

**Panasonic**

Industrial robot

**Pana-Robo**

RISC-A series

(AW - \* \* \* A)

(VR - \* \* \* A)

## Operation Manual

MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.  
MATSUSHITA INDUSTRIAL EQUIPMENT CO., LTD.  
Welding System Division

No. 9212265-17

This document comprises the operation manual of "Pana-Robo RISC-A series (AW-\*\*\*A and VR-\*\*\*A)", and contains an explanation of the operational procedures required to start welding jobs after robots have been installed.

This document consists of the chapters shown below:

|           |                                                             |
|-----------|-------------------------------------------------------------|
| Chapter 1 | Prior to starting operation                                 |
| Chapter 2 | Fundamental operations (Basic course)                       |
| Chapter 3 | Application (Intermediate course)                           |
| Chapter 4 | Various functions and system applications (Advanced course) |
| Chapter 5 | Teach coordinate system                                     |
| Chapter 6 | Explanation of commands                                     |
| Chapter 7 | Error and alarm codes                                       |

- \* Refer to the instruction manual regarding installation of the robot.

*"Operating of this machinery;*

*This machinery exclusively shall be operated by professional, special trained operators.*

*It shall not be operated by non-professional, not specially trained operators.*

*For training courses you may contact System integrator, PFA, PFAE or PIE UK."*

- \* While reading this document, open and refer to the "Operational part key layout" and "Teach pendant appearance" drawings provided at the end.
- \* If you find any mistakes, or do not understand any description, please contact our company.

|                                                      |
|------------------------------------------------------|
| * The contents of this manual are subject to change. |
|------------------------------------------------------|

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## CHAPTER 1

### PRIOR TO STARTING OPERATION

This chapter covers the explanations of the key operations of the robot and names of individual axes of the robot manipulator prior to starting operations of Pana-Robo.

1.0 To work safety

1.0.1 Safety measures for workers

Observe the safety measures to protect yourself.

The Pana-Robo safety manager, a person in charge of installation, operation and maintenance must keep "Safety First" in mind and take care to protect not only themselves but also the other persons from danger.

Below shown are some examples. Keep these instructions without fail.

- (1) Do not take dangerous actions near the place where Pana-Robo is installed.

- (2) Do not frolic



These instructions  
are essential  
conditions to  
secure safety.

- (3) Be sure to obey the instructions shown on the signs such as "Inflammable", "High Voltage", "Danger", "No Entry To Unauthorized Persons", etc. to ensure the safety in the plant.
- (4) Since Pana-Robo needs a work area, even an empty space becomes dangerous, and accidents may occur there.  
To prevent accidents, observe strictly the following instructions on clothing.  
(A) Be sure to wear the specified uniforms.  
(B) Do not wear gloves.  
(C) Undershirts, shirts and tie must not come out from the uniforms.  
(D) Do not wear rather big earrings and pendant.  
(E) Be sure to wear the preventive clothes, such as safety shoes and a helmet.
- (5) The workers in charge with the operation must be in good health.
- (6) Make it a rule that unauthorized persons are not allowed to approach the installation place of Pana-Robo, and keep it strictly.  
Be sure to secure the safety passage.

## 1.0.2 Safety measures for operation

Understand correctly the dangerous movements of the robot to ensure the safety.

Unlike the general-purpose machines, Pana-Robo requires a special operation, such as teaching.

Therefore, there are more chances of danger.

Keep the following instructions strictly when operating the robot.

### (1) "Operating of this machinery;

*This machinery exclusively shall be operated by professional, special trained operators.*

*It shall not be operated by non-professional, not specially trained operators.*

*For training courses you may contact System integrator, PFA, PFAE or PIE UK.*

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- (2) The safety manager must secure enough time for the teaching operation for the operators and instruct them so that they can work properly.  
Since the teaching operation requires a working space, a special care must be taken.
- (3) Before starting the operation, read thoroughly the operation manual, and understand sufficiently the contents.
- (4) Do not put tools and other articles on the floor around the robot manipulator, controller and jig. Otherwise, the operators may stumble over them, and may lead accidents. Do not put articles carelessly.  
Start the operation after confirming that there are no persons except the operators in the work envelope.
- (5) Before operating Pana-Robo, make sure that the safety fence, light-shields, covers, jigs and safety devices are in the correct state.
- (6) In the following operations, operate Pana-Robo from a safety area, and make sure that no persons are in the work envelope of Pana-Robo, and that the jig does not come out from the specified position.
  - (a) When turning on the power of Pana-Robo.
  - (b) When operate Pana-Robo by using the teach pendant
  - (c) In the trace operation
  - (d) In the automatic operationIf you sense danger during teaching or running, immediately press the emergency stop button. The emergency stop buttons are provided on the operation panel and the teach pendant. Use whichever you can access.
- (7) Before fitting the tools, such as a welding torch, on Pana-Robo, make sure that the primary power supply is "off", and put up a sign to forbid turning on the power.
- (8) Do not move forcibly Pana-Robo by hands, and do not hang on to it. Do not use Pana-Robo for any purpose other than specified.
- (9) Do not lean on the operation panel. Do not press the buttons carelessly.
- (10) During operation, take care that the unconcerned persons do not approach the controller.

- (11) To perform the teaching in the work envelope, pay attention to the followings.
- "Always stand in front of Pana-Robo."
  - "Obey the specified operation procedure."
  - "Keep always in mind the countermeasures against danger when Pana-Robo moves toward you."
  - "Predetermine where you take refuge in for emergencies."
- (12) After using the teach pendant, be sure to put it back to the specified position.
- If the teach pendant is left carelessly on Pana-Robo, jig or floor, when working Pana-Robo, Pana-Robo may hit it, and Pana-Robo, the tools or the teach pendant may be damaged.
- (13) Do not enter into the safety fence during the automatic operation.
- Put up a "Keep Out" sign to prevent unauthorized persons from entering.
- (14) Turn off the power after operation in the following procedure; at first press the emergency stop button provided on the controller operation panel to turn off the servo power, and turn off the main power switch on the controller.
- (15) After operation, clean the robot manipulator and the jig.
- In a dusty place, put covers on the robot manipulator and the controller after completion of operation.

## 1.1 Operations of the robot

A robot can memorize various tasks.

The robot classifies the kinds of tasks as a "Program"..

The robot classifies the tasks as shown below:

Program No.1 Workpiece A

Program No.2 Workpiece B

A "Program" can be called as a "Procedure" to make the robot work.

Therefore, operation of a robot means to create "procedure" for various tasks.

### \* Program structure

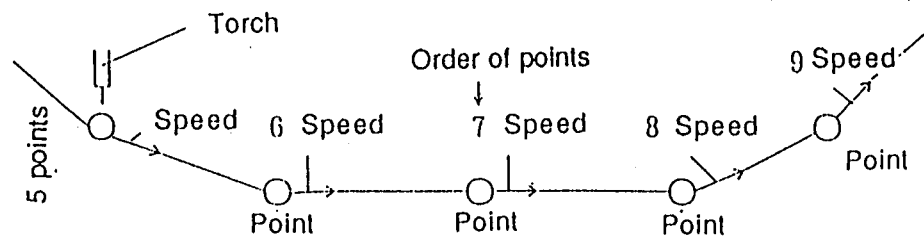
A program consists of "motions of the robot" and "communications of signals".

Program  
(Unit of work)

### Motions of the robot

(The operation of instructing a robot how to move is called as "Teaching".)

A robot does not memorize the entire motion. It only memorizes the points (locations) and the speed at which to move to the next point which are specified by the instruction. The points that a robot memorizes have numbers. Therefore, when the robot arrives at point 5, it moves to the next point at the speed that has been taught which it memorizes at point 5.



### Signal communications

Signal communications are called as "sequence instructions" in the language of a robot. (The operation of creating the sequence instructions is called "editing".)

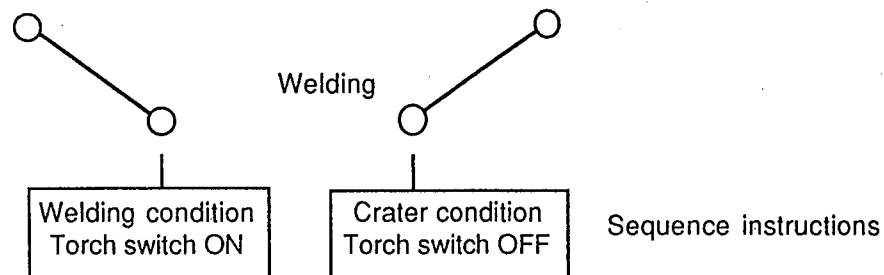
A robot cannot execute any task with only the motions shown above. Robot requires signal communications such as torch switch ON/OFF to execute the tasks.

\* The sequence instruction is the actual content of the task.

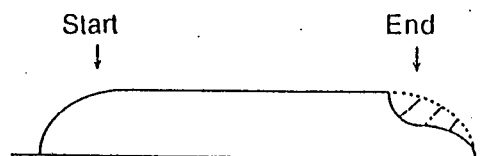
A robot and ON/OFF of the torch switch: Welding robot

A robot and ON/OFF of the chuck unit: Mounting robot

- \* The relationship between the "sequence instruction" and "point of motion" in the program is that a bag of sequence instruction hangs from the point as illustrated in the figure below:



- \* The crater conditions refers to the conditions of the welding to fill the convex at the welding end point.



- \* The cavity is called a crater since it looks like a crater on the moon.

- \* Welding conditions, torch switch ON and OFF are all sequence instructions. A robot can memorize these instructions effectively through instruction.

- \* The main job in operating a robot is creation of the programs.  
However, effective use of a robot cannot be achieved only by the programs.  
There are various other operations to be considered to ensure ease of use.

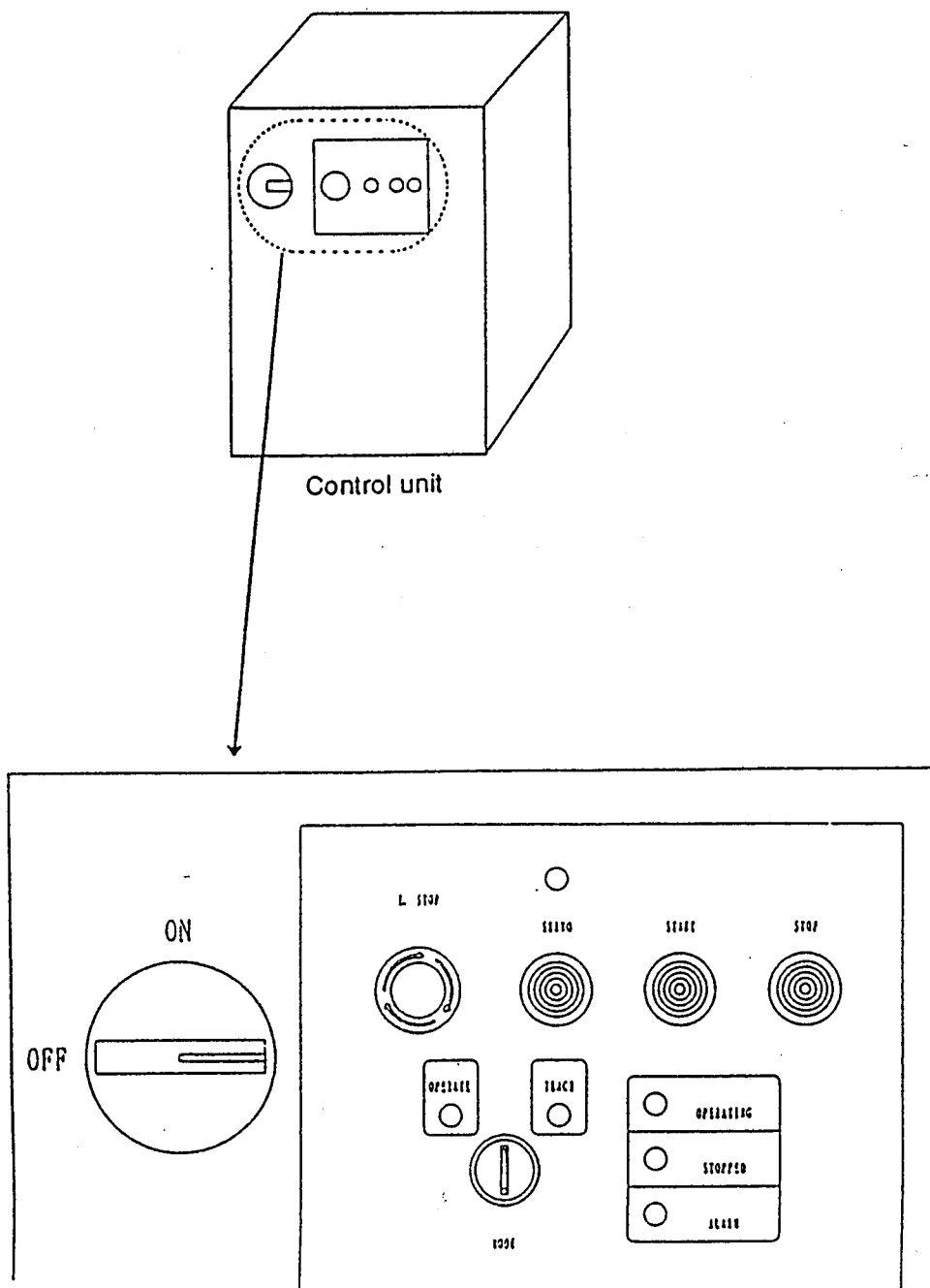


## 1.2 Operation keys of robot

A robot is operated with the key switches on the operation panel provided at the top of the Controller's front panel, as well as with the teach pendent.

### 1.2.1 Operation panel

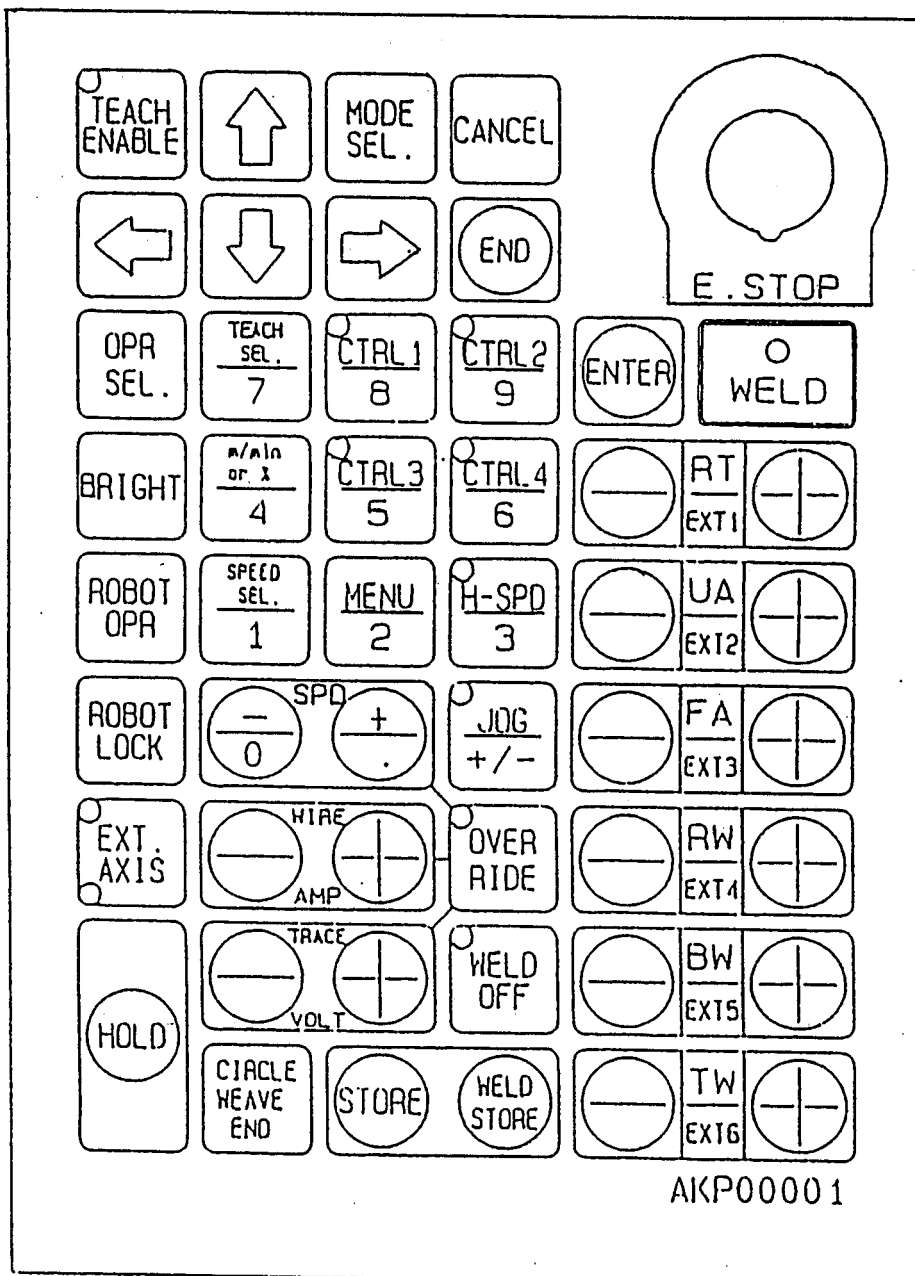
The operation panel is equipped with the switches and buttons required for the operation of mainly the robot (manipulator.)



### 1.2.2 Teach pendant

Major operations for a robot are carried out by using a teach pendant.

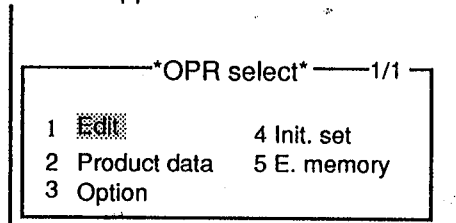
See "Appendix 1 Functions of individual keys of teach pendant" for the functions of the individual keys of the teach pendant.



### 1.2.2.1 Teach pendant screen induction screen

In order to make a robot execute a certain welding task, it is necessary to teach the robot the content of the task, such as the route of movements and where to start or stop welding.

As with Pana-Robo, the messages shown below appears:



\*The number displayed before the selection item is available with the main software of version "KO" or higher version.

By operating the keys in such a manner as to answer these questions, you can easily provide all necessary data.

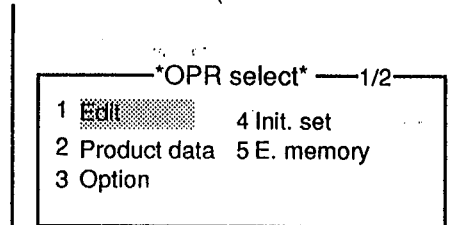
The order of messages which appear on the screen is given at the end of this document in a form of flow chart. (Once you are used to the operations of robots, you will be able to execute all of them simply by memorizing these flow charts.)

#### <NOTE>

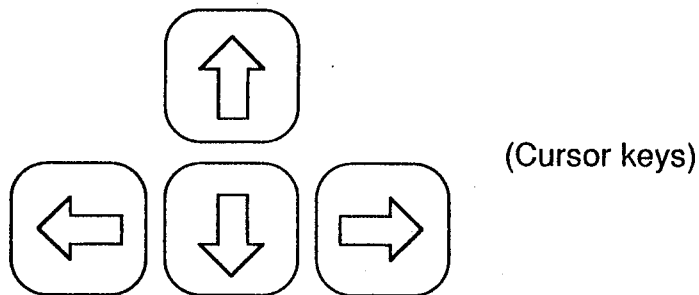
- \* If the non-operating condition lasts for one hour since the last key operation was executed, the liquid crystal display is automatically blacked out. During the operation, you can black out the display forcedly by means of the "display off" operation. (Refer to the item 4.7, "Display during operation.")
- \* The liquid crystal screen of the teach pendant is displayed by the standard brightness from power on to the display of the mode selection screen. On and after the display of the mode selecting screen, the screen is displayed by the brightness at power off.
- \* After power is turned on, the version while "Checking memory. Please wait." is displayed on the screen in PROM.  
(Available with the main software of version "FO" or higher version.)

### 1.2.2.2 Selection of operation

While selecting an operation to be executed (the screen is as illustrated below:),

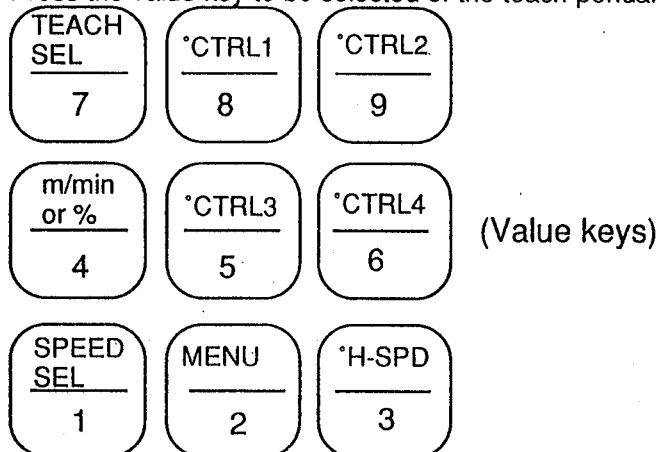


Method ①: Move the cursor to the item to be selected by using the following arrow keys of the teach pendant,



and press the ENTER key.

Method ②: Press the value key to be selected of the teach pendant.



Note) In case that the value is not indicated on the items to be selected, follow the method ①.

The method ② is available with the main software of version "KO" or higher version. The value is not displayed before the selection item for the main software of version "J3" or lower version, and only the method ① is available.



### 1.2.2.3 Indication of "COMMUNICATION ERROR: XX"

(It is indicated from the teach pendant soft version "BO.")

"COMMUNICATION ERROR: XX" appears under the command of the CPU of the teach pendant on such a case that the information exchange (communication) cannot be carried out between the CPU (Central Processing Unit) of the teach pendant and the Main CPU of the controller for some reasons.

|   |                         |
|---|-------------------------|
| 1 |                         |
| 2 |                         |
| 3 |                         |
| 4 | (Blank)                 |
| 5 | COMMUNICATION ERROR: XX |
| 6 | (Blank)                 |
| 7 |                         |
| 8 |                         |

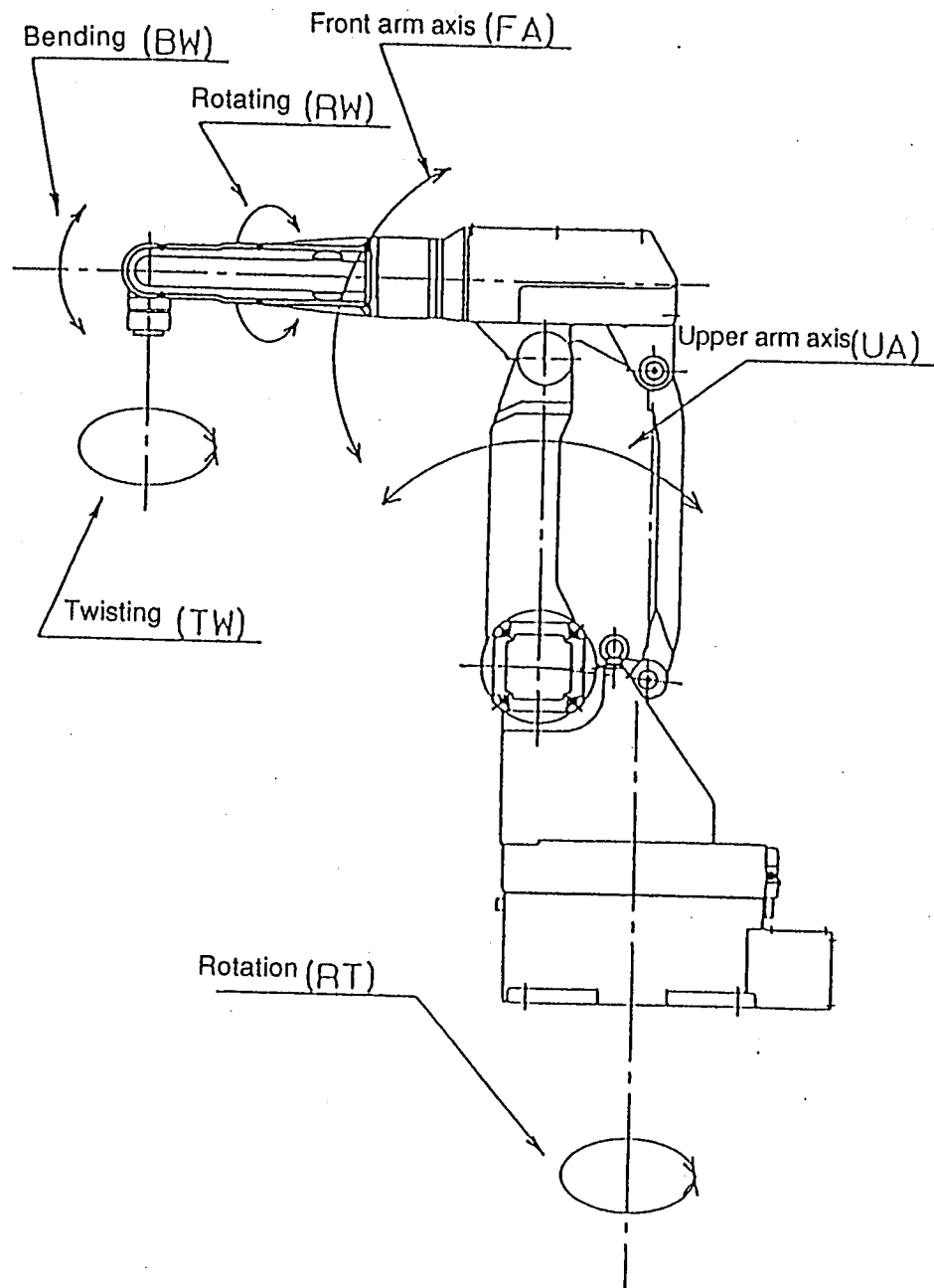
XX: Error No.

The meaning of each error No. is as follows;

|                                                       | No. |
|-------------------------------------------------------|-----|
| (1) Main 1.1 sec. non-communication error             | 00  |
| (2) Main time out after key data transmission         | 01  |
| (3) Twice of NAK response after key data transmission | 02  |
| (4) Parity error                                      | 11  |
| (5) Flaming error                                     | 12  |
| (6) Overrun error                                     | 13  |
| (7) BCC error of main communication data              | 20  |
| (8) Non-communication time out error when powered on. | 99  |

When error messages as described on the above appear on the screen, power off and then power on again. And if the message appears again, contact us regarding the details of the operation and the indicated error No.

1.3 Names of individual axes of the robot manipulator



## CHAPTER 2

### FUNDAMENTAL OPERATIONS (BASIC COURSE)

In this chapter, fundamental operations used to make the robot execute welding tasks are described.

Robot differs in some ways from conventional machines normally used. These differences include:

- \* Conventional machines: Movements and applications are limited to those specified before the machine is delivered. (These are rarely determined by the user.)
- \* Robot: Movements and applications are created after delivery of the robot to the user. (In this case, they are, or can be, determined by the user.)

This is the reason a robot has numerous PB switches and displays. However, even if these are many in number, the operational order is fixed, and, there are not many PB switches and displays for individual operations. You do not have to operate all the switches and displays all the time.

For example, when you start learning how to drive, you drive a car at the driving school. You may feel you are clumsy then. But, once you get used to driving, you can drive the car as you like. The operation of a robot is similar, except, for a car, you have to use both your hands and feet at the same time, while you can operate a robot using only your fingers, at the same time referring to the manuals.

This fundamental operation guide (Basic Course) covers the operations by which workpieces on the table are welded by a robot. Operational procedures and cautions are covered for the first time operator, as well as areas in which to exercise special care. When problems arise during operation, read this manual over again.

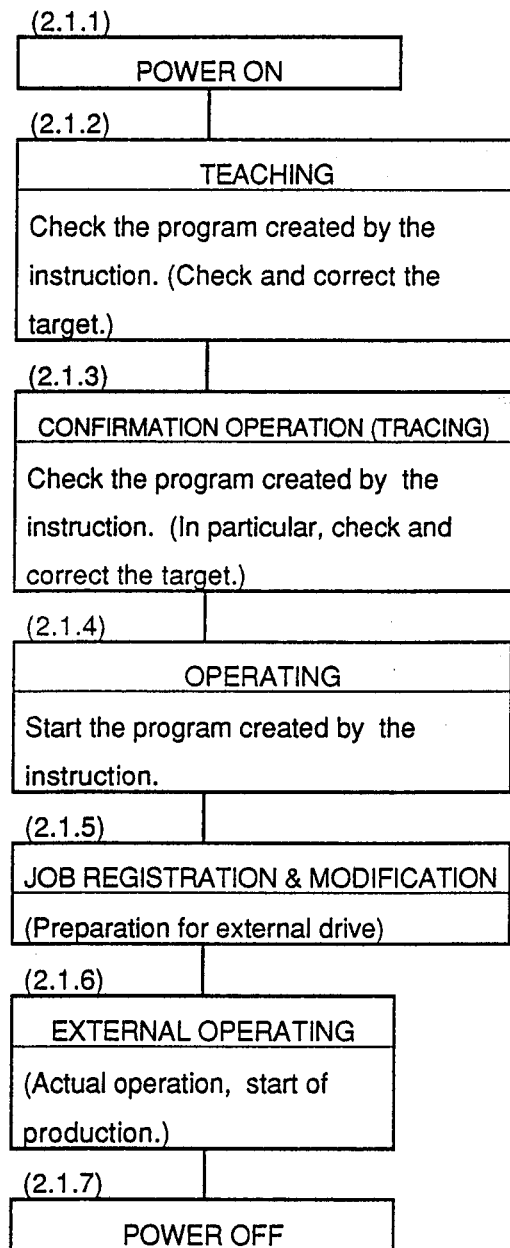
You should read this basic course over, even if you are an experienced operator.

This contents of this chapter cover from "Power on", " Robot start-up via panel operation" to "Modification of the welding conditions".



## 2.1 Fundamental operation procedure of Pana-Robo

Chapter 2 covers the procedures which comprise the "bare bones" of a robot's operations.



\* In "Chapter 2 Fundamental operations (Basic course)", explanations are limited to operations executed by linear interpolation. Operations executed by circular interpolation, (weaving and editing) are explained in Chapter 3. Individual functions and the system application operations are explained in Chapter 4.

\* Refer to the flow charts at the end of this manual for fundamental motions.

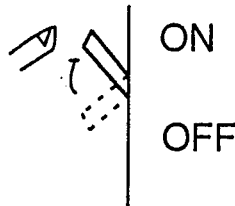
### 2.1.1 Power ON



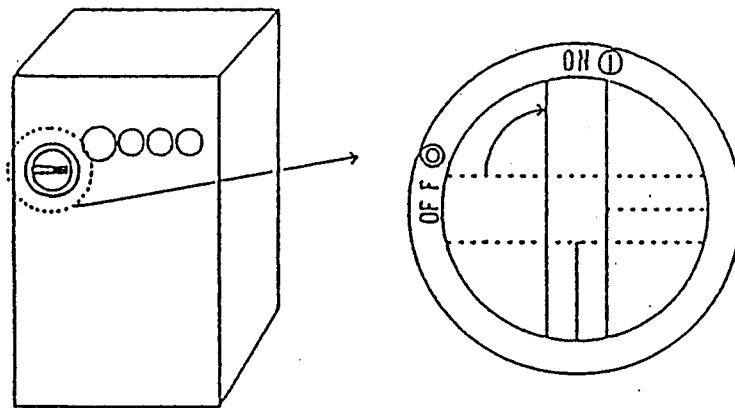
*Make sure that the work site is safe before turning on the power.*

*Make sure that all persons are outside the work envelope (outside the safety fence).*

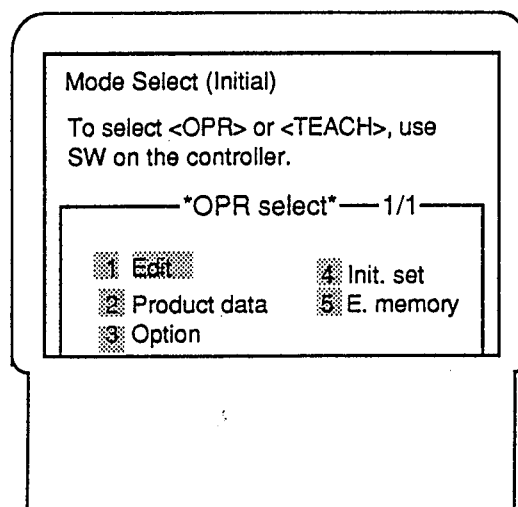
- (1) Turn on the switch of the power source facility. (User facility )



- (2) Power is turned on by turning the handle provided on the upper left of the controller front panel clockwise.



- (3) When power is turned on, the menu shown below appears on the teach pendant screen:



**- If an unusual screen is displayed (AW005A: YA-1AAR51Y) - -  
(AW006A: YA-1AAR62Y)**

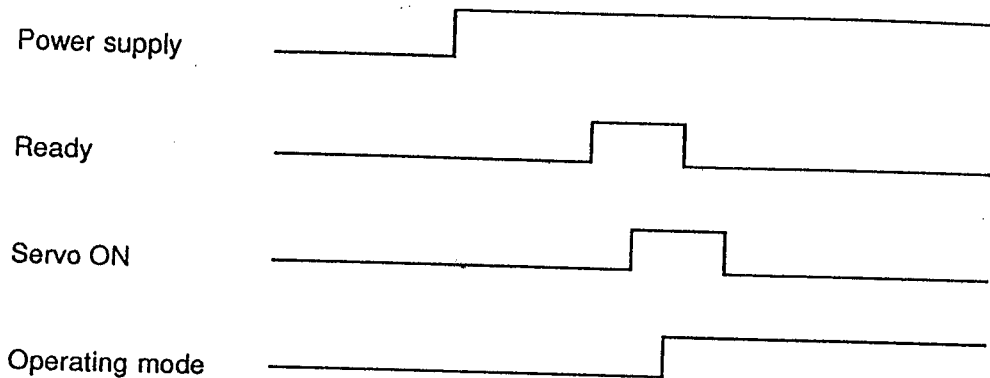
When the robot is not used for a long time or if a strong force is applied to the robot during shutdown, a strange initial screen may be displayed right after turning the power source. In such case, manipulate as follows according to the screen display.

| No. | Screen display                                                                                                                                                  | Operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | <div>Mode Select</div> <div>Check the lithium batteries.</div> <div></div>                                                                                      | <ol style="list-style-type: none"> <li>Usable in this state.</li> <li>Consult our service engineers before turning off the power or during operation. Proper treatment can be applied.</li> </ol>                                                                                                                                                                                                                                                                              |
| 2   | <div>Encoder position check</div> <div>Check axis.<br/>[ RT, UA... ]</div>                                                                                      | <ol style="list-style-type: none"> <li>Proceed "Servo On", "Start" operation according to the screen display..</li> <li>After the axis shown on the screen is moved slightly (about one degree) in the "Encoder position check"; <ol style="list-style-type: none"> <li>If the initial screen is obtained, use as it is.</li> <li>If screen No. 3 is displayed, follow the instruction below.</li> </ol> </li> </ol>                                                           |
| 3   | <div>Encoder position check</div> <div>After turning on power, check robot position with position check program.</div>                                          | <ol style="list-style-type: none"> <li>Turn off the power once and turn it on again, then check the encoder position with "Encoder position check".</li> <li>When the initial display appears, check the position with the check program, and use. ["Check program" is the program instructed by users. And the trace operation is required..]</li> <li>If the screen as shown on the left appears repeatedly by attempting several times, call a service engineer.</li> </ol> |
| 4   | <div>Encoder position check</div> <div>Reset axis.<br/>[ RT, UA, ... ]<br/>Please check Lithium battery, and aftr turning on power, check robot position.</div> | <ol style="list-style-type: none"> <li>Explain the display message to a service engineer and request repair..</li> </ol>                                                                                                                                                                                                                                                                                                                                                       |

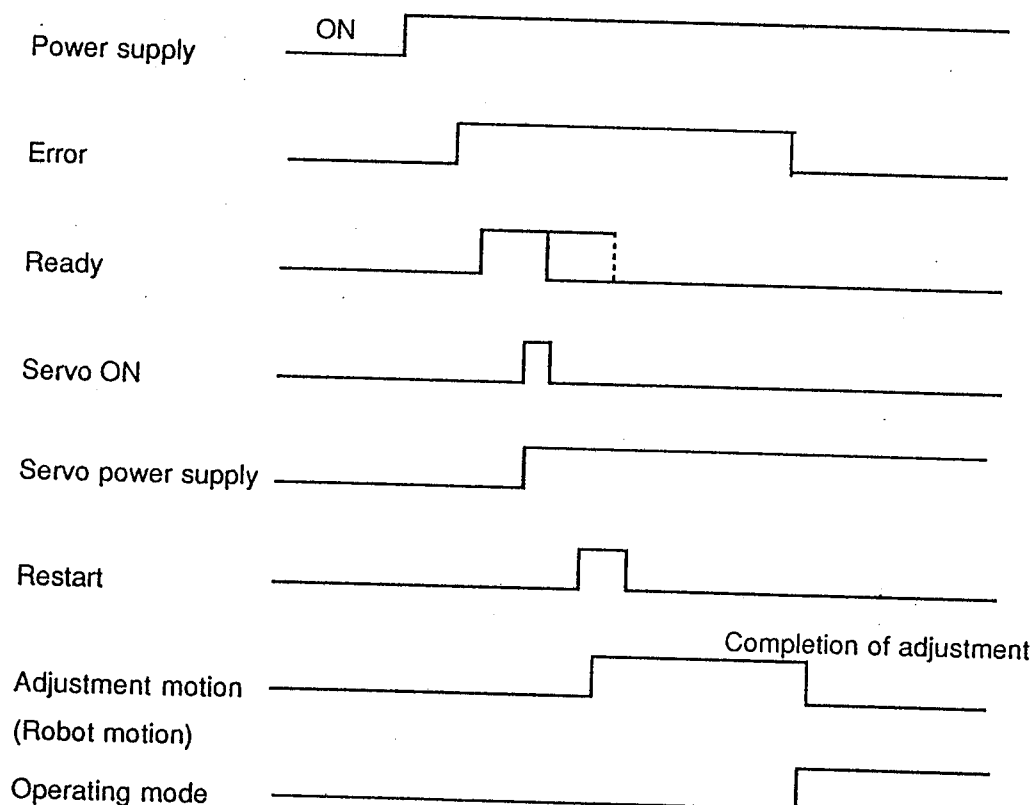
Encoder position check (AW005A YA-1AAR51Y) AW006A (YA-1AAR62Y)

This is to explain the manipulation by external signal of "encoder position checking" operation.

- Usually (non-error): The run mode is established by turning on the servo at the time of ready output.



- When "checking encoder": When operation is required, the sequence is as follows.



Note 1: When servo is turned on while ready signal is issued, generally, it becomes operating mode. If not setting in operating mode by turning on the servo while ready and an error is issued, try by restart. After completion of the encoder checking operation, the operating mode is established.

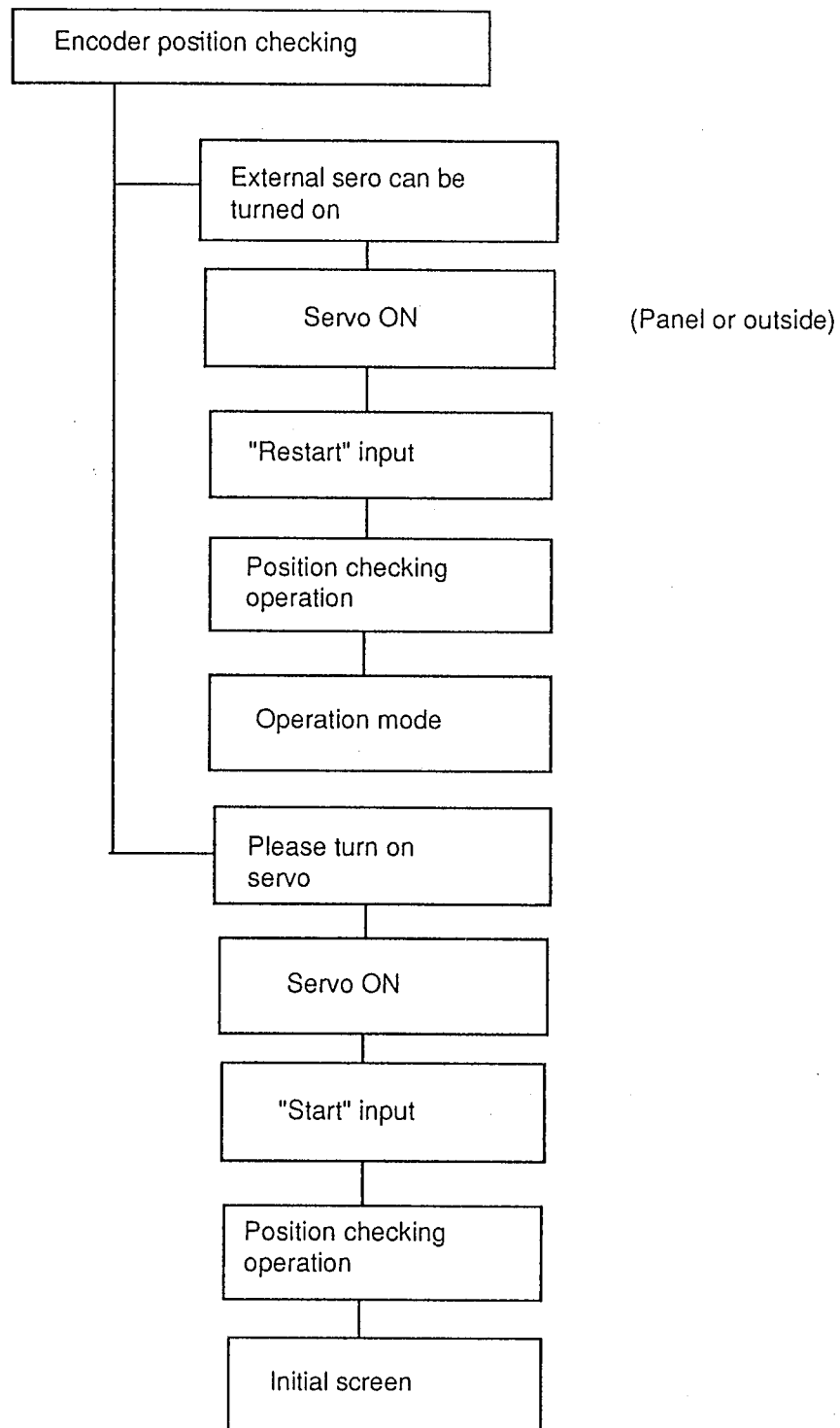
Note 2: The ready output is turned off in about 3 seconds. When the servo is turned on after that, "start" is required instead of "restart."

In such a case, after "encoder checking" operation, the initial screen appears, not setting in run mode.

Note 3: To the contrary, during ready output, the message "External servo can be turned on" appears.

At this time, when the servo ON switch on the panel is pressed, it becomes external mode, and "start" is not valid, and "restart" is required.

# Comparison of message and operation mode



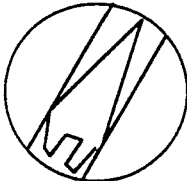
### 2.1.2 Teaching (Linear interpolation)



*The robot moves immediately when the MOVE key of the teach pendant is pressed.*

*Before operating the robot, make sure that no persons are in the work envelope.*

*"Teaching" in the operation that creates program by moving the robot and making it memorize individual positions.*

| No. | Operational method                                                                                                                                                                                                                     | Screen display                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | <p>&lt;To change to the teaching mode from another mode&gt;</p> <p>(1) Press the END key repeatedly to go back to the initial screen (Screen 1).</p> <p>(2) Press the MODE SEL (mode select) key to go back to the initial screen.</p> | <div>Mode Select (Initial)</div> <div>To select &lt;OPR&gt; or &lt;TEACH&gt;, use SW on the controller.</div> <div><div>*OPR select* 1/1</div><div><div>1 Edit</div><div>2 Product data</div><div>3 Option</div><div>4 Init. set</div><div>5 E. memory</div></div></div> <div>Screen 1</div> <div><div><div>○</div><div>→</div><div>☼</div></div><div>OPERATING</div><div>TEACHING</div></div> <div><div></div><div>MODE SELECT</div></div> |
| 1   | Set the mode selector switch on the Controller to <TEACHING>.                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 2   | <p>When the servo power supply is in OFF status, Screen 2 appears. Turn on the servo power supply by pressing the servo switch. (Refer to 1.2.1 "Key switch" provided on the top of the Controller front panel.)</p>                   | <div>Teaching</div> <div>Turn on [SERVO]</div> <div>Screen 2</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|     | <p>When the servo power source is in ON status, Screen 3 appears.</p>                                                                                                                                                                  | <div>Teaching</div> <div>Memory 99.9% (app.5668 steps)</div> <div><div>*OPR select* 1/1</div><div><div>1 Input No.</div><div>2 Home position</div><div>3 Conversion</div><div>4 Coordinates</div><div>5 File list</div></div></div> <div>Screen 3</div>                                                                                                                                                                                                                                                                          |
|     |                                                                                                                                                                                                                                        | Note ①                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Screen display                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3   | Since the cursor has shifted to "Input No." (No. specification), press the ENTER Key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <div>Teaching</div> <div>Memory 99.9% (app.5668 steps)</div> <div>*OPR select* 1/1</div> <div><div>1 Input No.</div><div>2 Home position</div><div>3 Conversion</div><div>4 Coordinates</div><div>5 File list</div></div>                                                                                                                                                                                                                                                                                                                                            |
| 4   | Enter the program No.<br><br>----* Note 1 *-----<br><i>Among programs No. 1~999, use a No. which has not been registered yet. However, bear in mind that the total number of programs which can be registered is 255.</i><br><br>-----* Note 2 *-----<br><i>To check the program No. already registered:</i><br><i>(1) Press the END key..</i><br><i>(2) Move the cursor to "File list (Directory display)". (Screen 4)</i><br><i>(3) Press the ENTER key.</i><br><i>The programs will be listed after the operations above are completed.</i><br><i>(Screen 6)</i><br><i>Press the END key and start operations from step No.3 again.</i> | <div>Screen 4</div> <div>Note ①</div> <div>Teaching</div> <div>Please input</div> <div>program number</div> <div>Program number → 0</div> <div>Screen 5</div> <div>Teaching</div> <div>File list</div> <div><div>10.1%</div><div>100.0%</div><div>150.3%</div><div>301.0%</div><div>700.0%</div><div>1300.2%</div></div> <div>Screen 6</div> <div>Teaching P:1</div> <div><div>* "TEACH ENABLE" → Continue</div><div>* "MODE SELECT" → Finish</div><div>* "END" → Trace</div></div> <div>Screen 7</div> <div><div>TEACH ENABLE</div> → <div>TEACH ENABLE</div></div> |
| 6   | Press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 7   | Screen 7 will appear. Press the TEACH ENABLE key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |



Note ① The display shown below appears on the screen ③ and ④ in the main software of version "J3" or lower version.

|                               |             |
|-------------------------------|-------------|
| Teaching                      |             |
| Memory 99.9% (app.5668 steps) |             |
| *OPR select*—1/1—             |             |
| Input No.                     | File list   |
| Home position                 | Coordinates |
| Conversion                    |             |

## ROBOT OPERATION FOR BEGINNERS



- \* A robot has several teaching coordinate systems. (Refer to Chapter 5 "teaching coordinate system".)

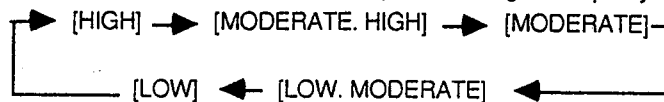
*Beware that the motions of a robot differ according to the applicable coordinate system even if you press the same key.*



- \* Re-confirm that no one is near the robot before you start it.

- \* Operate the robot at the lowest speed until you are used to robot operations.

Each time the SPEED SEL key is pressed, the speed changes step-by-step, in the order:



Set the speed by the SPD "+" / "-" key.

- \* Make sure that "Artc" is displayed on the teaching coordinate system.

It is recommended for beginners to first operate the robot on the "Artc" coordinate system, within which the motions of individual axes of a robot are simple. After attaining proficiency, move the cursor to the display of another coordinate system, press the TEACH S EL key, re-set the coordinate system and learn the motions on that coordinate system.

### \*NOTE 3\*

#### HOW TO SET THE TEACHING COORDINATE SYSTEM:

- (1)
 

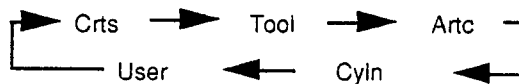
Speed=15.00(M/m) [M]

Add
Weaving
Crts

↑  
Move the cursor to Crts.
- (2) Each time the 

TEACH  
SEL  
7

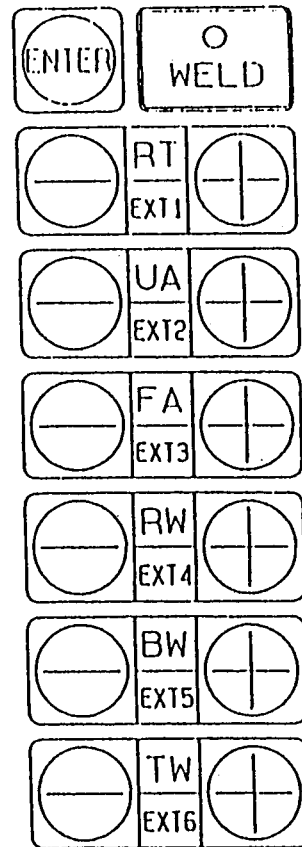
 key is pressed, the coordinate system displayed on the screen changes as shown below:



- \* Robot motion keys

- \* To move a robot, press the motion keys shown to the right while holding the ROBOT OPR key. While the key is being held down, the robot moves. If you want to operate the robot by using the "RT~TW" keys only, refer to Chapter 4 "Inner settings, expanded functions and robot operation keys".

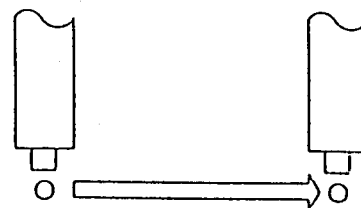
- \* When a robot is installed on the wall or hung from the ceiling, care should be exercised with regards to the directions of the robot's operation.



| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Screen display                                                                                                                                                                                                                      |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | <p>(Notes)</p> <ol style="list-style-type: none"> <li>1 The teaching point No. that is not displayed is the one set inside the machine that determines the movement from the current position to teaching point No. =1. Therefore, the position referred to by this No. does not actually exist.</li> <li>2 The speed to move from the current position to position No. 1 has been set to 7.5m/min.</li> </ol>                                                                                                                                                                                    |                                                                                                                                                                                                                                     |
| 8   | <p>Select the appropriate speed.</p> <p>(1) When the preset value (7.5 M/min) is used:<br/>Press the <b>STORE</b> key.</p> <p>(2) When the speed is to be changed:</p> <p>a) When the <b>SPEED SEL</b> (speed select) key is pressed, the speed setting changes in order of HIGH-MODERATE. HIGH-MODERATE-MODERATE.LOW-LOW. Adjust the speed by using the <b>SPEED</b> "+" or "-" key.</p> <p>b) Press the <b>STORE</b> key.</p> <p>* Screen 9 appears when, first, the <b>OPR SEL</b> key is pressed, second, the <b>Disp posi</b> is selected, and finally, the <b>Disp XYZ</b> is selected.</p> | <div>Teaching P 20 S= V=</div> <div>Speed=7.50(M/min)----[M.L]</div> <div>Add Linear Crts</div> <p>Screen 8</p>                                                                                                                     |
| 9   | <p>Register the teaching points along the route of movement.</p> <p><i>The following particulars from the next section must be understood in order to register the teaching points:</i></p> <p><b>** How to register the teaching points</b></p> <p><b>** How to use the <b>STORE</b> key and the <b>WELD STORE</b> key.</b></p> <p>During the time the instruction is being carried out, the current position, step No. (instruction No.), movement instruction and speed are displayed on the screen (screen 10)</p>                                                                            | <div>Teaching P 20 S= V=</div> <div>X= 200.00 ((mm) U= 20.05(°)</div> <div>Y=1502.01 (mm) V= 32.06 (°)</div> <div>Z= 150.03 (mm) W=120.35(°)</div> <div>Speed=7.50(M/min)----[M.L]</div> <div>Add Linear Crts</div> <p>Screen 9</p> |
|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <div>Step 0 Add completed</div> <div>o MOVEL * 7.50</div> <div>1 TOOL 1</div> <div>Speed=7.5 (M/min)----[M.L]</div> <div>Add Linear Crts</div> <p>↑</p> <p>"Add" is displayed during teaching.</p> <p>Screen 10</p>                 |

| No. | Operational method                                                                                                                                                                                                                                        | Screen display                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | <p>* To operate the robot, press the RT~TW keys while holding down the ROBOT OPR (robot operation) key. (See the previous page.)</p> <p>* To operate the external axis, press the EXT 1~6 keys after turning on the LED by pressing the EXT.AXIS key.</p> | <div> <div>STEP 1 Add completed</div> <div> X= 2100.20 ((mm) U= 31.10(°)<br/> Y= 250.10 (mm) V=100.00 (°)<br/> Z= 100.01 (mm) W= 92.03(°)<br/> Speed=7.50(M/min)---[M.L.]<br/> Add — PTP — Crts </div> </div> <div>Screen 11</div>                                                                                                                                                                                                        |
| 10  | Press the TEACH ENABLE key after completing instruction along the entire route.                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 11  | Press the END key.                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 12  | Move the cursor to "Yes" and press the ENTER key.                                                                                                                                                                                                         | <div> <div>Teaching P : 10</div> <div>*OPR select*</div> <div>Trace operate?</div> <div> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No </div> </div> <div>Screen 12</div>                                                                                                                                                                                                                                          |
| 13  | <p>To confirm each step, press the TEACH ENABLE key.</p> <p>To confirm the operation at the actual operation speed, press the START switch on the panel. (Screen 14)</p>                                                                                  | <div> <div>  TEACH<br/>ENABLE </div> → <div>  TEACH<br/>ENABLE </div> </div> <div> <div>Teaching P:10</div> <div> * "TEACH ENABLE" → Continue<br/> * "MODE SEL" → Finish<br/> * "END" → Trace </div> </div> <div>Screen 13</div> |
| 14  | To be continued in 2.1.3."Trace operation".                                                                                                                                                                                                               | <div> <div>Trace P : 10 S: V:</div> <div> * START → OPR program<br/> * MODE SEL → Finish<br/> * OPR SEL → Set OPR unit<br/> * TEACH ENABLE → Trace OPR </div> </div> <div>Screen 14</div>                                                                                                                                                                                                                                               |

- \* What is "Linear interpolation"?
- \* "Linear interpolation" is the path by which the robot moves linearly between two registered teaching points.



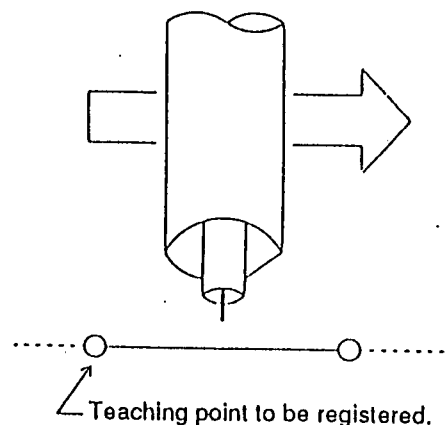
Linear movement

- \* How to register the teaching points (Position and speed)

When the WELD STORE or STORE key is pressed during teaching, the position to and speed at which the robot moves are registered.

- \* The speed to be registered is that of the movement from the current teaching point to the next one.
- \* Each time the SPEED SEL key is pressed, the speed setting displayed on the screen changes step by step in the order: HIGH - MODERATE. HIGH - MODERATE - MODERATE. LOW - LOW. Control the speed within individual steps by pressing the SPEED "+" or "-" key.

Speed registered



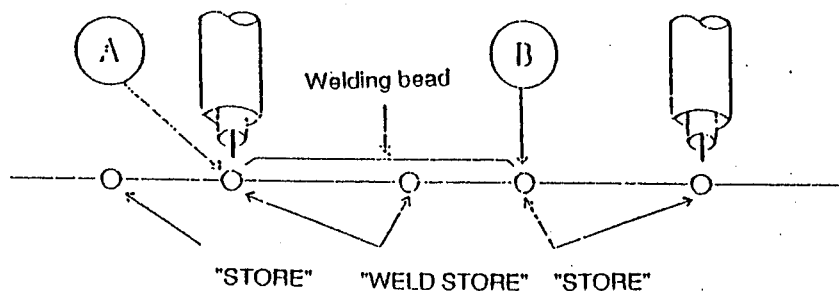
The speed levels in individual steps are as shown in the table below:

| Unit: M/min     |              |                |
|-----------------|--------------|----------------|
| Speed selection | Range        | Standard level |
| High            | 60.00~120.00 | 90.00          |
| Moderate. High  | 30.00~59.00  | 50.00          |
| Moderate        | 10.00~29.00  | 15.00          |
| Moderate. Low   | 1.00~9.90    | 7.50           |
| Low             | 0.01~0.99    | 0.50           |

\* How to use the  key and  key

Use of the STORE key or the WELD STORE key is determined by whether or not the route between the teaching point currently being registered and the next teaching point is the welding route.

|                                             |                                                                                                  |
|---------------------------------------------|--------------------------------------------------------------------------------------------------|
| * Arc start point .....                     | Use the  key. |
| * Arc intermediate (route) point .....      | Use the  key. |
| * Arc end point (Air-cut start point) ..... | Use the  key. |
| or air-cut intermediate point.              |                                                                                                  |



### \* Welding position

The screen shown below appears when the MENU key is pressed.

Enter the AJO No. and CJO No. 1 - 5.

| Trace           | P : S: V:         |
|-----------------|-------------------|
| * Menu Select * |                   |
| AJO             | =1                |
| CJO             | =1                |
| Weaving         | =2                |
| User C-sys      | =0                |
| Wrist cal.      | =0                |
| [OPR. SEL]      | =Change menu cnts |

Note ①

Since welding conditions are stored in menu No. 1 - 5, select the menu No. so that the appropriate welding conditions are available.

(Note ①) The default values of the weaving pattern at teaching are set as follows:

Main software of version "J3" or lower version: "2"

Main software of version "K0" or higher version: "1".

### \* Teaching of the welding points (summary)

At welding start position (A in the figure above), press the WELD STORE key after selecting a menu. The welding conditions corresponding to the selected menu No. as well as the welding start sequence No.1 (ASS 1) (torch switch ON, etc.) are automatically created.

At welding end position (B in the figure above), press the STORE key after selecting a menu. The crater welding conditions corresponding to the selected menu and the welding end sequence No.1 (AES 1) are automatically created.

[ WELD ] Indication LED is on during the whole time the robot is operating within the welding route (including the times when the teaching or trace operations are being performed).

To change the welding conditions at a position between A and B, change the menu No. and press the WELD STORE key.

### \* Jog motion

To make the robot perform minor movement (jog motion), press the JOG +/- key, confirm that the LED lights up and then press the movement key.

When the movement key is pressed once, the robot moves 1 unit of pitch. The distance moved per pitch unit can be set as a constant for the robot. Select an appropriate one from the following list by pressing the SPEED SEL. 1 key:

|                |                |
|----------------|----------------|
| HIGH :         | Approx. 1.00mm |
| MODERATE. HIGH | Approx. 0.75mm |
| MODERATE       | Approx. 0.50mm |
| MODERATE. LOW  | Approx. 0.35mm |
| LOW            | Approx. 0.20mm |

(The values on the right are the standard values.)

Press the JOG key again to cancel the jog movement. The LED will turn off. The movement distance per unit of pitch can be set within a range of 0.01~10.000 mm in individual speed ranges.



\* Wire inching (When the specified welding power supply and an interface box are used)

The wire inches when WIRE "FORWARD" or "BACKWARD" is pressed. When the FORWARD key is held down, the wire comes out at a low speed, and after 3 seconds it comes out at a higher speed.

When the BACKWARD key is held down, the wire moves in the same manner, but in the reversed direction. If the key is released and then pressed again, the wire movement re-starts from the low speed again. The speed of the wire inching can be freely set.

(Refer to the sections detailing system setting, welding conditions and inching speed in Chapter 4.)

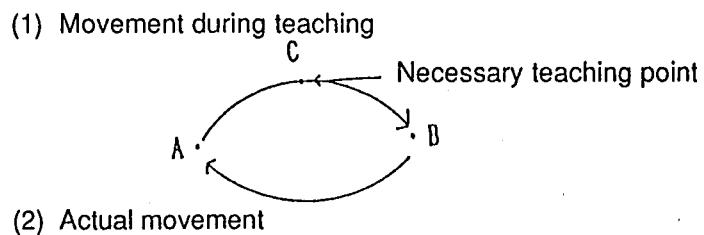
\* Multiple registration (Registration of same position)

When the STORE. WELD STORE key is pressed without moving the robot (ie. an attempt to register the same position twice is made), a buzzer sounds and "Multiple registration" is displayed on the teach pendent.

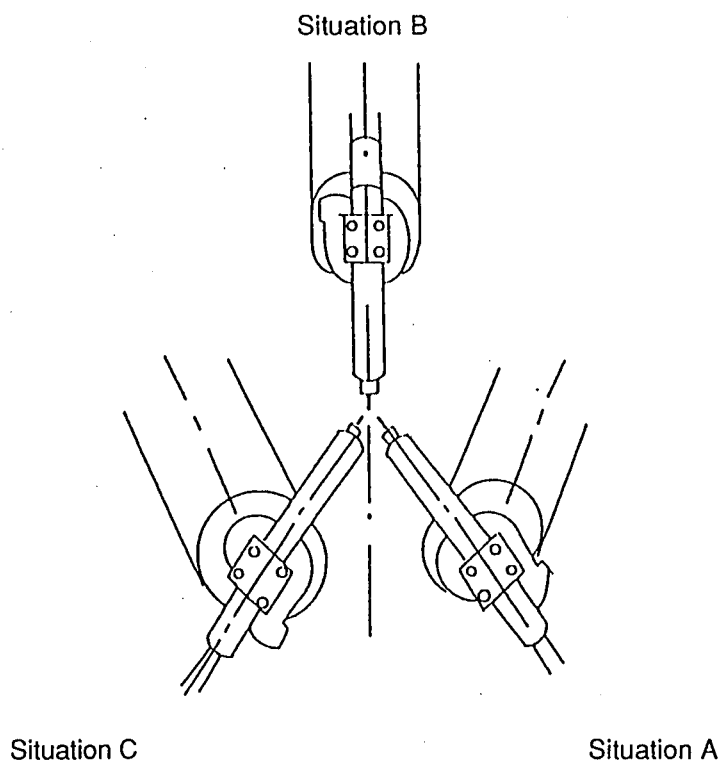
Press the STORE key again to register the position in duplicate. Press the CANCEL key if the attempt was a mistake.

\* Cautions for RW.TW axes teaching

For teaching in moving the wrist axes (RW and TW axes)  $180^\circ$  or more, a teaching point is required between the 2 extreme positions. If there is no intermediate teaching point, the wrist will try to move in the reversed direction (as shown by 2 in the figure below) and an error will occur.



[Example] When teaching to move the TW axis from situation A to situation C as shown in the figure below is made, situation B must be registered before registering situation C.



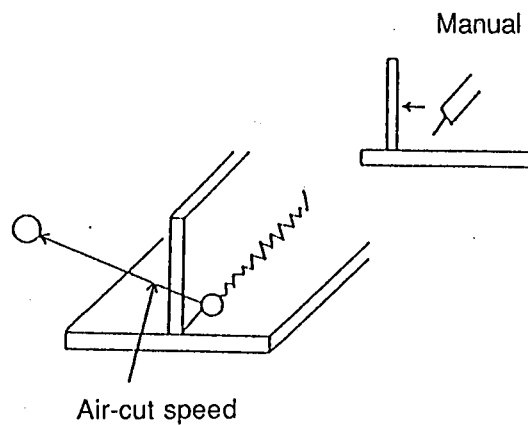
<Note> When teaching is conducted in such a way that the wrist turns  $180^\circ$  or more between 2 positions, as described above, the wrist may turn in the reversed direction at the beginning of operation or at the start of forward/backward tracing, depending on the situation at hand. Care must be exercised when initiating an operation or tracing (forward/backward).

### 2.1.3 Confirmation operation (tracing)

The "Trace Operation" is the operation carried out to Trace the movement and targeted positions, etc. which have been created by the instruction.

#### \* Before operation

- 1 Movement of a robot is determined by the positions taught. Therefore, one changes the movement of a robot in order to change the taught positions, not to change the movement itself.
- 2 Light up the JOG key  
When the confirmation operation is started, do not fail to light up the JOG key.  
When the targeted position is changed (in particular at the welding end position)



The air-cut speed is displayed after the welding end position.

The transfer speed is usually high and it remains the same even when the "MOVE" key is pressed. Therefore, the torch may hit the work -in -progress. This error will not occur when the "JOG +/-" LED is lighting.

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Screen display                                                                                                                                                                                               |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | <p>* When teaching is completed. (to be continued in No.12 of 2.1.2.)</p> <p>* Program stored in the robot</p> <p>Carry out teaching steps No.0~No.4 given in 2.1.2.</p> <p>If the number has already been registered, the status will become the same as when the teaching has been completed.</p> <p>&lt;&lt; Note&gt;&gt; In these two cases, the user I/O does not work even when the system has been started, being different from when in the operating mode.</p> <p>* Operating mode</p> <p>Press the TEACH ENABLE key.</p> <p>&lt;&lt; Note&gt;&gt; Even in the operating mode, the user I/O signal does not work when the robot is moved forward or backward by the teach pendant.</p> <p>However, if it has been specially designated in the OUTB commands, only the output works.</p> | <div> <div>TraceP 20 S:V:</div> <div> <div>* START → OPR program</div> <div>* ODE SEL → Finish</div> <div>* OPR SEL → Set OPR unit</div> <div>* TEACH ENABLE → Trace OPR</div> </div> </div> <p>Screen 1</p> |

| No.                       | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Screen display                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |         |     |       |         |   |       |      |  |   |        |  |  |   |       |      |  |                           |  |  |  |                  |  |  |  |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-----|-------|---------|---|-------|------|--|---|--------|--|--|---|-------|------|--|---------------------------|--|--|--|------------------|--|--|--|
| 1                         | <p>Press the TEACH ENABLE key and make sure that the lamp lights up.</p> <p>* To stop the robot at each teaching point and then to move it forward:<br/>Hold down the ROBOT OPR key and the "+" of the "TRACE +/- " key simultaneously until the robot stops. (Press these keys at each step.)</p> <p>* To move the robot backward by 1 step from the current position (effective from step No.2)<br/>Hold down the ROBOT OPR key and the "-" of the "TRACE +/- " key simultaneously until the robot stops. (Press these keys at each step.)</p> <p>Note) If the key is released while the robot is moving, the robot stops at the position it is at when the key is released. When the key is held down again, the robot moves to the teaching point and stops.</p> <p>Note) The movement speed is slower than the "speed limit" which has been set in the robot's parameters.</p> <p>Note) Even when the "JOG +/- " key is lighting, forward/backward tracing can be performed.</p> <p>The "JOG +/- " key is effective only for RT~TW axes.</p> | <div><div><div>●</div><div>TEACH<br/>ENABLE</div></div><div>→</div><div><div>⚙</div><div>TEACH<br/>ENABLE</div></div></div> <div><table><tr><th>Trace</th><th>P20</th><th>S : 2</th><th>V : 7.5</th></tr><tr><td>0</td><td>MOVEL</td><td>7.50</td><td></td></tr><tr><td>1</td><td>TOOL 1</td><td></td><td></td></tr><tr><td>1</td><td>MOVEL</td><td>7.50</td><td></td></tr><tr><td colspan="4">Speed=7.5 (M/m)----[M.L.]</td></tr><tr><td colspan="4">Add — PTP — Crts</td></tr></table></div> | Trace   | P20 | S : 2 | V : 7.5 | 0 | MOVEL | 7.50 |  | 1 | TOOL 1 |  |  | 1 | MOVEL | 7.50 |  | Speed=7.5 (M/m)----[M.L.] |  |  |  | Add — PTP — Crts |  |  |  |
| Trace                     | P20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | S : 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | V : 7.5 |     |       |         |   |       |      |  |   |        |  |  |   |       |      |  |                           |  |  |  |                  |  |  |  |
| 0                         | MOVEL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 7.50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |     |       |         |   |       |      |  |   |        |  |  |   |       |      |  |                           |  |  |  |                  |  |  |  |
| 1                         | TOOL 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |     |       |         |   |       |      |  |   |        |  |  |   |       |      |  |                           |  |  |  |                  |  |  |  |
| 1                         | MOVEL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 7.50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |     |       |         |   |       |      |  |   |        |  |  |   |       |      |  |                           |  |  |  |                  |  |  |  |
| Speed=7.5 (M/m)----[M.L.] |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |     |       |         |   |       |      |  |   |        |  |  |   |       |      |  |                           |  |  |  |                  |  |  |  |
| Add — PTP — Crts          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |     |       |         |   |       |      |  |   |        |  |  |   |       |      |  |                           |  |  |  |                  |  |  |  |

| No. | Operational method                                                                                                                                                                               | Screen display                                                                                                                                                                                                                    |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2   | <p><u>Modify the teaching points</u> according to your needs.</p> <p>Note) <u>If the program is protected, the teaching points cannot be modified.</u> (Refer to the section on protection.)</p> | <div>Step 2 Change completed</div> <div> X= 201.05 ((mm)      U= 30.01(°)<br/> Y=1038.11 (mm)      V= 95.01 (°)<br/> Z= 382.00 (mm)      W=103.20(°) </div> <div>Speed=15.50 (M/min)---[M.L]</div> <div>Add-----PTP-----Crt</div> |
| 3   | <p>To complete the trace operation:</p> <p>Press the TEACH ENABLE key. Make sure that the LED turns off.</p>                                                                                     | <div>Trace      P 20 S:2      V:7.5</div> <div> MOVEL<br/> X= 1025.01 (mm)      U= 90.00(°)<br/> Y= 360.25 (mm)      V= 30.00 (°)<br/> Z= 250.12 (mm)      W= 20.00(°) </div>                                                     |
| 4   | <p>Press the END key.</p>                                                                                                                                                                        | <div>Start or operation.</div>                                                                                                                                                                                                    |
|     | <p>To quit the teaching mode:</p>                                                                                                                                                                | <div>Teaching</div> <div>Memory 92.9% (app.3632 steps)</div> <div>*OPR SEL*      1/1</div> <div> 1 Input No.      5 File list<br/> 2 Home position<br/> 3 Conversion<br/> 4 Cooriantes </div>                                     |
| 5   | <p>Press the MODE SEL key. Move the cursor to "YES" and press the ENTER key.</p>                                                                                                                 | <div>Note ①</div> <div>*OPR select*</div> <div>Stop teaching?</div> <div>YES      NO</div>                                                                                                                                        |

Note ① The screen shown below appears in the main software of version "J3" or lower version.

|                               |            |
|-------------------------------|------------|
| Teaching                      |            |
| Memory 92.9% (app.3632 steps) |            |
| *OPR select* 1/1              |            |
| Input No.                     | File list  |
| Home position                 | Cooriantes |
| Conversion                    |            |

### 2.1.3.1 Modification of teaching point

#### a) Modification of a teaching point

| No. | Operational method                                                                                           | Screen display                                                       |
|-----|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| 1   | Stop the robot in the confirmation operation mode at teaching point A which is to be modified.               | <p>Before modification: B--A--C<br/>After modification: B--A'--C</p> |
| 2   | Move the robot to the new teaching point (A') by using the movement key.                                     |                                                                      |
| 3   | Change the modification selection display to "Change".<br>(Refer to Note 5 for selecting modification menu.) |                                                                      |
| 4   | Press the STORE key or WELD STORE key.                                                                       |                                                                      |

#### b) Addition of a teaching point

| No. | Operational method                                                                                                                                                                 | Screen display                                            |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| 1   | Stop the robot in the confirmation operation mode at a position (B) before the new teaching point or at a position between the new teaching point and the next teaching point (C). | <p>Before addition: B---C<br/>After addition: B--A--C</p> |
| 2   | Select "Add" in the modification menu.<br>(Refer to Note 5.)                                                                                                                       |                                                           |
| 3   | Move the robot to the teaching point to be added.                                                                                                                                  |                                                           |
| 4   | Press the STORE key or WELD STORE key.                                                                                                                                             |                                                           |

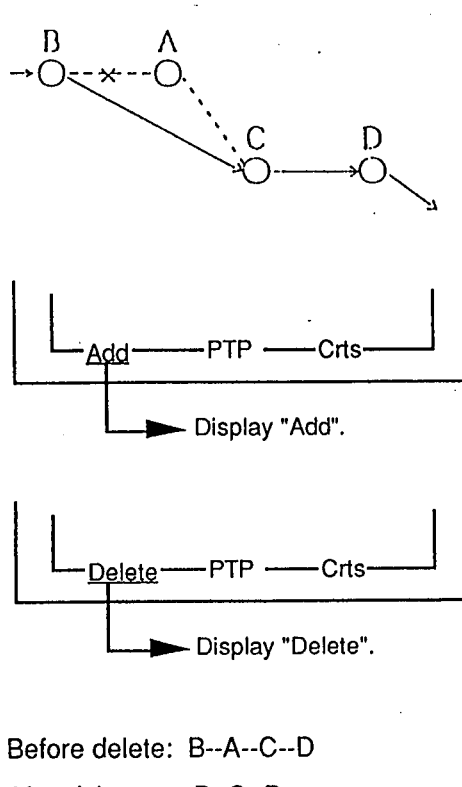
#### c) Deleting a teaching point

| No. | Operational method                                                                                                                                                                               | Screen display                                       |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| 1   | Stop the robot in the confirmation operation mode at a teaching point (B) before the teaching point to be deleted or at a position between the deleted position and the next teaching point (C). | <p>Before delete: B--A--C<br/>After delete: B--C</p> |
| 2   | Select "Delete" in the modification menu.                                                                                                                                                        |                                                      |
| 3   | Press the STORE or WELD STORE key.                                                                                                                                                               |                                                      |

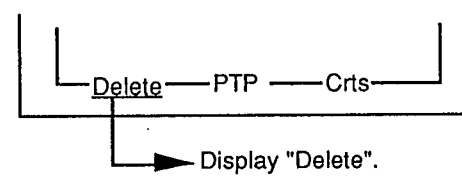
| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                         | Screen display                                                                                                                                                                                                                                         |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4   | <p>The screen as shown on the right appears after point A is deleted.\</p> <p><u>When continuing the delete operation:</u></p> <p>Select "Yes" with cursor key and press the ENTER key. Since step 2 is at point C, point C is deleted.</p> <p><u>When discontinuing the delete operation:</u></p> <p>Select "No" and press the ENTER key.</p> <p>The step indicates point B (step 1), and the initial screen appears.</p> | <div> <div>* OPR select *</div> <div> Step 2      delete<br/> Continue to delete? </div> <div> Yes              No </div> </div> |



d) Deleting the next teaching point

| No. | Operational method                                                                                                                                 | Screen display                                                                                                                                 |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Stop the robot in the confirmation operation mode at a point before the teaching point (A) to be deleted.                                          |  <p>Before delete: B--A--C--D<br/>After delete: B--C--D</p> |
| 2   | Select "Add" in the modification menu.<br>(Refer to Note 5.)                                                                                       |                                                                                                                                                |
| 3   | If point (A) is the welding point, press the WELD STORE key, while press the STORE KEY if it is non-welding point.                                 |                                                                                                                                                |
| 4   | Select "Delete" in the modification menu.<br>(Refer to note 5.)                                                                                    |                                                                                                                                                |
| 5   | Press the STORE key or WELD store key.                                                                                                             |                                                                                                                                                |
| 6   | Select "Delete" in the modification menu again.                                                                                                    |                                                                                                                                                |
| 7   | Press the STORE key or WELD STORE key.                                                                                                             |                                                                                                                                                |
| 8   | Now point (A) has been deleted. The robot moves to point (D) or point (C) in the figure when the FORWARD or BACKWARD key is pressed, respectively. |                                                                                                                                                |

d') Deleting the next teaching point --- method by robot lock

| No. | Operational method                                                                                            | Screen display                                                                                                |
|-----|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| 1   | Stop the robot at an appropriate point in the confirmation operation mode.                                    |  <p>Display "Delete".</p> |
| 2   | Press the ROBOT LOCK key and TRACE key simultaneously, and the make the display of the teaching point to (A). |                                                                                                               |
| 3   | Change the modification menu to "Delete".                                                                     |                                                                                                               |
| 4   | Press the STORE key or WELD STORE key.                                                                        |                                                                                                               |

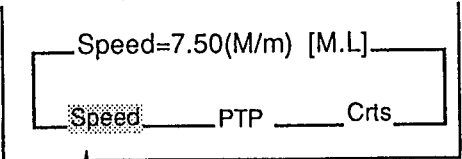
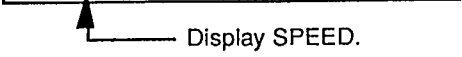
**\*Note 4\***

Deleting the weld start point and weld end point

When point (A) is the weld start point: Welding starts from point (C).

When point (A) is weld end point: Welding ends at point (B).

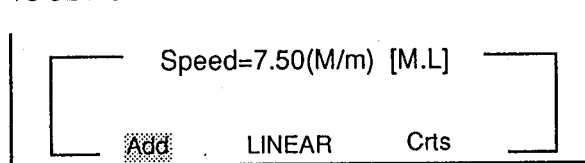
**e) Changing the speed**

| No. | Operational method                                                                                                                                               | Screen display                                                                     |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| 1   | Stop the robot in the confirmation operation mode at the teaching point at which the speed is to be changed or at a point on the way to the next teaching point. | Changed by the SPD +/- key. Changed by the SPEED SEL key.                          |
| 2   | Select "Speed" in the modification menu.<br>(Refer to Note 5.)                                                                                                   |  |
| 3   | When the SPEED SEL key is pressed, the speed changes step by step in order of HIGH - MODERATE. HIGH - MODERATE - MODERATE. LOW - LOW.                            |  |
| 4   | Control the speed within a range by pressing the "+" or "-" key.                                                                                                 |                                                                                    |
| 5   | Press the STORE key or WELD STORE key.                                                                                                                           |                                                                                    |

**\*NOTE 5\***

**HOW TO SELECT MODIFICATION ITEM**

(1)



Move the cursor to Add.

(2)

Each time the

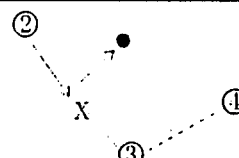
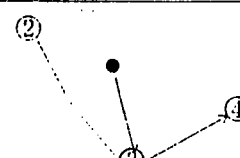
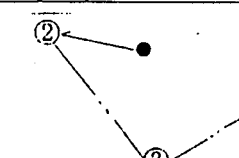
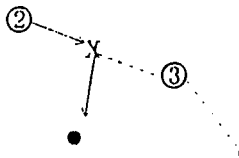
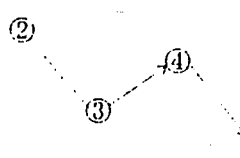
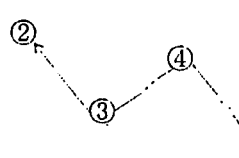
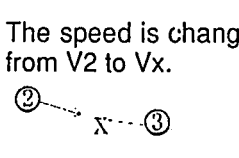
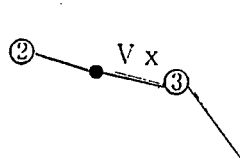
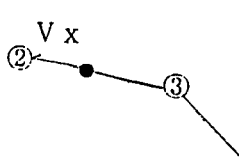
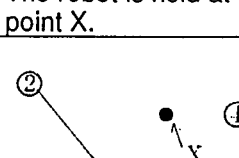
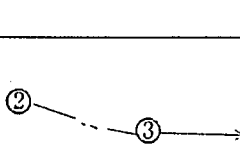
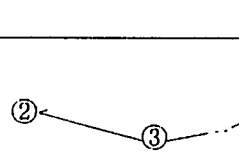
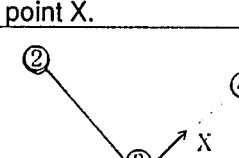
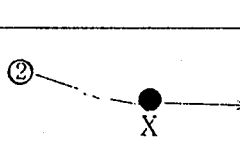
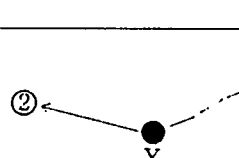
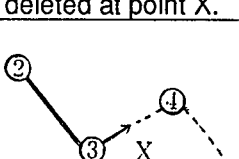
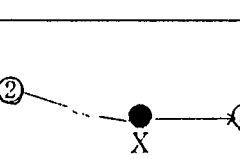
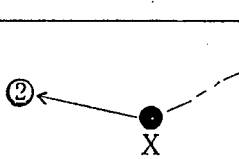


key is pressed, the modification item

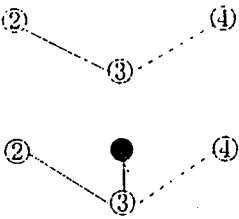
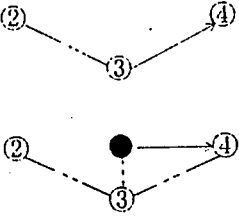
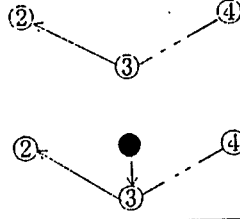
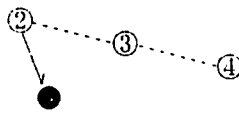
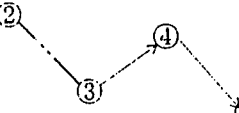
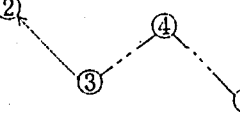
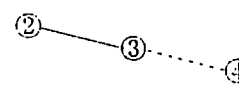
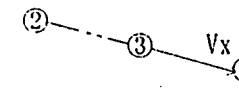
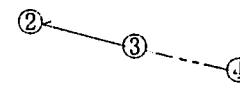
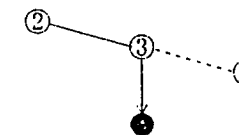
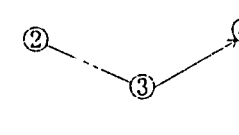
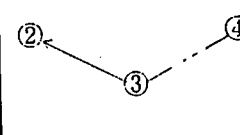
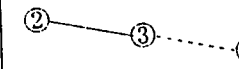
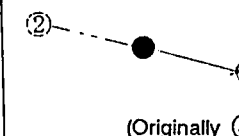
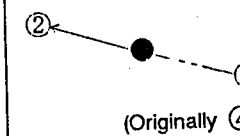
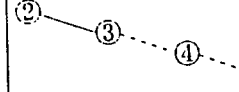
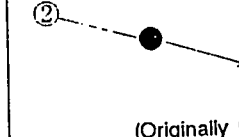
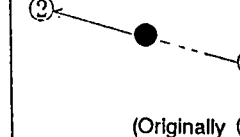
displayed on the screen changes as shown below:



Motions of a robot when it is in HOLD, TRACE (forward/backward) operation a) without any special procedures or after special procedures; b) adding teaching point(s), c) changing speed, d) changing teaching point(s), e) deleting a point or f) deleting points sequentially, between teaching points.

|                               | Hold status                                                                                                                             | The "FORWARD" key is pressed.                                                                              | The "BACKWARD" key is pressed.                                                                              |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| a) Nothing has done.          |  <p>The robot is held at point X.</p>                  |                          |                          |
| b) A teaching point is added. |  <p>The robot is held at point X.</p>                  |                          |                          |
| c) The speed is changed.      |  <p>The robot is held at point X.</p>                |                        |                        |
| d) Modified                   |  <p>The robot is held at point X.</p>                |                        |                        |
| e) Deleted                    |  <p>Teaching point 3 is deleted at point X.</p>      |  <p>(Originally ④)</p> |  <p>(Originally ④)</p> |
| f) Deleted (in series)        |  <p>Teaching points 3, 4 are deleted at point X.</p> |  <p>(Originally ⑤)</p> |  <p>(Originally ⑤)</p> |

Motions of a robot when it is in HOLD, TRACE (forward/backward) operation a) without any special procedures or after special procedures; b) adding teaching point(s), c) changing speed, d) changing teaching point(s), e) deleting a point or f) deleting points sequentially, at a teaching point.

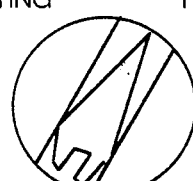
|                               | Hold status                                                                                                                         | The "FORWARD" key is pressed.                                                        | The "BACKWARD" key is pressed.                                                        |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| a) Nothing has done.          |                                                    |    |    |
| b) A teaching point is added. |                                                    |    |    |
| c) The speed is changed.      | <br>The speed is changed to $V_x$ .              |  |  |
| d) Modified                   |                                                  |  |  |
| e) Deleted                    | <br>Teaching point is deleted at point 3.        |  |  |
| f) Deleted (in series)        | <br>Teaching points 3, 4 are deleted at point 3. |  |  |

## 2.1.4 Operation of panel



"Operation" means that the robot starts to move at the high speed. Before operating the robot, make sure that no persons are in the work envelope of the robot and all the safety devices function properly.

- \* The robot has already been taught how to move (teaching) and the motions have already been checked and modified (trace operation). Now the actual welding process can be started.
- \* As for the operation in this step, the robot does not work only when the mode select switch is set to "Operating". (The robot does not know the contents of the motions.) Therefore, it is necessary to specify the contents of the motions. (There are various motion contents according to the points specified.)  
In this step, robots are simply moved.

| No.            | Operational method                                                                                                                                                                | Screen display                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |             |                |             |          |  |     |   |   |    |    |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------------|----------------|-------------|----------|--|-----|---|---|----|----|
| 0              | <p>&lt;To go to the operating mode from other modes&gt;</p> <p>The initial screen is brought back when the END key is pressed repeatedly or when the MODE SEL key is pressed.</p> | <div><p>Mode Select (Initial)</p><p>To select &lt;OPR&gt; or &lt;TEACH&gt;, use SW on the controller.</p><div><p>*OPR select* —1/1—</p><table><tr><td>1 Edit</td><td>4 Init. set</td></tr><tr><td>2 Product data</td><td>5 E. memory</td></tr><tr><td>3 Option</td><td></td></tr></table></div></div> <p>Screen 1</p> <p>OPERATING                      TEACHING</p>  <p>MODE SELECT</p> <table><tr><td>OPR</td><td>J</td><td>P</td><td>S=</td><td>V=</td></tr></table> <div><p>* JOB select start OK.</p><p>* OPR SELECT      ➡ Set OPR cond</p><p>* MODE SELECT    ➡ Exit</p></div> | 1 Edit | 4 Init. set | 2 Product data | 5 E. memory | 3 Option |  | OPR | J | P | S= | V= |
| 1 Edit         | 4 Init. set                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |             |                |             |          |  |     |   |   |    |    |
| 2 Product data | 5 E. memory                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |             |                |             |          |  |     |   |   |    |    |
| 3 Option       |                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |             |                |             |          |  |     |   |   |    |    |
| OPR            | J                                                                                                                                                                                 | P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | S=     | V=          |                |             |          |  |     |   |   |    |    |
| 1              | Set the mode select switch provided at the top of the Controller front panel to "OPERATING".                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |             |                |             |          |  |     |   |   |    |    |
| 2              | Press the OPR SEL key.                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |             |                |             |          |  |     |   |   |    |    |

| No. | Operational method                                   | Screen display                                                                                                                                                                                                                  |
|-----|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3   | Move the cursor to "OPR cond. (operating contents)". | <div> <div>OPR J P S= V=</div> <div> <div>*OPR select* 1/1</div> <div> <div>1 OPR cond</div> <div>2 Disp change</div> <div>3 E. memory</div> <div>4 Limit cond</div> <div>5 Edit</div> <div>6 Option</div> </div> </div> </div> |
| 4   | Press the ENTER key.                                 | Screen 3                                                                                                                                                                                                                        |

| No. | Operational method                                                                                                                                                                                                                                                                                             | Screen display                                                                                                                                                                                              |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5   | Move the cursor to "Panel".                                                                                                                                                                                                                                                                                    | <div> <div>OPR J P S: V:</div> <div>OPR cond</div> <div>Ext</div> <div>Panel (Job Program)</div> <div>0 0 0 0</div> <div>0 0 0 0</div> <div>Address search</div> <div>Job 0, Program 0, Step 0</div> </div> |
| 6   | Press the ENTER key. (The Panel is displayed inversed.)                                                                                                                                                                                                                                                        |                                                                                                                                                                                                             |
| 7   | Move the cursor to Program by using the cursor key.<br>(The "Program" is displayed inversed.)                                                                                                                                                                                                                  | <div> <div>OPR J P S: V:</div> <div>OPR cond</div> <div>Ext</div> <div>Panel (Job Program)</div> <div>0 0 0 0</div> <div>0 0 0 0</div> <div>Address search</div> <div>Job 0, Program 0, Step 0</div> </div> |
| 8   | Press the ENTER key.                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                             |
| 9   | Enter the program No. via the numerical key pad.<br>If you have made a mistake in entering the number, press the CANCEL key and enter the correct number again.<br><br>Note) Since the program No. is displayed in 3 digits, enter the number in each digit. For instance, enter <u>0 5 5</u> for program #55. | <div> <div>OPR J P S: V:</div> <div>OPR cond</div> <div>Ext</div> <div>Panel (Job Program)</div> <div>0 0 0 0</div> <div>0 0 0 0</div> <div>Address search</div> <div>Job 0, Program 0, Step 0</div> </div> |
| 10  | Press the ENTER key.<br><br>Note) The program No. can be entered up to 8 to make the robot operate without discontinuation.                                                                                                                                                                                    | <div> <div>OPR J P S: V:</div> <div>OPR cond</div> <div>Ext</div> <div>Panel (Job Program)</div> <div>0 0 0 0</div> <div>0 0 0 0</div> <div>Address search</div> <div>Job 0, Program 0, Step 0</div> </div> |

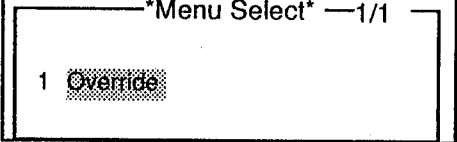
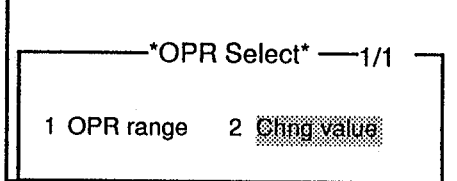
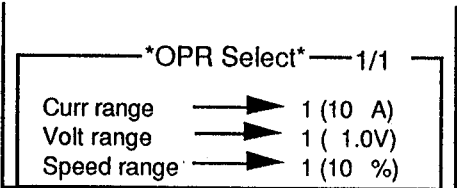
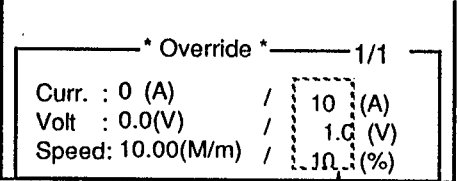
Screen 3

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                 | Screen display |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 11  | Press the END key.<br>This "END" means the end of entering various data of operating conditions.                                                                                                                                                                                                                                                                   |                |
| 12  | Press the START switch on the operation panel.<br><br>↓<br>Operating starts.<br><br>↓<br>The robot stops when the end of the selected program has reached.<br><br>Note) For air-cut (non-welding) movement, press the WELD OFF switch on the teach pendant before pressing the START switch on the operation panel.<br><br><u>To start the same program again.</u> |                |
| 1'  | Press the OPR SEL key. (Screen 3).                                                                                                                                                                                                                                                                                                                                 |                |
| 2'  | Press the ENTER key. (Screen 4)                                                                                                                                                                                                                                                                                                                                    |                |
| 3'  | Press the END key.                                                                                                                                                                                                                                                                                                                                                 |                |
| 4'  | Press the START switch on the panel.                                                                                                                                                                                                                                                                                                                               |                |



### 2.1.4.1 Fine adjustment of the welding conditions (Override)

- \* This function is used for fine adjustments of welding current, welding voltage and speed during the operation (play) of the robot.
- \* The welding conditions modified by using the fine adjustment function becomes effective from the next welding task. The welding conditions can be modified in the transfer mode (WELD OFF).

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Screen display                                                                       |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 1   | Set the override value.<br>Set the value on the Init. set/Sys. set/Weld cond/Set Override screen.<br>(Refer to chapter 4.)                                                                                                                                                                                                                                                                                                                                                                                                     |    |
| 2   | When the override value is set in Operating mode, press the MENU SEL key.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |    |
| 3   | Press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                      |
| 4   | When the ENTER key is pressed with the cursor positioned at "Chng value", the setting screen which is same as that of No.1 appears. Set the value on the screen.<br>Move the cursor to "OPR range" and press the ENTER key.<br>Select and set the values of current, voltage and speed among No.1~No.5 in the preset override value table.                                                                                                                                                                                     |  |
| 5   | Press the END key 3 times to go back to the Operation selection screen.                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                      |
| 6   | Press the OVERRIDE key to actually perform the override.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |
| 7   | Press the "+" or "-" key of the current, voltage and speed.<br>Current..... When the "+" or "-" key is pressed, the current level changes by the value of the No. set at the "OPR range" among the value set on the override value setting screen. The minimum value and the maximum value to be set is 1 A and 999 A, respectively. The current level for one time is displayed on the right side of the screen. In case of changing the current level, move the cursor to the current level and input the new current level. | Changes by these values                                                              |

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Screen display |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
|     | <p>Voltage: When the "+" or "-" key is pressed, the voltage level changes by the value of the No. set at the "OPR range" among the value set on the override value setting screen. The minimum value and the maximum value to be set is 0.1 V and 99.9 V, respectively. The voltage level for one time is displayed on the right side of the screen. In case of changing the voltage level, move the cursor to the voltage level and input the new voltage level.</p> <p>Speed: When the "+" or "-" key is pressed, the speed level changes by the value of the No. set at the "OPR range" among the value set on the override value setting screen. The maximum value to be set is 30 M/min. The speed level for one time is displayed on the right side of the screen. In case of changing the speed level, move the cursor to the speed level and input the new speed level.</p> <p><i>The output adjustment of the speed is accepted within the range of twice in "+" direction and twice in "-" direction between the teaching points per each processing step and also in the range from +25% to -25%.</i></p> |                |

Notes)

- \* The speed override does not work on weaving points. Even if override is attempted, it is ignored.  
(The override is effective on current and voltage).
- \* The override cannot be used on programs protected.  
(Even if override is attempted, it is ignored.)
- \* The override cannot be used during the address search.
- \* The effective range of the override of "speed" is below 30 m/min.

### 2.1.5 Registration and modification of job

"Job" is the unit for operation which must be registered to externally operate the robot. A job is created by connecting more than one program or more than one sequence.

When the robot is operated via the start switch externally provided, job is selected and started.

When a job is selected and started, the program and the sequence instructions are executed as stored.

Other programs can be externally executed by changing the contents of the job.

| No.            | Operational method                                                                                      | Screen display                                                                                                                                                                                                                                                                                            |             |             |                |             |           |          |           |           |
|----------------|---------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|----------------|-------------|-----------|----------|-----------|-----------|
| 1              | Press the END key to bring up the initial screen.                                                       | <div>Mode Select (Initial)<br/><br/>To select &lt;OPR&gt; or &lt;TEACH&gt;, use SW on the controller.<br/><br/>—————*OPR select* —1/1 —<br/><br/><table><tr><td>1 Edit</td><td>4 Init. set</td></tr><tr><td>2 Product data</td><td>5 E. memory</td></tr><tr><td>3 Option</td><td></td></tr></table></div> | 1 Edit      | 4 Init. set | 2 Product data | 5 E. memory | 3 Option  |          |           |           |
| 1 Edit         | 4 Init. set                                                                                             |                                                                                                                                                                                                                                                                                                           |             |             |                |             |           |          |           |           |
| 2 Product data | 5 E. memory                                                                                             |                                                                                                                                                                                                                                                                                                           |             |             |                |             |           |          |           |           |
| 3 Option       |                                                                                                         |                                                                                                                                                                                                                                                                                                           |             |             |                |             |           |          |           |           |
| 2              | Since the cursor shifts to "Edit", press the ENTER key.                                                 |                                                                                                                                                                                                                                                                                                           |             |             |                |             |           |          |           |           |
| 3              | Since the cursor shifts to "Job", press the ENTER key.                                                  | <div>Screen 1<br/><div>Edit<br/><br/>Memory 99.9% app. 5941 step<br/><br/>—————*OPR Select* —1/1 —<br/><br/><table><tr><td>1 Job</td><td>4 Program</td></tr><tr><td>2 A-S-S</td><td>5 A-E-S</td></tr><tr><td>3 Library</td><td></td></tr></table></div></div>                                             | 1 Job       | 4 Program   | 2 A-S-S        | 5 A-E-S     | 3 Library |          |           |           |
| 1 Job          | 4 Program                                                                                               |                                                                                                                                                                                                                                                                                                           |             |             |                |             |           |          |           |           |
| 2 A-S-S        | 5 A-E-S                                                                                                 |                                                                                                                                                                                                                                                                                                           |             |             |                |             |           |          |           |           |
| 3 Library      |                                                                                                         |                                                                                                                                                                                                                                                                                                           |             |             |                |             |           |          |           |           |
| 4              | Since the cursor shifts to "Input No.", press the ENTER key.                                            | <div>Screen 2<br/><div>—————* OPR Select* —1/1 —<br/><br/><table><tr><td>1 Input No.</td><td>5 File list</td></tr><tr><td>2 Copy</td><td>6 Divid</td></tr><tr><td>3 Merge</td><td>7 Delete</td></tr><tr><td>4 Comment</td><td>8 Protect</td></tr></table></div></div>                                     | 1 Input No. | 5 File list | 2 Copy         | 6 Divid     | 3 Merge   | 7 Delete | 4 Comment | 8 Protect |
| 1 Input No.    | 5 File list                                                                                             |                                                                                                                                                                                                                                                                                                           |             |             |                |             |           |          |           |           |
| 2 Copy         | 6 Divid                                                                                                 |                                                                                                                                                                                                                                                                                                           |             |             |                |             |           |          |           |           |
| 3 Merge        | 7 Delete                                                                                                |                                                                                                                                                                                                                                                                                                           |             |             |                |             |           |          |           |           |
| 4 Comment      | 8 Protect                                                                                               |                                                                                                                                                                                                                                                                                                           |             |             |                |             |           |          |           |           |
| 5              | Enter the job No. via the numerical keys.<br>The job No. should be of 3 digits.<br>Press the ENTER key. | <div>Screen 3<br/><div>—————* OPR Select* —<br/><br/>(Job)<br/>Please input No.<br/><br/>Job No.      —————&gt; 0</div></div>                                                                                                                                                                             |             |             |                |             |           |          |           |           |
| 6              | * Go to step No.11 to register a new job.                                                               | <div>Screen 4</div>                                                                                                                                                                                                                                                                                       |             |             |                |             |           |          |           |           |

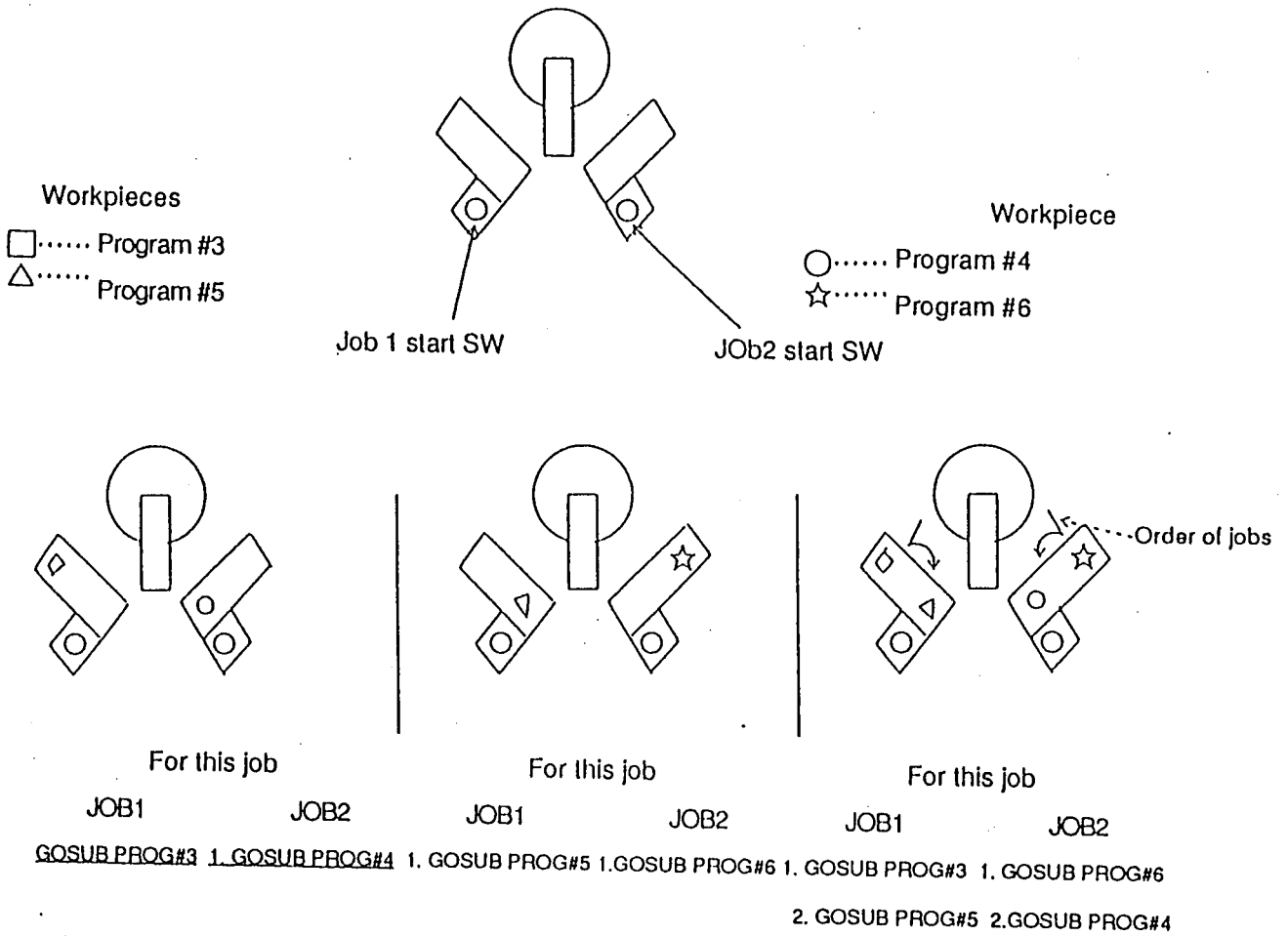
| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                  | Screen display                                                                                                                                                                                |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | <u>Modification of existing job</u>                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                               |
| 7   | Move the blink cursor to the targeted address by using the cursor key.                                                                                                                                                                                                                                                                                                              | <div> Edit Job 20<br/> —Address—Command—<br/> 1 GOSUB PROG 10<br/> 2 GO TO ADDR =1<br/> 3 OUTB OPORT 2 = 1 0 </div>                                                                           |
| 8   | Press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                | Screen 5                                                                                                                                                                                      |
| 9   | Move the cursor to "CHG (Change)" or "Add".                                                                                                                                                                                                                                                                                                                                         | <div> Edit Job 20<br/> —Address—Command—<br/> 1 GOSUB PROG 10<br/> 2 GO TO ADDR =1<br/> Change Add Delete </div>                                                                              |
| 10  | Press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                | Screen 6                                                                                                                                                                                      |
|     | <u>New registration</u>                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                               |
| 11  | Register the sequence No.s.<br>For instance, follow the procedure below to register Program 15 to Job 20:<br>(1) Move the cursor to "Flow control".<br>(2) Press the ENTER key.<br>(3) Press the OPR SEL key once.<br>(4) Move the cursor to "GOSUB PROG".<br>(5) Press the ENTER key.<br>(6) Enter the parameters as shown in the screen to the right.<br>(7) Press the ENTER key. | <div> Edit Job 20<br/> —Address—Command—<br/> 1 GOSUB PROG 10<br/> * OPR select *—1/1—<br/> 1 I/O 5 Flow control<br/> 6 Weld control<br/> 3 Ins. sentence 7 Move / Speed<br/> 8 Others </div> |
|     |                                                                                                                                                                                                                                                                                                                                                                                     | Screen 7                                                                                                                                                                                      |
|     |                                                                                                                                                                                                                                                                                                                                                                                     | <div> *Select command*—1/4—<br/> WAIT IPORT, (SW)<br/> WAIT IPORT, (Time), (SW)<br/> WAIT IPORT, (Count), (SW)<br/> DELAY </div>                                                              |
|     |                                                                                                                                                                                                                                                                                                                                                                                     | Screen 8                                                                                                                                                                                      |
|     |                                                                                                                                                                                                                                                                                                                                                                                     | <div> *Select command*—2/4—<br/> GOTO ADDR<br/> GOTO PROG<br/> GOTO JOB<br/> GOSUB PROG </div>                                                                                                |
|     |                                                                                                                                                                                                                                                                                                                                                                                     | Screen 9                                                                                                                                                                                      |
|     | The sequence instructions are registered by the procedures above.                                                                                                                                                                                                                                                                                                                   | <div> *Seq command*—<br/> Address = 2<br/> GOSUB PROG# 0 </div>                                                                                                                               |
|     |                                                                                                                                                                                                                                                                                                                                                                                     | Screen 10                                                                                                                                                                                     |

| No. | Operational method                                                                            | Screen display                                                                                                                    |
|-----|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| 12  | After completing the registration of all sequence commands, press the END key.<br>(Screen 11) | <div> Edit      Job 15<br/> <hr/> Address    Command    <hr/> <br/> 2 GOSUB PROG 15<br/> <br/> <br/> [ENTER] or [OPR SEL.] </div> |
| 13  | Press the END key 3 times to go back to the initial screen after completing editing.          | Screen 11                                                                                                                         |

### Example 1: One robot for two tables (left and right table)

Teaching has been completed  
on the left table.

Teaching has been completed  
on the right table.

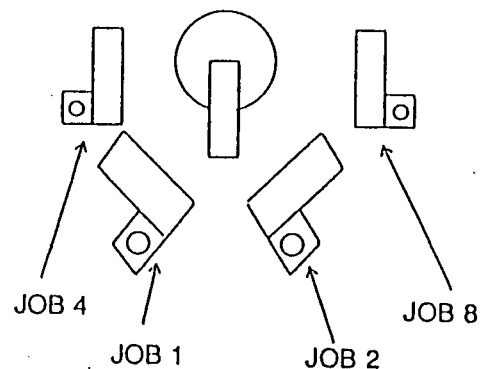


\* To retrieve the program.

### Example 2: The number of jobs should be

equal to that of the tables.

The Job No.s independently  
used are 1,2,4,8,16,32,64,128,  
256 and 512 (10 jobs).



Example 3: Even when the program connected to the job is changed, the program currently used  
is not erased.

### 2.1.6 External operating



*"Operation" means that the robot starts to move at the high speed. Before operating the robot, make sure that no persons are in the work envelope of the robot and all the safety devices function properly.*

- \* Starting external operating

Initial screen --- MODE SELECT switch "Operating" -- External start switch (Job starts.) --  
Operating starts.

- \* How to quit the external operating

When the operating has been completed: MODE SEL -- Confirmation of operating stop  
"YES" -----ENTER key.

During operation: -- "HOLD" ---MODE SEL -- Confirmation of operating stop "YES" ENTER  
key -- Initial screen

- \* How to use the external start switch

This switch is the reservation type one. When the Job 2 start switch is pressed during Job 1 is in process, execution of Job 2 starts automatically when job1 is completed..

Job 1 start switch -- Robot starts executing Job1.-- Job 2 start switch. -- Job 2 starts automatically after the end of Job 1.-- Removal of Job 1 workpiece and setting new parts -- Job 1 start switch -- Job 1 starts automatically after the end of Job 2. --

Repeated

### Cautions in using Jobs

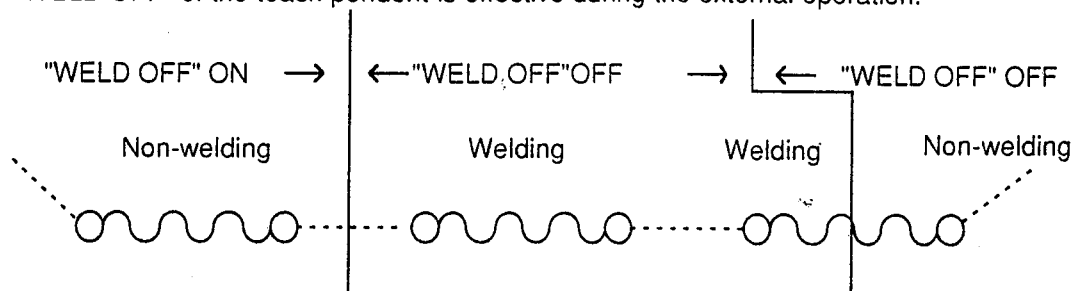
- \* Even when the start switch of the Job No. which is being executed is pressed, it is ignored.
- \* If the start switch of Job 2 is not pressed during the execution of Job 1, the robot stops at the end of Job 1.

- \* Reservation is accepted only once. A duplicate reservation is not accepted.

For instance, even when the start switch of Job 2 is pressed twice during Job 1 is being executed, Job 2 is executed once.

- \* Fine adjustment of welding conditions can also be performed during the external operation.  
(Refer to "2.1.4.1 Override".)

- \* "WELD OFF" of the teach pendent is effective during the external operation.



### 2.1.6.1 HOLD

The robot is halted when the HOLD switch on the panel or HOLD key of the teach pendant is pressed, and when external input terminal such as "HOLD", "NO ARC", "STICK", "TORCH CONTACT", "IGAS PRESSURE" and "NO WIRE" receives a signal.

When HOLD is activated during welding is in process, the robot stops after executing the welding end sequence (AES n:n=1~5) corresponding to the number "n" of the welding start sequence (ASS n:n=1~5). At this time, the output signal is turned off unless specially designated by the OUTB command. (OUTB OPORT#\*\*\* = \* 1.) After the restart, the arc start sequence (ASS) executed at the last is resumed. But the output terminals (except for OUTB OPORT #\*\*\* = \* 1 command) which is turned ON by means of the output command of the arc end sequence (AES) during the holding are cancelled.

| No.                         | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Screen display                                                                                                                                                                                                                                                       |     |                      |   |       |   |       |   |          |   |          |                             |  |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------|---|-------|---|-------|---|----------|---|----------|-----------------------------|--|
|                             | <p><b>HOLD</b></p> <p>The robot is halted when the "HOLD" switch on the panel or the "HOLD" key of the teach pendent is pressed. <u>When the TEACH ENABLE key of the teach pendent is pressed</u>, the movement keys become effective and the escape movement becomes possible.</p> <p><b>Re-start from the hold status</b></p> <p>Press the start switch (in case of external operation, the re-start of the external input terminal) after removing the cause for which the robot has been halted.</p> <p>If the robot has been moved during the halt, press the TEACH ENABLE key, make sure that the lamp turns off and then press the START switch.</p> <p>When resuming the operation after occurrence of welding abnormality such as "no arc", "stick", "torch contact", "gas pressure", and "no wire", remove the error cause and press the start switch.</p> | <table><tr><td>OPR</td><td>J:10 P:15 S:4 V:7.50</td></tr><tr><td>0</td><td>MOVEP</td></tr><tr><td>1</td><td>MOVEL</td></tr><tr><td>2</td><td>MOVEC CS</td></tr><tr><td>3</td><td>MOVEC CO</td></tr><tr><td colspan="2">Holding, start or operation</td></tr></table> | OPR | J:10 P:15 S:4 V:7.50 | 0 | MOVEP | 1 | MOVEL | 2 | MOVEC CS | 3 | MOVEC CO | Holding, start or operation |  |
| OPR                         | J:10 P:15 S:4 V:7.50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                      |     |                      |   |       |   |       |   |          |   |          |                             |  |
| 0                           | MOVEP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                      |     |                      |   |       |   |       |   |          |   |          |                             |  |
| 1                           | MOVEL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                      |     |                      |   |       |   |       |   |          |   |          |                             |  |
| 2                           | MOVEC CS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                      |     |                      |   |       |   |       |   |          |   |          |                             |  |
| 3                           | MOVEC CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                      |     |                      |   |       |   |       |   |          |   |          |                             |  |
| Holding, start or operation |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                      |     |                      |   |       |   |       |   |          |   |          |                             |  |

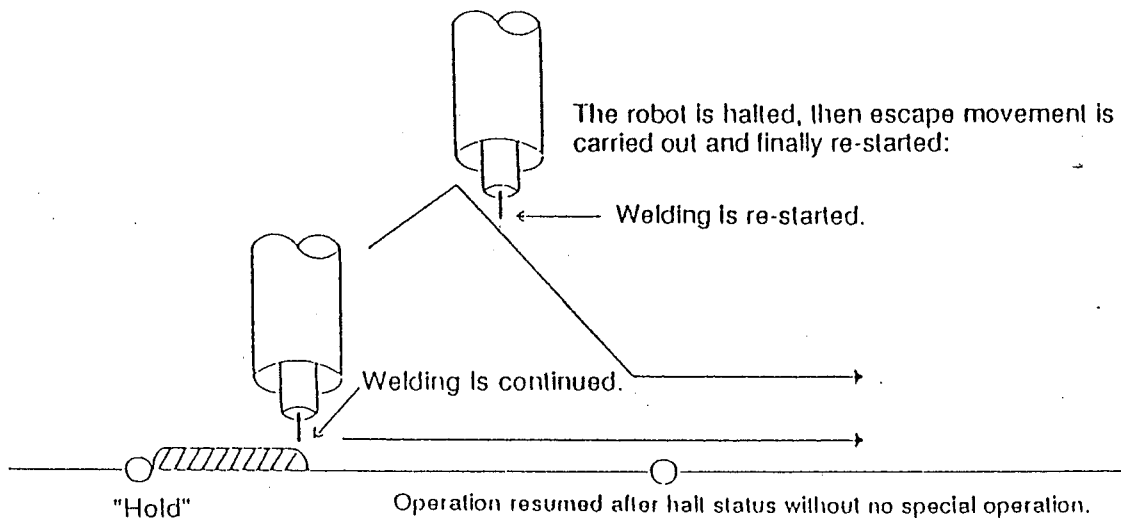


| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Screen display |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
|     | <p><b>During operating</b></p> <p>When the "START" switch is pressed, the operation (play) starts.</p> <p>Note) When in the external play mode, the operation is resumed by the "re-start" signal input.</p> <p>The welding conditions before the holding is re-produced by the "pre-hold output re-production function" and the operation is started.</p> <p><b>Trace</b></p> <ul style="list-style-type: none"> <li>* When the robot is hold during forward movement, the operation is resumed by pressing the ROBOT OPR and FORWARD keys of the teach pendent simultaneously.</li> <li>* When the robot is halted during backward movement, the operation is resumed by pressing the ROBOT OPR and BACKWARD keys of the teach pendent simultaneously.</li> </ul> |                |

\* Pre-hold output re-production function

This is effective when the robot is re-started without any changes, or when it is moved.

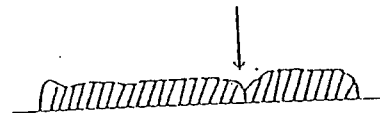
The I/O status before the halt (the status of individual I/O terminal, welding current and welding voltage) is stored and the welding is resumed from the point halted. (Refer to "3.8 Escape motions during pause and function reproducing output" for details.)



Method to connect the beat after the robot is halted during welding in process:

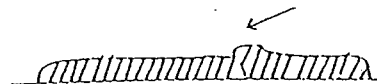
The bead connection is dented.

\* When the robot is re-started after the halt as it was:



\* When the robot is hold, slightly moved backward and then re-started:

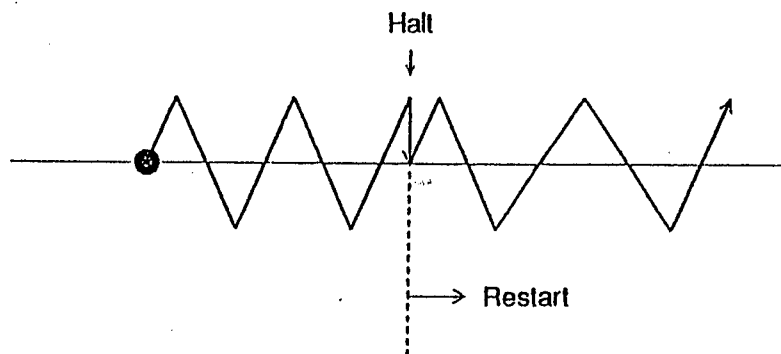
The bead connection is not dented.



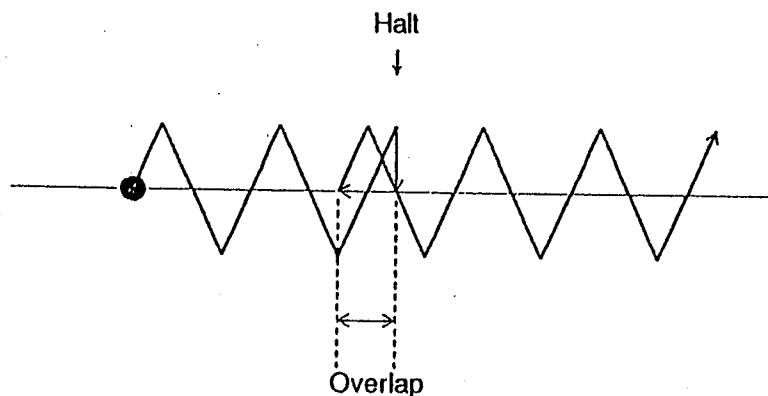
\* To proceed without welding, press the WELD OFF switch, and re-start the robot after confirming that the lamp light up.

#### Halt during weaving/Restart overlap

- In case that the robot halts during the weaving, it returns to a point on the main trace and stops.
- In case that the robot restarts after the halt, the re-calculation is carried out. And from the position where the robot stops, the robot resumes the weaving operation.



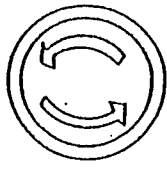
- Even if the TRACE '+' key is released during the trace forward movement, the robot returns to a point on the main trace and stops.
- The arc overlapping during the weaving and the circular weaving was enabled. In case that the "arc overlapping" is valid and the robot halts during the weaving, the robot returns to a point on the main trace and stops. And when the robot restarts, it overlaps the main trace.
- Refer to "4.1.2.19 Arc overlapping" on page 4-41-9 of this manual for the "Arc overlapping."



### 2.1.6.2 Emergency stop

When an emergency status occurs, press the EMERGENCY STOP PB switch or open the "EXTERNAL EMERGENCY STOP" terminals (normally closed).

When the emergency stop signal is input, the servo power supply is turned off and the output signals are also turned off.

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Screen display                                                                                                                                                                                                                                                                                                                                            |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | <p>&lt;Emergency stop input&gt;</p> <p>Press the EMERGENCY STOP PB switch on the panel or on the teach pendent.</p> <p>Or, open the "EMERGENCY STOP" input terminals of the external input terminals.</p> <p>(Note) The emergency stop signal should be of normally-closed contact (B contact). (it opens when emergency stop is actuated.)</p> <p>&lt;Releasing the emergency stop status&gt;</p> <ul style="list-style-type: none"> <li>* When the emergency stop is activated via the PB switch on the panel, turn the EMERGENCY STOP PB switch on the panel clockwise.</li> <li>* When the emergency stop is activated via the external terminal, remove the signal stored in the external "EMERGENCY STOP" terminal.</li> </ul> |  <p>E. STOP</p>                                                                                                                                                                                                                                                        |
| 1   | <p>Press the SERVO POWER switch when the TEACH ENABLE LED is OFF, and press the SERVO ON key of the teach pendent when the LED is ON. (Or, turn ON-OFF the external servo power supply terminals.)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <p><b>CAUTION</b></p> <p><i>When the emergency switch is activated, the contact of the magnet switch provided to the control unit is severely worn out. Do not use the emergency switch unless otherwise necessary. In normal operation or inspections, use the Halt switch. Also, the magnet switch should be periodically checked and replaced.</i></p> |
| 2   | <p>Press the START switch.</p> <p>The robot starts from the status before the emergency stop was activated.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                           |

Note 1) When the emergency stop switch on the teach pendent is pressed, it is mechanically locked. Turn the switch clockwise to release.

Note 2) When the emergency stop is activated in the teach mode or operation mode, the switches and keys effective are the SERVO POWER switch on the panel, OPR SEL, SERVO ON and R, LOCK keys on the teach pendent. The operations displayed on the menu screen when the OPR SEL key is pressed are also effective.

Note 3) In case the servo is turned on after the emergency stop, run at about 2 seconds.

#### 2.1.6.3 Conditions of control unit at power failure and the recovery

- \* The system is not affected by a momentary power failure of 0.01 sec or less, and it can be operated without any discontinuation.
- \* When the power failure lasts longer than 0.01 sec, the system protects the data currently being processed and the servo power supply will remain turned off even after the power supply is resumed.

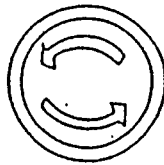
To resume the operation, turn off the power supply of the control panel, and then re-start the system start procedure from "Power ON".

### 2.1.7 Power OFF

Power off the robot according to the following procedures when all the operations are completed.

- ① Turn off the servo power.

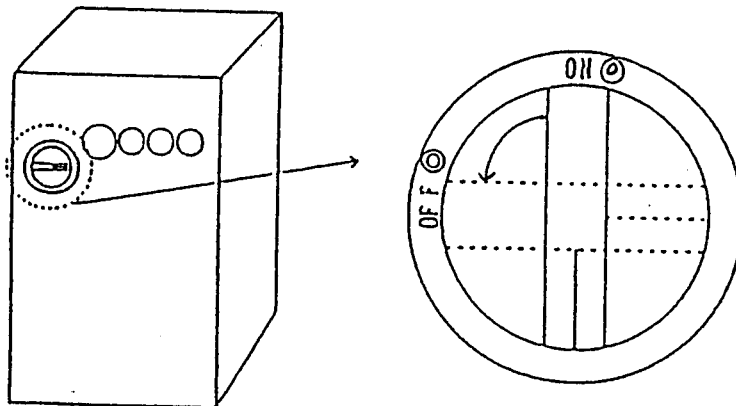
Press the **Emergency Stop** button on the panel or the teach pendant.



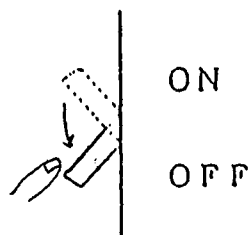
E. STOP

- ② Turn off the main power.

Main power is turned off by turning the handle provided on the upper left of the controller front panel to the "OFF" side.



- ③ Turn "OFF" the switch of the power source facility.



## 2.2 Manual operation



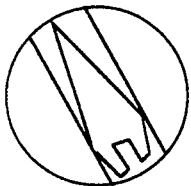
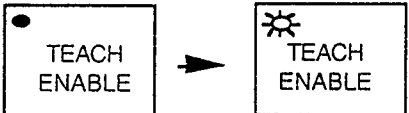
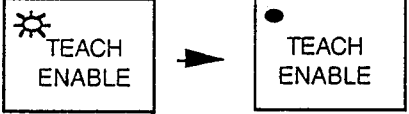
*The robot moves immediately when the MOVE key of the teach pendant is pressed.*

*Before operating the robot, make sure that no persons are in the work envelope.*

Manual operation is used only to move the robot via the teach pendant. No data is stored in the robot's memory.

(Examples)

- \* To move the robot to the position at which no torch contact will occur during address search.
- \* To check the relational positions of the robot and workpiece-setting-jig.
- \* To carry out wire inching after the wire replacement.

| No. | Operational method                                                                          | Screen display                                                                                                                            |
|-----|---------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | Start this procedure from the initial screen.                                               |                                                                                                                                           |
| 1   | Set the mode select switch to "OPERATION".                                                  | OPERATING      TEACHING                                                                                                                   |
| 2   | Press the TEACH ENABLE key.                                                                 |                                                      |
| 3   | Move the robot by using the movement keys.                                                  | MODE SELECT                                                                                                                               |
|     | * To quit.                                                                                  |                                                                                                                                           |
| 4   | Press the TEACH ENABLE key.                                                                 |                                                       |
| 5   | Press the MODE SEL key.                                                                     |                                                       |
| 6   | When message "Finish operating?" appears, move the cursor to "YES" and press the ENTER key. | <div>Finish operating?</div> <div> <div> <div>OPR select</div> <div>1/1</div> </div> <div> <div>1 YES</div> <div>2 NO</div> </div> </div> |

## 2.3 Welding conditions

As described in the section of "Program", the welding conditions are entered by the teaching. Among the 5 kinds of welding conditions available, appropriate one is selected and entered to the individual welding points. A welding condition can be selected as frequently as required. This step is the step to create the 5 kinds of welding conditions suitable for the workpiece. Also, the currently set conditions can be checked also in this step.

- \* Even when the 5 kinds of conditions are created and entered in this step, the welding conditions set to the program currently executed is not affected. The welding conditions entered to a program by using the teach pendant is specific to the program. (The No.s are not displayed.)

| No. | Operational method                                                                     | Screen display                                                                                                                                                                                                                                                    |
|-----|----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | This procedure starts from the operation mode selection (initial screen).              | <p>Initial screen</p> <p>Mode Select (Initial)</p> <p>To select &lt;OPR&gt; or &lt;TEACH&gt;, use SW on the controller.</p> <p>—*OPR select*— 1/1 —</p> <p>1 Edit                      4 Init. set</p> <p>2 Product data          5 E. memory</p> <p>3 Option</p> |
| 1   | Move the cursor to "Init. set".                                                        |                                                                                                                                                                                                                                                                   |
| 2   | Press the ENTER key.                                                                   |                                                                                                                                                                                                                                                                   |
| 3   | Since the cursor has shifted to "Sys. set (system setup)", press the ENTER key.        | <p>Init. set</p> <p>—*OPR select*— 1/1 —</p> <p>1 Sys. set                  2 Adv-func.</p>                                                                                                                                                                       |
| 4   | Move the cursor to "Weld cond".                                                        | <p>Screen 1</p> <p>Init. set : Sys. set</p> <p>—*OPR select*— 1/1 —</p> <p>1 RBT constant</p> <p>2 Weld cond</p> <p>3 Welder model</p> <p>4 Memory clear</p>                                                                                                      |
| 5   | Press the ENTER key.                                                                   |                                                                                                                                                                                                                                                                   |
| 6   | Since the cursor has shifted to "Weld table", press the ENTER key.                     | <p>Screen 2</p> <p>NOTE ①</p> <p>Init. set : Sys. set</p> <p>—*OPR select*— 1/1 —</p> <p>1 Weld table              4 Weaving table</p> <p>2 Inching                  5 Gas/Wire</p> <p>3 Override</p>                                                             |
| 7   | Move the cursor to "AJO" (welding start conditions) or "CJO" (welding end conditions). |                                                                                                                                                                                                                                                                   |
| 8   | Press the ENTER key.                                                                   | <p>Screen 3</p> <p>—*OPR select*— 1/1 —</p> <p>1 AJO                      2 CJO</p>                                                                                                                                                                               |
|     |                                                                                        | Screen 4                                                                                                                                                                                                                                                          |



| No. | Operational method                                                                     | Screen display                                                                                                                                                                                             |
|-----|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9   | Change the blink cursor position by using the cursor key and enter the numeric values. | <div> Init. set : Sys. set : Weld cond.<br/> AJO 1/1<br/> No. 1 = 120 (A) 19.0 (V)<br/> 2 = 160 (A) 21.5 (V)<br/> 3 = 200 (A) 24.0 (V)<br/> 4 = 260 (A) 27.0 (V)<br/> 5 = 320 (A) 33.0 (V)<br/> STD </div> |
| 10  | Press the ENTER key.                                                                   |                                                                                                                                                                                                            |
| 11  | After the setting is completed, Press the END key.                                     |                                                                                                                                                                                                            |
| 12  | Press the END key.                                                                     |                                                                                                                                                                                                            |
| 13  | Press the MODE SEL key.                                                                |                                                                                                                                                                                                            |
|     |                                                                                        | Screen 4 will be brought back.                                                                                                                                                                             |
|     |                                                                                        | Screen 3 will be brought back.                                                                                                                                                                             |
|     |                                                                                        | Screen 2 will be brought back.                                                                                                                                                                             |
|     |                                                                                        | Initial screen (mode selection) will be brought back.                                                                                                                                                      |

**\*Note 6\***

Setting the welding conditions

- \* The welding end conditions are normally approx. 2/3 of the welding start conditions.
- \* When the welding start conditions are renewed, the welding end conditions should also be renewed. (80A at the minimum)
- \* Press the ENTER key after entering all necessary items of No. 1 ~ No. 5.  
(When END key is pressed without pressing the ENTER key, the previous value becomes effective.)
- \* The data entered are erased by the memory clear key. However, when the "4.9 External memory" procedure is carried out, the data is stored on the floppy disk.

**\*Note 7\***

A rough welding conditions for the operators with no knowledge of welding

- \* Current Plate thickness x 2/5 x 100A = Current

\* Voltage

When CO<sub>2</sub> gas is used: 20V (100A), 21V (120A), 22V (140A),  
(Set the voltage lower than above by 3 volts) 23V (160A), 24V (180A)

\* Speed

0.5 m/min

Standard distance between the chip and mother material

|                          |       |
|--------------------------|-------|
| Wire 1.2ø 200A or more   | 20 mm |
| Wire 1.2ø less than 200A | 15 mm |
| Wire 0.9 ø               | 10 mm |

Note ① The display shown below appears on the screen ② in the main software of version "J3" or lower version.

|                      |              |
|----------------------|--------------|
| Init. set : Sys. set |              |
| *OPR select* —1/1—   |              |
| RBT constant         | Welder model |
| Weld cond            | Memory clear |

## 2.4 Cancellation of safety holder

- "Safety holder" is a torch holder which has a built-in shock sensor. When a torch hits against a work etc. by mistake during the teaching, or by work set mistakes etc. during the operation, the robot is stopped by the emergency stop SW so that the damage of the robot is restricted to the minimum.
- When this safety holder operates (that is, when a robot hits against a work), please cancel the safety holder according to the following procedures.

- (1) When the safety holder operates during the operation or teaching (while the LED of the TEACH ENABLE key is lit.)

| No. | Operational method                                          | Screen display                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----|-------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Press the SERVO ON key.<br><br>The servo power is supplied. | <div style="border: 1px solid black; padding: 10px; margin-bottom: 10px;"> <div style="border: 1px solid black; padding: 2px; text-align: center; margin-bottom: 10px;">Safety-holder working</div> <div style="display: flex; justify-content: space-between;"> <div>2 MOVE</div> <div>2.50</div> </div> <div style="display: flex; justify-content: space-between;"> <div>3 MOVE</div> <div>2.50</div> </div> <div style="display: flex; justify-content: space-between; align-items: center;"> <div><input type="checkbox"/> Speed=2.50 (M/m) - [M•L]</div> <div><input type="checkbox"/></div> </div> <div style="display: flex; justify-content: space-between; align-items: center;"> <div><input type="checkbox"/> Add</div> <div>Linear Cartrn</div> <div><input type="checkbox"/></div> </div> </div> <div style="border: 1px solid black; padding: 10px; margin-bottom: 10px;"> <div style="border: 1px solid black; padding: 2px; text-align: center; margin-bottom: 10px;">Safety-holder working</div> <div style="display: flex; justify-content: space-between;"> <div>2 MOVE</div> <div>2.50</div> </div> <div style="display: flex; justify-content: space-between;"> <div>3 MOVE</div> <div>2.50</div> </div> <div style="display: flex; justify-content: space-between; align-items: center;"> <div><input type="checkbox"/> Speed=2.50 (M/m) - [M•L]</div> <div><input type="checkbox"/></div> </div> <div style="display: flex; justify-content: space-between; align-items: center;"> <div><input type="checkbox"/> Add</div> <div>Linear Cartrn</div> <div><input type="checkbox"/></div> </div> </div> <div style="border: 1px solid black; padding: 10px;"> <div style="border-bottom: 1px solid black; padding-bottom: 5px; margin-bottom: 10px;">Teaching P S V</div> <div style="display: flex; justify-content: space-between;"> <div>1 MOVE*</div> <div>2.50</div> </div> <div style="display: flex; justify-content: space-between;"> <div>2 MOVE</div> <div>2.50</div> </div> <div style="display: flex; justify-content: space-between;"> <div>3 MOVE</div> <div>2.50</div> </div> <div style="display: flex; justify-content: space-between;"> <div>4 MOVE</div> <div>2.50</div> </div> <div style="display: flex; justify-content: space-between; align-items: center;"> <div><input type="checkbox"/> Speed=2.50 (M/m) - [M•L]</div> <div><input type="checkbox"/></div> </div> <div style="display: flex; justify-content: space-between; align-items: center;"> <div><input type="checkbox"/> Add</div> <div>Linear Cartrn</div> <div><input type="checkbox"/></div> </div> </div> |

- (2) When the safety holder operates during the operation or teaching (while the LED of the TEACH ENABLE key is turned off.)

| No. | Operational method                                                                                                                                                                       | Screen display                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Press the SERVO ON switch on the panel. And the servo power is supplied.                                                                                                                 | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <div style="border: 1px solid black; padding: 2px; text-align: center;">Safety-holder working</div> <div style="margin-top: 10px;"> 2 MOVE      2.50<br/> 3 MOVE      2.50 </div> <div style="margin-top: 10px;"> <input type="checkbox"/> Speed=2.50 (M/m) - [M•L]    <input type="checkbox"/><br/> <input type="checkbox"/> Add      Linear    Cartrn    <input type="checkbox"/> </div> </div>                                                                    |
| 2   | Press the TEACH ENABLE key.<br>(The LED of the TEACH ENABLE key is lit.)                                                                                                                 | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <div style="border: 1px solid black; padding: 2px; text-align: center;">Safety-holder working</div> <div style="margin-top: 10px;"> 2 MOVE      2.50<br/> 3 MOVE      2.50 </div> <div style="margin-top: 10px;"> <input type="checkbox"/> Speed=2.50 (M/m) - [M•L]    <input type="checkbox"/><br/> <input type="checkbox"/> Add      Linear    Cartrn    <input type="checkbox"/> </div> </div>                                                                    |
| 3   | Move the robot to cancel the interference of the torch.<br>(Note) Pay a full attention to the operation of the robot because the sensor of the safety holder does not work at this time. | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <div style="border: 1px solid black; padding: 2px; text-align: center;">Safety-holder working</div> <div style="margin-top: 10px;"> 2 MOVE      2.50<br/> 3 MOVE      2.50 </div> <div style="margin-top: 10px;"> <input type="checkbox"/> Speed=2.50 (M/m) - [M•L]    <input type="checkbox"/><br/> <input type="checkbox"/> Add      Linear    Cartrn    <input type="checkbox"/> </div> </div>                                                                    |
| 4   | The screen shown in the right appears when the safety holder is canceled.                                                                                                                | <div style="border: 1px solid black; padding: 5px;"> <div style="border: 1px solid black; padding: 2px; text-align: center;">Teaching   P   S   V</div> <div style="margin-top: 10px; text-align: center;"> TOOL   1 </div> <div style="margin-top: 5px;"> 1 MOVE      2.50<br/> 2 MOVE      2.50<br/> 3 MOVE      2.50 </div> <div style="margin-top: 10px;"> <input type="checkbox"/> Speed=2.50 (M/m) - [M•L]    <input type="checkbox"/><br/> <input type="checkbox"/> Add      Linear    Cartrn    <input type="checkbox"/> </div> </div> |

## Warning (message) when the servo is turned on

[ In case that a safety holder which is not equipped with a reset switch is used]

Due to interference of tools, such as welding torch, and the work, the servo is cut off when the safety holder is actuated.

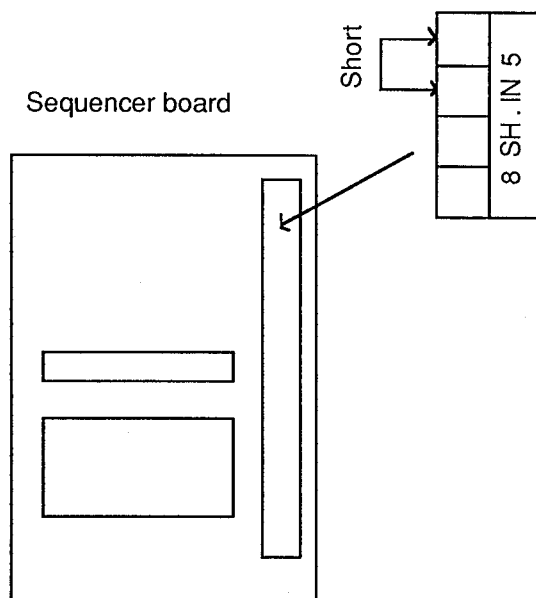
In this case, press the servo ON switch to turn on the servo power.

If the servo power is not turned on by pressing the servo ON switch, and the message

Short the mode input + and - of the safety holder

appears on the display of the teach pendant, proceed the following recovery procedures.

- ① Check the indicated mode input terminals of the safety holder on the sequence board for short-circuit. The sequence board is located on the right as you face it inside of the robot controller.
- ② If the message appears even if these terminals are shorted correctly, contact the shop you purchased the robot or our Pana-Robo service center.



[In case that a safety holder equipped with a reset switch is used]

Normally the above message does not appear. If the message appears, then the robot setting is not correct.

Contact the shop you purchased the robot or our Pana-Robo service center.

## CHAPTER 3

### APPLICATION (INTERMEDIATE COURSE)

- \* Teaching the circular interpolation and the modification
- \* Teaching the weaving and the modification
- \* Confirmation operation during operation (Teaching correction by tracing)
- \* Creation of high degree program using the sequence instructions
- \* Editing the jobs having been registered and the data of the program (copying, deleting)

----- Lets use the robot freely -----

### 3.1 Teaching (Circular interpolation)



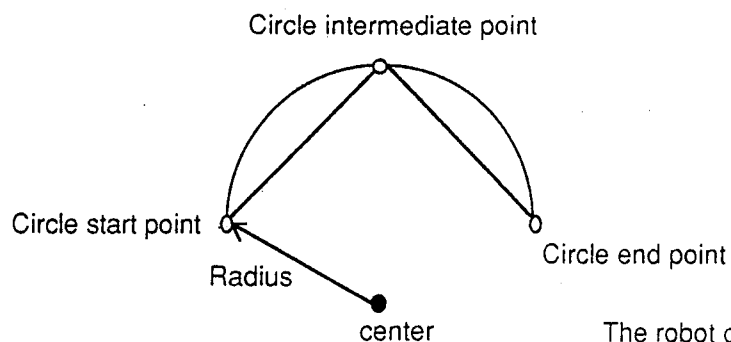
*The robot moves immediately when the MOVE key of the teach pendant is pressed.*

*Before operating the robot, make sure that no persons are in the work envelope.*

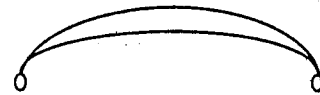
This section covers the explanation about the teaching (circular interpolation) procedure which is different from the teaching of linear interpolation explained in 2.1.2 "Teaching (linear interpolation)" in chapter 2.

The "circular interpolation" refers to the operation to draw a circle by teaching 3 points.

- 1 A circle is determined by 3 points.



A circle cannot be determined by 2 points.



The robot calculates the circumcenter by these 3 points.  
\* This calculation is the one Junior High School second grade students normally learns at school.

- 2 By teaching the robot steric movement, a 3-dimensional movement can be achieved.  
The movement of a robot is not limited to 2-dimensions.

#### 3.1.1 Circle registration method

| No. | Operation                                                                                   | Screen display                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Move the robot to the circular interpolation start teaching point.                          | <div style="border: 1px solid black; padding: 5px;"> Teaching P:20 S: 5 V: 20<br/><br/> <div style="display: flex; justify-content: space-between;"> <span>4</span> <span>MOVEL</span> </div> <div style="display: flex; justify-content: space-between;"> <span>X= 1026.01(MM)</span> <span>U= 95.00(°)</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Y= 232.22(MM)</span> <span>V= 15.12(°)</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Z= 2031.55(MM)</span> <span>W=121.22(°)</span> </div> <div style="border: 1px solid black; padding: 2px; margin-top: 5px;"> Speed=2.00(M/m)----[M.L]<br/> Add___Circular___Crts___ </div> </div> |
| 2   | Press the arrow key once and move the cursor to MOVEMENT display (Linear, PTP, etc.).       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 3   | Hold down the TEACH SEL 7 key until "Circular" appears on the display.                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 4   | Press the WELD STORE key.                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 5   | Move the robot to the next teaching point. (The second point of the circular interpolation) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 6   | Press the WELD STORE key.                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 7   | Move the robot to the next teaching point (The third point of the circular interpolation)   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

Screen 13-2

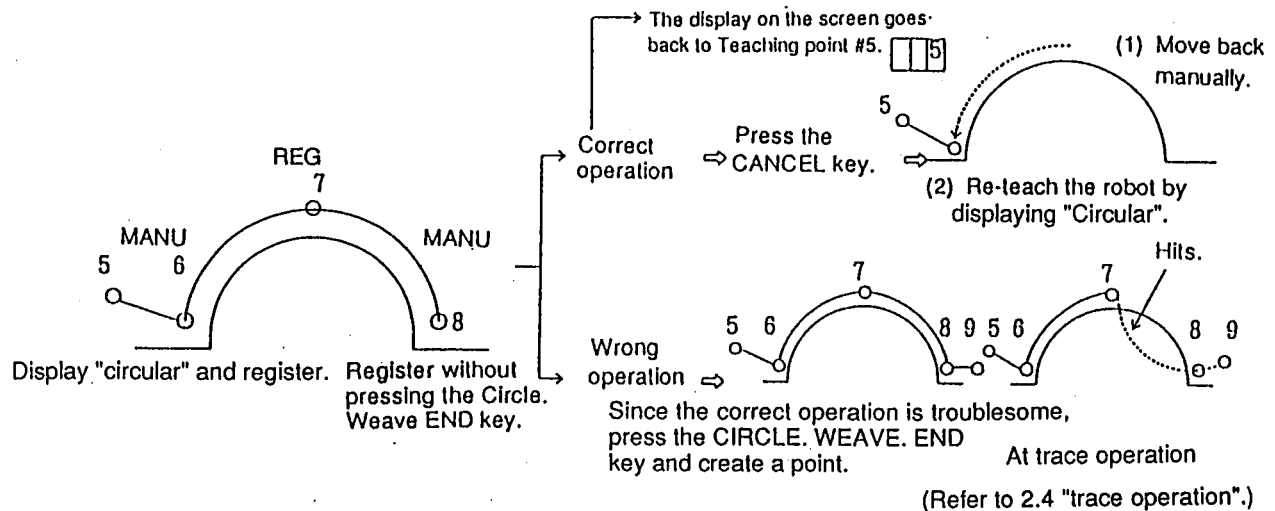
| No. | Operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Screen display                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8   | <p>* When continuous multiple points are taught as circle:<br/>Press the WELD STORE (or STORE) key and teach the movement route point by point.</p> <p>* End teaching point of the circular interpolation:<br/>(1) Press the CIRCLE. WEAVE. END key.</p> <p>(2) When the welding is completed at the current teaching point, press the STORE key, while press the WELD STORE key if the welding continues after the current teaching point.</p> <p>Note) Display on the screen may go off for 1 sec or longer after registration during calculation time of the computer.</p> | <p>The teaching point is registered as "MOVEC CO".</p> <div> <div>Teaching P:20 S: 7 V: 20</div> <div> <div>7</div> <div>MOVEC</div> <div> X= 2015.22(MM)      U= 38.00(°)<br/> Y= 151.20(MM)      V= -150.01(°)<br/> Z= 1521.11(MM)      W= 28.50(°) </div> <div>Speed=2.00(M/m)----[M.L]</div> <div> Add    <u>Linear</u>    Crts </div> </div> </div> <p>Automatically changes from "Circular" to "Linear".</p> |



### 3.1.2 Cautions in circular teaching

- 1 When "registered" without pressing the CIRCLE. WEAVE. END key at the end point of the circle:

Press the CANCEL key and the message "Store from the beginning?" will appear. Move the cursor to "YES" and press the ENTER key. Now you can start teaching from the circular start point again.



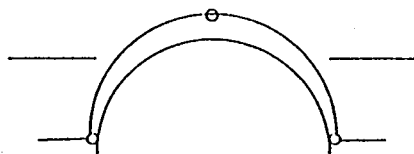
Since the CIRCLE. WEAVE. END key was not pressed, the movement has not been calculated yet. Therefore, you can re-teach the robot by pressing the CANCEL key. As for the linear interpolation, the data entered is not erased even when the CANCEL key is pressed.

- 2 When "registered" by pressing the CIRCLE. WEAVE. END key, the operation described in 1 above cannot be performed even if the CANCEL key is pressed.  
(Calculation of the circle has already been completed.)
- 3 When the CANCEL key is pressed while the movement of the circle is being created, the points on the circle are erased.  
If you "registered" with the circle displayed by mistake, press the CANCEL key. Then you can re-teach the robot linear movement.
- 4 Once you start circular teaching, do not change the display from "Circular" to "Linear".  
When "registration" is completed by pressing the "CIRCLE. WEAVE. END" key, the display automatically changes to "Linear". If "registration" is attempted after changing the display to "Linear", an error will return.  
"Circular" must be displayed during this process>
- 5 Make sure that "Add (addition)" is displayed.
- 6 During a circle is being drawn, forward/backward tracing can be carried out only inside the circle.  
However, the movement is limited to the linear one.  
(The movement is not calculated.)  
TRACE key is pressed .----- Error occurrence. ----- Press the CANCEL key. --  
Continue the teaching.
- 7 Whether the WELD STORE key is pressed or the STORE key is pressed after the CIRCLE. WEAVE. END key is determined by whether or not the welding is carried out from the point.

**\*Note 8\***

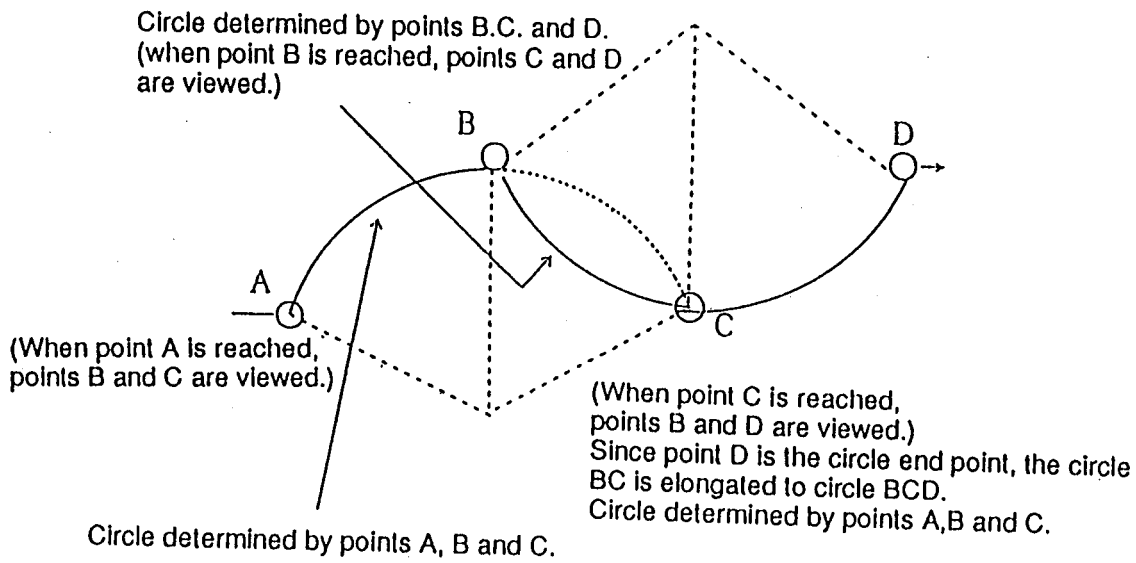
Do not press the CIRCLE. WEAVE. END key and the WELD STORE. STORE key simultaneously.

If they are pressed simultaneously, the teaching point immediately before the keys are pressed is changed to and registered as the circle end point and the current position cannot be taught.

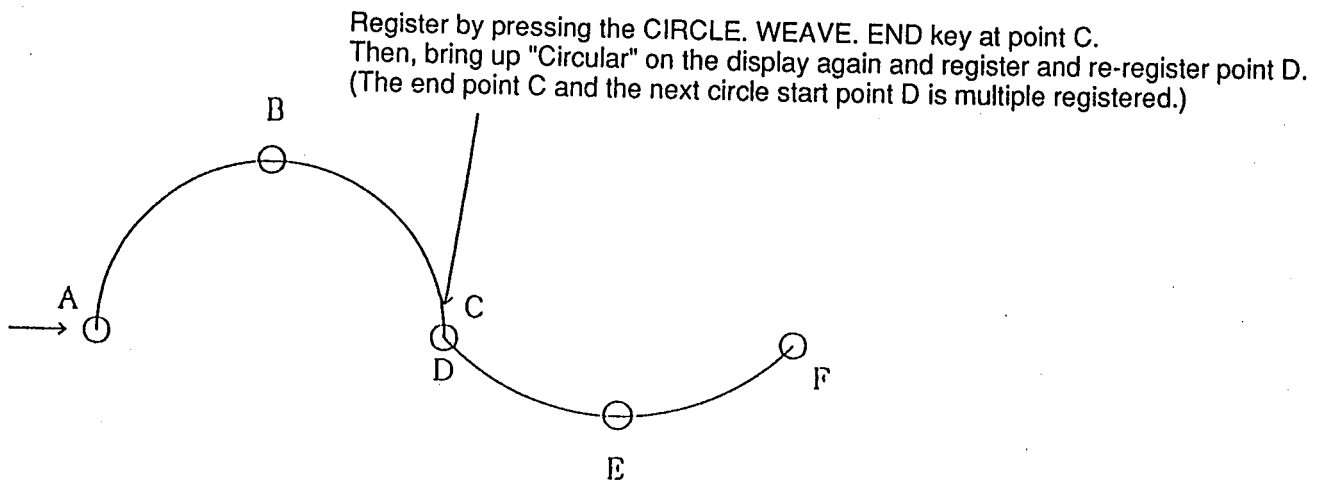


"WELD STORE" key to  
continue the welding  
process  
"STORE" key for transfer  
movement.

- Method to determine the continuous circle of 4 points or more



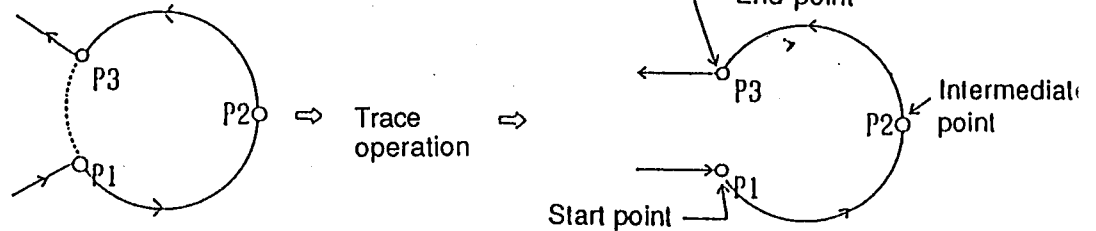
Continuous circle when duplicatedly registered:



- For a circular welding, the teaching points should be 4 or more.

(More than 6 points is recommended from the view point of deformation of the workpieces and precision.)

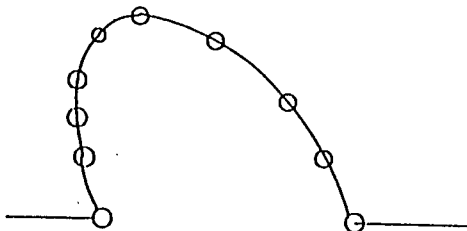
When 3 points (P1~P3) are taught in the direction shown by the arrows:



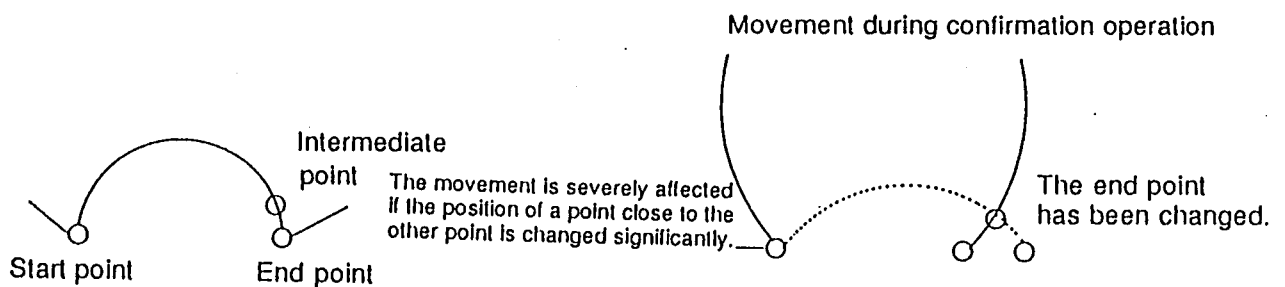
Only the points are stored in the robot. The movement performed via the manual keys are not stored.

- When a workpiece whose bending changes:

There should be many teaching points along the sharp curve. The number of teaching points can be less for a dull curve.



When beginners performs the teaching, the interval between the teaching points should be 1cm or more.

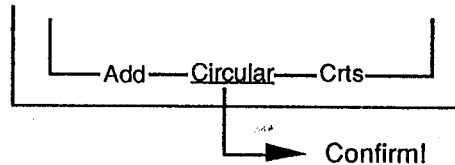


### 3.1.3 Change and deletion of circle

The circle which has been registered in the circular interpolation step can be changed or deleted during the trace operation.

#### 1) Addition or modification of a circle

- \* The addition or modification of a circle can be performed in the same manner as that for "Linear interpolation". However, confirm that the screen as shown below appears before starting the procedure for addition or modification.



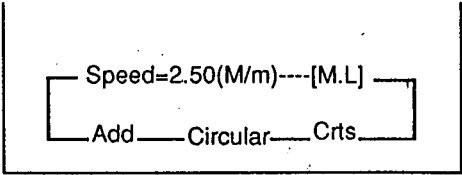
- \* When a circle is added at the circle end point, more than 3 teaching points should be created since the circular interpolation has been completed.

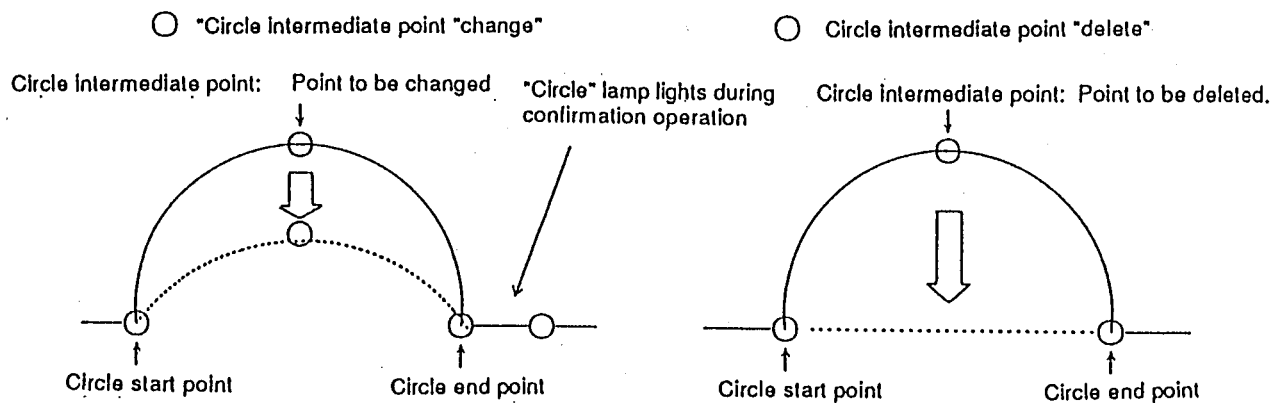
You can change the position of the circle end point and add the intermediate points.)

#### 2) Deletion of circle

- \* "Deletion of a circle" means that the intermediate points of the circle are all erased.
- \* The circle start point and end points cannot be erased until all the intermediate points have been erased.
- \* When an intermediate point is erased from a circle consisting of more than 4 points, the circle is changed to the one created by the remaining 3 points.

|   | Operation                                                                                                              | Screen display                                                                                                                                                                                                                                                                 |
|---|------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Press the ROBOT OPR key and the TRACE key simultaneously , and move the robot to the intermediate point of the circle. | <div>Teaching P:20 S: 5 V: 20</div> <div>5                      MOVEL</div> <div>X= 102.73(MM)      U= 20.00(°)</div> <div>Y= 2011.05(MM)    V= -50.25(°)</div> <div>Z= 356.23(MM)     W= 130.30(°)</div> <div>Speed=2.00(M/m)----[M.L.]</div> <div>Change—Circular—Crts</div> |
| 2 | Move the cursor to MODIFICATION SELECTION DISPLAY.                                                                     |                                                                                                                                                                                                                                                                                |
| 3 | Hold down the TEACH SEL key until "Delete" is displayed.                                                               | <div>MODIFICATION SELECTION DISPLAY</div>                                                                                                                                                                                                                                      |

|   | Operation                                                                                                                      | Screen display                                                                                                                                                                                                                                        |
|---|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4 | Press the STORE or WELD STORE key.                                                                                             |  <p>When all the intermediate points are erased, MOVEC CS is automatically changes to MOVEL. (A line is created by the start point and end point of the circle.</p> |
| 5 | When the circle consists of more than 4 points, repeat the procedures No.1~No.5 until all the intermediate points are deleted. |                                                                                                                                                                                                                                                       |



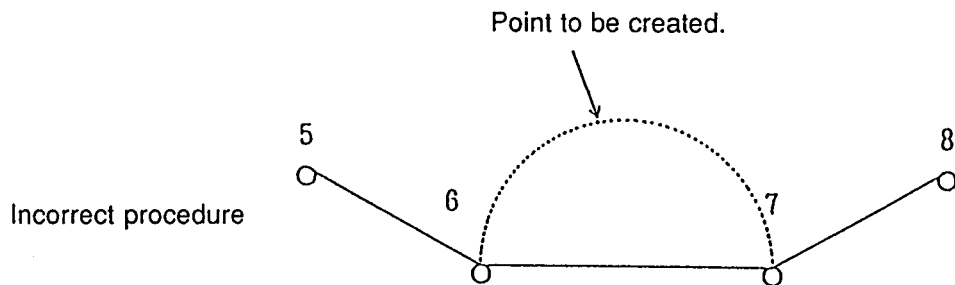
\* "Change" of the intermediate point of the circle

Note) When a teaching point is added between the circle end point and the next point on the straight line, set the movement to "Linear" and modification selection to "Add" first and then press the END key.

Note) When a step on a circle is deleted via the teach pendent, error may occur and the step cannot be deleted. This error is caused by the fact that the situation of the wrist is significantly changed by the deletion of the teaching point. If an error occurs, delete the step in the adding mode.

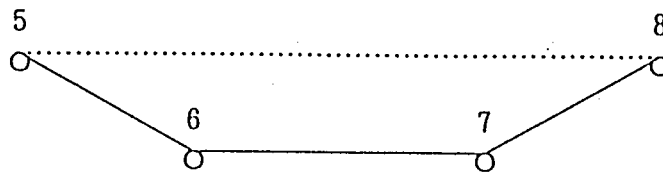
\* Cautions during the trace operation of the circle

1 The teaching points on a straight line cannot be the points on a circle.



Change the display to "Circular". -- "Change" is displayed. -- "STORE" -- Error occurs.

\* The reason why the start point and end point of the circle become the points on the straight line is because all the intermediate points are erased. The characteristics of the points cannot be changed via the teach pendant.



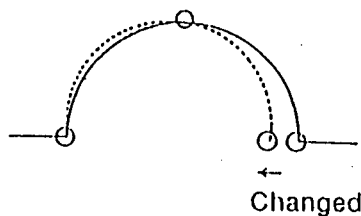
Correct procedure

- (1) "Delete" points 6 and 7. (The movement becomes as shown by the dotted line.)
- (2) Move backward straightly to 5, change the display to "add" and carry out the teaching procedure for a new circle.

2 Error caused by the change of the teaching point

Movement of other parts of the circle is affected when a teaching point is changed.

Movement here is affected. (The movement is re-calculated.)



#### 3.1.4 Selection of locus calculation methods

3 calculation methods, CL-1, CL-2 and CL-3, are incorporated beside the normal calculation method (CL) to the AW-005A, AW-006A, AW-010A and VR-008A. Use the appropriate method according to the use.

Both CL1 and CL2 are applied to calculation of circular interpolation. They are used when teaching for a circle or circular weaving.

For instance, the CL1 and CL2 are used when the teaching is difficult since the robot's posture significantly changes during the circular teaching such as a saddle-shaped workpieces.

##### 3.1.4.1 CL=1

- \* This calculation method is suitable when the torch vector to the axis which is vertical to the circular plane is  $10^\circ$  or less.

##### 3.1.4.2 CL=2

- \* This calculation method is suitable when the torch vector to the axis which is vertical to the circular plane is over  $10^\circ$



**\*Note 9\***

**Selection of calculation method**

**\* In teaching mode:**

(1) Press the MENU key once.

| *Menu Select* |   |                   |
|---------------|---|-------------------|
| AJO           | = | 1                 |
| CJO           | = | 1                 |
| Weaving       | = | 2                 |
| User C-sys    | = | 0                 |
| Wrist cal     | = | 0                 |
| [OPR SEL]     | = | Change menu cnts. |

See Note ①.

(2) The screen above appears.

(3) Move the cursor to the wrist calculation No. enter the calculation No. and press the ENTER key.

(4) Press the END key to quit the menu screen.

(5) The teaching points are registered by the calculation No. having been set in steps (1)~(4) above.

**In editing mode:**

| Edit | Program #15 |       |
|------|-------------|-------|
| Step | Command     |       |
| 1    | MOVEL       | 10.00 |
| 2    | MOVEL       | 7.50  |
| 3    | MOVEC       | 7.50  |
| 4    | MOVEC       | 7.50  |
| 5    | MOVEC       | 7.50  |
| 6    | MOVEL       | 10.00 |

Move the cursor to MOVE command in the screen above and press the ENTER key.

| * Select command*   |  |
|---------------------|--|
| MOVEC (Air-C Weld)  |  |
| V=7.50(M/m, %) CL=0 |  |

Enter the calculation No. to right of "CL" in the screen above and press the ENTER key.

(Note ①) The default values of the weaving pattern at the teaching are as follows;

"2" ——— Main software of version "J3" or lower version

"1" ——— Main software of version "KO" or higher version

#### 3.1.4.3 CL=3

- During teaching for linear interpolation or circular interpolation, the BW and RW axes become parallel and the two axes are looked like one line when viewed from the side (peculiar posture), an error may return if normal calculation method (CL=1) is used.

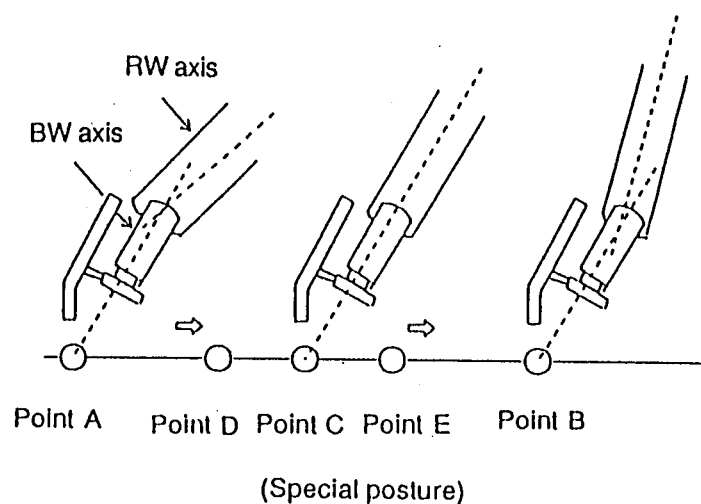
This error can be eliminated by creating two teaching points, one immediately before the error point and the other immediately after the peculiar posture, and registering by changing the calculation method to CL=3 according to the procedure below:

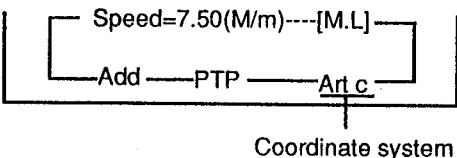
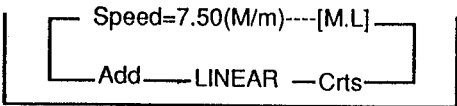
##### (Example of use of CL=3)

In this example, teaching is carried out by using the linear interpolation between point A and B in the figure below.

At point A, BW axis and RW axis are positioned at different angles. However, at point C, these two axes become parallel (peculiar posture). Therefore, an error occurs at a position immediately before point C.

Move the robot backward towards point A, change the calculation method from CL=0 to CL=3, and teach point D. Then, pass point C by using the indirect coordinate system of the PTP and move to point E. Then return to the vertical coordinate system of the linear interpolation, and change CL=3 back to CL=0 and teach point E.



|   | Operation                                                                                                                                        | Screen display                                                                                               |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| 1 | When an error occurs, move the robot backward.                                                                                                   |                                                                                                              |
| 2 | Press the MENU key and set the wrist calculation No. (CL) to 3.<br><br>Release the key when CL=3 is displayed.                                   |                                                                                                              |
| 4 | Change the modification selection display to "Add".                                                                                              |                                                                                                              |
| 4 | Store the point.                                                                                                                                 |                                                                                                              |
| 5 | Change the movement from "linear" to "PTP" and the coordinate system from "Crts" to "Artc".                                                      |  <p>Coordinate system</p> |
| 6 | Move the robot by using the PTP operation of individual axes so that the unique position is passed.                                              |                                                                                                              |
| 7 | Change the movement from "PTP" back to "Linear" and the coordinate system from "Artc" to "Crts", and change the modification selection to "Add". |                          |
| 8 | Change the calculation method back to the original one in the same manner as in No.2.<br>(CL=3 -- CL=0)<br>Store the point.                      |                                                                                                              |

Note 1) When the robot is moved backward from the point of No.8 above to the previous point by backward tracing, do not change the calculation method in step No.7 above and register the point of No.7 above by CL=3.  
When the calculation method is changed back to CL=0 and backward tracing is carried out, error will also occur at a point before the unique position.

Note 2) This operation is aimed at passing the point of unique position without any error occurrence. Therefore, the torch posture between the two points for which CL=3 is applied is not fixed. If this calculation method is applied during the welding process, the distance between the two points should be minimized.

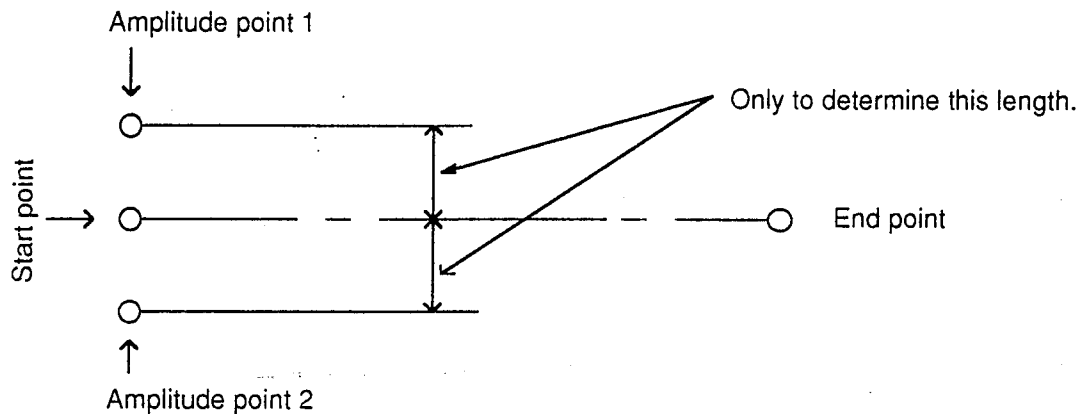
### 3.2 Teaching (weaving)



*The robot moves immediately when the MOVE key of the teach pendant is pressed.*

*Before operating the robot, make sure that no persons are in the work envelope.*

- \* Select a weaving pattern (1~6) and teach the start point, amplitude points (normally 2 points, 4 points for patterns 4 and 5) and the end point.
- \* The frequency cannot be selected at teaching. The auxiliary points are used only to teach the distance of movement with the line connecting the start point and end point at the center.



#### 3.2.1 Weaving registration method

| No. | Operation                                                                                                  | Screen display                                                                                                                                                                                                                                                      |
|-----|------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | Move the robot to the weaving start teaching point.                                                        | <div>Speed=2.00(M/m)----[M.L]</div> <div>Add----Weaving----Crts</div>                                                                                                                                                                                               |
| 1   | Move the cursor to movement display (PTP, Linear, etc.), press the TEACH SEL. "Weaving" will be displayed. | <div>Trace      P:      S:      V:</div> <div>*Menu select*</div> <div>AJO            = 1</div> <div>CJO            = 1</div> <div>Weaving        = 2</div> <div>User C-sys    = 0</div> <div>Wrist cal.     = 0</div> <div>[ OPR. SEL ]   = Change menu crts</div> |
| 2   | Press the MENU key.                                                                                        | Note ①                                                                                                                                                                                                                                                              |
| 3   | Move the cursor to the side of "Weaving", enter the table No. and press the ENTER, END key.                | <div>Teaching   P15   S:8   V: 7.50</div> <div>8                                  MOVLW</div> <div>X=1105.05(MM)      U= 30.25(°)</div> <div>Y= 820.11(MM)      V= 50.10(°)</div> <div>Z= 820.11(MM)      W= 95.30(°)</div>                                         |
| 4   | Press the STORE key or WELD STORE key.                                                                     | <div>Speed=7.50(M/m) (M.L)</div> <div>Add----Weaving----Crts</div>                                                                                                                                                                                                  |

| No. | Operation                                                                                   | Screen display                                                                                                                                                           |
|-----|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5   | Move the robot to weaving amplitude point 1.                                                | Teaching P15 S:8 V:7.50<br>8 MOVLW<br>X=1105.05(MM) U= 30.25(°)<br>Y= 820.11(MM) V= 50.10(°)<br>Z= 820.11(MM) W= 95.30(°)<br>Speed=7.50(M/m) (M.L)<br>Add Weaving Crts   |
| 6   | Press the STORE or WELD STORE key , the same one as that pressed in step No.4.              |                                                                                                                                                                          |
| 7   | Move the robot to weaving amplitude point 2.                                                | Teaching P15 S:9 V:7.50<br>9 MOVLW<br>X=1105.05(MM) U= 30.00(°)<br>Y= 750.01(MM) V= 70.20(°)<br>Z= 820.11(MM) W= 70.50(°)<br>Speed=7.50(M/m) (M.L)<br>Add Weaving Crts   |
| 8   | Press the STORE or WELD STORE key , the same one as that pressed in step No.4.              |                                                                                                                                                                          |
| 9   | Go to No.14 when the weaving pattern selected in step No.3 is 1, 2, 3 or 6.                 |                                                                                                                                                                          |
| 10  | Move the robot to weaving amplitude point 3.<br>(When weaving patterns selected is 4 or 5.) | Teaching P15 S:10 V:7.50<br>10 MOVEW<br>X=1085.22(MM) U= 40.00(°)<br>Y= 750.33(MM) V= 65.11(°)<br>Z= 800.11(MM) W= 70.20(°)<br>Speed=7.50(M/m) (M.L)<br>Add Weaving Crts |
| 11  | Press the STORE or WELD STORE key , the same one as that pressed in step No.4.              |                                                                                                                                                                          |
| 12  | Move the robot to weaving amplitude point 4.                                                | Teaching P15 S:8 V:7.50<br>11 MOVEW<br>X=1080.20(MM) U= 45.20(°)<br>Y= 750.20(MM) V= 70.11(°)<br>Z= 815.10(MM) W= 63.12(°)<br>Speed=7.50(M/m) (M.L)<br>Add Weaving Crts  |
| 13  | Press the STORE or WELD STORE key , the same one as that pressed in step No.4.              |                                                                                                                                                                          |
| 14  | Move the robot to the point at which the weaving is ended.                                  |                                                                                                                                                                          |

| No. | Operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Screen display                                                                                                                                                                                                                                                                                                                                                    |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15  | <p>(1) To quit the weaving, press the CIRCLE. WEAVING. END key and then press the STORE or WELD STORE key.</p> <p>(2) To continue the weaving, press the STORE or WELD STORE key, the same as that pressed in step. No.4 above.</p> <p>* When the weaving is continued without changing the weaving pattern nor the amplitude:</p> <p>(1) Move the cursor to "YES" and press the ENTER key.<br/>(It is registered as the weaving intermediate point.)</p> <p>(2) Go to step No.14.</p> <p>* When the weaving is continued by changing the weaving pattern and amplitude:</p> <p>(1) Move the cursor to "No." and press the ENTER key.</p> <p>(2) Enter the pattern No. and press the ENTER key.<br/>(It is registered as the weaving start point.)</p> <p>(3) Go to step No.5.</p> | <div>Teaching P15 S:10 V:7.50</div> <div> 12<br/> X= 1030.20(MM) U= 30.10(°)<br/> Y= 730.10(MM) V= 120.10(°)<br/> Z= 820.55(MM) W= 110.22(°) </div> <div> Speed=7.50(M/m) (M.L)<br/> Add——Weaving——Crts—— </div> <div> * OPR Select* 1/1<br/> Continue same weaving?<br/> 1 YES 2 NO </div> <div> Input pattern No.<br/> Pattern No. → 2 </div> <div>Note 1</div> |

Note 1: The default values of the weaving pattern at the teaching are as follows;

"2" \_\_\_\_\_ Main software of version "J3" or lower version

"1" \_\_\_\_\_ Main software of version "KO" or higher version

Note 1) If you press the registration key at the weaving end point without pressing the CIRCLE WEAVE END key, press the CANCEL key after performing weaving procedure No.15-(2). Then the message "Last middle point is set as weaving end." or "Last start point is set as weaving end ?" will appear. Move the cursor to "YES" and press the ENTER key. The point is registered as the weaving end point.

Note 2) The modification of the weaving frequency and timer count should be performed by changing the value at the teaching point in the program editing mode.

Note 3) The amplitude and frequency of the weaving should be within the ranges shown below:

(1) Frequency

Max. 5Hz for patterns 1~5

Max. 10Hz for pattern 6

(2) Amplitude x frequency

Max. 60mm. Hz (patterns 1~5)

(3) Angle (max. axis) x frequency

Max. 125°. Hz (pattern 6)

Note 4) If you press the CANCEL key on the teach pendant during the weaving teaching, a message "Store from the beginning?" will appear. Move the cursor to "YES" and press the ENTER key. The teaching points in the weaving process are erased.

Note 5) Pattern 6 is the weaving only by the wrist axis. Therefore, teach while moving the wrist. (If taught without moving the wrist, weaving is not carried out.)  
If the amplitude point of pattern 6 is taught by the vertical or tool coordinate system, the high speed vibration cannot be performed since the movement is not that of wrist 3 any more.

Note 6) Make sure that the weaving frequency and timer count which have been set meet the conditions below: If the robot is operated under an incorrect condition, calculation error will result.

$$T - (T_0 + T_1 + T_2 + T_3 + T_4) > A$$

T: Time for one cycle of weaving

A: Time determined by weaving pattern

Pattern 1, 2, 5 → A = 0.1

Pattern 3 → A = 0.075

Pattern 4 → A = 0.15

Pattern 6 → A = 0.05

Example 1 Pattern 1, Frequency 2.5Hz (T=0.4sec), stop time at both ends 0.2sec

$$T - (T_1 + T_2) > 0.1 \text{ sec.}$$

$$0.4 - (0.2 + 0.2) = 0 > 0.1 \text{ sec}$$

The conditions are not met and the error occurs.



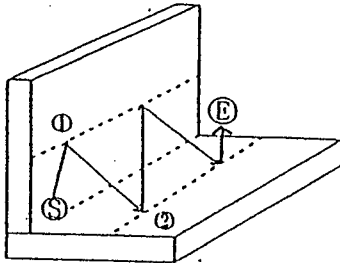
## Weaving pattern

(S) Weaving start point

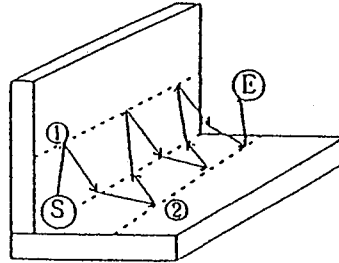
(E) Weaving end point

(1)~(4) Weaving amplitude points

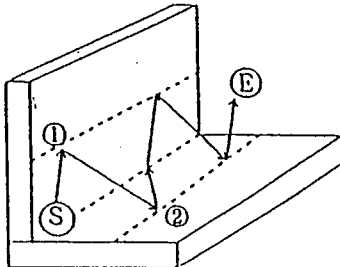
Pattern 1 (Low speed single amplitude)



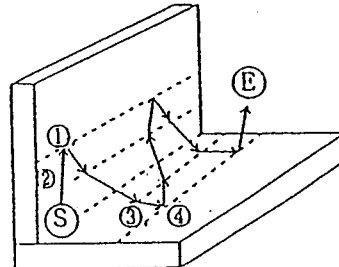
Pattern 2 (L shaped)



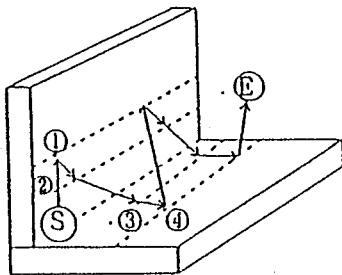
Pattern 3 (triangle)



Pattern 4 (U shaped)

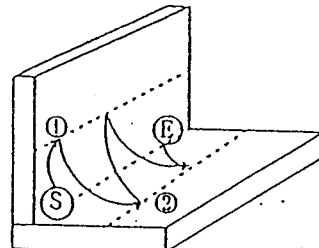


Pattern 5 (trapezoid)



Pattern 6 (high speed single amplitude)

\* After teaching the start point, teach amplitudes 1 and 2 by displaying "Artc" up to teaching coordinate system.  
After teaching 2, teach the end point by displaying "Cartsn".



### 3.2.2 Modification and deletion of weaving

The addition, modification and deletion of weaving are carried out in the trace operation mode.

#### 1) Addition and modification of weaving

- \* The addition and modification of weaving are carried out in the same manner as that for "linear interpolation".
- \* The weaving amplitude point can be retrieved by carrying out the backward tracing from the "weaving end point".
- \* When a "weaving end point" is added, a new weaving is created. Therefore, 4 new teaching points should be registered.

To change the weaving start point, press the STORE (WELD STORE) key while holding down the CANCEL key. The amplitude is changed by the amount of change of the start point.

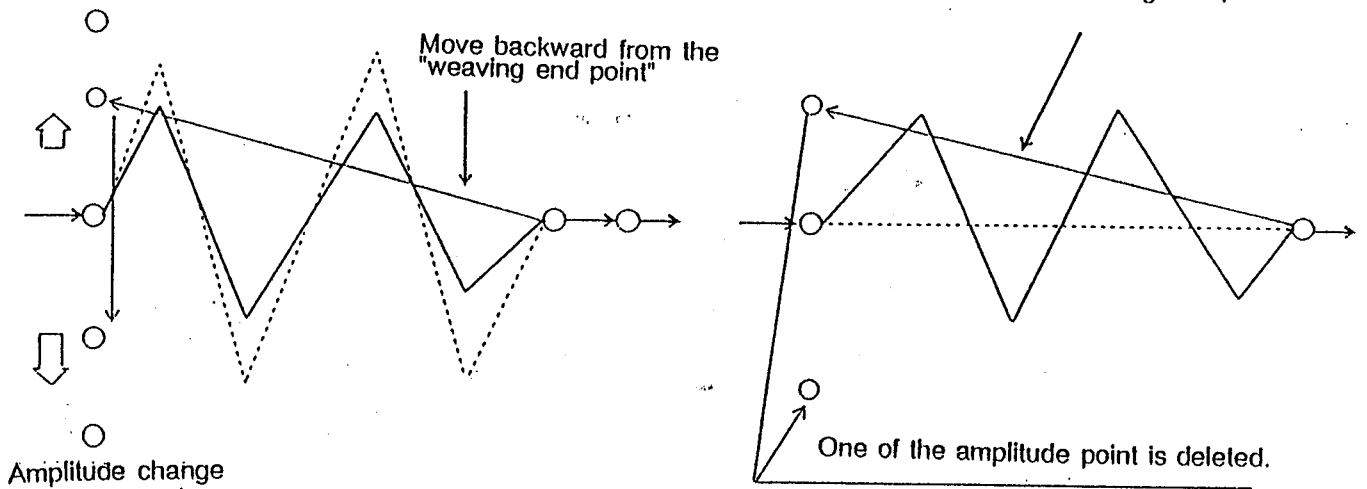
#### 2) Deletion of weaving

- \* Weaving is automatically cancelled and changes to linear interpolation when one of the amplitude points is erased.
- \* Circular weaving is automatically cancelled and changes to circular interpolation when one of the amplitude points is erased.
- \* Weaving start point and weaving end point

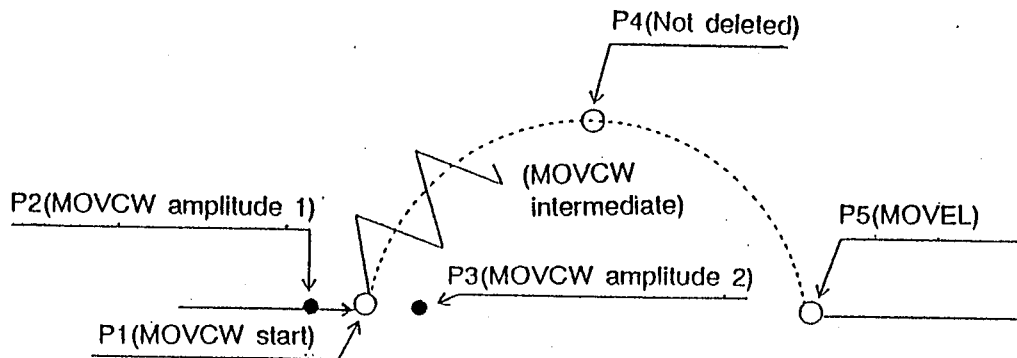
The weaving start point and end point can be erased only after one of the amplitude points is erased. (Refer to No.3 below.)

| No. | Operation                                                                                                                                                                                                                                                                       | Screen display                                                                    |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| 1   | Move the robot backward from the weaving end point to the auxiliary point by the confirmation operation (backward tracing).                                                                                                                                                     |                                                                                   |
| 2   | Operate the "Teaching modification selection display" key of the teach pendant.<br>Amplitude change: Do not change the display.<br>Erasing weaving: Change the menu on the teaching selection menu.<br>Move the robot to the new amplitude point when the amplitude is changed. | Teaching modification display<br>"Change"<br>"Change" ----- "Delete"              |
| 3   | Press the STORE or WELD STORE key.<br>When the weaving is erased, MOVEW START automatically changes to MOVE.<br>(The weaving start and end points becomes the points on the straight line)                                                                                      | Teaching modification display when erasing the weaving:<br>"Delete" ---- "Change" |

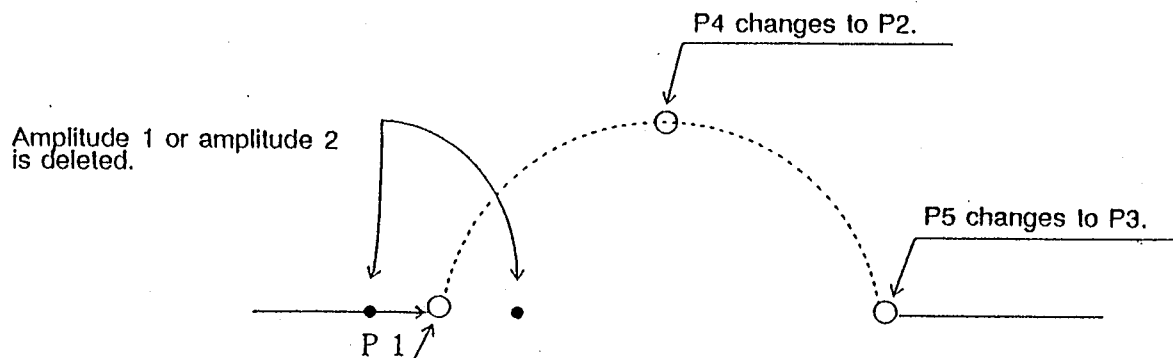
● Linear weaving



● Circular weaving



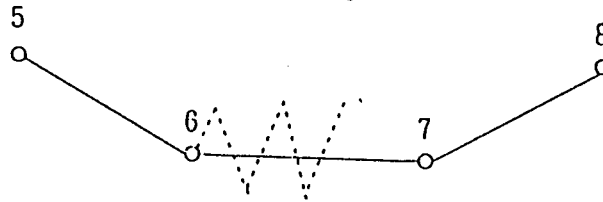
When either amplitude 1 or amplitude 2 is deleted, the circular weaving changes automatically to the circular interpolation.



\* Cautions in weaving trace operation

1. The points on the straight line cannot be the weaving points.

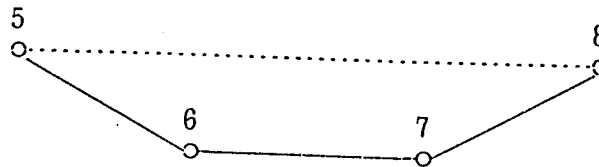
When the amplitude point is deleted and the start/end points are changed to the points on the straight line, they can not be the used for weaving.



Wrong procedure

"Weaving" is displayed. --- ""Change" is displayed. -- Store --- Error

\* The characteristics of the start point and end point have been changed by the deletion of the amplitude point. The characteristics of points cannot be changed by using the teach pendent.

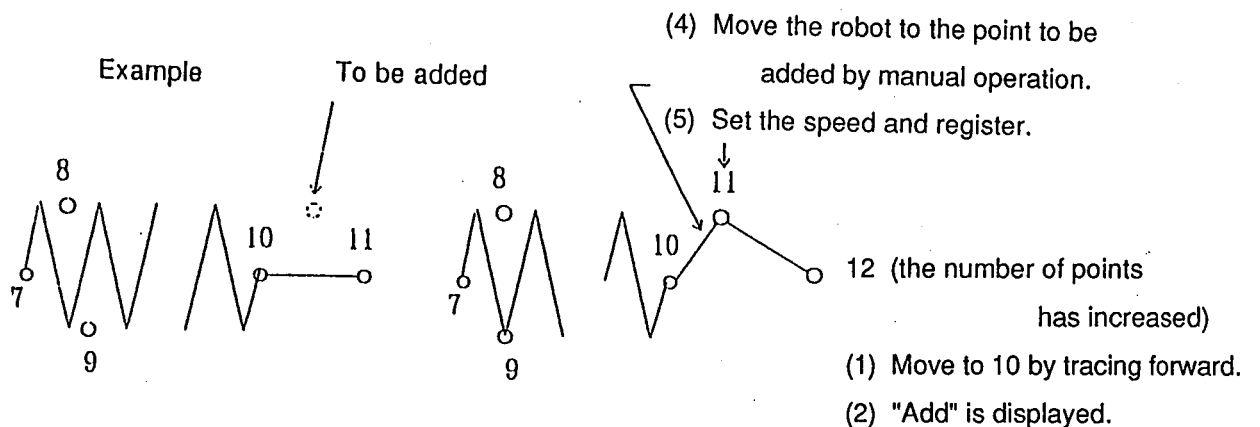


Correct

(1) Delete points 6 and 7. (Movement of dotted line)

(2) Display "Addition" after tracing backward to point 5 and then carry out teaching for new weaving.

2 when an linear point is added next to the weaving end point:



The operations described below became available with the main software of version "K0" or higher versions.

① Addition of intermediate point of weaving

- It became possible to add the intermediate point in the weaving (linear, circular) during the trace operation in the teaching mode and the TEACH ENABLE status in the operation mode.
- Display of message when the intermediate point is added.

- i) In case of registering the intermediate point of the linear weaving → Weaving Add completed. is displayed.

(In case of changing the pattern, this message appears when the registration of all the amplitude points is completed.)

- ii) In case of registering the intermediate point of the circular weaving → Circular weaving added is displayed.  
(No pattern change)

The operations described below became available with the main software of version "L0" or higher versions.

## 1. Summary

The weaving amplitude has been modified by means of the teaching. Using the MDI function, it can be modified by inputting the numerical values directly. The MDI function has improved the efficiency of the teaching operation.

## 2. Object weaving pattern

The numerical value input of the amplitude corresponds to the linear weaving, the circular weaving and also the harmonic movement.

The examples of pattern No. 1 are shown in Fig. 1 for the definition of the amplitude value of linear weaving and in Fig. 2 for the definition of the amplitude value of circular weaving. In case of pattern No. 1, the amplitude is practically  $d3$ , but the amplitude to be changed in this operation is  $d1$  and  $d2$ .

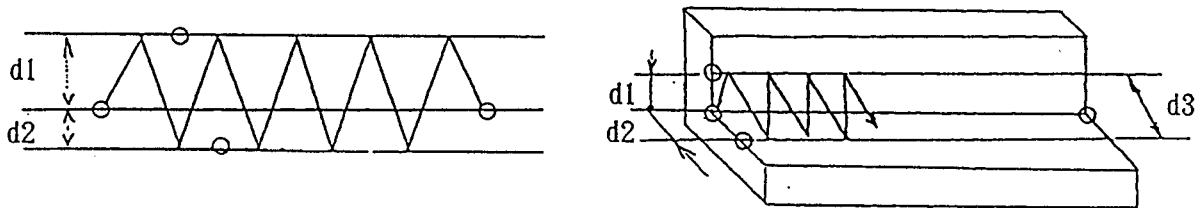


Fig. 1 Amplitude value of linear weaving

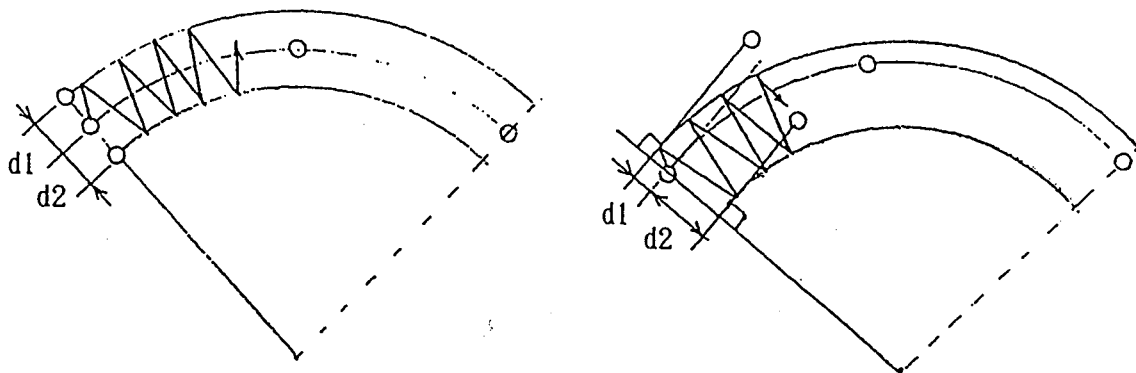


Fig. 2 Amplitude value of circular weaving

### 3. Procedures to change amplitude value (MDI)

The program edit screen where the teaching shown in Fig. 1 is executed is as follows.

```
0    MOVEP 30.00
1    MOVEL 15.00
2    • MOVLW 0.30 AJO : Weaving start point
3    • MOVLW 0.30      : Amplitude 1
4    • MOVLW 0.30      : Amplitude 2
5    MOVEL 15.00 CJO : Weaving end point
6    MOVEL 30.00
```

On the program edit screen above, move the cursor to the move command "• MOVLW" at the amplitude point 1, and press the ENTER key. (And the screen shown in Fig. 3 appears.)

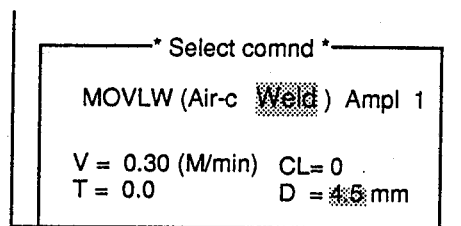


Fig. 3 Amplitude change operation screen

On the screen shown in Fig. 3, the value of "D" indicates the amplitude, "d1" shown in Fig. 1.

Input the value of "D" and press the ENTER key and the weaving amplitude can be changed. The input value is checked by "weaving conditions" when the edit is ended and any excessive values are treated as error. (Error No. 2007)

When the value is input, the coordinate data at the amplitude point (teaching position) is changed. Therefore, when the amplitude is changed by inputting the value of "D", the actual weaving amplitude is changed and also the amplitude point given by the "Trace back" operation is changed. While, if the conditions to calculate the weaving amplitude are not sufficient (for example, the weaving start point exists but the weaving end point does not exist, etc.) or if the weaving pattern No. 6 or No. 16 is selected, "D=?" appears on the screen and the amplitude cannot be calculated. When "??" appears on the screen, the amplitude value cannot be input. (The cursor does not move to the input position.)

### 3.3 Teaching (Circular weaving, PTP)



*The robot moves immediately when the MOVE key of the teach pendant is pressed.*

*Before operating the robot, make sure that no persons are in the work envelope.*

#### \* Circular weaving

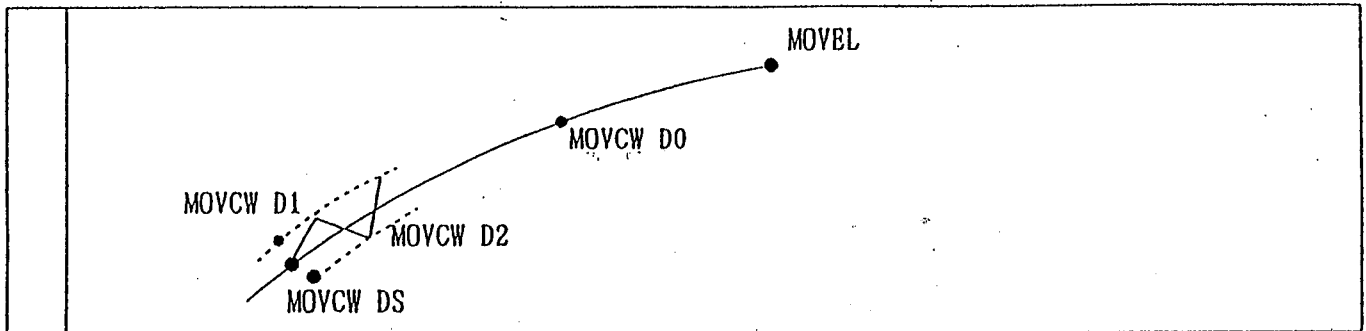
The circular weaving is carried out by teaching 5 points; weaving (circle) start point, 2 amplitude points, circular intermediate point and circular end point.

The weaving patterns which can be taught by the circular weaving is pattern #1 and #2.

Described in this section is the procedure which is different from that for linear weaving:



| No. | Operation                                                                                                                                                                                                                                                                           | Screen display                                                                                                                                                                                                                              |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Change the movement display of the teach pendent to "Circle-Weav".                                                                                                                                                                                                                  | <div>Speed=7.50(M/m) (M.L)</div> <div>Add Circle-Weav Crts</div>                                                                                                                                                                            |
|     | Note) In circular weaving, weaving pattern #2 is available.                                                                                                                                                                                                                         |                                                                                                                                                                                                                                             |
| 2   | When the robot reaches to the circular weaving start point, press the STORE/WELD STORE key.<br>(MOVCD DS) point in the figure below is registered.)<br>Note) The numeric values set in the weaving table in the system setting are automatically entered as the weaving conditions. | <div>Teaching P:15 S:17 V:7.50</div> <div>15 MOVCDWS</div> <div>X=1022.56(MM) U= 80.10(°)</div> <div>Y= 750.35(MM) V= 70.20(°)</div> <div>Z= 825.96(MM) W=150.22(°)</div> <div>Speed=7.50(M/m) (M.L)</div> <div>Add Circle-Weav Crts</div>  |
| 3   | Register 2 amplitude points in the same manner as for the Crts weaving.<br>(Register MOVCD D1 and MOVCD D2. in the figure below.0                                                                                                                                                   | <div>Teaching P:15 S:17 V:7.50</div> <div>17 MOVCDW2</div> <div>X=1105.23(MM) U= 90.20(°)</div> <div>Y= 780.11(MM) V= 85.10(°)</div> <div>Z= 820.30(MM) W=120.10(°)</div> <div>Speed=7.50(M/m) (M.L)</div> <div>Add Circle-Weav Crts</div>  |
| 4   | Move the robot to the circular intermediate point.                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                             |
| 5   | Press the STORE/WELD STORE key.                                                                                                                                                                                                                                                     | <div>Teaching P:15 S:18 V:7.50</div> <div>18 MOVCDWO</div> <div>X=1150.20(MM) U= 90.20(°)</div> <div>Y= 830.56(MM) V= 20.30(°)</div> <div>Z=1050.22(MM) W=130.50(°)</div> <div>Speed=7.50(M/m) (M.L)</div> <div>Add Circle-Weav Crts</div>  |
| 6   | Register the circular intermediate points.                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                             |
| 7   | Move the robot to the circular end point.                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                             |
| 8   | Press the STORE/WELD STORE key after pressing the CIRCLE.WEAVE END key..                                                                                                                                                                                                            | <div>Teaching P:15 S:18 V:7.50</div> <div>20 MOVCL</div> <div>X=1205.34(MM) U= 80.30(°)</div> <div>Y= 920.45(MM) V= 30.15(°)</div> <div>Z= 850.10(MM) W= 85.11(°)</div> <div>Speed=7.50(M/m) (M.L)</div> <div>Change Circle-Weav Crts</div> |



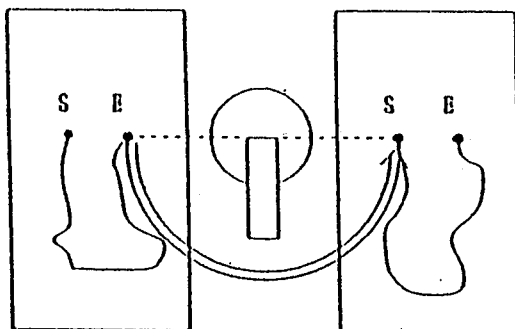
Note) When the CANCEL key of the teach pendant is pressed while the circular weaving is being taught, the points along the circular weaving teaching route are erased.

\* PTP (Point to point)

PTP refers to Point to point movement. The motors of individual axes of the robot move to the next point regardless of the movements of other axes.

As for the 6 axes robot, 3 axes are used for the wrist and this function can be used when a wrist cannot move to the next point by linear interpolation..

For example, when the robot is used as shown in the figure below, the linear movement shown by the dotted line will cause an error.



Movement programmed.

When this movement is taught using PTP function, the robot moves as shown by.

S: Program start point

E: Program end point

\* To move the robot as shown by

Display PTP before pressing the STORE key to register only the first speed of the teaching (refer to cautions for linear teaching 1.).

However, teaching point #1 (before pressing the STORE key) should be changed back to "linear".

This function can be used in the program.

The operations described below became available with the main software of version "K0" or higher versions.

① Addition of intermediate point of weaving

- It became possible to add the intermediate point in the weaving (linear, circular) during the trace operation in the teaching mode and the TEACH ENABLE status in the operation mode.

- Display of message when the intermediate point is added.

i) In case of registering the intermediate point of the linear weaving → Weaving Add completed. is displayed.

(In case of changing the pattern, this message appears when the registration of all the amplitude points is completed.)

ii) In case of registering the intermediate point of the circular weaving → Circular weaving added is displayed.  
(No pattern change)

The operations described below became available with the main software of version "L0" or higher versions.

## 1. Summary

The weaving amplitude has been modified by means of the teaching. Using the MDI function, it can be modified by inputting the numerical values directly. The MDI function has improved the efficiency of the teaching operation.

## 2. Object weaving pattern

The numerical value input of the amplitude corresponds to the linear weaving, the circular weaving and also the harmonic movement.

The examples of pattern No. 1 are shown in Fig. 1 for the definition of the amplitude value of linear weaving and in Fig. 2 for the definition of the amplitude value of circular weaving. In case of pattern No. 1, the amplitude is practically  $d3$ , but the amplitude to be changed in this operation is  $d1$  and  $d2$ .

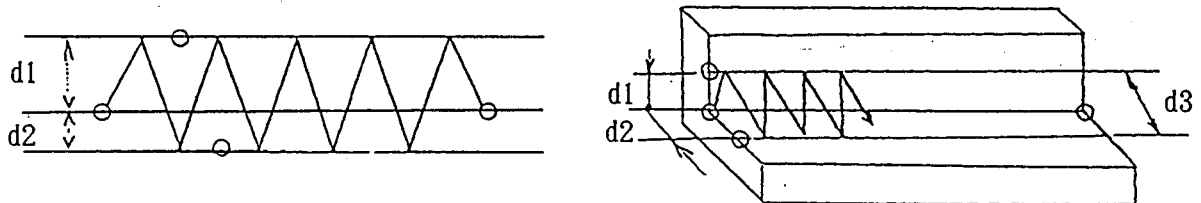


Fig. 1 Amplitude value of linear weaving

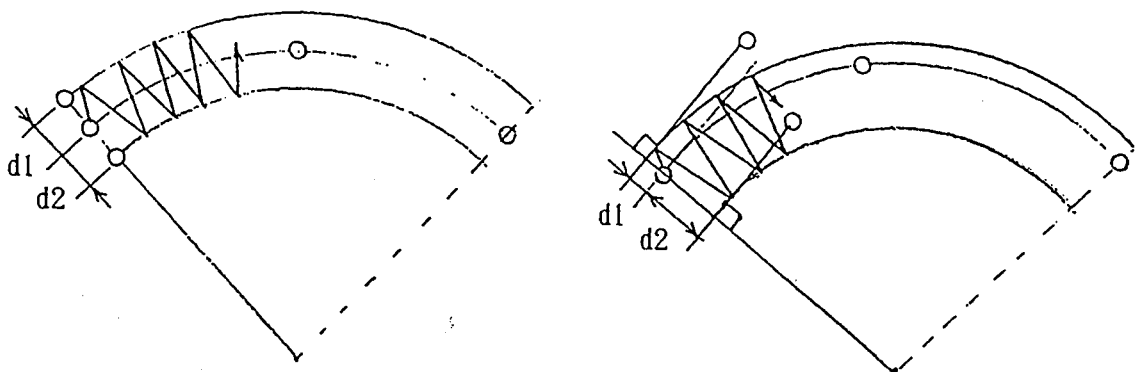


Fig. 2 Amplitude value of circular weaving

### 3. Procedures to change amplitude value (MDI)

The program edit screen where the teaching shown in Fig. 1 is executed is as follows.

```
0    MOVEP 30.00
1    MOVEL 15.00
2    • MOVLW 0.30 AJO : Weaving start point
3    • MOVLW 0.30      : Amplitude 1
4    • MOVLW 0.30      : Amplitude 2
5    MOVEL 15.00 CJO : Weaving end point
6    MOVEL 30.00
```

On the program edit screen above, move the cursor to the move command "• MOVLW" at the amplitude point 1, and press the ENTER key. (And the screen shown in Fig. 3 appears.)

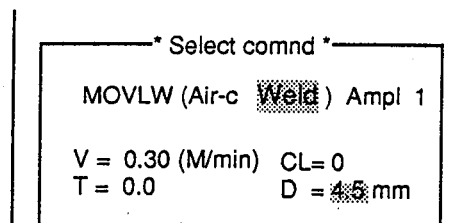


Fig. 3 Amplitude change operation screen

On the screen shown in Fig. 3, the value of "D" indicates the amplitude, "d1" shown in Fig. 1.

Input the value of "D" and press the ENTER key and the weaving amplitude can be changed. The input value is checked by "weaving conditions" when the edit is ended and any excessive values are treated as error. (Error No. 2007)

When the value is input, the coordinate data at the amplitude point (teaching position) is changed. Therefore, when the amplitude is changed by inputting the value of "D", the actual weaving amplitude is changed and also the amplitude point given by the "Trace back" operation is changed. While, if the conditions to calculate the weaving amplitude are not sufficient (for example, the weaving start point exists but the weaving end point does not exist, etc.) or if the weaving pattern No. 6 or No. 16 is selected, "D=?" appears on the screen and the amplitude cannot be calculated. When "??" appears on the screen, the amplitude value cannot be input. (The cursor does not move to the input position.)

### 3.4 Modification of teaching point during teaching

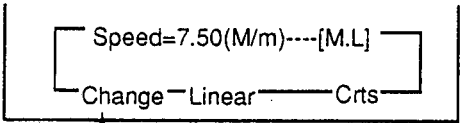
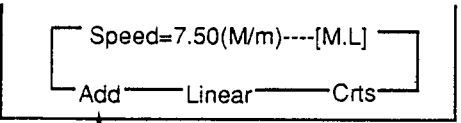


*The robot moves immediately when the MOVE key of the teach pendant is pressed.*

*Before operating the robot, make sure that no persons are in the work envelope.*

When a wrong teaching is done, the point can be corrected by returning the previous point.

Use the TRACE key to go back to the point having been taught. However, the later teaching should be carried out in the addition mode.

| No. | Operation                                                                                                                                                                                      | Screen display                                                                                                                                        |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | Teach the robot by following the procedure given in 2.1.2.                                                                                                                                     |                                                                                                                                                       |
| 1   | Move the robot to the point wrongly taught by using the ROBOT OPR key and TRACE BACKWARD key.                                                                                                  |  <p>Change "Add" to "Change" on the teach select menu screen.</p>   |
| 2   | Move the robot to the correct teaching position and press the STORE or WELD STORE key.<br><br>Note) The teaching points can be erased. the speed can also be changed.                          |                                                                                                                                                       |
| 3   | Move the robot to the point immediately before moved backward by using the ROBOT OPR and TRACE FORWARD keys.                                                                                   |  <p>Change "Change" to "Add" on the teach select menu screen.</p> |
| 4   | <u>Change the Modification select menu to Add.</u><br><br>Move the robot to the next teaching point and press the STORE or WELD STORE key.<br>Continue teaching following the procedure above. |                                                                                                                                                       |
|     | Add in the teaching modification menu must be displayed.<br>If Add is not displayed, new teaching points cannot be entered even when the STORE key is pressed.                                 |                                                                                                                                                       |
| 6   | Follow the procedure in 2.1.3.                                                                                                                                                                 |                                                                                                                                                       |

### Cautions in using teaching mode

- \* When the STORE key is pressed again without pressing the robot, the buzzer sounds.  
To register the same point duplicatedly, press the STORE key again.  
Press the CANCEL key of the teach pendant when you made a mistake in operation.
- \* When the emergency stop is activated during teaching or when the power failure occurs during teaching, perform the trace operation and add the teaching points from the final teaching point.

### 3.5 Conversion

#### 3.5.1 Parallel shift function/RT shift function (MDI input)

- When the teaching program and the workpiece does not coincide due to the replacement of torch, the teaching program can be shifted in parallel.

| No. | Operation                                                                                                                                                                                                                                                                                                                                                           | Screen display                                                                                                                                                             |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | This procedure is carried out in the teaching mode.                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                            |
| 2   | Move the cursor to "Conversion" (conversion compensation) and press the ENTER key.                                                                                                                                                                                                                                                                                  | <div> <div>* OPR select* — 1/1</div> <div> 1 Input No.      5 File list<br/> 2 Home position<br/> 3 <b>Conversion</b><br/> 4 Coordinates </div> </div>                     |
| 3   | Move the cursor to "Para-sht" or "RT shift", and press the ENTER key.                                                                                                                                                                                                                                                                                               | <div> <div>* OPR select* — 1/1</div> <div> 1 <b>Para-sht</b><br/> 2 RT shift </div> </div>                                                                                 |
| 4   | Enter the program No. and press the ENTER key.                                                                                                                                                                                                                                                                                                                      | <div> <div>* OPR select*</div> <div>Please input program number.</div> <div>Program number → 0</div> </div>                                                                |
| 5   | <p>(1) To store the program specified in No.4:<br/>1) Move the cursor to Yes and press the ENTER key.<br/>2) Enter the program No. to be stored and press the ENTER key.</p> <p>(The program before the conversion is stored to the No. specified in this step.)<br/>(2) To shift the program specified in No.4, move the cursor to No and press the ENTER key.</p> | <div> <div>* OPR select*</div> <div>Save program?</div> <div>1 Yes      2 No</div> </div> <div> <div>Input program to be saved.</div> <div>Program number → 0</div> </div> |



| No. | Operation                                                                                                                                                                                        | Screen display                                                                                                                                                                                                                                                                    |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | <div>When "Parallel shift" is selected :</div>                                                                                                                                                   |                                                                                                                                                                                                                                                                                   |
| 6   | <p>A message asking the interval in which the Crts coordinate system is applied appears.</p> <p>The coordinate position at this time is the same as that described in 4.8 "Teaching by MID".</p> | <div> <div>Teaching :      Convert</div> <div>Parallel shift</div> <hr/> <div>Parallel shift data</div> <div>X      =      0.00(mm)</div> <div>Y      =      0.00(mm)</div> <div>Z      =      0.00(mm)</div> <div>From 1 to 999 (Convert).</div> <div>Start convert</div> </div> |
| 7   | <p>Enter the numeric value and press the ENTER key.</p>                                                                                                                                          |                                                                                                                                                                                                                                                                                   |
|     | <div>When "RT shift" is selected :</div>                                                                                                                                                         |                                                                                                                                                                                                                                                                                   |
| 6'  | <p>A message asking the interval and angle in which the RT shift is applied appears.</p>                                                                                                         | <div> <div>Teaching :      Convert</div> <div>RT shift</div> <hr/> <div>RT shift data</div> <div>RT      =      0(°)</div> <div>Step:      From 1 to 999 (Convert).</div> <div>Start convert</div> </div>                                                                         |
| 7'  | <p>Enter the numeric value and press the ENTER key.</p>                                                                                                                                          |                                                                                                                                                                                                                                                                                   |
| 8   | <p>Move the cursor to "Start convert" and press the ENTER key.</p>                                                                                                                               | <div> <div>Teaching :      Convert</div> <div>Parallel shift</div> <hr/> <div>Program #10</div> <div>Converting</div> </div>                                                                                                                                                      |
|     | <p>To stop the conversion in process, press the ENTER key.</p>                                                                                                                                   | <div>Stop convert</div>                                                                                                                                                                                                                                                           |
|     |                                                                                                                                                                                                  | <div> <div>Teaching :      Convert</div> <div>Parallel shift</div> <hr/> <div>Program #10</div> <div>Convert completed.</div> </div>                                                                                                                                              |

Note 1) This robot is the teaching /playback type robot. Therefore, a slight difference may occur between the shift (numeric) data directly entered by MDI and the actual shift of the robot. The data entered by MDI should be considered as a reference. Follow the procedure below to carry out precise shift movement:

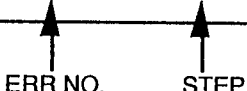
- Move the robot manually from the current position to the shift position. Read the actual movement distance on the coordinate system. Enter this value as the shift distance.
- After carrying out the shift operation, check the actual workpiece position and adjust precisely.

Further, after the shift movement is carried out, check the teaching position as well as the movement and correct the position if necessary.

Note 2) When an error occurs in the parallel shift arithmetic processing:

- (1) When the shifted teaching point comes out of the work envelope of the robot, the position data of the step at which the error occurred becomes to the value before the shift.
- (2) When errors such as out of work envelope or grammatical error occurs to the teaching point shifted, the value of the teaching point does not return to that before the shift.

| TEACH : CONV COMP |   |      |    |
|-------------------|---|------|----|
| — PARA SHIFT —    |   |      |    |
| 2001              | 1 | 2001 | 6  |
| 2001              | 2 | 2001 | 7  |
| 2001              | 3 | 2001 | 8  |
| 2001              | 4 | 2001 | 9  |
| 2001              | 5 | 2001 | 10 |

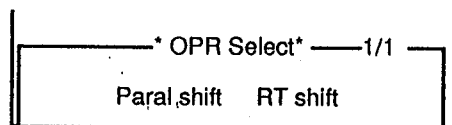


Note 3) In case that errors appear on the screen, refer to "7.4 Grammatical check error and calculation check error during editing" to take measures against such errors.

Note 4) The display shown below appears in the main software of version "J3" or lower version.

| * OPR select* — 1/1 |             |
|---------------------|-------------|
| Input No.           | File list   |
| Home position       | Coordinates |
| Conversion          |             |

Note 5) The display shown below appears in the main software of version "J3" or lower version.



3.5.2 Tool adjustment function (Available with the main software of version "K0" or higher version.)

1. Tool adjustment function

In case a tool (welding torch etc.) strikes against a work, the tool may deform and the welding position and the welding vector may change. On such a case, it is necessary to change all of the programs which have ever been used. The tool adjustment function enables to use the program before the deformation of the tool with the correction as little as possible by adjusting the shift of the tool.

2. Adjustment of tool

The following shows the principle of the tool adjustment. The welding torch is given as an example.

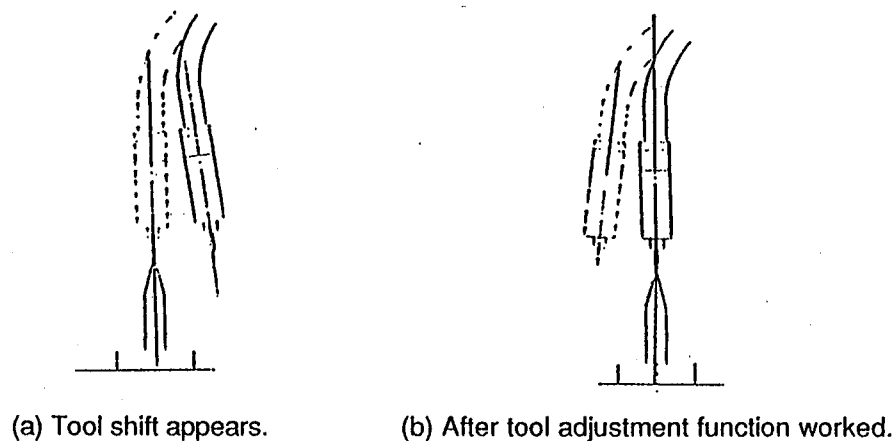


Fig. 1 Tool adjustment principle

See the above Fig. 1 (a). In case a torch is shifted from the position drawn by a dotted line to the position drawn by a solid line, the torch position is adjusted by means of the teaching operation. See the above Fig. 1 (b).

The teaching operation calculates and memorizes such a shift amount. And whenever the program is executed after this teaching operation, the torch of the robot is adjusted by such a shift amount.

### 3. Use

#### 3-1. Creation of reference program

This function adjusts the shift of the welding position and vector created by the difference between the condition of the tool attached to a robot (ex. welding torch) before the deformation and that after the deformation. Therefore, it is necessary to record the condition of the tool before the deformation as clear as possible.

- ① Make the check points by means of putting a mark or attaching a check jig on a robot work bench.
- ② Create the check program in which the wire tip aims at the check point. At that time, the condition of the torch shall be the same as that of the work program. And also the tool No. used at that time shall be the same as that used in the work program. (See Fig. 1.)

#### 3-2. Adjustment operation

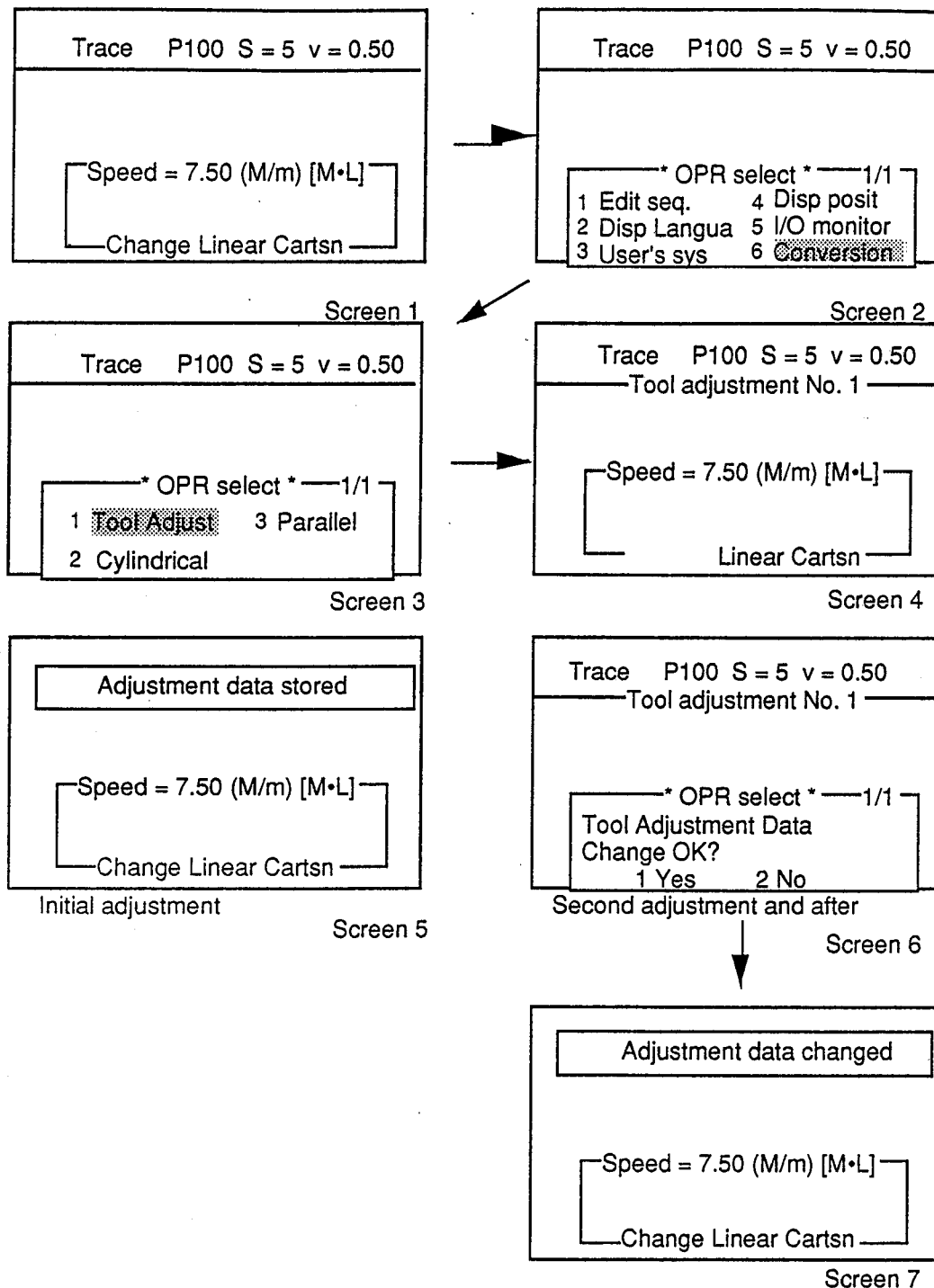
- (1) In case of changing or deforming the torch, adjust the torch by conforming it to the vector gauge to return the torch condition as it was.

Even if the torch is deformed and its vector is changed, do not change the value of the registered tool offset.

##### (2) Registration of adjustment data

- ① Execute the check program created at "3-1. Creation of reference program" in the teaching mode and step to the check point. The play mode shall be executed in the teaching mode. The check program cannot be executed by the trace modification operation in the play mode. (Screen 1)
- ② Press the OPR SEL key, and the screen 2 appears. Select "Conversion" using the cursor key and press the ENTER key.
- ③ On the screen 3, select "Tool Adjust" and the screen 4 appears. Check that "Tool Adjust" is displayed on the second line of the screen.
- ④ Using the teach pendant, return the torch tip position and the torch vector as the torch was not deformed. And then press the STORE key or the WELD STORE key.
- ⑤-1 When the adjustment operation is executed for the first time, carry out Step ④. And the screen 5 appears and the adjustment data is registered.
- ⑤-2 When more than twice of the adjustment operations are executed, carry out Step ④. And the screen (Screen 6) which inquires if the registered adjustment data is modified or not appears. And move the cursor to "Yes" and press the ENTER key. And the adjustment data is changed and the screen 7 appears.
- ⑥ After the adjustment data is registered, the robot moves by the amount modified by the adjustment data by means of the TRACE "+" "/" "-" key.

According to the operations described above, all the programs which use the same tool numbers as the check program are adjusted by the same method.



4. Precautions on using this function

- ① The tool numbers in which the adjustment data is registered are marked by "\*" and the tool offset data of these numbers cannot be changed.

In case of changing the tool offset data, it is necessary to delete the adjustment data according to the procedures shown on the following screens.

On the screen 8, select the tool number to be changed.

If the adjustment data is registered in the tool, the screen 9 appears, and if not, the screen 10 appears.

|                                   |             |
|-----------------------------------|-------------|
| Init. set: Sys. set: Rbt constant |             |
| Tool set                          |             |
| Tool No. 1*                       | Tool No. 5  |
| Tool No. 2                        | Tool No. 6* |
| Tool No. 3*                       | Tool No. 7  |
| Tool No. 4                        | Tool No. 8  |

Screen 8

|                                   |
|-----------------------------------|
| Init. set: Sys. set: Rbt constant |
| Tool No. 1*                       |
| L1 = 420.00 (MM)                  |
| L2 = 0.00 (MM)                    |
| L3 = 379.30 (MM)                  |
| TW = -20.00 (°)                   |
| [OPR SEL.] or [END]               |

Screen 9

|                                   |
|-----------------------------------|
| Init. set: Sys. set: Rbt constant |
| Tool No. 2                        |
| L1 = 420.00 (MM)                  |
| L2 = 0.00 (MM)                    |
| L3 = 379.30 (MM)                  |
| TW = -20.00 (°)                   |
| STD                               |

Screen 10

On the screen 10, the values can be changed.

In case of changing the values on the screen 9, press the OPR SEL key and the screen 11 appears.

In case of selecting "Yes" on the screen 11, the tool offset data can be changed.

|                                                                                                                        |       |                                                      |
|------------------------------------------------------------------------------------------------------------------------|-------|------------------------------------------------------|
| Init. set: Sys set: Rbt constant                                                                                       | "Yes" | Delete adjustment dat and display screen 10.         |
| Tool No. 1*                                                                                                            |       |                                                      |
| <div> <div>* OPR select * 1/1</div> <div>Tool adjustment data</div> <div>Delete OK?</div> <div>1 Yes 2 No</div> </div> | "No"  | Return to screen 8 without deleting adjustment data. |

Screen 11

- ② In case of carrying out the teaching newly using the tool number in which the tool adjustment data is registered, the position and vector which subtracts the adjustment data from the actual position are stored to prevent the double adjustment during the operation.
- ③ **Position and angle display during the edit**  
The position and angle position of each step displayed during the edit are the values adjusted by the tool adjustment data, that is, the actual movement amount of the robot during the trace and the operation.
- ④ **Specifications regarding external memory (floppy)**
- The tool adjustment data and the tool offset value are saved at the same time when the "save" operation is executed using "All," "Select," "System" and "Backup."
  - In case that the adjustment data is not registered in the robot where the data is loaded during the loading, the adjustment data and the tool offset value are loaded at the same time by means of "All," "Select," "System" and "Backup."
  - In case that the adjustment data is registered in the robot where the data is loaded, the adjustment data and the tool offset value are not loaded.



### 3.5.3 Parallel/cylindrical shift function (One point teaching)

(Available with the main software of version "L0" or higher versions.)

#### 1. Parallel/cylindrical shift at teaching

This is the function to shift the step of all the program or the designated range in parallel and cylindrically by moving a voluntary one teaching point in the program to another position and storing it when "TEACH ENABLE" of "Input No., Teaching mode" is turned ON.

Fig. 1 shows an example of parallel shift and cylindrical shift.

In case of the parallel shift, move Step 1 to 1' (or 1'') as shown in Fig. 1 (a) manually and store Step 1' or 1'', and designate the step range to be shifted in parallel as 1 to 4, and carry out the conversion. And Step 1 to 4 is shifted to Step 1' to 4' (or 1'' to 4'') in parallel. In case of the cylindrical shift, the robot is shifted cylindrically as shown in Fig. 1 (b).

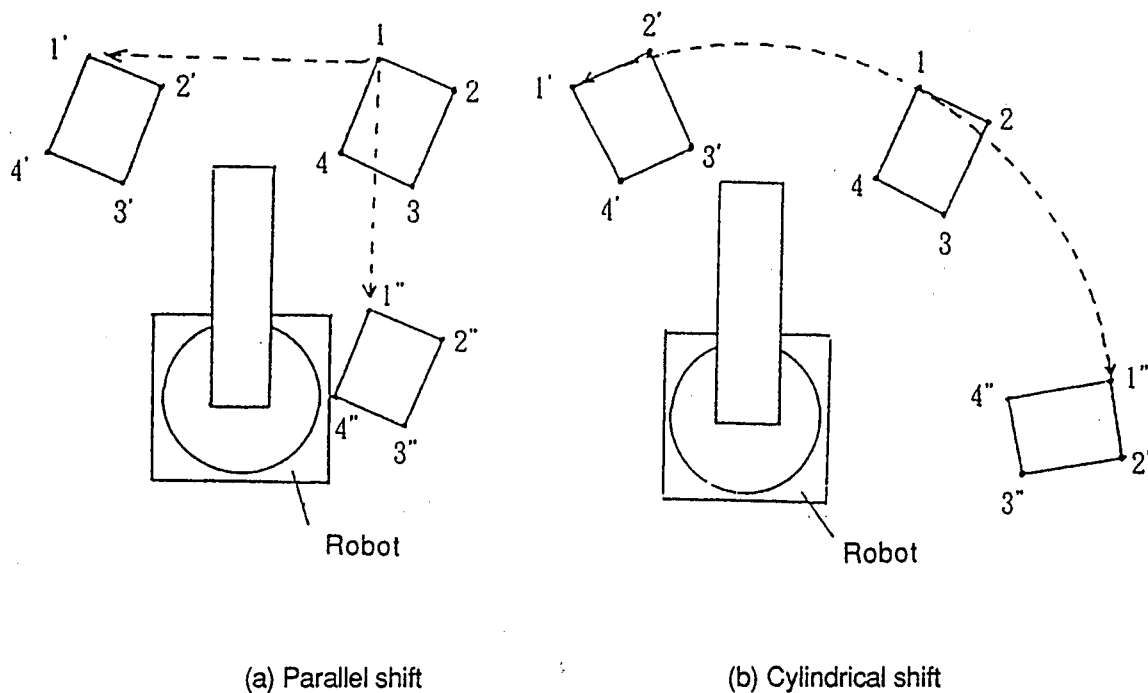


Fig. 1

## 2. Operational procedures of parallel/cylindrical shift

- ① Designate Program No. in teaching mode and press the TEACH ENABLE key.

(When trace operation is executed and new program is created.)

- ② At a voluntary teaching point in the program, select "OPR SEL" and then select "Conversion." And press the ENTER key.  
or "Teaching"

| Trace                                                                                                                                               | P | S= | V= |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|---|----|----|
| <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: 80%;"> Speed = 7.50 (M/m) [M • L]<br/> Change   Linear   Cartrn </div> |   |    |    |

(Screen ①)

"OPR SEL"

"END"

| Trace                                                                                                                                                                                                                                                                                                                                                                                           | P | S= | V= |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|----|
| <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: 80%;"> <div style="text-align: center;">* OPR select *</div> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> 1 Edit seq.<br/> 2 Disp Lanqua<br/> 3 Disp Posit<br/> 4 User's sys </div> <div style="width: 45%;"> 5 I/O monitr<br/> 6 <b>Conversion</b> </div> </div> </div> |   |    |    |

(Screen ②)

Select "Conversion" and press the ENTER key.

- ③ Move the cursor to "Parallel" or "Cylindrical" and press the ENTER key.

| Trace                                                                                                                                                                                                                                                                                                                        | P | S= | V= |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|----|
| <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: 80%;"> <div style="text-align: center;">* OPR select *</div> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> Tool Adjust<br/> Cylindrical </div> <div style="width: 45%;"> Parallel </div> </div> </div> |   |    |    |

(Screen ③)

Select "Parallel" or "Cylindrical" and press the ENTER key.

- ④ Move the tool tip to the position to be shifted manually and then press the STORE or WELD STORE key.

or "Cylindrical shift"

| Trace                                                                                                                                                                                                                                                                                       | P | S= | V= |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|----|
| <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: 80%;"> <div style="text-align: center;">Parallel shift</div> <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: 80%;"> Speed = 7.50 (M/m) [M • L]<br/> Linear   Cartrn </div> </div> |   |    |    |

(Screen ④)

Press the STORE or WELD STORE key.

- ⑤ Input the range of step Nos. to be shifted and move the cursor to "Start convert" and press the ENTER key.

| Trace                   | P | S= | V= |
|-------------------------|---|----|----|
| Parallel shift          |   |    |    |
| from 1 to 999 (Convert) |   |    |    |
| <u>Start convert</u>    |   |    |    |

(Screen ⑤)

Select "Convert" and press the ENTER key.

- ⑥ When an error appears during the conversion, "warning" is given to the error step as shown on screen ⑥.  
To end the screen, move the cursor to "Finish" and press the ENTER key. And screen ① appears again.

| Trace         | P | S=   | V= |
|---------------|---|------|----|
| 2001          | 3 | 2001 | 5  |
| ⋮             |   | ⋮    |    |
| <u>Finish</u> |   |      |    |

(Screen ⑥)

- ⑦ When the conversion is completed as specified, "Convert completed" appears as shown on screen ⑦.  
And press any key to return to screen ①.

| Trace             | P | S= | V= |
|-------------------|---|----|----|
| Parallel shift    |   |    |    |
| Convert completed |   |    |    |

(Screen ⑦)

### 3. Cautions on parallel/cylindrical shift

- ① "Conversion" cannot be executed as for program step 0.
- ② In case of executing the re-teaching manually, only "teach coordinate system" and "teaching speed" can be changed.
- ③ In case of executing the re-teaching manually, "jog feeding" is valid.
- ④ In case of executing the re-teaching manually, "trace forward/backward" and "robot lock" are not valid.
- ⑤ In case of executing the re-teaching manually, "parallel/cylindrical shift" can also be executed at the harmonic teaching point (the point whose teaching is executed by the external axis harmonic movement.)
- ⑥ In case of executing the re-teaching manually, the manual harmonic operation cannot be executed.

### 3.6 Trace operation at the teaching speed

During the trace operation carried out by forward/backward tracing, the Max. speed is the "speed limit" specified in the inner setting mode.

When the trace operation is carried out at the teaching speed, follow the procedure below:  
However, this cannot be performed during teaching. Further, the teaching points cannot be modified during the trace operation at the teaching speed.

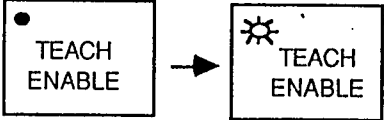
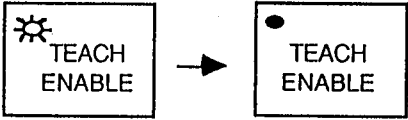
| No. | Operation                                                                         | Screen display                                                                                                                                                             |
|-----|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Carry out the procedures in 2.1.2.                                                | Trace      P: 20    S:    V:                                                                                                                                               |
| 2   | Press the ENTER key.                                                              | * START            ▶ OPR program<br>* MODE SEL        ▶ Finish<br>* OPR SEL          ▶ Set OPR unit<br>* TEACH ENABLE   ▶ Trace OPR                                        |
| 3   | Move the cursor to the "OPR UNIT" (operation unit) and press the ENTER key.       | * OPR select*<br>1 OPR unit<br>2 Disp language<br>3 Disp position                                                                                                          |
|     | To stop at each step:<br>Move the cursor to "Step" and press the ENTER key.       |                                                                                                                                                                            |
|     | To stop at each program:<br>Move the cursor to "Program" and press the ENTER key. | Note 1                                                                                                                                                                     |
| 4   | Press the START switch on the panel.                                              | * OPR select*<br>Step                      Program<br>Continuous                                                                                                           |
|     | Press the STOP switch or START switch repeatedly, when necessary.                 |   |

Note 1) The display shown below appears in the main software of version "J3" or lower version.

| * OPR select* |               |
|---------------|---------------|
| OPR unit      | Disp position |
| Disp language |               |

### 3.7 Modification of the teaching point during operation

Hold is activated during operation and the teaching point can be modified from the point.

| No. | Operation                                                                                                                                                                                                                                                  | Screen display                                                                     |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| 1   | Press the HOLD switch on the operation panel during the operation of 2.1.4.<br>Or, press the HOLD key of the teach pendant.                                                                                                                                |  |
| 1'  | Press the TEACH ENABLE key of the teach pendant.                                                                                                                                                                                                           |                                                                                    |
| 2   | After trace of the procedures above, the trace operation for operation of 2.1.3 above can be started from the point.<br><br>Correct the teaching points as necessary.<br>The robot can be moved step by step by using the ROBOT OPR key and the TRACE key. |  |
| 2'  | To stop this modification process, press the TEACH ENABLE key. (the lamp turns off.)                                                                                                                                                                       |                                                                                    |
| 3   | The operation can be resumed by pressing the START switch on the operation panel.<br>(Re-start signal is input from the external unit for external start-up)                                                                                               |                                                                                    |

### 3.8 Escapement movement during hold status and the output re-play function

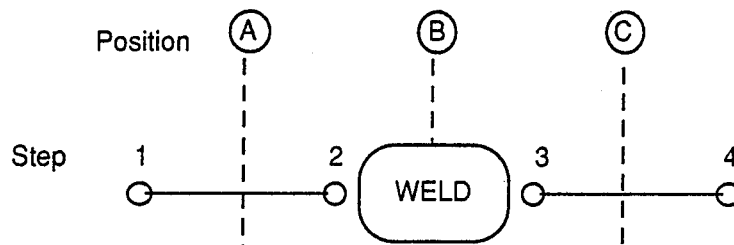
When the operation is resumed after the hold status, the "pre-hold output re-play function" is used to re-start the operation by applying the welding conditions set before the hold is activated. However, beware the particulars below when the robot has been moved by using the move keys of the teach pendant (escapement movement).

- (1) When the robot is held and moved via the teach pendant (escapement) after completing the execution of the sequence commands at the teaching point:

Output conditions after the re-start:

The I/o sequence commands at the teaching point is executed one by one at each time the robot passes the teaching point by the tracing forward/backward.

(Example 1)



Sequence Ex. output terminal 2--ON Torch switch.....ON Torch switch ...OFF  
 Gas .....ON Gas .....OFF  
 Ex. output terminal 1.ON Ex. output terminal 1..OFF  
 Ex output terminal 3 ON

|           |       |               | Output re-production conditions |     |          |          |          |
|-----------|-------|---------------|---------------------------------|-----|----------|----------|----------|
| Stop pos. | Trace | Re-start pos. | Torch                           | Gas | Output 1 | Output 2 | Output 3 |
| A         | FWD   | B             | ON*                             | ON  | ON       | ON       | -        |
| A         | FWD   | C             | OFF                             | OFF | OFF      | ON       | ON       |
| B         | BWD   | A             | OFF                             | OFF | OFF      | ON       | -        |
| B         | FWD   | C             | OFF                             | OFF | OFF      | ON       | ON       |
| C         | BWD   | A             | OFF                             | OFF | OFF      | ON       | OFF      |
| C         | BWD   | B             | ON**                            | ON  | ON       | ON       | OFF      |

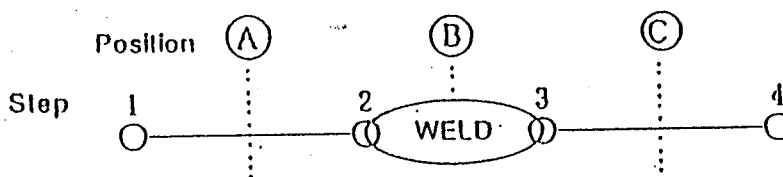
\* The welding start condition is that of AJO.

\*\* The welding start condition in the main software of version "K2" or lower versions and of version "L0" or higher versions is CJO and AJO (at step 2), respectively. (See Note 3.)



- Output conditions after the re-start:

(Example 2)



Hold during delay

|                        |       |               | Output re-production conditions |     |          |          |          |
|------------------------|-------|---------------|---------------------------------|-----|----------|----------|----------|
| Stop pos.              | Trace | Re-start pos. | Torch                           | Gas | Output 1 | Output 2 | Output 3 |
| During delay at step#2 | BWD   | A             | OFF                             | OFF | OFF      | ON       | -        |
|                        | FWD   | B             | ON                              | ON  | ON       | ON       | -        |
|                        | FWD   | C             | OFF                             | OFF | ON       | ON       | ON       |

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Note 3) Improvement of weld condition output monitoring

(Available with the main software of version "L0" or higher versions.)

1. Summary

When being actuated from a step in the weld section (from a step section) after the trace forward/backward, the condition of the "AMP/VOLT" command on the step or nearest in the previous steps is output.

2. Improvements

(1) Basis

① Trace forward

- As for both in or out of the weld section, when reaching a step, if the "AMP/VOLT" command exists in the step, the AMP/VOLT value of the command is output by the analogue output. (Including the AMP/VOLT command of Library, ASS and AES.)
- The data is not changed during the trace forward.

② Trace backward

- In the weld section (excluding the arc end point), when the trace backward key is released, the AMP/VOLT command value on the step or nearest from the step to the arc start point is output. (Including the AMP/VOLT command of Library and ASS.)
- Out of the weld section (including the arc end point), when the trace backward key is released, the analogue output data is not changed.
- The data is not changed during the trace backward.

(2) Special cases

① When the AMP and VOLT commands exist on the ASS of the arc start point and on the AES of the arc end point;

- Temporary stop (weld section):

The weld current and voltage value before the temporary stop is output as it is. If the last AMP/VOLT command executed before the temporary stop is within the ASS, the values are output as it is.

- Restart (weld section):

Trace forward/backward is not executed.

The weld current and voltage value before the temporary stop is output. If the last AMP/VOLT command executed before the temporary stop is within the ASS, the values are output.

- Restart:

Trace forward/backward is executed.

The weld current and voltage value output by the trace forward/backward is output.

### 3.9 Edit

#### \* What is "editing"?

Now you know that the movement differs according to the program. This is the "operational procedure" to make the robot execute tasks. As the contents of the task of an operator changes when the "operational procedure" for him is changed, the contents of the task of the robot changes when the "operational procedure" for his use is changed. The "editing" refers to the operation to "change the contents" or to "check the contents" of the task. Therefore, this operation is carried out without moving the robot. There are 5 kinds of instruction materials including program.

#### \* Instruction materials

|   |                       |                                                                      |       |                                                               |
|---|-----------------------|----------------------------------------------------------------------|-------|---------------------------------------------------------------|
| 1 | Job                   | No.1~No.999:<br>Standard 127<br>999 when expanded<br>memory is used. | ..... | Instructions for external<br>operations (Basic course)        |
| 2 | Program               | No.1~No.999:<br>Standard 255<br>999 when expanded<br>memory is used. | ..... | Instructions for handling<br>workpieces.                      |
| 3 | Arc start<br>sequence | No.1~No.5 : 5                                                        | ..... | Instructions for torch ON at the<br>welding start point       |
| 4 | Arc end<br>sequence   | No.1~No.5: 5                                                         | ..... | Instructions for torch OFF at the<br>welding end point        |
| 5 | Library               | No.1~No.99: 99                                                       | ..... | Instructions to use the groups of<br>signals frequently used. |

#### \* Program creates the movement by moving the robot by teaching.

(This is the process to create the operational instructions.)

#### \* As for arc start sequence and arc end sequence, the standard contents are entered prior to shipment.

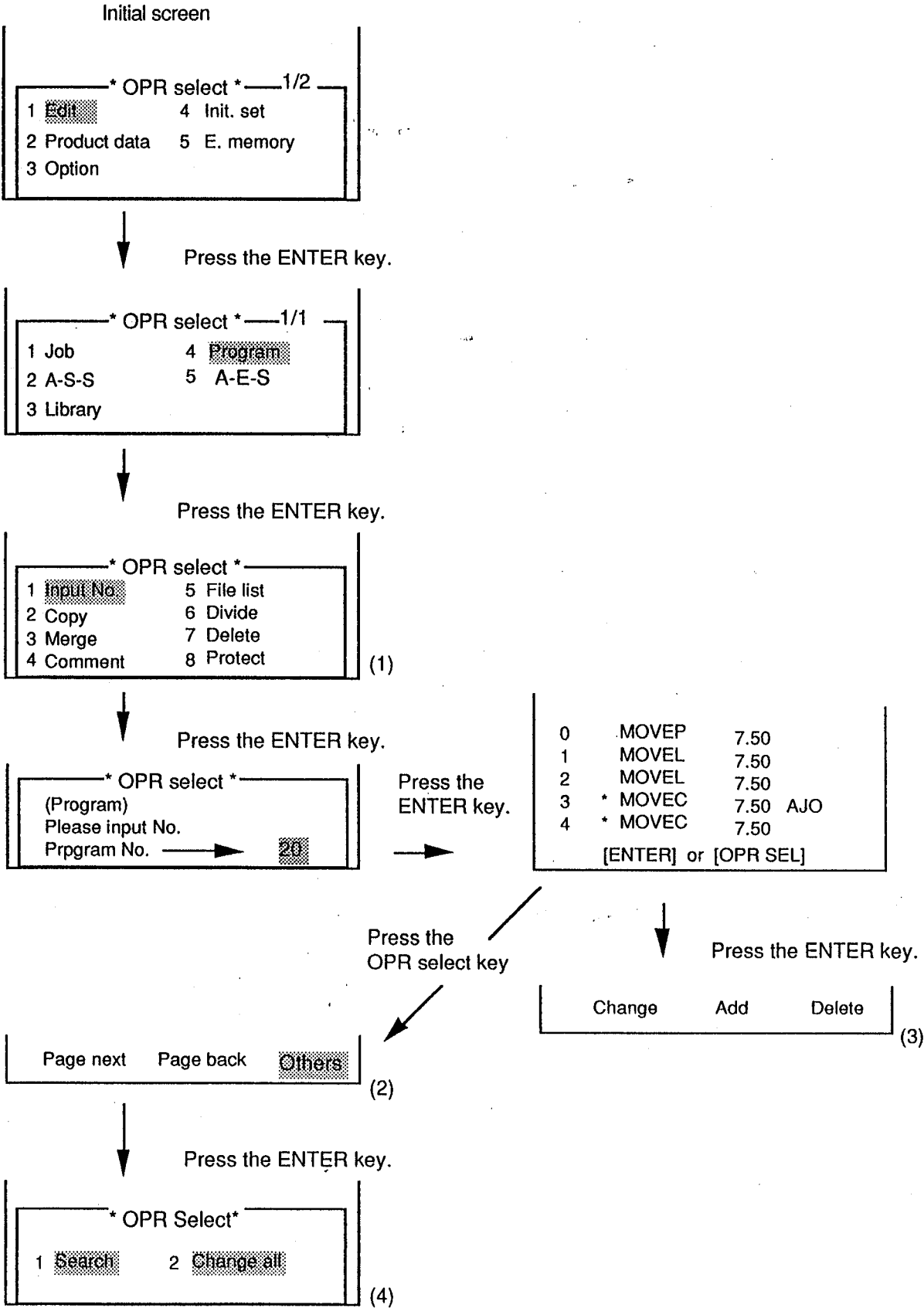
#### \* The operational procedure as the same except for the program.

(The 4 kinds of instruction materials other than the program are created by using the sequence commands.)

#### \* Cursor

The item at which this cursor blinks can be modified.

3.9.1. Operation flow chart (example of program editing)



### 3.9.2 Various functions in editing

#### Function on screen (1)

- \* File list (Directory display) ..... The No.s registered are displayed.

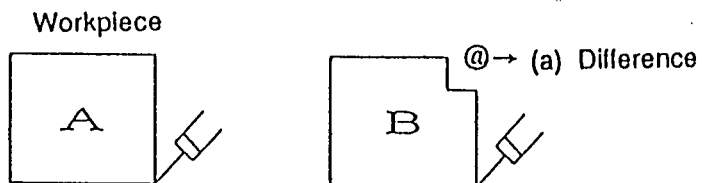
| Edit : Program |            |      |
|----------------|------------|------|
| File list      |            |      |
| 1              | PANAROBO   | 0.1% |
| 3              |            | 0.2% |
| 10             | MATSUSHITA | 0.0% |
| 25             |            | 0.5% |
| 100            |            | 0.1% |
| 150            |            | 0.2% |



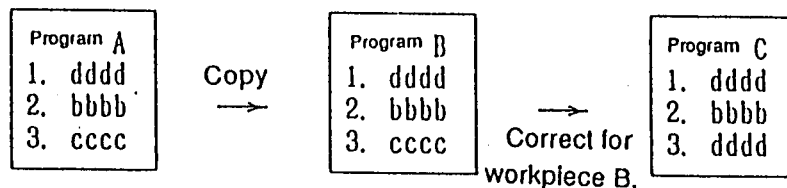
Job No. registered.

- \* Copy ..... Used to copy the contents of the instruction to the No. available.

(Example)



Instruction material



When the difference between workpieces A and B is (a), program B for workpiece B can be created by, first, copying program A for workpiece A to program B, and, second, modifying part (a).

- \* Division ..... This is used to create the instructions of other No. by using the contents of an instruction partially.

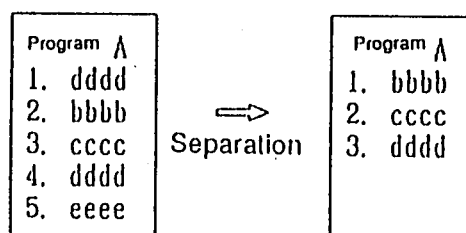
(Example)

Workpiece A

Workpiece B

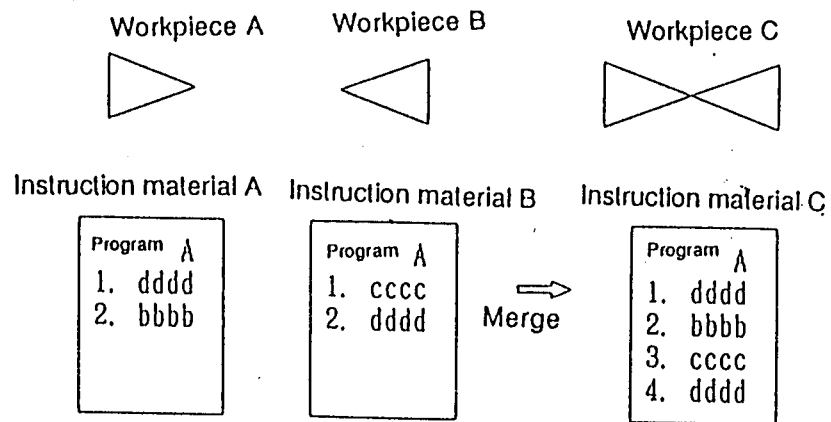


Instruction material



- \* Merge .....This is the function to create the new instruction by merging instructions with different No.s.

(Example)



- \* Delete .....This is the function to erase the entire contents of the instruction. (The No. currently used is removed from the registered No.s)

- \* Protect .....This is the function to prevent the contents of the instruction from being erased or modified.

Once protected, the contents cannot be modified even in the trace operation mode or edit mode. The protection can be cancelled.

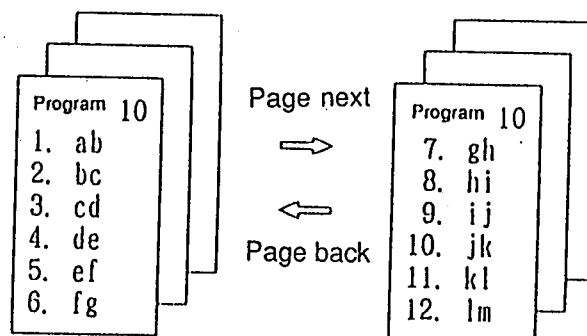
#### Functions on scree (2)

##### Page next

The contents of the instruction material is displayed on the screen. Since only 6 lines can be displayed on one page, this function is used to display the next page.

##### Page back

This is used to display the previous page.



### Functions on screen 3

Change .....By using this function, you can go into the contents and carry out necessary operations.

Add .....This is the function to create a point. (A point is created by N C in the same manner as that for machining center. As with the welding machine, however, the target angle is unknown even if the position of the point is the same. Therefore, this function cannot be used)

Delete .....This is the function to erase a point. During the trace operation, the start/end points of a circle and weaving cannot be erased. However, the point can be erased using this function. The robot does not move until the circle or weaving is entirely erased. This is because the instruction of the robot is significantly changed.)

### Functions on screen 4

Search .....This is the function to directly retrieve the contents to be checked.

All change.....This is the function to change the speed or welding conditions as a group.

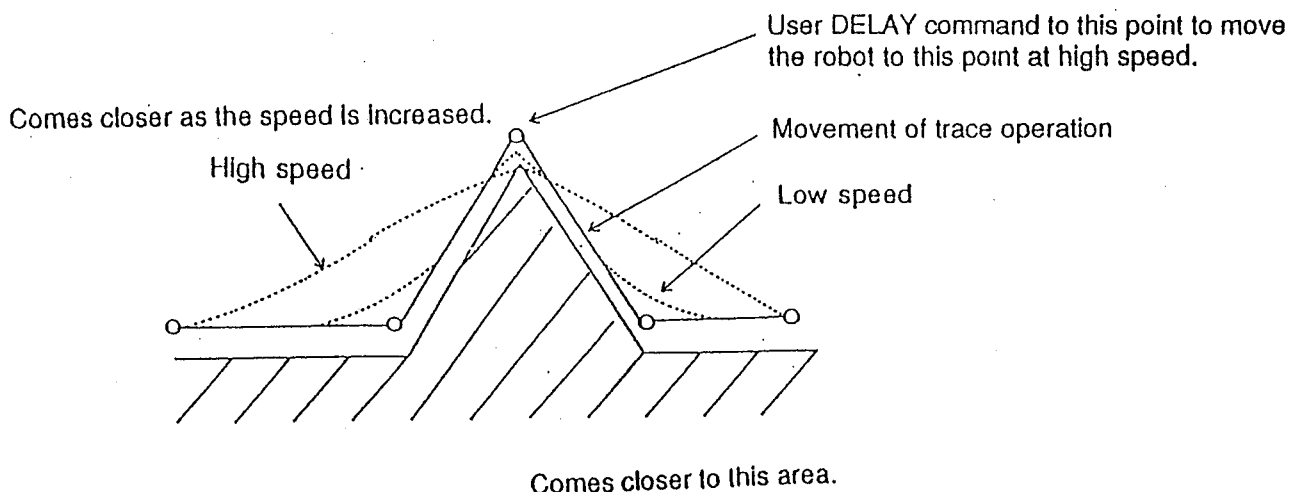
#### 1) Speed

Operations to change the speed of the air-cut section and welding section collectively.

- Even if there are several welded points and the welding speed is not fixed, this operation makes all the welding speed same.
- In case of increasing the speed of the air-cut section, do it 5 m by 5 m. If the speed is increased by 20 to 30 m at one time, the torch sometimes hits the work, set or jig.

#### 2) Weld condition

Operations to change all contents of AJO and CJO of the welding section.





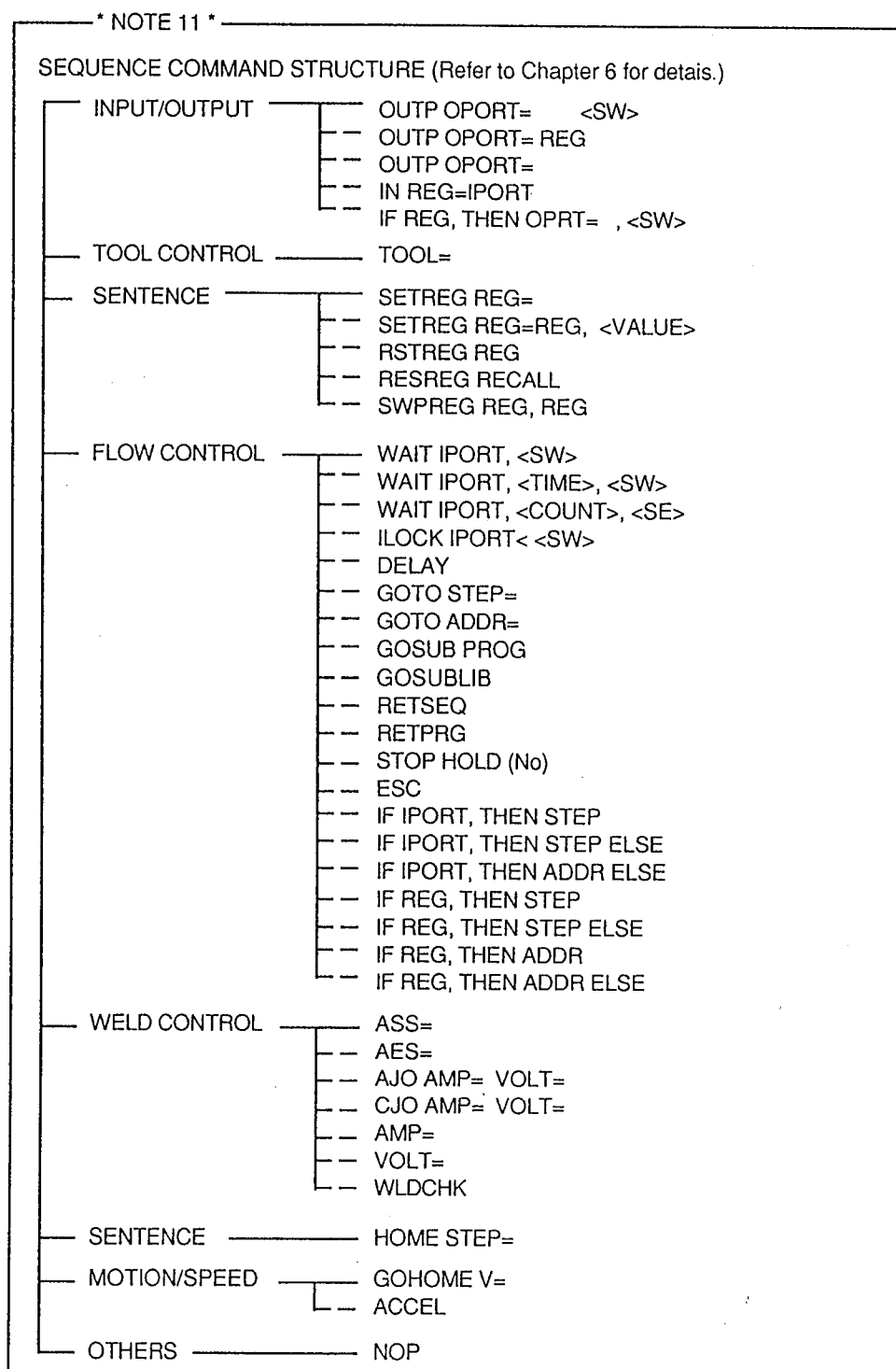
### 3.9.3 Creation and modification of the program

| No. | Operation                                                                                                                | Screen display                                                                                                                                                                                                                                                               |
|-----|--------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | Bring back the initial screen by pressing the END key and the MODE SEL key.                                              | <div>Mode Select (Initial)</div> <div>To select &lt;OPR&gt; or &lt;TEACH&gt;, use SW on the controller.</div> <div><div>*OPR select* — 1/2 —</div><div><div>1 Edit</div><div>2 Product data</div><div>3 Option</div><div>4 Init. set</div><div>5 E. memory</div></div></div> |
| 1   | Since the cursor has shifted to "Edit", press the ENTER key.                                                             | <div>Edit</div> <div><div>*OPR Select* — 1/1 —</div><div><div>1 Job</div><div>2 A-S-S</div><div>3 Library</div><div>4 Program</div><div>5 A-E-S</div></div></div>                                                                                                            |
| 2   | Move the cursor to "Program" and press the ENTER key.                                                                    | <div>Edit      Program</div> <div><div>* OPR select*</div><div><div>1 Input No.</div><div>2 Copy</div><div>3 Merge</div><div>4 Comment</div><div>5 File list</div><div>6 Divide</div><div>7 Delete</div><div>8 Protect</div></div></div>                                     |
| 3   | Since the cursor has shifted to "Input NO. " (No. specification), press the ENTER key.                                   | <div>Edit      Program</div> <div><div>* OPR select*</div><div>Please input No.</div><div>Program No.       15</div></div>                                                              |
| 4   | Enter the program No. using the numerical keys and press the ENTER key.<br>(When a new No. is specified, go to step #8.) |                                                                                                                                                                                                                                                                              |
| 5   | Move the cursor to the step to be modified by using the arrow keys.<br>Press the ENTER key.                              |                                                                                                                                                                                                                                                                              |

| No. | Operation                                                                                                                                                                                                                                                                                              | Screen display                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 6   | Since the cursor is at "Change", press the ENTER key. (to change only the MOVE command parameter, move the cursor to the command, press the ENTER key and go to step #9.)<br><br>* As for the operations for add and deletion, refer to 3.9.3.2 "addition" and "deletion" in the program modification> | <div>Edit :      Program#15 : Step 0</div> <div>Step 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| No. | Operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Screen display                                                                                                                                                                         |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | <p>* Note 10*</p> <p>(5) Set the wrist calculation No. (this is not displayed for PTP or linear interpolation.)<br/>Move the cursor to (5) and enter the value via the numerical keys.</p> <p>(6) Set the timer.<br/>Move the cursor to (6) and enter the value via the numerical keys.</p> <p>(7) Set the frequency. (Unit:Hz) (This is displayed for weaving start, circular weaving start.)<br/>Move the cursor to (7) and enter the value via the numerical keys.</p> <p>(8) Set the weaving pattern No. (Displayed only for weaving &lt;start&gt;, circular weaving &lt;start&gt;.)<br/>Set the weaving amplitude value. (Displayed only for weaving &lt;amplitude&gt;, circular weaving &lt;amplitude&gt;.)<br/>Move the cursor to (8) and enter the value via the numerical keys.</p> |                                                                                                                                                                                        |
| 10  | After completing the parameter settings, press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <div> Edit : Program #15<br/> —Pos: (Robot)—Stor—(Chng)—<br/> X= 1192.02(mm) U= 20.23(°)<br/> Y= - 2.51(mm) V= 55.23(°)<br/> Z= 1480.61(mm) W= 25.15(°) </div>                         |
| 11  | Enter the value via the numerical keys and correct the position. After completing the setting, press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                        |
| 12  | To register the sequence command, move the cursor to the margin at the right of the speed or the sequence command and press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <div> Edit : Program #15<br/> —Step—Command—<br/> 0 MOVEP 15.00<br/> 1 MOVEL 15.00<br/> 2 MOVEL 15.00<br/> 3 *MOVEC 7.00 AJO<br/> 4 *MOVEC 7.00<br/> 5 MOVEL 15.00 CJO </div>          |
| 13  | Select the commands to be registered.<br>(Refer to Note11 for the structure of the sequence commands.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <div> Edit<br/> —Address—Command—<br/> —*OPR Select*—1/1—<br/> 1 I/O 5 Flow control<br/> 2 Tool control 6 Weld control<br/> 3 Ins sentence 7 Move/Speed<br/> 4 Declare 8 Others </div> |
| 14  | Enter the parameters according to the instructions on the screen.<br><br>After completing the settings, press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <div> (Example : Bit output)<br/> Edit Program #15<br/> —Address—Command—<br/> —*Seq Command*—<br/> (MOVEC) Address=1<br/> OUTB OPORT#1=1 1 </div>                                     |
| 15  | Press the END key after completing the registration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                        |

| No. | Operation                                                                                                                                    | Screen display                                                                                                                                |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
|     | Press the END key to quit the modification of the sequence commands.<br><br>When the END key is pressed, the initial screen is brought back. | <div style="border: 1px solid black; padding: 5px;"> Edit   Program #15<br/> ----- Address ----- Command -----<br/> 1   OUTB OPORT#1=1 </div> |
|     | Construction of sequence commands (Refer to Chapter 6 for details.)                                                                          |                                                                                                                                               |

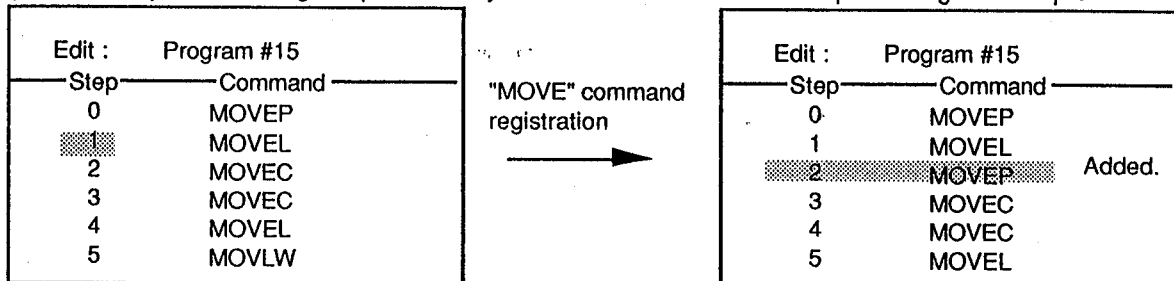


### 3.9.3.2 "Addition" and "Delete" in the program modification

#### 1 Addition of step

##### 1.1 Select "ADD" (addition) in the "Creation of modification of program" #6.

\*) When step 1 is blinking, step 2 is newly added and conventional step 2 changes to step 3.



##### 1.2 Enter the MOVE command and the position.

(Refer to "Note 10" in the "Creation and modification of program" for the method to enter them.)

##### 1.3 Press the END key after completing the registration of the steps added.

#### 2 Deletion of step (Available with the main software of version "J3" or lower vresion)

##### 2.1 Select "Delete" in the step #6 of "Creation and modification of program".

(Move the cursor to "Delete" and press the ENTER key.)

| Edit Program #15 |         |
|------------------|---------|
| Step             | Command |
| *OPR Select*     |         |
| Step 2           |         |
| Delete OK?       |         |
| Yes              | No      |

The screen shown above appears. Move the cursor to Yes and press the ENTER key.

In case the sequence command exists in the step to be deleted, the display shown below appears.

| *OPR Select*             |    |
|--------------------------|----|
| Step 2                   |    |
| Delete sequence command? |    |
| Yes                      | No |

2' Deletion of step (Available with the main software of version "KO" or higher version.)

2.1' Select "Delete" in the step#6 of "Creation and modification of program".

(Move the cursor to "Delete" and press the ENTER key.)

|                      |             |
|----------------------|-------------|
| Edit                 | Program #15 |
| Step                 | Command     |
| *OPR Select*         |             |
| Step 1 to 1 (Delete) |             |

The screen shown above appears. Input the step # to be deleted and press the ENTER key.

When the sequence command exists in the step to be deleted, the display shown below appears.

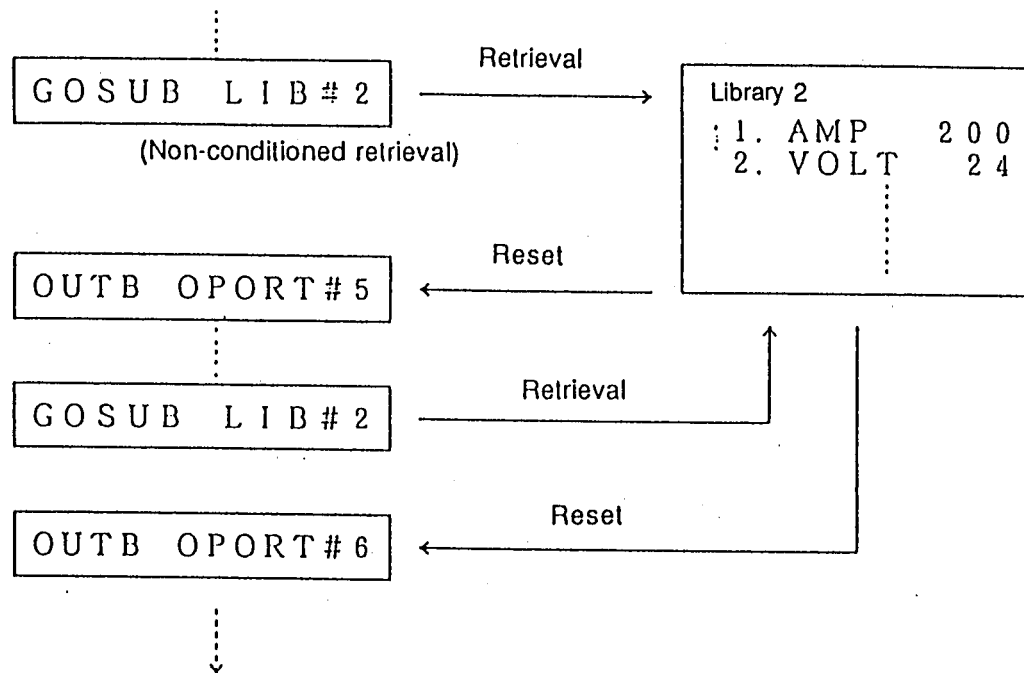
|                          |      |
|--------------------------|------|
| *OPR select*             |      |
| Step 3                   |      |
| Delete sequence command? |      |
| 1 Yes                    | 2 No |

Move the cursor to "Yes" in case of deleting the sequence command, or "No" in case of not deleting the sequence command, and press the ENTER key.

### 3.9.4 Creation and deletion of the arc start sequence, arc end sequence and library.

#### 3.9.4.1 What is library?

When creating a program, there are commands frequently used. If these commands can be grouped and if these commands can be retrieved and be executed as a group, the creation of program will be much easier and the structure of the program will become much clearer. With the consideration above, an area named "reservation sequence" is created for PANAROBO where the groups of commands are stored. The group commands stored there can be retrieved for execution with ease only by specifying the library No..



\* Prior to using the Library

- (1) the library can be registered up to 99 (NO.1~No.99)
- (2) A library should consists of 999 or less operation commands.
- (3) Create the library first and then create the retrieval command in the program.

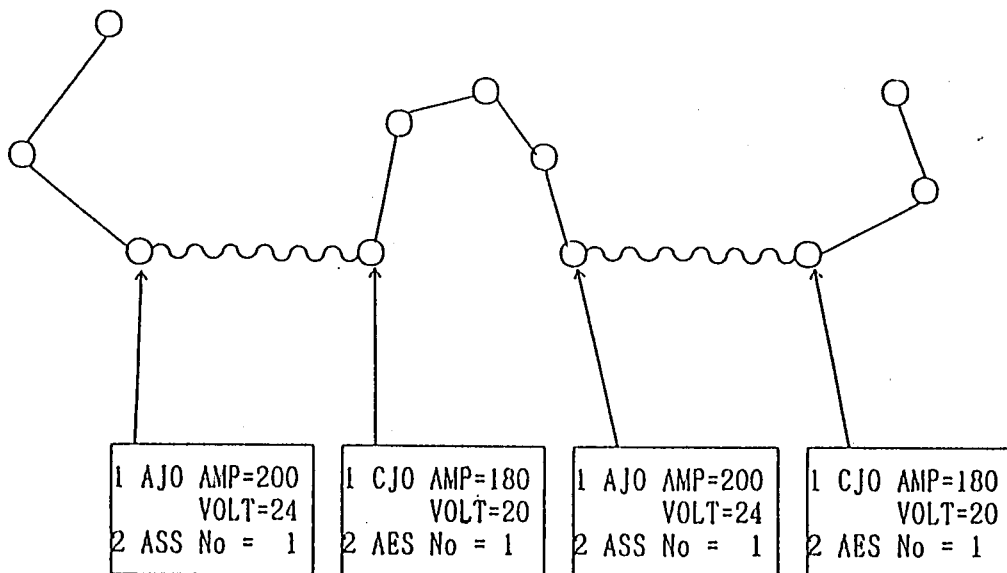
#### 3.9.4.2 What are the arc start sequence and arc end sequence?

The arc start/end sequences refer to the group of commands specific to starting and ending the welding task. You can consider this sequence as torch switch ON/OFF.

(However, signals other than ON/OFF signals required at arc start/end point are included.)

Therefore, when you create a program by teaching, the welding conditions (AJO, current and voltage) corresponding to the menu No. and arc start sequence (ASS) No.1 are automatically entered to the welding start point, while the crater conditions (CJO, current and voltage) corresponding to the menu No. and the arc end sequence (AES) No.1 are automatically entered to the welding end point.

\* ASS No.=1 and AES No.=1 are entered to each welding point.





### 3.9.4.3 Creation of reservation commands

The reservation commands are processed in the same manner as that for program creation.

| No. | Operation                                                                                                               | Screen display                                                                                                                                                                                                                            |
|-----|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Bring up the initial screen by pressing the END key and the MODE SEL key.                                               | <div>Mode Select (Initial)<br/>To select &lt;OPR&gt; or &lt;TEACH&gt;, use SW on the controller.<br/><div>*OPR select* —1/1—<br/>1 Edit                      4 Init. set<br/>2 Product data          5 E. memory<br/>3 Option</div></div> |
| 2   | Since the cursor has shifted to "Edit", press the ENTER key.                                                            |                                                                                                                                                                                                                                           |
| 3   | Move the cursor to "A-S-S" (arc start sequence), "A-E-S" (arc end sequence" or "Library" and press the ENTER key.       | <div>Edit<br/>Memory 97.7% (app.5811 steps)<br/><div>*OPR select* —1/1—<br/>1 Job                      4 Program<br/>2 A-S-S                  5 A-E-S<br/>3 Library</div></div>                                                           |
| 4   | Move the cursor to "Input No." and press the ENTER key.                                                                 |                                                                                                                                                                                                                                           |
| 5   | Enter the values via the numerical keys on the panel.                                                                   | <div>* OPR select *<br/>1 Input No.              5 File list<br/>2 Copy                  6 Divide<br/>3 Merge                7 Delete<br/>4 Comment              8 Protect</div>                                                          |
| 6   | Press the ENTER key.                                                                                                    |                                                                                                                                                                                                                                           |
|     | The procedure after this step is the same as that for the 3.9.3 "Creation and modification of program" No.13 and after. | <div>* OPR Select*<br/>(Library)<br/>Please input No.<br/>Library No.              → 5</div>                                                                                                                                              |

(Note) The arc start/end sequence commands stored when the product is shipped are as follows:

1. Arc Start sequence commands

| No. | ASS 1               | ASS 2               | ASS 3               | ASS 4               | ASS 5               |
|-----|---------------------|---------------------|---------------------|---------------------|---------------------|
| 1   | OUTB OPORT #210=1   | OUTB OPORT #210=1   | OUTB OPORT #210=1   | DELAY 0.1 SEC       | DELAY 0.1 SEC       |
| 2   | OUTB OPORT #209=1   | DELAY 0.1 SEC       | DELAY 0.2 SEC       | OUTB OPORT #210 = 1 | OUTB OPORT #210 = 1 |
| 3   | WAIT IPORT #217 = 1 | OUTB OPORT #209 = 1 | OUTB OPORT #209 = 1 | DELAY 0.2 SEC       | DELAY 0.2 SEC       |
| 4   |                     | WAIT IPORT #217 = 1 | WAIT IPORT #217 = 1 | OUTB OPORT #209 = 1 | OUTB OPORT #209 = 1 |
| 5   |                     |                     |                     | WAIT IPORT #217 = 1 | DELAY 0.2 SEC       |
| 6   |                     |                     |                     |                     | WAIT IPORT #217 = 1 |

Note) "OUTB OPORT #\*\*\* = \* 0" is used for the output command.

Meaning of the sequence command

| Robot's language  | Meaning              |                             |                 | Connection of robot and welding M/C                                                   | Japanese |
|-------------------|----------------------|-----------------------------|-----------------|---------------------------------------------------------------------------------------|----------|
| OUTB OPORT #210=1 | OUTB output          | OPORT #210 to #210 terminal | = 1<br>ON       | The cable of the gas valve is connected to #210 terminal.                             |          |
| OUTB OPORT #209=1 | OUTB output          | OPORT #209 to #209 terminal | = 1<br>ON       | The cable of the torch SW is connected to #209 terminal.                              |          |
| WAIT IPORT #217=1 | WAIT to wait         | OPORT #217 to #217 terminal | = 1<br>Input ON | The current detection cable is connected to #217 terminal.                            |          |
| DELAY 0.1 SEC     | DELAY to wait (time) | 0.1 second                  |                 |  |          |

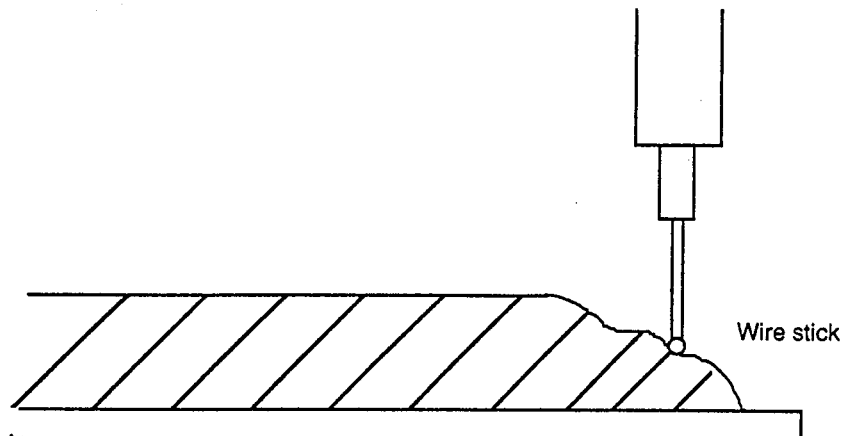
The robot does not stop unless this signal is sent to the robot.

## 2 Arc end sequence

- (1) The following contents are stored in the arc end sequence of the products shipped before June of 1994.

| No. | AES 1             | AES 2             | AES 3             | AES 4             | AES 5             |
|-----|-------------------|-------------------|-------------------|-------------------|-------------------|
| 1   | OUTB OPORT #209=0 | OUTB OPORT #209=0 | DELAY 0.3 SEC     | DELAY 0.3 SEC     | OUTB OPORT #209=0 |
| 2   | OUTB OPORT #210=0 | DELAY 0.5 SEC     | OUTB OPORT #209=0 | OUTB OPORT #209=0 | OUTB OPORT #210=0 |
| 3   | DELAY 0.5 SEC     | OUTB OPORT #210=0 | OUTB OPORT #210=0 | DELAY 0.5 SEC     | DELAY 0.2 SEC     |
| 4   | OUTB OPORT #211=1 | OUTB OPORT #211=1 | DELAY 0.5 SEC     | OUTB OPORT #210=0 | AMP = 150A        |
| 5   | DELAY 0.2 SEC     | DELAY 0.2 SEC     | OUTB OPORT #211=1 | OUTB OPORT #211=1 | OUTB OPORT #213=1 |
| 6   | OUTB OPORT #211=0 | OUTB OPORT #211=0 | DELAY 0.2 SEC     | DELAY 0.2 SEC     | DELAY 0.1 SEC     |
| 7   |                   |                   | OUTB OPORT #211=0 | OUTB OPORT #211=0 | OUTB OPORT #212=1 |
| 8   |                   |                   |                   |                   | DELAY 0.1 SEC     |
| 9   |                   |                   |                   |                   | OUTB OPORT #212=0 |
| 10  |                   |                   |                   |                   | DELAY 0.1 SEC     |
| 11  |                   |                   |                   |                   | OPORT#213=0       |
| 12  |                   |                   |                   |                   | OUTB OPORT#211=1  |
| 13  |                   |                   |                   |                   | DELAY 0.2 SEC     |
| 14  |                   |                   |                   |                   | OUTB OPORT #211=0 |

Note) "OUTB OPORT# \*\*\* = \* 0" is used for the output command.



OUTB OPORT #211 = 1  
DELAY 0.2 SEC  
OUTB OPORT #211 = 0



This command sends the signal for stick check (to check that the wire and the weld been contacts at the end point) to the welding machine. However, this check is actually carried out by the welding machine. If they contact with each other, the welding machine sends the signal to the robot so that the robot is held.

| Robot's language  | Meaning               |                          |                | Connection of robot and welding M/C                     |
|-------------------|-----------------------|--------------------------|----------------|---------------------------------------------------------|
| OUTB OPORT #209=0 | OUTB output           | OPORT #209 terminal #209 | =0<br>Turn OFF | The torch SW cable is connected to #209.                |
| OUTB OPORT #210=0 | OUTB output           | OPORT #210 terminal #210 | =0<br>Turn OFF | The gas valve cable is connected to #210.               |
| DELAY 0.2 SEC     | DELAY to wait         | 0.2 seconds              |                |                                                         |
| AMP = 150A        | AMP current detection | 150A<br>150 ampere       |                |                                                         |
| OUTB OPORT #213=1 | OUTB output           | OPORT #213 terminal #213 | =1<br>Turn ON  | The motor reversed rotation cable is connected to #213. |
| OUTB OPORT #212=1 | OUTB output           | OPORT #212 terminal #212 | =1<br>Turn ON  | The wire inching start cable is connected to #212.      |
| OUTB OPORT #212=0 | OUTB output           | OPORT #212 terminal #212 | =0<br>Turn OFF | The wire inching start cable is connected to #213.      |
| OUTB OPORT #213=0 | OUTB output           | OPORT #213 terminal #213 | =1<br>Turn OFF | The motor reversed rotation cable is connected to #213. |
| OUTB OPORT #211=1 | OUTB output           | OPORT #211 terminal #211 | =1<br>Turn ON  | The stick check cable is connected to #211.             |
| OUTB OPORT #211=0 | OUTB output           | OPORT #211 terminal #211 | =0<br>Turn OFF | The stick check cable is connected to #211.             |

AES5 #4 and after      Commands to pull in the wire coming from the tip at the arc end point.

AMP = 150A      —————> Determines the wire inching speed. (The larger, the faster.)  
(for both welding current and wire inching speed)

OUTB OPORT #213 = 1  
DELAY 0.1 SEC  
OUTB OPORT #212 = 1      } Wire reversed inching start

DELAY 0.1 SEC      —————> Reversed inching start

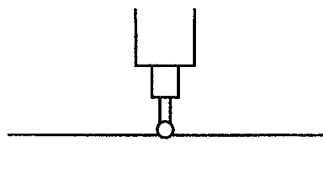
OUTB OPORT #212 = 0  
DELAY 0.1 SEC  
OUTB OPORT #213 = 0      } Wire reversed inching end

**WHY ARE THOSE 2 SIGNALS USED?**

OUTB OPORT #212=1 is for turning on the motor (when the motor is turned on, the wire comes out). The motor is rotated backward by the OUTB OPORT #213 = 1 command.

The wire moved in is determined by AMP = 150A X DELAY 0.1 sec.  
(speed) (time)

\* This is used when the arc start is deteriorated due to the contact of the wire and the mother material.

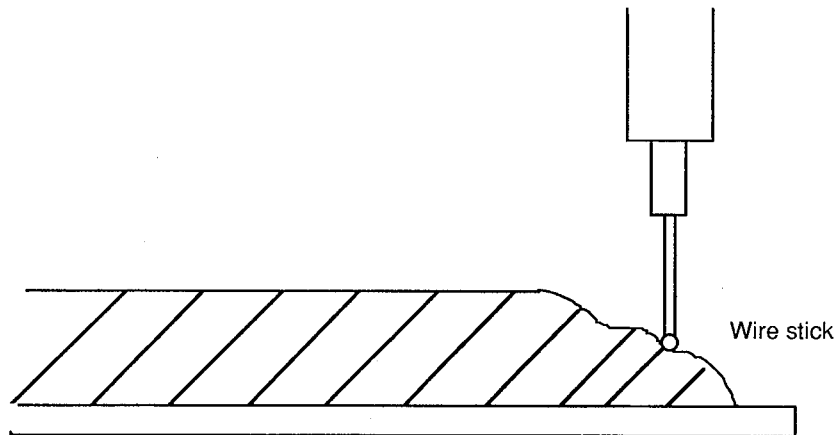


In the case shown in the figure to the left, the tip contacts the wire with the clicking sound at the arc start.

- (2) The following contents are stored in the arc end sequence of the products shipped after July of 1994.

| No. | AES 1                | AES 2                | AES 3                | AES 4                | AES 5                |
|-----|----------------------|----------------------|----------------------|----------------------|----------------------|
| 1   | OUTB OPORT<br>#219=0 | DELAY 0.1 SEC        | DELAY 0.2 SEC        | DELAY 0.3 SEC        | OUTB OPORT<br>#209=0 |
| 2   | DELAY<br>0.4SEC      | OUTB OPORT<br>#209=0 | OUTB OPORT<br>#209=0 | OUTB OPORT<br>#209=0 | DELAY 0.2 SEC        |
| 3   | OUTB OPORT<br>#211=1 | DELAY 0.4 SEC        | DELAY 0.4 SEC        | DELAY 0.4 SEC        | AMP=150A             |
| 4   | DELAY<br>0.3SEC      | OUTB OPORT<br>#211=1 | OUTB OPORT<br>#211=1 | OUTB OPORT<br>#211=1 | OUTB OPORT<br>#213=1 |
| 5   | OUTB OPORT<br>#211=0 | DELAY 0.3 SEC        | DELAY 0.3 SEC        | DELAY 0.3 SEC        | DELAY 0.1 SEC        |
| 6   | OUTB OPORT<br>#210=0 | OUTB OPORT<br>#211=0 | OUTB OPORT<br>#211=0 | OUTB OPORT<br>#211=0 | OUTB OPORT<br>#212=1 |
| 7   |                      | OUTB OPORT<br>#210=0 | OUTB OPORT<br>#210=0 | OUTB OPORT<br>#210=0 | DELAY 0.1 SEC        |
| 8   |                      |                      |                      |                      | OUTB OPORT<br>#212=0 |
| 9   |                      |                      |                      |                      | DELAY 0.1 SEC        |
| 10  |                      |                      |                      |                      | OUTB OPORT<br>#213=0 |
| 11  |                      |                      |                      |                      | OUTB OPORT<br>#211=1 |
| 12  |                      |                      |                      |                      | DELAY 0.3 SEC        |
| 13  |                      |                      |                      |                      | OUTB OPORT<br>#211=0 |
| 14  |                      |                      |                      |                      | OUTB OPORT<br>#210=0 |

Note) "OUTB OPORT# \*\*\* = \* 0" is used for the output command.



OUTB OPORT #211 = 1  
DELAY 0.3 SEC  
OUTB OPORT #211 = 0



This command sends the signal for stick check (to check that the wire and the weld been contacts at the end point) to the welding machine. However, this check is actually carried out by the welding machine. If they contact with each other, the welding machine sends the signal to the robot so that the robot is held.

| Robot's language  | Meaning               |                          |                 | Connection of robot and welding M/C                     |
|-------------------|-----------------------|--------------------------|-----------------|---------------------------------------------------------|
| OUTB OPORT #209=0 | OUTB output           | OPORT #209 terminal #209 | = 0<br>Turn OFF | The torch SW cable is connected to #209.                |
| DELAY 0.2 SEC     | DELAY to wait         | 0.2 seconds              |                 |                                                         |
| AMP = 150A        | AMP current detection | 150A<br>150 ampere       |                 |                                                         |
| OUTB OPORT #213=1 | OUTB output           | OPORT #213 terminal #213 | =1<br>Turn ON   | The motor reversed rotation cable is connected to #213. |
| OUTB OPORT #212=1 | OUTB output           | OPORT #212 terminal #212 | =0<br>Turn OFF  | The wire inching start cable is connected to #212.      |
| OUTB OPORT #212=0 | OUTB output           | OPORT #212 terminal #212 | =0<br>Turn OFF  | The wire inching start cable is connected to #213.      |
| OUTB OPORT #213=0 | OUTB output           | OPORT #213 terminal #213 | =1<br>Turn OFF  | The motor reversed rotation cable is connected to #213. |
| OUTB OPORT #211=1 | OUTB output           | OPORT #211 terminal #211 | =1<br>Turn ON   | The stick check cable is connected to #211.             |
| OUTB OPORT #211=0 | OUTB output           | OPORT #211 terminal #211 | =0<br>Turn OFF  | The stick check cable is connected to #211.             |
| OUTB OPORT #210=0 | OUTB output           | OPORT #210 terminal #210 | =0<br>Turn OFF  | The stick check cable is connected to #210.             |

AES5 #3 and after      Commands to pull in the wire coming from the tip at the arc end point.

AMP = 150A      → Determines the wire inching speed. (The larger, the faster.)  
(for both welding current and wire inching speed)

OUTB OPORT #213 = 1 }  
DELAY 0.1 SEC } Wire reversed inching start  
OUTB OPORT #212 = 1 }

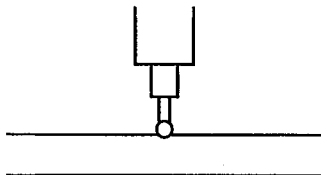
DELAY 0.1 SEC      → Reversed inching start

OUTB OPORT #212 = 0 }  
DELAY 0.1 SEC } Wire reversed inching end  
OUTB OPORT #213 = 0 }

WHY ARE THOSE 2 SIGNALS USED?  
OUTB OPORT #212=1 is for turning on the motor  
(when the motor is turned on, the wire comes out).  
The motor is rotated backward by the OUTB  
OPORT #213 = 1 command.

The wire moved in is determined by  $AMP = 150A \times DELAY 0.1 \text{ sec.}$   
(speed) (time)

\* This is used when the arc start is deteriorated due to the contact of the wire and the mother material.



In the case shown in the figure to the left, the tip contacts to the wire with the clicking sound at the arc start.

### 3.10.5 Protect

The jobs, programs, arc start sequence, arc end sequence and library can be protected so that any modification cannot be made to them.

| No. | Operation                                                                                                                                                                                | Screen display                                                                                                                                                                                                                                                         |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | Return to the initial screen by pressing the END key and the MODE SEL key.                                                                                                               | <div>Mode Select (Initial)</div> <div>To select &lt;OPR&gt; or &lt;TEACH&gt;, use SW on the controller.</div> <div>*OPR select* —1/1—</div> <div> <div>1 Edit</div> <div>2 Product data</div> <div>3 Option</div> <div>4 Init. set</div> <div>5 E. memory</div> </div> |
| 1   | Since the cursor has shifted to "Edit", press the ENTER key.                                                                                                                             | <div>Edit</div> <div>Memory 97.7% (app.5811 steps)</div> <div>*OPR select* —1/1—</div> <div> <div>1 Job</div> <div>2 A-S-S</div> <div>3 Library</div> <div>4 Program</div> <div>5 A-E-S</div> </div>                                                                   |
| 2   | Select the item from the menu on the screen using the cursor key and press the ENTER key.<br>For instance, to protect the program, move the cursor to "Program" and press the ENTER key. | <div>Screen 1</div> <div>Edit : Program</div> <div>* OPR select *</div> <div> <div>1 Input No</div> <div>2 Copy</div> <div>3 Merge</div> <div>4 Comment</div> <div>5 File list</div> <div>6 Divide</div> <div>7 Delete</div> <div>8 Protect</div> </div>               |
| 3   | Move the cursor to "Protect" and press the ENTER key.                                                                                                                                    | <div>Screen 2</div> <div>Edit : Protect</div> <div> <div>1</div> <div>8 * MATSUSHITA</div> <div>20</div> <div>55</div> <div>120 * PANASONIC</div> <div>Page next Page back Set-up</div> </div>                                                                         |
| 4   | Move the cursor to "Page next" or "Page back", press the ENTER key to change the page on the screen. Display the No. of the item to be protected.                                        | <div>Screen 3</div> <div>Edit : Protect</div> <div> <div>1</div> <div>8 * MATSUSHITA</div> <div>20</div> <div>55</div> <div>120 * PANASONIC</div> <div>[ENT] ► Set-up, [CAN] ► Release</div> </div>                                                                    |
| 5   | Move the cursor to "Set-up" and press the ENTER key.                                                                                                                                     | <div>Screen 4</div>                                                                                                                                                                                                                                                    |
| 6   | Move the cursor to the No. of the item to be protected and press the ENTER key.<br>(""" is displayed beside the No. protected.)                                                          |                                                                                                                                                                                                                                                                        |

| No. | Operation                                                                                                                                                                                                                                                                                             | Screen display                                                                                                                                                                                                                                                                       |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7   | <p>To protect the position data, move the cursor to YES, while move the cursor to NO to not to protect it.</p> <p>Press the ENTER key.</p> <p>(The No. whose position data is protected is marked with "***". If the No. is marked with "+", the position data is not protected.)</p>                 | <div> <div> Edit Program </div> <div> <div> *OPR select* Protect position Data? 1 Yes 2 No </div> </div> </div> <p>Screen 18-4</p> |
|     | <p>Note 12</p> <p>To release the protection</p> <p>Press the CANCEL key with the cursor at the No. protected. (The No.s protected are marked with "***" or "-".)</p> <p>Move the cursor to YES on the screen to the right and press the CANCEL key. (Make sure that "***" by the No. disappears.)</p> | <div> <div> * OPR Select* Release protection? 1 Yes 2 No </div> </div>                                                                                                                                                 |
|     |                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                      |



### 3.10.6 Copy, division, merge

The job, program, A-S-S, A-E-S and Library newly created are copied, divided or merged.

| No. | Operation                                                                                                            | Screen display                                                                                                                                                                                                                                                           |
|-----|----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | Press the END key and the MODE SEL key to return to the initial screen.                                              | <div>Mode Select (Initial)</div> <div>To select &lt;OPR&gt; or &lt;TEACH&gt;, use SW on the controller.</div> <div><div>*OPR select* 1/1</div><div><div>1 Edit</div><div>2 Product data</div><div>3 Option</div><div>4 Init. set</div><div>5 E. memory</div></div></div> |
| 1   | Since the cursor has shifted to "Edit", press the ENTER key.                                                         |                                                                                                                                                                                                                                                                          |
| 2   | Select the item from the menu screen 2 and press the ENTER key.                                                      | <div><div>* OPR select * 1/1</div><div><div>1 Job</div><div>2 A-S-S</div><div>3 Library</div><div>4 Program</div><div>5 A-E-S</div></div></div>                                                                                                                          |
| 3   | Select the item among "Copy", "Divide", "Merge", and "Delete" (move the cursor to the item) and press the ENTER key. | Screen 2 <div><div>* OPR select *</div><div><div>1 Input No.</div><div>2 Copy</div><div>3 Merge</div><div>4 Comment</div><div>5 File list</div><div>6 Divide</div><div>7 Delete</div><div>8 Protect</div></div></div>                                                    |
| 4   | Enter the value according to the instructions on the screen and press the ENTER key.                                 |                                                                                                                                                                                                                                                                          |
|     | When the CANCEL key is pressed while the value is being entered, the entered value is cleared.                       | <div>(COPY)</div> <div><div>* OPR Select*</div><div><div>Program</div><div>STEP</div><div>Program</div><div>0</div><div>1 to 999</div><div>(Copy)</div></div></div>                                                                                                      |
|     |                                                                                                                      | <div>(DIVIDE)</div> <div><div>* OPR Select*</div><div><div>Program</div><div>STEP</div><div>Program</div><div>0</div><div>1 to 999</div><div>(Divide)</div></div></div>                                                                                                  |
|     |                                                                                                                      | <div>(MERGE)</div> <div><div>* OPR Select*</div><div><div>Program</div><div>Program</div><div>&amp;</div><div>Create</div></div></div>                                                                                                                                   |
| 5   | Press the END key several times to go back to the initial screen.                                                    |                                                                                                                                                                                                                                                                          |

### 3.9.6-1 Delete

The job, program, A-S-S, A-E-S and library newly created are deleted.

| No. | Operation                                                                                                                                            | Screen display                                                                                                           |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| 0   | Follow the operations in 3.10.6 "Copy, division, merge" #0 to #2.                                                                                    | <div> * OPR select * <div> 1 Input No. 5 File list 2 Copy 6 Divide 3 Merge 7 Delete 4 Comment 8 Protect </div> </div>    |
| 1   | Select "Delete" and press the ENTER key.                                                                                                             |                                                                                                                          |
| 2   | Select either "Del. File" or "Del. Files" and press the ENTER key.                                                                                   | <div> * OPR Select* <div> 1 Del. File 2 Del. Files </div> </div>                                                         |
|     | In case of selecting Del. File                                                                                                                       |                                                                                                                          |
| 3   | Input the value according to the instructions on the screen and press the ENTER key.                                                                 | <div> * OPR Select* <div> Program Step: From 1 to 999 (Delete) </div> </div>                                             |
| 4   | "Delete OK?" appears. And select "Yes" and press the ENTER key.                                                                                      |                                                                                                                          |
|     | In case of selecting Del. Files                                                                                                                      |                                                                                                                          |
| 5   | Display the No. to be deleted by sending the page to the next or the back.                                                                           | <div> Teaching DEL File select 1/1 <div> 1 0.1% 10 0.0% 15 0.1% 30 0.2% 70 0.0% Page next Page back Set-up </div> </div> |
| 6   | Move the cursor to "Set-up" and press the ENTER key.                                                                                                 |                                                                                                                          |
| 7   | Move the cursor to the No. to be deleted and press the ENTER key. (The cursor blinks.) In case of making a mistake, press the CANCEL key.            | <div> Teaching DEL File select <div> 1 10 15 30 70 [ENT] ---&gt; Set-up, [CAN] ---&gt; Release </div> </div>             |
| 8   | In case of setting the other pages, press the END key to repeat the operations #5 to #7. When all the setting is completed, press the END key twice. |                                                                                                                          |
| 9   | The message "Delete OK?" appears on the screen. And select "Yes" and press the ENTER key.                                                            | <div> * OPR Select* Delete O.K.? <div> 1 YES 2 NO </div> </div>                                                          |

### 3.9.7. Searching

| No. | Operation                                                                           | Screen display                                                                                                                                                               |
|-----|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Carry out the procedures in 3.9.3 "Creation and modification of program" No.1~No.4. | <div> Edit : Program #15 </div> <div> 0 MOVEP 15.00<br/> 1 MOVEL 15.00<br/> 2 MOVEL 15.00<br/> 3 * MOVEC 3.00 AJO<br/> 4 * MOVEC 3.00<br/> [ENTER] or [OPR SEL] </div>       |
| 2   | Press the OPR SEL key.                                                              |                                                                                                                                                                              |
| 3   | Move the cursor to "Others" and press the ENTER key.                                | <div> Edit : Program #15 </div> <div> 0 MOVEP 15.00<br/> 1 MOVEL 15.00<br/> 2 MOVEL 15.00<br/> 3 * MOVEC 3.00 AJO<br/> 4 * MOVEC 3.00<br/> Page next Page back Others </div> |
| 3'  | Since the cursor has shifted to "Search", press the ENTER key.                      | <div> * OPR Select* </div> <div> 1 Search 2 Change all </div>                                                                                                                |
| 4   | Move the cursor to the item to be searched, and press the ENTER key.                | <div> *Search contents* </div> <div> 1 Step No.<br/> 2 Sequence cmd<br/> 3 Move command </div>                                                                               |
|     | <div>To search the step No.</div>                                                   | Note 1                                                                                                                                                                       |
| 5   | Enter the step No. to be searched.                                                  |                                                                                                                                                                              |
| 6   | Press the ENTER key.                                                                | <div> * Search contents * </div> <div> Input step No...<br/> Step No. → 0 </div>                                                                                             |

| No. | Operation                                                                                                                                                                                                                                                          | Screen display                                                                                                                                            |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | <b>To search the Sequence command</b>                                                                                                                                                                                                                              |                                                                                                                                                           |
| 5'  | Specify the sequence command to be searched in the same manner as that for setting the sequence command input in the "Creation and modification of program".                                                                                                       | <div> *Search contents* -1/1 <div> 1 <b>I/O</b> 2 Tool control 3 Ins sentence 4 Declare 5 Flow control 6 Weld control 7 Move/Speed 8 Others </div> </div> |
|     | <b>To search the Move command</b>                                                                                                                                                                                                                                  |                                                                                                                                                           |
| 5"  | Specify the Move command to be searched in the same manner as that for setting the sequence command input in the "Creation and modification of program".                                                                                                           | <div> *CMD Select* <div> 1 <b>PTP</b> 2 Circl (Start) 3 Weav' (Start) 4 Weav' (Mid) 5 Linear 6 Circl (Mid) 7 Weav' (Ampl) </div> </div>                   |
| 6   | Set the parameter as described on the above and press the ENTER key. And the screen shown on the right appears.                                                                                                                                                    | <div> *CMD Select* <div> OUTB OPROT# 1 = 1 0 1 Pre-search 2 Post-search </div> </div>                                                                     |
| 7   | Move the cursor to "Pre-search" in case of searching the latter part of the address where the cursor is currently placed, and to "Post-search" in case of searching the previous part of the address where the cursor is currently placed and press the ENTER key. |                                                                                                                                                           |
| 8   | The data can be searched by the procedures above.<br>When the search is completed, the screen shown on the right appears.                                                                                                                                          | <div> Search completed. <div> 1 <b>Re-search</b> 2 Stop </div> </div>                                                                                     |
| 9   | To search again, move the cursor to "Re-search", while move the cursor to "Stop" to quit the search mode.                                                                                                                                                          |                                                                                                                                                           |
| 10  | Press the ENTER key.<br>(When "Re-search" is selected, the contents previously searched is searched upward and downward.)                                                                                                                                          |                                                                                                                                                           |

Note 1) The display shown below appears in the main software of version "J3" or lower version.

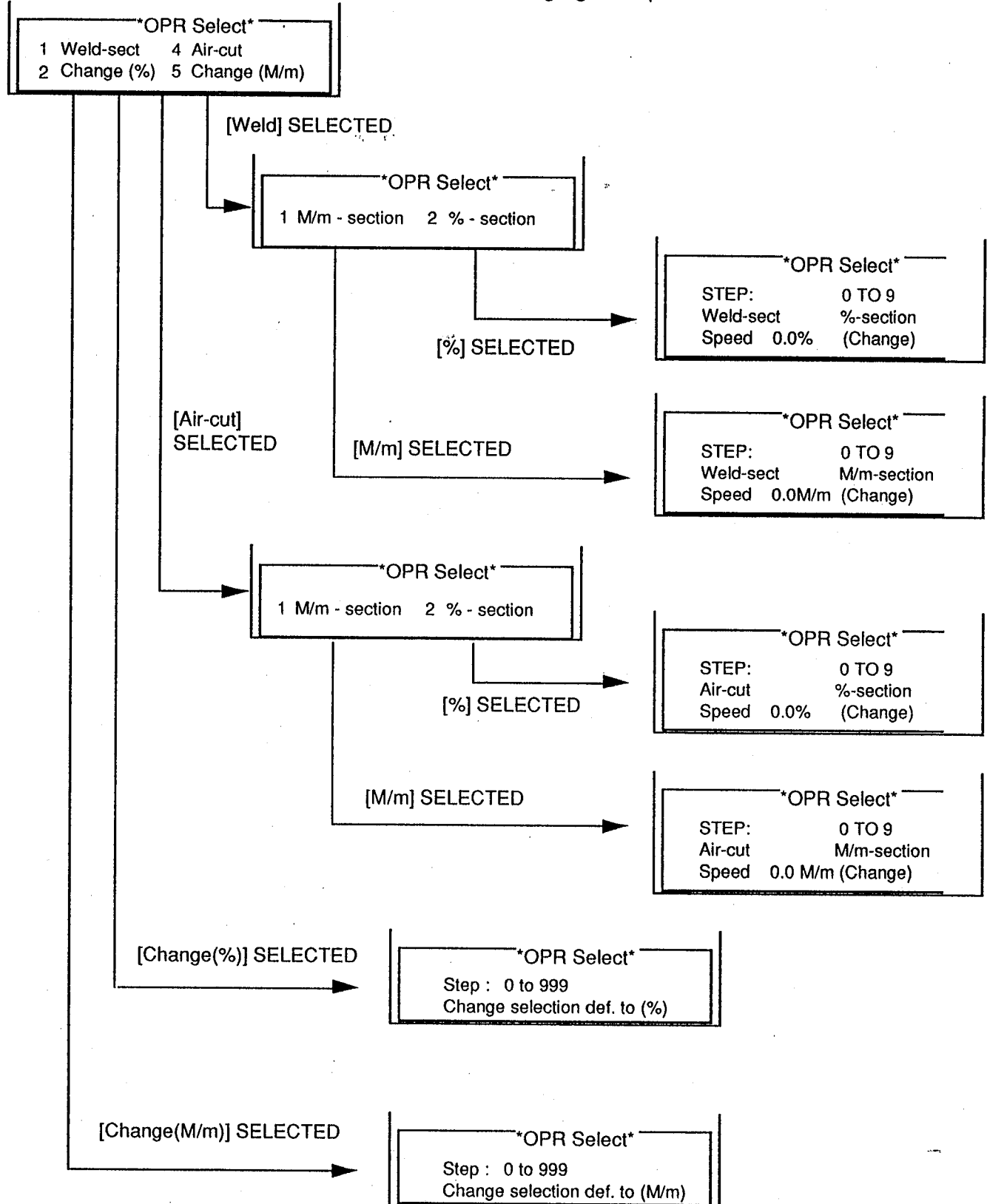
| *Search contents* |              |
|-------------------|--------------|
| Step No.          | Move command |
| Sequence cmd.     |              |

### 3.9.8 All change

| No.                 | Operation                                                                           | Screen display                                                                                                                                                               |
|---------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                   | Carry out the procedures in 3.9.3 "Creation and modification of program" No.1~No.4. | <div> Edit : Program #15 </div>                                                                                                                                              |
| 2                   | Press the OPR SEL key.                                                              | <div> 0 MOVEP 15.00<br/> 1 MOVEP 15.00<br/> 2 MOVEP 15.00<br/> 3 * MOVEC 3.00 AJO<br/> 4 * MOVEC 3.00<br/> [ENTER] or [OPR SEL] </div>                                       |
| 3                   | Move the cursor to "Others" and press the ENTER key.                                |                                                                                                                                                                              |
| 4                   | Move the cursor to "Change all" and press the ENTER key.                            | <div> Edit : Program #15 </div> <div> 0 MOVEP 15.00<br/> 1 MOVEP 15.00<br/> 2 MOVEP 15.00<br/> 3 * MOVEC 3.00 AJO<br/> 4 * MOVEC 3.00<br/> Page next Page back Others </div> |
| All change of speed |                                                                                     |                                                                                                                                                                              |
| 4                   | Move the cursor to "Speed" and press the ENTER key.                                 | <div> * OPR Select* </div> <div> 1 Search 2 Change all </div>                                                                                                                |
| 5                   | Select the kind of the step or the mode of the speed to be changed.                 | <div> * OPR Select* </div> <div> 1 Speed 2 Weld cond. </div>                                                                                                                 |
| 6                   | Enter the parameters according to the instructions on the screen.                   |                                                                                                                                                                              |
| 7                   | Press the ENTER key.                                                                | <div> * OPR Select* </div> <div> 1 Weld-sect 4 Air-cut<br/> 2 Change (%) 5 Change (M/m) </div>                                                                               |
|                     |                                                                                     | <div> * OPR Select* </div> <div> STEP: 0 TO 999<br/> Air-cut %-section<br/> Speed % (Change) </div>                                                                          |

| No. | Operation                                                                    | Screen display                                                                                                                                 |
|-----|------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
|     | All change of the welding conditions                                         |                                                                                                                                                |
| 4   | Move the cursor to "Weld cond" (welding conditions) and press the ENTER key. |                                                                                                                                                |
| 5   | Select the welding condition to be changed.                                  | <div> <div>*OPR Select* —1/1—</div> <div>1 AJO      2 CJO</div> </div>                                                                         |
| 6   | Enter or select the parameter according to the instructions on the display.  | <div> <div>*OPR Select* —1/1—</div> <div>STEP:      0 TO 999</div> <div>AJO</div> <div>A= 0(A) V=      0.0(V)</div> <div>(Change)</div> </div> |
| 7   | Press the ENTER key.                                                         |                                                                                                                                                |

### 3.9.8.1. Flow chart of the screens when changing the speed





### 3.9.9 Entering file comment

There are 5 kinds of edit files; job, program, arc start sequence, arc end sequence and library. Normally, these files are used according to the contents of the task performed by the robot. Comment can be entered in each file so that the content of the file can be easily understood. A comment is entered using alphabetical characters and special characters. The maximum number of characters in a comment is 8. The comment is entered in edit mode.

| No. | Operation                                                                          | Screen display                                                                                                                                                                                      |
|-----|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | Return to the initial screen.                                                      | Mode Select (Initial)<br>To select <OPR> or <TEACH>, use SW on the controller.                                                                                                                      |
| 1   | Since the cursor has shifted to "Edit", press the ENTER key.                       | <div> *OPR select* 1/1 </div> <div> 1 Edit                      4 Init. set<br/> 2 Product data          5 E. memory<br/> 3 Option </div>                                                           |
| 2   | Select the kind of file to which the comment is entered.                           | <div> * OPR select * 1/1 </div> <div> 1 Job                      4 Program<br/> 2 A-S-S                  5 A-E-S<br/> 3 Library </div>                                                              |
| 3   | Move the cursor to "Comment" and press the ENTER key.                              | <div> * OPR select * </div> <div> 1 Input No.              5 File list<br/> 2 Copy                    6 Divide<br/> 3 Merge                  7 Delete<br/> 4 Comment               8 Protect </div> |
| 4   | Enter the No. of file to which the comment is entered.<br><br>Press the ENTER key. | <div> (Program)<br/> Please input No.<br/> Program No. → 20 </div>                                                                                                                                  |

| No. | Operation                                                                                                                                                                                | Screen display |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 5   | Over-write or Insertion can also be selected.<br>These indications are displayed on the right upper area of the screen.<br>To change the settings,<br>Press the OPR SEL key.             |                |
| 6   | Move the cursor to the item to be selected and press the ENTER key.<br><br>(The item selected is displayed inverted.)                                                                    |                |
| 7   | When the OPR SEL key is pressed, the operation selection screen is brought back.                                                                                                         |                |
| 8   | To change the position of the characters to be entered, move the cursor to the "Cursor position" and press the ENTER key. The cursor at the right upper area of the screen can be moved. |                |
| 9   | Press the END key to return the cursor to the operation selection display.                                                                                                               |                |

| No. | Operation                                                                                                                                     | Screen display                                                                                                                                                                                                                                                                                                                         |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | <To enter the alphabetical/special characters>                                                                                                |                                                                                                                                                                                                                                                                                                                                        |
| 10  | Move the cursor to "Alphabet/special " and press the ENTER key.                                                                               | <div> EDIT : P:20 C: <br/> —Al/Sp—Full/Ins—1/5—<br/> 1 2 3 4 5<br/> 6 7 8 9 0<br/> A B C D E<br/> F G H I J<br/> K L M N O<br/> Page next Page back Set-up </div>                                                                                   |
| 11  | Move the cursor to "Page next" or "Page down" and press the ENTER key.                                                                        |                                                                                                                                                                                                                                                                                                                                        |
|     | The screen on which the characters to be entered are displayed appears when the procedures above are completed.                               | <div> EDIT : P:20 C: <br/> —Al/Sp—Full/Ins—1/5—<br/>  1 2 3 4 5<br/> 6 7 8 9 0<br/> A B C D E<br/> F G H I J<br/> K L M N O<br/> Select char in [ENTER] key </div> |
| 12  | Move the cursor to "Set-up" and press the ENTER key.                                                                                          |                                                                                                                                                                                                                                                                                                                                        |
| 13  | Move the cursor to the character to be entered and press the ENTER key, and then the character is entered at the cursor position after "C: ". |                                                                                                                                                                                                                                                                                                                                        |
| 14  | When all the characters are entered, screen No.6 is brought back.                                                                             |                                                                                                                                                                                                                                                                                                                                        |
| 15  | After completing registration of all characters, press the END key repeatedly. The initial screen is brought back.                            |                                                                                                                                                                                                                                                                                                                                        |

## CHAPTER 4

### VARIOUS FUNCTIONS AND SYSTEM APPLICATIONS (ADVANCED COURSE)

This chapter covers the explanations of the system settings and management displays necessary in teaching or operating robots.

In particular, the procedure to start the Pana-Robo externally in combination with the peripheral jigs is explained.

#### 4.1 Initial set-up

The "init. set" refers to the procedure to set the parameters used for the robot and the system. Since the standard parameters have been set prior to the shipping and the initial settings for other parameters are to be carried out at installation of the robot, this procedure is not required in daily operations unless otherwise the welding conditions are not modified.

The particulars and the outlines of the system settings are as described below:

##### 4.1.1 System set-up

###### 4.1.1.1 Robot constant (Setting the constant of the robot manipulator and the parameters for robot's motions)

- a. Software limit ----- Setting the data of software limit (limit of the work envelope of each axis).
- b. Speed limit ----- Setting the speed limits for teaching and trace operation.
- c. Standard tool No. ----- Setting the standard tool No. used in teaching.
- d. Jog ----- Setting the distance for jog feed.
- e. Tool offset ----- Setting the tool (torch) offset data.

###### 4.1.1.2 Welding conditions (Setting the conditions for welding)

- a. Welding table----- Condition menu (Welding start conditions, welding end conditions)
- b. Inching speed ----- Wire inching (high, low)
- c. Override ----- Values of current, voltage and speed for override
- d. Weaving table ----- Weaving frequency and the timer menu
- e. Gas / Wire----- Setting the gas and wire diameter.

###### 4.1.1.3 Characteristics of the welder

Method to input the welding current and voltage (Direct/code)

- a. Code: ----- Max output code, output compensation
- b. Direct: ----- Welding machine used and wire diameter, characteristic table compensation
- c. Direct (User welder): --- Welding machine characteristics generation

4.1.1.4 Memory clear (Erase all data having been taught)

- a. All clear                      Job. program, arc start sequence, arc end sequence and library are all erased while system setting data is reset to standard values.
- b. File clear                    Job. program, arc start sequence and library are all erased. The system set data is not affected.

4.1.2 Expanded functions (Presence or absence of the expanded function of the robot, setting the detailed conditions)

- \* 4.1.2.0 Other language                      Changes the language in which messages are shown. This function is provided to enable people of various nationalities to use this robot, considering that more and more companies are operating worldwide recently.
- 4.1.2.1 Robot operation key                      Effective/ineffective of the ROBOT OPR key in the teaching pendant
- 4.1.2.2 High speed key                      Setting of the key used to move the robot quickly in the low speed area during the confirmation operation.
- 4.1.2.3 CTRL key (1~4)                      Setting of the key used to control the output signals with the teach pendant in the teaching and drive mode.
- 4.1.2.4 Tool No. message                      Effective/ineffective of tool No. set-up function in teaching
- 4.1.2.5 Teaching                      Effective/ineffective if teaching interlock input
- 4.1.2.6 RT work envelope monitoring                      Specifying the direction, angle and I/O terminal for monitoring the RT axis work envelope.
- 4.1.2.7 Cube monitoring                      Setting the Direction and I/O terminal for cube monitoring
- 4.1.2.8 Start mode output                      Setting the output terminal informing that the drive motion has been set to " Panel ".

|      |            |                            |                                                                                                                                                                                                                              |
|------|------------|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ***  | 4.1.2.9    | This item No. is not used. |                                                                                                                                                                                                                              |
| **** | 4.1.2.9.1  | Welding off input          | This function is used to carry out the same operation as the WELD OFF key of the teach pendant by means of the input signal from the outside and to interrupt the welding motions during the operation.                      |
|      | 4.1.2.10   | Welding off output         | Setting the output terminal informing that the welding is in OFF status.                                                                                                                                                     |
|      | 4.1.2.11   | Home position return       | Setting the reset position output terminal for Home position return motion.                                                                                                                                                  |
|      | 4.1.2.12   | Interlock output           | Setting the output terminal informing that the interlock is in "operating" status when the DELAY or WAIT command is executed.                                                                                                |
|      | 4.1.2.13   | Interval timer output      | Setting the terminal used for interval timer output, and ON/OFF times.                                                                                                                                                       |
| **   | 4.1.2.13.1 | Teaching enable output     | Setting the output terminal to output while LED lamp lid in Operation mode.                                                                                                                                                  |
|      | 4.1.2.14   | Job selection method       | Setting the job select/start method to start the robot via the external unit.                                                                                                                                                |
|      | 4.1.2.15   | Cartesian drive            | When the robot is set to move in the Cartesian coordinate system, this function is used to choose whether it should move in the absolute Cartesian coordinate system.                                                        |
|      | 4.1.2.16   | Origin search              | This function is used to return the robot to the origin which is specified by the Origin Offset operation.                                                                                                                   |
| *    | 4.1.2.17   | Arc retry                  | When an arc is not generated at the start point, this function moves the robot slightly and tries to generate one. This function is not available in TIG welding and low-pulse MIG welding.                                  |
| *    | 4.1.2.18   | Stick release              | When the welding wire and base metal are sticking to each other after welding, this function resumes welding and clears the sticking automatically. This function is not available in TIG welding and low-pulse MIG welding. |

- \* 4.1.2.19 Arc overlapping
 

When the robot is stopped due to arc extinction or for other reasons before finishing welding, this function memories the position where it stops, and makes it resume welding a certain distance before the position. This function is available in linear and circular welding. When the robot is stopped before finishing weaving, either linear or circular, follow the regular procedure for resumption. This function is not available in TIG welding and low-pulse MIG welding.
- \*\*\* 4.1.2.20 Holding output
 

Setting the output terminals which must be turned off when the operation is temporarily stopped.

Setting the input terminal used when the operation is forcibly stopped.
- \*\*\*\* 4.1.2.21 Resume function
 

This function is provided to restore the robot operation which is suspended due to the interruption of the power supply during the stand-by or operation in the "Operation" mode, or during the program-teaching or checking in the "Teach" mode. When the power is reapplied, the robot operation will be restored from the step and/or the output status where the operation is suspended.
- \* These functions are available with the main software of version "F0" or higher versions.
- \*\* These functions are available with the main software of version "GO" or higher versions.
- \*\*\* The setup screen of the "Holding output" was stored on Page 3/- of the "Init. set/Adv-func" regarding the main software of version "H2" or lower versions. And it moved to Page 6/- regarding the main software of version "JO" or higher versions.
- \*\*\*\* These functions are available with the main software of version "JO" or newer versions.

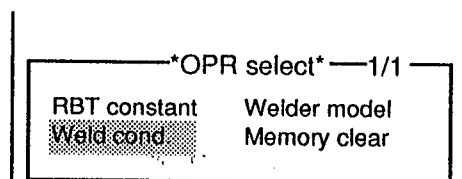


#### 4.1.1 System set-up

Parameters of the robot and the system can be modified in the system setting mode.

| No. | Operation                                                                                                               | Screen display                                                                                                                                                                                                                                                                      |
|-----|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | This operation is started from the operation mode selection (initial screen).                                           | <div>Mode Select (Initial)</div> <div>To select &lt;OPR&gt; or &lt;TEACH&gt;, use SW on the controller.</div>                                                                                                                                                                       |
| 1   | Move the cursor to "Init. set" and press the ENTER key.                                                                 | <div>*OPR select* — 1/1 —</div> <div>1 Edit                      4 Init. set</div> <div>2 Product data          5 E. memory</div> <div>3 Option</div>                                                                                                                               |
| 2   | Move the cursor to "System. set" and press the ENTER key.                                                               | <div>Init. set</div> <div>*OPR select* — 1/1 —</div> <div>1 System set            2 Adv-func.</div>                                                                                                                                                                                 |
| 3   | Select the item to be set (move the cursor to the item) and press the ENTER key.                                        | <div>Init. set: Sys. set</div> <div>*OPR select* — 1/1 —</div> <div>1 RBT constant</div> <div>2 Weld cond</div> <div>3 Welder model</div> <div>4 Memory clear</div>                                                                                                                 |
|     | <div>(1) Robot constant</div> <div>(2) Welding conditions</div> <div>(3) Welder model</div> <div>(4) Memory clear</div> | <div>Note 1</div> <div>4.1.1.1 Robot constant</div> <div>4.1.1.2 Welding conditions</div> <div>4.1.1.3 Welder model</div> <div>4.1.1.4 Memory clear</div> <div>(The screen display changes according to the contents selected. The explanations are given in later sections.)</div> |
| 4   | <div>Set the data for individual items selected.</div>                                                                  |                                                                                                                                                                                                                                                                                     |
| 5   | Press the END key repeatedly.                                                                                           | <div>Returns to the initial screen (mode select screen).</div> <div>*OPR select*</div> <div>1 Edit                      4 Init. set</div> <div>2 Product data          5 E. memory</div> <div>3 Option</div>                                                                        |

Note 1) The display shown below appears in the main software of version "J3" or lower version.



#### 4.1.1.1 Robot constant (when "Rbt constant" is selected.)

| No. | Operation | Screen display                                                                                                                                                                          |
|-----|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   |           | <div> Init. set: Sys. set: Rbt constant </div> <div> <div> *OPR select * 1/1 </div> <div> 1 Soft limit      4 Jog<br/> 2 Speed limit    5 Tool offset<br/> 3 Std tool No. </div> </div> |

#### 4.1.1-a Software limit

This is the data used to limit the work envelopes of individual axes.

| Init. set : Sys. set : Rbt const |             |          |
|----------------------------------|-------------|----------|
| Soft limit                       |             |          |
| 1/1                              |             |          |
| RT                               | = -180.00 ° | 180.00 ° |
| UA                               | = - 90.00 ° | 150.00 ° |
| FA                               | = -140.00 ° | 150.00 ° |
| RW                               | = -200.00 ° | 200.00 ° |
| BW                               | = -135.00 ° | 135.00 ° |
| TW                               | = -200.00 ° | 200.00 ° |

(The value on the screen is the standard value of AW-010A.)

The setting range is as specified in the "Standard specifications" and the "Instruction Manuals".

To enter the standard value, press the OPR SEL key, and move the cursor to "STD" and then press the ENTER key.

#### 4.1.1.1-b Speed limit

The speed limits set in this step are as follows:

Speed limit when the robot is operated in manual mode during teaching.

Speed limit of the High speed key.

Speed limit when a personnel stays within the work envelope of the robot.

| Init. set : Sys. set : Rbt const |         |         |
|----------------------------------|---------|---------|
| Speed limit                      |         |         |
| 1/1                              |         |         |
| Speed restrit                    | = 15.00 | (M/m) % |
| H-spd key                        | = 15.00 | (M/m) % |
| Manual speed                     | = 15.00 | (M/m) % |

(The value on the screen is the standard value.)

To enter the standard value, press the OPR SEL key, and move the cursor to "STD" and then press the ENTER key.

#### 4.1.1.1-c Standard tool No.

The standard tool No, for teaching is set.

|                                  |   |
|----------------------------------|---|
| Init. set : Sys. set : Rbt const |   |
| Std Tool No. 1/1                 |   |
| Tool No.                         | = |

#### 4.1.1.1-d Jog

The movement distance for jog feed is set.

|                                  |             |
|----------------------------------|-------------|
| Init. set : Sys. set : Rbt const |             |
| Jog 1/1                          |             |
| H                                | = 1.00 (mm) |
| M.H                              | = 0.75 (mm) |
| M                                | = 0.50 (mm) |
| M.L                              | = 0.35 (mm) |
| L                                | = 0.20 (mm) |
| STD                              |             |

(The value on the screen is the standard value.)

The data range is 0.01~10.00.

To enter the standard value, move the cursor to "STD" and press the ENTER key.

#### 4.1.1.1-e Tool offset

The dimensions of the tools (torch) 1~8 mounted on the wrist is defined.

|                                  |            |
|----------------------------------|------------|
| Init. set : Sys. set : Rbt const |            |
| Tool set                         |            |
| Tool No. 1                       | Tool No. 5 |
| Tool No. 2                       | Tool No. 6 |
| Tool No. 3                       | Tool No. 7 |
| Tool No. 4                       | Tool No. 8 |

Select the tool No. to be set (move the cursor to the tool No..) and press the ENTER key.

|                                  |             |
|----------------------------------|-------------|
| Init. set : Sys. set : Rbt const |             |
| Tool No. 1 1/1                   |             |
| L1 =                             | 420.00 (mm) |
| L2 =                             | 0.00 (mm)   |
| L3 =                             | 379.30 (mm) |
| L4 =                             | -20.00 (°)  |
| STD                              |             |

To enter the standard value, move the cursor to "STD" and press the ENTER key.

\* The value "L2" should be within the range as shown below:

$$L2 < L3/130 \times L1 \text{ (unit:mm)}$$

When value "L2" is set, the robot does not check whether or not the value entered meet the requirements above. Care must be exercised in setting value "L2".

If an inappropriate value is set to "L2", robot will not start, displaying an error message "Arithmetic processing impossible".

For the setting, refer to the section (1) "Definition of the control point" of "5.7.2 Definition of the tool coordinate system".

If the value of torch offset is changed during operation, the circular motions, weaving motions and circular weaving motions having been taught will change between the play process and trace forward/backward process.

To change the torch offset value during operation, carry out one of the procedures shown below to prevent the motions from changing:

- (1) Change the torch offset value to the one previously set.
- (2) Move the robot to the teaching point of circular, weaving or circular weaving by tracing forward/backward mode. Then register the change without changing the teaching point.
- (3) Move the cursor to the teaching point of circular, weaving or circular weaving in the program edit mode, and register the change without changing the teaching point.

## 4.1.1.2

## Welding conditions (When "Welding conditions" is selected)

| No. | Operation                                                                                                                        | Screen display                                                                                                                                |
|-----|----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 0   |                                                                                                                                  | <div> Init. set:   Sys. set:   Weld cond. </div>                                                                                              |
| 1   | Move the cursor to the item to be set and press the ENTER key.                                                                   | <div> <div> *OPR select *   1/1 </div> <div> 1 Weld table      4 Weaving table<br/> 2 Inching        5 Gas/Wire<br/> 3 Override </div> </div> |
|     | 1. Weld table .....> a<br>2. Inching speed .....> b<br>3. Override .....> c<br>4. Weaving table .....> d<br>5. Gas wire .....> e | } Refer to sample screens on the following pages.                                                                                             |
|     | * When the weld table is selected, select "AJO" or "CJO" and press the ENTER key.                                                |                                                                                                                                               |
| 2   | Move the blinking position by using the cursor keys and enter the numeric value.                                                 |                                                                                                                                               |
| 3   | Press the ENTER key.                                                                                                             |                                                                                                                                               |
| 4   | After completing the setting, press the END key.                                                                                 | The screen No.0 is brought back.                                                                                                              |
| 5   | Press the END key several times.                                                                                                 | The first screen of the system setting is brought back.                                                                                       |

#### 4.1.1.2-a Weld table

Welding start conditions (AJO) and welding end conditions (CJO) corresponding to menu No. 1~5 can be stored in the robot beforehand. These conditions are referred to as "weld table". By creating an appropriate weld table, suitable welding conditions can be selected from the menu and entered to the robot at individual teaching point.

The screen below appears when the "Welding conditions" is selected:

|                    |       |
|--------------------|-------|
| *OPR select* — 1/1 |       |
| 1 AJO              | 2 CJO |

Select "AJO" or "CJO" (move the cursor), and press the ENTER key.

Then the screen below appears. Enter the data by using the cursor keys and numerical keys.

| Init. set : Sys. set : Weld cond |   |         |          |
|----------------------------------|---|---------|----------|
| AJO — 1/1                        |   |         |          |
| No. 1                            | = | 120 (A) | 19.0 (V) |
| 2                                | = | 160     | 21.5     |
| 3                                | = | 200     | 24.0     |
| 4                                | = | 260     | 27.0     |
| 5                                | = | 320     | 33.0     |
| STD                              |   |         |          |

| Init. set : Sys. set : Weld cond |   |         |          |
|----------------------------------|---|---------|----------|
| CJO — 1/1                        |   |         |          |
| No. 1                            | = | 100 (A) | 18.0 (V) |
| 2                                | = | 120     | 19.0     |
| 3                                | = | 160     | 21.5     |
| 4                                | = | 200     | 24.0     |
| 5                                | = | 260     | 27.0     |
| STD                              |   |         |          |

To enter the standard value, move the cursor to "STD" and press the ENTER key.



#### 4.1.1.2-b Inching speed

The speed to move the wire by using the teach pendent is specified.

(Low speed) : For 3 seconds after the WIRE key is pressed. The wire moves slowly.

(High speed) : When the WIRE key is held down for more than 3 seconds, the wire moves fast.

Setting range : 0~255

| Init. set : Sys. set : Weld cond |   |     |     |
|----------------------------------|---|-----|-----|
| Inching                          |   |     | 1/1 |
| H- speed                         | = | 168 |     |
| L- speed                         | = | 10  |     |

(Data is set at delivery.)

To enter the "Standard value", move the cursor to "STD" and then press the ENTER key.

#### 4.1.1.2-c Override

Welding condition fine adjustment data is modified or set.

| Init. set : Sys. set : Weld cond. |   |     |         |
|-----------------------------------|---|-----|---------|
| Override                          |   |     | 1/1     |
| NO                                |   | (A) | (V) (%) |
| 1                                 | = | 10  | 1.0 10  |
| 2                                 | = | 5   | 0.7 5   |
| 3                                 | = | 7   | 0.5 7   |
| 4                                 | = | 2   | 0.2 2   |
| 5                                 | = | 1   | 0.1 1   |

To set the values shown above, press the OPR SEL key and, move the cursor to "STD" and press the ENTER key.

To set the values other than the standard value, enter the numeric value and press the ENTER key.

The max. current 999A, then voltage 99.9 V. The max. speed is 25%.

#### 4.1.1.2-d Weaving table

The weaving frequency and timer can be set beforehand for 6 types of weaving patterns. A weaving pattern is selected and registered during teaching, the values of frequency and timer pre-set in the weaving table are automatically registered in the program.

| Init. set : Sys. set : Weld cond |      |           |       |        |       |       |
|----------------------------------|------|-----------|-------|--------|-------|-------|
| Weaving table 1/2                |      |           |       |        |       |       |
| NO.                              | f    | T0        | T1    | T2     | T3    | T4    |
|                                  | (HZ) | (sec)     | (sec) | (sec)  | (sec) | (sec) |
| 1                                | 0.5  | .....     | 0.0   | 0.0    | ..... |       |
| 2                                | 0.5  | 0.0       | 0.0   | 0.0    | ..... |       |
| 3                                | 0.5  | 0.0       | 0.0   | 0.0    | ..... |       |
| Page next                        |      | Page back |       | Set-up |       |       |

(The data shown above are those stored at delivery)

#### Range of the set-up data

Frequency 0.1~ 5.0 (Hz) : Pattern (No.) 1~5

0.1~ 10.0 (Hz) : Pattern (No.) 6

T0~T4 0.0~ 9.9 (Sec)

(The timer values displayed by----- cannot be set.)

(Note) Make sure that the values of the weaving frequency and the timer meet the conditions given below. If operation is carried out using inappropriate conditions, calculation error will return.

$$T-(T_0+T_1+T_2+T_3+T_4) \geq A$$

T: Time for weaving one cycle

A: Time determined by weaving pattern

- Pattern 1, 2, 5 ----> A = 0.1
- Pattern 3 ----> A = 0.075
- Pattern 4 ----> A = 0.15
- Pattern 6 ----> A = 0.05

Example: Pattern 1, Frequency 2.5Hz (T=0.4sec), stop time at both ends: 0.2sec

$$T-(T_1+T_2) \geq 0.1 \text{ sec.}$$

0.4-(0.2+0.2)=0 $\geq$ 0.1 Since the value does not meet the requirements, an error will return.

#### 4.1.1.2-e Gas/Wire

Enter the type of the gas and wire used for welding.

|                                    |                 |
|------------------------------------|-----------------|
| Init. set : Sys. set : Welder cond |                 |
| Gas / Wire 1/1                     |                 |
| Gas                                | = (CO2 MAG)     |
| Wire                               | = (YM50 YM50T1) |

#### 4.1.1.3 Welder model (When "welder model" is selected.)

| No. | Operation                                                                                                                                | Screen display                                                                                                                                                                                      |
|-----|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   |                                                                                                                                          | Init. set: Sys. set: Welder model<br>YD350RF 1.2                                                                                                                                                    |
| 1   | Select "Direct specification" or "Code specification" (move the cursor to the item to be selected.), and press the ENTER key.            | Direct Code Charact.                                                                                                                                                                                |
|     | "Code" is selected:                                                                                                                      |                                                                                                                                                                                                     |
| 2   | Enter the max. code value and the correct value via the numerical keys and press the ENTER key.                                          | Init. set : Sys. set : Welder model<br>Code 1/1<br>Max. = 255<br>Current value:<br>Curr = 0<br>Volt = 0.0                                                                                           |
| 3   | To quit setting, press the END key.                                                                                                      |                                                                                                                                                                                                     |
|     | "Direct" is selected:                                                                                                                    |                                                                                                                                                                                                     |
| 2'  | Move the cursor to "page next" or "page back" and press the ENTER key.<br>Search the welding machine to be used by using this procedure. | Init. set : Sys. set : Welder model<br>Direct 1/4<br>Welder Wire/Mode<br>1 YD350RF (0.9 1.2)<br>2 YD500RF (1.2 1.6)<br>3 YD160HF (0.8 1.0)<br>4 YD350HF (0.9 1.2)<br>Page next Page back Welder set |
| 3'  | When the welding machine to be used is displayed on the screen, move the cursor to "Welder set" and press the ENTER key.                 |                                                                                                                                                                                                     |
| 4'  | Select the welder to be used and the wire diameter by using the cursor keys and press the ENTER key.                                     | Init. set : Sys. set : Welder model<br>Direct 1/4<br>Welder Wire/Mode<br>1 YD350RF (0.9 1.2)<br>2 YD500RF (1.2 1.6)<br>3 YD160HF (0.8 1.0)<br>4 YD350HF (0.9 1.2)<br>Select Char in [ENTER] key.    |

| No. | Operation                                                                                                                                                          | Screen display                                                                                                                                                                                                                                                                                       |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5'  | Press the OPR SEL (operation select) key to modify the current characteristics, voltage characteristics, ratings or correct value.                                 |                                                                                                                                                                                                                                                                                                      |
| 6'  | Move the cursor to "current characteristics", "voltage characteristics", "Rated value" or "correct value" and press the OPR SEL key.                               | <div> <div>Init. set : Sys. set : Welder model</div> <div>YD350RF 1.2</div> <div> <div>*OPR select* 1/1</div> <div> <div>1 Current 3 Voltage</div> <div>2 Rated value 4 Correct</div> </div> </div> </div>                                                                                           |
| 7'  | Move the cursor to "page next" or "page back" and press the ENTER key.<br>Bring up the screen on which the No. to be changed is displayed by using this procedure. | <div> <div>Init. set : Sys. set : Welder model</div> <div>Current 1/32</div> <div>YD350HF 1.2</div> <div> <div>1: 243 5: 224</div> <div>2: 242 6: 220</div> <div>3: 236 7: 214</div> <div>4: 230 8: 210</div> </div> <div> <div>Page next</div> <div>Page back</div> <div>Set-up</div> </div> </div> |
| 8'  | Move the cursor to "SET-UP" and press the ENTER key.                                                                                                               |                                                                                                                                                                                                                                                                                                      |
| 9'  | Enter the values by using the numerical keys and cursor keys according to the instructions on the screen.                                                          |                                                                                                                                                                                                                                                                                                      |
| 10' | Press the END key to quit the setting.                                                                                                                             |                                                                                                                                                                                                                                                                                                      |

4.1.1.3-a. Code specification: The max. code value at which the max. instruction is output is specified to the welder

4.1.1.3-b. Direct specification: The welding machine and the wire diameter are specified. (The condition outputs to the welding machine are carried out according to the characteristic curves of the welding machine and the wire diameter.)

| Init. set : Sys. set : Welder model |  |     |
|-------------------------------------|--|-----|
| Code                                |  | 1/1 |
| Max. = 255                          |  |     |
| Correct value:                      |  |     |
| Curr = 0                            |  |     |
| Volt = 0.0                          |  |     |

(Code specification)

| Init. set : Sys. set : Welder model |         |                      |
|-------------------------------------|---------|----------------------|
| Direct                              |         | 1/4                  |
|                                     | Welder  | Wire/Mode            |
| 1                                   | YD350RF | (0.9 1.2)            |
| 2                                   | YD500RF | (1.2 1.6)            |
| 3                                   | YD160HF | (0.8 1.0)            |
| 4                                   | YD350HF | (0.9 1.2)            |
| Page next                           |         | Page back Welder set |

(Direct specification)

The characteristics of the current and voltage can be changed in the direct specification mode.

| Init. set : Sys. set : Welder model |        |                  |
|-------------------------------------|--------|------------------|
| Current                             |        | 1/32             |
| YD350RF 1.2                         |        |                  |
| 1: 243                              | 5: 224 |                  |
| 2: 242                              | 6: 220 |                  |
| 3: 236                              | 7: 214 |                  |
| 4: 230                              | 8: 210 |                  |
| Page next                           |        | Page back Set-up |

(Current characteristics modification)

| Init. set : Sys. set : Welder model |        |                  |
|-------------------------------------|--------|------------------|
| Current                             |        | 1/32             |
| YD350RF 1.2                         |        |                  |
| 1: 226                              | 5: 210 |                  |
| 2: 222                              | 6: 206 |                  |
| 3: 218                              | 7: 202 |                  |
| 4: 214                              | 8: 198 |                  |
| Page next                           |        | Page back Set-up |

(Voltage characteristics modification)

The entire output characteristics can be shifted by using the compensation values of the current and voltage.

(Example: When the current setting and compensation value are 300A and 10A respectively, the instruction to the welding machine is 310A or equivalent.)

| Init. set : Sys. set : Welder model |  |     |
|-------------------------------------|--|-----|
| Direct                              |  | 1/1 |
| YD350RF                             |  |     |
| Correct value:                      |  |     |
| Curr = 0                            |  |     |
| Volt = 0.0                          |  |     |

The applicable welding machines (characteristics) registered are as listed below:

|         |    |            |      |      |
|---------|----|------------|------|------|
| Note 2) | 1  | YD350RF    | (0.9 | 1.2) |
|         | 2  | YD500RF    | (1.2 | 1.6) |
|         | 3  | YD160HF    | (0.8 | 1.0) |
|         | 4  | YD350HF    | (0.9 | 1.2) |
|         | 5  | YD500HF    | (1.2 | 1.6) |
|         | 6  | YD350HR    | (0.9 | 1.2) |
|         | 7  | YD500HR    | (1.2 | 1.6) |
|         | 8  | YD350ZC    | (0.9 | 1.2) |
|         | 9  | YD500ZC    | (1.2 | 1.6) |
|         | 10 | YD350HM    | (1.0 | 1.2) |
|         | 11 | YD500HM    | (1.2 | 1.6) |
|         | 12 | YD350HP    | (0.9 | 1.2) |
| Note 1) | 13 | YD200HG    | (DC  | AC)  |
|         |    | YD600RF    | (1.4 | 1.6) |
| Note 1) | 14 | YC300TWX   | (DC  | AC)  |
| Note 1) | 15 | YC300TR    | (DC  | AC)  |
|         | 16 | YD200RF    | (0.8 | 1.0) |
| Note 3) | 17 | User Wld 1 | (A   | B)   |
| Note 3) | 18 | User Wld 2 | (A   | B)   |

Note 1) As with the YD200HG, YC300TWX and YC300TR, mode (DC/AC) is switched instead of switching the wire diameter. And in the main software of version "KO" or higher version, YD600RF is registered instead of YD200HG.

Note 2) YD350RF 1, 2 is set at the time of the shipment.

Note 3) For the method to use User Wld 1 and User Wld 2, refer to P4-16-1 "4.1.1.3-C Direct (User welder)".

4.1.1.3-c. Direct (User welder) [Welding machine characteristics generation]  
(Available with the main software of version "H0" or higher version)

1. Purpose of this function

This function is used in the following cases.

That is, the function is used when desired to specify the welding conditions directly by current and voltage values in the methods other than the standard methods of:

- (1) Using in combination with the welding machine in which output characteristics are not incorporated in the robot.
- (2) Using the welding machine of which wire diameter is specified as 0.9/1.2, by using 1.0 wire.

2. Applicable welding machine specification

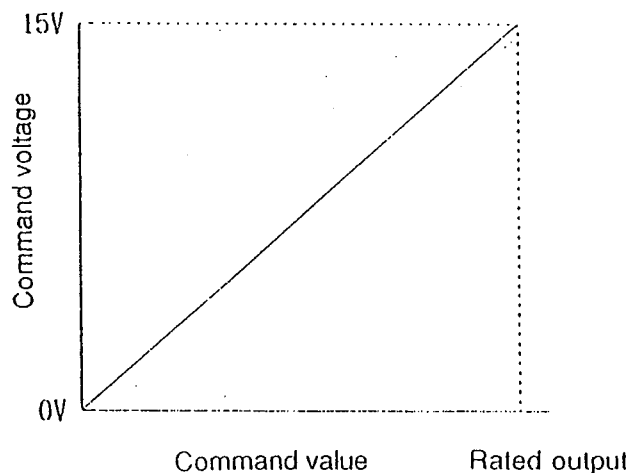
This function is applied to the welding machine that satisfies the following specification.

- (1) The output adjustment is of voltage individual setting method.
- (2) The output is adjusted in a range of DC 0 to 15 V.
- (3) The output adjustment is common in the ground level (at the same potential) of current and voltage commands.
- (4) The maximum output is current of 999 A or less and voltage of 99.9 V or less.

3. Outline of functions

- (1) Initialization of characteristics

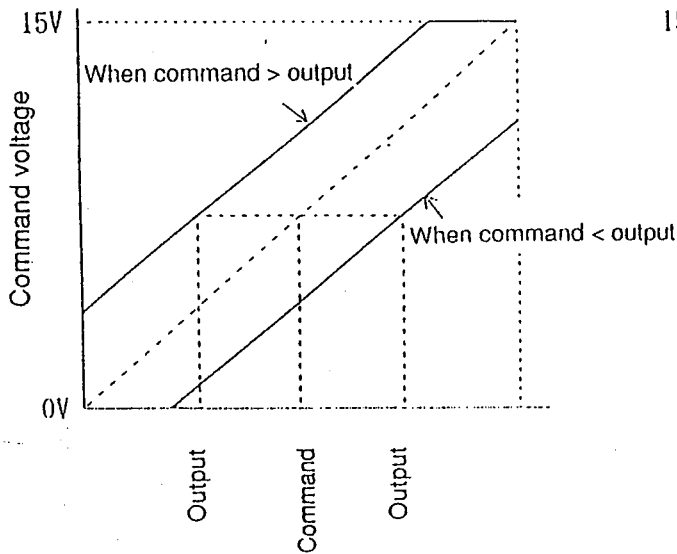
The command voltage characteristic to the robot to the command value is linearized between 0 V and 15 V.



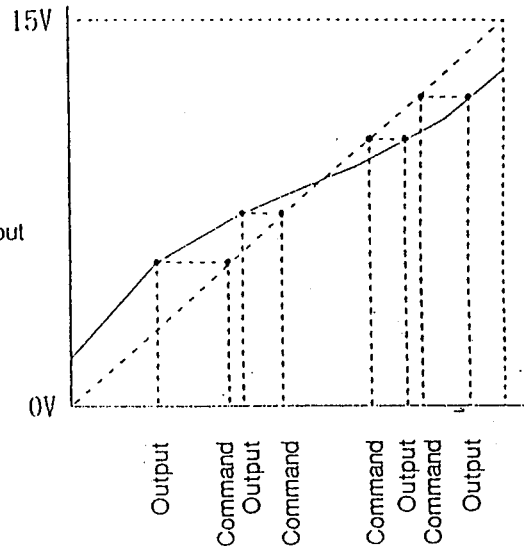


(2) Generation of characteristics

By actually welding, the characteristic curve is plotted by using the command values and output values.



If there is one set of data



If there are two or more sets of data

4. Outline of operation

The operating procedure of the function is as follows.

- (1) Set provisional characteristics of welding machine.
- (2) Weld actually, and determine the specified value from the robot and actual output value.
- (3) When the determined data is entered in the controller screen, the welding machine characteristics are generated.
- (4) The generated characteristics are saved as "user power source" characteristics, which can be called as required same as other general power source characteristics.
- (5) Four types of characteristics can be saved.

## 5. Operating procedure

### 5.1 Generation of provisional characteristics (Initialization of characteristics)

- (1) From the initial screen, store and select the initial setting, system setting and welder characteristics, and display screen 1..
- (2) On screen 1, store and select direct setting, and display user power source on power source selection screen by page forward, and set any one of user power sources 1A to 2B by power source setting. (Screen 2)
- (3) Press the END key, and store and select characteristic editing on screen 3, and display screen 4.
- (4) On screen 4, press the OPR SEL key to show screen 5.
- (5) On screen 5, store and select initialization of characteristics, and enter rated value of welding machine (memory select) on screen 6, and press the END key.
- (6) On screen 7, when asked whether or not to initialize (linearize) the characteristics of the welding machine in use, adjust cursor to Yes, and store and select.

|                                     |      |          |
|-------------------------------------|------|----------|
| Init. set : Sys. set : Welder model |      |          |
| YD350RF 1.2                         |      |          |
| Direct                              | Code | Charact. |

Screen 1

|                                     |            |                      |
|-------------------------------------|------------|----------------------|
| Init. set : Sys. set : Welder model |            |                      |
| Direct 5/5                          |            |                      |
| Welder                              |            | Wire/Mode            |
| 17                                  | User Wld 1 | (A B)                |
| 18                                  | User Wld 2 | (A B)                |
| Page next                           |            | Page back Welder set |

Screen 2

|            |      |          |
|------------|------|----------|
| User Wld 1 |      | A        |
| Direct     | Code | Charact. |

Screen 3

|                  |           |     |
|------------------|-----------|-----|
| *Characteristic* |           | 1/2 |
| 1 Current        | 3 Voltage |     |
| 2 Rated value    | 4 Correct |     |

Screen 4

\*Characteristic\* 2/2

1 Save  
2 Make     4 Initialize

Screen 5

Rated value

Curr = \*\*\*A  
Volt = \*\*. \*V

Screen 6

\*OPR select\* 1/1

Set initial value?

1 Yes     2 No

Screen 7

## 5.2 Use of welding condition data

Using the data initialized in the previous step, weld actually in the following procedures.

- (1) On screen 7, press the END key until the initial screen appears.
- (2) Put a bead of proper length by teaching (weld as far as the meters of welding current and voltage can be read).
- (3) Change the welding conditions properly, and record the specified welding conditions and actual current and voltage, and sum up as shown in Table 1. The number of sets of data should be five or less.

If the arc is not stabilized in the condition specified herein, use "Override". Record, however, the final specified value and output value changed by override.

- (4) Record the welding conditions in the ascending order.

Table 1. Test data of welding conditions

| No. | Condition |        | Actual Output |        |
|-----|-----------|--------|---------------|--------|
| 1   | 120A      | 20.0 V | 105A          | 19.5 V |
| 2   | 150A      | 21.5A  | 130A          | 20.9V  |
| 3   | 200A      | 23.5V  | 180A          | 21.5V  |
| 4   |           |        |               |        |
| 5   |           |        |               |        |

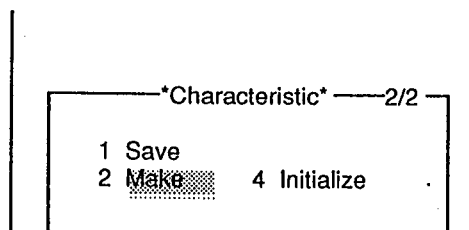
### 5.3 Generation of characteristics

- (1) Same as in generation of provisional characteristics (operation 4.1), show the screen of characteristic editing 2/2 (screen 8).
- (2) On screen 8, adjust the cursor to characteristics generation and store and select.
- (3) Enter the data of No. 1 of Table 1 on screen 9.
- (4) Feed page by operation select key, and enter the data of No. 2.
- (5) Similarly, enter other data, and after data input of final page, set the cursor to calculation start position, and store and select.

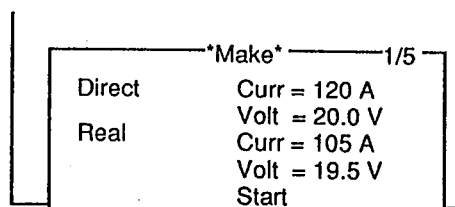
Now the welding machine characteristics are corrected from the provisional characteristics to the characteristics suited to the data.

#### Cautions

- (1) Enter the welding conditions in the ascending order. If there is a blank page on the way, it results in an error (welding condition sequence failure).
- (2) On each page of welding data, the display of "calculation start" is shown, but when calculation is started on other pages than final page, the subsequent data is ignored in calculation.



Screen 8



Screen 9

#### 5.4 Saving of characteristics

Up to four types of generated data can be saved (stored).

- (1) Adjust the cursor to characteristics storage on characteristics editing 2/2 screen 8, and store and select.
- (2) On screen 10, select the destination of saving by cursor, and store and select.
- (3) If data is already present at the destination, it is asked whether or not to replace with new data. (Screen 11)
- (4) To replace, reply Yes.
- (5) To save previous data, reply No, and select other destination of saving.

|                                     |         |
|-------------------------------------|---------|
| Init. set : Sys. set : Welder model |         |
| Save Charact.                       |         |
| Save concurrent charact. in         |         |
| User Wld 1                          | ( A B ) |
| User Wld 2                          | ( A B ) |

Screen 10

|                                     |         |
|-------------------------------------|---------|
| Init. set : Sys. set : Welder model |         |
| Save Charact.                       |         |
| Save concurrent charact. in         |         |
| User Wld 1                          | ( A B ) |
| User Wld 2                          | ( A B ) |
| * OPR select *                      |         |
| Permit overwriting?                 |         |
| 1 Yes                               | 2 No    |

Screen 11

#### 4.1.1.4 Memory clear (when "memory clear" is selected)

This procedure (All clear or File clear) is used to erase all the contents stored in the robot by teaching.

##### 4.1.1.4.1 All clear

Jobs, programs, arc start sequence, arc end sequence and library are all erased. The system setting data is also erased simultaneously. However, the standard specification values are written automatically after the system setting data has been erased.

| No. | Operation                                               | Screen display                                                                                                                                                |
|-----|---------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Move the cursor to "All clear" and press the ENTER key. | <div> Init. set : Sys. set : Memory clear </div> <div> <div>*OPR select* —1/1—</div> <div>1 File clear      2 All clear</div> </div>                          |
| 2   | Enter the code "39".                                    | <div> Init. set : Sys. set : Memory clear </div> <div> <div>All clear —1/1—</div> <div>Deletion of all files.</div> <div>Standardize set values.</div> </div> |
| 3   | Press the ENTER key.                                    | <div> <div>*OPR select* —1/1—</div> <div>Input code</div> <div>Code =</div> </div>                                                                            |
| 4   | Press the END key.                                      |                                                                                                                                                               |

#### 4.1.1.4.2 File clear

Jobs, programs, library and arc start/end sequences stored by the teaching are all erased.

| No. | Operation                                                                                       | Screen display                                                                                                                                                      |
|-----|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Move the cursor to "File clear" and press the ENTER key.                                        | <div> Init. set : Sys. set : Memory clear </div> <div> <div>*OPR select* —1/1</div> <div>1 File clear 2 All clear</div> </div>                                      |
| 2   | A message "All stored files deleted" appears, move the cursor to "YES" and press the ENTER key. | <div> Init. set : Sys. set : Memory clear </div> <div> All stored files<br/>will be deleted. </div> <div> <div>*OPR select* —1/1</div> <div>1 Yes 2 No</div> </div> |
| 3   | Press the END key.                                                                              |                                                                                                                                                                     |



#### 4.1.2 Advanced function (when "Adv-func" is selected)

| No. | Operation                                                                                                                                                                             | Screen display                                                                                                                                                                                                                                                                                          |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | Return to the mode selection initial screen.                                                                                                                                          | <div> Mode Select (Initial)<br/> To select &lt;OPR&gt; or &lt;TEACH&gt;, use SW on the controller.<br/> <div> *OPR select* —1/1—<br/> 1 Edit                      4 Init. set<br/> 2 Product data        5 E. memory<br/> 3 Option </div> </div>                                                        |
| 1   | Move the cursor to "Init. set" and press the ENTER key.                                                                                                                               |                                                                                                                                                                                                                                                                                                         |
| 2   | Move the cursor to "Adv-func" and press the ENTER key.                                                                                                                                | <div> Init. set<br/> <div> *OPR select * —1/1—<br/> 1 System. set              2 Adv.func </div> </div>                                                                                                                                                                                                 |
| 3   | 5 items of the advanced functions are displayed on one page on the screen. Display the function to be set by moving the cursor to "page next" or "page back" and press the ENTER key. | <div> Init. set : Adv - func<br/> <div> 1/1<br/> Other language      (No)      Yes<br/> Rbt opr key          (No)      Yes<br/> High-speed key      (No)      Yes<br/> CTRL 1 key          (No)      Yes<br/> CTRL 2 key          (No)      Yes<br/> Page next      Page back      Set-up </div> </div> |
| 4   | Move the cursor to "SET-UP" and press the ENTER key. The cursor will shift to "No, Yes". (The cursor position blinks.)                                                                | The item displayed inversed is selected.                                                                                                                                                                                                                                                                |
| 5   | Move the blinking cursor to " No" or " Yes" of the item to be set by using the cursor keys.<br><br>Now the detailed condition setting screen of the item selected appears.            |                                                                                                                                                                                                                                                                                                         |

| No. | Operation                                                                                                                                        | Screen display                      |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| 6   | <To set the detailed conditions><br>Select the conditions or enter the value via the numerical keys according to the instructions on the screen. |                                     |
| 7   | Press the ENTER key.                                                                                                                             |                                     |
| 8   | Press the END key several times after completing the settings.                                                                                   | The initial screen is brought back. |

#### 4.1.2.0

#### Other language

(Available with the main software of version "F0" or newer version)

When this function is valid, the language in which messages are shown can be changed easily. The function is provided to enable people of various nationalities to use this robot, considering that more and more companies are operating worldwide recently.

|                        |     |                                          |
|------------------------|-----|------------------------------------------|
| Init. set : Adv - func |     |                                          |
| 1/6                    |     |                                          |
| Other language         | (No | <input checked="" type="checkbox"/> Yes) |
| Rbt opr key            | (No | <input checked="" type="checkbox"/> Yes) |
| High-spd key           | (No | <input checked="" type="checkbox"/> Yes) |
| CTRL 1 key             | (No | <input checked="" type="checkbox"/> Yes) |
| CTRL 2 key             | (No | <input checked="" type="checkbox"/> Yes) |
| Set No / Yes           |     |                                          |

Place the cursor on "Yes" and press the ENTER key; the screen changes as shown below:

|                        |  |
|------------------------|--|
| Init. set : Adv - func |  |
| 1/1                    |  |
| Japanese               |  |
| English                |  |
| Make your choice.      |  |

Choose a language at your option, and press the ENTER key and END key in this order; the screen will be shown in the language you chose.

#### 4.1.2.1 Robot operation key

**Yes:** During teaching and trace operation, the robot does not move unless the move keys of individual axes or tracing forward (backward) key is pressed with the Robot OPR key is held down.

**No :** The robot can be moved by pressing the move keys of individual axes or the TRACE +/- Key.

| Init. set : Adv - func |      |      |
|------------------------|------|------|
| 1/6                    |      |      |
| Other language         | (No) | Yes) |
| Rbt OPR key            | (No) | Yes) |
| High-spd key           | (No) | Yes) |
| CTRL 1 key             | (No) | Yes) |
| CTRL 2 key             | (No) | Yes) |
| Set No / Yes           |      |      |

#### 4.1.2.2 High speed key

When tracing the low teaching speed area such as welding area in the Trace operation, a setting to increase the speed of the robot can be made by using this key.

Set this key to "Yes" and press the TRACE +/- key while holding down the H-SPD key. The robot will move at the max. speed limit.

When the robot is operated with this key, the settings of the "H-SPD" key is ignored.

The weaving and circular weaving are carried out at the teaching speed.

"H-SPD" key is available with the main software of version "KO" or higher version during the trace backward operation in the weaving.

| Init. set : Adv - func |      |      |
|------------------------|------|------|
| 1/6                    |      |      |
| Other language         | (No) | Yes) |
| Rbt OPR key            | (No) | Yes) |
| High-spd key           | (No) | Yes) |
| CTRL 1 key             | (No) | Yes) |
| CTRL 2 key             | (No) | Yes) |
| Set No / Yes           |      |      |

#### 4.1.2.3 CTRL key on teach pendent

The output signals can be controlled via the teach pendent in the teaching and operation mode according to the settings of this key.

|                        |          |  |
|------------------------|----------|--|
| Init. set : Adv - func |          |  |
| 1/6                    |          |  |
| Other language         | (No Yes) |  |
| Rbt OPR key            | (No Yes) |  |
| High-spd key           | (No Yes) |  |
| CTRL 1 key             | (No Yes) |  |
| CTRL 2 key             | (No Yes) |  |
| Set No / Yes           |          |  |

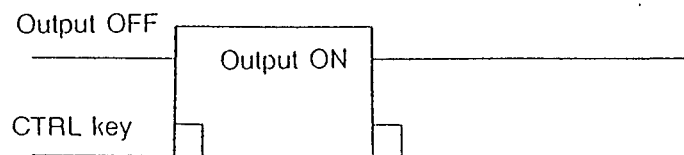
Move the cursor to "Yes" and press the ENTER key. The detailed setting screen shown below will appear:

|                        |            |
|------------------------|------------|
| Init. set : Adv - func |            |
| CTRL 1 key             |            |
| Output No.             | = 15       |
| Self hold              | ( NO YES ) |
| Initial State          | ( ON OFF ) |

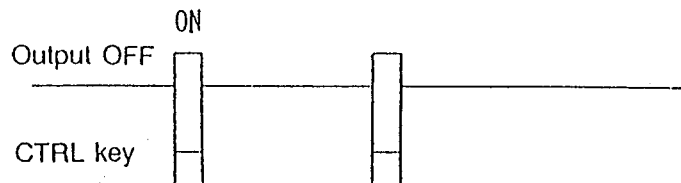
Output terminal No. :allocated among the Multi output (No.1~16). When expanded I/O is mounted, the terminal No. is allocated among No.1~80.

Self-maintaining function:

Yes: The output status changes each time the CTRL key is pressed. (Port to which the initial status is specified to OFF.)



No: The output turns on only when the key is held down. (Port to which the initial status is specified to OFF.)



Initial status: When the "TEACH ENABLE" lamp on the teach pendant is turned on, the processing is carried out according to the settings.

- \*1 The output can be controlled via the CTRL key when the robot lock and I/O lock are set in the operation mode. When the arc lock is set, the outputs other than the torch switch and gas valve output terminals can be controlled.
- \*2 The CTRL key cannot be used to control the output terminals of torch switch and gas valve in the operation and teaching modes.
- \*3 The terminal signals generated by the "OUTB OPORT31=1" command in the operation mode remains ON regardless of the initial status settings on the detailed setting screen even when the TEACH ENABLE lamp is turned on . However, the output can be controlled via the CTRL key.
- \*4 When the TEACH ENABLE lamp is turned off, the output status goes back to the one immediately before the TEACH ENABLE lamp was turned on.
- \*5 During the output is under control of the CTRL key, the output status is not affected even when the halt and emergency stop is activated.

#### 4.1.2.4 Tool No. message

When this function is set to effective, the screen below appears after the program No. is specified during teaching and the tool No. can be specified.

|                   |                                |
|-------------------|--------------------------------|
| *OPR. select* 1/1 |                                |
| Tool No. =        | <input type="text" value="1"/> |

|                        |                                              |
|------------------------|----------------------------------------------|
| Init. set : Adv - func |                                              |
| 2/6                    |                                              |
| CTRL 3 key             | (No <input checked="" type="checkbox"/> Yes) |
| CTRL 4 key             | (No <input checked="" type="checkbox"/> Yes) |
| Tool # message         | (No <input checked="" type="checkbox"/> Yes) |
| Teaching               | (No <input checked="" type="checkbox"/> Yes) |
| RT monitor             | (No <input checked="" type="checkbox"/> Yes) |
| Set No / Yes           |                                              |

#### 4.1.2.5 Teaching interlock

Yes: The robot operation mode is limited according to the status of the external "status interlock input".

- Input ON (=1)      (1) can go to the teaching mode.  
                         (2) Cannot go to the operating mode.
- Input OFF (=0)    (1) cannot go to the teaching mode.  
                         (2) can go to the operating mode.

(In either case, it is judged by the status of the "Interlock input" status when the mode is selected.)

No : The status of the "interlock input" is ignored.

|                        |                                              |
|------------------------|----------------------------------------------|
| Init. set : Adv - func |                                              |
| 2/6                    |                                              |
| CTRL 3 key             | (No <input checked="" type="checkbox"/> Yes) |
| CTRL 4 key             | (No <input checked="" type="checkbox"/> Yes) |
| Tool # message         | (No <input checked="" type="checkbox"/> Yes) |
| Teaching               | (No <input checked="" type="checkbox"/> Yes) |
| RT monitor             | (No <input checked="" type="checkbox"/> Yes) |
| Set No / Yes           |                                              |

When the cursor is moved to "Yes" and the ENTER key is pressed, the screen below appears:

|                          |                                       |
|--------------------------|---------------------------------------|
| Init. set : Adv - func   |                                       |
| Teaching 1/1             |                                       |
| Teach interlock state is |                                       |
| input terminal No. =     | <input checked="" type="checkbox"/> 0 |
| Changed with above term. |                                       |



#### 4.1.2.6 RT axis work envelope monitor

When the robots are aligned face to face or side by side, the settings for monitoring the work envelope of the RT axis is made so that the robots are prevented from interfering with each other.

|                        |      |     |
|------------------------|------|-----|
| Init. set : Adv - func |      |     |
|                        |      | 2/6 |
| CTRL 3 key             | (No) | Yes |
| CTRL 4 key             | (No) | Yes |
| Tool # message         | (No) | Yes |
| Teaching               | (No) | Yes |
| RT monitor             | (No) | Yes |
| Set No / Yes           |      |     |

Move the cursor to "Yes" and press the ENTER key. Then the detailed setting screen as shown below will appear:

|                        |           |        |
|------------------------|-----------|--------|
| Init. set : Adv - func |           |        |
| RT monitor             |           | 1/1    |
| Check direction        | (Side)    | Face ) |
| Auto re-start          | (No)      | Yes )  |
| Right                  | = 120.00  |        |
| Left                   | = -120.00 |        |
| Input No.              | = 14      |        |
| Output No.             | = 14      |        |

Monitor direction: Select "side" or "face".

Automatic re-start: Function to restart automatically when the counterpart robot moves outside the monitoring area. When this function is not effective, press the RE-START switch to resume the operation.

Right angle: Right boundary angle (-170°~+170°)

Left angle: Left boundary angle (-170°~+170°)  
(Left angle < right angle)

Input terminal No.: Terminal to which the information, whether or not the counterpart robot is in the monitoring area, is input (One of the multi-use input terminals is allocated.)

Output terminal No.: Terminal from which the information, that the robot is in the monitor area, is output to the counterpart robot. (One of the multi-use output terminals is allocated.)

## RT work envelope monitor function

### (1) RT axis work envelope monitor area

the work envelope monitor area is shown in Fig.1 below: One of the two areas can be selected.

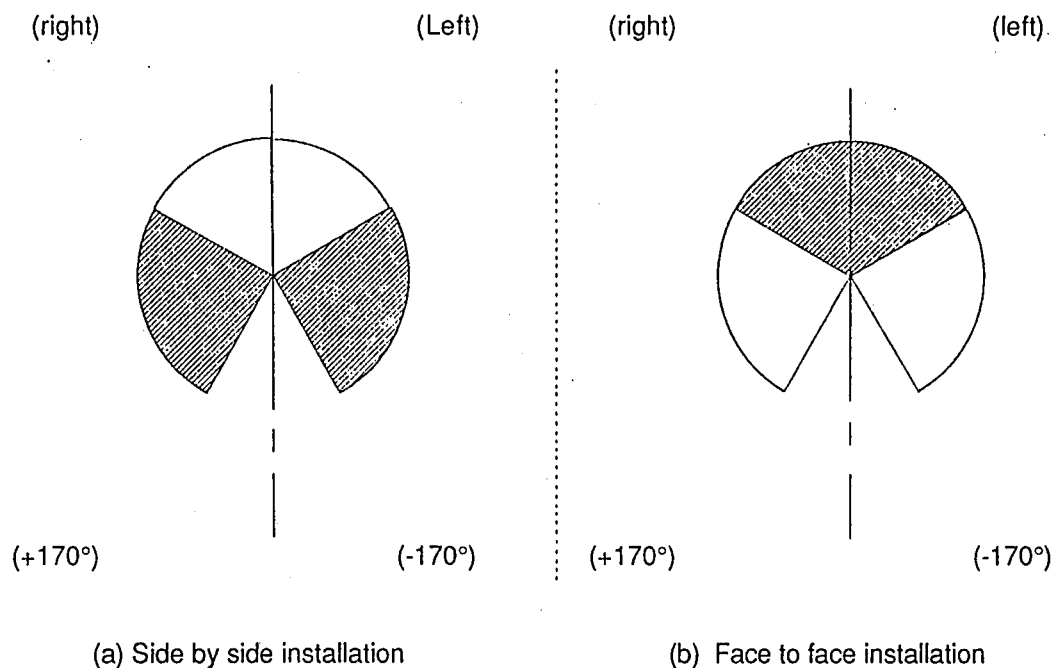


Fig.1 RT axis work envelope monitor area

### (2) Setting the work envelope monitor area

Set the area on the advanced function setting screen in the "Init. set" mode.

<Contents to be set>

- (a) Use or non-use of the work envelope monitor function ----- "Yes"
- (b) Selection of the monitor direction ----- Side or Face
- (c) Right angle ----- Right boundary angle (-170°~+170°)  
Left angle ----- Left boundary angle (-170°~+170°)  
(Left angle<right angle)
- (d) Input terminal No. ----- Specify one of the multi-use terminals as the input terminal/  
(The information whether or not the counterpart robot is inside the monitor area is input.)
- (e) Output terminal No. ----- Specify one of the multi-use terminals as the output terminal/  
(The information that the robot is inside the monitor area is output.)

(3) Inside the work envelope monitor area signal (output)

Signals as shown in the figure below are output from the output terminal with the No. specified in the previous step according to the position of the RT axis:

(Contact output which is closed when the axis is within the work envelope monitor area)

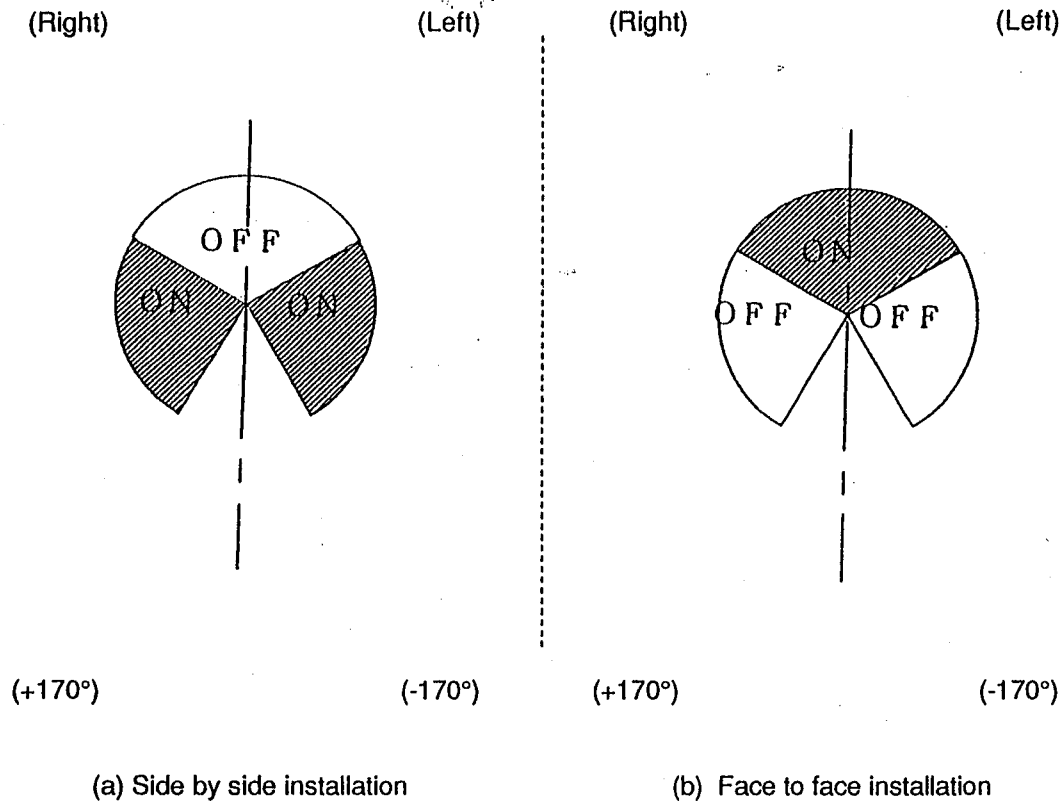


Fig.2 Work envelope monitor area IN signal (output)

(4) Hold activated by the work envelope monitor area IN signal

- \* Effective mode: Operation mode

However, this function is ineffective when the trace operation is carried out by using the teach pendant in the operation mode. (The robot does not stop.)

- \* Hold conditions:

(a) An input signal exists in the terminal specified in (2)-(d).

(the counterpart robot is within the monitor area.)

(b) The terminal specified in (2)-(e) is closed. (The robot is within the monitor area.)

When both conditions are met, the robot is held automatically.

- \* Releasing the hold status:

Move one of the robots out of the monitor area by using the teach pendant and re-start the other robot.

Note) If an attempt to re-start the robots is made without releasing the hold status, the robots do not move.

(5) Signal connections

Connect the outputs informing that the robot is accessing the monitor area to the input terminal of the interference monitor.

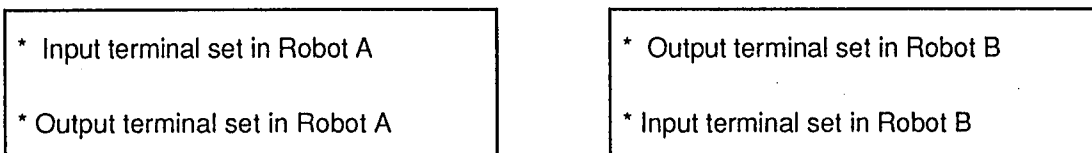
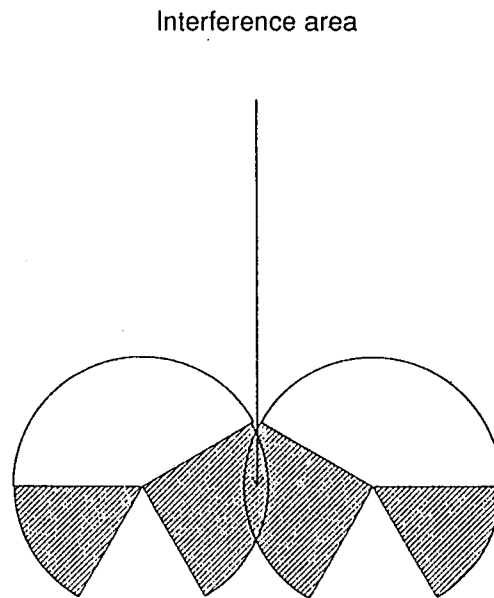
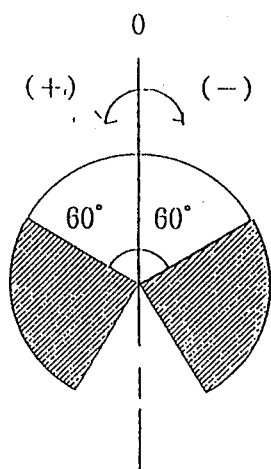


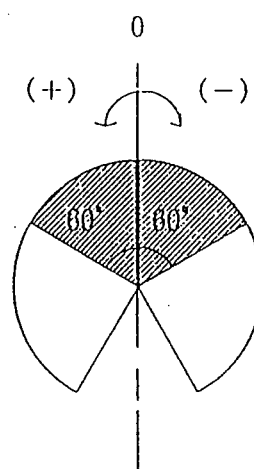
Fig.3 Connections

(6) Examples

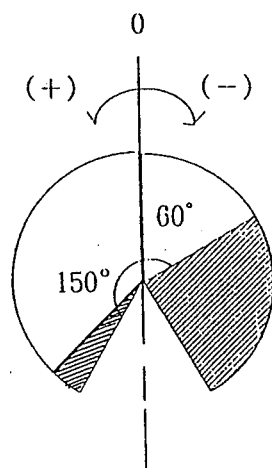
(A) (Right) (Left)



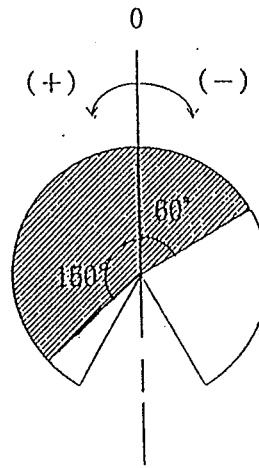
(B) (Right) (Left)



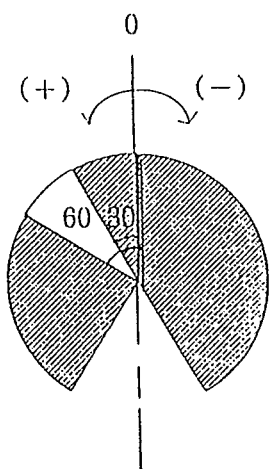
(C) (Right) (Left)



(D) (Right) (Left)



(E) (Right) (Left)



(F) (Right) (Left)

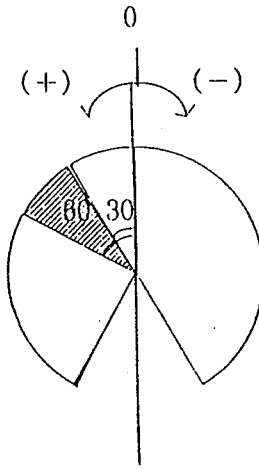


Fig.3 Examples of RT axis work envelope monitor area (marked with slanted lines)

Table 1                      Boundary angle and check direction

| Check direction      |      | Side | Face |
|----------------------|------|------|------|
| Right boundary angle | 60°  | (A)  | (B)  |
| Left boundary angle  | -60° |      |      |
| Right boundary angle | 150° | (C)  | (D)  |
| Left boundary angle  | -60° |      |      |
| Right boundary angle | 60°  | (E)  | (F)  |
| Left boundary angle  | 30°  |      |      |

The RT axis work envelope monitor area can be set according to the boundary angles and monitor direction shown in Table 1 above.

#### 4.1.2.7 Cube interference monitor function (2 areas)

(Available with the main software of version "GO" or higher version.)

The cube monitor function is used to prevent interference of the robots through monitoring the robot control point.

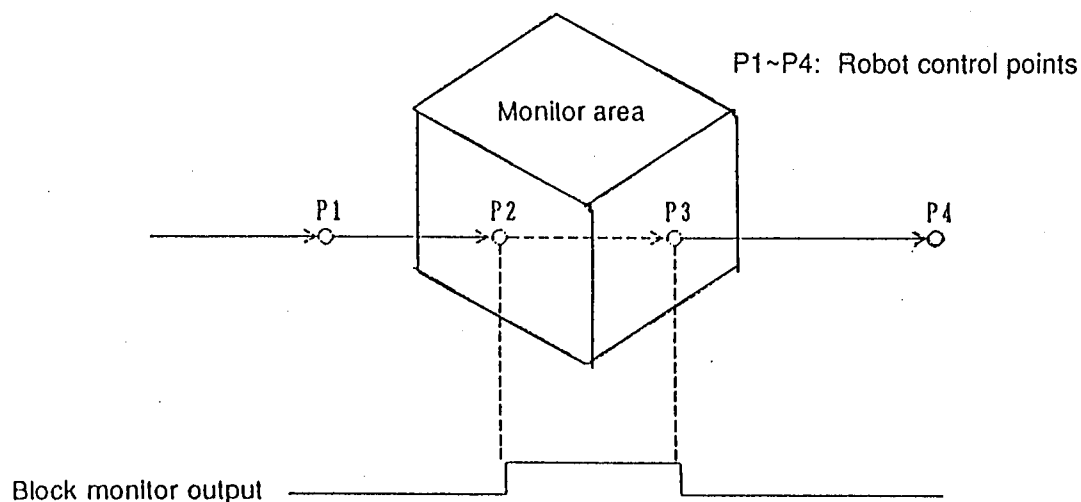
|                        |      |     |
|------------------------|------|-----|
| Init. set : Adv - func |      |     |
| 3/6                    |      |     |
| Cube monitor 1         | (No) | Yes |
| Cube monitor 2         | (No) | Yes |
| Operate output         | (No) | Yes |
| Weld off input         | (No) | Yes |
| Weld off output        | (No) | Yes |
| Set No / Yes           |      |     |

Move the cursor to "Yes" and press the ENTER key. The detailed setting screen shown below appears:

|                        |             |
|------------------------|-------------|
| Init. set : Adv - func |             |
| Cube monitor 1/1       |             |
| Auto re-start          | (NO) YES    |
| to X (mm)              | 0.00 ~ 0.00 |
| to Y (mm)              | 0.00 ~ 0.00 |
| to Z (mm)              | 0.00 ~ 0.00 |
| Input No. =            | 0           |
| Output No. =           | 0           |

- Automatic re-start : Select "Yes" or "No".
- X,Y and Z direction : Coordinate direction of the robot. The value can be entered within -9999.99~9999.99. However, "(Left specified value)<(Right specified value)" should be met.
- Input terminal No. : Specify one of the multi-use terminals as the input terminal/  
(The information whether or not the counterpart robot is inside the monitor area is input.)
- Output terminal No. : Specify one of the multi-use terminals as the output terminal/  
(The information that the robot is inside the monitor area is output.)

(1) Work envelope monitor area IN output signal



When the robot control point is accessing to the area in X, Y and Z direction specified by "Cube monitor", the output terminal also specified by "Cube monitor" turns on.  
When the robot control point is moving out of this area, the terminal turns off.

(2) Work envelope monitor input signal

When a signal is sent to the input terminal specified by "Cube monitor" during the robot's operation, the message "\*\*\* Cube monitor\*\*\*" is displayed immediately and the robot stops.  
(The counterpart robot is in the monitor area.)



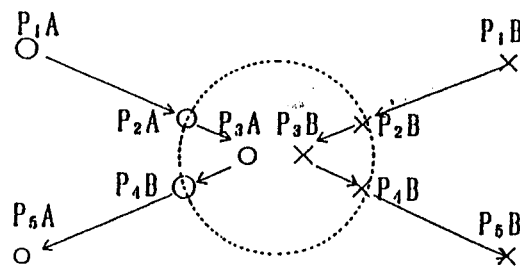
### (3) Automatic re-start

During block monitoring or in the error status resulted from RT axis interference, the drop of the monitor input is recognized as the re-start of the robot.

Robot A

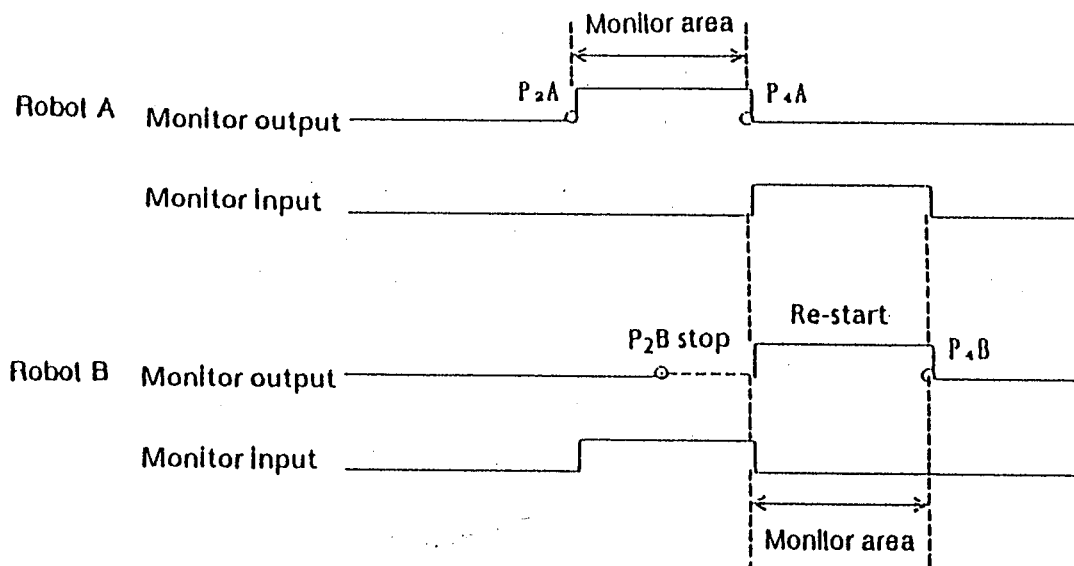
Robot B

Monitor area



When robot B enters the monitor area while robot A is operating there, robot B stops and the monitor output remains the previous condition (in this case, remains to be OFF)

When robot A moves out of the monitor area, the monitor input turns off and robot B moves into the monitor area, recognizing re-start.



\* The I/O status on the above is based on Fig. 3 "Connections" on Page 4-28.

#### 4.1.2.8 Operate output

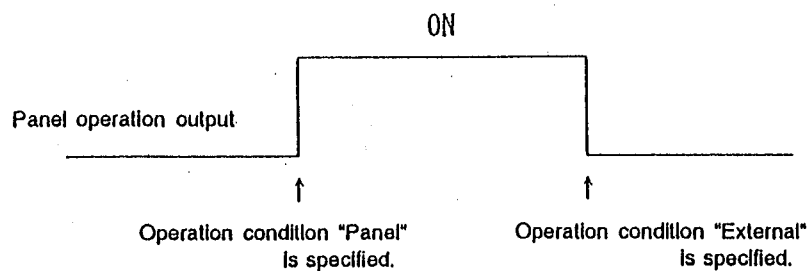
Settings for the output informing that the operational conditions "Panel/external" setting is set to "Panel" is carried out.

|                      |      |      |
|----------------------|------|------|
| Init. set.: Adv-func |      |      |
| 3/6                  |      |      |
| Cube monitor 1       | (No) | Yes) |
| Cube monitor 2       | (No) | Yes) |
| Operate output       | (No) | Yes) |
| Weld off input       | (No) | Yes) |
| Weld off output      | (No) | Yes) |
| Set No / Yes         |      |      |

Move the cursor to "Yes" and press the ENTER key. The screen shown below appears:

|                      |  |
|----------------------|--|
| Init. set : Adv-func |  |
| Operate output 1/1   |  |
| Panel state is       |  |
| Output No. = 13      |  |
| Output to            |  |

Output terminal No.: Allocate a terminal (one of the multi-use terminals) whose contact closes (Output ON) during the "Panel operation" status.



\* At address research, the operation condition "Panel" is specified.

4.1.2.9

(This item No. is ot used.)

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#### 4.1.2.9.1 Weld OFF input

(Available with the main software of version "JO" or higher version.)

This is the function to interrupt the welding operation during the operation of the robot by executing the same operation as the operation done by the WELD OFF key of the teach pendant using the input signal from the outside.

<Set up procedure>

|                               |      |     |
|-------------------------------|------|-----|
| Init. set : Advanced function |      |     |
| 3/6                           |      |     |
| Cube monitor 1                | (No) | Yes |
| Cube monitor 2                | (No) | Yes |
| Operate output                | (No) | Yes |
| Weld off input                | (No) | Yes |
| Weld off output               | (No) | Yes |
| Set No / Yes                  |      |     |

Move the cursor to "Yes" and press the ENTER key. And the screen shown below appears.

|                               |  |
|-------------------------------|--|
| Init. set : Advanced function |  |
| Weld off input 1/1            |  |
| Weld off input                |  |
| Weld off input is             |  |
| Input No. = 0                 |  |

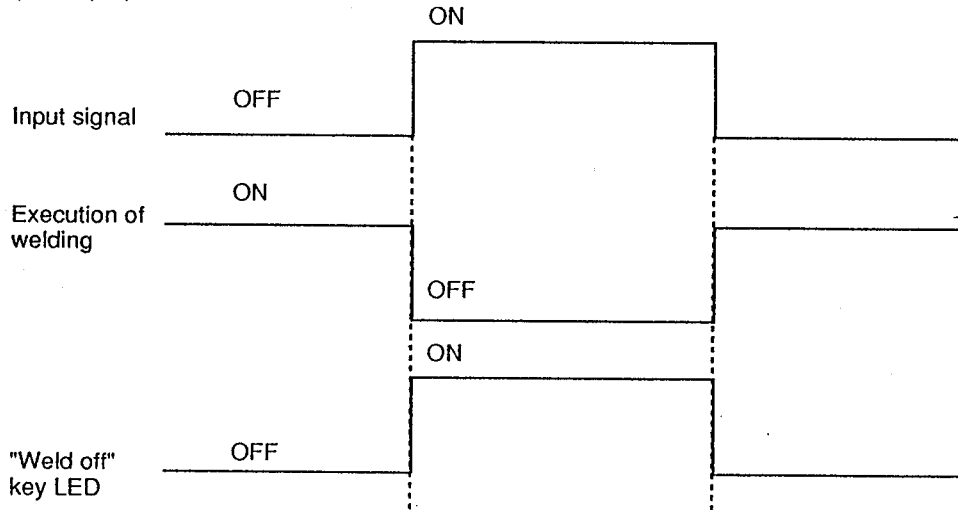
Input terminal No.: Allocate an external input terminal (one of the multi-use input terminals) which execute the weld off.

(Available main software: Ver. "JO" or higher)

(1) Execution of weld off

The weld off using the external input can be carried out only in the operation mode. When the "weld off input" is set at "Yes", the weld off is carried out while there is an input on the specified input terminal. And the "Weld off" key LED is lit. And also the "arc" of the restriction and the lock is displayed reversed.

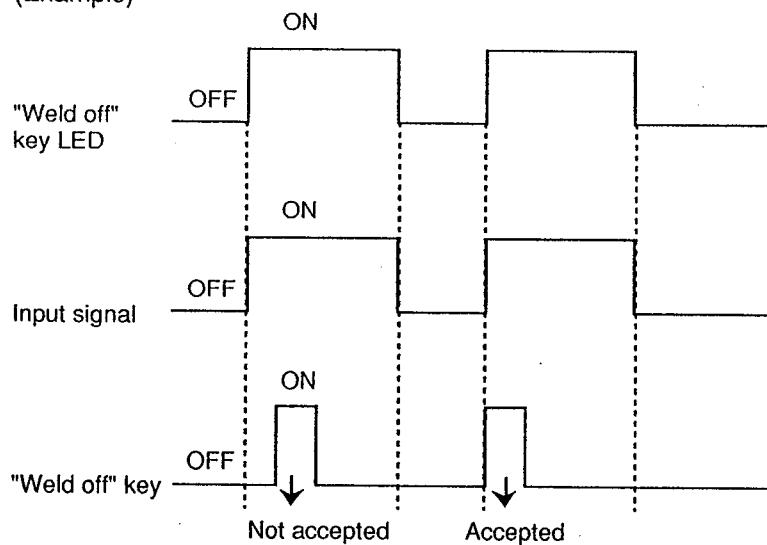
(Example)



(2) Priority of weld off

While there is an external input, the weld off by the external input has a priority and the operations of the WELD OFF key and of the restriction "arc lock" are not accepted.

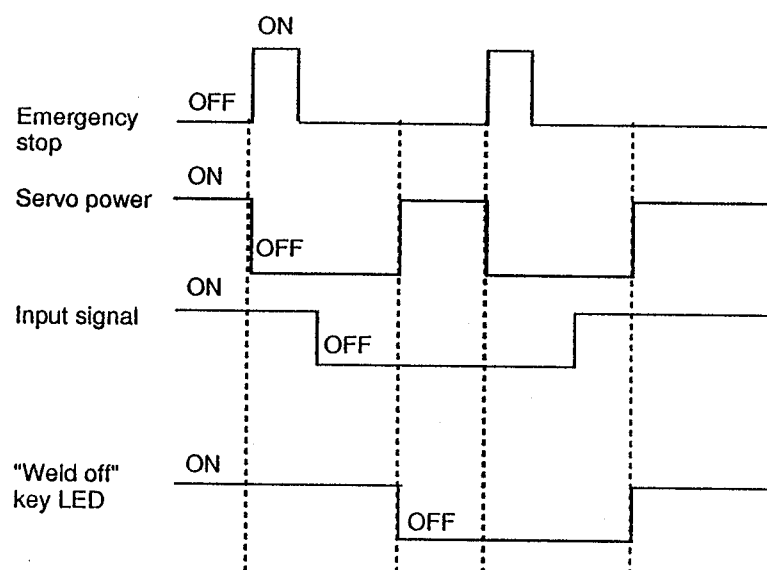
(Example)



(3) Execution during emergency stop

In case that the external input signal changes while the emergency stop is executed and the servo power is not supplied, the weld off is judged under the condition of the external input signal at the time of the servo power ON.

(Example)



#### 4.1.2.10 Weld off output

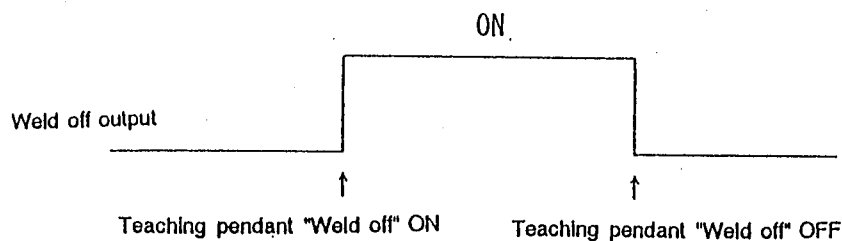
Settings for the terminal, which outputs the information that "weld off" status is set, is carried out in the operation mode.

|                        |      |      |
|------------------------|------|------|
| Init. set : Adv - func |      |      |
|                        |      | 3/6  |
| Cube monitor 1         | (No) | Yes) |
| Cube monitor 2         | (No) | Yes) |
| Operate output         | (No) | Yes) |
| Weld off input         | (No) | Yes) |
| Weld off output        | (No) | Yes) |
| Set No / Yes           |      |      |

Move the cursor to "Yes" and press the ENTER key. The screen shown below appears:

|                        |     |
|------------------------|-----|
| Init. set : Adv - func |     |
| Weld off OUT           | 1/1 |
| Weld off cond is       |     |
| Output No. = 14        |     |
| Output to              |     |

Output terminal No.: Allocate a terminal (one of the multi-use terminals) whose contact closes (output ON) during "weld off" status.



\* Even if the "Arc lock" of the restriction is set during the operation, the above signals are output.

#### 4.1.2.12 Home position return

Settings for the hold position where the robot waits for re-start after completing a workpiece, is carried out.

| Init. set : Adv - func |     |      |
|------------------------|-----|------|
| 4/6                    |     |      |
| Home return            | (No | Yes) |
| In't lock output       | (No | Yes) |
| Interval timer         | (No | Yes) |
| Teach output           | (No | Yes) |
| Job select start       | (No | Yes) |
| Set No / Yes           |     |      |

Move the cursor to "Yes" and press the ENTER key. The screen shown below appears:

| Init. set : Adv - func   |  |
|--------------------------|--|
| Home return 1/1          |  |
| Home position check = 15 |  |
| Output at above rate     |  |

Home position output terminal No.: Allocate an output terminal (one of the multi-use output terminals), which turns on (contact closes) when the robot returns to the hold position while the output turns off when the robot is away from the hold position.

Note)

When the home position output terminal is ON, set the home position return at "No" and then set it at "Yes", and the output terminal will be turned OFF.

In case of turning ON the output terminal, carry out the home position return again.



#### 4.1.2.12 Interlock output

Settings for the output informing to the external unit that the robot is in interlock (wait) status during the robot is executing sequence commands, DELAY, WAIT, in the operation mode, is carried out.

|                      |          |     |
|----------------------|----------|-----|
| Init. set : Adv-func |          |     |
|                      |          | 4/6 |
| Home return          | (No) Yes |     |
| In't lock output     | (No) Yes |     |
| Interval timer       | (No) Yes |     |
| Teach output         | (No) Yes |     |
| Job select start     | (No) Yes |     |
| Set No / Yes         |          |     |

Move the cursor to "Yes" and press the ENTER key. The screen shown below appears:

|                      |    |
|----------------------|----|
| Init. set : Adv-func |    |
| Interlock output 1/1 |    |
| Delay command        |    |
| Output No. =         | 15 |
| Wait command         |    |
| Output No. =         | 15 |

DELAY command execution output terminal No.:

Allocate a terminal (one of the multi-use output terminals) which turns on (contact closes) when the DELAY command is executed.

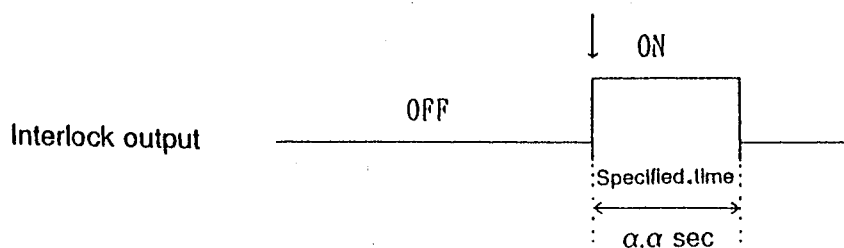
WAIT command execution output terminal No.:

Allocate a terminal (one of the multi-use output terminals) which turns on (contact closes) when the WAIT command is executed.

\* Interlock output (timing)

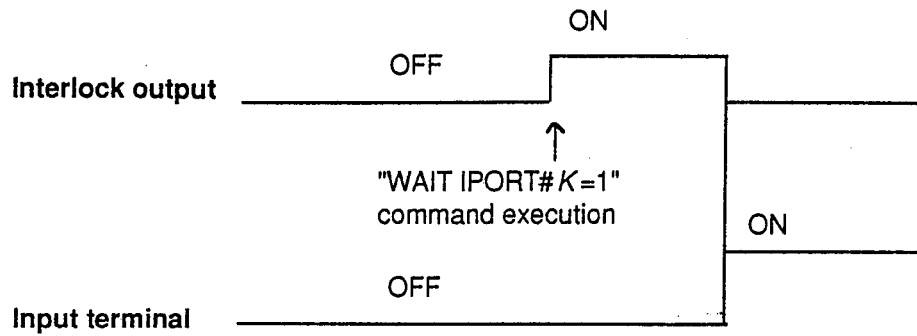
(1) DELAY command

"DELAY  $\alpha.\alpha$  sec" execution



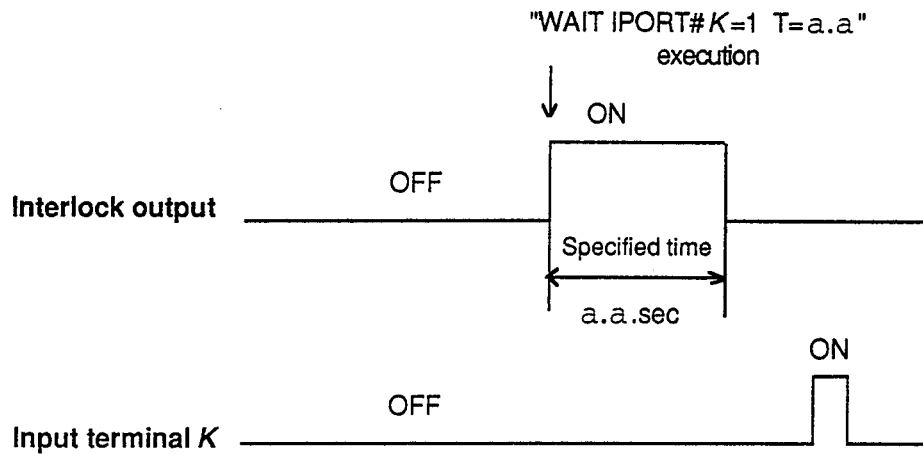
(2) WAIT command

(1) WAIT IPORT#K=1

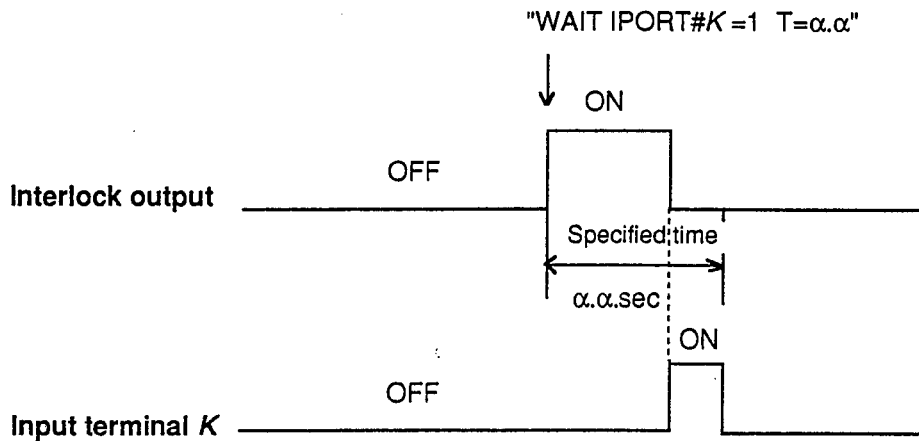


(2) WAIT IPORT#K=1 T=a.a

\* No signal is entered within the specified time length.



\* A signal is entered within the specified time length..



#### 4.1.2.13 Interval timer output

Settings for interval timer output, which repeats ON/OFF according to the movement of the robot during the operation of the robot, is carried out.

|                     |          |  |
|---------------------|----------|--|
| Init. set: Adv-func |          |  |
| 4/6                 |          |  |
| Home return         | (No) Yes |  |
| In't lock output    | (No) Yes |  |
| Interval timer      | (No) Yes |  |
| Teach output        | (No) Yes |  |
| Job select start    | (No) Yes |  |
| Set No / Yes        |          |  |

Move the cursor to "Yes" and press the ENTER key. The screen shown below appears:

|                      |  |
|----------------------|--|
| Init. set : Adv-func |  |
| Interval timer 1/1   |  |
| Output No. = 15      |  |
| ON time = 1.5 sec    |  |
| OFF time = 1.5 sec   |  |
| Output at above rate |  |

Output terminal No.: Allocate a terminal (one of the multi-use output terminals) to be used for interval timer output

ON time: Time when the output turns on (contact closes)

OFF time: Time when the output turns off (contact opens)

(The time can be set within the range of 0.1~25.5sec.)

Note 1) The interval timer output is under control of the normal output command (OUTB).

OUTB OPORT#15=1: Interval timer output starts.

OUTB OPORT#15=0: Interval timer output stops.

The output of multi-use output terminal K starts ON-OFF when sequence command "OUTB OPORT#K=1" is input, while stops when sequence command "OUTB OPORT#K=0" is input.

Note 2) Start the interval timer output by OUTB OPORT # \*\*\* = 1 1 command and hold down in the output OFF status. And the output will be turned OFF.

4.1.2.13.1 Teaching enable output (Available with the main software of version "GO" or higher version.)

By validating this function, when the "teaching enable" LED lamp of the teach pendant is lit in "Operation mode", the status output "teaching mode" is turned on. The ON output state is maintained until the teaching enable LED lamp goes out.

| Init. set : Advanced-function |                                              |  |
|-------------------------------|----------------------------------------------|--|
| 4/6                           |                                              |  |
| Home return                   | (No <input checked="" type="checkbox"/> Yes) |  |
| Int'lock output               | (No <input checked="" type="checkbox"/> Yes) |  |
| Interval timer                | (No <input checked="" type="checkbox"/> Yes) |  |
| Teach output                  | (No <input checked="" type="checkbox"/> Yes) |  |
| Job select start              | (No <input checked="" type="checkbox"/> Yes) |  |
| Set No / Yes                  |                                              |  |

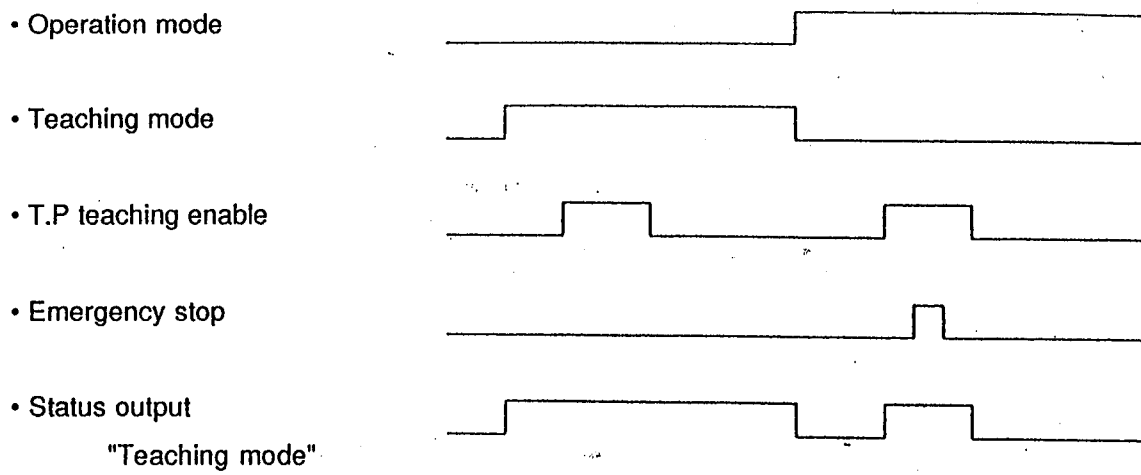
(Note)

**Yes:** When the "teaching enable" LED lamp of the teach pendant is lit in operating mode, the status output "teaching mode" is turned on.

The ON output state is maintained until the teaching enable LED lamp goes out.

**No:** Only in usual teaching mode, the status output "teaching mode" is turned on (issued).

Timing of the status output "Teaching mode"



#### 4.1.2.14 Job select start

Job selection method is set. Refer to 4.5 "Starting operation" for detailed explanation.

|                        |      |     |
|------------------------|------|-----|
| Init. set : Adv - func |      |     |
| 4/6                    |      |     |
| Home return            | (No) | Yes |
| In't lock output       | (No) | Yes |
| Interval timer         | (No) | Yes |
| Teach output           | (No) | Yes |
| Job select start       | (No) | Yes |
| Set No / Yes           |      |     |

Set the job selection method to "No".

The job selection method is judged by the status of the strobe input terminal (status of connection of the strobe terminal and the COM terminal).

Set the job selection method to "Yes".

The method shown in the figure below can be selected:

|                        |     |
|------------------------|-----|
| Init. set : Adv - func |     |
| Job select start       | 1/1 |
| STD                    |     |
| Binary                 |     |
| BCD                    |     |

##### (1) Standard method

10 jobs (1,2,4,8,16,32,64, 128, 256, 512) can be started by connecting the individual "job selection/start" terminals and the COM terminal.

##### (2) Binary method

Jobs No.1~999 can be started by connecting the "strobe input terminal" and the COM terminal after connecting the "job select/start" terminal and the COM terminal.

##### (3) BCD method

Jobs No. 1~399 can be started by connecting the "strobe input" terminal and the COM terminal after connecting the "job select/start" terminal and the COM terminal. At this time, job select/start No.1,2,4 and 8 are the 1's digit and No.16, 32, 64 and 128 are 10's digit, and No. 256 and 512 are 100's digit.

#### 4.1.2.15 Cartesian move

When the robot is set to move in the Cartesian coordinate system, this function is used to choose whether it should move in the absolute Cartesian coordinate system or in the relative Cartesian coordinate system.

| Init. set : Adv-func |     |      |
|----------------------|-----|------|
| 5/6                  |     |      |
| Crtsian move         | (No | Yes) |
| Origin search        | (No | Yes) |
| Arc retry            | (No | Yes) |
| Stick release        | (No | Yes) |
| Arc overlapping      | (No | Yes) |
| Set No / Yes         |     |      |

**Absolute:** The robot moves in the absolute Cartesian coordinate system. Refer to Section 5.4 "Motions of Cartesian coordinate system" for details.

**Relative:** The robot moves in the relative Cartesian coordinate system: it takes the UA or FA axis as the X-axis and the direction perpendicular to the axis as the Y-axis based on the direction of the RT axis. (the Z-axis direction is the same as that in the absolute Cartesian coordinate system.)

#### 4.1.2.16 Origin search

This function is used to return the robot to the origin which is specified by the Origin Offset operation.

|                      |          |  |
|----------------------|----------|--|
| Init. set : Adv-func |          |  |
| 5/6                  |          |  |
| Crtsian move         | (No) Yes |  |
| Origin search        | (No) Yes |  |
| Arc retry            | (No) Yes |  |
| Stick release        | (No) Yes |  |
| Arc overlapping      | (No) Yes |  |
| Set No / Yes         |          |  |

Set the cursor to "Yes" and press the ENTER key; the screen changes as shown below:

|                       |  |
|-----------------------|--|
| Init. set : Adv-func  |  |
| Origin search         |  |
| Speed = 7.50 (M/m, %) |  |

Speed: Set how fast the robot should return to the origin.

When Origin Search is set to "Yes":

1)"Origin Search" is added to the OPR Select screen menu.

|                                                       |              |
|-------------------------------------------------------|--------------|
| Mode Select (Initial)                                 |              |
| To select <OPR> or <TEACH>, use SW on the controller. |              |
| *OPR select* 1/1                                      |              |
| 1 Edit                                                | 4 Init. set  |
| 2 Product data                                        | 5 E. memory  |
| 3 Option                                              | 6 Org search |



- 2) "Org Offset" is added to the Produce Data menu.

|                                                                                                            |  |
|------------------------------------------------------------------------------------------------------------|--|
| Prod dat : Origin data                                                                                     |  |
| <div> <div>*OPR select* —1/1—</div> <div> 1 Std position<br/> 2 Org offset<br/> 3 Std offset </div> </div> |  |

Note 1

----- When an external servo system is being used -----

The recovery of power and the activation of the external servo mechanism will turn ON the input terminal for "External Origin Search", which allows the returning to the origin set by the "Origin Offset" operation.

Upon the completion of the return, the Origin Search End output terminal is turned on, and stays on until power is cut off.

Note 1)

The screen shown below appears in the main software of version "J3" or lower version.

|                                                                                                      |  |
|------------------------------------------------------------------------------------------------------|--|
| Prod dat : Origin data                                                                               |  |
| <div> <div>*OPR select* —1/1—</div> <div> Std position      Std offset<br/> Org offset </div> </div> |  |

#### 4.1.2.17 Arc retry (Available with the main software of version "FO" or higher version)

##### Caution :

**This function is not available in TIG welding and low-pulse MIG welding.**

| Init. set : Adv-func |        |       |
|----------------------|--------|-------|
| 5/6                  |        |       |
| Crtsian move         | ( No ) | Yes ) |
| Origin search        | ( No ) | Yes ) |
| Arc retry            | ( No ) | Yes ) |
| Stick release        | ( No ) | Yes ) |
| Arc overlapping      | ( No ) | Yes ) |
| Set No / Yes         |        |       |

When an arc is not generated at the start point, this function moves the robot slightly and tries to generate one.

##### 1. How to set the function

###### (1) Initial setting:

Call the advanced function menu, and set the Arc Retry function valid by placing the cursor on "Yes".

(2) Enter appropriate values to the screen as shown below. (Those on this screen are entered automatically when the memory is all cleared.)

| Init. set : Adv - func |   |          | Input range |   |     |
|------------------------|---|----------|-------------|---|-----|
| Arc retry              |   |          |             |   |     |
| 1 Using A-S-S No.      | = | 1        | 1           | ~ | 5   |
| 2 Arc detect time      | = | 1.5 sec. | 0.1         | ~ | 9.9 |
| 3 Retry count          | = | 3 times  | 1           | ~ | 9   |
| 4 Move pitch           | = | 3.0 mm   | 0.0         | ~ | 9.9 |
| 5 Return speed         | = | 1.0 M/m  | 0.1         | ~ | 9.9 |
| 6 Wire retract time    | = | 0.5 sec. | 0.1         | ~ | 9.9 |

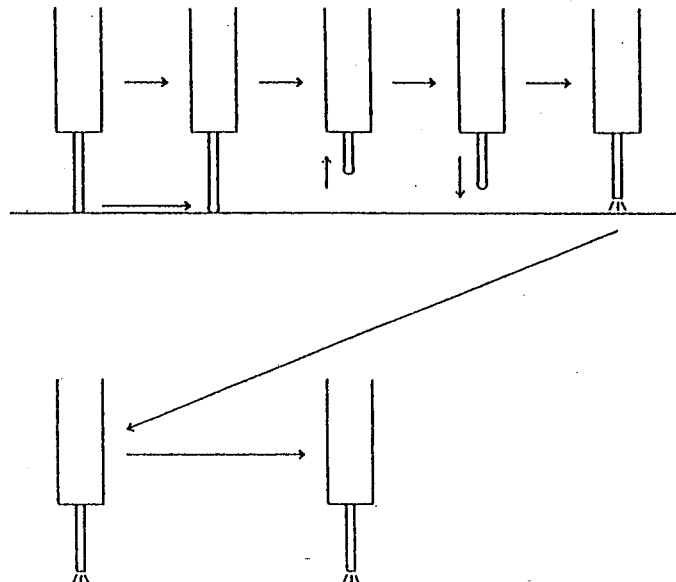
- 1) Using A-S-S No. : Enter the number of the Arc Start sequence in which the Arc Retry function should be executed. Whether it should be executed or not can be chosen in the program.
- 2) Arc detect time : Enter a period of time in which a start failure should be detected and the Retry operation should be started after the torch is turned on.
- 3) Retry count : Set the number of times the Arc Retry operation should be repeated.

- 4) Move pitch : Set how far the robot should move each time arc generation fails.
- 5) Return speed : Set how fast the robot should return to the initial start point when the robot was moved to generate an arc.
- 6) Wire retract time : Enter a period of time in which the wire should be retracted to avoid arc generation due to contact on the second trial of Arc Start or later. The retracting speed is controlled as is set on the initial setting screen ("Inching Low"). The wire should be retracted 5 mm to 10 mm. Set the speed and time to be appropriate for the welder.

## 2. Execution sequence

When the program has an Arc Start sequence for which the Arc Retry operation is set valid, the robot operates as follows:

- (1) The commands of the Arc Start sequence are executed. The "Wait" command, which delays input, is ignored.
- (2) The robot is kept waiting until an arc is generated, and then moves to the next teaching point.
- (3) When an arc is not generated within a set period of time, the torch is turned off, and the robot jogs to the arc end point.
- (4) The wire is retracted, and the torch is turned on again.
- (5) Operations (3) and (4) are repeated a specified number of times until an arc comes on.
- (6) When an arc is still not generated, an error indication is given, and the robot stops in a status of "No Arc".
- (7) When an arc is generated when the torch is turned on upon the second trial or later, the robot returns to the Arc Start position with the arc kept on, and performs regular operation.



### 3. Caution

- (1) If the robot jogs up to the next teaching point while this operation is being executed, it stops in a status of "No Arc" with an error indication.
- (2) Sequence commands which come after the Arc Start sequence command are executed after the Arc Start/Retry operation is completed. (They are executed after an arc comes on and the robot reaches the Arc Start position.)
- (3) If the robot is stopped in a status of emergency when it is performing the Arc Start/Retry operation, it gives up the operation halfway, and executes a regular Arc Start sequence when it resumes working.
- (4) After a stoppage due to a status of emergency, the robot operates as described above, executes commands that come after the Arc Start sequence command, and then moves to the next teaching point.
- (4) When the robot is stopped when it is performing Arc Start/Retry, it does not continue the operation when restarted, even if it is returned to the start point beforehand by tracing. The robot executes a regular Arc Start sequence command instead. It executes Arc Retry when restarted after moved backward beyond the start point.

4.1.2.18 Stick release (Available with the main software of version "FO" or higher version.)

**Caution :**

**This function is not available in TIG welding and low-pulse MIG welding.**

| Init. set : Adv - func |        |       |
|------------------------|--------|-------|
| 5/6                    |        |       |
| Crtisan move           | ( No ) | Yes ) |
| Origin search          | ( No ) | Yes ) |
| Arc retry              | ( No ) | Yes ) |
| Stick release          | ( No ) | Yes ) |
| Arc overlapping        | ( No ) | Yes ) |
| Set No / Yes           |        |       |

When the welding wire and base metal are sticking to each other after welding, this function resumes welding and clears the sticking automatically.

1. Setting :

(1) Initial setting:

Call the advanced function menu and set the Stick Release function valid by placing the cursor on "Yes".

(2) Enter appropriate values to the screen as shown below.

| Init. set : Adv - func |        |      |
|------------------------|--------|------|
| Arc retry              |        |      |
| 1 Using A-E-S No.      | = 1    |      |
| 2 Weld current         | = 100  | A    |
| 3 Weld voltage         | = 20.0 | V    |
| 4 Release time         | = 0.3  | sec  |
| 5 Wait-un-stick        | = 0.5  | sec. |

Input range

|     |   |      |
|-----|---|------|
| 1   | ~ | 5    |
| 1   | ~ | 350  |
| 1.0 | ~ | 50.0 |
| 0.1 | ~ | 9.0  |
| 0.1 | ~ | 9.9  |

- 1) Using A-E-S NO. : Enter the number of the Arc End sequence in which the Stick Release function should be executed.
- 2,3) Weld current/ voltage : Specify conditions under which the wire is welded.
- 4) Release time T1 : Set a period of time in which wire welding should be started.
- 5) Wait un-stick T2 : Set a period of time in which wire sticking should be detected after the torch is turned off.

## 2. Operation

- (1) The robot executes the Arc End sequence command at the Arc End point.
- (2) When sticking is detected, the torch is turned on under specified conditions. It is turned off in a specified period of time (T1).
- (3) Sticking is checked for again, and if it is found, an error indication is given.

## 3. Cautions

- (1) The registration of the stick check command in a specified Arc End sequence is required.
- (2) When welding conditions are not appropriate, the wire may stick to the tip, or sticking may not be cleared.
- (3) When the wire sticks to the tip during the Stick Release operation, raise the welding current amperage.
- (4) When sticking cannot be cleared by this operation, raise the welding voltage.

#### 4.1.2.21 Arc overlapping

(Available with the main software of version "F0" or higher versions.)

#### Caution :

**This function is not available in TIG welding and low-pulse MIG welding.**

| Init. set : Adv-func |        |       |
|----------------------|--------|-------|
| 5/6                  |        |       |
| Crtsian move         | ( No ) | Yes ) |
| Origin search        | ( No ) | Yes ) |
| Arc retry            | ( No ) | Yes ) |
| Stick release        | ( No ) | Yes ) |
| Arc overlapping      | ( No ) | Yes ) |
| Set No / Yes         |        |       |

When the robot is stopped due to arc extinction or for other reasons before finishing welding, this function memorizes the position where it stops, and makes it resume welding a certain distance before the position. This function is available in linear and circular welding. When the robot is stopped before finishing weaving, either linear or circular, follow the regular procedure for resumption. (This function is available with the main software of version "KO" or higher version even in the weaving section.)

#### 1. Setting

##### (1) Initial setting

Call the advanced function menu, and set the Arc Overlapping function valid by placing the cursor on "Yes".

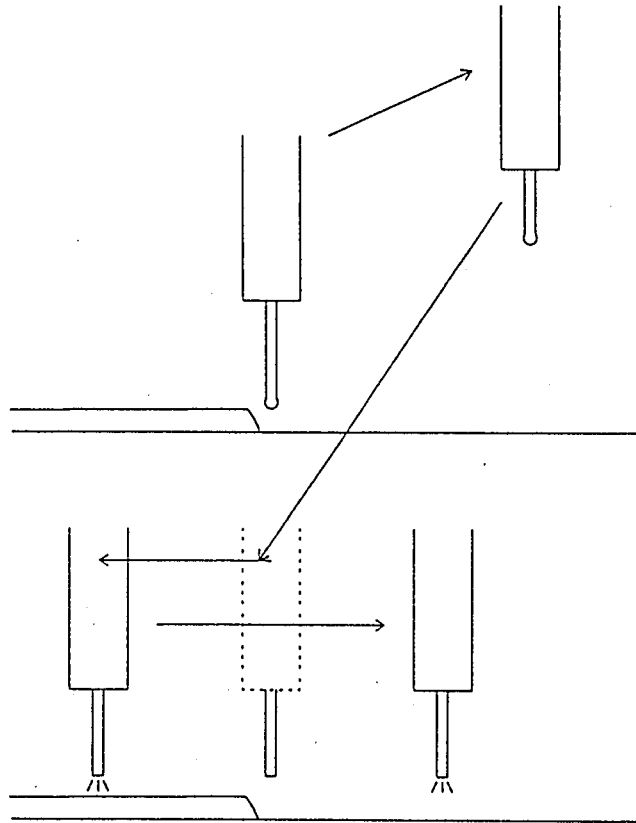
##### (2) Enter appropriate values to the screen as shown below.

| Init. set : Adv-func |           | Input range |
|----------------------|-----------|-------------|
| Arc overlapping      |           |             |
| 1. Overlap distance  | = 5 mm    | 1 ~ 50.0    |
| 2. Return speed      | = 1.0 M/m | 0.1 ~ 9.9   |

#### 2. Operation

- (1) The robot stops because the wire is cut or sticking to the tip.
- (2) Move the robot to the escape position by teaching pendant operation.
- (3) Clear the cause of the stopping by replacing the tip with a new one.
- (4) Resume robot operation.

- (5) The robot returns to the position where it stopped, moves back a specified distance and starts welding under the conditions set before the suspension.
- (6) If the robot fails to generate an arc, it does not perform the Arc Retry operation.



### 3. Cautions

The robot stays off in an error status with an indication of "Overlap Impossible" if it is restarted under the following conditions :

- (1) If overlapping is performed, the robot will reach or move beyond a teaching point.
- (2) The robot has reached a teaching point by tracing operation (forward/backward).
- (3) The WELD STORE or NORMAL STORE key is pressed;

To clear the error status, press the CANCEL key on the teach pendant or input cancel externally.

When the robot is then restarted, it begins welding on the spot, as does in a case of normal suspension.



#### 4.1.2.20

#### Operation interrupt processing

(Available with the main software of version "G0" or higher version)

Before version F2, the external input terminal (one of general inputs) cannot be specified for terminating the execution of operation by force, but it can be specified in version G0 and after. When temporarily stopping the operation and terminating the execution by force, the output terminal for turning off is determined.

|                               |                                                |
|-------------------------------|------------------------------------------------|
| Init. set : Advanced function |                                                |
| 6/6                           |                                                |
| Program Restart               | ( No <input checked="" type="checkbox"/> Yes ) |
| Resume                        | ( <input checked="" type="checkbox"/> No Yes ) |
| Set No / Yes                  |                                                |

Move the cursor to "Yes" and press the "ENTER" key; the following specific setting screen.

|                                                |
|------------------------------------------------|
| Init. set : Advanced function                  |
| 1/1                                            |
| Input No. for Reset No. = 14                   |
| Reset signal output No. = 14<br>(Chang to off) |

**Output terminal No.:** To assign the output terminal (one of general output) for turning off always when terminating the execution of operation by force.

**Input terminal No.:** To assign the external input terminal (one of general inputs) for terminating the execution of operation by force.  
When receiving a signal to the above input during pause in run mode or after servo ON following emergency stop, the job or program in execution interrupts execution wait for start of new job (external start mode), or to wait for selection of operation (internal start mode).

#### 4.1.2.21 Resume function

(Available with the main software of version "J0" or higher version.)

##### 1. Outline

This function is provided to restore the robot operation which is suspended due to the interruption of the power supply during the stand-by or operation in the "Operation" mode, or during the program-teaching or checking in the "Teach" mode. When the power is reapplied, the robot operation will be restored from the step and/or the output status where the operation is suspended.

This function is utilized in the cases as follows:

- \* To restore the operation suspended due to the power failure during the operation or the program teaching when the power failure recovers.
- \* To restore the robot operation such as palletizing which was suspended on the preceding day (by turning OFF the power supply.)

<Setup procedure>

|                        |        |       |
|------------------------|--------|-------|
| Init. set : Adv - func |        |       |
| 6/6                    |        |       |
| Program Restart        | ( No ) | Yes ) |
| Resume                 | ( No ) | Yes ) |
| Weld-set shift         | ( No ) | Yes ) |
| Soft limit TBL         | ( No ) | Yes ) |
| Set No / Yes           |        |       |

Move the cursor to "Yes" and press "ENTER" key, the following specific setting appears.

|                        |       |
|------------------------|-------|
| Init. set : Adv - func |       |
| Resume 1/1             |       |
| Unconditional          |       |
| Conditional            |       |
| Input No.              | = * * |
| Output No.             | = * * |

\* Refer to "4-1, Function setting" on page 4-41-24 for descriptions of each set-up items.

## 2. Specifications

| Items         | Applications                                                                                                                |
|---------------|-----------------------------------------------------------------------------------------------------------------------------|
| Mode          | Operation mode, Teaching mode (Teaching / Tracing)                                                                          |
| Welding       | Available                                                                                                                   |
| Sensor        | <ul style="list-style-type: none"> <li>• Arc / Spin sensor ... Available</li> <li>• Touch sensor ..... Available</li> </ul> |
| External axis | Available                                                                                                                   |
| Error         | Available                                                                                                                   |
| Alarm         | Not available                                                                                                               |

\*REMARKS\*

- o Within approx. 15 ms after the depression of Start, Trace forward, or Trace backward key.
- o Within approx. 25 ms after the robot's arrival at Teach point until its execution of the sequential processing.
- o Within approx. 15 ms after the depression of the Teach ready key until the respective LED turned ON is automatically turned OFF.
- o Within approx. 25 ms after the end of operation.
- o Within approx. 25 ms when the program is switched with the program called.

At the conditions listed above, a Resume command cannot be executed if the power supply is turned ON.

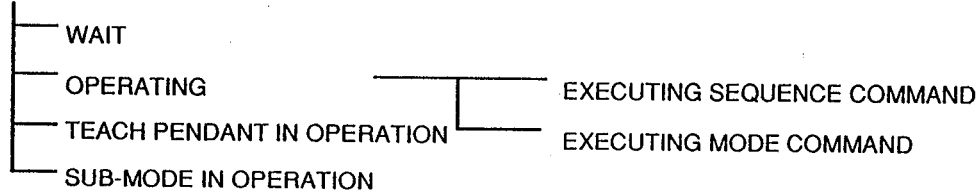
Mode Select Menu (Initial Menu) appears on the screen.

The ON signal will not be provided to the general output terminal preset to provide output (when the Resume command is executed).

### 3. Function

#### 3-1. Operation mode

##### OPERATION MODE



\* The SUB-MODE are:

- ① The Opr cond, Disp change, E. memory, Limit cond, Edit, and Option modes that may be selected with "OPR SEL" key when the machine is on stand-by or in operation.
- ② The Disp posi, I/O monitor, and User's sys mode that may be selected with "OPR SEL" key when the machine is Teach pendant-operated.

| No. | POWER OFF                        | POWER ON                                                                               | SERVO ON                                                               | RESTART                                                                             |
|-----|----------------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 1   | Home position                    | Restore the emergency stop status                                                      | Restores hold status                                                   | -                                                                                   |
| 2   | In operation                     |                                                                                        |                                                                        |                                                                                     |
|     | Sequence command in execution    | ↑                                                                                      | ↑                                                                      | Re-execute the sequence command from the step in which the power off occurred.      |
|     | Move command in execution        | ↑                                                                                      | ↑                                                                      | Re-execute the move command executed immediately before the power off. (See Note 1) |
| 3   | In operation using teach pendant | ↑                                                                                      | Restores the operation with teach pendant status before the power off. | -                                                                                   |
| 4   | SUB-MODE in execution            | Restores the emergency stop status before the execution of the sub-mode. (See Note 2). | Restores the hold status before the execution of the sub-mode.         | Does not restore during the execution of the sub-mode.                              |

#### [Note 1]

An abrupt interruption of the robot power supply may cause the deviation of the tool tip position. It is therefore needed to set the "Arc overlapping" of the expanded functions to "YES" in order to restart the welding from the point just before the position where the welding is suspended due to the power interruption.

Ⓐ      Ⓐ



|                   |     |     |     |    |
|-------------------|-----|-----|-----|----|
| OUTPUT PORT No. 1 | OFF | OFF | OFF | ON |
| OUTPUT PORT No. 1 | OFF | OFF | ON  | ON |

Overlapping distance [ = (A) - (a) should be entered with the "Arc overlapping" of the expanded functions set to "YES".

[Note 2]

Resume function in the event of power interruption during execution of sub-mode.

(1) Sub-mode that may be selected with "OPR SEL" key on stand-by or in operation:

① Opr cond:

In the event of power interruption when presetting the operating conditions in this sub-mode, all the data preset until the power interruption become invalid.

Restores to the screen where the sub-mode display is not yet included.

② Limit cond:

In the event of power interruption when presetting the limiting conditions in this sub-mode, all the data preset until the power interruption become invalid.

Restores to the screen where the sub-mode display is not yet included.

③ Edit:

In the event of power interruption when editing in this sub-mode, all the data edited until the power interruption are valid. Restores to the screen where the sub-mode display is not yet included. Select the Edit in the sub-mode once again to execute editing.

④ Disp change:

In the event of power interruption when selecting what to display or changing the current display, the display automatically changes into "Language display". Restores to the screen where the sub-mode display is not yet included.

⑤ E. memory:

- In the event of power interruption during execution of Save mode:

All the data saved until the power interruption become invalid. Restores to the screen where the sub-mode display is not yet included. Select the E. memory in the sub-mode once again to execute Save.

- In the event of power interruption during execution of Load mode:

All the data loaded until the power interruption are saved at the robot side. Restores to the screen where the sub-mode display is not yet included. Select the E. memory in the sub-mode once again to execute Load.

⑥ Option:

- In the event of power interruption during execution of Printer:

Prints out the data to a certain extent, but unable to print out the data successively.

Restores to the screen where the sub-mode display is not yet included. Select the Printer in the sub-mode once again to execute Printer.

- In the event of power interruption during execution of PC comm:  
All the data transmitted from the robot to PC by the PC comm editing function until the power interruption become invalid. Restores to the screen where the sub-mode display is not yet included.
  - \* It is impossible to transmit the data from PC to the robot by the use of PC COMM editing function in the Operation mode.
- (2) Sub-mode that may be selected with "OPR SEL" key during Teach pendant operation:
- ① Disp posi:  
In the event of power interruption when changing the current display, the display automatically changes into "Language display". Restores to the screen where the sub-mode display is not yet included.
- ② I/O monitor:
- In the event of power interruption when monitoring input: Restores to the screen where the sub-mode display is not yet included.
  - In the event of power interruption when monitoring output: Recovers the output condition preset until the power interruption. Restores to the screen where the sub-mode display is not yet included.
- ③ User's sys:  
In the event of power interruption when teaching the point in this sub-mode, all the point data taught until the power interruption are kept saved.  
Restores to the screen where the sub-mode display is not yet included. Selected the User's sys once again in the sub-mode to teach the points remained.

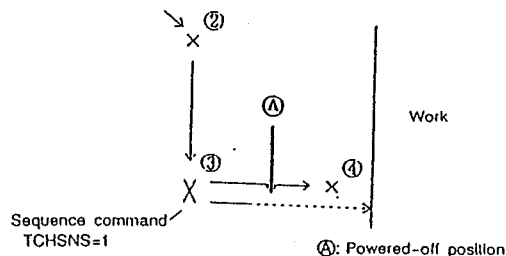
<For the operation with the sensors>

① Arc sensor, Spin arc

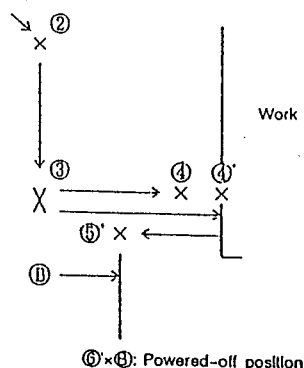
In the event of power interruption and recovery during execution, the operation may be restarted with the Restart command after processing with the Resume function.

② Touch sensor

- In case of power interruption and recovery when executing the touch sensing, the RESTART command will be rewarded with the warning "Sensing impossible" displayed on the screen as shown in the event of Emergency Stop. And it is impossible to automatically execute the operation in successive manner with the command externally applied.



- When the warning message "Sensing impossible" appears on the screen, restart the operation with the robot moved from the position (A) where the power interruption occurs to the Step 2 by the user of Trace backward command so that the Touch sensor command "TCHSNS = 1" may be executed at the Step 3 for successive operation.
- In the event of power interruption and recovery after the touch sensing operation is completed, the sensing amount (shift amount) is kept saved.



By touch sensing operation, the value (④-④') is to be accumulated in the buffer for correction.

For example, if the power is interrupted and recovered the, servo is activated, and the operation is restarted at the point ⑥' in the above Fig., the operation is successively executed and the robot moves to the point ⑥', the position shifted from (B) by the value accumulated in the buffer for correction (④-④').



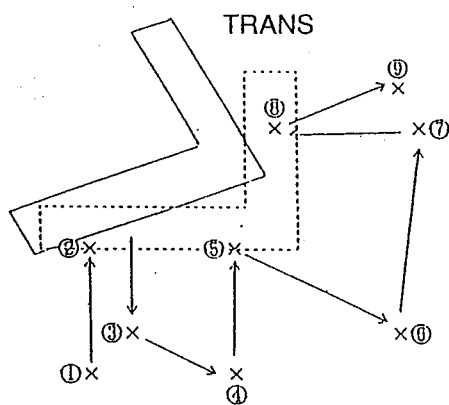
### ③ CHGPOS, TRANS commands

- In the event of power interruption and recovery during the execution of the command, the RESTART cannot re-execute the command in successive manner with the subsequent warning message displayed on the screen.

CHGPOS

: Can't convert posi. data

- In this case, restarting should be performed with the robot moved to the step immediately before the step where the CHGPOS command is registered, by the use of Trace backward command. Then, the CHGPOS command may be executed.



: Can't set Ref. position

[ ] : Teaching work position

[ ] : Deviated work position

| Step                                                    | Sequence command |
|---------------------------------------------------------|------------------|
| 1. Approach point                                       | : TCHSNS = 1     |
| 2. Contact point                                        | : TRANS BASE = 1 |
| 3. Waiting point                                        | :                |
| 4. Approach point                                       | : TCHSNS = 1     |
| 5. Contact point                                        | : TRANS BASE = 2 |
| 6. Waiting point                                        | :                |
| 7. Approach point                                       | : TCHSNS = 1     |
| 8. Contact point                                        | : TRANS BASE = 2 |
| 9. Waiting point                                        | :                |
| m A point just before the rotational shift start point. | : SFTBUF = 1     |
| n Rotational shift end point                            | : SFTBUF = 0     |

For example, if the power is interrupted and recovered during the execution of the command "TRANS BASE = 2" at the Step 5 in the above Fig., the Restart will be rewarded with the warning message "Can't set Ref. position" displayed on the screen.

- In this case, restart with the robot moved to the Step 3 by the use of Trace backward command. Then, the command "TRANS BASE = 2" at the Step 5 may be 3 executed.
- If restarted with the warning disregarded, the command "TRANS BASE = 2" will not be executed and the robot will move through the points as taught without rotation shift even if the command "SFTBUF = 1" is executed at the Step m.

<For the operation with the external shaft>

① System with an external shaft of absolute encoder type

- In the event of power interruption and recovery during execution, the operation may be restarted with the Restart command after processing with the Resume function.
- In the event of power interruption and recovery when executing the external shaft isolating function, the isolated status will be recovered.

If the isolated shaft starter terminal input is turned ON, it is inoperative (for safety purpose).

To operate, turn it OFF at first and then turn it ON again.

② System with an external shaft of incremental encoder type

- Resume function inoperative.

<Errors and alarms>

- o In the event of power interruption and recovery during the occurrence of errors, the Resume function is operative to allow the operation in successive manner. Error may be issued again if the causes of the error were not eliminated when restarted.  
If an Encoder position check error occurs in AW005A, 006A (II) when the power is recovered, the operation may not be resumed.
- o In the event of power interruption and recovery when an alarm is issued, the Resume function is inoperative, and then operation may not be continued.

<Others>

① Home position output

In the event of power interruption and recovery when the Home position output is turned ON, the Resume function is operative and the "ON" output is provided.

② Interval timer status output

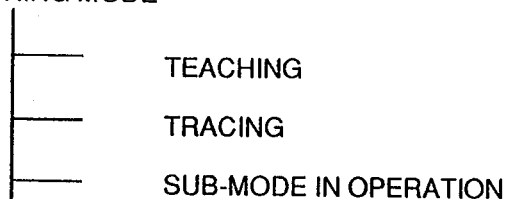
In the event of power interruption and recovery, the operation may be restarted with the Restart command after processing with the Resume function. For example, if the power is interrupted 3 seconds after the actuation of the interval timer preset to provide "ON" output for 5 seconds, it will provide "ON" output once again for 5 seconds when the power is recovered and the Restart commands is given after the processing of the Resume function.

③ Job Library

In the event of power OFF and recovery, the jobs reserved will be restored.

### 3-2. Teaching mode

#### TEACHING MODE



The SUB-MODE are:

- ① The Edit sequence, Disp posi, I/O monitor, and User's sys modes that may be selected with "OPR SEL" key during TEACH
- ② The OPr Unit and Disp posi mode that may be selected with "OPR SEL" key during the operation for check.

REGISTER HOME POSITION, TEACH COORDINATE SYSTEM, CONVERSION, FILE LIST

| NO. | POWER OFF             | POWER ON                                                                                  | SERVO ON                                                             | REACTIVATE                                                             |
|-----|-----------------------|-------------------------------------------------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------------------------------|
| 1   | TEACHING              | Restores the emergency stop status. (See Note 1)                                          | Restores the hold status.                                            | -                                                                      |
| 2   | TRACING               | ↑                                                                                         | ↑                                                                    | Re-executes the move command execute immediately before the power off. |
| 3   | SUB-MODE IN OPERATION | Restores the execution of sub-mode status before the execution of sub-mode. (See Note 2). | Restores the temporary stop status before the execution of sub-mode. | Does not restored during the execution of the sub-mode.                |
| 4   | HOME POSITION         | No restoration                                                                            | No restoration                                                       | No restoration                                                         |

[Note 1]

In the event of power interruption when teaching the circular motion and/or the weaving for the first time, the power recovery does not restore the status when the power is interrupted, and brings the normal mode select menu (Initial Menu) to the screen.

Erase the commands for the circular motion and/or the weaving in the EDIT mode screen, and teach it again in the TEACH mode.

[Note 2]

Resume function for the power interruption during the execution of sub-mode.

(1) Sub-modes that may be selected with OPR SEL key while teaching:

① Edit sequence:

In the event of power interruption when editing in this sub-mode, all the operation sequence completely registered until the power interruption are saved.

Restores to the screen where the sub-mode display is not yet included.

② Disp posi:

In the event of power interruption when changing the current display in this sub-mode, the display automatically changes into "Language display". Restores to the screen where the sub-mode display is not yet included.

③ I/O monitor:

- In the event of power interruption when monitoring Input: Restores to the screen where the sub-mode display is not yet included.

- In the event of power interruption when monitoring Output: Recovers the output status preset until the power interruption.

Restores to the screen where the sub-mode display is not yet included.

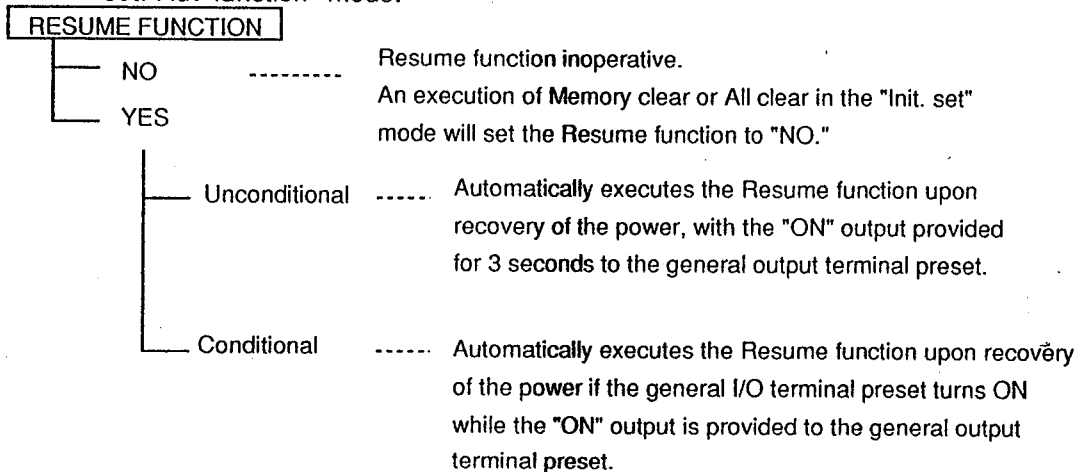
④ User's sys:

In the event of power interruption when teaching the point in this sub-mode, all the point data taught until the power interruption are kept saved. Restores to the screen share the sub-mode display is not yet included. Select the User's sys once again in the sub-mode to teach the points remained.

#### 4. Operation

##### 4-1 Setting of functions

Set the Resume function to "YES" by the use of the expanded function in the "Init. set: Adv-function" mode.



Setting of General Input terminal Number:     A terminal which receives "Resume function select" input signal

This is the terminal to be set for receiving an selection input whether it is required or not to execute the Resume function.

- \* If the Conditional is selected:  
Automatically executes the Resume function upon an input while the output terminal is turned ON for providing the signal telling that the Resume function is available.
- \* If the Unconditional is selected:  
Disregards any Input Terminal Number preset. Any input to those terminals will not affect the operation.

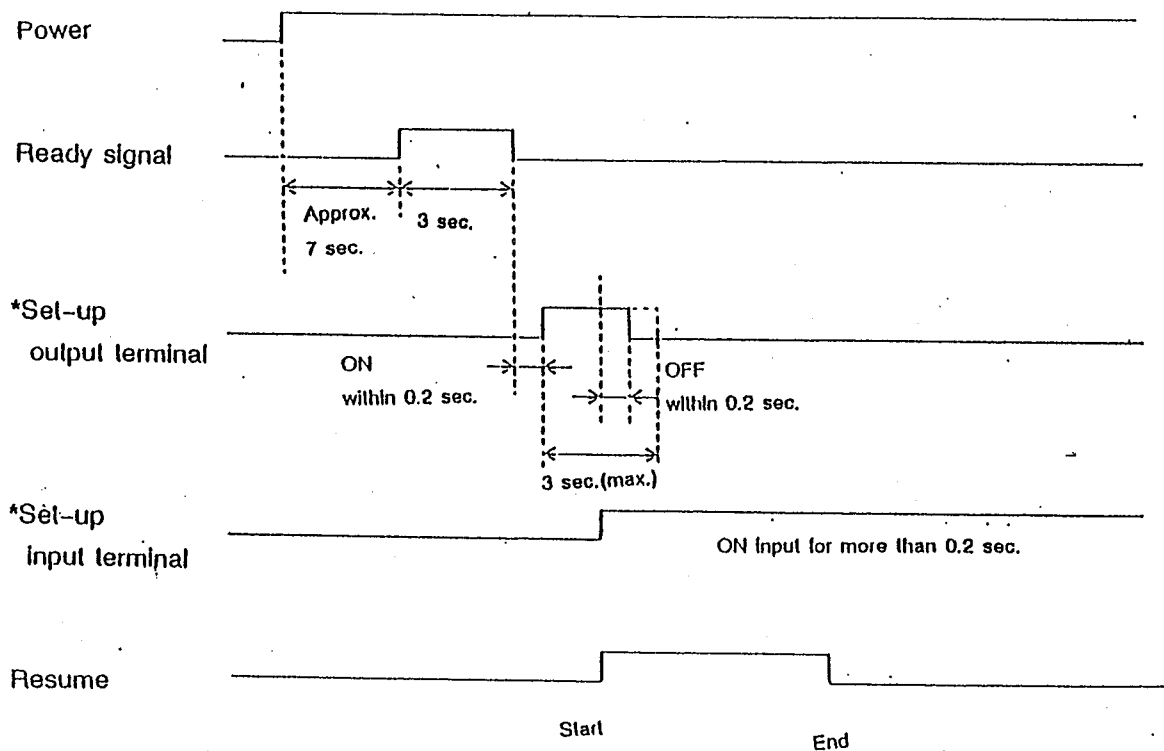
Setting of General Output Terminal Number:     A terminal which receives "Resume function effective" output signal

This is the terminal to be set for providing the signal telling that the Resume function is available.

- \* If the Conditional is selected:  
Turns on for max. 3 seconds after the READY signal is turned OFF. and turns OFF if an input is provided within such 3 seconds to the Input Terminal preset for receiving an selection input whether the execution of the Resume function is required or not. If the Input Terminal is turned on before this output terminal is turned ON, the edge output will be provided (ON signal for 0.2 sec.).
- \* If the Unconditional is selected:  
Turns ON for 3 seconds (fixed) after the READY signal is turned OFF.

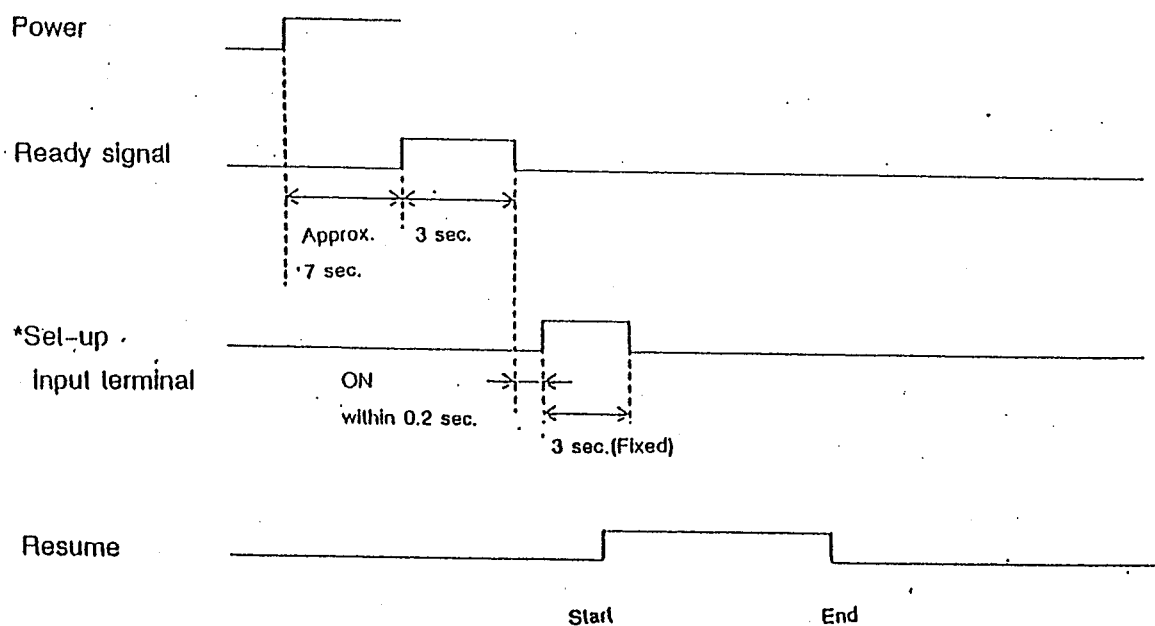
## 4-2. Timing to carry out Resume Function

### (1) Resume function "YES" (Conditional)



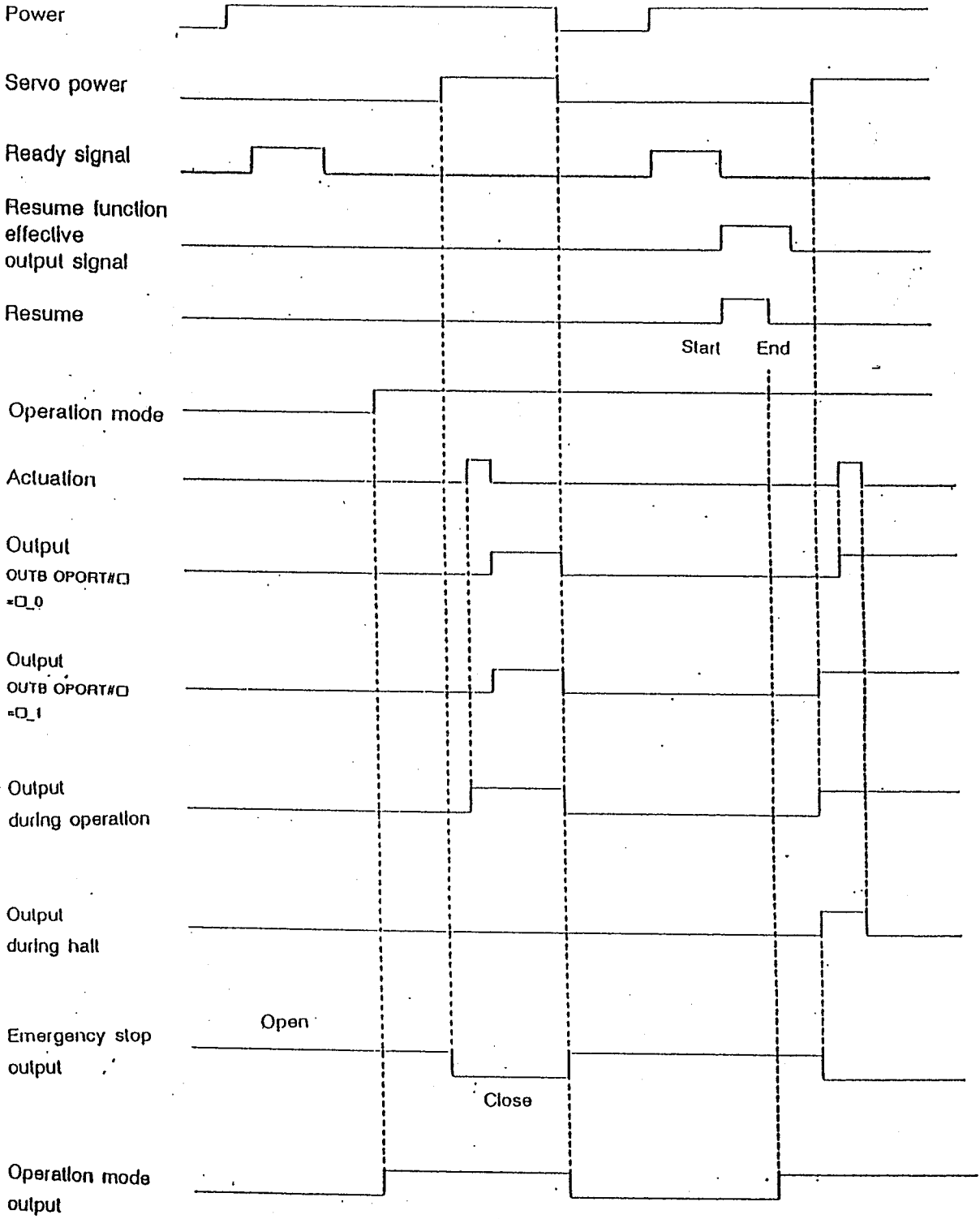
Set-up output terminal : Resume function "YES" output signal terminal  
 Set-up input terminal : Resume function "select" input signal terminal

### (2) Resume function "YES" (Unconditional)



Set-up output terminal : Resume function "YES" output signal terminal

4-3. Status output timing





#### 4.1.2.22 Welding section all shift function

(Available with the main software of version "L0" or higher versions.)

This is the function, by changing only the arc start point, to shift the position data in the welding section ranging from the arc start point to the arc end point in parallel and in batch.

<Setup procedures>

|                     |                                                                         |     |
|---------------------|-------------------------------------------------------------------------|-----|
| Init. set: Adv-func |                                                                         | 6/6 |
| Program Restart     | ( <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes ) |     |
| Resume              | ( <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes ) |     |
| Weld-sect shift     | ( <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes ) |     |
| Soft limit TBL      | ( <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes ) |     |
| Set No/Yes          |                                                                         |     |

Valid

Press the WELD STORE key when the arc start point is changed, and the message of "Weld-sect shift?" will be displayed on the screen. In case of using the welding section all shift function, select "Yes" and press the ENTER key. And the welding section from the arc start point to the arc end point will be shifted in parallel and in batch.

|                                         |                             |
|-----------------------------------------|-----------------------------|
| * OPR select *                          |                             |
| Weld-sect shift?                        |                             |
| <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |

Invalid

This function is not available.

<Notes>

- This function is not available for the external axis.  
When "Weld-sect shift? Yes." is selected and executed, only the robot teaching point will be shifted.
- In the harmonic section, this function is not available either for the robot or the external axis.
- In case that the harmonic movement is started during the welding, the welding section all shift function cannot be selected at the arc start point.
- If the power is shut off and then turned on when "Resume: Yes" is selected and this function is valid, the normal mode select screen (initial screen) will appear.
- This function is available for the palletizing operation step.

#### 4.1.2.23 Soft limit TBL

(Available with the main software of version "L0" or higher versions.)

##### 1. Summary

Eight software limits valid only during the robot teaching operation are added to this function in addition to the conventional standard software limits. These software limits can be selected freely during the teaching operation.

If the range of the software limit is set within the range required for the teaching program or the modification program, the safety of the teaching operator will be improved.

##### 2. Initial setting of the function

Carry out the initial setting of the function according to the following procedures.

(1) Select "Init. set" and "Advanced function" on the "Initial screen."

(2) Select "Yes" of "Soft limit TBL."

|                              |            |     |
|------------------------------|------------|-----|
| Init. set: Advanced function |            | 6/6 |
| Program Reset                | ( No Yes ) |     |
| Resume                       | ( No Yes ) |     |
| Weld-sect shift              | ( No Yes ) |     |
| Soft limit TBL               | ( No Yes ) |     |
| Set No/Yes                   |            |     |

(Screen ①)

<Operational procedures>

- Move the cursor to "Yes" using the cursor key and press the ENTER key.

(3) Select the soft limit No. to be used.

|                              |              |
|------------------------------|--------------|
| Init. set: Advanced function |              |
| Soft limit TBL               |              |
| Soft limit 1                 | Soft limit 5 |
| Soft limit 2                 | Soft limit 6 |
| Soft limit 3                 | Soft limit 7 |
| Soft limit 4                 | Soft limit 8 |

(Screen ②)

<Operational procedures>

- Move the block cursor to the soft limit No. using the cursor key and press the ENTER key.

(4) Set the work envelop of each axis.

|                              |         |
|------------------------------|---------|
| Init. set: Advanced function |         |
| Soft limit no. = X           |         |
| RT = -XXX. XX                | XXX. XX |
| UA = -XXX. XX                | XXX. XX |
| FA = -XXX. XX                | XXX. XX |
| RW = -XXX. XX                | XXX. XX |
| BW = -XXX. XX                | XXX. XX |
| TW = -XXX. XX                | XXX. XX |

(Screen ③)

<Operational procedures>

- Input the work envelop of each axis using the numerical value key and press the ENTER key.
- Press the END key and screen ② appears.
- Press the OPR SEL key and screen ④ appears.

|                              |         |
|------------------------------|---------|
| Init. set: Advanced function |         |
| Soft limit no. = X           |         |
| RT = -XXX. XX                | XXX. XX |
| UA = -XXX. XX                | XXX. XX |
| FA = -XXX. XX                | XXX. XX |
| RW = -XXX. XX                | XXX. XX |
| * OPR select 1/1             |         |
| 1 STD                        |         |

(Screen ④)

<Operational procedures>

- Press the ENTER key when the cursor is positioned at "1 STD" and the specific work envelop of the robot is set at standard.
- When the setting is completed, screen ③ appears.

### 3. How to use functions

In the teaching (including trace) mode or the operation mode, press the MENU key when the teach pendant is available (TEACH ENABLE LED is lit). And the soft limit No. selected in "Advanced function" is called.

In case that the robot is operated by means of the teach pendant (manual operation and trace forward/backward), the soft limit No. selected in "Menu select" becomes valid. When the MENU key is not pressed, the menu No. is set at "0" and the value set in "Rbt constant" of "System set" is valid.

#### <Operational procedures>

- ① In the teaching (or trace) mode or the operation mode, set the robot so that it is operated by means of the teach pendant. (TEACH ENABLE ON status)

- ② Press the MENU key.

| Menu select                     |   |    | 1/2 |
|---------------------------------|---|----|-----|
| AJO                             | = |    | X   |
| CJO                             | = |    | X   |
| Weaving                         | = | XX |     |
| User Cys                        | = |    | X   |
| Wrist Cal                       | = |    | X   |
| [OPR SEL] → Change menu content |   |    |     |

(Screen ⑤)

#### <Operational procedures>

- Press the "↑" key and screen ⑥ appears.
- Press the END key and the "Menu select" screen is ended.

- ③ Press the "↑" key.

| Menu select    |   |  | 2/2 |
|----------------|---|--|-----|
| Soft limit no. | = |  | X   |

(Screen ⑥)

#### <Operational procedures>

- Input the soft limit No. to be used among from the soft limits selected at "Advanced function" and press the ENTER key.
- Press the "↓" key and screen ⑦ appears.
- Press the END key and the "Menu select" screen is ended.

- ④ Select the soft limit No. which limits the work envelop during the operation of the teach pendant.

- ⑤ Press the END key. (After that, the soft limit designated at ④ becomes valid.)

## 4.2 Product data

The production management contents and the robot management data can be displayed and reset.

Contents displayed: (1) Accumulated time  
 (2) Job execution count  
 (3) Origin data  
 (4) Register content  
 (5) Error history  
 (6) Time  
 (7) PROM version

| No. | Operation                                                                                                                                                                                                                                                                                                             | Screen display                                                                                                                                                                      |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | This operation is started from the mode selection initial screen.                                                                                                                                                                                                                                                     | <div>           Mode Select (Initial)<br/>           To select &lt;OPR&gt; or &lt;TEACH&gt;, use SW on the controller.         </div>                                               |
| 1   | Move the cursor the "Product data" and press the ENTER key.                                                                                                                                                                                                                                                           | <div>           *OPR select* 1/1<br/>           1 Edit                      4 Init. set<br/>           2 Product data            5 E. memory<br/>           3 Option         </div> |
| 2   | Select the item required. (move the cursor to the item.)<br>4.2.1 Accumulated time<br>4.2.2 Job execution count<br>4.2.3 Origin data<br>4.2.4 Register contents<br>4.2.5 Error history<br>4.2.6 Time<br>4.2.7 PROM version<br>((5) to (9) are displayed when the OPR SEL key is pressed.)<br><br>Press the ENTER key. | <div>           Contents of the selected item<br/>           is displayed.<br/>           (Explanation is given later.)         </div>                                              |
| 3   | Confirm the contents, reset and then press the END key.                                                                                                                                                                                                                                                               |                                                                                                                                                                                     |

#### 4.2.1 Accumulated time (when "Accumulated time" is selected)

Various arithmetic processing time of the robot operation is displayed and reset.

|                        |            |
|------------------------|------------|
| Init. set : Adv - func |            |
| Accumul time 1/1       |            |
| Controller on time     | 31.6 hours |
| OPR time (Total)       | 0.0 hour   |
| Arc on time            | 0 hour     |
| OPR time in job        | 0 sec.     |
| Arc on time in job     | 0 sec.     |
|                        | (0.0%)     |

To reset, press the OPR SEL key and the screen shown below appears:

|                  |       |
|------------------|-------|
| *OPR select* 1/1 |       |
| 1                | Reset |

Press the ENTER key.

#### 4.2.2 Job execution count (when the "Job execution count" is selected)

The job execution count is displayed and reset.

|                   |    |           |           |
|-------------------|----|-----------|-----------|
| Prod dat          |    |           |           |
| Job exe count 1/1 |    |           |           |
| NO                | TM | NO        | TM        |
| 1                 |    | 6         |           |
| 2                 |    | 7         |           |
| 3                 |    | 8         |           |
| 4                 |    | 9         |           |
| 5                 |    | 10        |           |
| Page next         |    | Page back | All reset |

Move the cursor to "page next" or "page back" and press the ENTER key to switch the job to be displayed.

To reset, press the ENTER key after moving the cursor to "All reset".

#### 4.2.3 Origin data (when "Origin data" is selected)

|                        |            |
|------------------------|------------|
| Prod dat : Origin data |            |
| *OPR select* 1/1       |            |
| Std position           | Std offset |
| Org offset             |            |

|                        |  |
|------------------------|--|
| Prod dat : Origin data |  |
| *OPR select* 1/1       |  |
| 1 Std position         |  |
| 2 Org offset           |  |
| 3. Std offset          |  |

(Available with the main software of version "KO" or higher version.)

Move the cursor to the item to be set, and press the ENTER key.

##### 4.2.3.1 Standard position

|              |   |      |     |
|--------------|---|------|-----|
| Prod dat :   |   |      |     |
| Std position |   |      |     |
| RT           | = | 0.00 | (°) |
| UA           | = | 0.00 | (°) |
| FA           | = | 0.00 | (°) |
| RW           | = | 0.00 | (°) |
| BW           | = | 0.00 | (°) |
| TW           | = | 0.00 | (°) |

To change the value of the reference position, press the OPR SEL key and the screen shown below appears:

|                |        |     |
|----------------|--------|-----|
| * OPR select * |        | 1/1 |
| 1              | Change |     |

The screen below appears when the ENTER key is pressed.

|                |  |     |
|----------------|--|-----|
| * OPR select * |  | 1/1 |
| Input code     |  |     |
| Code =         |  |     |

Enter "39" and press the ENTER key.

The reference position can be changed by following the above procedures.



#### 4.2.3.2 Standard correct value

The compensation data used to determine the standard position and posture of the robot is displayed.

| Prod dat: Origin data |           |     |
|-----------------------|-----------|-----|
| Std offset            |           | 1/1 |
| RT                    | = -1935 * | 12  |
| UA                    | = 585 *   | 7   |
| FA                    | = - 387 * | 9   |
| RW                    | = - 491 * | 0   |
| BW                    | = 1319 *  | 14  |
| TW                    | = 394 *   | 16  |

The value can be changed by following the same procedure as for the reference position.

"Standard correct value" means the encoder pulse which indicates the distance between the control absolute origin of the absolute encoder and the standard position (joint mark) of the manipulator. Usually no need to change it.

#### 4.2.3.3 Origin offset

This function is used to specify the origin.

The screen as shown below appears when the Origin Search function is set valid on the initial screen (Init. set: And-func).

| Prod dat : Origin data |              |        |
|------------------------|--------------|--------|
| Org offset             |              | 1/1    |
| RT = 0.00 (°)          | RW = 0.00(°) |        |
| UA = 0.00 (°)          | BW = 0.00(°) |        |
| FA = 0.00 (°)          | TW = 0.00(°) |        |
| Page next              | Page back    | Set-up |

Set-up: This function is used to specify the origin.

The axes except BW are taken as being in the zero degree angle direction when the marks on the robot body meet each other. Input an offset angle for each axis with reference to that direction. The BW axis is considered being in the zero degree angle direction when it is parallel to the FA axis.

Page next / Page back : This function is used when external axes are connected.

#### 4.2.4 Register content

The register execution count is displayed and reset.

| Prod dat. |   |  | Register  |   |  | 1/10   |
|-----------|---|--|-----------|---|--|--------|
| NO        |   |  | NO        |   |  |        |
| 1         | 0 |  | 6         | 0 |  |        |
| 2         | 0 |  | 7         | 0 |  |        |
| 3         | 0 |  | 8         | 0 |  |        |
| 4         | 0 |  | 9         | 0 |  |        |
| 5         | 0 |  | 10        | 0 |  |        |
| Page next |   |  | Page back |   |  | Set-up |

Move the cursor to "page next" or "page back" and press the ENTER key to switch the job to be displayed.

To reset, press the OPR SEL key and the screen below appears:

|                |           |
|----------------|-----------|
| * OPR select * |           |
| 1              | Reset all |

Press the ENTER key.

#### 4.2.5 Error history (when "error history" is selected)

The error history is displayed.

|                                                          |
|----------------------------------------------------------|
| Prod dat : Origin data                                   |
| ——Error history——                                        |
| 1: 12556 04/1 04:10 Alarm<br>ALM 16 ABS. ENCODE ERR 0004 |
| Page next    Page back    Delete                         |

To erase the error history, move the cursor to "delete" and press the ENTER key. The screen shown below appears:

|                   |
|-------------------|
| *OPR select * 1/1 |
| Input code        |
| Code =            |

Enter "39" and press the ENTER key.

The error history is erased by following the procedures above.

#### 4.2.6 Time

The current date and time are displayed.

|                                         |
|-----------------------------------------|
| Prod dat : Time                         |
| Current time<br>"92 Y 05 M 01 D 12h 45m |
| Change                                  |

To set the time, move the cursor to "Change" and press the ENTER key.

The screen shown below appears;

|                                            |
|--------------------------------------------|
| Prod dat : Time                            |
| Current time<br>"92 Y 05 M 01 D 12h 45m    |
| Please set time<br>"92 Y 02 M 10 D 12h 45m |

Enter the value, press the ENTER key and then press the END key.

|                    |
|--------------------|
| * OPR select * 1/1 |
| Finish set-up?     |
| 1 Yes 2 No         |

Press the ENTER key.

Time can be set by following the procedure above.

#### 4.2.7 PROM version

This screen shows the PROM version of the functions which are provided when a servo system and optional equipment are connected besides main software.

| Prod. dat                   |    |
|-----------------------------|----|
| PROM version                |    |
| Main                        | F0 |
| Servo                       | G0 |
| Return to menu by [END] key |    |

### 4.3 Teaching of home position

The HOME POSITION refers to the position at which the robot waits for the next task to be started.

| No. | Operation                                                                                                                                    | Screen display                                                                                                                                                                                                                                                                                                                      |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   |                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                     |
| 1   | Set the Mode switch to TEACHING.                                                                                                             |                                                                                                                                                                                                                                                                                                                                     |
| 2   | (when the servo power has been turned off, turn on the power supply.)<br><br>Move the cursor to the "Home position" and press the ENTER key. | <div> <div>* OPR select * 1/1</div> <div> 1 Input No.      5 File list<br/> 2 Teach H-posi<br/> 3 Conversion<br/> 4 Teach coord. </div> </div> <div>Note 1</div> <div> Teaching: Teach H-position<br/> 1/1<br/> X= 998.00(MM) U= 0.00(°)<br/> Y= 0.00(MM)V= -90.00(°)<br/> Z=1035.00(MM) W= 0.00(°)<br/> Teach Home position </div> |
| 3   | Press the TEACH ENABLE key of the teach pendent.                                                                                             |                                                                                                                                                                                                                                                                                                                                     |
| 4   | Move the robot to the teaching position by using the MOVE keys.                                                                              |                                                                                                                                                                                                                                                                                                                                     |
| 5   | Press the STORE key.                                                                                                                         |                                                                                                                                                                                                                                                                                                                                     |
| 6   | Press the TEACH ENABLE key of the teach pendent.                                                                                             |                                                                                                                                                                                                                                                                                                                                     |
| 7   | Press the END key.                                                                                                                           | <div>Store H-pos completed.</div>                                                                                                                                                                                                                                                                                                   |

Note) Home position is set as parameter of "GO HOME" of

- PTP command : Move command
- Sequence command : Speed

Note 1) The display shown below appears in the main software of version "J3" or lower version.

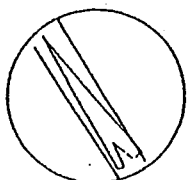
|                |              |     |
|----------------|--------------|-----|
| * OPR select * |              | 1/1 |
| Input No.      | File list    |     |
| Teach H-posi   | Teach coord. |     |
| Conversion     |              |     |

#### 4.4 Operation start (External operation)

This is the procedure used to start the operation from the external unit.

This operation is started when the external job select start signal is sent.

##### 4.4.1 External start operation

| No. | Operation                                                                                                                                                                                                | Screen display                                                                                 |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| 0   | When the increment specification type external axes are used, the robot has to be returned to its origin.                                                                                                |              |
| 1   | Set the mode selector switch to Operating.                                                                                                                                                               | OPERATING      ○                                                                               |
| 2   | Send the signal to the "Job select start" terminal.<br>↓<br><div>Operating starts.</div><br>↓<br>The robot stops when it completes the task started by the signal entered and waits for the next signal. | TEACHING<br> |

##### 4.4.2 Setting job selection method

The job selection method is set in the "Job select/start" in the inner setting/advanced function.

Set the job selection method to "NO".

The job select method is judged by the status of the connection of the strobe input terminal and COM terminal when the power is turned on.

Set the job select method to "YES"

The following methods can be selected:

(1) Standard method

Job 1,2,4,8,16, 32, 64, 128, 256, and 512 (10 jobs) are started by connecting the Job select /start terminal and the COM terminal.



(2) Binary method

Jobs #1~999 are started by connecting the strobe terminal and the COM terminal after connecting the Job select/start terminal and the COM terminal.

(3) BCD method

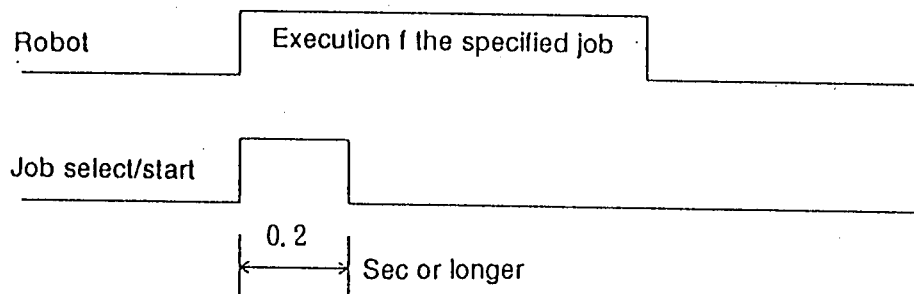
Job select / start #1, 2, 4, 8 are set to the 1's digit, those #16, 32, 64, and 128 to 10's digit and those #256 and 512 to 100's digit. Jobs #1~399 are started by connecting strobe input terminal and the COM terminal after connecting the job select / start terminal and the COM terminal are connected.

4.4.3 Job select/start signal input method

(1) Standard method

when the strobe input terminal and the COM terminal are connected before the power is supplied:

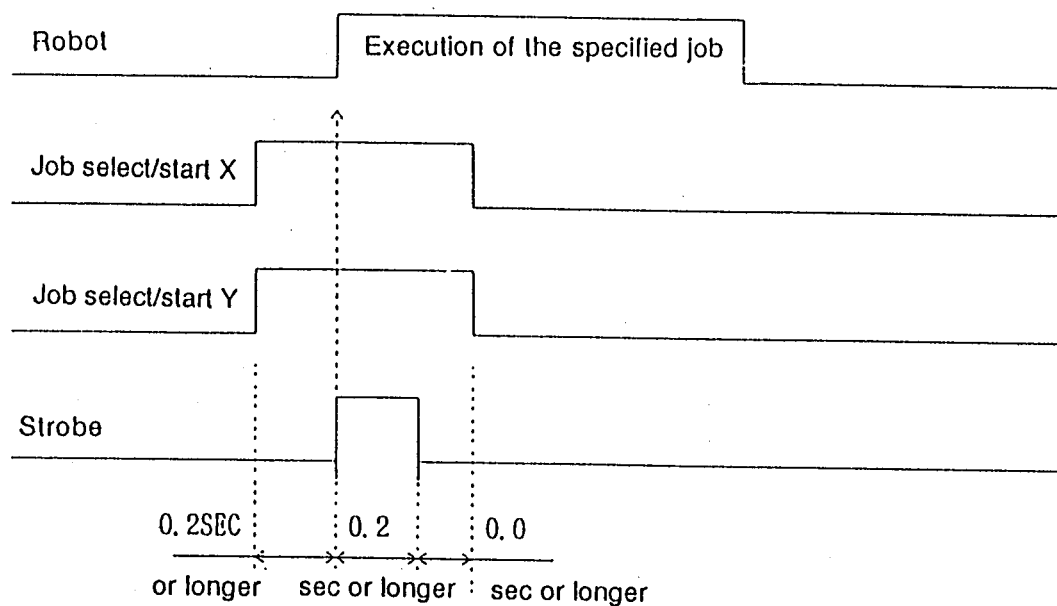
Job 1, 2, 4, 8, 16, 32, 64, 128, 256, and 512 (10 jobs) are started by connecting the Job select /start terminal and the COM terminal.



## (2) Binary method

When the power is supplied with the strobe terminal and the COM terminal opened (not connected):

Connect the strobe terminal and the COM terminal after connecting the necessary job select/start terminal and the COM terminal.



(Specified job No. = Total value of the No.s of the job select/start terminals connected to the COM terminal)

| Job select/<br>start No. | 512 | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | specified<br>Job No. |
|--------------------------|-----|-----|-----|----|----|----|---|---|---|---|----------------------|
| Example 1                | 0   | 0   | 0   | 0  | 0  |    |   | 0 | 0 | 0 | Job999               |
| Example 2                | 0   |     |     |    | 0  |    |   | 0 | 0 |   | Job550               |
| Example 3                |     |     |     |    | 0  | 0  |   |   | 0 |   | Job 50               |
| Example 4                |     |     |     |    |    | 0  |   |   |   | 0 | Job 17               |
| Example 5                |     |     |     |    |    |    |   |   |   | 0 | Job 1                |

Marked with "O": Terminals connected to the COM terminal.

### (3) BCD method

In the "BCD method", the job select inputs No. 1, 2, 4 and 8 are set to 1's digit, those No. 16, 32, 64 and 128 are set to 10's digit and those No. 256 and 512 to 100's digit. Then each digit is converted to binary numbers to start operation.

(BCD : Binary-coded decimal code)

The job No.s started by this method are 1~399.

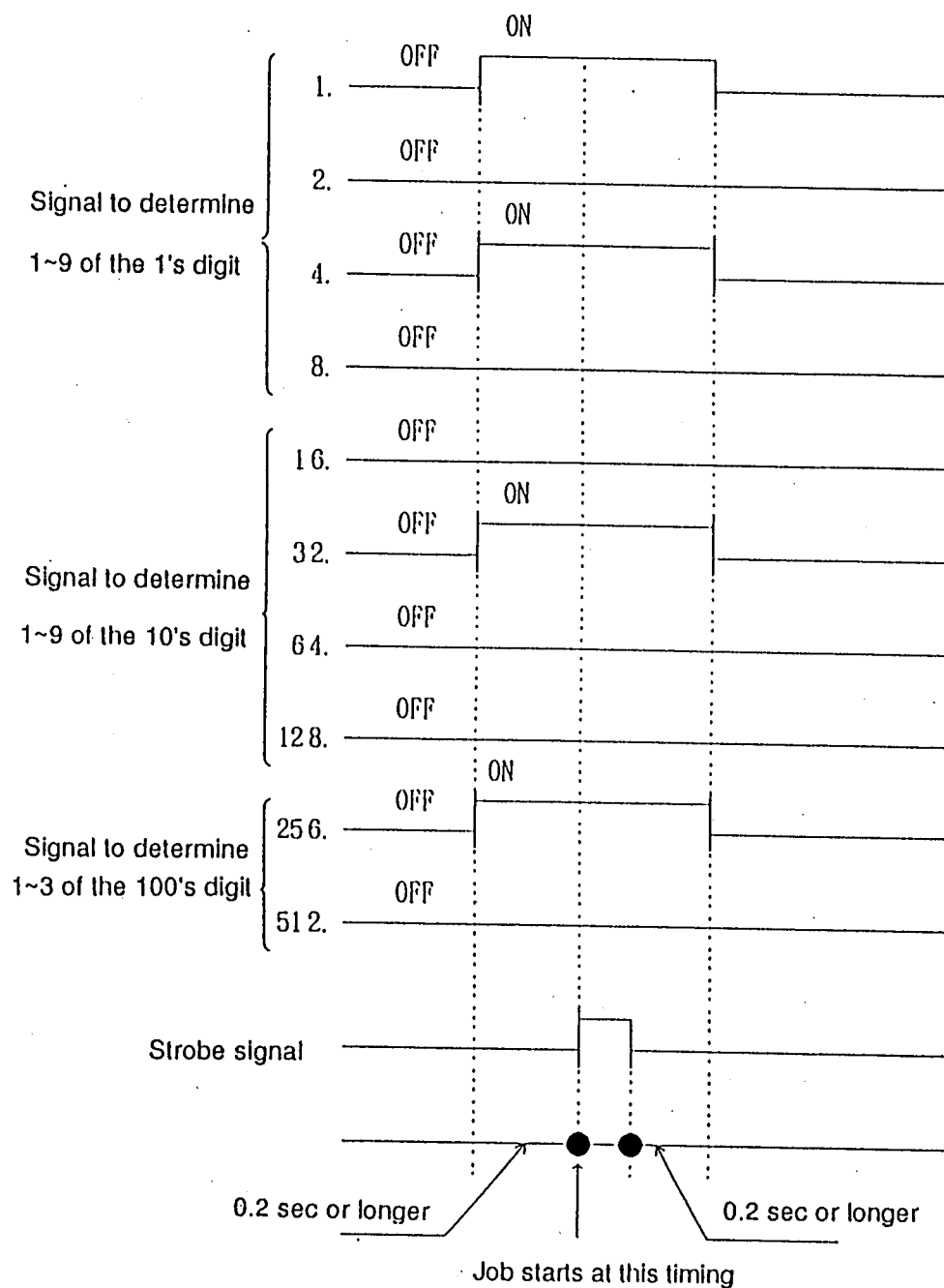
| Job select/<br>start No. | 100's digit |     | 10's digit |    |    |    | 1's digit |   |   |   | specified<br>Job No. |
|--------------------------|-------------|-----|------------|----|----|----|-----------|---|---|---|----------------------|
|                          | 512         | 256 | 128        | 64 | 32 | 16 | 8         | 4 | 2 | 1 |                      |
| Example 1                | 0           | 0   | 0          |    |    | 0  | 0         |   |   | 0 | 399                  |
| Example 2                |             | 0   |            |    | 0  |    |           | 0 |   | 0 | 125                  |
| Example 3                |             |     |            | 0  |    | 0  |           |   | 0 |   | 52                   |
| Example 4                |             |     |            |    | 0  |    |           | 0 |   | 0 | 25                   |
| Example 5                |             |     |            |    |    | 0  |           |   |   |   | 10                   |
|                          |             |     |            |    |    |    |           |   |   | 0 | 1                    |

Marked with "O": Terminals connected to the COM terminal.

\* When the BCD selection method is selected, the job No.s can be easily selected by connecting the rotary switch of the BCD specification which is sold on the market.

\* The job select/start timing when the BCD method is applied is as shown below:

<To select Job 125>



Note) In the BCD job selection method, the response output are turned off immediately if a signal whose 1's digit selection signal is 10 or larger is entered.

#### 4.4.4 Job reservation start (1)

When the power is turned on after short-circuiting the STROBE terminal and COM terminal, a maximum of 10 jobs can be reserved by short-circuiting the individual JOB SELECT/START terminals to the COM terminal with an interval of 0.2 sec or more.

#### 4.4.5 Job reservation start (2)

When the power is turned on with the STROBE terminal and COM terminal opened (not connected), a maximum of 16 jobs can be reserved by short-circuiting the STROBE terminal and COM terminal after short-circuiting the necessary JOB SELECT START terminals to the COM terminal with an interval of 0.2 sec or more.

#### 4.4.6 Specifications of the reservation function

- (1) This function becomes effective when the operation mode is set to "external".
- (2) The jobs with the same number or the jobs currently executed cannot be reserved.
- (3) The reservation is canceled in the order of completion of the execution of the task.
- (4) When the reservation cancel signal is entered, all reservation except for the job currently being executed is canceled.

#### 4.4.7 Signals relating to operation stop.

- (1) "Re-start" signal after "Hold"
- (2) Contact output which is closed during operation
- (3) Contact output which is closed during Hold status

[Note]

The robot outputs both the output in operation and that in hold during Hold status. However, at the emergency stop, the output will be turned off till the servo power is supplied.

#### 4.5 Finish the external operation

Finish external operation mode by switching the operation mode from "external" to "panel" or by quitting the operation mode.

| No. | Operational method                                                                                                                                                                                                                                                                                             | Screen display                                                                                                                                                                                                                                                   |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | <p>Press the STOP switch on the panel or press the Hold key of the teach pendent.</p> <p>* When the "re-start" signal is entered from external unit, the halt status is released and the operation is resumed.</p>                                                                                             |                                                                                                                                                                                                                                                                  |
| 2   | <p>(a) To change the start condition to "Internal", refer to step #3 and later in 2.1.4 "Operation of panel".</p> <p>(b) To finish the operation mode:</p> <p>1) Press the MODE SEL key.</p> <p>2) Press the ENTER key.</p> <p>The external operation is finished when the procedures above are completed.</p> | <div style="border: 1px solid black; padding: 10px; width: fit-content; margin: auto;"> <p style="text-align: right;">*OPR select *—1/1—</p> <p style="text-align: center;">Finish operating?</p> <p>1 <input checked="" type="radio"/> Yes      2 No</p> </div> |

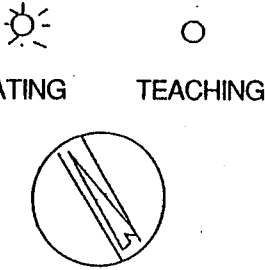
#### 4.6 Address search and lock operation

Address search: Moves the robot to a position in the program

The trace operation as well as the normal operating can be started at this point.

Lock operation: The robot's function is partially stopped.

##### 4.6.1 Address search

| No. | Operational method                                                                                                      | Screen display                                                                                                                                                                                                         |
|-----|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Set the mode selector switch to Operating.                                                                              |                                                                                                                                      |
| 2   | Move the cursor to "OPR cond" and press the ENTER key.                                                                  | <div>OPR : J: P: S: V:</div> <div> <div>*OPR select* 1/1</div> <div> <div>1 OPR cond</div> <div>2 Disp change</div> <div>3 E. memory</div> <div>4 Limit cond</div> <div>5 Edit</div> <div>6 Option</div> </div> </div> |
| 3   | Move the cursor to "Address search" and press the ENTER key.<br>("Address search" on the screen is displayed inversed.) | <div>OPR : J: P: S: V:</div> <div>OPR cond</div> <div> <div>External Panel (Job, Program)</div> <div>0 0 0 0</div> <div>0 0 0 0</div> <div>Address search</div> <div>Job 0, Program 3, Step 20</div> </div>            |
| 4   | Enter the job No., program No., and step No. via the numerical keys and press the ENTER key.                            |                                                                                                                                                                                                                        |

| No. | Operational method                                                                                                                                                                                                                                                | Display on the personal computer                                                                                                                |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 6   | <p>Press the ENTER key.</p> <p>(1) When the step No. specified in procedure No.5 exists:<br/>The message "Address is found" appears.</p> <p>(1) When the step No. specified in procedure No.5 does not exist:<br/>The message "Address is not found" appears.</p> | <div><div>Address is found</div><div>Panel (Job, Program)<br/>0 0 0 0<br/>0 0 0 0<br/>Address search<br/>Job 0, Program 3 , Step 20</div></div> |
| 7   | Press the END key.                                                                                                                                                                                                                                                |                                                                                                                                                 |
| 8   | Press the START switch.                                                                                                                                                                                                                                           |                                                                                                                                                 |
|     | <p><i>The robot moves to the specified step at speed of 8.4m.min.. Make sure that no obstructions along the robot's movement route.</i></p>                                                                                                                       |                                                                                                                                                 |
| 9   | When the robot reaches to the specified step, the message "Address search completed" appears.                                                                                                                                                                     |                                                                                                                                                 |
| 10  | <p>(1) To carry out trace operation:<br/>Light up the TEACH ENABLE key and press the ROBOT OPR key and forward.backward movement key.</p> <p>(2) To carry out operation:<br/>Press the START switch on the panel.</p>                                             | <div><div><div>●</div>TEACH<br/>ENABLE</div><div>→</div><div><div>○</div>TEACH<br/>ENABLE</div></div>                                           |



#### 4.6.2 Lock operation

[I/O]: The multi-use external I/O do not function. However, the inputs and outputs specifically used for welding are turned on and off.

[ARC]: The inputs and outputs specifically used for welding do not turn on nor off.

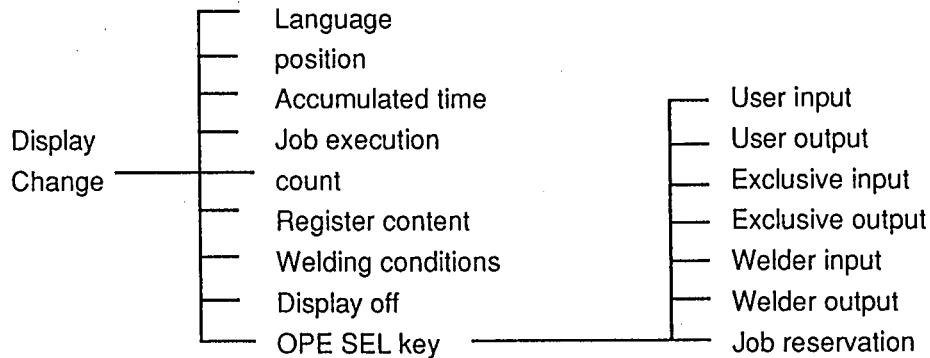
[ROBOT]: The multi-use external I/O can be confirmed without moving the robot. The output timing is sent or entered after the time for movement has elapsed on the assumption that the robot is moving.

| No. | Operational method                                                              | Screen display                                                                                                                                                                                      |
|-----|---------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | In the operating mode, move the cursor to "Limit cond" and press the ENTER key. | <div> <div>OPR : J: P: S: V:</div> <div> <div>*OPR select* 1/1</div> <div> 1 OPR cond    4 Limit cond<br/> 2 Disp change    5 Edit<br/> 3 E. memory    6 Option </div> </div> </div>                |
| 2   | Move the cursor to "I/O" by using the arrow key.                                |                                                                                                                                                                                                     |
| 3   | Move the cursor to the lock contents to be locked by using the arrow keys.      |                                                                                                                                                                                                     |
| 4   | Press the ENTER key.                                                            | <div> <div>OPR : J: P: S: V:</div> <div> <div>* OPR select *</div> <div> Max. sped: 15.0 (M/m %)<br/> OPR unit: Job Program<br/> Step continuous<br/> Lock cnt : I/O Arc Robot </div> </div> </div> |
| 5   | Press the END key.                                                              |                                                                                                                                                                                                     |

Note) When the WELD OFF lamp on the teach pendent lights up, the Arc Lock is automatically set.

#### 4.7 Display during operation

Select "display change" in the operation mode and press the ENTER key. The display modes shown below can be selected:



To enter the display-change mode, press the OPR SEL key during operation, select "Display change" and press the ENTER key.

##### 1 Language display

When operation is started, the contents currently executed is displayed on the screen.

##### 2 Position display

The top position of the robot is displayed. (this positions offset by torch tip.) The position is displayed by XYZ, angle, or by pulse.

##### 3 Accumulated time

The total time length of operation is displayed.

##### 4 Job execution count, register contents

The No.s of the Job execution count and register contents can be changed by using the Page next or Page back key.

##### 5 Welding conditions

The welding conditions up to next position can be displayed.

##### 6 Display off

The screen display is turned off. To resume the screen press any key except the "Display off".

##### 7 User input and output

The status of the signal used by the users is displayed.

##### 8 Exclusive input and output

The standard connection conditions of the robot is displayed.

##### 9 Welder input and output

The connection to the welding machine is displayed.

##### 10 Job reservation

The reservation status of jobs is displayed.

|                                              |
|----------------------------------------------|
| OPR J: 10, P: 15, S: 6, V: 7.50              |
| 1. MOVEL<br>2. MOVEL<br>3. MOVEP<br>4. MOVEC |

(Language display)

|                                 |
|---------------------------------|
| OPR J: 10, P: 15, S: 6, V: 7.50 |
| 1/1                             |
| 6 MOVEC                         |
| X= 723.31(MM) U= - 25.20(°)     |
| Y= 250.23(MM) V= 120.25(°)      |
| Z= 123.10(MM) W= 85.11(°)       |

(Position display: XYZ)

|                                 |
|---------------------------------|
| OPR J: 10, P: 15, S: 6, V: 7.50 |
| 1/1                             |
| MOVEC                           |
| RT = -20.00 (°) RW = 30.21 (°)  |
| UA = 53.25 (°) BW = -10.11 (°)  |
| FA = 30.20 (°) TW = 35.25 (°)   |

(Position display, angle display)

|                                 |
|---------------------------------|
| OPR J: 10, P: 15, S: 6, V: 7.50 |
| 1/1                             |
| MOVEC                           |
| RT = 007F:EA03 RW = 007F:EA03   |
| UA = 0300:E0F2 BW = 0300:E0F2   |
| FA = 0032:EF03 TW = 0032:EF03   |

(Position display: Pulse)

|                                 |
|---------------------------------|
| OPR J: 10, P: 15, S: 6, V: 7.50 |
| Accumulated time 1/1            |
| Controller on time 42.6 hours   |
| OPR time (Total) 5.4 hours      |
| Arc on time 0.0 hours           |
| OPR time in job 1559 sec.       |
| Page next Page back             |

(Accumulated time display)

|                                 |
|---------------------------------|
| OPR J: 10, P: 15, S: 6, V: 7.50 |
| Job exe count                   |
| No. 1 0 TM No. 6 0 TM           |
| 2 0 7 0                         |
| 3 0 8 0                         |
| 4 0 9 0                         |
| 5 0 10 0                        |
| Page next Page back             |

(Job execution count)

|                                 |
|---------------------------------|
| OPR J: 10, P: 15, S: 6, V: 7.50 |
| Register 1/1                    |
| No. 1 0 No. 6 0                 |
| 2 0 7 0                         |
| 3 0 8 0                         |
| 4 0 9 0                         |
| 5 0 10 0                        |
| Page next Page back             |

(Register content)

|                                 |
|---------------------------------|
| OPR J: 10, P: 15, S: 6, V: 7.50 |
| Welding cond 1/1                |
| Speed = 20.00 (M/m)             |
| Current = 0 (A)                 |
| Volt = 9.0 (V)                  |

(Welding conditions)

|                                 |    |    |    |    |     |
|---------------------------------|----|----|----|----|-----|
| OPR J: 10, P: 15, S: 6, V: 7.50 |    |    |    |    |     |
| User IN                         |    |    |    |    | 1/1 |
| 1                               | 2  | 3  | 4  | 5  |     |
| 6                               | 7  | 8  | 9  | 10 |     |
| 11                              | 12 | 13 | 14 | 15 |     |
| 16                              |    |    |    |    |     |

(User input)

|                                 |    |    |    |    |     |
|---------------------------------|----|----|----|----|-----|
| OPR J: 10, P: 15, S: 6, V: 7.50 |    |    |    |    |     |
| User OUT                        |    |    |    |    | 1/1 |
| 1                               | 2  | 3  | 4  | 5  |     |
| 6                               | 7  | 8  | 9  | 10 |     |
| 11                              | 12 | 13 | 14 | 15 |     |
| 16                              |    |    |    |    |     |

(User output)

|                                 |  |       |  |  |     |
|---------------------------------|--|-------|--|--|-----|
| OPR J: 10, P: 15, S: 6, V: 7.50 |  |       |  |  |     |
| Excl IN                         |  |       |  |  | 1/1 |
| Panel E-stop                    |  | Start |  |  |     |
| T.P E-stop                      |  | Stop  |  |  |     |
| Ext E-stop                      |  |       |  |  |     |
| Resv cncl                       |  |       |  |  |     |

(Exclusive input)

|                                                                                          |  |     |  |  |     |
|------------------------------------------------------------------------------------------|--|-----|--|--|-----|
| OPR J: 10, P: 15, S: 6, V: 7.50                                                          |  |     |  |  |     |
| Excl OUT                                                                                 |  |     |  |  | 1/1 |
| 200 Volt                                                                                 |  | Err |  |  |     |
|  In OPR |  |     |  |  |     |
| Holding                                                                                  |  |     |  |  |     |
| Ready                                                                                    |  |     |  |  |     |

(Exclusive output)

|                                                                                                    |  |           |  |  |     |
|----------------------------------------------------------------------------------------------------|--|-----------|--|--|-----|
| OPR J: 10, P: 15, S: 6, V: 7.50                                                                    |  |           |  |  |     |
| Welder IN                                                                                          |  |           |  |  | 1/1 |
|  Current detect |  | No wire   |  |  |     |
| No arc                                                                                             |  | Gas pres  |  |  |     |
| Stick                                                                                              |  | Err reset |  |  |     |
| Torch contct                                                                                       |  |           |  |  |     |

(Welder input)

|                                 |  |         |  |  |     |
|---------------------------------|--|---------|--|--|-----|
| OPR J: 10, P: 15, S: 6, V: 7.50 |  |         |  |  |     |
| Welder OUT                      |  |         |  |  | 1/1 |
| Torch SW                        |  | Retract |  |  |     |
| Gas valve                       |  |         |  |  |     |
| Stick chk                       |  |         |  |  |     |
| Inching                         |  |         |  |  |     |

(Welder output)

#### 4.8 Program creation by MDI

##### 4.8.1 Selection of MDI teaching

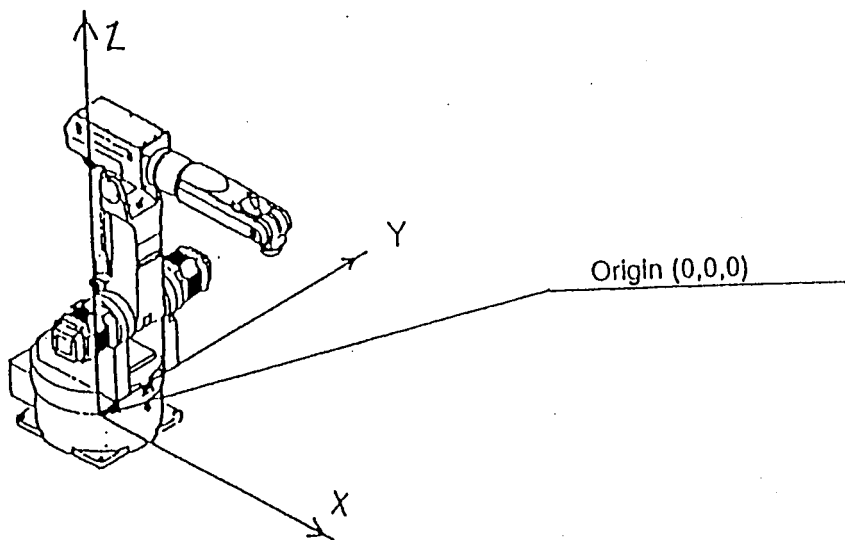
The creation and modification of programs by MDI teaching are carried out by directly entering the move commands, speed commands, positions and sequence commands according to the program edit procedures in the edit mode.

(Refer to 4.1.1.3 "Creation and modification of a program".)

##### 4.8.2 Position and angle of origin on the coordinate system

Refer to chapter 1 for the origin angle.

The origin position (0,0,0) is as illustrated below:



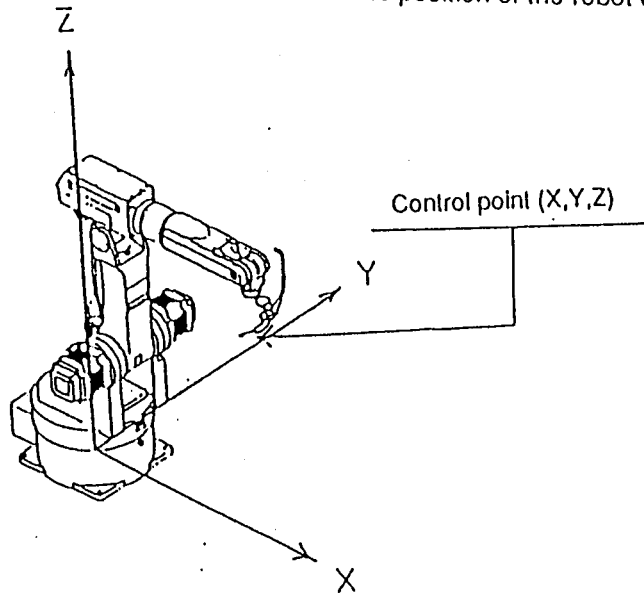
##### Cautions for MDI function

The standard of this robot is not MDI but teaching. Therefore, beware the following particulars:

- 1) When the values of the coordinate position and the angle are entered for "storage", there may be a slight difference between the entered value and the stored value. (in particular, second digit after the decimal point)
- 2) When the Y coordinate position is "stored", the X coordinate, which has already been stored, will be affected slightly.

# Position display (X,Y,Z,U,V,W)

The (X,Y,Z) value is the absolute position of the robot control point.



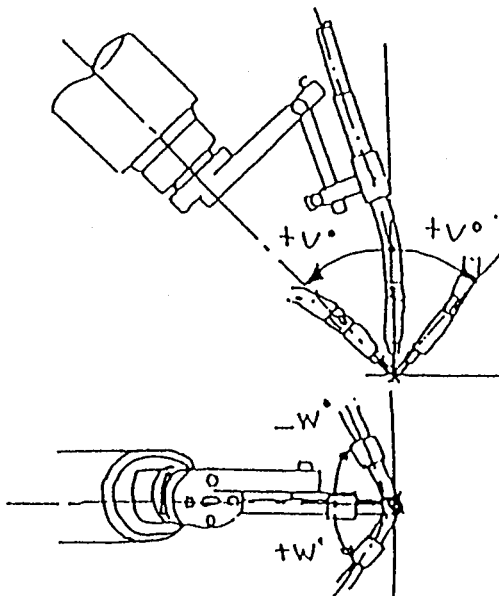
The (U,V,W) value is the coordinate system for the posture of the tool.

U: Rotation angle around the axis which is parallel to Z axis including the control point while retaining angle V.

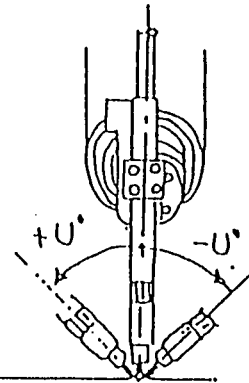
V: Angle of the tool to the vertical surface.

W: Twist angle of the wrist when the direction of the tool is fixed.

Posture when V=0



Posture when U=0



Control point

Posture when W=0

<Cautions>

Since this robot is the teaching playback robot, there may be a slight difference between the shift (numerical value) data entered by MDI and the distance of a shift in actual operation of the robot. Therefore, the shift distance entered by the MDI should be used as a reference.

Follow the procedure below for a more correct shifting:

- \* Move the robot manually from the current position to the shifted position. Read the distance on the coordinate display and enter this value for the shift.
- \* After carrying out the shift, check the difference between the shifted position and the current position of the workpiece, and carry out the fine adjustment of the shift.

After completing the shift, do not fail to confirm the position and motions by teaching. Further, the position should be corrected, when necessary, prior to starting operation.

#### 4.9 External memory

This function is provided so that the 3.5" floppy disk drive (personal computer is used) can be used as the external memory of the robots.

##### 4.9.1 Preparations for use of this function

- (1) \* RS232C connection cable (AWC80053) ..... 1 pc. (3m)
  - \*\* RS232C connection cable (KP-AXR) ..... 1 pc. (3m)
- (2) \* Floppy unit system software (AYU40103) ..... 1pc.
  - \*\* Floppy unit system software (AYF00001) ..... 1 pc.

(Create the master floppy disk from this floppy disk. This function cannot be used with only this floppy disk.)

Please purchase (1) and (2) above.

The following items should also be purchased:

- (1) \* Personal computer (manufactured by NEC, PC9801N, NV, NS/E, NS/T, NS/R, NA )
  - \*\* Personnel computer (manufactured by IBM, PC-AT or compatible)
- (2) \* Japanese MS-DOS (Ver. 3.3B, 3.3C or 3.3D)
  - \*\* PC-DOS (Ver. 3.3 or higher)
- (3) 3.5" floppy disk (2HD)..... 2 (or 3)

One for master floppy disk and the other for actual use.

(Another floppy disk is required when a back-up disk of the master disk is created.)

#### <Caution>

- \* This function is applied when PC-9801 series personal computer with Japanese specification manufactured by NEC is used abroad.

This function cannot be operated on the personal computers other than NEC PC9801N, NV, NS/E, NS/T, NS/R, NA (called as 98 notebook). If other PC-9800 series personal computer is used, it is necessary to change the batch file.

- \*\* This function cannot be operated on the personal computers other than IBM PC/AT and compatible.

In case of using this function, please read Manual No. 9307094 "EXTERNAL Floppy DISK UNIT" and this manual Page 4 - 75 "4.9.3 Explanation of operation."



#### 4.9.2 Connection with a personal computer and a settings

This function is applied when PC-9801 series personal computer with Japanese specifications manufactured by NEC is used abroad.

##### 4.9.2.1 To the beginners of personal computer

If this is your first time to use PC-9801N or NV (98 NOTE etc.), first, charge the battery and turn on the back-up memory switch, referring to the instruction manual of the computer.

If you fail to turn on the back-up memory switch, the contents of the RAM memory will be erased when the main unit is turned off.

Then, execute the set-up program by using the set-up disk (provided with the 98 NOTE).

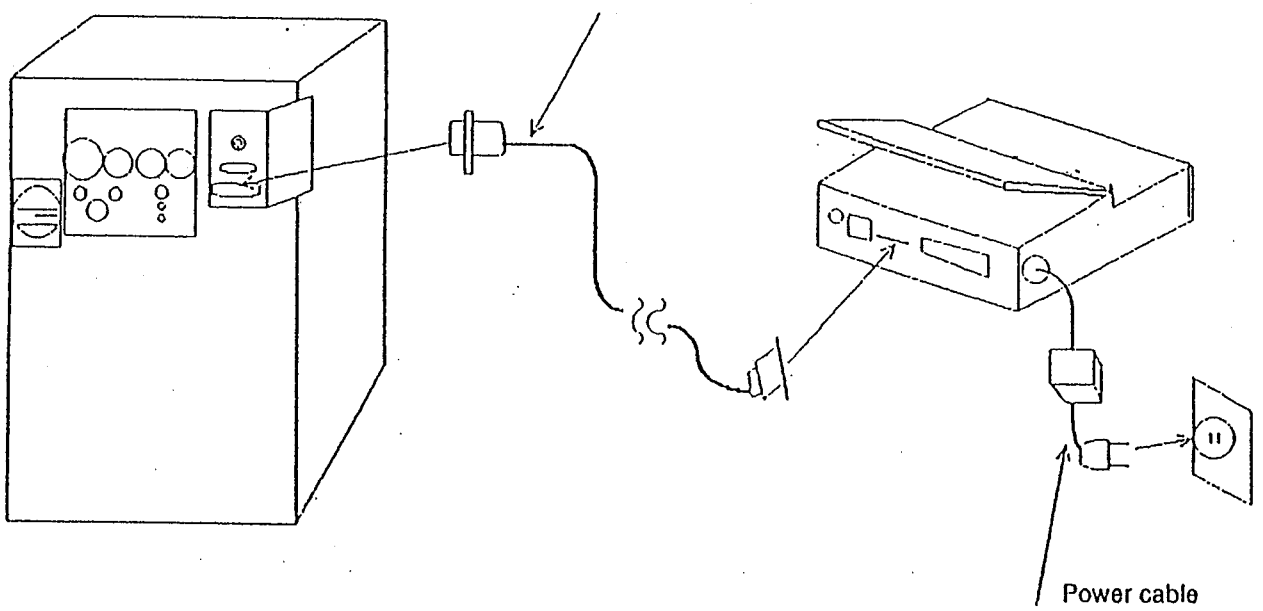
Modes cannot be set until this set-up program is executed.

The set-up program must be executed when it is used for the first time and after the battery has become completely empty and re-charged.

##### 4.9.2.2. Connection of power supply and RS232C cable

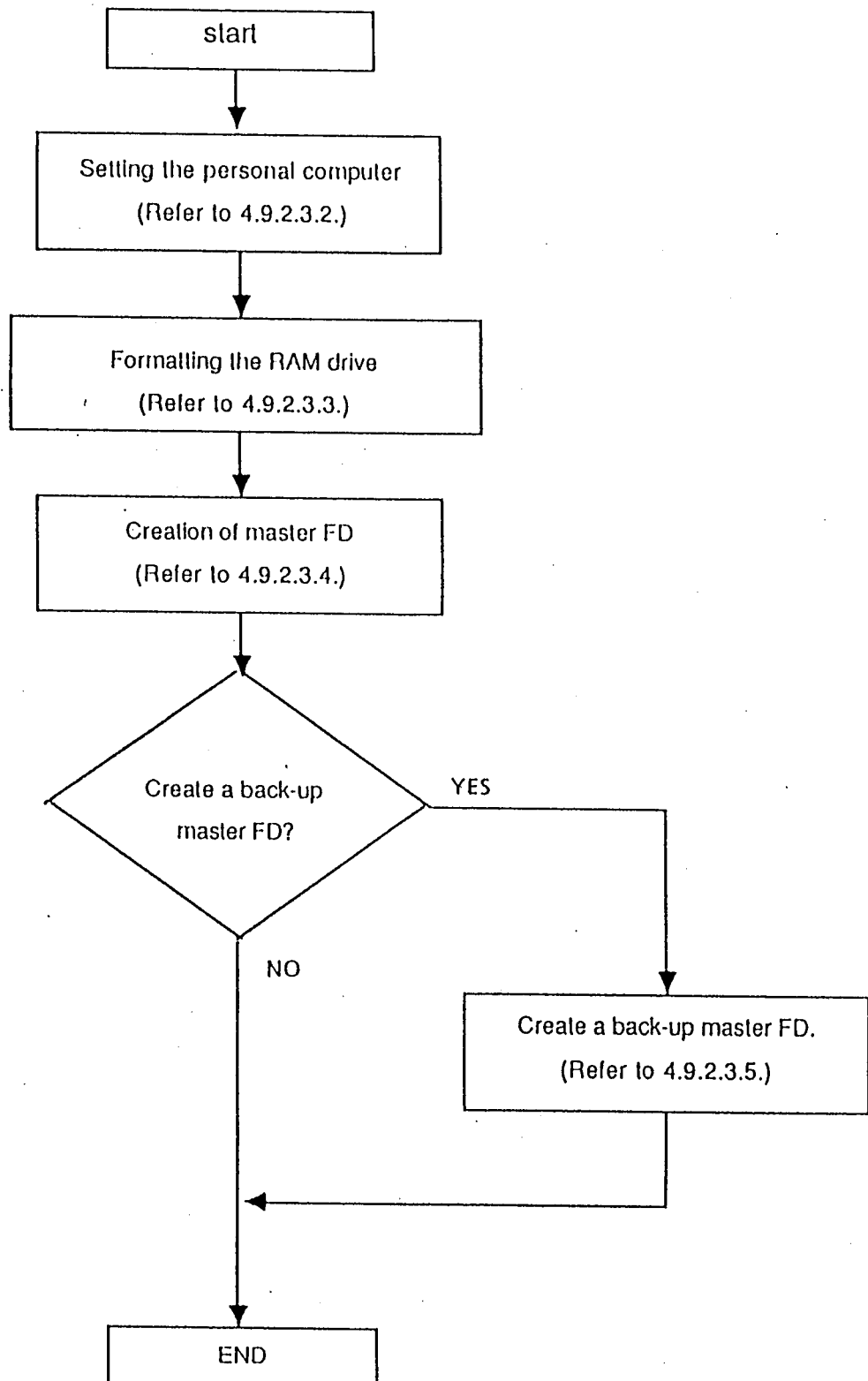
As illustrated below, connect the RS232C cable to the RS232C connector provided in the control box. Connect the power cable of the personal computer to the AC100V outlet in the factory. (If this is connected to the AC100V outlet in the control box, the fuse will blow off.)

The battery built-into the 98 NOTE lasts for approx. 1.5 hours (at standard specification, floppy disk occupation 10%). In this case, no power cable is required. (Refer to the guidebook of the 98NOTE for details.)



#### 4.9.3.2 Creallon of master FD

##### 4.9.2.3.1 Procedure for creating the master FD



#### 4.9.2.3.2 Settings of the personal computer

- (1) Turn on the power while holding down the HELP key. The personal computer menu screen appears.
- (2) Select "1. Mode setting" and press the return key, → and ←
- (3) Set as shown below using the arrow keys, , and ,

a. PC9801N shall be set as described below.

- |                                      |                             |
|--------------------------------------|-----------------------------|
| (1) RAM drive                        | (Used / Not used)           |
| (2) Specifying the system start unit | (FD / RAM drive / FD first) |
| (3) Specifying #1 drive              | (FD / RAM drive)            |
| (4) RAM drive write protect          | (Yes / No)                  |

The set-up menu of the PC9801NV includes (5) Setting of built-in modem. Set to "No" since no modem is used for communication with the robot.

b. PC9801 NS/E, NS/T, NS/R, NA, etc. shall be set as described below.

- |                                         |                                         |
|-----------------------------------------|-----------------------------------------|
| (1) Memory for RAM drive                | (RAM drive / Add-in memory / Not used)  |
| (2) Specifying the system start unit I  | (STD / Built-in fixed disk / ROM BASIC) |
| (3) Specifying the system start unit II | (FD / RAM DRIVE / FD FIRST)             |
| (4) Specifying #1 drive                 | (FD / RAM drive)                        |
| (5) RAM drive write protect             | (Yes / No)                              |
| (6) Setting of built-in modem board     | (V25bis / AT / half-duplex / Not used)  |

- (4) Select "Q. END" and press the RETURN key. The menu on the personal computer screen is brought back.
- (5) Insert the MS-DOS floppy disk into the drive unit and select "System start" and "End" for PC9801N and PC9801NV, respectively, and press the RETURN key.

#### 4.9.2.3.3      Formatting the RAM drive

- (1) When the MS-DOS command menu is displayed, press the STOP key and quit the menu or display the menu screen, select "F9 QUIT MENU" by using the arrow keys and press the return key.
- (2) Make sure that "B>" is displayed on the screen.  
(This means that the MS-DOS has started on drive B.)
- (3) Enter "FORMAT A:/S" and press the return key.  
Drive A (RAM drive) is initialized.
- (4) The message "Insert the new disk into Drive A: and press any key." appears. Press any key.
- (5) When the message "Disk type 1:640(KB) 2:1 (MB)" appears, select 2.
- (6) When the message "Do you format another disk?" appears, enter "N" and press the return key.
- (7) "B>" will be displayed on the screen.

#### 4.9.2.3.4 Creation of master floppy disk

- (1) Insert the provided floppy unit system software disk into the drive unit, enter "install" and press the RETURN key.
- (2) When the message "Insert MS-DOS system disk #1 into the drive unit. When you are ready, press any key." is displayed, insert the floppy disk for master FD into the drive unit and press any key.
- (4) When the message "Insert the floppy disk for normal use into the drive unit." is displayed on the screen, insert the floppy disk into the drive unit and press any key.
- (5) Now the master FD and normal use FD have been created. Insert the master FD into the drive unit and start the system.

(Note) A back-up FD of the master FD should be created.

The system disk of this personal computer floppy unit is created based on the MS-DOS (Ver.3.3B). The MS-DOS versions later than ver.3.3B can also be used by copying the following files on the master FD.

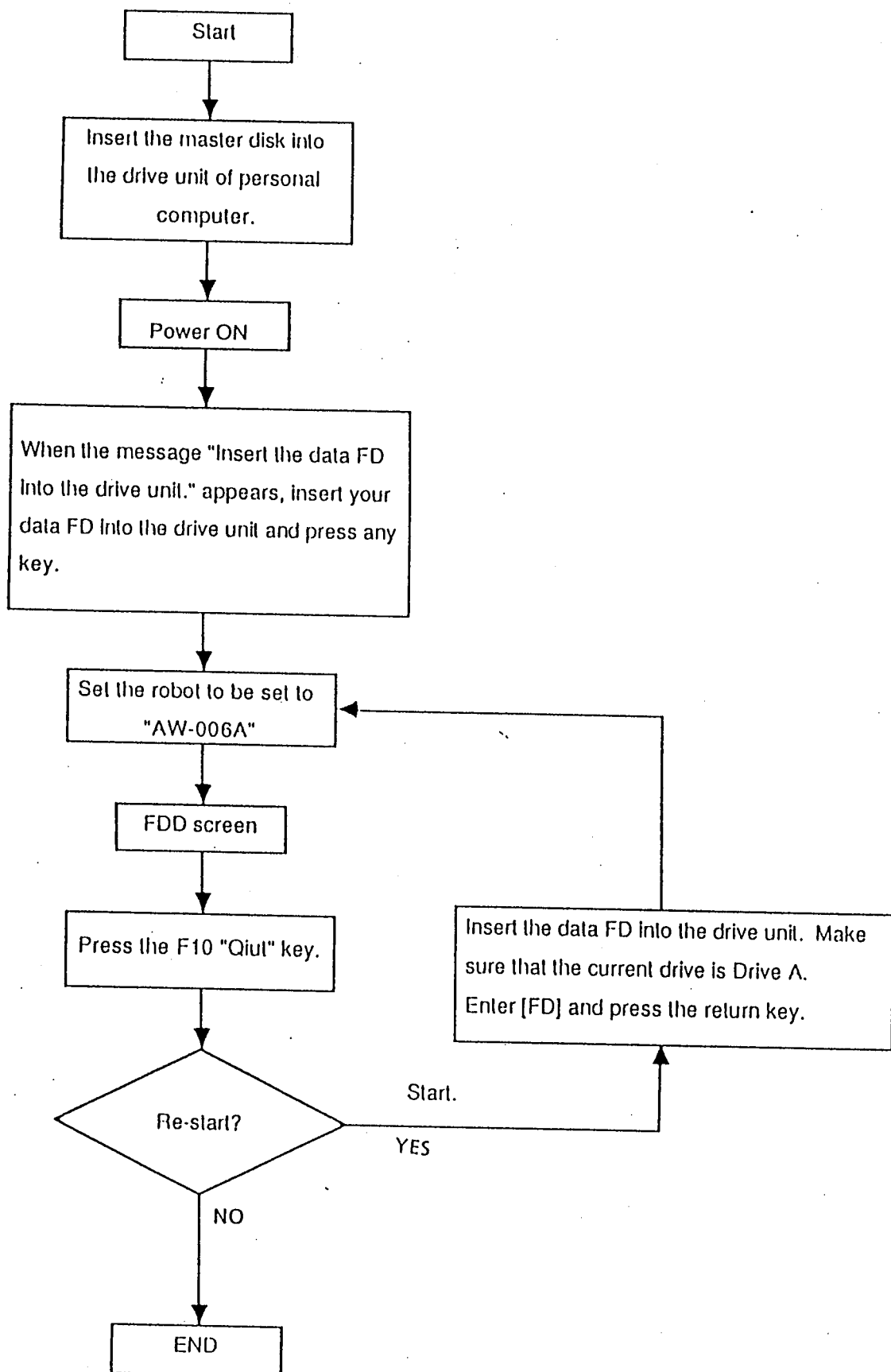
- \* FORMAT. EXE
- \* RSDRV. SYS
- \* SWITCH. EXE

#### 4.9.2.3.5 Creation of back-up master FD

- (1) Turn on the power while pressing the HELP key. The menu screen of the personal computer is brought up.
- (2) Select "4. FD --- FD COPY".
- (3) When the message "Copied by using the RAM drive as the task area. OK? (Y/N)" is displayed, select Y or N. Whichever you can select.  
(When Y is selected, the content of the RAM drive is erased.)
- (4) When the message "Copy the file while formatting? (Y/N)" is displayed, select Y.
- (5) When the message "Insert the original FD to be copied. (press the return key when you are ready.)" is displayed, insert the master FD into the drive unit and press the return key.
- (6) "Remove the original FD and insert the FD on which the data is copied. (Press the return key when you are ready.)" is displayed. Remove the master FD from the drive unit, insert the new FD and press the return key.

Note) It is recommended that the original FD is write-protected.

#### 4.9.2.4 Start from the master disk



#### 4.9.2.5 Creation of normal use disk

When the currently used disk is filled with the data and a new disk is required, create the disk by using the following procedure:

- (1) Insert the master FD into the drive unit and start the system.
- (2) Press the "F10. Quit" key to go back to MS-DOS.
- (3) Make sure that "A:¥>" is displayed, enter "F2HD" and press the return key.
- (4) When the message "Normal use FD is created. Insert a 2HD FD into the drive unit. Press any key when you are ready." is displayed, insert the normal use disk and press the return key.
- (5) "Do you format another disk? (Y/N)" is displayed. Enter Y to format another disk and carry out the procedures from (4) above. Enter N to quit.

#### 4.9.2.6 Starting method when the contents in the RAK drive is erased.

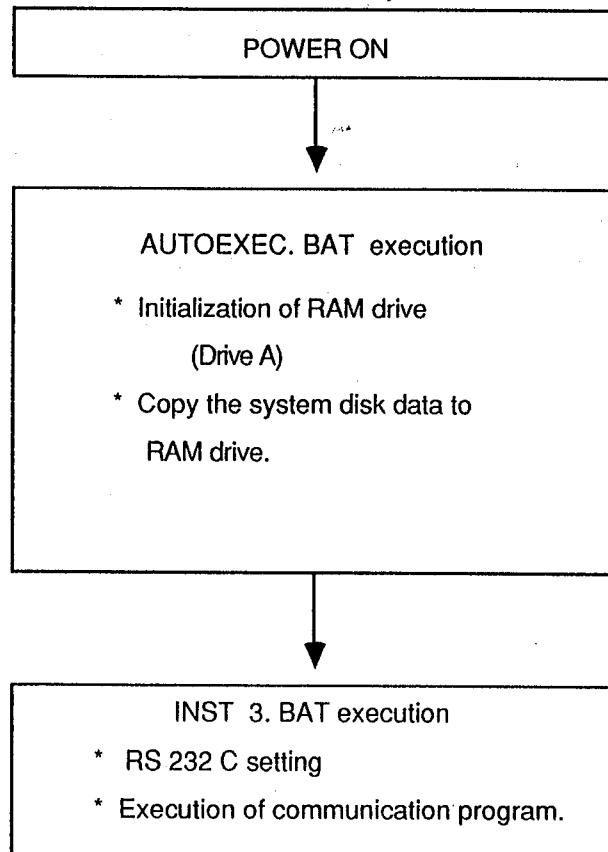
When the battery capacity is insufficient or when the personal computer has not been used for a long period, the contents of the RAM may be erased. When this occurs, start the master FD after carrying out the procedures in 4.9.2.3.2 "Settings of the personal computer" and 4.9.2.3.4 "Formatting RAM drive".



When a personal computer with built-in hard disk or disk top type personal computer is used:  
Personal computer PC9800 series 3.5" drive type with built-in hard disk or disk top type  
computer can also be used by changing the batch file in the system disk provided with this unit.  
When the batch file is changed, the system disk should be backed up beforehand.

#### 4.9.2.7.1 Execution procedure of this system

This system is programmed so that it can be used easily with the 98NOTE (built-in RAM drive).



#### 4.9.2.7.2 Changing the "batch file"

In this system program, the contents in drive A is initialized using AUTOEXEC. BAT.

Therefore, when this program is loaded and executed on the personal computer with built-in hard disk or with 2 drives, the contents in drive A will be erased.

Delete the following AUTOEXEC.BAT commands by using the screen editor, etc. sold on the market:

- \* FORMAT a:/S> FORMH.CTL
- \* COPY B:.\* A:

#### 4.9.3 Explanation of operations

The following 5 procedures are used to handle the floppy disk:

- \* Store the contents of the robot onto the floppy disk
- \* Check that the contents on the floppy disk and the contents in the robots correspond.
- \* Return the contents on the floppy disk to the robot.
- \* Delete the contents on the floppy disk file by file.
- \* Refer to the contents on the floppy disk.

STORAGE

CHECK

PLAY

DELET

REFERENCE

- \* Make sure that the mode of the personal computer is correctly set prior to operating the floppy disk.

When the battery is completely emptied, the mode set-up value returns to the one which has been set at delivery and the operation of the floppy disk cannot be correctly carried out.

If this occurs, refer to 4.9.2.3.2 "Settings of the personal computer" and correct the settings.

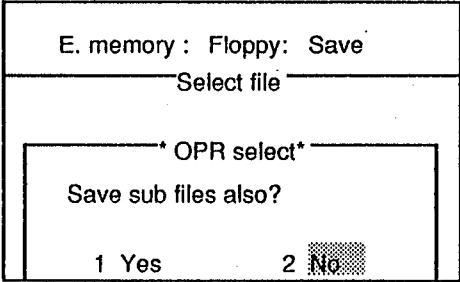
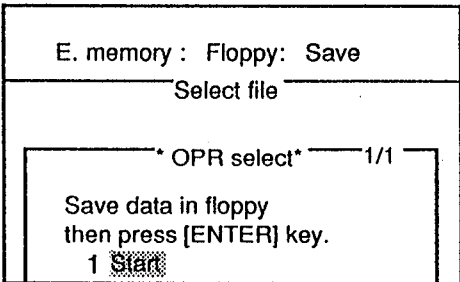
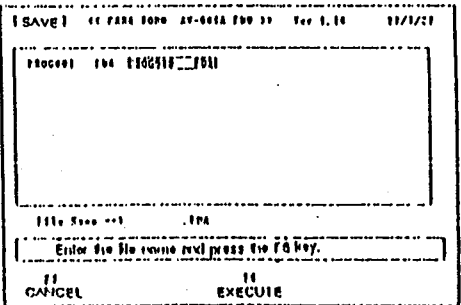
#### 4.9.3.1 Data storage on a floppy disk

The contents registered in the control unit or the contents of jobs, programs, arc start/end sequences, library and system settings are written and stored in the floppy disk.

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Screen display                                                                                                                                                                                                                                                                                             |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | Make sure 4.9.2 "Connection with a personal computer and settings.                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                            |
| 1   | Insert the master FD into the drive unit of the personal computer and turn on the power.                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                            |
| 2   | When the message "Insert the normal use floppy disk into the drive unit. Press any key when you are ready." is displayed on the personal computer, remove the master FD from the drive unit and insert the new FD.                                                                                                                                                                                                                                                                                                   | <div><div>CC PARA RORO AY-006A FDD &gt;&gt; Ver 1.10 02/1/92</div><div>PROGRAM FBA F00010-11A1</div><div>File Name --&gt; .FBA</div><div>Select by using the cursor key, space key or F key.</div><div>F1 F2 F3 F4 F5 F6 F7 F8 F9 F10</div><div>STORE PLAY ERASE DRIVE DISPLAY CONTENT PROGRAM</div></div> |
| 3   | "Which robot is connected?" is displayed. Move the cursor to "AW-006A" and press the RETURN key.                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                            |
| 4   | Press the END key on the teach pendent several times to go back to the initial screen.                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                            |
| 5   | <div><div>Mode Select (Initial)</div><div>To select &lt;OPR&gt; or &lt;TEACH&gt;, use SW on the controller.</div><div><div>*OPR select* 1/1</div><div><div>1 Edit</div><div>2 Product data</div><div>3 Option</div><div>4 Init. set</div><div>5 E. memory</div></div></div></div> <div>Move the cursor to "E. memory" (external memory) and press the ENTER key.</div> <div><div>E. memory : Floppy</div><div><div>*OPR select* 1/1</div><div><div>1 Save</div><div>2 Check</div><div>3 Load</div></div></div></div> |                                                                                                                                                                                                                                                                                                            |

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Screen display |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 6   | <p>Move the cursor to "Save" and press the ENTER key.</p> <div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |
| 7   | <p>Select "All" to store all files, while select "Select" to store the files necessary (for instance, program 2 and 4 are stored). When "System" (system data) is selected, the initial setting data (welding table, inching speed, override, gas/wire, software limit, weaving table, speed limit, jog, tool offset, welder characteristics, and advanced function), the job execution count and the register contents can be stored.</p> <p>When the "Origin" (origin data) is selected, the origin data (reference position, standard compensation value) is stored.</p> <p>To store all data above, press the OPR SEL key and select "Back-up".</p> <p>Go to procedure #15 when the item other than "Select file" is selected.</p> |                |

| No. | Operational method                                                                                                                                                                                                                                                          | Screen display |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 8   | <p>When "Select " is selected, the screen below appears:</p> <div> <pre> * OPR select * 1/1 1 Job          4 Program 2 Library      5 A-S-S 3 A-E-S       6 Execute </pre> </div> <p style="text-align: center;">Screen 1</p> |                |
| 9   | <p>Select Job, program, Library, A-S-S and A-E-S independently and press the ENTER key.</p> <div> <pre> E. memory : Floppy: Save Select file : Job 1 12 15 20 30 Page next  Page back  Select </pre> </div>                  |                |
| 10  | <p>Since the No. registered is displayed, move the cursor to "Select" and press the ENTER key.</p> <div> <pre> E. memory : Floppy: Check Select file : Job 1 12 15 20 30 [ENT]  ► setup, [CAN] ► release </pre> </div>      |                |
| 11  | <p>Move the cursor to the position of the No. to be stored and press the ENTER key.</p> <p>(The selected No. is displayed inversed.)</p> <p>*) When the ENTER key is pressed by moving the cursor to "Page next" or "Page back", the No. displayed changes.</p>             |                |

| No. | Operational method                                                                                                                                                                                                                                                                                                                     | Screen display                                                                       |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 12  | After the setting is completed, press the END key. (Screen 1 will be brought back.)                                                                                                                                                                                                                                                    |                                                                                      |
| 13  | Repeat procedures #8~#12 to set the files to be stored.                                                                                                                                                                                                                                                                                |                                                                                      |
| 14  | <p>After the settings are completed, move the cursor to "Execute" on screen 1. and press the ENTER key.</p> <p>In case that either "Job" or "Program" is selected, search the files called in the "Job" or "Program", and at the same time, select "Save-Yes" or "Save-No."</p> <p>However, "Job Reserve Command" is not included.</p> |                                                                                      |
|     |  <p style="text-align: right;">Screen 2</p>                                                                                                                                                                                                          |                                                                                      |
|     | <p>In case that "Job" or "Program" is not selected, the screen shown below appears.</p>                                                                                                                                                             |                                                                                      |
| 15  | Press the F1 "Store" key of the personal computer.                                                                                                                                                                                                                                                                                     |                                                                                      |
| 16  | Enter the file name to the personal computer. The number of characters of a file name should be 8 or less.                                                                                                                                                                                                                             |  |

| No.     | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Screen display                                                                                                                                                                                                                         |     |   |    |         |   |    |         |   |   |       |   |   |       |   |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---|----|---------|---|----|---------|---|---|-------|---|---|-------|---|
| 17      | Press the F6 "Execution" key of the personal computer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <div> <div>F1<br/>CANCEL</div> <div>F6<br/>EXECUTE</div> </div><br><div> FILE NAME: XXXXXXXX. FDD<br/> ..... ACCEPTED </div> <div> The number increases. </div><br><div> [NORMAL END]: RECVE END </div> <div> PRESS RETURN KEY. </div> |     |   |    |         |   |    |         |   |   |       |   |   |       |   |
| 18      | Press the ENTER key on the teach pendant.<br><div> <div>E. memory : Floppy: Save</div> <div>Select file</div> <table> <tr><td>Job</td><td>:</td><td>10</td></tr> <tr><td>Program</td><td>:</td><td>15</td></tr> <tr><td>Library</td><td>:</td><td>0</td></tr> <tr><td>A-S-S</td><td>:</td><td>0</td></tr> <tr><td>A-E-S</td><td>:</td><td>0</td></tr> </table> <div>Saving [OPR select] to stop</div> </div> <p>(Shown above is the screen displayed when the data is being saved.)</p> <p>Note) Do not press the emergency stop switch at this time. Normal communication will not be performed. To quit to the storage operation in process, press the F1 "Cancel" key of the personal computer, the RETURN key and then press the OPR SEL key. The screen below will appear:</p> <div> <div>* OPR select * 1/1</div> <div>Stop saving?</div> <div>1 Yes 2 No</div> </div> <p>Press the ENTER key.</p> <p>Storage completed.</p> |                                                                                                                                                                                                                                        | Job | : | 10 | Program | : | 15 | Library | : | 0 | A-S-S | : | 0 | A-E-S | : |
| Job     | :                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 10                                                                                                                                                                                                                                     |     |   |    |         |   |    |         |   |   |       |   |   |       |   |
| Program | :                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 15                                                                                                                                                                                                                                     |     |   |    |         |   |    |         |   |   |       |   |   |       |   |
| Library | :                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0                                                                                                                                                                                                                                      |     |   |    |         |   |    |         |   |   |       |   |   |       |   |
| A-S-S   | :                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0                                                                                                                                                                                                                                      |     |   |    |         |   |    |         |   |   |       |   |   |       |   |
| A-E-S   | :                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0                                                                                                                                                                                                                                      |     |   |    |         |   |    |         |   |   |       |   |   |       |   |
| 19      | Press the ENTER key of the personal computer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                        |     |   |    |         |   |    |         |   |   |       |   |   |       |   |
| 20      | Press the END key to quit without checking.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                        |     |   |    |         |   |    |         |   |   |       |   |   |       |   |

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Screen display |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
|     | <p>In case of saving a calling file in No. 14, the screen shown below appears when nonexist-files exist. In case of checking the nonexist-files, select "Yes". In case that nonexist-files don't exist, or "No" is selected on the screen shown below, or the calling files are not saved, go to No. 23.</p> <div> <div>E. memory : Floppy: Save</div> <div>Select file</div> <div>* OPR select* 1/1</div> <div>Check nonexist-files</div> <div>1 Yes 2 No</div> </div> |                |
| 21  | <p>Select the type of the nonexist-files. After the check of the nonexist-files is completed, go to No. 23.</p> <div> <div>E. memory : Floppy: Save</div> <div>Nonexist-file</div> <div>Nonexist-files can be checked.</div> <div>* OPR select* 1/1</div> <div>1 Program 4 Library</div> <div>2 A-S-S 5 A-E-S</div> <div>3 Checked</div> </div>                                                                                                                       |                |
| 22  | <p>Nonexist-file No. is indicated on the screen.</p> <p>Return to the previous screen after the check of the nonexist-files is completed.</p> <div> <div>E. memory : Floppy: Save</div> <div>Nonexist-file</div> <div>Library: Nonexist-files</div> <div>5 8</div> <div>Page next Page back Check end</div> </div> <p>(Note) "Library" is the item selected on the previous screen.</p>                                                                               |                |
| 23  | <p>In case that the check of the nonexist-files is not executed, press the END key.</p>                                                                                                                                                                                                                                                                                                                                                                                                             |                |



(1) In case that the "Select file" is selected, select job or program, and press the MEMORY SELECT key by moving the cursor to run on screen 1, then select whether or not to save the call file on screen 2.

a) If "Yes" is selected, the operation is as follows:

- Files of program and reserve sequence called by job, and files of library, Arc start sequence and Arc end sequence called by the program are saved.
- Files of Library, Arc start sequence and Arc end sequence called by program are saved.

Note: Job reservation is out of scope.

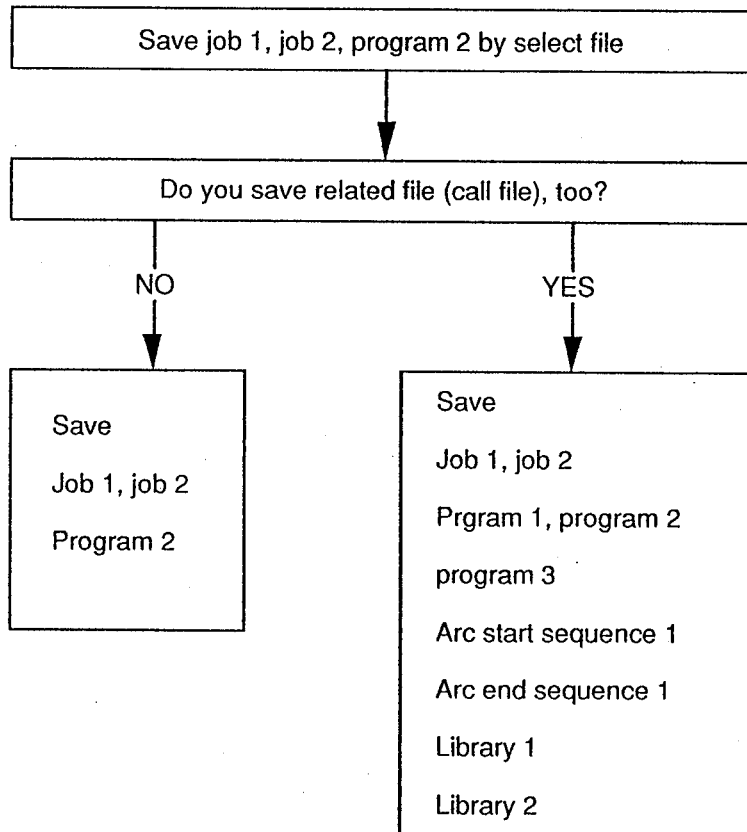
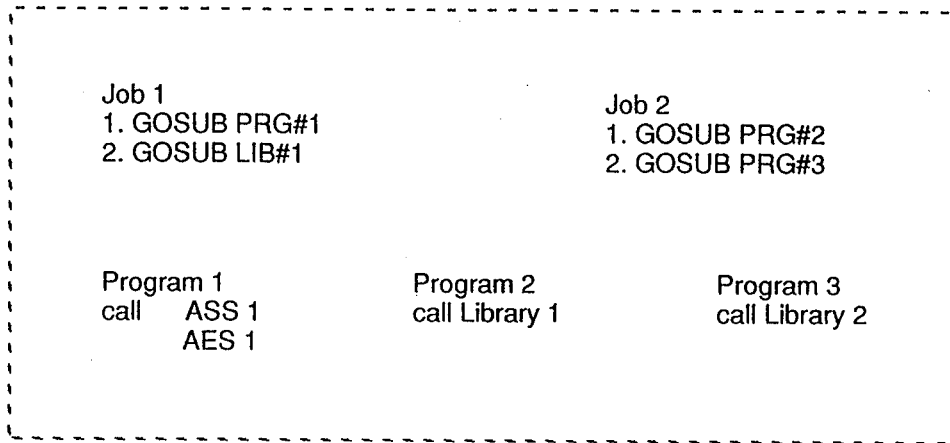
b) If "No" is selected, the operation is as follows:

- Only specified job is saved. Files of Program and Library called by the job are not saved.
- Only specified program is saved. Files of Library, Arc start sequence and Arc end sequence called by program are not saved.

(2) During the saving operation, if the "Disk is full." is shown on the screen of the computer, the files are not saved. Create a new data disk, and start saving again from the beginning.

(3) "Nonexist-file" refers to the file in which data could not be save because it is not exist in the robot although attempted to save the files of Program, Library, Arc start sequence and Arc end sequence called by the specified job or program.

For example,



#### 4.9.3.2 Reading data from a floppy disk (Load)

This is the operation to read the data saved in a floppy disk in the controller.

##### 4.9.3.2-a Reading data from a floppy disk during operation (Load: parallel mode)

This is the operation to read the data saved in a floppy disk in the controller during the operation.

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Display on the personal computer |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 0   | Carry out the procedures #0~#5 in 4.9.3.1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                  |
| 1   | Move the cursor to "Play" and press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                  |
| 2   | <p>To play all files, select "ALL FILE". Select "SELECT FILE" to play the necessary files (for instance, programs 2 and 4 are played.)</p> <p>When "System data" is selected, the inner setting data (reservation table, inching speed, override, gas/wire, software limit, weaving table, speed limit, pitch, tool offset, welding machine characteristics and expanded function), job execution count, and register contents are played.</p> <p>When the "Origin data" is selected, the origin data (reference position, reference compensation and origin) is played.</p> <p>To store all the data above, press the OPR SEL key and select "Back-up".</p> <p>Press the ENTER key.</p> <p>Go to step #10 when a menu other than "Select file" is selected.</p> |                                  |

| No. | Operational method                                                                                                                                                                                                                                                                        | Screen display |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 3   | <p>When "Select file" is selected, the screen below appears:</p> <div> <pre> * OPR select * 1/1 1 Job          4 Program 2 Library      5 A-S-S 3 A-E-S        6 Execute </pre> </div> <p style="text-align: right;">Screen 1</p>           |                |
| 4   | <p>Select Job/Program/ Library/ A-S-S/ A-E-S and press the ENTER key.</p> <div> <pre> E. memory : Floppy: Load Select file : Job 1 3 4 6 7 Page next  Page back  Select </pre> </div>                                                      |                |
| 5   | <p>The No. which can be played is displayed on the screen. Move the cursor to "Select" and press the ENTER key.</p> <div> <pre> E. memory : Floppy: Load Select file : Job 1 3 4 6 7 [ENT] -&gt; setup, [CAN] -&gt; release </pre> </div> |                |
| 6   | <p>Move the cursor to the No. to be played and press the ENTER key.</p> <p>(The specified No. is displayed inversed.)</p> <p>*) Move the cursor to Page next or Page back and press the Select key to change the No. displayed.</p>                                                       |                |

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Screen display                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7   | Press the ENTER key after completing the settings<br>(Screen 1 is brought back.)                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 8   | Repeat the procedures #4~7 and set the files to be loaded.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 9   | Move the cursor to "EXECUTION" and press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|     | <div style="border: 1px solid black; padding: 5px;"> <div style="border: 1px solid black; padding: 2px;">E. memory : Floppy: Load</div> <div style="border: 1px solid black; padding: 2px;">Select file</div> <div style="border: 1px solid black; padding: 2px; margin-top: 5px;"> <div style="border: 1px solid black; padding: 2px;"> * OPR select* 1/1 </div> <div style="padding: 2px;">Press [ENTER] key then load floppy.</div> <div style="border: 1px solid black; padding: 2px; margin-top: 2px;">1 Start</div> </div> </div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 10  | Press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|     | <div style="border: 1px solid black; padding: 5px;"> <div style="border: 1px solid black; padding: 2px;">E. memory : Floppy: Load</div> <div style="border: 1px solid black; padding: 2px;">Select file</div> <div style="padding: 2px;"> Job : 0 (Pass 0)<br/> Program : 0 (Pass 0)<br/> Library : 0 (Pass 0)<br/> A-S-S : 0 (Pass 0)<br/> A-E-S : 0 (Pass 0) </div> <div style="border: 1px solid black; padding: 2px; margin-top: 2px;">Checking [OPR select] to stop</div> </div>                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 11  | Press the F2 "Load" key of the personal computer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <div style="border: 1px solid black; padding: 10px;"> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; padding: 2px;">[PLAY]</div> <div style="margin: 0 10px;">←</div> <div>Flickers.</div> </div> </div>                                                                                                                                                                                                                |
| 12  | Select the file to be played with the arrow keys of the personal computer and display the file by using the space key.<br><br>If a wrong file is set, press the space key again to cancel the selection of the file.                                                                                                                                                                                                                                                                                                                    | <div style="border: 1px solid black; padding: 10px;"> <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="text-align: left;"> 00000000. FDA<br/><br/> F1<br/>CANCEL </div> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 2px; background-color: #cccccc;">XXXXXXXXXX.FDA</div> <div style="margin: 5px 0;">↑</div> <div>Inversed.<br/>F6<br/>EXECUTE</div> </div> </div> </div> |

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Screen display                                                                                 |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| 13  | <p>Press the F6 "Execute" key of the personal computer.</p> <div><div>E. memory : Floppy: Load</div><div>Select file</div><div><div>Job : 2 (Pass 0)</div><div>Program : 1 (Pass 0)</div><div>Library : 0 (Pass 0)</div><div>A-S-S : 5 (Pass 0)</div><div>A-E-S : 0 (Pass 0)</div></div><div>Loading [OPR select] to stop</div></div> <p>Note) Do not press the emergency stop switch. The normal communication cannot be made. To quit the replay in process, press the F1 "cancel" key and the ESC key of the personal computer and then press the OPR SEL of the teach pendent.</p> <p>The screen below appears:</p> <div><div>* OPR select * 1/1</div><div>Stop loading?</div><div><div>1 Yes</div><div>2 No</div></div></div> <p>Press the ENTER key.</p> <p>End of play.</p> | <div><div>FILE NAME: XXXXXXXX.FDD</div><div>SENT: XXX</div></div> <p>The number increases.</p> |
| 14  | <p>Press the ENTER key of the personal computer.</p> <p>If there is no file passed, go to step #19.</p> <div><div>* OPR select * 1/1</div><div>Check pass contents?</div><div><div>1 Yes</div><div>2 No</div></div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <div><div>[NORMAL END]: SENT</div><div>PRESS RETURN KEY.</div></div>                           |

| No. | Operational method                                                                                                                                                                                                                | Screen display |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 15  | When you check the contents of the files passed, select "YES", while select "NO" when the file is not checked.                                                                                                                    |                |
| 16  | Press the ENTER key. <div><div>→ OPR select * 1/1</div><div><div><div>1 Job</div><div>2 Library</div><div>3 A-E-S</div></div><div><div>4 Program</div><div>5 A-S-S</div><div>6 Check end</div></div></div></div>                  |                |
| 17  | Select the file to be confirmed and press the ENTER key. <div><div>E. memory : Floppy: Load</div><div><div>Job pass NO.</div><div><div>213355568</div><div>80100120</div></div><div>Page nextPage backCheck end</div></div></div> |                |
| 18  | After confirming the file, move the cursor to "Check END" and press the ENTER key.                                                                                                                                                |                |
| 19  | Press the END key when no checks are carried out.<br>To check, follow the procedures #10 and after given in "4.9.3.3 Operations for checking memory floppy disk (Verify)".                                                        |                |

- Note) • When the No. in the robot accords with that in the floppy disk in case of loading from a floppy disk, the No. in the floppy disk has priority. The loading from a floppy disk is passed.
- You cannot see the contents of the file in the floppy disk.

4.9.3.2-b Reading from a floppy disk (Load: Single mode)

This is the function to select "External memory" on the initial screen (mode select display) and read the data saved in a floppy disk in the controller.

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Display on the personal computer |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 0   | Carry out the procedures #0~#5 in 4.9.3.1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                  |
| 1   | Move the cursor to "Check" and press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                  |
| 2   | <p>To play all files, select "ALL FILE". Select "SELECT FILE" to play the necessary files (for instance, programs 2 and 4 are played.)</p> <p>When "System data" is selected, the inner setting data (reservation table, inching speed, override, gas/wire, software limit, weaving table, speed limit, pitch, tool offset, welding machine characteristics and expanded function), job execution count, and register contents are played.</p> <p>When the "Origin data" is selected, the origin data (reference position, reference compensation and origin) is played.</p> <p>To store all the data above, press the OPR SEL key and select "Back-up".</p> <p>Press the ENTER key.</p> <p>Go to step #11 when a menu other than "All file" or "Select file" is selected.</p> |                                  |



| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Screen display |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 3   | <p>When "All file" or "Select file" is selected, the screen shown below appears.</p> <div> <pre> Rewrite same No. files? -----* OPR select *-----1/1 1 Yes      2 <input checked="" type="checkbox"/> No </pre> </div> <p style="text-align: right;">Screen 1</p> <p>When "Yes" is selected, the file registered in the robot is loaded (rewritten) from a floppy disk. However, the protect file cannot be loaded.</p> <p>When "No" is selected, the file registered in the robot is not loaded.</p> <p>Select "Yes" or "No" and press the ENTER key.</p> <p>Whenever "All file" is selected, go to step #11. (The selection between "Yes" and "No" on screen 1 is ignored.)</p> |                |
| 4   | <p>When "Select file" is selected, the screen shown below appears.</p> <div> <pre> -----* OPR select *-----1/1 1 Job      4 Program 2 Library  5 A-S-S 3 A-E-S    6 Execute </pre> </div> <p style="text-align: right;">Screen 2</p>                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Display on the personal computer |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 5   | <p>Select Job/Program/ Library/ A-S-S/ A-E-S and press the ENTER key.</p> <div><div>E. memory : Floppy: Load</div><div>Select file : Job</div><div>1<br/>3<br/>4<br/>6<br/>7</div><div>Page next    Page back    Select</div></div> <p>(Load file No. select screen)</p>                                                                                                                                                                                                                                |                                  |
| 6   | <p>When "Yes" is selected on Screen 1, the registered No. is also displayed as the No. which can be loaded on the load file No. select screen. However, the No. which is registered and protected is not displayed. When "No" is selected, the registered No. is not displayed on the load file No. select screen because it is not loaded.</p> <div><div>E. memory : Floppy: Load</div><div>Select file : Job</div><div>1<br/>3<br/>4<br/>6<br/>7</div><div>[ENT] → setup, [CAN] → release</div></div> |                                  |
| 7   | <p>Move the cursor to the No. to be played and press the ENTER key.</p> <p>(The specified No. is displayed inversed.)</p> <p>*) Move the cursor to Page next or Page back and press the Select key to change the No. displayed.</p>                                                                                                                                                                                                                                                                     |                                  |

| No. | Operational method                                                                                                                                                                                                                                                                                    | Screen display                                                                                                                                                                                |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8   | Press the ENTER key after completing the settings<br>(Screen 1 is brought back.)                                                                                                                                                                                                                      |                                                                                                                                                                                               |
| 9   | Repeat the procedures #4~7 and set the files to be played.                                                                                                                                                                                                                                            |                                                                                                                                                                                               |
| 10  | Move the cursor to "EXECUTION" and press the ENTER key.                                                                                                                                                                                                                                               |                                                                                                                                                                                               |
|     | <div> <pre> E. memory : Floppy:  Load -----Select file-----  * OPR select* -----1/1----- Press [ENTER] key then load floppy. 1 Start </pre> </div> <p style="text-align: right;">Screen 3</p>                                                          |                                                                                                                                                                                               |
| 11  | Press the ENTER key.<br>Move the cursor to "Start" on Screen 3 and press the ENTER key.                                                                                                                                                                                                               |                                                                                                                                                                                               |
|     | <div> <pre> E. memory : Floppy:  Load -----Select file-----  Job      :      0 (Pass  0) Program  :      0 (Pass  0) Library  :      0 (Pass  0) A-S-S    :      0 (Pass  0) A-E-S    :      0 (Pass  0)  Checking [OPR select] to stop </pre> </div> |                                                                                                                                                                                               |
| 12  | Press the F2 "Play" key of the personal computer.                                                                                                                                                                                                                                                     | <div> <pre> [PLAY] ← Flickers. </pre> </div>                                                                                                 |
| 13  | Select the file to be played with the arrow keys of the personal computer and display the file by using the space key.<br><br>If a wrong file is set, press the space key again to cancel the selection of the file.                                                                                  | <div> <pre> 00000000. FDA  XXXXXXXXXX FDA                 ↑                 Inversed. F1             F6 CANCEL         EXECUTE </pre> </div> |

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Screen display                                                                                                                                                                                        |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14  | <p>Press the F6 "Execution" key of the personal computer.</p> <div><div>E. memory : Floppy: Load</div><div>Select file</div><div><div>Job : 2 (Pass 0)</div><div>Program : 1 (Pass 0)</div><div>Library : 0 (Pass 0)</div><div>A-S-S : 5 (Pass 0)</div><div>A-E-S : 0 (Pass 0)</div></div><div>Loading [OPR select] to stop</div></div> <p>Note) Do not press the emergency stop switch. The normal communication cannot be made. To quit the replay in process, press the F1 "cancel" key and the ESC key of the personal computer and then press the OPR SEL of the teach pendent. .</p> <p>The screen below appears.</p> <div><div>* OPR select * 1/1</div><div>Stop loading?</div><div><div>1 Yes</div><div>2 No</div></div></div> <p>Press the ENTER key.</p> <p>End of play.</p> | <div><div>FILE NAME: XXXXXXXX. FDD<br/>SENT: <del>XXX</del></div><div></div><div>The number increases.</div></div> |
| 15  | <p>Press the ENTER key of the personal computer.</p> <p>If there is no file passed, go to step #19.</p> <div><div>* OPR select * 1/1</div><div>Check pass contents?</div><div><div>1 Yes</div><div>2 No</div></div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <div><div>[NORMAL END]: SENT</div><div>PRESS RETURN KEY.</div></div>                                                                                                                                  |

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Screen display |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 16  | When you check the contents of the files passed, select "YES", while select "NO" when the file is not checked.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |
| 17  | Press the ENTER key.<br><div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <div style="text-align: center;">* OPR select * 1/1</div> <div style="display: flex; justify-content: space-between;"> <div>1 Job</div> <div>4 Program</div> </div> <div style="display: flex; justify-content: space-between;"> <div>2 Library</div> <div>5 A-S-S</div> </div> <div>3 A-E-S</div> </div>                                                                                                                                                                                                                                             |                |
| 18  | Select the file to be confirmed and press the ENTER key.<br><div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <div style="text-align: center;">E. memory : Floppy: Load</div> <hr/> <div>Job pass No.</div> <div style="display: flex; justify-content: space-around;"> <div>2</div> <div>13</div> <div>35</div> <div>55</div> <div>68</div> </div> <div style="display: flex; justify-content: space-around;"> <div>80</div> <div>100</div> <div>120</div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div>Page next</div> <div>Page back</div> <div>Check end</div> </div> </div> |                |
| 19  | After confirming the file, move the cursor to "Check END" and press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |
| 20  | Press the END key when no checks are carried out.<br><br>To check, follow the procedures #10 and after given in "4.9.3.3 Operations for checking memory floppy disk (Verify)."                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |

- (1) When "All files" is selected, on screen 1, if the MEMORY SELECT key is pressed by moving the cursor to either "Yes" or "No", the operation goes to "External memory: reading (loading) from the floppy disk" on screen 3.
  - a) If "Yes" is selected, the file of already registered Number is loaded (Rewritten). However, the file protected by the file in the registered Number is not loaded (rewritten).
  - b) If "No" is selected, the file in the already registered Number is not loaded.
- (2) In case that "Select file" is selected and the MEMORY SELECT key is pressed by moving the cursor to either "Yes" or "No", the operation goes to "External memory: reading (loading) from floppy disk" on screen 2.
  - a) If "Yes" is selected on the loading file Number selection screen, the registered Number is also displayed as the load available number. However, the registered Number which is protected is not displayed.
  - b) If "No" is selected on the loading file Number selection screen, the registered Number cannot be loaded and is hence not displayed.
- (3) The external memory operation (operation/external memory parallel mode) in run mode is not loaded in the same file, same as before.
- (4) You cannot see the contents of the file in a floppy disk.

#### 4.9.3.3 Confirmation of the memory and floppy disk (check)

This is the procedure used to check that the contents stored on the floppy disk and the contents stored in the memory of the control unit coincide.

If the floppy disk is damaged, the robot rejects the disk. This check must be carried out.

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Display on the personal computer |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 0   | Carry out the procedures #0~#5 in 4.9.3.1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                  |
| 1   | Move the cursor to "Play" and press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                  |
| 2   | <p>To play all files, select "ALL FILE". Select "SELECT FILE" to play the necessary files (for instance, programs 2 and 4 are played.)</p> <p>When "System data" is selected, the inner setting data (reservation table, inching speed, override, gas/wire, software limit, weaving table, speed limit, pitch, tool offset, welding machine characteristics and expanded function), job execution count, and register contents are played.</p> <p>when the "Origin data" is selected, the origin data (reference position, reference compensation and origin) is played.</p> <p>To store all the data above, press the OPR SEL key and select "Back-up".</p> <p>Press the ENTER key.</p> <p>Go to step #10 when an menu other than "Select file" is selected.</p> |                                  |

| No. | Operational method                                                                                                                                                                                                                                                                                                          | Screen display |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 3   | <p>When "Select file" is selected, the screen below appears:</p> <div><div>* OPR select * 1/1</div><div><div>1 Job4 Program</div><div>2 Library5 A-S-S</div><div>3 A-E-S6 Execute</div></div></div> <p style="text-align: right;">Screen 1</p>                                                                              |                |
| 4   | <p>Select Job/Program/ Library/ A-S-S/ A-E-S and press the ENTER key.</p> <div><div>E. memory : Floppy: Check</div><div>Select file : Job</div><div><div>1</div><div>3</div><div>4</div><div>6</div><div>7</div><div>Page next   Page back   Select</div></div></div>                                                       |                |
| 5   | <p>The No. which can be played is displayed on the screen. Move the cursor to "Select" and press the ENTER key.</p> <div><div>E. memory : Floppy: Check</div><div>Select file : Job</div><div><div>1</div><div>12</div><div>15</div><div>20</div><div>30</div><div>[ENT]   ➡   setup, [CAN]   ➡   release</div></div></div> |                |
| 6   | <p>Move the cursor to the No. to be checked and press the ENTER key.</p> <p>(The specified No. is displayed inversed.)</p> <p>*) Move the cursor to Page next or Page back and press the ENTER key to change the No. displayed.</p>                                                                                         |                |



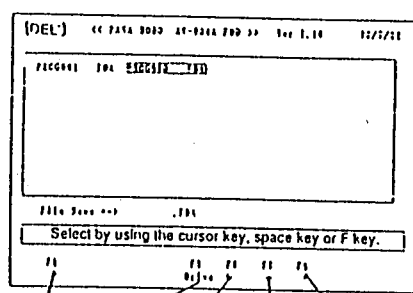
| No. | Operational method                                                                                                                                                                                                                                                      | Screen display                                                                                                                                                |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7   | Press the END key after completing the settings<br>(Screen 1 is brought back.)                                                                                                                                                                                          |                                                                                                                                                               |
| 8   | Repeat the procedures #4~7 and set the files to be checked.                                                                                                                                                                                                             |                                                                                                                                                               |
| 9   | Move the cursor to "Execute" and press the ENTER key.                                                                                                                                                                                                                   |                                                                                                                                                               |
|     | <div> <div>E. memory : Floppy: Check</div> <div>Select file</div> <div> <div>* OPR select* 1/1</div> <div>Press [ENTER] key then load floppy.</div> <div>1 Start</div> </div> </div>                                                       |                                                                                                                                                               |
| 10  | Press the ENTER key.                                                                                                                                                                                                                                                    |                                                                                                                                                               |
|     | <div> <div>E. memory : Floppy: Check</div> <div>Select file</div> <div> <div>Job : 0</div> <div>Program : 0</div> <div>Library : 0</div> <div>A-S-S : 0</div> <div>A-E-S : 0</div> </div> <div>Checking [OPR select] to stop</div> </div> |                                                                                                                                                               |
| 11  | Press the F2 "Load" key of the personal computer.                                                                                                                                                                                                                       | <div> <div>[PLAY] ← Flickers.</div> </div>                                                                                     |
| 12  | Select the file to be checked with the arrow keys of the personal computer and display the file by using the space key.<br><br>If a wrong file is set, press the space key again to cancel the selection of the file.                                                   | <div> <div>00000000. FDA      XXXXXXXX FDA</div> <div>↑</div> <div>Inversed.</div> <div>F1 CANCEL      F6 EXECUTE</div> </div> |

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Screen display                                                                                                                           |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 13  | <p>Press the F6 "Execution" key of the personal computer.</p> <div> <pre> E. memory : Floppy : Check ----- Select file Job          : 1 Program      : 10 Library      : 0 A-S-S       : 5 A-E-S       : 0 Checking [OPR select] to stop </pre> </div> <p>(Shown above is the screen displayed during checking.)</p> <p>Note) Do not press the emergency stop switch. The normal communication cannot be made. To quit the replay in process, press the F1 "cancel" key and the ESC key of the personal computer and then press the OPR SEL of the teach pendent.</p> <p>The screen below appears:</p> <div> <pre> *OPR select* 1/1 Stop checking? 1 Yes      2 No </pre> </div> <p>Press the ENTER key.</p> <p>End of play.</p> | <div> <pre> FILE NAME: XXXXXXXX. FDD SENT: XXX </pre> </div> <p>The number increases.</p> |
| 14  | <p>Press the Return key of the personal computer.</p> <div> <pre> E. memory : Floppy : Check ----- Select file * OPR select* 1/1 Press [ENTER] key then load floppy. 1 Start </pre> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <div> <pre> [NORMAL END]: SENT  PRESS RETURN KEY. </pre> </div>                         |

| No. | Operational method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Screen display |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 15  | <p>If any abnormality is detected during the check, the screen below appears:</p> <div><div>E. memory : Floppy : Check</div><div>Select file 1/1</div><div>Error occurred</div><div><div>*MODE SEL* 1/2</div><div><div>1 Job5 Program</div><div>2 Library6 A-S-S</div><div>3 A-E-S7 Others</div><div>4 Check end</div></div></div></div> <p>"Error while save-checking" for error during data save check.<br/>"Error while load-checking" for error during play check.</p> <p>Note) The files with no error are not displayed.</p> |                |
| 16  | Select the file type to be checked.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                |
| 17  | After checking, move the cursor to "Check end" and press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |
| 18  | Press the END key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |

#### 4.9.3.4 Deleting the file on the data floppy disk

This is the procedure to delete files stored on the data disk.

| No. | Operational method                                                                                                                                                                    | Display on the personal computer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | Insert the master floppy disk into the drive unit of the personal computer and turn the computer on.                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 1   | When the message "Insert the data disk into the drive unit. Press any key when ready" is shown on the screen, remove the master disk from the drive unit and insert the data disk.    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 2   | Press the F5 "DEL" key of the personal computer.                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 3   | Select the file to be deleted by using the arrow keys and display the files with the space key .<br>When a wrong file is selected, press the space key again to cancel the selection. |  <p>The screenshot shows a screen titled '(DEL)' with a header bar containing 'DATA 0000', 'AT-DATA FDD 33', 'Ver 1.10', and '12/5/11'. Below the header is a list of files: 'PROGRAM', 'FILE', and 'SECRET'. A prompt at the bottom reads 'Select by using the cursor key, space key or F key.' Below the screen, five function keys are labeled: F1 (CANCEL), F2 (DRIVE), F3 (EXECUTION), F4 (DISPLAY), and F5 (CONTENT).</p> |
| 4   | Press the F6 "Execution" key of the personal computer.                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 5   | The message "Delete OK?" appears on the screen of the personal computer. Press the F6 key to delete. Press the CANCEL(F1) key not to delete.                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

#### 4.9.3.5 File reference procedure of data disk

The file names stored on the data disk are listed on the screen of the personal computer. Move the cursor to the file name to be referred to and press the F8 "Content" key to check the data.

#### 4.9.4 Files for individual operation

##### (1) External memory mode

|             | Job | Program | Reservation<br>sequence | Weld start<br>sequence | Weld end<br>sequence | Inner<br>settings |
|-------------|-----|---------|-------------------------|------------------------|----------------------|-------------------|
| All files   |     |         |                         |                        |                      |                   |
| Select file |     |         |                         |                        |                      |                   |
| System data |     |         |                         |                        |                      |                   |
| Origin data |     |         |                         |                        |                      |                   |
| Back-up     |     |         |                         |                        |                      |                   |

|             | Teaching<br>reg. data | Job<br>execution<br>count | Register<br>content | Origin data |
|-------------|-----------------------|---------------------------|---------------------|-------------|
| All files   |                       |                           |                     |             |
| Select file |                       |                           |                     |             |
| System data |                       |                           |                     |             |
| Origin data |                       |                           |                     |             |
| Back-up     |                       |                           |                     |             |

|             | Job | Program | Reservation<br>sequence | Weld start<br>sequence | Weld end<br>sequence | Inner<br>settings |
|-------------|-----|---------|-------------------------|------------------------|----------------------|-------------------|
| All files   |     |         |                         |                        |                      |                   |
| Select file |     |         |                         |                        |                      |                   |
| System data |     |         |                         |                        |                      |                   |
| Origin data |     |         |                         |                        |                      |                   |
| Back-up     |     |         |                         |                        |                      |                   |

|             | Teaching<br>reg. data | Job<br>execution<br>count | Register<br>content | Origin data |
|-------------|-----------------------|---------------------------|---------------------|-------------|
| All files   |                       |                           |                     |             |
| Select file |                       |                           |                     |             |
| System data |                       |                           |                     |             |
| Origin data |                       |                           |                     |             |
| Back-up     |                       |                           |                     |             |

○ : Target file

△ : Specified file only

× : Non-targeted file

#### 4.10 Sequencer I/O test function

(Available with the main software of version "F0" or higher versions.)

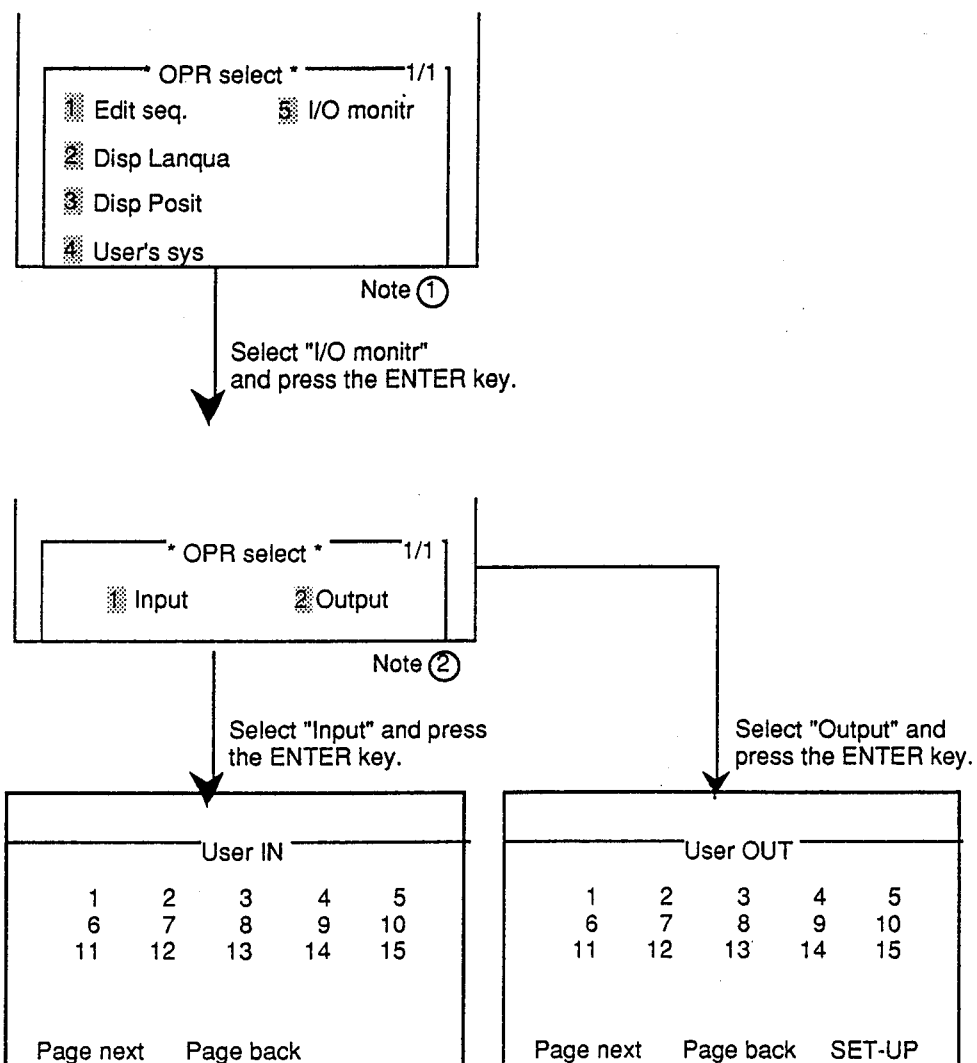
##### 4.10.1. Function

This function controls the input and output of the sequencer directly and checks the hardware of the sequencer easily.

##### 4.10.2. Setup method of the function

###### (1) Operational procedures:

Press the OPR SEL key in the operation mode, the teaching or trace mode when the TEACH ENABLE LED is lit, and select "I/O monitr."



- 1) Auxiliary I/O "No" ----- "Page next" and "Page back" are not indicated.  
 Auxiliary I/O "Yes" ----- "Page next" and "Page back" are indicated.  
 The user input terminal No. and the user output terminal No.  
 are indicated ranging from 1 to 80.
- 2) Press the END key to return to the idling screen of "TEACH ENABLE."
- 3) Select "I/O monitr," "Output" and "SET-UP" and move the cursor to the user out  
 terminal No. to be tested and press the ENTER key. And the output is set at HIGH  
 (ON.) Press the "CANCEL" key to set the output LOW (OFF.)
- (2) The user out terminal set at "HIGH (ON)" in "I/O monitr, Output" keeps the "HIGH (ON)"  
 state until the "TEACH ENABLE" is turned OFF.
- (3) When the user out which is allocated by "RT work envelop," "Block monitoring," "Weld  
 off output," "Home position return output" and "Start mode output" in "Init. set:  
 Advanced function" is set at "HIGH (ON)", the output terminal cannot be set at "HIGH  
 (ON)" or "LOW (OFF)" in the "I/O monitr, Output."
- (4) When the trace is carried out in the "TEACH ENABLE ON" state, and the  
 "OUTB...SW=0" command is executed assumptively, the output No. will not be  
 displayed inverted even if "I/O monitr:Output" is selected.
- (5) When the trace is carried out in the "TEACH ENABLE ON" state, and the  
 "OUTB...SW=1" command is executed assumptively, the output No. will be displayed  
 inverted if "I/O monitr:Output" is selected.
- (6) When the user out terminal is set at HIGH (ON) in "I/O monitr:Output," the set-up output  
 keeps the "HIGH (ON)" state even if the emergency stop SW is pressed.
- (7) The user out terminal No. in "CTRL key" can be set at "HIGH (ON)" or "LOW (OFF)" in "I/O  
 monitr."
- (8) The user out terminal set at "HIGH(ON)" or "LOW (OFF)" in "I/O monitr:Output" can be set  
 at "HIGH(ON)" or "LOW (OFF)" in "CTRL key."
- (9) When "I/O monitr" is ended after the user out terminal in "CTRL key" is set at "HIGH (ON)"  
 or "LOW (OFF)" in "I/O monitr," the screen returns to the "Initial state" of "CTRL key" in  
 "Init. set: Advanced function."



## CHAPTER 5

### TEACH COORDINATE SYSTEM

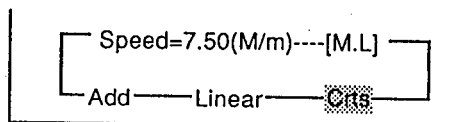
This chapter covers the explanation of motions on the teach coordinate system. The contents of this chapter regarding the coordinate system used in Pana-Robo (Articulate (link) coordinate system, cylindrical coordinate system, user coordinate system and tool coordinate system) should be well understood so that the performance of the robot can exhibit to its maximum.

## Teach coordinate system

|                                       |                                                                    |
|---------------------------------------|--------------------------------------------------------------------|
| * Articulate (link) coordinate system | Rotation of individual axes of robot                               |
| * Cylindrical coordinate system       | Cylindrical coordinate system fixed to robot                       |
| * Cartesian coordinate system         | Cylindrical coordinate system vertical to robot                    |
| * User coordinate system              | Coordinate system applied to workpiece                             |
| * Tool coordinate system              | Orthogonal coordinate system applied to the tools mounted on robot |

### 5.1 Selection of coordinate system

In teach mode:



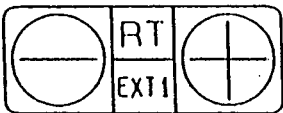
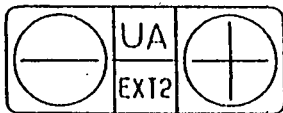
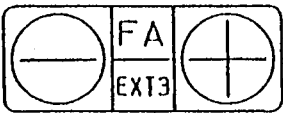
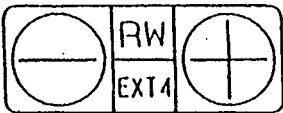
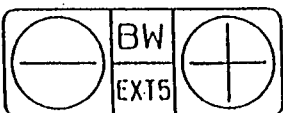
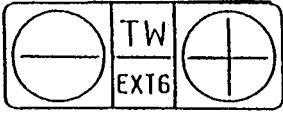
Move the cursor to "Crt5".

Press the TEACH SEL key to select the coordinate system.

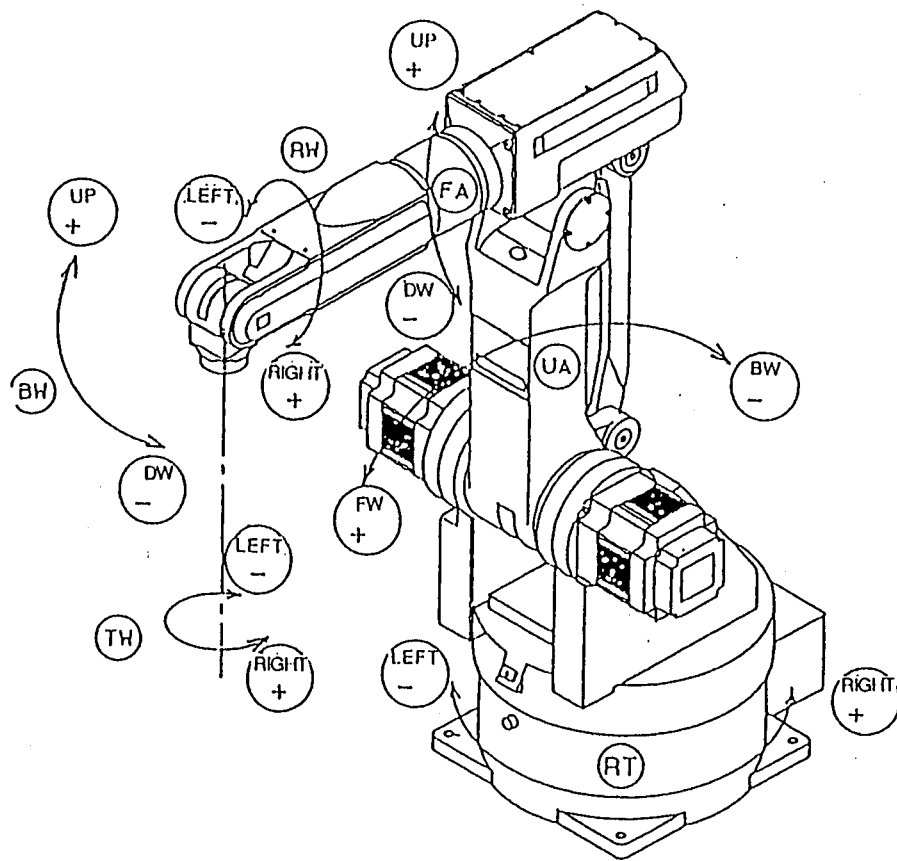
## 5.2 Motions of Articulate (link) coordinate system

Change the coordinate system displayed to "A rtc".

|                          |
|--------------------------|
| Speed=7.50(M/m)----[M.L] |
| Add____Linear____Artic   |

|                    | Operation key                                                                       | Name              | Motion                              |
|--------------------|-------------------------------------------------------------------------------------|-------------------|-------------------------------------|
| Standard<br>3 axes |    | RT<br>(Rotation)  | RT axis moves horizontally.         |
|                    |    | UA<br>(Upper arm) | UA axis moves forward and backward. |
|                    |   | FA<br>(Front arm) | FA axis moves vertically.           |
| Wrist<br>3 axes    |  | RW<br>(Rotation)  | RW axis rotates horizontally.       |
|                    |  | BW<br>(Bending)   | BW axis rotates vertically.         |
|                    |  | TW<br>(Twist)     | TW axis rotates horizontally.       |

When each key is pressed with the ROBOT OPR key held down, the axis corresponding to the key pressed moves as specified.



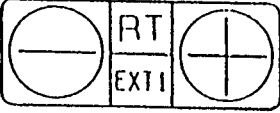
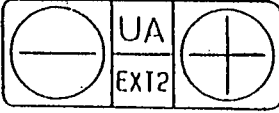
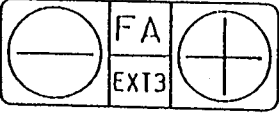
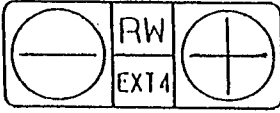
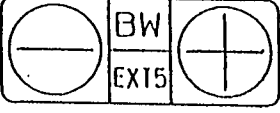
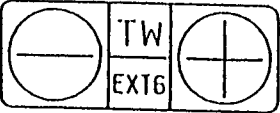
Motions on Articulate(link) coordinate system

\* The figure above shows the AW-010A.

### 5.3 Motions of Cylindrical coordinate system

Change the coordinate system displayed to "CylIn".

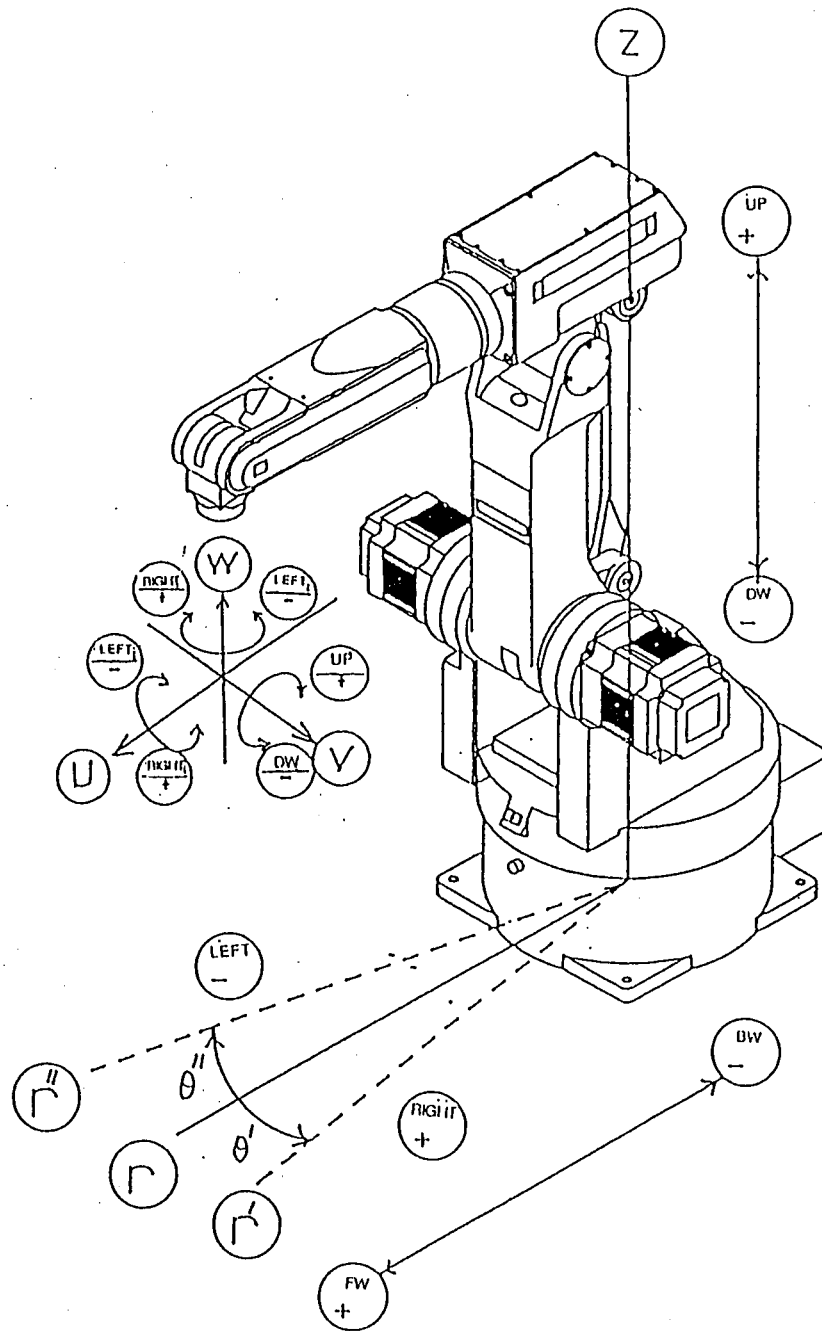
|                                    |
|------------------------------------|
| Speed=7.50(M/m)----[M.L]           |
| Add _____ Linear _____ CylIn _____ |

|                    | Operation key                                                                       | Name   | Motion                                          |
|--------------------|-------------------------------------------------------------------------------------|--------|-------------------------------------------------|
| Standard<br>3 axes |    | q axis | RT axis (rotation) rotates horizontally.        |
|                    |    | r axis | Forward/backward movement vertically to Z axis. |
|                    |   | z axis | Moves up and down in parallel to Z axis.        |
| Wrist<br>3 axes    |  | U axis | Rotates clockwise /counterclockwise to U axis.  |
|                    |  | V axis | Rotates clockwise /counterclockwise to V axis.  |
|                    |  | W axis | Rotates clockwise /counterclockwise to W axis.  |

\* Standard 3 axes: Cylindrical coordinate system fixed to the robot

\* Wrist 3 axes: With r and z axis of the cylindrical coordinate system and the axis vertical to these axes as coordinate, rotation around the coordinate point. (Fixed motion at control point)

q axis rotates around RT axis. r axis moves in parallel to UA axis. z axis moves in parallel to Z axis of the robot coordinate system.



Motions on cylindrical coordinate system

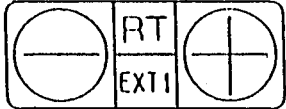
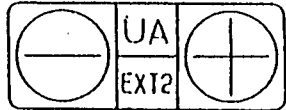
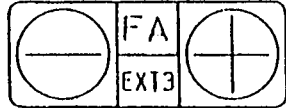
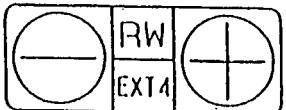
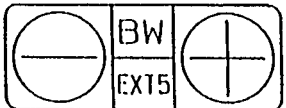
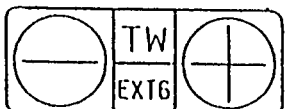
\* The figure above shows the AW-010A.

#### 5.4 Motions of Cartesian coordinate system

Change the coordinate system displayed to "Crts".

Speed=7.50(M/m)----[M.L]

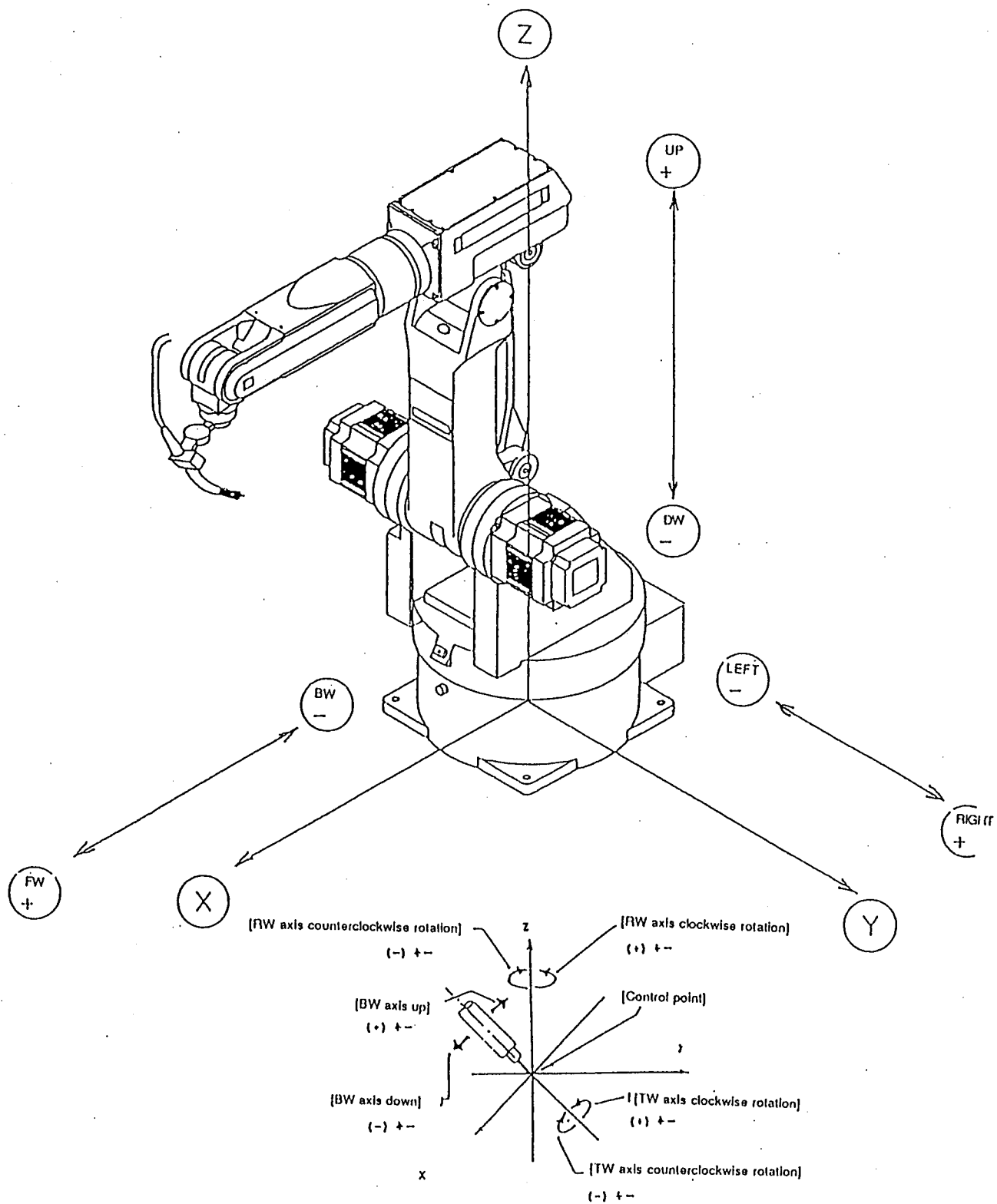
Add\_\_\_\_Linear\_\_\_\_Crts\_\_\_\_

|                    | Operation key                                                                       | Name   | Motion                                                                                                         |
|--------------------|-------------------------------------------------------------------------------------|--------|----------------------------------------------------------------------------------------------------------------|
| Standard<br>3 axes |    | Y axis | Moves left and right in parallel to Y axis of the robot coordinate system.                                     |
|                    |    | X axis | Moves forward/backward in parallel to X axis of the robot coordinate system.                                   |
|                    |   | Z axis | Moves up and down in parallel to Z axis of the robot coordinate system.                                        |
| Wrist<br>3 axes    |  |        | Rotates the torch clockwise/ counterclockwise on the corn while maintaining the torch angle and control point. |
|                    |  |        | Moves upward/downward while fixing the control point within the plane including vertical axis and the torch.   |
|                    |  |        | Rotates clockwise /counterclockwise while fixing the control with the torch direction as the center.           |

\* Standard 3 axes: Motions on the vertical coordinate system fixed to the robot

\* Wrist 3 axes:           Rotation around the axis of the wrist coordinate system (vertical)  
which is corresponding to the robot coordinate system.  
(Control point fixed motion)

Motions of Cartesian coordinate system are those in parallel to X,Y and Z axes of the robot coordinate system.



Motions on Cartesian coordinate system

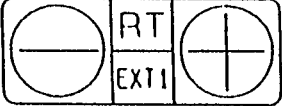
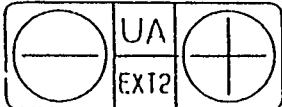
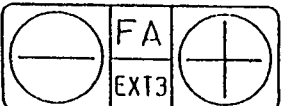
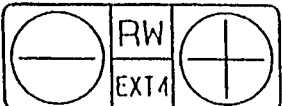
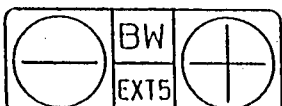
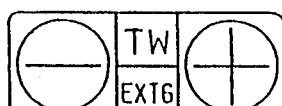
\* The figure above shows the AW-010A.



## 5.5 Motions of User coordinate system

Change the coordinate system displayed to "User".

|                           |
|---------------------------|
| Speed=7.50(M/m)----[M.L]  |
| Add____Linear____User____ |

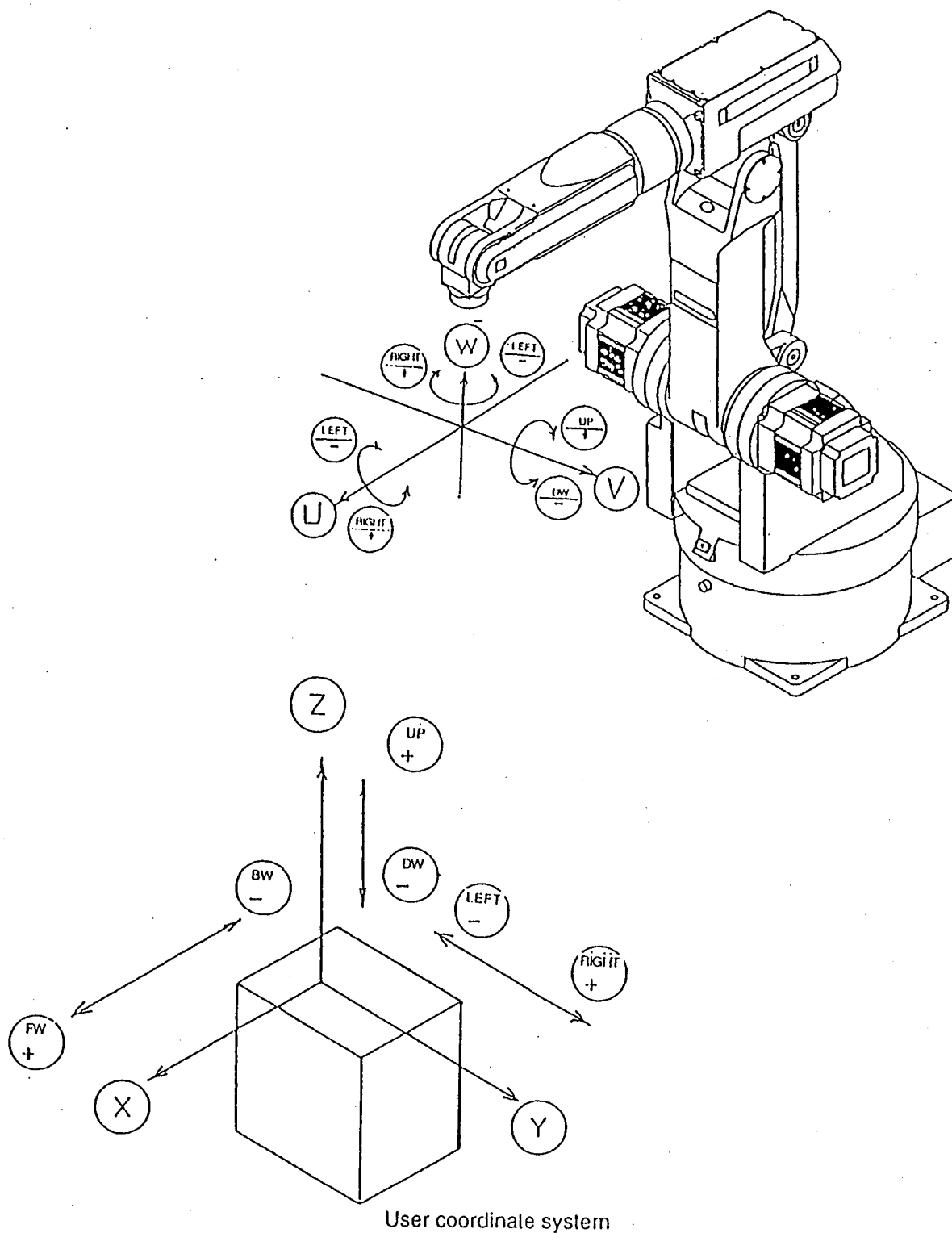
|                    | Operation key                                                                       | Name   | Motion                                                                      |
|--------------------|-------------------------------------------------------------------------------------|--------|-----------------------------------------------------------------------------|
| Standard<br>3 axes |    | Y axis | Moves left and right in parallel to Y axis of the user coordinate system.   |
|                    |    | X axis | Moves forward/backward in parallel to X axis of the user coordinate system. |
|                    |   | Z axis | Moves up and down in parallel to Z axis.                                    |
| Wrist<br>3 axes    |  | U axis | Rotates clockwise /counterclockwise to U axis.                              |
|                    |  | V axis | Rotates clockwise /counterclockwise to V axis.                              |
|                    |  | W axis | Rotates clockwise/ counterclockwise to W axis                               |

\* Standard 3 axes: Motions on the specified user coordinate system

\* Wrist 3 axes: Rotation around the specified user coordinate axis.

(Control point fixed motion)

On the user coordinate system, the axes move in parallel to each axis of the specified user coordinate system.

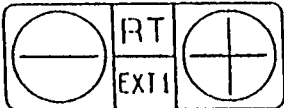
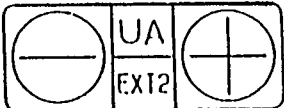
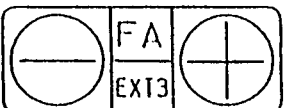
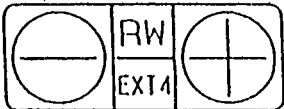
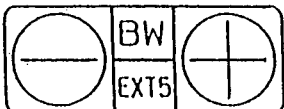
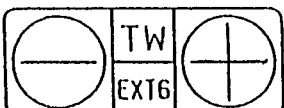


\* The figure above shows the AW-010A.

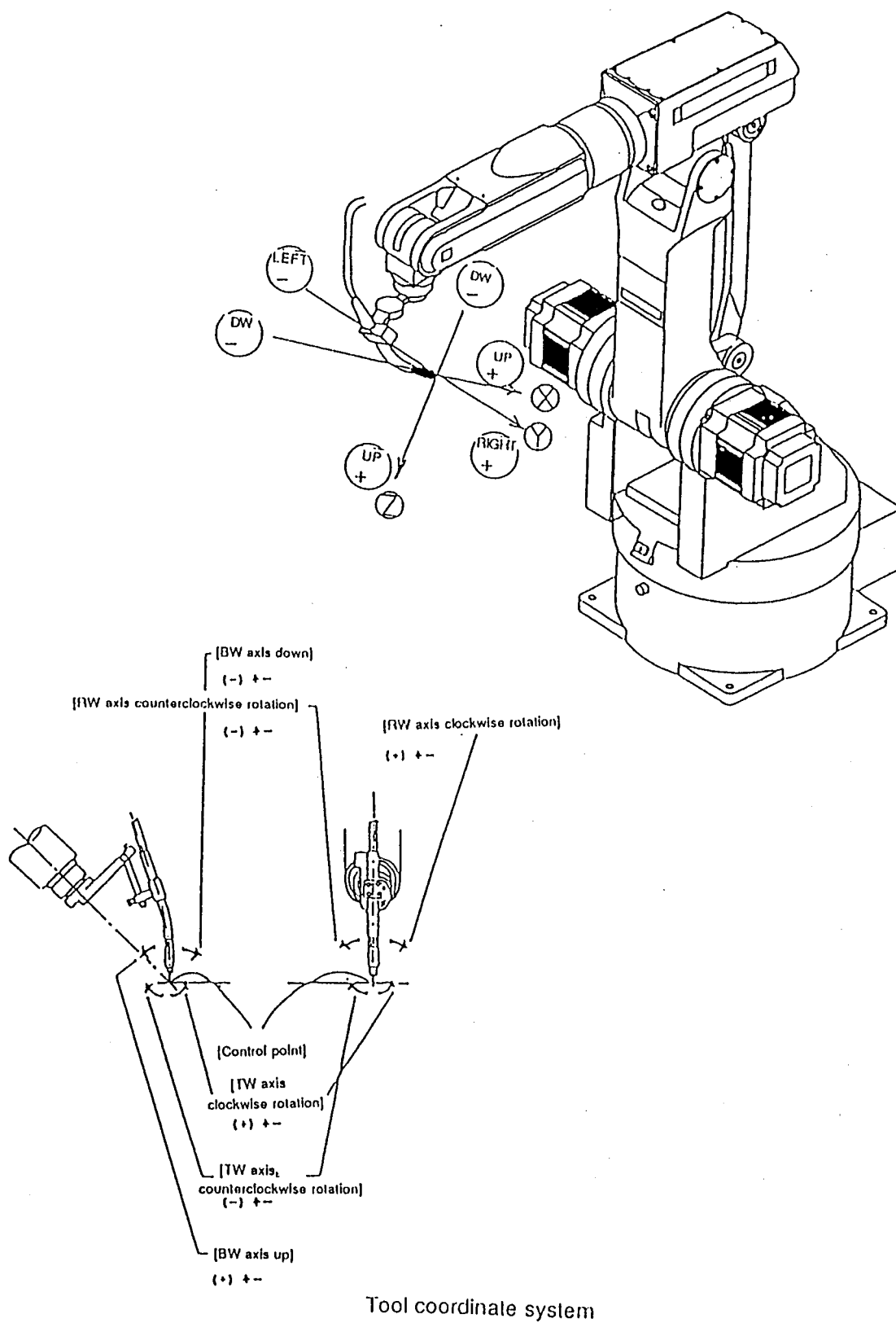
## 5.6 Tool coordinate system

Change the coordinate system displayed to "Tool".

|                           |
|---------------------------|
| Speed=7.50(M/m)---[M.L]   |
| Add____Linear____Tool____ |

|                    | Operation key                                                                       | Name   | Motion                                                                                                               |
|--------------------|-------------------------------------------------------------------------------------|--------|----------------------------------------------------------------------------------------------------------------------|
| Standard<br>3 axes |    | Y axis | Moves in parallel to Y axis of the tool coordinate system.                                                           |
|                    |    | X axis | Moves in parallel to X axis of the tool coordinate system.                                                           |
|                    |   | Z axis | Moves in parallel to Z axis of the tool coordinate system.                                                           |
| Wrist<br>3 axes    |  |        | Rotates clockwise /counterclockwise while fixing the control point within the plane vertical to the torch direction. |
|                    |  |        | Moves up and down while fixing the control point within the plane vertical to the torch direction.                   |
|                    |  |        | Rotates clockwise /counterclockwise while fixing the control point with the torch direction as the center.           |

\* Tool coordinate system

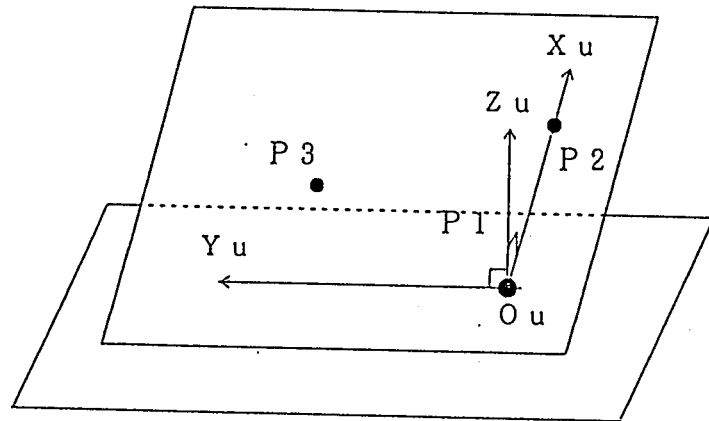


\* The figure above shows the AW-010A.

## 5.7 Definition and setting of the tool/user coordinate systems

### 5.7.1 Definition of the user coordinate system

The user coordinate system is the coordinate system applied in addition to the robot coordinate system. This coordinate system is applied with the workpiece as the reference and can be set freely. The user coordinate system can be set up to 8 kinds.



The setting data are:

- (1)  $P_1$ : Origin position ( $O_u$ ) of the user coordinate system
- (2)  $P_2$ : Point on the X axis of the user coordinate system
- (3)  $P_3$ : Point showing the Y direction of the user coordinate system (on the  $X_u$ - $Y_u$  plane)

$Y_u$  axis: Vertical to the  $X_u$  axis, on the  $X_u$ - $Y_u$  plane

$Z_u$  axis: Vertical to the  $X_u$ - $Y_u$  plane (Right hand system)

Points  $P_1$ ,  $P_2$  and  $P_3$  are entered by direct data input by MDI or through the teaching using the teach pendant.

### 5.7.2 Definition of the tool coordinate system

The tool coordinate system is the coordinate system applied to the tool mounted on the wrist flange of the robot manipulator, and is defined according to the posture (situation) of the tool.

On the tool coordinate system, the tool is moved regardless of the situation of the robot. Therefore, this system is suitable to move in parallel to the workpiece without changing the posture of the tool.

In this robot, the motions are controlled so that the torch tip is interpolated.

(Motions are carried out so that the linear velocity of the torch tip becomes constant through circular or linear interpolation.)

Therefore, when the torch is mounted, measure the dimensions in the table below precisely and enter these values into the Controller as the system setting data.

The values shown below are entered prior to shipping:

|    | At shipping | Max value limited by the precision |
|----|-------------|------------------------------------|
| L1 | 420 (450)   | 600                                |
| L2 | 0           | 100                                |
| L3 | 379.3 (350) | ----                               |
| TW | -20         | ----                               |

#### (1) Definition of the control point

Move the origin  $O_F$  to  $O_F'$ .

The setting is defined by L1mm, L2mm and angle TW.

The  $O_F'$  is the origin (control point) of the new tool coordinate system.

Definition of origin ( $O_F'$ ) of the tool coordinate system

| Model   | Lf (mm) |
|---------|---------|
| AW-005A | 100     |
| AW-005A | 130     |
| AW-010A | 130     |
| VR-008A | 155     |

Plane Q: Parallel to the TW axis flange surface. Includes the control point.

(Set-up parameters)

- \* L1: Distance between the center of rotation of BE axis and plane Q
- \* L2: Distance between the control point and the center line of the TW rotation
- \* TW: Rotation angle around the TW axis  $0^\circ$
- \* L3: Distance between the intersection of the TW flange plane and extended line of the tool and point  $O_F'$

The values are entered by MDI.

### 5.7.3 Procedures for setting tool coordinate system

The dimensions of the tool (torch) mounted on the wrist of the robot is defined.

|   | Operation                                                                   | Screen display                                                                                                                                                                                                                              |
|---|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 | This procedure is started from the initial screen.                          | <div>Mode Select (Initial)<br/>To select &lt;OPR&gt; or &lt;TEACH&gt;, use SW on the controller.<br/><div>*OPR select* —1/1—<br/>1 Edit                      4 Init. set<br/>2 Product data            5 E. memory<br/>3 Option</div></div> |
| 1 | Move the cursor to "Init. set" and press the ENTER key.                     |                                                                                                                                                                                                                                             |
| 2 | Since the cursor has shifted to "System. set", press the ENTER key.         | <div>Init. set<br/><div>*OPR select* —1/1—<br/>1 System. set            2 Adv-func.</div></div>                                                                                                                                             |
| 3 | Since the cursor has shifted to "RBT constant", press the ENTER key.        | <div>Init. set : Sys. set<br/><div>*OPR select* —1/1—<br/>1 RBT constant<br/>2 Weld cond<br/>3 Welder model<br/>4 Memory clear</div></div>                                                                                                  |
| 4 | Move the cursor to "Tool offset" and press the ENTER key.                   | <div>Note 1<br/>Init. set : Sys. set : Rbt constant<br/><div>*OPR select* —1/1—<br/>1 Soft limit              4 Jog<br/>2 Speed limit            5 Tool offset<br/>3 Std tool No.</div></div>                                               |
| 5 | Move the cursor the tool No. to be set and press the ENTER key.             | <div>Init. set : Sys. set : Rbt const<br/>Tool set<br/><div>Tool No. 1              Tool No. 5<br/>Tool No. 2              Tool No. 6<br/>Tool No. 3              Tool No. 7<br/>Tool No. 4              Tool No. 8</div></div>             |
| 6 | Enter values L1,L2, L3 and TW, and press the ENTER key.                     |                                                                                                                                                                                                                                             |
| 7 | To enter the standard value, move the cursor to "STD". Press the ENTER key. | <div>Init. set : Sys. set : Rbt const<br/>Tool No. 1 —1/1—<br/>L1        =        420.00 (mm)<br/>L2        =        0.00 (mm)<br/>L3        =        379.30 (° )<br/>TW        =        - 20.00<br/>STD</div>                              |
| 8 | Press the END key.                                                          | <div>Return to Tool # select screen.</div>                                                                                                                                                                                                  |

Note 1) The display shown below appears in the main software of version "J3" or lower version.

|                      |              |
|----------------------|--------------|
| Init. set : Sys. set |              |
| *OPR select* 1/1     |              |
| FBT constant         | Welder model |
| Weld cond            | Memory clear |



#### 5.7.4 Procedures for setting user coordinate system

8 user coordinate system can be set at maximum.

|   | Operation                                                                                                                                                                                                                                                                                                                                                                                              | Screen display                                                                                                                                                                                          |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 | This procedure is carried out in TEACH mode.                                                                                                                                                                                                                                                                                                                                                           | <div>Teaching</div> <div>Memory 99.9% (app.5668 steps)</div> <div>*OPR select* 1/1</div> <div>1 Input No. 5 File list</div> <div>2 Home position</div> <div>3 Conversion</div> <div>4 Coordinates</div> |
| 1 | Move the cursor to "Coordinates" (coordinate system teaching) and press the ENTER key.                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                         |
| 2 | Press the ENTER key.                                                                                                                                                                                                                                                                                                                                                                                   | Note 1                                                                                                                                                                                                  |
| 3 | Enter the No. of the coordinate system to be set.<br>Press the ENTER key.                                                                                                                                                                                                                                                                                                                              | <div>Teaching: Teach coordinates</div> <div>*OPR select* 1/1</div> <div>1 User's sys</div>                                                                                                              |
| 4 | Select the setting method.<br>[MDI] Enter the data directly via the numerical keys.<br>[Teach] Teach by using the teach pendent.<br>[Delete] The set-up data is deleted.<br>Move the cursor to one of the items above, and press the ENTER key.<br>(The setting method of each coordinate system is described in "Setting of the tool coordinate system" and "Setting of the user coordinate system".) | <div>Teaching: Teach coordinates</div> <div>No. = 1 No. = 5</div> <div>2 6</div> <div>3 7</div> <div>4 8</div> <div>Input coordinates No.</div>                                                         |
| 5 | After completing the settings, press the END key.                                                                                                                                                                                                                                                                                                                                                      | <div>* OPR select *</div> <div>1 Robot teaching 3 MDI</div> <div>2 Delete</div>                                                                                                                         |

Note) In standard specifications, a user coordinate system cannot be registered if 255 programs have already been registered. Delete unnecessary program (s).

When an expanded memory is used, a user coordinate system cannot be registered if 999 programs have already been registered. Delete unnecessary program (s).

Note 1) The display shown below appears in the main software of version "J3" or lower version.

|                                |             |
|--------------------------------|-------------|
| Teaching:                      |             |
| Memory 99.9% (app. 5268 steps) |             |
| *OPR select* — 1/1             |             |
| Input No.                      | File list   |
| Home position                  | Coordinates |
| Conversion                     |             |

5.7.4.1 Enter data to P1,P2 and P3 described in "definition of the user coordinate system"

(a) When "MDI" is selected as the setting method

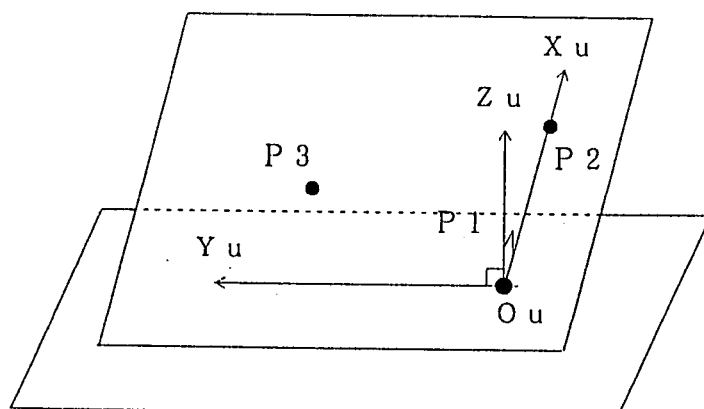
The screen shown to the right appears.

Select the point to be set (move the cursor to the point), and press the ENTER key.

| Teaching: Teach coordinates |         |
|-----------------------------|---------|
| No. = 1                     |         |
|                             | Point 1 |
|                             | Point 2 |
|                             | Point 3 |

Enter the data directly and press the ENTER key. To quit the setting mode, move the cursor to "Finish setup" and press the ENTER key.

| Teaching: Teach coordinates |                 |
|-----------------------------|-----------------|
| No. = 1 : Point 1           |                 |
| X = 924.13 (mm)             | U = -103.31 (°) |
| Y = -532.50 (mm)            | V = 52.30 (°)   |
| Z = 523.27 (mm)             | W = 179.37 (°)  |
| Finish setup                |                 |



Point 1 Origin ( $O_u$ )

Point 2 Point on the X axis

Point 3 Point in Y axis direction

(b) When "Robot teaching" is selected as the setting method:

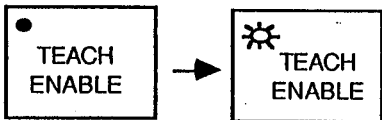
| Teaching: Teach coordinates |                 |
|-----------------------------|-----------------|
| No. = 1 : Point 1           |                 |
| X= 924.13 (mm)              | U= - 103.31 (°) |
| Y= - 532.50 (mm)            | V= 52.30 (°)    |
| Z= 523.27 (mm)              | W= 179.37 (°)   |
| Finish setup                |                 |
| Speed=7.50(M/m) (M.L)       |                 |
| Add                         | Linear Crts     |

Teach Points 1, 2 and 3. (Register the point via the "STORE" key on the teach pendant.)

After the setting is completed, press the END key.

### 5.7.5 Procedures for selecting user coordinate system

This is the procedure to change the coordinate system to the user coordinate system and select the appropriate one among the 8 systems available. This is performed during operation or teaching.

|                                 | Operation                                                                                             | Screen display                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |  |  |     |   |   |     |   |   |         |   |   |           |   |   |           |   |   |                                 |  |  |
|---------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--|--|-----|---|---|-----|---|---|---------|---|---|-----------|---|---|-----------|---|---|---------------------------------|--|--|
| 0                               | Select the operation mode or teach mode in which the operation of the teach pendant can be performed. |                                                                                                                                                                                                                                                                                                                                                       |                     |  |  |     |   |   |     |   |   |         |   |   |           |   |   |           |   |   |                                 |  |  |
| 1                               | Press the TEACH ENABLE key of the teach pendant.                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |  |  |     |   |   |     |   |   |         |   |   |           |   |   |           |   |   |                                 |  |  |
| 2                               | Press the MENU SEL key twice.                                                                         | <table border="1"> <thead> <tr> <th colspan="3">Teaching: P:1 S: V:</th> </tr> </thead> <tbody> <tr> <td>AJO</td> <td>=</td> <td>1</td> </tr> <tr> <td>CJO</td> <td>=</td> <td>1</td> </tr> <tr> <td>Weaving</td> <td>=</td> <td>2</td> </tr> <tr> <td>User Csys</td> <td>=</td> <td>0</td> </tr> <tr> <td>Wrist cal</td> <td>=</td> <td>0</td> </tr> <tr> <td colspan="3">[OPR SEL] → Change menu content</td> </tr> </tbody> </table> | Teaching: P:1 S: V: |  |  | AJO | = | 1 | CJO | = | 1 | Weaving | = | 2 | User Csys | = | 0 | Wrist cal | = | 0 | [OPR SEL] → Change menu content |  |  |
| Teaching: P:1 S: V:             |                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |  |  |     |   |   |     |   |   |         |   |   |           |   |   |           |   |   |                                 |  |  |
| AJO                             | =                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1                   |  |  |     |   |   |     |   |   |         |   |   |           |   |   |           |   |   |                                 |  |  |
| CJO                             | =                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1                   |  |  |     |   |   |     |   |   |         |   |   |           |   |   |           |   |   |                                 |  |  |
| Weaving                         | =                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2                   |  |  |     |   |   |     |   |   |         |   |   |           |   |   |           |   |   |                                 |  |  |
| User Csys                       | =                                                                                                     | 0                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |  |  |     |   |   |     |   |   |         |   |   |           |   |   |           |   |   |                                 |  |  |
| Wrist cal                       | =                                                                                                     | 0                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |  |  |     |   |   |     |   |   |         |   |   |           |   |   |           |   |   |                                 |  |  |
| [OPR SEL] → Change menu content |                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |  |  |     |   |   |     |   |   |         |   |   |           |   |   |           |   |   |                                 |  |  |
| 3                               | Move the cursor to "User C-sys" (User coordinate system) and enter the coordinate system No..         |                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |  |  |     |   |   |     |   |   |         |   |   |           |   |   |           |   |   |                                 |  |  |
| 4                               | Press the ENTER key.                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |  |  |     |   |   |     |   |   |         |   |   |           |   |   |           |   |   |                                 |  |  |
| 5                               | When manually operated, the motions are those on the selected user coordinate system.                 |                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |  |  |     |   |   |     |   |   |         |   |   |           |   |   |           |   |   |                                 |  |  |

Notes

Notes

(Note 1) The default values of the weaving pattern at teaching are as follows;

"2" \_\_\_ Main software of version "J3" or lower version.

"1" \_\_\_ Main software of version "K0" or higher version.

(Note 2) When a user coordinate system which has not been defined is selected, the motions in manual operation mode are those on the Cartesian coordinate system.

## CHAPTER 6

### EXPLANATION OF COMMANDS

This chapter covers the explanation of the commands used for PANAROBO.

By storing the commands into the robot in the order of the processes to be executed, the robot can execute the job.

It is necessary to fully understand the relationship of the commands and the robot's movement corresponding to individual commands.

## 6.1 Structure and name of the data of Panarobo

To make a robot execute the welding jobs, various data have to be stored in the robot. First explained in this section is the structure how these data are connected with each other.

6.1.1 Job: A job is the unit of work executed by the robot.

A job is managed according to the job No. (Max. 127 kinds). The structure is as shown below:

|               |                             |                                           |
|---------------|-----------------------------|-------------------------------------------|
| "Job No.1" =  | 1                           | (Program retrieval) or (Sequense command) |
| "Job No.2" =  | 2                           | (Program retrieval) or (Sequense command) |
| "Job No.3" =  | .....                       | .....                                     |
|               | 999                         | (Program retrieval) or (Sequense command) |
| "Job No.999=" | Address<br>No.<br>(Max.999) | Command                                   |

(Note) The job No. can be entered from 1 to 999. However, the maximum number which can be registered is 127. When an expanded memory is installed, jobs up to 999 can be registered.

6.1.2 Program: A program is created according to the teaching.

The program is managed according to the program No. (Max. 255). The structure of the program is as shown below:

|                      |     |              |       |                     |        |
|----------------------|-----|--------------|-------|---------------------|--------|
| "Program<br>No.1"=   | 0   | MOVE command |       |                     | Max.99 |
|                      | 1   | MOVE command | 1     | Sequence<br>command |        |
|                      |     |              | 2     | Sequence<br>command |        |
|                      |     |              | ..... | .....               |        |
| "Program<br>No.2"=   | 2   | MOVE command | 99    | Sequence<br>command | Max.99 |
|                      |     |              | 1     | Sequence<br>command |        |
|                      |     |              | 2     | Sequence<br>command |        |
|                      |     |              | ..... | .....               |        |
| "Program<br>No.999"= | 999 | MOVE command | 99    | Sequence<br>command | Max.99 |
|                      |     |              | 1     | Sequence<br>command |        |
|                      |     |              | 2     | Sequence<br>command |        |
|                      |     |              | ..... | .....               |        |

Step No.  
(Max.99) =  
Teaching  
point No.

Command

Address  
No.  
(Max.99  
in each  
step)

Command

Note) Although the program No. entered is 1~999, the maximum number of the program registered is 255. The programs can be registered up to 999 when an expanded memory is installed.



6.1.3 Reservation sequence: A group of sequence commands which are frequently used.  
 The reservation sequence is managed according to the reservation sequence No. (Max. 99).  
 The structure of the reservation sequence is as shown below:

"Reservation  
sequence  
No.1" =  
"Reservation  
sequence  
No.2" =  
  
"Reservation  
sequence  
No.99" =

|       |                  |
|-------|------------------|
| 1     | Sequense command |
| 2     | Sequense command |
| ..... | .....            |
| 99    | Sequense command |

Address  
No.  
(Max.99)
 

Command

6.1.4 Welding conditions : Welding start No., data of current and voltage at pass point  
 The welding conditions are managed according to the AJO No.s (5 kinds) in the reservation table in the system settings.

6.1.5 Crater welding conditions : Current and voltage at welding end point  
 The crater welding conditions are managed according to the CJO No.s (5 kinds) in the reservation table in the system settings.

6.1.6 Arc start sequence: A group of sequence commands which are used for welding start point

The arc start sequence is managed according to the arc start sequence No.s (ASS1~ASS5: Max.5 kinds).

The structure is as shown below:

|        |                       |                  |
|--------|-----------------------|------------------|
| ASS1 = | 1                     | Sequence command |
| ASS2 = | 2                     | Sequence command |
|        | .....                 | .....            |
| ASS5 = | 999                   | Sequence command |
|        | Address No. (Max.999) | Command          |

6.1.7 Arc end sequence: A group of sequence commands which are used for welding end point

The arc end sequence is managed according to the arc end sequence No.s (AES1~AES5: Max.5 kinds).

The structure is as shown below:

|        |                       |                  |
|--------|-----------------------|------------------|
| AES1 = | 1                     | Sequence command |
| AES2 = | 2                     | Sequence command |
|        | .....                 | .....            |
| AES5 = | 999                   | Sequence command |
|        | Address No. (Max.999) | Command          |

#### 6.1.8 Names of data created

Job No. .... Specified by 1~999. (Max. 127)

The Job No. is the data of the unit used for job execution by a robot, and consists of more than one programs or sequence commands. Max.999 program retrievals or sequence commands can be registered in one job.

Address No. .... Displayed by 1~999.

The address No. is the order of the registration of commands which consists operational unit. Addresses No. 1~999 can be registered in one job.. Addresses 1~99 can be registered per teaching point in one program.

Program No. .... Specified by 1~999. (Max.255)

The program No. is the group of command consisting of teaching points and sequence commands. Max. 999 (steps) teaching points can be set in one program.

Teaching point No. (Step No.) .... Displayed by 1~999.

The teaching point No. is the order of execution along the movement route registered by teaching. Max. 99 sequence commands can be registered at one teaching point (step).

Sequence command No. (sequence No.) .... Displayed by 1~99.

The sequence command No. is the order to execute the operation commands (sequence commands). This No. is determined per each teaching point and library No..

Sequence command

The sequence commands are created by encoding the execution instructions from and to a robot.

Library No. .... Specified by 1~99.

The group of commands which are frequently used are registered as the library for ease of repeated use. The registered library group is called as the library No. and max.99 sequence commands can be registered in one library.

Welding condition No./Crater welding condition No. .... Each one is specified by 1~5.

Only the welding current and welding voltage can be registered. These are the specific reservation commands by which the operation for simplifying the operation procedure.

Arc start sequence No./Arc end sequence No. .... Each one is specified by 1~5.

Among the library, the arc start sequence/arc end sequence are specially grouped. Max. 999 sequence commands can be registered in one arc start sequence/arc end sequence No..

## 6.2 Commands used for Pana-Robo

To make a robot execute a certain welding work, it is necessary to teach the robot the content of the work such that the movement route, where to start the welding process, welding conditions, and where to end the welding process.

This contents of the work is stored in the robot in the form of "commands" consisting of codes.

The robot executes the work according to the order of the commands stored.

### 1 Command structure

The commands of Pana-Robo consists of "OPE CODE" and "OPE LAND". (The number of OPE LAND differs according to the command.)

|          |            |
|----------|------------|
| OPE CODE | OPE LAND 1 |
|          | OPE LAND 2 |
|          | OPE LAND 3 |
|          |            |
|          | OPE LAND n |

Although the structure is shown above, it is not necessary to remember this structure in daily operations for entering commands.

When a command is selected, the parameter set-up screen shown below appears:

|                  |               |
|------------------|---------------|
| * Select comnd * |               |
| MOVE             | (Air-C, Weld) |
| V=0.75(M/m, %)   | CL=0          |

Enter the value or select the mode. Press the ENTER key to quit setting the parameters.

### 6.2.1 MOVE commands

This MOVE command is used to move a robot at a specified speed.

This command is registered automatically when the STORE/WELD STORE key on the teach pendant is pressed during teaching.

(Note) The code registered changes as shown below according to the combination of the setting made in the "TEACH SELECT" screen and the STORE/WELD STORE keys:

In the operation mode and the teaching mode:

\*\*\* is displayed before individual commands at welding start point and welding pass point.

Example: Welding point on the PTP coordinate system

#### \*MOVEP

| MOVE command | Meaning                                                                              |
|--------------|--------------------------------------------------------------------------------------|
| MOVEP        | PTP                                                                                  |
| MOVEL        | Straight line<br>Circle end point<br>Weaving end point<br>Circular weaving end point |
| MOVEC CS     | Circle start point                                                                   |
| MOVEC C0     | Circle intermediate point                                                            |
| MOVLW BS     | Weaving start point                                                                  |
| MOVLW B1     | Weaving amplitude auxiliary point 1                                                  |
| MOVLW B2     | Weaving amplitude auxiliary point 2                                                  |
| MOVLW B0     | Weaving intermediate point                                                           |
| MOV CW DS    | Circular weaving start point                                                         |
| MOV CW D1    | Circular weaving amplitude auxiliary point 1                                         |
| MOV CW D2    | Circular weaving amplitude auxiliary point 2                                         |
| MOV CW D0    | Circular weaving intermediate point                                                  |

Note 1) Weaving parameters

The weaving commands require the parameters listed in the table below other than the speed and calculation No.:

| Pattern No.<br>MOVE command | 1,6                                  | 2,3                                          | 4,5                          |
|-----------------------------|--------------------------------------|----------------------------------------------|------------------------------|
| Weaving start               | [Pattern No.] No.=<br>[Frequency] F= | [Pattern No.]<br>[Frequency]<br>[Timer : T0] | [Pattern No.]<br>[Frequency] |
| Weaving amplitude           | [Timer : T1]                         | [Timer : T1]                                 | [Timer : T1]                 |
|                             | [Timer : T2]                         | [Timer : T2]                                 | [Timer : T2]                 |
|                             |                                      |                                              | [Timer : T3]                 |
|                             |                                      |                                              | [Timer : T4]                 |
| Weaving intermediate        |                                      |                                              |                              |

Note 2) Circular weaving parameters

| Pattern No.<br>MOVE command   | 1,2                                          | 3,4,5,6 |
|-------------------------------|----------------------------------------------|---------|
| Circular weaving start        | [Pattern No.]<br>[Timer : T0]<br>[Frequency] |         |
| Circular weaving amplitude    | [Timer : T1]                                 |         |
|                               | [Timer : T2]                                 |         |
| Circular weaving intermediate |                                              |         |

Note 3) The circular weaving is applied for patterns 1 and 2 only.

## 6.2.2 I/O commands

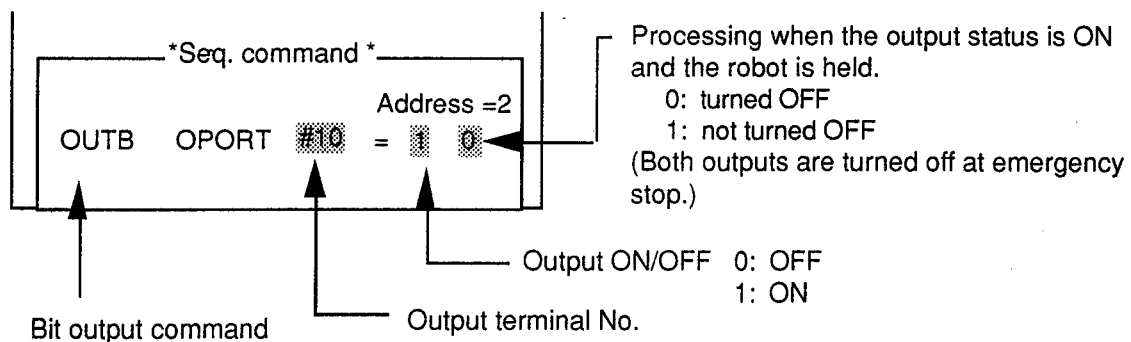
The I/O commands are used to operate other equipment by sending signals from a robot.

The terminals sending signals are called as output terminals and terminals No.1~No.16 are provided as standard specifications.

These terminals are turned on and off with the I/O commands.

There are three kinds of outputs, bit output, parallel output and analogue output.

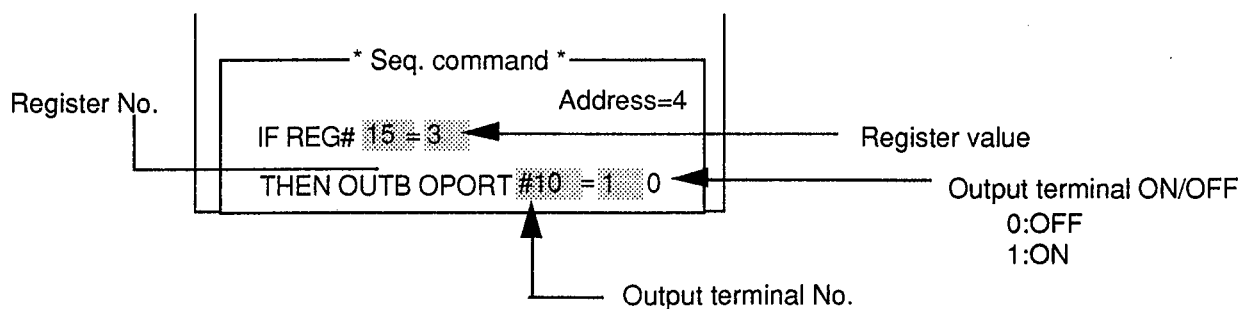
### 6.2.2.1 Bit output: Instructs the ON/OFF of output to the specified output terminals.



\* The screen above is the sequence command edit screen in the edit mode.

(The screen above shows the status "Output to output terminal No.10 is ON, but Output is OFF due to hold")

### 6.2.2.2 Condition output: This is the command to turn on and off the specified output terminals when the specified register is the specified value.



\* The screen above is the sequence command edit screen in the edit mode.

(The screen above shows the status that "Output to output terminal No.10 is ON when the register No.15 is 3, but output is OFF if held")



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### 6.2.2.5 Parallel output

This is the command for binary output with the structure of 7 bits + 1 strobe, or 15 bits + 1 strobe with an output terminal 1 bit.

In the parallel output, 8 bits or 16 bits are handled as a group as a parallel port.

8 bits parallel port      No.101: Terminal No. 1~8  
                                  No.102: Terminal No. 9~16

16 bits parallel port    No.201: Terminal No. 1~16

(Example of data output)

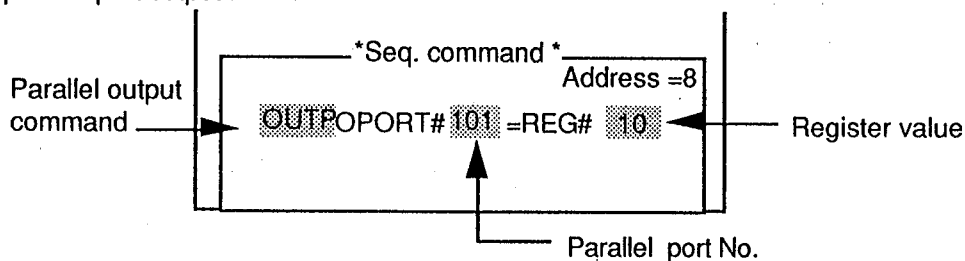
When data =26 is output to parallel port No.1:

| Bit             | 0   | 1  | 2   | 3  | 4  | 5   | 6   |
|-----------------|-----|----|-----|----|----|-----|-----|
| Output terminal | 1   | 2  | 3   | 4  | 5  | 6   | 7   |
| Data            | 0   | 1  | 0   | 1  | 1  | 0   | 0   |
| ON/OFF          | OFF | ON | OFF | ON | ON | OFF | OFF |

There are two types of parallel outputs; the data output is directly specified and the value of the specified register is output.

#### 6.2.2.5.1 Register content

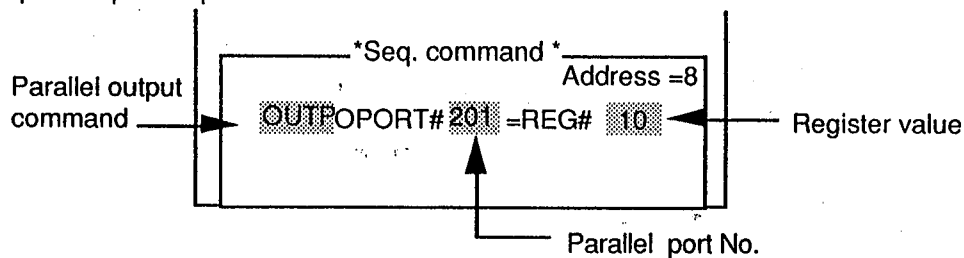
\* 8 bits parallel port output :



\* The screen above is the sequence command edit screen in the edit mode.

(The screen above shows the status "a logic action 'AND' is taken for the two bids, the contents of register No.10 and 007FH, and then output the result to parallel port No.101".)

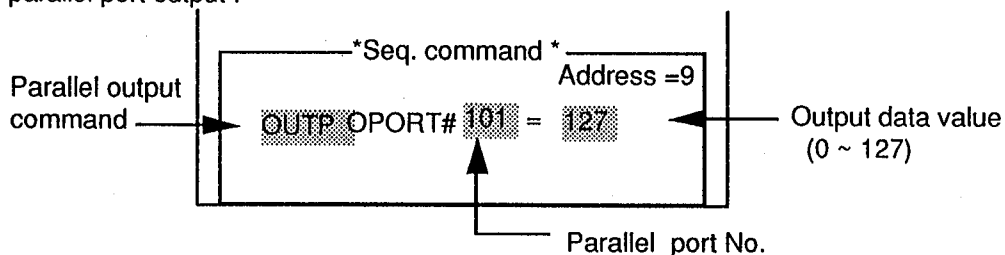
\* 16 bits parallel port output :



(The screen above shows the status "a logic action 'AND' is taken for the two bids, the contents of register No.10 and 7FFFH, and then output the result to parallel port No.101".)

#### 6.2.2.5.2 Specified value

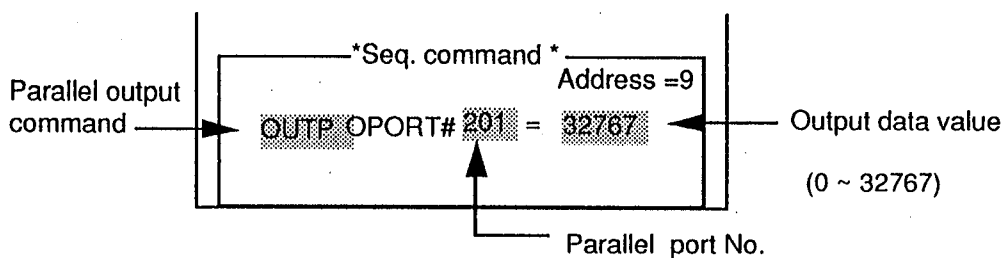
\* 8 bits parallel port output :



\* The screen above is the sequence command edit screen in the edit mode.

(The screen above shows the status "to output 127 to parallel port No.101".)

\* 16 bits parallel port output :

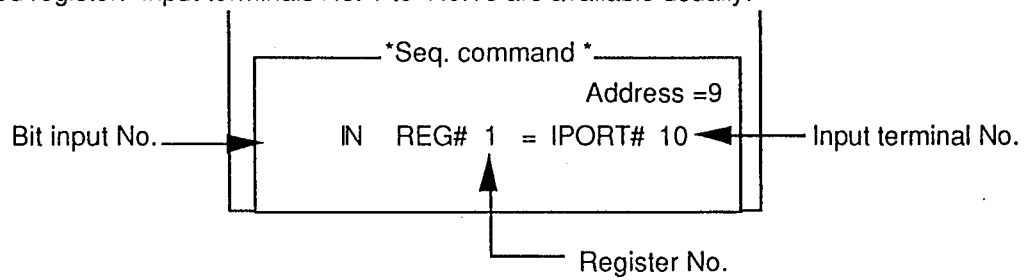


\* This screen above is the sequence command edit screen in the edit mode.

(The screen above shows the status "to output 32767 to parallel port No.201")

#### 6.2.2.6 Bit input

This is the command to store the ON/OFF status of the specified input terminal to the specified register. Input terminals No. 1 to No.16 are available usually.



\* This screen above is the sequence command edit screen in the edit mode.

(The screen above shows the status "to store ON/OFF status of input terminal No.10 to register #1.)

#### 6.2.2.7 Parallel input

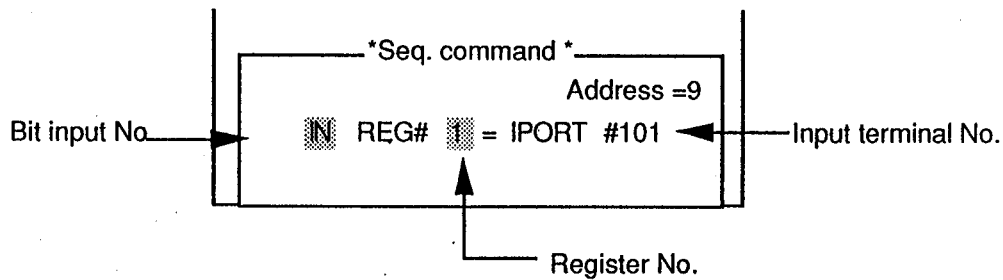
This is the command to store the status of the specified input port to the specified register.

In the parallel input, 8 bits are handled as a group as a parallel port with an input terminal 1 bit.

8 bits parallel port      No. 101: Terminal No. 1~8

                                 No. 102: Terminal No. 9~16

\* It is not possible to input by 16-bit unit.



\* The screen above is the sequence command edit screen in the edit mode.

(The screen above shows the status "to store the data input from parallel input port No.101 to #1.)

### 6.2.3 Register command

This is the command for setting a numerical value to the register or for calculating the data (addition, subtraction)

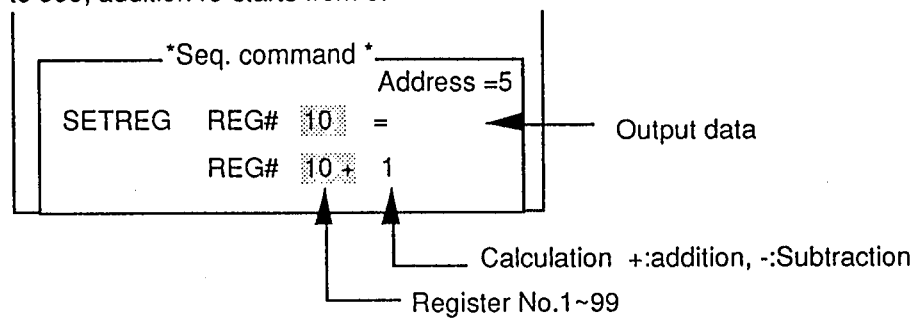
(Used as the counters, etc.)

This command is used in combination with the output commands or branch commands.

6.2.3.1 Register addition/subtraction command (set 1) : This is the command to add or subtract the value of the specified register,

Register value: After subtracting from 0, the subtraction re-starts from 999.

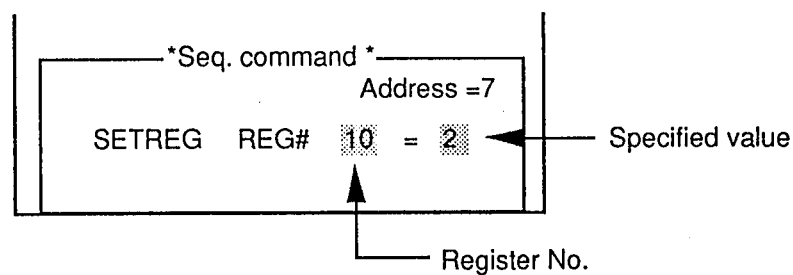
After adding to 999, addition re-starts from 0.



\* The screen above is the sequence command edit screen in the edit mode.

(The screen above shows the status "to enter the value obtained by adding 1 to the value of register No.10 to register No.10".)

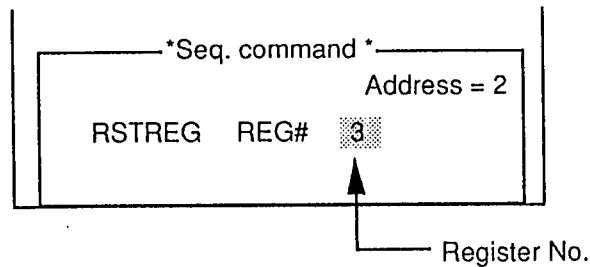
6.2.3.2 Register value replace command (set 2) : This is the command to set the specified value to the specified register.



\* The screen above is the sequence command edit screen in the edit mode.

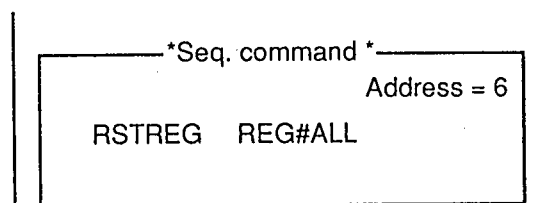
(The screen above shows the status "to set 2 to register No.10".)

6.2.3.3 Register reset command (reset 1) : This is the command to clear "0" the value of the specified register.



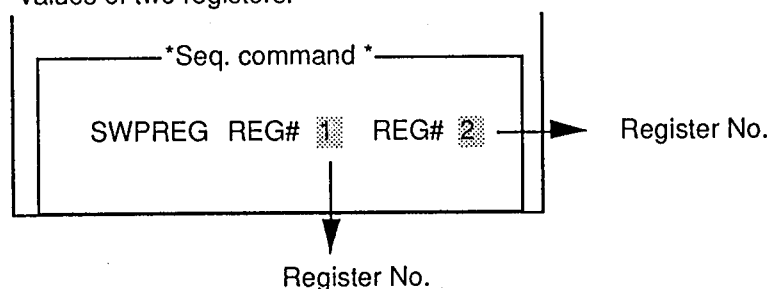
\* The screen above is the sequence command edit screen in the edit mode.  
(The screen above shows the status "to clear (0) the register No.3".)

6.2.3.4 All register reset command (reset 2) : This is the command to clear (0) all registers.



\* The screen above is the sequence command edit screen in the edit mode.

6.2.3.5 Register value switching command : This is the command to switch the values of two registers.



\* The screen above is the sequence command edit screen in the edit mode.  
(The screen above shows "to switch the values of register No.1 and No.2".)

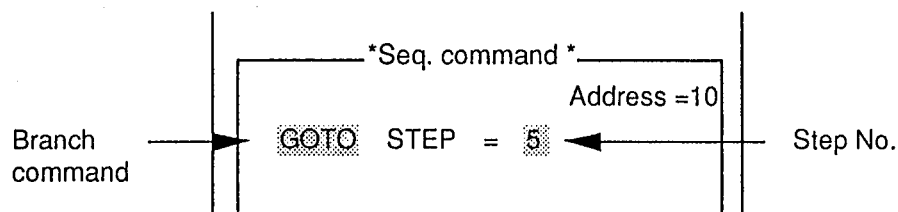
#### 6.2.4 Flow control command

This is the command to control the flow along which the robot executes the commands registered.

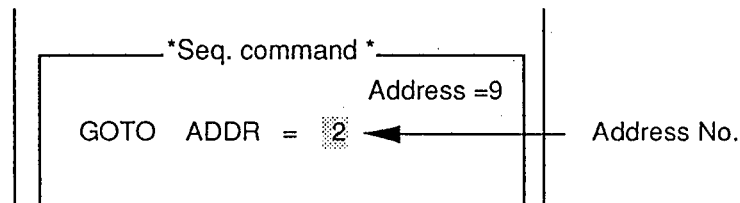
##### 6.2.4.1 Non-conditioned separation command

The robot operates according to the commands in the order in which the commands are registered. However, when this command is used, the robot jumps to the specified command.

6.2.4.1.1 Step separation : This is the command to jump to the specified step No. in the program.



6.2.4.1.2 Address separation: This is the command to jump to the specified address No. in the sequence command.

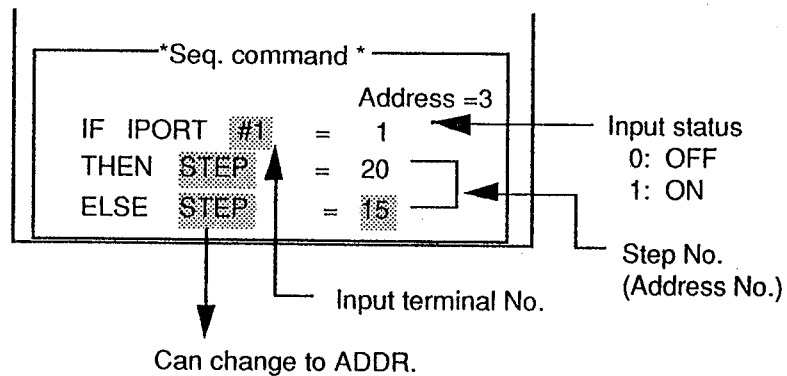




#### 6.2.4.2 Conditioned separation

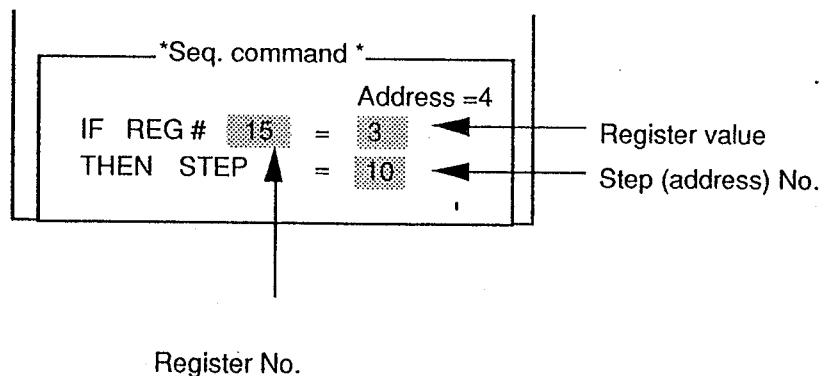
This is the command to jump when the conditions are met.

##### 6.2.4.2.1 Input status judgement: This is the command to jump to the specified step (or address) when the input to the specified input terminal becomes ON.



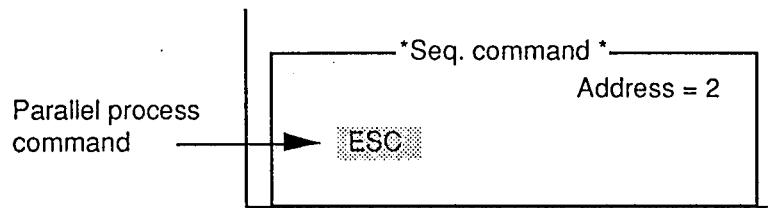
\* The screen above is the sequence command edit screen in the edit mode.  
There are cases where ELSE construction does not appear.  
(The screen above shows " to jump to step No.20 when input terminal No.1 is ON, while jump to step No.15 if the terminal is OFF. )

##### 6.2.4.2.2 Register content judgement: This is the command to jump to the specified step or address when the value of the specified register equals to the specified one.



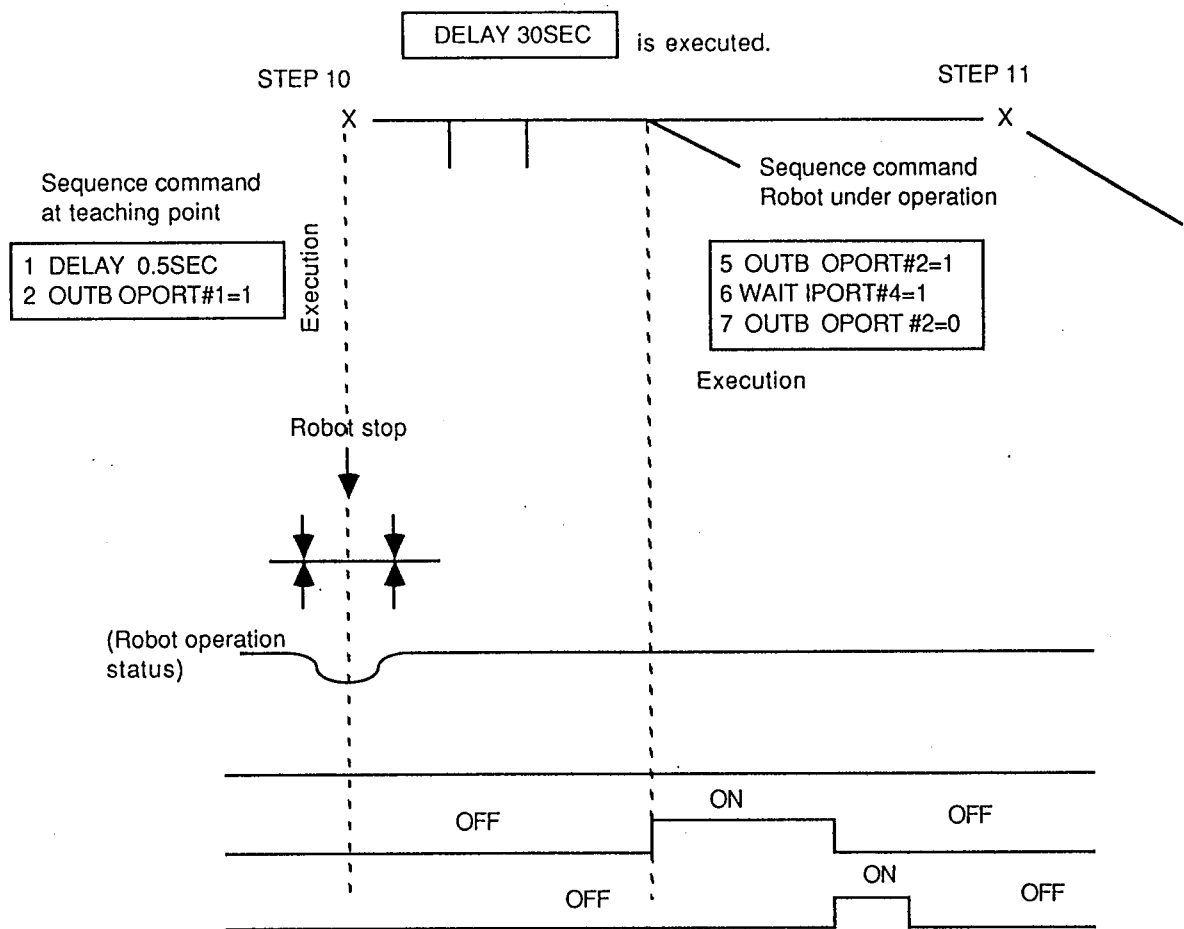
\* The screen above is the sequence command edit screen in the edit mode.  
There are cases where ELSE construction appears.  
(The screen above shows "to jump to step No.10 when the value of register No.15 is 3, while execute the next command if the value is other than 3.)

6.2.4.3 Parallel processing: This is the command to process the robot movement and sequence commands simultaneously.



\* The screen above is the sequence command edit screen in the edit mode. This command is registered to the address at which the parallel processing is to be started. Therefore, the sequence commands after the "ESC" command are the group of sequence commands for processing with the robot under operation.

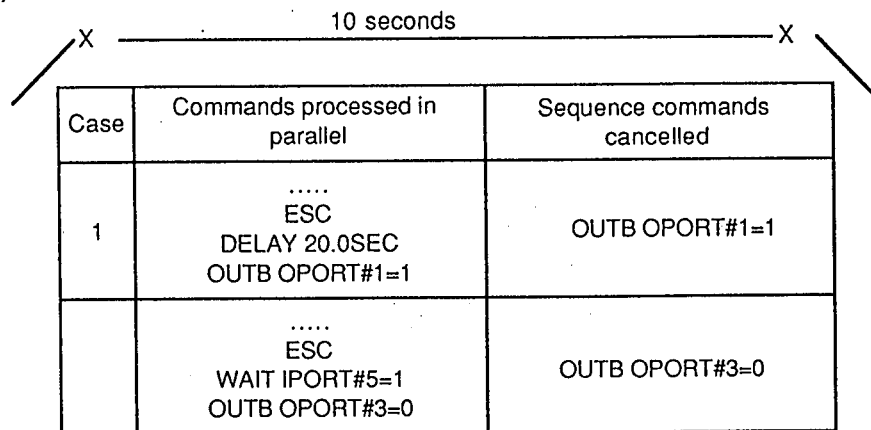
|             |            |   |                                  |                                                                    |
|-------------|------------|---|----------------------------------|--------------------------------------------------------------------|
| (Example) 5 | MOVEL 7.50 | 1 | DELAY 0.5 sec                    | Execution of normal sequence commands (Executed at teaching point) |
|             |            | 2 | OUTB                             |                                                                    |
|             |            | 3 | ESC (Parallel execution command) |                                                                    |
|             |            | 4 | DELAY                            | Sequence commands are executed with the robot being operated.      |
|             |            | 5 | OUTB                             |                                                                    |
|             |            | 6 | WAIT                             |                                                                    |



### Cautions in using the ESC command

- (1) If the sequence commands to be executed in parallel remains after the next teaching point is reached, the sequence commands not having been executed are cancelled.

(Example)



| Case | Commands processed in parallel                   | Sequence commands cancelled |
|------|--------------------------------------------------|-----------------------------|
| 1    | .....<br>ESC<br>DELAY 20.0SEC<br>OUTB OPORT#1=1  | OUTB OPORT#1=1              |
|      | .....<br>ESC<br>WAIT IPORT#5=1<br>OUTB OPORT#3=0 | OUTB OPORT#3=0              |

- (2) A sequence jump command from the sequence command group to be executed in parallel to the sequence before the ESC command cannot be used.

(Example)

|   |                          |              |
|---|--------------------------|--------------|
| 1 | DELAY 2.0SEC             |              |
| 2 | OUTB OPORT#1=1           |              |
| 3 | ESC                      |              |
| 4 | DELAY 3.0 SEC            |              |
| 5 | IF IPORT#4=1 THEN ADDR=2 | Not allowed. |

The sequence jump command to the command group to be processed in parallel can be used. However, if the address after the ESC command is specified, the command group to be processed in parallel, if any, is not processed.

|   |                |                                |
|---|----------------|--------------------------------|
| 1 | DELAY 2.0 SEC  |                                |
| 2 | OUTB OPORT#1=1 |                                |
| 3 | GOTO ADDR=5    | The robot stops for 7 seconds. |
| 4 | ESC            |                                |
| 5 | DELAY 5.0 SEC  |                                |

*(Note: In the original image, a dashed line connects command 3 to command 5, indicating a jump.)*

(3) The step jump command to the one before the ESC command cannot be used within the command group to be processed in parallel.

("...GO TO STEP .." command cannot be used within the ESC command group.)

(4) The processing before the reset command is as follows:

- \* When a reset command exists before the ESC command, the sequence command group after the reset command is cancelled.
- \* When a reset command exists before the ESC command, the sequence command group to be processed in parallel after the reset command is cancelled.

(5) When the robot is halted during the execution of the sequence command group to be processed in parallel, the execution is temporarily stopped and resumed by re-start. The emergency stop command is processed in the same manner.

(6) The processing of address search, I/O lock and robot lock are as shown below:

|                |                                                     |
|----------------|-----------------------------------------------------|
| Address search | Executed by assumption and actually output when the |
| I/O lock       | operation is resumed.                               |
| Robot lock     | Processed in the normal manner.                     |

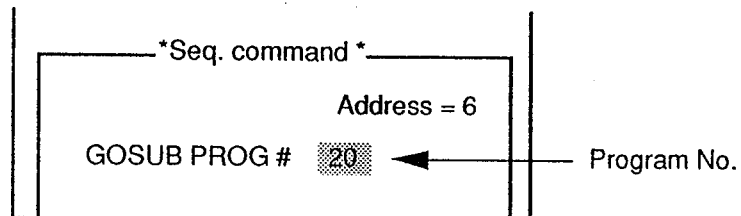
(7) The ESC command cannot be used for job, reservation sequence, weld start sequence, and weld end sequence.

- \* Wait for input (WAIT IPORT#.....) after the ESC command refers to the status that the input terminal waits for a signal. Therefore, the robot's operation does not stop although the execution of the sequence commands stops.

#### 6.2.4.4 Retrieval command

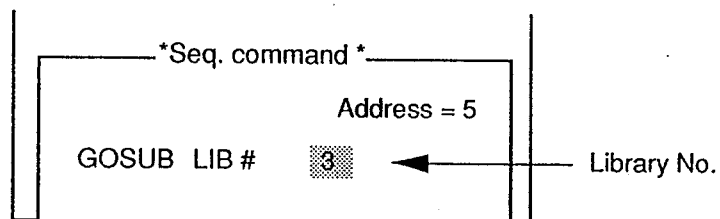
This is the command for addressing for program and library.

##### 6.2.4.4.1 Program retrieval command



\* Shown above is the sequence command edit screen in the edit mode.

##### 6.2.4.4.2 Library retrieval command



\* Shown above is the sequence command edit screen in the edit mode.

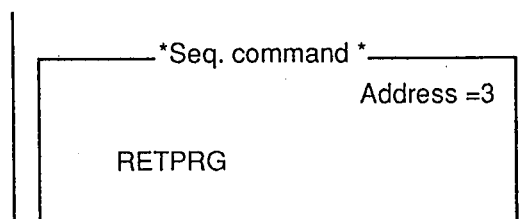
#### 6.2.4.5 Reset command

This is the command to return to the original job.

##### 6.2.4.5.1 Program reset command

At program retrieval from a job, the commands remaining in the program when this command is sent, are not processed and the sequence jumps to the command immediately after the original job.

(If the operation is being executed only by the program, the program stops.)



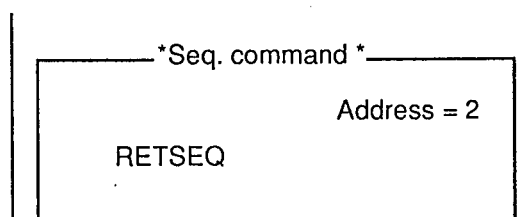
\* Shown above is the sequence command edit screen in the edit mode.

##### 6.2.4.5.2 Sequence reset command

When this command is used in sequence commands at a teaching point of the program, the remaining sequence commands are not processed and the process jumps to the next teaching point.

When this command is used in job, the execution of the job stops.

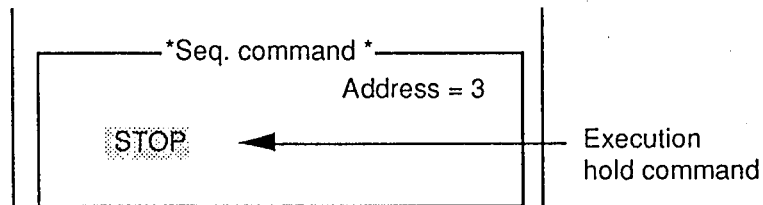
When this command is used in the library, the remaining sequence commands are not executed and the process goes back to the original job.



\* Shown above is the sequence command edit screen in the edit mode.

#### 6.2.4.6 Execution interruption command

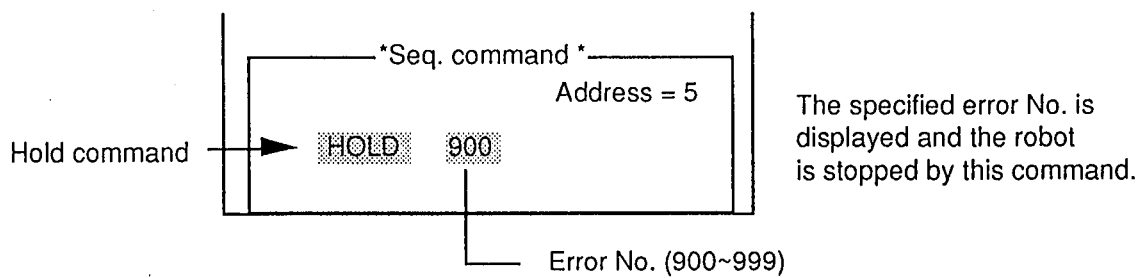
This is the command to turn off all inputs and outputs to stop entire operation.



\* Shown above is the sequence command edit screen in the edit mode.

#### 6.2.4.7 HOLD command

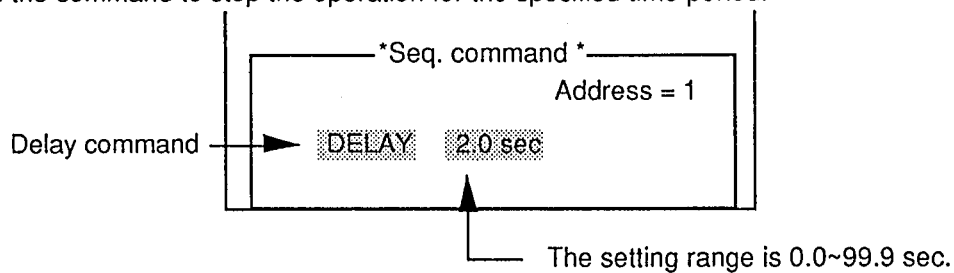
This is the command to hold the execution of the command (Hold status)



\* Shown above is the sequence command edit screen in the edit mode.

#### 6.2.4.8 Time-wait command

This is the command to stop the operation for the specified time period.



\* Shown above is the sequence command edit screen in the edit mode.  
(The screen above shows "to stop the operation for 2.0 sec.")

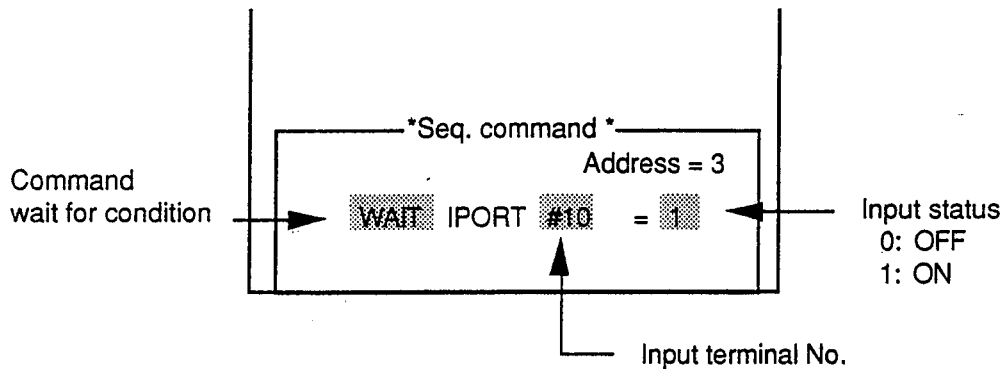


6.2.4.9 Condition-wait command: This is the command to stop the operation until the specified conditions are met.



*When the robot stops according to this command, it means that the robot does not hold but waits for the signal to be input. And in case of entering the robot work envelop, press the emergency stop SW.*

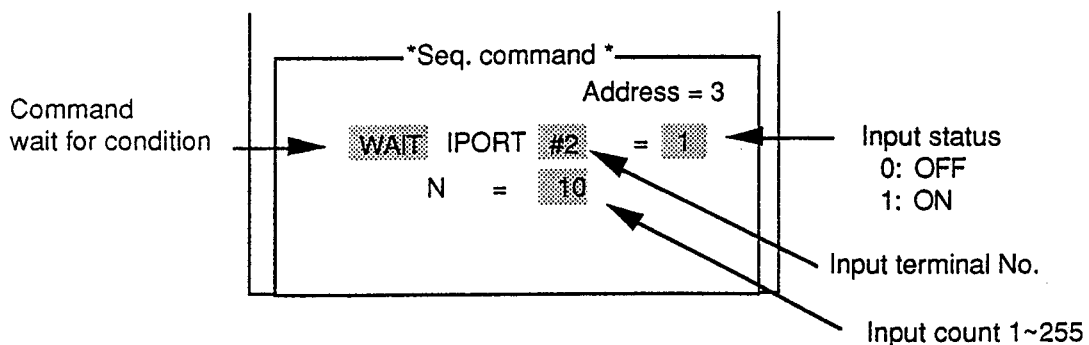
6.2.4.9.1 Input-wait command: This is the command to stop the operation until the signal is input to the specified input terminal.



\* Shown above is the sequence command edit screen in the edit mode.

(The screen above shows "to stop the operation until the input signal is sent from input terminal No.10")

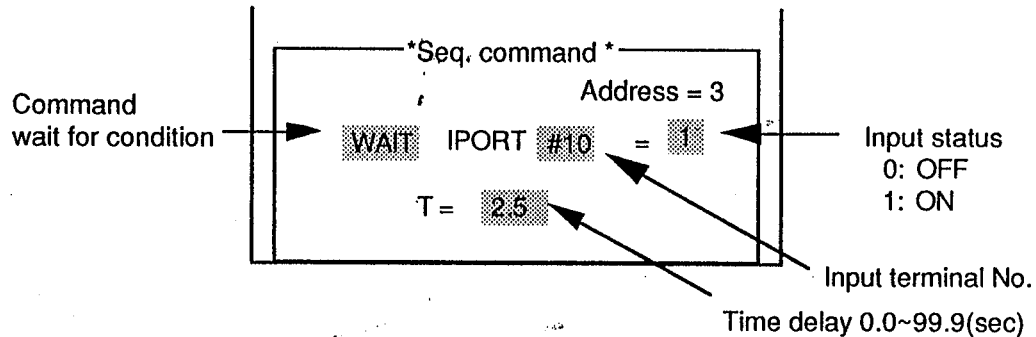
6.2.4.9.2 Input-wait count command: This is the command to stop the operation until the input signal is input to the specified input terminal for the specified times.")



\* Shown above is the sequence command edit screen in the edit mode.

(The screen above shows "to stop the operation until the signal is input from input terminal No.2 ten times, but this command is not effective at tracing.")

6.2.4.9.3 Input & time wait command: This is the command to stop the operation until the specified time has elapsed.

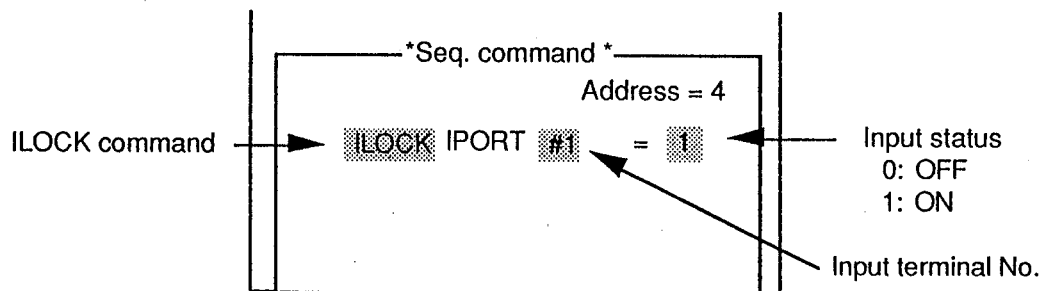


\* Shown above is the sequence command edit screen in the edit mode.

(The screen above shows "to stop the operation until the input signal is sent to input terminal No.10 or until 2.5 sec has elapsed." and also shows "this command is effective at tracing.")

6.2.4.9.4. Input wait command (valid in tracing)

This commands suspends robot operation until a specified input terminal is turned on or off. It is also valid during tracing in the operation mode.

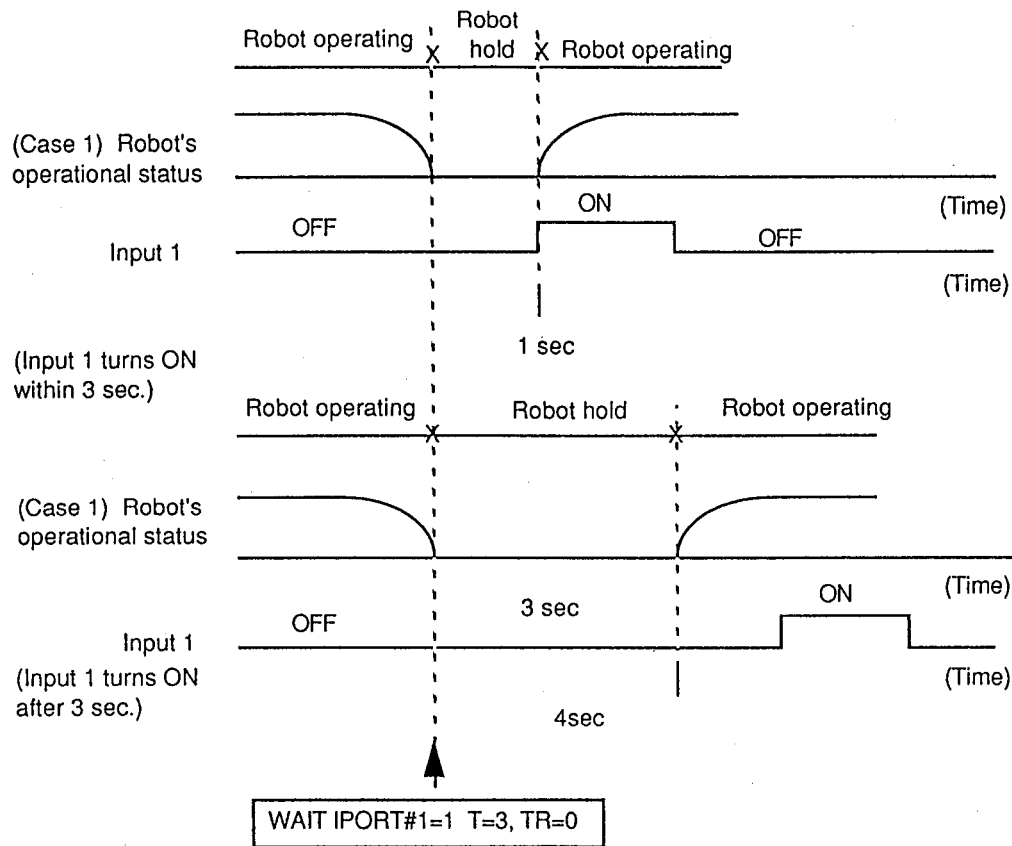


\* This is a sequence command edit screen in the edit mode.

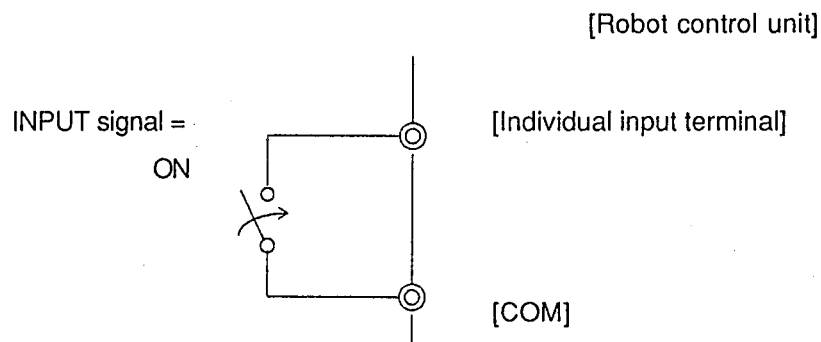
(It says "operation is suspended until a signal is sent to input terminal No.1. This command is valid during tracing in the operation mode.")

\* Shown below is an example of the execution of "Input & delay command".:

(Example) WAIT IPORT#1=1 T=3.0 TR=0 is executed.



Note) "Input signal exists" refers "User input terminals and the COM terminal are short-circuited."

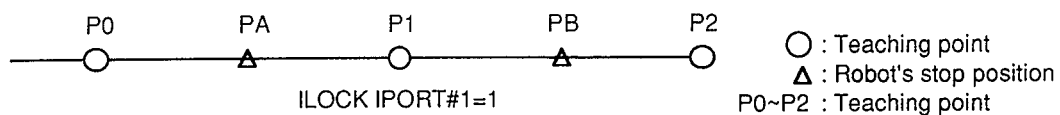


\* Shown below is the execution when the "ILOCK command " is effective at tracing:

- (1) When the forward tracing cannot be executed due to the execution of the [ILOCK], the process of 'ILOCK" command which is being executed is interrupted by pressing the CANCEL key and the ROBOT LOCK key on the teach pendent.

Even when more than two ILOCK commands have been input in one step, the process goes to the next target point when those two keys are pressed simultaneously the number of times the ILOCK command has been registered.

- (2) The ILOCK command cannot be used for Job, ASS, AES, and reservation sequence.



#### Operations and processing

| Operation start position | Individual input 1 | Operations       | Processing                                                                     |
|--------------------------|--------------------|------------------|--------------------------------------------------------------------------------|
| P1                       | ON                 | Tracing forward  | Moves to P2 after executing "ILOCK IPORT#1=1"                                  |
|                          |                    | Tracing backward | Inversed logic of "ILOCK IPORT#1=1" is processed. (User input 1: wait for OFF) |
|                          | OFF                | Tracing forward  | "ILOCK IPORT #1=1" is executed. (User input 1: wait for ON)                    |
|                          |                    | Tracing backward | Moves to P0 after processing inversed logic of "ILOCK IPORT #1=1" .            |
| PB                       | ON                 | Tracing forward  | Moves to P2 after executing "ILOCK IPORT#1=1"                                  |
|                          |                    | Tracing backward | "ILOCK IPORT#1=1" is not executed.                                             |
|                          | OFF                | Tracing forward  | "ILOCK IPORT#1=1" is executed. (User input: wait for ON)                       |
|                          |                    | Tracing backward | "ILOCK IPORT#1=1" is not executed.                                             |
| PA                       | ON                 | Tracing forward  | Moves to P1.                                                                   |
|                          |                    | Tracing backward | Moves to P0.                                                                   |
|                          | OFF                | Tracing forward  | Moves to P1.                                                                   |
|                          |                    | Tracing backward | Moves to P0.                                                                   |

6.2.5 Welding control command. This is the command to control the conditions or parameters required for the welding.

(This command can be registered in the program edit mode.)

6.2.5.1 Welding conditions: This is the command to set the arc start conditions (AJO).

\*Seq. command\*

(MOVEC) Address =9

AJO AMP = 120 VOLT = 16.0

Current (A)

Voltage (V)

\* Shown above is the sequence command edit screen in the edit mode.

6.2.5.2 Crater conditions: This is the command to set the arc end conditions (CJO).

\*Seq. command\*

(MOVEC) Address =8

CJO AMP = 110 VOLT = 14.0

Current (A)

Voltage (V)

\* Shown above is the sequence command edit screen in the edit mode.

6.2.5.3 Arc start sequence retrieval command

\* A series of welding start procedures frequently used are grouped in this command. The sequence No.s are 1~5.

\*Seq. command\*

(MOVEC) Address =7

ASS NO = 1

\* Shown above is the sequence command edit screen in the edit mode.

#### 6.2.5.4 Arc end sequence retrieval command

\* A series of welding end procedures frequently used are grouped in this command. The sequence No.s are 1~5.

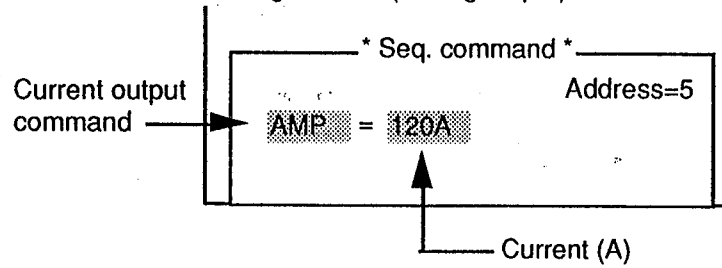
|                |            |
|----------------|------------|
| *Seq. command* |            |
| (MOVEC)        | Address =6 |
| AES NO         | = 1        |

\* Shown above is the sequence command edit screen in the edit mode.

#### 6.2.5.5

#### Current output

This is the command to set the welding current. (analog output)

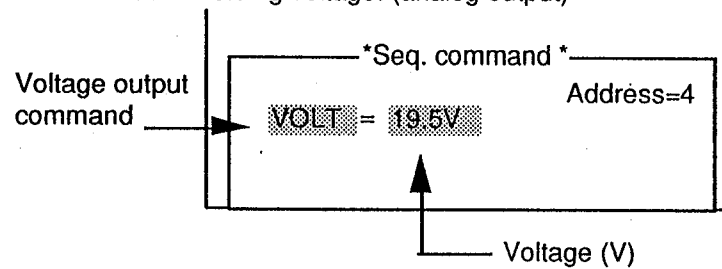


\* The screen above is the sequence command edit screen in the edit mode.

#### 6.2.5.6

#### Voltage output

This is the command to set the welding voltage. (analog output)



\* The screen above is the sequence command edit screen in the edit mode.

#### 6.2.5.7 Welding abnormality ignore command

(Available with the main software of version "G0" or newer version)

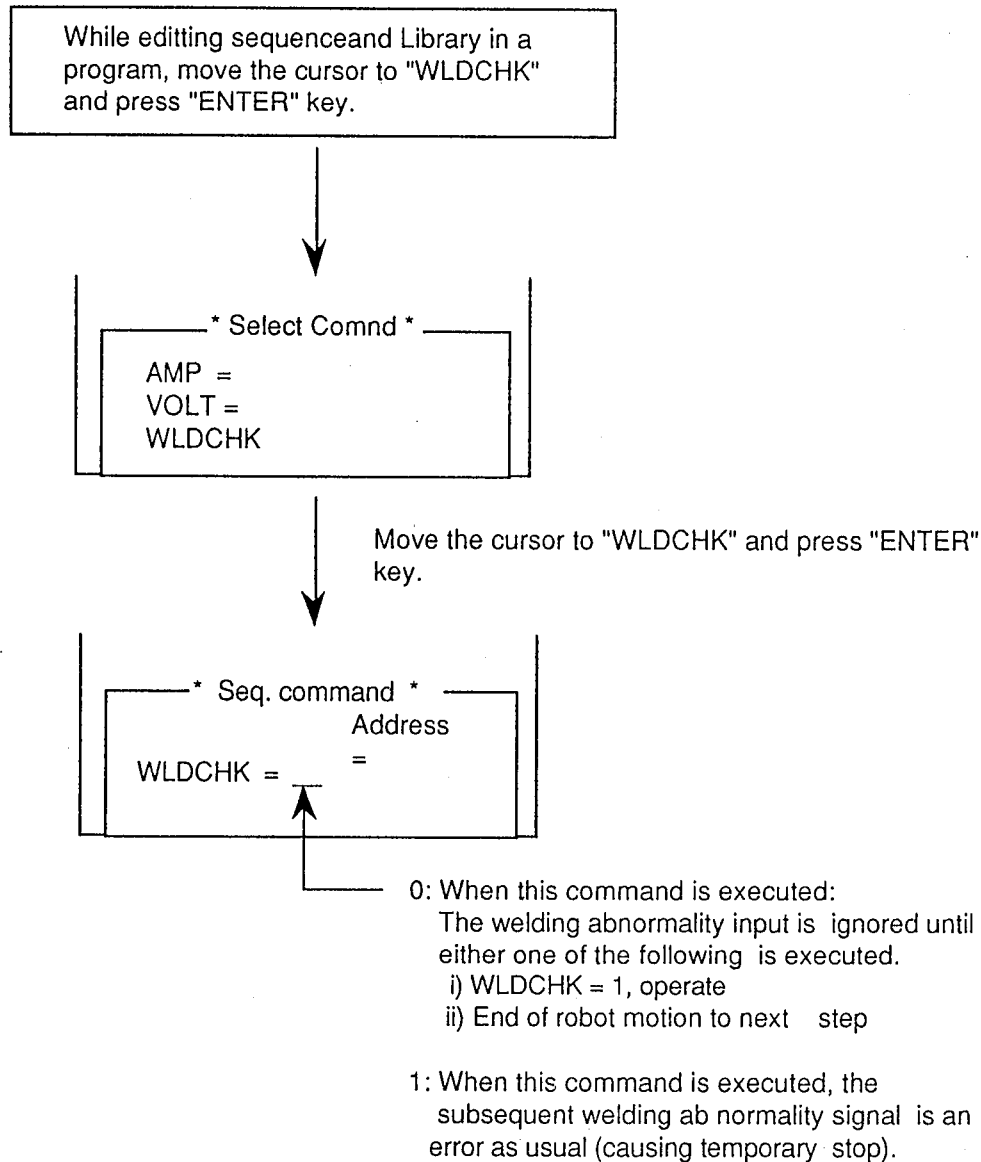
The welding abnormality ignore command WLDCHK is used in the form of

```

:
: WLDCHK = 0
:
:                               In this period, welding abnormality is ignored.
:
: WLDCHK = 1
:
:
```

and if there is any welding abnormality input in the specific sequence execution period, it is ignored, and error (pause) does not occur.

##### <Input method>

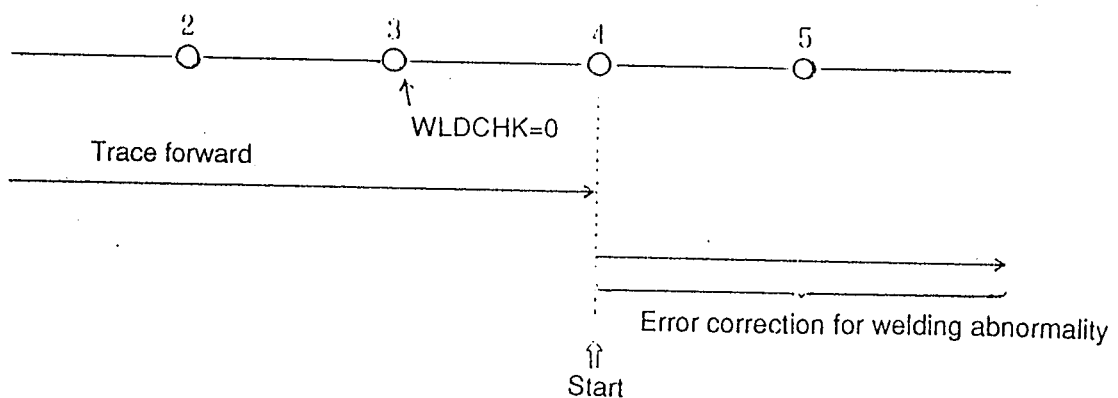
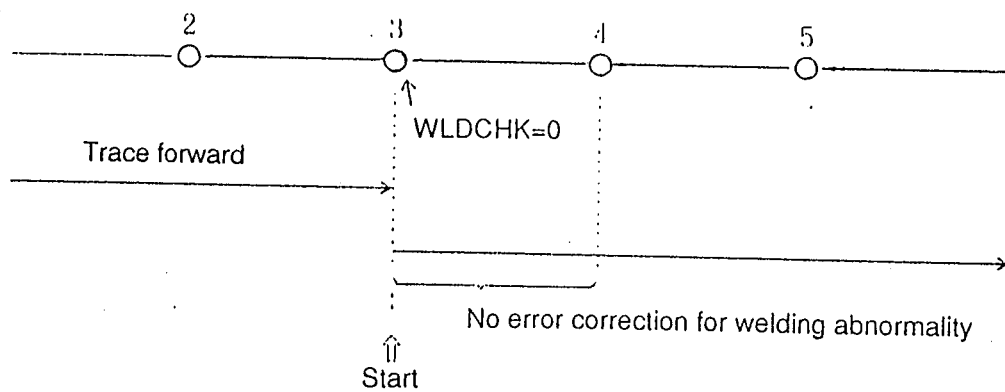




- This command can be registered as sequence command in program or sequence command of Library.

#### (1) Trace forward processing

1. When reaching a certain teaching point of this command in trace forward, the command is virtually executed. (Same processing as in existing model AW-8010)
2. In trace forward, when reaching next teaching point after passing a certain teaching point of this command, the command is canceled. (Same processing as in existing model AW-8010)

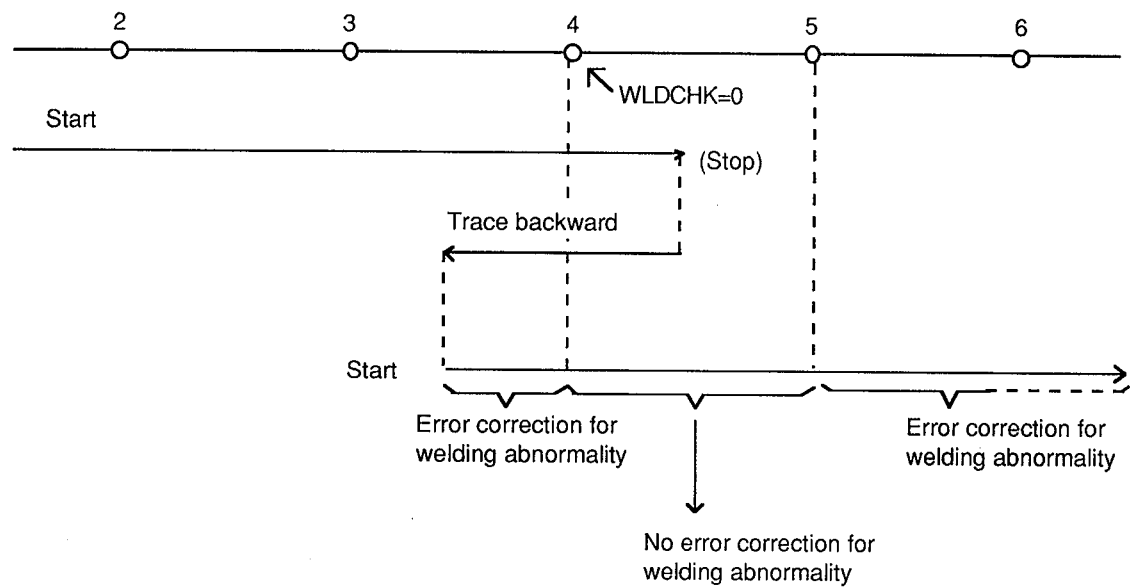


(2) Trace backward processing

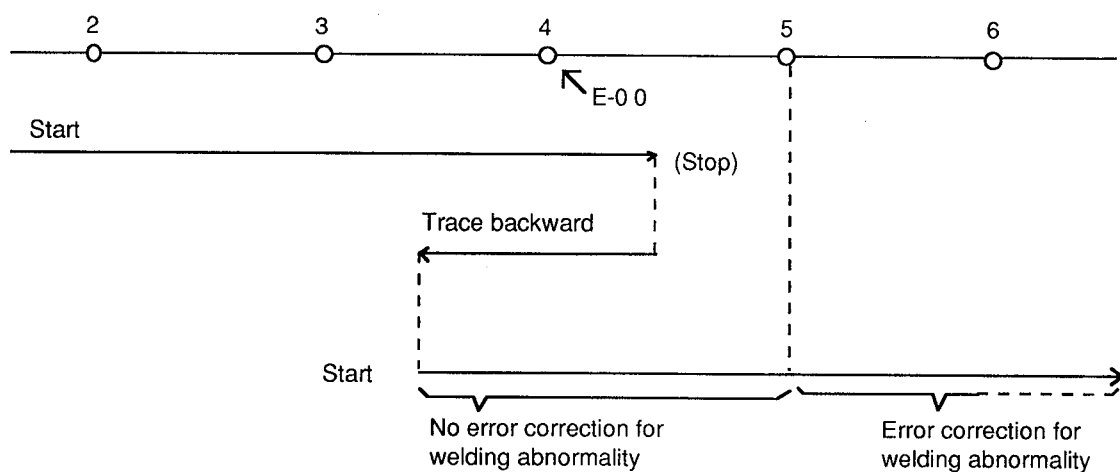
1. In trace backward, when passing over the teaching point of this command, this command is canceled. (Not canceled if only reaching the teaching point)

(Note) In case of the conventional model, AW-8010, in trace backward, passing over the teaching point of this command doesn't cancel this command.

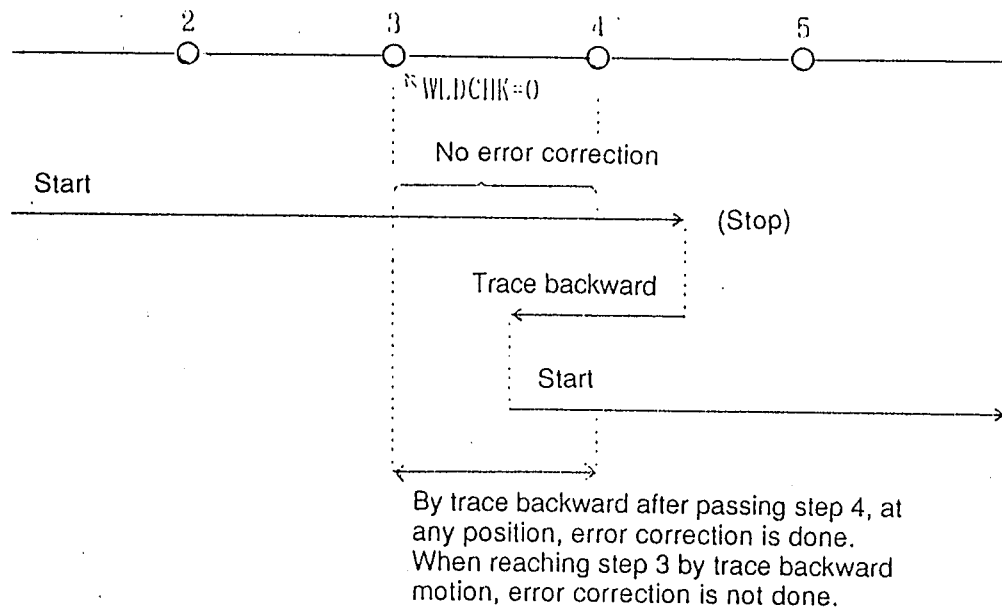
**<AW-006A/010A / VR-008A>**



**<AW-8010>**

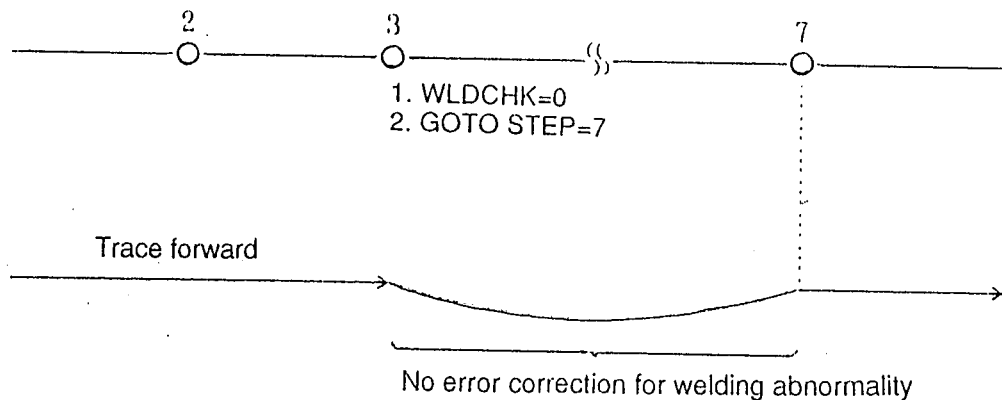


2. After reaching the next teaching point of a teaching point with this command, even by trace backward motion, this command is not executed until reaching the teaching point with the command.



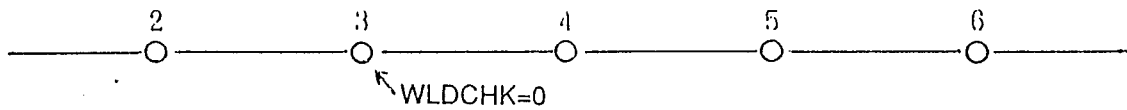
### (3) Jump command

If there is jump command after WLDCHK=0, error correction for welding abnormality is not done until reaching the teaching point specified by jump command. (Same processing as in existing model AW-8010)



#### (4) Address search

1. Arc lock state remains while moving to the teaching point to be searched by address search.
2. Processing of WLDCHK during address search is as follows.
  - Virtual processing if there is WLDCHK at one point before teaching point to be searched.
  - If there is WLDCHK at teaching point to be searched, it is executed when reaching the teaching point.



| Search step No. | While moving to search step                                 | Start processing after reaching step |
|-----------------|-------------------------------------------------------------|--------------------------------------|
| 2               | Error correction of torch contact<br>(arc lock state)       | WLDCHK executed at steps 3-4         |
| 3               | Error correction for torch contact only<br>(arc lock state) | WLDCHK executed at steps 3-4         |
| 4               | No error correction for welding abnormality at all          | Error correction after step 4        |
| 5 and after     | Error correction for torch contact only<br>(arc lock state) | Error correction to all              |

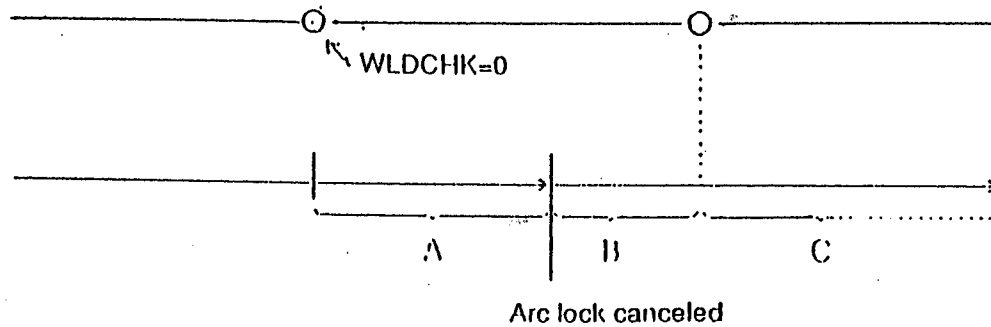
Note) In existing model AW-8010, in searching after step 3, all errors are skipped while moving.

#### <Reference>

| Error correction | Current detect | Torch contact | Gas wire | Arc cut | Stick |
|------------------|----------------|---------------|----------|---------|-------|
| Arc Lock         | No             | Yes           | No       | No      | No    |
| WLDCHK           | Yes            | No            | No       | No      | No    |

(5) Arc lock (weld off)

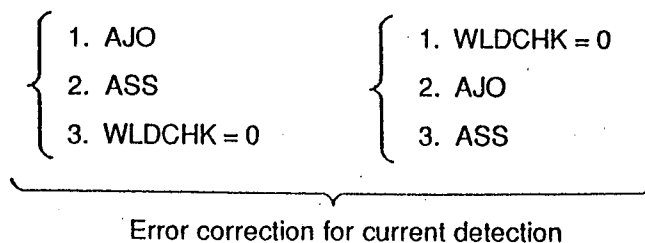
1. Even during arc lock, the command is virtually executed. (Same processing as in existing model AW-8010)
2. The arc lock specification is same as before.



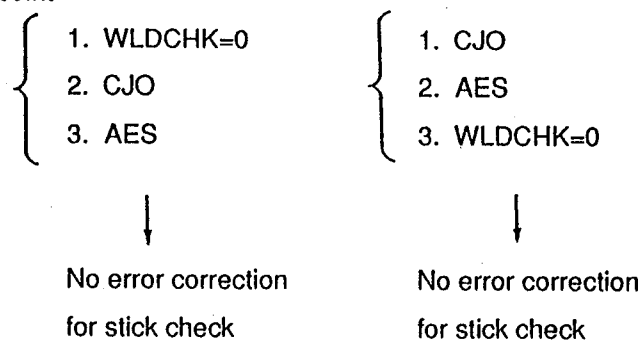
| Error correction | Current detect | Torch contact | Gas wire | No arc | Stick |
|------------------|----------------|---------------|----------|--------|-------|
| Section A        | No             | Yes           | No       | No     | No    |
| Section B        | No             | No            | No       | No     | No    |
| Section C        | Yes            | No            | No       | No     | No    |

(6) Processing at welding point

1 Starting point



2 End point



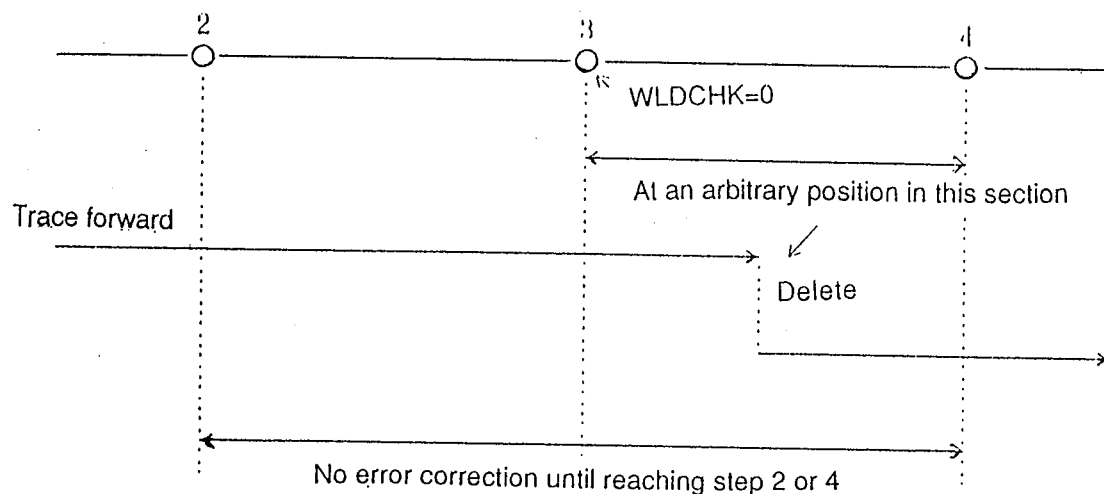
(7) Change, delete, add processing during operation

1. Change processing

When started after changing the position of a certain teaching point with WLDCHK, this command is executed. (Same processing as in existing model AW-8010)

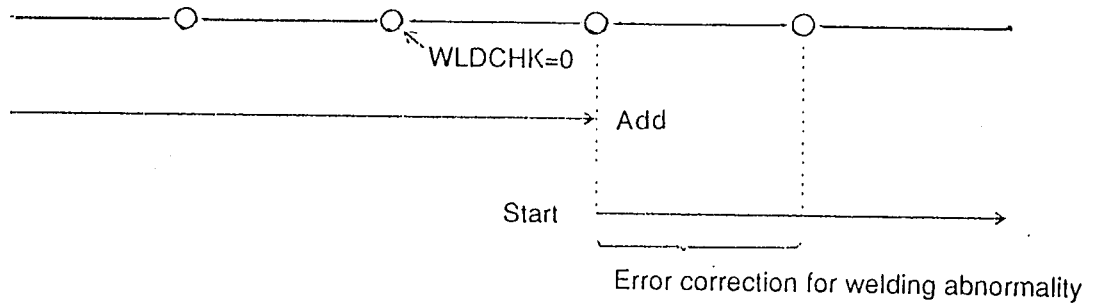
2. Delete processing

- If the teaching point is deleted after execution of WLDCHK command, the processing is not canceled until reaching the next teaching point.
- When the sequence command is deleted after execution of WLDCHK command, the processing is not canceled until reaching the next teaching point.



### 3. Add processing

- After adding teaching point, if started by registering this command at that teaching point, the command is not executed.
- When a new teaching point is added next to a certain teaching point with WLDCHK command, this command is canceled.



(Note: No error correction in AW-8010)

\* Note

I/O terminals exclusive for welding

These are the terminals connected to the welding machine and the use is the same as output command and wait command previously described.

\* I/O terminal exclusive for welding (ON-OFF) command, etc.

The numbers of the terminals exclusive for "welding start", "Gas valve", "Stick check" and "Current detection" etc. are as shown in the table below:

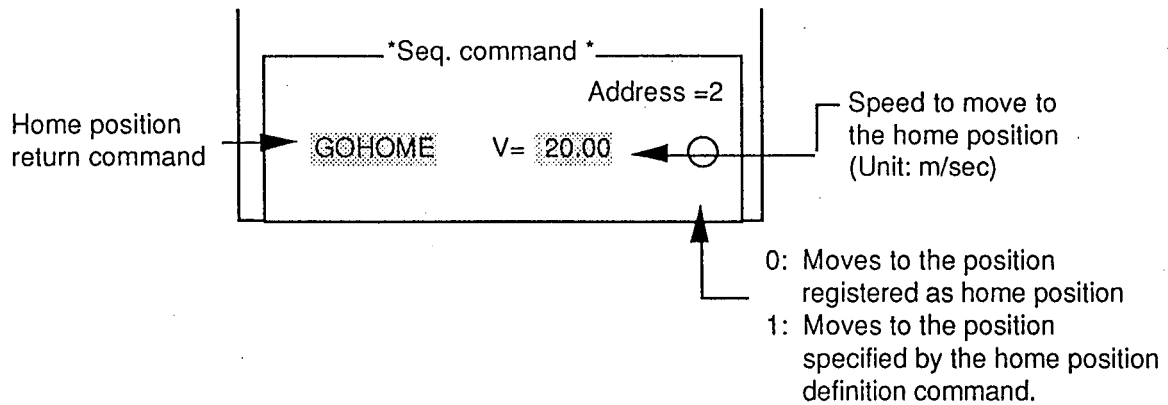
| Item                          | Name                         | Terminal No. |                                                                     |
|-------------------------------|------------------------------|--------------|---------------------------------------------------------------------|
| Exclu<br>-sive<br>input       | Current<br>detection         | 217          |                                                                     |
| Error<br>Input                | No arc                       | 218          | Error signal is<br>sent to the<br>robot and the<br>robot is halted. |
|                               | Stick                        | 219          |                                                                     |
|                               | Torch contact                | 220          |                                                                     |
|                               | No wire                      | 221          |                                                                     |
|                               | Insufficient gas<br>pressure |              |                                                                     |
| Exclu<br>-sive<br>out-<br>put | Torch switch                 | 209          |                                                                     |
|                               | Gas valve                    | 210          |                                                                     |
|                               | Stick check<br>command       | 211          |                                                                     |
|                               | Wire forward                 | 212          |                                                                     |
|                               | Wire backward                | 213          |                                                                     |

- \*1 The "Stick check command" of the output means that the robot gives the instruction "Check the stick." to the welding machine. The welding machine carries out the stick check, and if it is sticking, the input stick (terminal #219) is turned on and the robot stops.
- 2 The "wire forward" command turns on the wire motor only.  
The "wire backward" command changes the direction of the rotation of the wire motor. Therefore, both outputs have to be turned on to pull in the wire.
- 3 "Torch contact", "No wire" and "Insufficient gas pressure" cannot be unless the optional parts have not been connected.



### 6.2.6 Wait position reset command

This is the command to move to the wait position at the specified speed.

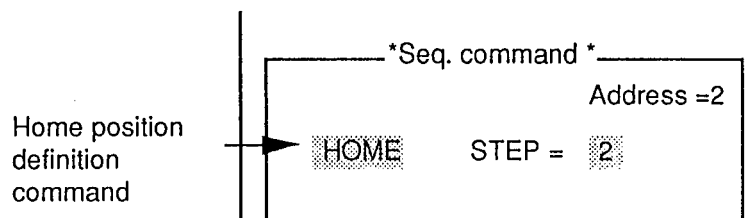


\* Shown above is the sequence command edit screen in the edit mode.

(The screen above shows " to move to the position registered as the hold position at 20.00m/min.")

### 6.2.7 Wait position definition command

This is the command to specify the step to be defined as the wait position.



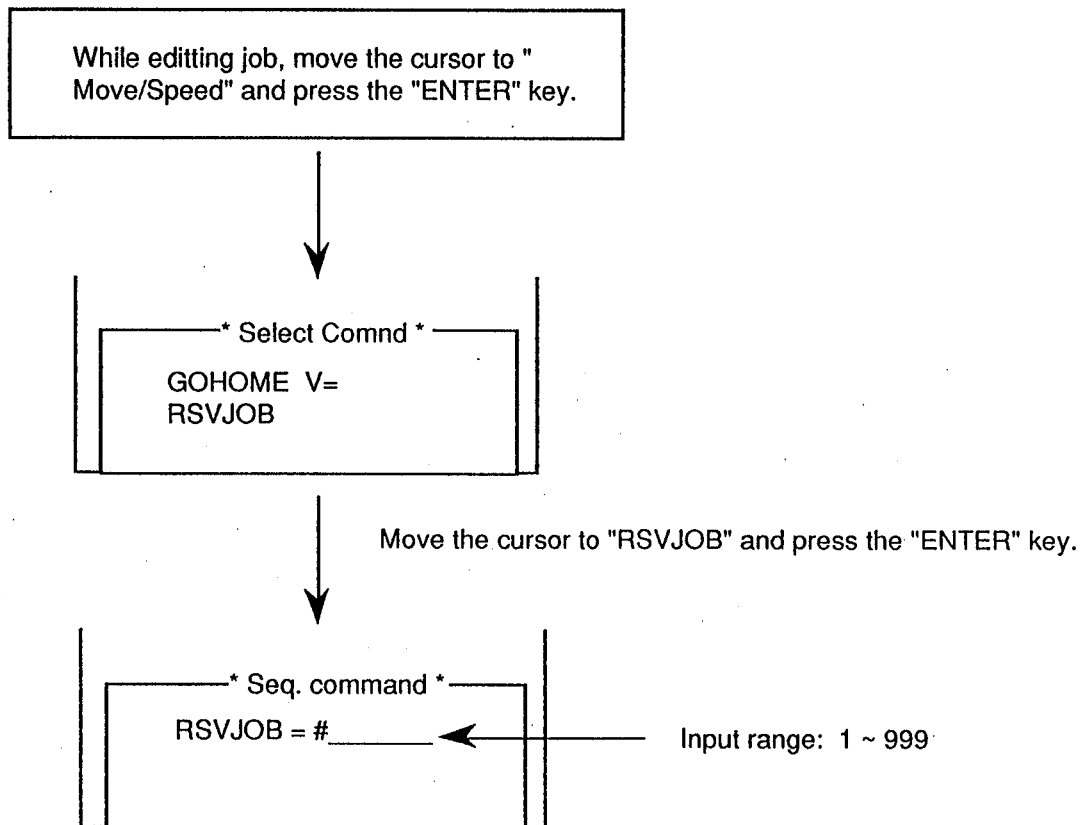
\* Shown above is the sequence command edit screen in the edit mode.

#### 6.2.8 Job reserve command

(Available with the main software of version "G0" or higher version)

- This is the sequence command for job reservation. (Allowed to register only when editing job.)
- By job editing, the job reserve command "RSVJOB" is added to the "Move/Speed" command.
- After execution of this command, the specified job number is reserved. (Valid only when started up from outside.)

<Input method>



<Example of use>

|       |                     |                                     |
|-------|---------------------|-------------------------------------|
| Job 1 | 1 OUTB OPORT# = 1 1 | 1. General output 1 is turned on.   |
|       | 2 DELAY 1.0 sec     | 2. Wait for 1 sec.                  |
|       | 3 RSVJOB JOB#2      | 3. Job 2 is reserved.               |
|       | 4 RSVJOB JOB#3      | 4. Job 3 is reserved.               |
|       | 5 GOSUB PRG#4       | 5. Program 4 is executed.           |
|       |                     | 6. Job 2 reserved in 3 is executed. |
|       |                     | 7. Job 3 reserved in 4 is executed. |

• Cautions for using RSVJOB command •

- (i) Valid only in external start up. If it is executed by panel start (internal start), this command is ignored, and the next command is executed.
- (ii) If the same job number is executed twice by this command in external start, it is registered despite the same number. However, if reserved to do the job of the same number continuously, the warning "Same job number has been reserved" appears when executing the job second time, thereby waiting for restart.
- (iii) This command is not executed (or not reserved) in trace forward or backward.
- (iv) If the job specified by this command is not registered, the warning "Job XXX not found" appears when executing this command, thereby waiting for restart.
- (v) The job reserved by this command can be canceled by the input from job cancel input terminal.
- (vi) Processing of pause and emergency stop during job execution is same as before.

### 6.2.9 Inward turning command

(Available with the main software of version "G0" or higher version)



*This command "SMOOTH=" affects the speed and track.*

This command "SMOOTH=" affects the speed and track.

This is the sequence command for smoothing the operation of the manipulator at the operating corner with a sharp angle.

By means of the sequence edit of the program (that is, in teaching mode and edit mode), the inward turning command "SMOOTH" is added to the "Move/Speed" command.

<Input method>

During the sequence edit of the program, move the cursor to "Move/Speed" and press the ENTER key.



| *Select Comnd* |
|----------------|
| GOHOME V =     |
| SMOOTH =       |
| ACCEL = (%)    |



Move the cursor to "SMOOTH" and press the ENTER key.

| *Seq. command * |
|-----------------|
| (MOVE) Step =   |
| SMOOTH = 1 ←    |

Default value : 0  
Input digit : 1 digit  
Input range : 0 to 7

- o If out of the input range, the error message of "Input value is out of range" appears.

○ Caution:

- a) If the speed is high and the setting level is low (for example, 90-degree, at the corner, 60 m/min., Level 4), the "acceleration over" may occur during the operation.



**Countermeasure;** Lower the speed or raise the setting level.

- b) If the speed is high and the setting level is high, the "HOLD" may occur during the first half of the smoothing operation and the tip of the robot may vibrate.



**Countermeasure;** Lower the speed or lower the setting level.

#### 6.2.10 Reduction of acceleration rate command

(Available with the main software of version "G0" or higher version)

This is the sequence command for lowering the limit value of acceleration of all axes of the robot. This is to enable improvement of residual vibration when stopping that is likely to occur when the load stiffness is low. It is, however, ineffective if the stiffness is extremely low.

The reduction of acceleration rate command "ACCEL" is added to "Move/Speed" command in the program sequence editing (teaching mode and edit mode).

- \* For the steps after the input of this command, this command specifies to lower the acceleration limit of all axes to which percent. To return to the standard value, enter 100%.

That is, the operation is in the state of (set acceleration limit) x (parameter set by this command) %.

<Input method>

While editing sequence in a program, move the cursor to "Move/Speed" and press the "ENTER" key.

\* Select Comnd \*  
GOHOME V=  
SMOOTH =  
ACCEL = (%)

Move the cursor to "ACCEL" and press the "ENTER" key.

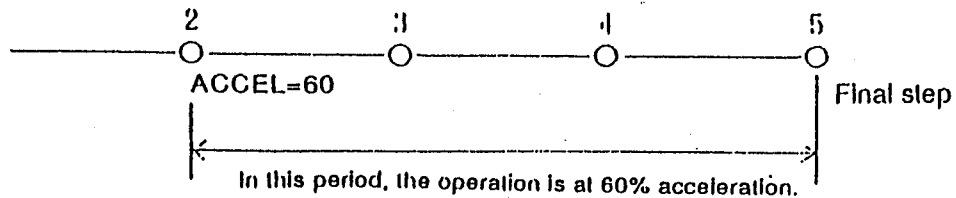
\* Seq. command \*  
(MOVE) ← Step =  
ACCEL = 100%

Default value : 100  
Input digit : 3 digits  
Input range : 100 to 50

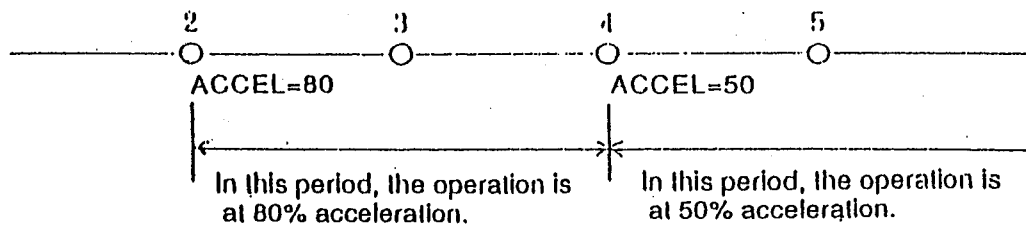
- If out of the input range, the error message of "Input value is out of range" appears.

(1) Effective period of ACCEL command

1. ACCEL command is valid within its program only, and after the program, it returns to the original standard value. (Same processing as in existing model AW-8010)



2. From the teaching point where ACCEL command is registered till the teaching point where the next ACCEL command is registered. (Same processing as in existing model AW-8010)



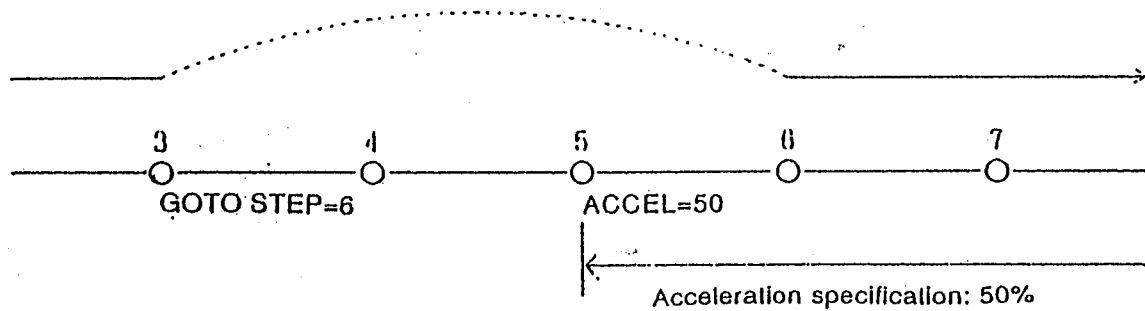
3. For default setting, register ACCEL=100(%).
4. At the same step, ACCEL command cannot be registered after the ESC command.

(2) Register disables steps

- o ACCEL command cannot be registered in the following steps.
  - Weaving amplitude point
  - Circular weaving amplitude point

### (3) Relation with jump command

This command is not executed if skipping the step where this command is registered.



In the case above, the operation after step 6 is the acceleration at step 3. That is, ACCEL command at step 5 is not executed.

#### Caution:

If the speed is high and the setting level of ACCEL command is low (for example, RT axis, PTP action 180-degree rotation, ACCEL = 50%), "acceleration over" may occur just before the stopping point.



**Countermeasure;** Lower the speed or raise the setting level.



## CHAPTER 7

### ERROR AND ALARM CODES

Pana-Robo is provided with the self-diagnosis function to detect and display abnormalities in operations and those in the control unit.

The contents of abnormalities are classified into "error" and "alarm".

"Error" refers to non-significant conditions such as abnormalities in the operation, while "alarm" refers to the abnormalities in the control unit. When an "alarm" occurs, the "servo power supply" is automatically shut down for safety.

## 7.1 Errors and alarm codes

When an abnormality is detected by the self-diagnosis function, the content of the abnormality is displayed as a code and the robot control stops.

Further, the contents of abnormalities are classified into Display code + Alarm message

### (1) Alarm

- a) This is used when a danger may result from the operation of the robot.
- b) The content is displayed on the screen by the form of "Display code and alarm message"
- c) The display code of an alarm consists of "A" and 4 digits numerical number such as "A 5010".
- d) The servo power supply is turned off.
- e) The "emergency stop status" output is released (normally closed, and opened at emergency cases), and the external outputs other than the emergency stop output are all turned off.
- f) When an "alarm" is issued, turn off the power, remove the cause of the abnormality and then resume the operation after returning to the origin.

### (2) Error

- a) Error refers to non-significant abnormalities and used for mis-operations and abnormal status.
- b) The contents are displayed on the screen as Error message
- c) The servo power supply is not turned off.
- d) "Operating" output remains ON.
- e) An error can be automatically reset when the CANCEL key is pressed.

## 7.2 Alarm code list

| Code  | Alarm message                 | Cause                                                                                      | Recovery                                                                                    |
|-------|-------------------------------|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| A5010 | System alarm 1                | Abnormality in the control unit                                                            | Turn off the power.<br>(Contact our service dept.)                                          |
| A5020 | System alarm 2                | Abnormality in the control unit                                                            | Turn off the power.<br>(Contact our service dept.)                                          |
| A5030 | System alarm 3                | Abnormality in the control unit                                                            | Turn off the power.<br>(Contact our service dept.)                                          |
| A5040 | Abort                         | Abnormality in the memory content                                                          | Turn off the power and clear the memory.                                                    |
| A6000 | Servo power supply OFF        | External emergency stop signal is input momentary and the servo power supply is shut down. | Turn off the power supply and then turn on the power.                                       |
| A6010 | Servo communication error     | Abnormality in the control unit, noise                                                     | Turn off the power supply and then turn on the power.                                       |
| A6020 | Sequencer communication error | Abnormality in the control unit                                                            | Turn off the power.<br>(Contact our service dept.)                                          |
| A6030 | T.P communication error       | Abnormality in control unit or teach pendent, noise                                        | Turn off the power supply and then turn on the power.                                       |
| A6040 | Main CPU error                | Abnormality in the control unit, noise                                                     | Turn off the power supply and then turn on the power.                                       |
| A6050 | Servo CPU error               | Abnormality in the control unit, noise                                                     | Turn off the power supply and then turn on the power. (Remove the cause of the abnormality) |
|       | Ext. 1 Servo CPU error        |                                                                                            |                                                                                             |
|       | Ext. 2 Servo CPU error        |                                                                                            |                                                                                             |
| A6060 | IOP, CPU error                | Abnormality in the control unit                                                            | Turn off the power supply.<br>(Contact our service dept.)                                   |
| A6070 | Memory battery error          | Abnormality in the battery                                                                 | Replace the battery.                                                                        |

| Code  | Alarm message                   | Cause                                                                 | Recovery                                                                                                   |
|-------|---------------------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| A6080 | Over temperature                | The temperature inside the control unit is too high.                  | Cool off the control unit by opening the door of the control unit. Check the operation of the cooling fan. |
| A6090 | Encoder cable error             | Breakage of the encoder cable                                         | Check the connection of the cable between the robot manipulator and the control unit.                      |
| A6100 | Absolute encoder error          | Abnormality in the absolute encoder                                   | Turn off the power supply and then turn on the power.                                                      |
| A6101 | Pos. data err                   | Absolute encoder abnormality                                          | Turn off the power supply and then turn on the power.                                                      |
| A6110 | Encoder battery error           | Voltage drop of the encoder battery                                   | Replace the battery.                                                                                       |
| A6110 | Ext. 1 Encoder cable            | Abnormality in the control unit of encoder cable of the external axis | Check the cable connectors.                                                                                |
| A6120 | Ext.1 absolute encoder error    | Abnormality in the absolute encoder                                   | Turn off the power supply and then turn on the power.                                                      |
| A6121 | Ext. 1 pos. data err            | Absolute encoder abnormality                                          | Turn off the power supply and then turn on the power.                                                      |
| A6120 | Ext.1 servo communication error | Abnormality in the control unit, noise                                | Turn off the power supply and then turn on the power.                                                      |
| A6130 | Ext.2 servo communication error |                                                                       | (Remove the cause of the abnormality)                                                                      |
| A6130 | Ext.1 Encoder battery           | Voltage drop of the encoder battery                                   | Replace the battery.                                                                                       |
| A6140 | Ext.2 Encoder cable             | Abnormality in the control unit or encoder cable of the external axis | Check the cable connectors.                                                                                |

| Code  | Alarm message           | Cause                                          | Recovery                                                                                                  |
|-------|-------------------------|------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| A6150 | Ext.2 absolute encoder  | Absolute encoder abnormality                   | Turn off the power and then turn it on.                                                                   |
| A6151 | Ext. 2 pos. data err    | Absolute encoder abnormality                   | Turn off the power supply and then turn on the power.                                                     |
| A6160 | Ext2. encoder battery   | Voltage drop of the encoder battery            | Replace the battery.                                                                                      |
| A7010 | Amp. ready error        | Servo amp. ready error                         | Turn off the power and then turn it on.                                                                   |
| A7020 | Amp.error 1             | Over-current detected.                         | Turn off the power and then turn it on. (Check the motor, servo amp, servo CPU card and encoder battery.) |
|       | Amp.error 2             | Over-voltage detected.                         |                                                                                                           |
|       | Amp.error 3             | Insufficient voltage of the amp. power supply. |                                                                                                           |
|       | Amp.error 4             | Excessive speed detected.                      | Turn off the power and then turn it on. (Check the motor, servo amp, servo CPU card and encoder battery.) |
|       | Amp.error 5             | Excessive load detected.                       |                                                                                                           |
|       | Amp.error 6             | Lock detected.                                 |                                                                                                           |
|       | Amp.error 7             | A/D error detected.                            |                                                                                                           |
|       | Amp.error 8             | DSP error detected.                            |                                                                                                           |
|       | Amp.error 9             | Parameter abnormality                          |                                                                                                           |
|       | Amp.error 10            | Servo power abnormality                        |                                                                                                           |
|       | Amp.error 11            | Absolute encoder abnormality                   |                                                                                                           |
|       | Amp.error 12            | Counter abnormality                            |                                                                                                           |
|       | Amp.error 13            | Encoder abnormality                            |                                                                                                           |
|       | Amp.error 14            |                                                |                                                                                                           |
|       | Amp.error 15            | Amp. timer abnormality                         |                                                                                                           |
| A7110 | Ext 1. amp. ready error | Servo amp. ready error                         | Turn off the power and then turn it on.                                                                   |
| A7120 | Ext.1 amp. error 1      | Over-current detected.                         | Turn off the power and then turn it on. (Check the motor, servo amp, servo CPU card and encoder battery.) |
|       | Ext.1 amp. error 2      | Over-voltage detected.                         |                                                                                                           |
|       | Ext.1 amp. error 3      | Insufficient voltage of the amp. power supply. |                                                                                                           |
|       | Ext.1 amp. error 4      | Excessive speed detected.                      |                                                                                                           |

| Code    | Alarm message           | Cause                                          | Recovery                                                                                                  |
|---------|-------------------------|------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| (A7120) | Ext.1 amp. error 5      | Excessive load detected.                       |                                                                                                           |
|         | Ext.1 amp. error 6      | Lock detected.                                 |                                                                                                           |
|         | Ext.1 amp. error 7      | A/D error detected.                            |                                                                                                           |
|         | Ext 1 amp.error 8       | DSP error detected.                            |                                                                                                           |
|         | Ext 1 amp.error 9       | Parameter abnormality                          |                                                                                                           |
|         | Ext 1 amp.error 10      | Servo power abnormality                        |                                                                                                           |
|         | Ext 1 amp.error 11      | Absolute encoder abnormality                   |                                                                                                           |
|         | Ext 1 amp.error 12      | Counter abnormality                            |                                                                                                           |
|         | Ext 1 amp.error 13      | Encoder abnormality                            |                                                                                                           |
|         | Ext 1 amp.error 14      |                                                |                                                                                                           |
|         | Ext 1 amp.error 15      | Amp. timer abnormality                         |                                                                                                           |
| A7210   | Ext 2. amp. ready error | Servo amp. ready error                         | Turn off the power and then turn it on.                                                                   |
| A7220   | Ext 2 amp.error 1       | Over-current detected.                         | Turn off the power and then turn it on. (Check the motor, servo amp, servo CPU card and encoder battery.) |
|         | Ext 2 amp.error 2       | Over-voltage detected.                         |                                                                                                           |
|         | Ext 2 amp.error 3       | Insufficient voltage of the amp. power supply. |                                                                                                           |
|         | Ext 2 amp.error 4       | Excessive speed detected.                      |                                                                                                           |
|         | Ext 2 amp.error 5       | Excessive load detected.                       |                                                                                                           |
|         | Ext 2 amp.error 6       | Lock detected.                                 |                                                                                                           |
|         | Ext 2 amp.error 7       | A/D error detected.                            |                                                                                                           |
|         | Ext 2 amp.error 8       | DSP error detected.                            |                                                                                                           |
|         | Ext 2 amp.error 9       | Parameter abnormality                          |                                                                                                           |
|         | Ext 2 amp.error 10      | Servo driver abnormality                       |                                                                                                           |
|         | Ext 2 amp.error 11      | Absolute encoder abnormality                   |                                                                                                           |
|         | Ext 2 amp.error 12      | Counter abnormality                            |                                                                                                           |
|         | Ext2 amp.error 13       | Encoder abnormality                            |                                                                                                           |
|         | Ext 2 amp.error 14      |                                                |                                                                                                           |
|         | Ext 2 amp.error 15      | Amp. timer abnormality                         |                                                                                                           |

| Code  | Alarm message             | Cause                                                                                                    | Recovery                                                                                                  |
|-------|---------------------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| A8010 | Count over                | Count over                                                                                               | Change the teaching so that an abrupt movement of an axis is avoided.<br>(Check the motor and amplifier). |
| A8020 | Amp. communication error  | Abnormality in the control unit, noise                                                                   | Turn off the power and then turn it on.<br>(Remove the cause of the abnormality.)                         |
| A8030 | Drift error               | Drift in the servo circuit is excessive.                                                                 | Adjust the drift in the servo circuit. (Contact our service dept.)                                        |
|       |                           | Fuse in the servo power supply has been blow off.<br>Or, fuse of the servo amplifier has been blown off. | Check the fuses.                                                                                          |
| A8110 | Ext 1 Count over          | Count over                                                                                               | Change the teaching so that an abrupt movement of an axis is avoided.<br>(Check the motor and amplifier.) |
| A8120 | Ext 1 communication error | Abnormality in the control unit, noise                                                                   | Turn off the power and then turn it on.<br>(Remove the cause of the abnormality.)                         |
| A8130 | Ext 1 drift error         | Drift in the servo circuit is excessive.                                                                 | Adjust the drift in the servo circuit. (Contact our service dept.)                                        |
|       |                           | Fuse in the servo power supply has been blow off.<br>Or, fuse of the servo amplifier has been blow off.  | Check the fuses.                                                                                          |

| Code  | Alarm message                  | Cause                                                                                                   | Recovery                                                                                                  |
|-------|--------------------------------|---------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| A8210 | Ext 2 Count over               | Count over                                                                                              | Change the teaching so that an abrupt movement of an axis is avoided.<br>(Check the motor and amplifier.) |
| A8220 | Ext 2 communication error      | Abnormality in the control unit, noise                                                                  | Turn off the power and then turn it on.<br>(Remove the cause of the abnormality.)                         |
| A8230 | Ext 2 drift error              | Drift in the servo circuit is excessive.                                                                | Adjust the drift in the servo circuit. (Contact our service dept.)                                        |
|       |                                | Fuse in the servo power supply has been blow off.<br>Or, fuse of the servo amplifier has been blow off. | Check the fuses.                                                                                          |
| A9010 | Arc sensor communication error | Abnormality in the control unit, noise<br>Power of the arc sensor unit has not been turned on.          | Turn off the power and then turn it on.                                                                   |
| A9060 | Arc sens:<br>Input parameter   | Tool No., current detector and rotation speed are out of input range.                                   | Turn off the power and then turn it on.<br>(Remove the cause of the abnormality.)                         |
| A9070 | Arc sens:<br>Main comm.        | Current position request is time-out.                                                                   | Turn off the power and then turn it on.<br>(Remove the cause of the abnormality.)                         |



### 7.3 Error code list

| Code  | Error message                                                   | Cause                                                                                 | Recovery                                                                                                          |
|-------|-----------------------------------------------------------------|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| E0010 | Welding error 1<br>No current detection                         | Abnormal signal sent from the welding power supply or interface box.                  | Check the cause of no current detected.                                                                           |
| E0020 | Welding error 1<br>No arc                                       |                                                                                       | Re-check the welding conditions and also check the wire transfer route.                                           |
| E0030 | Welding error 1<br>Wire stick                                   |                                                                                       | Cut off the wire contact.<br>Change the teaching position to prevent sticking.<br>Check the welding power supply. |
| E0040 | Welding error 1<br>Torch contact                                |                                                                                       | Remove the cause.                                                                                                 |
| E0050 | Welding error 1<br>No wire, gas                                 |                                                                                       | Remove the cause.                                                                                                 |
| E1010 | Calculation error<br>(Operation)<br>(Manual)                    | Arithmetic processing parameter error                                                 | Quit the mode. (Contact our service dept.)                                                                        |
| E1020 | Interpolation point generation error<br>(Operation)<br>(Manual) | Error in arithmetic processing of circle and weaving.<br>Interpolation is impossible. | Change the teaching point and speed.                                                                              |
| E1030 | Coordinate system conversion error<br>(Operation)<br>(Manual)   | Interpolation is impossible.                                                          | Change the teaching point and speed.                                                                              |
| E1040 | Movement data over<br>(Operation)<br>(Manual)                   | Interpolation is impossible.                                                          | Change the teaching point and speed.                                                                              |
| E1050 | Position does not match                                         | Refer to Page7-21.                                                                    | Refer to Page 7-21.                                                                                               |

| Code  | Error message                                | Cause                                                                                                                              | Recovery                                                                                       |
|-------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| E1060 | Wrist swing over                             | When the teaching point is registered, the combination of the specified interpolation type and calculation No. (CL No.) was wrong. | Correct the combination.                                                                       |
| E1070 | Acceleration over<br>(Operation)<br>(Manual) | Speed error                                                                                                                        | The rated speed is exceeded by the interpolation.<br>Reduce the speed by teaching.             |
| E1090 | Operation check error                        | Operation error.                                                                                                                   | Change the teaching point and speed.                                                           |
| E1100 | Nesting over                                 | Excessive number of addressing commands                                                                                            | Change the commands.                                                                           |
| E1900 | User Err ???                                 | This message is displayed when HOLD command is used.<br>(??? is the specified No. which is used with HOLD command.)                | Press the CANCEL key.<br>Press the START key again to resume the operation.                    |
| E2010 | Sensing impossible                           | The operation is resumed after the emergency stop from the teaching point to which the touch sensor operation command is input.    | Press the CANCEL key.<br>Press the START key again to resume the operation.                    |
| E2020 | No sensing input                             | No interruption occurs within the sensing distance.                                                                                | Press the CANCEL key.<br>Resume the operation after carrying out the tracing forward/backward. |
| E2030 | Shift operation error                        | Arithmetic processing error                                                                                                        | Change the teaching point and speed.<br>Also, check the weaving conditions.                    |

To customers who use the arc sensor unit (YA-IAPSA1Y)

| Code  | Error message                 | Cause                                                                                                                          | Recovery                                                                                                            |
|-------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| E2120 | Arc sensor: Welder            | Inappropriate settings for the welder                                                                                          | Correct the settings for the welder.                                                                                |
| E2130 | Arc sensor: Wire              | Inappropriate settings for the wire                                                                                            | Correct the settings for the wire.                                                                                  |
| E2140 | Arc sensor: Welding current   | A current other than 100~400(A) is set as the welding current.                                                                 | Press the CANCEL key.<br>Check the setting of the welding current.                                                  |
| E2150 | Arc sensor: Welding speed     | A speed other than 0.1~1.2 (m/min) is set as the welding speed.                                                                | Press the CANCEL key.<br>Check the setting of the welding speed.                                                    |
| E2160 | Arc sensor : Weave frequency  | The weave frequency set is other than 1~5(Hz).                                                                                 | Press the CANCEL key.<br>Correct the weave frequency.                                                               |
| E2170 | Arc sensor: Weave amplitude   | The weaving amplitude is out of the range of 2~6 (mm).                                                                         | Press the CANCEL key.<br>Set the weave amplitude to 2~6(mm) by teaching again.                                      |
| E2180 | Arc sensor: Weave pattern     | The weaving pattern is not single amplitude.                                                                                   | Press the CANCEL key.<br>Correct the weave pattern to single amplitude.                                             |
| E2190 | Arc sensor: Current detection | A current detection signal is not input even after 3 seconds has elapsed since the torch switch was turned on.                 | Press the CANCEL key.<br>Check the cause of no input of the current detection signal or no arc.                     |
| E2200 | Arc sensor: Buffer over       | Clearance between the teach line and the welding line is excessive.                                                            | Press the CANCEL key.<br>Correct the welding line by teaching again.                                                |
| E2210 | Arc sensor: Distance over     | The sensing area of the arc sensor is significantly deviated from the welding line, and the pre-set max. distance is exceeded. | Press the CANCEL key.<br>Check the setting of the Max. sensing distance.<br>Check the conditions of the arc sensor. |

| Code  | Error message                  | Cause                                                                         | Recovery                                |
|-------|--------------------------------|-------------------------------------------------------------------------------|-----------------------------------------|
| E2220 | Arc sensor: Data communication | Abnormality in the control unit. Noise. The arc sensor unit is not turned on. | Turn off the power and then turn it on. |

To customers who use the spin arc unit (YA-1APSS1Y)

| Code  | Error message                  | Cause                                                                                                                                                                                                                             | Recovery                                                                                                      |
|-------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| E2120 | Arc sensor: Welder             | <ul style="list-style-type: none"> <li>Signal of "A" pulse is not output from the encoder of the motor in the rotation head during a certain period. (Motor error)</li> <li>PCB error</li> <li>Connector contact error</li> </ul> | Press the Cancel key. Replace the rotation head and PCB.                                                      |
| E2160 | Arc sensor: Weave frequency    | <ul style="list-style-type: none"> <li>The spin rotation speed exceeded 4500 rpm.</li> <li>The over-current and overload were detected by the servo amplifier in the spin unit.</li> </ul>                                        | Turn off the power of the spin unit and then turn it on again. Replace the rotation head and PCB.             |
| E2190 | Arc sensor: Current detection  | <ul style="list-style-type: none"> <li>A current detection signal is not input even after 3 seconds has passed since the torch switch was turned on.</li> </ul>                                                                   | Press the CANCEL key. Check the cause of no input of the current detection signal or no arc.                  |
| E2200 | Arc sensor: Buffer over        | The clearance between the welding line of the actual work and the teach line is excessive.                                                                                                                                        | Press the CANCEL key. Teach again.                                                                            |
| E2210 | Arc sensor: Distance over      | The sensing area of the arc sensor is significantly deviated from the welding line, and the pre-set max. distance is exceeded.                                                                                                    | Press the CANCEL key. Check the setting of the max. sensing distance. Check the conditions of the arc sensor. |
| E2220 | Arc sensor: Data communication | Abnormality in the control unit. Noise. The arc sensor unit is not turned on.                                                                                                                                                     | Turn off the power and then turn it on again.                                                                 |

To customers who use the super small spin arc c sensor (YA-1APSU2Y)

| Code  | Error message                            | Cause                                                                                                                                                                                                                                  | Recovery                                                                                                                                                                      |
|-------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| E2120 | Arc sensor: Welder                       | <ul style="list-style-type: none"> <li>Signal of "Z" pulse is not output from the encoder of the motor in the spin head during a certain period. (Motor error)</li> <li>Abnormality in the welding current and voltage data</li> </ul> | Press the cancel key. Replace the spin head and PCB CT.                                                                                                                       |
|       |                                          | Or the data communication with the spin arc sensor is abnormal.                                                                                                                                                                        | Turn off the power of the spin arc sensor control unit and the robot and then turn it on again. And if the error is not canceled, contact the sales shop or the service shop. |
| E2130 | Arc sensor: Wire                         | <ul style="list-style-type: none"> <li>Abnormality in the counter data.</li> </ul>                                                                                                                                                     | Turn off the power and then turn it on again.                                                                                                                                 |
| E2190 | Arc sensor: Current detection            | <ul style="list-style-type: none"> <li>A current detection signal is not input even after 3 seconds have passed since the torch switch was turned on.</li> </ul>                                                                       | Press the CANCEL key. Check the cause of no input of the current detection signal or no arc.                                                                                  |
| E2200 | Arc sensor: Buffer over                  | The clearance between the welding line of the actual work and the teach line is excessive                                                                                                                                              | Press the CANCEL key. Teach again.                                                                                                                                            |
| E2210 | Arc sensor: Distance over                | The sensing area of the arc sensor is significantly deviated from the welding line, and the pre-set max. distance is exceeded.                                                                                                         | Press the CANCEL key. Check the setting of the max. sensing distance. Check the conditions of the arc sensor.                                                                 |
| E2230 | Sensor: Amplifier error                  | <ul style="list-style-type: none"> <li>Abnormality of the servo driver in the spin controller was detected.</li> <li>Motor temperature in the spin head is abnormal. (Torch use rate over)</li> </ul>                                  | Remove the spin controller cover and check the servo driver error display and investigate the cause of the error.                                                             |
| E2240 | Sensor: Operation error                  | Abnormality in the control unit. Shift amount operation error due to the noise.                                                                                                                                                        | Turn off the power and then turn it on again.                                                                                                                                 |
| E2260 | Arc sensor: Rotation speed               | Motor rotation speed over or insufficient in the spin head.                                                                                                                                                                            | Turn off the power and then turn it on again.                                                                                                                                 |
| E2270 | Arc sensor: Data communication           | Abnormality in the control unit. Noise. The arc sensor unit is not turned on.                                                                                                                                                          | Turn off the power and then turn it on again.                                                                                                                                 |
|       | Check the connection of the sensor unit. | The sensor unit is not connected. Power-OFF. The rotation stop position of the spin is not correct.                                                                                                                                    | Check the connection of the sensor unit. Turn off the power and then turn it on again.                                                                                        |

## 7.4 Grammatical check error and calculation check error during editing

### 7.4.1 Error display

When a grammatical error or an calculation error occurs in the file during editing, the screen shown below appears:

|                  |      |     |        |
|------------------|------|-----|--------|
| Edit: Program 20 |      |     |        |
| Err              | Step | Err | Step   |
| 2007             | 5    |     |        |
| 2004             | 2    |     |        |
|                  |      |     | Finish |

Press the END key.

|               |         |          |
|---------------|---------|----------|
| *OPR select * |         | 1/1      |
| 1             | Re-edit | 2 Finish |

Move the cursor to "Re-edit" to edit again.

Move the cursor to "Finish" to quit editing.

Press the ENTER key.

#### 7.4.2 Cause of and recovery

| Point           | Error No. | Cause                                                                                                                                                  | Recovery                                                   |
|-----------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| All of points   | 2001      | Coordinate system conversion error interpolation is impossible.                                                                                        | Change the teaching point.                                 |
|                 | 2002      | Software limit over                                                                                                                                    | Change the teaching point.                                 |
|                 | 2004      | Position does not match<br>Refer to Page 7-21.                                                                                                         | Refer to Page 7-21.                                        |
|                 | 2005      | Wrist swing over<br>When the teaching point is registered, the combination of the specified interpolation type and calculation No. (CL No.) was wrong. | Correct the combination.                                   |
| Step 0          | 0150      | Sequence commands which cannot be used at step 0 exist.                                                                                                | Cancel sequence commands.                                  |
| Air-cut point   | 0001      | An AJO or CJO command exists at an air-cut point.                                                                                                      | Delete the AJO or CJO command using the program edit mode. |
|                 | 0007      | An ASS command exists at an air-cut point.                                                                                                             | Delete the ASS command using the program edit mode.        |
|                 | 0010      | An AES command exists at an air-cut point.                                                                                                             | Delete the AES command using the program edit mode.        |
| Arc start point |           | At an arc start point, commands AJO<br>ASS<br>in a pair is required.                                                                                   |                                                            |



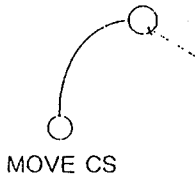
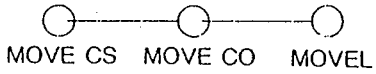
| Point             | Error No. | Cause                                                                                                                                                                                                                                                                | Recovery                                                                                                                                                                                                                                              |
|-------------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (Arc start point) | 0002      | <p>An arc end sequence command (COJ or AES) exists at the arc start point.</p> <p>(Example)</p> <p>1 AJO AMP=200 VOLT=24.0</p> <p>2 ASS No.=1</p> <p>3 DELAY 2.0 sec.</p> <p><u>4 CJO AMP= 150 VOLT= 21.0</u></p>                                                    | <p>Delete the CJO or AES commands using the program edit mode.</p> <p>1 AJO AMP=200VOLT=24.0</p> <p>2 ASS No. =1</p> <p>3 DELAY 2.0 sec.</p> <p><b>Note)</b> If arc spot welding should be performed at the same point, register the point twice.</p> |
|                   |           | <p>Neither AJO nor ASS command exists at the arc start point.</p> <p>(Example)</p> <p>1 DELAY 2.0 sec.</p>                                                                                                                                                           | <p>Add AJO and ASS commands using the program edit mode.</p> <p><u>1 AJO AMP=200 VOLT=24.0</u></p> <p><u>2 ASS No.=1</u></p> <p>3 DELAY 2.0 sec.</p>                                                                                                  |
|                   | 0005      | <p>Two or more AJO commands exist at the arc start point.</p> <p>(Example)</p> <p>1 AJO AMP=200 VOLT=24.0</p> <p>2 ASS No.=1</p> <p><u>3 AJO AMP=120 VOLT=19.0</u></p> <p><b>Note)</b> If two AJO commands exist consecutively, the error number will be "0006".</p> | <p>Delete extra AJO command(s) using the program edit mode.</p> <p>1 AJO AMP=200 VOLT=24.0</p> <p>2 ASS No.=1</p>                                                                                                                                     |

| Point             | Error No. | Cause                                                                                                                                                         | Recovery                                                                                                                                        |
|-------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| (Arc start point) | 0006      | An inappropriate command(s) exists between AJO command and ASS command.<br><br>(Example)<br>1 AJO AMP=200 VOLT=24.0<br>2 <u>DELAY 0.5 sec.</u><br>3 ASS No.=1 | Delete the command using the program edit mode.<br><br>1 AJO AMP=200 VOLT=24.0<br>2 ASS No.=1                                                   |
|                   | 0007      | An ASS command exists but no AJO command exists at the arc start point.<br><br>(Example)<br>1 ASS No.=1<br>2 DELAY 0.1 sec.                                   | Add an AJO command before the ASS command using the program edit mode.<br><br>1 <u>AJO AMP=200 VOLT=24.0</u><br>2 ASS No.=1<br>3 DELAY 0.1 sec. |
|                   |           | An extra ASS command exists at the arc start point.<br><br>(Example)<br>1 AJO AMP=200 VOLT=24.0<br>2 ASS No.=1<br>3 DELAY 0.1 sec.<br>4 <u>ASS No.=1</u>      | Delete the extra ASS command using the program edit mode.<br><br>1 AJO AMP=200 VOLT=24.0<br>2 ASS No.=1<br>3 DELAY 0.1 sec.                     |
|                   |           | AJO and ASS commands are registered in reverse.<br><br>(Example)<br>1 ASS No.=1<br>2 AJO AMP=200 VOLT=24.0                                                    | Move the ASS command after the AJO command using the program edit mode.<br><br>1 AJO AMP=200 VOLT=24.0<br>2 ASS No.=1                           |

| Point             | Error No. | Cause                                                                                                                                               | Recovery                                                                                           |
|-------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| (Arc start point) | 0010      | An AES command exists at the arc start point.<br><br>(Example)<br>1 AJO AMP=200 VOLT=24.0<br>2 ASS No. =1<br><u>3 AES No.=1</u>                     | Delete the AES command using the program edit mode.<br><br>1 AJO AMP=200 VOLT=24.0<br>2 ASS No. =1 |
|                   | 0011      | Welding command unmatched.<br>(Example)<br>In case the welding specification is the standard, the welding commands of low pulse and TIG etc. exist. | Use matched welding commands.                                                                      |
| Weld pass point   | 0003      | An CJO command exist at the weld pass point.<br><br>(Example)<br>1 AJO AMP=200 VOLT=24.0<br><u>2 CJO AMP=150 VOLT=21.0</u>                          | Delete the CJO command using the program edit mode.<br><br>1 AJO AMP=200 VOLT=24.0                 |
|                   | 0005      | Two AJO commands exist at an weld pass point.<br><br>(Example)<br>1 AJO AMP=200 VOLT=24.0<br><u>2 AJO AMP=200 VOLT=19.0</u>                         | Delete one of them using the program edit mode.<br><br>1 AJO AMP=200 VOLT=24.0                     |
|                   | 0007      | An ASS command exists at the weld pass point.<br><br>(Example)<br>1 AJO AMP=200 VOLT=24.0<br><u>2 ASS No.=1</u>                                     | Delete the ASS command using the program edit mode.<br><br>1 AJO AMP=200 VOLT=24.0                 |

| Point             | Error No. | Cause                                                                                                                                                | Recovery                                                                                                                          |
|-------------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| (Weld pass point) | 0010      | An AES command exists at the weld pass point.<br><br>(Example)<br>1 AJO AMP=200 VOLT=24.0<br>2 <u>AES No.=1</u>                                      | Delete the AES command using the program edit mode.<br><br>1 AJO AMP=200 VOLT=24.0                                                |
|                   | 0011      | Welding command unmatched.<br>(Example)<br>In case the welding specification is the standard, the welding commands of low pulse and TIG, etc. exist. | Use matched welding commands.                                                                                                     |
| Arc end point     |           | At an arc end point, commands AJO<br>ASS<br>in a pair is required.                                                                                   |                                                                                                                                   |
|                   | 0004      | An AJO command exists at the arc end point.<br><br>(Example)<br>1 CJO AMP=150 VOLT=21.0<br>2 AES No.=1<br>3 <u>AJO AMP=200 VOLT=24.0</u>             | Delete the AES command using the program edit mode.<br><br>1 CJO AMP=150 VOLT=21.0<br>2 AES No. =1                                |
|                   |           | Neither CJO nor AES command exists at the arc end point.<br><br>(Example)<br>1 DELYA 0.1 sec.                                                        | Add CJO and AES commands using the program edit mode.<br><u>1 CJO AMP=150 VOLT=21.0</u><br><u>2 AES No.=1</u><br>3 DELAY 0.1 sec. |
|                   | 0007      | An arc start (ASS) command exist at the arc end point.<br><br>(Example)<br>1 CJO AMP=150 VOLT=21.0<br>2 AES No. =1<br>3 <u>ASS No.=1</u>             | Delete the ASS command using the program edit mode.<br><br>1 CJO AMP=150 VOLT=21.0<br>2 AES No. =1                                |

| Point           | Error No. | Cause                                                                                                                                                      | Recovery                                                                                                |
|-----------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| (Arc end point) | 0008      | Two CJO commands exist at the arc end point.<br><br>(Example)<br>1 CJO AMP=150 VOLT=21.0<br>2 AES No.=1<br><u>3 CJO AMP=150 VOLT=21.0</u>                  | Delete the extra CJO command using the program edit mode.<br><br>1 CJO AMP=150 VOLT=21.0<br>2 AES No.=1 |
|                 | 0009      | An inappropriate command exists between CJO command and AES command.<br><br>(Example)<br>1 CJO AMP=150 VOLT=21.0<br><u>2 DELAY 0.5 sec.</u><br>3 AES No.=1 | Delete the sequence command using the program edit mode.<br><br>1 CJO AMP=150 VOLT=21.0<br>2 AES No.=1  |
|                 | 0010      | An extra AES command exists at the arc end point.<br><br>(Example)<br>1 CJO AMP=150 VOLT=21.0<br>2 AES No.=1<br><u>3 AES No.=2</u>                         | Delete the extra AES command using the program edit mode.<br><br>1 CJO AMP=150 VOLT=21.0<br>2 AES No.=1 |
|                 | 0011      | Welding command unmatched.<br>(Example)<br>In case the welding specification is the standard, the welding commands of low pulse and TIG, etc. exist.       | Use matched welding commands.                                                                           |

| Point  | Error No. | Cause                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Recovery                                                                                                                                                                                                                                                                |
|--------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Circle | 1001      | <p>The start point MOVEC CS or end point MOVEC CO of the circle does not exist.</p> <p>(Example)</p> <pre> 1  MOVEC      20.00 2  MOVEC CO   1.00 3  MOVEC CO   1.00 4  MOVEC      60.00 </pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <p>Add the start point or end point of the circle in the program edit mode.</p> <p>(Example)</p> <p>In the example on the left, add MOVEC CS.</p> <pre> 1  MOVEC      20.00 2  <u>MOVEC CS</u>   1.00 3  MOVEC CO   1.00 4  MOVEC CO   1.00 5  MOVEC      60.00 </pre>  |
|        | 2020      | <p>Circular operation is impossible.<br/>(Error returns during the initial calculation of the circle.)</p> <p>(Example 1)</p> <div style="display: flex; align-items: center;"> <div style="text-align: center;"> <p>MOVE CO<br/>&amp; MOVEC</p>  <p>MOVE CS</p> </div> <div style="margin-left: 20px;"> <p>Among 3 circular points, 2 of them are the same point or very close to each other.</p> </div> </div> <p>(Example 2)</p> <div style="text-align: center;">  <p>MOVE CS   MOVE CO   MOVEC</p> </div> <p>The 3 points are on a same straight line.</p> | <p>Correct the points in the program edit mode so that the circular operation can be achieved.</p> <p>(Example 1)</p> <p>Change the circle start point or end point slightly.</p> <p>(Example 2)</p> <p>Change the circle intermediate point or end point slightly.</p> |

| Point   | Error No. | Cause                                                                                                                                                                                                                                                                                                                           | Recovery                                                                                                                                                                                                                                                                                                                                                                                   |
|---------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Weaving | 1002      | <p>The weaving start point or amplitude point does not exist.</p> <p>(Example)</p> <pre> 1 MOVE      60.00 2 MOVLW BS   5.00 3 MOVLW B2   5.00 4 MOVE      60.00 </pre>                                                                                                                                                         | <p>Add the command skipped, weaving start point or amplitude point, in the program edit mode.</p> <p>(Example)</p> <p>In the example on the left, add MOVLW B1 command.</p> <pre> 1 MOVE      60.00 2 MOVLW BS   5.00 3 <u>MOVLW B1</u>   5.00 4 MOVLW B2   5.00 5 MOVE      60.00 </pre>                                                                                                  |
|         |           | <p>Although the weaving start point is the transfer point, the amplitude point is the welding point.</p> <p>Although the weaving start point is the welding point, the amplitude point is the transfer point.</p> <p>(Example)</p> <pre> 1 *MOVLW BS   5.00 2 <u>MOVLW B1</u>   5.00 3 MOVLW B2   5.00 4 MOVE      60.00 </pre> | <p>If the weaving start point is the transfer point, change the amplitude point to the transfer point in the program edit mode.</p> <p>If the weaving start point is the welding point, change the amplitude point to the welding pass point in the program edit mode.</p> <p>(Example)</p> <pre> 1 *MOVLW BS   5.00 2 <u>*MOVLW B1</u>   5.00 3 *MOVLW B2   5.00 4 MOVE      60.00 </pre> |

| Point     | Error No. | Cause                                                                                                                                                                                                                                                                                                                                                                                                                                | Recovery                                                                                                                                                      |
|-----------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (Weaving) | 1002      | <p>A sequence command exists at the amplitude point of weaving.</p> <p>(Example)</p> <pre> 1 MOVLW BS      2.00 2 MOVLW B1      2.00  WAIT 3 MOVLW B2      2.00 4 MOVE          60.00 </pre>                                                                                                                                                                                                                                         | <p>Erase the sequence command existing at the weaving amplitude point in the program edit mode.</p> <p>Erase the WAIT command in the example on the left.</p> |
|           | 2007      | <p>The weaving operation is impossible.<br/>(Error is returned at the initial calculation of the weaving.)</p> <p>(Example 1)</p> <div style="display: flex; align-items: center;"> <div style="text-align: center;"> </div> <div style="margin-left: 20px;"> <p>Check that the amplitude is larger than 20 mm.</p> </div> </div> <p>(Example 2)</p> <p>Weaving is impossible due to excessive speed at the weaving start point.</p> | <p>Reduce the amplitude to below the limit in the program edit mode.</p> <p>Reduce the speed in the program edit mode.</p>                                    |
|           | 2008      | <p>Weaving timer error<br/>Programmed weaving frequency or timer setting is out of range.</p>                                                                                                                                                                                                                                                                                                                                        | <p>Check frequency or timer setting.</p>                                                                                                                      |



| Point            | Error No. | Cause                                                                                                                                                                                                                                                                                                                                                                                                                                                | Recovery                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Circular weaving | 1003      | One of the commands of start point, end point, amplitude point, or intermediate point of the circular weaving is skipped.                                                                                                                                                                                                                                                                                                                            | Add the skipped command, start point, end point, amplitude point, or intermediate point of the circular weaving in the program edit mode.                                                                                                                                                                                                                                                                                                                                                                   |
|                  |           | (Example)<br>1 MOV CW DS      5.00<br>2 MOV CW D1      5.00<br>3 MOV CW D2      5.00<br>4 MOV EL          60.00                                                                                                                                                                                                                                                                                                                                      | (Example)<br>1 MOV CW DS      5.00<br>2 MOV CW D1      5.00<br>3 MOV CW D2      5.00<br><u>4 MOV CW D0      5.00</u><br>5 MOV EL          60.0                                                                                                                                                                                                                                                                                                                                                              |
|                  |           | <p>The circular weaving start point is the air-cut point, while the amplitude point or intermediate point is the weld pass point.</p> <p>The circular weaving start point is the welding point, while the amplitude point or intermediate point is the air-cut point.</p> <p>(Example)<br/>1 *MOV CW DS      5.00<br/>2 <u>MOV CW D1</u>      5.00<br/>3 <u>MOV CW D2</u>      5.00<br/>4 <u>MOV CW D0</u>      5.00<br/>5 MOV EL          60.00</p> | <p>In the program edit, when the circular weaving start point is the air-cut point, the amplitude point and intermediate point are also the air-cut point.</p> <p>In the program edit, when the circular weaving start point is the welding point, the amplitude point and intermediate point are also the welding point.</p> <p>(Example)<br/>1 *MOV CW DS      5.00<br/>2 *<u>MOV CW D1</u>      5.00<br/>3 *<u>MOV CW D2</u>      5.00<br/>4 *<u>MOV CW D0</u>      5.00<br/>5 MOV EL          60.00</p> |

| Point | Error No. | Cause                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Recovery                                                                                                                                                                          |
|-------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       |           | <p>The sequence command exists on the amplitude point of the circular weaving.</p> <p>(Example)</p> <pre> 1  MOV CW DS      1.00 2  MOV CW D1      2.00    <u>WAIT</u> 3  MOV CW D2      2.00 4  MOV CW D0      2.00 4  MOV EL         20.00 </pre>                                                                                                                                                                                                                          | <p>In the program edit, the sequence command at the amplitude point is deleted.</p> <p>In case of the example on the left, the sequence command <u>UNDERLINED</u> is deleted.</p> |
|       | 2007      | <p>The circular weaving operation is impossible. (Error is returned at the initial calculation of the circular weaving.)</p> <p>(Example 1)</p> <div style="display: flex; align-items: center;"> <div style="margin-right: 20px;"> <pre> MOV CW D1 MOV CW DS MOV CW D2 </pre> </div> <div> <p>Check that the amplitude exceeds the limit.</p> </div> </div> <p>(Example 2)</p> <p>Weaving is impossible due to the excessive speed at the circular weaving start point.</p> | <p>Reduce the amplitude in the program edit mode.</p> <p>Reduce the speed in the program edit mode.</p>                                                                           |
|       | 2008      | <p>Weaving timer error</p> <p>Programmed weaving frequency of timer setting is out of range.</p>                                                                                                                                                                                                                                                                                                                                                                             | <p>Check frequency or timer setting.</p>                                                                                                                                          |

| Point            | Error No. | Cause                                                                                                    | Recovery                                                                                   |
|------------------|-----------|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| Circular weaving | 2020      | (Example 1)<br>Among the 3 points on the circle, 2 points are the same point or too close to each other. | Move the intermediate point or end point of the circular weaving in the program edit mode. |
|                  |           | (Example 2)<br>The start point, intermediate point and the end point are on a same straight line.        | Move the intermediate point or end point of the circular weaving in the program edit mode. |
| ESC commands     | 0100      | ESC command exists after the ESC command.                                                                | Erase all commands after the ESC command.                                                  |
|                  | 0103      | "GOTO STEP= <i>k</i> " command exists after the ESC command.                                             |                                                                                            |
|                  | 0104      | "IF IPORT # <i>a</i> THEN STEP= <i>k</i> " command exists after the ESC command.                         |                                                                                            |
|                  | 0105      | "IF IPORT# <i>a</i> THEN STEP= <i>K</i><br>ELSE STEP= <i>B</i> " command exists after the ESC command.   |                                                                                            |
|                  | 0106      | "IF REG# <i>a</i> THEN STEP= <i>k</i> " command exists after the ESC command.                            |                                                                                            |
|                  | 0107      | "IF REG# <i>a</i> THEN STEP= <i>k</i> "<br>ELSE STEP= <i>B</i> " command exists after the ESC command.   |                                                                                            |
|                  | 0108      | A pair of AJO command and ASS command exists after the ESC command.                                      |                                                                                            |
|                  | 0109      | A pair of CJO command and AES command exists after the ESC command.                                      |                                                                                            |
|                  | 0110      | AJO command exists after the ESC command. (At the arc intermediate point)                                |                                                                                            |

| Point        | Error No. | Cause                                                                                                                                                 | Recovery                                  |
|--------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| ESC commands | 0112      | "GOHOME" command exists after the ESC command.                                                                                                        | Erase all commands after the ESC command. |
|              | 0113      | "HOME" command exists after the ESC command.                                                                                                          |                                           |
|              | 0114      | The address <i>K</i> in the "GOTO ADDR= <i>K</i> " command is the address before the ESC command.                                                     |                                           |
|              | 0115      | The address <i>K</i> in the "IF IPORT# <i>a</i> THEN ADDR= <i>K</i> " is the address before the ESC command.                                          |                                           |
|              | 0116      | The addressed <i>K</i> and <i>B</i> in the "IF IPORT# <i>a</i> THEN ADDR= <i>K</i><br>ELSE ADDR= <i>B</i> " command are those before the ESC command. |                                           |
|              | 0117      | The address <i>K</i> in the "IF REG# <i>a</i> THEN ADDR= <i>K</i> " command is the address before the ESC command.                                    |                                           |
|              | 0118      | The addressed <i>K</i> and <i>B</i> in the "IF REG# <i>a</i> THEN ADDR= <i>K</i><br>ELSE ADDR= <i>B</i> " command are those before the ESC command.   |                                           |
|              | 0119      | An ESC command exists in the final step.                                                                                                              |                                           |
|              | 0120      | Sensor commands exist after the ESC command.                                                                                                          |                                           |
|              | 0121      | ACCEL command exists after the ESC command.                                                                                                           |                                           |
|              | 0122      | RETPRG command exists after the ESC command.                                                                                                          |                                           |
|              | 0123      | Palletizing sequence commands or dedicated resisters (No. 101 - 140) for palletizing exist after the ESC command.                                     |                                           |

Note) If the power of the control unit is turned off while editing the job, program, arc start sequence, arc end sequence or library, re-confirm the contents in the edit mode.

## 7.5 E1050

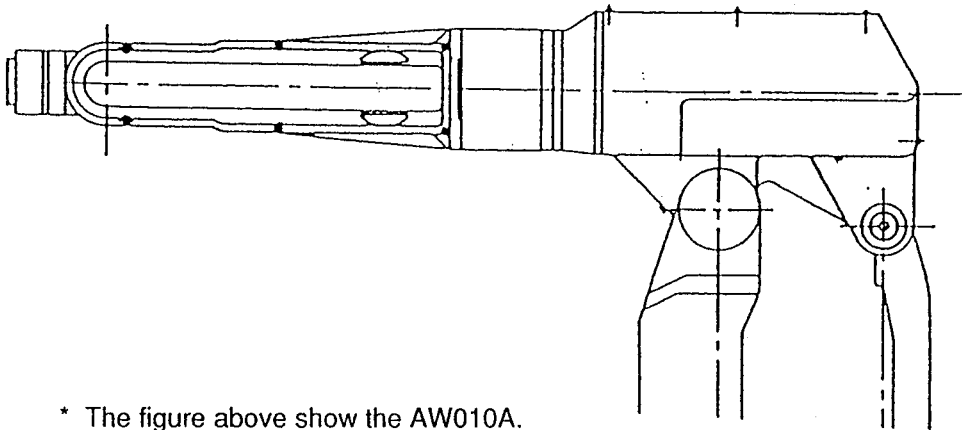
When a robot calculates the movement locus, the postures of individual axes may be different from those taught although the top position and the posture of the torch is as being taught. This is how error E1050 occurs.

For instance, although RW axis is taught not to move, a phenomena that RW axis turns but that the locus and posture meet those as taught may occur in the playback operation.

These movements occur in the calculation of the locus and posture due to the degree of freedom of a robot. This is handled as an error and the robot is stopped.

- (1) E1050 may occur when an attempt to move the robot between the teaching points by linear interpolation (MOVEL) with RW and TW axes of the wrist being rotated 180° or more. This error may also occur depending on the positions of the RW and TW axes when the robot is moved to the first point at start-up or when forward or backward tracing is carried out after moving the wrist manually in the tracing operation.  
If this error occurs, add a teaching point to prevent RW and TW axes from rotating more than 180°, or change the operation to PTP (MOVEP), or change the start position (RW, TW postures).

- (2) This error may occur when FA axis and BW axis become parallel (see the figure below) in the circular interpolation operation.



\* The figure above show the AW010A.

When this occurs, follow the procedure below:

- (1) Change the operation to PTP (MOVEP command).
- (2) Change teaching to prevent FA and BW axes from becoming parallel to each other.  
(Realize the targets of the same torch for individual axes of the robot by the position and conditions.)

## 7.6 Method to release overrun

Follow the procedure below to reset overrun:

- (1) Turn off the power.
- (2) Open the door of the RS232C box (upper right area of the control unit front panel).
- (3) Press the OVERRUN RESET switch in the box to the overrun reset side.
- (4) Turn on the power.
- (5) Press the servo power supply switch.
- (6) Move the robot to the direction opposite to the overrun and reset.  
(Refer to the message shown on the screen.)
- (7) Turn off the power.
- (8) Press the overrun reset switch to the normal operation side.
- (9) Turn on the power again and resume the operation.

Note) The overrun resetting is not effective unless the robot is in overrun status.

## 7.7 Communication error list of the teach pendant

| Error Message       | Cause                                                                                                                                                                                                                                                                                                                                                                                      | Recovery                                         |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| Communication error | <p>Communication error between the main CPU and the teach pendant.</p> <p>[Error No]</p> <p>00 ... No communication<br/>(More than 1.1 seconds)</p> <p>01 ... Time out</p> <p>02 ... NAK two times</p><br><p>11 ... Parity error</p> <p>12 ... Framing error</p> <p>13 ... Overrun error</p> <p>20 ... BCC error</p><br><p>99 ... No communication after the main switch is turned on.</p> | Turn off the main switch and then turn on again. |



## APPENDIX

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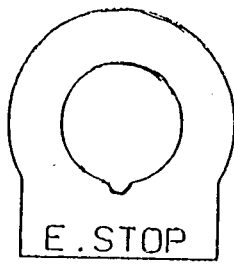
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## Appendix 0 PANAROBO RISC-A series

## List of registration dictionary

[illegible]

## APPENDIX 1 Functions of individual keys of the teach pendent



### 1 EMERGENCY STOP PB switch

This switch is used to activate the emergency stop. This switch is mechanically locked when pressed down. Turn the switch clockwise again to release.



### 2 TEACH ENABLE key

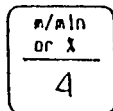
This key is used to change the mode to "Teach". This also functions as the LED indicating the current mode. Press this key to enter the "Teach" mode and start operation when this LED lights up.



### 3 "SPEED SELECT", NUMERICAL key "1"

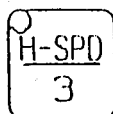
This key is used to change the speed of the robot. When this key is pressed, the speed changes step by step as shown below:

This key is also used as numerical key "1".



### 4 SPEED DISPLAY key

This key is used to select the mode displaying the speed; m/min or % which is the rate to the max. speed.



### 5 HIGH SPEED key, NUMERICAL key "3"

This key is used to trace the welding path at which the teaching speed is low. When this key and the forward/backward tracing keys are used in combination, the robot moves at the maximum limit speed.

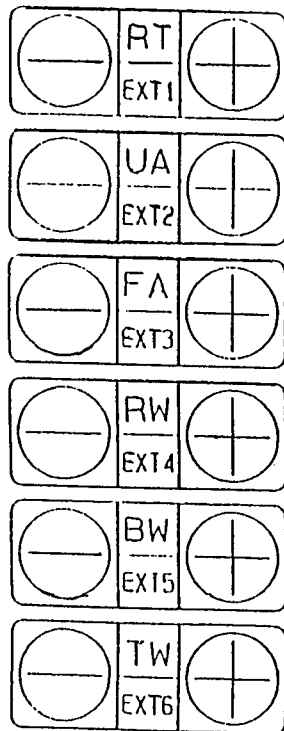
When the robot is operated via this key, the settings of the ROBOT MOVE keys are ignored. The robot moves the weaving path and circular weaving path at the teaching speed.

This key can be set either "effective" or "ineffective" in the "Inner setting/expanded function" menu.

(This key is set to "ineffective" at shipping.)

This key can also be used as the numerical key "3".

## 6 MOVE keys



These keys are used to move individual parts of the robot, such as robot manipulator itself, arm, wrist or external axes.

These keys can be set to either "effective" or "ineffective" in the "inner setting/expanded function" menu.

When set to "effective", these keys should be used while holding down the Robot Operation key.

(If set to "ineffective", the robot can be moved with only these keys.)

The orthogonal, cylindrical, tool, user and joint motions can be selected by using the "MENU SELECT" key. The speed can also be changed by using the SPEED SELECT key.

Use these keys in combination with the EXTERNAL AXES MOVE key to move the external axes. The auxiliary keys 1 and 2 are provided for special use, and not currently used.

## 7 ROBOT OPR key.



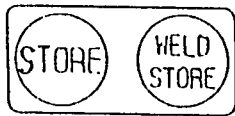
This key is used to rotate the robot manipulator and move the arms and wrists. This key is also used for forward and backward tracing. Press Individual axis move keys or forward/backward keys simultaneously with this key.

The function of this key can be set either "effective" or "ineffective" in the "inner setting/expanded function" mode. (This key is set to "effective" at shipment.)

## 8 EXTERNAL AXIS MOVE key



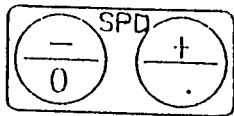
To move the external axes, press this key and turn on the LED. When one LED is lighting, the MOVE key controls the external axes 1~6, while this controls the external axes 7~12 when two LEDs are lighting.



#### 9 STORE, WELD STORE key

These keys are used to register the teaching points. The STORE and WELD STORE keys are for Transfer route and Welding route, respectively.

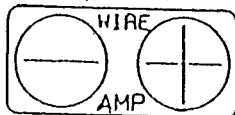
The STORE key is also used for registration of the sequence commands during the teaching operation.



#### 10. SPEED "+" / "-" key., numerical key "0" and ".".

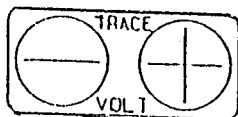
This key is used for speed override operation. This key is used

also as the numeric keys "0" and ".".



#### 11 WIRE "FORWARD" "BACKWARD" key. CURRENT "+", "-" key

This key is used to move the welding wire forward and backward in manual operation. This key is also used for welding current override operation.



#### 12 TRACE "FORWARD", "BACKWARD" key, VOLTAGE "+", "-" key

This key is used to move the robot forward and backward at each teaching point in confirmation operation (tracing).

When the ROBOT OPR key is set to effective in the system mode settings, move the robot forward (backward) while holding the ROBOT OPR key down.

To move the teaching point forward/backward without moving the robot, press the Forward (Backward) key while pressing the ROBOT LOCK key down.

The override operation of the welding voltage during operation can be performed via this key.



#### 13 ROBOT LOCK key

This key is used in the confirmation operation (tracing) to move the teaching point forward and backward without moving the robot. Press this key simultaneously with the Forward/Backward key.



1.4 MENU SELECT key, numerical key "2"

When this key is pressed during teaching, the set-up screen of the welding start conditions, welding end conditions, weaving table No. and the pitch No. is displayed. When this key is pressed again, the set-up screen of the user coordinate system No., wrist calculation No. and tool No. appears.

When setting a value, enter the value via the numerical keys, press the ENTER key and then press the END key. The initial screen will be brought back.

This key is used also as the numerical key "2".



15 JOG key

This key is used to move the robot pitch by pitch in manual operation. This key can be used when the LED is lighting.

The movement distance of the robot is determined by "speed range (High, High/moderate, Moderate, Moderate/low, LOW).

The movement rate of the pitch feed is set by the robot parameter in the system settings.



16 WELD OFF key

This key is used to interrupt the welding operation in process. When the signal of this key is accepted, the LED turns on and the WELD OFF status is brought. Press this key again to resume the welding.

(The LED goes off.)



17 CIRCULAR WEAVING END key

This key is used to reset the motion mode specified during the teaching such as circular, weaving or circular weaving.



18 CANCEL key

This key is used to release error, as well as to cancel the teaching operation in process.



19 HOLD key

This key is used to stop the robot temporally. The function of this key is the same as that of HOLD key on the console panel.



20 END key

This key is used to quit instructions of the program in the teaching mode. When this key is pressed simultaneously with the CANCEL key during tracing or in hold status, the current motion is forcibly stopped.



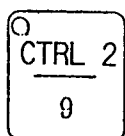
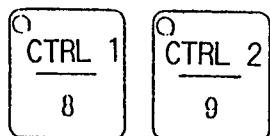
21 TEACH SELECT key

When this key is pressed, the modes of modification and movement as well as the coordinate system can be set. To set these modes, move the cursor to the item to be set and press this key repeatedly. This key is also used as the numerical key "7".



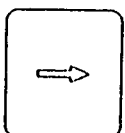
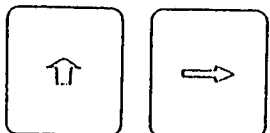
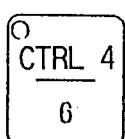
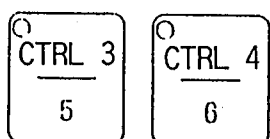
22 WELD POINT INDICATION LED

This LED indicates that the welding is in process during tracing and operation.



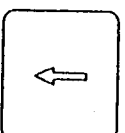
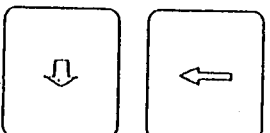
23 CTRL1 ~ CTRL4 keys

These keys control the signal output by the teach pendant in teach mode and in operation mode. These keys are used as numerical keys "5", "6", "7", "8" and "9".



24 Arrow keys

These keys are used to move the cursor on the screen or to monitor the I/O terminal status.



25 ENTER key

This key is used to confirm the item to be set. This key is pressed at the current cursor position. This key is used also when a numeric value is entered.





26 OPERATION SELECTION key

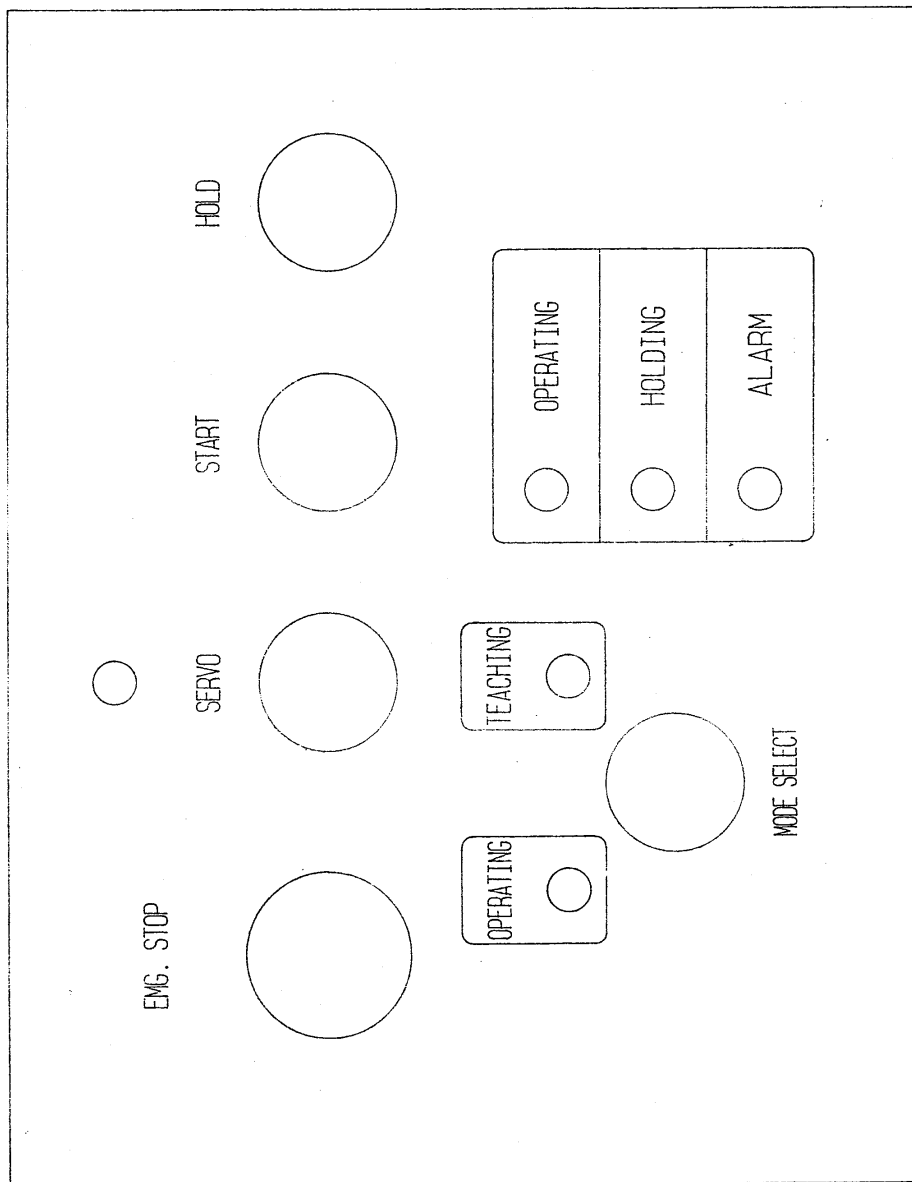
When this key is pressed, the menu of the functions executed on the current screen is displayed. To execute a function, move the cursor to the desired item and press the ENTER key.



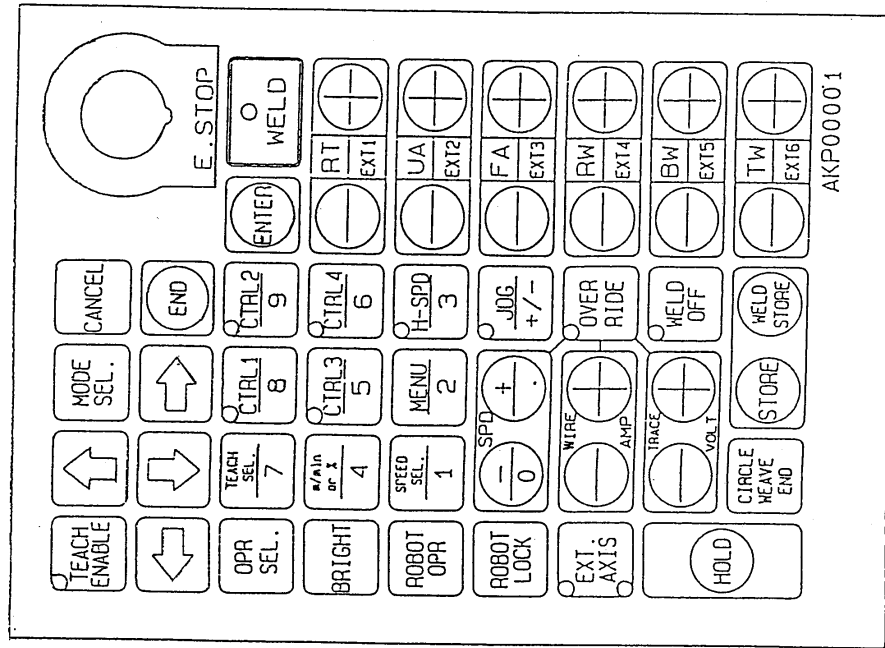
27 BRIGHTNESS key

The brightness of the screen is controlled by pressing the arrow keys while holding this key down.





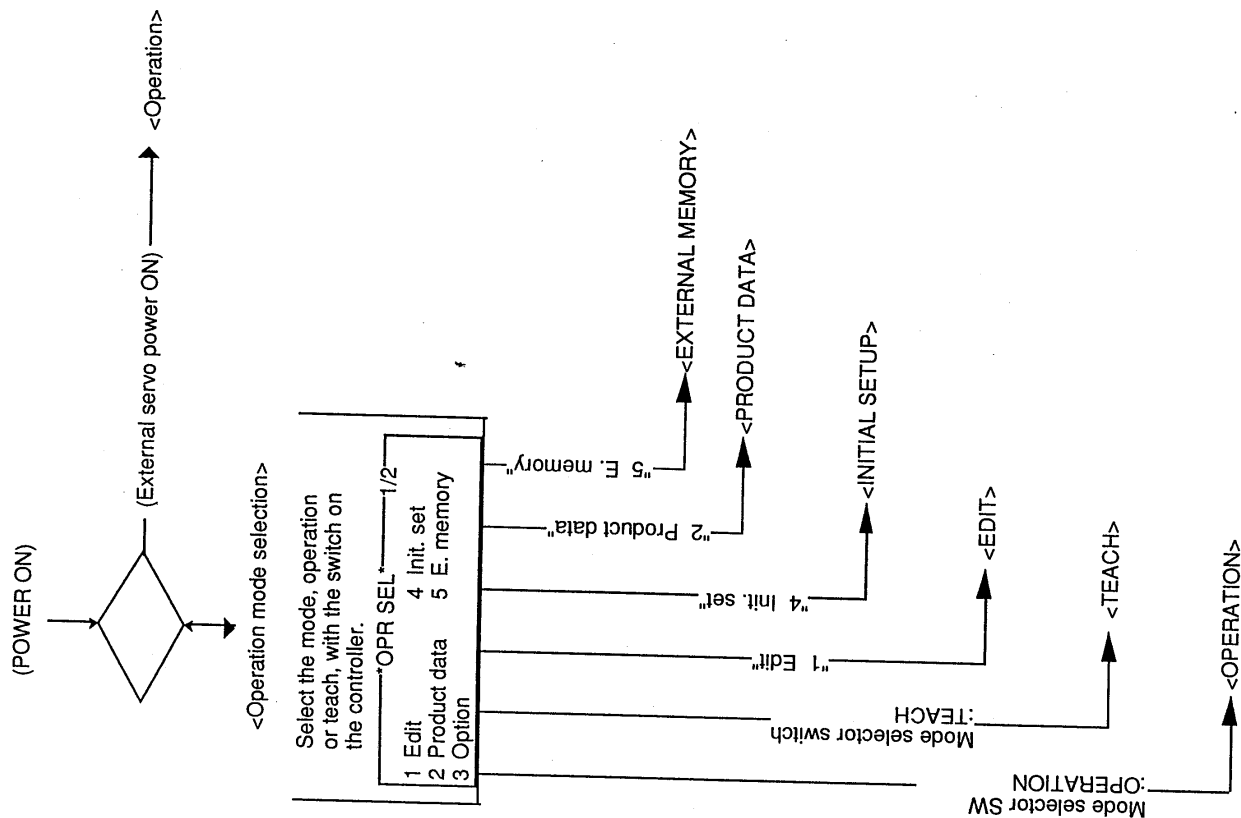
Appendix 2 Console panel drawing



# APPENDIX 4 OPERATION FLOW CHART

## 4.1 MODE SELECTION

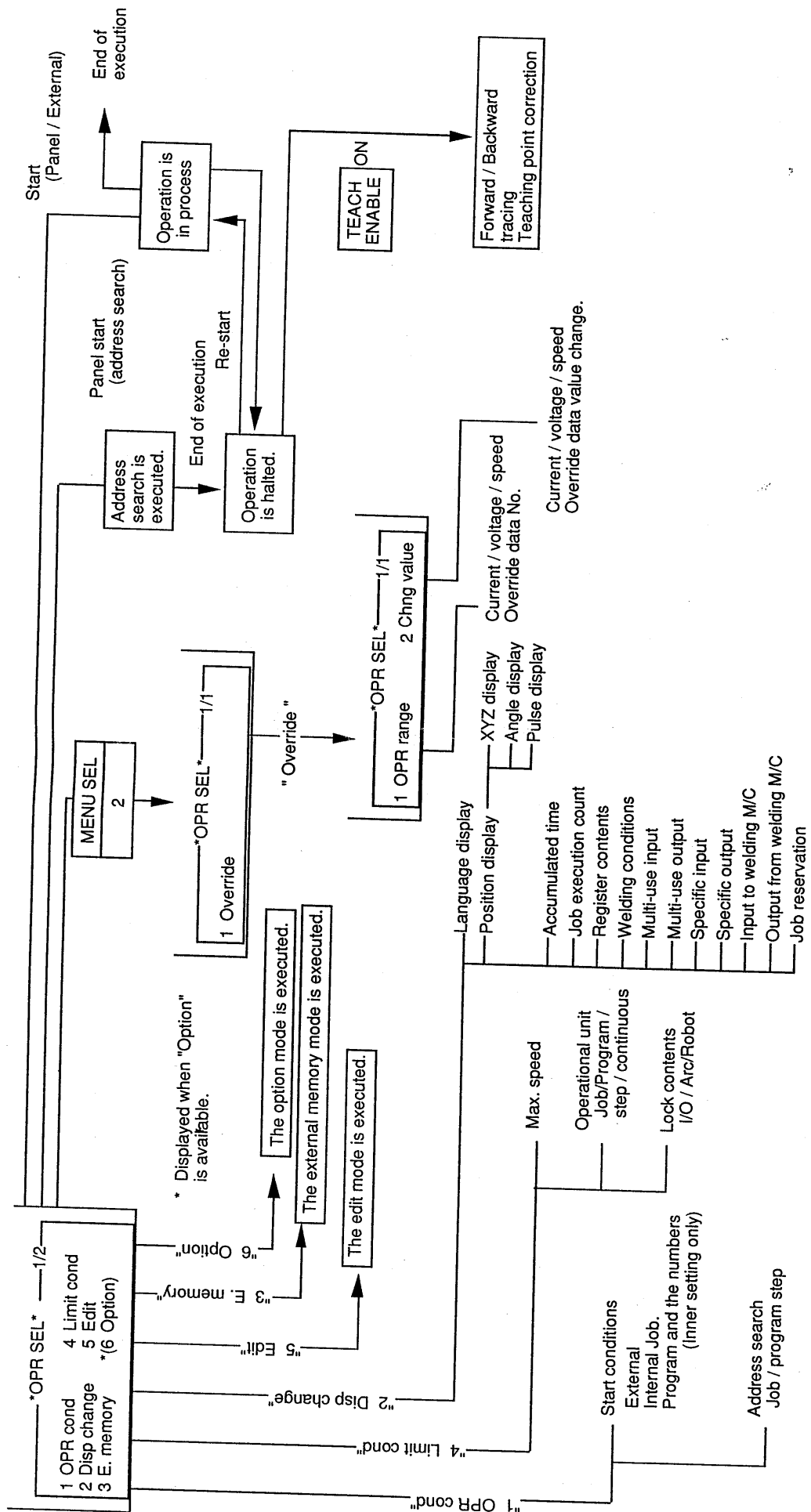
\* The number provided before each item is displayed in the main software of version "K0" or higher versions.



## 4.2 OPERATING

(Turn on the servo power supply if it has not been turned on.)

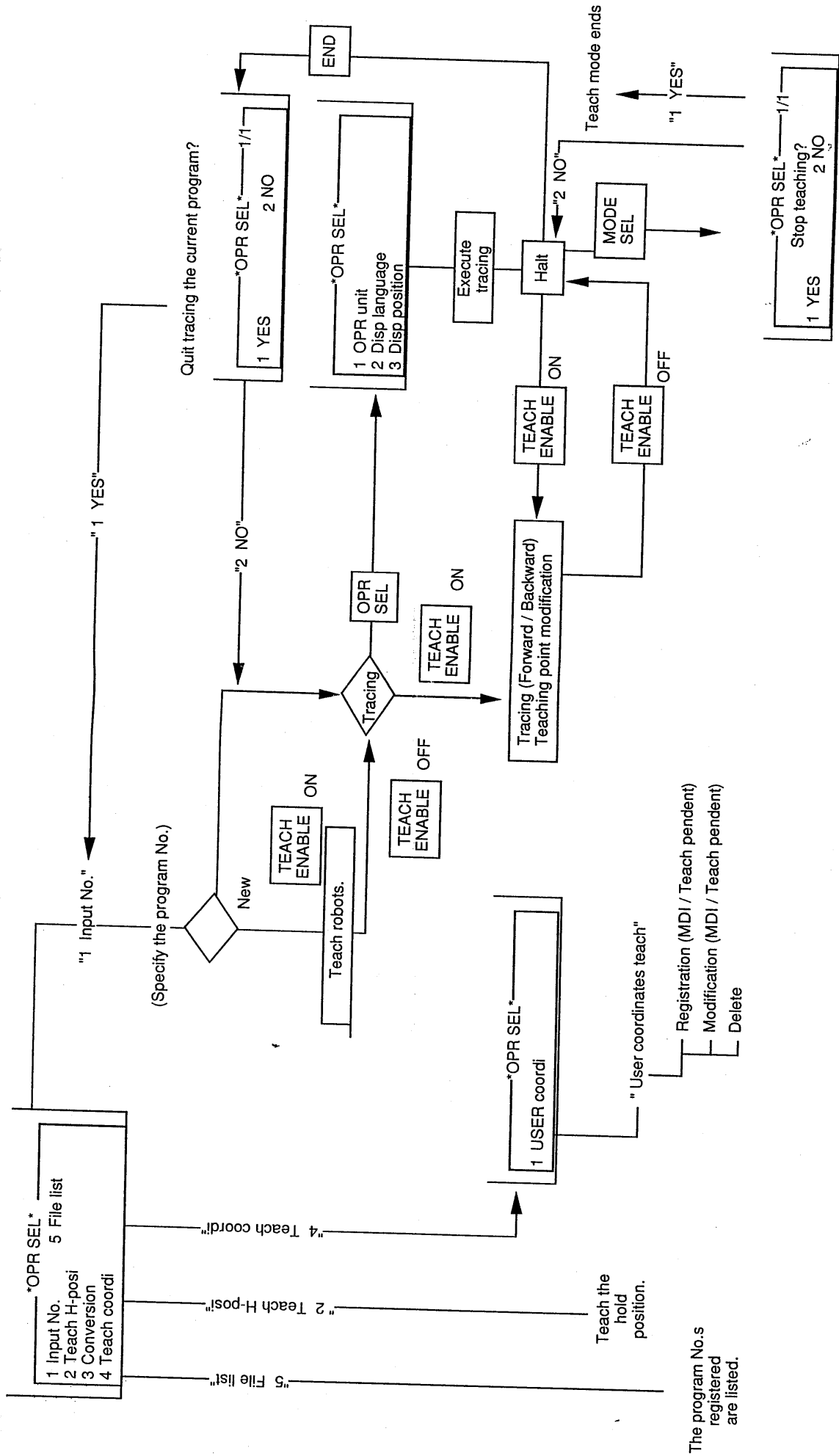
Select operation mode



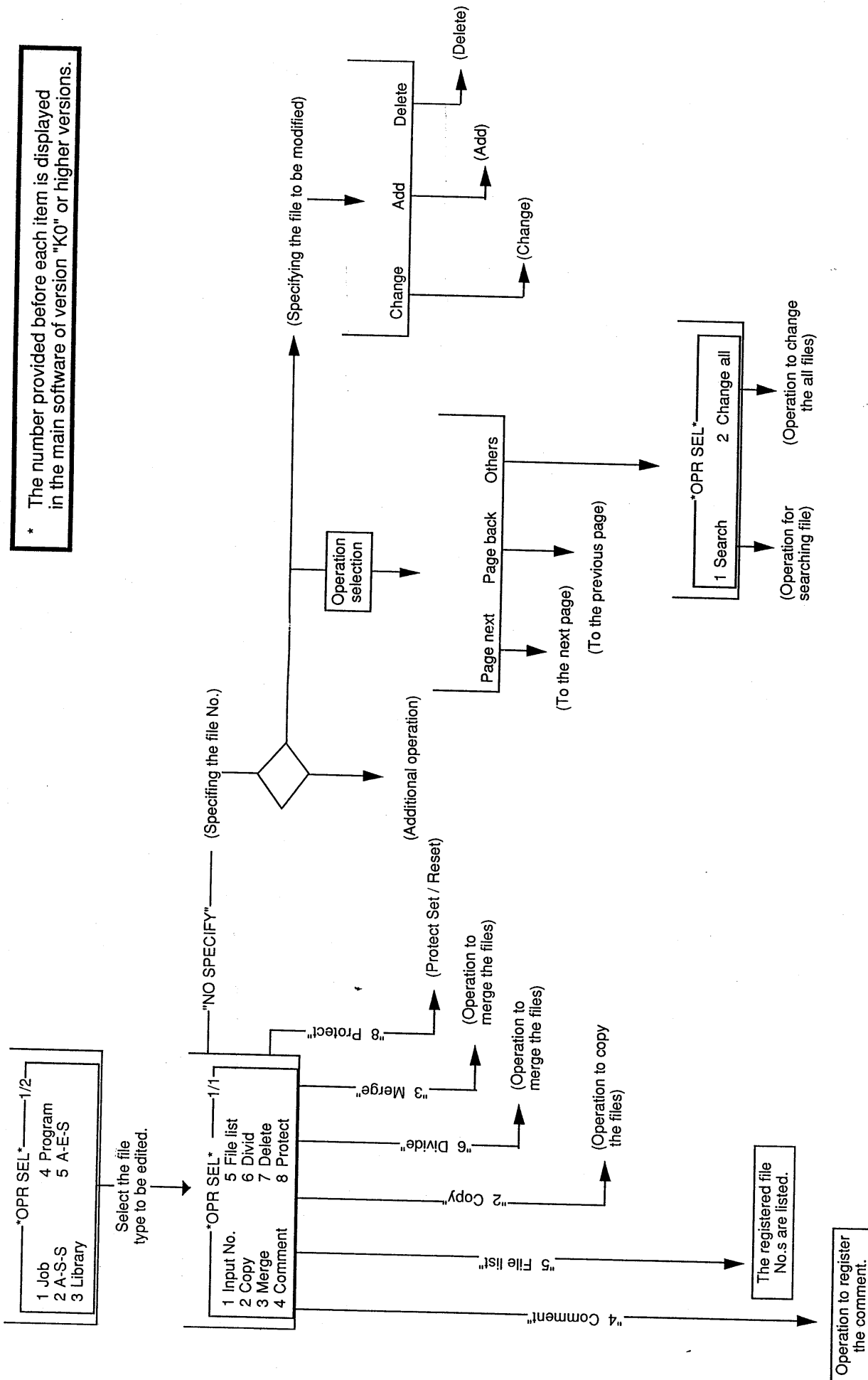
\* The number provided before each item is displayed in the main software of version "K0" or higher versions.

### 4.3 TEACHING

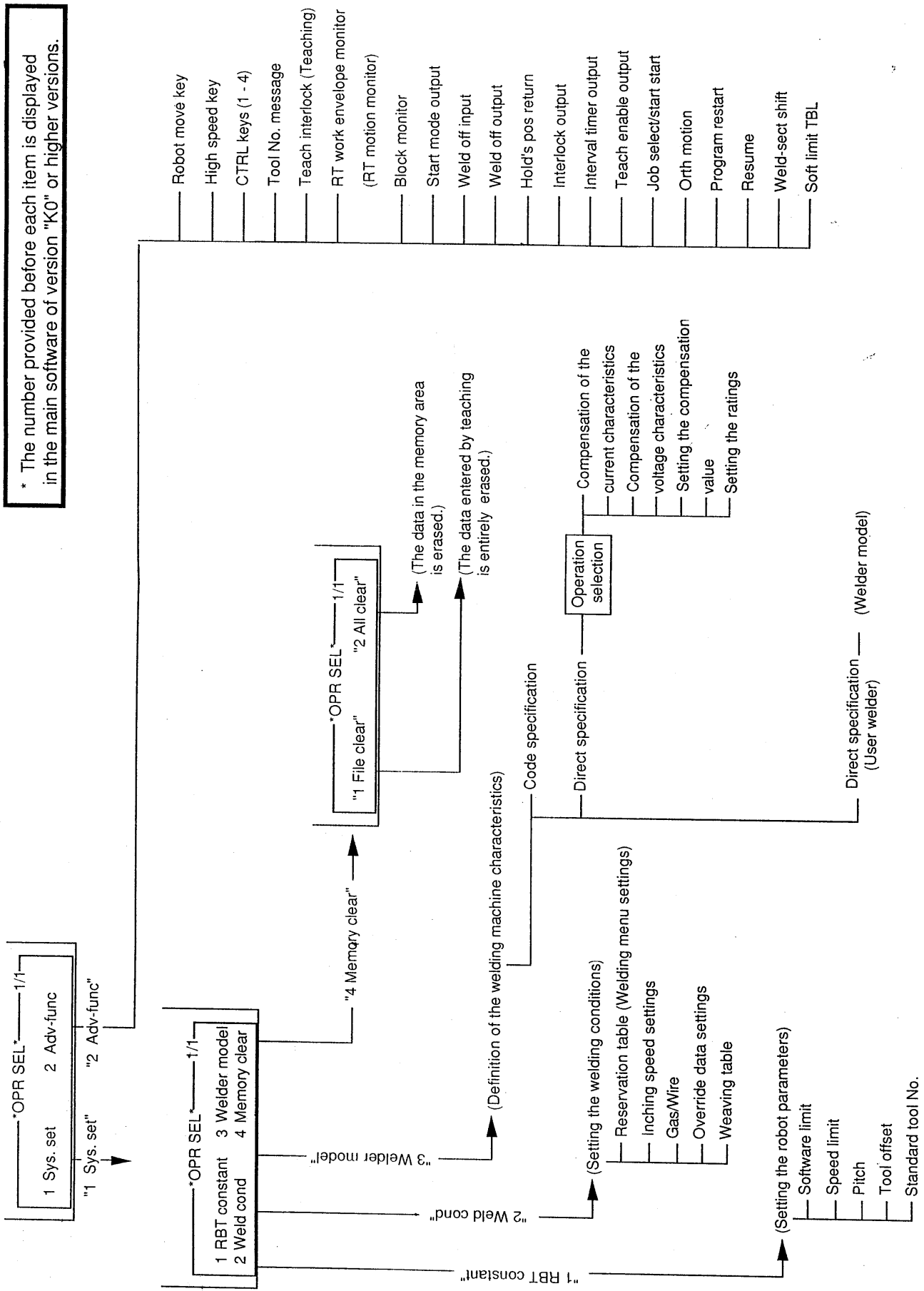
(Turn on the servo power supply  
if it has not been turned on.)



\* The number provided before each item is displayed in the main software of version "K0" or higher versions.

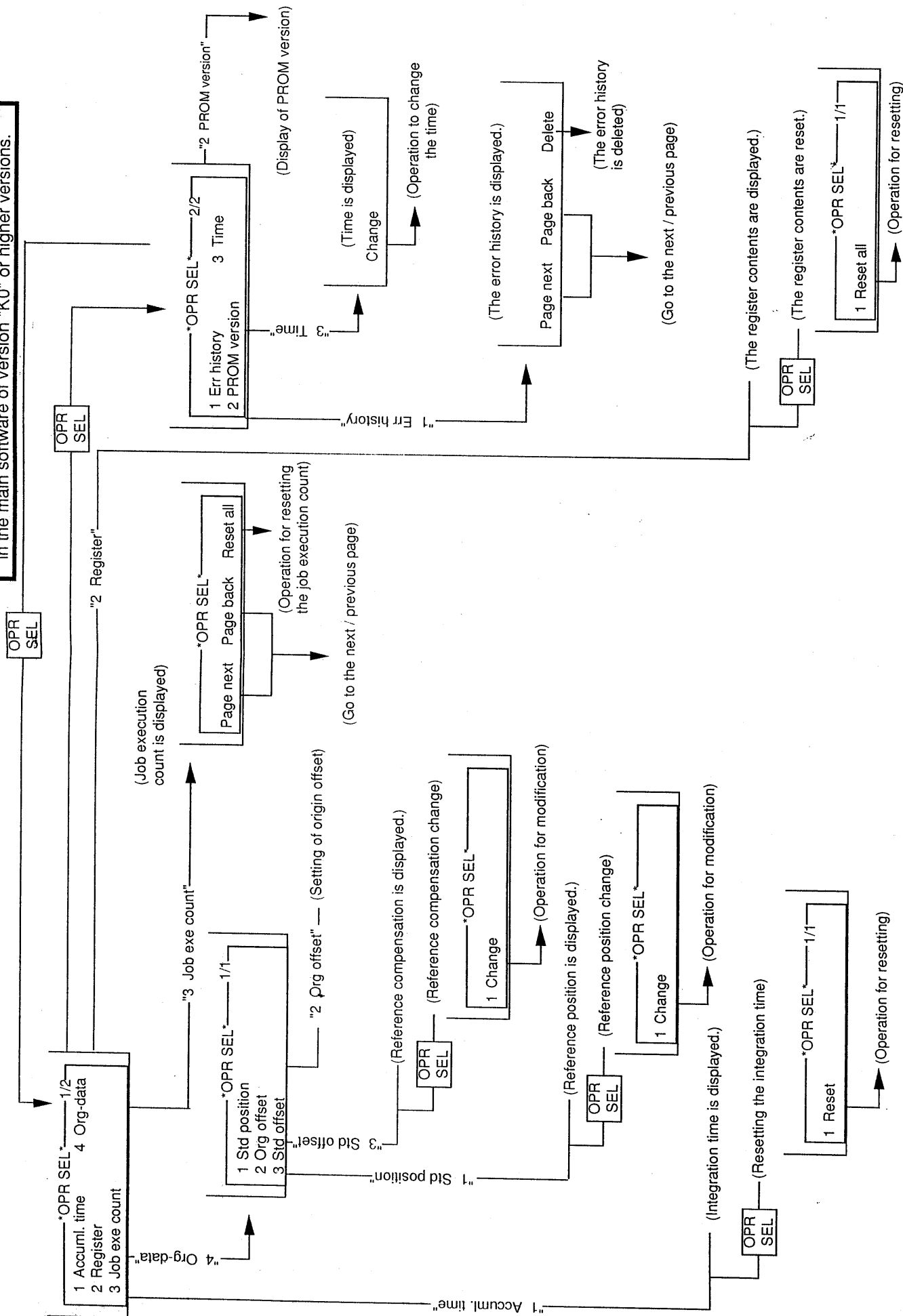


## 4.5 INITIAL SETUP



# 4.6 PRODUCT DATA

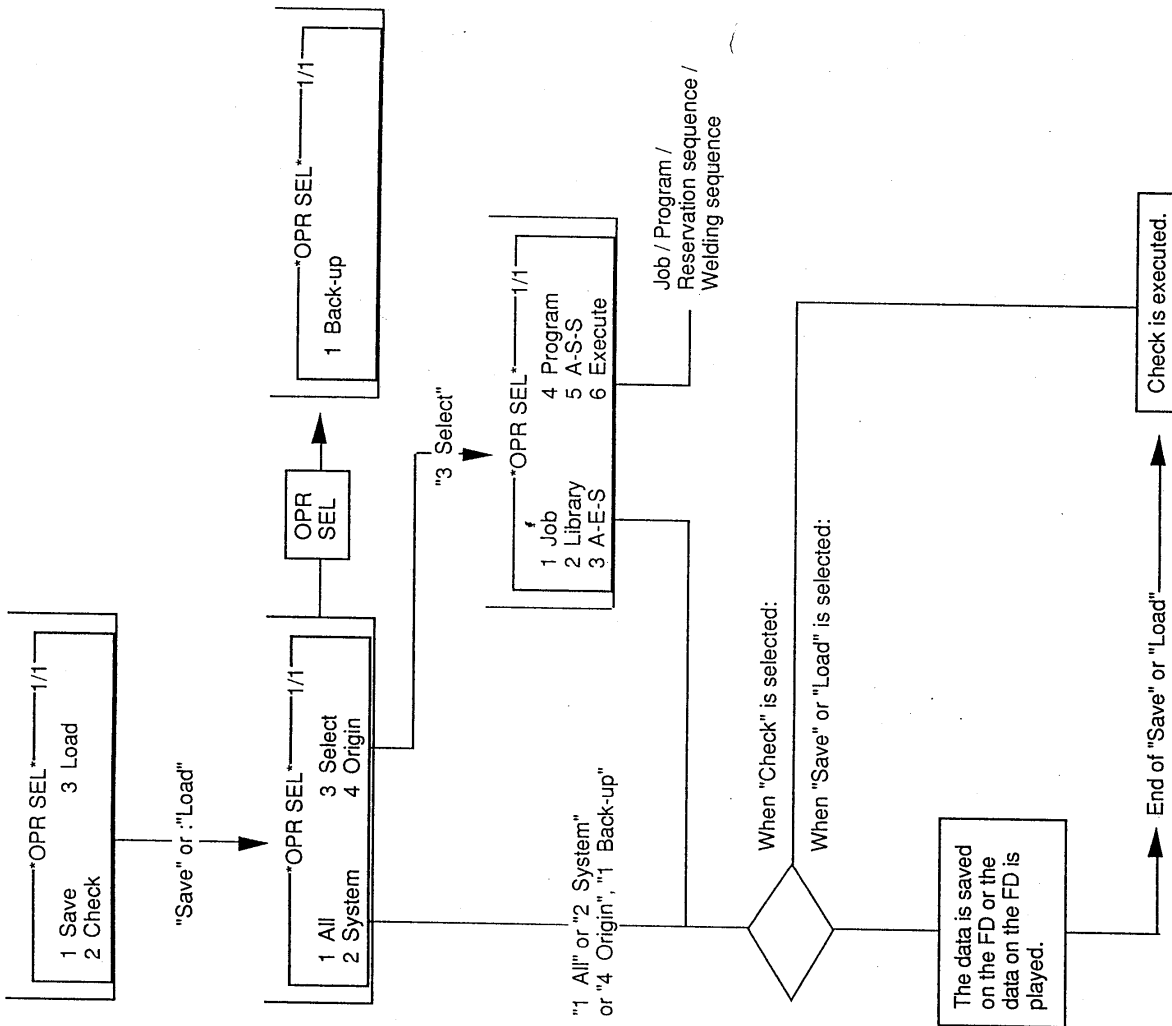
\* The number provided before each item is displayed in the main software of version "K0" or higher versions.





#### 4.7 EXTERNAL MEMORY

\* The number provided before each item is displayed in the main software of version "K0" or higher versions.



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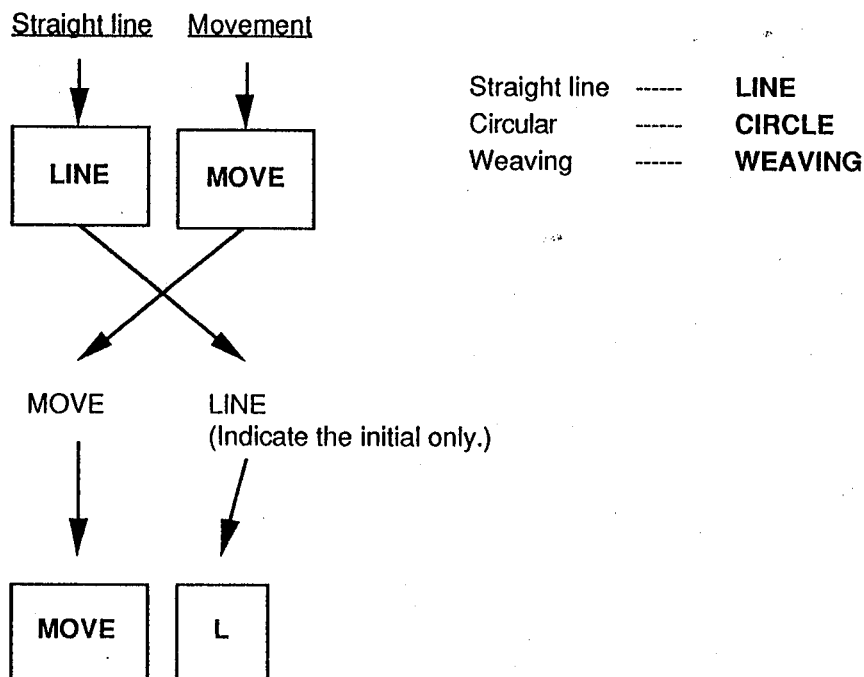


## APPENDIX 6 Differences between language used for RISC-A series and that for conventional machines (AW-8000 series etc.)

### (1) Move commands

Move commands of RISC-A series are made by combining MOVE and several other motions.

For instance, linear movement is created as follows;



Welding commands for conventional machines are indicated by "•". in A•O.  
For RISC-A series, these commands are indicated by adding "•" to the head of the respective operation commands.

(Example)

Welding point of linear interpolation ..... " • MOVEL "

| Move command<br>(conventional) | Description          | RISC-A series                                                                                                                                           |
|--------------------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| T-0<br>(T•0)                   | PTP                  | <b>MOVEP</b><br>For welding point, add "•" to head.<br>• MOVEP... welding point<br><br>Note)<br>For "•", refer to p.1.                                  |
| A-0<br>(A•0)                   | Linear interpolation | <b>MOVEL</b><br>(For welding point, same as PTP.)                                                                                                       |
| C-S<br>(C•S)                   | Circular start point | <b>MOVEC</b><br>(For welding point, same as PTP.)<br><br>Note)<br>"Circular (start)" is displayed while changing or adding in the program edit mode.    |
| C-S<br>(C•S)                   | Circular midpoint    | <b>MOVEC</b><br>(For welding point, same as PTP.)<br><br>Note)<br>"Circular (midpoint)" is displayed while changing or adding in the program edit mode. |
| C-E<br>(C•E)                   | Circular end point   | <b>MOVEL</b><br>(For welding point, same as PTP.)                                                                                                       |
| B-S<br>(B•S)                   | Weaving start point  | <b>MOVELW</b><br>(For welding point, same as PTP.)<br><br>Note)<br>"Weave (start)" is displayed while changing or adding in the program edit mode.      |
| B-1<br>(B•1)                   | Weaving amplitude 1  | <b>MOVELW</b><br>(For welding point, same as PTP.)<br><br>Note)<br>"Weave (amplitude)" is displayed while changing or adding in the program edit mode.  |

| Move command<br>(conventional) | Description                  | RISC-A series                                                                                                                                                           |
|--------------------------------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| B-2<br>(B•2)                   | Weaving amplitude 2          | <b>MOVEW</b><br>(For welding point, same as PTP.)<br><br>Note)<br>"Weave (amplitude)" is displayed while<br>changing or adding in the program edit mode.                |
| B-0<br>(C•0)                   | Weaving midpoint             | <b>MOVEW</b><br>(For welding point, same as PTP.)<br><br>Note)<br>"Weave (midpoint)" is displayed while<br>changing or adding in the program edit mode.                 |
| B-E<br>(C•E)                   | Weaving end point            | <b>MOVE</b><br>(For welding point, same as PTP.)                                                                                                                        |
| D-S<br>(D•S)                   | Circular weaving start point | <b>MOV CW</b><br>(For welding point, same as PTP.)<br>Note)<br>"Circular weaving (start)" is displayed while<br>changing or adding in the program edit mode.            |
| D-1<br>(D•1)                   | Circular weaving amplitude 1 | <b>MOV CW</b><br>(For welding point, same as PTP.)<br><br>Note)<br>"Circular weaving (amplitude)" is displayed<br>while changing or adding in the program edit<br>mode. |
| D-2<br>(D•2)                   | Circular weaving amplitude 2 | <b>MOV CW</b><br>(For welding point, same as PTP.)<br><br>Note)<br>"Circular weaving (amplitude)" is displayed<br>while changing or adding in the program edit<br>mode. |

| Move command<br>(conventional) | Description                | RISC-A series                                                                                                                                                          |
|--------------------------------|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| D-0<br>(D•0)                   | Circular weaving midpoint  | <b>MOV CW</b><br>(For welding point, same as PTP.)<br><br>Note)<br>"Circular weaving (midpoint)" is displayed<br>while changing or adding in the program edit<br>mode. |
| D-E<br>(D•E)                   | Circular weaving end point | <b>MOVE L</b><br>(For welding point, same as PTP.)                                                                                                                     |

(2) Sequence commands

1

Output command

| Move command<br>(conventional) | Function                                                                                                      | RISC-A series                                                                                                                                                              |
|--------------------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| O-0                            | Specified output terminal ON                                                                                  | <b>OUTB OPORT#10=1·0</b><br>Turns ON the output terminal #10: turns OFF for temporary or emergency stop.                                                                   |
| O-1                            | Specified output terminal OFF                                                                                 | <b>OUTB OPORT# 8=0·0</b><br>Turns OFF the output terminal #8.                                                                                                              |
| O-5                            | If register No. is as specified, turns ON specified output terminal. If not as specified, command is ignored. | <b>IF REG#15=3</b><br><b>THEN OUTB OPORT#10=1·0</b><br>Turns ON the output terminal #10 if "3" is set to the register #15.                                                 |
| O-6                            | Same function as O-0.<br>Does not turn OFF for temporary stop.                                                | <b>OUTB OPORT#10=1·1</b><br>Turns ON the output terminal #10: NOT turns OFF for temporary stop.<br><br>Note)<br>Output can be turned OFF.<br>Turns OFF for emergency stop. |
| O-7                            | Same function as O-5<br>Does not turn OFF for temporary stop.                                                 | <b>IF REG#10=5</b><br><b>THEN OUTB OPORT#1=1·1</b><br>Turns ON the output terminal #1 if "5" is set to the register #10.<br>Does not turn OFF for temporary stop.          |
| O-3                            | Sets welding power supply                                                                                     | <b>AMP=120A</b><br>(120 A output)                                                                                                                                          |
| O-4                            | Sets welding voltage                                                                                          | <b>VOLT=19.5V</b><br>(19.5 V output)                                                                                                                                       |
| O-2                            | Outputs data to specified parallel port.                                                                      | <b>OUTP OPORT#101=REG#10</b><br>Outputs data in register #10 to parallel port #101.<br><br><b>OUTP OPORT#101=50</b><br>Outputs "50" to parallel port#101.                  |

## 2 Waiting time

| Move command<br>(conventional) | Function                                                                          | RISC-A series                                                                                                                                                              |
|--------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| H-0                            | Holds until specified input terminal is turned ON.                                | <b>WAIT IPORT#10=1</b><br>Holds until input from input terminal #10.<br><br>Note)<br>There are 2 input states... 1: ON<br>0: OFF                                           |
| H-1                            | Holds for specified waiting time.<br>Time range: 0.1~99.9 sec.                    | <b>DELAY 2.0 sec..</b><br>Holds for 2.0 sec.                                                                                                                               |
| H-2                            | Holds until specified port is turned ON specified number of times.                | <b>WAIT IPORT#2=1</b><br><b>N=10</b><br>Holds until 10 inputs from input terminal #2.<br><br>Note)<br>There are 2 input states... 1: ON<br>0: OFF                          |
| H-4                            | Holds until specified input terminal is turned ON or until specified time passes. | <b>WAIT IPORT#10=1</b><br><b>T=2.5</b><br>Holds until input terminal #10 receives input signal or for 2.5 sec.<br><br>Note)<br>There are 2 input states... 1: ON<br>0: OFF |
| H-6                            | Holds until specified input terminal turns ON.                                    | <b>ILOCK IPORT#1=1</b><br>Holds until input from input terminal #1<br><br>Note)<br>There are 2 input states... 1: ON<br>0: OFF                                             |
| NEW                            | Stores data on specified input port state in specified register.                  | <b>IN REG#1=IPORT#101</b><br>Stores data input from parallel port #101 in register #1.                                                                                     |

### 3 Jump command

| Move command (conventional) | Function                                                                                              | RISC-A series                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| J-0                         | Unconditionally jumps to address of sequence command.                                                 | <b>GOTO ADDR=2</b><br>Jumps to address 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| J-1                         | Jumps to address of sequence command if a specified input terminal is ON. If OFF, command is ignored. | <b>IF IPORT#1=1</b><br><b>THEN ADDR 20</b><br><b>ELSE ADDR 15</b><br>Jumps to address 20 if input #1 is ON; If OFF, jumps to address 15.<br><br>Note)<br>When ELSE is not necessary, IF IPORT without ELSE clause is used.<br><br>Note)<br>There are 2 input states...    1: ON<br>0: OFF                                                                                                                                                                                                                                                                                                                                                                                              |
| J-3                         | Unconditionally jumps from a program to address within the job                                        | <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <u>PRG 20</u><br/><br/>           .....<br/>           3 MOVE 1 RETPRG<br/>           4 .....         </div> <div style="width: 45%;"> <u>JOB 1</u><br/><br/>           1 DELAY 5 sec.<br/>           2 GOUB PRG#20<br/>           3 GOTO ADDR=6<br/>           4 OUTB OPORT#1=1 0<br/>           5 OUTB OPORT#2=1 0<br/>           6 DELAY 10 sec.<br/>           7 .....         </div> </div> <p>Available if RETPRG command and GOTO ADDR=command is used.</p> <p>If JOB 1 is executed, operation proceeds to step 3 in program 20, then unconditionally jumps to address 6 in the job.</p> |
| J-4                         | Jumps to address within the job if a specified input terminal is ON.                                  | Note)<br>If specified input terminal is ON, jump is possible by creating a sequence as described above.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

| Move command<br>(conventional) | Description                                                                                                                | RISC-A series                                                                                                                                                                                                                                                                                   |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| J-5                            | Jumps to address of sequence command if specified value is set in specified register.                                      | <b>IF REG#15= 3</b><br><b>THEN ADDR=15</b><br><b>ELSE ADDR= 8</b><br>Jumps to address#10 if "3" is set to register#15.<br>If not set as "3", jumps to address# 8.<br><br>Note)<br>When ELSE is not necessary, IF IPORT without ELSE clause is used.                                             |
| J-6                            | Unconditionally jumps to program step No.<br>This command is valid only within a program.                                  | <b>GOTO STEP=5</b><br>Jumps to step 5.                                                                                                                                                                                                                                                          |
| J-7                            | Jumps to program step No. if a specified input terminal is ON.<br>This command is valid only within a program.             | <b>IF IPORT#= 1</b><br><b>THEN STEP 20</b><br><b>ELSE STEP 15</b><br>Jumps to step 20 if input terminal #1 is ON.<br>If OFF, jumps to step 15.<br><br>Note)<br>When ELSE is not necessary, IF IPORT without ELSE clause is used.<br><br>Note)<br>There are 2 input states...    1: ON<br>0: OFF |
| J-8                            | Jumps to program step No. if specified value is set in specified register.<br>This command is valid only within a program. | <b>IF REG#10= 5</b><br><b>THEN STEP= 9</b><br><b>ELSE STEP= 5</b><br>Jumps to step No. 9 if "5" is set to register#10.<br>If not "5", jumps to step 5.                                                                                                                                          |



| Move command<br>(conventional) | Description                                | RISC-A series                                                                                                                                                                    |
|--------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| J-H                            | Unconditionally jumps to waiting position. | <b>GOHOME V=20.00 0</b><br>Moves to waiting position at speed of 20.0 M/min.<br><br><b>GOHOME V=20.00 1</b><br>Moves to defined position by home command at speed of 20.0 M/min. |

#### 4 Call command

| Move command<br>(conventional) | Function                                                                                                                                                                                                                                       | RISC-A series                                                                                                                                                                                                                                                                                                     |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| L-0                            | Calls specified library                                                                                                                                                                                                                        | <b>GOSUB LIB# 3</b><br>Calls library #3.                                                                                                                                                                                                                                                                          |
| L-1                            | Calls library of specified No. if specified input terminal is ON. If OFF, command is ignored.                                                                                                                                                  | Command is made using jump command and call command.<br><b>IF IPORT# 1= 1</b><br><b>THEN ADDR 6</b><br><b>ELSE ADDR 7</b><br><br><b>-address 6-</b><br><b>GOSUB LIB# 2</b><br>Jumps to address 6 and calls library#2 if input terminal #1 is ON. If OFF, jumps to address 7 and executes the succeeding commands. |
| L-2                            | Calls library of specified No. if a specified value is set in a specified register. If NOT, command is ignored.                                                                                                                                | Command is made in same manner as L-1.<br><br><b>IF REG#1=10</b><br><b>THEN ADDR 8</b><br><b>ELSE ADDR 9</b><br><br><b>-address 8-</b><br><b>GOSUB LIB# 1</b><br>Jumps to address 8 and calls library #1 if "10" is set in register #1. If NOT, jumps to address 9 and executes the succeeding commands.          |
| P-C                            | Call program of specified No.                                                                                                                                                                                                                  | <b>GOSUB PRG#20</b><br>Calls program #20.                                                                                                                                                                                                                                                                         |
| U-0                            | If used in sequence in program, moves to next point without executing remaining sequences.<br>If used in job, terminates operation.<br>If used in library, returns to job or program originally called, without executing remaining sequences. | <b>RETSEQ</b>                                                                                                                                                                                                                                                                                                     |

| Move command<br>(conventional) | Function            | RISC-A series |
|--------------------------------|---------------------|---------------|
| NEW                            | Terminates program. | <b>RETPRG</b> |

**5 Welding control command**

| Move command<br>(conventional) | Function           | RISC-A series                     |
|--------------------------------|--------------------|-----------------------------------|
| AJO                            | Welding condition  | <b>AJO</b> (Same as conventional) |
| CJO                            | Crater condition   | <b>CJO</b> (Same as conventional) |
| ASS                            | Arc start sequence | <b>ASS</b> (Same as conventional) |
| AES                            | Arc end sequence   | <b>AES</b> (Same as conventional) |

**6 Register command**

| Move command<br>(conventional) | Function                                              | RISC-A series                                                                                                                                                                            |
|--------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| R-0                            | Sets specified value to specified register.           | <b>SETREG REG#10= 2</b><br>Sets "2" to register#10.                                                                                                                                      |
| R-1                            | Adds 1 to specified register.                         | <b>SETREG REG#10=</b><br>$\text{REG\#10} + 1$ $(-)$ Adds (subtracts) "1" to (from) register#10, then puts resultant value in register#10.<br><br>Note)<br>Addition/subtract range: 1~999 |
| R-2                            | Subtracts 1 from specified register.                  |                                                                                                                                                                                          |
| R-3                            | Switches values of specified registers.               | <b>SWPREG REG#1 REG#2</b><br>Switches values of register#1 and #2.                                                                                                                       |
| NEW                            | Clears (returns to ZERO) value of specified register. | <b>RETREG REG# 3</b><br>Clears register# 3.                                                                                                                                              |
| NEW                            | Clears (returns to ZERO) all register values.         | <b>RSTREG REG# ALL</b><br>Clears all register values.                                                                                                                                    |

## 7 Other new commands

| Move command (conventional) | Function                                                                                                | RISC-A series                                                            |
|-----------------------------|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Forced cancellation         | Forcibly cancels execution.                                                                             | <b>STOP</b><br>Cancels execution.                                        |
| Tool control                | Designates tool to be used.                                                                             | <b>TOOL# 1</b><br>Tool#1 is to be used.<br><br>Note)<br>Tool# range: 1~8 |
| Wait position definition    | Defines step as wait position.                                                                          | <b>HOME STEP=10</b><br>Define step 10 as wait position.                  |
| Non-operation               | No operation to be executed.<br>Clarifies commands by inserting between sequence commands such as jobs. | <b>NOP</b>                                                               |

## 8 Simultaneous treatment command / Temporary stop command

| Move command (conventional) | Function                                                                                   | RISC-A series                                                 |
|-----------------------------|--------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| ESC                         | Treats robot operation and sequence simultaneously.                                        | <b>ESC</b> (Same as conventional)                             |
| E-1                         | Terminates execution of command temporary.<br>"Restart" to execute the succeeding command. | <b>HOLD 20</b><br>Makes temporary stop and indicate ERROR 20. |