: $\begin{aligned} & \text { IN\# }(x x)=1 ; \operatorname{IGH} \#(x x)=4 \text { (per group); } \\ & \text { IG\#(xx)=8(per group) } \end{aligned}$ <br> Number of addressed output signals: $\begin{aligned} & \text { OT\# }(x x)=1 ; \text { OGH\# }(x x)=4 \text { (per group); } \\ & \text { OG\# }(x x)=8 \text { (per group) } \end{aligned}$ <br> IGH\#(xx) and OGH\#(xx) are not subject to parity check; only the binary specification is allowed. |  |
|  | Example | DIN B016 IN\#(16) DIN B002 IG\#(2) |  |
| WAIT | Function | Waits until the external input signal status matches the specified status. |  |
|  | Additional Item | IN\# (<input number>), <br> IGH\# (<input group number>), <br> IG\# (<input group number>), <br> OT\# (<user output number>), <br> OGH\# (<output group number>), <br> SIN\# (<system input number>), <br> SOUT\# (<system output number>) |  |
|  |  | <status>,B<variable number> |  |
|  |  | T=<time (seconds)> | $\begin{aligned} & 0.01 \text { to } \\ & 655.35 \mathrm{~s} \end{aligned}$ |
|  | Example | WAIT IN\# (12)=ON T=10.00 WAIT IN\# (12)=B002 |  |
| AOUT | Function | Outputs the specified voltage to the general-purpose analog output port. |  |
|  | Additional Item | AO\# (<output port number>) | 1 to 40 |
|  |  | <output voltage(V)> | -14.0 to 14.0 |
|  | Example | AOUT AO\# (2) 12.7 |  |


| ARATION | Function | Starts the analog output corresponding to the speed. |  |
| :---: | :---: | :---: | :---: |
|  | Additional Item | AO\#(<output port number>) | 1 to 40 |
|  |  | BV = <basic voltage> | -14.00 to 14.00 |
|  |  | $\mathrm{V}=$ <basic speed> | ```0 . 1 ~ t o 150.0 mm/s 1 to }9000\textrm{cm} min``` |
|  |  | OFV = <offset voltage> | -14.00 to 14.00 |
|  | Example | ARATION AO\#(1) BV=10.00 V=200.0 OFV=2.00 |  |
| ARATIOF | Function | Ends the analog output corresponding to the speed. |  |
|  | Additional Item | AO\#(<output port number>) | 1 to 40 |
|  | Example | ARATIOF AO\#(1) |  |

### 10.3 Control Instructions

| JUMP | Function | Jumps to the specified label or job. |  |
| :---: | :---: | :---: | :---: |
|  | Additional Item | * <label character string>,JOB:<job name>, <br> IG\# (<input group number>), <br> $\mathrm{B}<$ variable number>, <br> I<variable number>,D<variable number> |  |
|  |  | UF\# (user coordinates number) |  |
|  |  | IF statement |  |
|  | Example | JUMP JOB:TEST1 IF IN\#(14)=OFF |  |
| (label) | Function | Indicates a jump destination. |  |
|  | Additional Item | <jump destination> | 8 characters or less |
|  | Example | *123 |  |
| CALL | Function | Calls the specified job. |  |
|  | Additional Item | JOB:<job name>,IG\# (<input group number>), B<variable number>,l<variable number>, D<variable number> |  |
|  |  | UF\# (user coordinates number) |  |
|  |  | IF statement |  |
|  | Example | CALL JOB:TEST1 IF IN\# (24)=ON <br> CALL IG\#(2) <br> (The job is called by the patterns of input signal. In this example, Job 0 cannot be called.) |  |
| RET | Function | Returns to the call source job. |  |
|  | Additional Item | IF statement |  |
|  | Example | RET IF IN\#(12)=OFF |  |
| END | Function | Declares the end of a job. |  |
|  | Additional Item |  |  |
|  | Example | END |  |



| 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 |

10.4 Shift Instructions

| SFTON | Function | Starts a shift operation. |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Additional Item | $\mathrm{P}<$ variable number>, <br> $\mathrm{BP}<$ variable number>, <br> EX<variable number>, <br> BF,RF,TF, <br> UF\#(<user coordinate number>) |  | BF: <br> base coordi- <br> nates <br> RF: <br> robot coordi- <br> nates <br> TF: <br> tool coordi- <br> nates <br> UF: <br> user coordinates |
|  | Example | SFTON P001 UF\#(1) |  |  |
| SFTOF | Function | Stops a shift operation. |  |  |
|  | Additional Item |  |  |  |
|  | Example | SFTOF |  |  |
| MSHIFT | Function | Obtains the shift value in the specified coordinate system from Data 2 and 3, and stores the obtained element values in Data 1. Format:MSHIFT <Data1><Coordinate><Data2><Data3> |  |  |
|  | Additional Item | Data1 | $\mathrm{PX}<$ variable number> |  |
|  |  | Coordinate | BF,RF,TF, <br> UF\# (<user coordinate number>), <br> MTF | BF: <br> base coordi- <br> nates <br> RF: <br> robot coordi- <br> nates <br> TF: <br> tool coordi- <br> nates <br> UF: <br> user coordi- <br> nates <br> MTF: <br> tool coordinates for the master |
|  |  | Data2 | $\mathrm{PX}<$ variable number> |  |
|  |  | Data3 | $\mathrm{PX}<$ variable number> |  |
|  | Example | MSHIFT PX000 RF PX001 PX002 |  |  |

### 10.5 Operating Instructions

| ADD | Function | Adds Data1 and Data2, and stores the result in Data1. Format:ADD<Data1><Data2> |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Additional Item | Data1 | $B<$ variable number>, I<variable number>, D<variable number>, $R<$ variable number>, $\mathrm{P}<$ variable number>, $\mathrm{BP}<$ variable number>, EX<variable number> | Data1 must always be a variable. |
|  |  | Data2 | Constant, <br> $B<$ variable number>, I<variable number>, D<variable number>, $R<$ variable number>, $\mathrm{P}<$ variable number>, $\mathrm{BP}<$ variable number>, EX<variable number> |  |
|  | Example | ADD 10121013 |  |  |
| SUB | Function | Subtracts Data2 from Data1, and stores the result in Data1. Format:SUB<Data1><Data2> |  |  |
|  | Additional Item | Data1 | $\mathrm{B}<$ variable number>, I<variable number>, D<variable number>, $R<$ variable number>, $\mathrm{P}<$ variable number>, $\mathrm{BP}<$ variable number>, EX<variable number> | Data1 must always be a variable. |
|  |  | Data2 | Constant, B<variable number>, I<variable number>, D<variable number>, $R<$ variable number>, $\mathrm{P}<$ variable number>, $\mathrm{BP}<$ variable number>, EX<variable number> |  |
|  | Example | SUB 10121013 |  |  |


| MUL | Function | Multiplies Data1 by Data2, and stores the result in Data1. Format:MUL<Data1><Data2> <br> Data1 can be an element in a position variable. <br> $\operatorname{Pxxx}(0)$ :all axis data, $\operatorname{Pxxx}(1): \mathrm{X}$-axis data, <br> Pxxx(2):Y-axis data, Pxxx(3):Z-axis data, <br> Pxxx(4):Tx-axis data, Pxxx(5):Ty-axis data, <br> Pxxx(6):Tz-axis data |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Additional Item | Data1 | $B<$ variable number>, I<variable number>, D<variable number>, $R<$ variable number>, $\mathrm{P}<$ variable number> (<element number>), <br> BP<variable number> (<element number>), <br> EX<variable number> (<element number>) | Data1 must always be a variable. |
|  |  | Data2 | Constant, $B<$ variable number>, I<variable number>, D<variable number>, $R<$ variable number> |  |
|  | Example | MUL IO12 1013 <br> 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> <br> Data1 can be an element in a position variable. <br> Pxxx(0):all axis data, $\operatorname{Pxxx}(1): X$-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 | $\mathrm{B}<$ variable number>, <br> I<variable number>, <br> D<variable number>, <br> $R<$ variable number>, <br> $\mathrm{P}<$ variable number> (<element <br> number>), <br> BP<variable number> (<element number>), <br> EX<variable number> (<element number>) | Data1 must always be a variable. |
|  |  | Data2 | Constant, $B<$ variable number>, I<variable number>, D<variable number>, $R<$ variable number> |  |
|  | Example | $\begin{aligned} & \text { DIV IO12 I013 } \\ & \text { DIV P000 (3) } 2 \text { (Divide the Z-axis data by } 2 . \text {.) } \end{aligned}$ |  |  |


| INC | Function | Increments the value of the specified variable by 1. |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Additional Item | $\mathrm{B}<$ variable number>,l<variable number>, D<variable number> |  |  |
|  | Example | INC 1043 |  |  |
| DEC | Function | Decrements the value of the specified variable by 1. |  |  |
|  | Additional Item | $\mathrm{B}<$ variable number>,l<variable number>, D<variable number> |  |  |
|  | Example | DEC 1043 |  |  |
| AND | Function | Obtains the AND of Data1 and Data2, and stores the result in Data1. <br> Format:AND<Data1><Data2> |  |  |
|  | Additional Item | Data1 | B <variable number> |  |
|  |  | Data2 | B<variable number>, Constant |  |
|  | Example | AND B012 B020 |  |  |
| OR | Function | Obtains the OR of Data1 and Data2, and stores the result in Data1. Format:OR<Data1><Data2> |  |  |
|  | Additional Item | Data1 | $B<$ variable number> |  |
|  |  | Data2 | B<variable number>, Constant |  |
|  | Example | OR B012 B020 |  |  |
| NOT | Function | Obtains the NOT of Data2, and stores the result in Data1. Format:NOT<Data1><Data2> |  |  |
|  | Additional Item | Data1 | B<variable number> |  |
|  |  | Data2 | B<variable number>, Constant |  |
|  | Example | NOT B012 B020 |  |  |
| XOR | Function | Obtains the exclusive OR of Data1 and Data2, and stores the result in Data1. <br> Format:XOR<Data1><Data2> |  |  |
|  | Additional Item | Data1 | B<variable number> |  |
|  |  | Data2 | $B<$ variable number>, Constant |  |
|  | Example | XOR B012 B020 |  |  |


| SET | Function | Sets Data2 to Data1. <br> Format:SET<Data1><Data2> |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Additional Item | Data1 | $\mathrm{B}<$ variable number>, I<variable number>, D<variable number>, $R<$ variable number>, $\mathrm{P}<$ variable number>, $\mathrm{S}<$ variable number>, $\mathrm{BP}<$ variable number>, EX<variable number> | Data1 must always be a variable. |
|  |  | Data2 | Constant, $\mathrm{B}<$ variable number>, I<variable number>, D<variable number>, $R<$ variable number>, $\mathrm{S}<$ variable number>, EXPRESS |  |
|  | Example | SET 10121020 |  |  |
| SETE | Function | Sets data to an element in a position variable. |  |  |
|  | Additional Item | Data 1 | $\mathrm{P}<$ variable number> (<element number>), BP <variable number> (<element number>), EX<variable number> (<element number>) |  |
|  |  | Data 2 | D<variable number>, <double-precision integer type constant> |  |
|  | Example | SETE P012 (3) D005 |  |  |
| GETE | Function | Extracts an element in a position variable. |  |  |
|  | Additional Item | D<variable number> |  |  |
|  |  | $\begin{aligned} & \mathrm{P}<\text { variable number> (<element number>), } \\ & \mathrm{BP}<\text { variable number> (<element number>), } \\ & \mathrm{EX}<\text { variable number> (<element number>) } \end{aligned}$ |  |  |
|  | Example | GETE D006 P012 (4) |  |  |


| GETS | Function | Sets a system variable to the specified variable. |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | AdditionalItem | $\mathrm{B}<$ variable number>,l<variable number>, $D<$ variable number $>, R<$ variable number>, $P X<$ variable number> |  |  |
|  |  | \$B<variable number>,\$1<variable number>, \$D<variable number>,\$R<variable number>, \$PX<variable number>, \$ERRNO, Constant, $\mathrm{B}<$ variable number> |  | System variable |
|  | Example | GETS B000 \$B000 <br> GETS 1001 \$I[1] <br> 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. <br> Format:CNVRT<Data1><Data2><coordinate> |  |  |
|  |  | Data1 | PX<variable number> |  |
|  |  | Data2 | PX <variable number> |  |
|  | Additional Item | BF,RF, | \# (<user coordinate number>),MTF | BF: <br> base coordi- <br> nates <br> RF: <br> robot coordi- <br> nates <br> TF: <br> tool coordi- <br> nates <br> UF: <br> user coordi- <br> nates <br> MTF:tool coordinates for the master |
|  | Example | CNVRT PX000 PX001 BF |  |  |


| CLEAR | Function | Starting with the variable number in Data1, clears (sets to zero) as many variables as specified by a number in Data2. <br> Format:CLEAR<Data1><Data2> |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Additional Item | Data1 $\mathrm{B}<$ variable number $>$, I<variable <br>  number $>$, <br>  $\mathrm{D}<$ variable number $>$, R<variable <br>  number $>$ <br>  $\$ \mathrm{~B}<$ variable number $>, \$ \mathrm{l}<$ variable <br>  number $>$ <br>  $\$ \mathrm{D}<$ variable number $>, \$ \mathrm{R}<$ variable <br>  number $>$, |  |  |
|  |  | Data2 | <number of variables>, ALL,STACK | ALL:Clears variables of the variable number in Data1 and of all the variable numbers that follow. STACK:Clears all variables in the job call stack. |
|  | Example | CLEAR B000 ALL CLEAR STACK |  |  |
| SIN | Function | Obtains the sine of Data2, and stores the result in Data1. Format:SIN<Data1><Data2> |  |  |
|  | Additional Item | Data1 | R <variable number> | Data1 must always be a real type variable. |
|  |  | Data2 | <constant>,R<variable number> |  |
|  | Example | SIN R000 R001 (Sets the sine of R001 to R000.) |  |  |
| COS | Function | Obtains the cosine of Data2, and stores the result in Data1. Format:COS<Data1><Data2> |  |  |
|  | Additional Item | Data1 | R <variable number> | Data1 must always be a real type variable. |
|  |  | Data2 | <constant>,R<variable number> |  |
|  | Example | COS R000 R001 (Sets the cosine of R001 to R000.) |  |  |


| ATAN | Function | Obtains the arc tangent of Data2, and stores the result in Data1. Format:ATAN<Data1><Data2> |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Additional Item | Data1 | $\mathrm{R}<$ variable number> | Data1 must always be a real type variable. |
|  |  | Data2 | <constant>,R<variable |  |
|  | Example | ATAN R000 R001 (Sets the arc tangent of R001 to R000.) |  |  |
| SQRT | Function | Obtains the square root of Data2, and stores the result in Data1. Format:SQRT<Data1><Data2> |  |  |
|  | Additional Item | Data1 | $\mathrm{R}<$ variable number> | Data1 must always be a real type variable. |
|  |  | Data2 | <constant>,R<variable |  |
|  | Example | SQRT R000 R001 (Sets the square root of R001 to R000.) |  |  |
| MFRAME | Function | Creates a user coordinate using the position data for the given three points as definition points. <Data1> indicates the definition point ORG position data, <Data2> the definition point $X X$ position data, and <Data3> the definition point XY position data. <br> Format: MFRAME <user coordinate> <Data1> <Data2> <Data3> |  |  |
|  | Additional Item | UF\#(<user coordinate number>) |  | 1 to 24 |
|  |  | Data1 | PX <variable number> |  |
|  |  | Data2 | PX <variable number> |  |
|  |  | Data3 | PX <variable number> |  |
|  | Example | MFRAME UF\#(1) PX000 PX001 PX002 |  |  |
| MULMAT | Function | Obtains the matrix product of Data2 and Data3, and stores the result in Data1. <br> Format: MULMAT <Data1> <Data2> <Data3> |  |  |
|  | Additional Item | Data1 | P <variable number> |  |
|  |  | Data2 | P <variable number> |  |
|  |  | Data3 | P <variable number> |  |
|  | Example | MULMAT P000 P001 P002 |  |  |


| INVMAT | Function <br> Additional Item | Obtains the inverse matrix of Data2, and stores the result in Data1. Format: INVMAT <Data1> <Data2> |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Data1 | $\mathrm{P}<$ variable number> |  |
|  |  | Data2 | P <variable number> |  |
|  | Example | INVMAT P000 P001 |  |  |
| SETFILE | Function | Changes the contents data of a condition file into the numeric data of Data1. The contents data of a condition file to be changed is specified by the element number. |  |  |
|  | Additional Item | Contents data of a condition file | WEV\#(<condition file number>)(<element number>) |  |
|  |  | Data1 | Constant, D<variable number> |  |
|  | Example | SETFILE WEV\#(1)(1) D000 |  |  |
| GETFILE | Function | Stores the contents data of a condition file in Data1. The contents data of a condition file to be obtained is specified by the element number. |  |  |
|  | Additional Item | Data1 | D <variable number> |  |
|  |  | Contents data of a condition file | WEV\#(<condition file number>)(<element number>) |  |
|  | Example | GETFILE D000 WEV\#(1)(1) |  |  |
| GETPOS | Function | Stores the position data of Data2 (step number) in Data1. |  |  |
|  | Additional Item | Data1 | PX <variable number> |  |
|  |  | Data2 | STEP\# (<step number>) |  |
|  | Example | GETPOS PX000 STEP\#(1) |  |  |
| VAL | Function | Converts the numeric value of the character string (ASCII) of Data2 into the real number, and stores the result in Data1. <br> Format: VAL <Data1> <Data2> |  |  |
|  | Additional Item | Data1 | B <variable number>, I <variable number>, D <variable number>, R <variable number> |  |
|  |  | Data2 | Character string, $\mathrm{S}<$ variable number> |  |
|  | Example | VAL B000 "123" |  |  |


| ASC | Function <br> Additional Item | Obtains the character code of the first letter of the character string (ASCII) of Data2, and stores the result in Data1. <br> Format:ASC<Data1><Data2> |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Data1 | B <variable number>, I <variable number>, D <variable number> |  |
|  |  | Data2 | Character string, S <variable number> |  |
|  | Example | ASC B000 "ABC" |  |  |
| CHR\$ | Function | Obtains the character (ASCII) with the character code of Data2, and stores the result in Data1. <br> Format:CHR\$<Data1><Data2> |  |  |
|  | Additional Item | Data1 | S < variable number> |  |
|  |  | Data2 | Constant, B <variable number> |  |
|  | Example | CHR\$ S000 65 |  |  |
| MID\$ | Function | Obtains the character string (ASCII) of any length (Data 3, 4) from the character string (ASCII) of Data2, and stores the result in Data1. <br> Format:MID\$<Data1><Data2><Data3><Data4> |  |  |
|  | Additional Item | Data1 | S <variable number> |  |
|  |  | Data2 | Character string, S <variable number> |  |
|  |  | Data3 | Constant, B <variable number>, I <variable number>, D <variable number> |  |
|  |  | Data4 | Constant, B <variable number>, I <variable number>, D <variable number> |  |
|  | Example | MID\$ S000 "123ABC456" 43 |  |  |
| LEN | Function | Obtains the total number of bytes of the character string (ASCII) of Data2, and stores the result in Data1. <br> Format:LEN<Data1><Data2> |  |  |
|  | Additional Item | Data1 | B <variable number>, I <variable number>, D <variable number> |  |
|  |  | Data2 | Character string, S <variable number> |  |
|  | Example | LEN B000 "ABCDEF" |  |  |


| CAT\$ | Function <br>  | Additional <br> Item | Combines the character string (ASCII) of Data2 and Data3, and <br> stores the result in Data1. <br> Format:CAT\$<Data1><Data2><Data3> |
| :--- | :--- | :--- | :--- | :--- |
|  |  | Character string, S <variable num- <br> ber> |  |
|  |  | Character string, S <variable num- <br> ber> |  |

## 11 Error

### 11.1 Error Message List

Error warns the operator not to advance to the next operation caused by a wrong operation or the access method when using the programming pendant or an external equipment (computer, PLC, etc.).
When an error occurs, confirm the content of the error then release the error.
To release the error, perform either of the following operations:

- Press [CANCEL] on programming pendant.
- Input alarm/error reset signal (system input).

An error is different from an alarm because it does not stop the robot even if it occurred while the robot was operated (during playback).

### 11.1.1 System and General Operation

| Error No. | Data | Error Message | Contents |
| :---: | :---: | :---: | :---: |
| 10 | - | Turn off servo power and perform corrective action | It cannot be operated while servo power supply is ON . |
| 20 | - | Depress TEACH | Out of specified operation mode |
| 30 | - | Illegal setting for number of variables | Parameter setting error |
| 40 | - | Undefined robot position variables | Position variable cannot be used. |
| 60 | - | Undefined points (ORG, XX, XY) | Not registered user coordinates basic 3 points (ORG, XX, XY) |
| 70 | - | Program and current tool different | The tool number registered with teaching position data does not match the tool number selected at the programing pendant. |
| 80 | - | Same position in the 3 points |  |
| 100 | - | On overrun recovery status |  |
| 110 | - | Turn ON servo power |  |
| 120 | - | Set to PLAY mode |  |
| 130 | - | No start using external signal |  |
| 140 | - | No start using P.P. |  |
| 180 | - | TEACH mode select signal ON |  |
| 190 | - | Set variable number |  |
| 200 | - | Defined group axis |  |
| 210 | - | Undefined coordinated robots |  |
| 212 |  | Cannot register group combination |  |
| 230 | - | While releasing soft limit |  |
| 240 | - | Undefined robot |  |
| 270 | - | Undefined gun condition file |  |
| 280 | - | Lack of number of I/O points |  |
| 290 | - | Cannot set same No. |  |
| 300 | - | Undefined user frame |  |
| 310 | - | Cannot register Master JOB |  |
| 320 | - | Cannot operate CHECK-RUN |  |
| 330 | - | Cannot operate MACHINE LOCK |  |

11.1 Error Message List

| Error No. | Data | Error Message | Contents |
| :---: | :---: | :---: | :---: |
| 340 | - | Cannot operate Master JOB |  |
| 350 | - | Cannot initialize |  |
| 380 | - | Position not checked | Second home position was not checked. |
| 390 | - | Can specify servo off by safety relay |  |
| 410 | - | Time could not be measured | Time could not be measured for TRT function. |
| 420 | - | Incorrect number of taught points | The number of the taught points for tool calibration is incorrect. |
| 430 | - | Register start reserved JOB |  |
| 460 | - | Excess time for measuring |  |
| 500 | - | Undefined robot calibration data |  |
| 510 | - | Undefined axis |  |
| 520 | - | Cannot select two coordinated combination |  |
| 530 | - | Start reservation mode |  |
| 550 | - | Start reserved JOB change prohibit is set |  |
| 560 | - | Cannot teach position while soft limit released |  |
| 590 | - | Register group axis combination | [SYNCHRO] was pressed for coordinated job which was not registered as group. |
| 600 | - | Out of setting data range |  |
| 610 | - | Cannot use the user coordinate |  |
| 620 | - | Select JOB (robot) |  |
| 650 | - | Incorrect measured data |  |
| 660 | - | Wrong data type of position variable |  |
|  | - | Defined data |  |
|  | XXX |  | File No. |
| 700 | - | Wrong CMOS memory board type |  |
| 760 | - | Error in start condition set |  |
| 770 | - | During robot operation |  |
| 800 | - | The gun of designation is not connected |  |


|  |  |  | Error Message |
| :---: | :---: | :--- | :--- |
| 801 | - | The group axis of designation is not con- <br> nection |  |
| 810 | - | Servo power supply is limited |  |
| 820 | - | Modification range over |  |
| 930 | - | Undefined conveyor calibration data |  |
| 940 | - | Forced pressure signal ON |  |
| 950 | - | Negative correction distance |  |
| 960 | - | I/O axis mode requesting |  |
| 970 | - | ERRSVCPU signal error |  |

### 11.1.2 Editing

| Error No. | Data | Error Message | Contents |
| :---: | :---: | :--- | :--- |
| 1010 | - | EDIT LOCK mode |  |
| 1020 | - | Enter correct value |  |
| 1030 | - | Unauthorized ID No. |  |
| 1050 | - | Enter correct date |  |
| 1060 | - | Enter correct clock |  |
| 1070 | - | Enter an ID number in 4-8 figures |  |
| 1080 | - | Negative value can't be set |  |

### 11.1.3 Job Defined Data

| Error No. | Data | Error Message | Contents |
| :---: | :---: | :---: | :---: |
| 2010 | - | Incorrect character |  |
| 2020 | - | Name not entered |  |
| 2030 | - | Undefined JOB name |  |
| 2040 | - | Defined JOB name |  |
| 2050 | - | Address not found |  |
| 2070 | - | Set robot exactly to taught position |  |
| 2080 | - | Press INSERT or MODIFY |  |
| 2090 | - | Only modifying move instruction possible |  |
| 2100 | - | JOB cannot be edited. |  |
| 2110 | - | Over soft limit |  |
| 2120 | - | Cannot insert/alter/delete with servo off |  |
| 2150 | - | Inserting is not possible from this point |  |
| 2160 | - | Cannot modify or delete this position |  |
| 2170 | - | Press INSERT to record same step as previous step |  |
| 2180 | - | Cannot insert data |  |
| 2210 | - | Illegal data setting |  |
| 2220 | - | Display edit instruction |  |
| 2240 | - | Excessive instruction equation |  |

11.1 Error Message List

| Error No. | Data | Error Message | Contents |
| :---: | :---: | :---: | :---: |
| 2250 | - | Unmatched number of parentheses in equation |  |
| 2260 | - | Wrong group axis selection |  |
| 2270 | - | Cannot insert any more instruction in JOB |  |
| 2280 | * | JOB memory is full |  |
|  | 1 |  | Lack of position file memories |
|  | 2 |  | Lack of JOB registering memories |
|  | 3 |  | Lack of instruction file memories |
|  | 4 |  | Lack of memory pool |
|  | 5 |  | Lack of pass condition file for multilayer |
| 2290 | - | Undefined master JOB |  |
| 2291 | * | Undefined SUB Master JOB |  |
|  | 1 |  | Sub-master 1 |
|  | 2 |  | Sub-master 2 |
|  | 3 |  | Sub-master 3 |
|  | 4 |  | Sub-master 4 |
|  | 5 |  | Sub-master 5 |
|  | 6 |  | Sub-master 6 |
|  | 7 |  | Sub-master 7 |
|  | 8 |  | Sub-master 8 |
| 2292 | - | Undefined MASTER START JOB |  |
| 2293 | * | Undefined SUB START JOB |  |
|  | 1 |  | Sub-master 1 |
|  | 2 |  | Sub-master 2 |
|  | 3 |  | Sub-master 3 |
|  | 4 |  | Sub-master 4 |
|  | 5 |  | Sub-master 5 |
|  | 6 |  | Sub-master 6 |
|  | 7 |  | Sub-master 7 |
|  | 8 |  | Sub-master 8 |


| Error No. | Data | Error Message | Contents |
| :---: | :---: | :---: | :---: |
| 2300 | - | Cannot teach JOB without group-axis specification |  |
|  | * | Same label exists |  |
|  | XXX |  | Line No. |
| 2340 | - | Pasted data not found |  |
| 2360 | - | Cannot create editing area |  |
| 2370 | - | Cannot cut/copy NOP and END instructions |  |
| 2390 | - | Wrong group axis selection |  |
| 2400 | - | Cannot move in cut \& paste editing |  |
| 2430 | - | Reverse data not found |  |
| 2440 | - | Move C-and W-axis to basic position | Laser cutting |
| 2450 | - | Relative JOB not permitted |  |
| 2470 | - | Wrong JOB type |  |
| 2480 | - | Wrong JOB coordinates setting |  |
| 2500 | - | Cannot convert the JOB |  |
| 2510 | - | Cannot correct position in the JOB |  |
| 2520 | - | Enter JOB name |  |
| 2530 | - | Illegal step number |  |
| 2540 | - | Enter step number |  |
| 2550 | - | Duplicated step number |  |
| 2551 | - | Duplicated line number |  |
| 2560 | - | Cannot correct steps of position variables and REFP |  |
| 2570 | - | The step does not contain speed |  |
| 2580 | - | The step dose not contain PL/CONT |  |
| 2590 | - | Soft limit range over |  |
| 2600 | - | Cannot teach position in concurrent JOB |  |
| 2610 | - | Wrong JOB kind |  |
| 2620 | - | Cannot correct play speed in the JOB |  |
| 2630 | - | Conveyor position not reset |  |


|  |  |  | Error Message |
| :---: | :---: | :--- | :--- |
| 2640 | - | Incorrect JOB name | Contents |
| 2670 | - | Undefined target JOB |  |
| 2710 | - | Relative job can't be shifted with pulse <br> type |  |
| 2730 | - | Cannot use robot macro JOB |  |
| 2740 | - | Cannot use concurrent macro JOB |  |
| 2750 | - | Cannot use JOB with group-axis speci- <br> fication |  |
| 2760 | - | Cannot insert/modify/delete for group <br> axis detachment |  |
| 2761 | - | Axis is separated. <br> Cannot add, modify, or delete. |  |
| 2770 | - | Cannot reverse data of SVSPOTMOV <br> instruction |  |
| 2780 | - | Arithmetic error |  |

### 11.1.4 External Memory Equipment

| Error No. | Data | Error Message | Contents |
| :---: | :---: | :--- | :--- |
| 3010 | - | Floppy disk drive cable not connected |  |
| 3020 | - | Floppy disk not inserted into floppy <br> disk drive |  |
| 3030 | - | Floppy disk protection is ON |  |
| 3040 | - | File not saved on floppy disk or Com- <br> pact Flash |  |
| 33050 | - | File saved on floppy disk or Compact <br> Flash |  |
| 33060 | - | Out of memory on floppy disk or Com- <br> pact Flash |  |
| 3070 | - | Number of files on floppy disk or Com- <br> pact Flash is full |  |
|  | - | l/O error on floppy disk or Compact <br> Flash | Verify error |


| Error No. | Data | Error Message | Contents |
| :---: | :---: | :---: | :---: |
| 3140 | - | Wrong pseudo instruction |  |
| 3150 | * | Concurrent I/O record error |  |
|  | 1 |  | Format error |
|  | 2 |  | Ladder program is too long. |
|  | 3 |  | Exceed the range of the data |
|  | 4 |  | Specification error of channel No. |
|  | 5 |  | Specification error of relay No. |
|  | 6 |  | Timer value error |
|  | 7 |  | Specification error of timer No. |
| 3160 | - | Cannot load illegal system data |  |
| 3170 | * | Condition file data error |  |
|  | 1 |  | Format error |
|  | 2 |  | Specified file No. is omitted. |
|  | 3 |  | Specified tool No. is omitted. |
|  | 4 |  | User file is not registered. |


| Error No. | Data | Error Message | Contents |
| :---: | :---: | :---: | :---: |
| 3190 | * | Error in JOB data record |  |
|  | 1 |  | Record on the number of position data (NPOS) is wrong for the format. |
|  | 2 |  | Record on the user coordinate No. (USER) is wrong for the format. |
|  | 3 |  | Record on the tool No. (TOOL) is wrong for the format. |
|  | 4 |  | Record on the position data section is wrong for the format. |
|  | 5 |  | Record on the robot type of XYZ data (RCONF) is wrong for the format. |
|  | 6 |  | Date (DATE) record is wrong for the format. |
|  | 7 |  | Comment (COMM) record is wrong for the format. |
|  | 8 |  | Record on the JOB attribute data (ATTR) is wrong for the format. |
|  | 9 |  | Control group (GROUP) record is wrong for the format. |
|  | 10 |  | Local variable (LVARS) record is wrong for the format. |
|  | 11 |  | JOB argument (JARGS) record is wrong for the format. |
|  | 12 |  | Record on the teaching coordinates for relative job (FRAME) is wrong for the format. |
|  | 13 |  | Position data coordinates do not match relative job coordinates. |
| 3200 | - | NOP or END instruction not found |  |
| 3210 | - | Position No. storage area not found |  |
| 3220 | * | Syntax error in instruction data |  |
|  | 2 |  | Interior control error |
|  | 3 |  | Undefined instruction/tag |
|  | 4 |  | Instruction/tag shortage |
|  | 5 |  | Disuse instruction/tag |
|  | 6 |  | Sub instruction |

11.1 Error Message List

| Error No. | Data | Error Message | Contents |
| :---: | :---: | :---: | :---: |
| 3220 | 7 |  | No instruction |
|  | 8 |  | Invalid instruction |
|  | 9 |  | Invalid tag |
|  | 10 |  | Invalid character |
|  | 11 |  | Undefined intermediate code |
|  | 12 |  | Intermediate code shortage |
|  | 13 |  | Syntax stack overflow |
|  | 14 |  | Syntax stack underflow |
|  | 15 |  | Array type tag incomplete Tag [ARRAY] |
|  | 16 |  | Element type tag incomplete Tag [ELEMENT] |
|  | 17 |  | Macro JOB unregistered |
|  | 18 |  | Input format error |
|  | 19 |  | Data size over |
|  | 20 |  | MIN value over |
|  | 21 |  | MAX value over |
|  | 22 |  | Operation expression error |
|  | 23 |  | Job call argument setting error |
|  | 24 |  | Macro job call argument setting error |
|  | 25 |  | Position vector setting error |
|  | 26 |  | System error |
|  | 27 |  | Soft key designate error |
|  | 28 |  | Numerical input buffer overflow |
|  | 29 |  | Real type data precision error |
|  | 30 |  | Element format error |
|  | 35 |  | BOOL TYPE data error |
|  | 36 |  | CHAR data error |
|  | 37 |  | BYTETYPE, BINARY / HEXADECIMAL BYTE TYPE data error |
|  | 38 |  | INTEGER TYPE, DECIMAL WORD TYPE data error |

11.1 Error Message List

| Error No. | Data | Error Message | Contents |
| :---: | :---: | :---: | :---: |
| 3220 | 39 |  | BINARY/HEXADECIMAL WORD TYPE data error |
|  | 40 |  | DOUBLE PRECISION INTEGER TYPE, DECIMAL DWORD TYPE data error |
|  | 41 |  | BINARY/HEXADECIMAL WORD TYPE data error |
|  | 42 |  | REAL TYPE data error |
|  | 43 |  | LADDER SPECIAL TYPE data error |
|  | 44 |  | JCL text |
|  | 45 |  | Invalid text |
|  | 46 |  | LABEL NAME data error |
|  | 47 |  | JOB NAME data error |
|  | 48 |  | STRING data error |
|  | 49 |  | COMMENT data error |
|  | 58 |  | Invalid instruction/tag detection |
| 3230 | - | Syntax not matched |  |
| 3240 | - | Undefined application |  |
| 3250 | - | Cannot load this file |  |
| 3260 | - | Excess input data |  |
| 3270 | - | Cannot verify this file |  |
| 3280 | - | Wrong welding condition (STANDARD/ ENHANCED) |  |
| 3290 | - | Serial port not defined |  |
| 3300 | - | Serial port being used |  |
| 3310 | - | Protocol being used |  |
| 3350 | - | Not enough memory |  |
| 3360 | - | Invalid folder |  |
| 3370 | - | Incorrect folder name |  |
| 3450 | - | Cannot load macro JOB at current security mode | Load in management mode. |


| Error No. | Data | Error Message | Contents |
| :---: | :---: | :--- | :--- |
|  | $*$ | Cannot backup Compact Flash |  |
|  | 1 |  | Insufficient Compact Flash memory. |
|  | 2 |  | Not accessible to Compact Flash. |
| 3470 | - | Database not found |  |
| 3480 | - | Database access error |  |
| 3490 | - | Same database exists |  |
| 3500 | - | Check Compact Flash insertion |  |
| 3510 | - | Cannot delete folder. Check attribute <br> and inside file |  |
| 3520 | - | Same folder exists |  |
| 3530 | - | Cannot load at current security mode |  |

### 11.1.5 Concurrent I/O

| Error No. | Data | Error Message | Contents |
| :---: | :---: | :---: | :---: |
| 4010 | * | Illegal relay No. |  |
|  | XXX |  | Line No. |
| 4030 | * | Illegal instruction |  |
|  | XXX |  | Line No. |
| 4040 | * | Relay/register No. duplicated in OUT/ GOUT or arithmetic instruction | Multiple outputs are instructed to the relay or register. |
|  | XXX |  | Line No. |
| 4050 | * | The relay is not used |  |
|  | XXX |  | Line No. |
| 4060 | * | Excess STR-[-NOT] instructions |  |
|  | XXX |  | Line No. |
| 4070 | * | Excess AND [OR] STR instructions |  |
|  | XXX |  | Line No. |
| 4080 | * | Syntax error in CNT instructions |  |
|  | XXX |  | Line No. |
| 4090 | * | Enter STR [-NOT] at head of block | Need STR [-NOT] |
|  | XXX |  | Line No. |
| 4120 | - | Concurrent I/O memory is full | Exceeds memory capacity (10000 steps) |
| 4130 | - | END instruction not found | END instruction not found |
| 4140 | - | Wrong ladder program | Position and number of PART instruction are wrong. |
| 4150 | * | Wrong use of GSTR, GOUT commands | GSTR and GOUT is not used together. |
|  | XXX |  | Line No. |
| 4220 | - | Excess TMR/CNT or arithmetic instructions | More than 100 TMR, CNT or arithmetic instruction used |
| 4230 | - | Syntax error in TMR/CNT instructions |  |

### 11.1.6 Maintenance Mode

| Error No. | Data | Error Message | Contents |
| :---: | :---: | :--- | :--- |
| 8010 | - | Too many axes |  |
| 8020 | - | Too many I/O points |  |
| 8030 | - | Too many boards (XFB01B (MASTER)) |  |
| 8031 | - | Too many boards (MSC01B) |  |
| 8040 | - | Memory error (ControINet output condi- <br> tion) |  |
| 8041 | - | Memory error (UNIWIRE CONNECT DAT |  |
| 8050 | - | Robot model is not registered |  |
| 8060 | - | Cannot get UNIWIRE connection data |  |

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## NX100

OPERATOR'S MANUAL
FOR MATERIAL HANDLING, ASSEMBLING, AND CUTTING APPLICATIONS

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```

[^6]
[^0]:    The programming pendant does not have the [REFP] key for the application of spot weld- ing, general purposes (= material handling, assembling, cutting) or motor gun.

[^1]:    NOTE

    - FWD/BWD operation is performed with SLW speed even if INCH is selected.

[^2]:    NOTE

    - The direct open function cannot be used again while a directly opened window is shown. - If another window is selected while the direct open function is effective, the function is automatically cancelled and the lamp on the direct open key goes out.
    - Once another JOB CONTENT window is opened by the direct open function, the source job cannot be continuously operated. (Stopped until the opened JOB CONTENT window is closed.)

[^3]:    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."

[^4]:    ${ }^{* 1}$ For the operation, refer to instruction manuals for each optional function.

[^5]:    NOTE
    Removing the CF or disconnecting the control power supply while writing data to the CF/ reading data from the CF may cause data corruption in the CF.

    Please DO NOT remove the CF or disconnect the control power supply while

    - the remaining bytes indication is switching to the file list window after the data of the external memory device is saved, loaded, or verified, and the hourglass icon disappears.
    - the screen is switching to the file list window after the data of the external memory device is deleted.
    - the folder list is being updated after a folder is created to or deleted from a folder of the external memory.
    - the message "Under running auto backup is being displayed.
    - CMOS.BIN is being saved with the message "Saving system data. Don't turn the power off" displayed.
    - CMOS.BIN is being loaded with the message "Loading system data. Don't turn the power off" displayed.

[^6]:    Specifications are subject to change without notice
    for ongoing product modifications and improvements.

