DX100 OPTIONS

FOR INDEPENDENT/COORDINATED CONTROL FUNCTION

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

MOTOMAN INSTRUCTIONS MOTOMAN-DX100 INSTRUCTIONS DX100 OPERATOR'S MANUAL DX100 MAINTENANCE MANUAL

The DX100 operator's manuals above correspond to specific usage. Be sure to use the appropriate manual.

Part Number: 156431-1CD Revision: 0





- This manual explains the independent/coordinated control function of the DX100 system and general operations. Read this manual carefully and be sure to understand its contents before handling the DX100.
- General items related to safety are listed in Chapter 1: Safety of the DX100 Instructions. To ensure correct and safe operation, carefully read the DX100 Instructions before reading this manual.



Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the DX100.

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





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

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





Must never be performed.

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



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



 Before operating the manipulator, check that servo power is turned OFF when the emergency stop buttons on the front door of the DX100 and programming pendant are pressed.
 When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.

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

Fig. : Emergency Stop Button



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

Injury may result from unintentional or unexpected manipulator motion.

Fig. : Release of Emergency Stop



- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator
 - View the manipulator from the front whenever possible.
 - Always follow the predetermined operating procedure.
 - Keep in mind the emergency response measures against the manipulator's unexpected motion toward you.
 - Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

- Confirm that no persons are present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
 - Turning ON the DX100 power
 - Moving the manipulator with the programming pendant
 - Running the system in the check mode
 - Performing automatic operations

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an emergency stop button immediately if there are problems. The emergency stop buttons are located on the right of the front door of the DX100 and the programming pendant.



Definition of Terms Used Often in This Manual

DX100

The MOTOMAN is the YASKAWA industrial robot product.

The MOTOMAN usually consists of the manipulator, the controller, the programming pendant, and supply cables.

In this manual, the equipment is designated as follows.

Equipment	Manual Designation
DX100 Controller	DX100
DX100 Programming Pendant	Programming Pendant
Cable between the manipulator and the controller	Manipulator cable

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

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

Description of the Operation Procedure

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

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- Independent/Coordinated Control Function
- 1.1 Coordinated Control

1 Independent/Coordinated Control Function

1

With the DX100, a system can be configured to control multiple manipulators or stations simultaneously with a single controller.

With the independent / coordinated control function, manipulators and/or stations can be operated together or individually. Operation can be optimized for the jobs.

1.1 Coordinated Control

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

<Example>

Using two coordinated manipulators to execute a job.



1.2 Independent Control

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

<Example>

While executing a work job at one station, the other station executes a job to return to the home position for the next job.



2 Coordinated Positioner System

2.1 Outline

2 Coordinated Positioner System

2.1 Outline

The coordinated positioner system is a system which coordinates a job where a positioner (hereinafter called "station") holds a workpiece while a manipulator holds a tool.



In order to operate a station and a manipulator simultaneously, a coordinated job is needed.

In the coordinated job, there are two operations: a coordinated interpolation where a station and a manipulator perform a reciprocal movement as master and slave, and an individual interpolation where a station and a manipulator move individually.

The move instruction in a coordinated job displays two lines: The first line is for the slave side (manipulator), and the second line is for the master side (station).



- 2 Coordinated Positioner System
- 2.2 Function Keys

2.2 Function Keys

The function keys for the coordinated positioner system are assigned to the Numeric keys as shown in the figures below.

2.2.1 Arc Welding Application



1 TIMER	Registers a timer instruction "TIMER" in a job.
0 REFP	Registers a reference point "REFP" in a job, or modifies the registered reference point. [REFP] + [FWD] Moves the manipulator to the registered reference point.
8 ARCON	Registers a welding start instruction "ARCON."
5 ARCOFF	Registers a welding end instruction "ARCOF."
2 GAS	Use when performing a gas check. Gas is fed only while [Gas] is pressed. (Refer to "Chapter 9.3.2 Gas Flow Control Function" at page 9-7 in the Operator's Manual.)
9 🎸 FEED	Used for wire inching. Press [FEED] to feed the wire, and press [RETRACT] to retract the wire. While these keys are pressed, the wire feed motor operates.
6 Several RETRACT	The feed rate can be switched through 3 steps. [FEED] : Low speed [FEED] + [FAST] : Middle speed [FEED] + [HIGH SPEED] : High speed The retract speedfeed rate can be switched through 3
	steps. [RETRACT] : Low speed [RETRACT] + [HIGH SPEED] : High speed (Refer to "Chapter 9.3.1 Wire Inching Function" at page 9-7 in the Operator's Manual.)
	Modifies the welding current/voltage while welding during the play mode. Press [3/CUR/VOL] to increase the current/voltage value, and press [–/CUR/VOL] to decrease the current/voltage value. (Refer to "Chapter 9.13 Changing Welding Conditions
CUR/VOL	Changes the type of movement for the manipulator when teaching a coordinated job.
7 <u>SYNCRO</u> SINGLE	SYNCRO: The mark for "synchronized" appears in the status display area. When the master side is moved, the slave side will follow the movement of the master.
	SINGLE: Only the selected aroup axis moves.

2 **Coordinated Positioner System** 2.2 **Function Keys**



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

Coordinated: All the move instructions that are registered in this mode become coordinated instructions. Individual: The master-slave relationship is cancelled. Each

manipulator and station moves independently.

SUPPLE -MENT

Wire retraction, high-speed inching, or high-speed retraction cannot be performed depending on the Power Source.

2.2.2 General Application



	Registers the TOOLON instruction.
2 TOOL ON	If [INTERLOCK] is pressed simultaneously, the TOOLON operation is executed.
	Registers the TOOLOF instruction.
• TOOL OF	If [INTERLOCK] is pressed simultaneously, the TOOLOFF operation is executed.
	Registers the CALL instruction for the reserved job TOOLONxx.
3 TOOL ON JOB	
	Registers the CALL instruction for the reserved job TOOLOFxx.
- TOOL OF JOB	
	Changes the type of movement for the manipulator when
7	Each time this key is pressed, the movement type changes.
SINGLE	SYNCRO: The mark for "synchronized" appears in the status display area. When the master side is moved, the slave side will follow the movement of the master. SINGLE: Only the selected group axis moves.
	Selects either a coordinated or an individual interpolation when
4	Each time this key is pressed, the operation type changes.
SMOV	Coordinated: All the move instructions that are registered in this mode become coordinated instructions.
	Individual: The master-slave relationship is cancelled. Each manipulator and station moves independently

- 2 Coordinated Positioner System
- 2.3 Example of Job Teaching
- 2.3 Example of Job Teaching



- 2 Coordinated Positioner System
- 2.4 System Setup

2.4 System Setup

2.4.1 Registering Group Combination

Register a combination of a station and a manipulator.

- 1. Select {SETUP} under the main menu.
- 2. Select {GRP COMBINATION}.
 - The GROUP COMBINATION window appears.

DATA	EDIT	DISPLAY	UTILITY] 12 🗳 🖌	1 👒 🙋 🖳	- (")
GROUP COMBI GROUP AXI	NATION S	MASTER				
R1 S1						
Main Menu	J Simp	le Menu				

- 3. Press [SELECT].
 - The selection dialog box appears.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 📶 🖏 词 🖵 🕀
GROUP COMBI	NATION S	MASTER		
ADD GROUN Todify Gi Delete Gi	S ROUP ROUP			

- 4. Select "ADD GROUP."
 - The GROUP COMBI SET window appears

DATA	EDIT	DISPLAY	UTILITY) 12 🖻 📶 📢	12 🕞 👘
GROUP COMBI SET					
NO.1 CONTRO NO.2 CONTRO MASTER	DL GROUP	8 48 8 8 8 8 8 8 8 8 8 			
EXECUTE		CANCE	-		
Main Menu	Simp	ole Menu			

- 2 Coordinated Positioner System
- 2.4 System Setup
- 5. Press [SELECT].
 - The selection dialog box appears.

NO.1 CONTROL GROUP NO.2 CONTROL GROUP MASTER	RI:ROBU S1:STAT ***	DT 1 DTONT	

- 6. Select a group axis to be set.
 - Set a station as "MASTER."

DATA	EDIT	DISPLAY	UTILITY	12 🗹 📶 😣	10 🖳 👘
GROUP COMBI	SET				
NO.1 CO NO.2 CO MASTER	NTROL GROUP NTROL GROUP	R1 S1 S1			
EXEC	ITE	CANCEL			
Main Menu	Simpl	e Menu			

- 7. Select "EXECUTE."
 - The GROUP COMBINATION window reappears.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 📶 📢	檀 📮 👆
GROUP COMBI	NATION	MASTER			
R1		in the second			
R1+S1		S1			
Main Men	u Simp	le Menu			

- 2 Coordinated Positioner System
- 2.4 System Setup

2.4.2 Calibration between Manipulator and Station

For a coordinated motion between a manipulator and a station, prior registration of the settings for mutual positioning is required.

This relationship is set by calibration between the manipulator and the station.

2.4.2.1 Calibration Tool Setting

- 1. Mount a tool for calibration on the manipulator.
 - Use a tool whose exact dimensions are known.



- 2. Select {ROBOT} under the main menu.
- 3. Select {TOOL}.
 - The TOOL window appears.

DATA	EDIT	DISPLAY UTILITY	12 🗹 🖌 😒	ia 🕞 🙌
TOOL TOOL NO.	: 0 / 1			
X Y	0.000 mm 0.000 mm	Rx 0.0000 deg. Ry 0.0000 deg.		
z _	0.000 mm	Rz <u> 0.0000</u> deg.		
Xg	0.000 mm	Ix 0.000 kg.m2		
Zs	0.000 mm	Iz 0.000 kg.m2		
Main Men	u Simpl	e Menu		

- 4. Enter the tool dimensions.
- 5. Press [ENTER].

- 2 Coordinated Positioner System 2.4 System Setup
- 2.4.2.2 Teaching Positions for Calibration

For a station with one rotating axis

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



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



3. Turn the station axis further in the same direction as in step 2. Then, align the TCP of the manipulator to point P, and register it as C3.



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

- 2 Coordinated Positioner System
- 2.4 System Setup

For a station with two rotating axes

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



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



3. Turn the 2nd station axis again for about 30°. Align the TCP of the manipulator to point P, and register it as C3.



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



- 2 Coordinated Positioner System
- 2.4 System Setup
- 5. Turn the 1st station axis again for about 30°. Align the TCP of the manipulator to point P, and register it as C5.





• The position of the 2nd station axis for C4 and C5 must be the same as that for C3.

- 2 Coordinated Positioner System
- 2.4 System Setup

2.4.2.3 Calibration

- 1. Select {ROBOT} under the main menu.
- 2. Select {ROBOT CALIB}.
 - The ROBOT CALIBRATION list window appears.

DATA	EDIT	DISPLAY	UTILITY) 12 🖻 📶 🕏	🜢 🔟 🖵 🔶	
ROBOT CA	LIBRATION					
NO.	SET	ROBOT				
01	0					- 17
02	0					
03	0					
04	0					
05	0					
0.6	0					
07	0					
08	0					
0.9	0					
10	0					
11	0					
12	0					
13	0					
14	0					
15	0					
16	0					
17	0					
18	0					
-						
Main M	lenu Sii	mple Menu				

- 3. Select a robot calibration No.
 - The ROBOT CALIBRATION window for teaching appears.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 📶 🚷	🙋 🖵 👆
ROBOT CALI	ERATION ROBOT HHEEH	2 PDS < ST C1 C2 C3	ITION <u>[1]</u> ATUS > : ○ : ○ : ○		
COMP	LETE	CANCE			
Main Men	u Simp	le Menu			

- 2 Coordinated Positioner System
- 2.4 System Setup
- 4. Select "ROBOT."
 - The selection dialog box appears.
 - (1) Select a control group for calibration.

DATA	EDIT	DISPLAY	UTILITY	12 🗳	18	🔞 📑 🕀	
ROBOT CALIB	RATION						
N0.: 01	ROBOT RI+S	0 POS < ST C1 C2 C3	ITION <u>[C1</u> ATUS > : O : O : O				
			_	_			_
COMPL	LETE	CANCEL					
Main Men	u Sian	Le Menu					

- 5. Select a group axis combination for calibration.
 - The teaching positions are displayed.

DATA	EDIT	DISPLAY	UTILIT	12 🗹 📶 🔞	🔞 🖵 👆 🖻
ROBOT CALIBRAT	ION				
NO.: 01 ROB	OT R1+S1	P0:	SITION C1		
R1 :S	* TC)OL: 00 < S	TATUS >		
L	*	01	:0		
U	*	UZ D2	: 0		
К	*	.08	: 0		
т	т Ф				
	44				
COMPLETE		CANCE	EL		
Main Menu	Simp	le Menu			

- 2 Coordinated Positioner System
- 2.4 System Setup
- 6. Select "POSITION."
 - The selection dialog box appears.
 - (1) Select a position to be taught.

DATA	EDIT	DISPLAY	UTILITY] 12 🗳 📶 👒 🔟 🖳 👆	Þ
ROBOT CALIE NO.: 01 R1:S U R B T	RATION ROBOT <u>R1+S1</u> * * * * *	_ POS IOL: 00 < ST C1 C2 C3	ITION ITION III IIION IIIION IIIION IIION IIION IIION IIION IIION IIION II		
COMPL	LETE	CANCEI	_		
Main Men	u Simp	le Menu			

- 7. Press the axis key to move the manipulator to the desired position.
- 8. Press [MODIFY] and [ENTER].
 - The positions for calibration are registered.
 - Repeat Operations 6 and 8 to teach set positions C1 to C3.
 - On the window, "●" indicates that the teaching is completed while
 "O" indicates that the teaching is not completed.
 - The calibration positions appear according to the selected group axis.
 - Press the page key 🚺 to change the window.



- 2 Coordinated Positioner System
- 2.4 System Setup
- 9. Select "COMPLETE."
 - The robots are calibrated.
 - When the calibration is completed, the ROBOT CALIBRATION list window reappears.

DAT	<u>۱</u>	EDIT	DISPLAY	UTILITY	12 🗳 🖌	1 🛸 🔟 I	🤰 🕀
ROBOT	CALIBRAT	ION					
NO.	SET		ROBOT				
01	٠		R1+S1				
02	0						
03	0						
04	0						
05	0						
06	0						
07	0						
08	0						
09	0						
10	0						
11	0						
12	0						
13	0						
14	0						
15	0						
16	0						
17	0						
18	0						
_	_	_					
	121	T	T				
Mair	Menu	Simp	le Menu				

Alarm which is emitted when trouble occurs during calibration teaching

Alarm Number	Alarm Name	Sub Code	Meanings
4497	DEFECTIVE TAUGHT POINT(CALIB)	1	Some of the teaching points for master-group are on the same point.
		2	Some of the teaching points for slave-group are on the same point.
		3	The 2nd-axis positions of C3, C4, and C5 of station axes are not the same.
		4	The 1st-axis positions of C1, C2, and C3 of station axes are not the same.
		5	The 2nd-axis positions of C1, C2, and C3 of station axes are the same.
		6	The 1st-axis rotation direction of C3, C4, and C5 of station axes are not the same.
		7	The 1st-axis (elevation axis) positions of C1, C2, and C3 of station axes are not the same.
		8	The 1st-axis (elevation axis) positions of C3, C4, and C5 of station axes are not the same.

- 2 Coordinated Positioner System
- 2.5 JOB CONTENT Window

2.5 JOB CONTENT Window

An example of the contents of a coordinated job is shown below.

JOB	EDIT	DISPLAY	UTILIT	22 19 2 4 5	s 🙋 🖳 🕀	
JOB CONTENT J: TEST CONTROL GRO	: MASTER		S:0000 TOOL: **+**			
0000 NOP 0001 SMOVL +MOVJ 0002 MOVL W +NOVJ V 0003 END	V=138 '=138 J=0.78					
MOVI V=13; +MOVJ VJ=0.	a 78	_	_	_		
Main Men	JSimp	le Menu				

① Instructions

For a coordinated job, the move instruction is displayed in two lines: The first line is the instruction to the slave side; the second line is the instruction to the master side.

SMOVL V=138 ←Slave, a manipulator

+MOVJ ←Master, a station

② Synchronized/Single

Synchronized/single are the types of movement available for the manipulator during axis operation.

This mark appears when synchronized movement is selected.

Switch between movements by pressing [SYNCRO/SINGLE].

③ Group axis being handled

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

④ Coordinated interpolation/Individual interpolation

Switch between coordinated interpolation and individual interpolation by pressing [SMOV].

- 2 Coordinated Positioner System
- 2.6 Synchronized/Single

2.6 Synchronized/Single

There are two ways to handle axes when teaching: "Synchronized" and "Single."

Switch between movements by pressing [SYNCRO/SINGLE].



2.6.1 Synchronized

If the axes are handled in the "Synchronized" mode, the slave (manipulator) follows the master (station) when the master moves.

This feature is used to keep the position of the manipulator relative to the station.

However, the master does not move when the slave is moved.

A master axis is moved:



- 2 Coordinated Positioner System
- 2.6 Synchronized/Single

2.6.2 Single

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

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

A slave axis is moved:



A master axis is moved:





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

2 Coordinated Positioner System

2.7 Selecting Axis to be Handled

2.7 Selecting Axis to be Handled

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

2.7.1 When There is an Edit Job

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

• Pressing [ROBOT] selects a manipulator for axis handling.

UTILITY 12 📝 📶 🕵 🔟 📮 🙌

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

UTILITY 10 🔀 📶 📢 🔞 🖵 🙌

2.7.2 When There is No Edit Job

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

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

- 2 Coordinated Positioner System
- 2.8 Registering Job

2.8 Registering Job

- 1. Select {JOB} under the main menu.
- 2. Select {CREATE NEW JOB}.
 - The NEW JOB CREATE window appears.

JOB	EDIT	DISPLAY		1 21 🔞	L. (†)
NEW JOB CREA JOB NAME COMMENT GROUP SET JOB TYPE	TE R1 R0B0	80L T	*****		

- 3. Enter a job name.
 - Select "JOB NAME," and then enter a job name by entering the characters.

Refer to "1.2.6 Character Input" of the Operator's Manual.

- 4. Press [ENTER].
- 5. Select "GROUP SET."
- 6. Select a group combination.
- 7. Select "EXECUTE."
 - The job name is registered in the memory of DX100, and the JOB CONTENT window appears.

2 Coordinated Positioner System

2.9 Registering Move Instruction (S)MOV □+MOVJ

2.9 Registering Move Instruction (S)MOV □+MOVJ

Register a move instruction in the following manner.

2.9.1 Operating Master Side (Station)

- 1. Call the JOB CONTENT window in teach mode.
- 2. Press [EX. AXIS].
 - The master side (station) is selected for axis handling.

UTILITY] 10 💽 📶 🐯 🙆 📑 👘

10102108101

- 3. Select either "synchronized" or "single."
 - Press [SYNCRO/SINGLE] to select either "synchronized" or "single."
 - When "synchronized" is selected, the mark in the window below appears.

When the slave side is supposed to follow the master side motion, select "synchronized."

Synchronized→

- When "single" is selected, the mark in the window below appears.

UTILITY



4. Press the axis key to move to the desired position.
- Coordinated Positioner System
- 2.9 Registering Move Instruction (S)MOV □+MOVJ

2.9.2 Operating Slave Side (Manipulator)

2

- 1. Press [ROBOT].
 - The slave side (manipulator) is selected for axis handling.

UTILITY 👖 1 🔀 🔀 🚮 📢 🔯 🖵 🙌

- 2. Press the axis key to move to the desired position.
- 3. Select either a coordinated interpolation or an independent interpolation.
 - Press [SMOV] to select either interpolation.



- 4. Select an interpolation type.
 - Press [MOTION TYPE] to select an interpolation type.



- 5. Confirm the speed.
- 6. Press [ENTER].
 - The registration is completed as follows.

0003 SMOVC V=138 +MOVJ



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

Parameter	Contents and Set Value	Initial Value
S2C213	+MOV INSTRUCTION INTERPOLATION INPUT	2
	This parameter specifies which interpolation is permitted for move instructions for the master robot in a coordinated job. (bit specification)	
	D0: +MOVJ	
	D1: +MOVL	
	D2: +MOVC	
	D3: +MOVS	

Coordinated Positioner System

2.9 Registering Move Instruction (S)MOV □+MOVJ

2.9.3 (S) MOV D + MOVJ rate specification

2.9.3.1 Rate specification in a multiple line shift command

2

The relationship between the rate specification in a shift commnad which causes multiple groups such as "MOV \Box + MOVJ" or "SMOV \Box + MOVJ" to operate (i.e. to be configured by multiple lines), simultaneously, and the actual operation rate, is as follows.

- Each shift time for the robot (or station) is obtained according to the rate specified for each line.
- The maximum of the respective shift times is obtained, and all groups are operated according to this maximum shift time.

<Example>

MOVL V = 500.0 \cdots The shift time over the shift distance is 2 seconds at V = 500

+MOVJ VJ = 25.00...The shift time for the shift amount is 4 seconds at VJ = 25

*This "MOVL + MOVJ" functions when the shift time is 4 seconds.

Note that for lines in which the rate specification is omitted, the shift time is calculated based on the assumption that the maximum rate has been specified.

<Example>

MOVL V = 500.0 ··· The shift time of	ver the shift distance is 2 seconds at
V = 500	

+MOVJ VJ ····The shift time for the shift amount is 1 seconds at VJ = 25

*This "MOVL + MOVJ" functions when the shift time is 2 seconds.

2.9.3.2 Rate specification at coordination interpolation (SMOV □)

The rate specification for the manipulator on the slave side at coordination interpolation (SMOV \Box) is specified as "relative rate" as seem from the master side.

For example, in arc welding, in the case where the slave side manipulator holds the welding torch, this "relative rate" becomes the "welding rate" with respect to the work piece, so it is important to maintain this rate. In this case, by omitting the rate specification on the master side, the shift rate will be basically determined by the "relative rate."

<Example>

MOVL V = 100.0	\cdots The shift time at V = 100 over the relative shift dis-
	tance on the slave side with respect to the master
	is 5 seconds.
+MOVJ VJ	···The shift time at VJ = 100 for the master shift
	amount is 2 seconds.
*This "SMOVL +	MOVJ" functions when the shift time is 5 seconds.

Coordinated Positioner System
 Registering Move Instruction (S)MOV □+MOVJ

Parameter	Contents and Set Value	Initial Value
S2C212	+MOV INSTRUCTION SPEED INPUT Specifies whether the speed inputting for move instructions of the master side robot in a coordinated job is permitted or not.	0
	<example> 0: Not Provided 1: Provided SMOVL V=100 SMOVL V=100 +MOVJ ← Master side +MOVJ VJ=10.00 ← Master side </example>	

- 2 Coordinated Positioner System
- 2.10 Registering Reference Point Instruction (SREFP)

2.10 Registering Reference Point Instruction (SREFP)

Register a reference point instruction (SPEFP) for a coordinated interpolation in the following manner.

- 1. Select {JOB} under the main menu.
- 2. Select {JOB}.
- 3. Move the cursor.
 - Move the cursor to the line immediately before the line where the reference point instruction is to be registered.

0016	SMOVL V=658
	+MOVJ
0017	CALL JOB: WORK-A
0018	SMOVL V=658
	+MOV.I

- 4. Grasp the Enable switch.
 - Turn ON the servo power with the Enable switch.



- 5. Press the axis key.
 - Move the manipulator to the position which will be a reference point.
- 6. Press [REF PNT].

SREFP 1

- The reference point instruction appears in the input buffer line.



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

SREFP 2	

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



- 8. Press [INSERT].
 - The [INSERT] key lamp lights up.
 - When registering immediately before the END instruction, pressing [INSERT] is not needed.
- 9. Press [ENTER].
 - The REFP instruction is registered.



3 Jigless System

3.1 Outline

3 Jigless System

3.1 Outline

A jigless system is a system that welds by coordinating two manipulators; one holding the workpiece while the other holds the torch.

To coordinate the movements of the two manipulators, a coordinated job is needed.

In a coordinated job, there is a coordinated operation where two manipulators, master and slave, perform a reciprocal movement, and an individual operation where each of the two manipulators performs an independent movement.

Coordinated operation



←To DX100

Individual operation



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



- 3 Jigless System
- 3.2 Specific Keys

3.2 Specific Keys

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



1 TIMER	Registers a timer instruction "TIMER" in a job.
0 REFP	Registers a reference point "REFP" in a job, or modifies the registered reference point. [REFP] + [FWD] Moves the manipulator to the registered reference point.
8 ARCON	Registers a welding start instruction "ARCON" in a job.
5 ARCOFF	Registers a welding end instruction "ARCOF" in a job.
2 GAS	Use when performing a gas check. Gas is fed only while [Gas] is pressed. (Refer to "Chapter 9.3.2 Gas Flow Control Function" at page 9-7 in the Operator's Manual.)
9 K FEED	Used for wire inching. Press [FEED] to feed the wire, and press [RETRACT] to retract the wire. While these keys are pressed, the wire feed motor operates.
6 x RETRACT	The feed rate can be switched through 3 steps. [FEED] : Low speed [FEED] + [FAST] : Middle speed [FEED] + [HIGH SPEED] : High speed
	The retract speedfeed rate can be switched through 3 steps. [RETRACT] : Low speed [RETRACT] + [HIGH SPEED] : High speed (Refer to "Chapter 9.3.1 Wire Inching Function" at page 9-7 in the Operator's Manual.)
7 SYNCRO SINGLE	Changes the type of movement for the manipulator when teaching a coordinated job. Each time this key is pressed, the movement type changes. SYNCRO: The mark for "synchronized" appears in the status display area. When the master side is moved, the slave side will follow the movement of the master
	SINGLE: Only the selected group axis moves.

4 SMOV Selects either a coordinated or an individual interpolation when teaching a coordinated job.

Each time this key is pressed, the operation type changes.

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

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

SUPPLE -MENT Wire retraction, high-speed inching, or high-speed retraction cannot be performed depending on the Power Source.

- 3 Jigless System
- 3.3 Opening and Closing Handling Tool

3.3 Opening and Closing Handling Tool

This section explains how to open and close a handling tool by teaching.

It is unrelated to the content of the job being taught.

To close and open a handling tool by pressing the specific keys, the general output signals #17 to 20 are used.

The general output signal No. can be changed by the parameter A1P. A1P026 Tool1 ON general output No. (Initial value: 17) A1P027 Tool1 OFF general output No. (Initial value: 18)



3-5

- 3 Jigless System
- 3.4 Example of Teaching Job





- 3 Jigless System
- 3.5 System Setup

3.5 System Setup

3.5.1 Registering Group Combination

Register a combination of two manipulators.

- 1. Select {SETUP} under the main menu.
- 2. Select {GRP COMBINATION}.
 - The GROUP COMBINATION window appears.

DATA	EDIT	DISPLAY	UTILITY	1224	1 😢 🔟 🛛	
GROUP COMBI GROUP AXI	GROUP COMBINATION GROUP AXIS MASTER					
R1 R2						
				_	1	
Main Men	J Simp	le Menu				

- 3. Press [SELECT].
 - The selection dialog box appears.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 🖍 🔞 🖓 🕂
GROUP COMBIN	ATION	MASTER		
ADD GROUP Vodify Group Delete Group				

- 4. Select "ADD GROUP."
 - The GROUP COMBI SET window appears.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 📶 🐼	個 🖵 🗄
GROUP COMBI NO.1 CO NO.2 CO MASTER	SET NTROL GROUP NTROL GROUP	14 4 ++++ +++++ ++++++	1		
EXECU	ITE	CANCEL			
Main Menu	Sim	ple Menu			

- 3 Jigless System
- 3.5 System Setup
- 5. Press [SELECT].
 - The selection dialog box appears.

ROUP CONBI SET NO.1 CONTROL GRO NO.2 CONTROL GRO MASTER	UP R1:R0B011 UP R2:R0B012 8#8	

- 6. Select a group axis to be set.
 - Set R2: ROBOT1 as "MASTER."

DATA	EDIT	DISPLAY	UTILITY	12 🗹 📶 📢	個 📮 🙌
GROUP COMBI	SET		3		
NO.1 CC NO.2 CC MASTER	INTROL GROUP INTROL GROUP	R1 R2 R1			
EXEC		CANCEL			
Main Men	u Simpl	e Menu			

- 7. Select "EXECUTE."
 - The GROUP COMBINATION window reappears.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 🖌	1 📢 🔞 📑	(†)
GROUP COMBI GROUP AXI	NATION S	MASTER				
R1 R2		51				
RI TR2		NI .				
Main Menu	J Simp	le Menu				

3 Jigless System

3.5 System Setup

3.5.2 Calibration between Manipulators

For a coordinated operation between manipulators, prior registration of the settings for mutual positioning is required.

This relationship is set by calibration between manipulators.

3.5.2.1 Calibration Tool Setting

- 1. Mount a tool for calibration on the manipulator.
 - Use a tool whose exact dimensions are known.



Tool for calibration

- 2. Select {ROBOT} under the main menu.
- 3. Select {TOOL}.
 - The TOOL window appears.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 🖬 😣	🔟 📑 🕀
TOOL TOOL NO.	: 0 / 64				
NAME S X Y Z	TANDARD TOOL 0.000 mm 0.000 mm 0.000 mm	R× 0. Ry 0. Rz 0.	.0000 deg. .0000 deg. .0000 deg.		
Xg T Yg T Zg T	0.000 kg 0.000 mm 0.000 mm 0.000 mm	I× I Iy I Iz I).000 kg.m2 kg.m2 .000 kg.m2		
Main Men	u Simpl	e Menu			

- 4. Enter the tool dimensions.
- 5. Press [ENTER].

3.5 System Setup

3.5.2.2 Teaching Position for Calibration

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

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





- 3 Jigless System
- 3.5 System Setup

3.5.2.3 Calibration

- 1. Select {ROBOT} under the main menu.
- 2. Select {ROBOT CALIB}.
 - The ROBOT CALIBRATION list window appears.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 🖌) 🙋 🖳 👘	
ROBOT CAL	IBRATION					
NO.	SET	ROBOT				
01	0					
02	0					
03	0					
04	0					
05	0					
0.6	0					
07	0					
08	0					
09	0					
10	0					
11	0					
12	0					
13	0					
14	0					
15	0					
16	0					
17	0					
18	0					
Main M	enu Sim	ole Menu				

- 3. Select a robot calibration No.
 - The ROBOT CALIBRATION window for teaching appears.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 📶 📢	i 🙋 📮 👘
ROBOT CALI	BRATION				
NO.: 01	ROBOT ATTE	805 POS < ST C1 C2 C3	ITION [C] ATUS > : ○ : ○ : ○		
COMPI	LETE	CANCE	-		
Main Men	u Simi	ole Menu			

- 3 Jigless System
- 3.5 System Setup
- 4. Select "ROBOT."
 - The selection dialog box appears. Select a control group for calibration.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 📶 😣	🔞 🖵 👘
ROBOT CALI	BRATION				
NO.: 01	ROBOT R1+B	2 P05 < ST C1 C2 C3	ITION [C] ATUS > : O : O : O		
COMP	LETE	CANCE			
Main Mer	u Simp	le Menu			

- 5. Select a group axis combination for calibration.
 - The teaching positions are displayed.

DATA	EDIT	DISPLAY	UTILITY	12	🗹 📶 🕅	3 10 🖵 🦛	
ROBOT CALIE	BRATION						
NO.: 01	ROBOT R1+R2	POS	ITION C1				
R1 :S	* TC)OL: 00 < ST	ATUS >				
L	*	C1	: 0				
U	*	C2	: 0				
R	*	C3	: 0				
В	*						
Т	*						
				_			_
COMPL	LETE	CANCE	L				
		CANAL AR	and a				
Main Men	u Simp	Le Menu					

- 6. Select a group axis combination.
 - The selection dialog box appears. Select a position to be taught.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 📶 🔞	🗃 🖳 🕀	
ROBOT CALIBRA NO.: 01 ROI RI :S L U R B T	TION BOT <u>R1+R</u> * * * * *	2 POS 200L: 00 < ST C1 C2 C3	ITION I TION I TION I O I O O I O I O O I O O I O O I O O I O O O I O O O I O O O O O O O O O O O O O O O O O O O			
COMPLET	E	CANCE	L			
Main Menu	Sim	ole Menu				

3 Jigless System

- 3.5 System Setup
- 7. Select "POSITION."
- 8. Press the axis key to move the manipulator to the desired position.
- 9. Press [MODIFY] and [ENTER].
 - The positions for calibration are registered.
 - Repeat Operations 6 to 8 to teach set positions C1 to C3.
 - On the window, "●" indicates that the teaching is completed while "O" indicates that the teaching is not completed.
 - The calibration positions appear according to the selected group axis.
 - Press the page key to change the window.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 🖬 🚷	🙋 📑 👘	
ROBOT CALL	BRATION					
NO.: 01	ROBOT R1+F	2 PO:	SITION C1			
R1 :S	4663 1	'OOL: 00 < S	TATUS >			
L	-7460	C1	: ●			
U	15336	C2	: 0			
R	14306	C3	: 0			
В	-4672					
Т	3114					
COMF	PLETE	CANCE	EL			
Main Me	nu Sim	ple Menu				

- 10. Select "COMPLETE."
 - The robots are calibrated.
 - When the calibration is completed, the ROBOT CALIBRATION list window reappears.

DATA		EDIT	DISPLAY	UTILITY	12 🗹 📶 😣	🙋 📑 👘
ROBOT CAL	IBRATI	ION				
NO.	SET		ROBOT			
01	٠		R1+R2			
02	0					
03	0					
04	0					
05	0					
06	0					
07	0					
08	0					
09	0					
10	0					
11	Ó					
12	0					
13	0					
14	0					
10	0					
10	8					
10	ŏ					
10	V					
Main M	enu	Simp	le Menu			

3 Jigless System System Setup

3.5

Alarm which is emitted when trouble occurs during calibration teaching

Alarm Number	Alarm Name	Sub Code	Meanings
4497	DEFECTIVE TAUGHT POINT(CALIB)	1	Some of the teaching points for master-group are on the same point.
		2	Some of the teaching points for slave-group are on the same point.
		3	The 2nd-axis positions of C3, C4, and C5 of station axes are not the same.
		4	The 1st-axis positions of C1, C2, and C3 of station axes are not the same.
		5	The 2nd-axis positions of C1, C2, and C3 of station axes are the same.
		6	The 1st-axis rotation direction of C3, C4, and C5 of station axes are not the same.
		7	The 1st-axis (elevation axis) positions of C1, C2, and C3 of station axes are not the same.
		8	The 1st-axis (elevation axis) positions of C3, C4, and C5 of station axes are not the same.

- 3 Jigless System
- 3.6 Job Content Display

3.6 Job Content Display

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

JOB	EDIT	DISPLAY	UTILIT*	8818246) 🔟 🖵 👆
JOB CONTENT J: TEST CONTROL GRO	: MASTER		S:0000 TOOL: **+**		
00000 NOP 0001 SMOYL +HKOVJ 0002 MOYL V +HKOVJ V 0003 END	V=138 ≔138 J=0.78				
MOVI V=13: +MOVJ VJ=0.	3 .78				
Main Men	u Simpl	e Menu			

OInstructions

For coordinated jobs, the move instruction, the weaving instruction, the shift instruction, and others are displayed in two lines.

The first line is the instruction to the slave side; the second line is the instruction to the master side.

SMOVL V=138 ←Slave, the manipulator holding a torch

+MOVL ←Master, the manipulator holding a workpiece

②Synchronized/Single

Synchronized/single are the types of movement available for the manipulator during axis operation.

This mark appears when synchronized movement is selected.

Switch between movements by pressing [SYNCRO/SINGLE].

3Group axis being handled

Displays the group axis being handled.

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

Coordinated operation/Individual operation

Switch between coordinated operation and individual operation by pressing [SMOV].

3 Jigless System

3.7 Synchronized/Single

3.7 Synchronized/Single

There are two ways to handle axes when teaching: "Synchronized" and "Single".

Switch between movements by pressing [SYNCRO/SINGLE].



3.7.1 Synchronized

If the axes are handled in the "Synchronized" mode, the slave (torch) follows the master (workpiece) when the master moves.

This feature is used to keep the position of the manipulator relative to the other manipulator.

However, the master does not move when the slave is moved.



- 3 Jigless System
- 3.7 Synchronized/Single

3.7.2 Single

If an axis is handled in "Single" mode, only the manipulator whose axis is being handled moves.

This feature is used where each of the two manipulators executes an individual job.





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

3 Jigless System

3.8 Selecting Axis to be Handled

3.8 Selecting Axis to be Handled

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

3.8.1 When There is an Edit Job

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

• Pressing [ROBOT] selects a manipulator for axis handling.

UTILITY 🗍 12 🗷 📶 🐝 🔟 🖵 🙌

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

UTILITY 10 🖻 📶 😣 🙋 📑 👘

3.8.2 When There is No Edit Job

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

- 1. Press [SHIFT]+[ROBOT] to change the manipulator to be handled.
 - The LED of [ROBOT] flashes.
- 2. Select the group axes to be moved, and then move it by pressing the axis key.
- 3. Press [ROBOT] to return to the original display.

- 3 Jigless System
- 3.9 Registering Job

3.9 Registering Job

- 1. Select {JOB} under the main menu.
- 2. Select {CREATE NEW JOB}.
 - The NEW JOB CREATE window appears.

JOB	EDIT	DISPLAY UTILI	19 🗹 📶 😣	個 📮 👘
NEW JOB CREATE JOB NAME COMMENT GROUP SET JOB TYPE	R R R R R R R R R R R R R R R R R R R		## ### ##	
EXECUTE		CANCEL		
Main Menu	Sim	ple Menu		

- 3. Enter a job name.
 - Select "JOB NAME," and then enter a job name by entering the characters.
 - Refer to "1.2.6 Character Input" of the Operator's Manual.
- 4. Press [ENTER].
- 5. Select "GROUP SET."
- 6. Select a group combination.
- 7. Select "EXECUTE.
 - The job name is registered in the memory of DX100, and the JOB CONTENT window appears.

- 3 Jigless System
- 3.10 Registering Move Instruction (S)MOV □+MOV □

3.10 Registering Move Instruction (S)MOV 🗆 + MOV 🗆

Register a move instruction in the following manner.

3.10.1 Operating Master Side (Workpiece)

- 1. Call the JOB CONTENT window in teach mode.
- 2. Press [ROBOT].
 - The master side (manipulator) is selected for axis handling.

UTILITY 12 🗹 🖬 😪 🐻 🖵 🙌

- 3. Select either "synchronized" or "single."
 - Press [SYNCRO/SINGLE] to select either "synchronized" or "single."
 - When "synchronized" is selected, the mark in the window below appears.

When the slave side is supposed to follow the master side motion, select "synchronized."

- When "single" is selected, the mark in the window below appears.

Single→ _____ 1₀ 🗹 📶 🗞 🔞 🕞 👘

- 4. Press the axis key to move to the desired position.
- 5. Select an interpolation type.
 - Press [MOTION TYPE] to select an interpolation type.



Jigless System

3.10 Registering Move Instruction (S)MOV □+MOV □

3.10.2 SMOV - + MOV - rate specification

3.10.2.1 Rate specification in a multiple line shift command

3

The relationship between the rate specification in a shift commnad which causes multiple groups such as "MOV \Box + MOVJ" or "SMOV \Box + MOVJ" to operate (i.e. to be configured by multiple lines), simultaneously, and the actual operation rate, is as follows.

- Each shift time for the robot (or station) is obtained according to the rate specified for each line.
- The maximum of the respective shift times is obtained, and all groups are operated according to this maximum shift time.

<Example>

MOVL V = 500.0 \cdots The shift time over the shift distance is 2 seconds at V = 500

+MOVJ VJ = 25.00···The shift time for the shift amount is 4 seconds at VJ = 25

*This "MOVL + MOVJ" functions when the shift time is 4 seconds.

Note that for lines in which the rate specification is omitted, the shift time is calculated based on the assumption that the maximum rate has been specified.

<Example>

MOVL V = 500.0 ··· The shift time	over the shift distance is 2 seconds at
V = 500	

+MOVJ VJ ····The shift time for the shift amount is 1 seconds at VJ = 25

*This "MOVL + MOVJ" functions when the shift time is 2 seconds.

3.10.2.2 Rate specification at coordination interpolation (SMOV □)

The rate specification for the manipulator on the slave side at coordination interpolation (SMOV \Box) is specified as "relative rate" as seem from the master side.

For example, in arc welding, in the case where the slave side manipulator holds the welding torch, this "relative rate" becomes the "welding rate" with respect to the work piece, so it is important to maintain this rate. In this case, by omitting the rate specification on the master side, the shift

rate will be basically determined by the "relative rate."

<Example>

MOVL V = 100.0	···The shift time at V = 100 over the relative shift dis-
	tance on the slave side with respect to the master
	is 5 seconds.
+MOVJ VJ	···The shift time at VJ = 100 for the master shift
	amount is 2 seconds.

*This "SMOVL + MOVJ" functions when the shift time is 5 seconds.

3

 3
 Jigless System

 3.10
 Registering Move Instruction (S)MOV □+MOV □

Parameter	Contents a	nd Set Valu	Ie				Initial Value
S2C212	+MOV INST	RUCTION	SPEED INPUT				0
	Specifies wh coordinated	nether the s job is perm	peed inputting for n itted or not.	nove instru	ctions of the	master side robot in a	
	<exampl< th=""><th>e> 0: Not F</th><th>Provided</th><th>1: Provid</th><th>ded</th><th></th><th></th></exampl<>	e> 0: Not F	Provided	1: Provid	ded		
	SMOVL	V=100		SMOVL	V=100		
	+MOVJ		$\leftarrow \text{Master side}$	+MOVJ	VJ=10.00	\leftarrow Master side	
			Speed specifica- — tion not provided			Speed specifica- tion provided	

- 3 Jigless System
- 3.10 Registering Move Instruction (S)MOV □+MOV □

3.10.3 Operating Slave Side (Torch)

- 1. Press [ROBOT].
 - The slave side (manipulator) is selected for axis handling.

UTILITY 🛛 🏖 🛌 🎽 📢 🐻 📮 🙌

- 2. Press the axis key to move to the desired position.
- 3. Select either a coordinated interpolation or an independent interpolation.
 - Press [SMOV] to select either interpolation.
- 4. Select an interpolation type.

SMOVL V=138 +MOVJ

- Press [MOTION TYPE] to select an interpolation type.

SMOVC V=138		
+MOVJ		

- 5. Confirm the speed.
- 6. Press [ENTER].
 - The registration is completed as follows.

0003 SMOVC V=138 +MOVJ



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

- 3 Jigless System
- 3.11 Registering Reference Point Instruction (SREFP)

3.11 Registering Reference Point Instruction (SREFP)

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

- 1. Select {JOB} under the main menu.
- 2. Select {JOB}.
- 3. Move the cursor.
 - Move the cursor to the line immediately before the line where the reference point instruction is to be registered.

1	0016	SMOVL V=658
		+MOYJ
	0017	CALL JOB: WORK-A
	0018	SMOVL V=658
		+MOVJ

- 4. Grasp the Enable switch.
 - Turn ON the servo power with the Enable switch.



- 5. Press the axis key.
 - Move the manipulator to the position which will be a reference point.
- 6. Select the coordinated interpolation.
 - Press [SMOV] to select either interpolation.
- 7. Press [REF PNT].

SREFP 1

SREP

- The reference point instruction appears in the input buffer line.



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

				-
Þ	2			
	4			

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



- 9. Press [INSERT].
 - The [INSERT] key lamp lights up.
 - When registering immediately before the END instruction, pressing [INSERT] is not needed.
- 10. Press [ENTER].
 - The REFP instruction is registered.



- 3 Jigless System
- 3.12 Registering Handling Instructions

3.12 Registering Handling Instructions

To register handling instructions, the specific keys [TOOL1 ON], [TOOL1 OFF], [TOOL2 ON], and [TOOL2 OFF] are used.

When these keys are pressed, the instructions shown in the following table are registered.

The general output signals #17 to 20 and the general input signals #17 to 20 are used for handling.

ΤοοΙ		Specific key	General Output Signal No. (Instruction Output)	General Input Signal No. (Confirmation Input)	Instruction to be Registered
Tool 1	Open		#17	#17	CALL JOB: H1OPEN
	Close	· C TOOL1 OFF	#18	#18	CALL JOB: H1CLOSE
Tool 2	Open	3 TOOL2 ON	#19	#19	CALL JOB: H2OPEN
	Close	- D TOOL2 OFF	#20	#20	CALL JOB: H2CLOSE

Also by registering a CALL instruction from the instruction list dialog, the instructions in the above table can be registered.

The H1OPEN, H1CLOSE, H2OPEN, and H2CLOSE are reserved jobs. The job contents must have been registered beforehand. Register a handling instruction according to the application.

An example of H1OPEN registration is shown.

<Example>

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

NOP

PULSE OT#17···H1OPEN instruction 0.3 second pulse output WAIT IN#17···Waits for confirmation of H1OPEN RET

3 Jigless System

3.13 Other Convenient Features

3.13 Other Convenient Features

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



3.13.1 Example of Movement



- 3 Jigless System
- 3.13 Other Convenient Features

3.13.2 Operation Method

- 1. Select the tool coordinate system.
 - Press [COORD] and select a tool coordinate system.
- 2. Press [SHIFT] + [COORD].
 - The switch to tool coordination display is shown.

DATA	EDIT	DISPLAY	UTILITY) 12 🗹 🖌	👒 🙋 🖳	(+)
SWITCH TO ROBOT	TOOL COORD : R1					
CONTROL	POINT : R1	T00L00 T00L01	l			
		_		_		
Main Mer	nu Simpl	e Menu				

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

- 3 Jigless System
- 3.13 Other Convenient Features

3.13.3 Manipulator Movement

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

Axis Name	Axis Key	Movement
Basic axes	X: X+ S: Y+ Y- Z: Z+ Z+ Z+ Z+ Z+ Z+ Z+ Z+ Z+ Z+ Z+ Z+ Z+ Z	Moves in parallel to X, Y, and Z-axis of tool coordinates of the selected manipulator.
Wrist axes		With the tool center point of the selected manipulator as a reference point, TCP fixed operation is executed.

3.13.3.1 Basic axes



DX100	3 Jigless System3.13 Other Convenient Features
3.13.3.2 Wrist axes	
	Executing a TCP fixed operation by wrist axes, can change only the wrist orientation without changing its position, with the tool center point of the slave side manipulator as a reference point.
	TCP fixed operation

3.13.3.3 Synchronized/Single

■ When "synchronized" is selected:

The master moves with the tool center point of the slave as a reference point.

The slave follows the master.



■ When "single" is selected:

The master moves with the tool center point of the slave as a reference point.

The slave remains stationary.



4.1 Outline

4 Twin Synchronous System

4.1 Outline

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



In this system, two coordinated jobs are done at the same time.

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

A concurrent job or a robot job without control groups starts these two jobs and implements I/O control.

The master task job uses the independent control function to start the robot jobs of subtasks 1 and 2.

4 Twin Synchronous System

4.1 Outline

Two robot jobs can be created by the following two methods.

Method 1:

Copy one subtask job to create another subtask job.



This method is useful when two movement paths are symmetrical.

Use the mirror shift function to convert a job path and copy it. The same teaching operation does not have to be repeated.

Method 2:

Perform teaching for each manipulator.



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

- 4 Twin Synchronous System
- 4.2 Function Keys

4.2 Function Keys

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

4.2.1 Arc Welding Application


1 TIMER	Registers a timer instruction "TIMER" in a job.
0 REFP	Registers a reference point "REFP" in a job, or modifies the registered reference point. [REFP]+ [FWD] Moves the manipulator to the registered reference point
8 ARCON	Registers a welding start instruction "ARCON."
5 ARCOFF	Registers a welding end instruction "ARCOF."
2 GAS	Use when performing a gas check. Gas is fed only while [Gas] is pressed. (Refer to "Chapter 9.3.2 Gas Flow Control Function" at page 9-7 in the Operator's Manual.)
9 K FEED	Used for wire inching. Press [FEED] to feed the wire, and press [RETRACT] to retract the wire. While these keys are pressed, the wire feed motor operates.
6 K	The feed rate can be switched through 3 steps. [FEED] : Low speed [FEED] + [FAST] : Middle speed [FEED] + [HIGH SPEED] : High speed
3 CUR/VOL	The retract speedfeed rate can be switched through 3 steps. [RETRACT] : Low speed [RETRACT] + [HIGH SPEED] : High speed (Refer to "Chapter 9.3.1 Wire Inching Function" at page 9-7 in the Operator's Manual.) Modifies the welding current/voltage while welding during the play mode. Press [3/CUR/VOL] to increase the current/voltage value, and press [-/CUR/VOL] to decrease the current/voltage value. (Refer to "Chapter 9.13 Changing Welding Conditions During Playback" at page 9-134 in the Operator's Manual.)
7 SYNCRO SINGLE	 Changes the type of movement for the manipulator when teaching a coordinated job. Each time this key is pressed, the movement type changes. SYNCRO: The mark for "synchronized" appears in the status display area. When the master side is moved, the slave side will follow the movement of the master. SINGLE: Only the selected group axis moves.

4.2 **Function Keys**



Selects either a coordinated or an individual interpolation when teaching a coordinated job.

Each time this key is pressed, the operation type changes.

Coordinated: All the move instructions that are registered in this mode become coordinated instructions. Individual: The master-slave relationship is cancelled. Each

manipulator and station moves independently.



Wire retraction, high-speed inching, or high-speed retraction cannot be performed depending on the Power Source.

4 Twin Synchronous System

4.2 Function Keys

4.2.2 General Application



	Registers the TOOLON instruction.
2 TOOL ON	If [INTERLOCK] is pressed simultaneously, the TOOLON operation is executed.
	Registers the TOOLOF instruction.
• TOOLOF	If [INTERLOCK] is pressed simultaneously, the TOOLOFF operation is executed.
3 TOOL ON JOB	Registers the CALL instruction for the reserved job TOOLONxx.
TOOL OF JOB	Registers the CALL instruction for the reserved job TOOLOFxx.
7 SYNCRO SINGLE	Changes the type of movement for the manipulator when teaching a coordinated job. Each time this key is pressed, the movement type changes. SYNCRO: The mark for "synchronized" appears in the status display area. When the master side is moved, the slave side will follow the movement of the master. SINGLE: Only the selected group axis moves.
4 SMOV	Selects either a coordinated or an individual interpolation when teaching a coordinated job. Each time this key is pressed, the operation type changes. Coordinated: All the move instructions that are registered in this mode become coordinated instructions. Individual: The master-slave relationship is cancelled. Each manipulator and station moves independently.

- 4 Twin Synchronous System
- 4.3 Job Configuration

4.3 Job Configuration

Using the independent control function, configure jobs so that the concurrent job or robot job without control groups of master task operates the robot jobs in subtask 1 and 2.

Master task: Concurrent job (or robot job without control groups) Starts subtasks 1 and 2, and controls I/Os.

Subtask 1: Robot job

A coordinated job for one manipulator + the station

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

Subtasks 1 and 2 are determined as leader or follower with a tag SYNC in PSTART instruction.



4.4 Leader and Follower

4.4 Leader and Follower

Set either the subtask 1 or the subtask 2 as the follower.

To set a follower, add a tag SYNC and the leader subtask to the PSTART instruction of the master task.

The subtask to which a tag SYNC is added is follower while the subtask without a tag is leader.

The station axis is controlled by the leader job, and the follower job follows the movement of station axis.

		Subtook 1 (follower)
0004 PSTART JOB:JOB-1 SUB1 SYNC SUB2	•	- Sublask T (Iollower)
0005 PSTART JOB:JOB-2 SUB2		- Subtask 2 (leader)
 Master task job		In this case, the manipulator of subtask 1
-		synchronizes with the leader subtask 2



Register a PSTART instruction so that the follower job starts first.

If the PSTART command is not executed correctly, alarm 4103 will be emitted.

When an alarm is emitted, check the sub-code, and correct the job.

<Example>

PSTART JOB	: R1S1 SUB1
PSTART JOB	: R2 SUB1
	AL-4103: [1] Sub task being executed:
	During execution of SUB1, an attempt is being
	made to start a different job in the same SUB1.
PSTART JOB	: R1S1 SUB1
	(R1S1: A job for the robot 1 and the station 1)
PSTART JOB	: R2S1 SUB2
	(R2S1: A job for the robot 2 and the station 1)
	AL-4103 [2] Group axis being used:
	An attempt is being made to execute a job contain-
	ing station 1 in SUB2, despite the fact that station 1
	is being used by SUB1.
PSTART JOB	: R2S1 SUB2 SYNC SUB1
PSTART JOB	: R1S1 SUB1
	"Station twin coordination" is being correctly exe-
	cuted.

4 Twin Synchronous System4.4 Leader and Follower

Alarm Number	Alarm Name	Sub Code	Meanings				
4103	PARALLEL START INSTRUCTION ERROR	1	Sub task being executed: Although a job is being executed by instructed sub task, an attempt was made to execute another job by the sub task.				
		2	Group axis being used: The job operated by another sub task uses the same group axis.				
		3	Multiple start of same job: timing for start command again. The job that was tried to be started was executed by another sub task.				
						4	Unregistered master job: Although the master job was not registered, an attempt was made to execute PSTART SUB (job name omitted).
		5	Synchronization instruction error: When restarted by PSTART, synchronization instruction status of the sub task under interruption was different from the status to restart.				
				6	Stopped by an alarm: An attempt was made to start the sub task which is stopped by an alarm.		
						7	Synchronization task specification of SYNC instruction omit error
		9	I/O jog being executed				
		10	Separate group axis being used				
		11	The servo power supply is OFF.				
		12	Twin synchronous task ID error				
		16	PSTART instruction is the old specification.				
		17	PWAIT instruction is the old specification.				

- 4 Twin Synchronous System
- 4.5 Synchronizing with TSYNC

4.5 Synchronizing with TSYNC

4.5.1 Format



4.5.2 Procedure

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

When a TSYNC instruction is executed in one of the robot jobs, the manipulator waits until the same synchronized signal, TSYNC, is executed in the other robot job.

Set the number of synchronized tasks.

When setting "SYNCHRO NUM" to "UNUSED," the number of tasks is the same as when "SNUM=2."

- 1. Move the cursor to the line just above the line where TSYNC instruction is to be registered.
- 2. Press [INFORM LIST].
 - The instruction list appears.

	0	IN/OUT
JUMP	TSYNC	CONTROL
CALL		DEVICE
TIMER		MOTION
LABEL		ARITH
COMMENT		SHIFT
RET		OTHER
PSTART		SAME
PWAIT		PRIOR

3. Select "TSYNC."

- A TSYNC instruction is displayed in the input buffer line.

DX100)
-------	---

- 4 Twin Synchronous System
- 4.5 Synchronizing with TSYNC
- 4. Change additional items.
 - <To register items as displayed in the input buffer line> Proceed to Operation 5.
 - <To change the numerical data>
 - (1) Move the cursor to the numerical data.
 - (2) Press [SHIFT] and the cursor key simultaneously to increment or decrement the number.



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



- (4) Enter a number and press [ENTER], then the number in the input buffer line is changed.
- (5) After having changed the numerical data, press [ENTER]. The DETAIL EDIT window is closed and the the JOB CONTENT window reappears.

- <To edit additional items>

 To edit additional items, move the cursor to the instruction in the input buffer line, then press [SELECT]. The DETAIL EDIT window appears.

JOB	EDIT	DISPLAY	UTILITY	12 🛙	1	10 📮 🤚	6
DETAIL EDIT TSYNC							
SYNCHRO NU. Synchro num	UNUSED						
TSYNC 1							
Main Menu	Sim	ple Menu					

- 4 Twin Synchronous System
- 4.5 Synchronizing with TSYNC
 - (2) To change the synchronization number, select "1" of "SYNCHRO NO."

When the number input status enters, enter the synchronization number, "SYNCHRO NO." by pressing the Numeric keys, and press [ENTER].

JOB	EDIT	DISPLAY	UTILITY	12 🕑	📶 😪 [0 🖵 🗄	
DETAIL EDIT TSYNC							
SYNCHRO NO. Synchro num	UNUSED						
TSYNC 2							
Main Menu	Simple	e Menu					

(3) To add the number of synchronized tasks, select "UNUSED" of "SYNCHRO NUM."

The selection dialog box appears. Select "SNUM=."

JOB	EDIT	DISPLAY	UTILIT	18	2 📶 🛛	🕺 🙋 🖳	(
DETAIL EDIT TSYNC							
SYNCHRO NO. SYNCHRO NUM	2 SNUM= 2	9					
	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~						
TSYNC 2 SNUM=:	2						
Main Menu	Simpl	e Menu					

- (4) After changed or added the additional items, press [ENTER].
- (5) The DETAIL EDIT window is closed, and the JOB CONTENT window appears.

- Twin Synchronous System Synchronizing with TSYNC 4
- 4.5

### 5. Press [INSERT] and [ENTER].

- The instruction displayed in the input buffer line is registered.

NOP TSYNC 1 <del>(</del> MOVJ +MQVJ	NOP TSYNC 1 MOVJ +MOVJ	Synchronizes at the start of job.
i SMOVL +MOVJ TSYNC 2 ARCON I ARCOF SMOVL +MOVJ	SMOVL +MOVJ TSYNC 2 ARCON ARCOF SMOVL +MOVJ	Synchronizes just before the start of work (in this case, welding) Synchronizes just
TSYNC 3 DOUT OT#(1)=OFF MOVJ +MOVJ END	TSYNC 3 DOUT OT#(2)=OFF MOVJ +MOVJ END	after the end of work.

4.5 Synchronizing with TSYNC

#### 4.5.3 Items to note when using a TSYNC command

Note that even when TSYNC is being used, the steps of two manipulators will fail to match each other if the following operations are performed.

#### 4.5.3.1 When a cursor shift occurs during operation

If the cursor position is shifted to a different step during the execution of a job of one of the two sub-tasks when the robot stops during operation, and the robot is restarted while remaining in this condition, the steps will become misaligned, resulting in the risk of interference from the jig, for example.



Start both jobs from the same position (step).

In this case, the steps become misaligned, which may cause the manipulator to interfere with the work piece or the jig.

In this case, the steps do not become misaligned, so normal operation can take place.

If the set number of synchronizations is less than the number of tasks to be synchronized, the robot will be commanded as soon as the TSYNC commands corresponding to the set number of synchronizations are output, and the jobs that cannot be synchronized will remain stopped.

4 Twin Synchronous System4.5 Synchronizing with TSYNC

4.5.3.2 If three jobs were set when the number of TSYNC synchronizations was set to "Unused"

The two jobs that become synchronized first continue to move, and the third job remains stopped.



The two jobs that become synchronized first continue to move.

The job cannot be synchronized, and remains stopped.

- 4 Twin Synchronous System
- 4.6 Job Example

### 4.6 Job Example



- 4 Twin Synchronous System
- 4.7 JOB CONTENT Window

### 4.7 JOB CONTENT Window

The contents of coordinated job are displayed as shown below.

JOB	EDIT	DISPLAY	UTILIT	10246	) 🚾 🖵 🕀
JOB CONTENT J: TEST CONTROL GRO	: MASTER UP: R1+S1:S1		S:0000 TOOL: **+**		
0001 SMOVL +MOVJ 0002 MOVL V +MOVL V	V=138 =138 J=0.78				
0003 END					
+MOVJ VJ=0.	78				~
_					
Main Men	J Simpl	e Menu			

#### **① Instructions**

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

SMOVL V=138 ←Slave, a manipulator

+MOVJ ←Master, a station

### ② Synchronized/Single

Synchronized/single are the types of movement available for the manipulator during axis operation.

This mark appears when synchronized movement is selected.

Switch between movements by pressing [SYNCRO/SINGLE].

#### **3 Group axis being handled**

Displays the group axis being handled.

Pressing [ROBOT] selects the manipulator.

Pressing [EX. AXIS] selects the station.

#### ④ Coordinated interpolation/Individual interpolation

Changes between coordinated interpolation and individual interpolation by pressing [SMOV].

- 4 Twin Synchronous System
- 4.8 Synchronized/Single

### 4.8 Synchronized/Single

#### 4.8.1 Synchronized/Single Movement Between Station and Manipulator

There are two ways to handle axes when teaching: "Synchronized" and "Single."

Switch between movements by pressing [SYNCRO/SINGLE].



#### 4.8.1.1 Synchronized

If the axes are handled in the "Synchronized" mode, the slave (manipulator) follows the master (station) when the master moves.

This feature is used to keep the position of the manipulator relative to the station.

However, the master does not move when the slave is moved.



#### A master axis is moved:

DX100	<ul> <li>4 Twin Synchronous System</li> <li>4.8 Synchronized/Single</li> </ul>
4.8.1.2 Single	
	If an axis is handled in "Single" mode, the manipulator or the station whose axis has been handled, moves.

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

### A slave axis is moved:



### A master axis is moved:





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

4.8 Synchronized/Single

#### 4.8.2 Job Synchronized Mode for Subtask 1 and 2

When moving only the leader manipulator in FWD/BWD operation, the follower manipulator in stop status may interfere with a workpiece.

To prevent this, using "job synchronized mode" can move the follower synchronizing the motion of the leader.

The follower manipulator moves, keeping the relative position to the station.



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

Main Menu	Simple Menu	Twin coordinated mode OFF	

Also in the TEACHING CONDITION window, the job synchronized mode can be set and confirmed.

- 1. Select {SETUP} under the main menu.
- 2. Select {TEACHING COND}.
  - The TEACHING CONDITION window appears.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 🐋 🗃 🖵 👘
TEACHING CON LANGUAGE LI	NDITION SETT	ING	SUBSET	
INSTRUCTION INPUT LEARNING MOVE INSTRUCTION SET POSITION			VALID STEP	
BUZZER WHEN POSITION TEACHING STEP ONLY CHANGING			PROHIBIT	
TOOL NO. SI	TOOL NO. SWITCH			
POS.TEACH I JOB UNDELE	POS.TEACH ONLY JOG CONTROL GROUP JOB UNDELETE FUNCTION			
INDEPENDEN BWD OPERAT	T:MOTION OF	NEXT/TEST AXIS	SINGLE PERMIT	
BWD OPERAT STATION TW	ION CONCURRE	NT JOB	INVAL ID	
		_		
Main Menu	Simp	e Menu		

- 4 Twin Synchronous System
- 4.8 Synchronized/Single
- 3. Select "TWIN COORDINATED MODE."
  - Each time [SELECT] is pressed, "VALID" and "INVALID" is selected alternately.

D	ATA	EDIT	DISPLAY	UTILIT	18	≥ 📶 🛛	🕄 🔞	ə ( <del>†</del> )	
TEAO LAM INS MOV BUZ STE REC TOO TOO TOO TOO TOO TOO TOO TOO STA	HING COND IGUAGE LEV ITRUCTION 'E INSTRUC ZER WHEN IP ONLY CH T/CYLINDR IL NO. SWI IL NO. SWI IL NO. SWI L NO. INTE :TEACH ON DEPENDENT: DOPERATIO DOPERATIO DOPERATIO TION TWIN	ITION SETT EL INPUT LEAR POSITION T ANGING ICAL TCH RLOCK FOR FUNCTION MOTION OF N NO GROUPN CONCURRE	ING NING EACHING STEP ENTRY TROL GROUP NEXT/TEST AXIS NT JOB	SUBSET VALID STEP CONSIDER PROHIBIT RECT PERMIT INVALID SINGLE PERMIT PROHIBIT INVALID					
M	ain Menu	Simp	le Menu						



The job synchronized mode is enabled only when "SINGLE" is selected in "STEP/TEST RUN OPERATION MODE" for the follower manipulator.

- 4 Twin Synchronous System
- 4.9 Selecting Axis to be Handled

### 4.9 Selecting Axis to be Handled

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

#### 4.9.1 When There is an Edit Job

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

• Pressing [ROBOT] selects a manipulator for axis handling.

UTILITY | 12 🗹 📶 😢 🚾 🖵 🙌

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



#### 4.9.2 When There is No Edit Job

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

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

- 4 Twin Synchronous System
- 4.10 Registering Job

### 4.10 Registering Job

- 1. Select {JOB} under the main menu.
- 2. Select {CREATE NEW JOB}.
  - The NEW JOB CREATE window appears.?

	DIT DIS	SPLAY UTILI	n 🛛 🕄 📶 🕏	3 10 📮 🙌
NEW JOB CREATE JOB NAME COMMENT GROUP SET JOB TYPE	########## R1+\$1:\$1 R0B0T J0B			
EXECUTE		CANCEL		
Main Menu	Simple Mer	iu.		

- 3. Enter a job name.
  - Select "JOB NAME," and then enter a job name by entering the characters.
  - Refer to "1.2.6 Character Input" of the Operator's Manual.
- 4. Press [ENTER].
- 5. Select "GROUP SET."
- 6. Select a group combination.
- 7. Select "EXECUTE."
  - The job name is registered in the memory of DX100, and the JOB CONTENT window appears.

- Twin Synchronous System
- 4.11 Registering Move Instruction (S)MOV □+MOVJ

### 4.11 Registering Move Instruction (S)MOV □+MOVJ

Register a move instruction in the following manner.

#### 4.11.1 Operating Master Side (Station)

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- 1. Call the JOB CONTENT window in teach mode.
- 2. Press [EX. AXIS].
  - The master side (station) is selected for axis handling.



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- 3. Select either "synchronized" or "single."
  - Press [SYNCRO/SINGLE] to select either "synchronized" or "single."
  - When "synchronized" is selected, the mark in the window below appears.
    - When the slave side is supposed to follow the master side motion, select "synchronized."

Synchronized→

- When "single" is selected, the mark in the window below appears.

UTILITY

UTILITY	] 1.9 🗳 📶 🐯 🕲 🕞 🙌
	UTILITY

4. Press the axis key to move to the desired position.

DX100	4       Twin Synchronous System         0X100       4.11         Registering Move Instruction (S)MOV □+MOVJ			
4.11.2 O	erating Slave Side (Manipulator)			
	1. Press [EX. AXIS].			
	<ul> <li>The slave side (manipulator) is selected for axis handling.</li> </ul>			
	2. Press the axis key to move to the desired position.			
	<ul> <li>Select either a coordinated interpolation or an independent interpolation.</li> </ul>			
	<ul> <li>Press [SMOV] to select either interpolation.</li> </ul>			
	SMOVL V=138 +MOVJ			
	3. Select an interpolation type.			
	<ul> <li>Press [MOTION TYPE] to select an interpolation type.</li> </ul>			
	4. Confirm the speed.			
	5. Press [ENTER].			
	<ul> <li>The registration is completed as follows.</li> </ul>			
	0003 SMOVC V=188 +MOVJ			
	• When joint motion is set for the slave side (manipulato teaching cannot be done during a coordinated interpolition.	or), da-		
	<ul> <li>When "JOINT" is selected, the interpolation type will ne change to a coordinated interpolation, even if [SMOV] pressed.</li> </ul>	not ] is		
	<ul> <li>When "JOINT" is selected during coordinated interpolation, a coordinated move instruction such as "SMOVL" the input buffer line changes to "MOVJ," and the interpolation type becomes individual interpolation.</li> </ul>	a- ." in pola-		
Parameter	Contents and Set Value Ini Va	itial alue		

		value
S2C213	+MOV INSTRUCTION INTERPOLATION INPUT	2
	This parameter specifies which interpolation is permitted for move instructions for the master robot in a coordinated job.(bit specification)	
	D0 : +MOVJ D1 : +MOVL D2 : +MOVC D3 : +MOVS	

#### 4.11 Registering Move Instruction (S)MOV □+MOVJ

#### 4.11.3 (S) MOV □ + MOVJ rate specification

4.11.3.1 Rate specification in a multiple line shift command

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The relationship between the rate specification in a shift commnad which causes multiple groups such as "MOV  $\Box$  + MOVJ" or "SMOV  $\Box$  + MOVJ" to operate (i.e. to be configured by multiple lines), simultaneously, and the actual operation rate, is as follows.

- Each shift time for the robot (or station) is obtained according to the rate specified for each line.
- The maximum of the respective shift times is obtained, and all groups are operated according to this maximum shift time.

#### <Example>

MOVL V = 500.0  $\cdots$  The shift time over the shift distance is 2 seconds at V = 500

+MOVJ VJ = 25.00...The shift time for the shift amount is 4 seconds at VJ = 25

*This "MOVL + MOVJ" functions when the shift time is 4 seconds.

Note that for lines in which the rate specification is omitted, the shift time is calculated based on the assumption that the maximum rate has been specified.

#### <Example>

MOVL V = 500.0 ··	<ul> <li>The shift time over the</li> </ul>	shift distance is 2	seconds at
	V = 500		

+MOVJ VJ ····The shift time for the shift amount is 1 seconds at VJ = 25

*This "MOVL + MOVJ" functions when the shift time is 2 seconds.

4.11.3.2 Rate specification at coordination interpolation (SMOV □)

The rate specification for the manipulator on the slave side at coordination interpolation (SMOV  $\Box$ ) is specified as "relative rate" as seem from the master side.

For example, in arc welding, in the case where the slave side manipulator holds the welding torch, this "relative rate" becomes the "welding rate" with respect to the work piece, so it is important to maintain this rate. In this case, by omitting the rate specification on the master side, the shift rate will be basically determined by the "relative rate."

#### <Example>

MOVL V = 100.0	$\cdots$ The shift time at V = 100 over the relative shift dis-
	tance on the slave side with respect to the master
	is 5 seconds.
+MOVJ VJ	···The shift time at VJ = 100 for the master shift
	amount is 2 seconds.
*This "SMOVL +	MOVJ" functions when the shift time is 5 seconds.

4 Twin Synchronous System4.11 Registering Move Instruction (S)MOV □+MOVJ

Parameter	Contents and Set Value		Initial Value			
S2C212	+MOV INSTRUCTION SPEED INPUT Specifies whether the speed inputting for move instructions of the master side robot in a coordinated job is permitted or not.					
	<example> 0: Not Provided SMOVL V=100 +MOVJ ← Master sid Speed specif tion not provided</example>	1: Provided         SMOVL       V=100         de       +MOVJ       VJ=10.00         fica-       ✓       Speed specifica-         ided       ✓       tion provided				

- Twin Synchronous System
- 4.12 Registering Reference Point Instruction (SREFP)

### 4.12 Registering Reference Point Instruction (SREFP)

Register a reference point instruction (SPEFP) for a coordinated interpolation in the following manner.

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

4

- 3. Move the cursor.
  - Move the cursor to the line immediately before the line where the reference point instruction is to be registered.

0016	SMOVL V=658
	+MOVJ
0017	CALL JOB: WORK-A
0018	SMOVL V=658
	+MOV.

- 4. Grasp the Enable switch.
  - Turn ON the servo power with the Enable switch.



- 5. Press the axis key.
  - Turn ON the servo power with the Enable switch. Move the manipulator to the position which will be a reference point.
- 6. Select the coordinated interpolation.
  - Press [SMOV] to select a coordinated operation.
- 7. Press [REF PNT].
  - The reference point instruction appears in the input buffer line.



- 8. Change the reference point number.
  - Move the cursor to the reference point number, and press [SHIFT] + the cursor key to change the reference point number.



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



- 9. Press [INSERT].
  - The [INSERT] key lamp lights up.
  - When registering immediately before the END instruction, pressing [INSERT] is not needed.
- 10. Press [ENTER].

- 4 Twin Synchronous System
- 4.13 Switching Tasks
  - The REFP instruction is registered.
    - 0016 SMOVL V=858 +MOVJ 0017 CALL JOB:WORK-A 0018 SREFP 1 0019 SMOVL V=658 +MOVJ

### 4.13 Switching Tasks

To call the JOB CONTENT window for master task, subtask 1 or subtask 2, proceed the following operation.

- 1. Select {JOB} under the main menu.
- 2. Select {JOB}.
- 3. Press the page key 🚺 .

- Twin Synchronous System
- 4.14 Creating a Job in a Subtask Method 1 and 2

### 4.14 Creating a Job in a Subtask - Method 1 and 2

Subtasks 1 and 2 are robot jobs.

Subtask 1: Job of one manipulator + the station

Subtask 2: Job of the other manipulator + the station

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

#### Method 1:

4

Copy one subtask job to create another subtask.



This method is useful when two movement paths are symmetrical.

Use the mirror shift function to convert a job path and copy it. The same teaching operation does not have to be repeated.

#### Method 2

Perform teaching for each manipulator.



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

#### 4.14 Creating a Job in a Subtask - Method 1 and 2

#### 4.14.1 Method 1: Copy One Subtask Job and Create Another Job

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

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



Correct positional dislocation as necessary.

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



#### 4.14.2 Teaching and Mirror Shift

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



#### DX100

- Twin Synchronous System
- 4.14 Creating a Job in a Subtask Method 1 and 2

#### 4.14.2.1 Converting

Call the JOB CONTENT window for the job to be converted.

- For the job currently selected
  - 1. Select {JOB} under the main menu.
  - 2. Select {JOB}.

4

#### ■ To call another job

- 1. Select {JOB} under the main menu.
- 2. Select {SELECT JOB}.
  - The JOB LIST window appears.
- 3. Select a job to be displayed.

#### 4.14.2.2 Execute conversion

#### Fig. 4-1: MIRROR SHIFT window

DATA EDI	T DISPLAY	UTILITY	] 12 🕑 🖌	🛯 🖏 🐻 🖳	<b>(</b> †)
MIRROR SHIFT SOURCE JOB SOURCE CTRL GROU STEP SECTION DESTINATION JOB DESTINATION CTRL COORDINATES USER COORD NO. TARGET	P R1+S1:S (0001]-> JOB2 GROUP R24515 (## ## ##				
EXECUTE	CANCEL	-			
Main Menu	Simple Menu				

#### **OSOURCE JOB**

Selects the conversion source job.

To select another job to be converted, move the cursor to the name and press [SELECT] to call up the list of jobs. Select the desired job and press [SELECT].

#### **©SOURCE CTRL GROUP**

Displays the control group of the conversion source job.

#### **3STEP SELECTION**

Specifies the steps to be converted.

From the first step to the last step of the selected job are specified as initial value.

#### **@DESTINATION JOB**

Specifies the converted job name.

To enter the name, move the cursor to the name and press [SELECT]. The name of the conversion source job is displayed in the input line as initial value. When "***" is displayed, the name for the converted job is to be the same as that of the conversion source job.

- 4 Twin Synchronous System
- 4.14 Creating a Job in a Subtask Method 1 and 2

#### **SDEST CTRL GROUP**

Selects the control group for the converted job.

When the destination job name is entered, the same control group as the conversion source job is automatically set.

To change it, move the cursor to the control group and press [SELECT] to call up the selection dialog box.

#### **©COORDINATES**

Specifies the coordinates used for conversion.

"PULSE," "ROBOT," or "USER" can be selected. The initial value is "PULSE."

"PULSE": Executes the pulse mirror-shift conversion.

- "ROBOT": Executes the mirror-shift conversion on the basis of the cartesian coordinates.
- "USER": Executes the mirror-shift conversion on the basis of the specified user coordinates.

#### **ØUSER COORD NO.**

Specifies the user coordinates number when "USER" is selected in (6). "01" is automatically set as initial value when the "USER" is selected in (6).

This item cannot be set when "PULSE" or "ROBOT" is selected in 6.

#### **®TARGET**

Specifies the coordinate where conversion is to be done when "ROBOT" or "USER" is selected in  $\bigcirc$ .

"XY," "XZ," or "YZ" can be selected.

The "XZ" is automatically set as initial value when "ROBOT" or "USER" is selected in  $\mathcal{D}$ .

The "XZ" is automatically set as initial value when "ROBOT" or "USER" is selected in  $\bigcirc$ . Always specify "XZ" for "ROBOT."

#### **®EXECUTE**

Executes the conversion.

When the conversion destination job name is entered, the converted job is created with that name as a new job.

When the conversion destination job name is not entered, the conversion source job is converted and overwritten.

#### 4.14.2.3 Jobs Not to be Converted

The jobs and relative jobs without group axes cannot be converted.

#### 4.14.2.4 Group Axes for Conversion

When the group axes for the SOURCE JOB in the multiple group axes system, the axis configuration, etc. of each group axes for SOURCE JOB and DESTINATION JOB must be the same.

- Robot axis: Same type
- Base axis: Same axis configuration
- Station axis: Same axis configuration

#### 4.14.2.5 Position Type Variables

The position type variables are not for mirror-shift.

#### 4 Twin Synchronous System

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

### 4.14.2.6 Parameter

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

### S1C×G065: Mirror shift sign reversed axis specification



#### DX100

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

## 4.14.3 Correcting Positional Dislocation

In the job after mirror shift, a position may be dislocated due to the installation error.

In this case, all steps should be corrected by the same shift amount.

For this operation, the parallel shift job conversion function is used.

#### 4.14.3.1 Setting the Items for Conversion

- 1. Select {JOB} under the main menu.
- 2. Select {JOB}
  - The JOB CONTENT window appears.
- 3. Select {UTILITY} under the pull-down menu.
- 4. Select {PARALLEL SHIFT JOB}.
  - The PARALLEL SHIFT JOB window appears.

DATA EDI	T DISPLAY U	лістту 🚺 🔀 🖾 😣	🖲 📑 🙌
PARALLEL SHIFT SOURCE JOB STEP SECTION DESTINATION JO COORDINATES BASE POINT SHIFT VALUE	JOB JOB DB PULSE TEACH SET R1 :S L U R B T	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
EXECUTE	CANCEL		
Main Menu	Simple Menu		

- 5. Specify the conversion items.
  - Specify the following items.

#### **OSOURCE JOB**

Selects the job before conversion.

The job which is shown in the JOB CONTENT window is set initially. To change the job, perform the following procedure.

Move the cursor to the job name and press [SELECT]. The JOB LIST window appears. Select the desired job.

#### **©STEP SECTION (Start Step \rightarrow End Step)**

Specifies the step section of the source job.

All the steps are set initially.

If there is no steps in the source job, "***" is displayed.

To change the section, perform the following procedure.

Move the cursor to the step section indication and press [SELECT]. The input buffer line appears. Input the step number and press [ENTER].

### 4-36

- 4 Twin Synchronous System
- 4.14 Creating a Job in a Subtask Method 1 and 2

### **3 DESTINATION JOB**

Specifies the converted job.

If this is not specified( "*******" is displayed), the source job is specified. If the converted job is specified, the source job is copied and converted. To change the job, perform the following procedure.

Move the cursor to the converted job name indication and press [SELECT]. The character input line appears. The source job name is displayed in the input line. To enter job name without using the source job name, press [CANCEL] and then input a job name.

#### **@COORDINATES**

Selects the conversion coordinates.

Move the cursor to the coordinates name and press [SELECT]. The selection dialog box appears. Select the desired coordinates. When the user coordinates are selected, the input buffer line appears. Input the desired user coordinate number and press [ENTER].

- Twin Synchronous System 4.14 Creating a Job in a Subtask - Method 1 and 2
- 4.14.3.2 Setting the Shift Value

4

There are two methods for specifying the shift value.

- Directly input the shift value by numerical value.
- · Calculate the shift value by teaching the original base point and converted base point.

#### **Numerical Value Input**

- 1. Display the PARALLEL SHIFT JOB window. Select the shift value to be set.
  - The number can now be entered.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 📶 😣	🙋 📮 🙌
PARALLEL S SOURCE & STEP SEC DESTINA COORDINY BASE PO SHIFT V/	HIFT JOB JOB CTION TION JOB ATES INT ALUE R1	JOB1 0001 -> JOB2 JOB2 TEACH 5 Y Z C	> 0010 SETTING 1.000 0.000		
EXEC	UTE	CANCEI	-		
Main Men	u Sim	ple Menu			

- 2. Type the shift value using the Numeric keys.
- 3. Press [ENTER].
  - The shift value is set.

DATA EDIT	DISPLAY UTILI	TY 🛛 12 🗳 🖬 😒 📴 📑 🙌
PARALLEL SHIFT JOB SOURCE JOB STEP SECTION DESTINATION JOB COORDINATES BASE POINT SHIFT VALUE R1	J081 0001[-> [0010] J082 ROBOT TEACH SETTING Y 0.000 Y 0.000 Z 0.000	
EXECUTE	CANCEL	
Main Menu Si	mple Menu	

- 4 Twin Synchronous System
- 4.14 Creating a Job in a Subtask Method 1 and 2

#### Calculation by Teaching

- Display the PARALLEL SHIFT JOB window. Select "TEACH SETTING" in the item of "BASE POINT."
  - The BASE POINT window appears.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 🖬 🧐 🗔 🖨
PARALLEL SHIF BASE POI	T JOB NT(SRC)	BAS	e point(dest	T)
R1 :S	0	R1 :S	0	
L	0	L	0	
U	U	U	U	
R	0	B	0	
Ť	0	T	0	
EXECUTE		CANCE	L	
Main Menu	Simpl	e Menu		

- 2. Select "BASE POINT(SRC)."
- 3. Move the manipulator to the original base point by the axis keys.
- 4. Press [MODIFY] and [ENTER].
  - The original base point is set.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 🖬 😣	10 🖳 👘
PARALLEL SH BASE F R1 :X Y Z	HIFT JOB OINT(SRC) 230.000 40.000 20.000	BASE R1 :X Y Z	E POINT(DEST 0.000 0.000 0.000	()	
EXECUT	E	CANCEL	-		
Main Menu	Simpl	e Menu			

- 5. Select "BASE POINT(DEST)."
- 6. Move the manipulator to the converted base point by the axis keys.
- 4 Twin Synchronous System
- 4.14 Creating a Job in a Subtask Method 1 and 2
- 7. Press [MODIFY] and [ENTER].
  - The conversion base point is set.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 🖬 畅 🔞 📑 👘
PARALLEL S	HIFT JOB			
BASE I	201NT(SRC)	BASE	POINT (DEST	
NI IA Y	40 000	V IV	400.000	1
Z	20.000	Z	100.000	)
_		_		
EXECU	ITE	CANCEL	-	
	Rine I			

- 8. Select "EXECUTE."
  - The difference is calculated by the two teaching points and set as a shift value.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 📶 😣	🙋 🖵 🙌
PARALLEL S SOURCE S STEP SEC DESTINAT COORDINA BASE POI SHIFT VA	HIFT JOB IOB TION JOB TES NT LUE R1 :	JOB1 0001 -> JOB4 ROBOT TEACH S X 230 Y 20 Z 80	ETTING .000 .000 .000		
EXEC	JTE	CANCEL	1		
Main Menu	ı Simp	le Menu			

- 4 Twin Synchronous System
- 4.14 Creating a Job in a Subtask Method 1 and 2
- 4.14.3.3 Executing Conversion
  - 1. Display the PARALLEL SHIFT JOB window. Select "EXECUTE."
    - The confirmation dialog box appears when the converted job is not specified.
      - Select "YES" then the conversion is executed.
    - The JOB CONTENT window appears when the conversion is completed.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 🐋 🔯 📮 🙌	
PARALLEL S SOURCE S STEP SEC DESTINAT COORDINA BASE POI SHIFT VA	HIFT JOB JOB TTION TION JOB ATES INT	JOB3 0001[-> ######## ROBOT TEACH 5 FEACH 5	0010 DO10 DO10 DOVERWEI OVERWEI	ite?	
EXEC	JTE	CANCE	-		
Main Menu	J Simp	le Menu			

 If the converted results are outside the range of motion of the robot, the tag "/OV" will be attached.

Correct this step manually.

JOB	EDIT	DISPLAY	UTILITY	]12 🗹 🖬 🔂 🔯	] 🖵 🙌
JOB CONTENT J: TEST CONTROL GRO	: MASTER UP: R1+S1:S1		S:0000 TOOL: **+**		
00000 NOP 0001 WORK-4 0002 JUMP J 0003 MOVJ V 0004 MOVJ V 0005 MOVJ V 0005 END	008:J08-R1 /J=50.00 /OY VJ=50.00 /J=50.00				
+MOVJ VJ=0.	78				
Main Menu	J Simpl	e Menu			

# Twin Synchronous System

#### DX100

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

# 4.14.4 Method 2: Perform Teaching for Each Manipulator

4

## 4.14.4.1 Procedure

First, perform teaching a job for the combination of leader manipulator and station.

Next, perform teaching a job for the combination of follower manipulator and station.

For this operation, perform teaching so that the follower manipulator follows the motion of station by FWD operation of the leader job.



For Method 2, there are two ways of teaching depending on whether the master task is used or not.

- Teaching using Master Task
- Teaching using SUPERVISORY Window

- 4 Twin Synchronous System
- 4.14 Creating a Job in a Subtask Method 1 and 2

## Teaching using Master Task

Using the master task can omit the operation to register a job name in the SUPERVISORY window.



- 1. Teach the coordinated job of leader subtask.
  - Teach all the steps of coordinated job for one manipulator + the station.



- 2. New job registration for the coordinated job of follower subtask.
  - Register as a new job the coordinated job for the other manipulator
     + the station.

For new job registration, refer to " 4.10 Registering Job."



- 3. New job registration of master task.
  - Newly register the master task as concurrent job.
     For concurrent job, refer to "7.5.2 Concurrent Job."

- 4 Twin Synchronous System
- 4.14 Creating a Job in a Subtask Method 1 and 2
- 4. Register PSTART instruction.
  - (1) Register a PSTART instruction to start the job newly registered at Operation 2.

To specify this subtask as the follower, add a tag SYNC and the leader subtask.

(2) Then, register a PSTART instcution to start the job taught at Operation 1.



- 5. Set to "Single job operation mode."
  - Set the operation mode at FWD operation to "Single job operation mode."
  - Pressing [SHIFT] + [SMOV] switches the operation mode.
- 6. Move the cursor to the first PSTART instruction.
- 7. Press [INTERLOCK] + [FWD].
  - Starts the follower subtask.
- 8. Move the cursor to the second PSTART instruction.
- 9. Press [INTERLOCK] + [FWD].
  - Starts the leader subtask.
- 10. Press the page key **ID** to change to the leader subtask.
  - Each time the page key is pressed, the contents of the JOB CONTENT window change in order of master task, subtask 1, and subtask 2.
- 11. Move the cursor to the step 1.
- 12. Press [FWD].
- 13. Press the page key 🔝 to switch to the follower subtask.
  - Each time the page key is pressed, the contents of the JOB CONTENT window change in order of master task, subtask 1, and subtask 2.

- 4 Twin Synchronous System
- 4.14 Creating a Job in a Subtask Method 1 and 2
- 14. Register the step 1 of the follower subtask.
  - After the FWD operation of step 1 of leader, switch to the follower and register the position of the follower manipulator relative to the station current position.
    - 0000 NOP 0001 Smovl V=276 +movj
- 15. Register the step 2 and onward of the follower subtask.
  - (1) Change to the leader's JOB CONTENT window, and perform a FWD operation to the next step.
  - To maintain the follower manipulator position relative to the station, press [SHIFT] + [SYNCRO/SINGLE] to set the job synchronized mode.
  - (2) Change to the follower's JOB CONTENT window, and register the follower manipulator position relative to the station current position.
  - (3) Teach the follower job by repeating the above operations (1) and (2).

4 Twin Synchronous System

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

#### Teaching using SUPERVISORY Window

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



- 1. Teach a coordinated job of leader subtask.
  - Teach all the steps of the coordinated job of one manipulator + the station.



- 2. New job registration of a coordinated job of follower subtask.
  - Register as a new job the coordinated job of the other manipulator + the station.

For new job registration, refer to "4.10 Registering Job."



- 3. Select {JOB} under the main menu.
- 4. Select {CTRL MASTER}.
  - The SUPERVISORY window appears.

JOB	EDIT	DISPLAY	UTILITY	🖉 🗹 🖄	10 🖳 👘	Þ
SUPERVISORY:	MASTER		-			
MASTER JOB	MASTERTAS	SK				
RUUI JUB	MASTERTAS	5K 2K				
LINE NO.	0000					
STEP NO.	0000					
STATUS	STOP					
SYNC TASK	*****					
				DACE		
				THUE		
0.000 12						
Main Menu	Simp	le Menu				

5. Select the root job of master task.

- 4 Twin Synchronous System
- 4.14 Creating a Job in a Subtask Method 1 and 2
- 6. Select "CANCEL ROOT JOB."
  - The root jobs of master task, subtask1, and subtask 2 are cancelled.

JOB	EDIT	DISPLAY	UTILITY	) 上 🖄 👒	10 🖳 🕀	Þ
SUPERVISORY: MASTER JOB ROOT JOB EDIT JOB LINE NO. STEP NO. STATUS SYNC TASK	MASTER ######### ######### 0000 0000 ########		**************************************			
				PAGE		
Main Menu	Simp	le Menu				

- 7. Select the root job of subtask 1.
- 8. Select "REGISTER ROOT JOB."
  - The root jobs for subtask 1 and subtask 2 are registered.

JOB	EDIT	DISPLAY	UTILITY	12 上 🖞	1 📢 🔟 🔜 👘	
SUPERVISORY	: SUB1					
MASTER JOB ROOT JOB EDIT JOB LINE NO. STATUS STATUS SYNC TASK	100-81 JOB-RI <u>JOB-RI</u> 0000 0000 STOP #*******					
				PAGE		
Main Men	J Simp	le Menu				

- 9. Select a job to be registered as root job.
- 10. Select the root job of subtask 2.
- 11. Select "REGISTER ROOT JOB."

- 4 Twin Synchronous System
- 4.14 Creating a Job in a Subtask Method 1 and 2
- 12. Select a job to be registered as root job.
  - The root jobs for subtask 1 and subtask 2 are registered.

JOB	EDIT	DISPLAY	UTILITY	222 🖳 🎽 😣	10 🖳 🕀	Þ
SUPERVISORY: MASTER JOB ROOT JOB EDIT JOB LINE NO. STEP NO. STATUS SYNC TASK	SUB2 ########## JOB-R2 JOB-R2 0000 0000 5TOP #########	-	~ (#***#***			
				PAGE		
Main Menu	Simp	le Menu				

- 13. Select the synchronous task of subtask 1.
- 14. Select "SUB2."
  - Specify SUB2 of leader task to synchronize the synchronous task of subtask 1.

JOB	EDIT	DISPLAY	UTILITY	22 📃 💆	1 👒 🙋 🗆	a 🖗	Þ
SUPERVISORY:	SUB1						
MASTER JOB	******	******	******				
ROOT JOB	JOB-R1		15				
EDIT JOB	JOB-R1						
LINE NO.	0000						
STEP NU.	0000						
SYNC TASK	SUB2						
ond mon	10002						
			_			_	_
				PAGE			
			2	121914/211			
Main Menu	Simp	le Menu					

- 15. Select "Single job operation mode."
  - Set "Single job operation mode" for the operation mode at FWD operation.
  - Pressing [SHIFT] + [SMOV] switches the operation mode.
- 16. Select {JOB} under the main menu.
- 17. Select {JOB}.
- 18. Press the page key **I** to change to leader subtask.
  - Each time the page key is pressed, the contents of the JOB CONTENT window change in order of master task, subtask 1, and subtask 2.
- 19. Move the cursor to the step 1.
- 20. Press [FWD].

DX100	4 Twin Synchronous System
DX 100	
	21. Press the page key 🚺 to change to the leader subtask.
	<ul> <li>Each time the page key is pressed, the contents of the JOB CONTENT window change in order of master task, subtask 1, and subtask 2.</li> </ul>
	22. Register the step 1 of follower subtask.
	<ul> <li>to chage to leader subtask.*After the FWD operation of step 1 of leader, switch to follower and register the position of the follower manipulator relative to the station current position.</li> </ul>
	0000 NOP 0001 SMOVL V=276 +MOVJ
	23. Register the step 2 and onward of follower subtask.
	<ol> <li>Change to the leader's JOB CONTENT window and perform FWD operation to the next step.</li> </ol>
	<ul> <li>To maintain the follower manipulator position relative to the station, press [SHIFT] + [SYNCRO/SINGLE] to set the job synchronized mode.</li> </ul>
	(2) Change to the follower's JOB CONTENT window, and register the follower manipulator position relative to the station current posi- tion.
	0000 NOP 0001 SM0VL V=276 +H0VJ 0002 SM0VL V=278 +N0VJ

(3) Teach the follower job by repeating the above operations (1) and (2).

- 4 Twin Synchronous System
- 4.15 Job in Master Task

# 4.15 Job in Master Task

The job of master task is a concurrent job or a robot job without control groups.

- 1. Select {JOB} under the main menu.
- 2. Select {CREATE NEW JOB}.
  - The NEW JOB CREATE window appears.

JOB	EDIT	DISPLAY	UTILITY	10 🛛	1	個日。	( <del>r</del> )
NEW JOB CREAT JOB NAME COMMENT GROUP SET JOB TYPE	re Bill Robo	T J08					
EXECUT	E	CANCEL					
Main Menu	Sim	ple Menu					

- 3. Enter a job name.
  - Move the cursor to JOB NAME and press [SELECT], and enter a job name by entering the characters.
- 4. Set "GROUP SET."
  - Selecting "R1" of "GROUP SET" displays the selection dialog box. Select "NON GROUP."
- 5. Set "CONCURRENT JOB."
  - Select "ROBOT JOB" of "JOB TYPE."
     Each time [SELECT] is pressed, "ROBOT JOB" or "CONCURRENT JOB" is selected alternately.
- 6. Press [ENTER].

- 4 Twin Synchronous System
- 4.15 Job in Master Task
  - 7. Select "EXECUTE."
  - The job is registered in the memory of DX100, and the JOB CONTENT window appears.

NOP and END instructions are registered automatically.

JOB	EDIT	DISPLAY	UTILITY	) 🛛 🖌 📢	個 🖵 🙌
JOB CONTENT: J:MASTERTASK CONTROL GROU	MASTER P: NON GROU	Р	S:0000 TOOL: **		
0000 NOP 0001 END					
		1			
Main Menu	Simpl	e Menu			

NOTE	<ul> <li>If a tag occurs</li> </ul>
•	• If the
	task, i
	tools C

If a tag SYNC is added to neither of PSTARTs, an alarm occurs.

 If the synchronous task is set to "UNUSED," the follower task, if it is SUB1, performs the same motion as the leader task SUB2, and if it is SUB2, performs the same motion as the leader task SUB1.

- 4 Twin Synchronous System
- 4.16 Confirming Operation

# 4.16 Confirming Operation

# 4.16.1 Procedure

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

- 1. Create a concurrent job.
  - For procedure, refer to "4.15 Job in Master Task."
- 2. Select {JOB} under the main menu.
- 3. Select {CTRL MASTER}.
  - The SUPERVISORY window appears.

JOB	EDIT	DISPLAY	UTILITY	🛛 🗹 📢	10 🖓 👘	Þ
SUPERVISORY:	MASTER					
MASTER JOB	MASTERTA	SK				
ROOT JOB	MASTERTA:	SK				
EDIT JUB	MASTERIA	SK				
STEP NO.	0000					
STATUS	STOP					
SYNC TASK	*******					
				PAGE		
_	- T					_
Main Menu	Simo	Le Menu				

- 4. Move the cursor to the task where the master job is to be registered.
- 5. Press [SELECT].
- 6. Select "SETTING MASTER JOB."
- 7. Select a job to be the master job.

- 4 Twin Synchronous System
- 4.16 Confirming Operation
- 8. Press [SHIFT] + [SYNCRO/SINGLE].
  - Set to "Multi-job operation mode."
     Each time [SHIFT] + [SYNCRO/SINGLE] are pressed, the operation mode changes between "Multi-job operation mode" and "Single job operation mode."



- 9. Press [TEST START] or [FWD].
  - When a PSTART instruction is executed, the manipulator and the station move.

Parameter	Contents and Set Value	Initial Value
S4C286	Specifies the user output number to externally output the "Multi-job operation mode" status at teaching. 0: Not output	0
	1 to 1024: User output number	

4 Twin Synchronous System

4.16 Confirming Operation

# 4.16.2 Precautions for Confirming Operation

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

# 4.16.2.1 Stops during Operation

### <Example>

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

When restarting the operation in the states as explained above, an interference with jig, etc. may be caused.

Restart both jobs from the same position (step).

4.16.2.2 When "Multi-job operation mode" is Set in the TEACHING CONDITION Window

### <Example>

If the manipulator stops after operating to a certain step, and the step position of the follower R1 is changed and performs FWD operation again, the leader R2 proceeds to the next step but the R1 does not move.



As a result, the R2 goes forward by one step ahead.

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

In the above figure, at the FWD operation after the position change, the leader R2, whose step has not been changed, move to the step 3.

However, since position of the follower R1 is changed, the step after the change is executed again. As a result, operation is performed at the same position and it does not proceed to the next step.

In this way, the steps of the leader and follower do not correspond each other.

4 Twin Synchronous System4.16 Confirming Operation

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

DX100	4 Twin Synchronous System 4.16 Confirming Operation
4.16.2.3 If the master ta	ask is stopped by TSYNC
	If teaching that causes the master task station to move violently is carr out during the step following TSYNC, the locus of the slave robot may overy slightly when the master task is put into a standby status first by TSYNC.
	In this case, either carry out teaching in such a way that the station of master task is not moved by the step following TSYNC, or add an ADVSTOP command after the TSYNC command.
==Phenomenon==	
<sub1> Master Side : ARCOF <u>SMOVL + MOV</u> LJSYNC3   MOVJ + MOV</sub1>	<pre></pre>
DOUT OT#(1)=O MOVJ + MOVJ END	FF     Image: Construction of the state of t
==Measure(1)== Add the same (The position	e point immediately after TSYNC. of the station axis is the same.)
Same point ARCOF SMOVL + MOVJ TSYNC 3 MOVJ + MOVJ MOVJ + MOVJ DOUT OT#(1)=OK MOVJ + MOVJ END	ARCOF SMOVL + MOVJ TSYNC 3 MOVJ + MOVJ MOVJ + MOVJ DOUT OT#(1)=OFF MOVJ + MOVJ END
==Measure(2)== Add ADVSTC	P after TSYNC.
: ARCOF SMOVL + MOVJ TSYNC 3 <u>ADVSTOP</u> MOVJ + MOVJ DOUT OT#(1)=OF MOV I + MOVJ	F

4.17 Playback

# 4.17 Playback

### 4.17.1 Start

Call the master job in the following operation and perform a playback.

A job in the subtask is started by a PSTART instruction.

- 1. Select {JOB} under the main menu.
- 2. Select {CTRL MASTER}.
  - The SUPERVISORY window appears.
- 3. Move the cursor to MASTER JOB of MASTER.
- 4. Press [SELECT].
- 5. Select "CALL MASTER JOB."
- 6. Press [START].
  - The called master job is executed from the beginning and the subtask is executed by a PSTART instruction.



Performing the Operation 6 clears the job of subtask.

Therefore, if the master task is called while the subtask is interrupted in the middle of its execution, the information relating to the state of subtasks that are halted is lost.



4 Twin Synchronous System

4.17 Playback

# 4.17.2 Automatic Correction of Shift Value

During playback operation, as the station is controlled by the leader job, the follower job controls only the follower manipulator.

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



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

Main Menu	Simple Menu	PULSE LIMIT (TWIN COORDINATED) [RIR2S1]
	A Second State of the seco	

Parameter	Contents and Set Value	Initial Value
S3C1101	Maximum shift angle of station axis in twin (triple) synchronous system	Differs depending on system (in units of 0.1°)

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

Parameter	Contents and Set Value	Initial Value
S2C420	Control method of follower manipulator posture in twin (triple) synchronous system 0: Follow the motion of station 1: Constant to the earth	0

0: Follow the motion of station $\neg$
1: Constant to the earth —

# 5

- Triple Synchronous System
- 5.1 Outline

#### **Triple Synchronous System** 5

#### 5.1 Outline

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



In this system, three coordinated jobs are done at the same time.

- A coordinated job for the first manipulator and the station (R1+S1)
- A coordinated job for the second manipulator and the station (R2+S1)
- A coordinated job for the third manipulator and the station (R3+S1)

A concurrent job or a robot job without control groups starts these three jobs and implements I/O control.

The master task job uses the independent control function to start the robot jobs of subtasks 1, 2, and 3.

Three robot jobs can be created by the following two methods.

5 Triple Synchronous System5.1 Outline

# 5.1.1 Method 1: Copy one subtask job to create two other subtask jobs.



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

# 5.1.2 Method 2: Perform teaching for each manipulator.



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

- 5 Triple Synchronous System
- 5.2 Function Keys

# 5.2 Function Keys

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

# 5.2.1 Arc Welding Application



	Registers a timer instruction "TIMER" in a job.
1 TIMER	
	Registers a reference point "REFP" in a job, or modifies the
	registered reference point.
REFP	[REFP] + [FWD]
	Moves the manipulator to the registered reference point.
	Registers a welding start instruction "ARCON."
8 ARCON	
	Registers a welding end instruction "ARCOF."
5 ARCOFF	
	Use when performing a gas check.
	Gas is fed only while [Gas] is pressed. (Refer to "Chapter 9.3.2 Gas Flow Control Function" at page
2 GAS	9-7 in the Operator's Manual.)
	Used for wire inching.
9 4	Press [FEED] to feed the wire, and press [RETRACT] to retract the wire
FEED	While these keys are pressed, the wire feed motor operates.
6 5	The feed rate can be switched through 3 steps
RETRACT	[FEED] : Low speed
	[FEED] + [FAST] : Middle speed
	[FEED] + [FIGH SPEED] . Fight speed
	The retract speedfeed rate can be switched through 3
	steps.
	[RETRACT] + [HIGH SPEED] : High speed
	(Refer to "Chapter 9.3.1 Wire Inching Function" at page 9-7 in the Operator's Manual.)
	Modifies the welding current/voltage while welding during the play mode
3	Press [3/CUR/VOL] to increase the current/voltage value,
CUR/VOL	and press
	[-/UUK/VUL] to decrease the current/voltage value. (Refer to "Chapter 9.13 Changing Welding Conditions
CUR/VOL	During Playback" at page 9-134 in the Operator's Manual.)

# 5 5.2 Triple Synchronous System Function Keys

	Changes the type of movement for the manipulator when teaching a coordinated job.
7 SYNCRO	Each time this key is pressed, the movement type changes.
SINGLE	SYNCRO: The mark for "synchronized" appears in the status display area. When the master side is moved, the slave side will follow the movement of the master.
	SINGLE: Only the selected group axis moves.
	Selects either a coordinated or an individual interpolation when teaching a coordinated job.
4	Each time this key is pressed, the operation type changes.
SMOV	Coordinated: All the move instructions that are registered in this mode become coordinated instructions.
	Individual: The master-slave relationship is cancelled. Each manipulator and station moves independently.
SUPPLE MENT Cannot	traction, high-speed inching, or high-speed retraction be performed depending on the Power Source.

Triple Synchronous System Function Keys 5

5.2

# 5.2.2 General Application



	Registers a timer instruction "TIMER" in a job.
1 TIMER	
0 REFP	Registers a reference point "REFP" in a job, or modifies the registered reference point. [REFP] + [FWD] Moves the manipulator to the registered reference point.
8 ARCON	Registers a welding start instruction "ARCON" in a job.
5 ARCOFF	Registers a welding end instruction "ARCOF" in a job.
2 K GAS	Use when performing a gas check. Gas is fed only while [Gas] is pressed. (Refer to "Chapter 9.3.2 Gas Flow Control Function" at page 9-7 in the Operator's Manual.)
9 & FEED	Used for wire inching. Press [FEED] to feed the wire, and press [RETRACT] to retract the wire. While these keys are pressed, the wire feed motor operates.
6 x RETRACT	The feed rate can be switched through 3 steps. [FEED] : Low speed [FEED] + [FAST] : Middle speed [FEED] + [HIGH SPEED] : High speed
	The retract speedfeed rate can be switched through 3 steps. [RETRACT] : Low speed [RETRACT] + [HIGH SPEED] : High speed (Refer to "Chapter 9.3.1 Wire Inching Function" at page 9-7 in the Operator's Manual.)
3 CUR/VOL	Modifies the welding current/voltage while welding during the play mode. Press [3/CUR/VOL] to increase the current/voltage value, and press [–/CUR/VOL] to decrease the current/voltage value. (Refer to "Chapter 9.3 Changing Welding Conditions During Playback"at page 9-134 in the Operator's Manual.)
7 SYNCRO SINGLE	<ul> <li>Changes the type of movement for the manipulator when teaching a coordinated job.</li> <li>Each time this key is pressed, the movement type changes.</li> <li>SYNCRO: The mark for "synchronized" appears in the status display area. When the master side is moved, the slave side will follow the movement of the master.</li> <li>SINGLE: Only the selected group axis moves.</li> </ul>

# 5 Triple Synchronous System5.2 Function Keys

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

Coordinated: All the move instructions that are registered in

this mode become coordinated instructions. Individual: The master-slave relationship is cancelled. Each manipulator and station moves independently. 5 Triple Synchronous System

5.3 Job Configuration

# 5.3 Job Configuration

Using the independent control function, configure jobs so that the concurrent job or robot job without control groups of master task operates the robot jobs in subtask 1, 2, and 3.

Master task: Concurrent job (or robot job without control groups) Starts subtasks 1, 2, and 3, and controls I/Os.

Subtask 1: Robot job

A coordinated job for the first manipulator + the station

Subtask 2: Robot job

A coordinated job for the second manipulator + the station

Subtask 3: Robot job

A coordinated job for the third manipulator + the station

Subtasks 1, 2, and 3 are determined as leader or follower with a tag SYNC in PSTART instruction.



- 5 Triple Synchronous System
- 5.4 Leader and Follower

# 5.4 Leader and Follower

Set the two out of the subtask 1, the subtask 2, and the subtask 3 as the followers. To set a follower, add a tag SYNC and the leader subtask to the PSTART instruction of the master task.

The subtask to which a tag SYNC is added is follower while the subtask without a tag is leader.

The station axis is controlled by the leader job, and the follower job follows the movement of station axis.





Register a PSTART instruction so that the follower job starts first.

- 5 Triple Synchronous System
- 5.5 Synchronizing with TSYNC

# 5.5 Synchronizing with TSYNC

#### 5.5.1 Format



If the PSTART command is not executed correctly, alarm 4103 will be emitted.

When an alarm is emitted, check the sub-code, and correct the job.

### <Example>

PSTART JOB : R1S1 SUB1

PSTART JOB : R2 SUB1

... AL-4103: [1] Sub task being executed: During execution of SUB1, an attempt is being made to start a different job in the same SUB1.

PSTART JOB : R1S1 SUB1 (R1S1: A job for the robot 1 and the station 1)

PSTART JOB : R2S1 SUB2 (R2S1: A job for the robot 2 and the station 1)

... AL-4103 [2] Group axis being used:

An attempt is being made to execute a job containing station 1 in SUB2, despite the fact that station 1 is being used by SUB1.

PSTART JOB : R2S1 SUB2 SYNC SUB1

PSTART JOB : R1S1 SUB1

... "Station twin coordination" is being correctly executed

# 5 Triple Synchronous System 5.5 Synchronizing with TSYNC

Alarm Number	Alarm Name	Message	Sub Code	Meanings
4103	PARALLEL START INSTRUCTION ERROR	An error occurred in the independent control startup operation.	1	Sub task being executed: Although a job is being executed by instructed sub task, an attempt was made to execute another job by the sub task.
			2	Group axis being used: The job operated by another sub task uses the same group axis.
			3	Multiple start of same job: timing for start command again. The job that was tried to be started was executed by another sub task.
			4	Unregistered master job: Although the master job was not registered, an attempt was made to execute PSTART SUB (job name omitted).
			5	Synchronization instruction error: When restarted by PSTART, synchronization instruction status of the sub task under interruption was different from the status to restart.
			6	Stopped by an alarm: An attempt was made to start the sub task which is stopped by an alarm.
			7	Synchronization task specification of SYNC instruction omit error
			8	The task is specified by synchronization task of SYNC instruction.
			9	I/O jog being executed
			10	Separate group axis being used
			11	The servo power supply is OFF.
			12	Twin synchronous task ID error
			16	PSTART instruction is the old specification.
			17	PWAIT instruction is the old specification.

5 Triple Synchronous System

5.5 Synchronizing with TSYNC

#### 5.5.2 Procedure

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

When a TSYNC instruction is executed in one of the robot jobs, the manipulator waits until the same synchronized signal, TSYNC, is executed in the other two robot jobs. Set the number of synchronized tasks.

When setting "SYNCHRO NUM" to "UNUSED," the number of tasks is the same as when "SNUM=2."

- 1. Move the cursor to the line just above the line where TSYNC instruction is to be registered.
- 2. Press [INFORM LIST].
  - The instruction list appears.

	9	IN/OUT
JUMP	TSYNC	CONTROL
CALL		DEVICE
TIMER		MOTION
LABEL		ARITH
COMMENT		SHIFT
RET		OTHER
PSTART		SAME
PWAIT		PRIOR

3. Select "TSYNC."

- A TSYNC instruction is displayed in the input buffer line.



- 4. Change additional items.
  - <To register items as displayed in the input buffer line> Proceed to Operation 5.
  - <To change the numerical data>
  - (1) Move the cursor to the numerical data. Press [SHIFT] and the cursor key simultaneously to increment or decrement the number.

TSYNC 2

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



- (3) Enter a number and press [ENTER], then the number in the input buffer line is changed.
- (4) After having changed the numerical data, press [ENTER].
- (5) The DETAIL EDIT window is closed and the JOB CONTENT window reappears.

5-13

- 5 Triple Synchronous System
- 5.5 Synchronizing with TSYNC

# 5. Press [INSERT] and [ENTER].

- <To edit additional items>
- (1) To edit additional items, move the cursor to the instruction in the input buffer line, then press [SELECT]. The DETAIL EDIT window appears.

JOB	EDIT	DISPLAY	UTILITY	12 🗹 🖌	8 🙋 🖵 👘	
DETAIL EDIT TSYNC						
SYNCHRO NO. Synchro num	UNUSED					
TSYNC 1						
Main Menu	Simpl	e Menu				

(2) To change the synchronization number, select "1" of "SYNCHRO NO."

When the number input status enters, enter the synchronization number, "SYNCHRO NO." by pressing the Numeric keys, and press [ENTER].

To add the number of synchronized tasks, select "UNUSED" of "SYNCHRO NUM."

(3) The selection dialog box appears. Select "SNUM=."

JOB	EDIT	DISPLAY	UTILITY	12 🗹 🖌	1 😪 🙋 📮	<b>(</b> <del>1)</del>
DETAIL EDIT TSYNC						
SYNCHRO NO. Synchro num	2 SNUM= 3	8				
TSYNC 2 SNU	M= 3					
Main Menu	Simp	le Menu				

(4) After changed or added the additional items, press [ENTER]. The DETAIL EDIT window is closed, and the JOB CONTENT window appears.

- 5 Triple Synchronous System
- 5.5 Synchronizing with TSYNC
  - (5) Press [ENTER].

JOB	EDIT DIS	PLAY UTILIT	12 🖻 🖞	1 😪 🔟 📮	( <del>h)</del>
DETAIL EDIT TSYNC					
SYNCHRO NO. Synchro num	2 UNUSED				
TSYNC 2					
Main Menu	Simple Men				

- 6. The instruction displayed in the input buffer line is registered.
  - <Example>



Triple Synchronous System 5.5 Synchronizing with TSYNC

#### 5.5.3 Items to note when using a TSYNC command

5

Note that even when TSYNC is being used, the steps of two manipulators will fail to match each other if the following operations are performed.

#### 5.5.3.1 When a cursor shift occurs during operation

If the cursor position is shifted to a different step during the execution of a job of one of the two sub-tasks when the robot stops during operation, and the robot is restarted while remaining in this condition, the steps will become misaligned, resulting in the risk of interference from the jig, for example.

Start both jobs from the same position (step).



In this case, the steps become misaligned, which may cause the manipulator to interfere with the work piece or the jig.

In this case, the steps do not become misaligned, so normal operation can take place.

Triple Synchronous System Job Example

5 5.6

#### 5.6 Job Example

Master task	
(Concurrent job or robot job without control groups	s) Jobs in subtasks 1, 2 and 3
NOP *G 'RESET DOUT OG#(1) 0 DOUT OG#(2) 0 DOUT OG#(4) 0 DOUT OG#(4) 0 DOUT OG#(8) 0	Home position return job
' RETURN TO HOME 1 PSTART JOB:R1 HOME 1 SUB1 (R1+S1) — PSTART JOB:R2 HOME 2 SUB2 (R2) — PSTART JOB:R3 HOME 3 SUB3 (R3) — PWAIT SUB1 ← PWAIT SUB2 ←	R1 HOME 1 (R1+S1) R2 HOME 2 (R2) R3 HOME 3 (R3)
PWAIT SUB3 <	
'WAITING FOR THE FIRST START WAIT IN#(1)=ON PSTART JOB:R1 WAIT SUB1 (R1) — PSTART JOB:R2 WAIT SUB2 (R2) — PSTART JOB:R3 WAIT SUB3 (R3) — PWAIT SUB1 ← PWAIT SUB2 ← PWAIT SUB3 ←	Waiting JOB R1 WAIT (R1) R2 WAIT (R2) R3 WAIT (R3)
JUMP *G *A	
'RETURN TO HOME 1 JUMP *B IF IG#(3)<>99 PSTART JOB:R1 HOME 1 SUB1 PSTART JOB:R2 HOME 2 SUB2 PSTART JOB:R3 HOME 3 SUB3 PWAIT SUB1 PWAIT SUB2 PWAIT SUB3 JUMP *G *B 'WORK JOB JUMP *C IF IG#(3)=0 'WORK 1 JUMP *E IF IG#(3)<>1 PSTART JOB:TES11-R1 SUB1 SYNC SUB3 PSTART JOB:TSE11-R2 SUB2 SYNC SUB3 PSTART JOB:TSE11-R3 SUB3 (R1+S1)- PSTART JOB:TSE11-R3 SUB3 (R3+S1)- PWAIT SUB1 ←	Work JOB (coordinated job)          TES11-R1(R1+S1)       TES11-R2(R2+S1)         NOP       TES11-R3(R3+S1)         TSYNC 1 SNUM=3        NOP         MOVJ+MOVJ       TSYNC 1 SNUM=3         MOVJ+MOVJ       TSYNC 1 SNUM=3         MOVJ+MOVJ       SMOVL+MOVJ         SMOVL+MOVJ       SMOVL+MOVJ         SMOVL+MOVJ       SMOVL+MOVJ         ARCOF       SMOVL+MOVJ         SMOVL+MOVJ       ARCOF         SMOVL+MOVJ       SMOVL+MOVJ         TSYNC 3 SNUM=3       ARCOF         SMOVL+MOVJ       TSYNC 3 SNUM=3         DOUT 0T#(1)=OFF       SMOVL+MOVJ         MOVJ+MOVJ       TSYNC 3 SNUM=3         DOUT 0T#(1)=OFF       DOUT 0T#(2)=OFF         MOVJ+MOVJ       FND
PWAIT SUB1	
PWAIT SUB2 PWAIT SUB2 *E ' WORK 2 JUMP *F IF IG#(3)<>2 PSTART JOB:TES12-R1 SUB1 SYNC SUB3 (R1+S1) PSTART JOB:TES12-R2 SUB2 SYNC SUB3 (R2+S1) PSTART JOB:TES12-R3 SUB3 (R3+S1) PWAIT SUB1 PWAIT SUB1 PWAIT SUB2 PWAIT SUB3 *C DOUT OG#(4) 15 JUMP *C	
END	
- 5 Triple Synchronous System
- 5.7 JOB CONTENT Window

# 5.7 JOB CONTENT Window

The contents of coordinated job are displayed as shown below.

JOB	EDIT	DISPLAY	UTILIT	22 19 2 4 5	ð 🙋 🖵 🖣	
JOB CONTENT J: TEST CONTROL GRO	: MASTER UP: R1+S1:S1		S:0000 TOOL: **+**			
IDDDD NOP 0001 SMOVL +HOVJ 0002 MOVL V +MOVJ V 0003 END	V=138 =138 ⊨0.78					
MITVI V=138 +MOVJ VJ=0.78						
Main Menu	Simpl	e Menu				

## **OInstructions**

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

SMOVL V=138 ←Slave, a manipulator

+MOVJ  $\leftarrow$ Master, a station

# **©Synchronized/Single**

Synchronized/single are the types of movement available for the manipulator during axis operation. This mark appears when synchronized movement is selected.

Switch between movements by pressing [SYNCRO/SINGLE].

## **3 Group axis being handled**

Displays the group axis being handled.

Pressing [ROBOT] selects the manipulator.

Pressing [EX. AXIS] selects the station.

#### Coordinated interpolation/Individual interpolation

Switch between coordinated interpolation and individual interpolation by pressing [SMOV].

- 5 Triple Synchronous System
- 5.8 Synchronized/Single

# 5.8 Synchronized/Single

## 5.8.1 Synchronized/Single Movement Between Station and Manipulator

There are two ways to handle axes when teaching: "Synchronized" and "Single."

Change between movements by pressing [SYNCRO/SINGLE].

UTILITY	10 🗹 🖬 🏍 词 📑 👘
UTILITY	) 1o 🗹 📶 🚳 🗃 🗔 🙌

# 5.8.1.1 Synchronized

If the axes are handled in the "Synchronized" mode, the slave (manipulator) follows the master (station) when the master moves. This feature is used to keep the position of the manipulator relative to the station.

However, the master does not move when the slave is moved.

# A master axis is moved:



DX100	5 5.8	Triple Synchronous System Synchronized/Single
5.8.1.2 Single		

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

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

## A slave side axis is moved



A master side axis is moved:





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

- 5 Triple Synchronous System
- 5.8 Synchronized/Single

## 5.8.2 Job Synchronized Mode for Subtask 1, 2, and 3

When moving only the leader manipulator in FWD/BWD operation, the follower manipulator in stop status may interfere with a workpiece. To prevent this, using "job synchronized mode" can move the follower synchronizing the motion of the leader.

The follower manipulator moves, keeping the relative position to the station.



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



Also in the TEACHING CONDITION window, the job synchronized mode can be set and confirmed.

- 1. Select {SETUP} under the main menu.
- 2. Select {TEACHING COND}.
  - The TEACHING CONDITION window appears.



3. Select "TWIN COORDINATED MODE."

- 5 Triple Synchronous System
- 5.8 Synchronized/Single
  - Each time [SELECT] is pressed, "VALID" and "INVALID" is selected alternately.

DATA EDIT DISPLA	Y UTILITY	12 🗹 📶 😣	10 🕞 👆
TEACHING CONDITION SETTING			
LANGUAGE LEVEL INSTRUCTION INPUT LEARNING MOVE INSTRUCTION SET POSITION BUZZER WHEN POSITION TEACHING STEP ONLY CHANGING RECT/CYLINORICAL TOOL NO. SWITCH TOOL NO. SWITCH TOOL NO. SWITCH TOOL NO. SWITCH TOOL NO. SUBJECT FUNCTION JOB UNDELETE FUNCTION INDEFENDENT: MOTION OF NEXT/TES BWD OPERATION NO ROUP AXIS BWD OPERATION CONCURRENT JOB STATION TWIN	SUBSET           VALID           STEP           CONSIDER           PROHIBIT           RECT           PERMIT           PERMIT           INVALID           SINGLE           PERMIT           PROHIBIT           INVALID           SINGLE           PROHIBIT           INVALID		
Main Menu Simple Menu			



The job synchronized mode is enabled only when "SINGLE" is selected in "STEP/TEST RUN OPERATION MODE" for the follower manipulator.

- 5 Triple Synchronous System
- 5.9 Selecting Axis to be Handled

# 5.9 Selecting Axis to be Handled

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

## 5.9.1 When There is an Edit Job

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

• Pressing [ROBOT] selects a manipulator for axis handling.

UTILITY	12 🗹 🖌 😵 🗃 📮 🙌

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

UTILITY 📕 🎧 🖻 🦾 🕼 🕞 👘

## 5.9.2 When There is No Edit Job

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

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

- 5 Triple Synchronous System
- 5.10 Registering Job

# 5.10 Registering Job

- 1. Select {JOB} under the main menu.
- 2. Select {CREATE NEW JOB}.
  - The NEW JOB CREATE window appears.

JOB	EDIT	DISPLAY	UTILITY	] 19 🗳	1	ð 🔞 🖳	<b>(</b> +)
NEW JOB CREA JOB NAME COMMENT GROUP SET JOB TYPE	re 			4.8.9.4 			
EXECUT	E	CANCEL					
Main Menu	Sim	ple Menu					

- 3. Enter a job name.
  - Select "JOB NAME," and then enter a job name by entering the characters.
  - Refer to "1.2.7 Character Input" of the Operator's Manual.
- 4. Press [ENTER].
- 5. Select "GROUP SET."
- 6. Select a group combination.
- 7. Select "EXECUTE."
  - The job name is registered in the memory of DX100, and the JOB CONTENT window appears.

- Triple Synchronous System
- 5.11 Registering Move Instruction (S)MOV □+MOVJ

# 5.11 Registering Move Instruction (S)MOV □+MOVJ

Register a move instruction in the following manner.

## 5.11.1 Operating Master Side (Station)

5

- 1. Call the JOB CONTENT window in teach mode.
- 2. Press [EX. AXIS].
  - The master side (station) is selected for axis handling.



- 3. Select either "synchronized" or "single."
  - Press [SYNCRO/SINGLE] to select either "synchronized" or "single." When "synchronized" is selected, the mark in the window below appears.



- When the slave side is supposed to follow the master side motion, select "synchronized."
- 4. Press the axis key to move to the desired position.

DX100	5 5.1	Triple Synchronous System 11 Registering Move Instruction (S)MOV □+MOVJ
5.11.2 Operating Slave S	ide	(Manipulator)
	1.	Press [ROBOT].
		<ul> <li>The slave side (manipulator) is selected for axis handling</li> </ul>
		UTILITY 12 🗹 😢 🚾 🕞 🙌
	2.	Press the axis key to move to the desired position
	3.	Select either a coordinated interpolation or an independent interpolation.
		<ul> <li>Press [SMOV] to select either interpolation.</li> </ul>
		SMOVL V=138 +MOVJ
	4.	Select an interpolation type.
		<ul> <li>Press [MOTION TYPE] to select an interpolation type.</li> </ul>
		SMOVC V=138 +MOVJ
	5.	Confirm the speed.
	6.	Press [ENTER].
	•	The registration is completed as follows.
		10008 SMOVC V=138 +MOVJ
	6	• When joint interpolation is set for the slave side (manipula- tor), teaching cannot be done during a coordinated inter- polation.
		<ul> <li>When "JOINT" is selected, the operation will not change to a coordinated interpolation, even if [SMOV] is pressed.</li> </ul>
		<ul> <li>When "JOINT" is selected during coordinated interpola- tion, a coordinated move instruction such as "SMOVL" in the input buffer line changes to "MOVJ," and the operation becomes individual interpolation.</li> </ul>
Paramotor Contonto and Sa	+ \/~	

S2C213         +MOV INSTRUCTION INTERPOLATION INPUT         2	
This parameter specifies which interpolation is permitted for move instructions for the master robot in a coordinated job. (bit specification)	
D0: +MOVJ, D1: +MOVL	
D2: +MOVC, D3: +MOVS	

Triple Synchronous System

5.11 Registering Move Instruction (S)MOV □+MOVJ

## 5.11.3 (S) MOV $\square$ + MOVJ rate specification

5.11.3.1 Rate specification in a multiple line shift command

5

The relationship between the rate specification in a shift commnad which causes multiple groups such as "MOV  $\Box$  + MOVJ" or "SMOV  $\Box$  + MOVJ" to operate (i.e. to be configured by multiple lines), simultaneously, and the actual operation rate, is as follows.

- Each shift time for the robot (or station) is obtained according to the rate specified for each line.
- The maximum of the respective shift times is obtained, and all groups are operated according to this maximum shift time.

#### <Example>

MOVL V = 500.0  $\cdots$  The shift time over the shift distance is 2 seconds at V = 500

+MOVJ VJ = 25.00...The shift time for the shift amount is 4 seconds at VJ = 25

*This "MOVL + MOVJ" functions when the shift time is 4 seconds.

Note that for lines in which the rate specification is omitted, the shift time is calculated based on the assumption that the maximum rate has been specified.

#### <Example>

MOVL V = 500.0 ··	••The shift time over the shift distance is 2 secord	nds at
	V = 500	

+MOVJ VJ ····The shift time for the shift amount is 1 seconds at VJ = 25

*This "MOVL + MOVJ" functions when the shift time is 2 seconds.

5.11.3.2 Rate specification at coordination interpolation (SMOV D)

The rate specification for the manipulator on the slave side at coordination interpolation (SMOV  $\Box$ ) is specified as "relative rate" as seem from the master side.

For example, in arc welding, in the case where the slave side manipulator holds the welding torch, this "relative rate" becomes the "welding rate" with respect to the work piece, so it is important to maintain this rate. In this case, by omitting the rate specification on the master side, the shift rate will be basically determined by the "relative rate."

#### <Example>

MOVL V = 100.0	$\cdots$ The shift time at V = 100 over the relative shift dis-
	tance on the slave side with respect to the master
	is 5 seconds.
+MOVJ VJ	···The shift time at VJ = 100 for the master shift
	amount is 2 seconds.
*This "SMOVL +	MOVJ" functions when the shift time is 5 seconds.

# 5 Triple Synchronous System5.11 Registering Move Instruction (S)MOV □+MOVJ

Parameter	Contents and Se	t Value					Initial Value
S2C212	+MOV INSTRUCTION SPEED INPUT Specifies whether the speed inputting for move instructions of the master side					0	
	robot in a coord	nated job	is permitted or no	ot.			
	<example> 0: Not Provided</example>			1: Provided			
	SMOVL	V=100		SMOVL	V=100		
	+MOVJ		<ul> <li>← Master side</li> <li>Speed specifica-</li> <li>— tion not provided</li> </ul>	+MOVJ	VJ=10.00	← Master side Speed specifica- - tion provided	

- Triple Synchronous System
- 5.12 Registering Reference Point Instruction (SREFP)

# 5.12 Registering Reference Point Instruction (SREFP)

Register a reference point instruction (SPEFP) for a coordinated interpolation in the following manner.

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

5

- 3. Move the cursor.
  - Move the cursor to the line immediately before the position where the reference point is to be registered.

0016	SMOVL V=658
	+MOVJ
0017	CALL JOB: WORK-A
0018	SMOVL V=658
	THOAT

- 4. Grasp the Enable switch.
- 5. Press the axis key.
  - (1) Turn ON the servo power with the Enable switch.
  - (2) Move the manipulator to the position which will be a reference point.
- 6. Select the coordinated interpolation.
  - Press [SMOV] to select a coordinated interpolation.
- 7. Press [REF PNT].

SREEP 1



- 8. Change the reference point number.
  - Move the cursor to the reference point number, and press [SHIFT] + the cursor key to change the reference point number.



- If you use the Numeric keys to change the reference point number, press [SELECT] when the cursor is on the reference point number. Input the number and press [ENTER].
  - Ref SREFF
- 9. Press [INSERT].
  - The [INSERT] key lamp lights up.
  - When registering immediately before the END instruction, pressing [INSERT] is not needed.
- 10. Press [ENTER].
  - The REFP instruction is registered.



- 5 Triple Synchronous System
- 5.13 Changing Tasks

# 5.13 Changing Tasks

To call the JOB CONTENT window for master task, subtask 1, subtask 2, and subtask 3, proceed the following operation.

- 1. Select {JOB} under the main menu.
- 2. Select {JOB}.
- 3. Press the page key 💽 .
  - Each time the page key is pressed, the contents of the JOB CONTENT window change in order of master task, subtask 1, subtask 2, and subtask 3.
  - When there is no job in a task, the JOB CONTENT window for this task is not displayed.

Triple Synchronous System

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

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

Subtasks 1, 2, and 3 are robot jobs.

Subtask 1: Job of the first manipulator + the station Subtask 2: Job of the second manipulator + the station Subtask 3: Job of the third manipulator + the station

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

• Method 1: Copy one subtask job to create two other subtasks.



This method is useful when movement paths are symmetrical.

Use the mirror shift function to convert a job path and copy it. The same teaching operation does not have to be repeated.

• Method 2: Perform teaching for each manipulator.



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

- 5 Triple Synchronous System
- 5.15 Method 1: Copy One Subtask Job and Create Other Two Jobs

# 5.15 Method 1: Copy One Subtask Job and Create Other Two Jobs

## 5.15.1 Procedure

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

Perform teaching for either R1 + S1, R2 + S1, or R3+S1. Use the mirror shift to create a job for the other two manipulators.



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



Triple Synchronous System

# 5.15 Method 1: Copy One Subtask Job and Create Other Two Jobs

## 5.15.2 Teaching and Mirror Shift

5

Teach the job for one manipulator + the station, and confirm the movement.

After having completed the teaching, perform mirror shift the job.



5.15.2.1 Converting

Call the JOB CONTENT window for the job to be converted.

# For the job currently selected

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

# To call another job

- 1. Select {JOB} under the main menu.
- 2. Select {SELECT JOB}.
  - The JOB LIST window appears.
- 3. Select a job to be displayed.

5 Triple Synchronous System

5.15 Method 1: Copy One Subtask Job and Create Other Two Jobs

#### Execute conversion

DATA EDIT	DISPLAY UTILIT	1) 12 🗹 🕼 🕲 📮 👆
MIRROR SHIFT SOURCE JOB SOURCE CTRL GROUP STEP SECTION DESTINATION JOB DESTINATION CTRL GRO COORDINATES USER COORD NO. TARGET	JOB1 R1+S1:S1 JOB2 JOB2 PULSE ## ##	
EXECUTE	CANCEL	
Main Menu Sim	ple Menu	

#### **OSOURCE JOB**

Selects the conversion source job.

To select another job to be converted, move the cursor to the name and press [SELECT] to call up the list of jobs. Select the desired job and press [SELECT].

#### **©SOURCE CTRL GROUP**

Displays the control group of the conversion source job.

#### **3STEP SELECTION**

Specifies the steps to be converted.

From the first step to the last step of the selected job are specified as initial value.

### **@DESTINATION JOB**

Specifies the converted job name.

To enter the name, move the cursor to the name and press [SELECT]. The name of the conversion source job is displayed in the input line as initial value.

When "***" is displayed, the name for the converted job is to be the same as that of the conversion source job.

#### **©DEST CTRL GROUP**

Selects the control group for the converted job.

When the destination job name is entered, the same control group as the conversion source job is automatically set.

To change it, move the cursor to the control group and press [SELECT] to call up the selection dialog box.

- 5 Triple Synchronous System
- 5.15 Method 1: Copy One Subtask Job and Create Other Two Jobs

#### **©COORDINATES**

Specifies the coordinates used for conversion.

"PULSE," "ROBOT," or "USER" can be selected.

The initial value is "PULSE."

"PULSE": Executes the pulse mirror-shift conversion.

"ROBOT": Executes the mirror-shift conversion on the basis of the cartesian coordinates.

"USER": Executes the mirror-shift conversion on the basis of the specified user coordinates.

#### **OUSER COORD NO.**

Specifies the user coordinates number when "USER" is selected in (6). "01" is automatically set as initial value when the "USER" is selected in (6).

This item cannot be set when "PULSE" or "ROBOT" is selected in .

#### **®TARGET**

Specifies the coordinate where conversion is to be done when "ROBOT" or "USER" is selected in ⁽⁶⁾.

"XY," "XZ," or "YZ" can be selected. The "XZ" is automatically set as initial value when "ROBOT" or "USER" is selected in ⁽⁶⁾.

Always specify "XZ" for "ROBOT."

#### **®EXECUTE**

Executes the conversion.

When the conversion destination job name is entered, the converted job is created with that name as a new job.

When the conversion destination job name is not entered, the conversion source job is converted and overwritten.

5.15.2.2 Jobs Not to be Converted

The jobs and relative jobs without group axes cannot be converted.

# 5.15.2.3 Group Axes for Conversion

When the group axes for the SOURCE JOB in the multiple group axes system, the axis configuration, etc. of each group axes for SOURCE JOB and DESTINATION JOB must be the same.

- Robot axis: Same type
- Base axis: Same axis configuration
- Station axis: Same axis configuration

#### 5.15.2.4 Position Type Variables

The position type variables are not for mirror-shift.

 5
 Triple Synchronous System

 5.15
 Method 1: Copy One Subtask Job and Create Other Two Jobs

 5.15.2.5
 Parameter

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

 S1C×G065: Mirror shift sign reversed axis specification



# 5.15.3 Correcting Positional Dislocation

In the job after mirror shift, a position may be dislocated due to the installation error.

In this case, all steps should be corrected by the same shift amount.

For this operation, the parallel shift job conversion function is used.

# 5.15.3.1 Setting the Items for Conversion

- 1. Select {JOB} under the main menu.
- 2. Select {JOB}.
  - The JOB CONTENT window appears.
- 3. Select {UTILITY} under the pull-down menu.
- 4. Select {PARALLEL SHIFT JOB}.
  - The PARALLEL SHIFT JOB window appears.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 ៅ 🧐 🕞 侍
PARALLEL S SOURCE & STEP SEC DESTINA COORDIN/ BASE PO SHIFT V/	HIFT JOB JOB TTION TTION JOB ATES ALUE R1	U081 0001> #****** PULSE TEACH : :S L U R B B T	> 0010 +************************************	****
EXEC	UTE	CANCE	L	
Main Men	J Sim	ole Menu		

- 5 Triple Synchronous System
- 5.15 Method 1: Copy One Subtask Job and Create Other Two Jobs
- 5. Specify the conversion items.
  - Specify the following items.

## **OSOURCE JOB**

Selects the job before conversion.

The job which is shown in the JOB CONTENT window is set initially. To change the job, perform the following procedure.

Move the cursor to the job name and press [SELECT]. The JOB LIST window appears. Select the desired job.

#### **©STEP SECTION (Start Step \rightarrow End Step)**

Specifies the step section of the source job.

All the steps are set initially.

If there is no steps in the source job, "***" is displayed.

To change the section, perform the following procedure.

Move the cursor to the step section indication and press [SELECT]. The input buffer line appears. Input the step number and press [ENTER].

### **3 DESTINATION JOB**

Specifies the converted job.

If this is not specified( "*******" is displayed), the source job is specified. If the converted job is specified, the source job is copied and converted. To change the job, perform the following procedure.

Move the cursor to the converted job name indication and press [SELECT]. The character input line appears. The source job name is displayed in the input line. To enter job name without using the source job name, press [CANCEL] and then input a job name.

#### **COORDINATES**

Selects the conversion coordinates.

Move the cursor to the coordinates name and press [SELECT].

The selection dialog box appears. Select the desired coordinates. When the user coordinates are selected, the input buffer line appears. Input the desired user coordinate number and press [ENTER].

- 5 Triple Synchronous System
- 5.15 Method 1: Copy One Subtask Job and Create Other Two Jobs

## 5.15.3.2 Setting the Shift Value

There are two methods for specifying the shift value.

- Directly input the shift value by numerical value.
- Calculate the shift value by teaching the original base point and converted base point.

## Numerical Value Input

- 1. Display the PARALLEL SHIFT JOB window. Select the shift value to be set.
  - The number can now be entered.

DATA	EDIT	DISPLAY	UTILITY	12 🗳 📶 😣	🙋 📮 🙌
PARALLEL S SOURCE JI STEP SEC DESTINAT COORDINA BASE PORT SHIFT VA	HIFT JOB OB TION ION JOB TES NT LUE R1	JOB1 10001 JOB2 JOB2 TFACH 3 			
EXECU	TE	CANCE	-		
Main Menu	Sim	ple Menu			

- 2. Type the shift value using the Numeric keys.
- 3. Press [ENTER].
  - The shift value is set.

DATA EDI	IT DISPLAY	UTILITY	12 🗹 📶 😣	10 🕞 🙌
PARALLEL SHIFT SOURCE JOB STEP SECTION J COORDINATES BASE POINT SHIFT VALUE	JOB JOB JOB2 JOB2 ROBOT TEACH R1 :X Y Z	-> 0010 SETTING 00.000 0.000 0.000		
EXECUTE	CAN	ÆL		
Main Menu	Simple Menu			

- 5 Triple Synchronous System
- 5.15 Method 1: Copy One Subtask Job and Create Other Two Jobs

## Calculation by Teaching

- Display the PARALLEL SHIFT JOB window. Select "TEACH SETTING" in the item of "BASE POINT."
  - The BASE POINT window appears.

DATA	EDIT	DISPLAY	UTILITY	12 🗹 🖬 🏍 🗃 🕞 🖨
PARALLEL S	HIFT JOB	DAG		T \
D1 · C	PUINI (SRC)	D1 · C	E PUINI (DESI	1)
1	0	1	0	
Ŭ	0	Ū	õ	
R	0	R	0	
В	0	В	0	
Т	0	Т	0	5
		_		
EXEC	JTE	CANCI	EL	
Main Menu	J Simp	le Menu		

- 2. Select "BASE POINT(SRC)."
- 3. Move the manipulator to the original base point by the axis keys.
- 4. Press [MODIFY] and [ENTER].
  - The original base point is set.

DATA	EDIT	DISPLAY	UTILITY	121	2 📶 😣	1	•
PARALLEL SH BASE F R1 :X Y Z	11FT JOB OINT(SRC) 230.000 40.000 20.000	BASI R1 :X Y Z	J E POINT(C 0.0 0.0 0.0	EST) 00 00 00			,
EXECUT	E	CANCE	L				
Main Menu	Simpl	e Menu					

- 5. Select "BASE POINT(DEST)."
- 6. Move the manipulator to the converted base point by the axis keys.

- 5 Triple Synchronous System
- 5.15 Method 1: Copy One Subtask Job and Create Other Two Jobs
- 7. Press [MODIFY] and [ENTER].
  - The conversion base point is set.

DATA	EDIT	DISPLAY	UTILITY	12 🗳 📶 😣 (	0 🖳 👘
PARALLEL S	HIFT JOB	DACE		N.	
R1 :X Z	230.000 40.000 20.000	I R1 :X Y I Z	460.00 60.00 100.00		
EXEC	JTE	CANCE	L		
Main Menu	J Simpl	e Menu			

- 8. Select "EXECUTE."
  - The difference is calculated by the two teaching points and set as a shift value.

DATA	EDIT	DISPLAY	UTILITY	12 🗳 📶 😣	🙋 📑 🕀
PARALLEL SHTI SOURCE JOB STEP SECTI DESTINATIO COORDINATE3 BASE POINT SHIFT VALU	<del>T JOB</del> NN JOB S E R1 :	JOB1 0001 -> JOB4 ROBOT TEACH S X 230 Y 20 Z 80	0010 000 000 000		
EXECUTE		CANCEL	•		
Main Menu	Simp	le Menu			

- Triple Synchronous System
- 5.15 Method 1: Copy One Subtask Job and Create Other Two Jobs
- 5.15.3.3 Executing Conversion

5

- 1. Display the PARALLEL SHIFT JOB window. Select "EXECUTE."
  - The confirmation dialog box appears when the converted job is not specified.
    - Select "YES" then the conversion is executed.
  - The JOB CONTENT window appears when the conversion is completed.

DATA	EDIT	DISPLAY	UTILITY	12 🗳 📶 😣	10 🖳 🔭
PARALLEL S SOURCE S STEP SEC DESTINAT COORDINA BASE POI SHIFT V/	HIFT JOB JOB TTION JOD ATES INT ALUE	JOB3 0001 -> ******** ROBOT TEACH S TEACH S	0010 DOTO DOTA DOTA DVerwri DVerwri	te?	
EXEC	JTE	CANCEI	-		
Main Menu	JSimp	le Menu			



"/OV" is added to a step whose converted result is outside the movable range of the robot. At this step, correct the teaching position.

JOB	EDIT	DISPLAY	UTILITY	12 🗹 🖬 🐼 ն	] 📮 🙌
JOB CONTENT J: TEST CONTROL GRO	: MASTER UP: R1+S1:S1		S:0000 TOOL: **+**		
000000 NOP 0001 WORK-/ 0002 JUNK-/ 0003 MOVJ V 0003 MOVJ V 0004 MOVJ V 0005 MOVJ V 0006 END	4 08:J08-R1 /J-50.00 ′0Y YJ=50.00 /J=50.00				
MOVI V=13: +MOVJ VJ=0.	78				
Main Men	J Simpl	e Menu			

5 Triple Synchronous System

## 5.16 Method 2: Perform Teaching for Each Manipulator

# 5.16 Method 2: Perform Teaching for Each Manipulator

#### 5.16.1 Procedure

First, perform teaching a job for the combination of leader manipulator and station.

Next, perform teaching a job for the combination of follower manipulator and station.

For this operation, perform teaching so that the follower manipulator follows the motion of station by FWD operation of the leader job.



For Method 2, there are two ways of teaching depending on whether the master task is used or not.

#### Triple Synchronous System

#### 5.16 Method 2: Perform Teaching for Each Manipulator

#### 5.16.2 Teaching using Master Task

5

Using the master task can omit the operation to register a job name in the SUPERVISORY window.



- 1. Teach the coordinated job of leader subtask.
  - Teach all the steps of coordinated job for one manipulator + the station.



- 2. New job registration for the coordinated job of follower subtask.
  - Register as a new job the coordinated job for other respective manipulators + the station.
  - For new job registration, refer to chapter 4.10 "Registering Job" at page 4-24.



- 3. New job registration of master task.
  - Register the master task as concurrent job.
  - For concurrent job, refer to *chapter 1.7.2 "Concurrent Job" at page 1-25*.

- 5 Triple Synchronous System
- 5.16 Method 2: Perform Teaching for Each Manipulator
- 4. Register PSTART instruction.
  - Register a PSTART instruction to start the job that was registered at Operation 2.
  - (1) To specify this subtask as the follower, add a tag SYNC and the leader subtask.
  - (2) Then, register a PSTART instruction to start the job that was taught at Operation 1.



- 5. Set to "Single job operation mode."
  - Set the operation mode at FWD operation to "Single job operation mode."
  - Pressing [SHIFT] + [SMOV] changes the operation mode.
- 6. Move the cursor to the first PSTART instruction.
- 7. Press [INTERLOCK] + [FWD].
  - Starts the follower subtask.
- 8. Move the cursor to the second PSTART instruction.
- 9. Press [INTERLOCK] + [FWD].
  - Starts the leader subtask.
- 10. Press the page key to change to the leader subtask.
  - Each time the page key is pressed, the contents of the JOB CONTENT window change in order of master task, subtask 1, subtask 2, and subtask 3.
- 11. Move the cursor to the step 1.
- 12. Press [FWD].
- 13. Press the page key to change to the follower subtask.
  - Each time the page key is pressed, the contents of the JOB CONTENT window change in order of master task, subtask 1, subtask 2, and subtask 3.

- 5 Triple Synchronous System
- 5.16 Method 2: Perform Teaching for Each Manipulator
- 14. Register the step 1 of the follower subtask.
  - After the FWD operation of step 1 of leader, change to the follower and register the position of the follower manipulator relative to the station current position.



- 15. Register the step 2 and onward of the follower subtask.
  - Change to the leader's JOB CONTENT window, and perform a FWD operation to the next step.
  - To maintain the follower manipulator position relative to the station, press [SHIFT] + [SYNCRO/SINGLE] to set the job synchronized mode.
  - (2) Change to the follower's JOB CONTENT window, and register the follower manipulator position relative to the station current position.

0000 NOP	
0001 SMOVL V=276	
+MOVJ	
0002 SMOVL V=276	
+MOVJ	

(3) Teach the follower job by repeating the above operations (1) and (2).

#### 5 Triple Synchronous System

5.16 Method 2: Perform Teaching for Each Manipulator

## 5.16.3 Teaching using SUPERVISORY Window

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



- 1. Teach a coordinated job of leader subtask.
  - Teach all the steps of the coordinated job of one manipulator + the station.



- 2. New job registration of a coordinated job of follower subtask.
  - Register as a new job the coordinated job of other respective manipulators + the station.
  - For new job registration, refer to chapter 5.10 "Registering Job" at page 5-24.
- 3. Select {JOB} under the main menu.
- 4. Select {CTRL MASTER}.
  - The SUPERVISORY window appears.



5. Select the root job of master task.

#### DX100

- 5 Triple Synchronous System
- 5.16 Method 2: Perform Teaching for Each Manipulator
- 6. Select "CANCEL ROOT JOB."
  - The root jobs of master task, subtask 1, subtask 2, and subtask 3 are cancelled.

JOB	EDIT	DISPLAY	UTILITY	) 📙 📶 📢	à 🙋 📮 侍	Þ
SUPERVISORYS MASTER JOB ROOT JOB EDIT JOB LINE NO. STEP NO. STATUS SYNC TASK	MASTER ######## ######### ######### 0000 0000 ######	了。 林市市市市市市市市市市市市市市市市市市市市市市市市市市市市市市市市市市 新市市市市市市				
				PAGE		
Main Menu	Simp	le Menu				

- 7. Select the root job of subtask 1.
- 8. Select "REGISTER ROOT JOB."
  - The root job for subtask 1 is registered.

JOB	EDIT	DISPLAY	UTILITY	12 🖳 🎽 🛸	🔞 📑 🕀	
SUPERVISORY: MASTER JOB ROOT JOB EDIT JOB LINE NO.	SUB1 ********* JOB-R1 JOB-R1 0000	****	*****			
STEP NO. STATUS SYNC TASK	0000 STOP *******					
			_			_
				PAGE		
Main Menu	Simp	le Menu				

- 9. Select a job to be registered as root job.
- 10. Select the root job of subtask 2.

- 5 Triple Synchronous System
- 5.16 Method 2: Perform Teaching for Each Manipulator
- 11. Select "REGISTER ROOT JOB."
  - The root job for subtask 2 is registered.

JOB	EDIT	DISPLAY	UTILITY	22 上	21 😢 🖄	I 📑 👘	
SUPERVISORY MASTER JOB ROOT JOB EDIT JOB LINE NO. STEP NO. STATUS SYNC TASK	: SUB2 <b>1</b> 08-R2 <u>100-R2</u> <u>0000</u> <u>0000</u> <u>510P</u> <b>*******</b> ***	-	*****				
				PAGE			
Main Menu	Simp	le Menu					

- 12. Select a job to be registered as root job.
- 13. Select the root job of subtask 3.
- 14. Select "REGISTER ROOT JOB."
- 15. Select a job to be registered as root job.
  - The root job for subtask 3 is registered.

JOB	EDIT	DISPLAY	UTILITY	222 🕒 🎽 🛸	10 📮 👘	Þ
SUPERVISORY: MASTER JOB ROOT JOB EDIT JOB LINE NO. STEP NO. STATUS SYNC TASK	SUB3 ########### JOB-R3 JOB-R3 JOB-R3 STOP ##*##################################	-	*****			
				PAGE		
Main Menu	Simp	le Menu				

16. Select the synchronous task of subtask 1 (2).

- 5 Triple Synchronous System
- 5.16 Method 2: Perform Teaching for Each Manipulator

17. Select "SUB3."

 Specify SUB3 of leader task to synchronize the synchronous task of subtask 1 (2).

JOB	EDIT	DISPLAY	UTILITY	12 🖳 🎽 🛸	10 📮 👆	Þ
SUPERVISORY: MASTER JOB ROOT JOB EDIT JOB LINE NO. STEP NO. STATUS SYNC TASK	: SUB1 <b>868-88888</b> JOB-R1 0000 0000 0000 STOP SUB3	-				
				PAGE		
Main Menu	Simp	le Menu				

- 18. Select "Single job operation mode."
  - Set "Single job operation mode" for the operation mode at FWD operation.
  - Pressing [SHIFT] + [SMOV] changes the operation mode.
- 19. Select {JOB} under the main menu.
- 20. Select {JOB}.
- 21. Press the page key to change to the leader subtask.
  - Each time the page key is pressed, the contents of the JOB CONTENT window change in order of master task, subtask 1, subtask 2, and subtask 3.
- 22. Move the cursor to the step 1.
- 23. Press [FWD].
- 24. Press the page key to change to the follower subtask.
  - Each time the page key is pressed, the contents of the JOB CONTENT window change in order of master task, subtask 1, subtask 2, and subtask 3.
- 25. Register the step 1 of the follower subtask.
  - After the FWD operation of step 1 of leader, change to follower and register the position of the follower manipulator relative to the station current position.



- 5 Triple Synchronous System
- 5.16 Method 2: Perform Teaching for Each Manipulator

26. Register the step 2 and onward of the follower subtask.

- (1) Change to the leader's JOB CONTENT window and perform FWD operation to the next step.
- To maintain the follower manipulator position relative to the station, press [SHIFT] + [SYNCRO/SINGLE] to set the job synchronized mode.
- (2) Change to the follower's JOB CONTENT window, and register the follower manipulator position relative to the station current position.

0000	NOP		
0001	SMOVL	V=276	
	+MOVJ		
0002	SMOVL	V=276	
	+MOVJ		

(3) Teach the follower job by repeating the above operations (1) and (2).

- 5 Triple Synchronous System
- 5.17 Job in Master Task

# 5.17 Job in Master Task

The job of master task is a concurrent job or a robot job without control groups.

- 1. Select {JOB} under the main menu.
- 2. Select {CREATE NEW JOB}.
  - The NEW JOB CREATE window appears.

JOB	DIT DISPLAY	UTILITY	] 10 🖻 🖌	😣 🔞 📑	( <del>*)</del>
NEW JOB CREATE JOB NAME COMMENT GROUP SET JOB TYPE	****************		9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9		
EXECUTE	CANCEL	L.			
Main Menu	Simple Menu				

- 3. Enter a job name.
  - Move the cursor to JOB NAME and press [SELECT], and enter a job name by entering the characters.
- 4. Set "GROUP SET."
  - Selecting "R1" of "GROUP SET" displays the selection dialog box. Select "NON GROUP."
- 5. Set "CONCURRENT JOB."
  - Select "ROBOT JOB" of "JOB TYPE."
  - Each time [SELECT] is pressed, "ROBOT JOB" or "CONCURRENT JOB" is selected alternately.
- 6. Press [ENTER].

- 5 Triple Synchronous System
- 5.17 Job in Master Task
- 7. Select "EXECUTE."
  - The job is registered in the memory of DX100, and the JOB CONTENT window appears.
  - NOP and END instructions are registered automatically.

JOB	EDIT	DISPLAY	UTILITY	) 🛛 🖄 🔅 🖾 🕞 🔶
JOB CONTENT J:MASTERTAS CONTROL GRO	: MASTER K JUP: NON GROU	P	S:0000 TOOL: **	
0000 NOP 0001 END				
Main Men	u Simp	le Menu		

- 8. Register a PSTART instruction.
  - (1) Register PSTART instructions to start the subtask 1, 2, and 3.
  - Since the first PSTART instruction is for starting the follower subtask, add a tag SYNC and the leader subtask.
  - (2) Then, register a PSTART instruction to start the leader subtask.

JOB	EDIT	DISPLAY	UTILITY	🔞 🖳 🖣	
JOB CONTENT J:MASTERTAS CONTROL GRO	: MASTER K JUP: NON GROU	P	S:0000 TOOL: **		
0000 NOP 0001 MASTER 0002 PSTART, 0003 PSTART, 0004 PSTART, 0005 END	JOB 108:JOB1 SUB1 S 108:JOB2 SUB2 S 108:JOB3 SUB3	YNC SUB3			
Main Men	u Simp	le Menu			

- 5 Triple Synchronous System
- 5.18 Confirming Operation

# 5.18 Confirming Operation

## 5.18.1 Procedure



For confirming operation, set to "Multi-job operation mode."

In the multi-job operation mode, the jobs in all the tasks operate. (The operation procedures are explained below.)

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

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

- 1. Create a concurrent job.
  - For procedure, refer to chapter 5.17 "Job in Master Task" at page 5-51..
- 2. Select {JOB} under the main menu.
- 3. Select {CTRL MASTER}.
  - The SUPERVISORY window appears.
  - Each time the page key is pressed, the contents of the window changes. When the four columns show information for the master task, subtask 1, subtask 2, and subtask 3 press the page key and the information for subtasks 4 to 7 appears instead. Press the page key again, and the information for the master task, subtask 1, subtask 2, and subtask 3 reappears.

JOB	EDIT	DISPLAY	UTILITY	) 🛛 🖄 🚯	🔟 🖵 👘	Þ
SUPERVISORY MASTER JOB ROOT JOB EDIT JOB LINE NO. STEP NO. STATUS SYNC TASK	MASTER MASTERTAS MASTERTAS 0000 0000 STOP ******	<u>к</u> К К				
				PAGE		
Main Menu	Simpl	e Menu				

- 4. Move the cursor to the task where the master job is to be registered.
- 5. Press [SELECT].
- 6. Select "SETTING MASTER JOB."
- 7. Select a job to be the master job.
- 5 Triple Synchronous System
- 5.18 Confirming Operation

# 8. Press [SHIFT] + [SYNCRO/SINGLE].

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



- 9. Press [TEST START] or [FWD].
  - When a PSTART instruction is executed, the manipulator and the station move.

Parameter	Contents and Set Value	Initial Value
S4C286	Specifies the user output number to externally output the "Multi-job operation mode" status at teaching. 0: Not output 1 to 1024: User output number	0

# 5.18.2 Precautions for Confirming Operation

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

## 5.18.2.1 Stops during Operation

### <Example>

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

When restarting the operation in the states as explained above, an interference with jig, etc. may be caused.

Restart three subtask jobs from the same position (step).

5 Triple Synchronous System

5.18 Confirming Operation

5.18.2.2 When "Multi-job operation mode" is Set in the TEACHING CONDITION Window

#### <Example>

If the manipulator stops after operating to a certain step, and the step position of the follower R1 is changed and performs FWD operation again, the leader R3 and the follower R2 proceed to the next step but the R1 does not move.



As a result, the R3 and R2 go forward by one step.

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

In the above figure, at the FWD operation after the position change, the leader R3 and the follower R2, whose steps have not been changed, move to step 3.

However, since the position of the follower R1 is changed, the step after the change is executed again. As a result, operation is performed at the same position and does not proceed to the next step. In this way, the steps of the three manipulators do not correspond to each other. To make the steps of the three manipulators correspond with each other in the FWD operation after the position change in the above case, move the cursor to the next step for the job where a change has been made, then perform the FWD operation, TEST run, and playback.

5 Triple Synchronous System

5.19 Playback

# 5.19 Playback

### 5.19.1 Start

Call the master job in the following operation and perform a playback.

A job in the subtask is started by a PSTART instruction.

- 1. Select {JOB} under the main menu.
- 2. Select {CTRL MASTER}.
  - The SUPERVISORY window appears.
- 3. Move the cursor to MASTER JOB of MASTER.
- 4. Press [SELECT].
- 5. Select "CALL MASTER JOB."
- 6. Press [START].
  - The called master job is executed from the beginning and the subtask is executed by a PSTART instruction.



5 Triple Synchronous System

5.19 Playback

### 5.19.2 Automatic Correction of Shift Value

During playback operation, as the station is controlled by the leader job, the follower job controls only the follower manipulator.

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



The shift between the teaching position and the station current position is always monitored.

If the shift value exceeds the set value of parameter, the following message is displayed.

Main Menu	Simple Menu	PULSE LIMIT (TWIN COORDINATED) [RIR2S1]
Main Menu	Simple Menu	PULSE LIMIT (TWIN COORDINATED) [10221]

Parameter	Contents and Set Value	Initial Value
S3C1101	Maximum shift angle of station axis in twin (triple) synchronous system	Differs depending on system (in units of 0.1°)

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

Parameter	Contents and Set Value	Initial Value
S2C420	Control method of follower manipulator posture in twin (triple) synchronous system 0: Follow the motion of station 1: Constant to the earth	0





6 Coordinated Control

6.1 Outline

# 6 Coordinated Control

# 6.1 Outline

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





Twin synchronous system

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

- 6 Coordinated Control
- 6.2 Group Combination

# 6.2 Group Combination

The group combination in a coordinated job is to specify two group axes to be coordinated.

The master-slave relationship must be assigned between two group axes.

When executing a coordinated instruction, the slave side executes relative interpolation on the tool coordinate system of the master side. A group combination is set at the registration of new job name.



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

<u>Step</u>	<u>Instruc</u> <u>tion</u>	
001	SMOVL +MOVL	
002	MOVL +MOVL	←Slave side ←Master side

- 6 Coordinated Control
- 6.3 Coordinated and Individual Interpolations

# 6.3 Coordinated and Individual Interpolations

Two types of operation are available for a coordinated job.

### 6.3.1 Coordinated Interpolation

The coordinated interpolation is performed by two group axes in a masterslave relationship.

The slave executes a relative interpolation on the tool coordinate system of the master side.

This feature is used in works that require coordinating to the movement of workpiece.

### 6.3.2 Individual Interpolation

The individual interpolation is performed with the master-slave relationship cancelled.

The master side and the slave side both perform their own individual movements, but the starts and the ends of the movements taught to each are the same.

This operation is used when, after the master side and the slave side completed a job of the coordinated operation, each side is to perform its own job.

### <Example>

### Example of play speed slowed down with individual interpolation

If an identical speed is given to two group axes, in order that they might finish works as far as the step 2 simultaneously, the group axis 2 is given movement slower than V=276.



### 6.3.3 Changing Interpolation Mode

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

SMOVL V=138	
+MOVL	
MOYL Y=138	

6 Coordinated Control

6.4 Restriction

# 6.4 Restriction

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

- 00
- 7 Independent Control
- 7.1 Independent Control

# 7 Independent Control

# 7.1 Independent Control

The DX100 is configured to be able to decode and execute four jobs (with option, maximum eight jobs) each independently.

A multitask control performed by this mechanism is called "independent control."

Four mechanisms which execute jobs are called as follows:

- Master task
- Subtask 1
- Subtask 2
- Subtask 3

The subtask1, subtask 2, and subtask3 are the tasks to execute jobs that are started by the master task.

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

Robot job	A job which moves robot axes or station axes with move instructions.
Concurrent job	This is used as a job to start robot jobs, or as specialized job to control calculations and I/O.

The jobs of subtask 1, subtask 2, and subtask 3 (hereinafter, referred to as "subtask1/2/3") are started by the PSTART instruction.

To start a job always fixed, it is convenient to use the master job.



Since a robot job without control groups can start another robot job, it can be used as a master task job.

DX100

# 7 Independent Control

7.1 Independent Control



# <Example>

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



DX100

- 7 Independent Control7.1 Independent Control

<Example>

When implementing control of calculations or I/O, make the subtask 1 a concurrent job.?



7.2 Startup Method

# 7.2 Startup Method

### 7.2.1 Starting a Job always Fixed (Master Job)

To execute a job always fixed in each task, it is convenient to use a master job.

One master job (a series of jobs including related jobs) can be registered for each task.

Always register a master job for master tasks.

If there is no master job registered, it 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.





7 Independent Control 7.2

Startup Method

Even if a master job is registered, another unrelated job can be started.

Refer to chapter 7.2.2 "Starting Various Jobs" at page 7-6.

0002 PSTART JOB:WORK-A SUB1

Starts "WORK-A" in subtask 1.

7.2 Startup Method

## 7.2.2 Starting Various Jobs

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

PSTART JOB: job name SUB □····A specified job is started in a specified task.



JOB EDIT DISPLAY UTILITY 🛛 1 🔀 🔀 🛃	
JOB CONTENT: MASTER JOB NAME: M-TASK STEP NO: 000 CONTROL GROUP: NON GROUP TOOL: 00	
00001 NOP 100E 80   0002 PSTART JOB:WORK-A SUB 11   0003 PSTART JOB:WORK-D SUB 11	Starts "WORK-A" with subtask 1. Starts "WORK-D" with subtask 2.
0008 PWAIT SUB1 • 11 0009 PWAIT SUB2 • 11	Waits for the completion of subtask 1. Waits for the completion of subtask 2.
0012 PSTART JOB:WORK-B SUB 0013 PSTART JOB:WORK-E SUB 11	Starts "WORK-B" with subtask 1. Starts "WORK-E" with subtask 2.
0017 PWAIT SUB1 • 11 0018 PWAIT SUB2 • 11	Waits for the completion of subtask 1. Waits for the completion of subtask 2.
0022 PSTART JOB:WORK-C SUB• 11	Starts "WORK-C" with subtask 1.

- 7 Independent Control
- 7.2 Startup Method

If the PSTART command is not executed correctly, alarm 4103 will be emitted.

When an alarm is emitted, check the sub-code, and correct the job.

# <Example>

PSTART JOB	: R1S1 SUB1
PSTART JOB	: R2 SUB1
	AL-4103: [1] Sub task being executed:
	During execution of SUB1, an attempt is being made to
	start a different job in the same SUB1.
PSTART JOB	: R1S1 SUB1 (R1S1: A job for the robot 1 and the sta- tion 1)
PSTART JOB	: R2S1 SUB2 (R2S1: A job for the robot 2 and the sta- tion 1)
	AL-4103 [2] Group axis being used:
	An attempt is being made to execute a job containing
	station 1 in SUB2, despite the fact that station 1 is
	being used by SUB1.

# 7 Independent Control7.2 Startup Method

Alarm Number	Alarm Name	Sub Code	Meanings
4103	PARALLEL START INSTRUCTION	1	Sub task being executed: Although a job is being executed by instructed sub task, an attempt was made to execute another job by the sub task.
		2	Group axis being used: The job operated by another sub task uses the same group axis.
		3	Multiple start of same job: timing for start command again. The job that was tried to be started was executed by another sub task.
		4	Unregistered master job: Although the master job was not registered, an attempt was made to execute PSTART SUB (job name omitted).
		5	Synchronization instruction error: When restarted by PSTART, synchronization instruction status of the sub task under interruption was different from the status to restart.
		6	Stopped by an alarm: An attempt was made to start the sub task which is stopped by an alarm.
		7	Synchronization task specification of SYNC instruction omit error
		8	The task is specified by synchronization task of SYNC instruction.
		9	I/O jog being executed
		10	Separate group axis being used
		11	The servo power supply is OFF.
		12	Twin synchronous task ID error
		16	PSTART instruction is the old specification.
		17	PWAIT instruction is the old specification.

- 7 Independent Control
- 7.3 Job Examples

# 7.3 Job Examples

### 7.3.1 Non-Synchronous Operation

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

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

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



7.3 Job Examples

### 7.3.2 Synchronous Operation

The example below is a job configuration for the manipulators 1 and 2 to achieve detailed synchronization mode.

This is used when an interference area exists between manipulators.

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

The synchronization of each subtask is executed by TSYNC instruction.



- 7 Independent Control
- 7.4 Switching Task Window

# 7.4 Switching Task Window

To call the JOB CONTENT window of the master task and subtask 1/2/3, take the following procedure.

- 1. Select {JOB} under the main menu.
- 2. Select {JOB}
- 3. Press the page key.
  - Each time the page key is pressed, the contents of the JOB CONTENT window change in order of Master task, Subtask 1, Subtask 2, and Subtask 3.
  - The JOB CONTENT window of the task where no job is registered, is not shown.

- 7 Independent Control
- 7.5 Synchronizing with TSYNC

# 7.5 Synchronizing with TSYNC

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

When a TSYNC instruction is executed in one of the robot jobs, the manipulator waits until the same synchronized signal, TSYNC, is executed in the other robot job.

Set the number of synchronized tasks. When setting "SYNCHRO NUM" to "UNUSED," the number of tasks is the same as when "SNUM=2."

### Format



### 7.5.1 TItems to note when using a TSYNC command

Note that even when TSYNC is being used, the steps of two manipulators will fail to match each other if the following operations are performed.

- 7 Independent Control
- 7.5 Synchronizing with TSYNC

## 7.5.1.1 When a cursor shift occurs during operation

If the cursor position is shifted to a different step during the execution of a job of one of the two sub-tasks when the robot stops during operation, and the robot is restarted while remaining in this condition, the steps will become misaligned, resulting in the risk of interference from the jig, for example.

Start both jobs from the same position (step).



In this case, the steps become misaligned, which may cause the manipulator to interfere with the work piece or the jig.

In this case, the steps do not become misaligned, so normal operation can take place.

If the set number of synchronizations is less than the number of tasks to be synchronized, the robot will be commanded as soon as the TSYNC commands corresponding to the set number of synchronizations are output, and the jobs that cannot be synchronized will remain stopped. 7 Independent Control

7.5 Synchronizing with TSYNC

7.5.1.2 If three jobs were set when the number of TSYNC synchronizations was set to "Unused"

The two jobs that become synchronized first continue to move, and the third job remains stopped.



The two jobs that become synchronized first continue to move.

The job cannot be synchronized, and remains stopped.

- 7 Independent Control
- 7.6 Registering Instructions

# 7.6 Registering Instructions

Register an instruction when the cursor is in the address area in the JOB CONTENT window in teach mode.

- 1. Select {JOB} under the main menu.
- 2. Select {JOB}
- 3. Move the cursor to the address area.

JOB	EDIT	DISPLAY	UTILITY	] 12 🗹 📶	👒 🔟 📑 🤚	6
JOB CONTENT J:TEST CONTROL GRO 0000 NOP 0001 TESTJO 0002 MOVJ V 0003 MOVJ V 0004 MOVL V 0005 TIMER 0006 DOUT O 00007 END	UP: R1 IB J=60.00 J=12.50 =276 T=1.00 T#(1) ON		S:0000 TOOL: **			
MOVL V=270	}					
Main Men	J Simpl	e Menu				

### 7.6.1 PSTART Instruction

- 1. Move the cursor to the line just above the place where PSTART instruction is to be registered.
- 1. Press [INFORM LIST].
  - The instruction list appears.

	8	IN/OUT
JUMP	TSYNC	CONTROL
CALL		DEVICE
TIMER		MOTION
LABEL		ARITH
COMMENT		SHIFT
RET		OTHER
PSTART		SAME
PWAIT		PRIOR

- 2. Select "PSTART."
  - A PSTART instruction is displayed in the input buffer line.

PSTART JOB:JOB-R1 SUB1

- 7 Independent Control
- 7.6 Registering Instructions
- 3. Change additional items.
  - <To register items as displayed in the input buffer line> Proceed to Operation 5.
  - <To edit additional items>
  - (1) When the job name is to be changed, move the cursor to the job name, then press [SELECT].
  - The window for job name selection appears. Select a job to be changed.
  - (2) To edit additional items, move the cursor to the instruction in the input buffer line, then press [SELECT]. The DETAIL EDIT window appears.

JOB	EDIT	DISPLAY	UTILITY	12 🖳 🎽	😢 🔟 🗖	} ( <del>n</del>
DETAIL EDIT PSTART						
TARGET JOB STARTUP TASK SYNC SET CONDITION	JOE: JOB SUB1 UNUSED UNUSED	-R1				
PSTART JOB:	JOB-R1 SUB1					
Main Menu	Simp	e Menu				

- (3) To change the target task, move the cursor to "JOB:," then press [SELECT].
- The selection dialog box appears. Select a target job to be changed with.

JOB	EDIT	DISPLAY	UTILITY	12 上 🎽 🔞	個 🖵 🙌
JOB DETAIL EDIT PSTART TARGET JOB STARTUP TASK SYNC SET CONDITION	UNUSED	-R1	UTILITY		
PSTART JOB:	Job-R1 SUB	ſ			]
Main Menu	Simp	le Menu			

- 7 Independent Control
- 7.6 Registering Instructions
  - (4) To change the startup task, select "SUB1" of "STARTUP TASK."
  - The selection dialog box appears. Select the startup task to be changed with.

JOB	EDIT	DISPLAY	UTILITY	12 🖳	21 😫	( <del>h)</del>
DETAIL EDIT PSTART						
TARGET JOB STARTUP TASK	JOB: JOE SUB1	I-R1				
SYNC SET CONDITION	UNUSED UNUSED					
PSTART JOB:	JOB-R1 SUB	1				
Main Menu	Simp	le Menu				

- (5) After changed or added the additional items, press [ENTER].
- (6) The DETAIL EDIT window is closed and the JOB CONTENT window appears.
- 4. Press [INSERT] and [ENTER].
  - The instruction displayed in the input buffer line is registered.

- 7
- Independent Control
- 7.6 **Registering Instructions**

# 7.6.2 PWAIT Instruction

- 1. Move the cursor to the line just above the place where PWAIT instruction is to be registered.
- 2. Press [INFORM LIST].
  - The instruction list appears.

	9	IN/OUT
JUMP	TSYNC	CONTROL
CALL		DEVICE
TIMER		MOTION
LABEL		ARITH
COMMENT		SHIFT
RET		OTHER
PSTART		SAME
PWAIT		PRIOR

- 3. Select "PWAIT."
  - A PWAIT instruction is displayed in the input buffer line.



- 4. Change additional items.
  - <To register items as displayed in the input buffer line> Proceed to Operation 5.
  - <To edit additional items>
  - (1) To edit additional items, move the cursor to the instruction in the input buffer line, then press [SELECT]. The DETAIL EDIT window appears.

JOB	EDIT	DISPLAY	UTILITY	) 12 上 🎽 🛸	10 📮 🙌
DETAIL EDIT PWAIT					
TARGET TASK CONDITION	SUB1 UNUSED				
PWAIT SUB1					
Main Menu	Simpl	e Menu			

- (2) To change the target task, select "SUB1" of "TARGET TASK."
- The selection dialog box appears. Select a target task to be changed with.

7 Independent Control

7.6 Registering Instructions

JOB	EDIT	DISPLAY	UTILITY	12 上	<b>31 👒 i</b> e	] 🖵 🗄	
DETAIL EDIT PWAIT							
TARGET TASK CONDITION	SUB2 Unused						
PWAIT SUB2							Ĵ
Main Menu	Sim	ple Menu					

- (3) To add a condition, select "UNUSED" of "CONDITION."
- (4) The selection dialog box appears. Select "IF."
- "IF" is shown in the DETAIL EDIT window.

JOB	EDIT	DISPLAY	UTILITY	12 上	¥1 🛸 ĭ	o 📮 👆	
DETAIL EDIT PWAIT							
TARGET TASK CONDITION	SUB2						
PWAIT SUB2	IF IN#(1)=0	IN.					
Main Menu	Simp	e Menu					

- (5) Press [ENTER] to add "IF."
- (6) After changed or added the additional items, press [ENTER].
- (7) The DETAIL EDIT window is closed, and the JOB CONTENT window appears.
- 5. Press [INSERT] and [ENTER].
  - The instruction displayed in the input buffer line is registered.

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  - Independent Control
- 7.6 **Registering Instructions**

### 7.6.3 TSYNC Instruction

- 1. Move the cursor to the line just above the place where TSYNC instruction is to be registered.
- 2. Press [INFORM LIST].
  - The instruction list appears.

	8	IN/OUT
JUMP	TSYNC	CONTROL
CALL		DEVICE
TIMER		MOTION
LABEL		ARITH
COMMENT		SHIFT
RET		OTHER
PSTART		SAME
PWAIT		PRIOR

- 3. Select "TSYNC."
  - A TSYNC instruction is displayed in the input buffer line.



- 4. Change the numerical data.
  - <To register items as displayed in the input buffer line> Proceed to Operation 5.
  - <To change the numerical data>
  - (1) Move the cursor to the numerical data.
  - (2) Press [SHIFT] and the cursor key simultaneously to increment or decrement the number.
  - TSYNC 2 - To enter a number by pressing the Numeric keys, press [SELECT] to display the input buffer line.



- (3) Enter a number, then press [ENTER]. The number displayed in the input buffer line is changed.
- (4) After changed the numerical data, press [ENTER].
- The DETAIL EDIT window is closed, and the JOB CONTENT window appears.

- 7 Independent Control
- 7.6 Registering Instructions

<To edit additional items>

(1) Enter a number, then press [ENTER]. The number displayed in the input buffer line is changed. To edit additional items, move the cursor to the instruction in the input buffer line, then press [SELECT]. The DETAIL EDIT window appears.

JOB	EDIT	DISPLAY	UTILITY	12 🗹 📶 😣	🔞 🖵 🙌
DETAIL EDIT TSYNC					
SYNCHRO NO. Synchro num	UNUSED				
TSYNC 1					
Main Menu	Simpl	le Menu			

- (2) To change the synchronization number, select "1" of "SYNCHRO NO."
- When the number input status enters, enter the synchronization number, "SYNCHRO NO." by pressing the Numeric keys, and press [ENTER].

JOB	EDIT	DISPLAY	UTILIT	12 🖸	2 📶 😣	個日(	T)
DETAIL EDIT TSYNC							
SYNCHRO NUM	UNUSED						
TSYNC 2							
Main Menu	Sim	ple Menu					

- 7 Independent Control
- 7.6 Registering Instructions
  - (3) To add the number of synchronized tasks, select "UNUSED" of "SYNCHRO NUM."
  - f synchronized tasks, select "UNUSED" of "SYNCHRO NUM." The selection dialog box appears. Select "SNUM=."

JOB	EDIT	DISPLAY	UTILITY	12 🗹 🖬	🔒 🔟 🖳 🕀	
DETAIL EDIT TSYNC						
SYNCHRO NO. Synchro Num	2 Snum= 2	Ø				
TSYNC 2 SNU	M=2					
Main Menu	Simp	le Menu				

- (4) After changed or added the additional items, press [ENTER].
- (5) The DETAIL EDIT window is closed, and the JOB CONTENT window appears.
- 5. Press [INSERT] and [ENTER].
  - The instruction displayed in the input buffer line is registered.

- 7 Independent Control
- 7.7 Registering Job

# 7.7 Registering Job

## 7.7.1 Robot Job

Register a job in the subtasks.

The robot jobs in subtasks are registered task by task.

- 1. Select {JOB} under the main menu.
- 2. Select {CREATE NEW JOB}.
  - The NEW JOB CREATE window appears.

JOB I	EDIT DISPL	AY UTILITY	1. 2	M 😣 🙋	I 📮 🕀
NEW JOB CREATE JOB NAME COMMENT GROUP SET JOB TYPE	800000 JOB		*****		
EXECUTE		CANCEL			
Main Menu	Simple Menu				

- 3. Enter a job name.
  - Move the cursor to the job name, then press [SELECT]. Enter a job name by character input operation.
- 4. Set "GROUP SET."
  - Select "R1" of "GROUP SET." The selection dialog box appears. Select a group combination or "NON GROUP."
- 5. Set "ROBOT JOB."
  - Set "ROBOT JOB" for "JOB TYPE."
- 6. Press [ENTER].
- 7. Select "EXECUTE."
  - The job name is registered in the memory of DX100, then the JOB CONTENT window appears.

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- 7.7

– NOP and END instructions are automatically registered.

JOB	EDIT	DISPLAY	UTILITY	12 🗹 📶 👒	🔞 🖳 🙌
JOB CONTENT J:TEST CONTROL GRO	: MASTER NUP: R1		S:0000 TOOL: **		
0000 NOP 0001 END	eren alter				
<u> </u>					
Main Men	u Simp	le Menu			

- 7 Independent Control
- 7.7 Registering Job

## 7.7.2 Concurrent Job

Register a job in the master task.

- 1. Select {JOB} under the main menu.
- 2. Select {CREATE NEW JOB}.
  - The NEW JOB CREATE window appears.

JOB EI	DIT DISPLAY	UTILITY	) 1o 🗳 b	1 😪 🔞 🛙	🤰 🕀
NEW JOB CREATE JOB NAME CONMENT GROUP SET JOB TYPE	######################################				
EXECUTE	CANC	EL			
Main Menu	Simple Menu				

- 3. Enter a job name.
  - Move the cursor to the job name, then press [SELECT]. Enter a job name by character input operation.
- 4. Set "GROUP SET."
  - Select "R1" of "GROUP SET." The selection dialog box appears. Select "NON GROUP."
- 5. Set "CONCURRENT JOB."
  - Move the cursor to "ROBOT JOB" of "JOB TYPE," then press [SELECT]. Each time [SELECT] is pressed, "ROBOT JOB" and "CONCURRENT JOB" is shown alternately.
- 6. Press [ENTER].

- 7 Independent Control
- 7.7 Registering Job

7. Select "EXECUTE."

- The job name is registered in the memory of DX100, and the JOB CONTENT window appears.
- NOP and END instructions are automatically registered

JOB	EDIT	DISPLAY	UTILITY	🛛 🖻 🖬 📢	🙋 📑 🙌
JOB CONTENT J:MASTERTAS CONTROL GRO	T: MASTER SK DUP: NON GROU		S:0000 TOOL: **		
0000 NOP 0001 END					
Main Men	u Simp	le Menu			

- 7 Independent Control
- 7.8 Confirming Operation

# 7.8 Confirming Operation

# 7.8.1 FWD/BWD Operation and Test Run

7.8.1.1 Confirming the Operation of the Task being Displayed

When confirming operation in FWD/BWD operation or a test run, usually only the job of the task currently being displayed is targeted.

Operation can be confirmed with [FWD], [BWD], and [TEST START].

7.8.1.2 Confirming the Operation of All Tasks

To operate all tasks at the same time, perform the following operations 1 to 4.

- 1. Set the operation mode at independent control to "Multi-job operation mode."
- 2. Register a concurrent job as the master job.
- 3. Perform FWD operation on the concurrent job, and execute PSTART instruction.
- 4. Continue performing FWD operation so that all the tasks simultaneously perfome FWD operation.



Sometimes operation is performed at a different speed from the playback speed.

Exercise full caution to any interference between manipulators.

# 7.8.2 Switching Operating Method

There are two operating methods during FWD/BWD operation and a test run:

- Operate only the task currently being displayed ····*Single job operation mode"
- · Operate all tasks ···· "Multi-job operation mode"

These two operating methods can be switched on the TEACHING CONDITION window.

For arc coordinated system and jigless system, simply pressing [SHIFT]+[SMOV] can switch the operating method.

# 7.8.2.1 Switching by [SHIFT]+[SMOV]

For arc coordinated system and jigless system, simply pressing [SHIFT]+[SMOV] can switch the operating method.



- 7
- Independent Control
- 7.8 Confirming Operation

# 7.8.2.2 Switching on TEACHING CONDITION Window

- 1. Select {SETUP} under the main menu.
- 2. Select {TEACHING COND}.
  - The TEACHING CONDITION window appears.

DATA EDIT DISPLA	Y UTILITY	12 🗹 🖌 🦇 🗃 🖳 👘
TEACHING CONDITION SETTING		
LANGUAGE LEVEL INSTRUCTION INPUT LEARNING MOVE INSTRUCTION SET POSITION BUZZER WHEN POSITION TEACHING STEP ONLY CHANGING RECT/CYLINDRICAL TOOL NO. SWITCH TOOL NO. INTERLOCK FOR STEP ENT POS.TEACH ONLY JOG CONTROL GRO JOB UNDELETE FUNCTION INDEPENDENT: MOTION OF MEXT/TES BWD OPERATION NO GROUP AXIS BWD OPERATION CONCURRENT JOB STATION TWIN	VALID STEP CONSIDER PROHIBIT RECT PROHIBIT INVALID SINGLE PERMIT PROHIBIT INVALID	
Main Menu Simple Menu		

- 3. Select "STEP/TEST RUN OPERATION MODE."
  - Each time [SELECT] is pressed, the setting changes between "ALL" and "SINGLE."

LANGUAGE L LANGUAGE L INSTRUCTIO MOVE INSTF BUZZER WHE STEP ONLY RECT/CYLIN TOOL NO. IN POS.TEACH JOB UNDELE INDEPENDEN BWD OPERAT BWD OPERAT	INDITION SET EVEL IN INPUT LEAN UCTION SET I CHANGING IDARICAL WHITCH ITERLOCK FOR ONLY JOG COI ITE FUNCTION ITE FUNCTION OF ION NO GROUN IN	RNING POSITION TEACHING STEP ENTRY NTROL GROUP NEXT/TEST P AXIS ENT JOB	SUBSET   YALID   STEP   CONSIDER   PROHIBIT   RECT   PERMIT   PROHIBIT   INVALID   ALL   PROHIBIT   INVALID		

Parameter	Contents and Set Value	Initial Value
S4C286	Specifies the user output number to externally output the "Multi-job operation mode" status at teaching. 0: Not output 1 to 1024: User output number	0
- 7 Independent Control
- 7.8 Confirming Operation

## 7.8.3 BWD Operation of Concurrent Job

During BWD operation, a concurrent job and a job without control groups can be set so that they do not back, on the TEACHING CONDITION window. For the operation procedures, refer to *chapter 7.8.2 "Switching Operating Method" at page 7-27*.

7 Independent Control

7.9 Playback

## 7.9 Playback

#### 7.9.1 Procedure

A playback is performed in the manner described in the following diagram.

Executing PSTART instruction in master task, starts the job in subtasks.

The operation status of each task can be checked on the SUPERVISORY window.



For information a tor's Manual. This manual exp

For information about playback, refer to the DX100 Operator's Manual.

This manual explains the independent control characteristic operations.

- 7 7.9
- Independent Control Playback
- 7.9.2 Registering Master Job
- 7.9.2.1 Registering

Register a master job in teach mode.

- 1. Select {JOB} under the main menu.
- 2. Select {CTRL MASTER}.
  - The SUPERVISORY window appears.



- 3. Move the cursor to the task where a master job is to be registered.
- 4. Press [SELECT].
  - The selection dialog box appears.

JOB	EDIT	DISPLAY	UTILITY	12 🗹 📶 😣	🔞 📮 👘	
SUPERVISORY: MASTER JOB	MASTER	TER JOB				
EDIT JOB LINE NO.		MASTER JOB				
STEP NO. STATUS	0000 Stop					
				PAGE		
Main Menu	Simp	le Menu				

- 7 Independent Control
- 7.9 Playback
- 5. Select "SETTING MASTER JOB."
  - The JOB NAME window appears.

DATA	EDIT	DISPLAY	UTILITY	12 🗳	1 📢 🔟	] 🖳 👘	Þ
JOB NAME TEST TEST1 MASTERTASK JOB-R2 JOB1 JOB2 JOB1 B A MASTER	EDII	UISPLAT				, <u>L</u>	
Main Menu	Simp	le Menu					

- 6. Select a job to be registered as a master job.
  - The selected job is registered as a master job.

JOB	EDIT	DISPLAY	UTILITY	12 🗹 📶 😣	🗃 🖳 👘	
SUPERVISORY:	MASTER					
MASTER JOB	JOB-R1					
EDIT JOB	JOB-R1					
LINE NU.	0000					
STATUS	STOP					
				DACE		
				PAGE		
Main Menu	Simpl	e Menu				

- 7 Independent Control
- 7.9 Playback

## 7.9.2.2 Cancelling Registration

- 1. Move the cursor to the task whose registration is to be cancelled.
- 2. Press [SELECT].
- 3. Select "CANCEL MASTER JOB."
  - The selection dialog box appears.

JOB	EDIT	DISPLAY	UTILITY	] 12 🕑 🖌	1 😣 🔟 🖳	h 🕨
SUPERVISORY: MASTER JOB EDIT JOB LINE NO. STEP NO. STATUS	MASTER CALL NAS CANCEL I 0000 STOP	STER JOB MASTER JOB ASTER JOB				
				PAGE		
Main Menu	Simp	le Menu				

- 7
  - Independent Control
- 7.9 Playback

## 7.9.3 Calling Master Job

- 1. Move the cursor to the master job whose task is to be called.
- 2. Press [SELECT].
  - The selection dialog box appears.

JOB	EDIT	DISPLAY	UTILITY	12 🗹 📶 😣	🙋 🖳 👘	Þ
SUPERVISORY MASTER JOB EDIT JOB LINE NO. STEP NO. STATUS	CALL MA Setting Cancel 10000 Stop	, STER JOB MASTER JOB MASTER JOB				
		_		DACE		_
	Simp	le Menu		PAGE		_

- 3. Select "CALL MASTER JOB."
  - The master job is called.

JOB	EDIT	DISPLAY	UTILITY	🛛 🖄 🐼 🖬 📮 👘
JOB CONTENT J:MASTERTAS CONTROL GRO 0000 NOP 0001'START	: MASTER K UP: NON GR	OUP	S:0000 TOOL: **	
0002 PSTART 0003 PSTART 0004'END WA 0005 PWAIT 0006 PWAIT 0007 END	JOB: JOB1 JOB: JOB2 IT SUB1 SUB2	SUB1 SUB2		
	_			)
Main Men	J Sin	sple Menu		

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7.9.3.1 When the Master Job in the Master Task is Called

The master job of the master task is called, and the jobs of the subtasks are cleared.



7.9.3.2 When the Master Job in a Subtask 1/2/3 is Called

Only the master job in a specified subtask is called.

The jobs in other tasks are as they were before calling.





For the subtask 1/2/3, it can be selected whether the master job is to be called or the root job (job started by PSTART) is to be called.

Parameter	Contents and Set Value	Initial Value
S2C232	Call the master job: 0 Call the root job: 1	0

7.9 Playback

#### 7.9.4 Registration of Root (startup) Job

The root job is a job executed at starting up each task.

As the root job is determined automatically according to the job configuration, normally it is not necessary to be registered.

However, when the currently active job is to be changed forcibly, register a desired root job to start the task.

The task is executed from the registered root job.

#### <Example>

During execution of a series of jobs in the subtask 1 as shown in the figure below, the task is stopped in the middle of "Work-P."

To restart the task from "Work-Q" without executing the remaining of "Work-P," register "Work-Q" for "ROOT JOB" in the SUPERVISORY window.



JOB	EDIT	DISPLAY	UTILITY	2 🖌 🗵	10 🖳 🕀	
SUPERVISORY: MASTER JOB ROOT JOB EDIT JOB LINE NO. STEP NO. STATUS SYNC TASK	SUB1 JUB-R1 JUB1 JUB1 0001 0000 STOP CREASEARCE	·				
				PAGE		
Main Menu	Simp	le Menu				

- 7 Independent Control
- 7.9 Playback

## 7.9.4.1 Registrering

Register a root job in teach mode.

- 1. Select {JOB} under the main menu.
- 2. Select {CTRL MASTER}.
  - The SUPERVISORY window appears.



- 3. Move the cursor to the task where a root job is to be registered.
- 4. Press [SELECT].
  - The selection dialog box appears

JOB	EDIT	DISPLAY	UTILITY	🖻 🐼 比 🗵	📮 (†) 🛛 📘
SUPERVISORY MASTER JOB ROOT JOB EDIT JOB LINE NO. STEP NO. STATUS	MASTER Marketare CALL RO SETIIC CARCEL 0000 #****	OT JOB ROOT JOB ROOT JOB	-		
				PAGE	
Main Menu	Sim	ole Menu			

5. Select "REGISTER ROOT JOB."

- 7 Independent Control
- 7.9 Playback
  - The JOB NAME window appears.

DATA	EDIT	DISPLAY	UTILITY	12 🖻 🛓	1 👒 🔟 🖵	(†)
JOB NAME						
TEST TEST1 MASTERTASK						
MASTERTASK	í.					
JOB-R1						
JOB2 JOB1						
В						
A MASTER						
Main Menu	Simp	le Menu				

- 6. Select a job to be registered as a root job.
  - The selected job is registered as a root job.

JOB	EDIT	DISPLAY	UTILITY	12 🗳	18	🔞 📑 🕀	
SUPERVISORY: MASTER JOB	MASTER *******	*******	******				_
EDIT JOB	JOB-R1 0000						
STEP NO. STATUS	0000 Stop						
SYNC TASK	*****						
				PAGE			
Main Menu	Simp	le Menu					

- 7 Independent Control
- 7.9 Playback

## 7.9.4.2 Cancelling Registration

- 1. Move the cursor to the task whose registration is to be cancelled.
- 2. Press [SELECT].
  - The selection dialog box appears.

JOB	EDIT	DISPLAY	UTILITY	122	1	🗃 📑 🙌	Þ
SUPERVISORY MASTER JOB ROOT JOB EDIT JOB LINE NO. STEP NO. STATUS	MASTER ########## CALL CON SETTING CANCEL 0000 STOP	- ****************** T JOB ROOT JOB ROOT JOB	****				
				PAGE			
Main Menu	Simp	le Menu					

- 3. Select "CANCEL ROOT JOB."
  - The root job registration is cancelled

JOB	EDIT	DISPLAY	UTILITY	12	2 🖌	1	0	<b>(</b> <del>1)</del>	Þ
SUPERVISORY:	MASTER								
MASTER JOB	******	****	****	*					
ROOT JOB	******	*******	*****	*					
EDIT JUB	0000	*********	********	*					
STEP NO.	0000								
STATUS	******								
					PAGE				
		1		- 12 - 12 - 12 - 12 - 12 - 12 - 12 - 12	e 10				
Main Menu	Simp	le Menu	Cancel	ed regist	tration				

7.9 Playback

#### 7.9.5 Confirming Operating Status (SUPERVISORY Window)

The operating status of each task can be confirmed on the SUPERVISORY window.

- 1. Select {JOB} under the main menu.
- 2. Select {CTRL MASTER}.

#### - The SUPERVISORY window appears.



JOB	EDIT	DISPLAY	UTILITY	] 🛛 🗹 📢	10 🖳 🕀	
SUPERVISORY:	SUB1					
MASTER JOB	JOB-R1					
ROOT JOB	JOB1			)		
EDIT JUB	JUB1					
STEP NO.	0001					
STATUS	STOP					
SYNC TASK	*****					
1				PLOS		_
				PAGE		
Main Menu	Simp	le Menu				

#### **① MASTER JOB**

Displays the master job of each task.

#### **© ROOT JOB**

Displays a job at starting each task.

It is displayed when "1" (call a root job) is set to the parameter S2C232.

## **③ EXEC JOB/EDIT JOB**

In play mode, displays the currently active job.

In teach mode, displays the currently editing job.

The line number and step number of the current cursor position of the EXEC JOB/EDIT JOB are displayed in "LINE NO." and "STEP NO." respectively.

- 7 Independent Control
- 7.9 Playback

#### **④ STATUS**

Displays the status of execution of the task.

- START: Displays during playback or during a test run.
- RUN: Displays while executing FWD/BWD operation.

STOP: Displays while stopped.

ALARM: Displays while an alarm is occurring.

HOLD: Displays while holding.

E.STOP: Displays during emergency stop.

PWAIT1: Displays while waiting completion of subtask 1.

PWAIT2: Displays while waiting completion of subtask 2.

PWAIT3: Displays while waiting completion of subtask 3.

DX100		<ul><li>7 Independent Control</li><li>7.9 Playback</li></ul>
7.9.6 P	recautions	
7.9.6.1	Stopping	
		If a hold or an emergency stop procedure is performed, all currently executing jobs are stopped.
7.9.6.2	Restarting	
		The following methods are available for restarting after a hold or an emergency stop.
	•	<b>To continue operation</b> If operation is restarted from the stopped position, the master task and subtasks1/2/3/4/5/6/7 all continue their execution from the line (step) number at the time of the stop.
		However, if a job selection is made and the message "SUB task restart impossible" is displayed, subtasks 1/2/3/4/5/6/7 cannot continue their execution. Only the master task is restarted.
	•	<b>To execute only one of the subtasks from the beginning</b> Before conducting start procedures, first turn ON the system input signal "Sub □ Master job call" (40071 to 40077 of the subtask to be executed from the beginning, and press the start button.
		The job of the subtask for which this signal is ON, is executed from the beginning. The jobs of other tasks continue execution from the line (step) number at the time of the stop.
	•	<b>To execute jobs of both subtasks from the beginning</b> First turn ON the system input signal "Master job call" (40070), then press the start button.
		When the master job of the master task is called, subtasks 1/2/3/4/5/6/7 which were stopped in the middle are canceled. When PSTART instruction is executed in the job of the master task, the jobs of both subtasks start and are executed from the beginning.
7.9.6.3	Stopping and Rest	arting a Subtask Alone
		During operation of subtasks 1/2/3/4/5/6/7, with an I/O alarm or a PAUSE instruction, only a specified subtask can be stopped. Refer to the system inputs 40021 to 40027, and the system outputs 50621 to 50627, for I/O alarm.
		When subtask 1/2/3/4/5/6/7 is halted, the system output signal 50601 to 50607 "HELD" is output. The system output signal 50070 "RUN" stays ON, but the start lamp on the programming pendant flashes when a subtask is halted.
		To restart the halted subtask 1/2/3/4/5/6/7, reset the alarm and press the external start or the start botton on the programming pendant.

8 Servo Power Supply Individual Control Function

8.1 Outline

## 8 Servo Power Supply Individual Control Function

## 8.1 Outline

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

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



The servo power supply individual control function is to control the servo power supply in units of contactor unit. To use this function, use the contactor unit originally designed for separation in units of control group.

#### 8 Servo Power Supply Individual Control Function

8.2 Connection of Signals for Servo Power Supply Individual Control

## 8.2 Connection of Signals for Servo Power Supply Individual Control

The servo power supply individual control function turns ON/OFF the servo power supply in units of contactor unit. "ON_EN" signal of power supply contactor unit is used.

"ON_EN" signals of each power supply contactor unit is connected to the following terminals.

- power supply contactor unit (JZNC-YSU01-□E): 1 to 8 of CN211
- The ON/OFF of the servo power supply for the first system (robot) of the contactor unit is controlled by the "ON-EN" signals of CN211-1 & -2 and -3 & -4.
- The ON/OFF of the servo power supply for the second system (external axes) of the contactor unit is controlled by the "ON-EN" signals of CN211-5 & -6 and -7 & -8.



For safety reasons, dual circuits are used for the Servo-ON Enable input signals. Connect the signal so that both input signals are turned ON or OFF at the same time.

If only one signal is turned ON, an alarm occurs.

Connect the servo power supply individual control signals in the following manner.

- 1. Remove the jumpers connected to the above mentioned contactor unit terminals.
- 2. Connect an output contact such as area sensor to "ON_EN" terminal as shown in the figure below.



#### DX100



For the wiring termination and connecting method, refer to "WAGO Connector" in "12.3.2 Units and Circuit Boards in the CPU Unit" of DX100 Instructions.

Short-circuited between the above terminals as a standard.

- 8 Servo Power Supply Individual Control Function
- 8.3 Confirming Connection

## 8.3 Confirming Connection

The status of "ON_EN" signals connected to each contactor unit and the servo power supply status can be confirmed on the SERVO POWER STATUS window.

- 1. Select {IN/OUT} under the main menu.
- 2. Select {SV POWER STATUS}.
  - The SERVO POWER STATUS window appears.



#### **O ON_EN SIGNAL**

Displays the status of "ON_EN" signal of contactor unit connected to each control group.

- O: Open (OFF) status
  - Turns OFF the servo power supply.
- Closed (ON) status

Turns ON the servo power supply when the servo ON lamp is lit.

#### **② SERVO ON**

- Displays the status of servo power supplied to each control group.
- O: Servo power OFF status
- •: Servo power supply ON completed status

#### 8 Servo Power Supply Individual Control Function

DX100

8.4 Application Examples

## 8.4 Application Examples

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

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

As shown below, when the servo power supply is turned ON with only the "ON_EN" signal of contactor unit connected to S2 set to "ON," the servo power is supplied only to S2.



- 8 Servo Power Supply Individual Control Function
- 8.4 Application Examples

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

When an operator touches the positioner in such a case as replacement of workpiece, only the servo power supply for the positioner to be touched can be turned OFF for security.



As shown below, with the "ON_EN" signal of contactor unit connected to S2 set to "OFF," only the servo power supply to S2 can be turned OFF even during playback operation.



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



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

8 Servo Power Supply Individual Control Function

8.5 System Output Signals

## 8.5 System Output Signals

## 8.5.1 Servo Power ON Status Signal for Each Control Group

The servo power ON status of each control group is output to the following system output signal.

In the standard concurrent I/O ladder, these system output signals are not output externally. When installing an interlock operated by PLC, etc., modify the concurrent I/O ladder so that the system output signals are output externally.

50327	50326	50325	50324	50323	50322	50321	50320
SOUT#256	SOUT#255	SOUT#254	SOUT#253	SOUT#252	SOUT#251	SOUT#250	SOUT#249
Servo power ON status Robot 8	Servo power ON status Robot 7	Servo power ON status Robot 6	Servo power ON status Robot 5	Servo power ON status Robot 4	Servo power ON status Robot 3	Servo power ON status Robot 2	Servo power ON status Robot 1

50337	50336	50335	50334	50333	50332	50331	50330
SOUT#264	SOUT#263	SOUT#262	SOUT#261	SOUT#260	SOUT#259	SOUT#258	SOUT#257
Servo power ON status Station 8	Servo power ON status Station 7	Servo power ON status Station 6	Servo power ON status Station 5	Servo power ON status Station 4	Servo power ON status Station 3	Servo power ON status Station 2	Servo power ON status Station 1

50347	50346	50345	50344	50343	50342	50341	50340
SOUT#272	SOUT#271	SOUT#270	SOUT#269	SOUT#268	SOUT#267	SOUT#266	SOUT#265
Servo power ON status Station 16	Servo power ON status Station 15	Servo power ON status Station 14	Servo power ON status Station 13	Servo power ON status Station 12	Servo power ON status Station 11	Servo power ON status Station 10	Servo power ON status Station 9

50357	50356	50355	50354	50353	50352	50351	50350
SOUT#280	SOUT#279	SOUT#278	SOUT#277	SOUT#276	SOUT#275	SOUT#274	SOUT#273
Servo power ON status Station 24	Servo power ON status Station 23	Servo power ON status Station 22	Servo power ON status Station 21	Servo power ON status Station 20	Servo power ON status Station 19	Servo power ON status Station 18	Servo power ON status Station 17

## 8.5.2 "During Servo ON" Signal

The system output signal 50073 (during servo ON) is output in connection with the servo ON lamp on the programming pendant.

After the servo power supply is turned ON, even if all the "ON_EN" signals connected to contactor unit are set to "OFF," the servo ON lamp remains lit and the system output signal "During Servo ON" does not turn "OFF."

- 8 Servo Power Supply Individual Control Function
- 8.6 Operation of Job Without Control Group Specification

## 8.6 Operation of Job Without Control Group Specification

When the servo power supply is individually turned OFF where jobs in multiple number of tasks are operated using the independent control function, the job execution of the control group whose servo power supply is turned OFF is interrupted.

The jobs of other control groups continue their execution.

For the jobs without control group specification such as master job, the conditions for execution can be set by the parameter.

Parameter	Contents and Set Value	Initial Value
S2C687 (Condition of execution of job without control group specification)	<ul> <li>0: Execution possible only when servo power supply to all the axes have been turned ON</li> <li>1: Execution possible when servo power supply to any axis is turned ON.</li> </ul>	1

9 Robot Language (INFORM III) Instructions

9.1 Coordinated Motion Instructions

# 9 Robot Language (INFORM III) Instructions

## 9.1 Coordinated Motion Instructions

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

SMOVL	Function	While coordinating the slave side with the master side, moves to teaching position with linear interpolation. (Coordinated move instruction to the slave side manipulator)				
	Additional Item	Position data, base axis position data	These data do not appear on the screen.			
		V= <play speed=""> VR=<play for="" posture="" speed=""></play></play>	V: 0.1 to 1500.0 mm/s 0.6 to 9000.0 cm/min VR: 0.1 to 180.0°/s			
		PL= <position level=""></position>	PL: 0 to 8			
		UNTIL statement				
		NWAIT				
		+MOVJ instruction, +MOVL instruction				
	Example	SMOVL V=150 +MOVL				
SMOVC	Function	While coordinating the slave side with the master side, moves to teaching position with circular interpolation. (Coordinated move instruction to the slave side manipulator)				
	Additional Item	Position data, base axis position data	These data do not appear on the screen.			
		V= <play speed=""> VR=<play for="" posture="" speed=""></play></play>	V: 0.1 to 1500.0 mm/s 0.6 to 9000.0 cm/min VR: 0.1 to 180.0°/s			
		PL= <position level=""></position>	PL: 0 to 8			
		NWAIT				
		+MOVJ instruction, +MOVL instruction				
	Example	SMOVL V=150 NWAIT +MOVL				

9 9.1

## Robot Language (INFORM III) Instructions Coordinated Motion Instructions

SIMOV	Function	While coordinating the slave side with the specified increments with linear interview of the specified increments with linear interview.	ne master side, moves by only rpolation.			
	Additional Item	P <variable no.="">, BP <variable no.=""></variable></variable>				
		V= <play speed="">, VR=<play for="" posture="" speed="">, VS=<speed at="" point="" reach=""></speed></play></play>	V: 0.1 to 1500.0 mm/s 0.6 to 9000.0 cm/min VR: 0.1 to 180.0°/s VS: 0.1 to 1500.0 mm/s 0.6 to 9000.0 cm/min			
		PL = <position level=""></position>	PL: 0 to 8			
		UNTIL statement				
		NWAIT				
		+IMOV instruction				
	Example	SIMOV P000 V=138 PL=1 +IMOV P001				
		SIMOV P001 BP002 +IMOV P000				
SREFP	Function	During coordinated movement, specifies a reference point such as wall point for weaving. (Reference point instruction to the slave side manipulator)				
	Additional Item	Position data, base axis position data	These data do not appear on the screen.			
		<reference no.="" point=""></reference>	Wall point 1 for weaving: 1 Wall point 2 for weaving: 2			
	Example	SREFP1				
+MOVJ	Function	The master side moves to the teach position with joint interpolation. This instruction should always be placed after a coordinated move instruction (individual interpolation). (Coordinated move instruction to the master side manipulator)				
	Additional Item	Position data, base axis position data, station axis position data	These data do not appear on the screen.			
		VJ= <play (%)="" speed=""></play>	Effective in parameter setting			
	Example	MOVL=138 PL=0 +MOVJ				
+MOVL	Function	The master side moves to the teach por This instruction should always be place instruction (coordinated interpolation, in (Coordinated move instruction to the ma	sition with linear interpolation. d after a coordinated move dividual interpolation). aster side manipulator)			
	Additional	Position data, base axis position data, s	tation axis position data			
		V= <play speed=""></play>	Effective in parameter setting			
	Example	SMOVL V=276 +MOVL				
		MOVL V=276 +MOVL				

9 Robot Language (INFORM III) Instructions9.1 Coordinated Motion Instructions

+IMOV	Function	The master side moves by only the specified increment with linear interpolation.				
	Additional Item	P <variable no.="">, BP <variable no.=""></variable></variable>				
		V= <play speed="">, VR=<play for="" posture="" speed="">, VE=<play axes="" external="" of="" speed="">, VS=<speed at="" point="" reach=""></speed></play></play></play>	V: 0.1 to 1500.0 mm/s 0.6 to 9000.0 cm/min VR: 0.1 to 180.0°/s VE: 0.01 to 100.00 % VS: 0.1 to 1500.0 mm/s 0.6 to 9000.0 cm/min			
		BR, RF, TF, UF# ( <user coordinate="" no.=""> )</user>	BF: Base coordinate RF: Robot coordinate TF: Tool coordinate UF: User coorcinate			
	Example	IMOV P000 V=138 PL=1 RF +IMOV P001				
		SIMOV P001 BP002 +IMOV P000				
SSFTON	Function	Starts coordinated shift movement.				
	Additional Item	<robot axis="" position="" variable=""></robot>				
	Example	SSFTON P000				
SSFTOF	Function	Stops coordinated shift movement.				
	Additional Item	None				
	Example	SSFTOF	•			
SWVON	Function	Starts coordinated weaving.				
	Additional Item	WEV# ( <weaving condition="" file="" no.="">)</weaving>	1 to 16			
	Example	SWVON WEV#(3)				
SWVOF	Function	Stops coordinated weaving.				
	Additional Item	None				
	Example	SWVOF				

- 9 Robot Language (INFORM III) Instructions
- 9.2 Independent Control Instructions

## 9.2 Independent Control Instructions

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

PSTART	Function	Starts a job.				
	Additional	JOB: <job name=""></job>				
	Item	SUB1, SUB2, SUB3 (SUB4, SUB5, SUB6, SUB7)	Subtask that is started			
		SYNC	Added to follower task			
		SUB1, SUB2, SUB3 (SUB4, SUB5, SUB6, SUB7)	Leader subtask to be synchronized			
		IF statement				
	Example	PSTART SUB1 PSTART JOB:TEST-1 SUB1 PSTART JOB: TEST-1 SUB1 SYNC SUB2				
	Remarks	If the job name is omitted, the master job registered in the selected subtask is started.				
PWAIT	Function	Waits for completion of subtask.				
	Additional Item	SUB1, SUB2, SUB3 (SUB4, SUB5, SUB6, SUB7)	Subtask waiting for completion			
	Example	PWAIT SUB1				
TSYNC	Function	Synchronizes tasks.				
	Additional	<synchronization no.=""></synchronization>	1 to 32			
	nem	SNUM= <the number="" of="" synchronized="" tasks=""></the>	2 to 4 (8)			
	Example	TSYNC 1 TSYNC 1 SNUM=3				

# DX100 OPTIONS

#### FOR INDEPENDENT/COORDINATED CONTROL FUNCTION

HEAD OFFICE

2-1 Kurosaki-Shiroishi, Yahatanishi-ku, Kitakyusyu-shi, 806-0004, Japan Phone +81-93-645-7745 Fax +81-93-645-7746

MOTOMAN INC. HEADQUARTERS 805 Liberty Lane, West Carrollton, OH 45449, U.S.A. Phone +1-937-847-6200 Fax +1-937-847-6277

MOTOMAN ROBOTICS EUROPE AB Franska Vagen 10, Box 4004, SE-390 04 Kalmar, Sweden Phone +46-480-417800 Fax +46-480-417999

MOTOMAN ROBOTEC GmbH Kammerfeld strasse 1, 85391 Allershausen, Germany Phone +49-8166-90-100 Fax +49-8166-90-103

YASKAWA ELECTRIC KOREA CORPORATION 1F, Samyang Bldg. 89-1, Shinchun-dong, Donk-Ku, Daegu, Korea Phone +82-53-382-7844 Fax +82-53-382-7845

YASKAWA ELECTRIC (SINGAPORE) PTE. LTD. 151 Lorong Chuan, #04-01, New Tech Park, Singapore 556741 Phone +65-6282-3003 Fax +65-6289-3003

YASKAWA ELECTRIC (MALAYSIA) SDN. BHD. Unit 47-1 and 2. Jalan PJU 5/9, Dataran Sunway, Kota Damansara, 47810, Petailng Jaya Selangor, Malaysia Phone +60-3614-08919 Fax +60-3614-08929

YASKAWA ELECTRIC (THAILAND) CO., LTD. 252/246, 4th Floor. Muang Thai-Phatra office Tower II Rechadapisek Road, Huaykwang Bangkok 10320, Thailand Phone +66-2-693-2200 Fax +66-2-693-4200

SHOUGANG MOTOMAN ROBOT CO., LTD. No.7,Yongchang-North Road, Beijing Economic and Technological and Development Area, Beijing 100076, China Phone +86-10-6788-0541 Fax +86-10-6788-0542

MOTOMAN MOTHERSON ROBOTICS LTD. Plot Number 195-196, First Floor, Imt Manesar -Sector 4, Gurgaon (Haryana),Pin-122050, India Phone +91-124-475-8500 Fax +91-124-475-8542



YASKAWA ELECTRIC CORPORATION

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