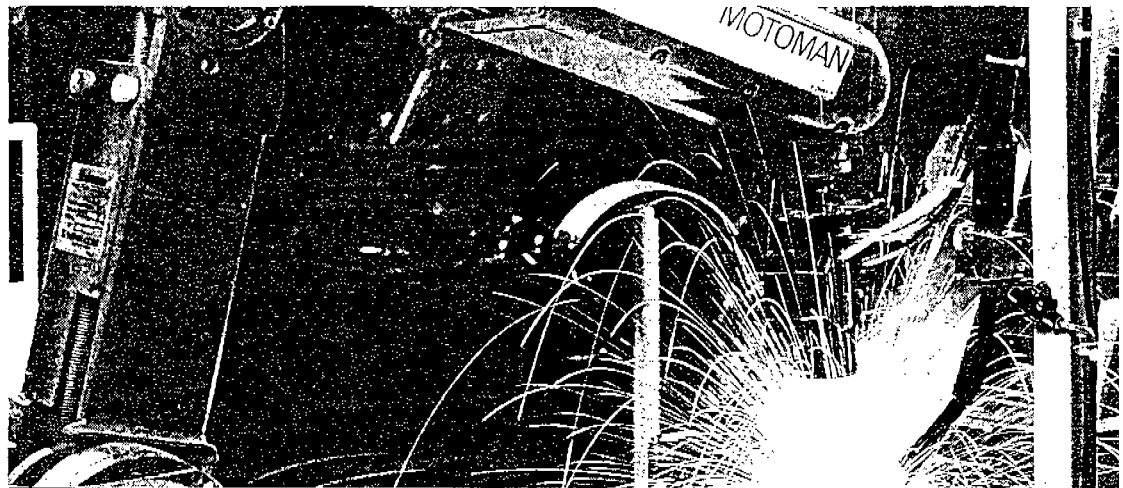


YASNAC MRC

CONTROLLER FOR INDUSTRIAL ROBOT MOTOMAN

INSTRUCTION MANUAL FOR STATION COORDINATION FUNCTIONS



Before initial operation, read these instructions thoroughly, and retain for future reference.



YASKAWA



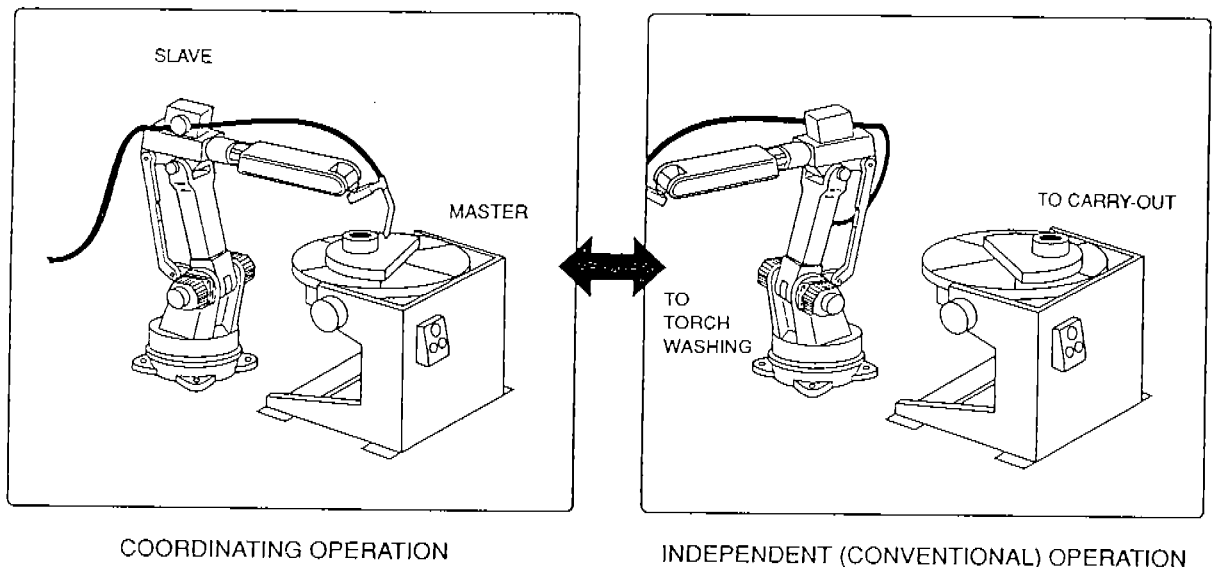
■ COORDINATION JOB TEACHING

WHAT IS A COORDINATION JOB

COORDINATION JOB A job to move a manipulator and station simultaneously in a system is called a coordination job.

[Example] Arc welding by coordination job

One manipulator holds the torch and the other the workpieces; they work coordinately. The one holding the workpiece is specified as the master side and the one with the torch is specified as the slave side.



There are two types of operation : "COORDINATING OPERATION" and "INDEPENDENT OPERATION" (when a coordinate job is played back.). By using these two types of operations separately, operation can be performed in a jigless system.

COORDINATING OPERATION Operation of a manipulator at the slave side and station at the master side according to the master/slave relation is a coordinating operation. The manipulator at the slave side performs relative interpolation on the tool coordinate system which is made by the manipulator at the master side. It is convenient to use this for operations conducted according to the movement of the jig.

INDEPENDENT OPERATION

Operation where the master/slave relation is released is independent operation. Each manipulator at the slave side and a station at the master side operates independently.

However, each taught operation starts and finishes at the same time.

It is convenient to use this when completing coordinating operation and starting each independent operation.

MASTER/SLAVE AND DISPLAY

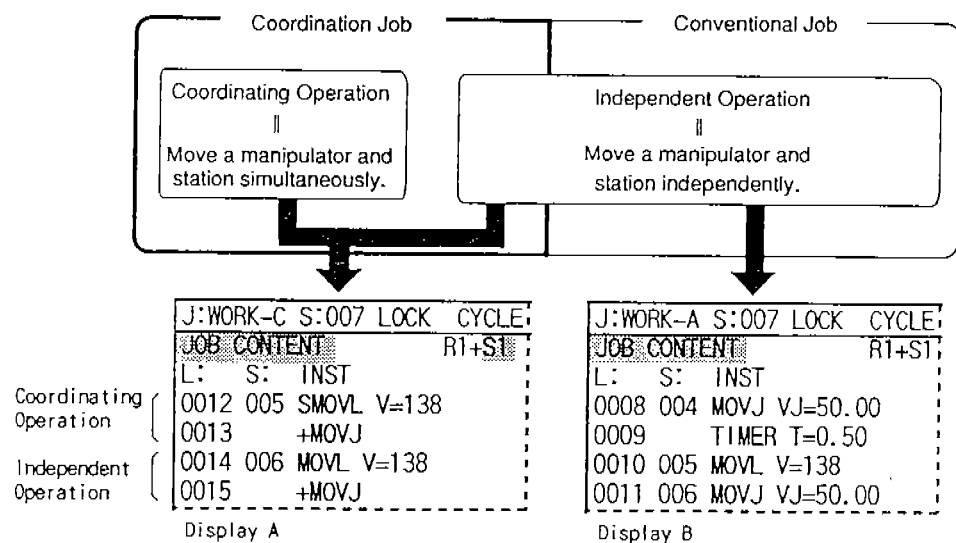
Master/slave is selected in the group combination display at registration of job names.

GROUP COMBINATION			
GROUP AXIS	MASTER		
R 1			NO GROUP AXIS
S 1			
R 1 + S 1		S 1	

Group Combination Display

A job to move a manipulator and station in combination simultaneously is a coordination job. The following shows the difference of move instruction display from that of the conventional jobs.

Combination of manipulator and station



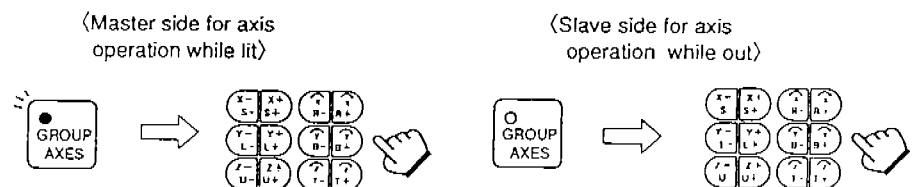


When teaching a coordination job, the move instruction is always displayed in two lines as shown in Display A. The upper line of the two is an instruction to the slave side and the lower line marked with "+" is an instruction to the master side.

By depressing **COORD/INDEP**, the displays of "COORDINATE" and "INDEPENDENT" are interchanged with each other. In the move instructions or weaving instructions registered while "COORDINATE" is displayed, "S" is prefixed to the instruction to a slave (SMOVL...) to indicate that the instruction gives coordinating operation.

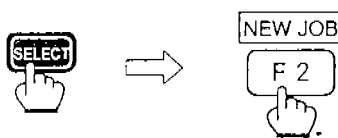


The robot for which axis teaching is currently being performed can be checked by the lamp of **GROUP AXES**. While this key lamp lights, the master side is for axis operation, and while it is out, the slave axis is for axis operation.



REGISTERING A JOB NAME

1



Depress **SELECT** and **F2** [NEW JOB] in teach mode. The job list (sorting) display appears.

J:*****	S:***	LOCK	CYCLE	STOP	SEL
JOB LIST (SORTING)					
TEST-1	TEST-2	WORK-1	WORK-2		
WORK-3	WORK-4				
>					
! Set cursor on character					
ABC	SYMBOL				
CAP/LC	←	BACK SP	→	QUIT	

Job List Display

2

ENTRY OF
CHARACTERS

Enter a job name.

3

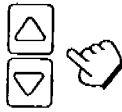


After entering characters, depress **ENTER**. The group combination display appears.

J:*****	S:***	LOCK	CYCLE	STOP	SEL
GROUP COMBINATION					
GROUP AXIS	MASTER				
R 1			NO GROUP AXIS		
S 1					
R 1 + S 1	S 1				

Group Combination Display

4



J:*****	S:***	LOCK	CYCLE	STOP	SEL
GROUP COMBINATION					
GROUP MASTER		--			
R 1	NO GROUP AXIS				
S 1					
R 1 + S 1	[S 1]				

In this step, since the job is to operate a manipulator and station move the cursor to combination of a manipulator and station such as "R1+S1". At this time, the manipulator displayed in the area of "MASTER" becomes the master side.

5



J:WORK-C	S:000	LOCK	CYCLE	STOP	EDIT
JOB CONTENT		R1+S1			
L: S: INST	TOOL:*+*				
0000 000	NOP				
0001	END				
=> MOVL V=138					
+MOVJ					
! Select instruction group					
MOTION	ARITH	SHIFT			
IN/OUT	CONTROL	DEVICE	PRIOR	SAME	

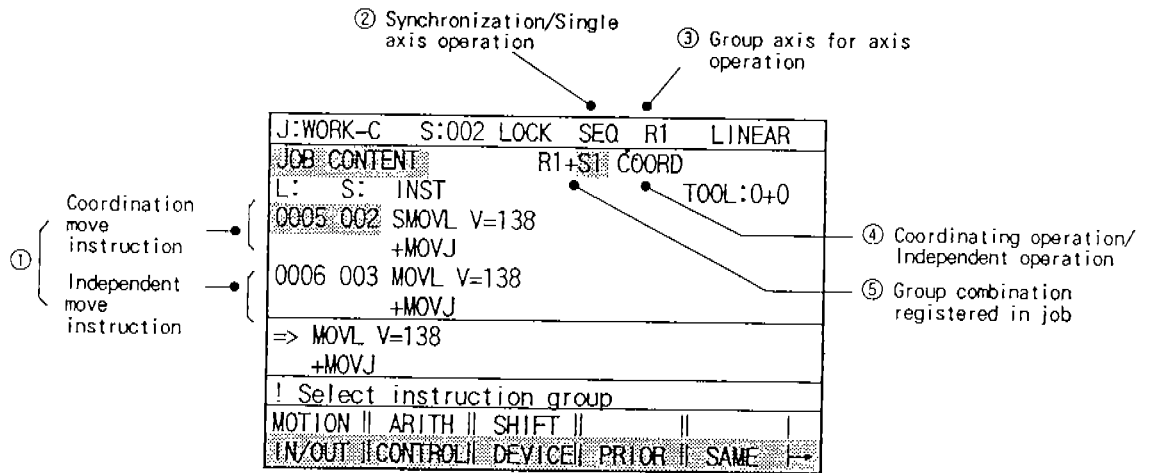
Job Contents Display

Depress **ENTER**.

The job name is stored in the YASNAC MRC memory and displayed in the status area. At the same time, the job content is displayed and NOP and END instructions are stored automatically. Combination of the group is displayed on the right side of the display title and the master side is displayed in reverse. The display mode is changed automatically to the edit mode.

JOB CONTENTS DISPLAY

A coordinate job is displayed in the job contents display as shown below.



- ① Coordination move instruction and independent move instruction
Move instructions are registered in the coordinating operation step in the following form.

In the coordination move instruction, "S" is prefixed to the instruction to the slave side.

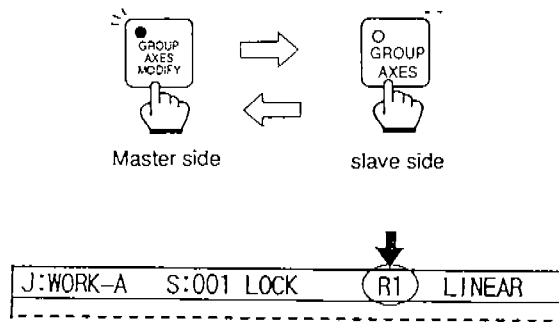
Coordination move instruction	{	SMOVL L = 138 :	Slave side (Manipulator)
		+MOVJ :	Master side (Station)

Independent move instruction	{	MOVL V = 138 :	(Manipulator)
		+MOVJ :	(Station)

- ② Synchronization/single axis operation
Displayed when "SYNCHRONIZATION" is selected for synchronization/single. Nothing is displayed when "SINGLE" is selected.
- ③ Group axis for axis operation
Group axis for axis operation is displayed.
- ④ Coordinating operation/independent operation
Either of coordinating operation or independent operation that is selected is displayed.
- ⑤ Group combination registered in job.
Group combination registered in the edit job is displayed. The master side group axis is displayed in reverse.

SELECTING MANIPULATOR FOR AXIS OPERATION

Group axis is changed in the following operation while the coordination job, which is also the edit job at the present time, is being taught.



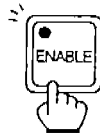
Depress **GROUP AXES**. Each time this key is depressed, the group axis for axis operation changes to/from master side or slave side.

- The lamp of **GROUP AXES** lights when the master side station is ready for axis operation.
- At the same time, group axes which are ready for axis operation are displayed in the status display area.

<Group axis changing when edit job not provided>

To move the group axis when there is no edit job in the teach mode, perform the following operation.

1



Depress **ENABLE** to light the key. The group combination display appears.

J:*****	S:***	LOCK	1CYCLE	STOP	EDIT
GROUP COMBINATION					
GROUP AXIS		MASTER			
R 1	NO GROUP AXIS				
S 1					
R 1 + S 1	S 1				

Group Combination Display

2

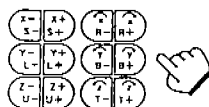


J:*****	S:***	LOCK	S1	JOINT
R 1 + S 1 S 1				

Move the cursor to the group combination to be selected using the cursor keys.

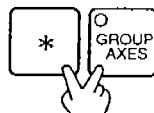
The group axes in the cursor line become ready for axis operation. The group axes are displayed in the status display area.

3



Move the axis using the axis keys.

4



Depress ***** and **GROUP AXES** to return to the preceding display.

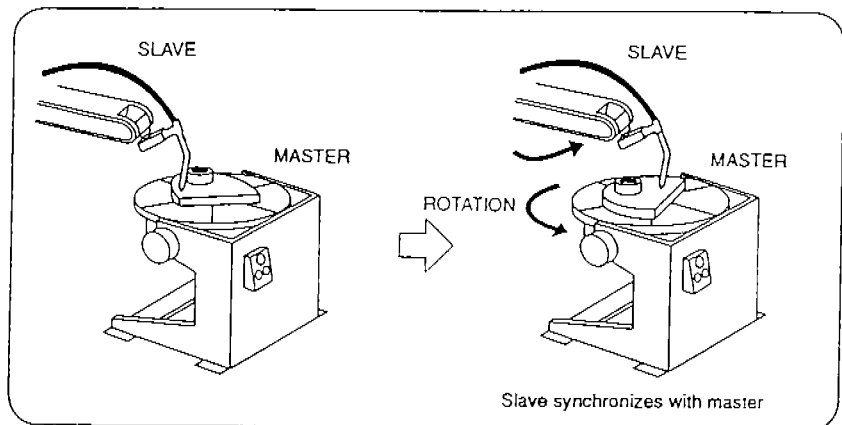
SELECTING SYNCHRONIZATION / SINGLE

There are two ways to move the manipulators for teaching a coordination job; "SYNCHRONIZATION" and "SINGLE".

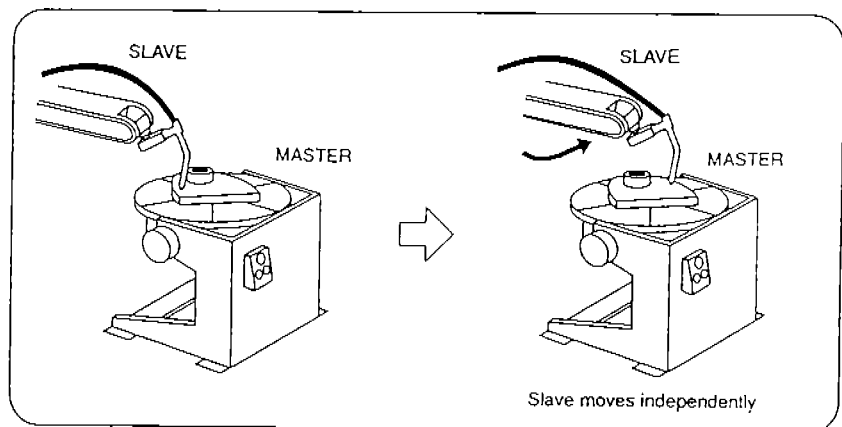
SYNCHRONIZATION

By setting "SYNCHRONIZATION" to perform axis operation, when the station (at master side) is moved, the manipulator (at slave side) starts operation synchronized with the master side. This is used when a manipulator and station are operated in the same way in parallel.

- Moving the manipulator does not move the station at the master side.



Axis operation for master by "SYNCHRONIZATION"



Axis operation for slave by "SYNCHRONIZATION"

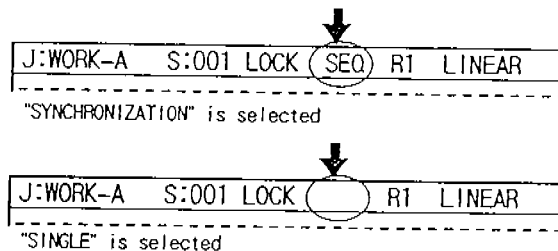
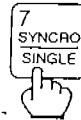
SINGLE

By setting "SINGLE" to perform axis operation, only the manipulator for axis operation or station moves independently. This is used in a step where the manipulators at the master side and slave side move in different ways.

**SELECTION
OF
SYNCHRO-
NIZATION/
SINGLE**

Each time **[SYNCRO/SINGLE]** is depressed, the setting of synchronization/single changes.

- When "SYNCHRONIZATION" is selected, it is displayed in the status display area but when "SINGLE" is selected, nothing is displayed.



< To change the master when "SYNCHRONIZATION" is selected >

When the group combination display appears move the cursor to the desired master combination. Then depress **[SYNCRO/SINGLE]** to select "SYNCHRONIZATION".

Notes :

1. The setting of **[SYNCRO/SINGLE]** is held unless it is changed.
2. When "SYNCHRONIZATION" is selected, if any combination other than that registered in the job is selected in the group combination display, it is changed to "SINGLE" automatically.
3. When the edit job is changed, "SINGLE" is set automatically.

TEACHING OF COORDINATION MOVE INSTRUCTION

How to register a coordination move instruction is described the following example.

[Example] SMOVL V = 138
+MOVJ

Notes:

1. Setting of coordination/independent is held unless it is selected again.
2. When the edit job is changed, "INDEPENDENT" is selected automatically.

WARNING

To set "INDEPENDENT" for teaching, sufficient attention must be paid so that the manipulators will not interfere with each other.

1

JOB CONTENT
DISPLAY IN TEACH MODE



Call up the job content display in teach mode.

Depress **ENABEL** to light the lamp, if it is not already lit.

J:WORK-A	S:000	LOCK	SEQ	R1	JOINT
JOB CONTENT			R1+ST		
L:	S:	INST	TOOL:*+*		
0000	000	NOP			
0001		END			
=> MOVL V=276					
+MOVJ					
! Select instruction group					
MOTION		ARITH	SHIFT		
IN/OUT		CONTROL	DEVICE	PRIOR	SAME

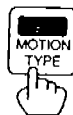
2



Depress **COORD/INDEP** to select "COORD".

JOB CONTENT	R1+ST	COORD
-------------	-------	-------

3



Depress **MOTION TYPE** to change the mode to "LINEAR".

J:WORK-A	S:000	LOCK	R1	LINEAR
----------	-------	------	----	--------

4

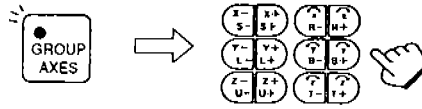


Depress **PLAY SPD** to select the play speed using the cursor keys.

Then depress **PLAY SPD** again to extinguish the lamp.

LINEAR/CIRCULAR	
1:	66cm/min
2:	138cm/min
3:	276cm/min

5



J:WORK-A S:000 LOCK R2 LINEAR

Depress **GROUP AXES** to light the lamp. The master side becomes ready for axis operation. Then depress axis keys to move the cursor to the desired position.

6



0000 000 NOP
0001 001 SMOVL V=138
+MOVJ
0002 END

Depress **ENTER** to register a coordination move instruction "SMOVL V=138+MOVJ".

Notes :

When "COORDINATION" is selected, synchronized interpolation is performed at the slave side and teaching is disabled as described below.

- When interpolation method is set to "SYNCHRONIZATION", "COORDINATION" cannot be selected even by depressing **COORD/INDEP**.
- When "COORDINATION" is selected and interpolation is set to "SYNCHRONIZATION", coordination move instruction "SMOVL..." or the like on the input buffer line changes to "MOVJ..." and becomes an independent move instruction.

YASNAC MRC

CONTROLLER FOR INDUSTRIAL ROBOT MOTOMAN .

INSTRUCTION MANUAL FOR STATION COORDINATION FUNCTIONS

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