YASKAWA

YASNAC MRC
OPERATOR'S MANUAL

INDEPENDENT/COORDINATED FUNCTION

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

YASKAWA

MANUAL NO. RE-CKI-A401◊

This manual explains functions and operation of systems using YASNAC MRC coordinated control and independent control.

This manual is composed of the two parts below in order to have wide application among users of various systems.

Please read through the manual and be sure to understand the contents before operating the YASNAC MRC.

Part 1 System Section
This section explains various functions and operation methods for jigless systems, station coordinated systems, coordinated systems, and twin synchronous systems.

Part 2 Function Section
This section explains coordinated control, independent control, and other functions as well as various features in common among the systems of Section 1.

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

General Precautions

- **Some drawings in this manual are shown with the protective cover or shields removed, in order to describe the detail with more clarity. Make sure all covers and shields are replaced before operating this product.**
- **Drawings and photographs in this manual are typical examples and may vary somewhat from products delivered to you.**
- **This manual may be modified when necessary because of improvement of the product, modificarion, or changes in specifications.**
  Such modification is made as a revision by renewing the manual No.
- **To order a copy of this manual, if your copy has been damaged or lost, contact your YASKAWA representative listed on the last page stating the manual No. on the front page.**
- **YASKAWA is not responsible for any modification of the product made by the user since that will void our guarantee.**

NOTES FOR SAFE OPERATION

Read this operator's manual thoroughly before installation, operation, maintenance or inspection of the YASNAC MRC. In this manual, the NOTES FOR SAFE OPERATION are classified as "WARNING" or "CAUTION".

⚠ 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, may result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practice.

Even items described in ⚠ CAUTION may result in a vital accident in some situations. In either case, follow these important items.

NOTE These are steps to be taken to insure proper operation and to avoid malfunctions etc.

Safety relating to MOTOMAN operation.

⚠ WARNING

- **Before operating the manipulator, check that the SERVO ON lamp goes out when the emergency stop buttons on the playback box and programming pendant are pressed.**
  Injury or damage to machinery may result if the manipulator cannot be stopped in case of an emergency.
- **Always set the teach lock before starting teaching.**
  Failure to observe this caution may result in injury by the operation on the playback box.
- **Observe the following precautions when performing teaching operations within the working envelope of the manipulator:**
  - Always view the manipulator from the front.
  - Always follow the predetermined operating procedure.
  - Always have an escape plan in mind in case the manipulator comes toward you unexpectedly.
  - Ensure that you have a place to retreat to in case of emergency.

  Improper or unintentional manipulator operation can result in injury.

⚠ WARNING

- **Prior to performing the following operations, be sure that there is no one within the working envelope of the manipulator, and be sure that you are in a safe place yourself.**
  - Turning the power ON to the YASNAC MRC.
  - Moving the manipulator with the programming pendant.
  - Running check operation.
  - Performing automatic operation.

  Injury may result from collision with the manipulator to anyone entering the working envelope of the manipulator.
- **Always press an emergency stop button immediately if there are problems.**
  Emergency stop buttons are provided at the upper right of the YASNAC MRC playback box and on the right of the programming pendant.

⚠ CAUTION

- **Anyone operating the manipulator teaching or inspection should have undergone all training required by the relevant governmental agencies.**
  (See "Safety Manual.")
- **Perform the following inspection procedures prior to operating the 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 of insulation and sheathing of external wires.
- **Always return the programming pendant to its specified position after use.**
  If the programming pendant is inadvertently left on the manipulator or fixture, or on the floor, the manipulator or a tool could collide with it during manipulator movement, possibly causing injuries or equipment damage.

General Table of Contents

System Section

Function Section

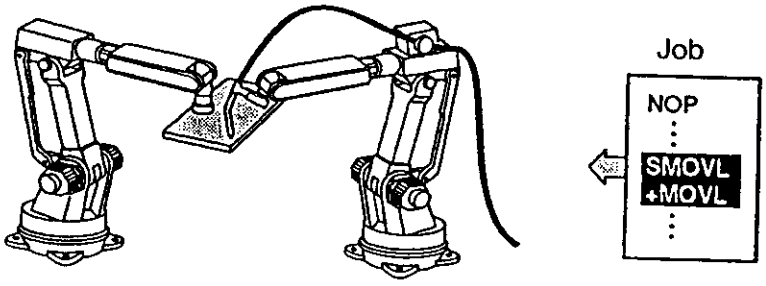
Chapter Titles

System being used	Chapters that should be read	
	System Section	Function Section
Jigless system	Chapter 2 Jigless system	Chapter 5 Coordinated control
Station coordinated system	Chapter 3 Station coordinated system	Chapter 5 Coordinated control
Twin synchronous system	Chapter 4 Twin synchronous system	Chapter 5 Coordinated control Chapter 6 Independent control

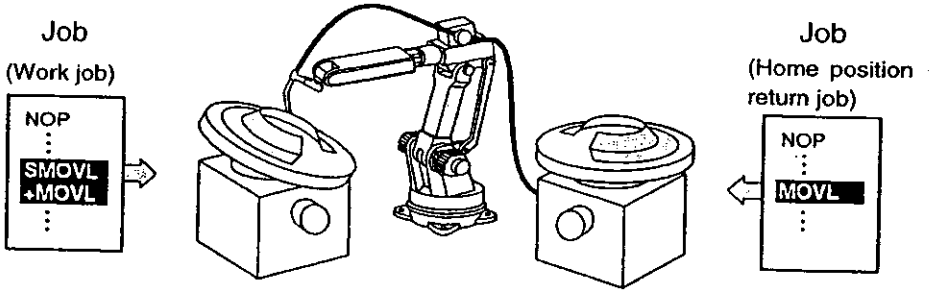
Introduction

With the YASNAC MRC, a system can be configured to control multiple manipulators or stations simultaneously with a single controller.
With the independent / coordinated functions you can operate manipulators or stations together or operate them each individually. Operation can be optimized to match the task.

Coordinated control : This is the function of manipulators or stations performing tasks while coordinated together.
[Example] Using two coordinated manipulators to perform a task.



Independent control : This is the function of manipulators or stations performing unsynchronized tasks independently.
[Example] While performing a work job with one station, the other station performs a job to return to home position to prepare for the next task.



Chapter 1

System set up

1.1 Jigless system set up

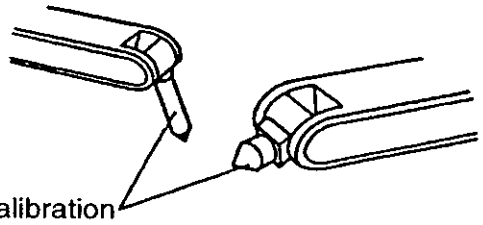
1.1.1 Group combination registration

Combination of two manipulators is registered. The manipulator holding the work is the master.
(For registration procedure to combine groups, see Chap. 1.4.)

```
GROUP COMBINATION
        GROUP AXIS      MASTER
        R1
        R2
        R1+R2           R2
```

1.1.2 Calibration between manipulators

① Attach a tool for calibration to each of the two manipulators.



NOTE Use a tool for which accurate dimensions are known.

② Press the keys in the order the [CUSTOMER] key then the [F1] (TOOL) key, and enter each of the individual tool dimensions in the tool file.

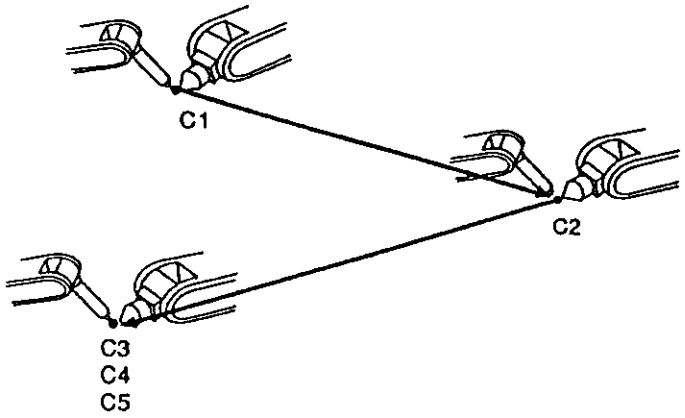
```
TOOL
TOOL NO.: 0
NAME: TORCH
X       0.000 mm        Rx      0.00 deg.
Y       0.000 mm        Ry      0.00 deg.
Z     200.000 mm        Rz      0.00 deg.
```

③ Create a job for calibration, and perform calibration.
(For jobs for calibration, see Chap. 1.1.3.)
(For calibration work, see Chap. 1.5.)

1.1.3 Job for calibration

Align control points for both manipulators at five locations, and register those positions.
C1 to C3 are arbitrarily chosen positions.

① First perform teaching for C1. Move one of the manipulators to the desired position. Align the control point of the other manipulator at that control point using axis operation, and register those steps.
② Perform teaching for C2 to C3 by repeating ①.
③ Register C4 and C5 as the same point as C3.



NOTE

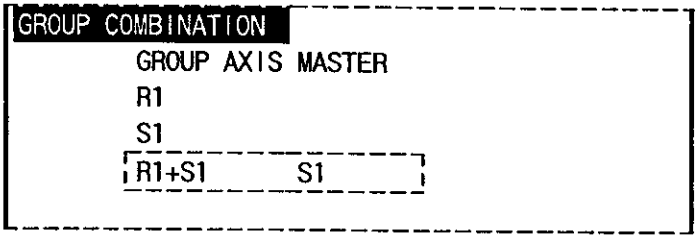
- For the calibration job, 5 points must be taught. For the fourth point (C4) and the fifth point (C5), register the same point as C3.
- When registering the points of C2 and after C2, both tools should maintain as far as possible the orientation when C1 was registered.
- The distances between C1 and C2, C2 and C3 and C1 to C3 should be 1m or more.
- Perform teaching so that C1 to C3 form a triangle, not a straight line.
- Do not teach with the LU axis fully extended or contracted. This could cause decline in calibration accuracy.

Reference sections :
Registration of group combination ▶ 1.4
Calibration ▶ 1.5

1.2 Station coordinated system set up

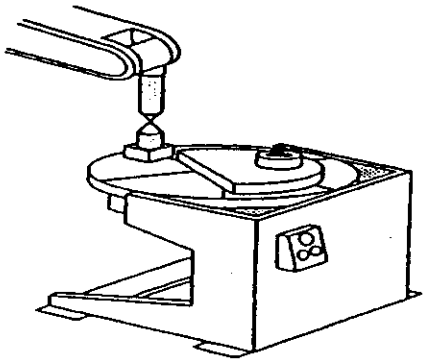
1.2.1 Group combination registration

Combination of a manipulator and a station is registered. The station is the master.
(For registration procedure for group combination, see Chap. 1.4.)



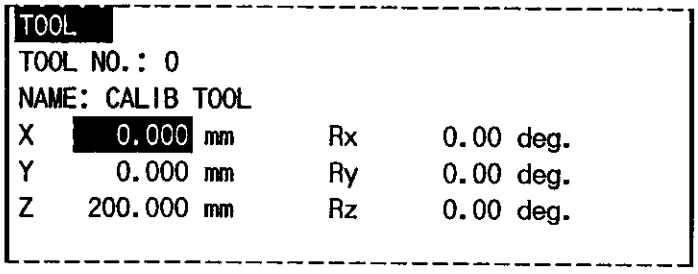
1.2.2 Calibration between a manipulator and a station

① Attach a tool for calibration to a manipulator.



NOTE Use a tool for which accurate dimensions are known.

② Press the keys in the order the [CUSTOMER] key then the [F1] (TOOL) key, and enter each of the individual tool dimensions in the tool file.

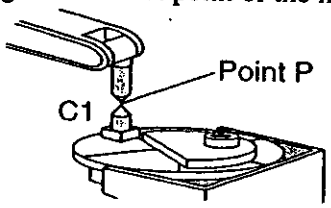


③ Create a job for calibration, and perform calibration.
(For job for calibration, see Chap. 1.2.3.)
(For calibration work, see Chap. 1.5.)

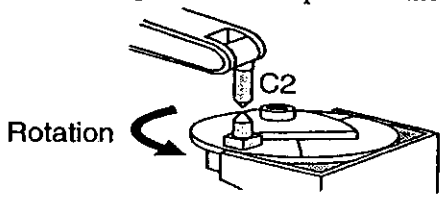
1.2.3 Job for calibration

(1) For the station of 1 rotating axis

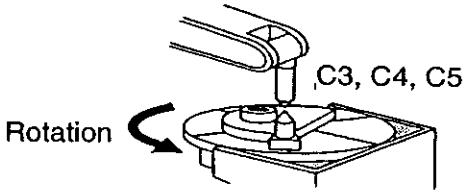
① On the turntable of the station axis, select a point (point P) (as far from the center of the turntable as possible). Align the control point of the manipulator to point P, and register C1.



② Next rotate the station axis a small amount. (There are no restrictions on the amount of rotation, but about 30°, in either a + or − direction.)
After rotation, align the control point of the manipulator to point P, and register C2.



③ Further rotate the station axis in the same direction as in ② above. After rotation, align the control point of the manipulator to point P, and register C3.



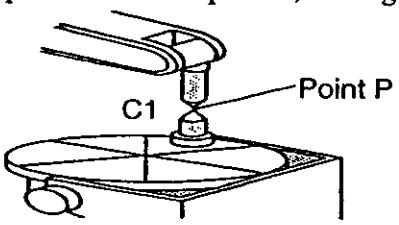
④
⑤ } Register C4 and C5 as the same point as C3.

NOTE

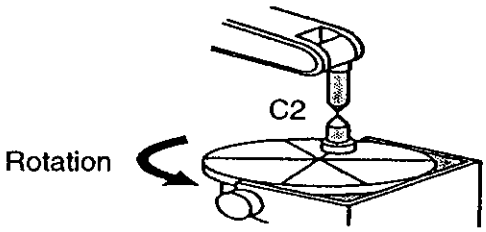
- We recommend attaching a tool with a sharp tip to the station axis as shown in the drawing and then teaching with this tip as the arbitrary point. (This is in order to reduce teaching deviation as much as possible.)
- When registering those from C2 on, the manipulator tool should maintain as much as possible the orientation when C1 was registered.
- When teaching the manipulator, keep the orientation of the L axis 90° to the ground, and the U axis parallel to the ground.
- Do not teach with the LU axis fully extended or contracted. This could cause decline in calibration accuracy.

(2) For the station of 2 rotating axes

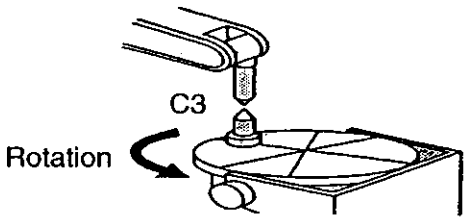
① On the turntable of the station axis, select a point (point P) (as far from the center of the turntable as possible). Make the number 1 axis of the station axis parallel to the ground, and align point P and the control point of the manipulator, and register C1.



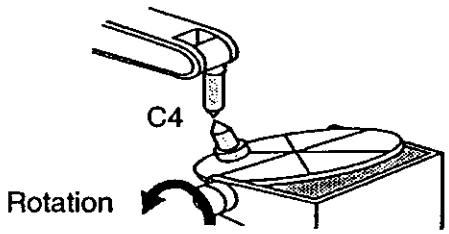
② Rotate the number 2 axis of the station axis about 30°. Align point P and the control point of the manipulator, and register C2.



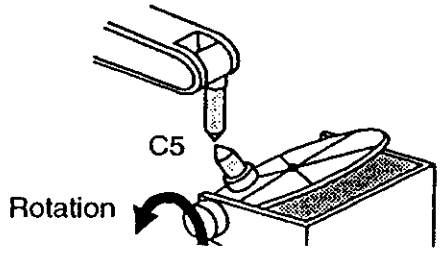
③ Further rotate the number 2 axis of the station axis about 30°. Align point P and the control point of the manipulator, and register C3.



④ Next, rotate the number 1 axis about 30°. Align point P and the control point of the manipulator, and register C4.



⑤ Further rotate the number 1 axis about 30°. Align point P and the control point of the manipulator, and register C5.



NOTE

- We recommend attaching a tool with a sharp tip to the station axis as shown in the drawing and then teaching with this tip as the arbitrary point. (This is in order to reduce teaching deviation as much as possible.)
- When registering those from C2 on, the manipulator tool should maintain as much as possible the orientation when C1 was registered.
- When teaching the manipulator, keep the orientation of the L axis 90° to the ground, and the U axis parallel to the ground.
- Do not teach with the LU axis fully extended or contracted. This could cause decline in calibration accuracy.
- Make the positions of the number 2 axis of stations C1, C2, and C3 the same.
- Make the positions of the number 1 axis of stations C4, and C5 the same as the number 1 axis of C3.

Reference sections :
Registration of group combination ▶ 1.4
Calibration ▶ 1.5

1.3 Twin synchronous system set up

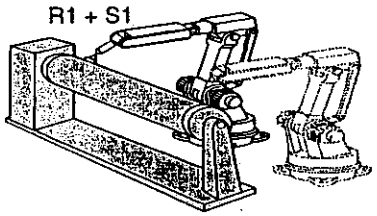
1.3.1 Group combination registration

Combination of manipulators and a station is registered. The station is the master.
(For registration procedure for group combination, see Chap. 1.4.)

```
GROUP COMBINATION
        GROUP AXIS MASTER
        R1
        R2
        S1
        R1+S1      S1
        R2+S1      S1
```

1.3.2 Calibration between two manipulators

① Attach a tool for calibration to one of the manipulators.



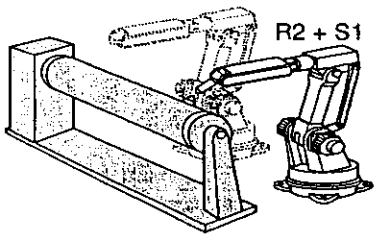
NOTE Use a tool for which accurate dimensions are known.

② Press the keys in the order the [CUSTOMER] key then the [F1] (TOOL) key, and enter each of the individual tool dimensions in the tool file.

```
TOOL
TOOL NO.: 0
NAME: TOOL 1
X      0.000 mm      Rx     0.00 deg.
Y      0.000 mm      Ry     0.00 deg.
Z    200.000 mm      Rz     0.00 deg.
```

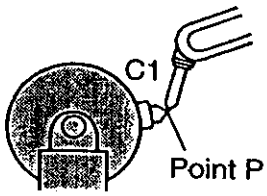
③ Create a job for calibration, and perform calibration.
(For job for calibration, see Chap. 1.3.3.)
(For calibration work, see Chap. 1.5.)

④ Procedure for the other manipulator is the same as in ① to ③ above.

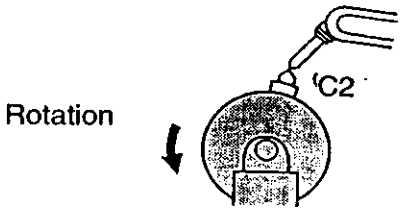


1.3.3 Job for calibration

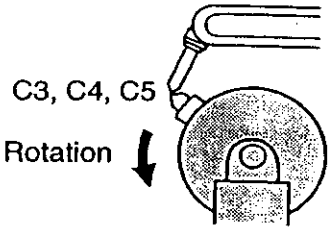
① On the station axis, select a point (point P). Align the control point of the manipulator to point P, and register C1.



② Next rotate the station axis a small amount. (There are no restrictions on the amount of rotation, but about 30°, in either a + or − direction.)
After rotation, align the control point of the manipulator to point P, and register C2.



③ Further rotate the station axis in the same direction as in ② above. After rotation, align the control point of the manipulator to point P, and register C3.



④
⑤ } Register C4 and C5 as the same point as C3.

NOTE

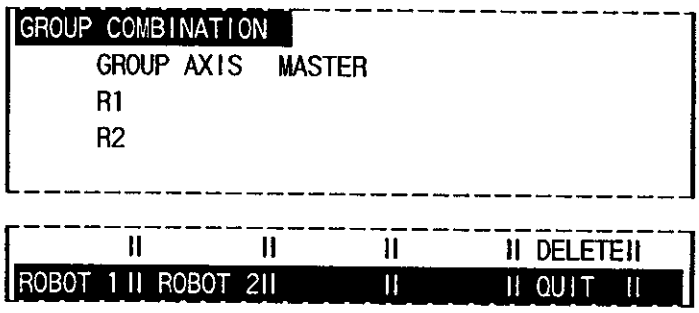
- We recommend attaching a tool with a sharp tip to the station axis as shown in the drawing and then teaching with this tip as the arbitrary point. (This is in order to reduce teaching deviation as much as possible.)
- When registering those from C2 on, the manipulator tool should maintain as much as possible the orientation when C1 was registered.
- When teaching the manipulator, keep the orientation of the L axis 90° to the ground, and the U axis parallel to the ground.
- Do not teach with the LU axis fully extended or contracted. This could cause decline in calibration accuracy.

Reference sections :
Registration of group combination ▶ 1.4 Calibration ▶ 1.5

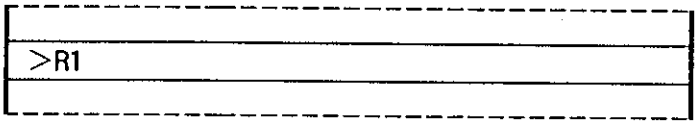
1.4 Registration of group combination

Group alignment of manipulators and stations, and master/slave relationship between these units, is registered by the following procedure. The combination of R1 and R2 is registered here.

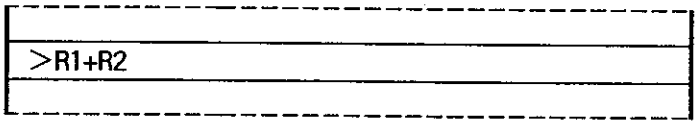
① Press the keys in the order the [CUSTOMER] key, the [MORE] key, then the [F5] (ORG) key, and enter the ID number. After entry, press the [F5] (GR RGTR) key and the group combination display is be displayed.



② Press the [F1] (ROBOT1) key.

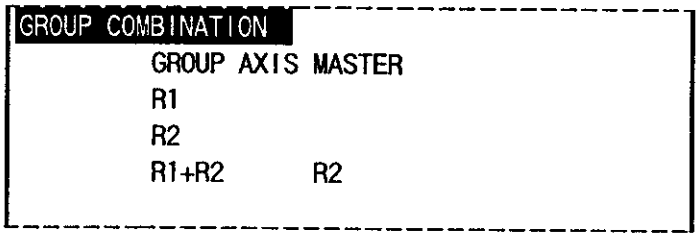


③ Press the [F2] (ROBOT2) key.



④ Press the [ENTER] key.

⑤ When setting master/slave, press the soft key of the robot or station axis to be a master.

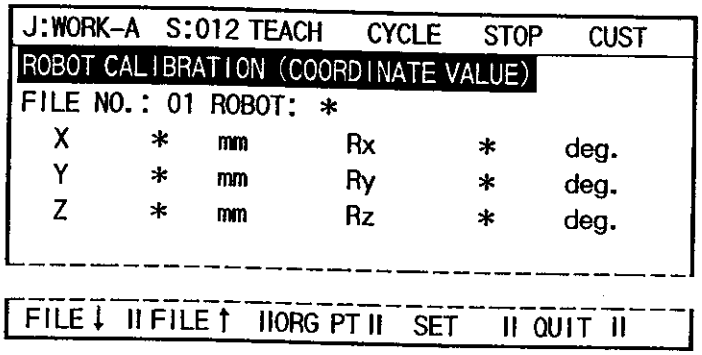


1.5 Calibration

In performing coordinated opetation between manipulators or between a manipulator and a station, prior registration is required of the mutual position relationship. This mutual position relationship is set by robot calibration or by robot - station calibration.

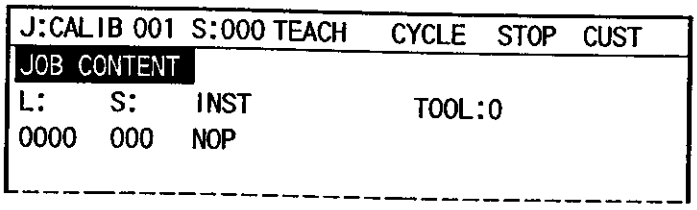
① Teach a coordinating job for calibration at the desired group combination.
(For job for calibration, see Chaps. 1.1 and 1.2.)

② Press the keys in the order the [CUSTOMER] key, the [MORE] key, then the [F5] (ORG) key, and enter the ID number. After entry, press the [F5] (RB CAL) key and the robot calibration coordinate value display is displayed.

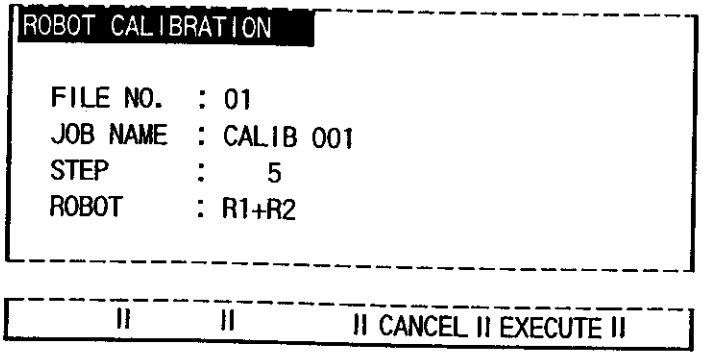


③ Display the file number to be registered, and press the [F4] (SET) key.

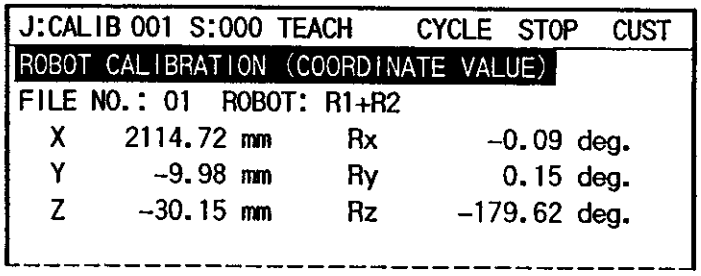
④ If the current editing job has a job for calibration, move on to step ⑤.
When calling a job for calibration, press the [F1] (SEL JOB) key, enter the job name, and press the [ENTER] key.



⑤ Press the [F5] (CALC) key to display, the contents of the calibration. Check the contents.



⑥ Press the [F5] (EXECUTE) key to perform the calibration.



System Section

Chapter 2

Jigless system

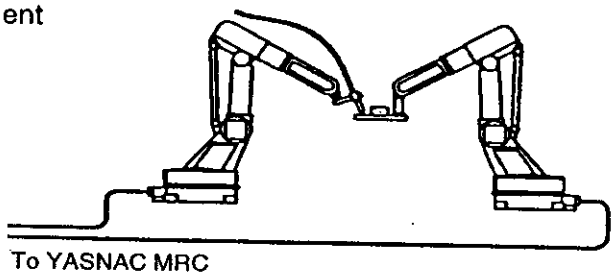
Overview

A jigless system is a system to perform welding by coordinating two manipulators, one holding the workpiece while the other holds the torch.

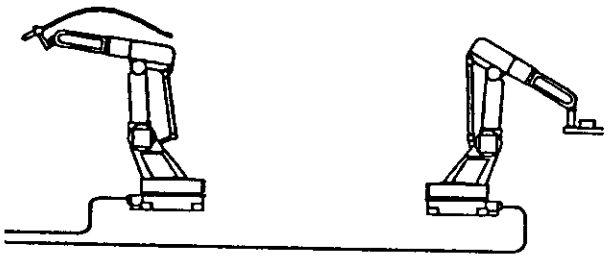
In order to coordinate the movements of two manipulators, a coordinated job is taught.

In a coordinated job, there are coordinated movement, where a reciprocal movement is performed, and individual movement, which makes separate movements.

Coordinated movement

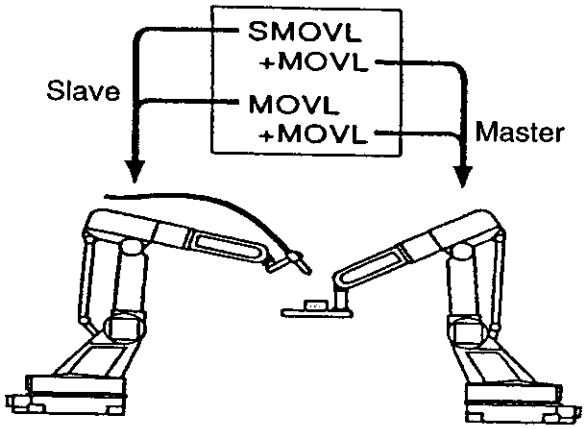


Individual movement



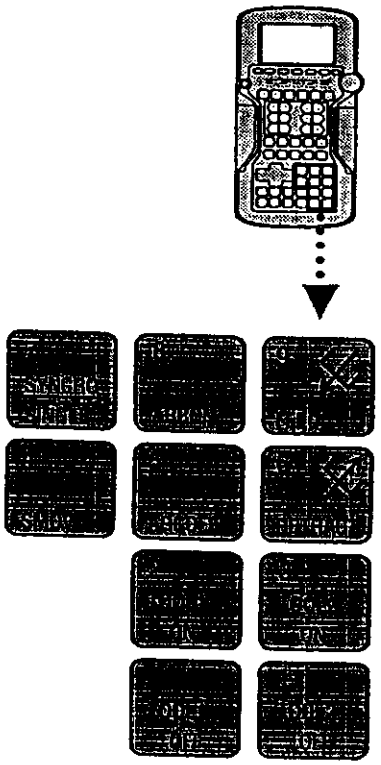
When "Coordinated" is displayed in the screen title, a "Coordinated" movement instruction is registered, and when "Coordinated" is not displayed, individual movement instruction is registered.
The "Coordinated" display can be switched with the specific [COORD] key.

The move instruction for coordinated jobs usually has two lines displayed. The top line is the instruction for the slave side (torch), and the bottom line is for the master side (workpiece).



2.1 Specific keys

Specific keys in the jigless system are allocated to the number keys as shown in the diagram.



2.1.1 [FEED], [RETRACT] keys

Performs wire inching. Pressing the [FEED] key supplies wire, and pressing the [RETRACT] key reels it in.

2.1.2 [ARC ON], [ARC OFF] keys

Pressing the [ARC ON] key registers ARCON instruction.
Pressing the [ARC OFF] key registers an ARCOF instruction.

2.1.3 [SYNCRO / SINGLE] key

Selects the movement type for the manipulator when teaching a coordinated job. Each time this key is pressed, the movement type switches.

SYNCRO: "SEQ" is displayed in the status display area. If the manipulator on the master side is moved at this time, the slave will move following the motion of the master.

SINGLE: Only selected manipulator moves.

2.1.4 [*] + [SYNCRO / SINGLE] keys

Turns the job synchronized movement mode ON and OFF.

2.1.5 [SMOV] key

Selects coordinated or individual movement when teaching a coordinated job. Each time this key is pressed, the movement type switches.

Coordinated: "Coordinated" is displayed in the screen title. At this time, registered movement instructions will be coordinated instructions.

Individual: The master-slave relationship is canceled, and each of the two units performs its own individual movement.

2.1.6 [TOOL 1 ON], [TOOL 1 OFF], [TOOL 2 ON], [TOOL 2 OFF] keys

When in teaching mode, if the [TOOL 1 ON] or [TOOL 1 OFF] keys are pressed, a tool 1 on instruction or a tool 1 off instruction is registered respectively.
If the [TOOL 2 ON] or [TOOL 2 OFF] keys are pressed, a tool 2 on instruction or a tool 2 off instruction is registered respectively.

[*] + [TOOL 1 ON], [*] + [TOOL 1 ON],
[*] + [TOOL 2 ON], [*] + [TOOL 2 ON] keys
Opens and closes the tools 1 and 2.

Reference sections :
Synchronized / Single ▶ 2.5 Coordinated and individual movements ▶ 5.3
Registration of handling instructions ▶ 2.9 Opening and closing tools ▶ 2.2

2.2 Opening and closing tools

This is the procedure to open and close tools by teaching. It is unrelated to the content of the teaching. When operating specific keys, a general output signals #121 to 124 are used. To use different output signals, this is performed on the relay on display.

2.2.1 With specific keys

[*] + [TOOL 1 ON] : Outputs an open instruction to tool 1.
Only while the key is pressed, general output signal #121 is ON.

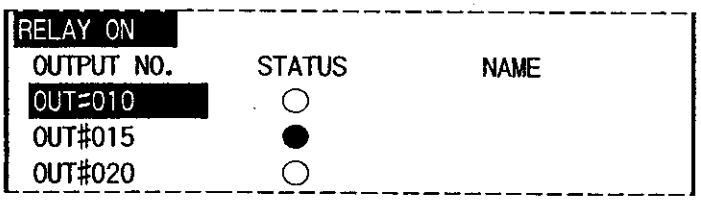
[*] + [TOOL 1 OFF] : Outputs a close instruction to tool 1.
Only while the key is pressed, general output signal #122 is ON.

[*] + [TOOL 2 ON] : Outputs an open instruction to tool 2.
Only while the key is pressed, general output signal #123 is ON.

[*] + [TOOL 2 OFF] : Outputs a close instruction to tool 2.
Only while the key is pressed, general output signal #124 is ON.

2.2.2 On the relay on display

① In the teaching mode, press the [SELECT] key, the [MORE] key, the [F1] (RLY OPN) key, and display the relay on display.



② Move the cursor to the number of the external output signal for which tool opening and closing are set.

③ Press the [F3] (ON) or [F4] (OFF) key to open or close the tool.

NOTE

1. It is necessary that external output signal numbers (operating relay numbers) be set in advance in parameters S2C148 to 163 on the parameter display.
2. It is possible to make the settings so that opening and closing can be performed with only the [F3] (ON) key. The settings are made with parameters S2C164 to 179 on the parameter display.
   「Relay operation mode : 0」 : This makes the settings so that both keys, [F3] (ON) and [F4] (OFF), are used in opening and closing.
   「Relay operation mode : 1」 : This makes the settings so that only the [F3] (ON) key is used in opening and closing. In this state, the tool does not move even if the [F4] (OFF) key is pressed.

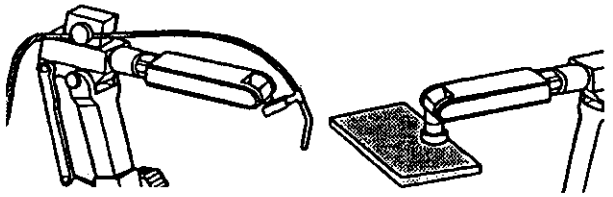
Reference materials :
Parameter settings ▶ User Functions Manual (TOE-C945-404)

2.3 Job example

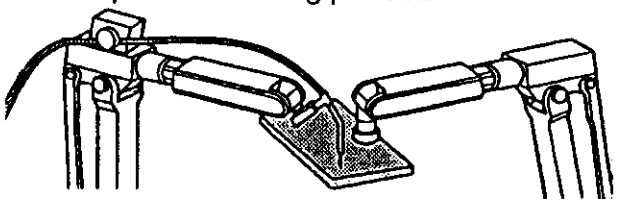
Step	Instruction
001	MOVJ VJ=50.00 +MOVJ
002	SMOVL V=200 +MOVL
	SWVON WEV#(1)
	ARCON ASF#(1)
003	SMOVL V=200 +MOVL
004	SMOVL V=200 +MOVL
	ARCOF AEF#(1)
	SWVOF
005	MOVJ VJ=50.00 +MOVJ
006	MOVJ VJ=50.00 +MOVJ

Coodinated movement

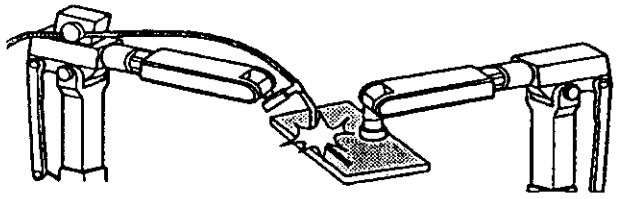
To the stand by position



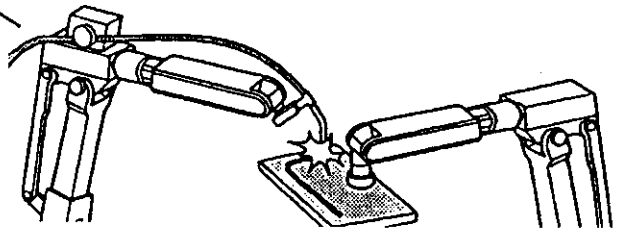
To the operation starting position



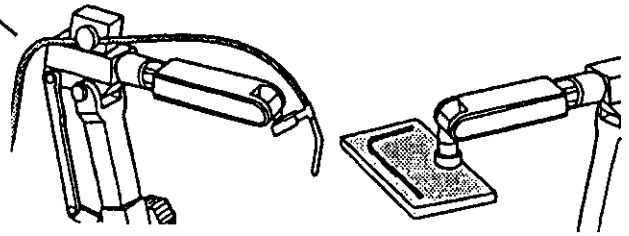
During operation



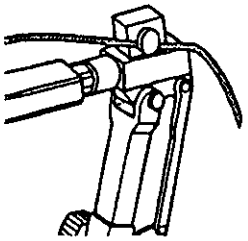
To the operation end position



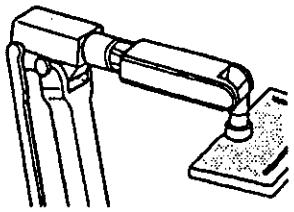
Separates from workpiece



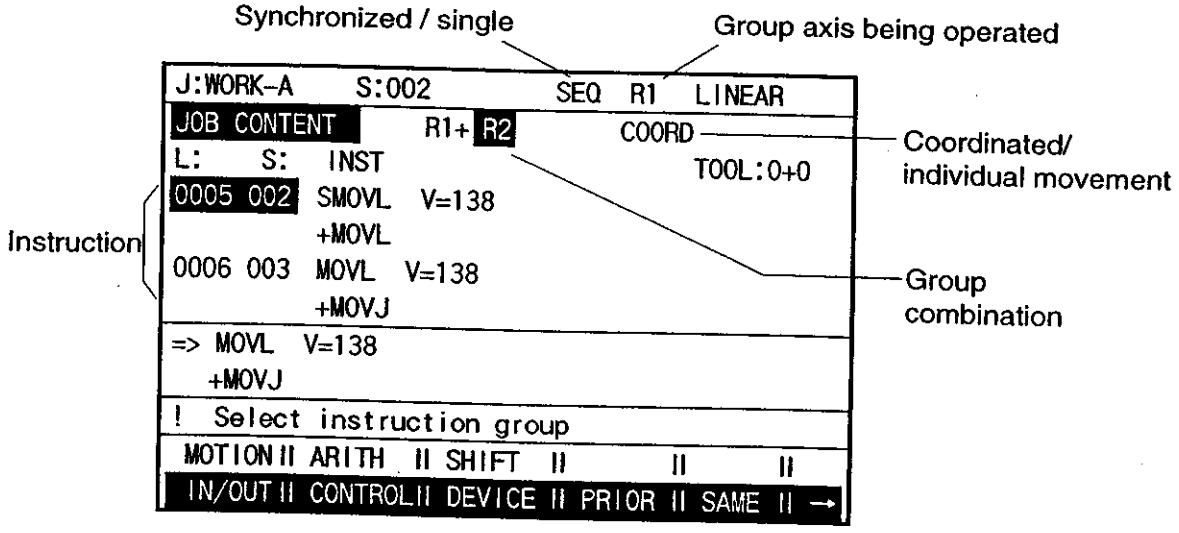
The torch moves to the cleaner.



The workpiece is discharged.



2.4 Job content display



2.4.1 Instruction

For coordinated jobs, movement instruction, weaving instruction, shift instruction, etc. are displayed in two lines. The top is the instruction to the slave side, and the bottom to the master side.

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

2.4.2 Synchronized / single

Synchronized/single selects the type of movement for the manipulator during axis operation. Displayed when synchronized is selected. Can be switched with the [SYNCRO / SINGLE] key.

2.4.3 Group axis being operated

The group axis being operated is displayed. Can be switched with the [GROUP AXES] key.

2.4.4 Coordinated / individual movement

When coordinated movement is selected "Coordinated" is displayed. Can be switched with the [SMOV] key.

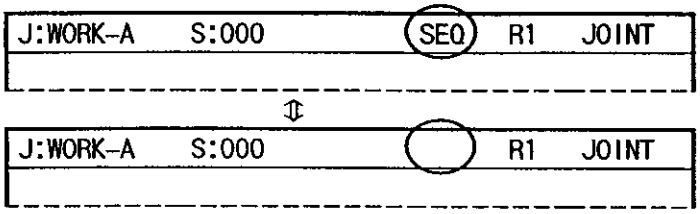
2.4.5 Group combination registered in job

The master side is displayed inversely.

Reference sections :
Master, slave ▶ 5.2 Synchronized / single ▶ 2.5 Selection of target operating axis ▶ 2.6
Coordinated / individual movements ▶ 5.3

2.5 Synchronized / single

In axis operation during teaching, there are two methods "synchronized" and "single." Can be switched with the specific [SYNCRO/SINGLE] key.

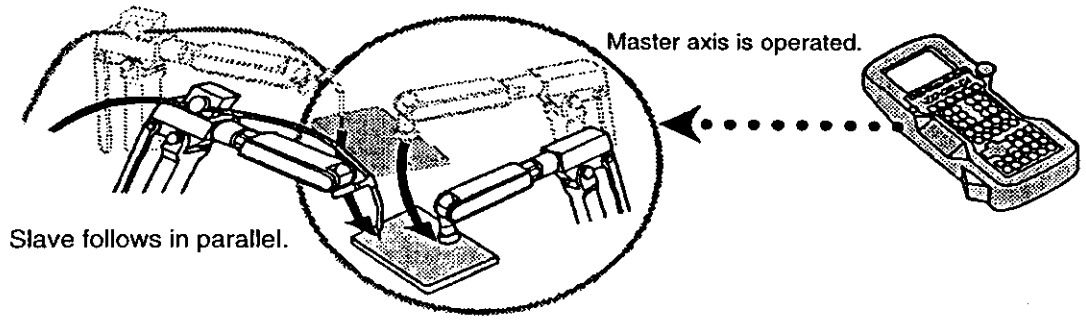


Nothing is displayed in "single" mode.

2.5.1 Synchronized

If the axis operation is performed in synchronized mode, when the master (workpiece) side is moved, the slave side (torch) follows the motion. This feature is used to maintain the relative positions of the manipulator and station.

However, the master does not move even if the slave is moved.

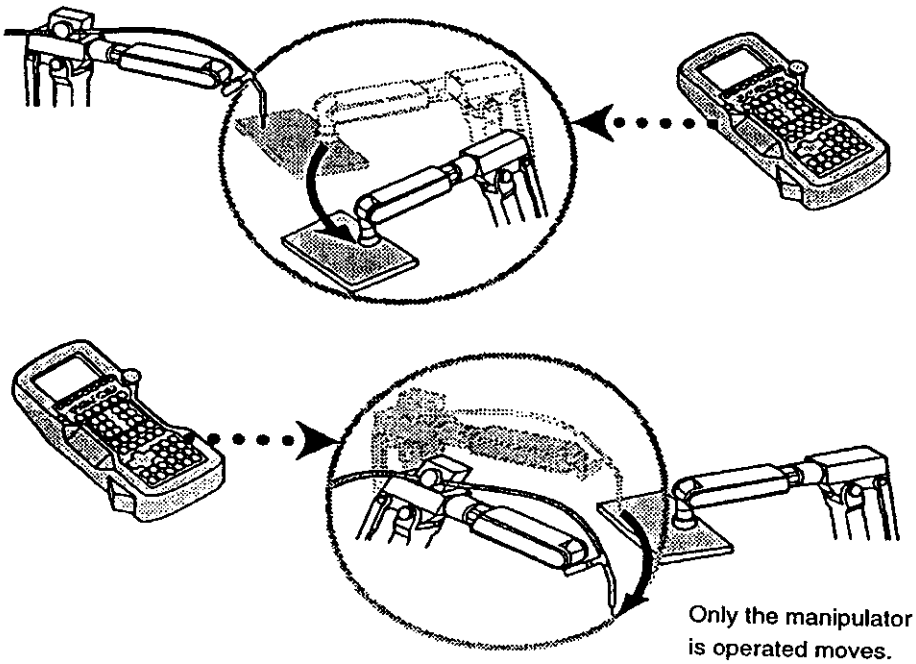


To switch the master during synchronized operation, follow the procedure below.

① Display the group combination selection display.
② Move the cursor to the desired master combination.
③ Press the [SYNCRO / SINGLE] key and choose "SEQ."

2.5.2 Single

If the axis operation is performed in single mode, only the selected manipulator is performed. This is used at steps where two manipulators perform separate tasks.



Only the manipulator whose axis is operated moves.

NOTE

1. Synchronized / single selection is maintained until the next selection is made.
2. During synchronized mode, on the group combination selection display, if a combination other than the combination registered in the job is selected, a switch is automatically made to "Single."
3. If the editing job is changed, a switch is automatically made to "Single."

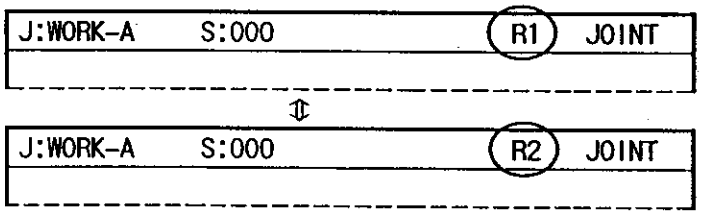
Reference sections :
Master, slave ▶ 5.2

2.6 Selection of axis to be operated

This is the procedure to switch the manipulator of the axis to be operated at teach mode.

2.6.1 Switching between manipulators

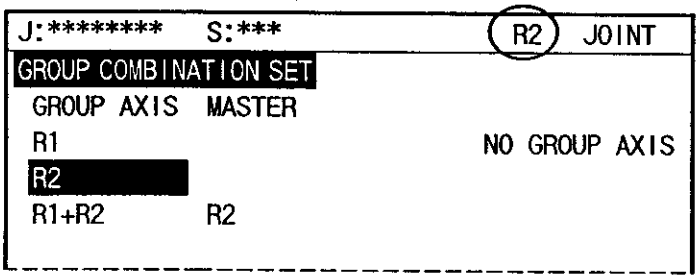
This switches each time the [GROUP AXES] key is pressed. The lamp of this key is lit when the the axis operation is perfomed for the master manipulator.



2.6.2 Switching the group axis when there is no editing job

When there is no editing job at teach mode, the procedure to move the manipulator is as follows.

① Display the group combination set display with the [ENABLE] key.



② Move the cursor to the combination to be operated. Group axes able to be operated are displayed in the status display area.

③ Move the manipulator with the axis keys.

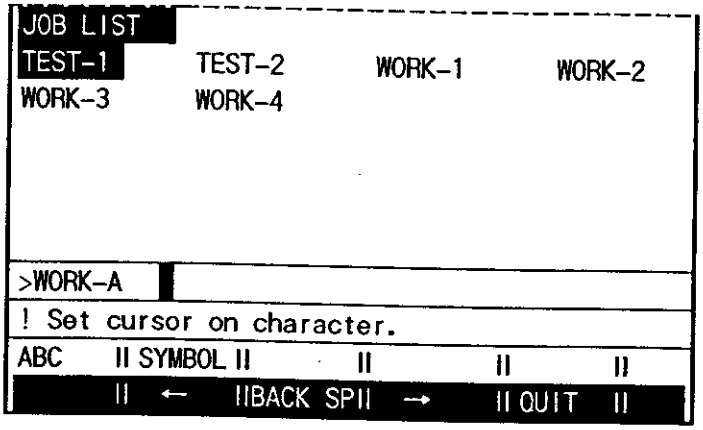
④ Press the [*] + [GROUP AXES] keys, to return to the original display.

Reference sections :
Master, slave ▶ 5.2

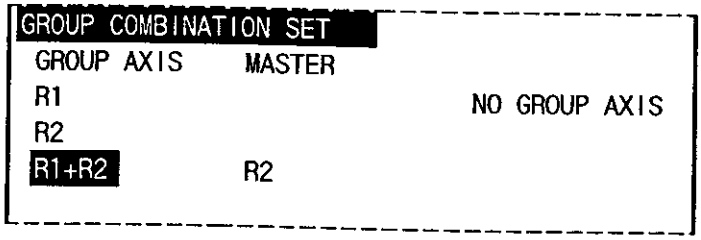
2.7 Registration of new job name

① Press the [SELECT] key and the [F2] (NEW JOB) key.

② Enter the job name, and then press the [ENTER] key.



③ Select the group combination, and then press the [ENTER] key.
The new job is registered, and the contents for that job is displayed.

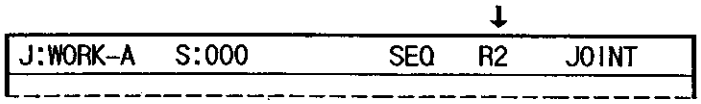


2.8 Registration of move instructions (S)MOV□+ MOV□

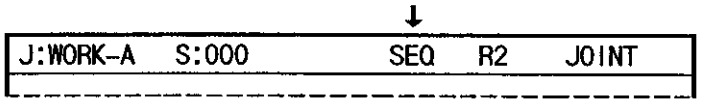
Display the job content display in the teach mode, and press the [EDIT] key.
If the lamp on the [ENABLE] key is not lit, press it and turn it ON.

2.8.1 Registration of the move instruction for the master (workpiece) side

① Press the [GROUP AXES] key to make the master the operation target.

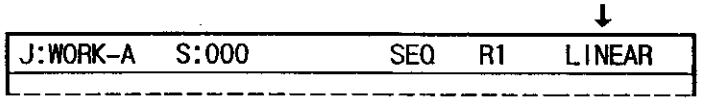


② Press the [SYNCRO / SINGLE] key and choose "synchronized" or "single."
If the slave will be made to follow, select synchronized mode.



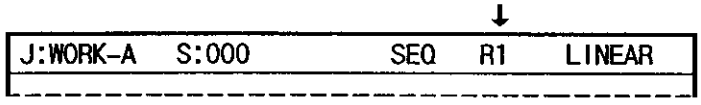
③ Move the manipulator to the desired position with the axis keys.

④ Press the [MOTION TYPE] key and select motion type.



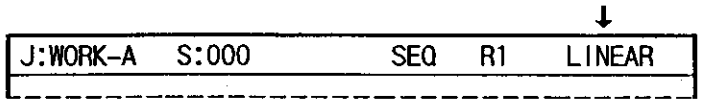
2.8.2 Registration of the move instruction for the slave (torch) side

① Press the [GROUP AXES] key to make the slave the operation target.



② Press the [SMOV] key and choose coordinated or individual movement.

③ Press the [MOTION TYPE] key and select motion type.



④ Move the manipulator to the desired position with the axis keys.

⑤ Confirm motion type and speed, then press the [ENTER] key, and registration is completed.

```
0003 001  SMOVL  V=138
          +MOVL
```

NOTE

When joint motion type is set for the slave side (torch), teaching cannot be performed during coordinated movement.

- When "JOINT" is selected, even if the [SMOV] key is pressed, "COORD" is not displayed.
- During coordinated movement, when "JOINT" is selected, "SMOVL" and other coordinating instructions in the input buffer line are changed to "MOVJ," and the mode changes to individual movement.

Reference sections :
Coordinated and individual movements ▶ 5.3 Synchronized / single ▶ 2.5

2.9 Registration of handling instructions

To register handling instructions, the specific keys [TOOL 1 ON] , [TOOL 1 OFF] , [TOOL 2 ON] , and [TOOL 2 OFF] can be used. When these keys are pressed, the instructions in the following table will be registered.
General output signals #121 to 124 and general input signals #121 to 124 are used for handling.

Tool		Specific keys	General output signals (instruction output)	General input signals (confirmation input)	Instruction registered
Tool 1	Open	[TOOL 1 ON]	#121	#121	CALL JOB: H1OPEN
	Close	[TOOL 1 OFF]	#122	#122	CALL JOB: H1CLOSE
Tool 2	Open	[TOOL 2 ON]	#123	#123	CALL JOB: H2OPEN
	Close	[TOOL 2 OFF]	#124	#124	CALL JOB: H2CLOSE

- By registering the CALL instruction from a soft key label, the instructions of the above table can be registered.
- H1OPEN, H1CLOSE, H2OPEN, H2CLOSE are reserved jobs. The job content must have already been registered. Register corresponding to the application.
  [Example] H1OPEN registration example
  - The open and close instruction for the tools are pulse output.
  - After opening and closing the tools, it waits for confirmation of movement.

```
NOP
PULSE OT#121 ··· Tool 1 open instruction   0.3 second pulse output
WAIT IN#121  ··· Waiting for confirmation of Tool 1 opening.
RET
```

Registration

① On the job content display at edit mode, press any of the specific keys for handling instructions.

```
=> CALL JOB:H1OPEN
```

Input buffer line when the [TOOL 1 ON] key is pressed

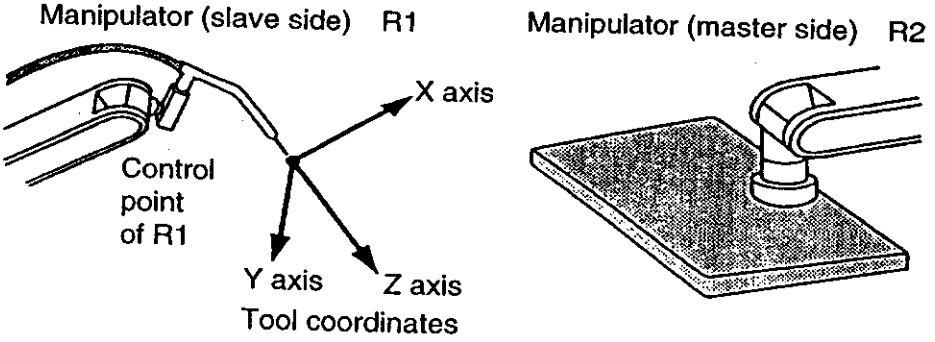
② To use the instruction displayed in the input buffer line without changing, simply press the [ENTER] key.

- If any modification is needed, press the [F1] (MODIFY) key, and edit the instruction.

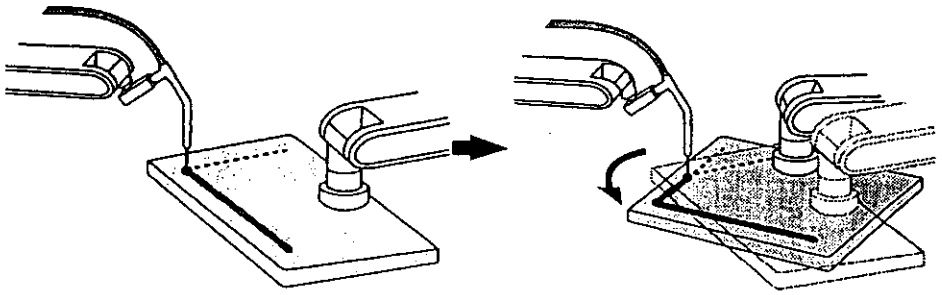
2.10 Convenient features

2.10.1 Moving the master following the control point of the slave

On a jigless system, the control point of the manipulator on the slave side can be made the reference point, and the manipulator on the master side can be moved.



Movement example



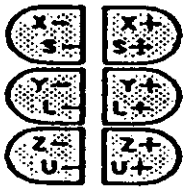
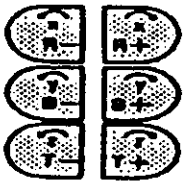
① Select tool coordinate system. Press the [COORD] key and "TOOL" of the [COORD] key lamp lights up.

② With the [*] + [COORD] keys, call the switching to tool coord display. Then select the control point of which robot will move.

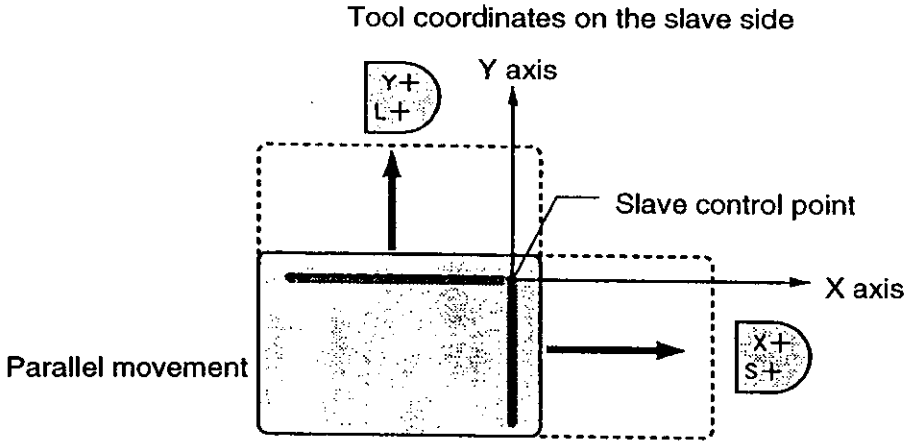
- When the power is ON, the control point of the currently selected robot axis is selected.

```
SWITCHING TO TOOL COORD
 ROBOT        R2
 CONTROL  POINT
   R1       TOOL 0
   R2       TOOL 1
```

The operation with the axis keys are as shown below, the same as that on the ordinary tool coordinate system.

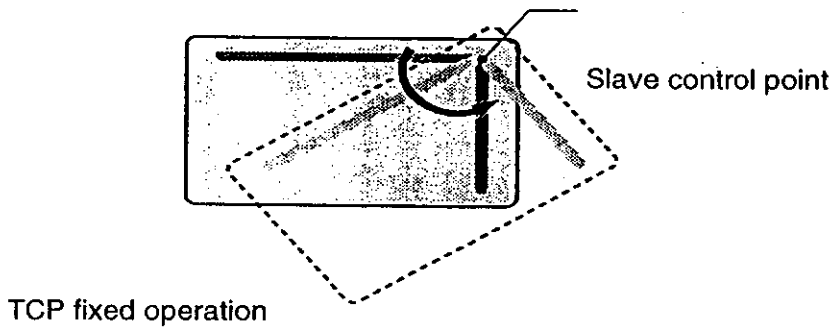
Axis name	Axis keys	Movements
Basic axes		Moves parallel to X-, Y- and Z- axes of tool coordinates of the selected manipulator.
Wrist axes		With the control point of the selected manipulator as the standard, TCP control motion is executed.

(1) Basic axes



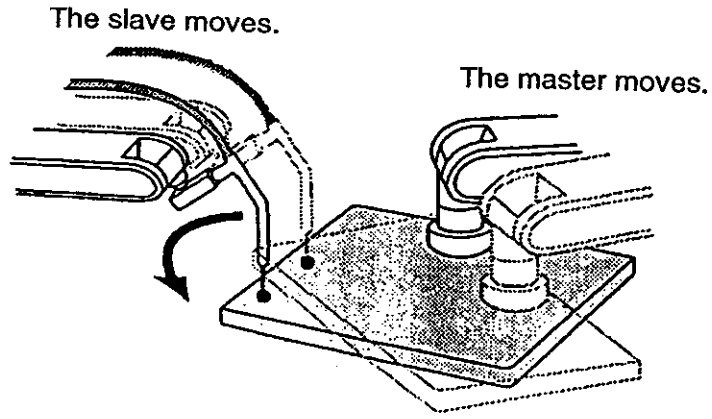
(2) Wrist axes

A TCP fixed operation is possible to change only wrist orientation with the control point of the slave manipulator as the reference point.

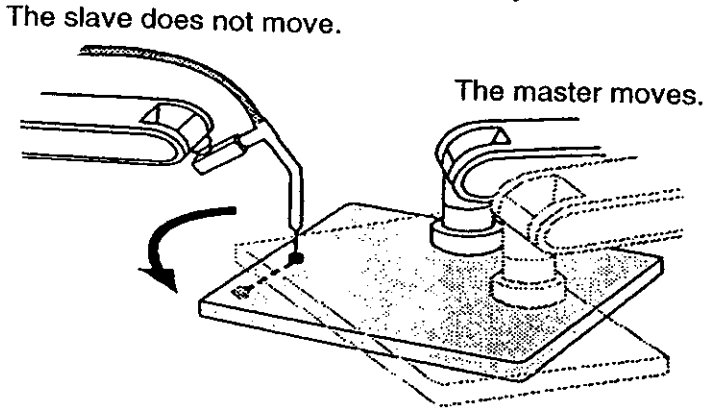


(3) Synchronized / single

When in "synchronized" mode : The master moves with the control point of the slave as reference.
The slave moves following the master.



When in "single" mode : The master moves with the control point of the slave as reference.
The slave remains stationery.



Chapter 3

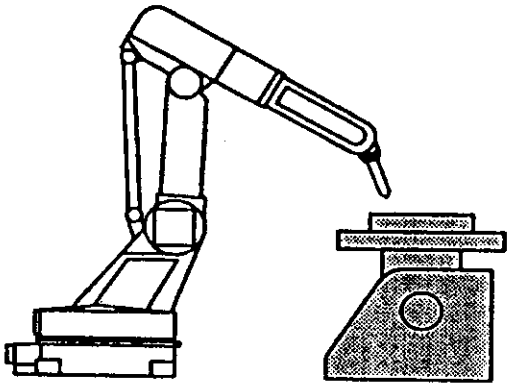
Station coordinated system

Overview

A station coordinated system is a system to perform work by coordinating two units, a station to hold the workpiece while the manipulator holds the tool.

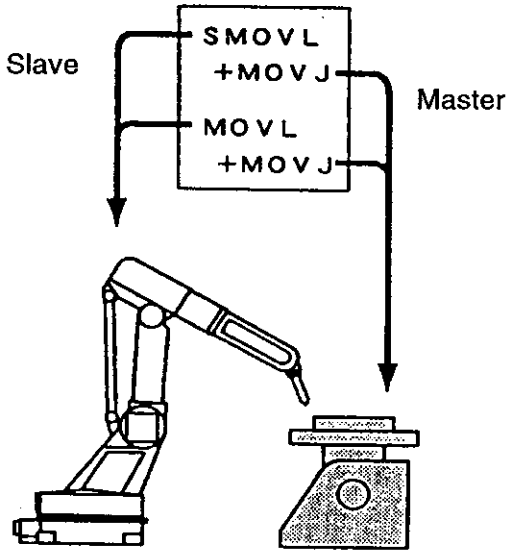
In order to move the station and the manipulator simultaneously, a coordinated job is taught.

In a coordinated job, the station and the manipulator through a master/slave relationship, can execute coordinated movement, where a reciprocal movement is performed, or individual movement, which makes separate movements.



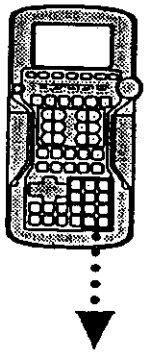
When "Coordinated" is displayed in the screen title, a "Coordinated" movement instruction is registered, and when "Coordinated" is not displayed, individual movement instruction is registered.
The "Coordinated" display can be switched with the specific [SMOV] key.

The move instruction for coordinated jobs usually has two lines displayed. The top line is the instruction for the slave side (manipulator) and the bottom line is for the master side (station).



3.1 Specific keys

Specific keys for station coordinated systems are assigned to the number keys as shown in the diagram.



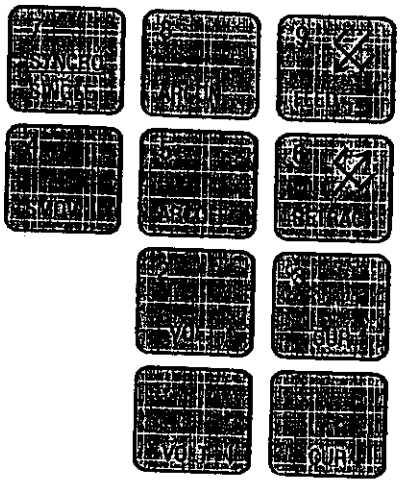
3.1.1 [FEED], [RETRACT] keys

Performs wire inching. Pressing the [FEED] key supplies wire, and pressing the [RETRACT] key reels it in.

3.1.2 [ARC ON], [ARC OFF] keys

Pressing the [ARC ON] key registers ARCON instruction.
Pressing the [ARC OFF] key registers an ARCOF instruction.

3.1.3 [SYNCRO / SINGLE] key



Selects the movement type for the manipulator when teaching a coordinated job. Each time this key is pressed, the movement type switches.

SYNCRO : "SEQ" is displayed in the status display area. If the manipulator on the master side (station) is moved at this time, the slave (manipulator) will move following the motion of the master.

SINGLE : Only selected group axis will move.

3.1.4 [SMOV] key

Selects coordinated or individual movement when teaching a coordinated job. Each time this key is pressed, the movement type switches.

Coordinated: "Coordinated" is displayed in the screen title. At this time, registered movement instructions will be coordinated instructions.

Individual: The master-slave relationship is canceled, and the manipulator and station each performs its own individual movement.

3.1.5 [VOLT ↑], [VOLT ↓], [CUR ↑], [CUR ↓] keys

[CUR ↑]: Registers ARCCUR, the welding current output instruction. Pressing this key during welding operation in the play mode increases the welding current.

[CUR ↓]: Registers AWELD, the welding current reference value instruction. Pressing this key during welding operation in the play mode decreases the welding current.

[VOLT ↑]: Registers ARCVOL, the welding voltage output instruction. Pressing this key during welding operation in the play mode increases the welding voltage.

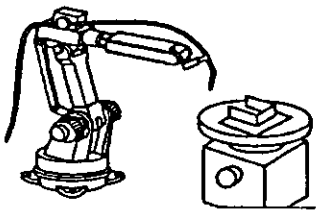
[VOLT ↓]: Registers VWELD, the welding voltage reference value instruction. Pressing this key during welding operation in the play mode decreases the welding voltage.

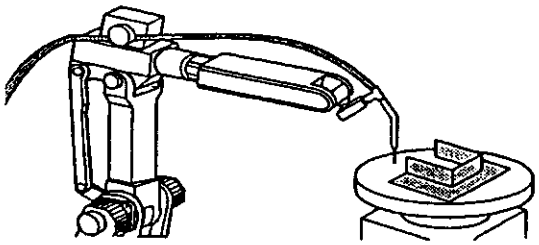
Reference sections :
Synchronized / single ▶ 3.4 Coordinated and individual movements ▶ 5.3

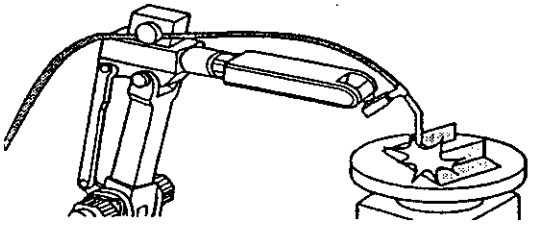
3.2 Job example

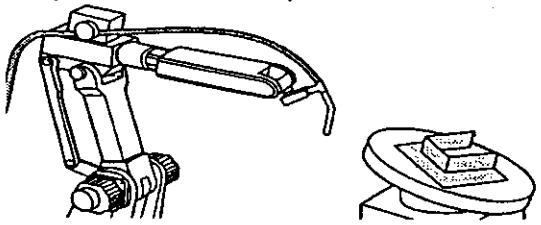
Step	Instruction	
001	MOVJ VJ=50.00	To the standby position
	+MOVJ	
002	SMOVL V=200	To the operation starting position
	+MOVJ	
	SWVON WEV#(1)	
	ARCON ASF#(1)	
003	SMOVL V=200	To the work end position
	+MOVJ	
004	SMOVL V=200	
	+MOVJ	
005	SMOVL V=200	Separates from workpiece
	+MOVJ	
	ARCOF AEF#(1)	
	SWVOF	
006	MOVJ VJ=50.00	The torch moves to the cleaner. The workpiece is discharged.
	+MOVJ	
007	MOVJ VJ=50.00	
	+MOVJ	

Coodinated movement

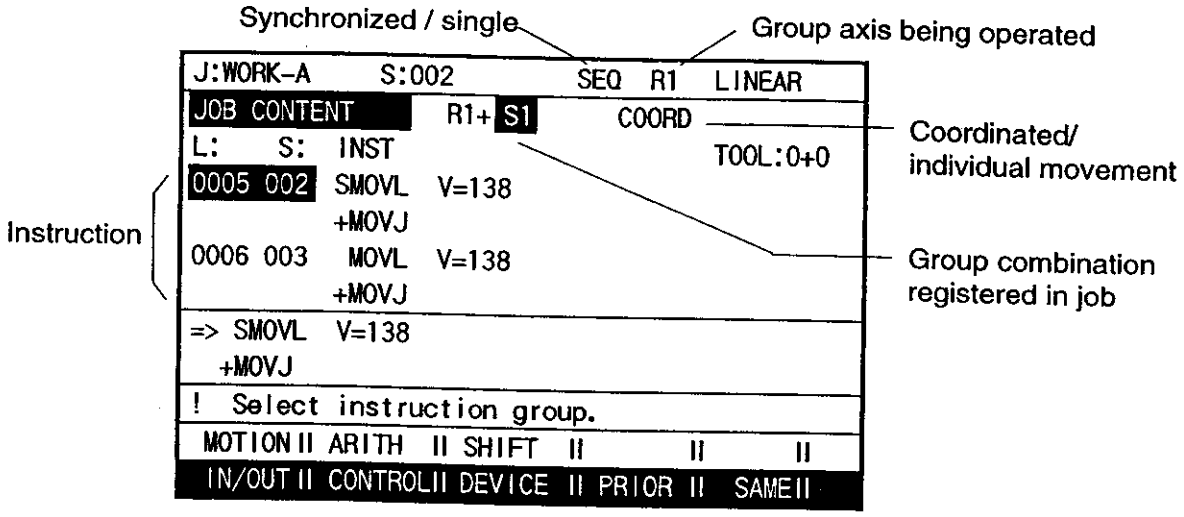








3.3 Job content display



3.3.1 Instruction

For coordinated jobs, movement instruction, weaving instruction, shift instruction, etc. are displayed in two lines. The top is the instruction to the slave (manipulator) side, and the bottom to the master (station) side.

SMOVL V=138 ← Slave, the manipulator
+MOVJ ← Master, the station

3.3.2 Synchronized / single

Synchronized/single selects the type of movement for the manipulator during axis operation. Displayed when synchronized is selected. Can be switched with the [SYNCRO / SINGLE] key.

3.3.3 Group axis being operated

The group axis being operated is displayed. Can be switched with the [GROUP AXES] key.

3.3.4 Coordinated / individual movement

When coordinated movement is selected "Coordinated" is displayed. Can be switched with the [SMOV] key.

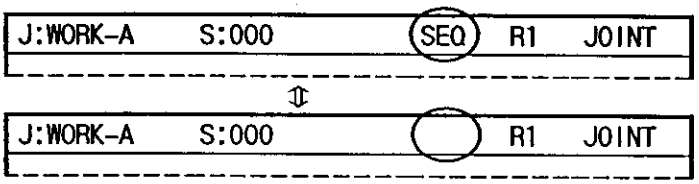
3.3.5 Group combination registered in job

The master side is displayed inversely.

Reference sections :
Master, slave ▶ 5.2 Synchronized / single ▶ 3.4 Selection of axis to be operated ▶ 3.5
Coordinated and individual movements ▶ 5.3

3.4 Synchronized / single

In axis operation during teaching, there are two methods "synchronized" and "single." Can be switched with the specific [SYNCRO / SINGLE] key.



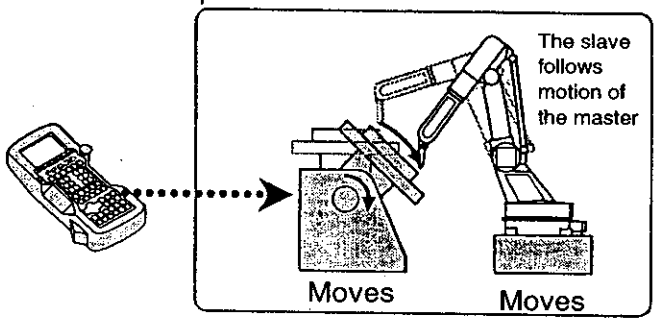
Nothing is displayed in "single" mode.

3.4.1 Synchronized

If the axis operation is performed in synchronized mode, when the master (station) is moved, the slave (manipulators) follows the motion. This feature is used to maintain the relative positions of the manipulator and station.

However, the master does not move even if the slave is moved.

Master axis is operated.



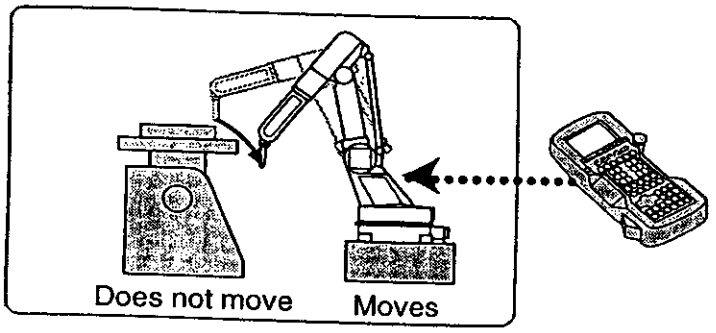
To switch the master during synchronized operation, follow the procedure below.

① Display the group combination selection display.
② Move the cursor to the desired master combination.
③ Press the [SYNCRO / SINGLE] key and choose "SEQ."

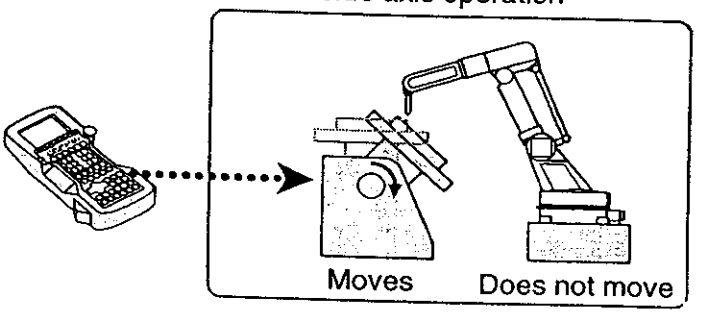
3.4.2 Single

If the axis operation is performed in single mode, only the selected manipulator is performed. This is used at steps where the manipulator and the station perform separate tasks.

Slave side axis operation



Master side axis operation



NOTE

1. Synchronized / single selection is maintained until the next selection is made.
2. During synchronized mode, on the group combination selection display, if a combination other than the combination registered in the job is selected, a switch is automatically made to "Single."
3. If the editing job is changed, a switch is automatically made to "Single."

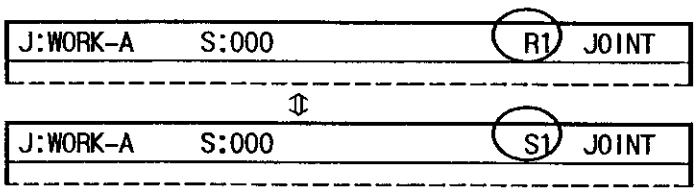
Reference sections :
Master, slave ▶ 5.2

3.5 Selection of axis to be operated

This is the procedure to switch the axis of the robot to be operated at teach mode.

3.5.1 Switching between manipulator and station

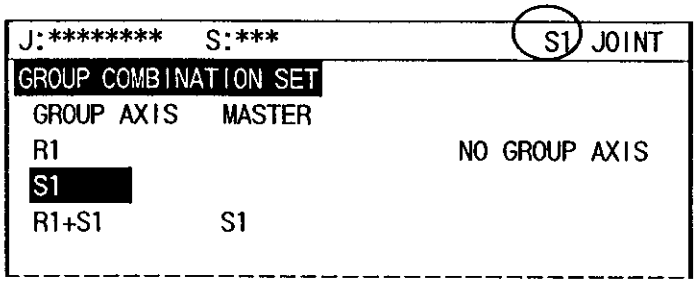
This switches each time the [GROUP AXES] key is pressed. The lamp of this key is lit when the axis operation is performed for master (station).



3.5.2 Switching the group axis when there is no editing job

When there is no editing job at teach mode, the procedure to move the manipulator is as follows.

① Display the group combination set display with the [ENABLE] key.



② Move the cursor to the combination to be operated. Group axes able to be operated are displayed in the status display area.

③ Move the manipulator with the axis keys.

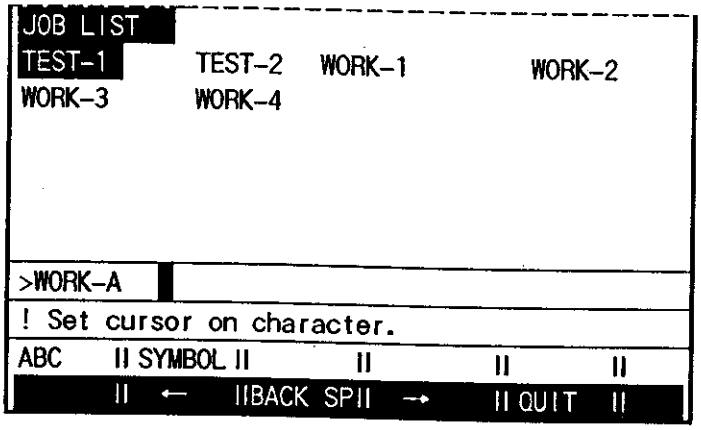
④ Press the [*] + [GROUP AXES] keys to return to the original display.

Reference sections :
Master, slave ▶ 5.2

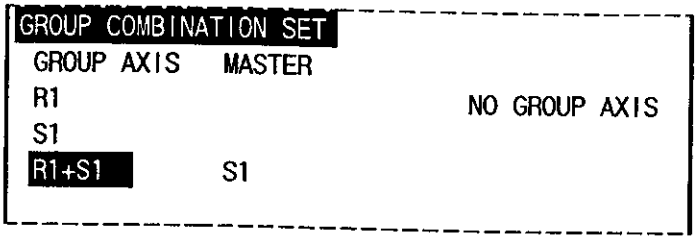
3.6 Registration of new job name

① Press the [SELECT] key and the [F2] (NEW JOB) key.

② Enter the job name, and then press the [ENTER] key.



③ Select the group combination, and then press the [ENTER] key.
The new job is registered, and the contents for that job is displayed.

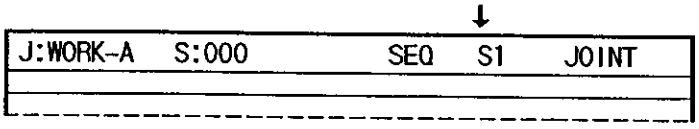


3.7 Registration of move instructions (S)MOV□+ MOVJ

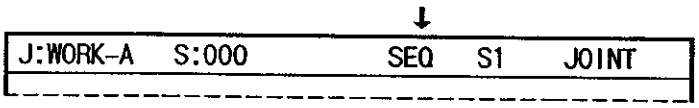
Display the job content display in the teach mode, and press the [EDIT] key.
If the lamp on the [ENABLE] key is not lit, press it and turn it ON.

3.7.1 Registration of the move instruction for the master (station) side

① Press the [GROUP AXES] key to make the master the operation target.



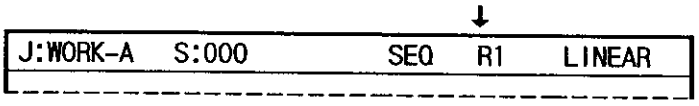
② Press the [SYNCRO / SINGLE] key and choose "synchronized" or "single."
If the slave will be made to follow, select synchronized mode.



③ Move the manipulator to the desired position with the axis keys.

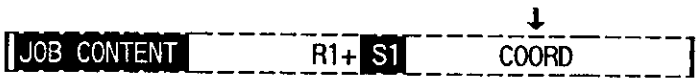
3.7.2 Registration of the move instruction for the slave (manipulator) side

① Press the [GROUP AXES] key to make the slave the operation target.

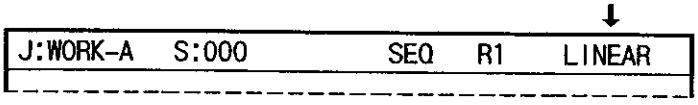


② Move to the manipulator the desired position with the axis keys.

③ Press the [SMOV] key and choose coordinated or individual movement.



④ Press the [MOTION TYPE] key and select motion type.



⑤ Confirm motion type and speed, then press the [ENTER] key, and registration is completed.

```
0003 001 SMOVL  V=138
         +MOVJ
```

NOTE

When joint motion type is set for the slave side (manipulator), teaching cannot be performed during coordinated movement.

- When "JOINT"is selected, even if the [SMOV] key is pressed, "COORD" is not displayed.
- During coordinated movement, when "JOINT" is selected, "SMOVL" and other coordinating instructions in the input buffer line are changed to "MOVJ," and the mode changes to individual movement.

Reference sections :
Coordinated and individual movements ▶ 5.3 Synchronized / single ▶ 3.4

Chapter 4

Twin synchronous system

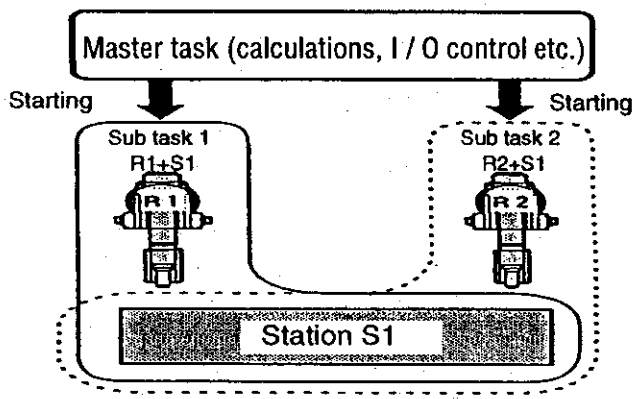
Overview

A twin synchronous system is a system to perform work by coordinating two robots for one station.

With this system, two coordinated jobs are used simultaneously.

- A coordinated job for one of the manipulators and the station (R1+S1)
- A coordinated job for the other manipulator and the station (R2+S1)

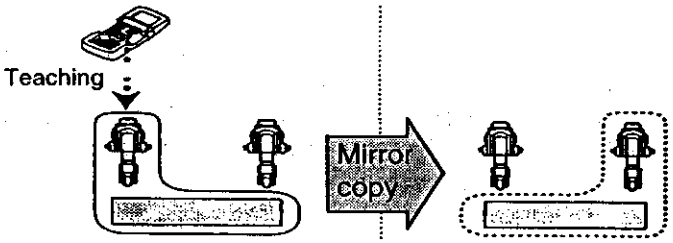
Then in order to start two jobs or to implement I/O control, a concurrent job is used.
This master task job uses the function of independent control which the master task job starts the robot jobs of subtasks 1 and 2.



Jobs for the two robots can be created with either of the two following methods.

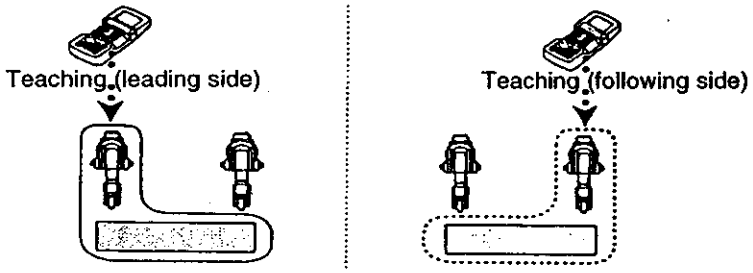
[Method 1] · Copy one subtask job and create another job.

Method 1 is convenient when the job path has left to right symmetry. Since the mirror copy function which copies a job converting is used, the job path symmetrically repeating the same teaching procedures is saved.



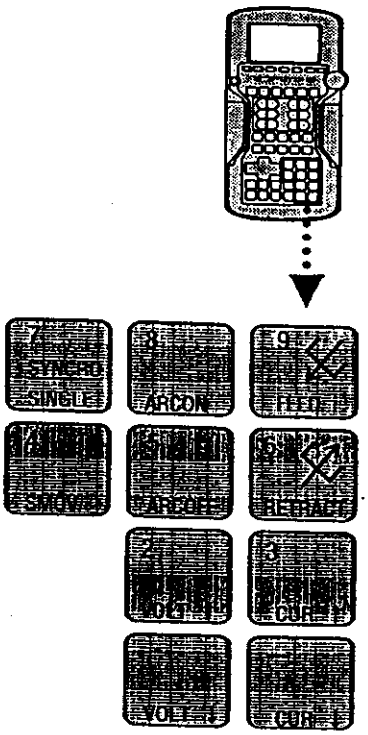
[Method 2] · Teaching one unit at a time

In cases where the there are few points in common between the paths and job of the two manipulators, jobs can be created with method 2.



4.1 Specific keys

Specific keys for station coordinated systems are assigned to the number keys as shown in the diagram.



[FEED], [RETRACT] keys

Performs wire inching. Pressing the [FEED] key supplies wire, and pressing the [RETRACT] key reels it in.

[ARC ON], [ARC OFF] keys

Pressing the [ARC ON] key registers ARCON instruction.
Pressing the [ARC OFF] key registers ARCOF instruction.

[SYNCRO / SINGLE] key

Selects the movement type for the manipulator and station when teaching a coordinated job. Each time this key is pressed, the movement type switches.

SYNCRO: "SEQ" is displayed in the status display area. If the manipulator on the master side (station) is moved at this time, the slave (manipulator) will move following the motion of the master.

SINGLE: Only selected group axis moves.

[*]+ [SYNCRO / SINGLE] keys

Turns the job synchronized movement mode ON and OFF.

[SMOV] key

Selects coordinated or individual movement when teaching a coordinated job. Each time this key is pressed, the movement type switches.

Coordinated: "Coordinated" is displayed in the screen title. At this time, registered movement instructions will be coordinated instructions.

Individual: The master-slave relationship is canceled, and the manipulator and station each performs its own individual movement.

[*]+[SMOV] keys

Switches between multiple jobs and single job.

[VOLT ↑], [VOLT ↓], [CUR ↑], [CUR ↓] keys

[CUR ↑]: Registers ARCCUR, the welding current output instruction. Pressing this key during welding operation in the play mode increases the welding current.

[CUR ↓]: Registers AWELD, the welding current reference value instruction. Pressing this key during welding operation in the play mode decreases the welding current.

[VOLT ↑]: Registers ARCVOL, the welding voltage output instruction. Pressing this key during welding operation in the play mode increases the welding voltage.

[VOLT ↓]: Registers VWELD, the welding voltage reference value instruction. Pressing this key during welding operation in the play mode decreases the welding voltage.

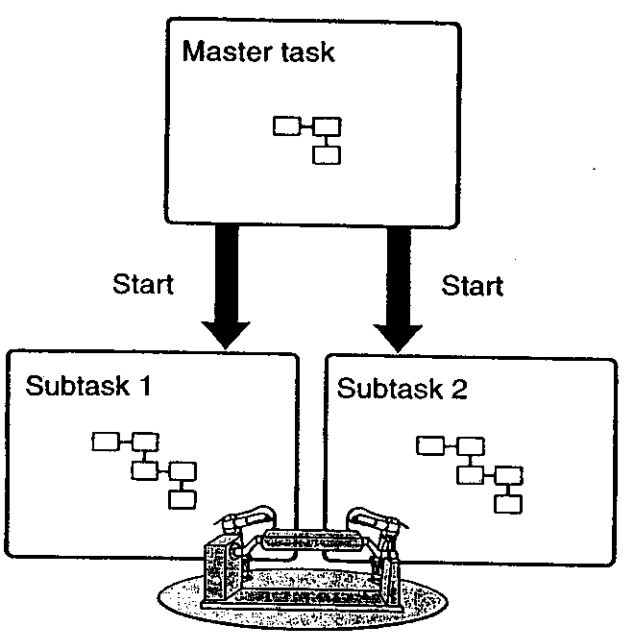
Reference sections :
Job synchronized modes ▶ 4.7.2 Multiple jobs / single job ▶ 4.16.1
Coordinated and individual movements ▶ 5.3

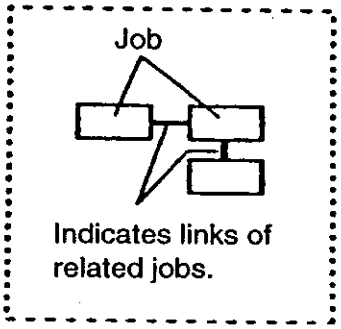
4.2 Job configuration

Using the function of independent control, the concurrent job of the master task is configured so it will start the robot jobs of subtasks 1 and 2.

Master task:	Concurrent job Starts subtasks 1 and 2, and controls I / O.
Subtask 1:	Robot job Coordinated job of one of the manipulators and the station.
Subtask 2:	Robot job Coordinated job of the other manipulator and the station.

Subtasks 1 and 2 are designated as leading or following side with tag SYNC of the PSTART instruction.





Reference sections :
Master task, subtask, master job, concurrent job, robot job ▶ 6.1, 6.2, 6.5, 6.6 PSTART ▶ 6.2
Supervisory display ▶ 6.9.5

4.3 Leading side and following side

Always make either subtask 1 or 2 the following side. To make one side the following side, include the tag "SYNC" in the PSTART instruction of the master task. The one with the SYNC included will be the following side, and the other automatically becomes the leading side.
The leading side job controls the station axis. The job of the following side moves in conformity with the movement of the station axis.

```
0004   PSTART  JOB:JOB-1  SUB1        <-- Subtask 1, leading side
0005   PSTART  JOB:JOB-2  SUB2 SYNC   <-- Subtask 2, following side
```

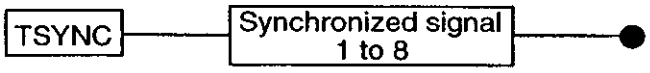
Master task job

In this case the manipulator of subtask 2 is synchronized with leading side subtask 1.

4.4 Synchronizing with TSYNC

While performing a job, the movement of the two manipulators sometimes get out of alignment. To obtain synchronized operation, execute the TSYNC instruction immediately before that step.
Once TSYNC is executed on one of the robot jobs, even the other robot job also waits until the same TSYNC synchronized signal is executed.

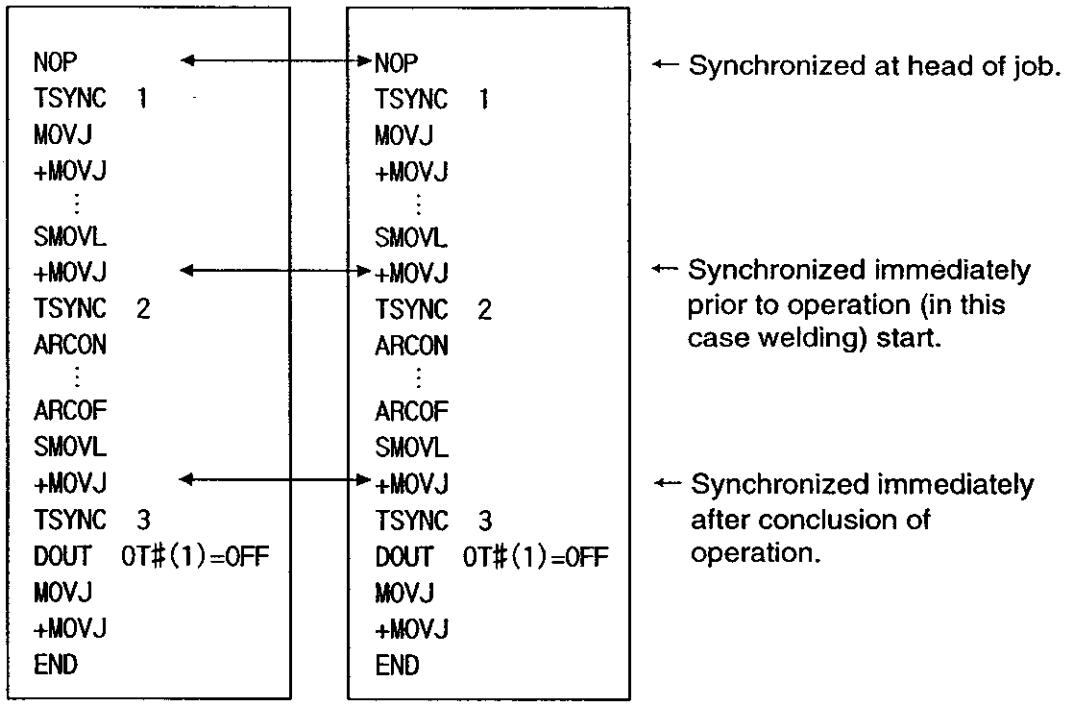
Format



Registration

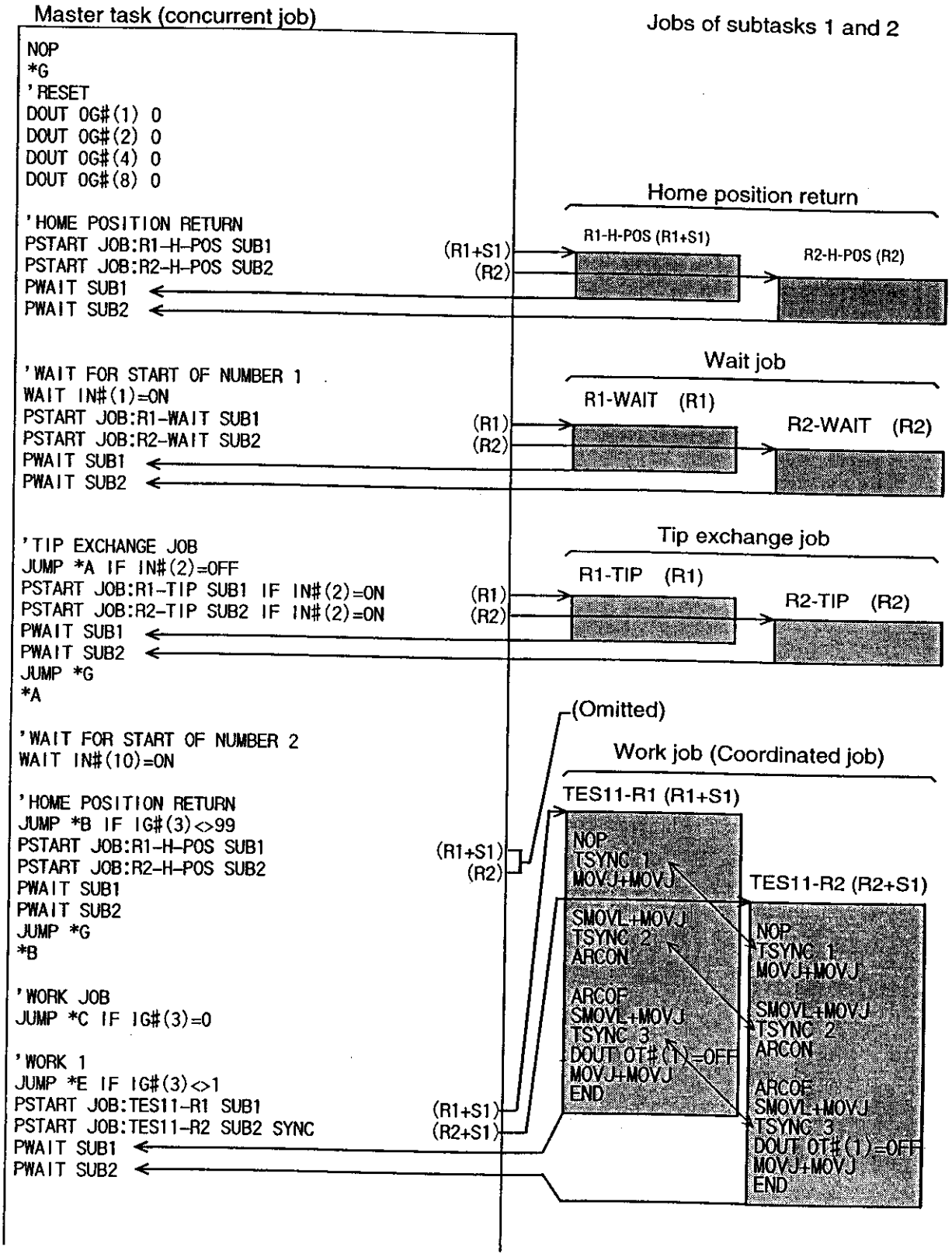
Press the keys in the order the [EDIT] key, then the [F2] (CONTROL) key, then the [F1] (TSYNC) key.
TSYNC is displayed in the soft key label of the control instruction.

Example



Reference sections :
Job example ▶ 4.5

4.5 Job example

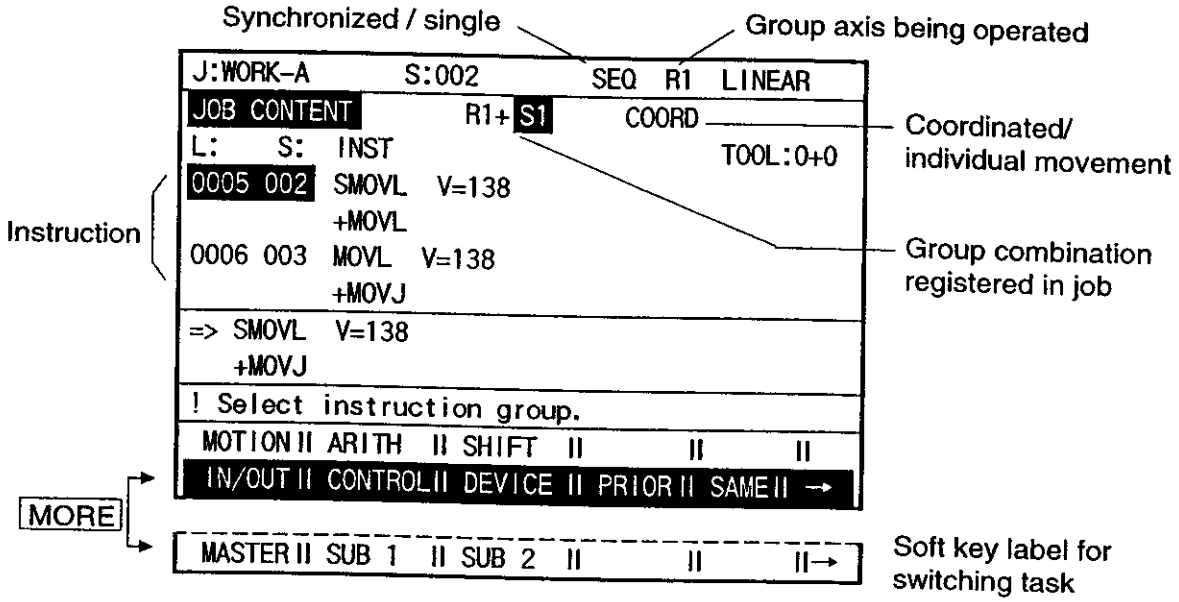


```
*E

'WORK 2
JUMP *F IF IG#(3)<>2
PSTART JOB:TES12-R1 SUB1                (R1+S1)
PSTART JOB:TES12-R2 SUB2 SYNC           (R2+S1)
PWAIT SUB1
PWAIT SUB2
*F
JUMP *H IF IN#(2)=OFF
PSTART JOB:R1-TIP SUB1                    (R1)
PSTART JOB:R2-TIP SUB2                    (R2)
PWAIT SUB1
PWAIT SUB2
*H

'NOZZLE CLEANING
JUMP *G IF IN#(2)=ON
PSTART JOB:R1 NOZZLE SUB1                 (R1)
PSTART JOB:R2 NOZZLE SUB2                 (R2)
PWAIT SUB1
PWAIT SUB2
JUMP *G
*C
DOUT OG#(4) 15
JUMP *C
END
```

(Omitted)

Reference sections :
TSYNC ▶ 4.4

4.6 Job content display



4.6.1 Instruction

For coordinated jobs, movement instruction, weaving instruction, shift instruction, etc. are displayed in two lines. The top is the instruction to the slave (manipulator) side, and the bottom to the master (station) side.

SMOVL V=138 ← Slave, the manipulator
+MOVJ ← Master, the station

4.6.2 Synchronized / single

Synchronized/single selects the type of movement for the manipulator and station during axis operation. Displayed when synchronized is selected. Can be switched with the [SYNCRO / SINGLE] key.

4.6.3 Group axis being operated

The group axis being operated is displayed. Can be switched with the [GROUP AXES] key.

4.6.4 Coordinated / individual movement

When coordinated movement is selected "Coordinated" is displayed. Can be switched with the [SMOV] key.

4.6.5 Group combination registered in job

The group combination of the currently displayed job is displayed. The master side is displayed inversely.

4.6.6 Soft key label for task switching

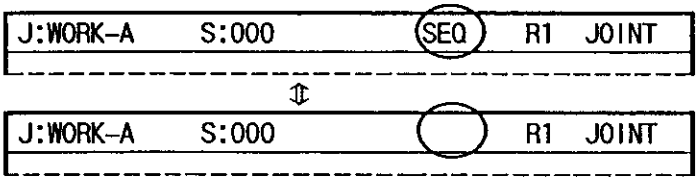
If the [MORE] key is pressed in edit mode, this soft key label is displayed. The job content display of each task can be displayed with one touch.

Reference sections :
Master, slave ▶ 6.2 Synchronized/single ▶ 4.7.1 Group axis being operated ▶ 4.8
Coordinated and individual movements ▶ 5.3 Task switching ▶ 4.11

4.7 Synchronized / single

4.7.1 Synchronized / single of station and manipulator

In axis operation during teaching, there are two methods "synchronized" and "single."
Can be switched with the specific [SYNCRO/SINGLE] key.

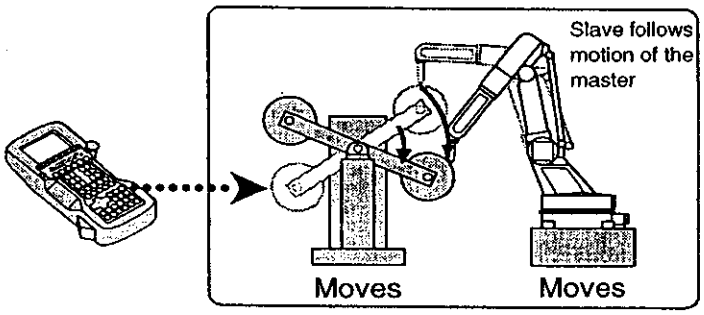


Nothing is displayed in "single" mode.

(1) Synchronized

If the axis operation is performed in synchronized mode, when the master (station) is moved, the slave (manipulator) follows the motion. This feature is used to maintain the relative positions of the manipulator and station.
However, the master does not move even if the slave is moved.

Master side axis operation

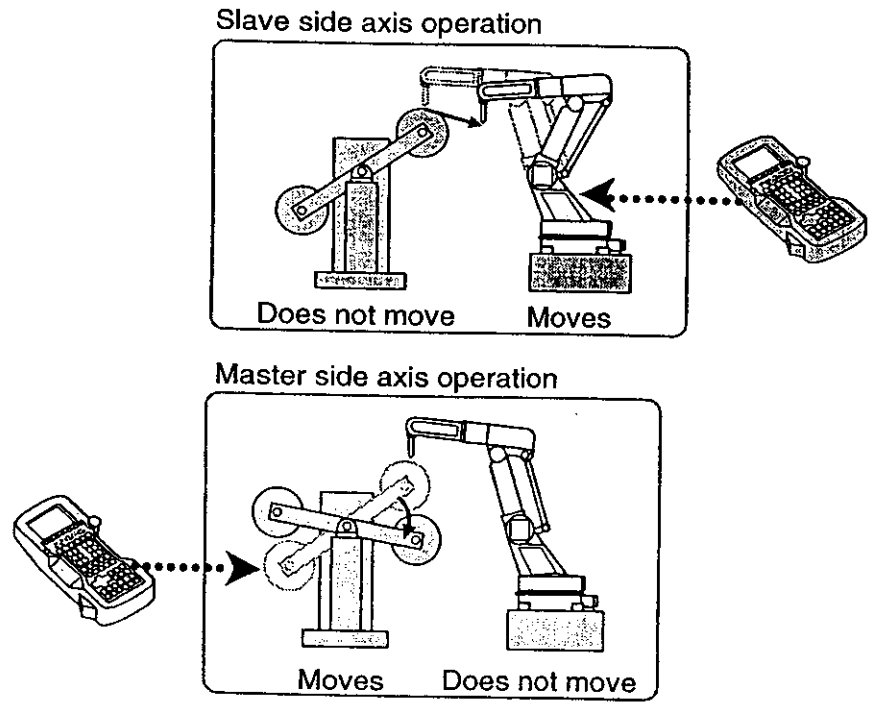


To switch the master during synchronized operation, follow the procedure below.

① Display the group combination selection display.
② Move the cursor to the desired master combination.
③ Press the [SYNCRO / SINGLE] key and choose "SEQ."

(2) Single

If the axis is operated in single mode, only the selected axis of the group is performed. This is used at steps where the manipulator and the station perform separate tasks.



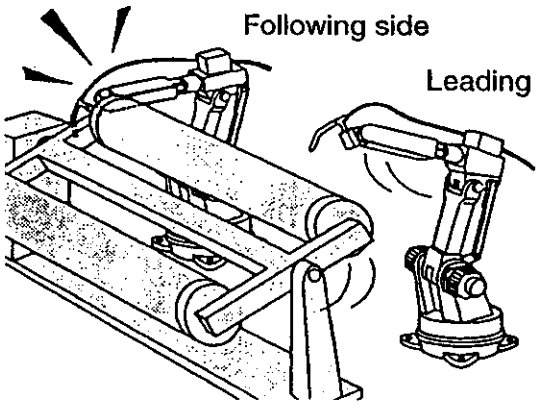
NOTE

1. Synchronized / single selection is maintained until the next selection is made.
2. During synchronized mode, on the group combination selection display, if a combination other than the combination registered in the job is selected, a switch is automatically made to "Single."
3. If the editing job is changed, a switch is automatically made to "Single."

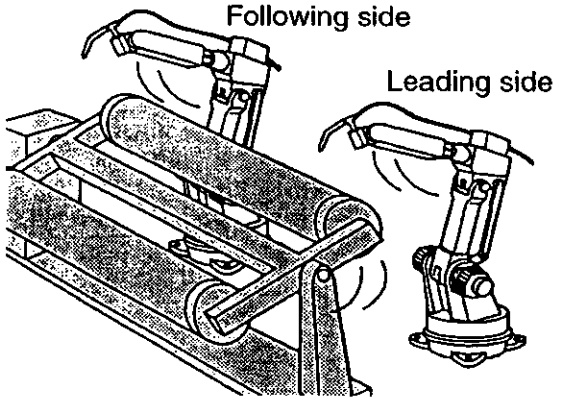
Reference sections :
Master, slave ▶ 5.2

4.7.2 Job synchronized mode for subtask 1, 2

If only the leading side manipulator is operated FWD / BWD, when the following side manipulator is stopped, it will sometimes interfere with the workpiece. To prevent it, the following side can be synchronized with the leading side by switching to "job synchronized mode." The following side manipulator moves while maintaining its relative position with the station.



FWD operation on the leading side.



In job synchronized mode, FWD operation on the leading side.

The following side job synchronized mode switches during the FWD / BWD operation on the leading side each time the [*] + [SYNCRO / SINGLE] keys are pressed.

```
! Twin coordinated mode ON
```

⇕

```
! Twin coordinated mode OFF
```

Furthermore, if the [SELECT], [MORE], [F4] (COND1) keys are pressed in teach mode, confirmation and setting can be done even on the Teaching condition 1 set display.

```
9. TWIN COORDINATED MODE  (●)          ●
```

Teaching condition 1 set display

- ● (ON): Job synchronized mode
- ○ (OFF): Canceled

The job synchronized mode is effective only at the following side manipulator when single job operation is selected.

```
8. STEP/TEST RUN OPERATION MODE          ○
  MULTI JOB  (●)      / SINGLE-JOB  (○)
```

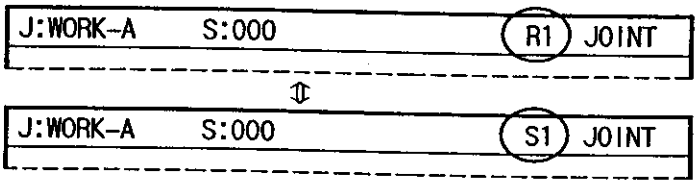
Teaching condition 1 set display

4.8 Selection of axis to be operated

This is the procedure to switch the axis of the group for whict operation is performed at teach mode.

4.8.1 Switching between manipulator and station

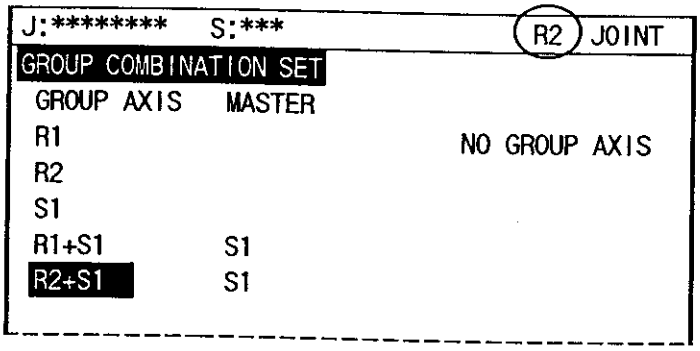
This switches each time the [GROUP AXES] key is pressed. The lamp of this key is lit when the the axis operation is performed for the master (station).



4.8.2 Switching the group axis when there is no editing job

When there is no editing job at teach mode, the procedure to move the manipulator is as follows.

① Display the group combination set display with the [ENABLE] key.



② Move the cursor to the combination to be operated. Group axes able to be operated are displayed in the status display area.

③ Move the manipulator with the axis keys.

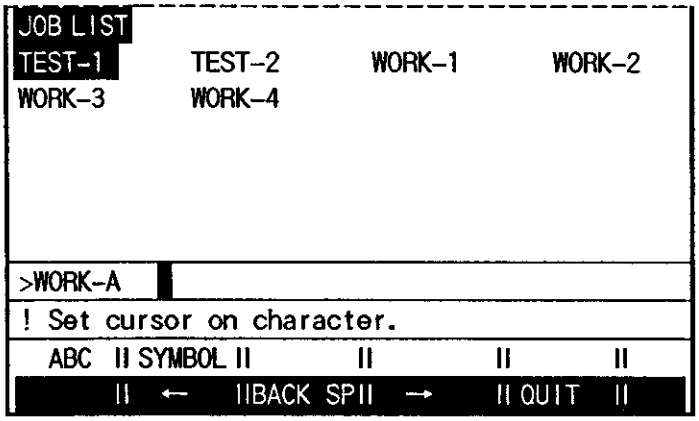
④ Press the [*] + [GROUP AXES] keys to return to the original display.

Reference sections :
Master, slave ▶ 5.2

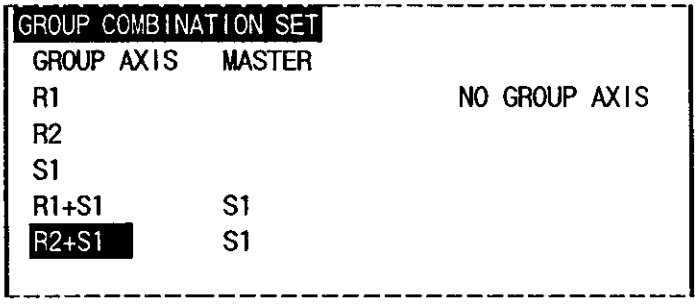
4.9 Registration of new job name

① Press the [SELECT] key and the [F2] (NEW JOB) key.

② Enter the job name, and then press the [ENTER] key.



③ Select the group combination, and press the [ENTER] key.
The new job is registered, and the contents for that job is displayed.

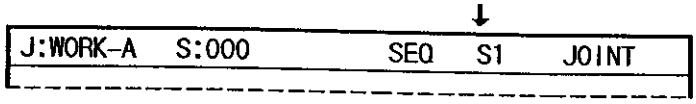


4.10 Registration of move instructions (S)MOV□+ MOVJ

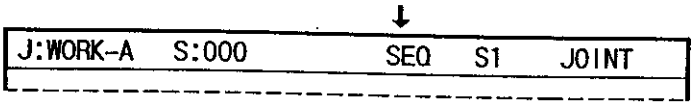
Display the job content display in the teach mode, and press the [EDIT] key.
If the lamp on the [ENABLE] key is not lit, press it and turn it ON.

4.10.1 Registration of the move instruction for the master (station) side

① Press the [GROUP AXES] key to make the master the operation target.



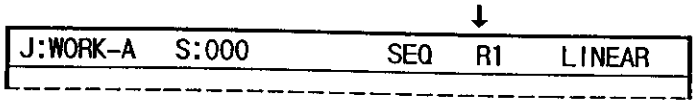
② Press the [SYNCRO / SINGLE] key and choose "synchronized" or "single."
If the slave will be made to follow, select synchronized mode.



③ Move the manipulator to the desired position with the axis keys.

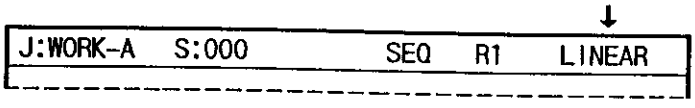
4.10.2 Registration of the move instruction for the slave (manipulator) side

① Press the [GROUP AXES] key to make the slave the operation target.



② Press the [SMOV] key and choose coordinated or individual movement.

③ Press the [MOTION TYPE] key and select motion type.



④ Move the manipulator to the desired position with the axis keys.

⑤ Confirm motion type and speed, then press the [ENTER] key, and registration is completed.

```
0003 001 SMOVL  V=138
         +MOVJ
```

NOTE

When joint motion type is set for the slave side (manipulator), teaching cannot be performed during coordinated movement.

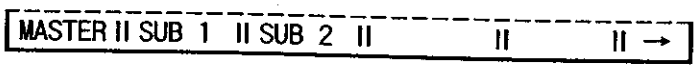
- When "JOINT"is selected, even if the [SMOV] key is pressed, "COORD" is not displayed.
- During coordinated movement, when "JOINT" is selected, "SMOVL" and other coordinating instructions in the input buffer line are changed to "MOVJ," and the mode changes to individual movement.

Reference sections :
Coordinated and individual movements ▶ 5.3 Synchronized/Single ▶ 4.7.1

4.11 Switching tasks

During teaching, any task can be switched with a single touch by calling up the task switching soft key labels. This is convenient for teaching the following side while executing FWD operation of the leading side job.

① Press the [EDIT] key then the [MORE] key.



② Switch the display of any task with the soft keys.
However, for jobs that have not been called up, nothing is displayed.

4.12 Job creation for a subtask: [Method 1] and [Method 2]

Jobs of subtasks 1 and 2 are robot jobs.

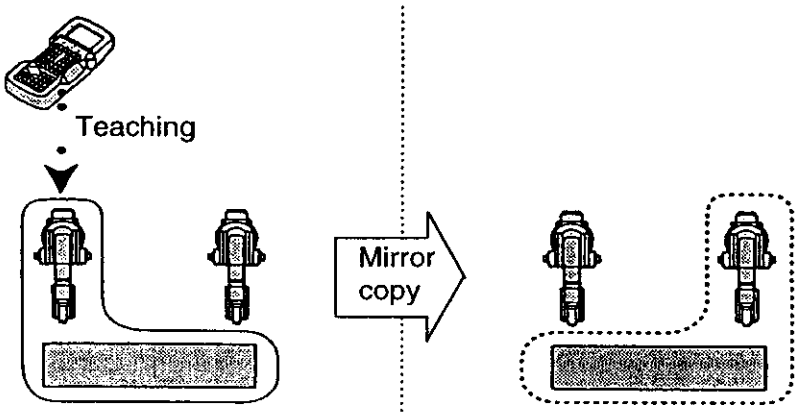
Subtask 1: Job of one of the manipulators + the station

Subtask 2: Job of the other manipulator + the station

There are two ways to create robot jobs for subtasks.

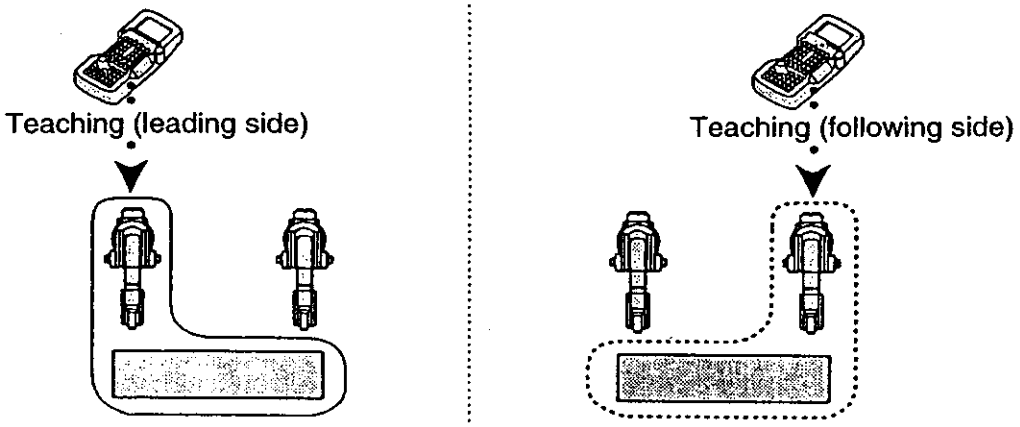
[Method 1] ·Copy one subtask job and create another job.

Method 1 is convenient when the job path has left to right symmetry. Since the mirror copy function which copies a job converting is used, the job path symmetrically repeating the same teaching procedures is saved.



[Method 2] ·Teaching one unit at a time

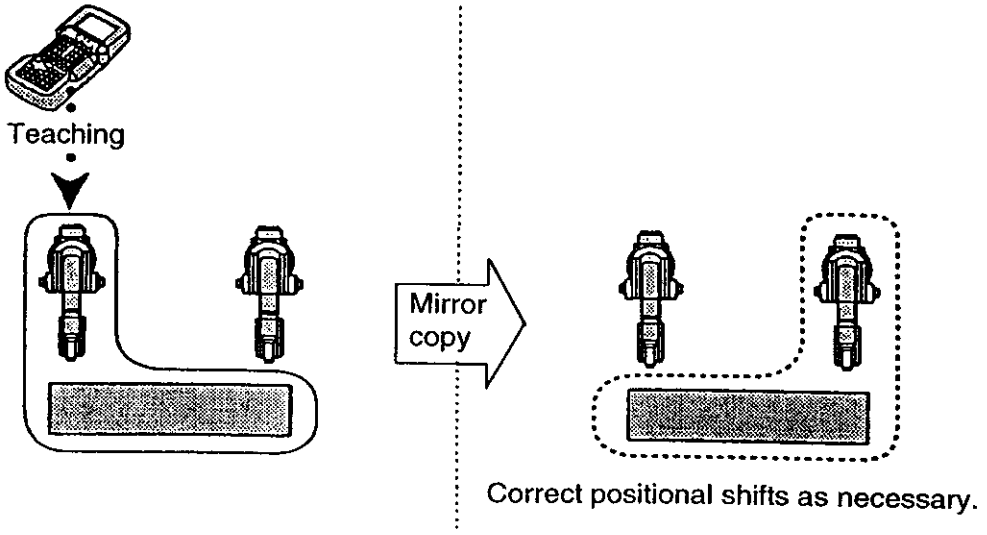
In cases where the there are few points in common between the paths and job of the two manipulators, jobs can be created with this method.



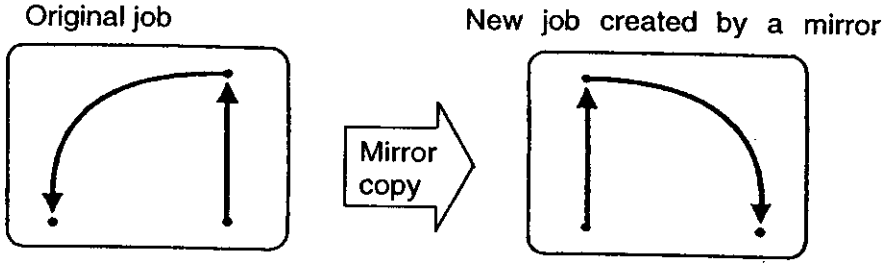
4.13 [Method 1]: Copy one subtask job and create another job

4.13.1 Procedure

In cases where the work path has left to right symmetry, using a job taught on one manipulator, a job for the other manipulator can be created.
First, teach either R1+S1 or R2+S1. Then, make a mirror copy of that job, and make it the job for the other manipulator.



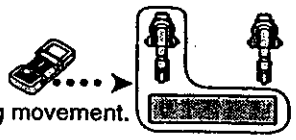
A mirror copy is one type of job copy, which creates jobs by reversing the signs of position data for the S, R, and T axes.



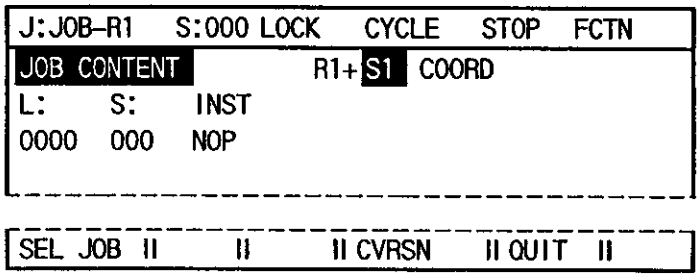
Reference sections :
Mirror copy ▶ 4.18.1

4.13.2 Teaching and mirror copying

① Teach a job of one of the manipulators and the station, and check the movement.

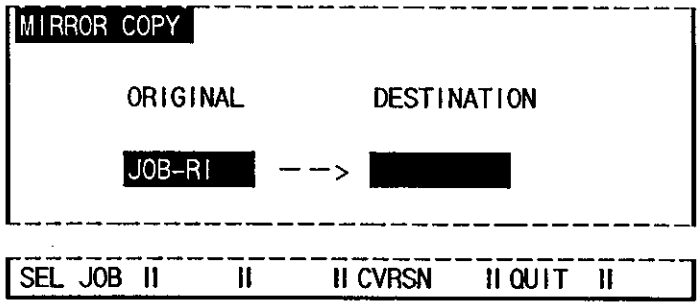


② When teaching is completed, copy the job of ① with a mirror copy.
Press the [FUNC] key, the [MORE] key, then the [F5] (MIRROR) key. The contents of the edit job is displayed.

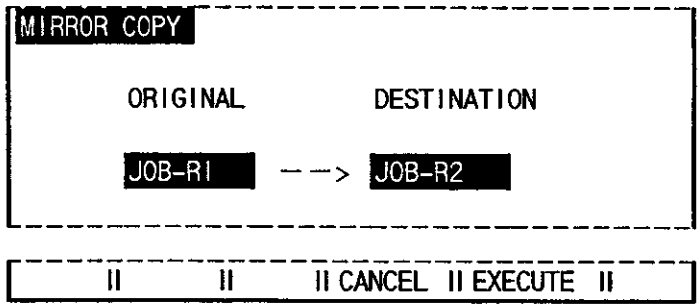


③ To make a mirror copy of the job being displayed, go to step ④.
To copy a different job, press the [F1] (SEL JOB) key to call up the desired job, and then press the [ENTER] key.

④ Press the [F4] (CVRSN) key.



⑤ Enter the name for the job made from the mirror copy, and then press the [ENTER] key.



⑥ When the [F5] (EXECUTE) key is pressed, mirror copying starts.

Reference sections :
Registration of new job name ▶ 4.9 Registering move instructions ▶ 4.10
Mirror copy ▶ 4.18.1

4.13.3 Correcting positional shifts

Jobs after a mirror copy sometimes have shifted in position due to installation error. In this case, all steps should be corrected by the same shift amount. The function of parallel shift job conversion is used.

NOTE The amount of shift should have been previously entered into the position variable.

```
POSITION VARIABLE                COORD: USER 01
#P010    NAME: SHIFT DATA
           X          30.000    TOOL: 00
           Y           0.000    TYPE: REAR
           Z         -10.000          UP
           RX          0.00           NO FLIP
           RY          0.00           S<180
           RZ          0.00           R>=180
```

① Press the [FUNC] key, then the [F4] (PSHIFT) key. The contents of the edit job is displayed.

```
J:JOB-R1   S:000 LOCK   CYCLE   STOP   FCTN
JOB CONTENT          R1+S1 COORD
L:    S:    INST
0000  000   NOP
```

```
SEL JOB || FILE || RELATED || SINGLE || QUIT  ||
```

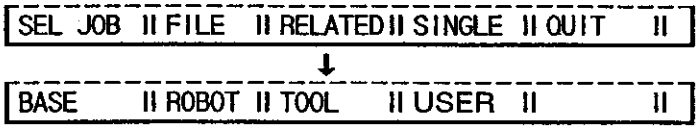
② To convert the job being displayed, go to step ③.
To convert a different job, press the [F1] (SEL JOB) key to call up the desired job, and then press the [ENTER] key.

③ Press the [F2] (FILE) key. After entering the position variable which is to be used, press the [ENTER] key, then the [F5] (QUIT) key.

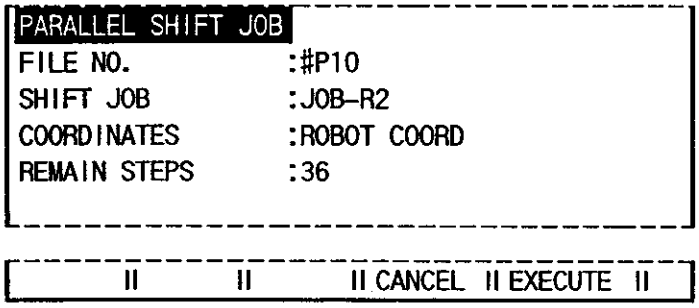
```
PARALLEL SHIFT JOB          COORD:  ROBOT
#P010    NAME: SHIFT DATA
           X          30.000        TOOL:00
           Y           0.000        TYPE:REAR
           Z         -10.000        UP
           RX          0.00         NO FLIP
           RY          0.00         S<180
           RZ          0.00         R>=180
```

```
P      ||      ||      ||      || QUIT  ||
```

④ Press the [F4] (SINGLE) key, then select the desired conversion coordinates.



⑤ Check the contents, then press the [F5] (EXECUTE) key to start conversion.

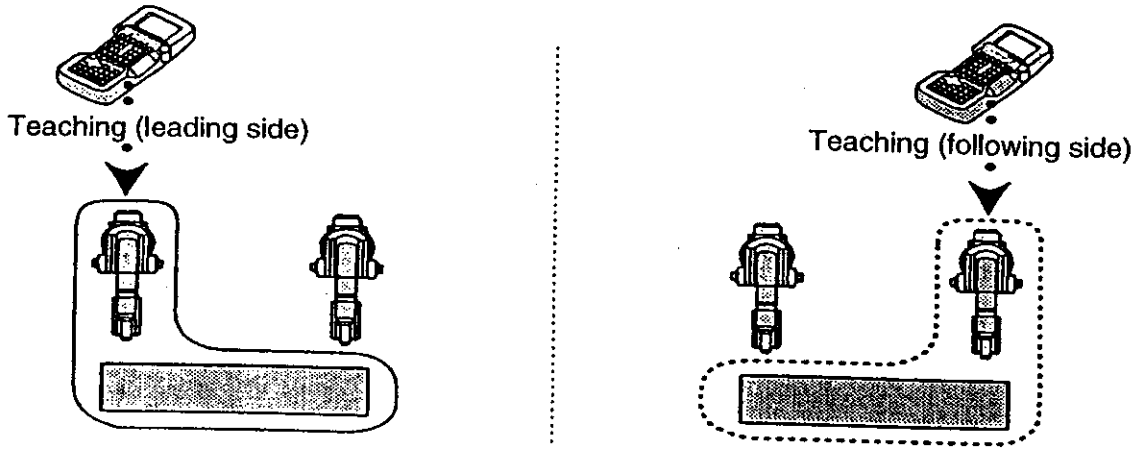


Reference materials :
Position variable ▶ YASNAC MRC Operator's Manual
Parallel shift job conversion ▶ YASNAC MRC Operator's Manual

4.14 [Method 2]: Teaching one unit at a time

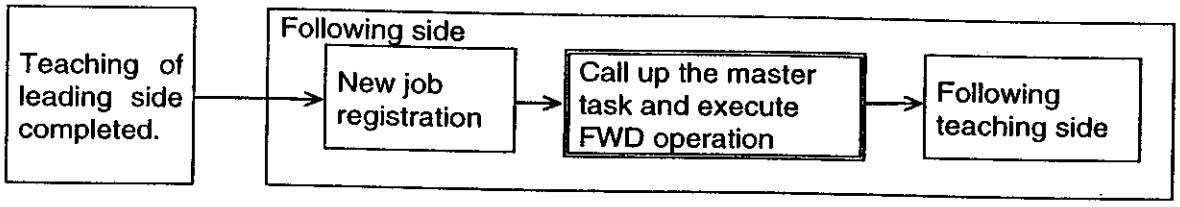
4.14.1 Procedure

First, teach the combined jobs of the leading side manipulator and station.
Then, teach the combination of the following side manipulator and station. At this point, the teaching should be done by aligning the following side manipulator with the movement of the station and at the same time executing FWD operation on the job on the leading side.

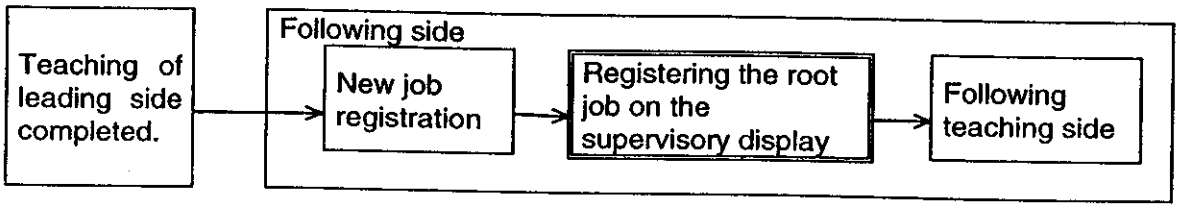


In method 2, depending on whether the master task is used or not, there are the two methods below.

- If the master task is used, registering the job name can be omitted on the supervisory display.
  Refer to "4.14.2 Teaching using a master task."



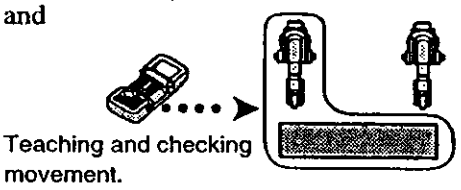
- When teaching without a master task, it is necessary to register the root job on the supervisory display.
  Refer to "4.14.3 Teaching using a supervisory screen."



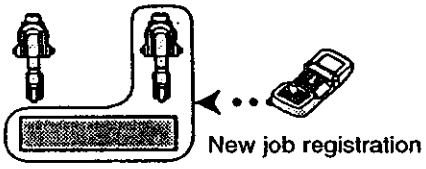
Reference sections :
Supervisory display ▶ 6.9.5 Using a master task ▶ 4.14.2
Using a supervisory display ▶ 4.14.3

4.14.2 Teaching using a master task

① Teach a coordinated job of manipulator and station on the leading side subtask.



② Register the coordinated job of manipulator and station on the following side subtask as a new job.



③ If there is no job for the master task yet, register a job for the master task as a new job, and also register the instruction.

- Register the PSTART instruction which starts the job which was taught in ①.
- Register the PSTART instruction which starts the job which was newly registered in ②. This becomes the following side, so the synchronizing tag SYNC is added.

```
J:JOB-M  S:002 TEACH     CYCLE    STOP   EDIT
JOB CONTENT
L:    S:   INST
0000 000 NOP
0001       'MASTER JOB
0002       PSTART JOB:JOB-R1 SUB1
0003       PSTART JOB:JOB-R2 SUB2 SYNC
0004       END
```

④ Set the movement type for next operation to "single job movement." When the [*] + [SMOV] keys are pressed, the movement type changes.

⑤ Press the [EDIT], [MORE], and [F1] (MASTER) keys, and call up the start job for the master task. Press the [FWD] key, and execute the first PSTART instruction.
(In the example, line 0002 and line 0003.)

⑥ Press the [F ⬚] (SUB ⬚) key to switch to the leading side, press the [FWD] key, and move to Step 1.

⑦ After Step 1 of the leading side is executed, press the [F ⬚] (SUB ⬚) key to switch to the following side.
Register the position of the following side manipulator corresponding to the position of the current station, and press the [ENTER] key.

```
0003 001  MOVJ VJ=50.00
          +MOVJ
```

⑧ Press the [F ⬚] (SUB ⬚) key to switch to the job content display for the leading side. Press the [FWD] key, and move on to the next step.

NOTE To maintain the relative positions of the following manipulator and the station, press the [*] + [SYNCRO / SINGLE] keys to switch to job synchronized mode.

⑨ Press the [F ⬚] (SUB ⬚) key to switch to the following side. Register the position of the following side manipulator corresponding to the position of the current station, and press the [ENTER] key.

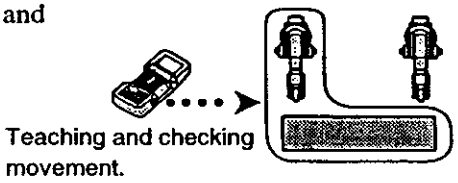
```
0003 001  MOVJ VJ=50.00
          +MOVJ
0004 002  MOVJ VJ=50.00
          +MOVJ
```

⑩ Repeat Steps ⑧ and ⑨ to teach following side jobs.

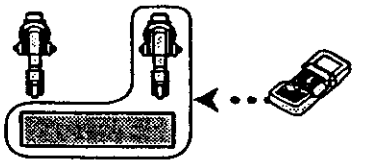
Reference sections :
Registration of new job name ▶ 4.9 Registration of move instructions ▶ 4.10
Job of a master task ▶ 4.15 Job synchronized mode ▶ 4.7.2

4.14.3 Teaching using the supervisory display

① Teach a coordinated job of manipulator and station on the leading side subtask.



② Register the coordinated job of manipulator and station on the following side subtask as a new job.



③ Press the [SELECT] key in the teach mode. After pressing the [MORE] key twice, press the [F4] (SUPV) key.

```
SUPERVISORY
                MASTER      SUB 1       SUB 2
MASTER JOB      :********  ********    ********
ROOT JOB        :JOB-R2    ********    ********
EDIT JOB        :********  ********    ********
 LINE NO.       :0         0           0
 STEP NO.       :0         0           0
EXEC JOB        :STOP      STOP        STOP
 LINE NO.       :----      ----        ----
!
MJ RGTR|| MJ CANC || RT RGTR|| RT CANC || QUIT || →
```

```
ROOT JOB        :********  ********    ********
```

④ Press the [F4] (RT CANC) key, the [F1] (MASTER) key, and cancel the root job of the master task.

⑤ Press the [F3] (RT RGTR) key. After registering job names for the root jobs of subtasks 1 and 2 respectively, press the [ENTER] key.

```
ROOT JOB        :********  JOB-R1      JOB-R2
```

⑥ Press in the following order the [MORE], [F1] (SYNC), and [F3] (SUB2ON) keys.

```
SYNC            :----      ----        ON
```

⑦ Press the [*] + [SMOV] keys to change the type of movement to "single job movement."

⑧ Press in the following order the [EDIT], [MORE], and [F ⬚] (SUB ⬚) keys to display the job content display for the leading side. Press the [FWD] key to execute Step 1.

⑨ Press the [F ⬚] (SUB ⬚) key, then the [FWD] key to switch to the following side. Register the position of the following side manipulator corresponding to the position of the current station, and press the [ENTER] key.

```
0003 001  MOVJ VJ=50.00
          +MOVJ
```

⑩ Press the [F ⬚] (SUB ⬚) key to switch to the job content display for the leading side. Press the [FWD] key, and move on to the next step.

NOTE

To maintain the relative positions of the following side manipulator and the station, press the [*] + [SYNCRO / SINGLE] keys to switch to job synchronized mode.

⑪ Press the [F ⬚] (SUB ⬚) key to switch to the following side. Register the position of the following side manipulator corresponding to the position of the current station, and press the [ENTER] key.

```
0003 001  MOVJ VJ=50.00
          +MOVJ
0004 002  MOVJ VJ=50.00
          +MOVJ
```

⑫ Repeat Steps ⑩ and ⑪ to teach following side jobs.

Reference sections :
Registration of new job name ▶ 4.9 Registration of move instructions ▶ 4.10
Job of a master task ▶ 4.15 Job synchronized mode ▶ 4.7.2
Master supervisory display ▶ 6.9.5

4.15 Job of the master task

The job of the master task is a concurrent job.

① Register the job of the master job as a new job.
Select "NO GROUP AXIS" for the group axis combination.

```
GROUP COMBINATION SET
 GROUP AXIS    MASTER
 R1                        NO GROUP AXIS
 R2
 S1
 R1+S1         S1
 R2+S1         S1
```

② Register the instruction.

- Register the PSTART instruction which starts subtasks 1 and 2.
- With the PSTART instruction to the following side, start the new job registered in ①.
  A synchronizing tag SYNC is added to the following side.

NOTE If no SYNC has not been added to neither of PSTART instructions, an alarm occurs.

- A PWAIT instruction is registered for the purpose of waiting for completion of subtasks 1 and 2.

```
J:JOB-M  S:002 TEACH   CYCLE   STOP   EDIT
JOB CONTENT
L:   S:  INST
0000 000 NOP
0001     'MASTER JOB
0002     PSTART JOB:JOB-R1 SUB1
0003     PSTART JOB:JOB-R2 SUB2 SYNC
0004     PWAIT SUB1
0005     PWAIT SUB2
0006     END
```

Reference sections :
Registration of new job name ▶ 4.9 Concurrent jobs ▶ 6.6

4.16 Confirming operation

4.16.1 Procedure

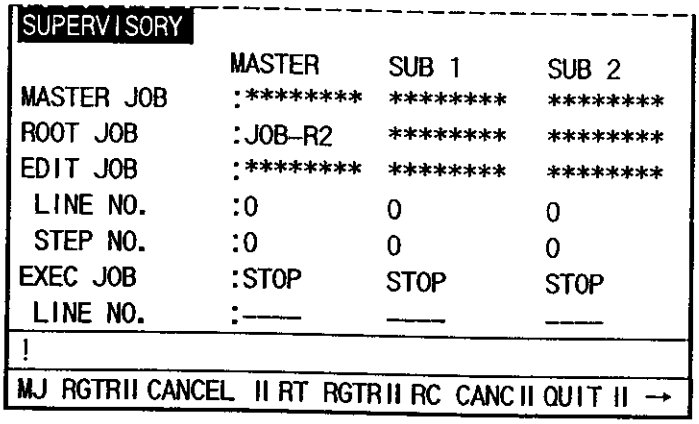
NOTE

When confirming operation, switch to "Multi-job operation mode."
When multi-job operation mode is selected, the jobs of all tasks are executed. (Procedure is ③ below.)
If the following side subtask is executed in single mode, only the following side manipulator will move. The station will not move. The following side manipulator tries to move in alignment with the current position of the station. As a result, an alarm will occur, and the manipulator may interfere with the station.

To confirm the manipulator of the following side in single mode, do not check operation in twin synchronous mode, but call it with the job selection procedure, and check the operation of that job in single mode.

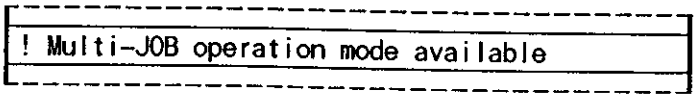
① If there is no concurrent job of the master task yet, create one with the procedure of "4.15 Job of a master task."

② Press in the following order the [DISP] key, the [MORE] key, and the [F4] (SUPV) key to display the supervisory display.



③ After pressing in the following order the [F1] (MJ RGTR) key, and the [F1] (MASTER) key, register the master job of the master task.

④ Change to multi-job mode. Each time the [*] + [SYNCRO/SINGLE] keys are pressed, the movement type switches.



⑤ Start FWD operation or a test run.
When the PSTART instruction is executed, the manipulator and the station move.

Reference sections:
Multi-job operating mode ▶ 6.8.2 Supervisory screen ▶ 6.9.5
Cautions when checking operation ▶ 4.16.2

4.16.2 Precautions when confirming operation

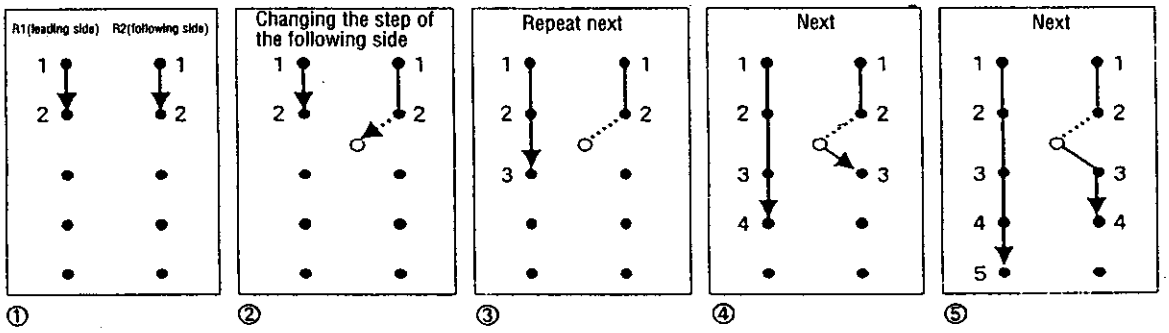
(1) If the manipulator stops during operation for some reasons, the steps of the two manipulators will not coincide when procedures similar to the following are performed.

[Example] · When the manipulator stops during operation, move the cursor position to another step on the job of either of the subtasks.
· Call up the master job on only either of the subtasks.

In this kind of state, there is the danger that a jig or similar tool might interfere. Start both jobs from the same position (step).

(2) When "Multi-job operation" is set on the teaching condition 1 setting display, if a procedure similar to the following is performed, the steps of the two manipulators will not coincide.

[Example] ·After operating up to a certain step, the manipulator stops in the middle. When the step position of the following side R2 is changed and the FWD operation is performed again, the leading side R1 proceeds to the next step, but R2 does not move. As a result, R1 moves one step ahead.



(The numbers in the diagrams are step numbers.)

This is because, on the FWD operation after the position change, the step after the change is redone. In the above diagram, when the FWD operation is redone, the leading side R1 which did not have its position changed, proceeds to Step 3. However, since positin of the following side R2 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. Thus, the steps of the two manipulators are out of alignment.
To align the steps for the repeated next operation on both sides, move the cursor of the job that was changed to the next step. Then perform FWD operation, test run, and playback.

4.17 Playback

4.17.1 Start

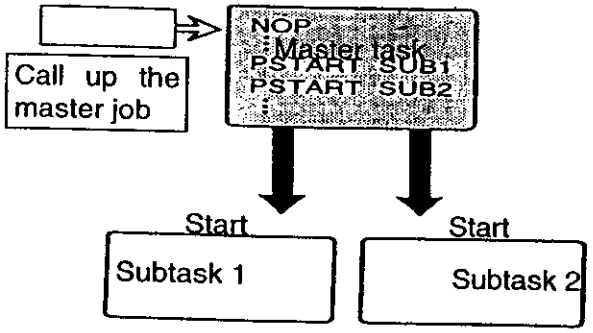
With the procedure below, call up a master job and play it back. Start the job of the subtask with the PSTART instruction.

① Press the [SELECT] key in the teach mode, and the [F5] (MJ CALL) key. Or in play mode, press the [SELECT] key, and the [F2] (MJ CALL) key.

MASTER	SUB 1	SUB 2		QUIT

② Press the [F1] (MASTER) key, and then the start button.
The master job that is called up is executed from the first. The subtasks are executed with the PSTART instruction.

NOTE If the procedure of ② above is performed, the jobs of subtasks are cleared.
Thus, if subtasks are stopped in the middle for some reason, when the master job of the master task is called up, information relating to the state of the subtasks that are halted is lost.

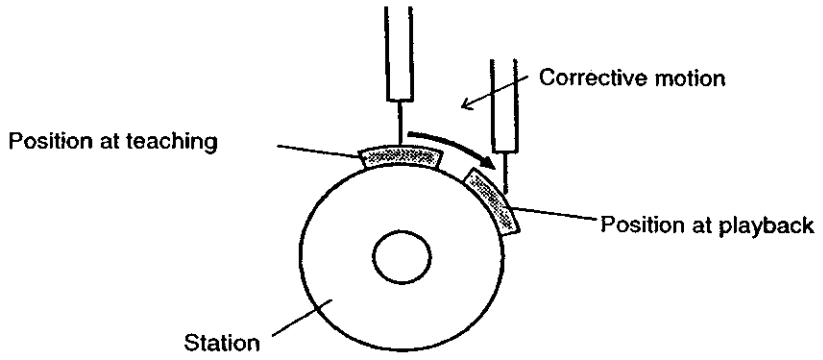


References sections :
Details of Playback ▶ 6.9

4.17.2 Automatic correction of shift amount

During playback, stations are controlled by the leading side job, so the following side job controls only the following side manipulator.

If a shift occurs in the gap between the teaching position of the station of the following side job and the current position of the station (controlled by the leading side job), the following side manipulator automatically corrects the deviation while moving to maintain the position on the station when it was taught.



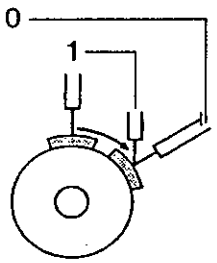
The amount of shift between the teaching position and the current position of the station is regularly monitored. If the amount of shift exceeds the set value of the parameter, the following message is displayed.

```
! Station following side out of tolerance range
```

Parameter	Contents and settings	Initial value
S3C080	Maximum shift of the station axis in twin synchronous system.	Varies with the system (Units: 0.1°)

Furthermore, control of the orientation when a correction is made can be selected with the following parameter.

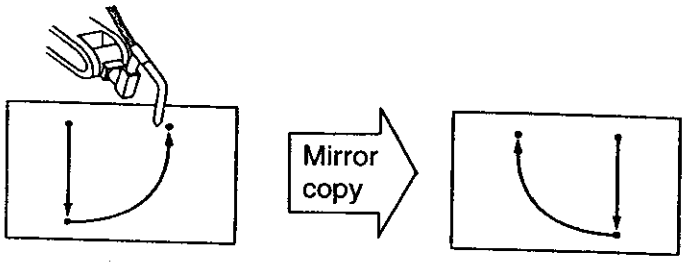
Parameter	Contents and settings	Initial value
S2C185	Orientation control method of the following side manipulator in twin synchronous system: 0: Aligned with station movement 1: Constant with reference to the ground	0



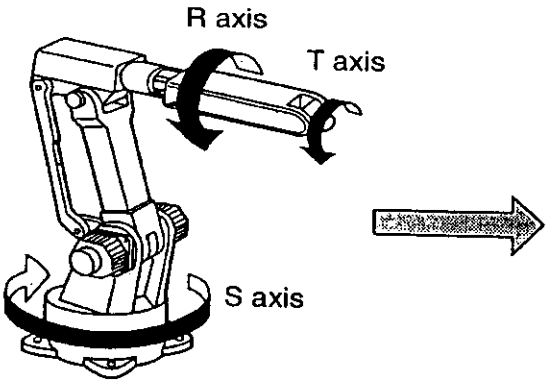
4.18 Convenient features

4.18.1 Mirror copy

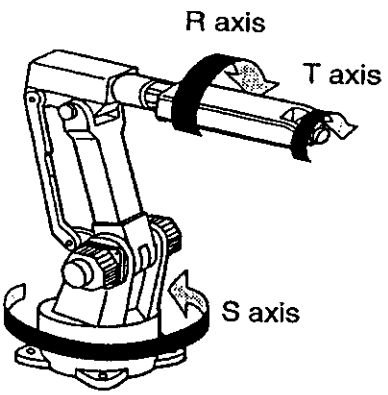
A mirror copy is one type of job copy. New jobs are created in which the signs of position data for the S, R, and T axes are reversed.
With the twin synchronous system, this is used for work performed by two manipulators tracing a left-to-right symmetrical path. Since only one of the jobs is needed to teach, teaching time is reduced.



Coordinated job of R ⬚ + S ⬚	New job by mirror copying.
Teaching as a regular coordinated job between one of the robot axes and the station axis.	A job in which the signs of the S, R, and T axes are reversed is created.



Movement of the job before mirror copying



The job after a mirror copy has the signs (+ / -) of the S, R, and T axes reversed.

(1) Target job

The job to be mirror-copied is a job registered on the following group axes.

- R ⬚ (Robot axis)
- R ⬚ + S ⬚ (Robot axis + station axis)

If the job belongs to a group axis other than these, for example in the case of a job of S1 only, the data of the positions does not change at all even if a mirror copy is performed.

(2) Position variable

A position variable cannot be mirror-copied.

(3) Parameters

Mirror copy conditions (when used as twin synchronous function)

Parameter	Contents and settings	Initial value
S4C002	In making a mirror copy of a twin synchronous function, this designates whether the position data undergoes mirror conversion or not. 0: Mirror conversion performed 1: Mirror conversion not performed	0

Reference sections :
Operating methods for mirror copying ▶ 4.13.2

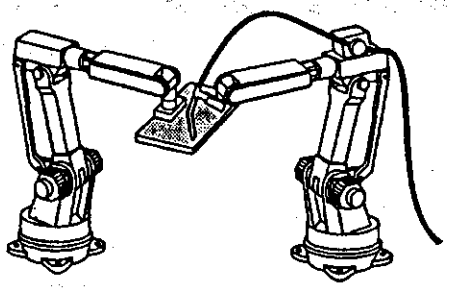
Function Section

Chapter 5

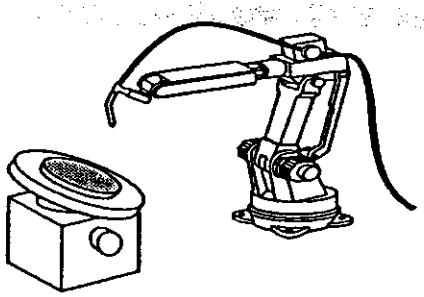
Coordinated control

5.1 What is coordinated control?

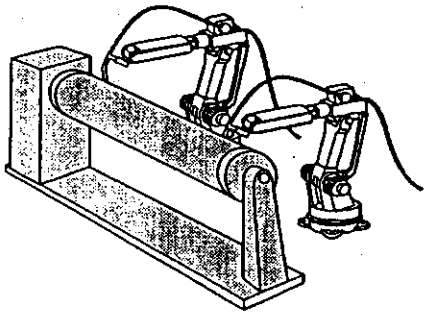
Coordinated control is the function of controlling several manipulators or stations at the same time.



Jigless system



Station coordinated system



Twin synchronous system

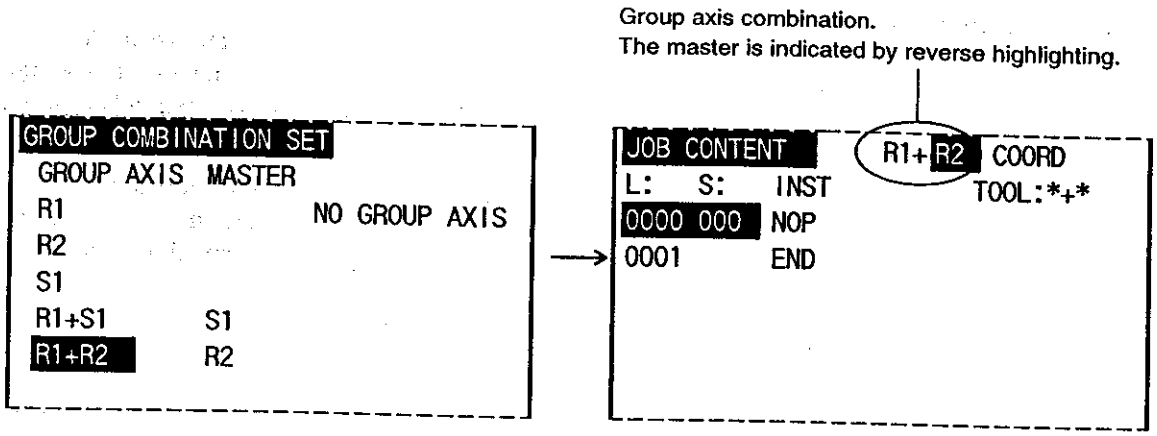
A job to implement coordinated control is a coordinated job.

A coordinated job controls two group axes at the same time.

```
J:WORK-A   S:000                    SEQ  S1  LINEAR
JOB CONTENT                (R1+ S1)      COORD
L:    S:   INST                           TOOL:*+*
0000 000   NOP
0001       END

=> SMOVL V=138
   +MOVJ
!  Select instruction group.
 MOTION|| ARITH   || SHIFT ||      ||     ||
 IN/OUT|| CONTROL || DEVICE|| PRIOR || SAME|| →
```

5.2 Group combination

Group combination of coordinated jobs is the designation of which group axis will be coordinated with which group axis. A 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.
This setting is made on the group combination set display when registering the new job name.



When a coordinated job is taught, as shown in the displays below, the move instruction is ordinarily shown in two lines. The top of the two lines is the instruction to the slave side. The one marked with a "+" is the instruction to the master side.

Step	Instruction		
001	SMOVL	←	Slave side
	+MOVL	←	Master side
002	MOVL	←	Slave side
	+MOVL	←	Master side

5.3 Coordinated and individual movements

Coordinated jobs can be either **coordinated** and **individual movements.**

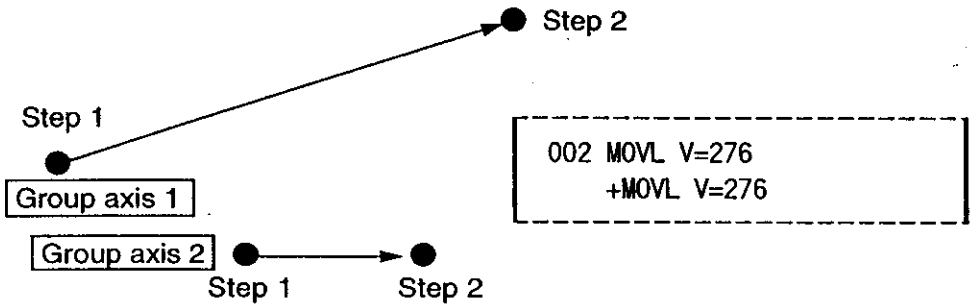
5.3.1 Coordinated movement

Coordinated movement is movement performed by two group axes in a master-slave relation.
The slave executes relative movement on the tool coordinate system of the master side. This is used in tasks aligning movement of workpiece.

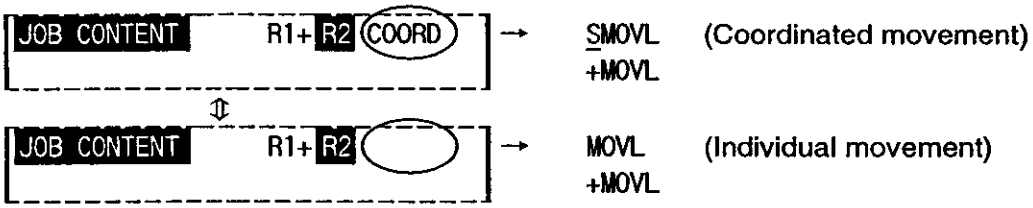
5.3.2 Individual movement

Individual movement is movement performed with the master-slave relation canceled.
The master and the slave sides both perform their own individual movements, but the start and end of the movements taught to each are simultaneous. This type is used when movement of coordinated movement is completed, and each manipulator is performing its own work.

[Example] Example of play speed slowed down with individual movement
If identical speed is given to two group axes, in order that they might finish work as far as Step 2 simultaneously, group axis 2 is given movement slower than V=276.



Each time the [SMOV] key is pressed, the display of "COORD" in the screen title bar appears and disappears.
While "COORD" is displayed, if move instructions or weaving instructions are registered, these become coordinated instructions to the slave side with an "S" attached, indicating them as coordinated movement.
If move instructions or weaving instructions are registered when "COORD" is not displayed, those instructions become movements of individual movement.



5.4 Restrictions

Only MOVJ instruction can be used as move instruction for the station.

Chapter 6

Independent control

6.1 What is independent control?

The YASNAC MRC is configured to be able to decode and execute a maximum of three jobs each independently. Multitask control performed by this mechanism is called independent control.

The three mechanisms which execute jobs are called the following.

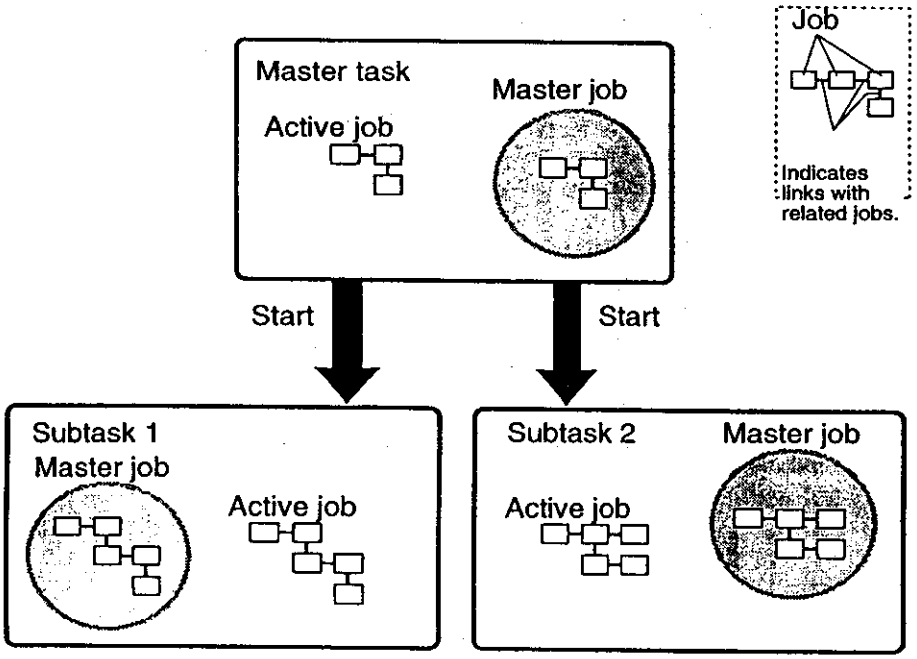
- Master task
- Subtask 1
- Subtask 2

} Tasks which execute jobs started by the master task.

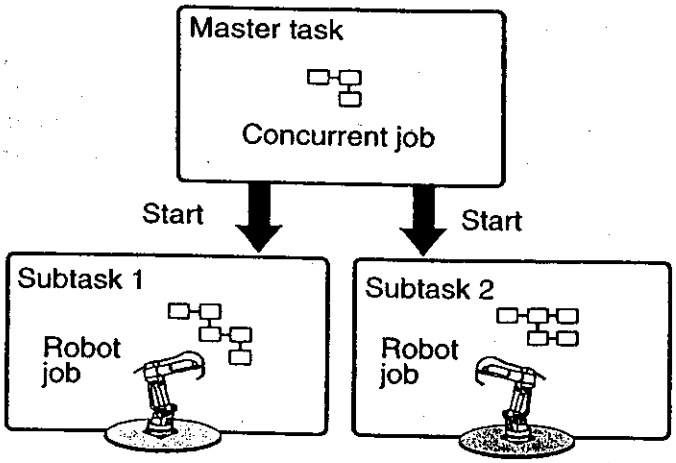
Of these three tasks, up to two tasks can use move instructions.
A job able to use move instructions is called a robot job. A job which does not use a move instruction is called a concurrent job. A concurrent job is used as a job to start the two robot jobs, or as a specialized job to implement control of calculations or I / O.

Robot job	A job which moves robot axes or station axes with move instructions. Up two tasks can use move instructions.
Concurrent job	This is used as a job to start robot jobs, or as a specialized job to implement control of calculations or I / O control.

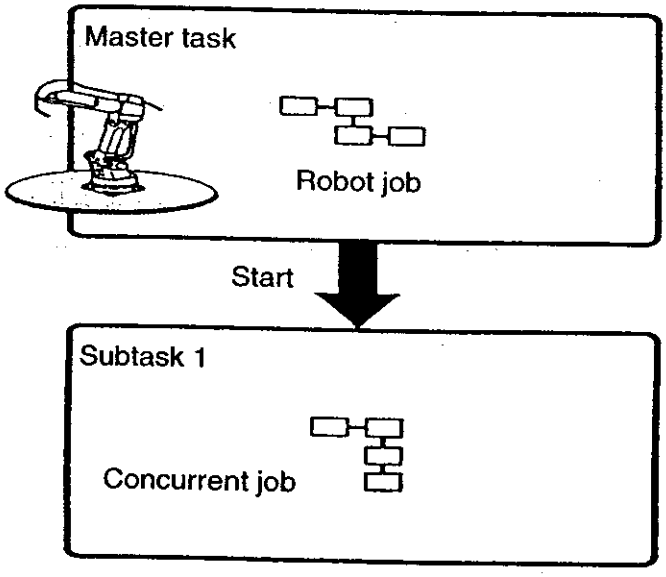
The jobs of subtask 1 and subtask 2 (below called subtask 1 / 2) are started by the PSTART instruction. For cases where a predetermined job is started, it is convenient to use the master job.



[Example 1] When executing two robot jobs, make the master task the concurrent job.



[Example 2] When implementing control of calculations or I / O, make the subtask 1 the concurrent job.



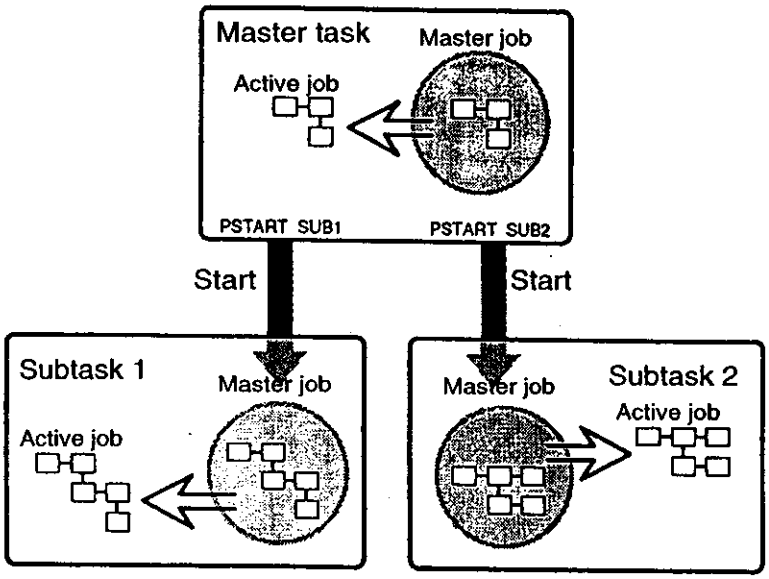
Reference sections :
Master jobs ▶ 6.2.1 PSTART ▶ 6.2

6.2 Start up methods

6.2.1 Starting a certain job - Master job -

For each of the tasks which executes jobs that are always decided, it is convenient to use the 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 not one registered, it cannot 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.




```
JOB CONTENT
L:   S:  INST                    TOOL:0
0000 000 NOP
0001     'MASTER TASK JOB
0002     PSTART SUB1   <-- Starts the master job of subtask 1.
0003     PSTART SUB2   <-- Starts the master job of subtask 2.
  :        :
0017     PWAIT SUB1    <-- Waits on completion of subtask 1.
0018     PWAIT SUB2    <-- Waits on completion of subtask 2.
```

Even if a master job is registered, another unrelated job can be started. Refer to "6.2.2 Starting various jobs."

```
0002     PSTART JOB:WORK-A SUB1
```

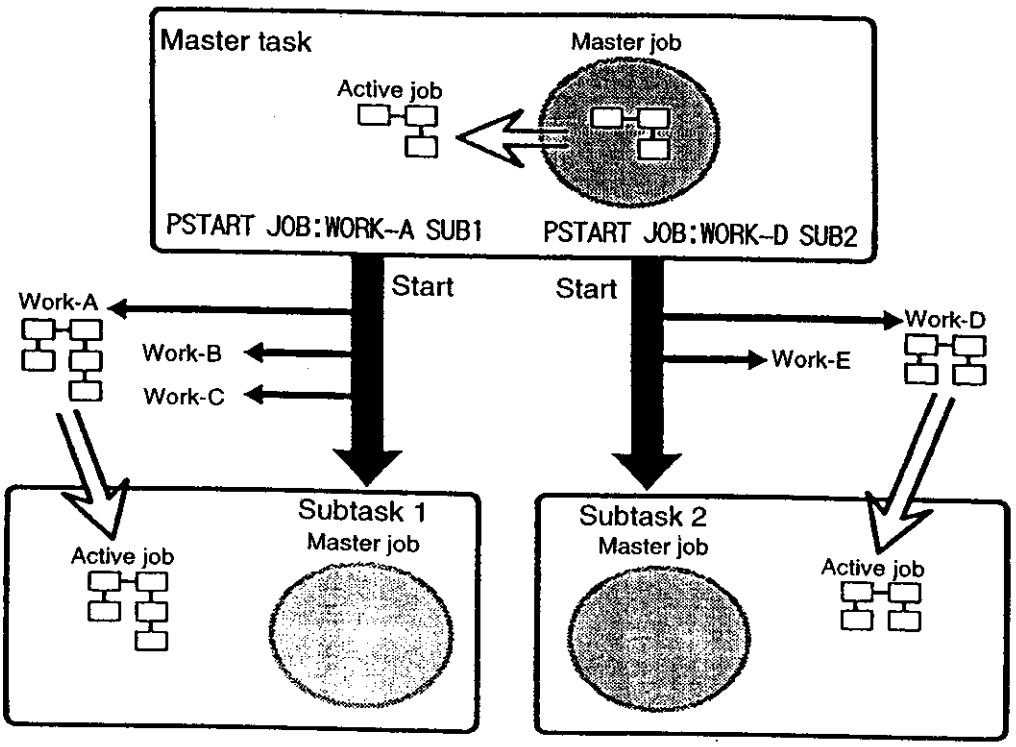
<-- Starts "Work-A" in subtask 1.

Reference section :
Starting various jobs ▶ 6.2.2

6.2.2 Starting various jobs

For each task in which one job to be executed is not decided, the job names to be started are set in a PSTART instruction.

PSTART JOB : job name SUB ⬚ ··· The specified job is started by the specified subtask.



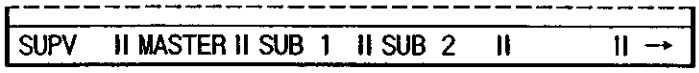

```
JOB CONTENT
L:  S:  INST                    TOOL:0
0000 000 NOP
0001     'MASTER TASK JOB
0002     PSTART JOB:WORK-A SUB1 <-- Starts Work-A with subtask 1.
0003     PSTART JOB:WORK-D SUB2 <-- Starts Work-D with subtask 2.
  :        :
0008     PWAIT SUB1             <-- Waits on completion of subtask 1.
0009     PWAIT SUB2             <-- Waits on completion of subtask 2.
  :        :
0012     PSTART JOB:WORK-B SUB1 <-- Starts Work-B with subtask 1.
0013     PSTART JOB:WORK-E SUB2 <-- Starts Work-E with subtask 2.
  :        :
0017     PWAIT SUB1             <-- Waits on completion of subtask 1.
0018     PWAIT SUB2             <-- Waits on completion of subtask 2.
  :        :
0022     PSTART JOB:WORK-C SUB1 <-- Starts Work-C with subtask 1.
```

6.3 Switching tasks

When displaying the job content of the master task or subtasks 1 / 2, the following methods are available.

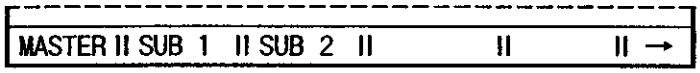
6.3.1 In the display mode

Press the [DISP] key and the [F1] (job) key, select the desired task to display from the supervisory display.



6.3.2 In the edit mode

Press the [EDIT] key and the [MORE] key, select the desired task to display from the job content display.



6.3.3 Regarding the command position display

On the command position display, the command position displayed for the job which is displayed in the current status display area.

6.3.4 Regarding the job stack display

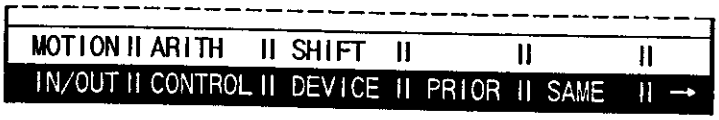
On the job stack display, the stacked state is displayed for each task which is calling the job displayed on the current status line.

Reference section :
Supervisory screen ▶ 6.9.5

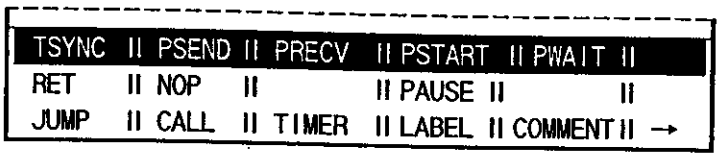
6.4 Registration of instructions

Instructions related to independent control are registered with soft key labels for control instructions.

① Press the [EDIT] key on the job content display.

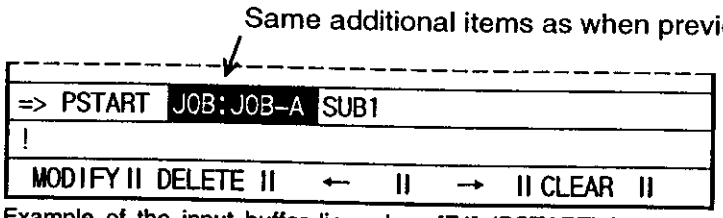


② Press the [F2] (CONTROL) key to display the soft key labels for control instructions.



Registering and editing instructions

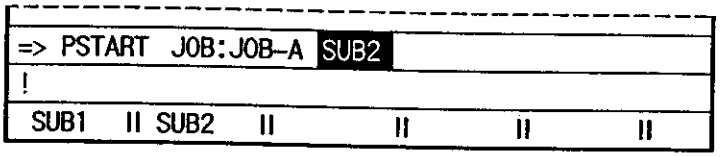
Subsequently, press the soft keys and select an instruction, the following soft key labels are displayed. On the input buffer line, the selected instruction is displayed with the same additional items as when it was previously registered.



Example of the input buffer line when [F4] (PSTART) has been pressed and soft key labels for instruction editing.

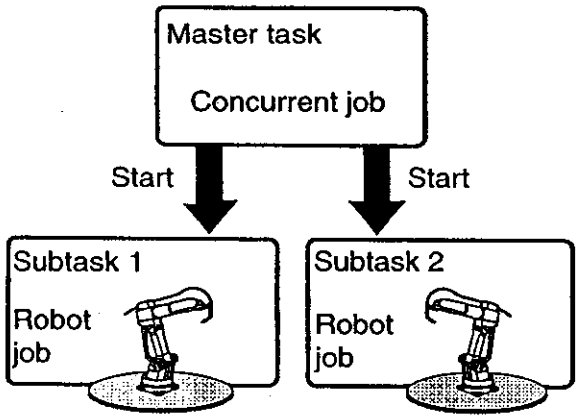
At this time, by simply pressing the [ENTER] key, the input buffer line can be registered.
The additional items can be edited with the [F1] (MODIFY) to [F5] (CLEAR) keys.
After pressing the [F1] (MODIFY) key, the additional items can be edited with the number keys or the soft keys.

[Example] Press the [F1] (CLEAR) key, the [F1] (SUB1) key or the [F2] (SUB2) key to modify a subtask.

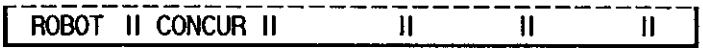


6.5 Robot job

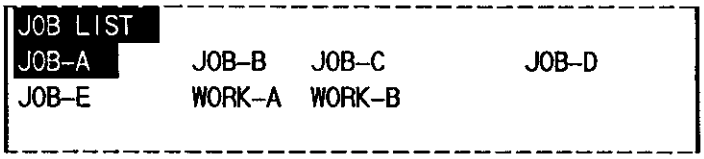
The procedures for registering jobs of subtasks with combination jobs such as in the diagram using independent control are explained. Two robot jobs each will be registered and edited.



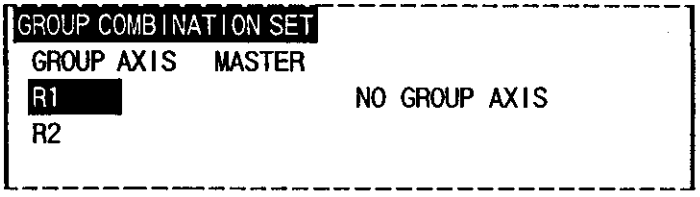
① Press the [SELECT] key in the teach mode and the [F2] (NEWJOB) key to display the following soft key labels.



② Press the [F1] (ROBOT) key, enter the job name, and press the [ENTER] key.



③ Select the group axis for this job, and press the [ENTER] key.

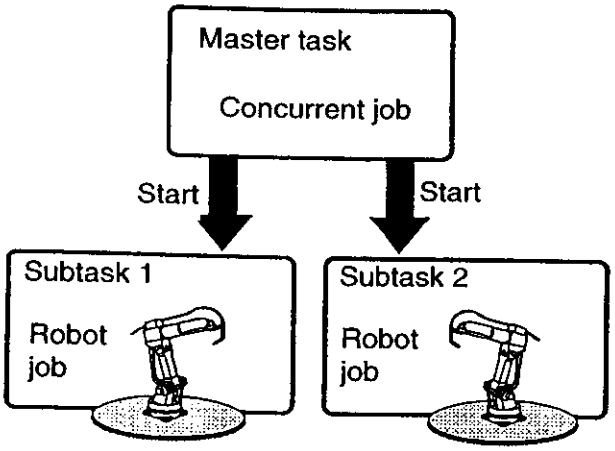


The job name is registered in the memory of the YASNAC MRC, and displayed in the status display area. At the same time, the job contents display is displayed. NOP and END instructions are registered.
In the right column of the screen title bar, the group axis combination is displayed, and in cases where there is a master-slave relationship, the master side is displayed in reverse highlighting. The screen mode automatically switches to the edit mode.

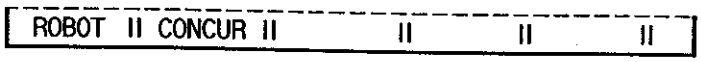
Reference section :
Robot jobs ▶ 6.1

6.6 Concurrent job

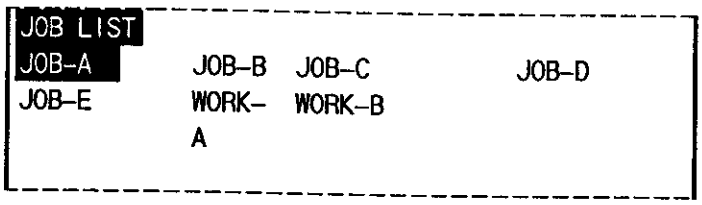
The procedures for registering jobs of master tasks with combination jobs, such as in the diagram, using independent control are explained.



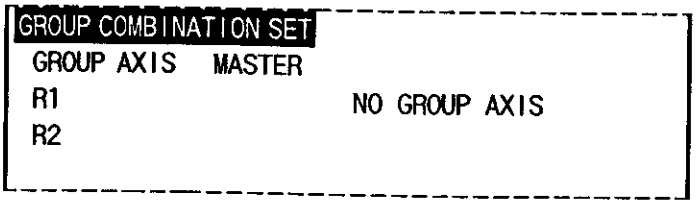
① Press the [SELECT] key in the teach mode, and the [F2] (NEWJOB) key to display the following soft key labels.



② Press the [F2] (CONCUR) key, enter the job name, and press the [ENTER] key.



③ Select "No group axis" and press the [ENTER] key.



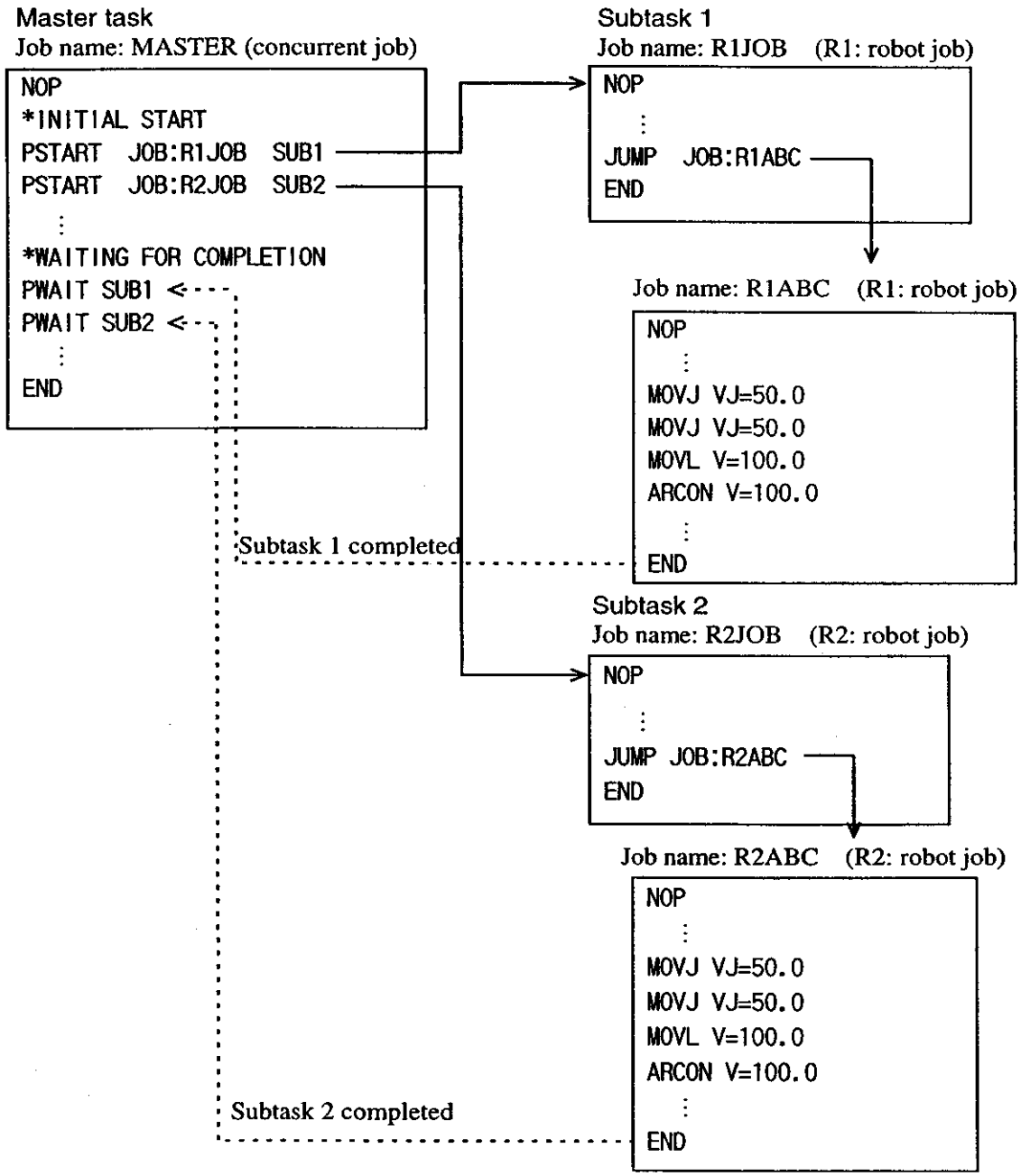
The job name is registered in the memory of the YASNAC MRC, and displayed in the status display area. At the same time, the job contents display is displayed. NOP and END instructions are registered.
The screen mode automatically switches to the edit mode.

Reference section :
Concurrent jobs ▶ 6.1

6.7 Job example

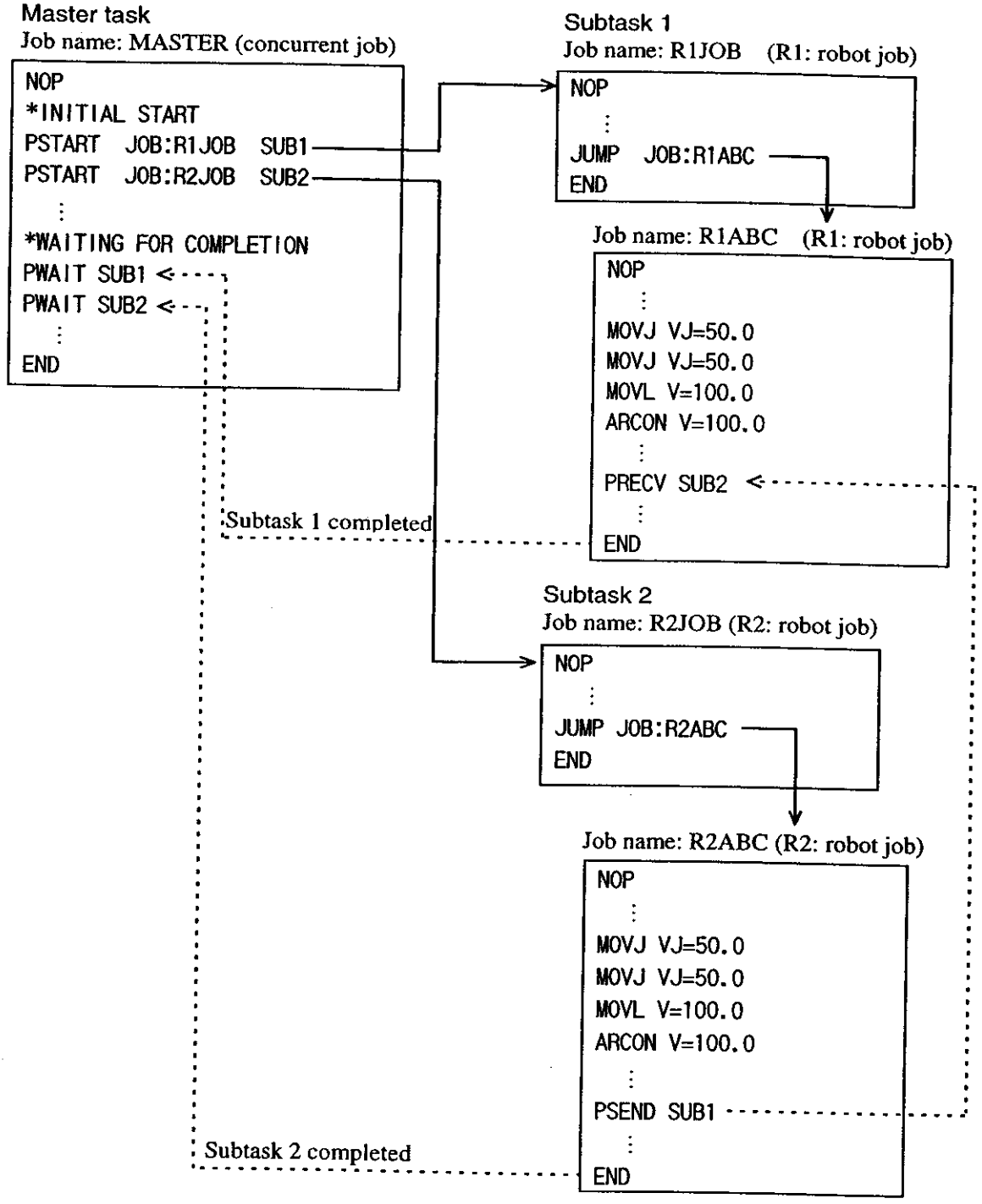
[Example 1] Listed below is a job configuration for manipulators 1 and 2 to perform entirely separate tasks in non-synchronous mode.

Set the concurrent job as the master task, and start the R1 job on subtask 1, and the R2 job on subtask 2 from the master task.
Check whether each subtask has finished or not is executed on the master task.



[Example 2] Listed below is a job configuration for manipulators 1 and 2 to achieve detailed synchronization mode. This is used when a zone of interference exists between the two manipulators.

Set the concurrent job as the master task, and start the R1 job on subtask 1, and the R2 job on subtask 2 from the master task.
The synchronization of each subtask is performed with PSEND and PRECV instructions.



Reference section :
PSEND, PRECV ▶ 6.10

6.8 Confirming operation

6.8.1 FWD / BWD operation, test run

(1) Confirming the operation of the task being displayed

When confirming operation of FWD/BWD operation or a test run, ordinarily only the job of the task currently being displayed is targeted.
Operation can be confirmed with the [FWD] key, the [BWD] key, and the [TEST START] key.

(2) Confirming the operation of all tasks

To operate all tasks at the same time, perform steps ① to ④ below.

① Switch the operating method to independent control.
② Register the concurrent job as the master job.
③ Perform FWD operation on the concurrent job, and execute PSTART instruction.
④ The when a FWD operation is performed, the jobs of all tasks will simultaneously perform FWD operation.

NOTE

Sometimes operation is performed at a different speed from the playback speed.
Exercise full caution that there is no interference between the manipulators.

Reference sections :
Switching operating methods ▶ 6.8.2 Registering a master job ▶ 6.9.2

6.8.2 Switching operating methods

There are two ways of operating during FWD / BWD operation, test run:

- Operate only the task currently being displayed
- Operate all tasks

These two operating methods can be switched on the teaching condition 1 set display.
Further, for arc coordinated, jigless, or general-purpose coordinated systems, the [*] + [SMOV] keys can be used.

(1) Switching with the [*] + [SMOV] keys

(For arc coordinated, jigless, or general-purpose coordinated systems)

```
! Switched to Multi-job operating mode.
```

(2) Switching on the teaching condition 1 set display

① Press the [SELECT] key, the [MORE] key, and the [F4] (COND1) key to display the teaching condition 1 set display.

```
TEACHING CONDITION 1 SET
                          ●:ON  ○:OFF  SET
1.  RECT (●) / CYL (○)                  ●
2.  MOVE INSTRUCTION SET                ○
      NEXT (●)/NEXT STEP (○)
3.  JOB EDIT LOCK ON                    ●
      STEP CHANGE PROHIBIT ONLY (●)
4.  SPEED CHANGE: CONT (●) / SINGLE (○) ○
5.  MASTER JOB CHANGE PROHIBIT          ○
! Select item using cursor keys.
        ||      ||  ON  ||  OFF  || QUIT  ||
```

② Move the cursor to the item 8, and switch their settings with the [F3] (ON) and [F4] (OFF) keys.

```
8.  STEP / TEST RUN OPERATION MODE      ●
      MULTI-JOB (●) / SINGLE-JOB (○)
! Select item using cursor keys
        ||      ||  ON  ||  OFF  || QUIT  ||
```

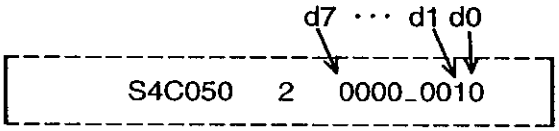
○(OFF) : Displayed task jobs are performed individually.
●(ON) : All the task jobs are performed at the same time.

6.8.3 BWD operation of concurrent jobs

During BWD operation, concurrent jobs and jobs without group axes can have their parameters set so they do not back.

Parameter	Contents and setting values	Initial value
S4C050	BWD execution specification d0: Whether backing of jobs with no group axis is to be permitted or prohibited. 0: Permitted 1: Prohibited d1: Whether backing of concurrent jobs is to be permitted or prohibited. 0: Permitted 1: Prohibited	2 (d0=0 d1=1)

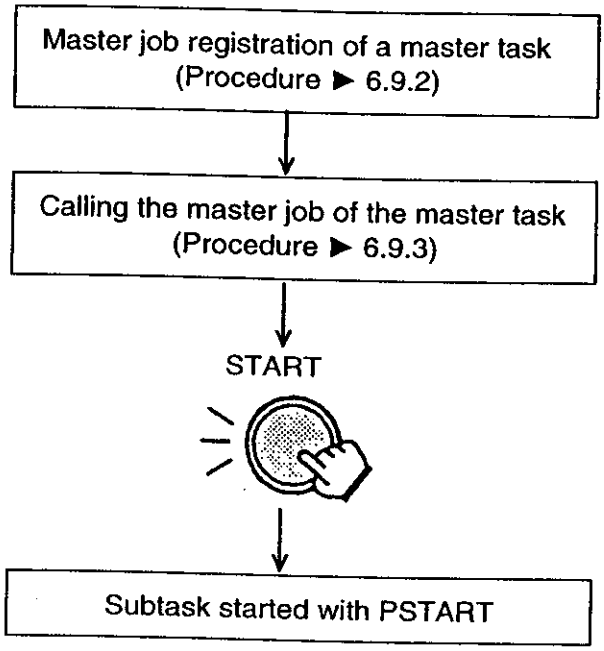
For example, the following settings are made for the initial value.



6.9 Playback

6.9.1 Procedure

Playback is performed by the procedure of the diagram below.
On the master task, by executing the PSTART instruction, the subtask job is started. The operating status of each task can be checked on the supervisory display.



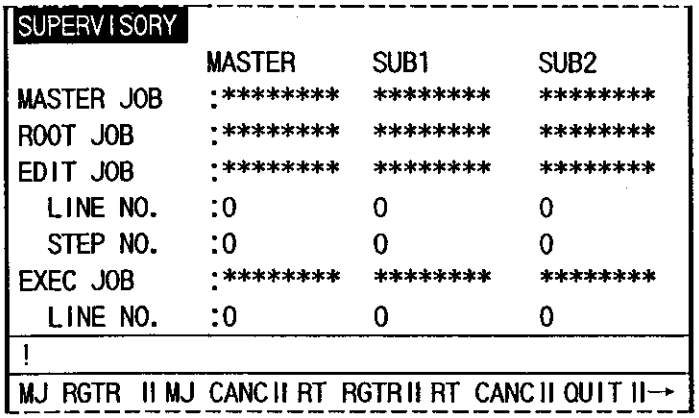
Refer to "Section 7 PLAYBACK" of the YASNAC MRC operator's manual for information about playback in general. This manual explains independent control characteristic operation.

Reference sections :
Master job ▶ 6.2.1 Supervisory screen ▶ 6.9.5 Master job registration ▶ 6.9.2
Calling a master job ▶ 6.9.3 Cautions when selecting jobs ▶ 6.11

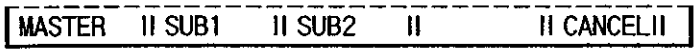
6.9.2 Registration of master job

(1) Registration

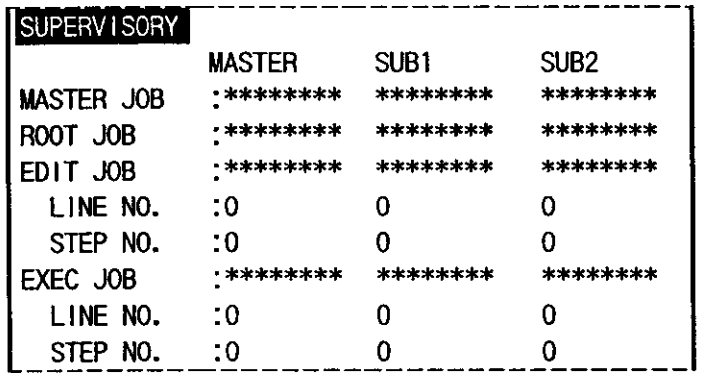
① Press in the following order the [SELECT], [MORE], and [F4] (MJ RGTR) keys in the teach mode to display the supervisory display.



② Press the [F1] (MJ RGTR) key, and select the task where a master job to be registered with the soft keys.



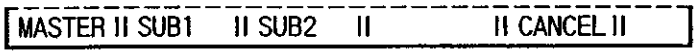
③ Enter the job name to register, and press the [ENTER] key. A master job is registered for the selected task.



(2) Cancel

① With the procedure in ① above, display the supervisory display, and press the [F2] (CANCEL) key.

② Select a task of master job to be cleared with the soft keys and press the [ENTER] key.



6.9.3 Calling up a master job and start operation

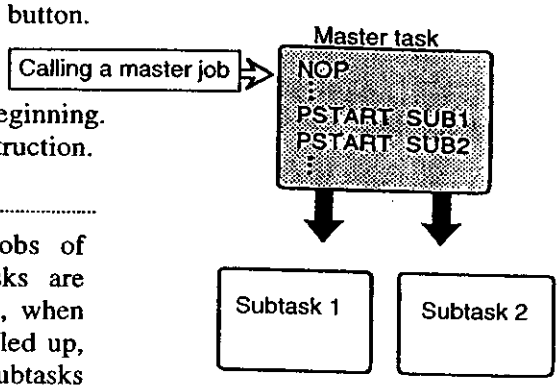
① In the teach mode, press the [SELECT] key, and the [F5] (MJ CALL) key. Or in the play mode, press the [SELECT] key, and the [F2] (MJ CALL) key.

MASTER	SUB1	SUB2		CANCEL

② Call up the master job and start.

- When executing both manipulators from the beginning

Press the [F1] (MASTER) key, then the start button.

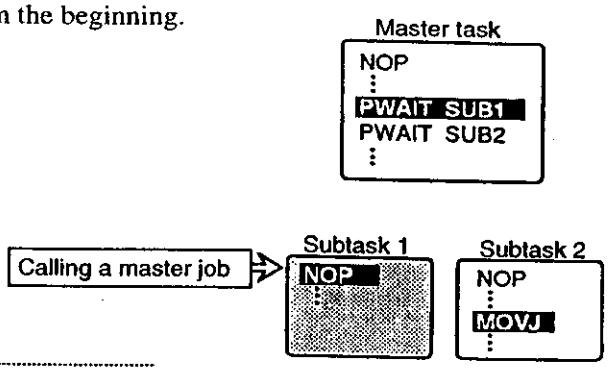


The called master job is executed from the beginning.
Subtasks are executed with the PSTART instruction.

NOTE By performing this procedure, the jobs of subtasks are cleared. Thus, if subtasks are stopped in the middle for some reason, when the master job of the master task is called up, information relating to the state of the subtasks that are halted is lost.

- When executing only one manipulator from the beginning

Press the [F2] (SUB1) key or the [F3] (SUB2) key, then the start button.
Only the selected subtask is executed from the beginning.



NOTE In the case of subtask 1 / 2, calling of the master job, or a root job (job started with PSTART) can be selected.

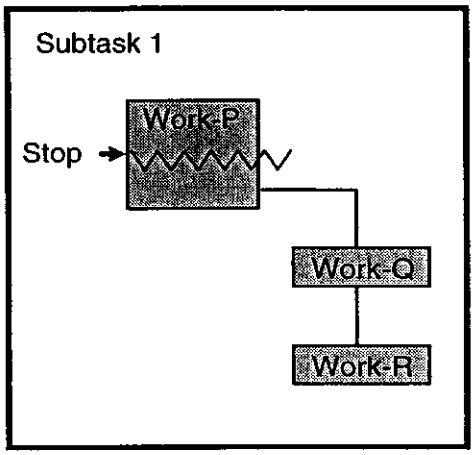
Parameter	Contents and settings	Initial value
S2C059	Call master job : 0 Call root job : 1	0

6.9.4 Registration of root job

The root job is the job at task start-up. Ordinarily, it is determined automatically according to job configuration, so registration of a root job is not necessary.
However, to make a forced change of the currently active job, register the desired root job, then start. Execution begins with the registered job.

[Example] Usage example of root job registration

During execution of a series of jobs with subtask 1 as in the diagram, for some reason in the middle of "Work-P" the manipulator stops. To skip over the remainder of "Work-P" and start again from "Work-Q," register "Work-Q" in the root job on the supervisory display.



Change this location to "WORK-Q"

```
SUPERVISORY
                MASTER    SUB1      SUB2
MASTER JOB    :JOB-0    WORK-P    JOB-2
ROOT JOB      :JOB-0    WORK-P    JOB-2
EDIT JOB      :JOB-0    ********  ********
  LINE NO.    :0000     0000      0000
  STEP NO.    :000      000       000
EXEC JOB      :JOB-0    WORK-P    WORK-E
  LINE NO.    :0010     0020      0007
  STEP NO.    :008      006       004
STATUS        :STOP     STOP      STOP
```

(1) Registration

① In the teach mode, press the [SELECT], [MORE], and [F4] (SUPV) keys to display the supervisory display.

② Press the [F3] (RT RGTR) key.

```
MJ RGTR || MJ CANC || RT RGTR || RT CANC || QUIT ||→
```

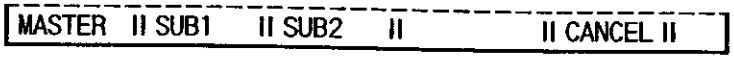
③ Select the task to register a root job for, and select the job to register. Then press the [ENTER] key.

```
JOB LIST
JOB-0     JOB-1     JOB-2     JOB-3
JOB-4     WORK-A    WORK-B
```

(2) Cancel

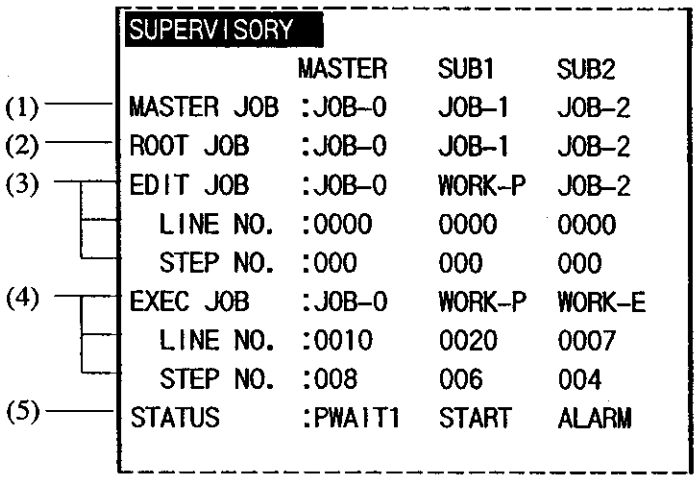
① With the procedure in ① above, display the supervisory display, and press the [F4] (RT CANC) key.

② Select a task of root job to be cleared with the soft keys and press the [ENTER] key.



6.9.5 Observing operating status - Supervisory display -

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



(1) MASTER JOB

Displays the master job of each task.

(2) ROOT JOB

Displays the job when the task was started.
The procedures of "6.9.3 Calling up a master job and start operation" and "6.9.4 Registration of root job" are used.

(3) EDIT JOB

Displays the current edit job.
The line number and step number of the current cursor position of the edit job are displayed in "LINE NO." and "STEP NO." respectively.

(4) EXEC JOB

Displays the currently active job. Depending on the root job of ②, jobs, etc. that have been called or jumped to, are displayed here.
The line number and step number of the current cursor position of the job being executed are displayed in "LINE NO." and "STEP NO." respectively.

(5) STATUS

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

Reference sections:
Master job ▶ 6.2.1 Root job ▶ 6.9.4 PWAIT ▶ 6.2

6.9.6 Precautions

(1) Regarding stopping

If a hold procedure or an emergency stop procedure are performed, all currently operating jobs are halted.

(2) Regarding restarting

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

- For continuous operation

  If operation is started from the stopped position, the master task and subtasks 1 / 2 all continue execution from the line (step) number at the time of the stop.
  However, if a job selection is made, and the message "SUB1 / SUB2 RESTART IMPOSSIBLE" is displayed, subtasks 1 / 2 cannot continue execution. Only the master task is restarted.

- For executing only one of the subtasks from the beginning

  Before conducting start procedures, first turn ON the specific input signal "Sub □ Master job call" (4054, 4055) of the subtask to be executed from the beginning, and press the start button. The job of the subtask for which this signal is turned ON is executed from the beginning.
  The jobs of other tasks continue execution from the line (step) number at the time of the stop.

- For executing both jobs from the beginning

  First turn ON the specific input signal "Master job call" (4053), then press the start button. When the master job of the master task is called, subtasks 1 / 2 which were stopped in the middle are canceled. When the PSTART instruction is executed by the job of the master task, each of the subtasks start and execute from the beginning.

- For cases to change the operating job of the subtask

  Following the procedure of "6.9.4 Registration of root job," change the root job of the subtask. Then when start operation is performed, only the modified subtask operates from the head of the registered root job. The jobs of other tasks continue execution from the line number at the time of the stop.

NOTE Exercise caution regarding interference of the manipulators and matching of the master task.

(3) Regarding stopping and restarting the subtasks alone

During operation of subtask 1 / 2, with an I/O alarm or a PAUSE instruction, only the specified subtask alone can be stopped. (Refer to specific input 4027, 4037, and specific output 5152, and 5162 regarding I/O alarms.)
When subtask 1 / 2 is halted, the specific output signals 5153 and 5163 are output. The specific output 5070 during operation is still ON, but the start lamp on the playback box will flash if the subtask has been halted. When halted subtasks 1 / 2 are restarted, after resetting alarm, press the external start or the start button on the playback box.

6.10 Mail box

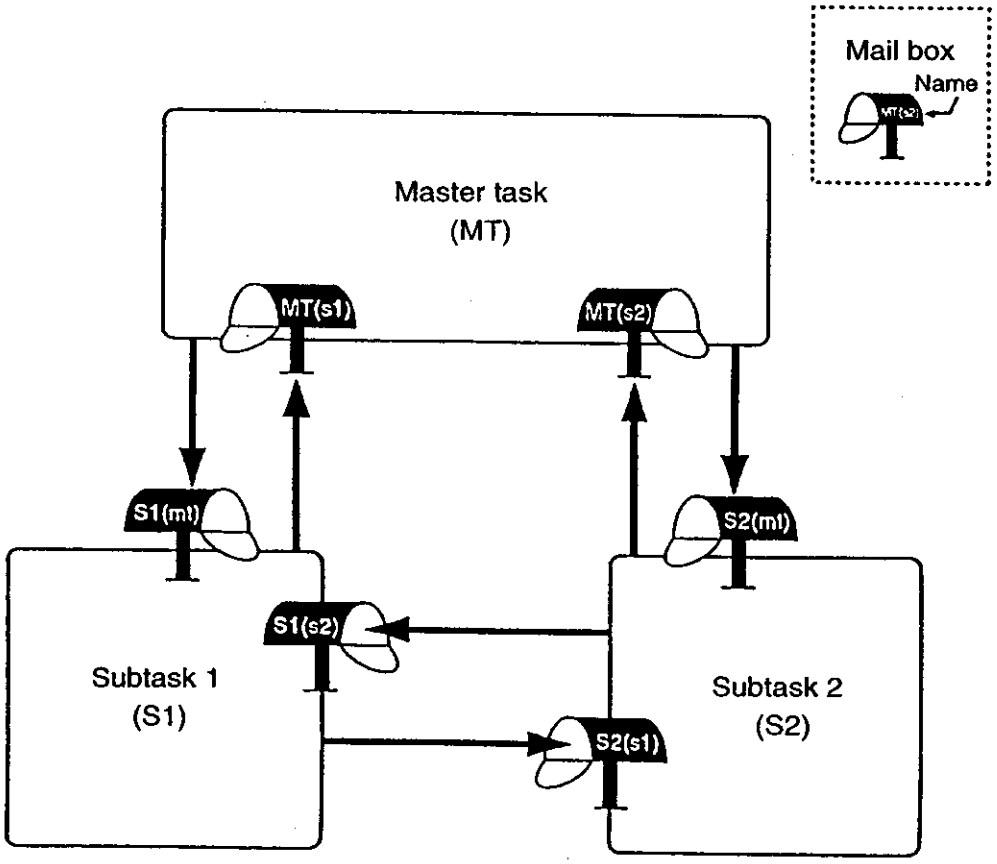
6.10.1 What is a mail box?

A mailbox is a means for exchanging mail between multiple tasks.
It can be used for sending mail, sending numerical data by mail, receiving mail, returning a reply to mail received, and can be used with various applications.

As in the diagram below, each task has two mail boxes.
Each mail box has a name and is differentiated by transmission source.

Mail box name MT (s1)

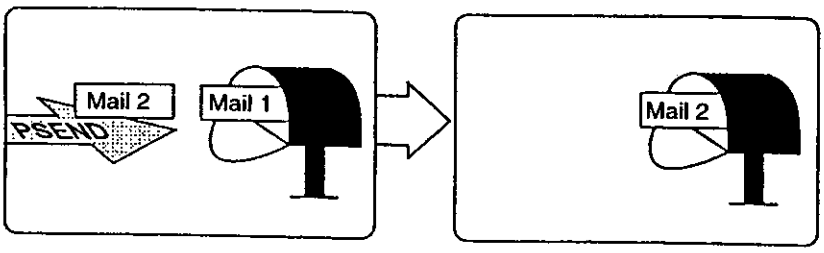
Receiving task Sending task



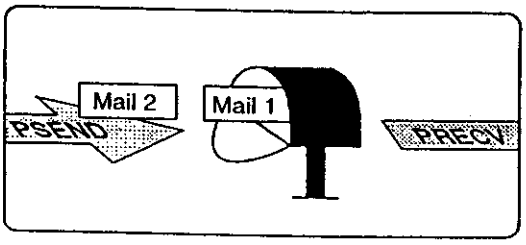
(1) Sending and receiving of mail

Mail is exchanged by using PSEND and PRECV instructions.
PSEND is the data transmission instruction. When PSEND is executed, data is sent from that task to another task. The transmitted data is stored in the mail box of the transmission destination.
PRECV is the data reception instruction. When PRECV is executed, data stored in the mail box of that task is received.

Only one item of mail can be stored in a mail box at a time.
When PSEND is executed, if there is already a mail in the destination mail box, the new mail overwrites the old.



When PRECV is executed, if there is no mail in that mail box, it waits until a mail comes.

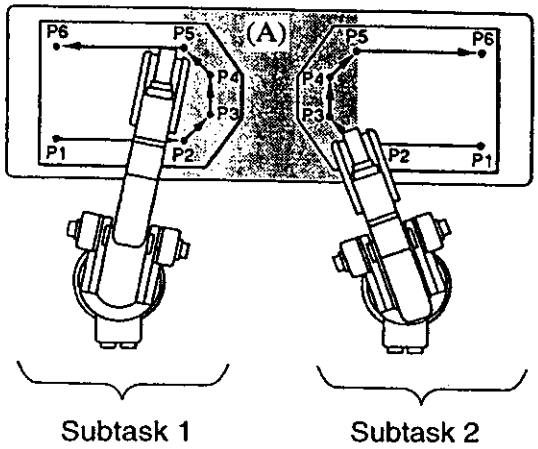


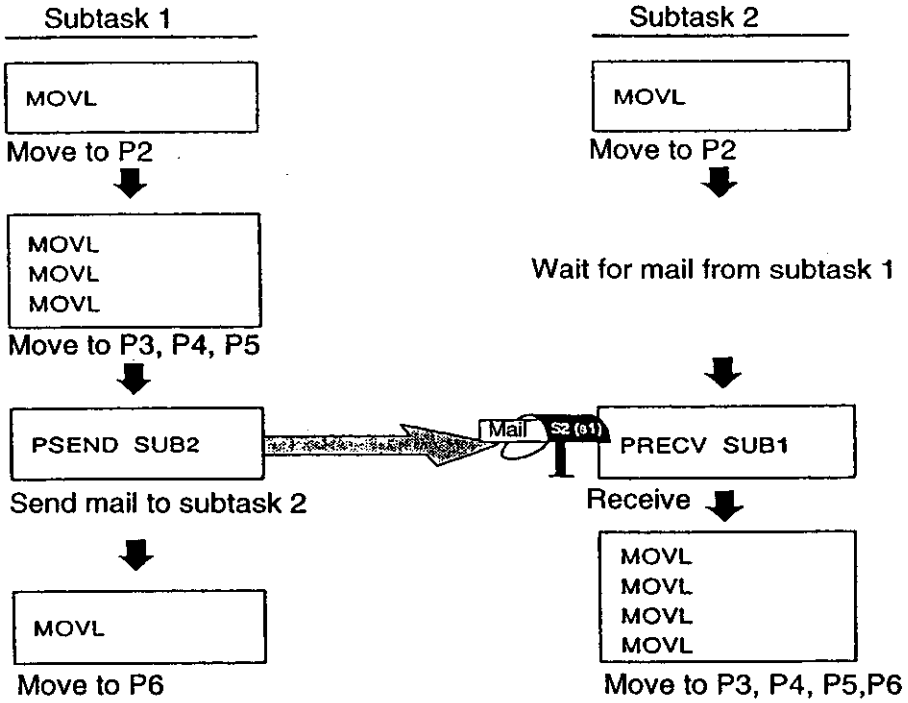
(2) Clearing the data in a mail box

- If the master job of a master task is called, or a job is selected, all mail boxes are cleared.
- A selected mail box can be cleared with a CLEAR instruction.
- If the main power is interrupted, mail box data is maintained.

6.10.2 Example of usage

[Example] During operation of two manipulators, if both enter region (A) at the same time, there is danger they will interfere with each other, so subtask 2 should wait at position P2 until the manipulator of subtask 1 passes through region (A).

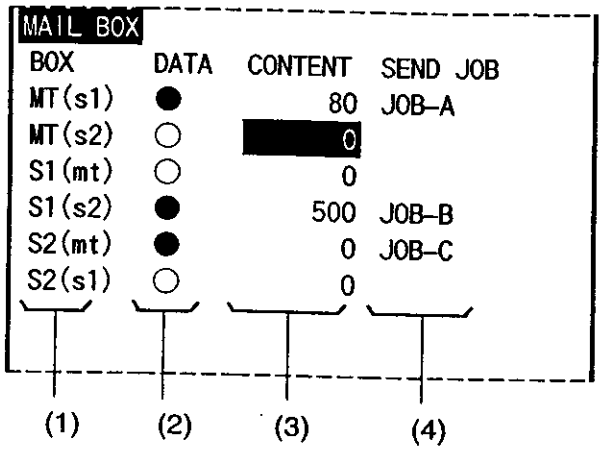




Reference section :
Mail box ▶ 6.10.1

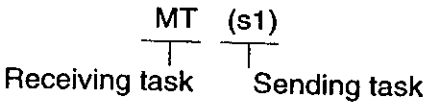
6.10.3 Confirming and changing status

Mail box status is displayed on the mail box display. On this display, presence of data can be verified, and its contents modified.



(1) BOX

Displays the names of the mail box.



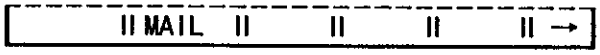
(2) DATA
Displays whether or not there is a mail in the mail box.
●: Yes ○: No

(3) CONTENT
Displays the contents of the mail.

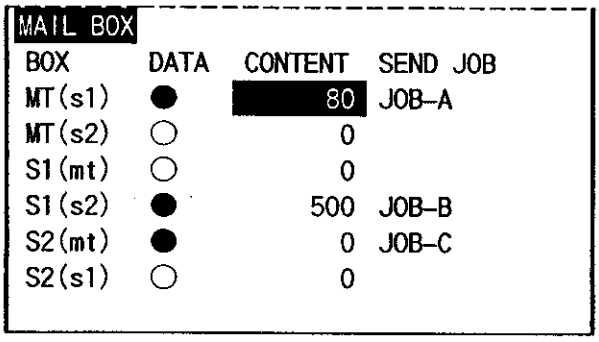
(4) SEND JOB
Displays the name of the job that sent the mail.

The mail box can be displayed with the procedure below.

① In the teach mode, press the [DISP], [F5] (DIAG), and [MORE], keys to display the following soft key label.



② Press the [F2] (MAIL) key to display the mail box display.



Existence of mail can be changed with the procedure below.

① Press the [EDIT] key, move the cursor to the mail box to be modified, and modify it with the soft keys. When modified, numerical data is cleared.

Data can be modified with the procedure below.

① Press the [EDIT] key, move the cursor to the mail box to be modified. After pressing the [MODIFY] and number keys to modify the data, press the [ENTER] key.
If data is input box with ○ (No) mark, the mark automatically changes to ● (Yes).

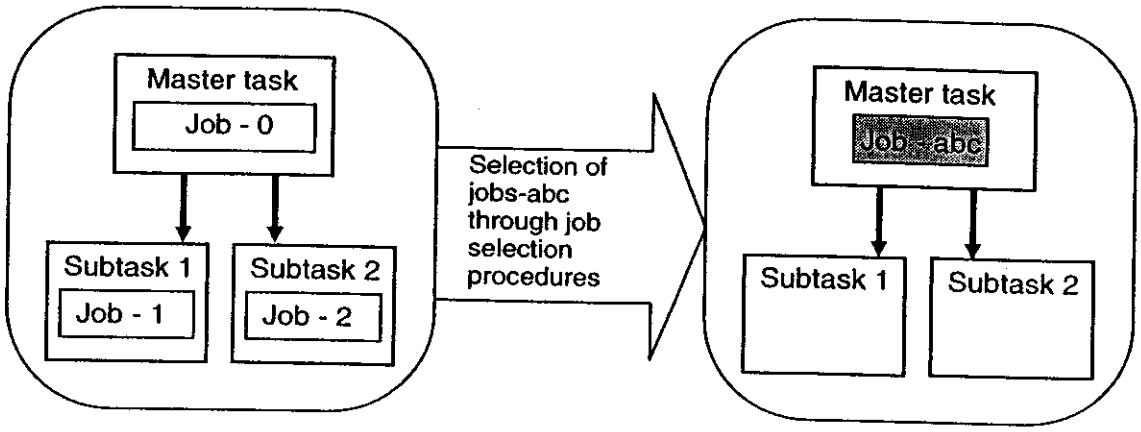
Reference sections :
Mail box ▶ 6.10.1

6.11 Restrictions

(1) Cautionary items when selecting jobs

When a job is selected, information of subtasks is cleared, and the newly selected job is set as the master task. Thus, if operation is started in this state, only the newly selected job executes. In the same way as when selecting jobs, when new jobs are created, copied, deleted, or names modified, information of subtasks is cleared.

If the job of a subtask is cleared, the message "SUB1 / SUB2 RESTART IMPOSSIBLE" is displayed.



Chapter 7

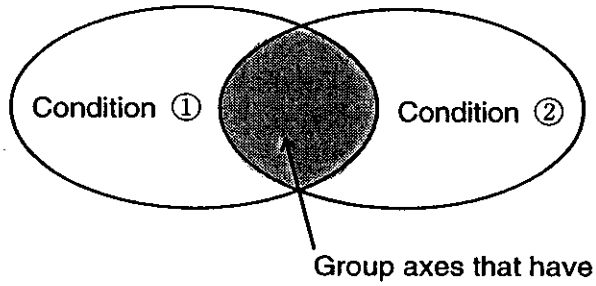
Convenient features

7.1 Servo power source individual control functions

7.1.1 Function explanation

When teaching a system having multiple axes, there is the danger that erroneous operation might cause a manipulator or a station other than the one being taught to move.
The servo power source individual control function is a function to prevent it by supplying servo power (Servo ON) to only necessary group axes. Since only those group axes that are in servo ON state will be taught, work can be performed safely.

The group axes that satisfy both of the two types of conditions will be servo ON.



(1) Condition ①: Group axes that are set as "○ (permit)" on the servo power on condition display

Those group axes with contact permitted are those that are servo ON.
After turning the main power ON, ordinarily all contacts are set to "○ (permit)."
If there are groups of axes to be turned OFF, set them to "● (inhibit)."

(2) Condition ②: Group axes of edit jobs

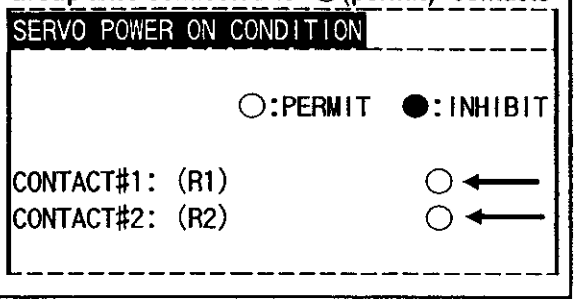
After calling the desired job into the edit job, press the servo ON button. The groups of axes that are registered in that job, will be those that have servo power turned ON.
Whether or not this condition ② is used is selected by the parameter.

Parameter	Contents and settings	Initial value
S4C001	Use of condition ②. (Sets that edit job group axes will have servo power ON.) 0: Use 1: Do not use	0

- When parameter S4C001 is 0, group axes satisfying both condition ① and condition ② will have servo power turned ON. For example, in the case of the following diagram, only R1 will have servo power turned ON.

Condition ①

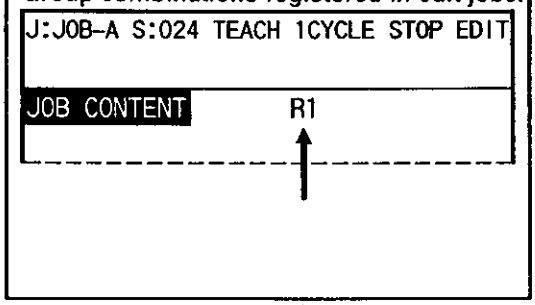
Group axes connected to "○(permit)" contacts



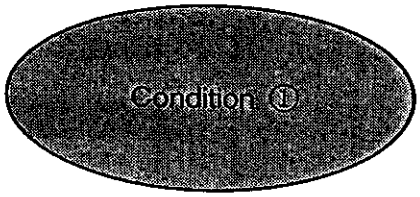
AND

Condition ②

Group combinations registered in edit jobs.



- If condition ② will not be used, set "1" in parameter S4C001. Only group axes of condition ① ("○ (permit)" on the servo power on condition display) will have servo power turned ON.

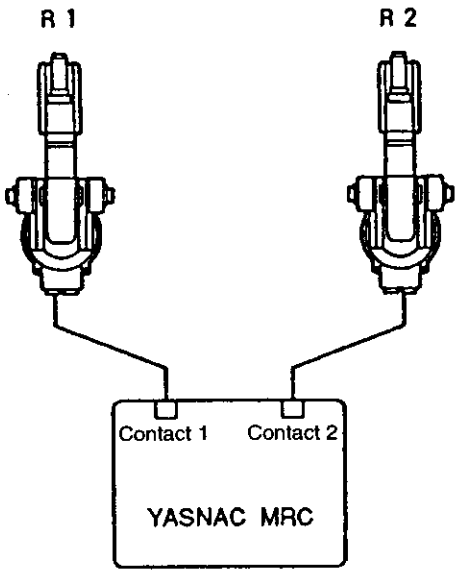


NOTE Conditions ① and ② are conditions when the Servo power is turned ON, so after it is turned ON, the servo ON status of each group axis cannot be changed. To make a change, turn OFF the servo power (Servo OFF), then set each of the conditions again, and turn the servo power ON again.

7.1.2 Example of usage

(1) Teaching only R1

If only group axes of the currently called edit job have servo power ON, it is convenient for checking job operation and correcting positions.



Condition ① : The servo power on condition display does not change.

SERVO POWER ON CONDITION

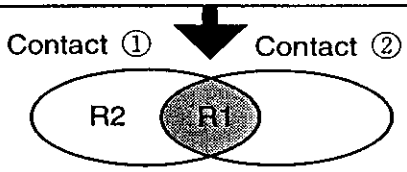
○:PERMIT ●:INHIBIT

CONTACT#1: (R1) ○
CONTACT#2: (R2) ○

Condition ② : Call job R1.

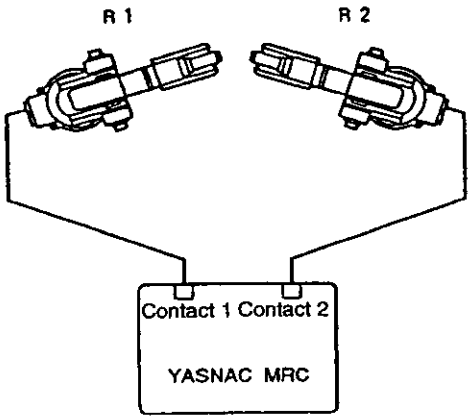
J:JOB-A S:024 TEACH CYCLE STOP DISP

JOB CONTENT R1



(2) While teaching a coordinated job of R1 + R2, turn servo power of R2 OFF.

When the edit job is the coordinated job R1 + R2, if the servo on button is pressed in that state, both manipulators will have servo power turned ON. At this point, if on the servo power on condition display the contact of R2 is changed to "● Inhibit," and press the servo on button, only R1 will be ON, so it is possible to teach R1 without moving R2.



Condition ① : On the servo power on condition display, R2 is changed to "● (Inhibit)."

SERVO POWER ON CONDITION

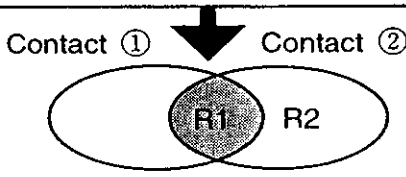
○:PERMIT ●:INHIBIT

CONTACT#1: (R1) ○
CONTACT#2: (R2) ●

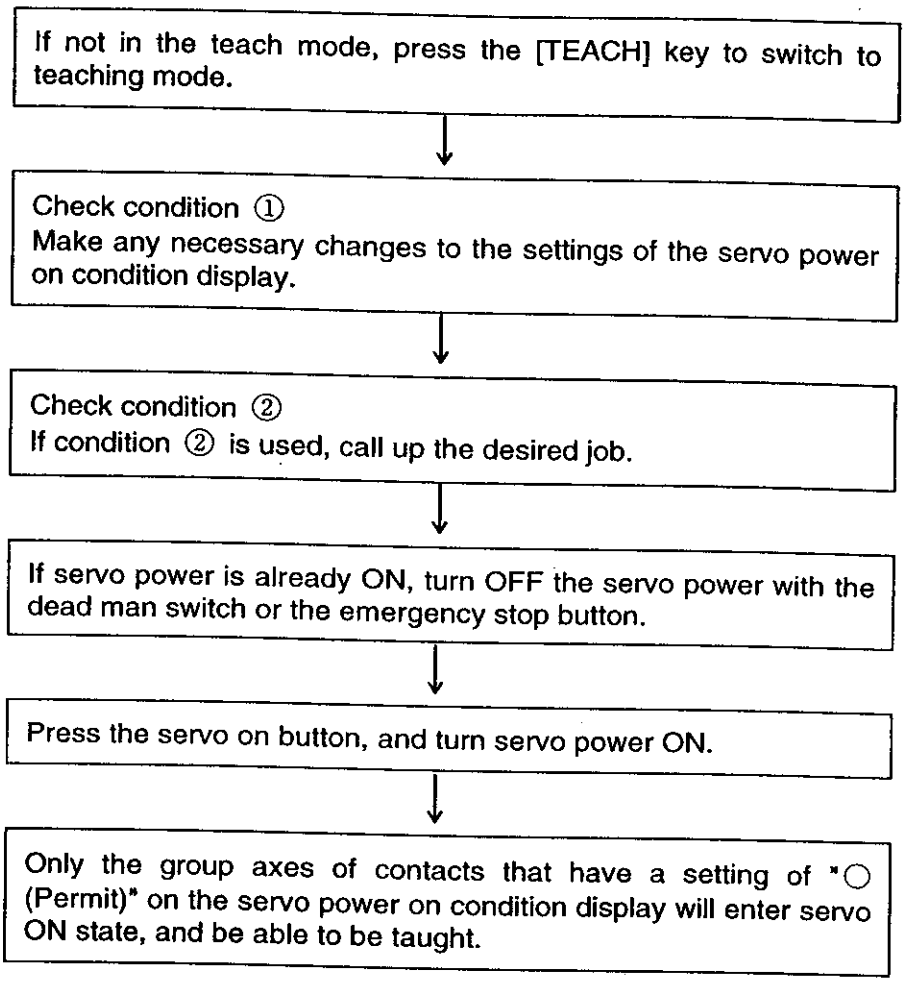
Condition ② : The R1 + R2 coordinated job stays the same.

J:JOB-A S:024 TEACH CYCLE STOP DISP

JOB CONTENT R1+R2



7.1.3 Flow of operation

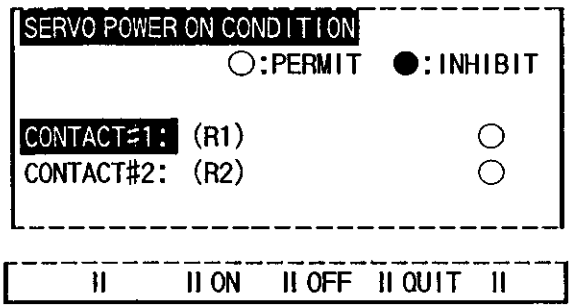


7.1.4 Condition ① Changing the settings on the servo power on condition display

After turning the main power ON, all contacts are set to "○ (Permit)." For group to be turned OFF, set them to "● (Inhibit)" with the following procedure.

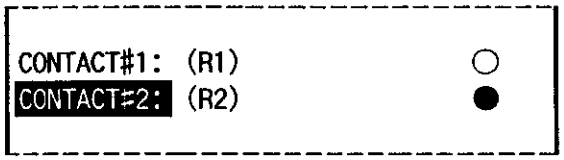
NOTE If the main power is turned OFF, the settings on this display are ineffective.

① In the teach mode, press the [SELECT], [MORE], and [F3] (SERVOON) keys to display the servo power on condition display.



[ON] : Sets to servo power inhibit (●).
[OFF] : Sets to servo power permit (○).

② Move the cursor to the contacts of group axes to be turned OFF, and press the [F3] (ON) key to set to "● (Inhibit)". Pressing the [F4] (OFF) key sets to "○ (Permit)."



7.1.5 Precautions when using condition ②

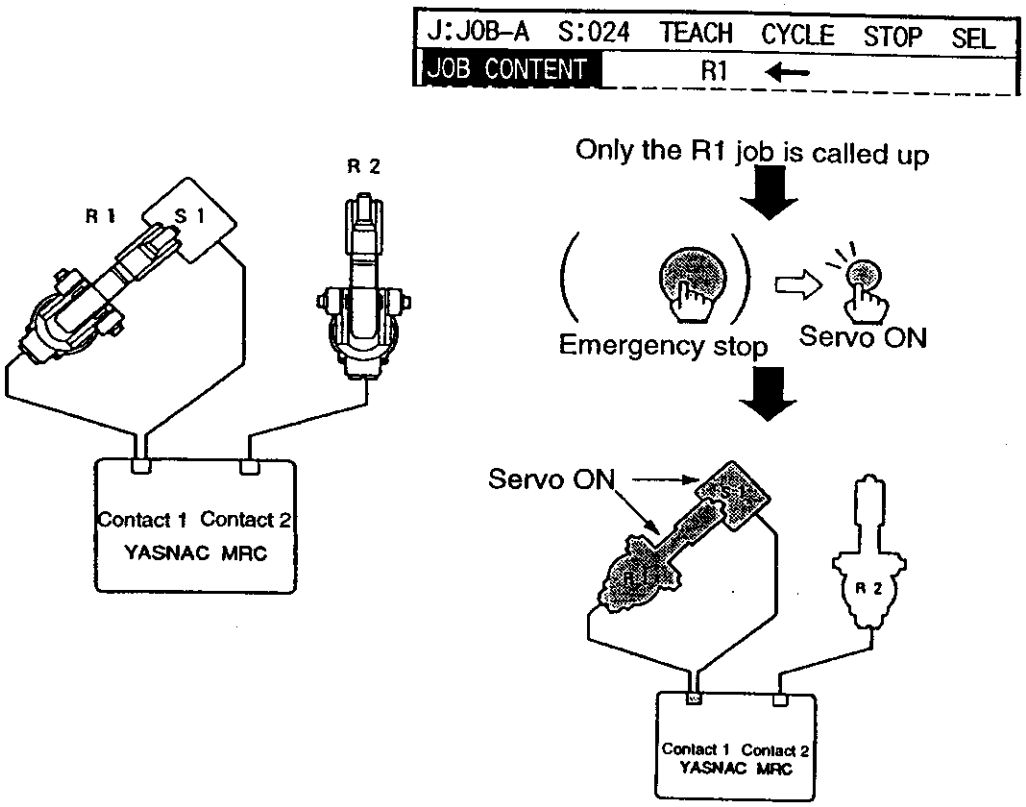
When using condition ② which turns servo power ON for group axes of edit jobs, be careful of the following items.

(1) If jobs with no group axis or concurrent jobs are edit jobs, all group axes will have servo power turned ON.

(2) Since jobs are deleted, if no edit job is called, all group axes have servo power turned ON.

(3) If two control groups are connected to one contact, both will have it turned ON at the same time. Only one of the control group cannot be turned ON.

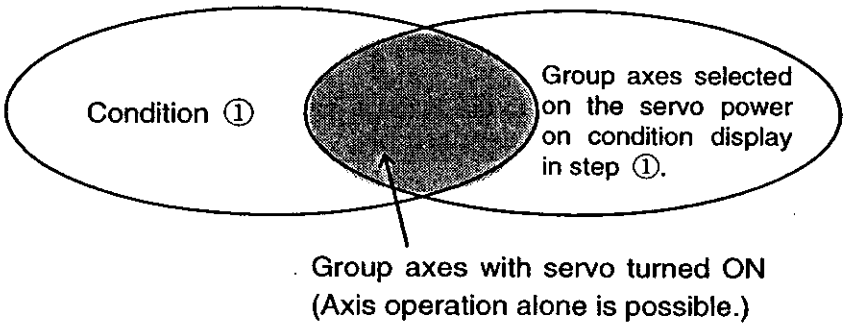
[Example] R1 and S1 are connected to Contact 1.
To turn only R1 ON by calling up the R1 job and pressing the servo on button. However, both R1 and S1 have servo power turned ON.



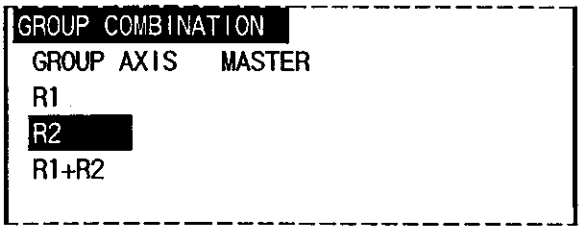
7.1.6 Moving the group axis with the servo OFF state

For example, while teaching R1, if it seems that it will interfere with R2 which does not have servo power, the following procedure can be used to retract R2. However, here only motion through axis movement is possible with R2, teaching cannot be performed.

At Step ② of this procedure, when the servo on button is pressed, the servo is turned ON for group axes both selected in step ① and satisfying condition ①.

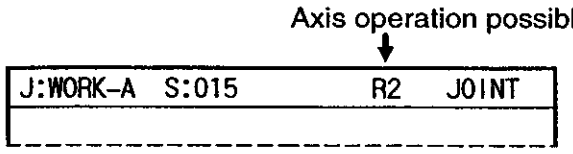


① Press the [*] + [GROUP AXES] keys to display the group combination display. Move the cursor to the group axis to be retracted.

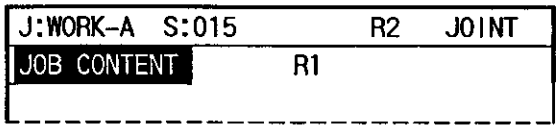


② If servo power is already ON, press the deadman switch or emergency stop button once, and turn the servo power OFF. With the group combination display displayed, press the servo on button.

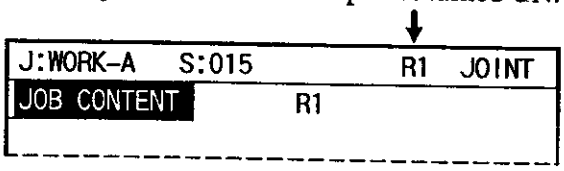
③ The group axes selected in step ① will have servo power turned ON, so can be retracted with the axis keys.



④ Press the [DISP] key, the [F1] (JOB) key to display the job contents of the edit job.



⑤ With the job contents displayed, turn the servo power OFF, and then turn it ON again. Only the group axes of edit jobs will have servo power turned ON.



7.1.7 Servo ON in the play mode

In play mode, if the servo on button is pressed, all group axes have servo power turned ON. However, if the set value of parameter S4C000 is changed, only those group axes that have contacts with a "○ (Permit)" setting on the servo power on condition display will have servo power turned ON.

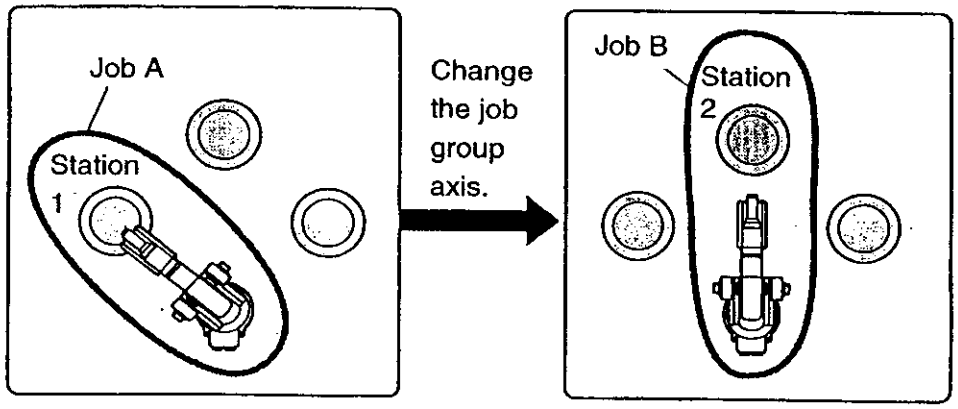
Parameters	Contents and settings	Initial value
S4C000	Servo ON conditions in the play mode 0: Servo ON for all groups 1: Only those group axes that a "○(Permit)" setting on the servo power on condition display have servo ON	0

Ordinarily, use with the initial value of 0.

7.2 Job group axis change

7.2.1 Function explanation

The YASNAC MRC can control up to 2 manipulators and 6 stations. When the same work is performed at multiple stations, teaching time can be shortened by using the job group axis change function to send a copy of the same job to other stations.



A copy of job A at station 1 is sent to job B at station 2. Using the job group axis change function, teaching for station 2 is not necessary.

7.2.2 Procedures

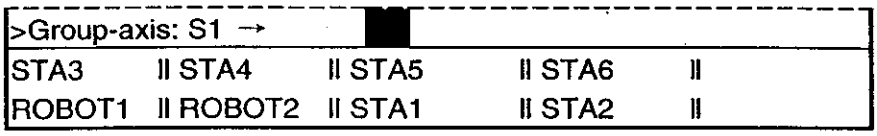
①Display the job header display for the original job in the teach mode. Or display the job list display and press the [EDIT] key and select the original job name using the cursors.
Next, press the [F1](COPY) key and enter the new job name, then press the [ENTER], then [F5](EXECUTE) keys.

②If the new job header display is not displayed, press the [DISPLAY], [F1](JOB), [F1](DIS CHG), and then [F1](HEADER) keys.

JOB HEADER

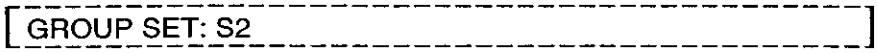
GROUP SET: S1

③Press the [EDIT], [MORE], and then [F2](GROUP) keys.



④Select the destination group axis with the soft keys and press the [F5](EXECUTE) key.

⑤When group axis change is performed, "GROUP DESIGNATION" of the job header display changes.



⑥Perform the changed group job by using the [FWD] key to verify positions and make adjustments as necessary.

7.2.3 Restrictions

(1) Robot axes can only be changed when robots (and base axes, when used) are the same type.

(2) Station axes can only be changed when the number of station axes is the same.

Appendix

Appendix Robot language (INFORM II) instructions

- < > indicates numerical or string data.
- If multiple items are shown in one section, select one of the items.

Coordinated operation instructions

SMOVL	Function	While coordinating the slave side with the master side, moves to teaching position with linear movement. (Coordinated move instruction to the slave side manipulator)	
	Format	Position data, base axis position data	Not displayed on the display
		V = <Play speed>, VR = <Play speed for posture>	V : 0.1 to 1500.0 mm / sec 0.6 to 9000.0 cm / min VR : 0.1 to 180.0° / sec
		PL= <Positioning level>	PL : 0 to 4
		UNTIL statement	
		NWAIT	
		+MOVL instruction	
	Example	SMOVL V=150 +MOVL	
SMOVC	Function	While coordinating the slave side with the master side, moves to teaching position with circular movement. (Coordinated move instruction to the slave side manipulator)	
	Format	Position data, base axis position data	Not displayed on the display
		V = <Play speed>, VR = <Play speed for posture>	V : 0.1 to 1500.0 mm / sec 0.6 to 9000.0 cm / min VR : 0.1 to 180.0° / sec
		PL= <Positioning level>	PL : 0 to 4
		NWAIT	
		+MOVL instruction	
	Example	SMOVL V=150 NWAIT +MOVL	
SIMOV	Function	While coordinating the slave side with the master side, moves by only the specified increment with linear movement.	
	Format	P <Variable number>, BP <Variable number>	
		V = <Play speed>, VR = <Play speed for posture>, VS = <Speed at reach point>	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= <Positioning level>	PL : 0 to 4
		UNTIL statement	
		NWAIT	
		+IMOV instruction	
	Example	SIMOV P000 V=138 PL=1 +IMOV P001 SIMOV P000 BP002 +IMOV P001	

SREFP	Function	During coordinated movement, specifies a reference point such as wall point for weaving. (Reference point instruction to the slave side manipulator)	
	Format	Position data, base axis position data	Not displayed on the display
		<Reference point number>	Wall point 1 for weaving: 1 Wall point 2 for weaving: 2
	Example	SREFP 1	
+MOVJ	Function	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)	
	Format	Position data, base axis position data, station axis position data	Not displayed on display
		VJ = <Play speed (%)>	Effective in parameter setting
	Example	┌MOVL =138 PL=0 └+MOVJ	
+MOVL	Format	The master side moves to the teach position with linear movement. This instruction should always be placed after a coordinated move instruction (coordinated movement, individual movement). (Coordinated move instruction to the master side manipulator)	
	Format	Position data, base axis position data, station axis position data	Not displayed on display
		V = <Play speed>	Effective in parameter setting
	Example	┌SMOVL V=276 └+MOVL ┌MOVL V=276 └+MOVL	
+IMOV	Function	The master side moves by only the specified increment with linear movement.	
	Format	P <Variable number>, BP <Variable number>	
		V = <Play speed>, VR = <Play speed for posture>, VE = <Play speed of external axes>, VS = <Speed at reach point>	V : 0.1 to 1500.0 mm / sec 0.6 to 9000.0 cm / min VR : 0.1 to 180.0° / sec VE : 0.01 to 100.00% VS : 0.1 to 1500.0 mm / sec 0.6 to 9000.0 cm / min
		BF, RF, TF, UF# (<User coordinate numbers>)	BF : Base coordinate RF : Robot coordinate TF : Tool coordinate UF : User coordinate
	Example	┌IMOV P000 V=138 PL=1 RF └+IMOV P001 ┌SIMOV P000 BP002 └+IMOV P001	
SSFTON	Function	Starts coordinated shift movement.	
	Format	<Robot axis position variable>	
	Example	SSFTON P000	

SSFTOF	Function	Stops coordinated shift movement.	
	Format	None	
	Example	SSFTOF	
SWVON	Function	Starts coordinated weaving.	
	Format	WEV# <Weaving condition file number>	1 to 16
	Example	SWVON WEV#(3)	
SWVOF	Function	Stop coordinated weaving.	
	Format	None	
	Example	SWVOF	

Independent control instructions

PSTART	Function	Start a job.	
	Format	JOB : <Job name>	
		SUB1, SUB2	Subtask that is started
		SYNC	Added to following side task
		IF statement	
	Example	PSTART SUB1 PSTART JOB:TEST-1 SUB1	
	Remarks	If the job name is omitted, the master job registered in the selected subtask is started.	
PWAIT	Function	Waits for completion of subtask	
	Format	SUB1, SUB2	Subtask waiting for completion
	Example	PWAIT SUB1	
PSEND	Function	Transmits data. Data is sent from that task to another task. The transmitted data is stored in the mail box of the send destination.	
	Format	SUB1, SUB2	Send destination subtask
		<Data>, LD <Variable number>	When omitted, a 0 is sent. <Data> : Constant LD : Variable which stores transmitted data
		ANS : LB <Variable number>	Answer back number
		NWAIT	
	Example	PSEND SUB1 PSEND SUB1 1 PSEND SUB1 LD001 ANS:LB001 NWAIT	
	Remarks	· Transmission data is stored in LDxxx. · When data to be sent is omitted, data "0" is sent. · When a PSEND instruction is completed, if the called station is waiting for mail, a 1 is stored in ANS : LBxxx. If it is not waiting, a 0 is stored. · If there is no NWAIT, execution of the next instruction waits until mail is received. If there is an NWAIT, the next instruction is executed without waiting to receive mail.	

PRECV	Function	Receives data. Data stored in the mail box of that task is received, and stored in a variable.	
	Format	SUB1, SUB2	Send source subtask
		LD <Variable number>	Variable which stores received data
		ANS : LB <Variable number>	Answer back number
		NWAIT	
	Example	PRECV SUB1 PRECV SUB1 LD001 PRECV SUB1 LD001 ANS:LB001 NWAIT	
	Remarks	· Received data is stored in LDxxx. · When a PRECV instruction is completed, an answer whether or not mail was received is stored in ANS: LBxxx. 0: No mail 1: Mail reception completed · If there is no NWAIT, execution of the next instruction waits until mail is received. If there is an NWAIT, the next instruction is executed even if there is no mail.	
CLEAR	Function	Clears the data stored in the mail boxes for that task.	
	Format	MB	Mail boxes for that task
		ALL	Mail boxes for all the tasks
	Example	CLEAR MB CLEAR MB ALL	
	Remarks	Without ALL, the mail boxes (2) for that task are cleared. With ALL, the mail boxes (6) for all the tasks are cleared.	
TSYNC	Function	Synchronizes tasks.	
	Format	<Synchronous signal>	1 to 8
	Example	TSYNC 1	

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YASKAWA ELECTRIC CORPORATION

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Specifications are subject to change without notice
for ongoing product modifications and improvements.

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