Motoman XRC 2001 Controller

Independent-Coordinated Function Manual

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SECTION 1
INTRODUCTION

1.1 About this Document

This manual provides instructions for Independent/Coordinated 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 – INDEPENDENT/COORDINATED FUNCTION
Provides detailed instructions to utilize the Independent/Coordinated 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)
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).
Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

The YASNAC XRC operator’s manuals above correspond to specific usage. Be sure to use the appropriate manual.
This manual explains the independent/coordinated function of the YASNAC XRC system and general operations. Read this manual carefully and be sure to understand its contents before handling the YASNAC XRC.

General items related to safety are listed in Section 1: Safety of the Setup Manual. To ensure correct and safe operation, carefully read the Setup Manual before reading this manual.

Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating this product.

The drawings and photos in this manual are representative examples and differences may exist between them and the delivered product.

YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such modification is made, the manual number will also be revised.

If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.

YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.
NOTES FOR SAFE OPERATION

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

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

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

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

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

- **PROHIBITED**
  Must never be performed.

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

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

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

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

Injury may result from unintentional or unexpected manipulator motion.

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

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

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

Improper or unintended manipulator operation may result in injury.

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

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

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

With the XRC, a system can be configured to control multiple manipulators or stations simultaneously with a single controller. With the independent / coordinated function, manipulators and/or stations can be operated together or individually. Operation can be optimized for the jobs.

1.1 Coordinated Control

With this function, manipulators or stations execute jobs in a coordinated operation.

<Example>
Using two coordinated manipulators to execute a job.

![Diagram of two coordinated manipulators]

Job

- NOP
- SMOVL
- MOVL
1.2 Independent Control

With this function, manipulators and/or stations execute jobs independently without synchronization.

<Example>
While executing a work job at one station, the other station executes a job to return to the home position for the next job.
2 Station Coordinated System

2.1 Outline

The station coordinated system is a system which coordinates a job where a station holds a workpiece while a manipulator holds a tool.

In order to operate a station and a manipulator simultaneously, a coordinated job is needed. In the coordinated job, there are two operations: a coordinated operation where a station and a manipulator perform a reciprocal movement as master and slave, and an individual operation where a station and a manipulator move individually. The move instruction in a coordinated job displays two lines: The first line is for the slave side (manipulator), and the second line is for the master side (station).
The specific keys for the station coordinated system are assigned to the number keys as shown in the figures below.

2.2.1 Arc Welding Application
2.2 Specific Keys

Performs wire inching.

[FEED]: Supplies wire.

[RETRACT]: Reels wire in.

[ARC ON]: Registers an ARCON instruction.

[ARC OFF]: Registers an ARCOF instruction.

Changes the welding conditions during playback.

[CUR/VOL (3)]: Increases the current and voltage values.

[CUR/VOL (-)]: Decreases the current and voltage values.

Changes the type of movement for the manipulator when teaching a coordinated job. Each time this key is pressed, the movement type changes.

SYNCRO: The mark for “synchronized” appears in the status display area. When the master side is moved, the slave side will follow the movement of the master.

SINGLE: Only the selected group axis moves.

Selects either a coordinated or an individual operation when teaching a coordinated job. Each time this key is pressed, the operation type changes.

Coordinated: All the move instructions that are registered in this mode become coordinated instructions.

Individual: The master-slave relationship is cancelled. Each manipulator and station moves independently.
2.2 Specific Keys

2.2.2 General Application

![Diagram of control panel with keys labeled:
- 7: SYNCRO SINGLE
- 8: f·7
- 9: f·8
- 4: SMOV
- 5: f·5
- 6: f·6
- 1: TIMER
- 2: f·3
- 3: f·4
- 0: REF PNT
- f·1
- f·2]
2.2 Specific Keys

Registers a tool control instruction “TOOLON”.
Pressing [INTERLOCK] + [f-3] (TOOLON) executes the tool ON operation.

Registers a tool control instruction “TOOLOF”.
Pressing [INTERLOCK] + [f-1] (TOOLOF) executes the tool OFF operation.

Registers a CALL instruction for a reserved job “TOOLONxx”.

Registers a CALL instruction for a reserved job “TOOLOFxx”.

Changes the type of movement for the manipulator when teaching a coordinated job. Each time this key is pressed, the movement type changes.

SYNCRO: The mark for “synchronized” appears in the status display area. When the master side is moved, the slave side will follow the movement of the master.

SINGLE: Only the selected group axis moves.

Selects either a coordinated or an individual operation when teaching a coordinated job. Each time this key is pressed, the operation type changes.

Coordinated: All the move instructions that are registered in this mode become coordinated instructions.

Individual: The master-slave relationship is cancelled. Each manipulator and station moves independently.
### 2.2.3 Spot-welding Application

**Calls the manual spot display.**

**Call the task origin position display.**

Press the [FWD] + [TASK ORIGIN] while the task origin position display is displayed in the teach mode to move the manipulator to the task origin.

**Registers the SPOT instruction, the spot welding start instruction.**

[INTERLOCK] + [SPOT]

While the manual spot display is being shown, press this key to execute manual spot welding. See "10.1 Manual Spot Welding Function ".

**Registers the GUNCL instruction, the dry spotting instruction.**

To perform dry spotting, press the [INTERLOCK] and the [GUN CLOSE] simultaneously.
2.2 Specific Keys

Press the [INTERLOCK] and the [WELD ON/OFF] simultaneously in the tach mode to turn the welding ON/OFF signal ON or OFF.

Registers the STROKE SHORT instruction, the short-open stroke change instruction when a double stroke gun is used.

Press the [INTERLOCK] and the [SHORT OPEN] simultaneously to change the stroke signal to the short-open status.

Registers the STROKE LONG instruction, the full-open stroke change instruction when a double stroke gun is used.

Press the [INTERLOCK] and the [FULL OPEN] simultaneously to change the stroke signal to the full-open status.

The alarm reset signal to the connected welders remains ON while the [INTERLOCK] and the [WELD ALM RESET] are pressed simultaneously. The welding conditions, gun pressure and weld instruction are also reset.

Changes the type of movement for the manipulator when teaching a coordinated job. Each time this key is pressed, the movement type changes.

SYNCRO: The mark for “synchronized” appears in the status display area. When the master side is moved, the slave side will follow the movement of the master.

SINGLE: Only the selected group axis moves.

Selects either a coordinated or an individual operation when teaching a coordinated job. Each time this key is pressed, the operation type changes.

Coordinated: All the move instructions that are registered in this mode become coordinated instructions.

Individual: The master-slave relationship is cancelled. Each manipulator and station moves independently.
2.3 Example of Job Teaching

### Stand-by

<table>
<thead>
<tr>
<th>Step</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>MOVJ VJ=50.00 +MOVJ</td>
</tr>
</tbody>
</table>

### Starting

<table>
<thead>
<tr>
<th>Step</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>002</td>
<td>SMOVL V=200 +MOVJ</td>
</tr>
<tr>
<td></td>
<td>SWVON WEV#(1)</td>
</tr>
<tr>
<td></td>
<td>ARCON ASF#(1)</td>
</tr>
</tbody>
</table>

### Ending

<table>
<thead>
<tr>
<th>Step</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>003</td>
<td>SMOVL V=200 +MOVJ</td>
</tr>
<tr>
<td></td>
<td>SWVON</td>
</tr>
<tr>
<td>004</td>
<td>SMOVL V=200 +MOVJ</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>005</td>
<td>SMOVL V=200 +MOVJ</td>
</tr>
<tr>
<td></td>
<td>ARCOF AEF#(1)</td>
</tr>
<tr>
<td></td>
<td>SWVOF</td>
</tr>
</tbody>
</table>

### Separate from the workpiece

<table>
<thead>
<tr>
<th>Step</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>006</td>
<td>MOVJ VJ=50.00 +MOVJ</td>
</tr>
<tr>
<td>007</td>
<td>MOVJ VJ=50.00 +MOVJ</td>
</tr>
</tbody>
</table>

The torch moves to the cleaner. The workpiece is unloaded.
2.4 System Setup

2.4.1 Registering Group Combination

Register a combination of a station and a manipulator.

**Operation**

Select {SETUP} under the top menu ➔ Select {GRP COMBINATION} ➔ Press [SELECT] ➔ select “ADD GROUP” ➔ Press [SELECT] ➔ select a group axis to be set ➔ Press [SELECT] ➔ Select “EXEC”

**Explanation**

* 1 The group combination registration display is shown.

* 2 The selection dialog is displayed.

* 3 The group combination setting display is shown.
* 4 The selection dialog is displayed.

* 5 Set a station as “MASTER”.

* 6 The group combination registration display reappears.
2.4.2 Calibration between Manipulator and Station

For a coordinated operation between a manipulator and a station, prior registration of the settings for mutual positioning is required. This relationship is set by calibration between the manipulator and the station.

Calibration Tool Setting

**Operation**

Mount a tool for calibration on the manipulator*1

- Select (ROBOT) under the top menu
- Select (TOOL) *2
- Enter the tool dimensions
- Press [ENTER]

**Explanation**

*1 Use a tool whose exact dimensions are known.

*2 The tool display is shown.
Teaching Positions for Calibration

For a station with one rotating axis

1. Determine an arbitrary point (point P) on the turntable of the station axis. Point P should be as far as possible from the turntable rotation center. Align the tool center point of the manipulator with point P, and register it as C1.

2. Turn the station axis. The amount of turning is not limited but should be 30° or more. It does not matter if the rotational direction is positive or negative. Then, align the tool center point of the manipulator to point P, and register it as C2.

3. Turn the station axis further in the same direction as in step 2. Then, align the tool center point of the manipulator to point P, and register it as C3.
For a station with two rotating axes

1. Determine an arbitrary point (point P) on the turntable. Point P should be as far as possible from the rotation center of the turntable. With the 1st station axis parallel to the ground, align the tool center point of the manipulator to point P, and register it as C1.

2. Turn the 2nd station axis about 30°. Align the tool center point of the manipulator to point P, and register it as C2.

**NOTE**

- To minimize teaching error, attach a tool with a pointed end tool on the station axis as shown in the figure above, and use this pointed end as an arbitrary point (point P) when teaching.
- When registering C2 and C3, the manipulator tool should keep as much as possible the same orientation as when C1 was registered.
- The manipulator at teaching should have its L-axis at a 90° angle to the ground and its U-axis parallel to the ground.
- Do not teach with the LU axis fully extended or tightly contracted. Otherwise, inaccurate calibration will result.
3. Turn the 2nd station axis again for about 30°. Align the tool center point of the manipulator to point P, and register it as C3.

4. Turn the 1st station axis about 30°. Align the tool center point of the manipulator to point P, and register it as C4.

5. Turn the 1st station axis again for about 30°. Align the tool center point of the manipulator to point P, and register it as C5.

**NOTE**

- To minimize teaching error, attach a tool with a pointed end tool on the station axis as shown in the figure above, and use this pointed end as an arbitrary point (point P) when teaching.
- When registering the others, the manipulator tool should keep as much as possible the same orientation as when C1 was registered.
- The manipulator at teaching should have its L-axis at a 90° angle to the ground and its U-axis parallel to the ground.
- Do not teach with the LU axis fully extended or tightly contracted. Otherwise, inaccurate calibration will result.
- For C1, C2, and C3, the position of the 1st station axis should be the same.
- The position of the 2nd station axis for C4 and C5 should be the same as that for C3.
### Calibration

**Operation**

- Select (ROBOT) under the top menu ➔ Select (ROBOT CALIB)
- Select a robot calibration No.
- Select “ROBOT” ➔ Select a group axis combination for calibration ➔ Select “POSITION” ➔ Press the axis key to move the manipulator to the desired position ➔ Press [MODIFY] and [ENTER] ➔ Select “COMPLETE”

**Explanation**

* 1 The robot calibration list display is shown.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROBOT CALIBRATION</td>
<td>R1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO.</td>
<td>SET</td>
<td>ROBOT</td>
<td></td>
</tr>
<tr>
<td>01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>05</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* 2 The robot calibration teaching display is shown.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROBOT CALIBRATION</td>
<td>R1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO. : 01 ROBOT : *****</td>
<td></td>
<td>POSITION : C1</td>
<td></td>
</tr>
<tr>
<td>&lt; STATUS &gt;</td>
<td>C1 :</td>
<td>C2 :</td>
<td>C3 :</td>
</tr>
</tbody>
</table>

COMPLETE CANCEL

* 3 The selection dialog is displayed.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROBOT CALIBRATION</td>
<td>R1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO. : 01 ROBOT : *****</td>
<td></td>
<td>POSITION : C1</td>
<td></td>
</tr>
<tr>
<td>&lt; STATUS &gt;</td>
<td>C1 :</td>
<td>C2 :</td>
<td>C3 :</td>
</tr>
</tbody>
</table>

R1+S1:S1

COMPLETE CANCEL
**4** The teaching positions are displayed.

![Image of teaching positions]

**5** The selection dialog is displayed.

![Image of selection dialog]

**6** The positions for calibration are registered.
Repeat steps *5 and *6 to teach set positions C1 to C3.
In the display, “●” indicates that the teaching is completed while “○” indicates that the teaching is not completed.
The calibration positions appear according to the selected group axis. Press the page key to change the display.

![Image of calibration positions]
2.5 Job Content Display

The contents of a coordinated job are displayed as shown below.

1. **Instructions**
   For a coordinated job, the move instruction, the weaving instruction, the shift instruction, and others are displayed in two lines: The first line is the instruction to the slave side; the second line is the instruction to the master side.

   SMOVL V=138 ← Slave, a manipulator
   +MOVL ← Master, a station

2. **Synchronized/Single**
   Synchronized/single are the types of movement available for the manipulator during axis operation. This mark appears when synchronized movement is selected. Switch between movements by pressing [SYNCRO/SINGLE].

3. **Group axis being handled**
   Displays the group axis being handled. Pressing [ROBOT] selects the manipulator. Pressing [EX AXIS] selects the station.
Coordinated operation/Individual operation
Switch between coordinated operation and individual operation by pressing [SMOV].

2.6 Synchronized/Single

There are two ways to handle axes when teaching: “Synchronized” and “Single”
Switch between movements by pressing [SYNCRO/SINGLE].

2.6.1 Synchronized

If the axes are handled in the “Synchronized” mode, the slave (manipulator) follows the master (station) when the master moves. This feature is used to keep the position of the manipulator relative to the station.
However, the master does not move when the slave is moved.

• A master axis is moved
2.6.2 Single

If an axis is handled in “Single” mode, the manipulator or the station whose axis has been handled, moves. This feature is used where a manipulator and a station each execute an individual job.

- A slave side axis is moved

![Diagram of slave side axis moved](image)

- A master side axis is moved

![Diagram of master side axis moved](image)

**NOTE**

- The selected mode, Synchronized or Single, is maintained until the next selection is made.
- When an edit job is changed, “Single” is automatically selected.
2.7 Selecting Axis to be Handled

In a coordinated system with multiple numbers of group axes, select a group axis to be handled in the following manner.

2.7.1 When There is an Edit Job

When the edit job is displayed, the group axes registered in the displayed job is the one to be handled.

Pressing [ROBOT] selects a manipulator for axis handling.

Pressing [EX AXIS] selects a station for axis handling.

2.7.2 When There is No Edit Job

When there is no edit job, move a manipulator in the following manner.

1. Press [SHIFT]+[ROBOT] to change the manipulator for axis handling. The LED of [ROBOT] flashes.
   Press [SHIFT]+[EX AXIS] to change the station for axis handling. The LED of [EX AXIS] flashes.
2. Select the group axes to be moved, and then move it by pressing the axis key.
3. Press [ROBOT] or [EX AXIS] to return to the original display.
2.8 Registering Job

**Operation**

Select (JOB) under the top menu ➔ Select (NEW JOB CREATE)① ➔ Enter a job name② ➔ Press [ENTER] ➔ Select “GROUP SET” ➔ Select a group combination ➔ Select “EXEC”③

**Explanation**

① The new job create display is shown.

② Select “JOB NAME”, and then enter a job name by entering the characters. Refer to Section 1.3.5 “Character Input Operation” of the Operator’s Manual.

③ The job name is registered in the memory of XRC, and the job content display appears.

2.9 Registering Move Instruction (S)MOV☐+MOVJ

Register a move instruction in the following manner.

2.9.1 Operating Master Side (Station)

**Operation**

Call the job content display in teach mode ➔ Press [EX AXIS]① ➔ Select either “synchronized” or “single”② ➔ Press the axis key to move to the desired position

**Explanation**

① The master side (station) is selected for axis handling.
2.9 Registering Move Instruction (S)MOV□+MOVJ

* 2 Press [SYNCRO/SINGLE] to select either “synchronized” or “single”.
When “synchronized” is selected, the mark in the display below appears.
When the slave side is supposed to follow the master side motion, select “synchronized”.
When “single” is selected, nothing is shown here.

When “Single” is selected, nothing appears here.

2.9.2 Operating Slave Side (Manipulator)

**Operation**

Press [EX AXIS]* 1 Press the axis key to move to the desired position Select either a coordinated movement or an independent movement* 2 Select a motion type* 3 Confirm the speed ➔ Press [ENTER]

**Explanation**

* 1 The slave side (manipulator) is selected for axis handling.

* 2 Press [SMOV] to select a coordinated operation.

* 3 Press [MOTION TYPE] to select a motion type.

* 4 The registration is completed as follows.
2.10 Registering Reference Point Instruction (SREFP)

Register a reference point instruction (SREFP) for a coordinated operation in the following manner.

**Operation**

Select {JOB} under the top menu ➔ Select {JOB} ➔ Move the cursor ➔ Grasp the deadman switch ➔ Press the axis key ➔ Select the coordinated operation ➔ Press [REF PNT] ➔ Change the reference point number ➔ Press [INSERT] ➔ Press [ENTER]

**Explanation**

*1 Move the cursor to the line immediately before the position where the reference point is to be registered.

Before the registration position ➔

003 SMOVL V=558
004 +MOVJ
005 CALL JOB:TEST
006 SMOVL V=138
007 +MOVJ

*2 Turn ON the servo power with the deadman’s switch. Move the manipulator to the position which will be a reference point.

*3 Press [SMOV] to select a coordinated operation.

*4 The reference point instruction appears in the input buffer line.

*5 Move the cursor to the reference point number, and press [SHIFT] + the cursor key to change the reference point number.

If you use the number keys to change the reference point number, press [SELECT] when the cursor is on the reference point number. Input the number and press [ENTER].

*6 The [INSERT] key lamp lights up.

When registering before the END instruction, [INSERT] is not needed.
2.10 Registering Reference Point Instruction (SREFP)

* 7 The REFP instruction is registered.

<table>
<thead>
<tr>
<th>Line</th>
<th>Instruction</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>003</td>
<td>SMOVL V=558</td>
<td></td>
</tr>
<tr>
<td>004</td>
<td>+MOVJ</td>
<td></td>
</tr>
<tr>
<td>005</td>
<td>CALL JOB:TEST</td>
<td></td>
</tr>
<tr>
<td>006</td>
<td>SREEP 1</td>
<td></td>
</tr>
<tr>
<td>007</td>
<td>SMOVL V=138</td>
<td></td>
</tr>
<tr>
<td>008</td>
<td>+MOVJ</td>
<td></td>
</tr>
</tbody>
</table>

Reference point is registered.

**NOTE**

- When joint motion is set for the slave side (manipulator), teaching cannot be done during a coordinated operation.
- When “JOINT” is selected, the operation will not change to a coordinated operation, even if [SMOV] is pressed.
- When “JOINT” is selected during coordinated operation, a coordinated move instruction such as “SMOVL” in the input buffer line changes to “MOVJ”, and the operation becomes individual operation.
3 Jigless System

3.1 Outline

A jigless system is a system that welds by coordinating two manipulators; one holding the workpiece while the other holds the torch. To coordinate the movements of the two manipulators, a coordinated job is needed. In a coordinated job, there is a coordinated operation where two manipulators, master and slave, perform a reciprocal movement, and an individual operation where each of the two manipulators performs an independent movement.
3.2 Specific Keys

A move instruction in coordinated jobs displays two lines. The first line is for the slave side (torch); the second line is for the master side (workpiece).

The specific keys for the jigless system are allocated to the number keys as shown in the figure below.
3.2 Specific Keys

Performs a wire inching.

[FEED]: Supplies wires.

[RETRACT]: Reels a wire in.

[ARC ON]: Registers an ARCON instruction.

[ARC OFF]: Registers an ARCOF instruction.

Changes the type of movement for the manipulator when teaching a coordinated job. Each time this key is pressed, the movement type changes.

SYNCRO: The mark for “synchronized” appears in the status display area. When the master side is moved, the slave side will follow the movement of the master.

SINGLE: Only the selected manipulator moves.

Selects either a coordinated or an individual operation when teaching a coordinated job. Each time this key is pressed, the operation type changes.

Coordinated: All the move instructions that are registered in this mode become coordinated instructions.

Individual: The master-slave relationship is cancelled. Each manipulator and station moves independently.
3.3 Opening and Closing Handling Tool

This section explains how to open and close a handling tool by teaching. It is unrelated to the content of the job being taught. To close and open a handling tool by pressing the specific keys, the general output signals #9 to 12 are used.

The general output signal No. can be changed by the parameter A1P.
A1P026 Tool1 ON general output No. (Initial value: 9)
A1P027 Tool1 OFF general output No. (Initial value: 10)
A1P028 Tool 2 ON general output No. (Initial value: 11)
A1P029 Tool 2 OFF general output No. (Initial value: 12)

<table>
<thead>
<tr>
<th>INTER LOCK +</th>
<th>2 TOOL1 ON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sends an open instruction to Tool 1. Only while the keys are pressed, general output signal #9 is ON.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTER LOCK +</th>
<th>TOOL1 OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sends a close instruction to Tool 1. Only while the keys are pressed, general output signal #10 is ON.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTER LOCK +</th>
<th>3 TOOL2 ON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sends an open instruction to Tool 2. Only while the keys are pressed, general output signal #11 is ON.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTER LOCK +</th>
<th>TOOL2 OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sends a close instruction to Tool 2. Only while the keys are pressed, general output signal #12 is ON.</td>
</tr>
</tbody>
</table>
### 3.4 Example of Teaching Job

**Stand-by**

**Starting**

- **Step 002**
  - `SMOVL V=200 +MOVJ`
  - `SWON WEV#(1)`
  - `ARCON ASF#(1)`

- **Step 003**
  - `SMOVL V=200 +MOVJ`

**During an operation**

- **Step 004**
  - `SMOVL V=200 +MOVJ`
  - `ARCOF AEF#(1)`

**Ending**

- **Step 005**
  - `MOVJ VJ=50.00 +MOVJ`

**Separate from the workpiece**

- **Step 006**
  - `MOVJ VJ=50.00 +MOVJ`

---

The torch moves to the cleaner. The workpiece is unloaded.

---

**Coordinated operation**

**Step 001**

- `MOVJ VJ=50.00 +MOVJ`
3.5 System Setup

3.5.1 Registering Group Combination

Register a combination of two manipulators.

**Operation**

Select {SET UP} from the top menu ➔ Select {GRP COMBINATION} ➔ Press [SELECT] ➔ select “ADD GROUP” ➔ Press [SELECT] ➔ select a group axis to be set ➔ Press “EXEC”

**Explanation**

*1 The group combination registration display is shown.

![Group Combination Registration Display](image1)

*2 The selection dialog is displayed.

![Selection Dialog](image2)

*3 The group combination setting display is shown.

![Group Combination Setting Display](image3)
**4** The selection dialog is displayed.

![Selection Dialog](image1)

**5** Set R2: ROBOT2 as “MASTER”.

![Selection Dialog](image2)

**6** The group combination registration display reappears.

![Selection Dialog](image3)
3.5 System Setup

3.5.2 Calibration between Manipulators

For a coordinated operation between manipulators, prior registration of the settings for mutual positioning is required. This relationship is set by calibration between manipulators.

Operation

Mount a tool for calibration on the manipulator

Select {ROBOT} under the top menu
Select {TOOL} Enter the tool dimensions Press [ENTER]

Explanation

*1 Use a tool whose exact dimensions are known.

*2 The tool display is shown.

Teaching Position for Calibration

Calibrate the control point for two manipulators at three arbitrary points (C1 to C3) in the space between the manipulators.

1. Move a manipulator to an arbitrary position. Align the tool center point of the other manipulator or to the tool center point of the first manipulator by handling the axis. Register it as C1.
2. Register C2 and C3 in the same manner as C1.

**NOTE**
- When registering C2 and C3, the manipulator tool should keep as much as possible the same orientation as when C1 was registered.
- The standard distance between C-1 and C-2, C2 and C3, and C3 and C1 should be 1 m or more.
- Teach C1, C2, and C3 so that a triangle, not a straight line, is formed.
- Do not teach with the LU axis fully extended or tightly contracted. Otherwise, inaccurate calibration will result.

## Calibration

**Operation**

Select (ROBOT) under the top menu ➔ Select (ROBOT CALIB) ➔ Select a robot calibration No. ➔ Select “ROBOT” ➔ Select a combination of group axes for calibration ➔ Select “SET” ➔ Press the axis key to move the manipulator to the desired position ➔ Press [MODIFY] and [ENTER] ➔ Press “COMPLETE”

**Explanation**

*1 The robot calibration list display is shown.
* 2 The robot calibration teaching display is shown.

* 3 The selection dialog is displayed.

* 4 The teaching positions are displayed.

* 5 The selection dialog is displayed.
3.5 System Setup

*6 The positions for calibration are registered. Repeat steps *5 and *6 to teach set positions C1 to C3. The “●” in the display indicates that the teaching is completed while “○” indicates that the teaching is not completed. The calibration positions appear according to the selected group axis. Press the page key [ Page ] to change the display.

![Robot Calibration Data]

*7 The robots are calibrated. When the calibration is completed, the robot calibration list display appears.

![Robot Calibration List]
3.6 Job Content Display

The contents of a coordinated job are displayed as shown below.

Instructions
For coordinated jobs, the move instruction, the weaving instruction, the shift instruction, and others are displayed in two lines. The first line is the instruction to the slave side; the second line is the instruction to the master side.

SMOVL V=138 ← Slave, the manipulator holding a torch
+MOVL ← Master, the manipulator holding a workpiece

Synchronized/Single
Synchronized/single are the types of movement available for the manipulator during axis operation. This mark appears when synchronized movement is selected. Switch between movements by pressing [SYNCRO/SINGLE].

Group axis being handled
Displays the group axis being handled. Press [ROBOT] to change the group axis to be handled.

Coordinated operation/Individual operation
Switch between coordinated operation and individual operation by pressing [SMOV].
3.7 Synchronized/Single

There are two ways to handle axes when teaching: “Synchronized” and “Single”. Switch between movements by pressing [SYNCRO/SINGLE].

3.7.1 Synchronized

If the axes are handled in the “Synchronized” mode, the slave (torch) follows the master (workpiece) when the master moves. This feature is used to keep the position of the manipulator relative to the other manipulator. However, the master does not move when the slave is moved.
3.7 Synchronized/Single

### 3.7.2 Single

If an axis is handled in “Single” mode, only the manipulator whose axis is being handled moves. This feature is used where each of the two manipulators executes an individual job.

- The selected mode, Synchronized or Single, is maintained until the next selection is made.
- When an edit job is changed, “Single” is automatically selected.
3.8 Selecting Axis to be Handled

This section explains the methods to select a manipulator to be handled in teach mode.

3.8.1 When There is an Edit Job

Each time [ROBOT] is pressed, a manipulator to be handled changes.

1. Press [SHIFT]+[ROBOT] to change the manipulator to be handled. The LED of [ROBOT] flashes.

2. Select the group axes to be moved, and then move it by pressing the axis key.

3. Press [ROBOT] to return to the original display.

3.8.2 When There is No Edit Job

When there is no edit job, move the manipulator in the following manner.

1. Press [SHIFT]+[ROBOT] to change the manipulator to be handled. The LED of [ROBOT] flashes.

2. Select the group axes to be moved, and then move it by pressing the axis key.

3. Press [ROBOT] to return to the original display.
3.9 Registering Job

**Operation**

Select (JOB) under the top menu ➔ Select (NEW JOB CREATE)*1 ➔ Enter a job name*2 ➔ Press [ENTER] ➔ Select “GROUP SET” ➔ Select a group combination ➔ Select “EXEC”*3

**Explanation**

*1 The new job create display is shown.

*2 Select “JOB NAME” and enter a job name by entering the characters. For character input operation, refer to Section 1.3.5 “Character Input Operation” of the Operator’s Manual.

*3 The job name is registered in the memory of XRC, and the job content display appears.
3.10 Registering Move Instruction (S)MOV□+MOV□

Register a move instruction in the following manner.

3.10.1 Operating Master Side (Workpiece)

**Operation**

Call the job content display in teach mode  ➔ Press [ROBOT]*1 ➔ Select either “synchronized” or “single”*2 ➔ Press the axis key to move the manipulator to a desired position ➔ Select a motion type*3

**Explanation**

*1 The master side manipulator is selected for axis handling.

*2 Press [SYNCRO/SINGLE] to select either “synchronized” or “single”. When “synchronized” is selected, the mark in the display below appears. When the slave is supposed to follow the master side motion, select “synchronized”.

*3 Press [MOTION TYPE] to select a motion type.

When "Single" is selected, nothing appears here.

When "Single" is selected, nothing appears here.

When "Single" is selected, nothing appears here.

When "Single" is selected, nothing appears here.

When "Single" is selected, nothing appears here.

When "Single" is selected, nothing appears here.
### 3.10.2 Operating Slave Side (Torch)

**Operation**

Press [ROBOT] *1* ➡️ press the axis key to move the manipulator to the desired position

- Select either a coordinated movement or an independent movement *2* ➡️ select a motion type *3* ➡️ confirm the speed ➡️ press [ENTER] *4*

**Explanation**

*1* The slave side manipulator is selected for axis handling.

*2* Press [SMOV] to select a coordinated operation.

```
=> SMOVL V=138
+ MOVL
```

*3* Press [MOTION TYPE] to select a motion type.

```
=> SMOVC V=138
+ MOVL
```

*4* The registration is completed as follows.

```
0003 SMOVC V=138
+ MOVL
```

**NOTE**

- When joint motion is set for the slave side (torch), teaching cannot be done during a coordinated operation.
- When “JOINT” is selected, the operation will not change to a coordinated operation, even if [SMOV] is pressed.
- When “JOINT” is selected during coordinated operation, a coordinated move instruction such as “SMOVL” in the input buffer line changes to “MOVJ”, and the operation becomes individual operation.
3.11 Registering Reference Point Instruction (SREFP)

Register a reference point instruction (SREFP) for a coordinated operation in the following manner.

**Operation**

Select {JOB} under the top menu ➔ Select {JOB} ➔ Move the cursor ➔ Grasp the deadman switch ➔ Press the axis key ➔ Select the coordinated operation ➔ Press [REF PNT] ➔ Change the reference point number ➔ Press [INSERT] ➔ Press [ENTER]

**Explanation**

* 1 Move the cursor to the line immediately before the position where the reference point is to be registered.

Before the registration position ➔

003 SMOVL V=558
004 +MOVJ
005 CALL JOB:TEST
006 SMOVL V=138
007 +MOVJ

* 2 Turn ON the servo power with the deadman’s switch. Move the manipulator to the position which will be a reference point.

* 3 Press [SMOV] to select a coordinated operation.

* 4 The reference point instruction appears in the input buffer line.

* 5 Move the cursor to the reference point number, and press [SHIFT] + the cursor key to change the reference point number.

If you use the number keys to change the reference point number, press [SELECT] when the cursor is on the reference point number. Input the number and press [ENTER].

* 6 The [INSERT] key lamp lights up.
When registering before the END instruction, [INSERT] is not needed.
3.11 Registering Reference Point Instruction (SREFP)

* 7 The REFP instruction is registered.

Reference point is registered.

```
003 SMOVL V=558
004 +MOVJ
005 CALL JOB:TEST
006 SREFP 1
007 SMOVL V=138
008 +MOVJ
```
To register handling instructions, the specific keys [TOOL1 ON], [TOOL1 OFF], [TOOL2 ON], and [TOOL2 OFF] are used. When these keys are pressed, the instructions shown in the following table are registered. The general output signals #9 to 12 and the general input signals #9 to 12 are used for handling.

<table>
<thead>
<tr>
<th>Tool</th>
<th>Specific key</th>
<th>General Output Signal No. (Instruction Output)</th>
<th>General Input Signal No. (Confirmation Input)</th>
<th>Instruction to be Registered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tool 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open</td>
<td>2 TOOL1 ON</td>
<td>#9</td>
<td>#9</td>
<td>CALL JOB: H1OPEN</td>
</tr>
<tr>
<td>Close</td>
<td>- TOOL1 OFF</td>
<td>#10</td>
<td>#10</td>
<td>CALL JOB: H1CLOSE</td>
</tr>
<tr>
<td>Tool 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open</td>
<td>3 TOOL2 ON</td>
<td>#11</td>
<td>#11</td>
<td>CALL JOB: H2OPEN</td>
</tr>
<tr>
<td>Close</td>
<td>- TOOL2 OFF</td>
<td>#12</td>
<td>#12</td>
<td>CALL JOB: H2CLOSE</td>
</tr>
</tbody>
</table>

Also by registering a CALL instruction from the instruction list dialog, the instructions in the above table can be registered. The H1OPEN, H1CLOSE, H2OPEN, and H2CLOSE are reserved jobs. The job contents must have been registered beforehand. Register a handling instruction according to the application.

An example of H1OPEN registration is shown.

<Example>
The OPEN and CLOSE instructions are of pulse outputs. After the OPEN or CLOSE instruction, the manipulator waits for a confirmation of the movement.

NOP
PULSE OT#9 ……H1OPEN instruction 0.3 second pulse output
WAIT IN#9…….Waits for confirmation of H1OPEN
RET
3.13 Other Convenient Features

In a jigless system, the control point of slave side manipulator can be set as a reference point so that the master side manipulator can be moved.

3.13.1 Example of Movement
3.13 Other Convenient Features

3.13.2 Operation Method

**Operation**

Select the tool coordinate system*1 Press [SHIFT] + [COORD] *2 Select a operation tool coordinate*3

**Explanation**

*1 Press [COORD] and select a tool coordinate system.

*2 The switch to tool coordination display is shown.

*3 Select a manipulator with whose tool center point the manipulator is moved. At turning ON the power supply, the tool center point of the currently selected manipulator is shown.

3.13.3 Manipulator Movement

The operation by the axis keys is the same as that on normal tool coordinate system.

<table>
<thead>
<tr>
<th>Axis Name</th>
<th>Axis Key</th>
<th>Movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic axes</td>
<td><img src="image" alt="Basic Axes Diagram" /></td>
<td>Moves in parallel to X, Y, and Z-axis of tool coordinates of the selected manipulator.</td>
</tr>
<tr>
<td>Wrist axes</td>
<td><img src="image" alt="Wrist Axes Diagram" /></td>
<td>With the tool center point of the selected manipulator as a reference point, TCP fixed operation is executed.</td>
</tr>
</tbody>
</table>
Basic axes

Executing a TCP fixed operation by wrist axes, can change only the wrist orientation without changing its position, with the tool center point of the slave side manipulator as a reference point.
### Synchronized/Single

When “synchronized” is selected:  The master moves with the tool center point of the slave as a reference point. The slave follows the master.

When “single” is selected:  The master moves with the tool center point of the slave as a reference point. The slave remains stationery.
4 Twin Synchronous System

4.1 Outline

The twin synchronous system is a system where two manipulators operate in coordination for one station.

In this system, two coordinated jobs are done at the same time.
  - A coordinated job for one manipulator and the station (R1+S1)
  - A coordinated job for the other manipulator and the station (R2+S1)

A concurrent job starts these two jobs and implements I/O control. The master task job uses the independent control function to start the robot jobs of subtasks 1 and 2. Two robot jobs can be created by the following two methods.
Method 1: Copy one subtask job to create another subtask job.

This method is useful when two movement paths are symmetrical. Use the mirror shift function to convert a job path and copy it. The same teaching operation does not have to be repeated.

Method 2: Perform teaching for each manipulator.

Where there are not many similarities in the paths and movements of the two manipulators, create jobs in Method 2.
4.2 Specific Keys

The specific keys for the twin synchronous system are assigned to the number keys as shown in the figures below.

4.2.1 Arc Welding Application
4.2 Specific Keys

Performs wire inching. 
[FEED]: Supplies wire.

[RETRACT]: Reels wire in.

[ARC ON]: Registers an ARCON instruction.
[ARC OFF]: Registers an ARCOF instruction.

Changes the welding conditions during playback. 
[CUR/VOL (3)]: Increases the current and voltage values.
[CUR/VOL (-)]: Decreases the current and voltage values.

Changes the type of movement for the manipulator when teaching a coordinated job. Each time this key is pressed, the movement type changes.

SYNCRO: The mark for “synchronized” appears in the status display area. When the master side is moved, the slave side will follow the movement of the master.
SINGLE: Only the selected group axis moves.

Selects either a coordinated or an individual operation when teaching a coordinated job. Each time this key is pressed, the operation type changes.

Coordinated: All the move instructions that are registered in this mode become coordinated instructions.
Individual: The master-slave relationship is cancelled. Each manipulator and station moves independently.
4.2.2 General Application

- 7: SYNCRO SINGLE
- 8: f 7
- 9: f 8
- 4: SMOV
- 5: f 5
- 6: f 6
- 2: f 3
- 3: f 4
- 0: REF PNT
- f 1
- f 2
4.3 Job Configuration

Using the independent control function, configure jobs so that the concurrent job of master task operates the robot jobs in subtask 1 and 2.

Master task: Concurrent job
- Starts subtasks 1 and 2, and controls I/Os.

Subtask 1: Robot job
- A coordinated job for one manipulator + the station

Subtask 2: Robot job
- A coordinated job for the other manipulator + the station

Registers a tool control instruction “TOOLON”.
- Pressing [INTERLOCK] + [f-3] (TOOLON) executes the tool ON operation.

Registers a tool control instruction “TOOLOF”.
- Pressing [INTERLOCK] + [f-1] (TOOLOF) executes the tool OFF operation.

Registers a CALL instruction for a reserved job “TOOLONxx”.

Registers a CALL instruction for a reserved job “TOOLOFxx”.

Changes the type of movement for the manipulator when teaching a coordinated job. Each time this key is pressed, the movement type changes.
- SYNCRO: The mark for “synchronized” appears in the status display area.
  - When the master side is moved, the slave side will follow the movement of the master.
- SINGLE: Only the selected group axis moves.

Select either a coordinated or an individual operation when teaching a coordinated job. Each time this key is pressed, the operation type changes.
- Coordinated: All the move instructions that are registered in this mode become coordinated instructions.
- Individual: The master-slave relationship is cancelled. Each manipulator and station moves independently.
Subtasks 1 and 2 are determined as leading or following side with a tag SYNC in PSTART instruction.

Set either the subtask 1 or the subtask 2 as the following side. To set a following side, add a tag SYNC and the leading side subtask to the PSTART instruction of the master task. The subtask to which a tag SYNC is added is following side while the subtask without a tag is leading side.

The station axis is controlled by the leading side job, and the following side job follows the movement of station axis.

```
0004 PSTART JOB:JOB-1 SUB1 SYNC SUB2
0005 PSTART JOB:JOB-2 SUB2
```

In this case, the manipulator of subtask 1 synchronizes with the leading side subtask 2.

**NOTE** Register a PSTART instruction so that the following side job starts first.
4.5 Synchronizing with TSYNC

During the execution of the jobs, a deviation between the movements of the two manipulators may occur. In the steps where the movements of the two manipulators should be exactly the same, execute a TSYNC instruction immediately before these steps. When a TSYNC instruction is executed in one of the robot jobs, the manipulator waits until the same synchronized signal, TSYNC, is executed in the other robot job. Set the number of synchronized tasks. When setting “SYNCHRO NUM” to “UNUSED”, the number of tasks is the same as when “SNUM=2”.

**Format**

![Diagram showing TSYNC and synchronization number 1 to 32.]

**Operation**

Move the cursor to the line just above the place where TSYNC instruction is to be registered ➞ Press [INFORM LIST] ➞ Select “TSYNC”* 2 ➞ Change additional items * 3 ➞ Press [INSERT] and [ENTER]* 4

**Explanation**

* 1 The instruction list dialog is displayed.

* 2 A TSYNC instruction is displayed in the input buffer line.

* 3 To register items as displayed in the input buffer line>
Perform operation * 4

<To change the numerical data>
Move the cursor to the numerical data. Press [SHIFT] and the cursor key simultaneously to increment or decrement the number.
To enter a number by pressing the number keys, press [SELECT] to display the input line.

```
=> TSYNC 1
> Synchronization_no:
```

Enter a number and press [ENTER], then the number in the input buffer line is changed.

After having changed the numerical data, press [ENTER]. The detail edit display is closed and the job content display reappears.

<To edit additional items>

- To edit additional items, move the cursor to the instruction in the input buffer line, then press [SELECT]. The detail edit display is shown.

```
=> TSYNC 1

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>DETAIL EDIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSYNC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYNCHRO NO.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYNCHRO NUM</td>
<td>UNUSED</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

To change the synchronization number, select “1” of “SYNCHRO NO.”. When the number input status enters, enter the synchronization number, “SYNCHRO NO.” by pressing the number keys, and press [ENTER].

```
=> TSYNC 2

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>DETAIL EDIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSYNC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYNCHRO NO.</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYNCHRO NUM</td>
<td>UNUSED</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

To add the number of synchronized tasks, select “UNUSED” of “SYNCHRO NUM”. The selection dialog is displayed. Select “SNUM=”.

```
=> TSYNC 2 SNUM=3

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>DETAIL EDIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSYNC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYNCHRO NO.</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYNCHRO NUM</td>
<td>SNUM=3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

After changed or added the additional items, press [ENTER]. The detail edit display is closed, and the job content display appears.
4.5 Synchronizing with TSYNC

*4 The instruction displayed in the input buffer line is registered.

<Example>

```
NOP  TSYNC 1
    MOVJ
    +MOVJ
    SMOVL
    +MOVJ
TSYNC 2
    ARCON
    ARCOF
    SMOVL
    +MOVJ
TSYNC 3
    DOUT OT(#1)=OFF
    MOVJ
    +MOVJ
    END
```

```
NOP  TSYNC 1
    MOVJ
    +MOVJ
    SMOVL
    +MOVJ
TSYNC 2
    ARCON
    ARCOF
    SMOVL
    +MOVJ
TSYNC 3
    DOUT OT(#2)=OFF
    MOVJ
    +MOVJ
    END
```

- Synchronizes at the start of job.
- Synchronizes just before the start of work (in this case, welding).
- Synchronizes just after the end of work.
4.6 Job Example

Master task (Concurrent job)

Jobs in subtasks 1 and 2

Home position return job

Waiting JOB

Tip replacement JOB

Work JOB (coordinated job)
4.7 Job Content Display

The contents of coordinated job are displayed as shown below.

For coordinated jobs, the move instruction, the weaving instruction, the shift instruction, and others are displayed in two lines. The first line is the instruction to the slave side; the second line is the instruction to the master side.

SMOVL V=138 ← Slave, a manipulator
+MOVL ← Master, a station

Synchronized/Single

Synchronized/single are the types of movement available for the manipulator during axis operation. This mark appears when synchronized movement is selected. Switch between movements by pressing [SYNCRO/SINGLE].

Group axis being handled

Displays the group axis being handled. Pressing [ROBOT] selects the manipulator. Pressing [EX AXIS] selects the station.

Coordinated operation/Individual operation

Changes between coordinated operation and individual operation by pressing [SMOV].
4.8 Synchronized/Single

4.8.1 Synchronized/Single Movement Between Station and Manipulator

There are two ways to handle axes when teaching: “Synchronized” and “Single”. Switch between movements by pressing [SYNCRO/SINGLE].

- **Synchronized**

  If the axes are handled in the “Synchronized” mode, the slave (manipulator) follows the master (station) when the master moves. This feature is used to keep the position of the manipulator relative to the station. However, the master does not move when the slave is moved.

  - A master axis is moved
4.8 Synchronized/Single

- **Single**

If an axis is handled in “Single” mode, the manipulator or the station whose axis has been handled, moves.

This feature is used where a manipulator and a station each executes an individual job.

- A slave side axis is moved.

![Diagram of a slave side axis moving](image)

- A master side axis is moved.

![Diagram of a master side axis moving](image)

- The selected mode, Synchronized or Single, is maintained until the next selection is made.
- When an edit job is changed, “Single” is automatically selected.

**NOTE**
4.8 Synchronized/Single

4.8.2 Job Synchronized Mode for Subtask 1 and 2

When moving only the leading side manipulator in FWD/BWD operation, the following side manipulator in stop status may interfere with a workpiece. To prevent this, using “job synchronized mode” can move the following side synchronizing the motion of the leading side. The following side manipulator moves, keeping the relative position to the station.

Pressing [SHIFT] + [SYNCRO/SINGLE] changes the job synchronized mode.

<table>
<thead>
<tr>
<th>Twin coordinated mode ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twin coordinated mode OFF</td>
</tr>
</tbody>
</table>

Also in the teaching condition display, the job synchronized mode can be set and confirmed.

**Operation**

Select (SET UP) under the top menu ➔ Select (TEACHING COND)*₁ ➔ Select “TWIN COORDINATED MODE”*₂

**Explanation**

*₁ The teaching condition display appears.

---

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEACHING CONDITION</td>
<td>R1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LANGUAGE LEVEL</td>
<td>SUBSET</td>
<td>MOVE INSTRUCTION SET</td>
<td>LINE</td>
</tr>
<tr>
<td>STEP ONLY CHANGING</td>
<td>PROHIBIT</td>
<td>STEP/TEST RUN OPERATION MODE</td>
<td>SINGLE</td>
</tr>
<tr>
<td>BWD OPERATION NO GROUP AXIS</td>
<td>PERMIT</td>
<td>BWD OPERATION CONCURRENTJOBPERMIT</td>
<td></td>
</tr>
<tr>
<td>TWIN COORDINATED MODE</td>
<td>INVALID</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.9 Selecting Axis to be Handled

In a coordinated system with multiple numbers of group axes, select a group axis to be handled in the following manner.

4.9.1 When There is an Edit Job

When the edit job is displayed, the group axes registered in the displayed job is the one to be handled.

Pressing [ROBOT] selects a manipulator for axis handling.

Pressing [EX AXIS] selects a station for axis handling.

4.9.2 When There is No Edit Job

When there is no edit job, move a manipulator in the following manner.

2. Select the group axes to be moved, and then move it by pressing the axis key.
3. Press [ROBOT] or [EX AXIS] to return to the original display.
4.10 Registering Job

**Operation**

Select (JOB) under the top menu ➔ Select (NEW JOB CREATE)* 1 ➔ Enter a job name* 2 ➔ Press [ENTER] ➔ Select “GROUP SET” ➔ Select a group combination ➔ Select “EXEC”* 3

**Explanation**

* 1 The new job create display is shown.

* 2 Select “JOB NAME”, and then enter a job name by entering the characters. Refer to Section 1.3.5 “Character Input Operation” of the Operator’s Manual.

* 3 The job name is registered in the memory of XRC, and the job content display appears.

4.11 Registering Move Instruction (S)MOV□+MOVJ

Register a move instruction in the following manner.

4.11.1 Operating Master Side (Station)

**Operation**

Call the job content display in teach mode ➔ Press [EX AXIS]* 1 ➔ Select either “synchronized” or “single”* 2 ➔ Press the axis key to move to the desired position

**Explanation**

* 1 The master side (station) is selected for axis handling.
4.11 Registering Move Instruction (S)MOV□+MOVJ

* 2 Press [SYNCRO/SINGLE] to select either “synchronized” or “single”. When “synchronized” is selected, the mark in the display below appears. When the slave side is supposed to follow the master side motion, select “synchronized”.

When “synchronized” is selected, the mark in the display below appears.

When "Single" is selected, nothing appears here.

4.11.2 Operating Slave Side (Manipulator)

**Operation**

Press [EX AXIS]* 1 Press the axis key to move to the desired position Select either a coordinated movement or an independent movement* 2 Select a motion type* 3 Confirm the speed ➔ Press [ENTER]

**Explanation**

* 1 The slave side ( manipulator) is selected for axis handling.

* 2 Press [SMOV] to select a coordinated operation.

* 3 Press [MOTION TYPE] to select a motion type.

* 4 The registration is completed as follows.

**NOTE**

- When joint motion is set for the slave side ( manipulator), teaching cannot be done during a coordinated operation.
- When “JOINT” is selected, the operation will not change to a coordinated operation, even if [SMOV] is pressed.
- When “JOINT” is selected during coordinated operation, a coordinated move instruction such as “SMOVL” in the input buffer line changes to “MOVJ”, and the operation becomes individual operation.
4.12 Registering Reference Point Instruction (SREFP)

Register a reference point instruction (SREFP) for a coordinated operation in the following manner.

**Operation**

Select (JOB) under the top menu ➔ Select (JOB) ➔ Move the cursor ➔ Grasp the deadman's switch ➔ Press the axis key ➔ Select the coordinated operation ➔ Press [REF PNT] ➔ Change the reference point number ➔ Press [INSERT] ➔ Press [ENTER]

**Explanation**

* 1 Move the cursor to the line immediately before the position where the reference point is to be registered.

Before the registration position ➔ 003 SMOVL V=558  
004 +MOVJ  
005 CALL JOB:TEST  
006 SMOVL V=138  
007 +MOVJ

* 2 Turn ON the servo power with the deadman's switch. Move the manipulator to the position which will be a reference point.

* 3 Press [SMOV] to select a coordinated operation.

* 4 The reference point instruction appears in the input buffer line.

=> SREFP

* 5 Move the cursor to the reference point number, and press [SHIFT] + the cursor key to change the reference point number.

=⇒ SREFP

If you use the number keys to change the reference point number, press [SELECT] when the cursor is on the reference point number. Input the number and press [ENTER].

=⇒ SREFP 1

* 6 The [INSERT] key lamp lights up. When registering before the END instruction, [INSERT] is not needed.
4.13 Switching Tasks

The REFP instruction is registered.

To call the job content display for master task, subtask 1 or subtask 2, proceed the following operation.

**Operation**

Select {JOB} under the top menu ➔ Select {JOB CONTENT} ➔ Press the page key

* 1

**Explanation**

* 1 Each time the page key is pressed, the contents of the job content display change in order of master task, subtask 1 and subtask 2. When there is no job in a task, the job content display for this task is not displayed.
Subtasks 1 and 2 are robot jobs.
Subtask 1: Job of one manipulator + the station
Subtask 2: Job of the other manipulator + the station

There are two methods to create a robot job for a subtask.

Method 1: Copy one subtask job to create another subtask.

This method is useful when two movement paths are symmetrical. Use the mirror shift function to convert a job path and copy it. The same teaching operation does not have to be repeated.

Method 2: Perform teaching for each manipulator.

Where there are not many similarities in the paths and movements of the two manipulators, create jobs in Method 2.
4.15 Method 1: Copy One Subtask Job and Create Another Job

4.15.1 Procedure

When two movement paths are symmetrical, one subtask job can be created by using the job taught by the other manipulator.

Perform teaching for either R1 + S1 or R2 + S1. Use the mirror shift to create a job for the other manipulator.

The mirror shift is a function for copying jobs, which creates a job by reversing the signs of the position data for the S-, R-, and T-axes.

Correct positional dislocation as necessary.

Original job

New job created by mirror shift
4.15.2 Teaching and Mirror Shift

Teach the job for one manipulator + the station, and confirm the movement. After having completed the teaching, perform mirror shift the job.

Teaching and confirming movements.

■ Converting

Call the job content display for the job to be converted.

For the job currently selected

**Operation**

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

To call another job

**Operation**

Select {JOB} under the top menu ➔ Select {SELECT JOB}* ➔ Select a job to be displayed

**Explanation**

*1 The job list display appears.
Execute conversion

**Operation**

Select {UTILITY} of the menu ➔ Select {MIRROR SHIFT}

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIRROR SHIFT</td>
<td>SOURCE JOB : JOB1</td>
<td>SOURCE CTRL GROUP : R1+S1</td>
<td>DESTINATION JOB : JOB2</td>
</tr>
</tbody>
</table>

1. **SOURCE JOB**
   Select a job name of the conversion origin.
   Move the cursor to the name, then press [SELECT]. The job list display appears. Select a job to be converted, then press [SELECT].

2. **SOURCE CTRL GROUP**
   Displays the control group of the SOURCE JOB.

3. **DESTINATION JOB**
   Select a job name for the converting destination.
   Move the cursor to the name, then press [SELECT] to enter the character input status.
   The name of SOURCE JOB is displayed in the input line. If the name of SOURCE JOB is not to be used, press [CANCEL] and enter a job name for the converting destination.

4. **DEST CTRL GROUP**
   When a job name is set for DESTINATION JOB, the same control group as that of SOURCE JOB is set. If the control group for DESTINATION JOB is to be changed, move the cursor to DEST CTRL GROUP and press [SELECT] to display the selection dialog.
   Select a control group and press [SELECT].

5. **EXEC**
   Move the cursor to “EXEC” and press [SELECT]. The conversion is executed.
   When a name of DESTINATION JOB is set, a job is created by the conversion.
   When a name of DESTINATION JOB is not set, the SOURCE JOB itself is converted.

- Jobs Not to be Converted
  The jobs and relative jobs without group axes can not be converted.

- Group Axes for Conversion
  When the group axes for the SOURCE JOB in the multiple group axes system, the axis configuration, etc. of each group axes for SOURCE JOB and DESTINATION JOB must be the same.
  - Robot axis: Same type
  - Base axis: Same axis configuration
  - Station axis: Same axis configuration
4.15 Method 1: Copy One Subtask Job and Create Another Job

### Position type variables
The position type variables are not for mirror-shift.

### Parameter
Which axis is to be shifted (reverse the sign) is specified by the following parameter.

- S1C×G065: Mirror shift sign reversed axis specification

#### 4.15.3 Correcting Positional Dislocation
In the job after mirror shift, a position may be dislocated due to the installation error. In this case, all steps should be corrected by the same shift amount. For this operation, the parallel shift job conversion function is used.

### Set the items for conversion

**Operation**

1. Select {JOB} under the top menu
2. Select {JOB CONTENT}  
3. Select {UTILITY} of the menu
4. Select {PARALLEL SHIFT JOB}

**Explanation**

* 1 The job content display appears.

* 2 The parallel shift job display appears.

* 3 Set each item.

#### SOURCE JOB
Set a job of the conversion origin. The initial setting is the job currently shown in the job content display.

To change the job, move the cursor to SOURCE JOB and press [SELECT]. The job list display appears. Move the cursor to the job to be changed with and press [SELECT]. The SOURCE JOB is set.
2 **STEP SECTION (start step → end step)**
Set the steps of **SOURCE JOB** to be converted. The initial value is set to all the steps of **SOURCE JOB**. If there is no step in **SOURCE JOB**, "****" is displayed. To change the setting, move the cursor to **STEP SECTION** and press [SELECT] to enter the number input status. Enter the step numbers and press [ENTER].
The step numbers are changed.

3 **DESTINATION JOB**
Set a job name for the converting destination. If a job name is not specified ("********" is displayed), the **SOURCE JOB** is the object for conversion. If a job name is set, the **SOURCE JOB** is copied to **DESTINATION JOB** to be converted. To change the **DESTINATION JOB**, move the cursor and press [SELECT] to display the job list display. Move the cursor to a job to be set and press [SELECT]. The **DESTINATION JOB** is set.

4 **COORDINATES**
Set a coordinate system to be used for conversion. Move the cursor to **COORDINATES** and press [SELECT] to display the selection dialog. Select a coordinate system to be set and press [SELECT]. The **COORDINATES** is set.
When **USER** coordinate system is selected, the number input status enters. Enter the desired user coordinate number, then press [ENTER].

- Set the Shift Amount

The shift amount can be set in the following two ways.
- Enter directly the value of shift amount.
- Teach two points, the base (reference) point of **SOURCE JOB** and the base (reference) point of **DESTINATION JOB**, then the difference between these two points is taken as the shift amount.

**Enter directly the value of shift amount**

<table>
<thead>
<tr>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select a shift value to be set on the parallel shift job display* 1 Enter the shift amount to be set by pressing the number keys ➔ Press [ENTER]* 2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>* 1 The number input status enters.</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PARALLEL SHIFT JOB</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SOURCE JOB</strong></td>
<td>JOB1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>STEP SECTION</strong></td>
<td>001</td>
<td>010</td>
<td></td>
</tr>
<tr>
<td><strong>DESTINATION JOB</strong></td>
<td>JOB2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>COORDINATES</strong></td>
<td>ROBOT</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BASE POINT</strong></td>
<td>TEACH SETTING</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SHIFT VALUE</strong></td>
<td>R1: X 0.000</td>
<td>Y 0.000</td>
<td>Z 0.000</td>
</tr>
</tbody>
</table>
4.15 Method 1: Copy One Subtask Job and Create Another Job

*2 The shift value is set.

To take the difference between two points as the shift amount

**Operation**

Select “TEACH SETTING” of “BASE POINT” on the parallel shift job display**1** Select “BASE POINT (SRC)” **→ Move to the source job base point by using the axis keys **→ Press [MODIFY] and [ENTER]**2** Select “BASE POINT (DEST)” **→ Move to the destination job base point by using the axis keys **→ Press [MODIFY] and [ENTER]**3** Select “EXEC” **4**

**Explanation**

*1 The parallel shift job base point display appears.

*2 The source job base point is set.
4.15 Method 1: Copy One Subtask Job and Create Another Job

* 3 The destination job base point is set.

![Image](https://via.placeholder.com/150)

* 4 The difference between two taught points (base points) is calculated. This difference is reflected in the parallel shift job display as a shift value.

![Image](https://via.placeholder.com/150)

**Execute conversion**

**Operation**

Select “EXEC” in the parallel shift job display* 1

**Explanation**

* 1 When the destination job is not set, a confirmation dialog is displayed. Select “YES” to execute the conversion.

When the conversion is completed, the job content display reappears.
4.16 Method 2: Perform Teaching for Each Manipulator

4.16.1 Procedure

First, perform teaching a job for the combination of leading side manipulator and station. Next, perform teaching a job for the combination of following side manipulator and station. For this operation, perform teaching so that the slave side manipulator follows the motion of station by FWD operation of the master side job.

For Method 2, there are two ways of teaching depending on whether the master task is used or not used.
4.16 Method 2: Perform Teaching for Each Manipulator

4.16.2 Teaching using Master Task

Using the master task can omit the operation to register a job name in the supervisory display.

**Operation**

Teach the coordinated job of leading side subtask  
New job registration for the coordinated job of following side subtask  
New job registration of master task  
Register PSTART instruction  
Set to “Single job operation mode”  
Move the cursor to the first PSTART instruction  
Press [INTERLOCK] + [FWD]  
Move the cursor to the second PSTART instruction  
Press [INTERLOCK] + [FWD]  
Press the page key  
Move the cursor to the leading side subtask  
Press [FWD]  
Move the cursor to the step 1  
Press [FWD]  
Press the page key  
Press the following side subtask  
Register the step 1 of the following side subtask  
Register the step 2 and onward of the following side subtask

**Explanation**

*1 Teach all the steps of coordinated job for one manipulator + the station.

*2 Register as a new job the coordinated job for the other manipulator + the station. For new job registration, refer to Section 4.10 “Registering Job”.

*3 Newly register the master task as concurrent job. For concurrent job, refer to Section 7.5.2 “Concurrent Job”.
4.16 Method 2: Perform Teaching for Each Manipulator

*4 Register a PSTART instruction to start the job newly registered at *2 To specify this subtask as the following side, add a tag SYNC and the leading side subtask. Then, register a PSTART instruction to start the job taught at *1

*5 Set the operation mode at FWD operation to “Single job operation mode”. Pressing [SHIFT] + [SMOV] switches the operation mode.

*6 Starts the following side subtask.

*7 Starts the leading side subtask.

*8 Each time the page key is pressed, the contents of the job content display change in order of master task, subtask 1 and subtask 2.

*9 After the FWD operation of step 1 of leading side, switch to the following side and register the position of the following side manipulator relative to the station current position.

*10 Change to the leading side job content display, and perform a FWD operation to the next step. To maintain the following side manipulator position relative to the station, press [SHIFT] + [SYNCRO/SINGLE] to set the job synchronized mode.

1. Change to the following side job content display, and register the following side manipulator position relative to the station current position.

2. Teach the following side job by repeating the steps ① and ②.
4.16.3 Teaching using Supervisory Display

When teaching without master task, it is necessary to register the startup job (ROOT JOB) in the supervisory display.

<table>
<thead>
<tr>
<th>Leading side</th>
<th>Following side</th>
<th>New job registration</th>
<th>Register a startup (root) job in the supervisory display</th>
<th>Following side teaching</th>
</tr>
</thead>
</table>

**Operation**

Teach a coordinated job of leading side subtask "1 ➔ new job registration of a coordinated job of following side subtask "2 ➔ select (JOB) under the top menu ➔ select [SUPERVISORY] "3 ➔ Select the root job of master task ➔ Select “CANCEL ROOT JOB” ➔ select the root job of subtask 1 ➔ Select “REGISTER ROOT JOB” "5 ➔ Select a job to be registered as root job ➔ Select the root job of subtask 2 ➔ select “REGISTER ROOT JOB” ➔ Select a job to be registered as root job "5 ➔ Select the synchronous task of subtask 1 ➔ Select “SUB2” "6 ➔ Select “Single job operation mode” "7 ➔ Select (JOB) under the top menu ➔ Select [JOB CONTENT] ➔ Press the page key ▼ change to leading side subtask. "8 ➔ Move the cursor to the step 1 ➔ Press [FWD] ➔ Press the page key ▼ to change to the leading side subtask "8 ➔ Register the step 1 of following side subtask "9 ➔ Register the step 2 and onward of following side subtask "10

**Explanation**

*1 Teach all the steps of the coordinated job of one manipulator + the station.

*2 Register as a new job the coordinated job of the other manipulator + the station.

For new job registration, refer to Section 4.10 “Registering Job”.

Teaching and confirming movements.

New job registration
4.16 Method 2: Perform Teaching for Each Manipulator

* 3 The supervisory display appears.

* 4 The root jobs of master task, subtask1 and subtask 2 are cancelled.

* 5 The root jobs for subtask 1 and subtask 2 are registered.

* 6 Specify SUB2 of leading side task to synchronize the synchronous task of subtask 1.

* 7 Set “Single job operation mode” for the operation mode at FWD operation. Pressing [SHIFT] + [SMOV] switches the operation mode.

* 8 Each time the page key is pressed, the contents of the job content display change in order of master task, subtask 1 and subtask 2.

* 9 After the FWD operation of step 1 of leading side, switch to following side and register the position of the following side manipulator relative to the station current position.

* 10 Change to the leading side job content display and perform FWD operation to the next step. To maintain the following side manipulator position relative to the station, press [SHIFT] + [SYNCRO/SINGLE] to set the job synchronized mode.

2 Change to the following side job content display, and register the following side manipulator position relative to the station current position.

Teach the following side job by repeating the steps 1 and 2.
4.17 Job in Master Task

The job of master task is a concurrent job.

**Operation**

Select (JOB) under the top menu  ➔ Select [NEW JOB CREATE]*1  ➔ Enter a job name*2 ➔
Set “GROUP SET”*3  ➔ Set “CONCURRENT JOB”*4  ➔ Press [ENTER]  ➔ Select “EXEC”*5 ➔
Register a PSTART instruction*6

**Explanation**

* 1 The new job create display appears.

* 2 Move the cursor to JOB NAME and press [SELECT], and enter a job name by entering the characters.

* 3 Selecting “R1” of “GROUP SET” displays the selection dialog. Select “NON GROUP”.

* 4 Select “ROBOT JOB” of “JOB TYPE”.

Each time [SELECT] is pressed, “ROBOT JOB” or “CONCURRENT JOB” is selected alternately.

* 5 The job is registered in the memory of XRC, and the job content display appears. NOP and END instructions are registered automatically.
* 6 Register PSTART instructions to start the subtask 1 and 2. Since the first PSTART instruction is for starting the following side subtask, add a tag SYNC and the leading side subtask. Then, register a PSTART instruction to start the leading side subtask.

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB CONTENT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J:M-TASK</td>
<td>S:000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0000 NOP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0001 JOB FOR MASTER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0002 PSTART JOB:JOB-R1 SUB1 SYNC SUB2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003 PSTART JOB:JOB-R2 SUB2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0004 PWAIT SUB1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0005 PWAIT SUB2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0006 END</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- If a tag SYNC is added to neither of PSTARTs, an alarm occurs.
- If the synchronous task is set to “UNUSED”, the following side task, if it is SUB1, performs the same motion as the leading side task SUB2, and if it is SUB2, performs the same motion as the leading side task SUB1.
4.18 Confirming Operation

4.18.1 Procedure

- For confirming operation, set to “Multi-job operation mode”.
  In the multi-job operation mode, the jobs in all the tasks operate. (The operation procedures are explained below.)

  If the following side subtask is operated individually, only the following side manipulator moves but not the station. As the following side manipulator moves following to the station current position, an alarm may occur and the manipulator may interfere the station as a result.

  To verify the individual operation of the following side manipulator itself, call the job by job selection operation and confirm the individual operation of the job, but not in the twin synchronization.

**Operation**

Create a concurrent job

1. Select (JOB) under the top menu
2. Select [CTRL MASTER]

Move the cursor to the task where the master job is to be registered

Press [SELECT]

Select “SETTING MASTER JOB”

Select a job to be the master job

Press [SHIFT] + [SYNCRO/SINGLE]

Press [TEST START] or [FWD]

**Explanation**

* 1 For procedure, refer to Section 4.17 “Job in Master Task”.

* 2 The supervisory display appears.

<table>
<thead>
<tr>
<th>SUPERVISORY</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASTER</td>
<td>SUB1</td>
<td>SUB2</td>
<td></td>
</tr>
<tr>
<td>MASTER JOB:</td>
<td>M-TASK</td>
<td>******</td>
<td>******</td>
</tr>
<tr>
<td>ROOT JOB:</td>
<td>M-TASK</td>
<td>******</td>
<td>******</td>
</tr>
<tr>
<td>EDIT JOB:</td>
<td>M-TASK</td>
<td>******</td>
<td>******</td>
</tr>
<tr>
<td>LINE NO.</td>
<td>0000</td>
<td>0000</td>
<td>0000</td>
</tr>
<tr>
<td>STEP NO.</td>
<td>000</td>
<td>000</td>
<td>000</td>
</tr>
<tr>
<td>STATUS</td>
<td>STOP</td>
<td>STOP</td>
<td>STOP</td>
</tr>
<tr>
<td>SYNC TASK:</td>
<td>******</td>
<td>******</td>
<td>******</td>
</tr>
</tbody>
</table>

* 3 Set to “Multi-job operation mode”
  Each time [SHIFT] + [SYNCRO/SINGLE] are pressed, the operation mode changes between “Multi-job operation mode” and “Single job operation mode”.

* 4 When a PSTART instruction is executed, the manipulator and the station move.
4.18.2 Precautions for Confirming Operation

In the following operations, the steps of two manipulators will not coincide.

- **Stops during Operation**

  <Example>
  - When the manipulator stops during operation, move the cursor position to another step of the job in one of the subtasks.
  - Call the master job only by one of the subtasks.

When restarting the operation in the states as explained above, an interference with jig, etc. may be caused. Restart both jobs from the same position (step).
When “Multi-job operation mode” is set in the teaching condition display

<Example>
If the manipulator stops after operating to a certain step, and the step position of the following side R1 is changed and performs FWD operation again, the leading side R2 proceeds to the next step but the R1 does not move. As a result, the R2 goes forward by one step ahead.

![Diagram of step operations](image)

This is because, in the FWD operation after position change, the step after the change is usually re-executed.

In the above figure, at the FWD operation after the position change, the leading side R2, whose step has not been changed, move to the step 3. However, since position of the following side R1 is changed, the step after the change is executed again. As a result, operation is performed at the same position and it does not proceed to the next step. In this way, the steps of both sides do not correspond each other.

To make the steps of two sides correspond each other at the FWD operation after the position change in the above case, move the cursor to the next step for the job where a change has been made, then perform FWD operation, TEST run and playback.
4.19 Playback

4.19.1 Start

Call the master job in the following operation and perform a playback. A job in the subtask is started by a PSTART instruction.

**Operation**

Select {JOB} under the top menu ➔ Select [CTRL MASTER] ➔ Move the cursor to MASTER JOB of MASTER ➔ Press [SELECT] ➔ Select “CALL MASTER JOB” ➔ Press [START]

**Explanation**

* 1 The supervisory display appears.

* 2 The called master job is executed from the beginning and the subtask is executed by a PSTART instruction.

**Note**

Performing the operation of * 2: clears the job of subtask. Therefore, if the master task is called while the subtask is interrupted in the middle of its execution, the information relating to the state of subtasks that are halted is lost.
4.19.2 Automatic Correction of Shift Amount

During playback operation, as the station is controlled by the leading side job, the following side job controls only the following side manipulator. If there is a shift between the teaching position of the leading side job station and the station current position (controlled by the leading side job), the following side manipulator moves correcting automatically the shift amount in order to keep the position on the station at teaching.

The shift between the teaching position and the station current position is always monitored. If the shift amount exceeds the set value of parameter, the following message is displayed.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Contents and Set Value</th>
<th>Initial Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>S3C416</td>
<td>Maximum shift angle of station axis in twin (triple) synchronous system</td>
<td>Differs depending on system (in units of 0.1°)</td>
</tr>
</tbody>
</table>

The control method of manipulator posture during correction is set by the following parameter.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Contents and Set Value</th>
<th>Initial Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>S2C250</td>
<td>Control method of following side manipulator posture in twin (triple) synchronous system 0: Follow the motion of station 1: Constant to the earth</td>
<td>0</td>
</tr>
</tbody>
</table>
5 Triple Synchronous System

5.1 Outline

The triple synchronous system is a system where three manipulators operate in coordination for one station.

In this system, three coordinated jobs are done at the same time.
- A coordinated job for the first manipulator and the station (R1+S1)
- A coordinated job for the second manipulator and the station (R2+S1)
- A coordinated job for the third manipulator and the station (R3+S1)

A concurrent job starts these three jobs and implements I/O control. The master task job uses the independent control function to start the robot jobs of subtasks 1, 2 and 3. Three robot jobs can be created by the following two methods.
Method 1: Copy one subtask job to create two other subtask jobs.

1. Teaching

2. Mirror shift

This method is useful when two movement paths are symmetrical. Use the mirror shift function to convert a job path and copy it. The same teaching operation does not have to be repeated.

Method 2: Perform teaching for each manipulator.

1. Teaching (Leading side)

2. Teaching (Following side) Teaching (Following side)

Where there are not many similarities in the paths and movements of the three manipulators, create jobs in Method 2.
5.2 Specific Keys

The specific keys for the triple synchronous system are assigned to the number keys as shown in the figures below.

5.2.1 Arc Welding Application

![Diagram of specific keys for Arc Welding Application]
5.2 Specific Keys

Performs wire inching.
[FEED]: Supplies wire.

[RETRACT]: Reels wire in.

[ARC ON]: Registers an ARCON instruction.

[ARC OFF]: Registers an ARCOF instruction.

Changes the welding conditions during playback.
[CUR/VOL (3)]: Increases the current and voltage values.

[CUR/VOL (-)]: Decreases the current and voltage values.

Changes the type of movement for the manipulator when teaching a coordinated job. Each time this key is pressed, the movement type changes.

SYNCRO: The mark for “synchronized” appears in the status display area. When the master side is moved, the slave side will follow the movement of the master.

SINGLE: Only the selected group axis moves.

Selects either a coordinated or an individual operation when teaching a coordinated job. Each time this key is pressed, the operation type changes.

Coordinated: All the move instructions that are registered in this mode become coordinated instructions.

Individual: The master-slave relationship is cancelled. Each manipulator and station moves independently.
5.2.2 General Application

This application is to be added in the future.
5.2 Specific Keys

Registers a tool control instruction “TOOLON”.
Pressing [INTERLOCK] + [f.3] (TOOLON) executes the tool ON operation.

Registers a tool control instruction “TOOLOF”.
Pressing [INTERLOCK] + [f.1] (TOOLOF) executes the tool OFF operation.

Registers a CALL instruction for a reserved job “TOOLONxx”.

Registers a CALL instruction for a reserved job “TOOLOFxx”.

Changes the type of movement for the manipulator when teaching a coordinated job. Each time this key is pressed, the movement type changes.

SYNCRO: The mark for “synchronized” appears in the status display area. When the master side is moved, the slave side will follow the movement of the master.

SINGLE: Only the selected group axis moves.

Select either a coordinated or an individual operation when teaching a coordinated job. Each time this key is pressed, the operation type changes.

Coordinated: All the move instructions that are registered in this mode become coordinated instructions.

Individual: The master-slave relationship is cancelled. Each manipulator and station moves independently.
5.3 Job Configuration

Using the independent control function, configure jobs so that the concurrent job of master task operates the robot jobs in subtask 1, 2 and 3.

Master task: Concurrent job
Starts subtasks 1, 2 and 3, and controls I/Os.

Subtask 1: Robot job
A coordinated job for the first manipulator + the station

Subtask 2: Robot job
A coordinated job for the second manipulator + the station

Subtask 3: Robot job
A coordinated job for the third manipulator + the station

Subtasks 1, 2 and 3 are determined as leading or following side with a tag SYNC in PSTART instruction.
5.4 Leading Side and Following Side

Set either the subtask 1, the subtask 2, or the subtask 3 as the following side. To set a following side, add a tag SYNC and the leading side subtask to the PSTART instruction of the master task. The subtask to which a tag SYNC is added is following side while the subtask without a tag is leading side.

The station axis is controlled by the leading side job, and the following side job follows the movement of station axis.

```
004 PSTART JOB:JOB-1 SUB1 SYNC SUB3
005 PSTART JOB:JOB-2 SUB2 SYNC SUB3
006 PSTART JOB:JOB-3 SUB3
```

### Master task job

Subtask 1 (following side)
Subtask 2 (following side)
Subtask 3 (leading side)

In this case, the manipulators of subtask 1 and 2 synchronize with the leading side subtask 3.

**NOTE**

Register a PSTART instruction so that the following side job starts first.

5.5 Synchronizing with TSYNC

During the execution of the jobs, a deviation between the movements of the three manipulators may occur. In the steps where the movements of the three manipulators should be exactly the same, execute a TSYNC instruction immediately before these steps.

When a TSYNC instruction is executed in one of the robot jobs, the manipulator waits until the same synchronized signal, TSYNC, is executed in the other two robot jobs. Set the number of synchronized tasks. When setting “SYNCHRO NUM” to “UNUSED”, the number of tasks is the same as when “SNUM=2”.

**Format**

```
TSYNC
```

Synchronization No. 1 to 32

Number of synchronized tasks 2 or 3
5.5 Synchronizing with TSYNC

**Operation**

Move the cursor to the line just above the place where TSYNC instruction is to be registered ➔ Press [INFORM LIST] ➔ Select “TSYNC” ➔ Change additional items ➔ Press [INSERT] and [ENTER].

**Explanation**

*1 The instruction list dialog is displayed.

<table>
<thead>
<tr>
<th>IN/OUT</th>
<th>CONTROL</th>
<th>DEVICE</th>
<th>MOTION</th>
<th>ARITH</th>
<th>SHIFT</th>
<th>COMMENT</th>
</tr>
</thead>
</table>

*2 A TSYNC instruction is displayed in the input buffer line.

=> TSYNC

*3 <To register items as displayed in the input buffer line>
Perform operation *4

<To change the numerical data>
Move the cursor to the numerical data. Press [SHIFT] and the cursor key simultaneously to increment or decrement the number.

=> TSYNC

To enter a number by pressing the number keys, press [SELECT] to display the input line.

=> TSYNC

> Synchronization_no.

Enter a number and press [ENTER], then the number in the input buffer line is changed.

After having changed the numerical data, press [ENTER]. The detail edit display is closed and the job content display reappears.

<To edit additional items>
- To edit additional items, move the cursor to the instruction in the input buffer line, then press [SELECT]. The detail edit display is shown.

**Comment**

RET
NOP
PAUSE
PSTART
PWAIT
TSYNC

=> TSYNC

SYNCHRO NO. 1
SYNCHRO NUM UNUSED
5.5 Synchronizing with TSYNC

To change the synchronization number, select “1” of “SYNCHRO NO.”. When the number input status enters, enter the synchronization number, “SYNCHRO NO.” by pressing the number keys, and press [ENTER].

To add the number of synchronized tasks, select “UNUSED” of “SYNCHRO NUM”. The selection dialog is displayed. Select “SNUM=".

After changed or added the additional items, press [ENTER]. The detail edit display is closed, and the job content display appears.

*4 The instruction displayed in the input buffer line is registered.

<Example>

Synchronizes at the start of job.
Synchronizes just before the start of work (in this case, welding).
Synchronizes just after the end of work.
5.6 Job Example

Master task (Concurrent job)

```
NOP
'G
'RESET
DOUT OG#(1) 0
DOUT OG#(2) 0
DOUT OG#(4) 0
DOUT OG#(8) 0

' RETURN TO HOME 1
PSTART JOB: R1 HOME 1 SUB1  (R1+S1)
PSTART JOB: R2 HOME 2 SUB2  (R2)
PSTART JOB: R3 HOME 3 SUB3  (R3)
PWAIT SUB1  <

PWAIT SUB2  <

PWAIT SUB3  <

' RETURN TO HOME 1
PSTART JOB: R1 HOME 1 SUB1  (R1+S1)
PSTART JOB: R2 HOME 2 SUB2  (R2)
PSTART JOB: R3 HOME 3 SUB3  (R3)
PWAIT SUB1  <

PWAIT SUB2  <

PWAIT SUB3  <

JUMP 'G
'A

' RETURN TO HOME 1
PSTART JOB: R1 HOME 1 SUB1  (R1+S1)
PSTART JOB: R2 HOME 2 SUB2  (R2)
PSTART JOB: R3 HOME 3 SUB3  (R3)
PWAIT SUB1  <

PWAIT SUB2  <

PWAIT SUB3  <

JUMP 'G
'B

' WORK JOB
JUMP 'C IF IG#(3)=0

' WORK 1
JUMP 'E IF IG#(3)<1
PSTART JOB: TES11-R1 SUB1 SYNC SUB3  (R1+S1)
PSTART JOB: TES11-R2 SUB2 SYNC SUB3  (R2+S1)
PSTART JOB: TES11-R3 SUB3  (R3+S1)
PWAIT SUB1  <

PWAIT SUB2  <

PWAIT SUB3  <

' WORK 2
JUMP 'F IF IG#(3)<2
PSTART JOB: TES12-R1 SUB1 SYNC SUB3  (R1+S1)
PSTART JOB: TES12-R2 SUB2 SYNC SUB3  (R2+S1)
PSTART JOB: TES12-R3 SUB3  (R3+S1)
PWAIT SUB1  <

PWAIT SUB2  <

PWAIT SUB3  <

'C

DOUT OG#(4) 15
JUMP 'C

END
```
The contents of coordinated job are displayed as shown below.

**Instructions**
For coordinated jobs, the move instruction, the weaving instruction, the shift instruction, and others are displayed in two lines. The first line is the instruction to the slave side; the second line is the instruction to the master side.

- SMOV L V=138 \(\leftrightarrow\) Slave, a manipulator
- +MOVL \(\leftrightarrow\) Master, a station

**Synchronized/Single**
Synchronized/single are the types of movement available for the manipulator during axis operation. This mark appears when synchronized movement is selected. Switch between movements by pressing [SYNCRO/SINGLE].

**Group axis being handled**
Displays the group axis being handled. Pressing [ROBOT] selects the manipulator. Pressing [EX AXIS] selects the station.

**Coordinated operation/Individual operation**
Switch between coordinated operation and individual operation by pressing [SMOV].
5.8 Synchronized/Single

5.8.1 Synchronized/Single Movement Between Station and Manipulator

There are two ways to handle axes when teaching: “Synchronized” and “Single”. Change between movements by pressing [SYNCRO/SINGLE].

- **Synchronized**

  If the axes are handled in the “Synchronized” mode, the slave (manipulator) follows the master (station) when the master moves. This feature is used to keep the position of the manipulator relative to the station. However, the master does not move when the slave is moved.

  - A master axis is moved

When “Single” is selected, nothing appears here.
5.8 Synchronized/Single

### Single

If an axis is handled in “Single” mode, the manipulator or the station whose axis has been handled, moves. This feature is used where a manipulator and a station each executes an individual job.

- A slave side axis is moved.

![Slave Side Axis Moved](image)

- A master side axis is moved.

![Master Side Axis Moved](image)

- The selected mode, Synchronized or Single, is maintained until the next selection is made.
- When an edit job is changed, “Single” is automatically selected.
5.8.2 Job Synchronized Mode for Subtask 1, 2 and 3

When moving only the leading side manipulator in FWD/BWD operation, the following side manipulator in stop status may interfere with a workpiece. To prevent this, using “job synchronized mode” can move the following side synchronizing the motion of the leading side. The following side manipulator moves, keeping the relative position to the station.

Pressing [SHIFT] + [SYNCRO/SINGLE] changes the job synchronized mode.

![Synchronized/Single Mode Diagram]

Also in the teaching condition display, the job synchronized mode can be set and confirmed.

**Operation**

Select {SET UP} under the top menu ➔ Select {TEACHING COND} ➔ Select “TWIN COORDINATED MODE”

**Explanation**

*1 The teaching condition display appears.
5.9 Selecting Axis to be Handled

In a coordinated system with multiple numbers of group axes, select a group axis to be handled in the following manner.

5.9.1 When There is an Edit Job

When the edit job is displayed, the group axes registered in the displayed job is the one to be handled.

Pressing [ROBOT] selects a manipulator for axis handling.

Pressing [EX AXIS] selects a station for axis handling.

5.9.2 When There is No Edit Job

When there is no edit job, move a manipulator in the following manner.


2. Select the group axes to be moved, and then move it by pressing the axis key.

3. Press [ROBOT] or [EX AXIS] to return to the original display.
5.10 Registering Job

Operation

Select {JOB} under the top menu ➔ Select {NEW JOB CREATE} ➔ Enter a job name ➔ Press [ENTER] ➔ Select “GROUP SET” ➔ Select a group combination ➔ Select “EXEC”.

Explanation

* 1 The new job create display is shown.

![New Job Create Display](image)

* 2 Select “JOB NAME”, and then enter a job name by entering the characters. Refer to Section 1.3.5 “Character Input Operation” of the Operator’s Manual.

* 3 The job name is registered in the memory of XRC, and the job content display appears.

5.11 Registering Move Instruction (S)MOV□+MOVJ

Register a move instruction in the following manner.

5.11.1 Operating Master Side (Station)

Operation

Call the job content display in teach mode ➔ Press [EX AXIS] ➔ Select either “synchronized” or “single” ➔ Press the axis key to move to the desired position

Explanation

* 1 The master side (station) is selected for axis handling.
5.11 Registering Move Instruction (S)MOV□+MOVJ

* 2 Press [SYNCRO/SINGLE] to select either “synchronized” or “single”. When “synchronized” is selected, the mark in the display below appears. When the slave side is supposed to follow the master side motion, select “synchronized”.

When "Single" is selected, nothing appears here.

5.11.2 Operating Slave Side (Manipulator)

Operation

Press [EX AXIS] * 1 Press the axis key to move to the desired position Select either a coordinated operation or an independent movement * 2 Select a motion type * 3 Confirm the speed ➔ Press [ENTER]

Explanation

* 1 The slave side (manipulator) is selected for axis handling.

* 2 Press [SMOV] to select a coordinated operation.

* 3 Press [MOTION TYPE] to select a motion type.

* 4 The registration is completed as follows.

NOTE

- When joint motion is set for the slave side (manipulator), teaching can not be done during a coordinated operation.
- When “JOINT” is selected, the operation will not change to a coordinated operation, even if [SMOV] is pressed.
- When “JOINT” is selected during coordinated operation, a coordinated move instruction such as “SMOVL” in the input buffer line changes to “MOVJ”, and the operation becomes individual operation.
5.12 Registering Reference Point Instruction (SREFP)

Register a reference point instruction (SREFP) for a coordinated operation in the following manner.

**Operation**

Select {JOB} under the top menu ➔ Select {JOB} ➔ Move the cursor *7 ➔ Grasp the deadman switch ➔ Press the axis key *2 ➔ Select the coordinated operation *3 ➔ Press [REF PNT] *4 ➔ Change the reference point number *5 ➔ Press [INSERT] *6 ➔ Press [ENTER] *7

**Explanation**

*1 Move the cursor to the line immediately before the position where the reference point is to be registered.

```
003 SMOV L V=558
004 +MOVJ
005 CALL JOB:TEST
006 SMOV L V=138
007 +MOVJ
```

*2 Turn ON the servo power with the deadman’s switch. Move the manipulator to the position which will be a reference point.

*3 Press [SMOV] to select a coordinated operation.

*4 The reference point instruction appears in the input buffer line.

```
=> SREFP 1
```

*5 Move the cursor to the reference point number, and press [SHIFT] + the cursor key to change the reference point number.

```
=> SREFP 1
> Ref-point_no. 
```

If you use the number keys to change the reference point number, press [SELECT] when the cursor is on the reference point number. Input the number and press [ENTER].

```
=> SREFP 1
> Ref-point_no. 
```

*6 The [INSERT] key lamp lights up.

When registering before the END instruction, [INSERT] is not needed.
5.13 Changing Tasks

To call the job content display for master task, subtask 1 or subtask 2, proceed the following operation.

**Operation**

Select {JOB} under the top menu ➔ Select {JOB CONTENT} ➔ Press the page key

**Explanation**

*1 Each time the page key \[\text{Page}^1\] is pressed, the contents of the job content display change in order of master task, subtask 1 and subtask 2. When there is no job in a task, the job content display for this task is not displayed.

5.14 Creating a Job in a Subtask - Method 1 and 2

Subtasks 1, 2 and 3 are robot jobs.
- Subtask 1: Job of the first manipulator + the station
- Subtask 2: Job of the second manipulator + the station
- Subtask 3: Job of the third manipulator + the station

There are two methods to create a robot job for a subtask.
Method 1: Copy one subtask job to create two other subtasks.

This method is useful when two movement paths are symmetrical. Use the mirror shift function to convert a job path and copy it. The same teaching operation does not have to be repeated.

Method 2: Perform teaching for each manipulator.

Where there are not many similarities in the paths and movements of the three manipulators, create jobs in Method 2.
5.15 Method 1: Copy One Subtask Job and Create Other Two Jobs

5.15.1 Procedure

When two movement paths are symmetrical, two subtask jobs can be created by using the job taught by another manipulator. Perform teaching for either R1 + S1, R2 + S1 or R3+S1. Use the mirror shift to create a job for the other two manipulators.

The mirror shift is a function for copying jobs, which creates a job by reversing the signs of the position data for the S-, R-, and T-axes.
5.15.2 Teaching and Mirror Shift

Teach the job for one manipulator + the station, and confirm the movement. After having completed the teaching, perform mirror shift the job.

- Converting

Call the job content display for the job to be converted.

**For the job currently selected**

**Operation**

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

**To call another job**

**Operation**

Select {JOB} under the top menu ➔ Select {SELECT JOB} ➔ select a job to be displayed

**Explanation**

*1 The job list display appears.
Execute conversion

Operation

Select {UTILITY} of the menu ➔ Select {MIRROR SHIFT}

① SOURCE JOB
Select a job name of the conversion origin.
Move the cursor to the name, then press [SELECT]. The job list display appears. Select a job to be converted, then press [SELECT].

② SOURCE CTRL GROUP
Displays the control group of the SOURCE JOB.

③ DESTINATION JOB
Select a job name for the converting destination.
Move the cursor to the name, then press [SELECT] to enter the character input status. The name of SOURCE JOB is displayed in the input line. If the name of SOURCE JOB is not to be used, press [CANCEL] and enter a job name for the converting destination.

④ DEST CTRL GROUP
When a job name is set for DESTINATION JOB, the same control group as that of SOURCE JOB is set. If the control group for DESTINATION JOB is to be changed, move the cursor to DEST CTRL GROUP and press [SELECT] to display the selection dialog. Select a control group and press [SELECT].

⑤ EXEC
Move the cursor to “EXEC” and press [SELECT]. The conversion is executed. When a name of DESTINATION JOB is set, a job is created by the conversion. When a name of DESTINATION JOB is not set, the SOURCE JOB itself is converted.

Jobs Not to be Converted
The jobs and relative jobs without group axes can not be converted.

Group Axes for Conversion
When the group axes for the SOURCE JOB in the multiple group axes system, the axis configuration, etc. of each group axes for SOURCE JOB and DESTINATION JOB must be the same.
- Robot axis: Same type
- Base axis: Same axis configuration
- Station axis: Same axis configuration
5.15 Method 1: Copy One Subtask Job and Create Other Two Jobs

- **Position type variables**
The position type variables are not for mirror-shift.

- **Parameter**
Which axis is to be shifted (reverse the sign) is specified by the following parameter.
S1C×G065: Mirror shift sign reversed axis specification

```
T B R U L S
```

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

6th axis

5.15.3 Correcting Positional Dislocation

In the job after mirror shift, a position may be dislocated due to the installation error. In this case, all steps should be corrected by the same shift amount. For this operation, the parallel shift job conversion function is used.

- **Set the items for conversion**

  **Operation**
  
  Select {JOB} under the top menu ➔ Select {JOB CONTENT} ➔ Select {UTILITY} of the menu ➔ Select {PARALLEL SHIFT JOB} ➔ Set the items for conversion

  **Explanation**
  
  *1 The job content display appears.

  *2 The parallel shift job display appears.

  *3 Set each item.

  SOURCE JOB
  
  Set a job of the conversion origin. The initial setting is the job currently shown in the job content display.
  
  To change the job, move the cursor to SOURCE JOB and press [SELECT]. The job list display appears. Move the cursor to the job to be changed with and press [SELECT]. The SOURCE JOB is set.
5.15 Method 1: Copy One Subtask Job and Create Other Two Jobs

2 **STEP SECTION (start step → end step)**
Set the steps of SOURCE JOB to be converted. The initial value is set to all the steps of SOURCE JOB. If there is no step in SOURCE JOB, “****” is displayed. To change the setting, move the cursor to STEP SECTION and press [SELECT] to enter the number input status. Enter the step numbers and press [ENTER]. The step numbers are changed.

3 **DESTINATION JOB**
Set a job name for the converting destination. If a job name is not specified (“********” is displayed), the SOURCE JOB is the object for conversion. If a job name is set, the SOURCE JOB is copied to DESTINATION JOB to be converted. To change the DESTINATION JOB, move the cursor and press [SELECT] to display the job list display. Move the cursor to a job to be set and press [SELECT]. The DESTINATION JOB is set.

4 **COORDINATES**
Set a coordinate system to be used for conversion. Move the cursor to COORDINATES and press [SELECT] to display the selection dialog. Select a coordinate system to be set and press [SELECT]. The COORDINATES is set.
When USER coordinate system is selected, the number input status enters. Enter the desired user coordinate number, then press [ENTER].

Set the Shift Amount

The shift amount can be set in the following two ways.
- Enter directly the value of shift amount.
- Teach two points, the base (reference) point of SOURCE JOB and the base (reference) point of DESTINATION JOB, then the difference between these two points is taken as the shift amount.

Enter directly the value of shift amount

**Operation**
Select a shift value to be set on the parallel shift job display* ¹ Enter the shift amount to be set by pressing the number keys ➔ Press [ENTER]* ²

**Explanation**
* ¹ The number input status enters.
5.15 Method 1: Copy One Subtask Job and Create Other Two Jobs

*2 The shift value is set.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARALLEL SHIFT JOB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOURCE JOB</td>
<td>JOB1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEP SECTION</td>
<td>001 ➔ 010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESTINATION JOB</td>
<td>JOB2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COORDINATES</td>
<td>ROBOT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASE POINT</td>
<td>TEACH SETTING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHIFT VALUE</td>
<td>R1:X 200.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Y 0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Z 0.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To take the difference between two points as the shift amount

**Operation**

Select “TEACH SETTING” of “BASE POINT” on the parallel shift job display*1 ➔ Select “BASE POINT (SRC)” ➔ Move to the source job base point by using the axis keys ➔ Press [MODIFY] and [ENTER]*2 ➔ Select “BASE POINT (DEST)” ➔ Move to the destination job base point by using the axis keys ➔ Press [MODIFY] and [ENTER]*3 ➔ Select “EXEC”*4

**Explanation**

*1 The parallel shift job base point display appears.

*2 The source job base point is set.
5.15 Method 1: Copy One Subtask Job and Create Other Two Jobs

* 3 The destination job base point is set.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARALLEL SHIFT JOB</td>
<td>R1 S</td>
<td>C</td>
<td>L</td>
</tr>
<tr>
<td>BASE POINT(SRC)</td>
<td>BASE POINT(DEST)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R1:X</td>
<td>230.000</td>
<td>R1:X</td>
<td>460.000</td>
</tr>
<tr>
<td>Y</td>
<td>40.000</td>
<td>Y</td>
<td>60.000</td>
</tr>
<tr>
<td>Z</td>
<td>20.000</td>
<td>Z</td>
<td>100.000</td>
</tr>
</tbody>
</table>

* 4 The difference between two taught points (base points) is calculated. This difference is reflected in the parallel shift job display as a shift value.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARALLEL SHIFT JOB</td>
<td>R1 S</td>
<td>C</td>
<td>L</td>
</tr>
<tr>
<td>SOURCE JOB</td>
<td>JOB1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEP SECTION</td>
<td>001 → 010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESTINATION JOB</td>
<td>JOB2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COORDINATES</td>
<td>ROBOT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASE POINT</td>
<td>TEACH SETTING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHIFT VALUE</td>
<td>R1:X</td>
<td>230.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>20.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Z</td>
<td>80.000</td>
<td></td>
</tr>
</tbody>
</table>

- Execute conversion

**Operation**

Select “EXEC” in the parallel shift job display

**Explanation**

* 1 When the destination job is not set, a confirmation dialog is displayed. Select “YES” to execute the conversion.
When the conversion is completed, the job content display reappears.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARALLEL SHIFT JOB</td>
<td>R1 S</td>
<td>C</td>
<td>L</td>
</tr>
<tr>
<td>SOURCE JOB</td>
<td>JOB1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEP SECTION</td>
<td>001 → 010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESTINATION COORDINATES</td>
<td>ROBOT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASE POINT</td>
<td>TEACH SETTING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHIFT VALUE</td>
<td>OVERWRITE?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Overwrite?

<table>
<thead>
<tr>
<th>OVERWRITE</th>
<th>EXEC</th>
<th>CANCEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5-28
5.16 Method 2: Perform Teaching for Each Manipulator

5.16.1 Procedure

First, perform teaching a job for the combination of leading side manipulator and station. Next, perform teaching a job for the combination of following side manipulator and station. For this operation, perform teaching so that the slave side manipulator follows the motion of station by FWD operation of the master side job.

For Method 2, there are two ways of teaching depending on whether the master task is used or not used.
5.16 Method 2: Perform Teaching for Each Manipulator

5.16.2 Teaching using Master Task

Using the master task can omit the operation to register a job name in the supervisory display.

![Diagram](image)

**Operation**

Teach the coordinated job of leading side subtask

1. New job registration for the coordinated job of following side subtask
2. New job registration of master task
3. Register PSTART instruction
4. Set to “Single job operation mode”
5. Move the cursor to the first PSTART instruction
6. Press [INTERLOCK] + [FWD]
7. Move the cursor to the second PSTART instruction
8. Press [INTERLOCK] + [FWD]
9. Press the page key to change to the leading side subtask
10. Move the cursor to the step 1
11. Press [FWD]
12. Press the page key to change to the following side subtask
13. Register the step 1 of the following side subtask
14. Register the step 2 and onward of the following side subtask

**Explanation**

*1 Teach all the steps of coordinated job for one manipulator + the station.

*2 Register as a new job the coordinated job for the other manipulator + the station.
For new job registration, refer to Section 5.10 “Registering Job”.

*3 Newly register the master task as concurrent job.
For concurrent job, refer to Section 7.5.2 “Concurrent Job”.

For new job registration, refer to Section 5.10 “Registering Job”.

New job registration
5.16 Method 2: Perform Teaching for Each Manipulator

*4 Register a PSTART instruction to start the job newly registered at *2 To specify this subtask as the following side, add a tag SYNC and the leading side subtask. Then, register a PSTART instruction to start the job taught at *1.

5 Set the operation mode at FWD operation to “Single job operation mode”. Pressing [SHIFT] + [SMOV] changes the operation mode.

6 Starts the following side subtask.

7 Starts the leading side subtask.

8 Each time the page key is pressed, the contents of the job content display change in order of master task, subtask 1, subtask 2 and subtask 3.

9 After the FWD operation of step 1 of leading side, change to the following side and register the position of the following side manipulator relative to the station current position.

10 Change to the leading side job content display, and perform a FWD operation to the next step.

To maintain the following side manipulator position relative to the station, press [SHIFT] + [SYNCRO/SINGLE] to set the job synchronized mode.

Change to the following side job content display, and register the following side manipulator position relative to the station current position.

Teach the following side job by repeating the steps 10 and 12.
5.16 Method 2: Perform Teaching for Each Manipulator

5.16.3 Teaching using Supervisory Display

When teaching without master task, it is necessary to register the startup job (ROOT JOB) in the supervisory display.

![Diagram of teaching process](image)

| Leading side Teaching completed | Following side | New job registration | Register a startup (root) job in the supervisory display | Following side teaching |

Operation

Teach a coordinated job of leading side subtask*1 ➔ new job registration of a coordinated job of following side subtask*2 ➔ select (JOB) under the top menu ➔ select [SUPERVISORY]*3 ➔

Select the root job of master task ➔ Select “CANCEL ROOT JOB” ➔ Select the root job of subtask 1 ➔ Select “REGISTER ROOT JOB”*5 ➔ Select a job to be registered as root job ➔ Select the root job of subtask 3 ➔ select “REGISTER ROOT JOB” ➔ Select a job to be registered as root job*5 ➔ Select the synchronous task of subtask 1 (2) ➔ Select “SUB3”*6 ➔ Select “Single job operation mode”*7 ➔ Select {JOB} under the top menu ➔ Select [JOB CONTENT] ➔ Press the page key ➔ change to leading side subtask.*8 ➔

Move the cursor to the step 1 ➔ Press [FWD] ➔ Press the page key ➔ to change to the leading side subtask*8 ➔

Register the step 1 of following side subtask*9 ➔ Register the step 2 and onward of following side subtask*10

Explanation

*1 Teach all the steps of the coordinated job of one manipulator + the station.

*2 Register as a new job the coordinated job of the other manipulator + the station. For new job registration, refer to Section 5.10 “Registering Job”.

![Teaching and confirming movements](image)

![New job registration](image)
*3 The supervisory display appears. Each time the page \( \text{Q} \) is pressed, the contents of the display changes. When the three columns show information for the master task, subtask 1, and subtask 2, press the page \( \text{R} \) and the information for subtasks 3 to 5 appears instead. Press the page \( \text{G} \) again, and the information for the master task, subtask 1, and subtask 2 reappears.

*4 The root jobs of master task, subtask 1, subtask 2 and subtask 3 are cancelled.

*5 The root jobs for subtask 1 (2) and subtask 3 are registered.

*6 Specify SUB3 of leading side task to synchronize the synchronous task of subtask 1 (2).

*7 Set “Single job operation mode” for the operation mode at FWD operation. Pressing [SHIFT] + [SMOV] changes the operation mode.

*8 Each time the page key \( \text{Q} \) is pressed, the contents of the job content display change in order of master task, subtask 1, subtask 2 and subtask 3.

*9 After the FWD operation of step 1 of leading side, change to following side and register the position of the following side manipulator relative to the station current position.
5.17  Job in Master Task

* 1  ○ Change to the leading side job content display and perform FWD operation to the next step.
   To maintain the following side manipulator position relative to the station, press
   [SHIFT] + [SYNCRO/SINGLE] to set the job synchronized mode.

○ Change to the following side job content display, and register the following side
manipulator position relative to the station current position.

Teach the following side job by repeating the steps ① and ②.

5.17  Job in Master Task

The job of master task is a concurrent job.

Operation

Select {JOB} under the top menu  ➔ Select [NEW JOB CREATE]  ➔ Enter a job name  ➔
Set “GROUP SET”  ➔ Set “CONCURRENT JOB”  ➔ Press [ENTER]  ➔ Select “EXEC”
⇒ Register a PSTART instruction

Explanation

* 1  The new job create display appears.

* 2  Move the cursor to JOB NAME and press [SELECT], and enter a job name by entering
the characters.

* 3  Selecting “R1” of “GROUP SET” displays the selection dialog.  Select “NON GROUP”.

* 4  Select “ROBOT JOB” of “JOB TYPE”.  Each time [SELECT] is pressed, “ROBOT JOB” or “CONCURRENT JOB” is selected alternately.
*5 The job is registered in the memory of XRC, and the job content display appears. NOP and END instructions are registered automatically.

```
** JOB CONTENT:MASTER **
J:MASTER S:000 TOOL:* 0000 NOP 0001 END
```

*6 Register PSTART instructions to start the subtask 1, 2 and 3. Since the first PSTART instruction is for starting the following side subtask, add a tag SYNC and the leading side subtask. Then, register a PSTART instruction to start the leading side subtask.

```
** JOB CONTENT:MASTER **
J:M-TASK S:000 0000 NOP 0001 JOB FOR MASTER 0002 PSTART JOB:JOB-R1 SUB1 SYNC SUB3 0003 PSTART JOB:JOB-R2 SUB2 SYNC SUB3 0004 PSTART JOB:JOB-R3 SUB3 0005 PWAIT SUB1 0006 PWAIT SUB2
```
Confirming Operation

5.18.1 Procedure

- For confirming operation, set to “Multi-job operation mode”.
  In the multi-job operation mode, the jobs in all the tasks operate. (The operation procedures are explained below.)
  If the following side subtask is operated individually, only the following side manipulator moves but not the station. As the following side manipulator moves following to the station current position, an alarm may occur and the manipulator may interfere the station as a result.
  To verify the individual operation of the following side manipulator itself, call the job by job selection operation and confirm the individual operation of the job, but not in the twin synchronization.

**Operation**

Create a concurrent job"1 Select (JOB) under the top menu ➔ Select [CTRL MASTER]"2
Move the cursor to the task where the master job is to be registered ➔ Press [SELECT] ➔
Select “SETTING MASTER JOB” ➔ Select a job to be the master job ➔ Press [SHIFT] + [SYN-CRO/SINGLE]"1 ➔ Press [TEST START] or [FWD]"4

**Explanation**

*1 For procedure, refer to Section 5.17 “Job in Master Task”.

*2 The supervisory display appears. Each time the page key is pressed, the contents of the display changes. When the three columns show information for the master task, subtask 1, and subtask 2, press the page key and the information for subtasks 3 to 5 appears instead. Press the page key again, and the information for the master task, subtask 1, and subtask 2 reappears.
5.18 Confirming Operation

* 3 Set to “Multi-job operation mode”
Each time [SHIFT] + [SYNCRO/SINGLE] are pressed, the operation mode changes between “Multi-job operation mode” and “Single job operation mode”.

* 4 When a PSTART instruction is executed, the manipulator and the station move.

5.18.2 Precautions for Confirming Operation

In the following operations, the steps of three manipulators will not coincide.

■ Stops during Operation

<Example>
- When the manipulator stops during operation, move the cursor position to another step of the job in one of the subtasks.
- Call the master job only by one of the subtasks.

When restarting the operation in the states as explained above, an interference with jig, etc. may be caused. Restart both jobs from the same position (step).
When “Multi-job operation mode” is set in the teaching condition display

**<Example>**

If the manipulator stops after operating to a certain step, and the step position of the following side R1 is changed and performs FWD operation again, the leading side R3 and the following side R2 proceed to the next step but the R1 does not move. As a result, the R3 and R2 go forward by one step ahead.

This is because, in the FWD operation after position change, the step after the change is usually re-executed.

In the above figure, at the FWD operation after the position change, the leading side R3 and the following side R2, whose steps have not been changed, move to the step 3. However, since position of the following side R1 is changed, the step after the change is executed again. As a result, operation is performed at the same position and it does not proceed to the next step. In this way, the steps of both sides do not correspond each other.

To make the steps of two sides correspond each other at the FWD operation after the position change in the above case, move the cursor to the next step for the job where a change has been made, then perform FWD operation, TEST run and playback.
5.19 Playback

5.19.1 Start

Call the master job in the following operation and perform a playback. A job in the subtask is started by a PSTART instruction.

**Operation**

Select (JOB) under the top menu ➔ Select [CTRL MASTER]** 1 ➔ Move the cursor to MASTER JOB of MASTER ➔ Press [SELECT] ➔ Select “CALL MASTER JOB” ➔ Press [START]** 2

**Explanation**

* 1 The supervisory display appears.

* 2 The called master job is executed from the beginning and the subtask is executed by a PSTART instruction.

---

**NOTE**

Performing the operation of **2:clears the job of subtask. Therefore, if the master task is called while the subtask is interrupted in the middle of its execution, the information relating to the state of subtasks that are halted is lost.
5.19.2 Automatic Correction of Shift Amount

During playback operation, as the station is controlled by the leading side job, the following side job controls only the following side manipulator.

If there is a shift between the teaching position of the leading side job station and the station current position (controlled by the leading side job), the following side manipulator moves correcting automatically the shift amount in order to keep the position on the station at teaching.

The shift between the teaching position and the station current position is always monitored. If the shift amount exceeds the set value of parameter, the following message is displayed.

![PULSE LIMIT (TWIN COORDINATED)]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Contents and Set Value</th>
<th>Initial Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>S3C416</td>
<td>Maximum shift angle of station axis in twin (triple) synchronous system</td>
<td>Differs depending on system (in units of 0.1°)</td>
</tr>
</tbody>
</table>

The control method of manipulator posture during correction is set by the following parameter.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Contents and Set Value</th>
<th>Initial Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>S2C250</td>
<td>Control method of following side manipulator posture in twin (triple) synchronous system 0: Follow the motion of station 1: Constant to the earth</td>
<td>0</td>
</tr>
</tbody>
</table>
6 Coordinated Control

6.1 Outline

The coordinated control is the function of controlling multiple manipulators and stations at the same time.

A job to implement the coordinated control is a coordinated job. A coordinated job controls two group axes at the same time.
6.2 Group Combination

The group combination in a coordinated job is to specify two group axes to be coordinated. The master-slave relationship must be assigned between two group axes. When executing a coordinated instruction, the slave side executes relative interpolation on the tool coordinate system of the master side. A group combination is set at the registration of new job name.

When a coordinated job is taught, as shown below, a move instruction is normally displayed in two lines: the first line is for slave side, and the second line marked with “+” is for master side.

<table>
<thead>
<tr>
<th>Step</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>SMOVL +MOVL</td>
</tr>
<tr>
<td></td>
<td>←Slave side</td>
</tr>
<tr>
<td>002</td>
<td>MOVL +MOVL</td>
</tr>
<tr>
<td></td>
<td>←Slave side</td>
</tr>
</tbody>
</table>

6.3 Coordinated and Individual Operations

Two types of operation are available for a coordinated job.

6.3.1 Coordinated Operation

The coordinated operation is performed by two group axes in a master-slave relationship. The slave executes a relative movement on the tool coordinate system of the master side. This feature is used in works that require coordinating to the movement of workpiece.
6.3.2 Individual Operation

The individual operation is performed with the master-slave relationship cancelled. The master side and the slave side both perform their own individual movements, but the starts and the ends of the movements taught to each are the same. This operation is used when, after the master side and the slave side completed a job of the coordinated operation, each side is to perform its own job.

<Example>
Example of play speed slowed down with individual movement
If an identical speed is given to two group axes, in order that they might finish works as far as the step 2 simultaneously, the group axis 2 is given movement slower than $V=276$.

6.3.3 Changing Operation Mode

Each time [SMOV] is pressed, the instruction in the input buffer line changes between coordinated operation and individual operation.

6.4 Restriction

Only MOVJ instruction can be used as move instructions for the station.
6.4 Restriction
7 Independent Control

7.1 Independent Control

The XRC is configured to be able to decode and execute three jobs (with option, maximum six jobs) each independently. A multitask control performed by this mechanism is called “independent control”.

Three mechanisms which execute jobs are called as follows:
- Master task
- Subtask 1
- Subtask 2

The subtask1 and subtask 2 are the tasks to execute jobs that are started by the master task.

A job able to use move instructions is called a robot job. A job which does not use a move instruction is called a concurrent job.

<table>
<thead>
<tr>
<th>Robot job</th>
<th>A job which moves robot axes or station axes with move instructions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concurrent job</td>
<td>This is used as a job to start robot jobs, or as specialized job to control calculations and I/O.</td>
</tr>
</tbody>
</table>

The jobs of subtask 1 and subtask 2 (hereinafter, referred to as “subtask1/2”) are started by the PSTART instruction. To start a job always fixed, it is convenient to use the master job.
7.1 Independent Control

<Example>
When executing two robot jobs, make the master task a concurrent job.

Diagram:

- Master task
  - Concurrent job
  - Subtask 1
    - Robot job
  - Subtask 2
    - Robot job
<Example>
When implementing control of calculations or I/O, make the subtask 1 a concurrent job.

7.2 Startup Method

7.2.1 Starting a Job always Fixed (Master Job)

To execute a job always fixed in each task, it is convenient to use a master job. One master job (a series of jobs including related jobs) can be registered for each task.

Always register a master job for master tasks. If there is no master job registered, it can not function as a master task.

For subtasks, if a master job is registered, the job name which starts with a PSTART instruction can be omitted.

PSTART SUB1 ---- The master job of subtask 1 starts automatically.
PSTART SUB2 ---- The master job of subtask 2 starts automatically.
Even if a master job is registered, another unrelated job can be started. Refer to Section 7.2.2 “Starting Various Jobs”.

Starts "WORK-A" in subtask 1.
7.2.2 Starting Various Jobs

When a job executed in each task is not fixed, set each job name to be started with a PSTART instruction.

PSTART JOB: job name SUB □... A specified job is started in a specified task.
7.3 Switching Task Display

To call the job content display of the master task and subtask 1/2, take the following procedure.

**Operation**

Select {JOB} under the top menu ➔ Select {JOB} ➔ Press the page key

**Explanation**

*1 Each time the page key is pressed, the contents of the job content display change in order of Master task, Subtask 1, and Subtask 2. The job content display of the task where no job is registered, is not shown.

7.4 Registering Instructions

Register an instruction when the cursor is in the address area in the job content display in teach mode.

**Operation**

Select {JOB} under the top menu ➔ Select {JOB} ➔ Move the cursor to the address area.
### 7.4.1 PSTART Instruction

**Operation**

Move the cursor to the line just above the place where PSTART instruction is to be registered ➡ Press [INFORM LIST] ➡ Select “PSTART” ➡ Change additional items ➡ Press [INSERT] and [ENTER]

**Explanation**

*1* The instruction list dialog is displayed.

*2* A PSTART instruction is displayed in the input buffer line.

*3* To register items as displayed in the input buffer line

Perform operation *4*

<To register items as displayed in the input buffer line>

<To edit additional items>

• When the job name is to be changed, move the cursor to the job name, then press [SELECT]. The job name selection display is shown. Select a job to be changed.

• To edit additional items, move the cursor to the instruction in the input buffer line, then press [SELECT]. The detail edit display is shown.

---

*4* This is displayed for the twin synchronous system.
To change the target task, move the cursor to “JOB:”, then press [SELECT]. The selection dialog is displayed. Select a target job to be changed with.

To change the startup task, select “SUB1” of “STARTUP TASK”. The selection dialog is displayed. Select the startup task to be changed with.

To specify the synchronization, select “UNUSED” of “SYNC SET”. The selection dialog is displayed. Select “SYNC”.

To change the master side task to synchronize, select “UNUSED” of “SYNC TASK”. The selection dialog is displayed. Select a synchronous task to be changed.

If the synchronous task is set to “UNUSED”, SUB1 performs the same motion as the synchronous task SUB2 where SUB1 is a startup task, SUB2 performs the same motion as the synchronous task SUB1 where SUB2 is a startup task.
7.4 Registering Instructions

To add a condition, select “UNUSED” of “CONDITION”. The selection dialog is displayed. Select “IF”.
“IF” is shown in the detail edit display. Press [ENTER] to add “IF”.

After changed or added the additional items, press [ENTER]. The detail edit displayed is closed and the job content display appears.

* 4 The instruction displayed in the input buffer line is registered.

7.4.2 PWAIT Instruction

**Operation**

Move the cursor to the line just above the place where PWAIT instruction is to be registered

Press [INFORM LIST]* 1 ➞ Select “PWAIT”* 2 ➞ Change additional items * 3 ➞ Press [ADD] and [ENTER]* 4

**Explanation**

* 1 The instruction list dialog is displayed.
7.4 Registering Instructions

* 2 A PWAIT instruction is displayed in the input buffer line.

```
=> PWAIT SUB1
```

* 3 To register items as displayed in the input buffer line
   Perform operation * 4

   To edit additional items
   - To edit additional items, move the cursor to the instruction in the input buffer line, then press [SELECT]. The detail edit display is shown.

   To change the target task, select “SUB1” of “TARGET TASK”. The selection dialog is displayed. Select a target task to be changed with.

   To add a condition, select “UNUSED” of “CONDITION”. The selection dialog is displayed. Select “IF”. “IF” is shown in the detail edit display. Press [ENTER] to add “IF”.

   After changed or added the additional items, press [ENTER]. The detail edit display is closed, and the job content display appears.

* 4 The instruction displayed in the input buffer line is registered.
7.4.3 TSYNC Instruction

**Operation**

Move the cursor to the line just above the place where TSYNC instruction is to be registered. Press [INFORM LIST] *1  
Select “TSYNC”*2  
Change the numerical data*3  
Press [ADD] and [ENTER]  
*4

**Explanation**

*1 The instruction list dialog is displayed.

*2 A TSYNC instruction is displayed in the input buffer line.

*3 <To register items as displayed in the input buffer line>
Perform operation *4

<To change the numerical data>
Move the cursor to the numerical data. Press [SHIFT] and the cursor key simultaneously to increment or decrement the number.

To enter a number by pressing the number key, press [SELECT] to display the input buffer line.

Enter a number, then press [ENTER]. The number displayed in the input buffer line is changed.

After changed the numerical data, press [ENTER]. The detail edit display is closed, and the job content display appears.
7.4 Registering Instructions

<To edit additional items>

• To edit additional items, move the cursor to the instruction in the input buffer line, then press [SELECT]. The detail edit display is shown.

To change the synchronization number, select “1” of “SYNCHRO NO.”. When the number input status enters, enter the synchronization number, “SYNCHRO NO.” by pressing the number keys, and press [ENTER].

To add the number of synchronized tasks, select “UNUSED” of “SYNCHRO NUM”. The selection dialog is displayed. Select “SNUM=”. 

After changed or added the additional items, press [ENTER]. The detail edit display is closed, and the job content display appears.

* 4 The instruction displayed in the input buffer line is registered.
7.5 Registering Job

7.5.1 Robot Job

Register a job in the subtasks. The robot jobs in subtasks are registered task by task.

**Operation**

Select {JOB} under the top menu ➔ Select {NEW JOB CREATE} ➔ Enter a job name ➔ Set “GROUP SET” ➔ Set “ROBOT JOB” ➔ Press [ENTER] ➔ Select “EXEC”

**Explanation**

*1 The new job create display is shown.

*2 Move the cursor to the job name, then press [SELECT]. Enter a job name by character input operation.

*3 Select “R1” of “GROUP SET”. The selection dialog is displayed. Select a control axis.

*4 Set “ROBOT JOB” for “JOB TYPE”.

*5 The job name is registered in the memory of XRC, then the job content display is shown. NOP and END instructions are automatically registered.
7.5 Registering Job

7.5.2 Concurrent Job

Register a job in the master task.

**Operation**

Select [JOB] under the top menu ➔ Select [NEW JOB CREATE]*1 ➔ Enter a job name*2 ➔ Set “GROUP SET”*3 ➔ Set “CONCURRENT JOB”*4 ➔ press [ENTER]

Select “EXEC”*5

**Explanation**

*1 The new job create display is shown.

*2 Move the cursor to the job name, then press [SELECT]. Enter a job name by character input operation.

*3 Select “R1” of “GROUP SET”. The selection dialog is displayed. Select “NO GROUP”.

*4 Move the cursor to “ROBOT JOB” of “JOB TYPE”, then press [SELECT]. Each time [SELECT] is pressed, “ROBOT JOB” and “CONCURRENT JOB” is shown alternately.

*5 The job name is registered in the memory of XRC, and the job content display is shown. NOP and END instructions are automatically registered.
7.6 Job Examples

7.6.1 Non-Synchronous Operation

The example below is a job configuration for the manipulators 1 and 2 to perform entirely separate operations in non-synchronous mode.

Set a concurrent job as the master task, and start the R1 job in subtask 1, and the R2 job in subtask 2 from the master task.

Whether each subtask has completed or not can be confirmed in the master task.
7.6.2 Synchronous Operation

The example below is a job configuration for the manipulators 1 and 2 to achieve detailed synchronization mode. This is used when an interference area exists between manipulators.

Set a concurrent job as the master task, and start the R1 job in subtask 1, and the R2 job in subtask 2.

The synchronization of each subtask is executed by TSYNC instruction.
7.7 Confirming Operation

7.7.1 FWD/BWD Operation and Test Run

- Confirming the operation of the task being displayed
  
  When confirming operation in FWD/BWD operation or a test run, usually only the job of the task currently being displayed is targeted. Operation can be confirmed with [NEXT], [BACK], and [TEST RUN].

- Confirming the operation of all tasks
  
  To operate all tasks at the same time, perform the steps ① to ④.
  ① Switch the operating method to independent control.
  ② Register a concurrent job as the master job.
  ③ Perform FWD operation on the concurrent job, and execute PSTART instruction.
  ④ Continue performing FWD operation so that all the tasks perform simultaneously FWD operation.

**NOTE** Sometimes operation is performed at a different speed from the playback speed. Exercise full caution to any interference between manipulators.

7.7.2 Switching Operating Method

There are two operating methods during FWD/BWD operation and a test run:
- Operate only the task currently being displayed
- Operate all tasks

These two operating methods can be switched on the teaching condition display. For arc coordinated system and jigless system, simply pressing [SHIFT]+[SMOV] can switch the operating method.

- Switching by [SHIFT]+[SMOV]
  (For arc coordinated system and jigless system)

[Multi-JOB operation mode available]
7.7 Confirming Operation

## Switching on Teaching Condition Display

### Operation

Select `{CONTROLLER SET}` under the top menu ➔ Select `{TEACHING COND}`

Select “STEP/TEST RUN OPERATION MODE”

### Explanation

1. The teaching condition display is shown.

   ![Teaching Condition Display](image)

2. Each time [SELECT] is pressed, the setting changes between [ALL] and [SINGLE].

   ![Teaching Condition Display](image)

   *Multi-job operation mode available

### 7.7.3 BWD Operation of Concurrent Job

During BWD operation, a concurrent job and a job without group axes can be set so that they do not back, on the teaching condition display. For the operation procedures, refer to Section 7.7.2 “Switching Operating Method”.

7-18
7.8 Playback

7.8.1 Procedure

A playback is performed in the manner described in the following diagram. Executing PSTART instruction in master task, starts the job in subtasks. The operation status of each task can be checked on the supervisory display.

For information about playback, refer to the XRC Operator’s Manual. This manual explains the independent control characteristic operations.
7.8.2 Registering Master Job

Registering

Register a master job in teach mode.

Operation

Select (JOB) under the top menu ➔ Select (CTRL MASTER)* 1 ➔ Move the cursor to the task where a master job is to be registered ➔ Press [SELECT]* 2 ➔ Select “SETTING MASTER JOB”* 3 ➔ Select a job to be registered as a master job* 4

Explanation

* 1 The supervisory display is shown.

* 2 The selection dialog is displayed.

* 3 The job name display is shown.
The selected job is registered as a master job.

*C 4  The selected job is registered as a master job.

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPERVISORY</td>
<td>R1</td>
<td>S</td>
<td>U</td>
</tr>
<tr>
<td>MASTER JOB</td>
<td>MASTER</td>
<td>SUB1</td>
<td>SUB2</td>
</tr>
<tr>
<td>EDIT JOB</td>
<td>MASTER-1</td>
<td>*****</td>
<td>*****</td>
</tr>
<tr>
<td>LINE NO.</td>
<td>.0000</td>
<td>0000</td>
<td>0000</td>
</tr>
<tr>
<td>STEP NO.</td>
<td>.000</td>
<td>000</td>
<td>000</td>
</tr>
<tr>
<td>STATUS</td>
<td>:STOP</td>
<td>*****</td>
<td>*****</td>
</tr>
</tbody>
</table>

- C Cancelling Registration

**Operation**

Move the cursor to the task whose registration is to be cancelled. ➡️ Press [SELECT]* 1
➡️ Select “CANCEL MASTER JOB”* 2

**Explanation**

* 1  The selection dialog is shown.

* 2  The master job registration is cancelled.
7.8 Playback

7.8.3 Calling Master Job

Operation

Move the cursor to the master job whose task is to be called ➡ Press [SELECT]*1 ➡
Select “CALL MASTER JOB”*2

Explanation

*1 The selection dialog is shown.

*2 The master job is called.

When the master job in the master task is called
The master job of the master task is called, and the jobs of the subtasks are cleared.
When the master job in a subtask 1/2 is called

Only the master job in a specified subtask is called. The jobs in other tasks are as they were before calling.

For the subtask 1/2, it can be selected whether the master job is to be called or the root job (job started by PSTART) is to be called.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Contents and Set Value</th>
<th>Initial Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>S2C112</td>
<td>Call the master job: 0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Call the root job: 1</td>
<td></td>
</tr>
</tbody>
</table>
7.8.4 Registration of Root (startup) Job

The root job is a job executed at starting up each task. As the root job is determined automatically according to the job configuration, normally it is not necessary to be registered. However, when the currently active job is to be changed forcibly, register a desired root job to start the task. The task is executed from the registered root job.

<Example>

During execution of a series of jobs in the subtask 1 as shown in the figure below, the task is stopped in the middle of “Work-P”. To restart the task from “Work-Q” without executing the remaining of “Work-P”, register “Work-Q” for “ROOT JOB” in the supervisory display.
7.8 Playback

**Registering**

Register a root job in teach mode.

**Operation**

1. Select (JOB) under the top menu ➪ Select (CTRL MASTER)*1 ➪ Move the cursor to the task where a root job is to be registered ➪ Press [SELECT]*2 ➪ Select “REGISTER ROOT JOB”*3 ➪ Select a job to be registered as a root job *4

**Explanation**

*1 The supervisory display appears.

*2 The selection dialog is displayed.

*3 The job name display appears.

---

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPERVISORY</td>
<td>MASTER</td>
<td>SUB1</td>
<td>SUB2</td>
</tr>
<tr>
<td>MASTER JOB</td>
<td>********</td>
<td>********</td>
<td>********</td>
</tr>
<tr>
<td>ROOT JOB</td>
<td>********</td>
<td>********</td>
<td>********</td>
</tr>
<tr>
<td>EDIT JOB</td>
<td>********</td>
<td>********</td>
<td>********</td>
</tr>
<tr>
<td>LINE NO.</td>
<td>:0000</td>
<td>0000</td>
<td>0000</td>
</tr>
<tr>
<td>STEP NO.</td>
<td>:000</td>
<td>000</td>
<td>000</td>
</tr>
<tr>
<td>STATUS</td>
<td>:STOP</td>
<td>********</td>
<td>********</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPERVISORY</td>
<td>R1</td>
<td>C</td>
<td>L</td>
</tr>
<tr>
<td>MASTER</td>
<td>SUB1</td>
<td>SUB2</td>
<td></td>
</tr>
<tr>
<td>MASTER JOB</td>
<td>TEST JOB</td>
<td>WELDJOB</td>
<td></td>
</tr>
<tr>
<td>ABC</td>
<td>MJOB</td>
<td>JOB-1</td>
<td></td>
</tr>
<tr>
<td>JOB2</td>
<td>JOB3</td>
<td>JOB4</td>
<td></td>
</tr>
<tr>
<td>1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPERVISORY</td>
<td>R1</td>
<td>C</td>
<td>L</td>
</tr>
<tr>
<td>MASTER</td>
<td>SUB1</td>
<td>SUB2</td>
<td></td>
</tr>
<tr>
<td>MASTER JOB</td>
<td>********</td>
<td>********</td>
<td>********</td>
</tr>
<tr>
<td>ROOT JOB</td>
<td>********</td>
<td>********</td>
<td>********</td>
</tr>
<tr>
<td>EDIT JOB</td>
<td>********</td>
<td>********</td>
<td>********</td>
</tr>
<tr>
<td>LINE NO.</td>
<td>:0000</td>
<td>0000</td>
<td>0000</td>
</tr>
<tr>
<td>STEP NO.</td>
<td>:000</td>
<td>000</td>
<td>000</td>
</tr>
<tr>
<td>STATUS</td>
<td>:STOP</td>
<td>********</td>
<td>********</td>
</tr>
</tbody>
</table>

---
The selected job is registered as a root job.

4. The selected job is registered as a root job.

Cancelling Registration

Operation

Move the cursor to the task whose registration is to be cancelled ➔ Press [SELECT]° 1

Select “CANCEL ROOT JOB”° 2

Explanation

° 1 The selection dialog is displayed.

° 2 The root job registration is cancelled.
7.8.5 Confirming Operating Status (Supervisory Display)

The operating status of each task can be confirmed on the supervisory display.

**Operation**

Select {JOB} under the top menu ➔ Select {CTRL MASTER}* 1

**Explanation**

* 1 The supervisory display is shown.

<table>
<thead>
<tr>
<th>SUPERVISORY</th>
<th>R1</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. MASTER JOB</td>
<td>JOB-0</td>
<td>SUB1</td>
<td>SUB2</td>
</tr>
<tr>
<td>2. ROOT JOB</td>
<td>JOB-0</td>
<td>JOB-1</td>
<td>JOB-2</td>
</tr>
<tr>
<td>3. EXEC JOB</td>
<td>JOB-0</td>
<td>WORK-P</td>
<td>WORK-E</td>
</tr>
<tr>
<td>4. STATUS</td>
<td>PWAIT1</td>
<td>START</td>
<td>ALARM</td>
</tr>
</tbody>
</table>

1. **MASTER JOB**
   - Displays the master job of each task.

2. **ROOT JOB**
   - Displays a job at starting each task.
   - It is displayed when “1” (call a root job) is set to the parameter S2C112.

3. **EXEC JOB/EDIT JOB**
   - In play mode, displays the currently active job.
   - In teach mode, displays the currently editing job.
   - The line number and step number of the current cursor position of the EXEC JOB/EDIT JOB are displayed in “LINE NO.” and “STEP NO.” respectively.

4. **STATUS**
   - Displays the status of execution of the task.
   - **START**: Displays during playback or during a test run
   - **RUN**: Displays while executing FWD/BWD operation.
   - **STOP**: Displays while stopped.
   - **ALARM**: Displays while an alarm is occurring.
   - **HOLD**: Displays while holding.
   - **E.STOP**: Displays during emergency stop.
   - **PWAIT1**: Displays while waiting completion of subtask 1.
   - **PWAIT2**: Displays while waiting completion of subtask 2.
7.8 Playback

7.8.6 Precautions

- **Stopping**

If a hold or an emergency stop procedure is performed, all currently executing jobs are stopped.

- **Restarting**

The following methods are available for restarting after a hold or an emergency stop.

**To continue operation**

If operation is restarted from the stopped position, the master task and subtasks 1/2/3/4/5 all continue their execution from the line (step) number at the time of the stop. However, if a job selection is made and the message “SUB task restart impossible” is displayed, subtasks 1/2/3/4/5 cannot continue their execution. Only the master task is restarted.

**To execute only one of the subtasks from the beginning**

Before conducting start procedures, first turn ON the specific input signal “Sub □ Master job call” (4091 to 4095) of the subtask to be executed from the beginning, and press the start button. The job of the subtask for which this signal is ON, is executed from the beginning. The jobs of other tasks continue execution from the line (step) number at the time of the stop.

**To execute jobs of both subtasks from the beginning**

First turn ON the specific input signal “Master job call” (4090), then press the start button. When the master job of the master task is called, subtasks 1/2/3/4/5 which were stopped in the middle are canceled. When PSTART instruction is executed in the job of the master task, the jobs of both subtasks start and are executed from the beginning.

- **Stopping and restarting a subtask alone**

During operation of subtasks 1/2/3/4/5, with an I/O alarm or a PAUSE instruction, only a specified subtask can be stopped. Refer to the specific inputs 4101 to 4105, and the specific outputs 5041 to 5045, for I/O alarm. When subtask 1/2/3/4/5 is halted, the specific output signal 5031 to 5035 “HELD” is output. The specific output signal 5070 "RUN" stays ON, but the start lamp on the playback panel flashes when a subtask is halted. To restart the halted subtask 1/2/3/4/5, reset the alarm and press the external start or the start button on the playback panel.
8 Servo Power Supply Individual Control Function

8.1 Outline

The servo power supply individual control function is to turn ON/OFF the servo power supply in units of specified control group freely in the robot system with multiple control group configuration.

Using this function, without stopping whole the system operation, the servo power supply only for the control group selected by an operator can be turned OFF. Therefore, the safe operation for removing a workpiece with the system running and maintenance for robot tool, is secured, moreover, the operating efficiency is increased.

Note: The servo power supply individual control function is to control the servo power supply in units of power-ON unit. To use this function, the power-ON unit originally designed for separation in units of control group should be used.
The servo power supply individual control function turns ON/OFF the servo power supply in units of power-ON unit. "ON_EN" signal of power unit is used. "ON_EN" signals of each power unit is connected to the following terminals.

- I/O power-ON unit (JZNC-XIU01): CN27-9 and -10
- Power-ON unit for external axis (JZRCR-XSU01): CN9-9 and -10
- I/O power-ON unit for Europe (JZRCR-XSU02): CN28-7 and -8
  CN28-9 and -10

Connect the servo power supply individual control signals in the following manner.
1. Remove the jumpers connected to the above mentioned power-ON unit terminals.
2. Connect an output contact such as area sensor to "ON_EN" terminal as shown in the figure below.
For the wiring termination and connecting method, refer to “WAGO Connector” in the section 7.2.2 of XRC Instructions.
Short-circuited between the above terminals as a standard.
8.3 Confirming Connection

The status of “ON_EN” signals connected to each power-ON unit and the servo power supply status can be confirmed on the servo power status display.

**Operation**

Select {IN/OUT} under the top menu ➤ Select {SV POWER STATUS} *1

**Explanation**

*1 The servo power status display appears.

① **ON_EN SIGNAL**

Displays the status of “ON_EN” signal of power-ON unit connected to each control group.

- ○: Open (OFF) status
  - Turns OFF the servo power supply.

- ●: Closed (ON) status
  - Turns ON the servo power supply when the servo ON lamp is lit.

② **SERVO ON**

Displays the status of servo power supplied to each control group.

- ○: Servo power OFF status
- ●: Servo power supply ON completed status
8.4 Application Examples

8.4.1 Turn ON Only the Servo Power Supply for the Selected Control Group at Teaching

At turning the servo ON, only the servo power supply for the selected control group can be turned ON.

As shown below, when the servo power supply is turned ON with only the “ON_EN” signal of power-ON unit connected to R1 set to “ON”, the servo power is supplied only to R1.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERVO POWER STATUS</td>
<td>ON-EN SIGNAL</td>
<td>SERVO ON</td>
<td></td>
</tr>
<tr>
<td>R1</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8.4.2 Turn OFF Only the Servo Power Supply for the Selected Control Group at Playback

When an operator touches the positioner in such a case as replacement of workpiece, only the servo power supply for the positioner to be touched can be turned OFF for security.
As shown below, with the “ON_EN” signal of power-ON unit connected to S1 set to “OFF”, only the servo power supply to S1 can be turned OFF even during playback operation.

<table>
<thead>
<tr>
<th>DATA</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
<th>SERVO POWER STATUS</th>
<th>ON-EN SIGNAL</th>
<th>SERVO ON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>S1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>S2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

While the servo ON lamp is lit, if “ON_EN” signal is turned ON, the servo power supply for the corresponding control group is turned ON.

**NOTE**

To control individually the servo power supply for a selected control group without stopping whole the system during playback, it is necessary to prepare an application job, using the independent control function.
8.5 Specific Output Signals

8.5.1 Servo Power ON Status Signal for Each Control Group

The servo power ON status of each control group is output to the following specific output signal. In the standard concurrent I/O ladder, these specific output signals are not output externally. When installing an interlock operated by PLC, etc., modify the concurrent I/O ladder so that the specific output signals are output externally.

| 5170 | Servo power ON status Robot 1 | 5171 | Servo power ON status Robot 2 | 5172 | Servo power ON status Robot 3 | 5173 | Servo power ON status S1 | 5174 | Servo power ON status S2 | 5175 | Servo power ON status S3 | 5176 | Servo power ON status S4 | 5177 | Servo power ON status S5 | 5180 | Servo power ON status S6 | 5181 |
|------|------------------------------|------|------------------------------|------|------------------------------|------|------------------------------|------|------------------------------|------|------------------------------|------|------------------------------|------|------------------------------|------|------------------------------|

8.5.2 “During Servo ON” Signal

The specific output signal 5073 (during servo ON) is output in connection with the servo ON lamp on the playback panel. After the servo power supply is turned ON, even if all the “ON_EN” signals connected to power-ON unit are set to “OFF”, the servo ON lamp remains lit and the specific output signal “During Servo ON” does not turn “OFF”.

8-7
8.6 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.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Set Value and Contents</th>
<th>Initial Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>S4C049</td>
<td>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.</td>
<td>1</td>
</tr>
</tbody>
</table>
# 9 Robot Language (INFORM II) Instructions

## 9.1 Coordinated Operation Instructions

< > shows numbers or character data. When there are more than one item in the additional item, choose one.

### SMOVL

<table>
<thead>
<tr>
<th>Function</th>
<th>While coordinating the slave side with the master side, moves to teaching position with linear interpolation. (Coordinated move instruction to the slave side manipulator)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional items</td>
<td>Position data, base axis position data</td>
</tr>
<tr>
<td>V=</td>
<td>&lt;Play speed&gt;</td>
</tr>
<tr>
<td>VR=</td>
<td>&lt;Play speed for posture&gt;</td>
</tr>
<tr>
<td>PL=</td>
<td>&lt;Positioning level&gt;</td>
</tr>
<tr>
<td>NWAIT</td>
<td></td>
</tr>
<tr>
<td>+MOV instruction</td>
<td></td>
</tr>
</tbody>
</table>

**Example**

SMOVL V=150 +MOVVL

### SMOVC

<table>
<thead>
<tr>
<th>Function</th>
<th>While coordinating the slave side with the master side, moves to teaching position with circular interpolation. (Coordinated move instruction to the slave side manipulator)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional items</td>
<td>Position data, base axis position data</td>
</tr>
<tr>
<td>V=</td>
<td>&lt;Play speed&gt;</td>
</tr>
<tr>
<td>VR=</td>
<td>&lt;Play speed for posture&gt;</td>
</tr>
<tr>
<td>PL=</td>
<td>&lt;Positioning level&gt;</td>
</tr>
<tr>
<td>NWAIT</td>
<td></td>
</tr>
<tr>
<td>+MOV instruction</td>
<td></td>
</tr>
</tbody>
</table>

**Example**

SMOVC V=150 NWAIT +MOVJ
### 9.1 Coordinated Operation Instructions

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Additional items</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIMOV</td>
<td>While coordinating the slave side with the master side, moves by only the specified increments with linear interpolation.</td>
<td>P &lt;Variable No.&gt;, BP &lt;Variable No.&gt;, V=&lt;Play speed,&gt; VR=&lt;Play speed for posture&gt;, VS=&lt;Speed at reach point&gt;, V: 0.1 to 1500.0 mm/sec 0.6 to 9000.0 cm/min VR: 0.1 to 180.0°/sec VS: 0.1 to 1500.0 mm/sec 0.6 to 9000.0 cm/min PL &lt;Positioning level&gt;, PL: 0 to 4</td>
</tr>
</tbody>
</table>

**Example**
- SIMOV P000 V=138 PL=1 +IMOV P001
- SIMOV P001 BP002 +IMOV P000

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Additional items</th>
</tr>
</thead>
<tbody>
<tr>
<td>SREFP</td>
<td>During coordinated movement, specifies a reference point such as wall point for weaving. (Reference point instruction to the slave side manipulator)</td>
<td>Position data, base axis position data Not shown on the display &lt;Reference point No.&gt; Wall point 1 for weaving: 1 Wall point 2 for weaving: 2</td>
</tr>
</tbody>
</table>

**Example**
- SREFP 1

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Additional items</th>
</tr>
</thead>
<tbody>
<tr>
<td>+MOVJ</td>
<td>The master side moves to the teach position with joint movement. This instruction should always be placed after a coordinated move instruction (individual movement). (Coordinated move instruction to the master side manipulator)</td>
<td>Position data, base axis position data, station axis position data Not shown on the display VJ=&lt;Play speed (%)&gt; Effective in parameter setting</td>
</tr>
</tbody>
</table>

**Example**
- MOVL=138 PL=0 +MOVJ
### 9.1 Coordinated Operation Instructions

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Additional items</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>+MOVL</strong></td>
<td>The master side moves to the teach position with linear interpolation. This instruction should always be placed after a coordinated move instruction (coordinated movement, individual movement). (Coordinated move instruction to the master side manipulator)</td>
<td>Position data, base axis position data, station axis position data</td>
<td>SMOVL V=276 +MOVL MOVIL V=276 +MOVL</td>
</tr>
<tr>
<td><strong>=IMOV</strong></td>
<td>The master side moves by only the specified increment with linear interpolation.</td>
<td>P &lt;Variable No.&gt;, BP &lt;Variable No.&gt;, V=&lt;Play speed&gt;, VR=&lt;Play speed for posture&gt;, VE=&lt;Play speed of external axes&gt;, VS=&lt;Speed at reach point&gt;, BR, RF, TF, UF# (&lt;User coordinate Nos.&gt;)</td>
<td>IMOV P000 V=138 PL=1 RF +IMOV P001 SIMOV P001 BP002 +IMOV P000</td>
</tr>
<tr>
<td><strong>SSFTON</strong></td>
<td>Starts coordinated shift movement.</td>
<td>&lt;Robot axis position variable&gt;</td>
<td>SSFTON P000</td>
</tr>
<tr>
<td><strong>SSFTOF</strong></td>
<td>Stops coordinated shift movement.</td>
<td>None</td>
<td>SSFTOF</td>
</tr>
</tbody>
</table>
## 9.1 Coordinated Operation Instructions

<table>
<thead>
<tr>
<th>Function</th>
<th>Starts coordinated weaving.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SWVON</strong></td>
<td></td>
</tr>
<tr>
<td>Additional item</td>
<td>WEV# (Weaving condition file No.)</td>
</tr>
<tr>
<td>Example</td>
<td>SWVON WEV#(3)</td>
</tr>
<tr>
<td><strong>SWVOF</strong></td>
<td>Stops coordinated weaving.</td>
</tr>
<tr>
<td>Additional item</td>
<td>None</td>
</tr>
<tr>
<td>Example</td>
<td>SWVOF</td>
</tr>
</tbody>
</table>
## 9.2 Independent Control Instructions

< > shows numbers or character data. When there are more than one item in the additional item, choose one.

<table>
<thead>
<tr>
<th>Function</th>
<th>Additional items</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSTART</td>
<td>JOB: &lt;Job name&gt;</td>
<td>Starts a job.</td>
</tr>
<tr>
<td></td>
<td>SUB1, SUB2 (SUB3, SUB4, SUB5)</td>
<td>Sub task that is started</td>
</tr>
<tr>
<td></td>
<td>SYNC</td>
<td>Added to following side task</td>
</tr>
<tr>
<td></td>
<td>SUB1, SUB2 (SUB3, SUB4, SUB5)</td>
<td>Leading side subtask to be synchronized</td>
</tr>
<tr>
<td></td>
<td>IF statement</td>
<td></td>
</tr>
<tr>
<td>Example</td>
<td>PSTART SUB1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSTART JOB:TEST-1 SUB1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSTART JOB: TEST-1 SUB1 SYNC SUB2</td>
<td></td>
</tr>
<tr>
<td>Remarks</td>
<td>If the job name is omitted, the master job registered in the selected task is started.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Additional item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWAIT</td>
<td>SUB1, SUB2 (SUB3, SUB4, SUB5)</td>
<td>Subtask waiting for completion</td>
</tr>
<tr>
<td>Example</td>
<td>PWAIT SUB1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Additional item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSYNC</td>
<td>&lt;Synchronization No.&gt;</td>
<td>1 to 32</td>
</tr>
<tr>
<td></td>
<td>SNUM=&lt;the number of synchronized tasks&gt;</td>
<td>2 to 3 (6)</td>
</tr>
<tr>
<td>Example</td>
<td>TSYNC 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TSYNC 1 SNUM=3</td>
<td></td>
</tr>
</tbody>
</table>
9.2 Independent Control Instructions
YASNAC XRC OPTIONS
INSTRUCTIONS
FOR INDEPENDENT/COORDINATED FUNCTION

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