Motoman XRC Controller

Relative Job Function Manual

for UP/SKX-Series Robots

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SECTION 1
INTRODUCTION

1.1 About this Document

This manual provides instructions for Relative Job Function and contains the following sections:

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

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

SECTION 3 – RELATIVE JOB FUNCTION
Provides detailed instructions to utilize the Relative Job Function.

1.2 Reference to Other Documentation

For additional information refer to the following:

- Concurrent I/O Parameters Manual (P/N 142102-1)
- Operator’s Manual for General Purpose (P/N 142099-1)
- Operator’s Manual for Handling (P/N 142100-1)
- Operator’s Manual for Spot Welding (P/N 142101-1)
- Operator’s Manual for Arc Welding (P/N 142098-1)
- Motoman UP6, XRC Manipulator Manual (P/N 142104-1)
- Motoman SK16X, XRC Manipulator Manual (P/N 142105-1)
- Motoman SK45X, XRC Manipulator Manual (P/N 142106-1)
- Motoman UP130, XRC Manipulator Manual (P/N 142107-1)

1.3 Customer Service Information

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

- Robot Type (UP6, SK16X, etc.)
- Application Type (welding, handling, etc.)
- Robot Serial Number (located on the back side of the robot arm)
- Robot Sales Order Number (located on back side of XRC controller)

NOTES

SECTION 2
SAFETY

2.1 Introduction

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

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

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

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

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

This safety section addresses the following:

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

2.2 Standard Conventions

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

- DANGER
- WARNING
- CAUTION
- NOTE

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

DANGER!

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

WARNING!

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

CAUTION!

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

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

2.3 General Safeguarding Tips

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

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

2.4 Mechanical Safety Devices

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

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

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

2.5 Installation Safety

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

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

2.6 Programming Safety

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

- Any modifications to PART 1 of the MRC controller PLC can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to PART 1. Making any changes without the written permission of Motoman will **VOID YOUR WARRANTY!**
- Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. **YOUR WARRANTY WILL BE VOID** if you use these special passwords.
- Back up all programs and jobs onto a floppy disk whenever program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.
- The concurrent I/O (Input and Output) function allows the customer to modify the internal ladder inputs and outputs for maximum robot performance. Great care must be taken when making these modifications. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations that may damage the robot or other parts of the system.
- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.

- Inspect the robot and work envelope to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Be sure that all safeguards are in place.
- Check the E-STOP button on the teach pendant for proper operation before programming.
- Carry the teach pendant with you when you enter the workcell.
- Be sure that only the person holding the teach pendant enters the workcell.
- Test any new or modified program at low speed for at least one full cycle.

2.7 Operation Safety

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

- Be sure that only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories are permitted to operate this robot system.
- Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Inspect the robot and work envelope to ensure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Ensure that all safeguards are in place.
- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot. This includes controller parameters, ladder parts 1 and 2, and I/O (Input and Output) modifications. Check and test all changes at slow speed.

2.8 Maintenance Safety

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

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

YASNAC XRC OPTIONS
INSTRUCTIONS

RELATIVE JOB FUNCTION

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

MOTOMAN INSTRUCTIONS

MOTOMAN SETUP MANUAL
MOTOMAN-☐☐☐ INSTRUCTIONS
YASNAC XRC INSTRUCTIONS
YASNAC XRC OPERATOR'S MANUAL
YASNAC XRC OPERATOR'S MANUAL for BEGINNERS

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

YASKAWA

MANUAL NO. RE-CKI-A415

MANDATORY

- This manual explains the relative job function of the YASNAC XRC system. Read this manual carefully and be sure to understand its contents before handling the YASNAC XRC.
- General items related to safety are listed in Section 1: Safety of the Setup Manual. To ensure correct and safe operation, carefully read the Setup Manual before reading this manual.

CAUTION

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

NOTES FOR SAFE OPERATION

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

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

WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.
MANDATORY	Always be sure to follow explicitly the items listed under this heading.
PROHIBITED	Must never be performed.

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

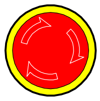
NOTE

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

WARNING

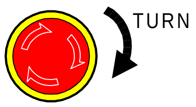
- Before operating the manipulator, check that servo power is turned off when the emergency stop buttons on the playback panel or programming pendant are pressed.
  When the servo power is turned off, the SERVO ON READY lamp on the playback panel and the SERVO ON LED on the programming pendant are turned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

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

  Emergency Stop Button 

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

  Injury may result from unintentional or unexpected manipulator motion.

  Release of Emergency Stop 

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

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

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

  Improper or unintended manipulator operation may result in injury.

- Confirm that no persons are present in the manipulator's work envelope and that you are in a safe location before:
  - Turning on the YASNAC XRC power
  - Moving the manipulator with the programming pendant
  - Running check operations
  - Performing automatic operations

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

CAUTION

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

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

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

- Read and understand the Explanation of the Alarm Display in the setup manual before operating the manipulator.

Definition of Terms Used Often in This Manual

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

Equipment	Manual Designation
YASNAC XRC Controller	XRC
YASNAC XRC Playback Panel	Playback Panel
YASNAC XRC Programming Pendant	Programming Pendant

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

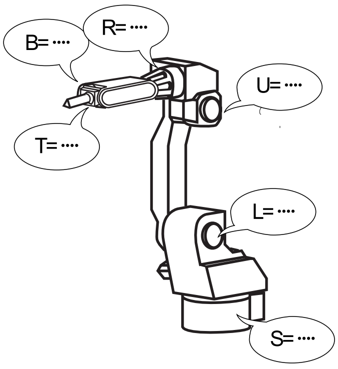
Equipment		Manual Designation
Programming Pendant	Character Keys	The keys which have characters printed on them are denoted with [ ]. ex. [ENTER]
	Symbol Keys	The keys which have a symbol printed on them are not denoted with [ ] but depicted with a small picture. ex. page key  The cursor key is an exception,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

Description of the Operation Procedure

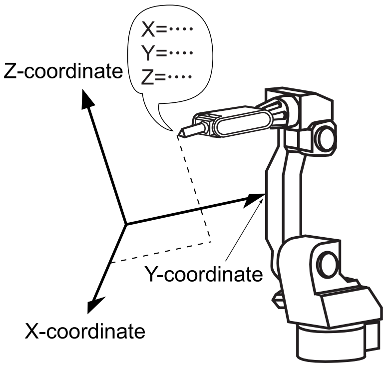
In the explanation of the operation procedure, the expression "Select • • • " means that the cursor is moved to the object item and the SELECT key is pressed.

1 Relative Job

In a standard job, each position is defined by a set of pulse numbers, which represent the amount of revolutions of the S, L, U, R, B, and T axes.
In a relative job, however, each position is represented with a set of three values (X, Y, Z) in a specified coordinate system.



Pulse Type Position Data of Standard Job



XYZ-type Position Data of Relative Job

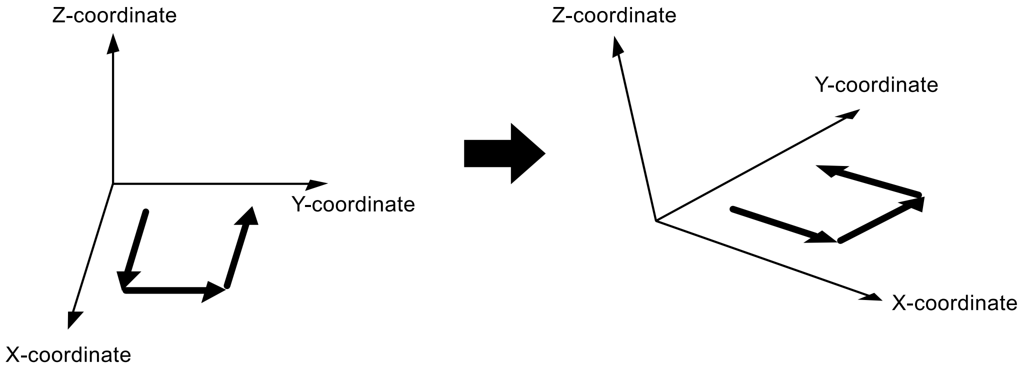
1.1 Coordinate Systems

In a relative job, any of the following three types of coordinate systems can be used:

- Base coordinate system
- Robot coordinate system
- User coordinate system (24 systems available)

1.2 Relative Job Shift Functions

In a relative job that uses a user coordinate system, changing the definition points to re-determine the coordinate system also changes the coordinates used for the robot operations accordingly.
Also when the operating coordinate system number is changed, the coordinates used for operations are also changed accordingly.



Movement in User Coordinate System No. 1

Relative Job Shifting Operation when Definition Point is Changed

NOTE

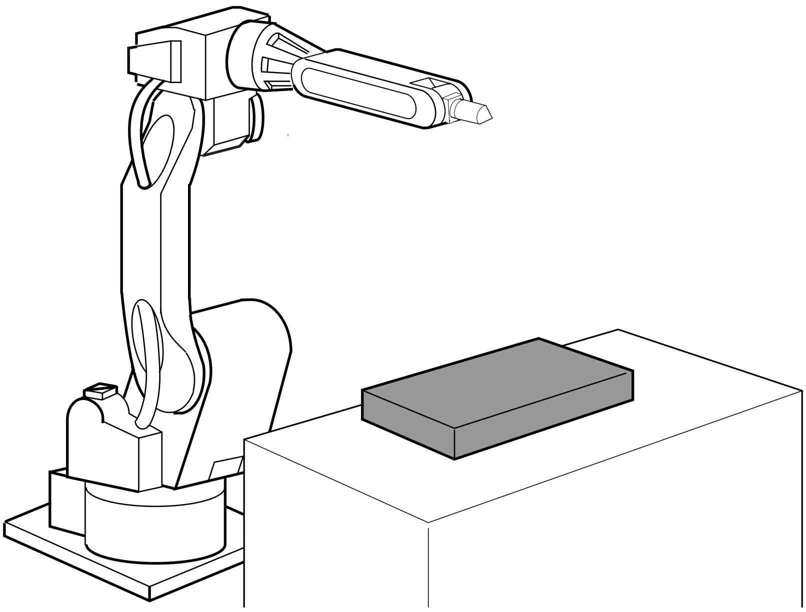
- Changing definition points of the user coordinate system or varying the coordinate system number without due consideration may cause the manipulator to move in an unexpected direction when the job is executed. Be careful when changing the coordinate system.
- Shifting the steps that have been taught by the MOVJ instruction may distort the path. Be careful and avoid interference with jigs and other machinery.

2 Examples of Use of Relative Jobs

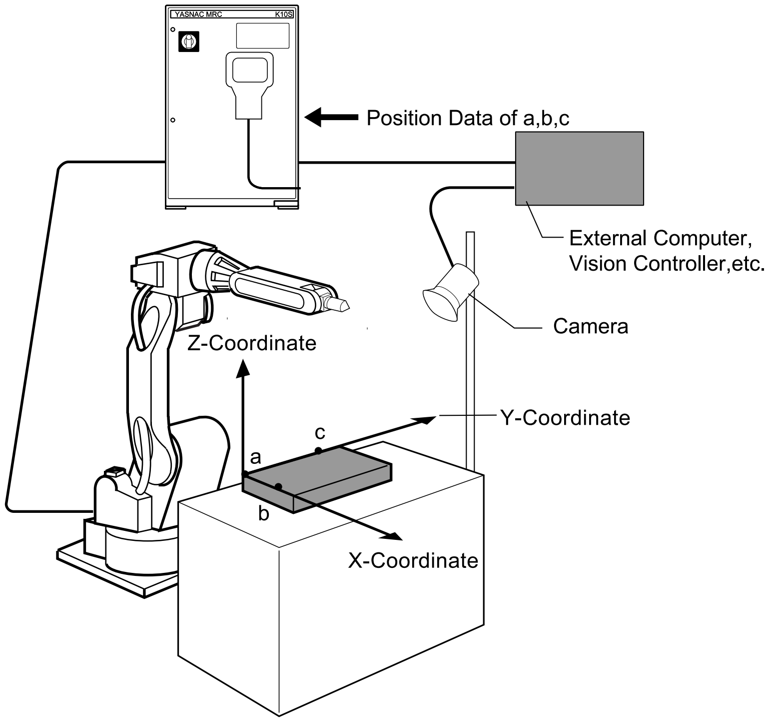
2.1 Shift Function to Offset Workpiece Position Error

After teaching a standard job for a workpiece placed at a reference point, the job is converted into a relative job in a user coordinate system. With a shift function and sensors, possible differences of workpiece positions between teaching and playback can be offset.

1. Place a workpiece at a reference point and teach as usual. Name the job as “STANDARD-1”.



2. Create a user coordinate system for the workpiece. Execute a job that creates a user coordinate system based on the position data of three definition points detected on the workpiece by sensors.



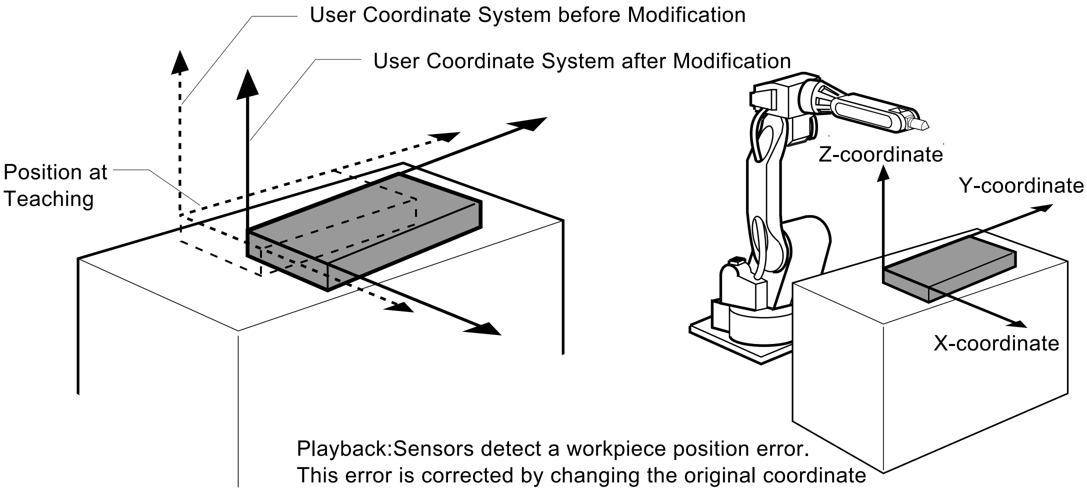

```
NOP

LOADV P000 ← a
LOADV P001 ←b      } Position data of points detected by external sensors is
LOADV P002 ←c        received and stored as position variables.

MFRAME  UF#(1)   P000   P001   P002    ←User coordinate system created.

END
```

3. Create a relative job. Convert “STANDARD-1” created in step 1 into a relative job called “RELATIVE-1” using user coordinate system No. 1 created in step 2.

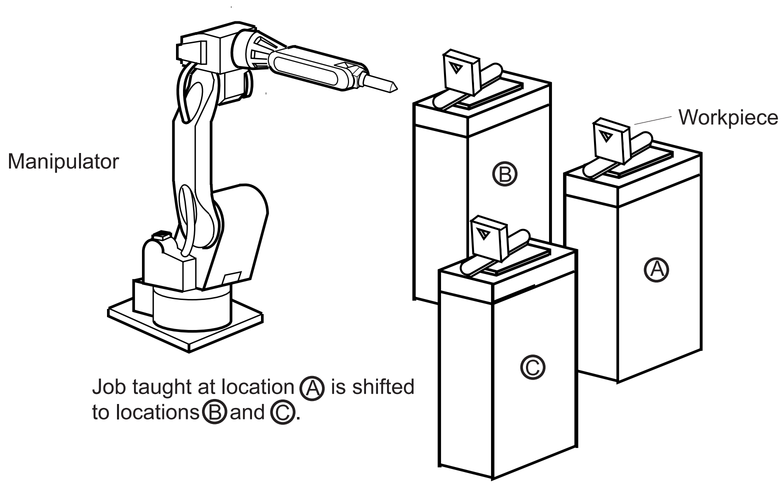
4. Play back the job.
   Use the following job to perform the relative job.

```
NOP

LOADV P000
LOADV P001     } Position data of points detected by external sensors is received
LOADV P002       and stored as position variables.

MFRAME  UF#(1)   P000   P001   P002    ←User coordinate system created
MOVJ VJ=50.0                           ←Moving to waiting position
CALL JOB:RELATIVE-1                    ←"RELATIVE-1" of user coordinate system
                                         No.1 executed

END
```

.



2.2 A Single Manipulator to Work on the Same Type of Workpiece in Different Locations



A Single Manipulator to Work on the Same Workpiece in Different Locations

With the relative job function, a single manipulator can easily work on the same type of work-piece in different locations in the following two ways.

2.2.1 By Modifying the Teaching Coordinate

Create a job for a single workpiece, and then shift the job to another location to create another job. In this way, create a job at each location, fine adjustment at each position is possible.

1. Create a job for a single workpiece.

2. Teach a user coordinate system (for instance, UF#1) for the workpiece in that location.

3. Convert the job created in step 1 into a relative job in the user coordinate system taught in step 2.

4. Move the workpiece to another location and teach another user coodinate system (for instance, UF#2) for the workpiece in that location.

5. Call up the job header display of the relative job created in step 3 and change the coordinate system to the user coordinate system (UF#2) taught in step 4.

6. Create a new standard job by converting the relative job of the modified coordinate system.
   This new standard job is to be executed at the location of step 4.

7. To create more jobs for other locations, repeat steps 4 to 6 using other user coordinate system numbers.

2.2.2 By Converting the User Coordinate when Operating

A single relative job can be executed at more than one position. In this way, the memory can be used effectively.

1. Create job “ABCDEF” for a single workpiece.

2. Teach a user coordinate system (for instance, UF#1) for the workpiece in that location.

3. Convert the job created in step 1 into a relative job using the user coordinate system taught in step 2.

4. Move the workpiece to another location and teach another user coordinate system (for instance, UF#2) for the workpiece in that location.

5. Specify the operating coordinate system when calling the work job from a control job.

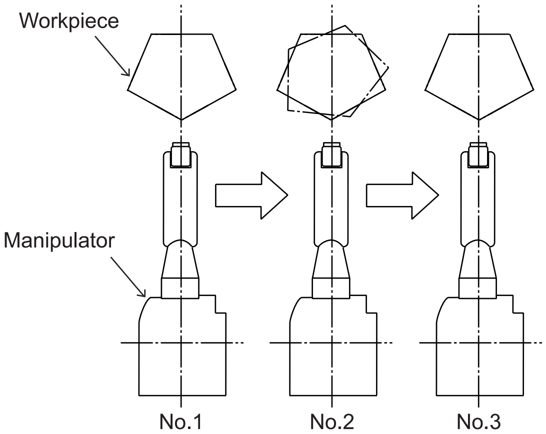
```
NOP
 |
CALL JOB:ABCDEF UF#2
 |
END
```

When the CALL instruction is executed, relative job “ABCDEF” that was taught using UF#1 is performed using UF#2.

6. To create more jobs to execute at other locations, repeat steps 4 and 5 using other user coordinate system numbers.

NOTE The manipulator is not always capable of carrying out the operation depending on the operating position. Do not force the manipulator to make excessive position changes.

2.3 Using One Job on Multiple Manipulators



Using One Job on Multiple Manipulators

A job taught to one manipulator can be used for other manipulators on the line.

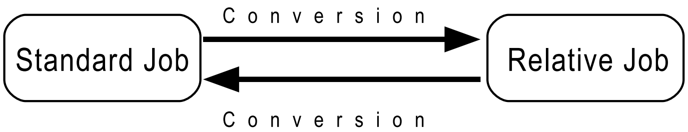
1. On manipulator No.1, create a job for a single workpiece.
2. Teach a user coordinate system (for instance, UF#1) for the workpiece in that location.
3. Convert the job created in step 1 into a relative job using the user coordinate system taught in step 2.
4. Save the created relative job to a floppy disk via the YASNAC FC1 or FC2.
5. Set workpieces to manipulators No. 2 and No. 3 to which the job will be shifted. Teach the user coordinate system (UF#1) to the manipulators.
6. Load the relative job saved in step 4 and convert it to standard jobs for manipulators No. 2 and No. 3.

NOTE The manipulator is not always capable of carrying out the operation depending on the operating position. Check the positions by FWD and BWD operations.

3 Operations Related to Relative Jobs

3.1 Converting into a Related Job

To create a relative job, convert a standard job into a relative job. The conversion of a relative job into a standard job is also possible.

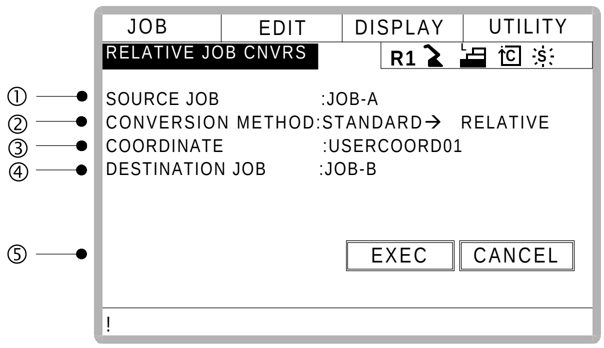


Operation

Select {JOB} under the top menu ➡ Select {JOB CONTENTS} ➡ Select {UTILITY} under the menu ➡ Select {RELATIVE JOB}*1

Explanation

1 Relative job conversion display is shown.



①SOURCE JOB

Selects the job to be converted.
Select {SOURCE JOB} and the job list display is shown. Select the job to be converted.

②CONVERSION METHOD

Displays the conversion method.

- STANDARD→RELATIVE : Converts a standard job into a relative job
- RELATIVE→STANDARD : Converts a relative job into a standard job

③COORDINATE

Selects a coordinate system where a standard job is converted into a relative job.
Select {COORDINATE}, and the selection dialog is displayed. Select one of BASE, ROBOT, and USER. When {USER} is selected, enter the user coodinate number and press [ENTER].

④DESTINATION JOB

Sets a job name for the conversion destination.
Select {DESTINATION}. Enter a job name for the conversion destination. When a job name for the conversion destination has been set, a new job is created when converting. When a job name has not been set, the job at the conversion source itself is used.

⑤EXEC

Executes job conversion.
Select {EXEC} to execute the conversion.

NOTE

- During conversion, all key operations are disabled.
- Any alarm during the conversion interrupts the operation.
- When the conversion is completed, the job contents display is shown.
- The following diagram shows, that when a relative job has been converted into a standard job, "/OV" is displayed in the programming steps when the new position is not within the manipulator working envelope. This "/OV" display disappears after modifying the position.

```
J:JOB-A   S:000          TOOL:00
0000 NOP
0001 'JOB FOR CARMODEL-A
0002 JUNP JOB:JOB-01
0003 MOVJ VJ=50.00
0004 MOVJ /OV VJ=50.00
0005 MOVJ VJ=50.00
0006 JUMP JOB:JOB-02
```

"/OV"is displayed when the position is not within the manipulator working envelope.

3.2 Verification of Information Related to Relative Job

3.2.1 Verifying Coordinate System

The coordinate system used for teaching can be verified in the job header display.

Operation

Select {JOB} under the top menu ➡ Select {JOB CONTENTS} ➡ Select {DISPLAY} under the menu ➡ Select {JOB HEADER}*1

Explanation

***1** The job header display is shown. The screen is scrolled with the cursor.

```
JOB      EDIT      DISPLAY   UTILITY
JOB HEADER                R1
JOB NAME         :TEST JOB
COMM.:THIS JOB IS TEST JOB
DATE              :1998/05/27 12:00
JOB TYPE          :RELATIVE
TEACH COORD       :USER COORD02
```

When the coordinate system used for teaching is a user coordinate system, the user coodinate numbers can be changed in this display.

Operation

Select {TEACH COORD} ➡ Enter the user coordinate number and press [ENTER].

3.2.2 Verifying Command Positions

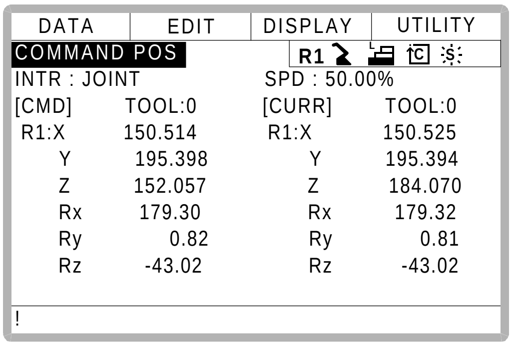
By calling up the command position display for the relative job, the command position of XYZ-type appears.

Operation

Select {ROBOT} under the top menu ➡ Select {COMMAND POS}*1

Explanation

1 The command position display is shown.

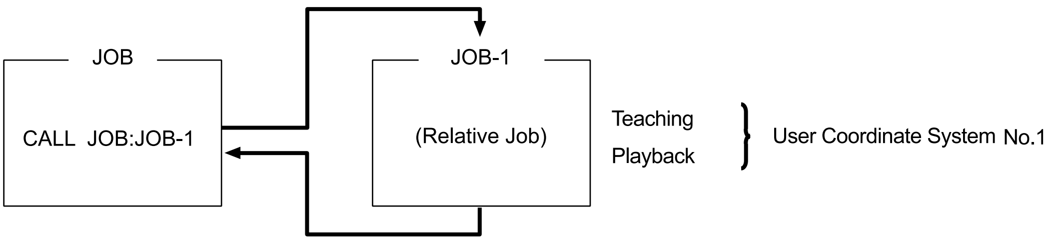


3.3 Instructions Related to Relative Job

3.3.1 CALL/JUMP

CALL or JUMP are the instructions used to call and execute a relative job.
If no coordinate system number is specified for the job, the job is carried out with the coordinate system used for teaching.

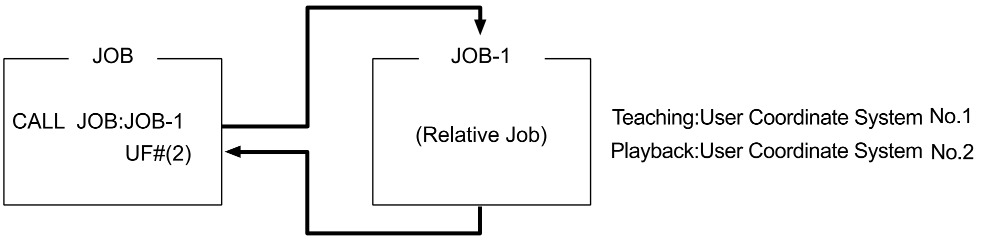
CALL JOB: JOB-1
JUMP JOB: JOB-1 IF IN#(1)=OFF



If the job was taught using a user coordinate system, the job can be carried out using another user coordinate system when called by CALL or JUMP.

<Example>
When executing relative job “JOB-1” that was taught using the user coordinate system No. 1, change the coordinate system to No. 2. The coordinates of the steps in JOB-1 are converted into the coordinates of coordinate system No. 2.

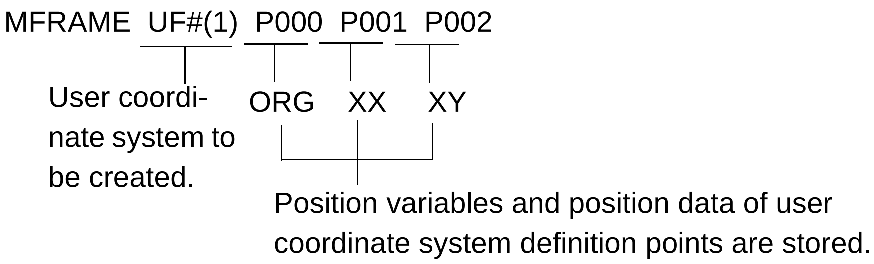
CALL JOB: JOB-1 UF#(2)



3.3.2 MFRAME

The MFRAME instruction creates a user coordinate system from position data detected by sensors.

<Example>
Position data of sensor-detected definition points of the user coordinate system are stored as position variables. Using the position variables, a user coordinate system is created.



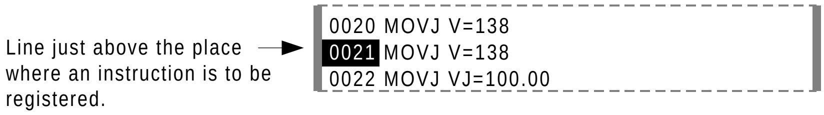
3.3.3 Registering an Instruction

Operation

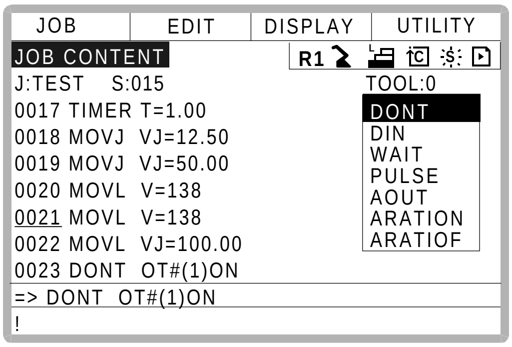
Move the cursor to the address area ➜ Move the cursor to the line just above the place where an instruction is to be registered in the job content display[*1] ➜ Press[INFORM LIST][*2] ➜ Select an instruction to be registered[*3] ➜ Change the additional items and variable data[*4] ➜ Press [ADD] and [ENTER][*5]

Explanation

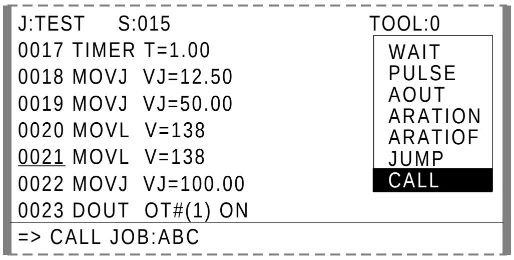
***1** In the job content display in the teach mode, move the cursor to the line just above the place where an instruction is to be registered.



2 The instruction list dialog is displayed. The cursor moves to the instruction list dialog while the cursor in the address area changes to an underbar.

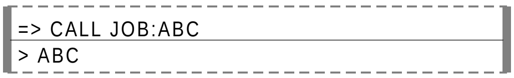


3 The instruction where the cursor is positioned is displayed with the previously registered additional items in the input buffer line.



4 <To register items as displayed in the input buffer>
Perform operation *5.

<To edit any additional items>
Move the cursor to the additional item to be changed, and then press [SELECT] to display an input line.



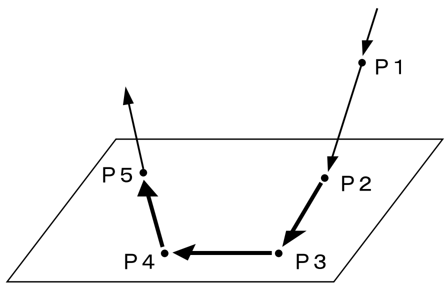
Enter the desired characters and press [ENTER]. The characters in the input buffer line are changed.

NOTE

Notes on registering CALL and JUMP instructions

When a relative job is started, the manipulator moves from its current position. Therefore, teach the manipulator to assume a stance or positioning similar to the positioning required for the first step of a relative job before calling the job.
If the manipulator starts a relative job with a stance that is very different from that required in the first step, it may move in an unexpected way.

<Example>



P1: Posture near relative job first step posture

```
MOVJ  VJ=20.00
CALL  JOB: RELATIVE-1←P2 to P5
MOVJ  VJ=20.00
```

3.4 Editing Relative Jobs

Relative jobs, like standard jobs, can be edited with the programming pendant for adding, modifying, and deleting positions.
The differences of editing relative jobs and editing standard jobs are explained in this section.

3.4.1 Blinking Display of Move Instruction on Job Content Display

XYZ type current positions are updated by the FWD operation and not by just calling the job. Therefore, when only moving the cursor after the job is called, the move instructions only blink and do nothing else even if the current and the commanded manipulator positions match.

3.4.2 Addition and Modification of Steps

• Coordinate system of teaching	Taught coordinate system of a relative job is used. If the taught coordinate system is a user coordinate system and another user coordinate system has been specified for the operating coordinate system, the operating coordinate system is used.
• Teaching tool	Coordinates of operation positions are registered by the tool used when the axis is operated.

3.4.3 Cut & Paste Function

Cutting and pasting from a standard job to a relative job is impossible, and vice versa. Cutting and pasting between relative jobs in different coordinate systems is also impossible.

3.5 Relative Job Operation Method

When a relative job is performed, there are several ways of moving to the step position. The following three methods can be used.

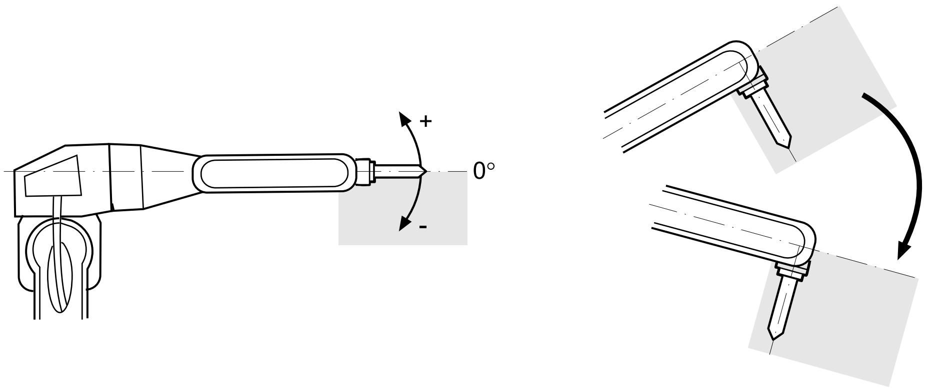
• Previous Step Regarded (B-axis sign constant)	Effective for a job where the B-axis does not move past 0°. For example, when operation is performed with the B-axis pointed downward.
• Previous Step Regarded (Minimum R-axis movement)	Effective for a job where the B-axis moves past 0°.
• Type Regarded	Effective when a job created by offline teaching is to be performed.

The operation method can be specified by the following parameter.
When converting a relative job into a standard job, the method specified by this parameter is also used.

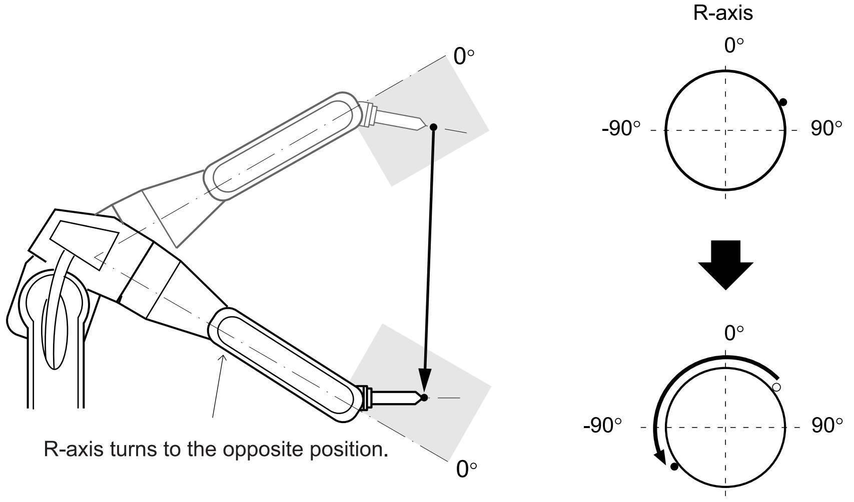
Parameter	Settings	Initial value
S2C260	0 : Previous step regarded (B-axis sign constant) 1 : Type regarded 2 : Previous step regarded (Minimum R-axis movement)	0

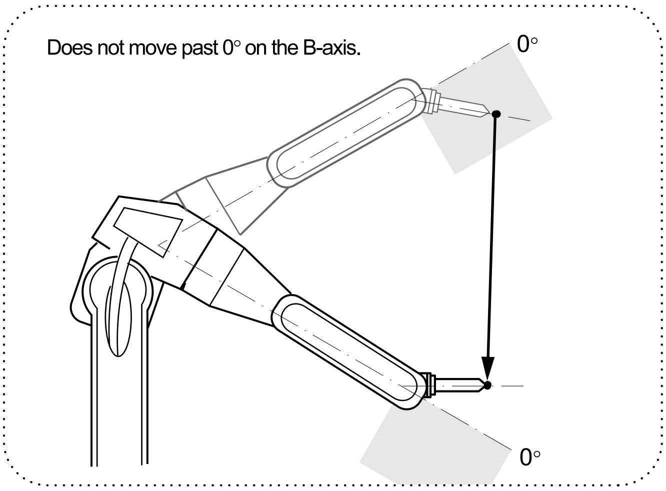
3.5.1 Previous Step Regarded (B-axis Sign Constant)

This method allows movement to the specified step in relation to the B-axis angle of the previous step. During operation, movement is made keeping the B-axis angle sign (+/-) constant so that it does not change.
Therefore, it is used for a job where the B-axis does not move past 0°



If a job where the B-axis moves past 0°is taught, the angle of the B-axis stays unchanged even though it should be changed, resulting in the R-axis turning to the position opposite by 180°.



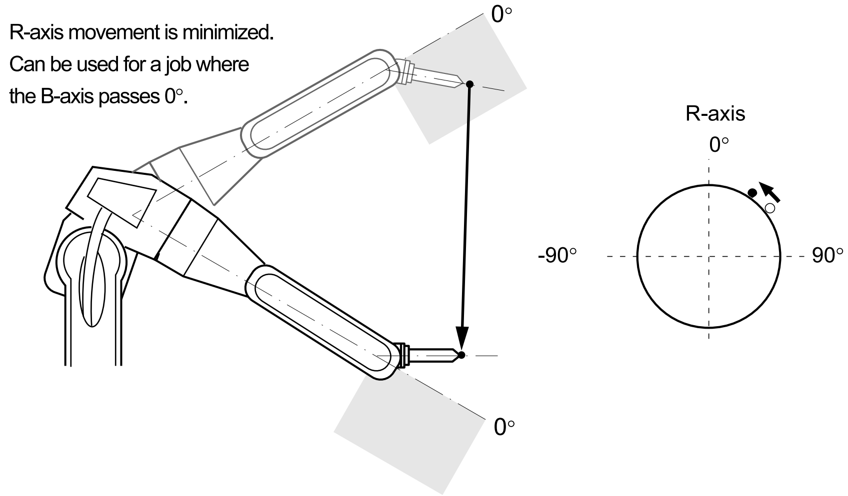


NOTE

- When converting a standard job into a relative job, teach a standard job where the B-axis does not pass 0°.
- When converting a relative job into a standard job, the manipulator's current stance or positioning is a reference point. When converting place the manipulator in a stance similar to the positioning required by the first step of the relative job to be converted.

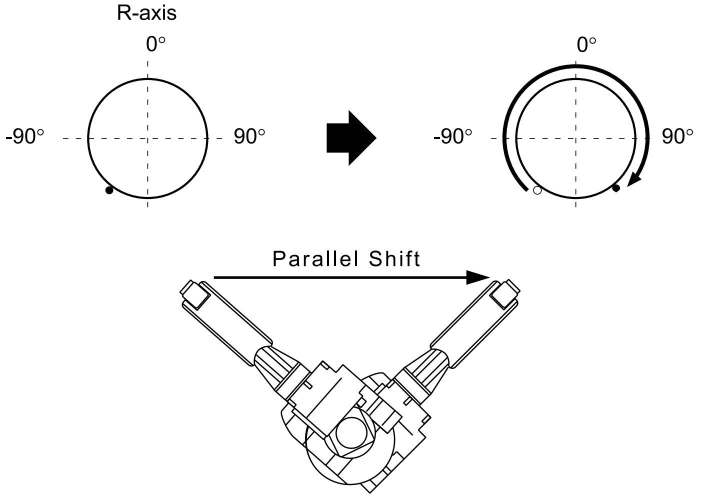
3.5.2 Previous Step Regarded (Minimum R-axis Movement)

This method keeps the R-axis movement to a minimum when the manipulator moves from the previous step to the next step.Therefore, it can be used for jobs where the B-axis passes 0°. Since this method minimizes R-axis movement, add some steps to the prescribed path when the R-axis is to be moved within a wide range.



If a parallel shift is executed in a relative job, the R-axis may have to rotate greatly when the shift amount is large. In such cases, this method can not be applied. Use the method described in Section 3.5.1 "Previous Step Regarded (B-axis Sign Constant)."

.

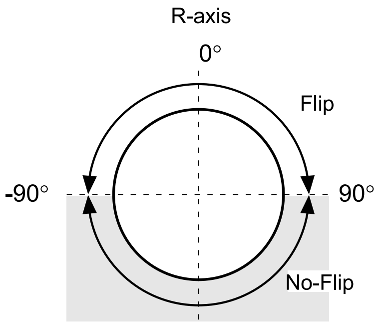


NOTE
- When converting a standard job into a relative job, a standard job should be taught so that the R-axis movement between steps does not exceed 90°. To move the R-axis in an angle measuring more than 90°, add some steps to devide the large angle into smaller ones.
- When converting a relative job into a standard job, the manipulator's current stance or positioning is a reference point. When converting, place the manipulator in a stance similar to the positioning of first step of the relative job to be converted.

3.5.3 Type Regarded

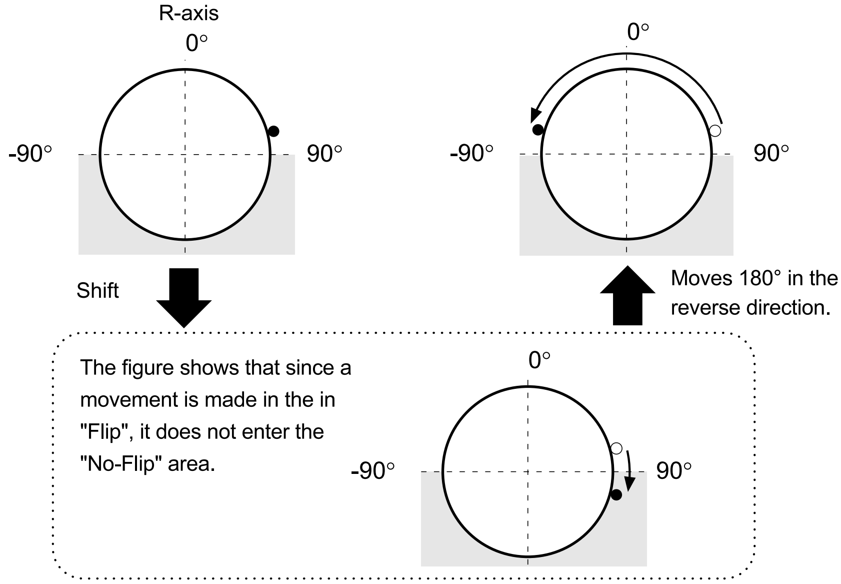
When a relative job is converted from a standard job, position data of each step is classified into XYZ type position data and type data. In the type operation method, movement is made so that the type can be added to the position data.

Since a movement is made for the specified type, this method is effective when performing a job taught offline .



However, when a relative job is used as the shifting function for workpiece dislocation, special attention must be paid. If the teaching position is near the pole changing point, the movement may not be made for the specified type when the position is shifted according to the workpiece dislocation.

For example, when the angle of the R-axis of the teaching position for a standard job is close to but less than 90° and this position is changed, the angle of the R-axis may change to exceed 90°.
The movement is made in "flip" before shifting and "no-flip" after shifting.
Since a movement is made for a specified type even when using the type regarded method, the angle of the R-axis is near -90° when reversing 180°. Therefore, moving 180° in the opposite direction to the position taught by the R-axis may cause interference with the workpiece.
The final tool position and stance are not changed before and after shifting.


R-axis
0°
-90°
90°
Shift
0°
-90°
90°
Moves 180° in the reverse direction.
The figure shows that since a movement is made in the in "Flip", it does not enter the "No-Flip" area.
0°
-90°
90°

4 Interface with an Easy Offline Teaching System

A relative job can be used as an interface with an easy offline teaching system. The necessary information to create a relative job on the easy offline teaching system is described in this chapter.

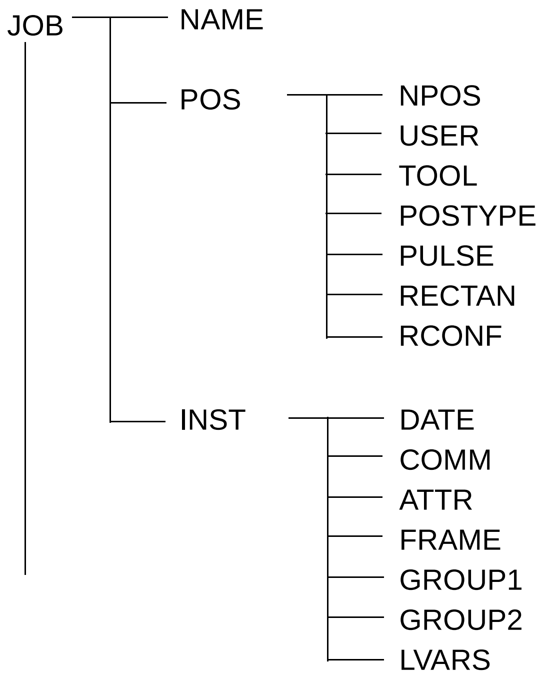
4.1 Job Data Format

When a relative job is output via the YASNAC FC1 or FC2 or by data transmission, the output file contents are as follows.

```
FILE NAME .JBI

/JOB
//NAME <JOB NAME>
//POS
///NPOS  <C>,<BC>,<EC>,<P>,<BP>,<EX>
///USER <N>
///TOOL <N>
///POSTYPE <T>
///RECTAN
///RCONF <l>,<m>,<n>,<o>,<p>,<q>
Cxxxx =X,Y,Z,Rx,Ry,Rz
BCxxxx=X0,Y0,Z0
ECxxxx=1,2
        ¦
        ¦
//INST
///DATE <YYYY>/<MM>/<DD> <HH>:<TT>
///COMM  <COMMENT CHARACTER LINE>
///ATTR  <ATTRIBUTE 1>,<ATTRIBUTE 2>,····,<ATTRIBUTE 16>
///FRAME <C>
///GROUP1 <m1>,<m2>,<m3>
///GROUP2 <m1>,<m2>,<m3>
NOP
MOVJ  Cxxx BCxxx ECxxx VJ=xxx.x
        ¦
        ¦
END
```

A pseudo instruction is distinguished by a single slash (/) at its beginning. Each level of individual instructions are marked with a double slash (//), a triple slash (///), and a fourfold slash (////).

A pseudo instruction related to the job is made as follows.



4.1.1 JOB

Function : Shows that this is a job.
Format : /JOB

4.1.2 NAME

Function : Shows the job name.
Format : //NAME <Name>

<Name> : up to 8 characters

4.1.3 POS

Function : Shows the position data.
Format : //POS

NPOS

Function : Shows the number of position data items.
Format : ///NPOS <C>,<BC>,<EC>,<P>,<BP>,<EX>

<C> : Number of robot axis teaching positions
<BC>: Number of base axis teaching positions
<EC>: Number of external (station) axis teaching positions
<P> : Number of robot axis position variables
<BP>: Number of base axis position variables
<EX>: Number of external (station) axis position variables

USER

Function : Shows the currently selected user coordinate system No.
Format : ///USER <N>

<N>: User coordinate system No.(0 to 23)

TOOL

Function : Shows the currently selected tool No.
Format : ///TOOL <N>

<N>: Tool No.(0 to 23)

POSTYPE

Function : Shows the position data type.
Format : ///POSTYPE<T>

<T>: |PULSE||BASE||ROBOT||TOOL||USER||MTOOL|
<PULSE>: Pulse data
<BASE> : Cartesian data, base coordinate system
<ROBOT>: Cartesian data, robot coordinate system
<TOOL> : Cartesian data, tool coordinate system
<USER> : Cartesian data, user coordinate system
<MTOOL>: Cartesian data, master tool coordinate system

PULSE

Function : Shows that palse data is defined during and after this pseudo instruction.
Format : ///PULSE

<Pulse data>:<C>|<BC>|<EC>|<P>|<BP>|<EX>
<C>:<Cxxxx>=<S>,<L>,<U>,<R>,<B>,<T>,<E1>,<E2>
<BC>:<BCxxxx>=<1>,<2>,<3>,<4>,<5>,<6>,<E1>,<E2>
<EC>:<ECxxxx>=<1>,<2>,<3>,<4>,<5>,<6>,<E1>,<E2>
<P>:<Pxxx>=<S>,<L>,<U>,<R>,<B>,<T>,<E1>,<E2>
<BP>:<BPxxx>=<1>,<2>,<3>,<4>,<5>,<6>,<E1>,<E2>
<EX>:<EXxxx>=<1>,<2>,<3>,<4>,<5>,<6>,<E1>,<E2>
<Cxxxx>: Robot axis teaching position
<BCxxxx>: Base axis teaching position
<ECxxxx>: External (station) axis teaching position
<Pxxx>: Robot axis position variables
<BPxxx>: Base axis position variables

<EXxxx>: External (station) axis position variables
<S>: S-axis pulse data
<L>: L-axis pulse data
<U>: U-axis pulse data
<R>: R-axis pulse data
<B>: B-axis pulse data
<T>: T-axis pulse data
<E1>: Not used
<E2>: Not used

xxxx := A number from 0 to 999

RECTAN

Function : Shows that Cartesian data is defined during and after this pseudo instruction.
Format : ///RECTAN

<Cartesian data>: <C>|<BC>|<P>|<BP>
<C> : <Cxxxx> = <X>,<Y>,<Z>,<Rx>,<Ry>,<Rz>
<BC>: <BCxxxx> = <1>,<2>,<3>,<4>,<5>,<6>
<P> : <Pxxx> = <X>,<Y>,<Z>,<Rx>,<Ry>,<Rz>
<BP>: <BPxxx> = <1>,<2>,<3>,<4>,<5>,<6>
<Cxxxx> : Robot axis teaching position
<BCxxxx>: Base axis teaching position
<Pxxx> : Robot axis position variables
<BPxxx> : Base axis position variables
<X> : X-axis Cartesian data
<Y> : Y-axis Cartesian data
<Z> : Z-axis Cartesian data
<Rx> : Rx-axis Cartesian data
<Ry> : Ry-axis Cartesian data
<Rz> : Rz-axis Cartesian data

RCONF

Function : Shows the manipulator type of the Cartesian data defined during and after this pseudo instruction.
Format : ///RCONF <l>,<m>,<n>,<o>,<p>,<q>

<l>: 0: Flip, 1: No-flip
<m>: 0: Upper arm, 1: Lower arm
<n>: 0: Front, 1: Rear
<o>: 0: R < 180, 1: R >= 180
<p>: 0: T < 180, 1: T >= 180
<q>: 0: S < 180, 1: S >= 180
For manipulator type, refer to Section 4.4 “Manipulator Type”.

4.1.4 INST

Function : Shows that it is an instruction.
Format : //INST

DATE

Function : Shows the date.
Format : ///DATE <YYYY>/<MM>/<DD> <HH>:<TT>

<YYYY>: Year
<MM>: Month
<DD>: Day
<HH>: Hour
<TT>: Minute

COMM

Function : Shows that it is a job comment.
Format : ///COMM <Comment character line>

<Comment character line> : Up to 32 characters

ATTR

Function : Shows the job attribute.
Format : ///ATTR <Attribute 1>,<Attribute 2>,····,<Attribute16>

<Attribute>: JD|DD|SC|{RO|WO|RW}|RJ
<JD>: Job Destroy
<DD>: Directory Destroy
<SC>: Save Complete

{RO|WO|RW}
<RO>: Writing disabled “Edit-lock”(Read Only)
<WO>: Reading disabled(Write Only)
<RW>: Reading/Writing capable(Read/Write)
<RJ>: Relative job

FRAME

Function : Shows relative job teaching coordinate system.
Format : ///FRAME <C>

<C>: BASE|ROBOT|N|
<N>: User coordinate system No.(1 to 24)
<BASE>: Base coordinate system(Cartesian)
<ROBOT>: Robot coordinate system(Cartesian)
<USER>: User coordinate system(Cartesian)

GROUP1

Function : Shows 1st MOVE control group.
Format : ///GROUP1 <m1>,<m2>,<m3>

Add any of the following to<m1>,<m2>, and<m3>.
RB1(robot 1)
RB2(robot 2)
BS1(base 1)
BS2(base 2)
ST1(station 1)
ST2(station 2)
ST3(station 3)
ST4(station 4)
ST5(station 5)
ST6(station 6)

GROUP2

Function : Shows 2nd MOVE control group.
Format : ///GROUP2 <m1>,<m2>,<m3>

Add any of the following to<m1>,<m2>, and<m3>.
RB1(robot 1)
RB2(robot 2)
BS1(base 1)
BS2(base 2)
ST1(station 1)
ST2(station 2)
ST3(station 3)
ST4(station 4)
ST5(station 5)
ST6(station 6)

LVARS

Function : Shows the number of local variables.
Format : ///LVARS <LB>,<LI>,<LD>,<LR>,<LP>,<LBP>,<LEX>

<LB>: Number of byte type local variables
<LI>: Number of integer type local variables
<LD>: Number of double-precision type local variables
<LR>: Number of real number type local variables
<LP>: Number of robot axis position type local variables
<LBP>: Number of base axis position type local variables
<LEX>: Number of external (station) axis position type local variables

4.2 Relative Job Data Examples

4.2.1 Job for User Coordinate System No. 3, Only for Robot Axis

File Name : SAMPLE1.JBI

```
/JOB
//NAME SAMPLE1
//POS
///NPOS 5,0,0,0,0,0
///USER 3
///TOOL 0
///POSTYPE USER
///RECTAN
///RCONF 0,0,0,0,0
C0000=171.314,36.037,36.032,179.99,-1.52,85.23
C0001=39.290,36.037,36.014,179.99,-1.51,85.23
C0002=39.292,-65.965,36.016,179.99,-1.51,85.23
C0003=39.288,-65.949,-75.987,179.99,-1.52,85.24
C0004=171.314,36.037,36.032,179.99,-1.52,85.23
//INST
///DATE 1993/07/23 16:34
///ATTR SC,RW,RJ
///FRAME 3
///GROUP1 RB1
NOP
MOVJ C0000 VJ=50.00
MOVL C0001 V=46.0
MOVL C0002 V=46.0
MOVL C0003 V=46.0
MOVJ C0004 VJ=50.00
END
```

4.2.2 Job for Robot Axis + Base axis (Base Coordinate System)

File Name : SAMPLE2.JBI

```
/JOB
//NAME SAMPLE2
//POS
///NPOS 3,3,0,0,0,0
///TOOL 0
///POSTYPE BASE
///RECTAN
///RCONF 0,0,0,0,0
C0000=-415.000,0.000,770.000,180,00,-90.00,0.00
C0001=874.552,-626.159,1031.906,64.76,-37.91,95.22
C0002=1344.117,582.515,1090.264,52,72,-37.72,18.41
BC0000=0.000,0.000
BC0001=1343.952,-531.981
BC0002=1838.601,830.637
//INST
///DATE 1993/07/23 17:36
///ATTR SC,RW,RJ
///FRAME BASE
///GROUP1 RB1,BS1
NOP
MOVJ C0000 BC0000 VJ=25.00
MOVJ C0001 BC0001 VJ=25.00
MOVJ C0002 BC0002 VJ=25.00
END
```

4.2.3 Job for Robot Axis + Base Axis + Station Axis (Base Coordinate System, Single Job)

File Name : SAMPLE3.JBI

```
/JOB
//NAME SAMPLE3
//POS
///NPOS 2,2,2,0,0,0
///TOOL 0
///POSTYPE BASE
///RECTAN
///RCONF 0,0,0,0,0
C0000=-494.484,-248.122,1090.264,52.72,-37.2,118.41
C0001=-157.216,-187.240,1079.290,84.07,-35.63,118.76
BC0000=0.000,0,000
BC0001=550.647,485.316
///POSTYPE PULSE
///PULSE
EC0000=7103,27536
EC0001=7230,27577
///INST
///DATE 1993/07/23 18:11
///ATTR SC,RW,RJ
///FRAME BASE
///GROUP1 RB1,BS1,ST1
NOP
MOVJ C0000 BC0000 EC0000 VJ=25.00
MOVJ C0001 BC0001 EC0001 VJ=25.00
END
```

4.2.4 Job for Robot Axis + Base Axis + Station Axis (Base Coordinate System, Coordinate Job)

File Name:SAMPLE4.JBI

```
/JOB
//NAME SAMPLE3
//POS
///NPOS 2,2,2,0,0,0
///TOOL 0
///POSTYPE BASE
///RECTAN
///RCONF 0,0,0,0,0
C0000=-494.484,-248.122,1090.264,52.72,-37.2,118.41
C0001=-157.216,-187.240,1079.290,84.07,-35.63,118.76
BC0000=0.000,0,000
BC0001=550.647,485.316
///POSTYPE PULSE
///PULSE
EC0000=7103,27536
EC0001=7230,27577
///INST
///DATE 1993/07/23 18:11
///ATTR SC,RW,RJ
///FRAME BASE
///GROUP1 RB1,BS1,ST1
NOP
MOVJ C000 BC000 VJ=25.00 +MOVJ EC000 VJ=25.00
MOVJ C001 BC001 VJ=25.00 +MOVJ EC001 VJ=25.00
END
```

4.2.5 Job for Robot Axis + Robot Axis (Base Coordinate System, Coordinate Job)

File Name:SAMPLE5.JBI

```
/JOB
//NAME SAMPLE5
//POS
///NPOS 10,0,0,0,0,0
///TOOL 0
///POSTYPE BASE
///RECTAN
///RCONF 0,0,0,0,0
C0000=-765.337,202.936,1118,673,0.00,1.59,160.42
///TOOL 1
C0001=-856.025,-93.532,1134.850,1.43,-25.69,172.39
///TOOL 0
C0002=-831.637,122.110,1130.506,-0.36,6.81,167.30
///TOOL 1
C0003=-812.058,-39.516,1162.852,1.42,-25.68,172.39
///TOOL 0
C0004=-767.908,249.592,1071.301,0.00,1.59,157.08
///TOOL 1
C0005=-882.057,-101.531,1070.875,1.42,-25.68,172.40
///TOOL 0
C0006=-557.794,402.473,1033.164,0.63,-7.68,137.99
///TOOL 1
C0007=-920.071,-149.510,1042.893,1.41,-25.67,172.41
///TOOL 0
C0008=-765.337,202.936,1118.673,0.00,1.59,160.42
///TOOL 1
C0009=-856.025,-93.532,1134.850,1.43,-25.69,172.39
//INST
///DATE 1993/07/23 16:41
///ATTR SC,RW,RJ
///FRAME BASE
///GROUP1 RB1
///GROUP2 RB2
NOP
MOVJ C0000 VJ=50.00 +MOVJ C0001 VJ=50.00
SMOVL C0002 V=46.0 +MOVL C0003
SMOVL C0004 V=46.0 +MOVL C0005
MOVL C0006 V=46.0 +MOVL C0007 V=11.0
MOVJ C0008 VJ=50.0 +MOVJ C0009 VJ=50.00
END
```

4.3 Configuration of Position Data

The configuration of the position data for each axis in each coordinate system is as follows.

4.3.1 Position Data of Each Axis

■ Robot Axis

R1 = X, Y, Z, RX, RY, RZ + type
The position of a robot axis is represented in a specified coordinate system.

■ Station Axis

S1 = W1, W2
The position of a station axis is represented by a pulse number.

■ Base Axis

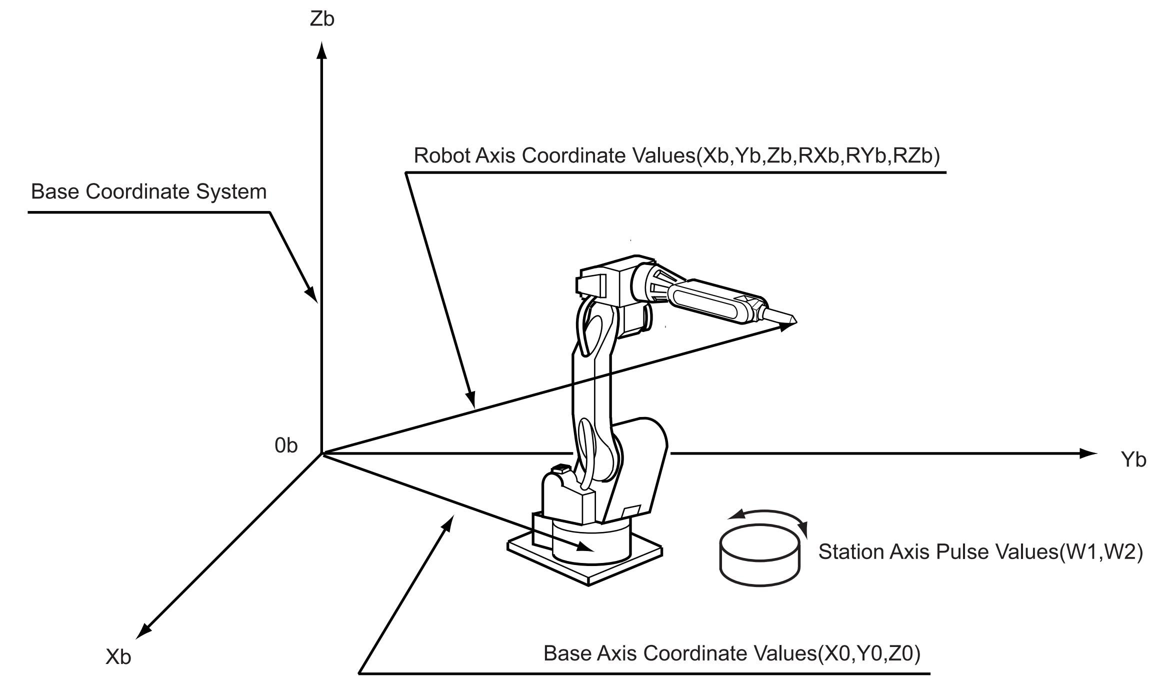
B1 = X0, Y0, Z0
The position of a base axis is represented as the distance of the axis from the origin of the coordinate system of teaching . (For the used axes only)

- For the base coordinate system, the distance from the origin of the base coordinate system.
- For the robot coordinate system, the distance from the origin of the base coordinate system.
- For the user coordinate system, the distance from the origin of the user coordinate system.

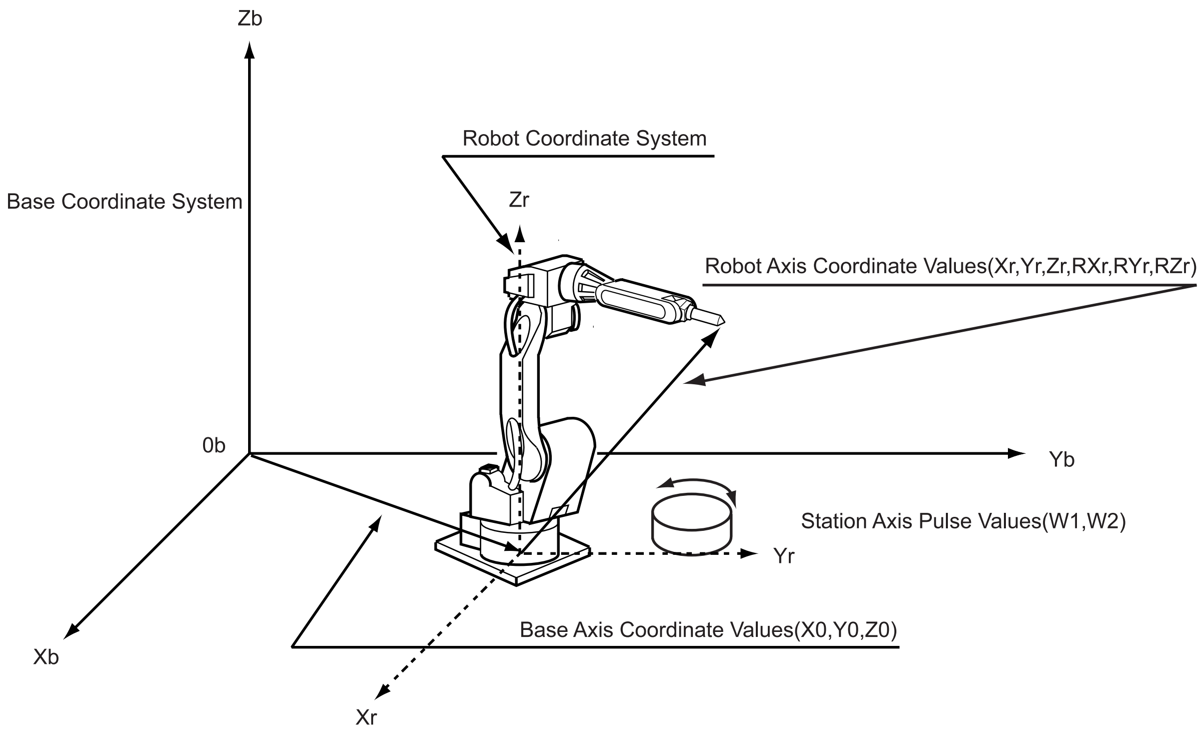
4.3.2 Position Data of Each Coordinate System

The position data of a robot axis, base axis, and station axis in each coordinate system is as follows.

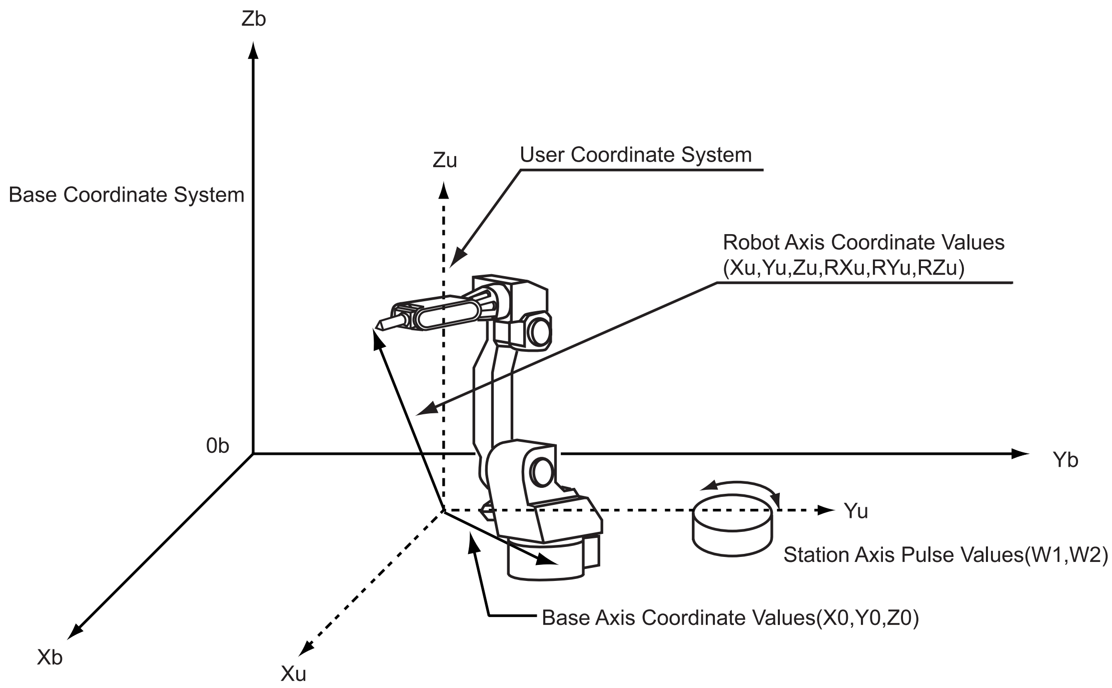
■ Base Coordinate System



■ Robot Coordinate System



■ User Coordinate System

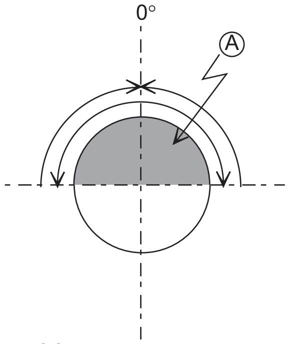
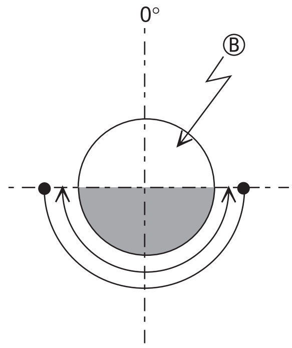


4.4 Manipulator Type

To describe robot axis position data in the XYZ type, several solutions can be obtained due to the manipulator mechanism when the manipulator is moved to the described position. In order to select one solution, it is necessary to specify the manipulator type. This manipulator type is called “TYPE”.
The XRC has up to six types. The number of types differs depending on the manipulator models.
Six types are explained in this section.

4.4.1 Flip/No-flip (R-axis position)

The following diagram shows that “flip” is when the R-axis position is at position A and “no-flip” is when the R-axis is at position B. However, with a manipulator whose R-axis moves more than ±180°even at position A, it is necessary to specify whether the R-axis is between -90°to 90°, 270°to 360°, or -360°to -270°. This also applies to position B. For specifying R-axis, refer to the manipulator type explained in section 4.4.2. “R-axis Angle” for more details.

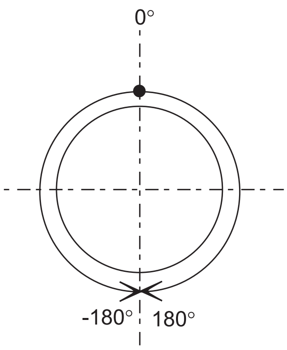
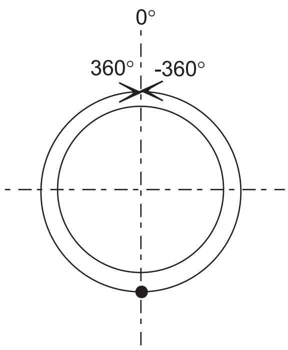
Flip	No-flip
 -90<θR<=90 270<θR<=360,-360<θR<=-270	 90<θR<=270 -270<θR<=-90

Note : θR is the angle when the R-axis zero-point position is assumed to be at 0°.

This specification is required for SK and UP model mainipulators.

4.4.2 R-axis Angle

Specify whether the R-axis angle is within ±180°or exceeds ±180°.

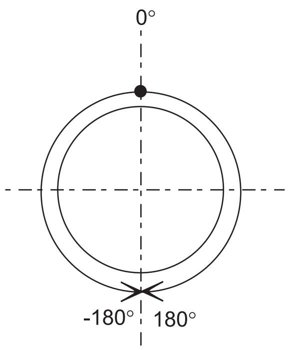
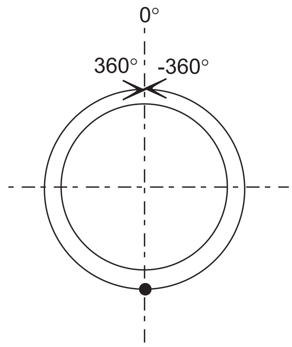
R<180°	R>=180°
 -180<θR<=180	 180<θR<=360,-360<θR<=-180

Note :θR is the angle when the R-axis zero-point position is assumed to be at 0°.

This specification is required for SK and UP model manipulators.

4.4.3 T-axis Angle

Specify whether the T-axis angle is within ±180°or exceeds ±180°in a manipulator with a three-axis wrist, paying attention to the T-axis angle.

T<180°	T>=180°
 $-180<\theta T<=180$	 $180<\theta T<=360,-360<\theta T<=-180$

Note :θT is the angle when the T-axis zero-point position is assumed to be at 0°.

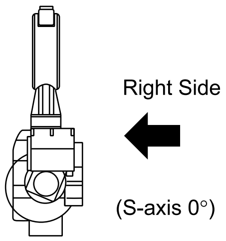
This specification is required for SK and UP model manipulators.

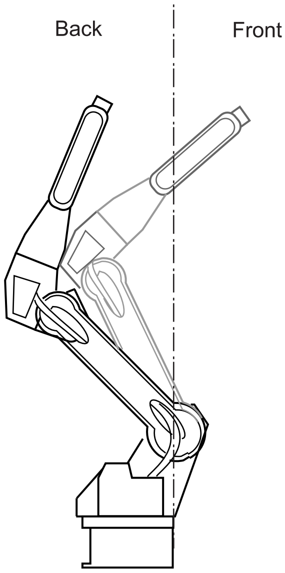
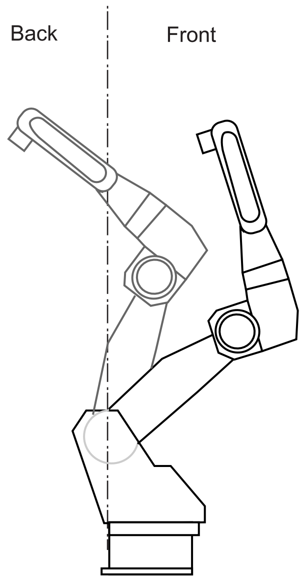
The specifications in the sections 4.4.1, 4.4.2, and 4.4.3 determine the positions of the R, B, and T-axes respectively.

4.4.4 Front/Back (Relation between S-axis and Control Point)

Viewing the L-axis and U-axis from the right side, specify the side of the S-axis rotation center where the B-axis rotation center will be located. The right side of the S-axis rotation center is the front and left side is back.

.



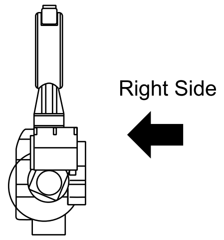
S-axis 0°	S-axis 180°
	

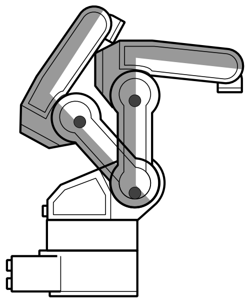
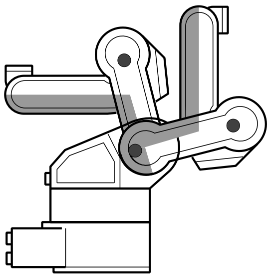
The above diagrams show the S-axis angle at 0°and 180°. Specification must be performed by always viewing the L-axis and U-axis from the right side.

This specification is required for SK and UP model manipulators.

4.4.5 Upper/Lower Arm (Type Comprised of an L-axis and U-axis

Specify the type comprised of the L-axis and the U-axis when the L-axis and the U-axis are viewed from the right side.

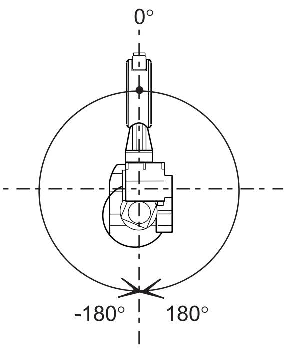


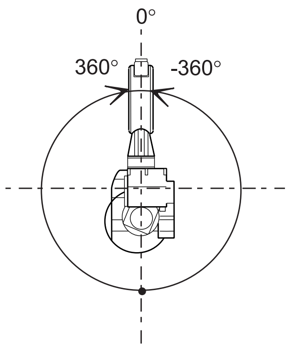
Upper arm	Lower arm
	

This specification is required for the UP model manipulator, but not for the SK model manipulator. The SK model manipulator always uses the upper arm type.

4.4.6 S-axis Angle

Specify whether the S-axis angle is within ±180°or exceeds ±180°.

<table>
<tr><th>S<180°</th><th>S>=180°</th></tr>
<tr><td>

$-180^{\circ} < \theta s <= 180^{\circ}$</td><td>

$180^{\circ} < \theta s <= 360^{\circ}$
$-360^{\circ} < \theta s <= -180^{\circ}$</td></tr>
</table>

Note : θs is the angle when the S-axis zero-point position is assumed to be at 0°.

This specification is required for the manipulators whose working envelope is greater than ±180°.

5 Alarm and Error Message List

5.1 Alarm Messages

Alarm Number	Message	Cause	Remedy
4500	UNDEFINED USER FRAME [Decimal Data]	Undefined user coordinates were used.	Define the user coordinate.
4509	MFRAME ERROR [Decimal Data]	Impossible to create user coordinates. 8 : No position file registered	Register the position file (variables).
4512	THREE STEPS SAME LINE [No data display]	The three points for creating the user coordinates lie on the same line.	Teach again so that the three points do not lie on the same line.

5.2 Error Messages

Error Number	Message	Contents
300	Undefined user frame	The user coordinate system to be used at conversion is not registered.
2470	Wrong JOB type	Setting of coordinate system for a standard job is not possible.
2480	Wrong JOB coordinates setting	Coordinate systems other than the user coordinate system can not be changed.
2500	Cannot convert the JOB.	A job with only a station axis and without group axis can not be converted into a relative job.

6 Instruction List

< >shows number or character data. When there are more than one additional items in one section, choose one.

Instruction	Section	Item		Range
MFRAME	Function	Creates a user coordinate system using the position data of the given three points as the definition point. Format : MFRAME UF#(xx) <Data 1><Data 2><Data 3>		
	Additional items	UF#(<User coordinate system No.>)		1 to 24
		Data 1	Definition point ORG position data	
		Data 2	Definition point XX position data	
		Data 3	Definition point XY position data	
		IF statement		
	Example	MFRAME UF#(1) P001 P002 P003		
CALL	Function	Calls for a specified job and executes it. If a user coordinate system number is specified, the job is executed using the coordinate system indicated by that number when calling a relative job.		
	Additional items	JOB<Job name> IG#(<Input group No.>) B<Variable No.>		
		UF#(<User coordinate system No.>)		1 to 24
		IF statement		
	Example	CALL JOB:TEST-1 CALL JOB:TEST-1 UF#(2) CALL IG#(02) (Job call according to input signal pattern. In this case, job 0 can not be called.)		
JUMP	Function	Jumps to the specified job or label. If a user coordinate system number is specified, the job is executed using the coordinate system indicated by that number when jumping to a relative job.		
	Additional items	JOB:<Job name> IG#(<Input group No.>) B<Variable No.> <Label No.>		
		UF#(<User coordinate system No.>)		1 to 24
		IF statement		
	Example	JUMP JOB:TEST1 IF IN#(14)=OFF		

YASNAC XRC OPTIONS INSTRUCTIONS

RELATIVE JOB FUNCTION

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