

Motoman ERC Controller

Programming Manual

for Software Version 4.0

Part Number: 479950-3CD
Revision: 2



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1.0 SAFETY

It is the purchaser's responsibility to ensure that all local, county, state, and national codes, regulations, rules, or laws relating to safety and safe operating conditions for each installation are met and followed.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems. This information can be obtained from the Robotic Industries Association by requesting ANSI/RIA R15.06. The address is as follows:

Robotic Industries Association

900 Victors Way
P.O. Box 3724
Ann Arbor, Michigan 48106
TEL: 313/994-6088
FAX: 313/994-3338

Ultimately, the best safeguard is trained personnel. The user is responsible for providing personnel who are adequately trained to operate, program, and maintain the robot cell. **The robot must not be operated by personnel who have not been trained!**

We recommend that all personnel who intend to operate, program, repair, or use the robot system be trained in an approved Motoman training course and become familiar with the proper operation of the system.

This safety section addresses the following:

- Standard Conventions (see Section 1.1)
- General Cautions and Warnings (see Section 1.2)
- Mechanical Safety Devices (see Section 1.3)
- Installation Safety (see Section 1.4)
- Programming Safety (see Section 1.5)
- Operation Safety (see Section 1.6)
- Maintenance Safety (see Section 1.7)

1.1 **STANDARD CONVENTIONS**

This manual includes information essential to the safety of personnel and equipment. As you read through this manual, be alert to the four signal words:

- DANGER
- WARNING
- CAUTION
- NOTE

Pay particular attention to the information provided under these headings which are defined below (in descending order of severity).



DANGER!

Information appearing under the DANGER caption concerns the protection of personnel from the immediate and imminent hazards that, if not avoided, will result in immediate, serious personal injury or loss of life in addition to equipment damage.



WARNING!

Information appearing under the WARNING caption concerns the protection of personnel and equipment from potential hazards that can result in personal injury or loss of life in addition to equipment damage.



CAUTION!

Information appearing under the CAUTION caption concerns the protection of personnel and equipment, software, and data from hazards that can result in minor personal injury or equipment damage.

NOTE:

Information appearing in a NOTE caption provides additional information which is helpful in understanding the item being explained.

1.2 GENERAL SAFEGUARDING TIPS

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

- Improper operation can result in personal injury and/or damage the equipment. Only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this robot system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the robot cell.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
- The robot must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06, section 6.13.4 and 6.13.5, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

1.3 MECHANICAL SAFETY DEVICES

The safe operation of the robot, positioner, auxiliary equipment, and system is ultimately the user's responsibility. The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, ANSI/RIA R15.06 safety standards, and other local codes that may pertain to the installation and use of industrial equipment. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety measures are available:

- Safety fences and barriers
- Light curtains
- Door interlocks
- Safety mats
- Floor markings
- Warning lights

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.

1.4 **INSTALLATION SAFETY**

Safe installation is essential for protection of people and equipment. The following suggestions are intended to supplement, but not replace, existing federal, local, and state laws and regulations. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. Installation tips are as follows:

- Be sure that only qualified personnel familiar with national codes, local codes, and ANSI/RIA R15.06 safety standards are permitted to install the equipment.
- Identify the work envelope of each robot with floor markings, signs, and barriers.
- Position all controllers outside the robot work envelope.
- Whenever possible, install safety fences to protect against unauthorized entry into the work envelope.
- Eliminate areas where personnel might get trapped between a moving robot and other equipment (pinch points).
- Provide sufficient room inside the workcell to permit safe teaching and maintenance procedures.

1.5 **PROGRAMMING SAFETY**

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Programming tips are as follows:

- Any modifications to PART 1 of the MRC controller PLC can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to PART 1. Making any changes without the written permission of Motoman will **VOID YOUR WARRANTY!**
- Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. **YOUR WARRANTY WILL BE VOID** if you use these special passwords.
- Back up all programs and jobs onto a floppy disk whenever program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.
- The concurrent I/O (Input and Output) function allows the customer to modify the internal ladder inputs and outputs for maximum robot performance. Great care must be taken when making these modifications. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations that may damage the robot or other parts of the system.
- Improper operation can cause personal injury and/or damage the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.

- Inspect the robot and work envelope to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Be sure that all safeguards are in place.
- Check the E-STOP button on the teach pendant for proper operation before programming.
- Carry the teach pendant with you when you enter the workcell.
- Be sure that only the person holding the teach pendant enters the workcell.
- Test any new or modified program at low speed for at least one full cycle.

1.6 OPERATION SAFETY

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Operation tips are as follows:

- Be sure that only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories are permitted to operate this robot system.
- Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Inspect the robot and work envelope to ensure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Ensure that all safeguards are in place.
- Improper operation can cause personal injury and/or damage the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.
- The robot must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot. This includes controller parameters, ladder parts 1 and 2, and I/O (Input and Output) modifications. Check and test all changes at slow speed.

1.7 MAINTENANCE SAFETY

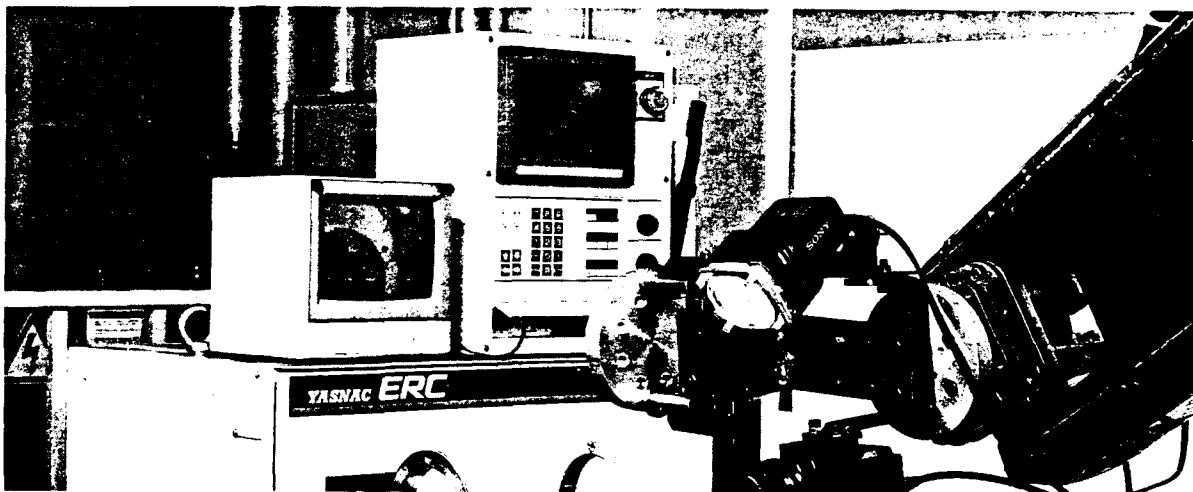
All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Maintenance tips are as follows:

- Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.
- Check all safety equipment for proper operation. Repair or replace any non - functioning safety equipment immediately.
- Improper operation can cause personal injury and/or damage the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.
- Back up all your programs and jobs onto a floppy disk whenever program changes are made. A backup must always be made before any servicing or changes are made to options, accessories, or equipment to avoid loss of information, programs, or jobs.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.
- The robot must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- Be sure all safeguards are in place.
- Use proper replacement parts.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot. This includes controller parameters, ladder parts 1 and 2, and I/O (Input and Output) modifications. Check and test all changes at slow speed.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).

YASNAC ERC

CONTROLLER FOR INDUSTRIAL ROBOT MOTOMAN

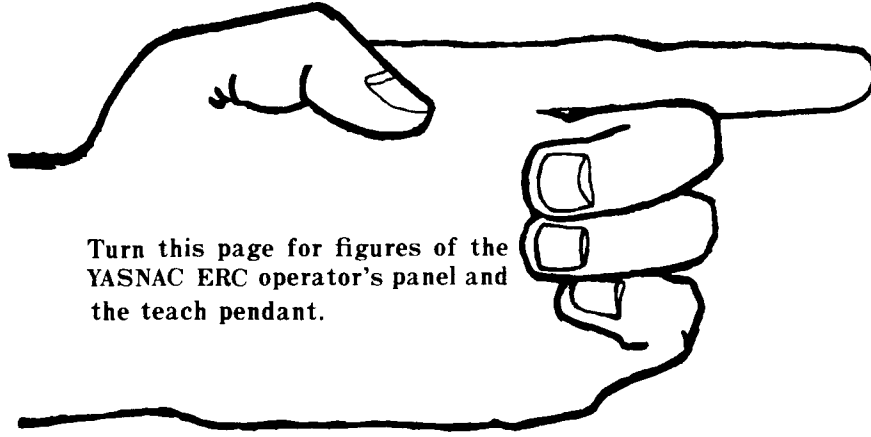
BASIC OPERATOR'S MANUAL



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



YASKAWA



Turn this page for figures of the YASNAC ERC operator's panel and the teach pendant.

This manual illustrates graphically the basic operation procedures for MOTOMAN robots, as shown below.



Refer to the standard Operator's Manual and Maintenance Manual, respectively, for details.

■ Related Publications

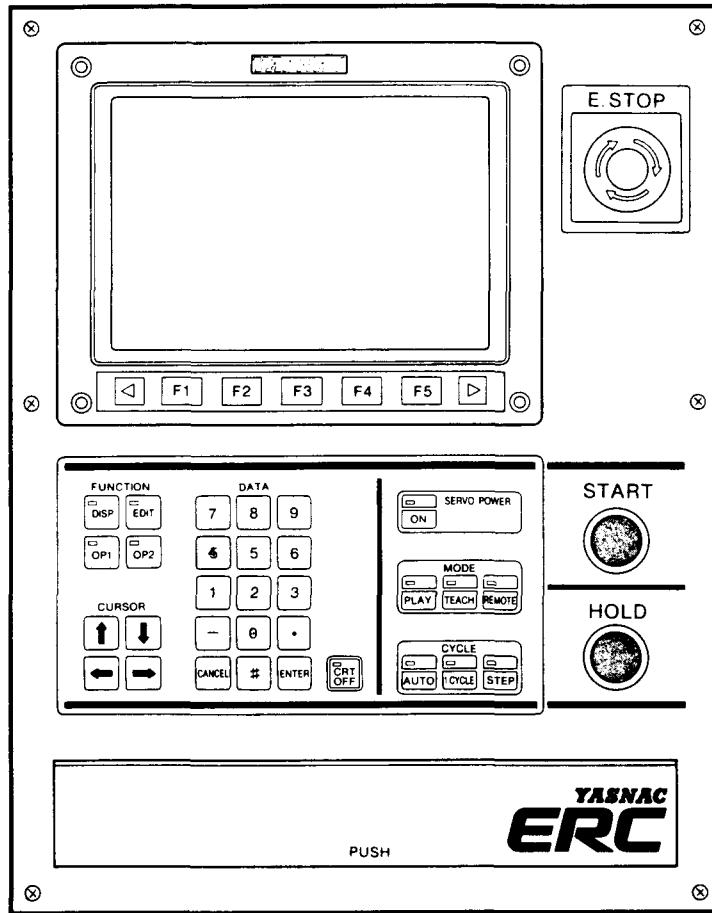
- Motoman Series with YASNAC ERC CONTROLLER
OPERATOR'S MANUAL (TOE-C945-100)
- YASNAC ERC MAINTENANCE MANUAL (TOE-C945-130)

CONTENTS

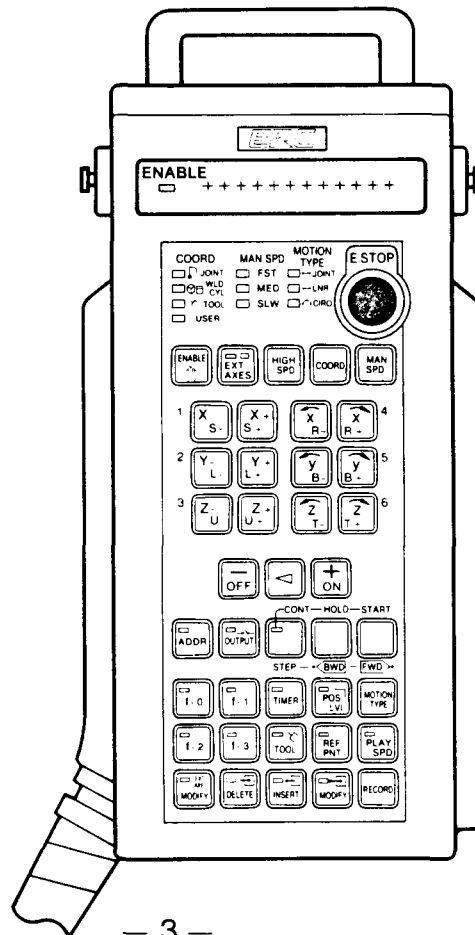
- POWER ON /4
- JOB CREATION
 - Teaching Preparation /6
 - Teaching Operation /8
 - Matching First Step and Last Step /12
 - Checking Step Operation /14
 - Teaching Unlock /15
- PLAYBACK
 - Playback Preparation (Master Entry) /15
 - Playback Preparation (Display of Job Text) /17
 - Playback Operation /18
- POWER OFF /19

Keep this page unfolded while performing key operation.

Operator's Panel
of YASNAC ERC



Teach Pendant

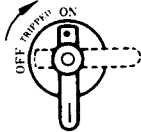




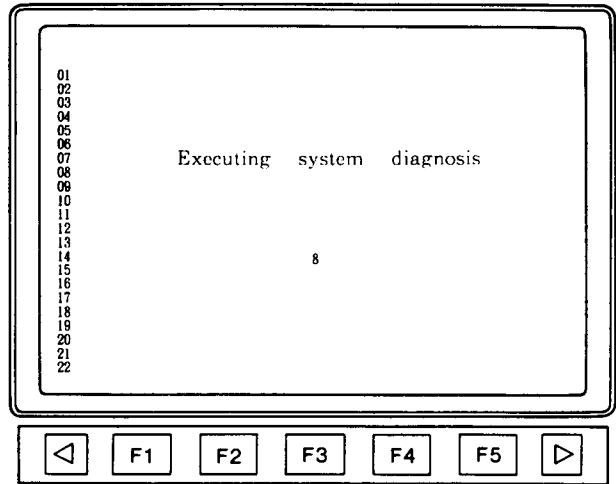
How to use the Operator's Panel.

Now, here you are in front of the operator's panel.

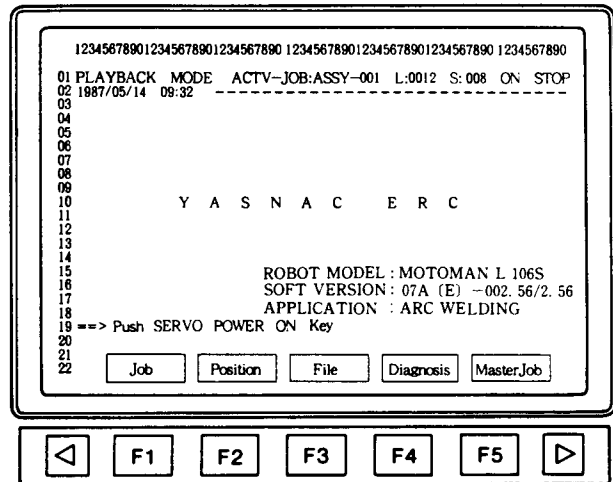
- 1 Turn the power supply switch on the control panel to ON position.



Executing memory test is displayed on CRT. When the power is turned on, all the lamps on operator's panel and teach pendant blink momentarily during memory test.



When the numerical value becomes 0, memory test is completed and ERC system starts to operate. Then the display on the right appears.

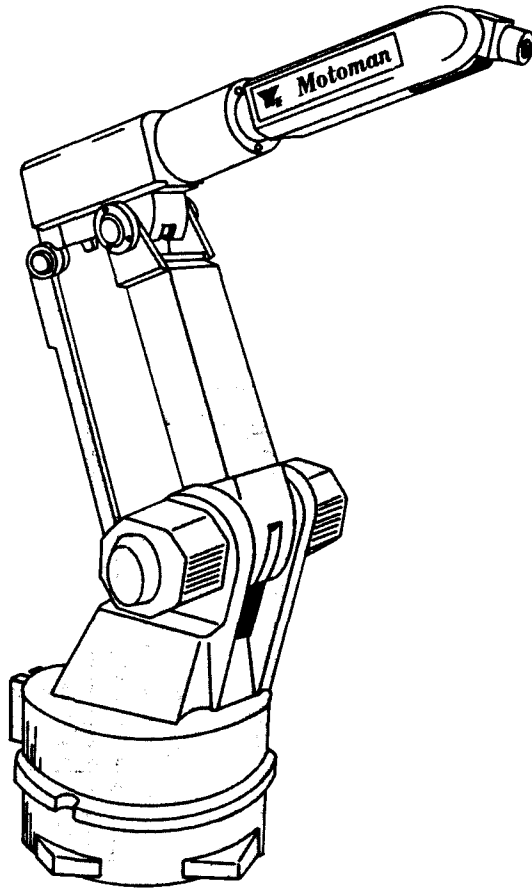




How to use the Operator's Panel.

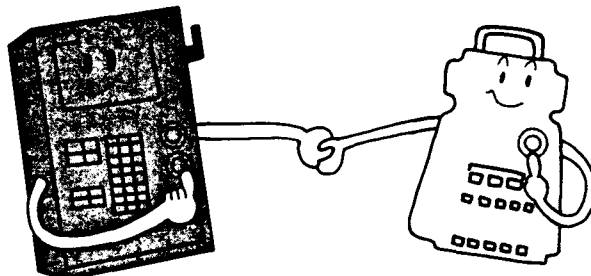
2 Depress  key.

- The servo power is turned on.

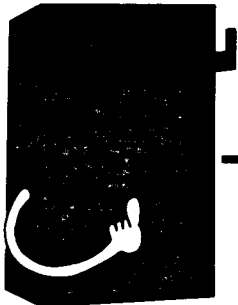


OPERATOR'S PANEL

TEACH PENDANT



Working together hand-in-hand!



How to use
Operator's Panel

TEACHING PREPARATION

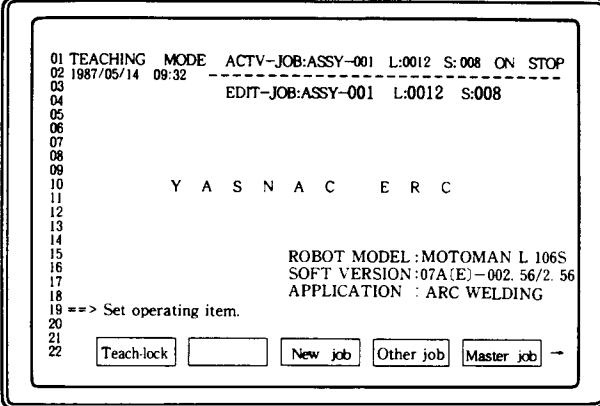
For teaching, specify job for the work to be taught.

3 Depress  key.

The **TEACH** key lamp will light.

4 Depress  key.

F3



01 TEACHING MODE ACTV-JOB:ASSY-001 L:0012 S:008 ON STOP
02 1987/05/14 09:32 -----
03 EDIT-JOB:ASSY-001 L:0012 S:008
04
05
06
07
08
09
10
11
12
13
14
15
16
17
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20
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22

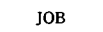
Y A S N A C E R C

ROBOT MODEL :MOTOMAN L 106S
SOFT VERSION:07A(E)-002.56/2.56
APPLICATION : ARC WELDING

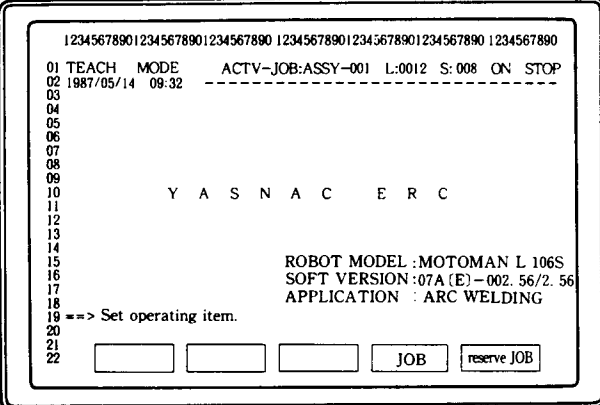
==> Set operating item.

Teach-lock New job Other job Master job -

F1 F2 F3 F4 F5

5 Depress  key.

F4



123456789012345678901234567890 12345678901234567890 1234567890 1234567890

01 TEACH MODE ACTV-JOB:ASSY-001 L:0012 S:008 ON STOP
02 1987/05/14 09:32 -----
03
04
05
06
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10
11
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14
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16
17
18
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22

Y A S N A C E R C

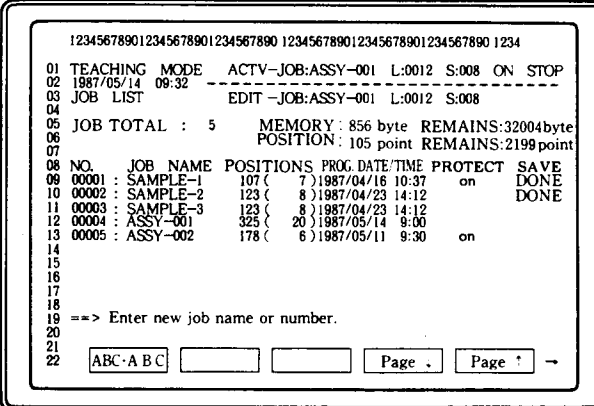
ROBOT MODEL :MOTOMAN L 106S
SOFT VERSION:07A(E)-002.56/2.56
APPLICATION : ARC WELDING

==> Set operating item.

JOB reserve JOB

F1 F2 F3 F4 F5

The display on the right appears.



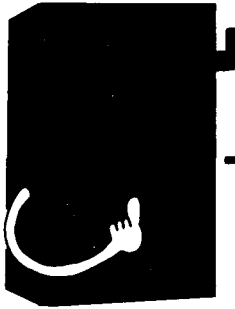
123456789012345678901234567890 123456789012345678901234567890 1234

01 TEACHING MODE ACTV-JOB:ASSY-001 L:0012 S:008 ON STOP
02 1987/05/14 09:32 -----
03 JOB LIST EDIT-JOB:ASSY-001 L:0012 S:008
04
05 JOB TOTAL : 5 MEMORY : 856 byte REMAINS:32004byte
06 POSITION : 105 point REMAINS:2199point
07
08 NO. JOB NAME POSITIONS PROG.DATE/TIME PROTECT SAVE
09 00001 : SAMPLE-1 107 (7) 1987/04/16 10:37 on DONE
10 00002 : SAMPLE-2 123 (8) 1987/04/23 14:12 DONE
11 00003 : SAMPLE-3 123 (8) 1987/04/23 14:12
12 00004 : ASSY-001 325 (20) 1987/05/14 9:00
13 00005 : ASSY-002 178 (6) 1987/05/11 9:30 on
14
15
16
17
18
19
20
21
22

==> Enter new job name or number.

ABC-A BC Page . Page ! -

F1 F2 F3 F4 F5



How to use the Operator's Panel.

TEACHING PREPARATION

6 If using number key, depress **ENTER** key.

• If signals are inputted, depress **▶** key and **Exit** key appears. After depressing

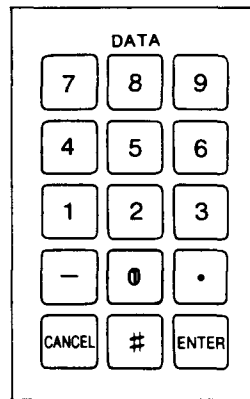
Exit key, depress **ENTER** key.



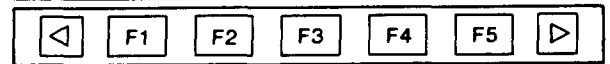
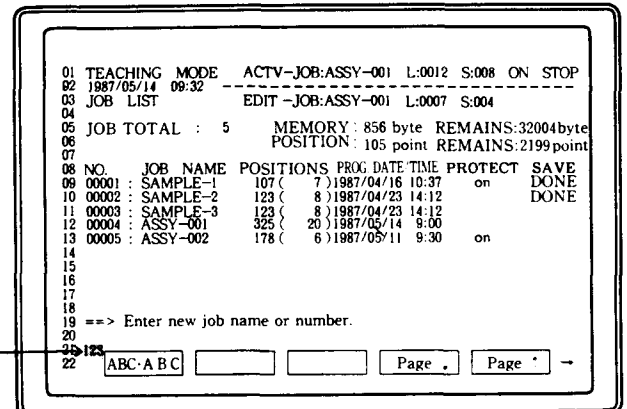
If the job number is wrong, depress **CANCEL** key to register the job number again.

Another method is as follows. Depress **▶** key, and **Back Space** key appears. Then depress

Back Space key to register the job number again.



If job number 1 2 3 is registered.

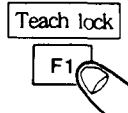


For the job name, the following number of the character is available:

Half-size - 8 characters

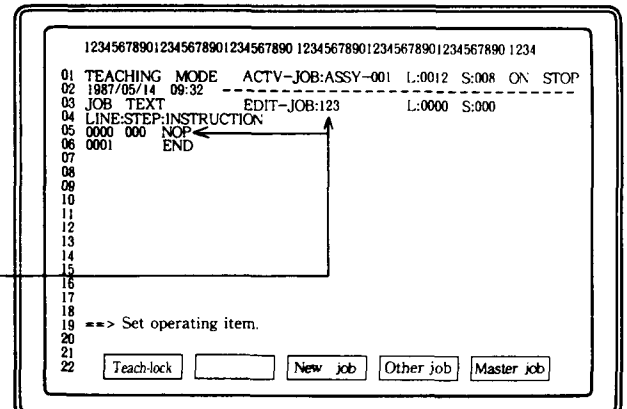
Full-size - 4 characters

7 Depress **Teach lock** key.



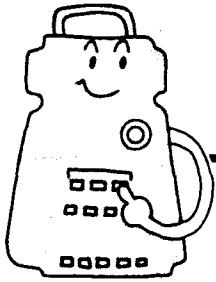
for personnel safety.

The new job name (or number) and its text is displayed on the CRT.



• TEACH MODE in the display changes to TEACH LOCK and its characters blink.

JOB CREATION



How to use the Teach Pendant.

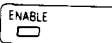
TEACHING OPERATION

Is the numbering completed ?

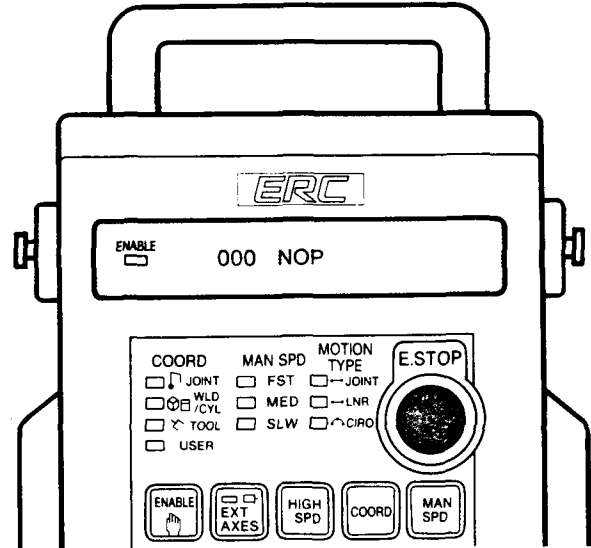
Then, hold the teach pendant, and stand in front of the manipulator.

Are you sure that you are outside the operation envelop of the manipulator ? Are you sure that there is no danger ?


8 Depress  key.


• The  lamp will light.

• The following display appears on the teach pendant and the operation is possible.




9 Depress  key to set the speed at "high".













• Speed changes FST → MED → SLW everytime depressing  key. If three lamps are lit, the manipulator starts inching.

• If axial operation is performed with depressing  key, the manipulator moves at highest speed with manual operation.

Now let's see what the manipulator will do. Let's watch the operation of each axis.

10 Depress the operation key of each axis, one by one, to move the axes of the manipulator.

• User Coordinates for link, rectangular, or cylindrical tools are selected each time the  key is depressed.

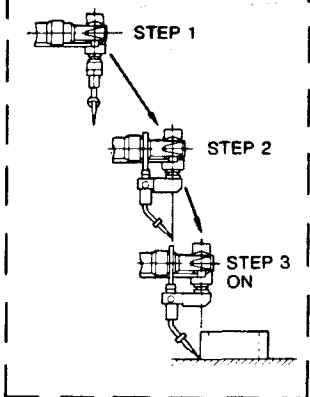
- | | | |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|----------------------------|
|  |  | S-axis(Rotation) |
|  |  | L-axis(Lower arm movement) |
|  |  | U-axis(Upper arm movement) |
|  |  | R-axis(Rolling) |
|  |  | B-axis(Bending) |
|  |  | T-axis(Turning) |

Did the manipulator move as intended ?



How to use the Teach Pendant.

Torch Position on Welding (Step 1 to Step 3)



Now, let's try teaching. Is the ENABLE lamp on? Teaching cannot be done without this lamp on.

11 Let the manipulator move to a start point by axial operation. (STEP 1)

Depress key and depress

key to set the speed at "50%".

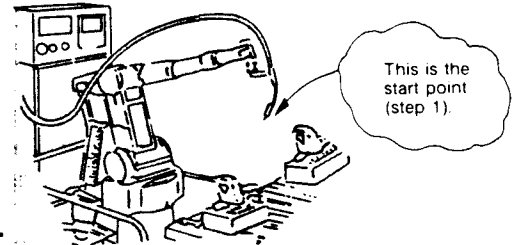
Then depress key.

For joint motion, after

depressing key to light

the lamp,

depress key.

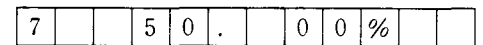


NOTE

Determine the start point considering the workpiece position.

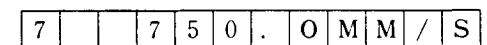
- If motion type is joint, the following display appears on the teach pendant.

Step



- If motion type is linear or circular, the following display appears on the teach pendant.

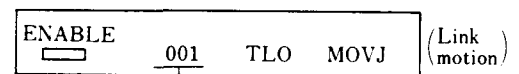
Step



- Eight speed(1 to 8)steps are selectable.

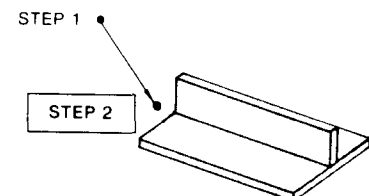
(When depressing key, speed increases.

When depressing key, speed reduces.)



The numeral increases by "1" each time the key is depressed. (Up to 999 steps are available.)

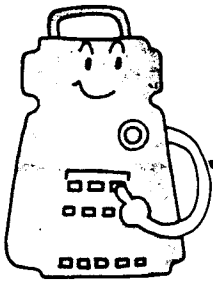
12 Let the manipulator move to the point near a welding start point by axial operation. (STEP 2)



13 Depress key.


- The following display appears on the teach pendant.





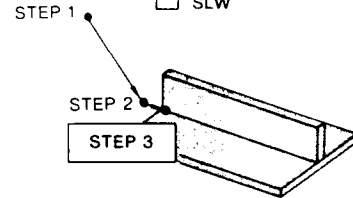
How to use the Teach Pendant.

Let's continue the teaching.

14 Depress  key to set the speed at MED.

MAN SPD
 FST
 MED lamp will be lit.
 SLW

15 Let the manipulator move to a welding start point by axial operation. (STEP 3)





16 Depress  key.

• The following display appears on the teach pendant.

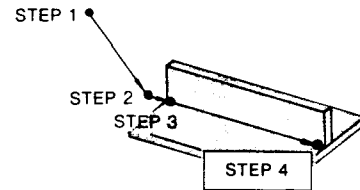
Then, after depressing



0	0	3	T	L	O	M	O	V	J
---	---	---	---	---	---	---	---	---	---

 key to set the speed at "12.47%", depress  key.


17 Let the manipulator move to a welding end point by axial operation. (STEP 4)

• Between the welding start point (STEP 3) and end point (STEP 4), let the manipulator move arbitrarily to avoid contact with the workpiece.



18 Depress  key.
 For linear motion, after depressing  key to light

• The following display appears on the teach pendant.


MOTION TYPE
 JOINT
 LNR
 CIRO
 the  lamp,

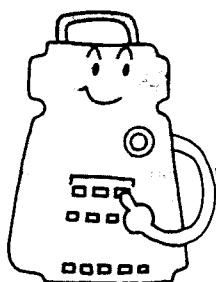
0	0	4	T	L	O	M	O	V	L
---	---	---	---	---	---	---	---	---	---

 (Link motion)

depress  key.

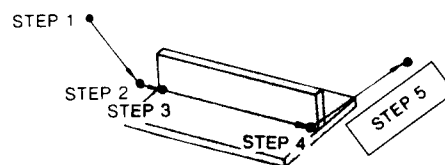
19 Depress  key to set the speed at FST.




MAN SPD
 FST
 MED
 SLW
 • The  lamp will be lit.



How to use the Teach Pendant.

20 Let the manipulator move away from the welding end point by axial operation. (STEP 5)

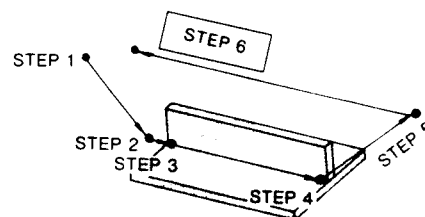


21 Depress  key.
After depressing  Key to set the speed at "50%", depress  key.

• The following display appears on the teach pendant.

0	0	5	T	L	O	M	O	V	J
---	---	---	---	---	---	---	---	---	---

22 Let the manipulator return to the point near the start point by axial operation. (STEP 6)

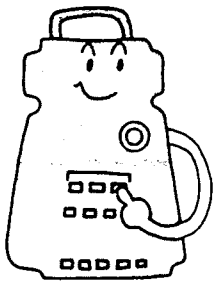


23 Depress  key.

• The following display appears on the teach pendant.

0	0	6	T	L	O	M	O	V	J
---	---	---	---	---	---	---	---	---	---

This ends the basic teaching operation.



How to use the Teach Pendant.

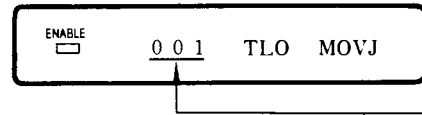
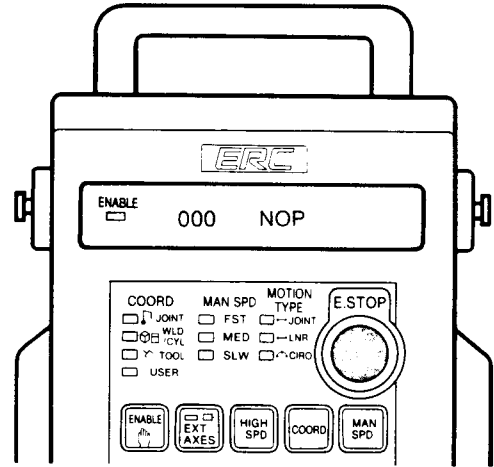
**MATCHING
FIRST STEP
AND
LAST STEP**

First, return the manipulator from the last step (step 6) to the first step (step 1).

24 Depress  key.




25 Depress    keys simultaneously.

Depress  key.

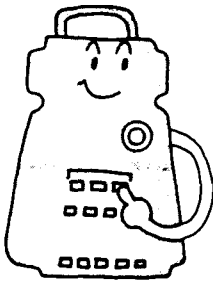


• If displayed step is different from the actual position of manipulator, 001 blinks.

Next, operate as follows while watching the movement of the manipulator.

26 Continue depressing    key until the manipulator returns to the first step (STEP 1).

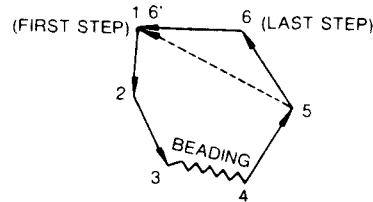
Does the manipulator return to the first step ?





How to use the Teach Pendant.

When the manipulator returns to the first step (step 1), let's match the last step (step 6) with this first step.

The manipulator moves in sequence from step 1 to step 6 and then from step 6 back to step 1. If these positions are different, alter step 6 to the same position as step 1 for efficient operation.



27 After depressing  key, depress  key three times,

and the last step (STEP6) of a program is displayed on CRT.

0 0 0 N O P once

0 0 6 E N D twice

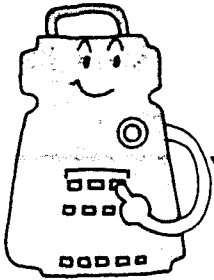
0 0 6 T L O M O V J three times

Blinks

28 Depress  key.

29 Depress  key.

With the above, the first step(step 1)and last step(step 6)will be at the same position.



How to use the Teach Pendant.

CHECKING STEP OPERATION

Next, check if the taught points are correct.

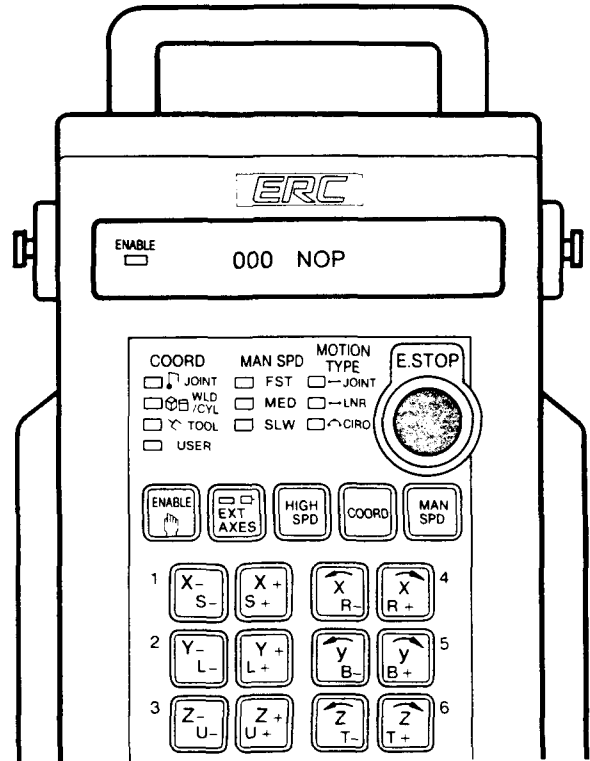
30 Depress  key.

Depress   



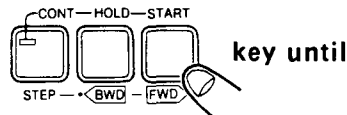
Depress  key.

0 0 1 T L O M O V J




Next, operate as follows, while watching the movement of the manipulator.

31 Continue depressing

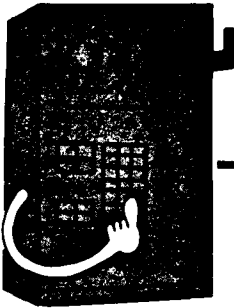


the manipulator moves from step 1 to step 6.

- Depress  key until the manipulator moves from step 1 to step 2. When the manipulator stops its motion, depress again to move to each subsequent step up to step 6.
- Operation speed can be changed by changing the data of teach pendant. At first, select lower speed e.g. "MED".

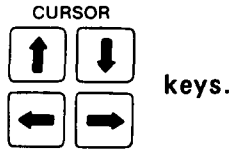
Hold down the  key, when 

key is depressed, the manipulator continues to operate, after once confirming the locus with low speed, perform this operation. (When the manipulator moves to the step of more than 25%, it operates with in-guard-safety speed.)



How to use the Operator's Panel.

35 Move the cursor with



Cursor

123456789012345678901234567890123456789012345678901234

```

01 TEACHING MODE ACTV-JOB:ASSY-001 L:0012 S:008 ON STOP
02 1987/05/14 09:32 --MASTER JOB:123-----
03 JOB LIST EDIT-JOB:123 L:0007 S:007
04
05 JOB TOTAL : 6. MEMORY : 963byte REMAINS:31897byte
06 POSITION : 112point REMAINS:2192point
07
08 NO. JOB NAME POSITIONS PROG DATE/TIME PROTECT SAVE
09 00001 : SAMPLE-1 107 ( 7 ) 1987/04/16 10:37 on DONE
10 00002 : SAMPLE-2 123 ( 8 ) 1987/04/23 14:12 on DONE
11 00003 : SAMPLE-3 123 ( 8 ) 1987/04/23 14:12
12 00004 : ASSY-001 325 ( 20 ) 1987/05/14 9:00
13 00005 : ASSY-002 178 ( 6 ) 1987/05/11 9:30 on
14 00006 : 123 107 ( 7 ) 1987/05/14 9:32
15
16
17
18
19 ==> Cursor on master job.
20
21
22 ABC ABC   Page * Page ! ->

```

◀ F1 F2 F3 F4 F5 ▶

36 Depress key.

Cursor

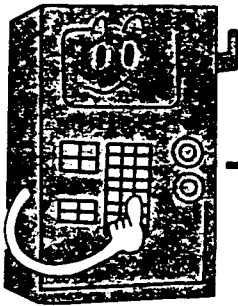
123456789012345678901234567890123456789012345678901234

```

01 TEACHING MODE ACTV-JOB:ASSY-001 L:0012 S:008 ON STOP
02 1987/05/14 09:32 --MASTER JOB:123-----
03 JOB LIST EDIT-JOB:123 L:0007 S:007
04
05 JOB TOTAL : 6. MEMORY : 963byte REMAINS:31897byte
06 POSITION : 112point REMAINS:2192point
07
08 NO. JOB NAME POSITIONS PROG DATE/TIME PROTECT SAVE
09 00001 : SAMPLE-1 107 ( 7 ) 1987/04/16 10:37 on DONE
10 00002 : SAMPLE-2 123 ( 8 ) 1987/04/23 14:12 on DONE
11 00003 : SAMPLE-3 123 ( 8 ) 1987/04/23 14:12
12 00004 : ASSY-001 325 ( 20 ) 1987/05/14 9:00
13 00005 : ASSY-002 178 ( 6 ) 1987/05/11 9:30 on
14 00006 : 123 107 ( 7 ) 1987/05/14 9:32
15
16
17
18
19 ==> Set operating item.
20
21
22 Teach-lock  New job Other job Master job

```

◀ F1 F2 F3 F4 F5 ▶

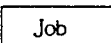



How to use the Operator's Panel.

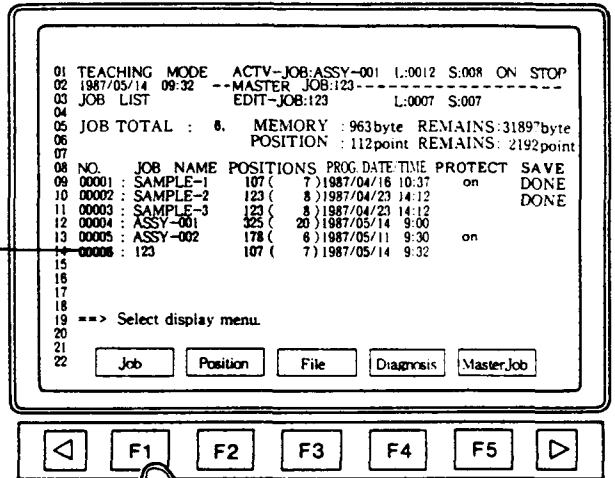
PLAYBACK PREPARATION (Display of Job text)

Now, let's move the manipulator from the beginning. Check that there is no one near the manipulator.

37 Depress  key.

38 Depress  key.
 key.

Cursor

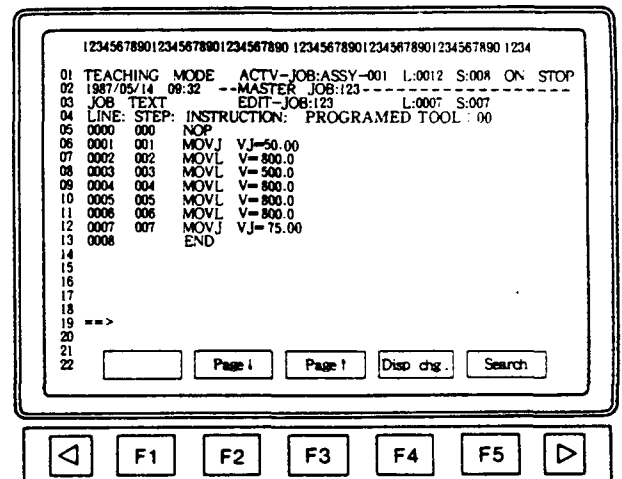


```

01 TEACHING MODE ACTV-JOB:ASSY-001 L:0012 S:008 ON STOP
02 1987/05/14 09:32 --MASTER JOB:123-----
03 JOB LIST EDIT-JOB:123 L:0007 S:007
04
05 JOB TOTAL : 6. MEMORY : 963byte REMAINS:31897byte
06 POSITION : 112point REMAINS: 2192point
07
08 NO. JOB NAME POSITIONS PROG DATE TIME PROTECT SAVE
09 00001 : SAMPLE-1 107 ( 7 ) 1987/04/16 10:37 on DONE
10 00002 : SAMPLE-2 123 ( 8 ) 1987/04/23 14:12 DONE
11 00003 : SAMPLE-3 123 ( 8 ) 1987/04/23 14:12
12 00004 : ASSY-001 325 ( 20 ) 1987/05/14 9:00
13 00005 : ASSY-002 178 ( 6 ) 1987/05/11 9:30 on
14 00006 : 123 107 ( 7 ) 1987/05/14 9:32
15
16
17
18
19 ==> Select display menu.
20
21
22 Job Position File Diagnosis MasterJob
  
```

Navigation buttons: < F1 F2 F3 F4 F5 >

• The display on the right appears.



```

123456789012345678901234567890123456789012345678901234
01 TEACHING MODE ACTV-JOB:ASSY-001 L:0012 S:008 ON STOP
02 1987/05/14 09:32 --MASTER JOB:123-----
03 JOB TEXT EDIT-JOB:123 L:0007 S:007
04 LINE: STEP: INSTRUCTION: PROGRAMED TOOL : 00
05 0000 000 NOP
06 0001 001 MOVJ VJ=50.00
07 0002 002 MOVL V=800.0
08 0003 003 MOVL V=500.0
09 0004 004 MOVL V=800.0
10 0005 005 MOVL V=800.0
11 0006 006 MOVL V=800.0
12 0007 007 MOVJ VJ=75.00
13 0008 END
14
15
16
17
18
19 ==>
20
21
22 Page 1 Page 1 Disp chg. Search
  
```

Navigation buttons: < F1 F2 F3 F4 F5 >

PLAYBACK




How to use the Operator's Panel.


PLAYBACK OPERA- TION

Now, let's move the manipulator from the beginning. Check that there is no one near the manipulator.

39 Depress  key.

• The  key lamp will light.

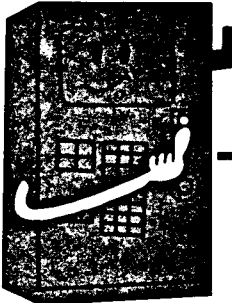
40 Depress  key.

• The  key lamp will light.

41 Push  button.

• The START button lamp will light, and the manipulator moves.

Did the manipulator move from step 1 to step 6 and stop, just as it was taught ?



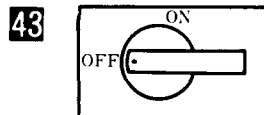
How to use the Operator's Panel.

POWER OFF

Always turn off the power when ending the operation. If you want to continue the teaching operation, start again from the "Teaching Preparation" on page 6 .

42 Push  button.

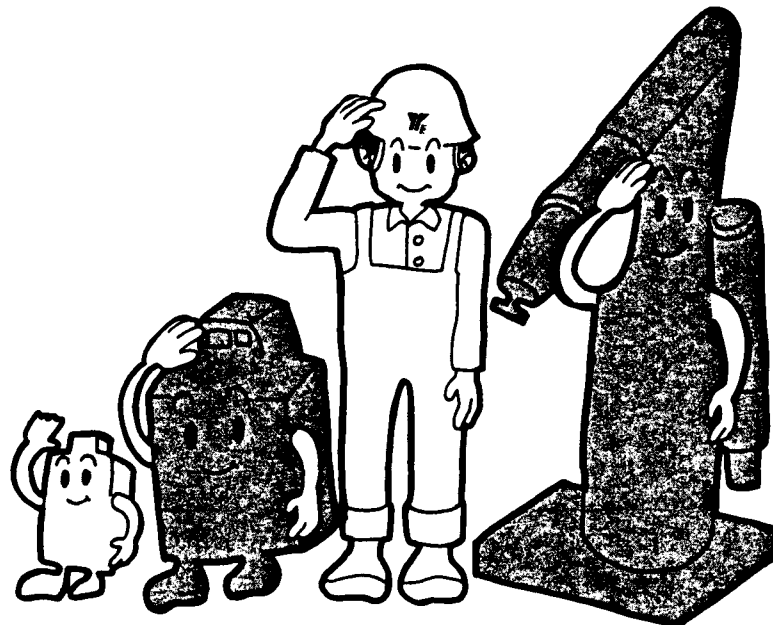
• The servo power is turned OFF.



• The power is turned off.

Turn the power supply switch to OFF.

Now the basic operation is completed.



Always at your service!

YASNAC ERC

CONTROLLER FOR INDUSTRIAL ROBOT MOTOMAN

BASIC OPERATOR'S MANUAL

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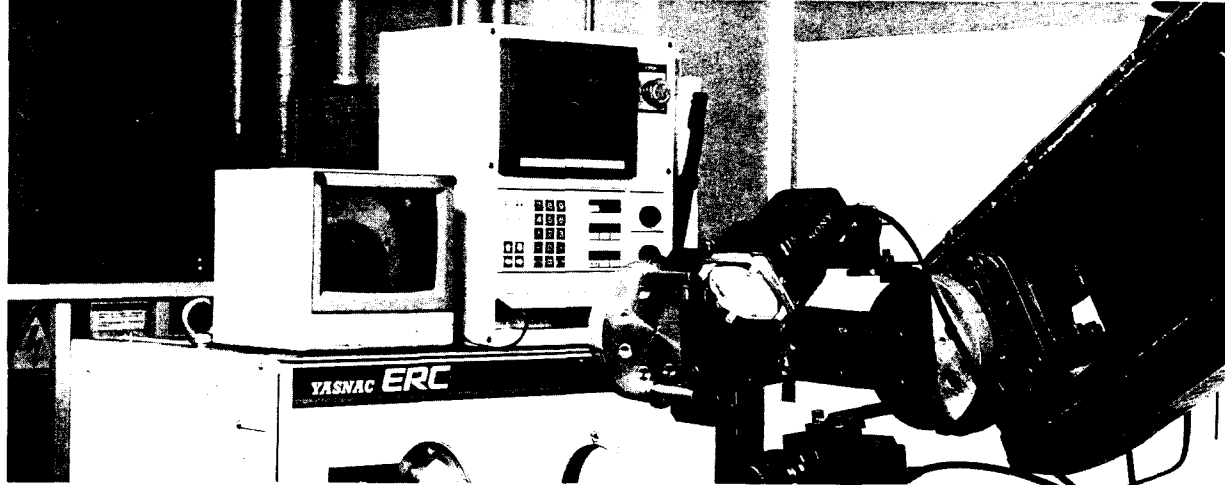
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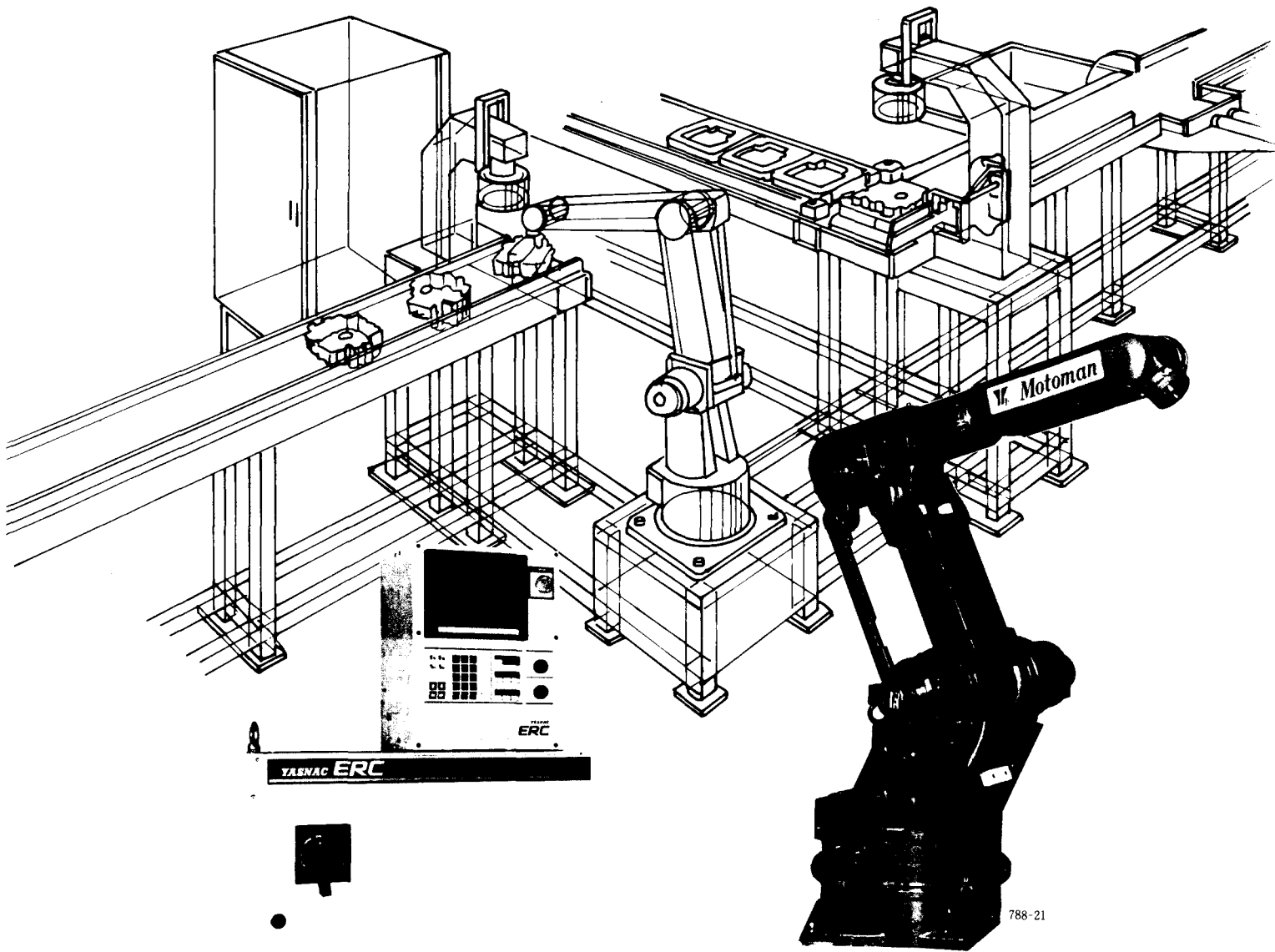
CONTROLLER FOR INDUSTRIAL ROBOT MOTOMAN
OPERATOR'S MANUAL



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



YASKAWA



Manipulator-K6SB



587-51

YASNAC ERC
Controller

This manual consists of **Basic Operation** and **Applied Operation**.

Basic Operation is summarized each key function, operation of “Main power ON → Teaching → Play back → Main power OFF”, movement of manipulator, etc.

Applied Operation is explained the job edition in operator’s panel and teach pendant, data storage, diagnosis operation, etc.

Become thoroughly familiar with this manual, and utilize it for active operation of Motoman series.

RELATED MANUAL

YASNAC ERC (KAE-C945-100)

YASNAC ERC
Maintenance Manual (TOE-C945-130)

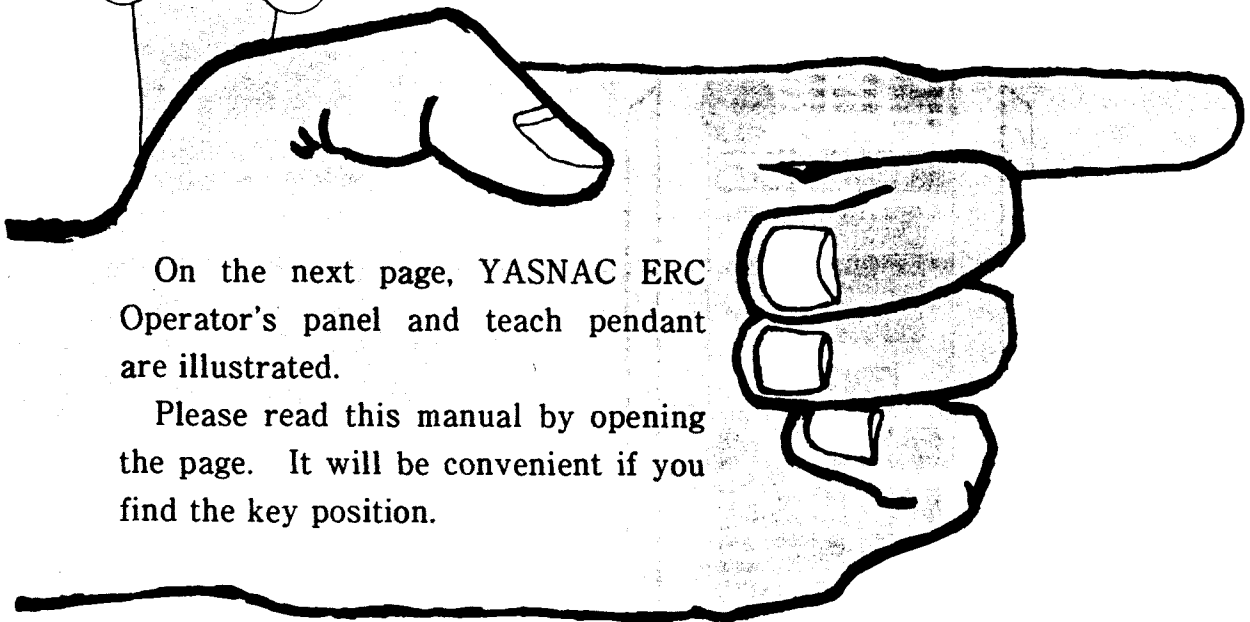
Motoman Series
Basic Operator’s Manual (TOE-C945-160)

For Each Application
Motoman Series
Operator’s Manual (TOE-C945-161)

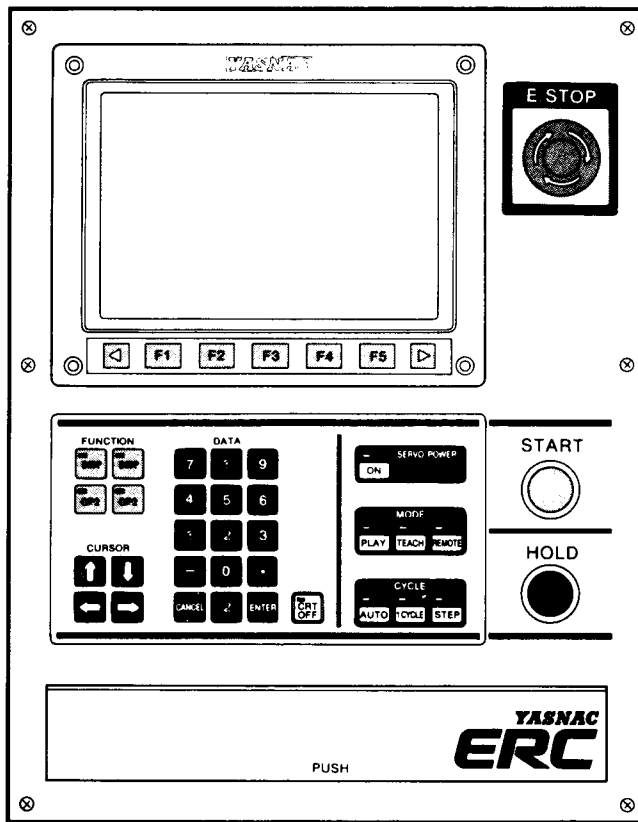


On the next page, YASNAC ERC Operator’s panel and teach pendant are illustrated.

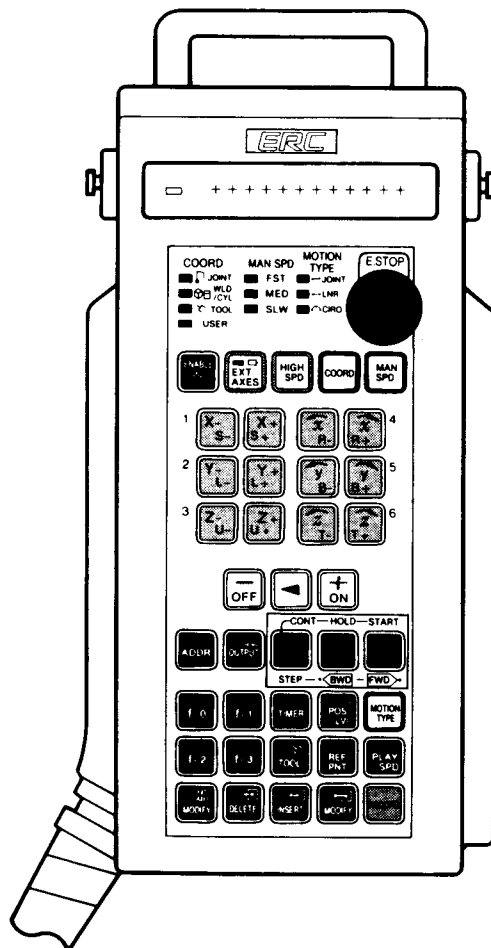
Please read this manual by opening the page. It will be convenient if you find the key position.



Keep open this page to visualize the key position.



YASNAC ERC
Operator's Panel















Teach Pendant

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BASIC OPERATION

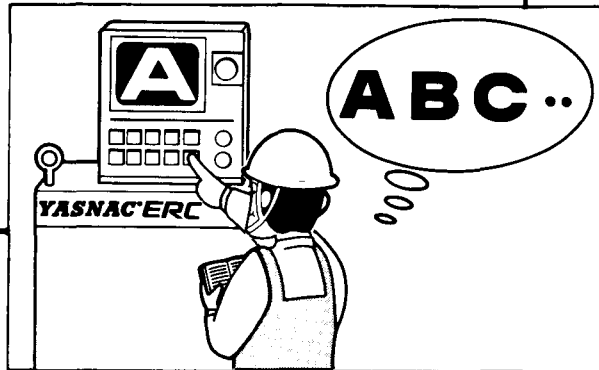
SECTION 1

SWITCH, BUTTON AND KEY FUNCTIONS

1

This section describes the following items.

- Approximate function of controller, operator's panel and teach pendant
- Description of soft keys and CRT display
- How to input data



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1. 1 POWER SUPPLY SWITCH ON CONTROLLER

Main power switch is provided on the front door of controller.

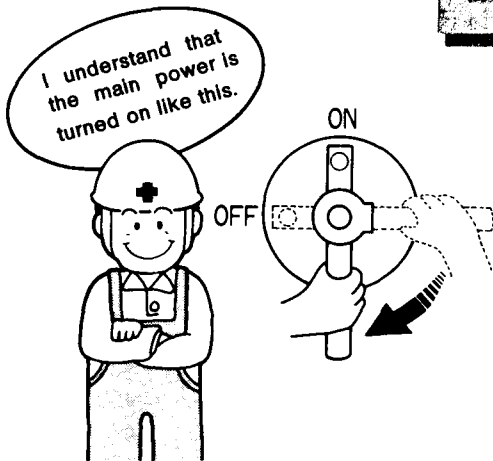
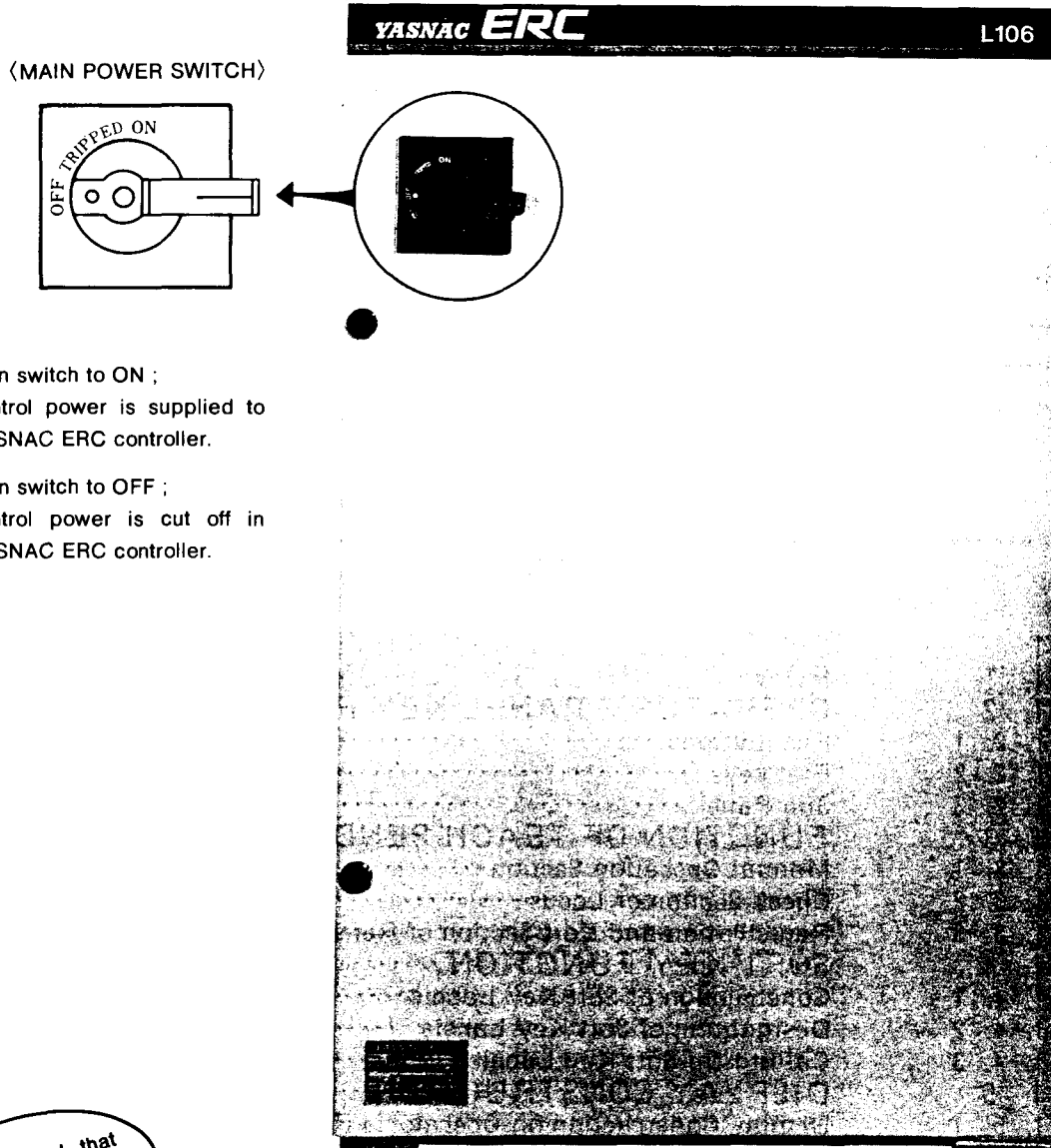


Fig. 1.1 YASNAC ERC Controller

1. 2 OPERATOR'S PANEL KEY FUNCTION

CRT DISPLAY is constructed so that data can be seen easily.

- 9-inch CRT display
- 22-lines, 32 characters
(66 characters in half-size character)

FLAT KEYS arranged according to their function.

- Control keys for manipulator operation (Servo power, start, hold)
- Keys for display switching and data input/edition
- Soft keys for interactive operation

AUXILIARY PANEL is the following parts.

INTERNAL AUX. PANEL

- Receptacle of 100 VAC power (for floppy)
- Connector for floppy and personal computer connection (D-SUB connector)
- Overrun recovery switch
- Edit lock with key (Memory protect)

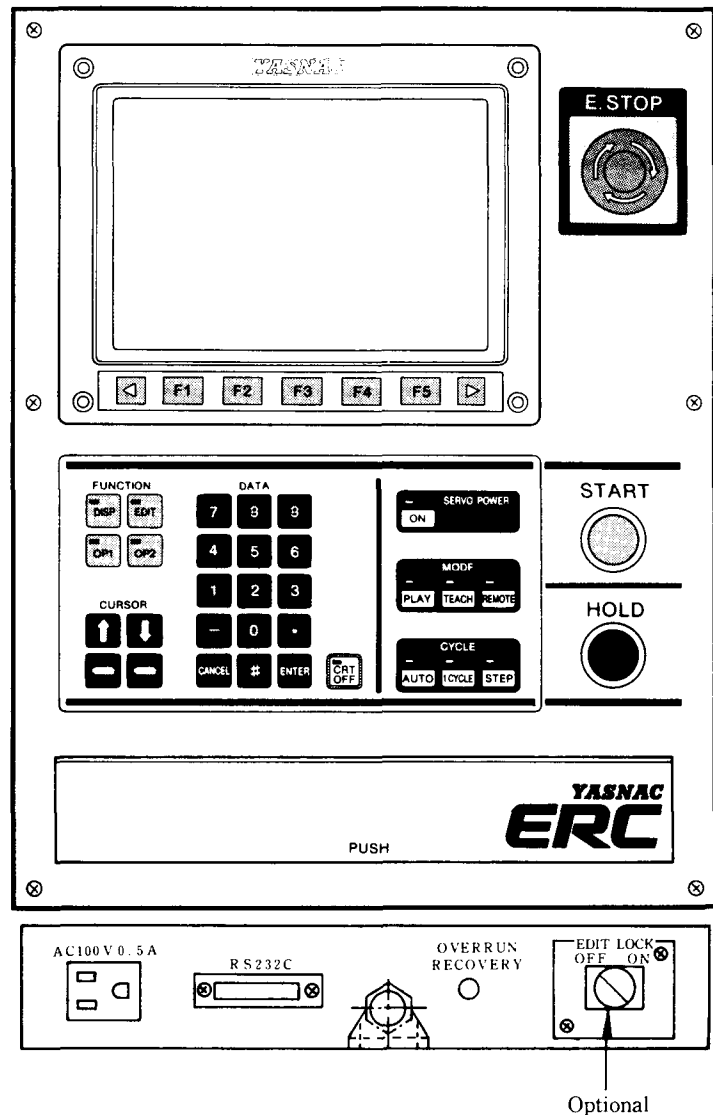
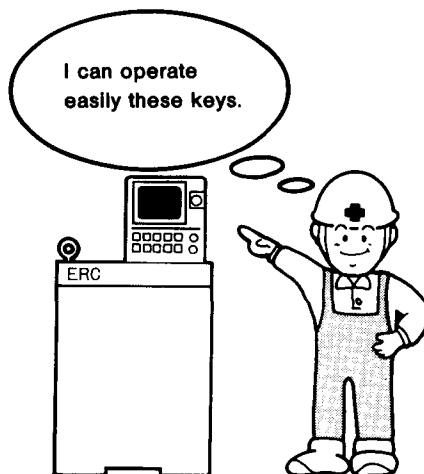


Fig. 1.2 Operator's Panel

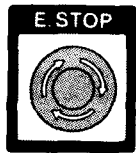
NOTE


If operator's panel is not operated for more than about 10 minutes, the CRT display brightness automatically lowers in order to prevent deterioration of the CRT display.



1. 2. 1 Pushbuttons

Cuts only the servo power to the manipulator and stops it immediately.



The SERVO POWER key lamp  is turned off and CRT display will show a message.

This switch is locked by pushing it and released by turning it in the direction of the arrow.

Depress SERVO POWER key  to supply the servo power again.

START



Starts the manipulator automatic operation in the PLAY mode only.

If the start from operator's panel is prohibited, an error will occur.

When the automatic operation is possible, the START lamp remains lit.

HOLD



Stops temporarily manipulator motion in any mode.

HOLD lamp is lit while HOLD pushbutton is depressed.

Start and axis operations cannot be executed.

If the lamp is turned off by releasing the pushbutton, the manipulator remains at stop until the next starting is designated.

In the following cases, HOLD lamp is lit automatically to indicate that the system is on HOLD.

- HOLD operation on the teach pendant.
- HOLD signal is received through special input.
- HOLD requirement from external computer in the REMOTE mode.
- During welding.

1. 2. 2 Flat Keys

[**SERVO POWER** : Turns on servo power.]



Lights when servo power for all axes is turned on.

To cut off it, depress



key.

1

[**MODE** : Executes automatic operation by teaching, playback, external reference. The selected key lamp is lit.]



Enables automatic manipulator operation of the taught job.



Enables axis operation on teach pendant and editing operation on the operator's panel.

If EDIT LOCK is set, only axis operation is possible and the data cannot be changed.



Enables automatic manipulator operation by the designation through an external computer.

This key does not respond in a standard system.

[**CYCLE** : Selects operating method in playback for specified job.]



Operates the master job repeatedly.

Except for master jobs, manipulator executes the job once and stops.



Operates the selected job once.



Operates one step of the job each time the STEP key is depressed.

1. 2. 2 Flat Keys (Cont'd)

[**FUNCTION** : Changes the soft key labels shown on CRT, and calls up the desired labels.]



Calls up the soft key labels to select CRT display (display text).



Calls up the soft key labels for data editing.

This key cannot be used when EDIT LOCK key is set on sub panel or when the display is for any function other than edit operation.



Calls up the soft key labels to select floppy disk operation display and optional function display.




Normally this key is not used.

[**CURSOR**]



Moves the cursor on the CRT display in the direction of the arrows.

When  keys are depressed simultaneously, the cursor is placed on the upper-left portion of the display.

The size and movable sphere of the cursor are determined previously depending on each display.

[**DATA**]



Inputs numeric values when soft key label for numeric input is displayed.



Minus for assigning a negative number



Cancels erroneous input data or error status with message.



Reserve key. When the characters are input, inputting as character #, is possible.



Designates the execution of each process for search or editing operation of data.

By depressing this key, the data inside the input buffer line are registered, modified, or inserted the cursor position..

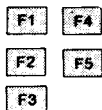
If this key is depressed while a character display appears, the characters designated by the cursor will be input in the input line. To release character input, depress Exit soft key.

[CRT OFF]



Deletes the display on CRT. The deletion is released by depressing this key again and the previous display reappears.

[SOFT KEY]



Corresponds to the function of soft key labels at the bottom of the CRT display.



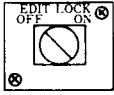
Calls up the next five soft key labels of the same level while the “→” symbol appears at the lower right portion.



Calls up the soft key labels one rank higher than the soft key being displayed.

If this key is depressed before ENTER key is depressed, the input operation will be disabled.

1. 2. 3 Sub Panel



(Optional)


Prohibits the editing operation from the operator's panel or teach pendant at ON position. At this time, **EDIT** Key cannot be operated.

This switch is used with a key. The key can be pulled out at ON position.

Even if EDIT LOCK is set, the data is saved in a floppy disk.



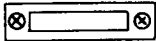
Releases momentarily the overrun status (OT-LS : when overrun limit switch is operated) while this key is depressed.

If the servo power is turned ON again at overrun status, depress "  SERVO" key while holding down this pushbutton. Then overrun status can be avoided by axes operation on the teach pendant.



If this pushbutton is depressed when OT-LS is not operated, servo power is cut off and an alarm occurs.

RS232C



Transmission (D-SUB) connector for floppy disks.

By using an option function, connection with a personal computer is also possible. However, the personal computer models and functions that can be accessed are limited. Contact your Yaskawa representative.

AC100V 0.5A



Power for floppy disk. This cannot be used for any other purpose.

1. 3 FUNCTION OF TEACH PENDANT

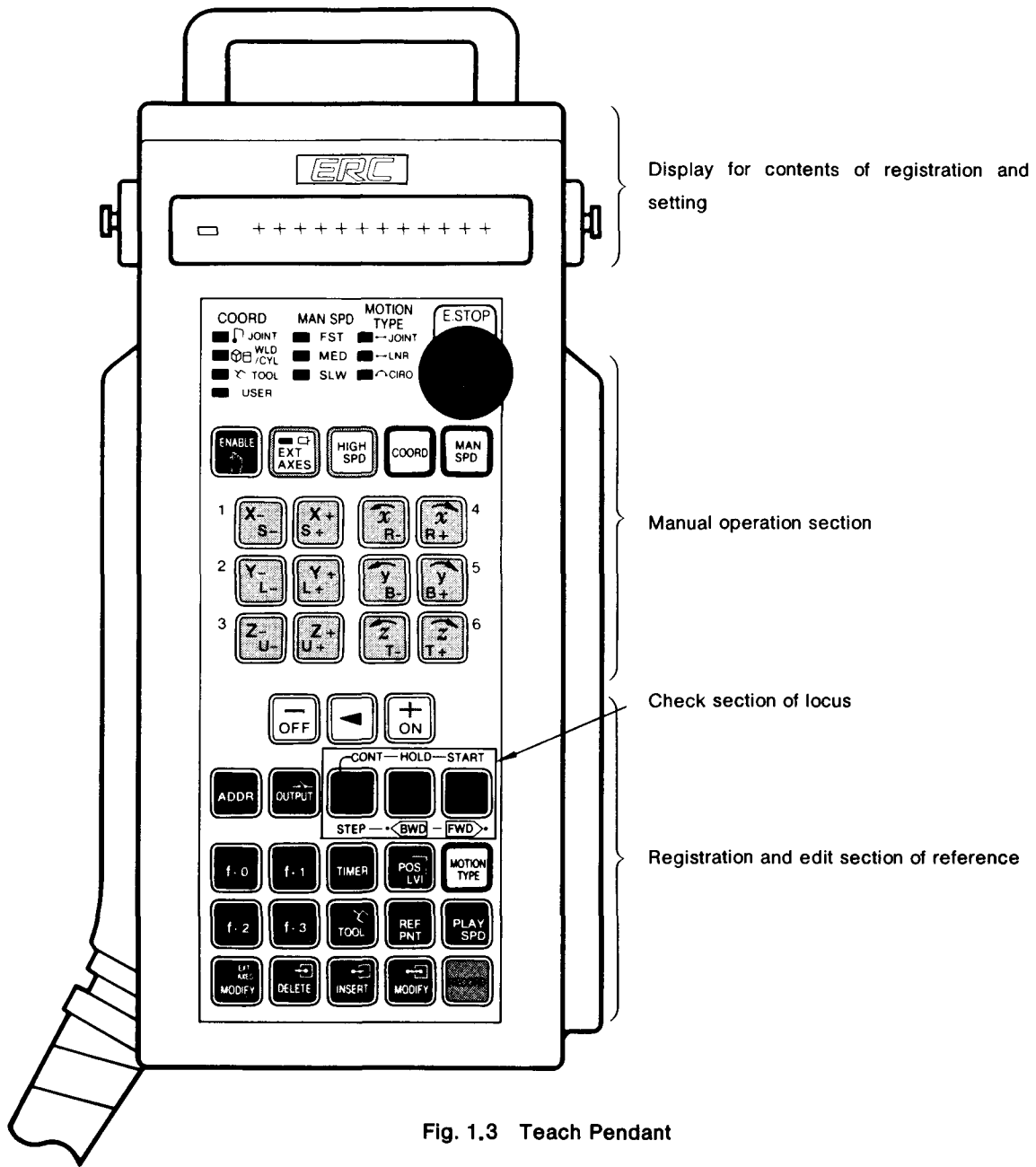
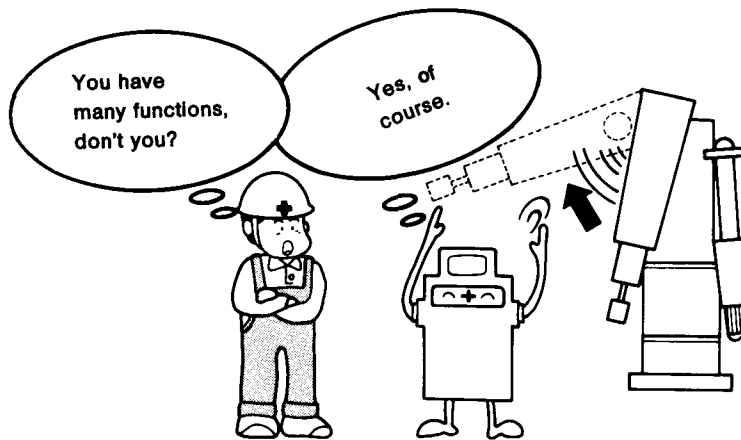


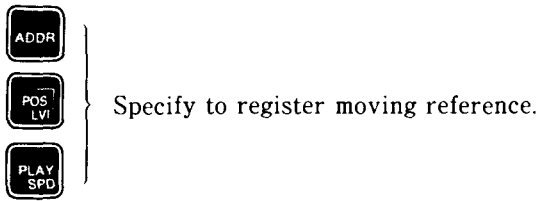
Fig. 1.3 Teach Pendant



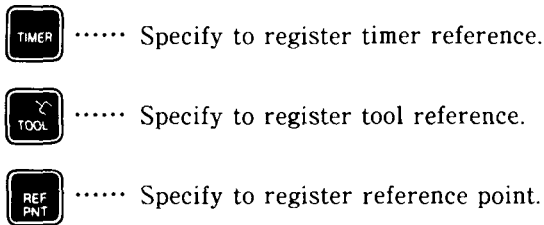
1. 3 FUNCTION OF TEACH PENDANT (Cont'd)

Teach pendant enables the operation of the manipulator and teaching of the loci. Teach pendant has eleven service keys as shown below. The lighting key is effective.

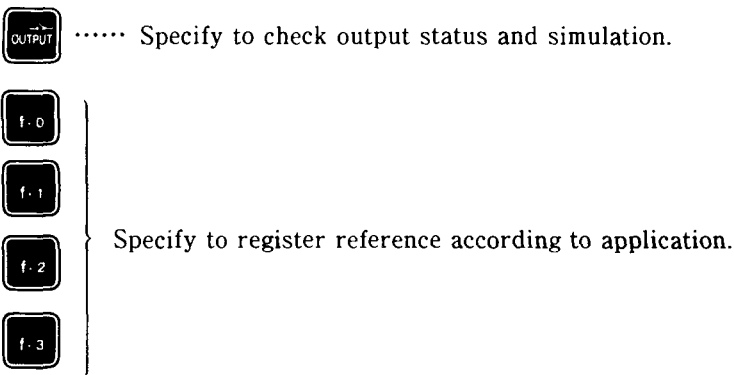
- Registration as moving reference



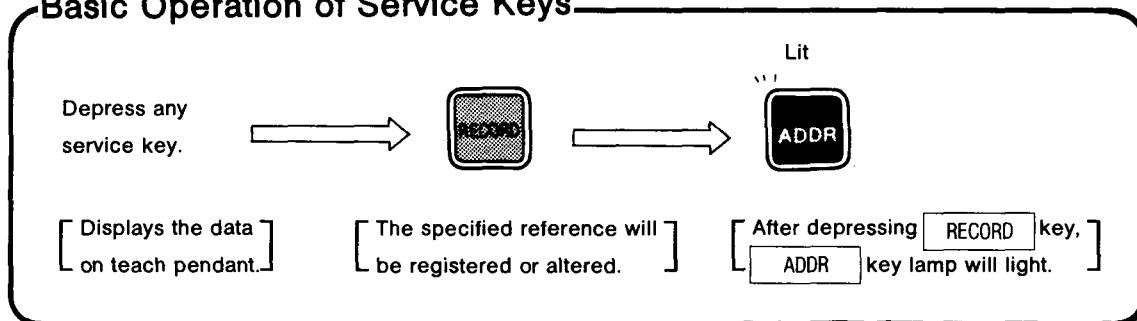
- Registration for reference related to Motoman movement



- Others



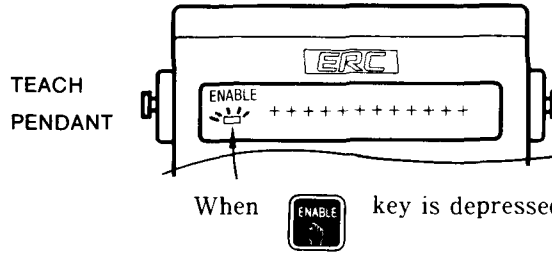
Basic Operation of Service Keys



1. 3. 1 Manual Operation Section



Enables operation on the teach pendant while the ENABLE key lamp is lit.

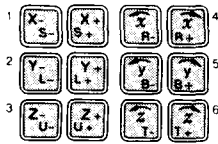


1



(External axis select)

Used when the external axes are to be operated by axis operation keys. This key is activated in system with added external axes.



(Axis operation keys)

Moves specified axis on manipulator in specified coordinates while the key is depressed.

Where the key is set, the specified axis on external axis will be moved the same as an axis on manipulator.



(High speed)

Moves manipulator at high speed while this key is depressed.

High speed is a one-step speed and high-speed movement is for one axis.



(Coordinates)

Selects coordinate system for manual operation.

Four kinds of coordinate systems [Joint, world (rectangular)/cylindrical, tool, user] can be selected.

The selected coordinate lamp

- JOINT
- WORLD
- TOOL
- USER

on teach pendant will light.



(Manual speed)

Sets the speed for manual operation (including FORWARD/BACKWARD).

Three speed steps (fast, medium, slow) and inching are selectable.

The selected speed lamp

- FST
- MED
- SLW

on teach pendant will light.

1. 3. 2 Check Section of Locus



(Continuous/Step)

Designates the operation mode to check the taught locus.

During locus confirmation, the continuous operation mode (to confirm as a continuous locus) or the step operation mode (to confirm the taught position for each step) can be selected.



(Hold/Backward)

Operates the taught locus in the opposite direction.

If this key is depressed during playback, the key is used as HOLD specification.



(Start/Forward)

Used to check the taught locus.

Manipulator moves only while this key is depressed.

The motion speed differs depending on operation mode designation set by using



key.

1. 3. 3 Registration and Edit Section of Reference



Decreases

} the displayed numeric value data.



Increases

While **OUTPUT** key is selected, these keys enable control by output relay.



Shifts the display one column to the left if the data is more than 12 columns and cannot be displayed at the same time.





(Address)

Searches the address.





The text of the taught instruction is displayed.



Checks the output status with display.

Output is controlled by depressing  key or  key while holding down this key.

[**Function Key Use** : The functions of these keys differ depending on use.
In standard specifications, the functions of these keys are allocated for welding.]

Key	Arc welding	Spot welding	Handling
	For arc ON instruction. Designates work conditions.	For gun ON instruction. Designates work conditions.	For handling ON instruction. Designates work conditions.
	For arc OFF instruction. Designates work conditions.	—	For handling ON instruction. Designates work conditions.
	For welding voltage instruction. Enables change during operation.	Gun operating output 1.	Handling operating output 1.
	For welding current instruction. Enables change during operation.	Gun operating output 2.	Handling operating output 2.

1. 3. 3 Registration and Edit Section of Reference (Cont' d)



Enables registration of the timer instruction or changing the setting value.



(Position)

Performs the following operation during playback.

- Positioning to the taught point
- Positioning designation of the desired step inward operation
- Setting of positioning zone level



Designates motion type of Motoman at playback.

Three motion types (joint, linear, circular) are selectable.

The selected motion type lamp



on teach pendant will light.



Changes tool coordinates and registers tool instructions.

If user coordinates are selected, user coordinate frames will be affected.

Note : This key is an optional function.



(Reference point)

Registers the necessary reference point (wall point, corner auxiliary point, etc.) to move the manipulator at weaving.



(Play speed)

Sets the motion speed at playback.

Eight play speed steps can be registered.

Changing speed is possible during playback.



(External axes modifying)

Modifies only external axes data of the position data already taught.



Deletes the instruction already taught.



Inserts new instruction.



Modifies the position data and instruction already taught.



Inputs the data.

Be sure to depress this key when desiring to register and edit the instruction from teach pendant.

1. 4 SOFT KEY FUNCTION

1. 4. 1 Construction of Soft Key Labels

Five soft keys are mounted just below the CRT display.

Depress these soft keys to perform desired operations. The functions matching the soft keys are displayed on the bottom line of the CRT display as soft key labels. The soft key labels are hierarchical structure, as shown in Fig. 1. 4.

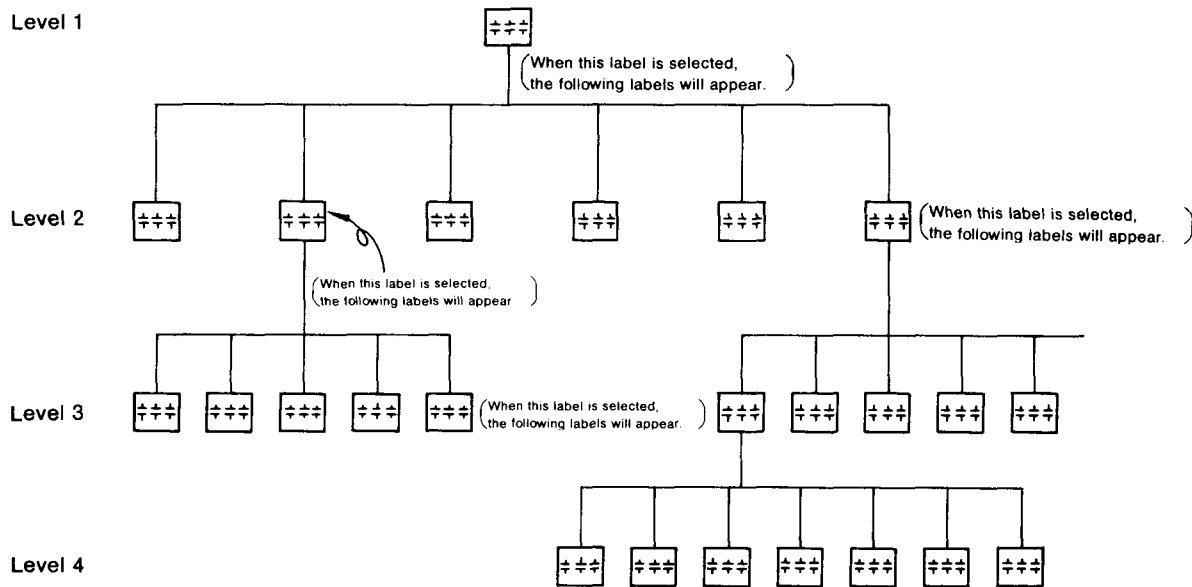


Fig. 1. 4 Construction of Soft Key Labels

1. 4. 2 Designation of Soft Key Labels

Depress the soft key to designate desired soft key labels.

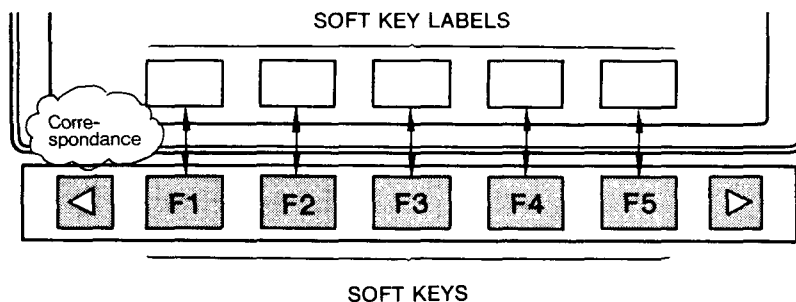


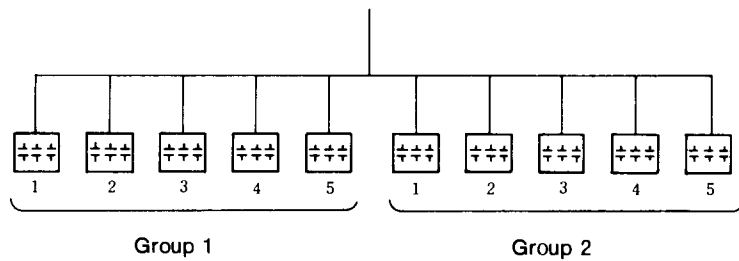
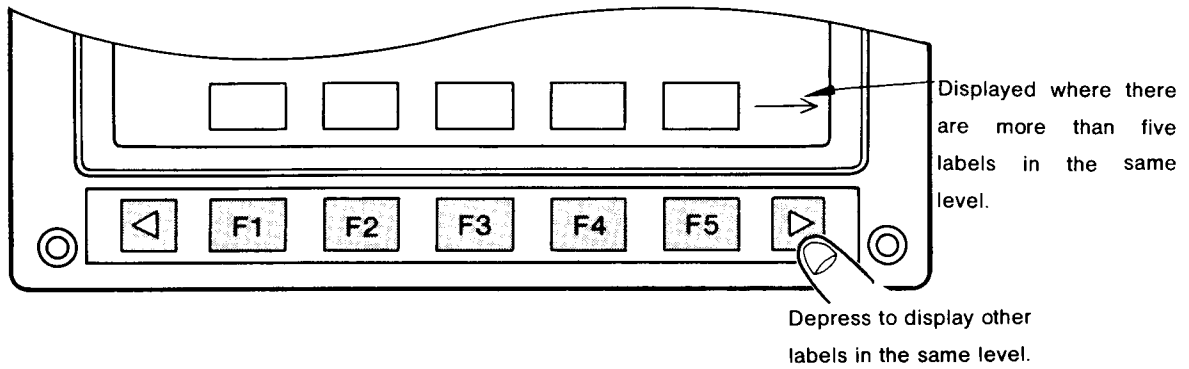


Fig. 1. 5 Correspondence between Soft Keys and Soft Key Labels

Only five soft key labels are displayed at one time. If there are more than five labels in the same level, a "→" mark is displayed at the right edge of the soft key labels.

Those key labels which are not displayed can be called up by depressing the  key to the right of soft key 




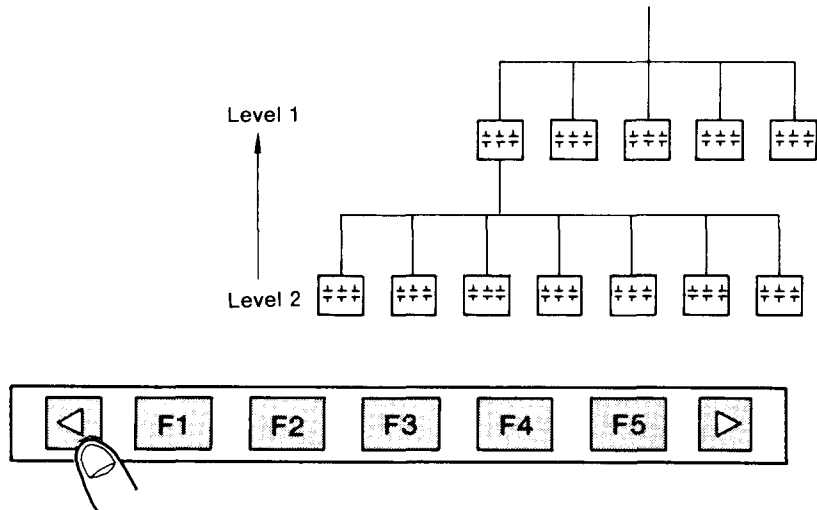
If group 1 and group 2 are in the same level, these soft key labels are sequentially displayed each time the  key is depressed.

Fig. 1.6 Calling up Soft Key Labels in the Same Level

1. 4. 2 Designation of Soft Key Labels (Cont'd)

To trace back one level, depress  key to the left of soft key 



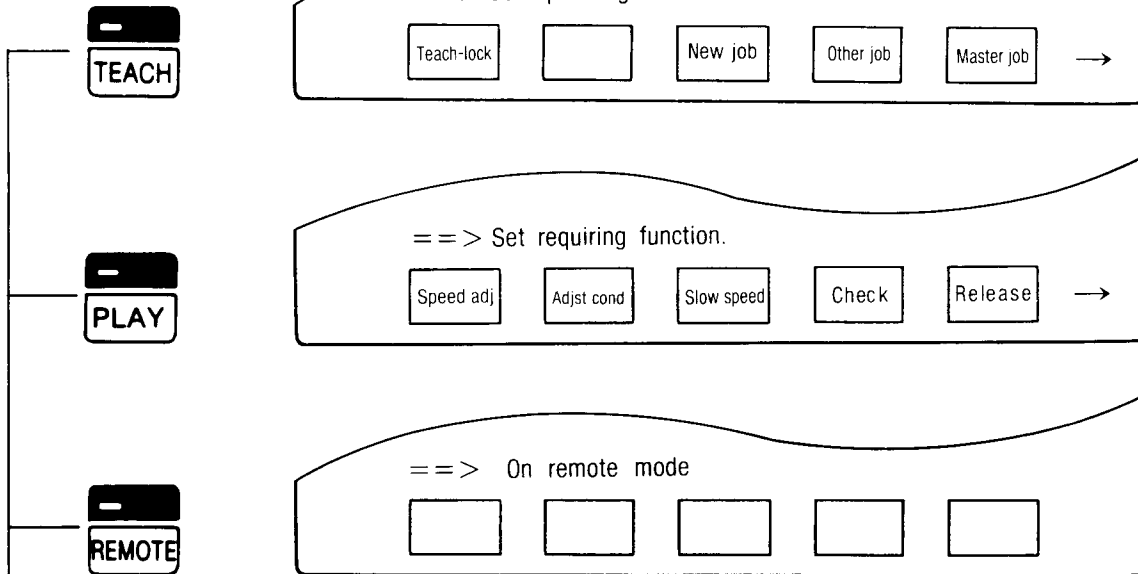
Depress this key to trace back one level.

Fig. 1. 7 Backtrace of Soft Key Labels

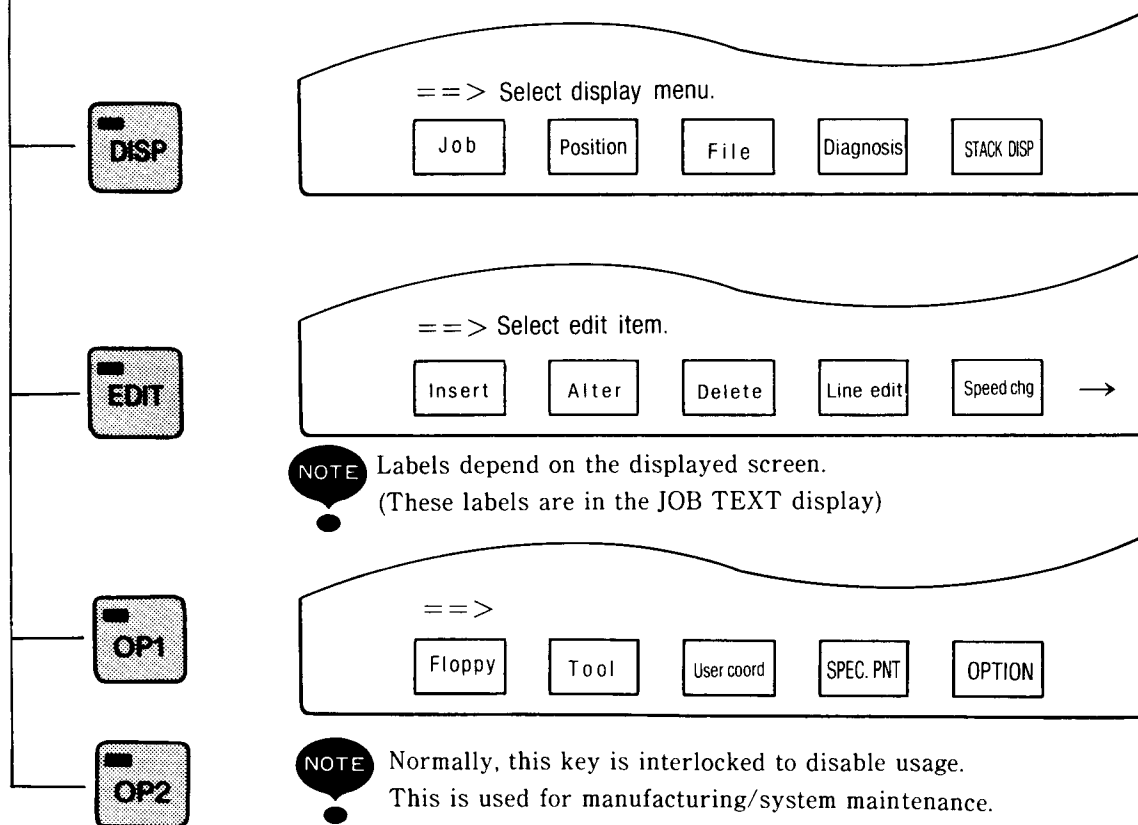
1. 4. 3 Calling Up Soft Key Labels

Depress the following mode keys or function keys on the operator's panel to call up the top label (level 1) of the desired soft key.

MODE KEY



FUNCTION KEY



NOTE Labels depend on the displayed screen.
(These labels are in the JOB TEXT display)

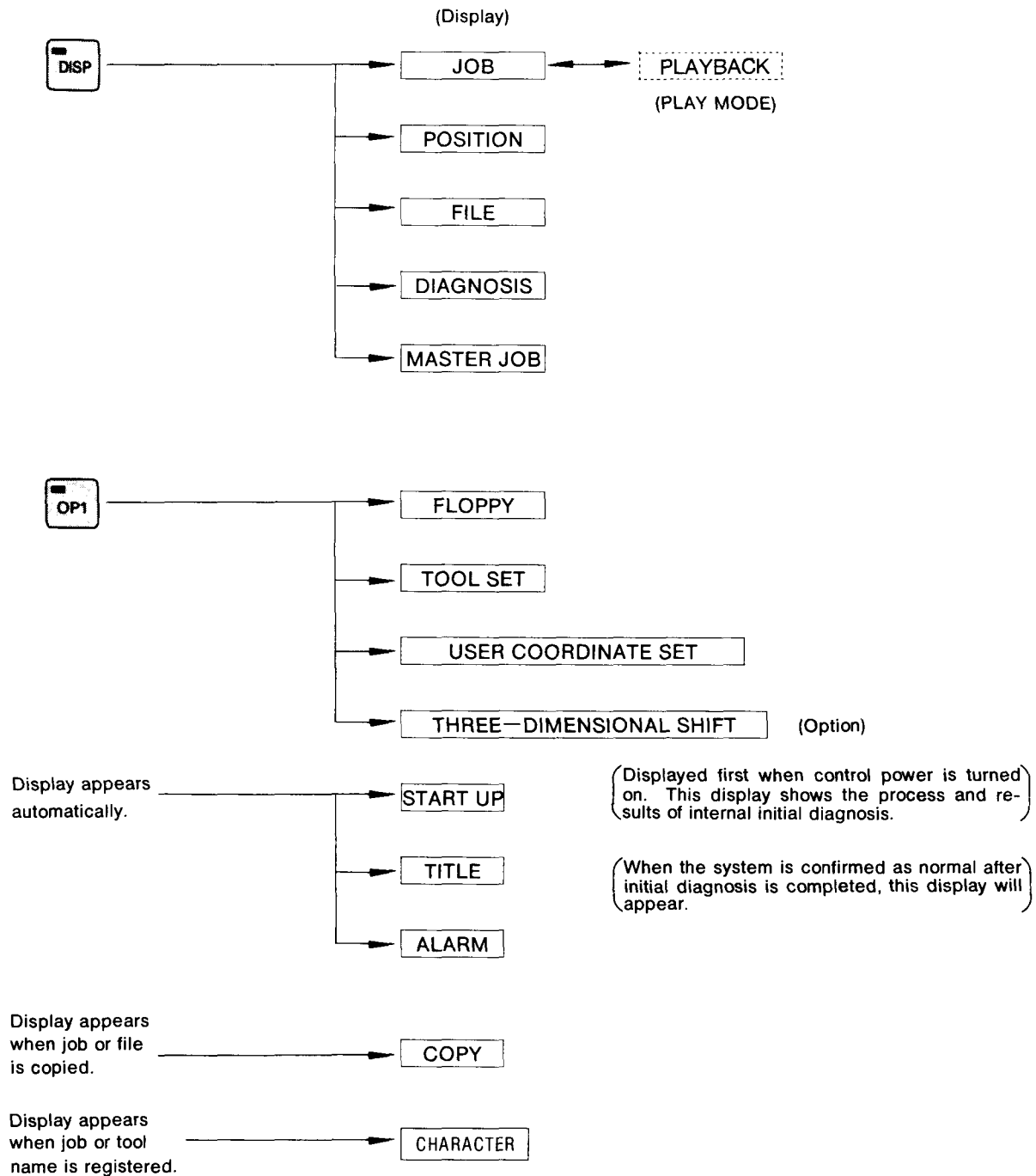
NOTE Normally, this key is interlocked to disable usage.
This is used for manufacturing/system maintenance.

1. 5 DISPLAY CONSTRUCTION

A variety of displays in the system is displayed on the operator's panel and used with dialog form. The display for teaching is also confirmed on the teach pendant. The display construction and display calling up are described below.

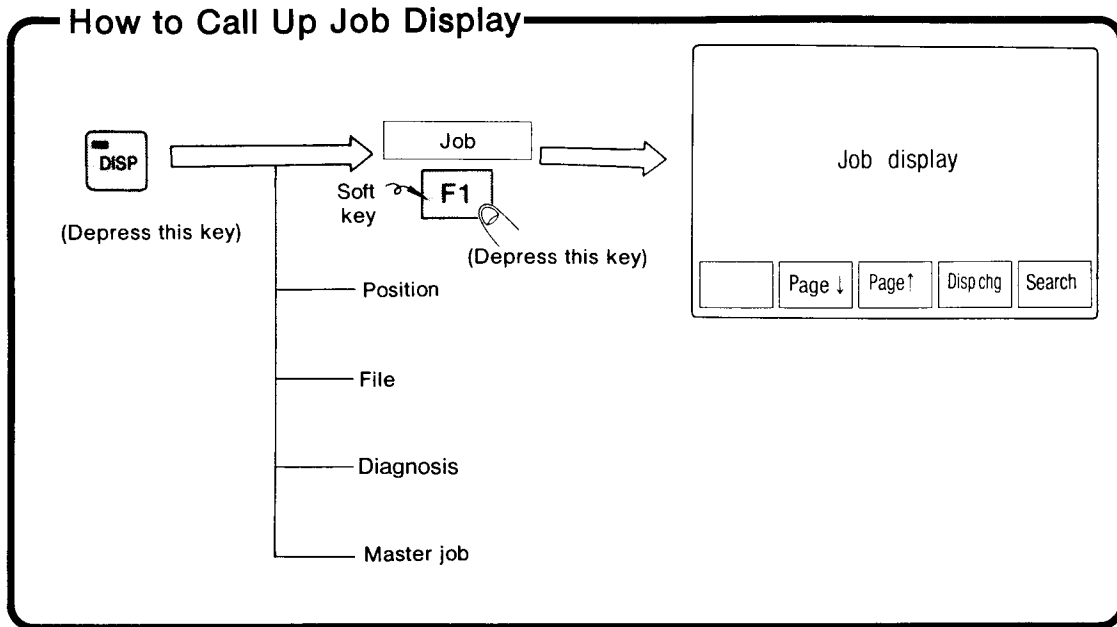
1. 5. 1 Display Construction on Operator's Panel

The operator's panel of YASNAC ERC has 10 different basic displays.

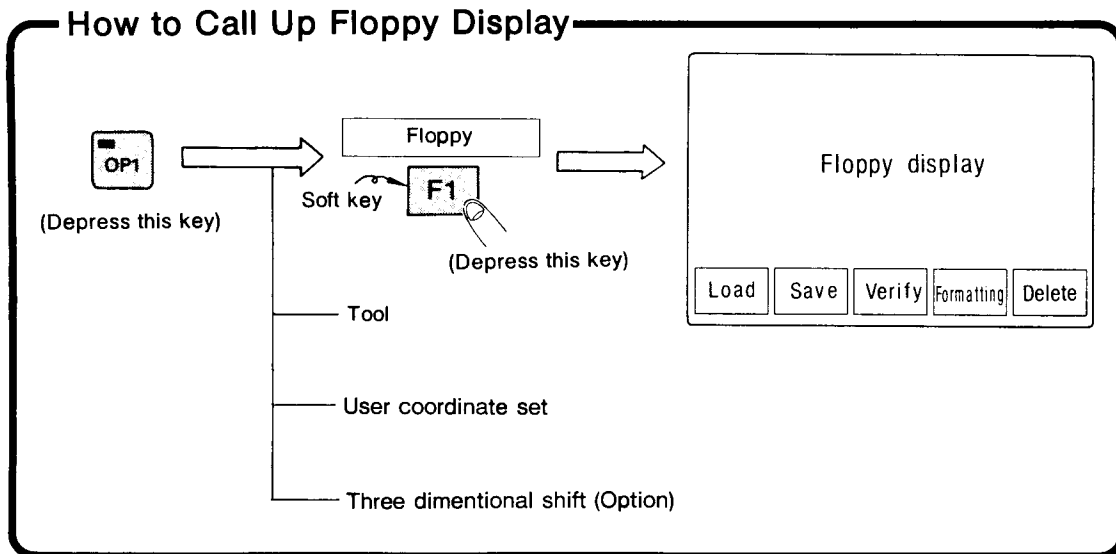


1. 5. 2 Display Calling Up

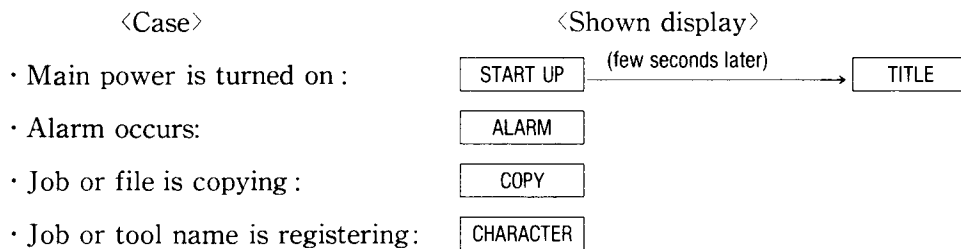
- (1) When desiring to call up displays that are frequently used.



- (2) When desiring to call up displays that are not frequently used or of optional functions.




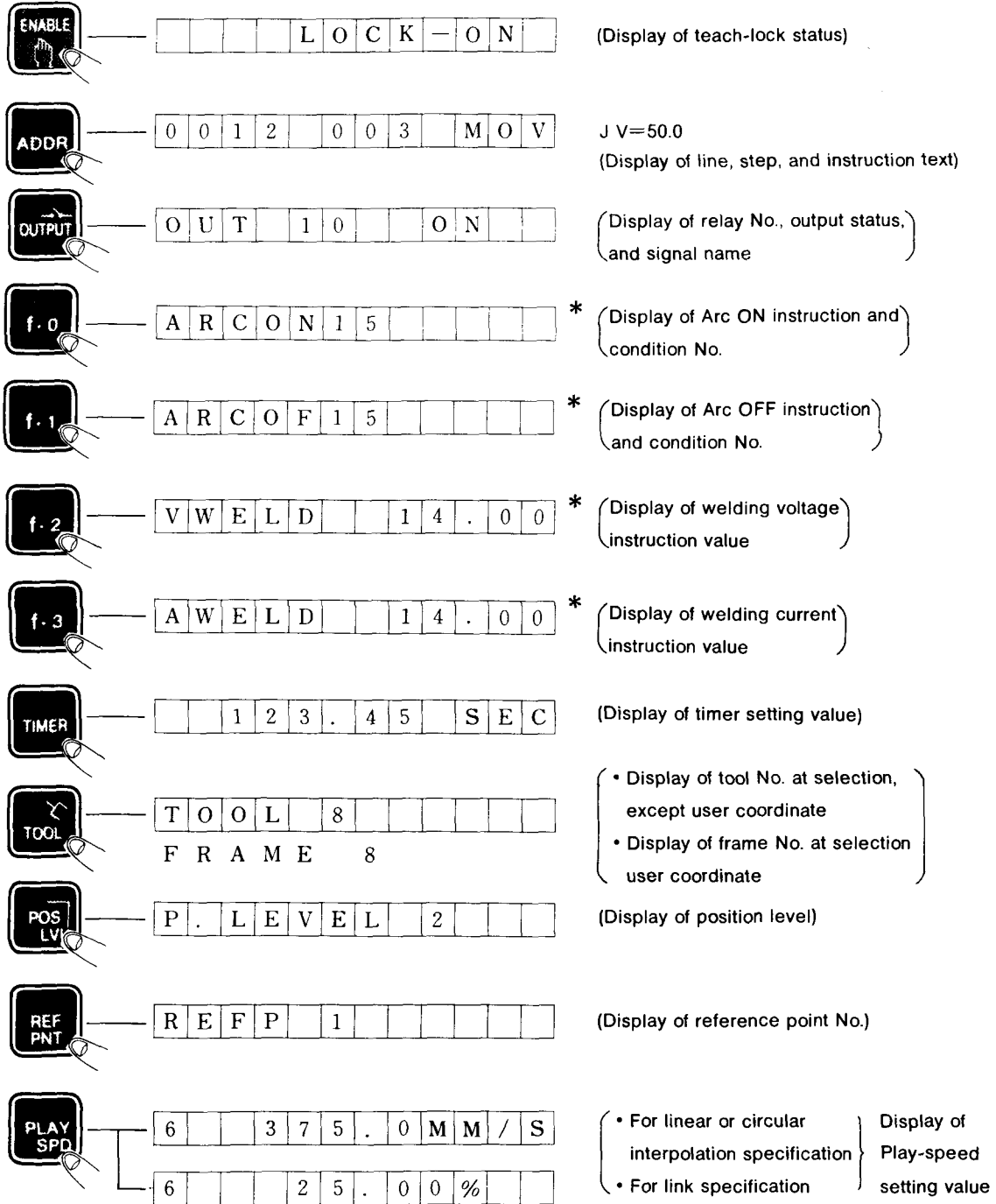
- (3) Others



1. 5. 3 Teach Pendant Display

The teach pendant has a 12-digit display. It can show various data needed during teaching.

If the display data are more than 12 digits in length, depress  (shift) key to check data by moving the display to the left. To change the display, depress either one of the following keys.



*The display differs depending on the application. This is an example of arc welding.
The details of each display are described in sections for operation of the various functions.

1. 6 DESCRIPTION OF CRT DISPLAY

1. 6. 1 Basic Format

The CRT display is divided into three areas as shown in Fig. 1. 8.

The upper status and lower human interface display areas are fixed display areas, and always display the same data.

The center part of the display is a general-purpose display area and a variety of data are displayed by soft key selection.

The fixed display areas are described below. The general-purpose display area is described in the sections for the various functions.

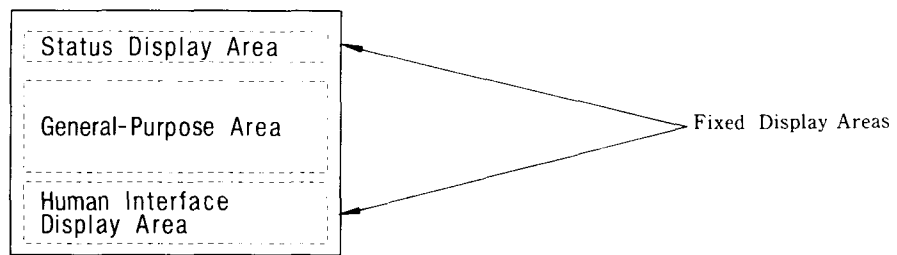


Fig. 1. 8 Basic Construction of CRT Display

1. 6. 1. 1 Status Display Area

This area shows the system status data. (Fig. 1. 9). The display items are always displayed or are updated as status changes. The following information is displayed.

- (1) Mode during selecting
 - (2) Job name and address during execution
 - (3) Status during executing
 - (4) Calendar/Time (hours ; minutes)
 - (5) Level of job stack
 - (6) Display of battery status
 - (7) Display name during display
 - (8) Job name and address during editing
 - (9) Status during editing
- } → Usually displayed.
- Displayed only when the call instruction is executed.
- Displayed when battery is low.
- Usually displayed.
- } → Displayed only during editing.

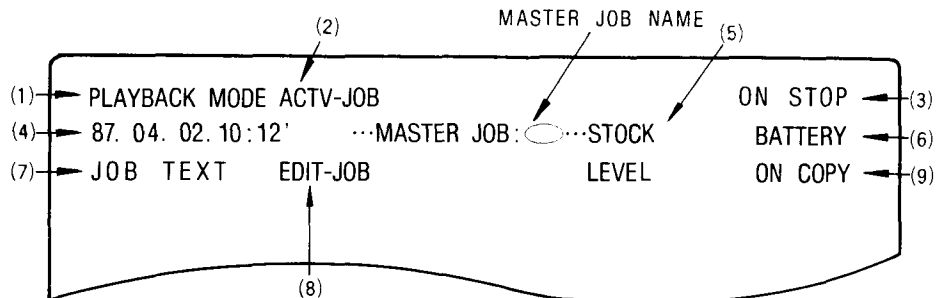


Fig. 1. 9 Status Display Area

1. 6. 1. 2 Human Interface Display Area

This area displays data for human interface and consists of four lines.

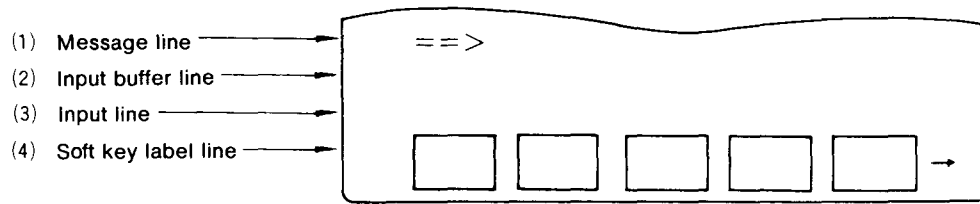


Fig. 1. 10 Human Interface Display Area

(1) Message line

A variety of messages for dialog and error messages are displayed on this line. While displaying an error message, operation cannot be continued. Depress key to eliminate error message.

When there are some messages, the prompt "==">" on message line blinks. The others messages will be displayed by depressing and keys simultaneously.

(2) Input buffer line

The instructions during input are displayed. The instruction on this line is registered by depressing key.

(3) Input line

Numerical value during input by DATA keys is displayed on this line.

(4) Soft-Key label line

A maximum of five soft key labels are displayed. If more than five soft key labels exist, the "→" mark is displayed at the right edge. If there are less than five labels, the surplus labels are blank and do not have functions allocated to them.

Refer to Par. 1. 4 for the details of the soft key labels.

1. 6. 2 CRT Display Control

1. 6. 2. 1 Automatic Brightness Control

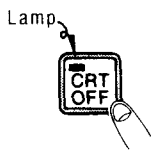
The automatic brightness control function prevents the deterioration of the CRT display caused by extensive operating time, etc.

The CRT display brightness automatically decreases if the operator's panel is not operated for more than 10 minutes. If the brightness is low and the CRT is dark, normal brightness is resumed whenever any of the keys on the operator's panel is depressed.

1. 6. 2. 2 CRT Display OFF

If the display on the CRT is not needed, it can be turned off in order to prevent CRT display deterioration. The alarm code is displayed if an alarm occurs even if there is no display. The CRT alarm code is turned off again after the alarm is reset.

The CRT display is turned off as follows at any time.



If it is depressed once, the display will disappear. Depress this key again and the display will reappear. While the display does not appear, the lamp is lit.

NOTE

Once set, the CRT remains turned off until it is reset. If the status is OFF when power is turned off, only the start-up display will appear when power is turned on again. After the initial diagnosis, the CRT display is reset to the status at the time of power OFF.

1. 7 DATA INPUT

There are roughly four methods to input data.

- (1) "Numeric value" input by using numeric value keys.
- (2) "Character" input by using the character display.
- (3) "Selection value (ON/OFF etc)" input by using the soft keys.
- (4) "Variable Data" input through the transmission line or the floppy disk.

Only basic operations are explained here. For the individual inputting methods, see each section.

1. 7. 1 Numeric Value Input

The message "Enter value" automatically appears in the message line if numerical input data is needed. Numerical data input by using DATA keys is possible only if the message appears. The numeric value being input is displayed in the input line.

Incorrect input can be corrected by soft key labels which appear at this time. (See Table 1. 1.)

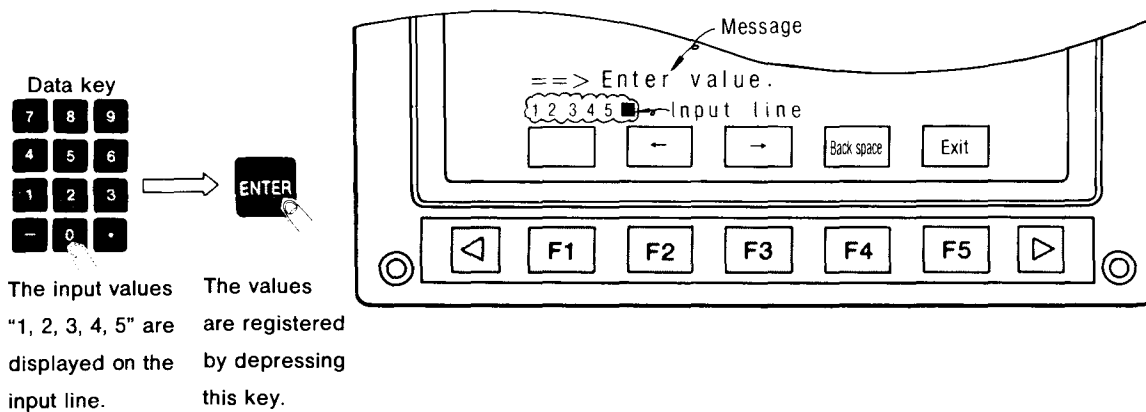




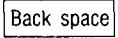









Fig. 1. 11 Numerical Value Input


Table 1.1 Cursor Setting Method for Data Correction

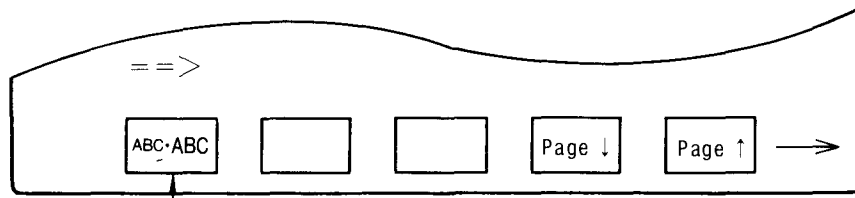
Soft key Label	Meaning	Depressed key	Indication
	The cursor moves one space to the left.		<pre> 1 2 3 4 5 █←Cursor ↓ 1 2 3 4 5 █ </pre>
	The cursor moves one space to the right.		<pre> █ 2 3 4 5 1 █ 3 4 5 ↓ 1 2 █ 4 5 </pre>
	The data on the cursor is deleted.		<pre> █ 2 3 4 5 ↓ █ 3 4 5 </pre>
	The minus is added preceding the cursor.		<pre> █ 3 4 5 ↓ - █ 3 4 5 </pre>
	The numerical data is added preceding the cursor by depressing DATA key.	(ex) 	<pre> █ 3 4 5 ↓ 0 █ 3 4 5 </pre>

 **NOTE** If the  key is depressed, the all instructions during input are canceled.


1

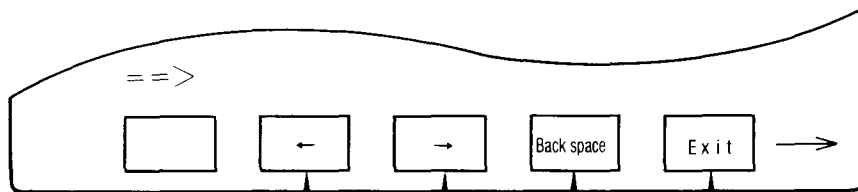
1. 7. 2 Character Input

The following soft key labels appear when characters can be input. Depress the  soft key to display the designated character display. Input characters using this character display.



Alphabet (capital/small letters) display will appear by depressing this soft key.

When  key is depressed, the following soft key labels are displayed.



Returns from character display to the previous display.

Deletes one character on the left of the cursor, in input buffer line.

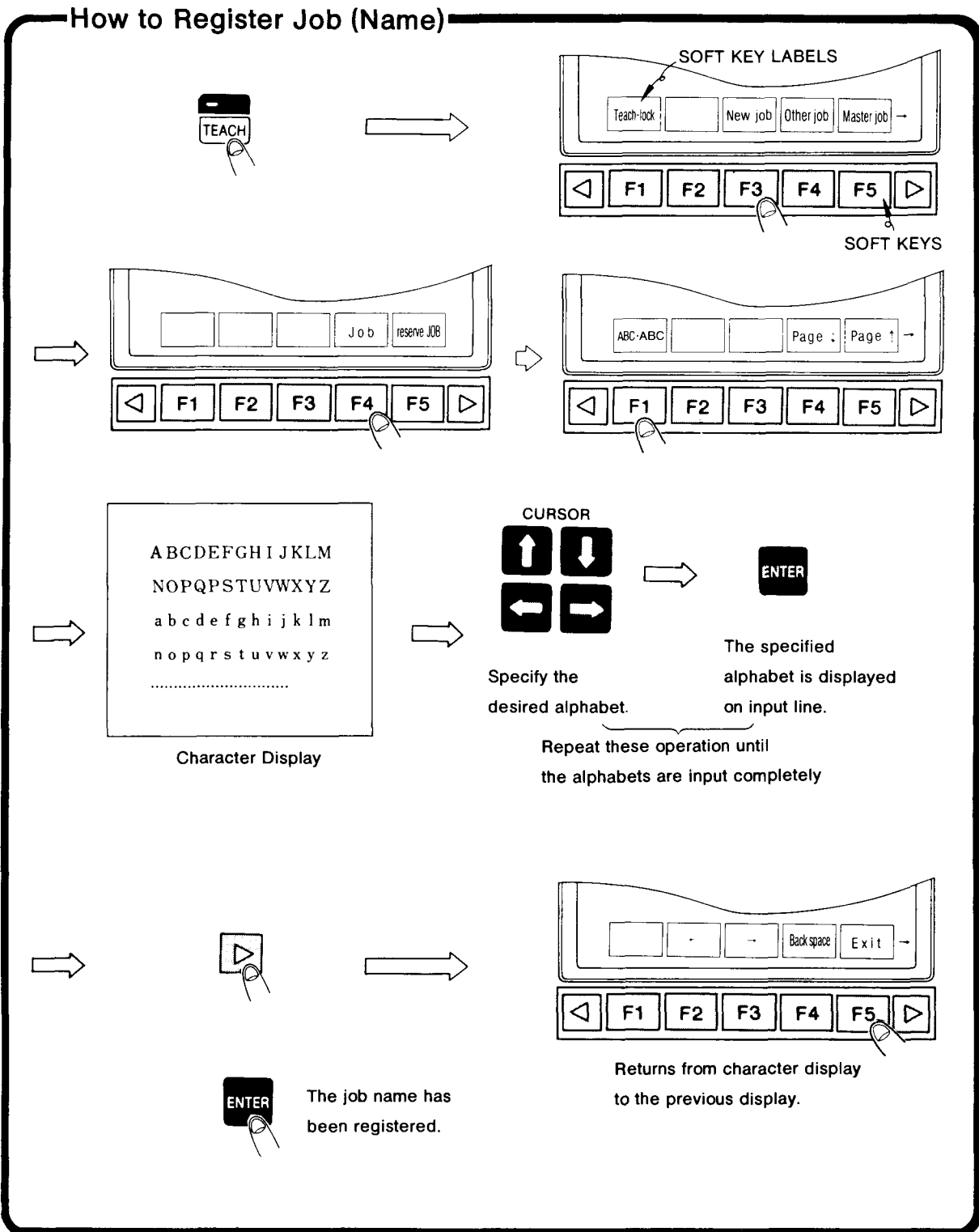
Moves the cursor to the right in input buffer line.

Moves the cursor to the left in input buffer line.

Fig.1. 12 Soft Key Labels Display for Character Input

★ Character Input Operation

How to Register Job (Name)

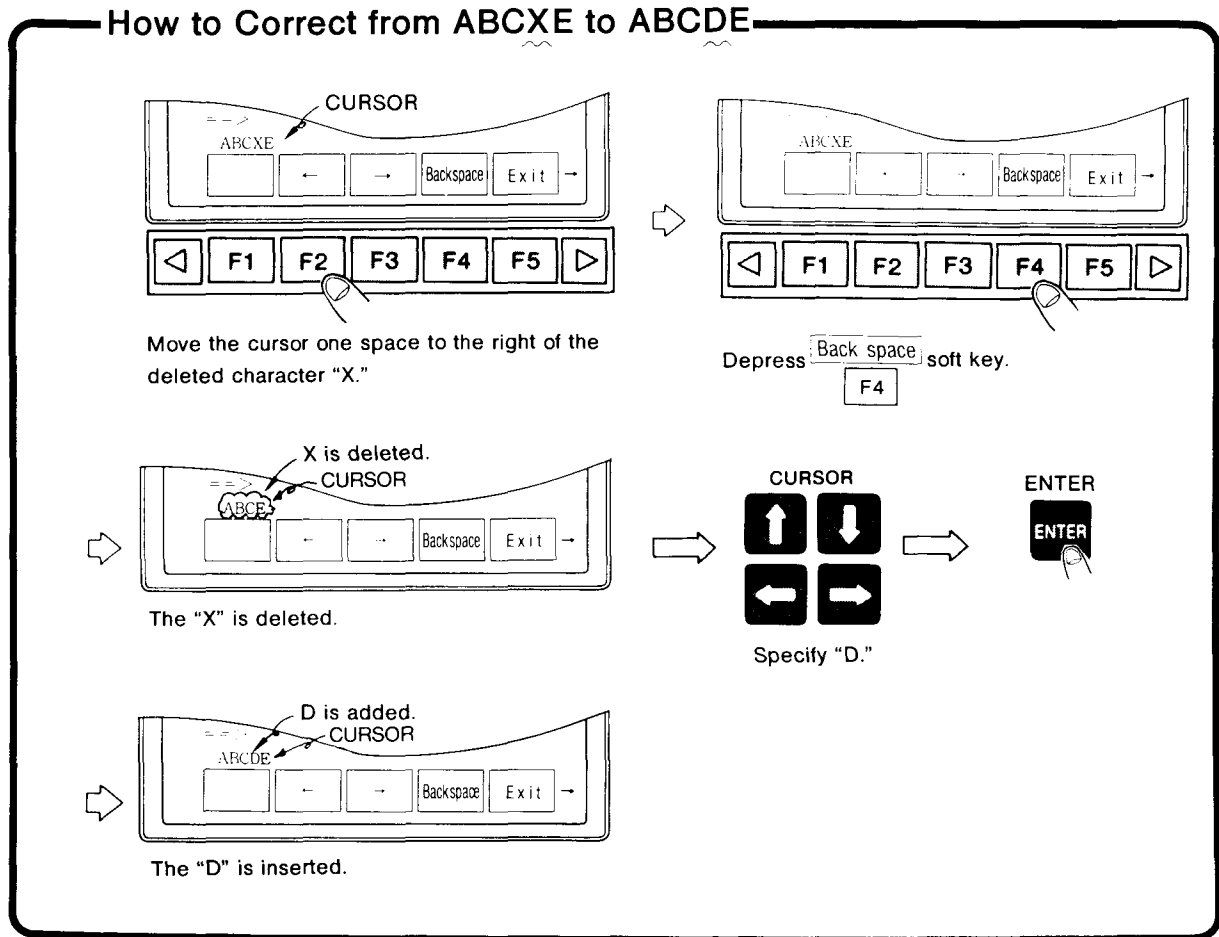


1

NOTE

- The following characteres cannot be used for registration of job name.
 (SPACE) (") (*)(+)(,)(.)(/)(:)(;) (<)(=)(>)(?)([)(¥)(]) (|)
- Before the **ENTER** key is depressed, depress **Exit** / **F5** soft key to register the job name in the character display.

★ Character Correcting Operation



1. 7. 3 CANCEL Key Function

The **CANCEL** key has the following three functions.

- (1) Error cancel
The error is cancelled if the error message is displayed. Display of the data being programmed does not change.
- (2) Input value cancel
Data in the input line are cancelled if depressed once. The status of the soft keys, etc. does not change at this time and new data can be input continuously.
- (3) Operation Interruption

If the **CANCEL** key is depressed while the input line is empty, data inside the input buffer and previous operations are cancelled. In this case, the soft key labels also backtraced by one level.

The **CANCEL** key does not function if both the input line and input buffer are empty.

1. 7. 4 ENTER Key Function

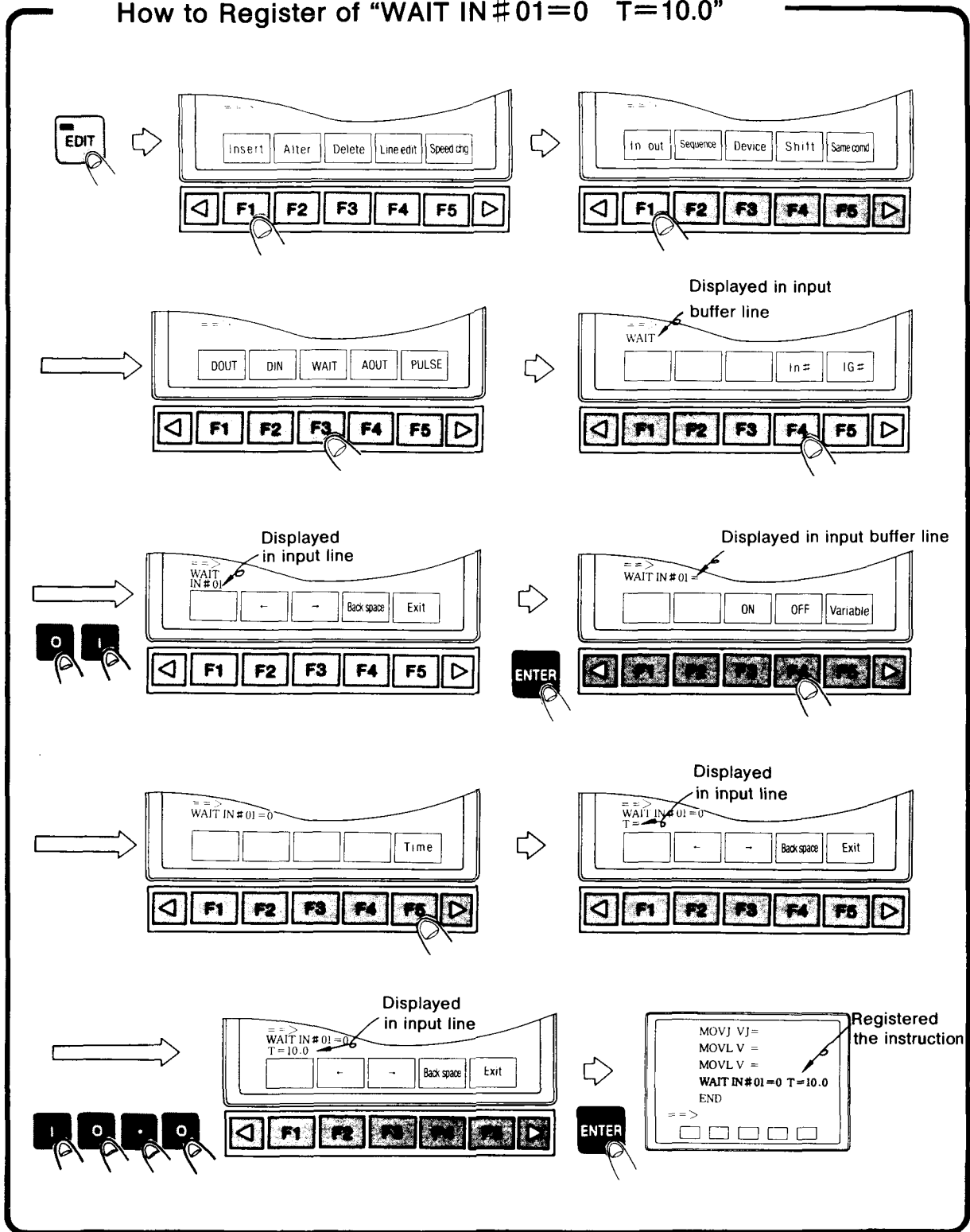
Data registration or editing is executed when **ENTER** key is depressed.

If input data exists in the input line when this key is depressed, the data are temporarily registered in the input buffer line.

If the input line is empty and data exist inside the input buffer line, the data are registered in the memory as final data.

1

How to Register of "WAIT IN #01=0 T=10.0"

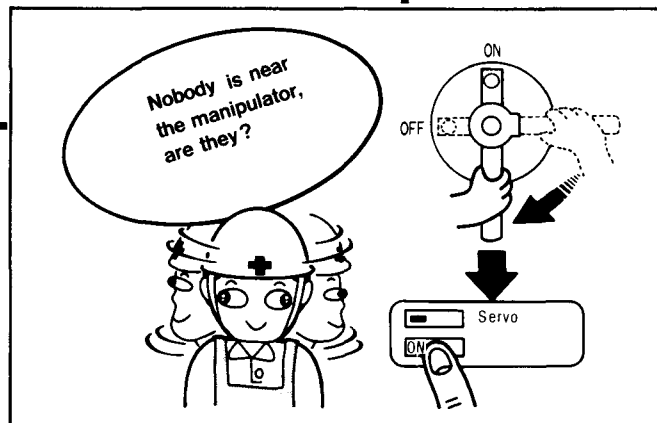


SECTION 3

TURNING POWER ON/OFF

This section describes the method of turning on the power and turning off the servo/main power.

Before the Motoman is operated, be sure to check that nobody is near the manipulator.



3

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3. 1 MAIN POWER ON

Main power can be supplied by turning on the main power switch provided on the control panel. See Fig. 3. 1.

Turning this switch to the ON position, control power is turned on inside the controller, allowing operation on the operator's panel. If the switch is turned to the OFF position, power supply to the entire controller is turned off. The data stored in the memory are protected by the backup battery and is not erased even if power is turned off.

The startup display (Fig. 3. 2) appears on the CRT display when the handle is turned to ON. This display allows the operator to verify the process and results of the controller initial diagnosis.

The title display (Fig. 3. 3) will be shown automatically if the results of the diagnosis are satisfactory on all points and the system is verified to be in good condition. This title display shows that key operation on the operator's panel has become possible. A desired display can be called up and the manipulator can be operated by turning on servo power.

The title display will not appear if trouble is detected in the initial diagnosis. If trouble exists, the details of the trouble will be displayed, or the CRT will not display any information.

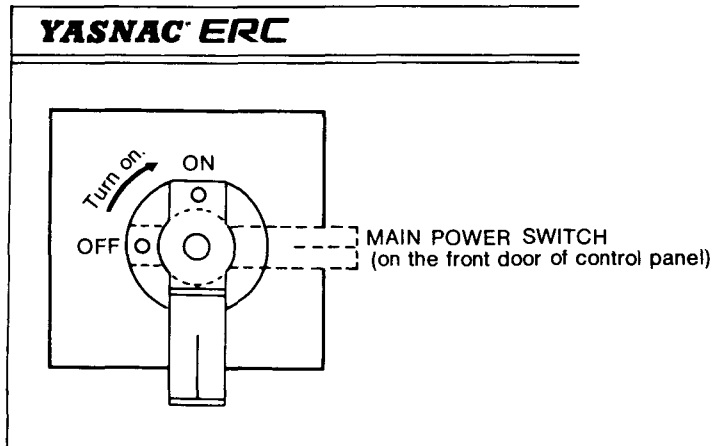


Fig. 3. 1 Turning the Main Power ON

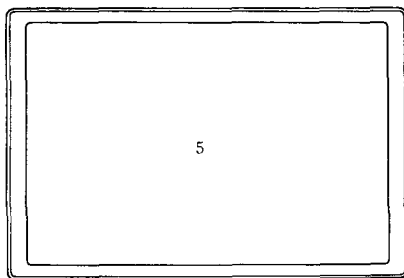


Fig. 3. 2 Startup Display

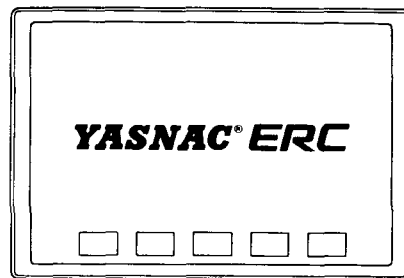


Fig. 3. 3 Title Display

3. 2 INITIAL DIAGNOSIS AND SYSTEM INITIALIZATION

3. 2. 1 Initial Diagnosis

By turning on power, initial diagnosis of the control panel is performed. The system condition can be checked by decreasing the numerical data shown in the startup display. When the numerical data decrease to 0, initial diagnosis is completed. At this time, the controller system starts operation and the title display appears automatically.

The lamps of the operator's panel and teach pendant blink momentarily when power is turned on and initial diagnosis starts.

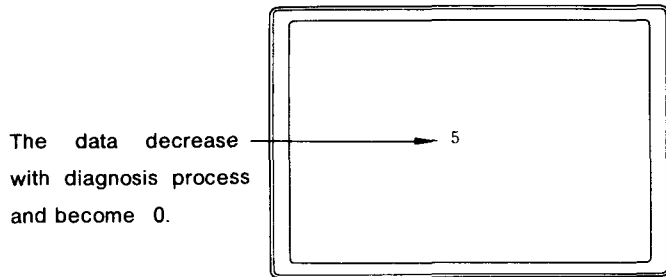


Fig. 3. 4 Startup Display

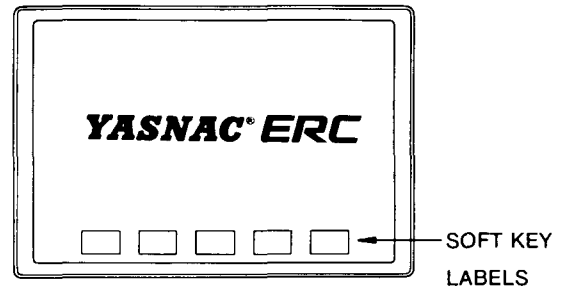


Fig. 3. 5 Title Display

3. 2. 2 Present Value Creation

The controller has an AC servo system with an absolute position detector.

To create the present values of the manipulator, position data are read automatically by the detector of each axis when power is turned on.

Therefore, no home position resetting operation is required when power is turned on.

3. 2. 3 Status at Power OFF

When the initial diagnosis is completed, the following lamps are OFF and the following displays on CRT disappear.

- Lamps :

MODE		
—	—	—
PLAY	TEACH	REMOTE


CYCLE		
—	—	—
AUTO	1CYCLE	STEP

CRT OFF



- Address of execution job and edit job (Line No. and step No.)

3. 3 SERVO POWER ON

There are three methods for turning servo power ON.

- Depress  key on operator's panel.
- Use the reference from external input (special input).
- Use the transmission command from host computer.

3. 4 EMERGENCY STOP (SERVO POWER OFF)

When turning the servo power off, depress  button on the operator's panel or  button on teach pendant. These buttons can be operated anytime and under any condition.

As soon as servo power is turned off, mechanical brake is operated and the manipulator stops at its current position.

Emergency stop can also be operated by external input (special input).

3. 5 MAIN POWER OFF

When turning the main power off, depress emergency stop push button and turn the main power switch (handle) to the OFF position

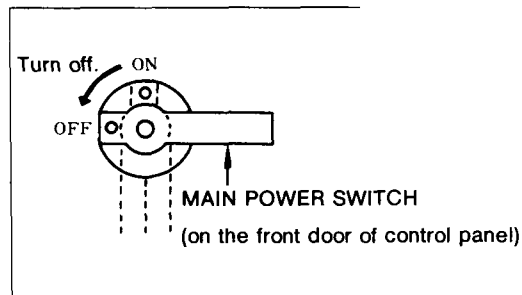
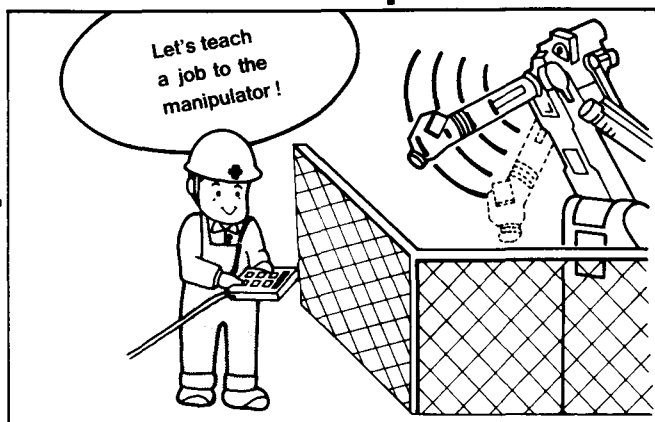


Fig. 3.6 Turning the Main Power OFF

SECTION 4

TEACHING

This section describes preparation before teaching (Job name registration, confirmation of emergency stop button) and teaching operation (path registration, overlapping method of steps, confirmation of each step and path, alteration and addition and deletion of teach points).

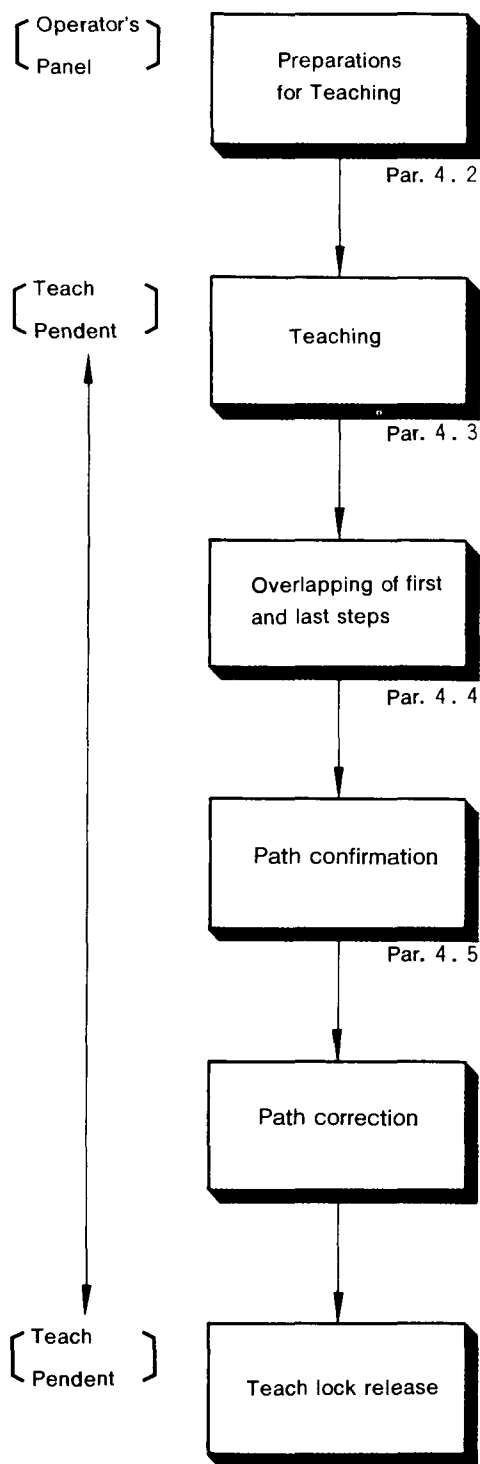


4

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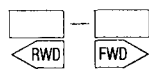
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4. 3. 1. 3	Play(Motion)Speed Registration	4. 7	TEACH LOCK RELEASE
4. 3. 1. 4	Motion Type(Link,Linear,Circular)Registration..	4. 8	TEMPORARY RELEASE OF SOFT LIMIT CHECK
4. 3. 1. 5	Positioning Level Specification	4. 9	INTERFERENCE PREVENTION FUNCTION IN THE INTERFERENCE AREA.....
4. 3. 1. 6	Reference Point Specification		
4. 4	OVERLAPPING OF FIRST AND LAST STEPS ..		
4. 5	LOCUS CONFIRMATION		
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4. 1 TEACHING OPERATION FLOWCHART



- Registration of job name Par. 4. 2. 1
 - By using DATA keys 4. 2. 1. 1
 - By inputting alphabets 4. 2. 1. 2
 - By using reserved job name 4. 2. 1. 3
- Confirmation of E. STOP button 4. 2. 2
- Setting of TEACH LOCK 4. 2. 3

- Teaching of path 4. 3. 1
 - Precautions 4. 3. 1. 1
 - Manipulator position 4. 3. 1. 2
 - Play speed (Motion speed) 4. 3. 1. 3
 - Motion type 4. 3. 1. 4
 - Positioning level 4. 3. 1. 5
 - Reference point 4. 3. 1. 6

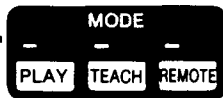
- Backward/forward operation 4. 5. 1
 - Mode selection 4. 5. 1. 1
 - Precautions 4. 5. 1. 2
 - Relationship between
 -  keys and motion 4. 5. 1. 3
 - Motion speed selection 4. 5. 1. 4
 - Motion to reference point 4. 5. 1. 5

- Inserting position data 4. 6. 1
- Modifying position data 4. 6. 2
- Deleting position data 4. 6. 3
- Modifying motion type 4. 6. 4
- Modifying motion speed data 4. 6. 5
- Modifying positioning level 4. 6. 6
- Modifying reference point specification 4. 6. 7

(Others)

- Temporary release of soft limit check 4. 8
- Temporary release of interference check ... 4. 9

Before teaching begins, we'll mention the mode key selection.



SELECTION

The mode selection determines the method of operation of the manipulator axes. Select one of three mode keys on the operator's panel according to the purpose. If necessary, mode can be selected through external input (specified input).

A mode can be selected anytime. Be sure to stop the manipulator when the mode is changed during manipulator operation.

New soft key labels appear on the CRT display when a MODE key is depressed. The program will ask about the first operation to be performed. Depress only when this is needed. (The soft key labels do not change if a mode is selected by external input.)

Usually if control power is turned on, the mode will return to the conditions at the time when power was turned off. However, if a mode is designated by external input or by the operator's panel when power is turned on, the desired mode is set.

NOTE

1. The mode is not changed if different modes are designated simultaneously or if another key remains depressed.
2. For safety, TEACH mode selection on the operator's panel has priority over other mode selections.

Therefore, the TEACH mode can be selected by operating the operator's panel even if the PLAY mode is selected by external input.

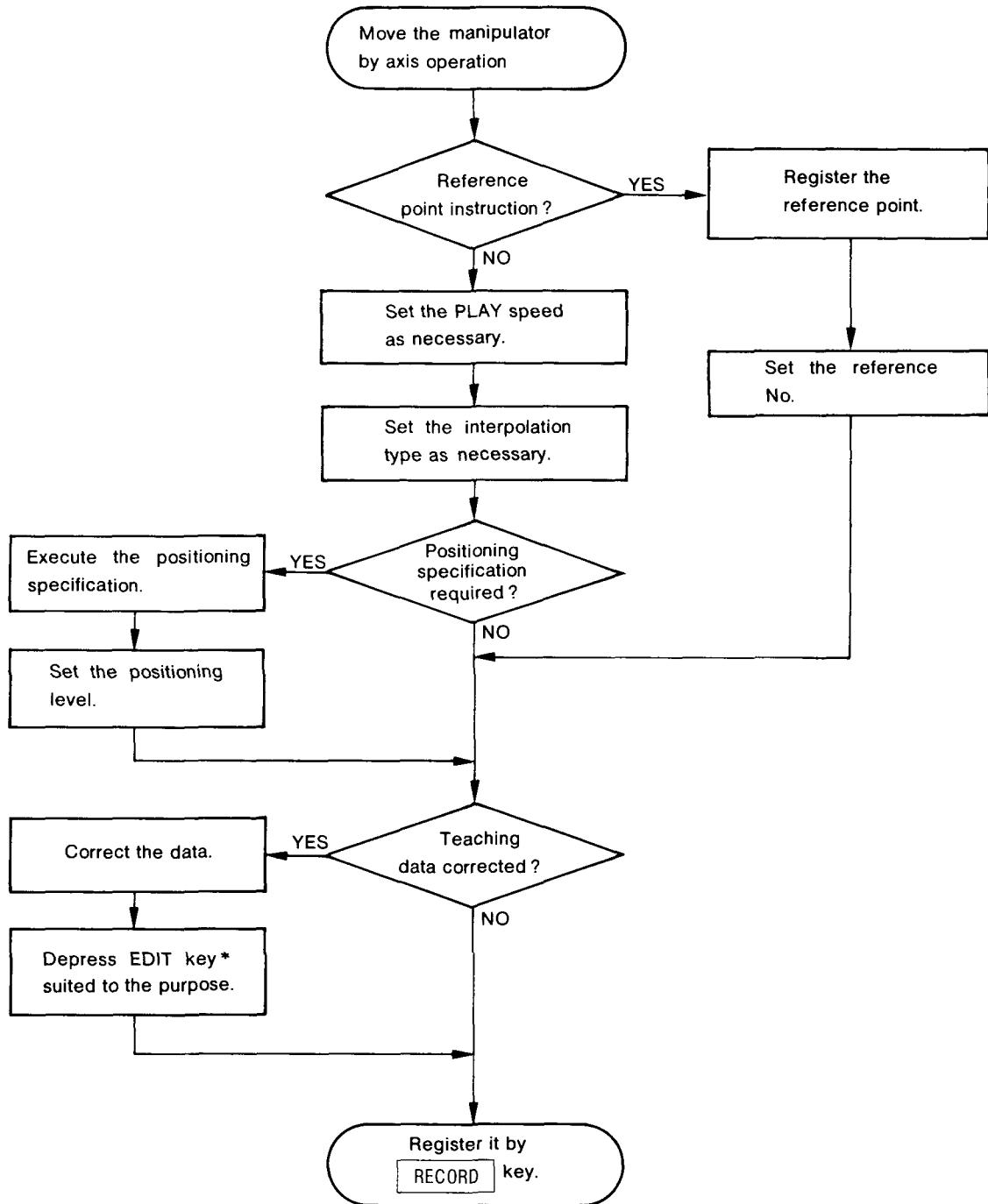
3. The REMOTE mode select key becomes enabled if an option is added.

Therefore, in a standard system, this key does not respond even if it is depressed. This is true for external input also.

4

4. 1 TEACHING OPERATION FLOWCHART (Cont'd)

Operation Flowchart for Teaching Data Registration and Correction.



* EDIT key



Data on indicating line No. are changed.
Instruction can not be changed.



Data are inserted on the line immediately below
the indicating line No.



Instruction on indicating line No. is deleted.
Move instruction has conditions for deletion.



Only positioning data of external axis
are changed. Positioning data of robot axis
can not be changed.

4. 2 PREPARATION FOR TEACHING

4. 2. 1 Registration of Job

The job name for the intended teaching must be previously registered.
Register the job name by using one of following three methods.

[Job Name Registration]

- (1) Registration by using DATA keys (par. 4 . 2 . 1 . 1)
- (2) Registration by inputting alphabets (par. 4 . 2 . 1 . 2)
- (3) Registration by adding 2 digits to the reserved job name (par. 4 . 2 . 1 . 3)

When the job names related to the same workpiece is registered at batch as a common name, (3) above is most effective.

The work condition job names have already been reserved. (par. 8 . 1 . 6)

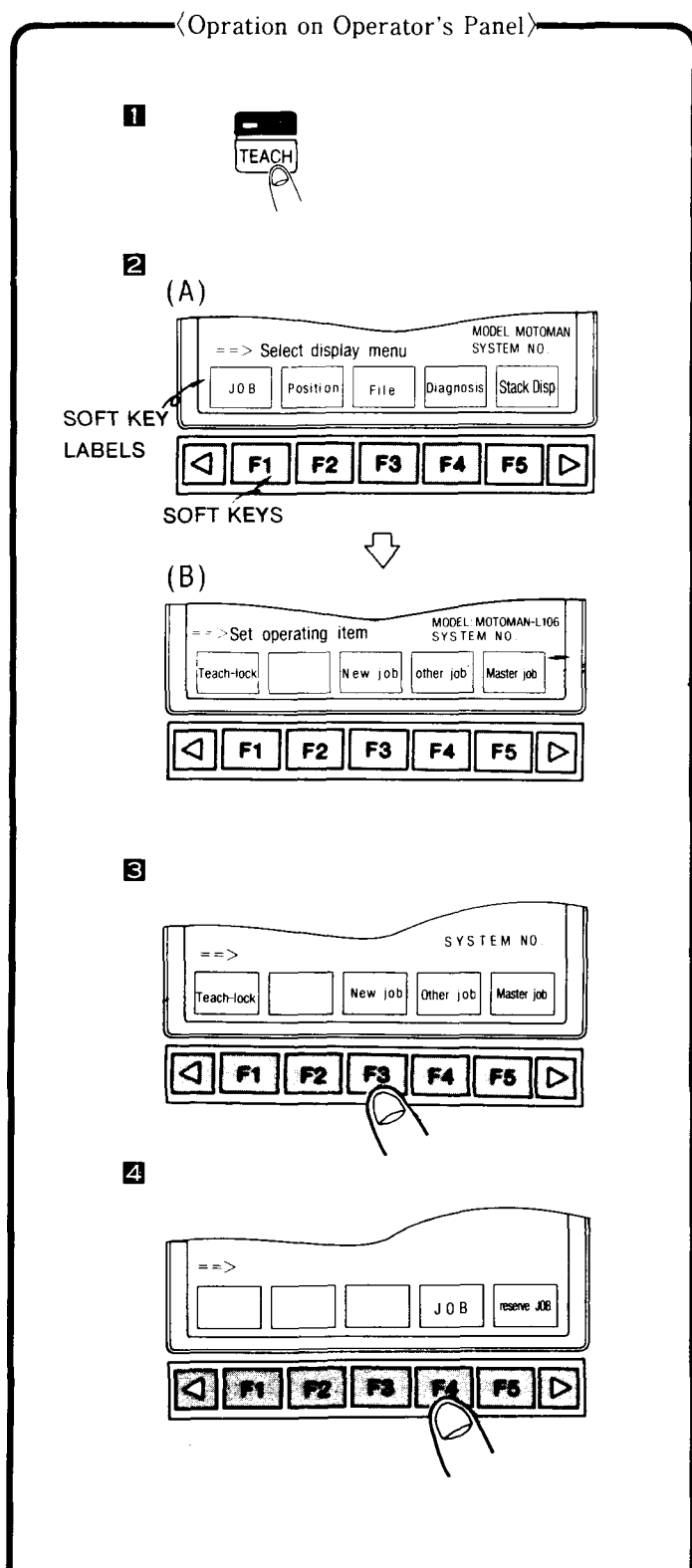
NOTE

The following characters cannot be used for registration of job name.

(SPACE) (") (*) (+) (,) (.) (/) (:) (;)
(<) (=) (>) (?) ([) (¥) (]) (|)

4

4. 2. 1. 1 Job Name Registration by using Data Keys



〈Description〉

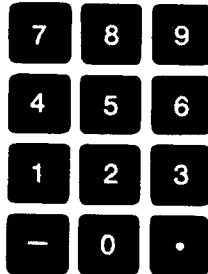
Depress TEACH key even if the TEACH key lamp is already lit.

As a result, the soft key labels (A) are changed to the soft key labels (B).

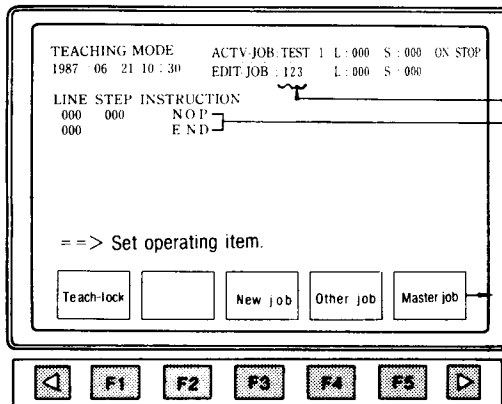
Depress New job soft key.
F3

Depress Job soft key.
F4

5 DATA keys




6 ENTER



CRT Display at New Job Registration

Register the job No. by using DATA keys.

If you make a mistake on the input, delete the job No. by using  key and reset the correct job No.

4

Depress **ENTER** key when the registration is completed.

The job name has been registered and displayed on the CRT display.

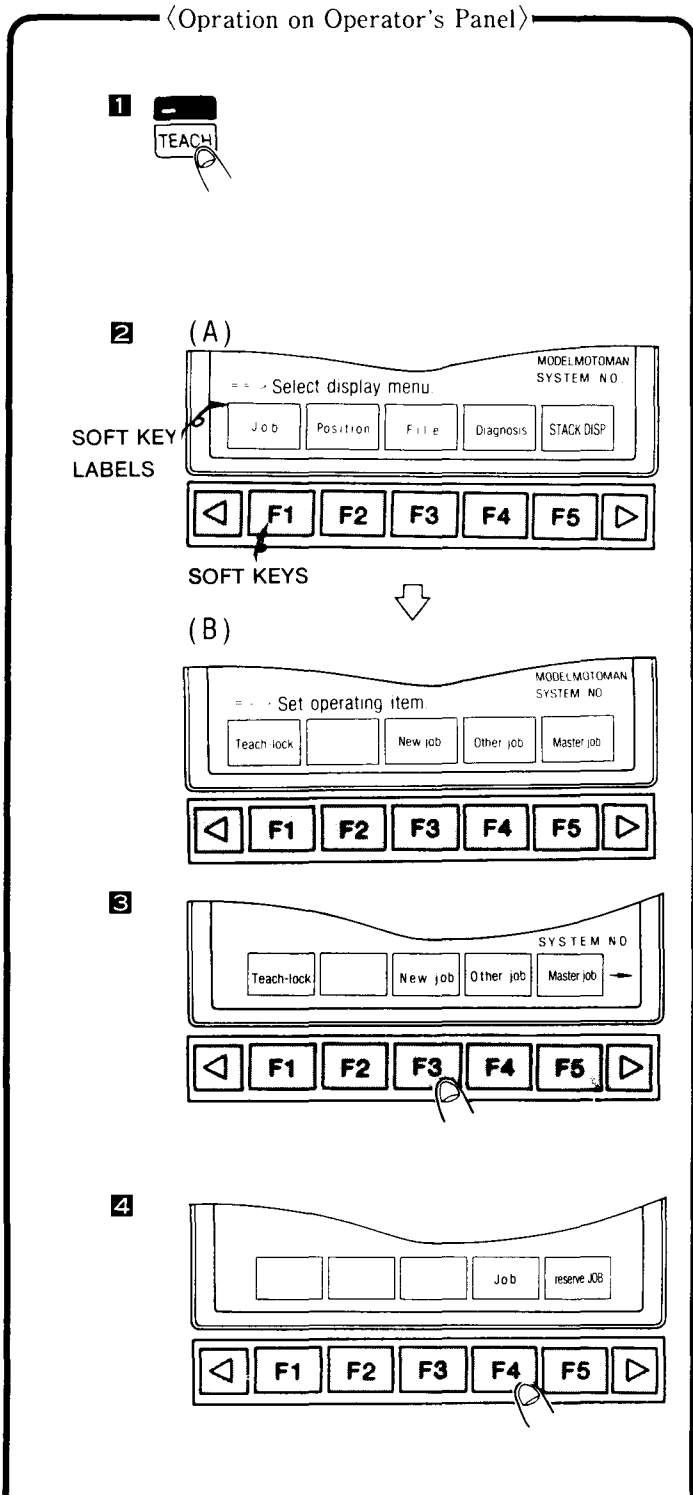
When the new job name has been registered, two instructions are also registered automatically.

- NOP : No operation
- END : End

To create a complete job, teach the position data at teach pendant and register or edit the instruction at operator's panel.

4. 2. 1. 2 Job Name Registration by Inputting Alphabets

<Description>



Depress TEACH key even if the TEACH key lamp is already lit.

As a result, the soft key labels (A) are changed to the soft key labels (B).

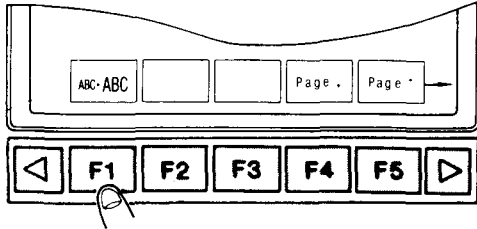
Depress **New job** soft key.

F3

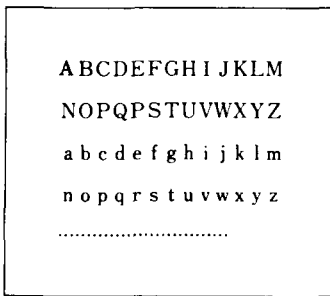
Depress **Job** soft key.

F4

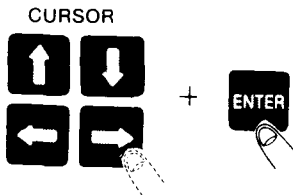
5



6



Character Display

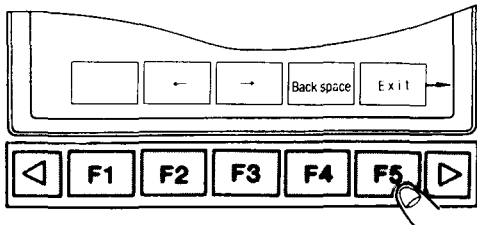


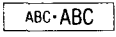

NOTE Register the job name within 8 characters (4 characters when double-space character is used).

7



8




Depress  soft key.


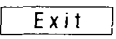

Character display appears.

4

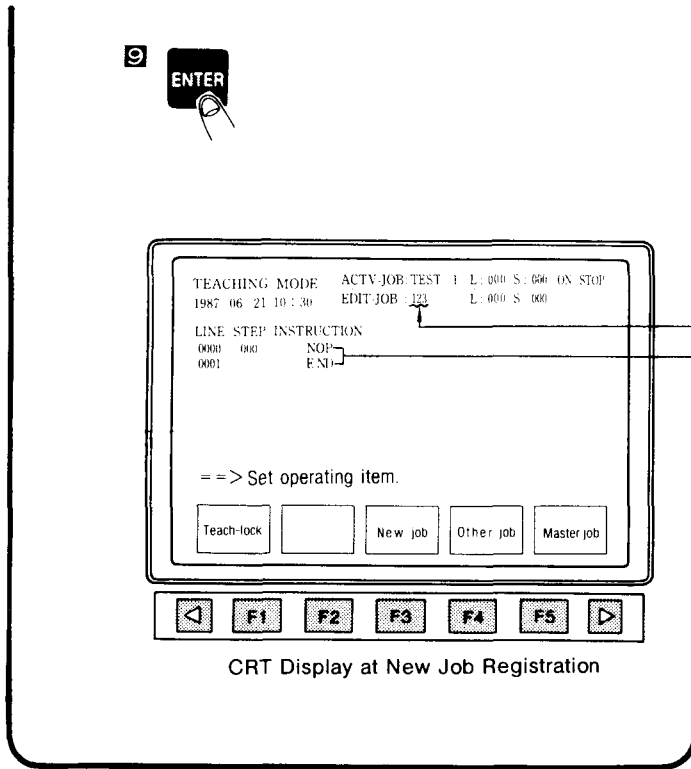
Place the cursor on the desired alphabet by using CURSOR keys and depress ENTER key. Repeat these operations until the alphabets are input completely.

If you make a mistake on the input, correct the job name referring par. 1 . 7 . 2 . "How to correct from ABCXE to ABCDE."

Depress  soft key to return the character display to the previous display.

Be sure to depress  soft key to end the character inputting. Otherwise, the job name cannot be registered.


4. 2. 1. 2 Job Name Registration by Inputting Alphabets (Cont'd)



Depress ENTER key when the registration is completed.

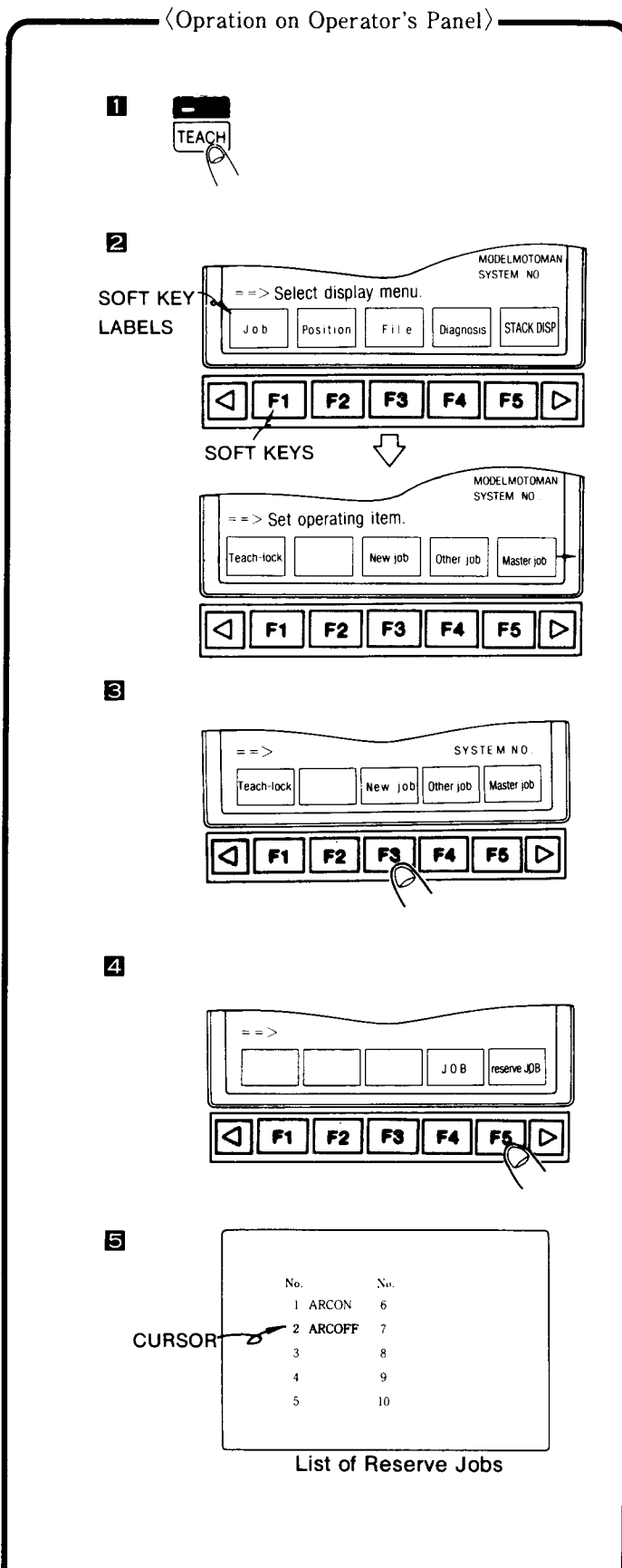
The job name has been registered and displayed on the CRT display.

When the new job name has been registered, two instructions are also registered automatically.

- NOP : No operation
- END : End

To create the complete job, teach the position data at teach pendant and register or edit the instruction at operator's panel.

4. 2. 1. 3 Job Name Registration by Adding 2 Digits to Reserved Job Name



〈Description〉

Depress TEACH key even if the TEACH key lamp is already lit.

As a result, the soft key labels (A) are changed to the soft key labels (B).

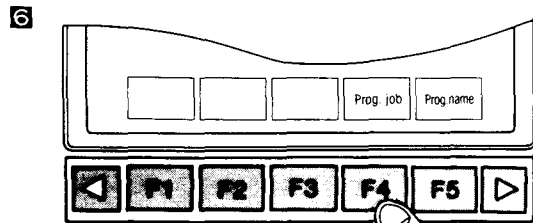
4

Depress F3 soft key.

Depress F5 soft key.

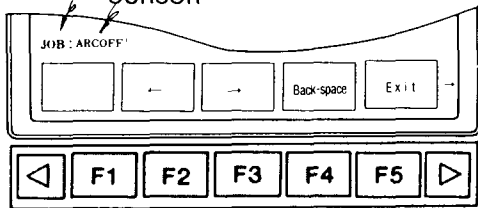
The list of reserve jobs is shown on the CRT display. Place the cursor on the desired reserve job.

4. 2. 1. 3 Job Name Registration by Adding 2 Digits to Reserved Job Name (Cont'd)



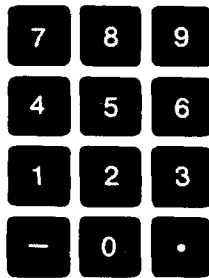
Depress Prog. job soft key.
F4

RESERVE JOB NAME CURSOR



The soft key labels changes as shown in the left.

7 DATA keys



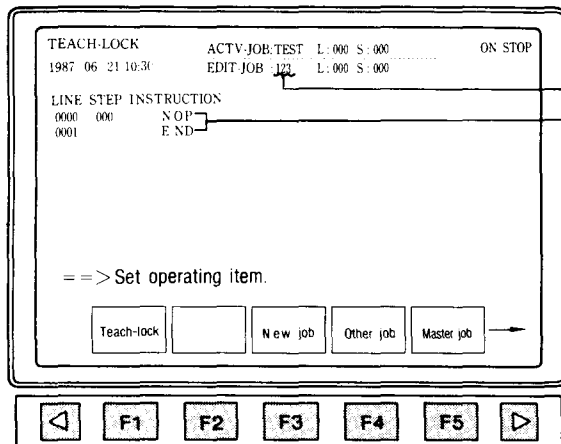
Register the job No. by using DATA keys.

If you make a mistake on the input,

delete the job No. by using CANCEL key and reset the correct job No.



Depress ENTER key when the registration is completed.



The job name has been registered and displayed on the CRT display.

When the new job name has been registered, two instructions are also registered automatically.

- NOP : No operation
- END : End

To create the complete job, teach the position data at teach pendant and register or edit the instruction at operator's panel.

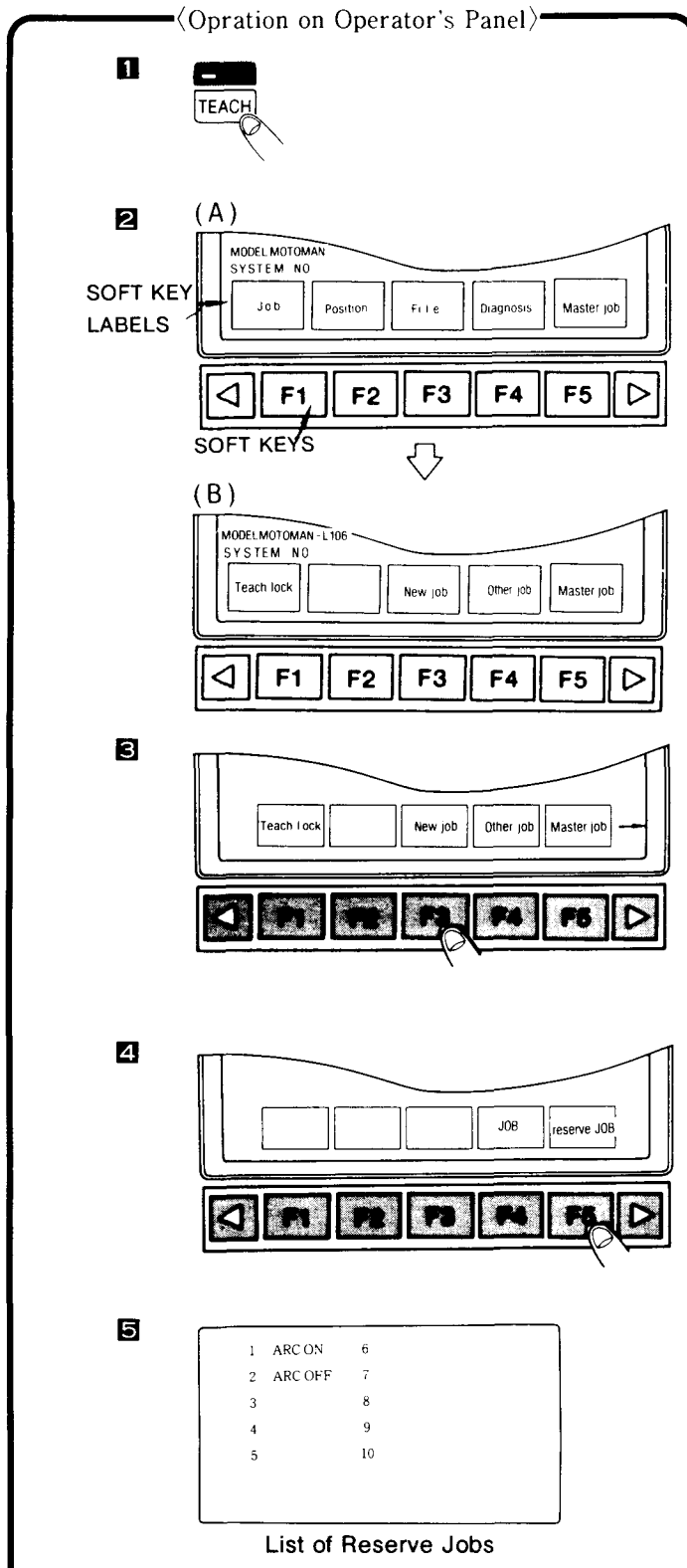
CRT Display at New Job Registration

★ When desiring to reserve the job name

A Maximum of 8 job names are previously reserved. The number of reservable job names may differ according to the applications.

A Maximum of 6 characters (3 characters in full size) can be registered in a job name.

Reserve job name in the following sequence.



〈Description〉

Depress TEACH key even if the TEACH key lamp is already lit.

4

As a result, the soft key labels (A) are changed to the soft key labels (B).

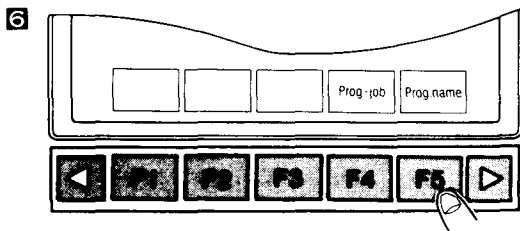
Depress **New job** soft key.
F3

Depress **reserve JOB** soft key.
F5

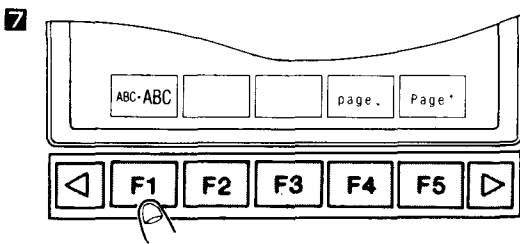
The list of reserve jobs is shown on the CRT display.

Place the cursor on the desired reserve position.

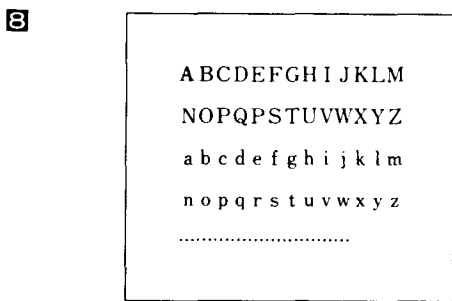
★ When desiring to reserve the job name (Cont'd)



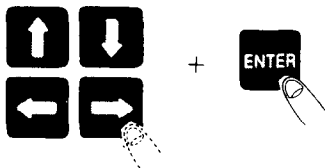
Depress Prog-name soft key.
F5



Depress ABC-ABC soft key.
F1



Character Display



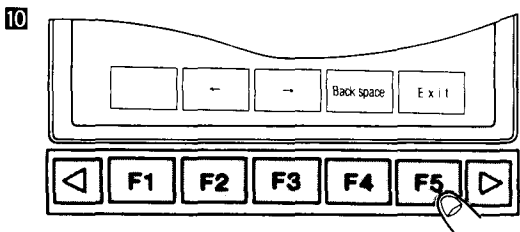
Character display appears.

Place the cursor on the desired alphabet by using CURSOR keys and depress ENTER key. Repeat these operations until the alphabets are input completely.

If you make a mistake on the input, correct the job name referring par. 1. 7. 2 "How to correct from ABCXE to ABCDE."



Depress ▶ soft key to return the character display to the previous display.



Be sure to depress Exit soft key to end the character inputting. Otherwise, the job name cannot be registered.

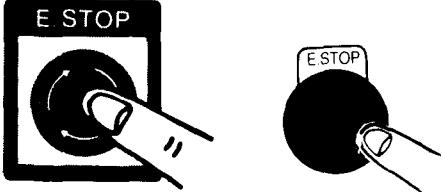


Depress ENTER key.
 The job name has been reserved.

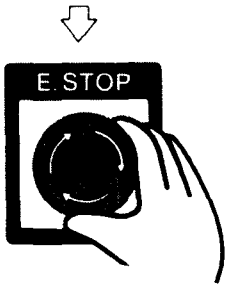
4. 2. 2 Confirmation of Emergency Stop Button

The servo power must be cut off by depressing the emergency stop button on the operator's panel or on the teach pendant. These buttons can be operated anytime and under any conditions.


1 Depress emergency stop buttons. Check that the servo power is cut off.



2 After checking, reset the emergency button on the operator's panel to the original position. The button on the teach pendant remains active.



Turn in the direction of arrow.

3 Depress  key.

4


4. 2. 3 Setting of Teach Lock

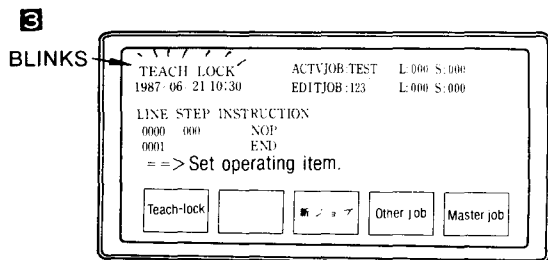
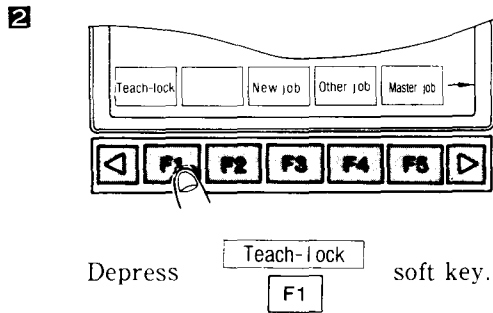
Be sure to set the teach lock for secure operation. As a result, operations only by the teach pendant become possible.

This setting can be made on both the operator's panel and teach pendant.

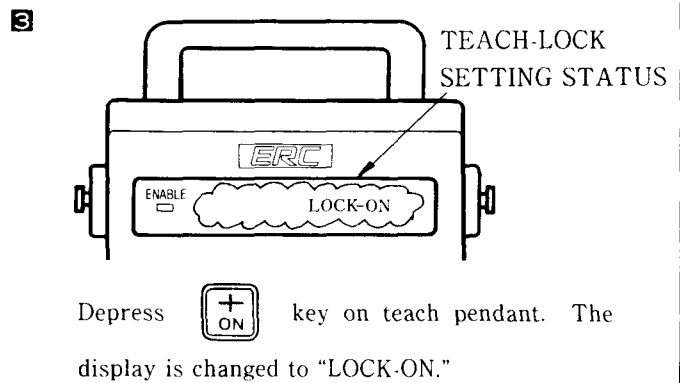
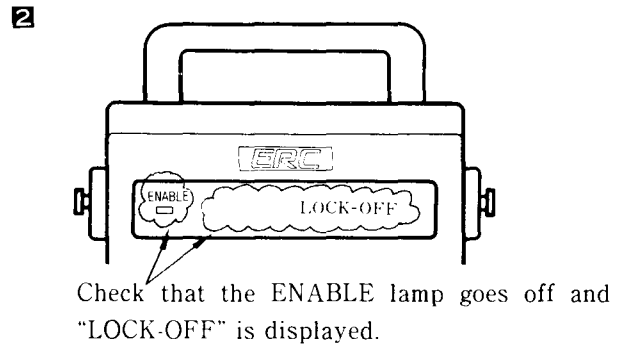
<Setting by using operator's panel>

<Setting by using teach pendant>

- 1 Depress  key on operator's panel even if the TEACH key lamp is already lit.

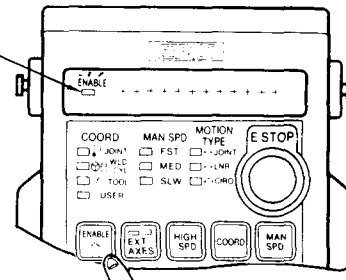


The teach-lock is set and the display above will appear.



- 4 Depress  key on teach pendant.

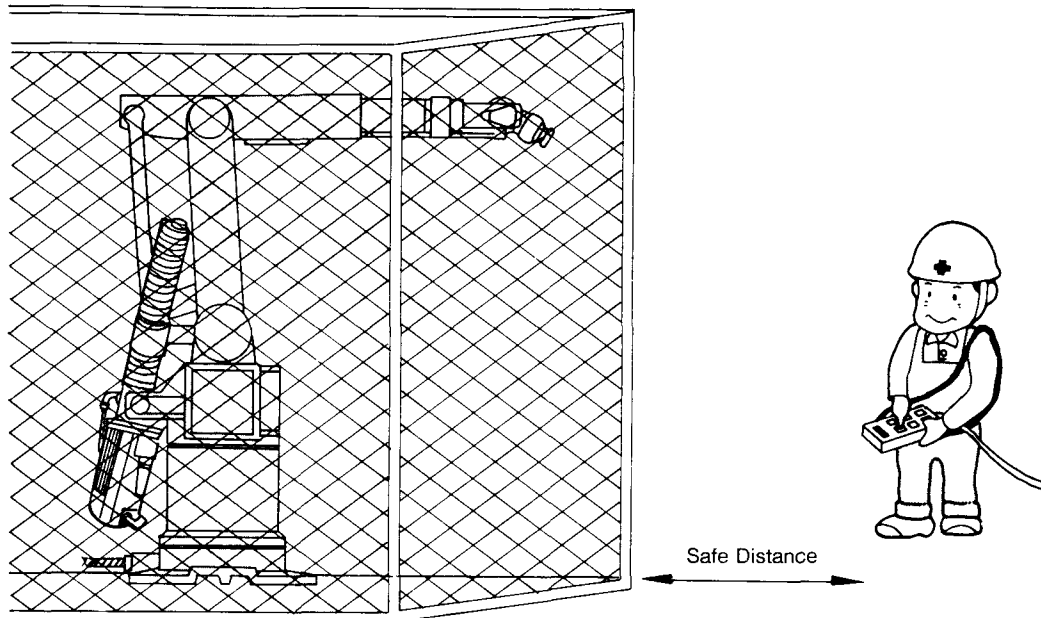
The ENABLE lamp is lit and keys on teach pendant are effective.



NOTE If keys on the teach pendant are not operated for more than 30 seconds (standard value), the ENABLE lamp goes out automatically. The display is changed to "0000 000 NOP."

4. 3 TEACHING



Let's teach the jobs with teach pendant from in front of the manipulator.


















4

Teaching Outline (Teach Pendant Operation)




- 1** TEACH LOCK
(See par. 4. 2. 3. 1)

→ **2**  → **3**  →



MAN SPD
 FST
 MED
 SLW
- 4** Axis keys




1					4
2					5
3					6

Check each axis movement by using Axis keys.
- 5** STEP 1
(Safe place and position corresponding to the workpiece.)
Move the manipulator to STEP 1 by using Axis keys.

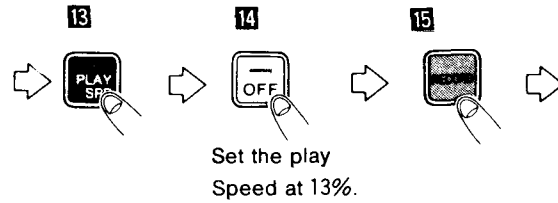
→ **6**  → **7**  → **8**  →

Set the play speed at 50%.
- 9** STEP 2
(Near the operation starting position)
Move the manipulator to STEP 2 and make the posture so that the welding, gluing or handling can be executed by using Axis keys.

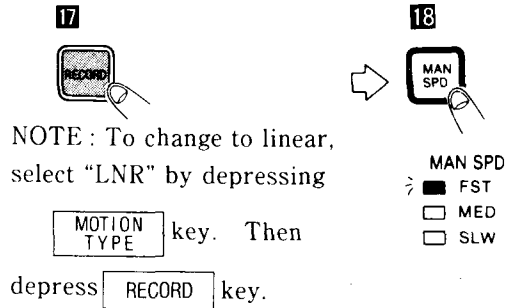
→ **10**  → **11**  →

MAN SPD
 FST
 MED
 SLW

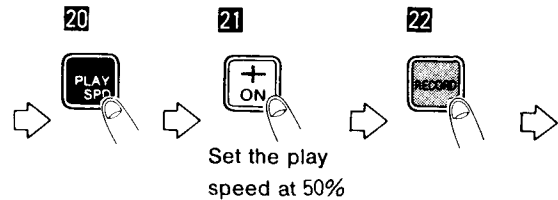
- 12** STEP 3
 (Operation starting position)
 Move the manipulator to STEP 3
 with the posture on STEP 2.



- 16** STEP 4
 (Operation end position)
 Move the manipulator to STEP 4
 by using Axis keys.



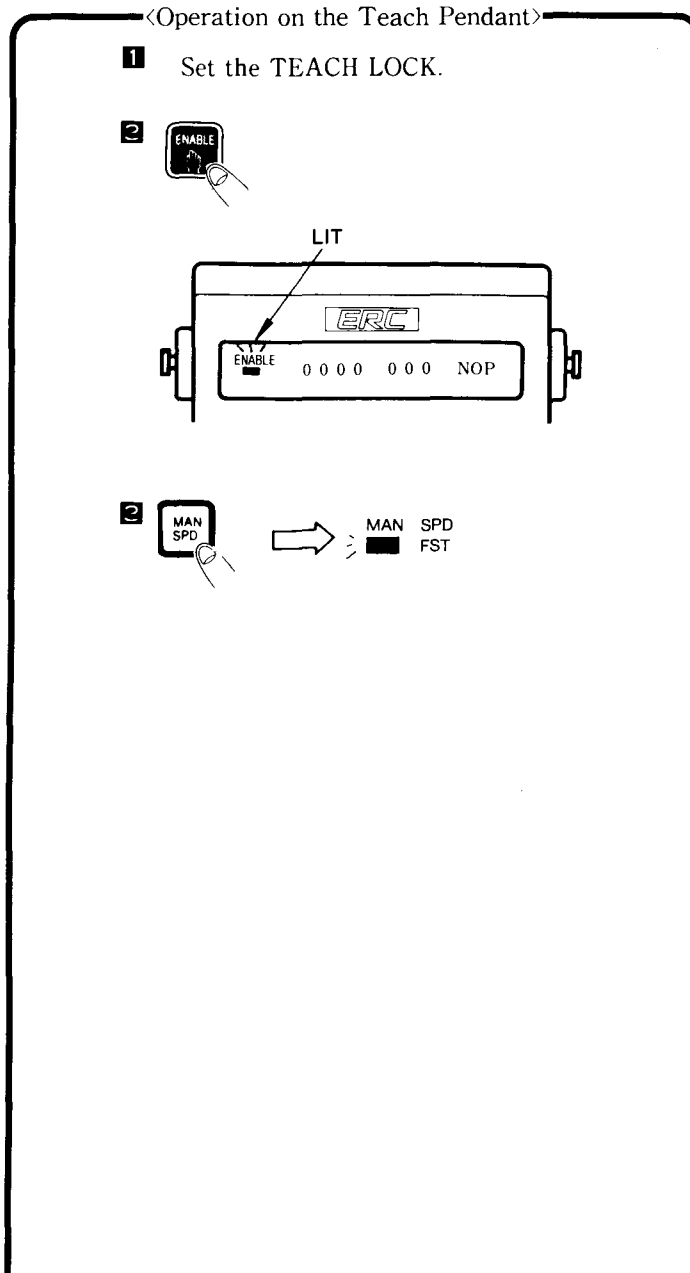
- 19** STEP 5
 (Separate position from operation end position, does not contact the workpiece.)
 Move the manipulator to STEP 5 by using Axis keys.



- 23** STEP 6
 (Near the operation starting position)
 Move the manipulator to STEP 6
 by using Axis keys.



★ Description of Teaching




〈Description〉


Refer to par. 4. 2. 3. 1

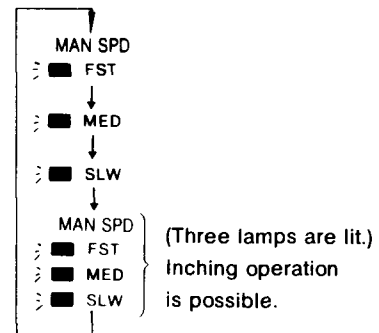
Depress ENABLE key.

The ENABLE lamp is lit and the operation by teach pendant becomes possible.

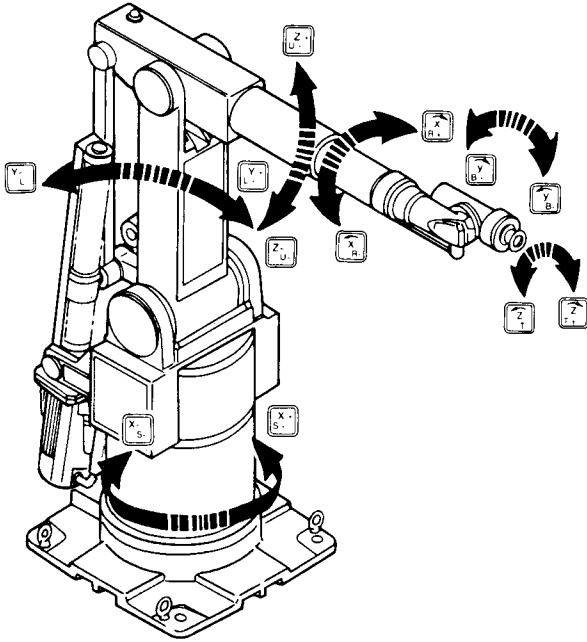
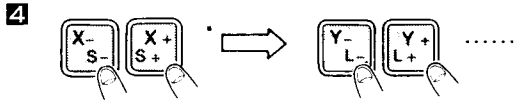
4

Set the manual speed to FST (fast) by depressing  key.

NOTE The lighting position of MAN SPD lamp is shifted down every time  key is depressed.

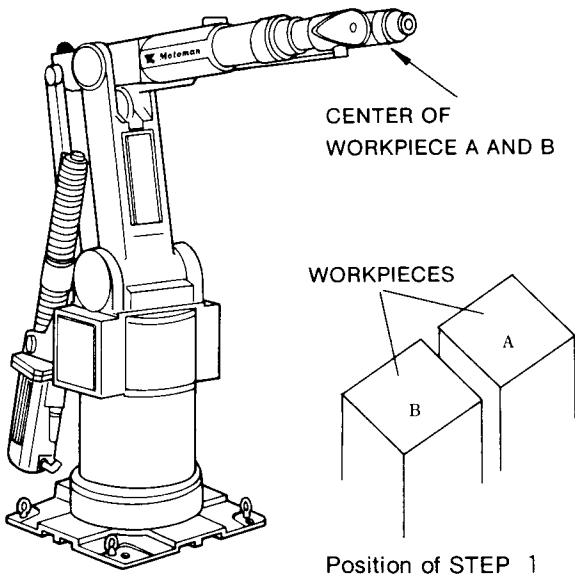


★ Description of Teaching (Cont'd)



5 Move the axes to STEP 1.

<Example>



Check roughly each axis movement by depressing the axis keys below.

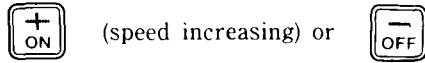
Axis key	Axis	Movement
1 X- S- X+ S+	S	Rolling (Right/left)
2 Y- L- Y+ L+	L	Forward/backward
3 Z- U- Z+ U+	U	Up/down
X-tilde R- X-tilde+ R+	4 R	Rolling (Right/left)
y-tilde B- y-tilde+ B+	5 B	Bending (Up/down)
Z-tilde T- Z-tilde+ T+	6 T	Turning (Right/left)

STEP 1 (the first position) should be at a safe location and in a position corresponding to the same workpieces.



Depress  key.

7 Set the play speed at 50% by using

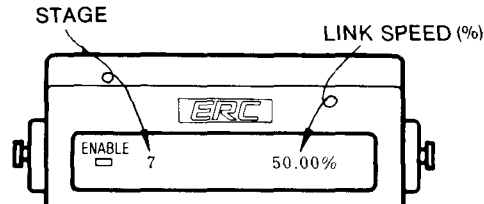


(speed decreasing) key.

Play speed has 8 stages :

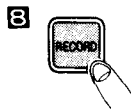
Stage	1	2	3	4	5	6	7	8
Play speed %	0.78	1.56	3.12	6.25	12.50	25.00	50.00	100.00

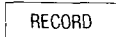
(Example) Link interpolation



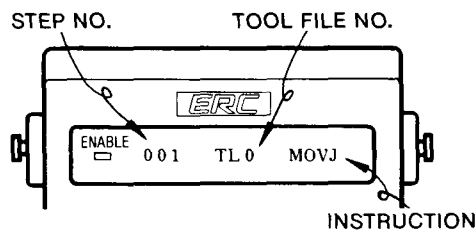
NOTE Where interpolation is link, the play speed is displayed at link speed (% data). The play speed is changed only at link interpolation.

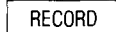
Where interpolation is linear or circular, the play speed is displayed at linear speed (absolute data in mm/s). The play speed is changed only at linear/circular interpolations.



Depress  key.

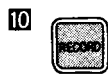
(Example)

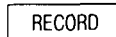


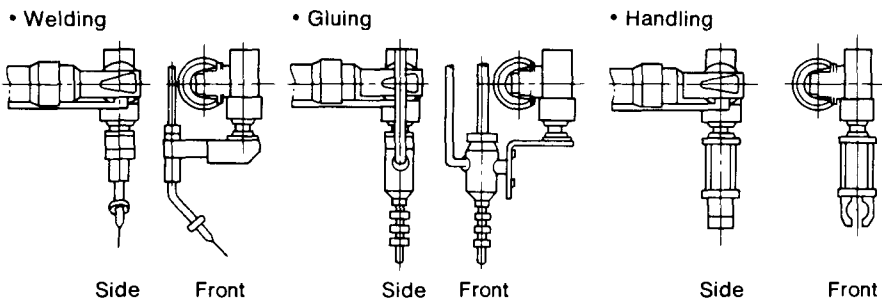
The display changes as shown on the left. STEP No. is increased by one every time you depress  key. (999 max.)

9 Move the axes to STEP 2 .

STEP 2 should be near the operation starting position where the welding, gluing or handling can be executed.



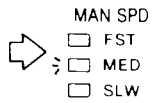
Depress  key.




Basic Wrist Posture for Operation Starting

★ Description of Teaching (Cont'd)

11

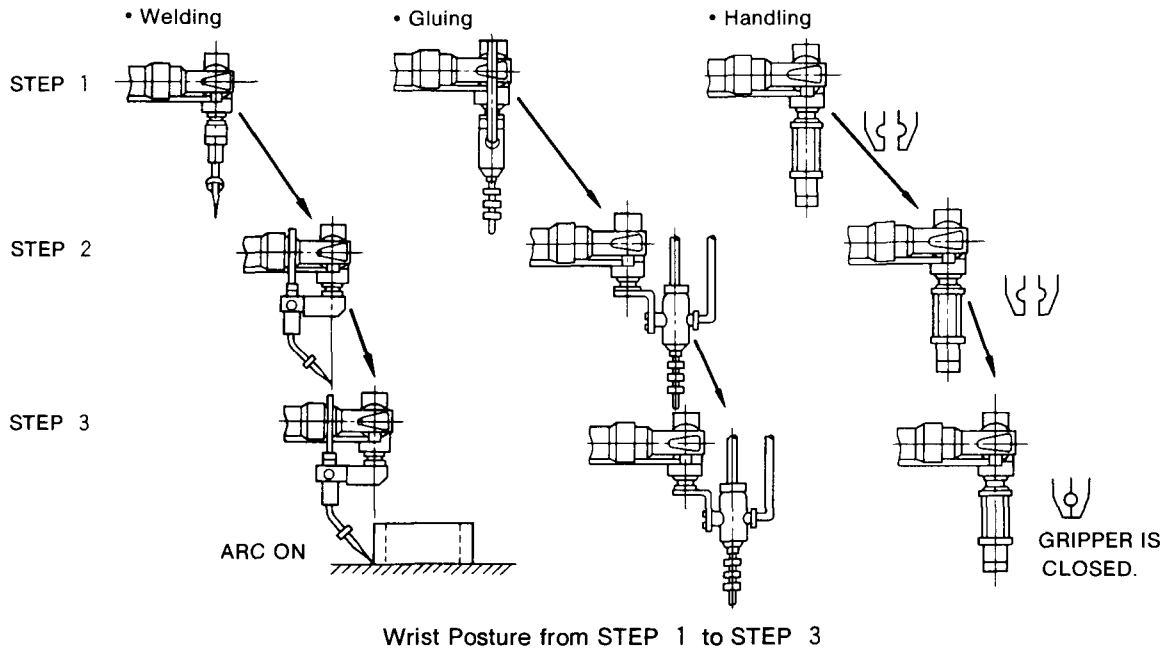


Set the manual speed to MED (medium)
by depressing  key.

12

Move the axes to STEP 3
(Operation starting position)

keeping wrist posture of STEP 2.

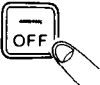


13




Depress  key.

14

Set the play speed at 13 %
by depressing  key.

15



Depress  key.



16

In this way, teach STEPS 4 to 6
(near start position).


The play speed can be increased
according to the conditions.

24

4. 3. 1 Path Registration in Teaching

In teaching, depress  key to register “manipulator position.” At this time, “Playback speed data” and “Move instruction corresponding with motion type” are registered simultaneously. The line and step Nos. of the new teaching data are increased by one and registered under displaying line No. The registered step can be checked by depressing  key.


Move instruction display on teach pendant


Confirm the registered step by depressing  key.


0	1	2		T	L	O		M	O	V	L		V=750.0		PL=1		UNTIL	IN#02=	1
---	---	---	--	---	---	---	--	---	---	---	---	--	---------	--	------	--	-------	--------	---




↑ Instruction and additional items.

↑ Tool file No. (Tool file data in step registration).

↑ Step No. (Displays only for Move instruction.
Increased by one every time  key is depressed.)

- The display on teach pendant is up to 12 characters. To display more than 12 characters, depress  key on teach pendant to move the display to the left.

To return the display, depress  key.

- NOTE**
1. When the instruction is registered above END instruction, depress  key. For registration to the other position, depress  and  keys.
 2. To correct the position, be sure to specify the MOVE instruction.

4

Improvement for movements between points

For high speed motion (air-cut motion) in sequence of P 1 → P 2 → P 3 .



〈Conventional method〉

Teaching

- ① Move the arm to point P 1 with teach pendant.
- ② Specify the interpolation to link.
- ③ Set the play speed level to stage 8 (100.00%).
Then, record it.
- ④ Teach points P 2 and P 3 the same as for point P 1 .
The job contents are displayed as shown below.

Line:	Step:	Instruction:	Teach tool : 0
0000	000	NOP	
0001	001	MOVJ VJ=100.00	
0002	002	MOVJ VJ=100.00	
0003	003	• MOVJ VJ=100.00	
0004		END	

Movement

In this case, the speed from P 1 may be decreased once at P 2 , and the speed is increased forward again at P 3 .

〈Improved method〉

Teaching

When points P 1 , P 2 and P 3 are taught by teach pendant the same as for conventional method, the CONT or PL specification is set with MOVE instruction at that time.

Registration

- ① When depressing **RECORD** key without specification of positioning level, "CONT" is registered.
(ex) `MOVJ VJ=100.00 CONT`
- ② When depressing **RECORD** key with specification of positioning level, "PL= 0 to 4 " is registered.
(ex) `MOVJ VJ=100.00 PL= 4`



1. The deletion and addition of "CONT" specification should be executed with line editing (operation on operator's panel).
2. The specification of "CONT" and "PL" can not be executed at the same time.

Movement

- For the teaching point specified at "CONT", the manipulator will move without decreasing speed.
- For the teaching point not specified at "CONT" and "PT" (inward turning), the manipulator decreases speed at P 2 and increases forward at P 3 .

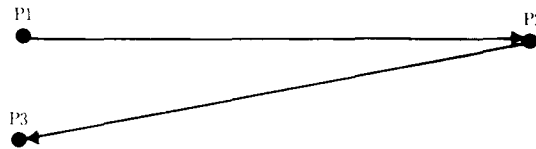


1. Take care of the following points when the job programmed in previous version 4.00 are arranged and operated by using program of version 4.00 and beyond.

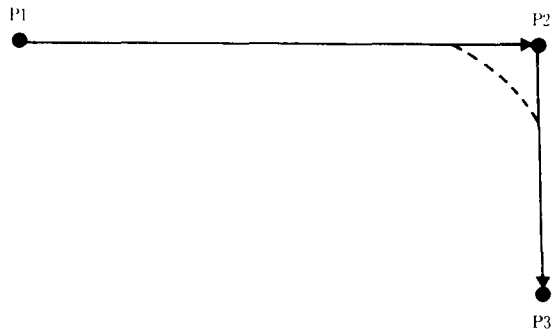
- ① When operating without "CONT" specification, the acting time is a little longer than programmed in previous version 4.00.
- ② When "CONT" is registered in previous job, the inward turning radius in the corner is a little larger than it was of the previous job. Be careful of interference.

2. Note for motion with "CONT" or "PL" specification.

- ① Where the manipulator is operated in a reverse direction in sequence P 1 → P 2 → P 3, it decreases and increases speed at P 2.



- ② Where the manipulator has corner motion with "CONT" specification, it moves along an inward turning path as shown by the dotted line. For this inward turning, the motion speed is higher and the manipulator is larger, the rate of the inward turning is higher.



- ③ When an instruction other than MOVE instruction is registered in a step of MOVE instruction, the manipulator will decrease the speed or keep the speed according to the registered instruction.

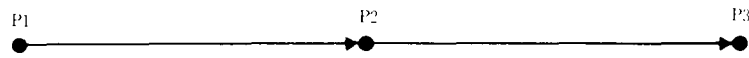
LINE :	STEP	INSTRUCTION: TEACH TOOL:0
0000	000	NOP
0001	001	MOVJ VJ=100.00 CONT
0002	002	MOVJ VJ=100.00 CONT
0003		TIMER T=0.30
0004	003	MOVJ VJ=100.00 CONT
0005		END

In this case, the speed is decreased at P 2. After timer instruction is executed, the speed is increased forward at P 3.

When the following instruction is registered in a step of MOVE instruction, keeping speed processing (at CONT specification) or inward turning processing (at PL specification) can not be executed.

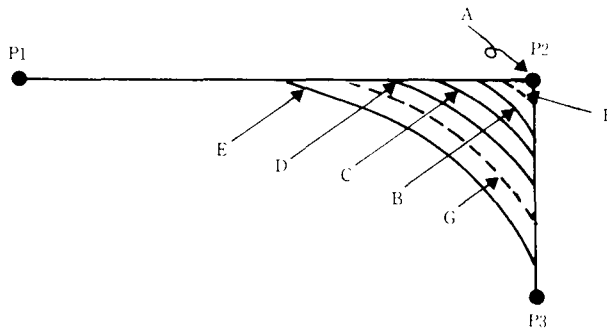
- All arithmetic instructions
- Some control instructions
TIMER, PAUSE, STOP, CALL, JUMP, RET, END
- Some I/O instructions
WAIT, BRWAIT, POSOUT, DIN
- Some device instructions
ARCON, ARCOF, GUNON, GUNOF, HAND 1 , HAND 2 , TOOLON, TOOLOF, LASERON, LASEROF
- Instructions for optional functions

- ④ When "PL" (inward turning) is specified for an almost straight line, it is regarded as "CONT" specification automatically.



- ⑤ When "PL" is specified for the position in which the wrist axis moves widely, segment over alarm will occur. Change the PL specification to CONT.

3. Note for path in corner point when CONT and PL specification.



< The setting of inward turning distance >

- | | | |
|---|---------------------|----------------------------------------|
| A | Path of PL= 0 | |
| B | Path of PL= 1 | Determined at parameter (SC044) value. |
| C | Path of PL= 2 | Determined at parameter (SC045) value. |
| D | Path of PL= 3 | Determined at parameter (SC046) value. |
| E | Path of PL= 4 | Determined at parameter (SC047) value. |
| F | Without CONT and PL | } Vary according to the speed. |
| G | Path of CONT | |

Refer to par. 4. 3. 1.

<Conventional method>

When a MOVE instruction is registered or added from the teach pendant, CONT is added without any condition unless PL is specified.

There is no means to delete CONT/PL from the teach pendant.

<Improved method>

A function to register MOVE instructions without CONT/PL from the teach pendant and a function to delete registered CONT/PL are added. The operation procedures are as shown below:

Operation Procedures

- Depress key as keeping depressing key, the teach pendant display will be changed as shown below:

The above display is changed by and keys.

- When NO-CONT is displayed,

or + : Registration without CONT/PL

+ : CONT/PL deletion if it is registered

- When CONT is displayed,

or + : Registration with CONT/PL

+ : Changed to CONT

4. 3. 1. 1 Notes for Path Registration

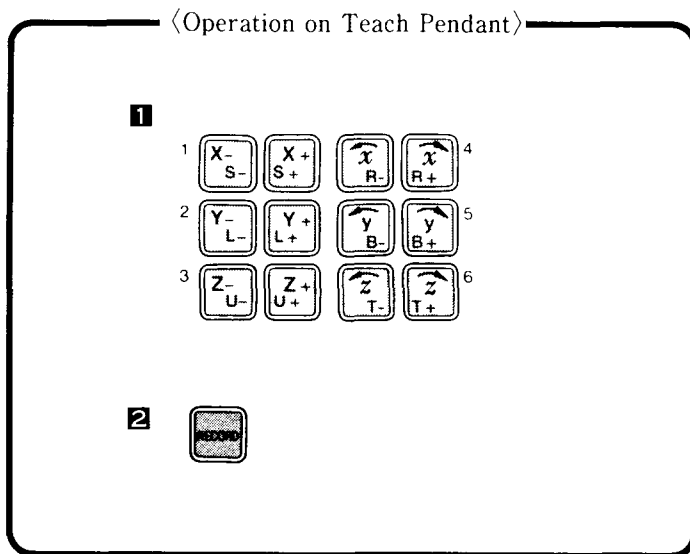
Before registering the path, check the following items.

- Is the registering position correct ?
 - Confirmation of jobs and steps
 - Confirmation of registered instructions

- Is the data for registering completed ?
 - Specification of manipulator position (Par. 4 . 3 . 1 . 2)
 - Specification of play speed (Par. 4 . 3 . 1 . 3)
 - Specification of motion type (Par. 4 . 3 . 1 . 4)
 - Specification of positioning level (Par. 4 . 3 . 1 . 5)
 - only when the specification is executed
 - Specification of reference point (Par. 4 . 3 . 1 . 6)

4. 3. 1. 2 Manipulator Position Registration

Manipulator position is registered in TEACH mode by using teach pendant.



〈Description〉

Move the manipulator to the desired position.


Depress RECORD key.

4. 3. 1. 3 Play (Motion) Speed Registration

When the Motoman position is registered, the play speed data are also registered. 8-stage playback speed is available. Select it as follows. The selected data is stored temporarily in the memory and registered to the input move instructions until it is changed.

〈Operation on Teach Pendant〉

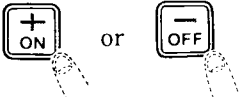
1



• Teach pendant display

STAGE										LINEAR*
1				1	1	.	0	M	M	/ S
↓										
2				2	3	.	0	M	M	/ S
↓										
3				4	6	.	0	M	M	/ S
⋮										
8	1	5	0	0	.	0	M	M	/ S	

2




〈Description〉

Depress  key.

* Interpolation type	Unit
Linear, circular	mm/s
Link	%


Select the play speed from among 8 stages.

NOTE



1. Even if the manual speed is changed, play speed stages (for registration) are not changed.
2. The play speed data setting is abbreviated by depressing  keys.

• Teach pendant display.

0				0	.	0	M	M	/ S
---	--	--	--	---	---	---	---	---	-----

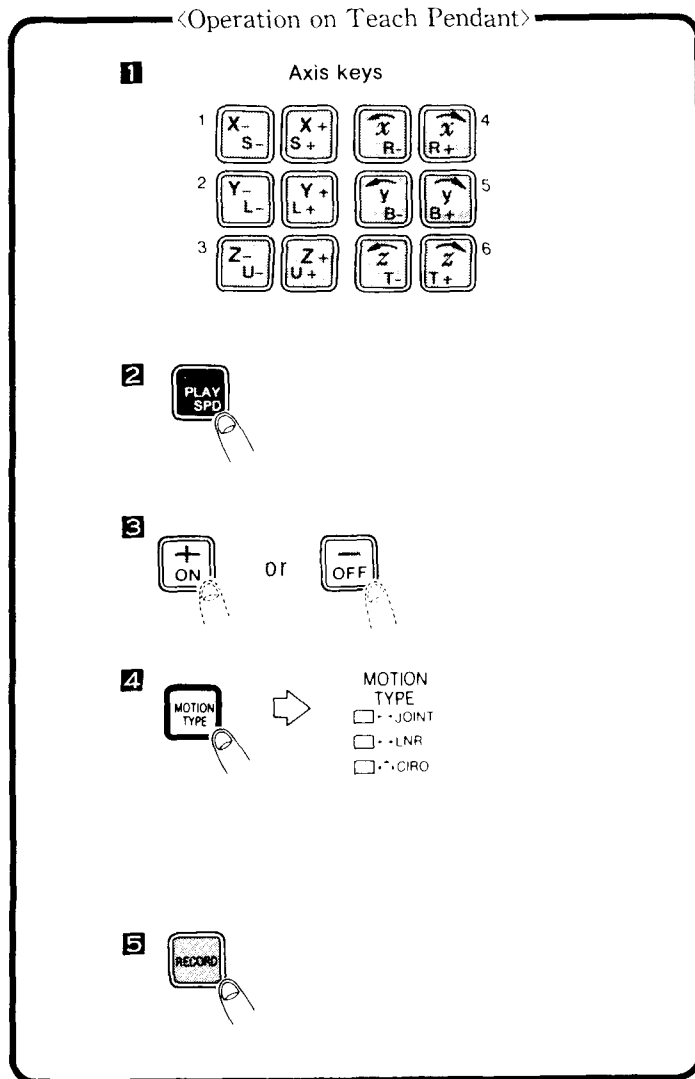
Before depressing  key, register the interpolation type to specify the moving path during playback, referring to par. 4. 3. 1. 4.

4. 3. 1. 4 Motion Type (Link, Linear, Circular) Registration

Before depressing  key, specify the motion type to indicate the move path at playback.
When  key is depressed, the motion type with positioning data is registered as MOVE instruction, as shown below.


MOTION TYPE	Instruction	Movement
<input type="checkbox"/> JOINT	MOVJ	Joint
<input type="checkbox"/> LNR	MOVL	Linear
<input type="checkbox"/> CIRC	MOVC	Circular
<input type="checkbox"/> LNR } <input type="checkbox"/> CIRC }	MOVS	Free curve interpolation

★ Speed reset and Motion type specification



<Description>

Move the manipulator to the operating position by using Axis keys.


Depress  key.


Select the play speed from among 8 stages.

Set the motion type (link, linear, circular or linear/circular).

Refer to "★ Description of motion type" on the next page.

The lighting position of MOTION TYPE lamp is shifted down every time

 key is depressed.

Depress  key.

Now, "Manipulator teaching operation" and "Play speed" are registered.

★ Description of motion type

(1) Link operation (□ → JOINT)

For 1st step, be sure to teach at link operation.

(2) Linear operation (□ → LINEAR)

Manipulator moves linearly between steps taught in linear.

The wrist position is changed automatically in accordance with path position, as shown below.



Normally, teach the manipulator in linear for the welding section.

(3) Circular operation (□ → CIR)

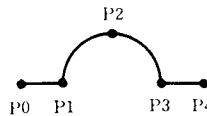
In playback, the circular operation is executed during section taught in circular.

NOTE

Point is abbreviated to P after this.

• Single circular

Teach P 1 to P 3 in circular.



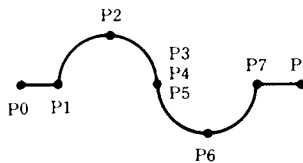
P 1 to P 3 : Circular

• Continuous circular

Teach P 1 to P 3 in circular.

Teach P 4 in link or linear to separate between 1st circular and 2nd circular.

Teach P 5 to P 7 in circular.

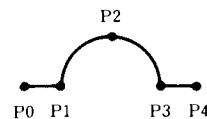


P 1 to P 3 : Circular
P 4 : Link or linear
P 5 to P 7 : Circular.

Note : P 3 to P 5 are the same point.

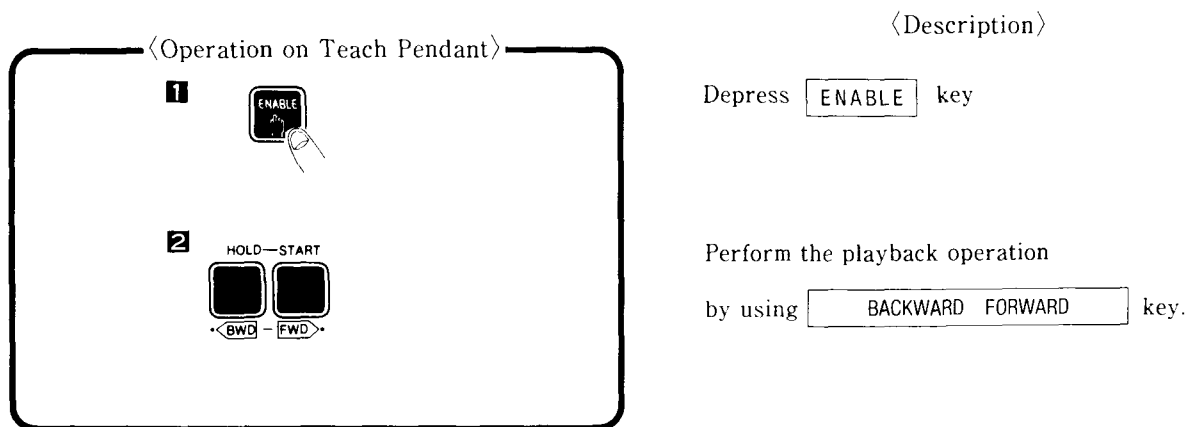
• Speed in circular operation

Manipulator moves from P1 to P 2 at speed taught in P 2 and from P 2 to P 3 at speed taught in P 3.



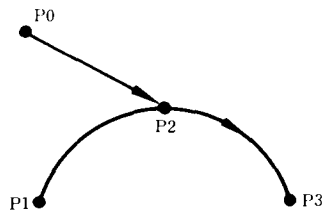
Note : When the circular operation is taught at high speed, the executed path is smaller than taught path.

★ Circular job (MOVC) operating method



NOTE

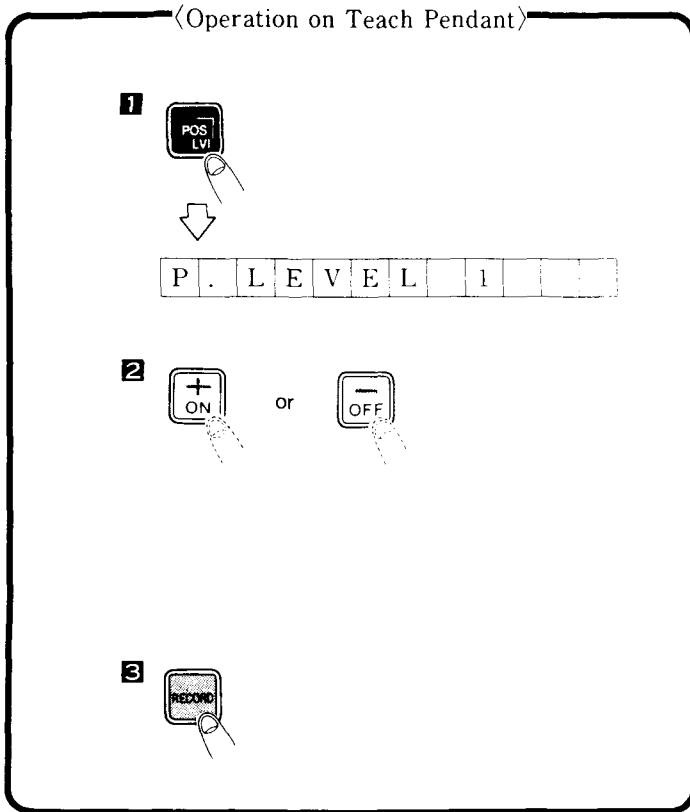
1. For the first step toward MOVC job, manipulator moves linearly. The manipulator moves circularly from 2nd step in MOVC job.
2. For the following cases, manipulator executes the linear operation, not circular operation.
 - The axis operation is executed during the circular operation.
 - The cursor or search operation is executed.
 - The taught points are three points or below in sequence. However, the circular operation can be executed in case below.



When the manipulator moves from P 0 to P 2 and from P 2 to P 3 by using FORWARD key, the movement from P 2 to P 3 is circular because the three points (P 1 to P 3) are regarded as the sequence points.

4. 3. 1. 5 Positioning Level Specification

Perform the following operation only when registering the step (position) which particularly requires positioning level specification at playback operation.



<Description>

Depress **POS LVI** key.

The lamp is lit.

The positioning level selected previously is displayed.

Select the desired level by depressing **ON** or **OFF** key.

The relation between positioning level and the accuracy is as follows.

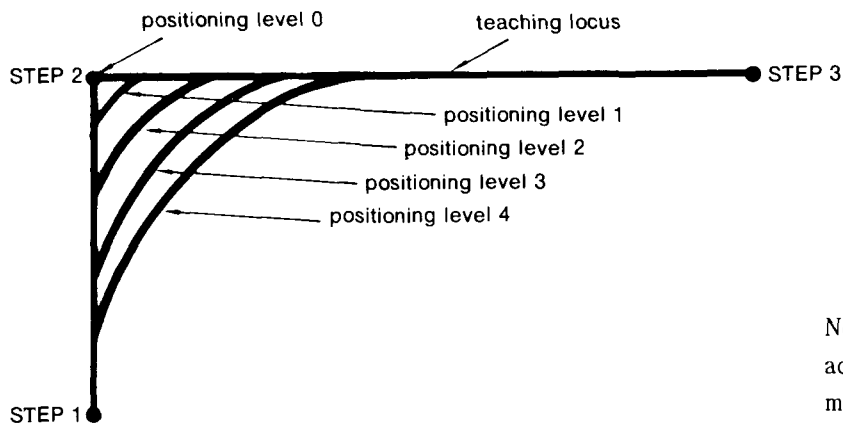
Depress **RECORD** key.

The MOVE instruction and positioning level are registered simultaneously.

4

★ The relation between positioning level and the accuracy

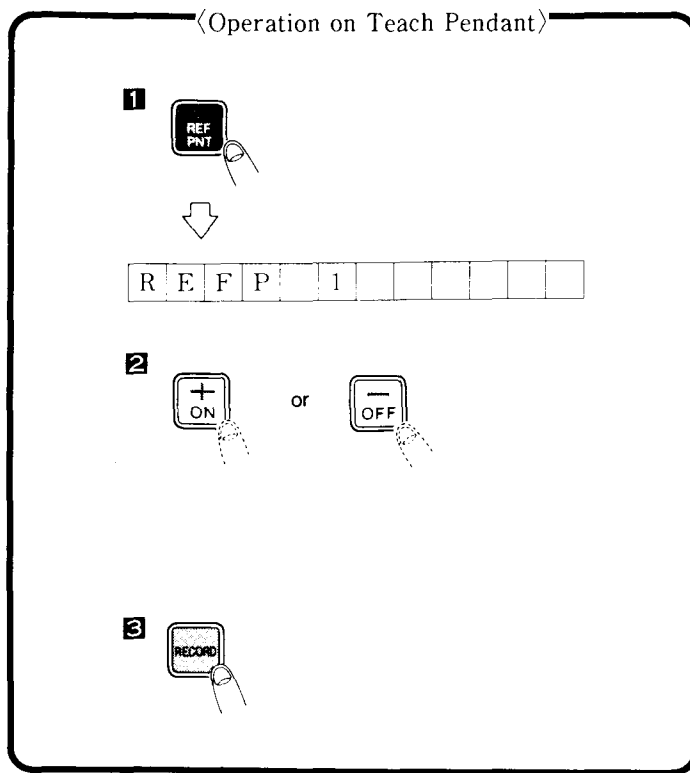
P.LEVEL	0	Precise	} Inward turning positioning (4 stages)
(Positioning Level)	1	Fair	
	↓		
	4	Rough	



Note : The positioning accuracy depends on the motion speed.

4. 3. 1. 6 Reference Point Specification

Perform the following operation only when the reference point registration is needed for motion in addition to wall point of weaving, auxiliary point, etc.



〈Description〉

Depress key.
The lamp is lit.

The reference number selected in the previously is displayed.

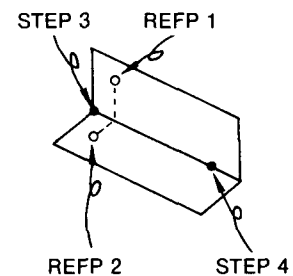
Select the desired number by depressing or key.

Each reference point number is determined as follows.

Depress key.
The reference point instruction and taught data are registered simultaneously.

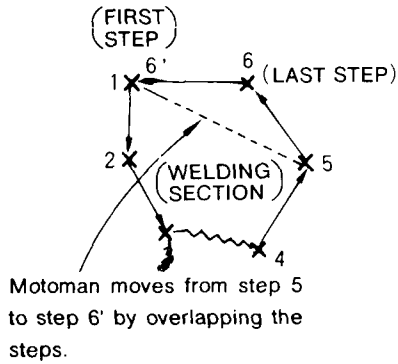
★ Reference point number

Instruction	No.	Meaning
REFP (reference position)	1 2	Wall point of weaving Auxiliary point



4. 4 OVERLAPPING OF FIRST AND LAST STEPS

Why the first and last steps should be overlapped



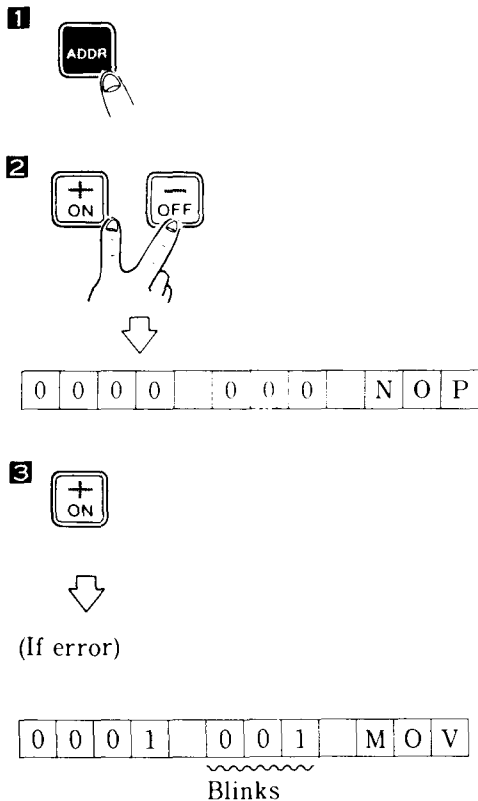
Because the Motoman moves at effective movement.

- Overlapping
Step 1 → 2 → 3 → 4 → 5 → 6'
- No Overlapping
Step 1 → 2 → 3 → 4 → 5 → 6 → 6'
This movement is waste.

4

Perform the following operation to overlap the first and last steps.

〈Operation on Teach Pendant〉



〈Description〉

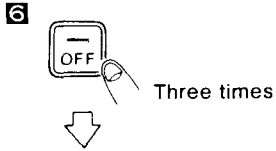
Depress **ADDR** key.

Depress **+ON** and **-OFF** keys simultaneously.

This display will be shown.

Depress **+ON** key.

If the display on teach pendant and the Motoman position are different, the step display will blink.



Times	Display
1	0 0 0 0 0 0 0 0 N O P
	↓
2	0 0 0 7 E N D
	↓
3	0 0 6 T L O M O V L



Depress key until the step returns to the first (STEP 1) position, while watching the movement of the manipulator.

Depress key.

Depress key three times.

The last (STEP 6) step will be displayed.

Depress key.

Depress key.


Now, the first and last steps becomes the same point.

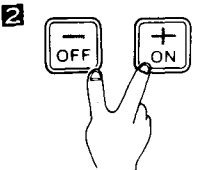
4. 5 PATH CONFIRMATION

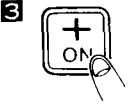
Check that the taught path is correct.

〈Operation on Teach Pendant〉

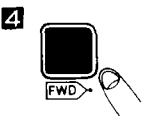
At first, display of STEP 1 should be shown.

1 

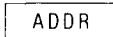
2 



3 


Next, confirm the movement each step.


4 

〈Description〉

Depress  key.

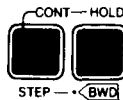
Depress  and  keys simultaneously.

Depress  key.

Check the movement between steps and the step position in sequence by depressing  key.

NOTE

1. Set the manual speed at middle until you are familiar with the operation.
2. After checking the path, the manipulator moves continuously at playback speed by depressing







keys simultaneously.

4



4. 5. 1 Backward and Forward Key Operation

(Confirmation of Taught Position on Teach Pendant)


The path can be confirmed by operating the  and  keys on the teach pendant after registering the position data. These keys have a deadman switch style for safety. The manipulator moves only while the  or  key is depressed.

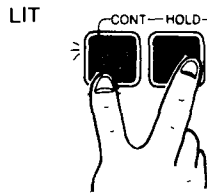
4. 5. 1. 1 Mode Selection

During path confirmation (BACKWARD/FORWARD), it is possible to select between checking as a continuous path or checking the teach position for each step. The former is called the CONTINUOUS mode and the latter, the STEP mode.



The  and  key functions differ depending on each mode.

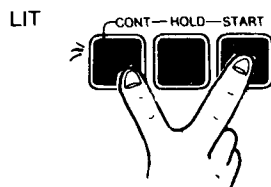
CONTINUOUS MODE

While  key is holding down, this lamp is lit and the CONTINUOUS mode is activated.



- Manipulator stops temporarily.

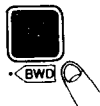
This is released when  and  keys are depressed simultaneously.



- Manipulator moves during these keys depression.

STEP MODE

See par. 4. 5. 1. 3 for detailed.





- The taught points are traced in reverse.



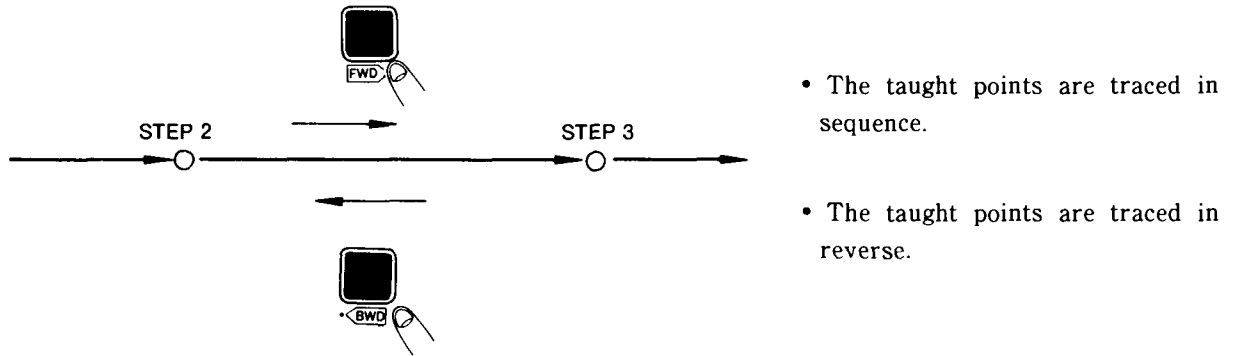
- The taught points are traced in sequence.

4. 5. 1. 2 Precautions during Backward/Forward Key Operation

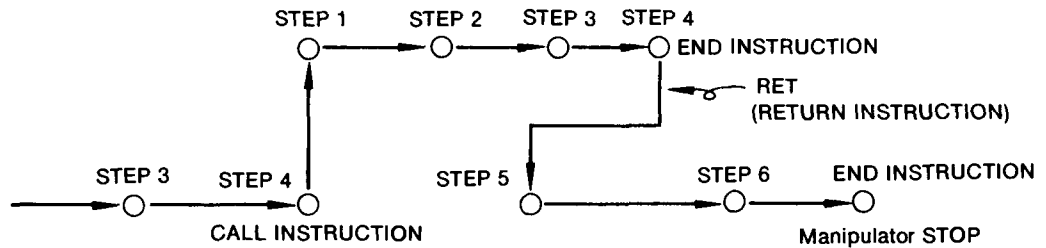
- (1) If instructions other than the MOVE instructions are registered, the address do not advance by merely operating the  key. Instructions are not executed neither. (Refer to par. 4. 5. 1. 3.)
- (2) For the movement to the reference point, the special operation is needed. (Refer to par. 4. 5. 1. 5.)
- (3) During  key operation, only MOVE instructions are able to executed.
- (4) Be careful that the manipulator moves to the teaching point in back operation during parallel shift operation.



4. 5. 1. 3 Relation between Backward/Forward Key Operation and Movement

The Motoman moves only while depressing  or  key. When it reaches the taught point, it stops automatically.



- (1) At FORWARD operation
Operation ends after 1 cycle. If the manipulator has reached the END instruction, no response is made subsequently even if the FORWARD key is depressed. The manipulator moves to the instruction next to the call instruction if the job is a called job.

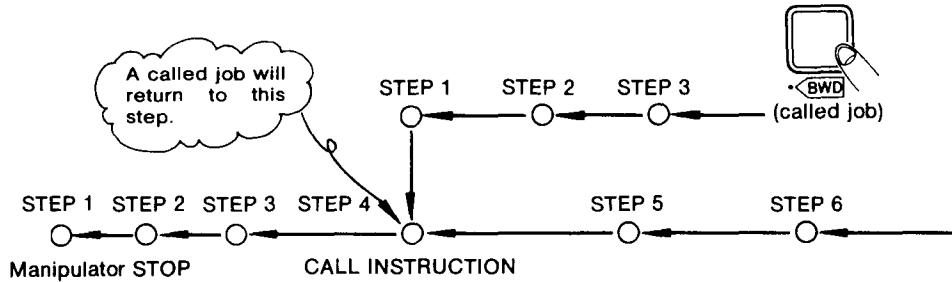


NOTE All instruction are able to be executed when  and  keys are depressed simultaneously.

(2) At BACKWARD operation

Only the MOVE instruction is executed.

If the steps have reached the first step, no response is made subsequently even if the BACKWARD key is depressed. The manipulator moves immediately prior to the call instruction if the job is a called job.



(3) For an instruction other than the MOVE instruction

When a instruction other than the move instruction is executed, depress and

keys simultaneously.

If the instruction is not necessary to be executed, advance by key.

After address is modified by or key,

- When key is depressed, the instruction being displayed is executed.
- When key is depressed,

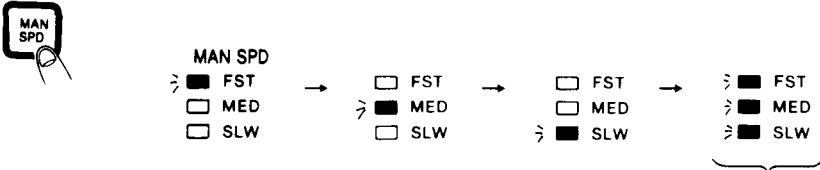
If the instruction being displayed is the MOVE instruction, the manipulator moves to the specified position.

If the instruction is other than the MOVE instruction, the immediately instruction prior MOVE instruction is executed.

4. 5. 1. 4 Motion Speed Selection

The motion speed in the STEP mode is executed at the selected manual speed. Select it as follows.

〈Teach Pendant〉



Each time this key is depressed,

MAN SPD

MAN SPD

MAN SPD

MAN SPD

Inching operation is possible.
Motion speed is slow.

HIGH SPD

Only while this key is depressed, high speed is selected.

Note : At BACKWARD operation, this key cannot be used.

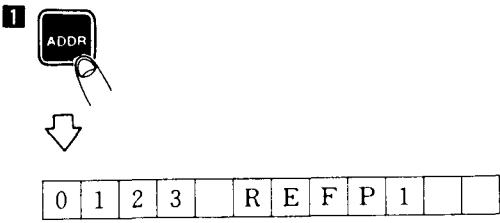
4

4. 5. 1. 5 Motion to Reference Point (REFP)


Operate as follows to confirm the positions taught as reference points.

〈Operation on Teach Pendant〉

1



2



〈Description〉

Depress key.

Check that the present address is the reference point (REFP) instruction.

While holding down key, depress


key.

The manipulator moves to the reference points displayed on teach pendant.

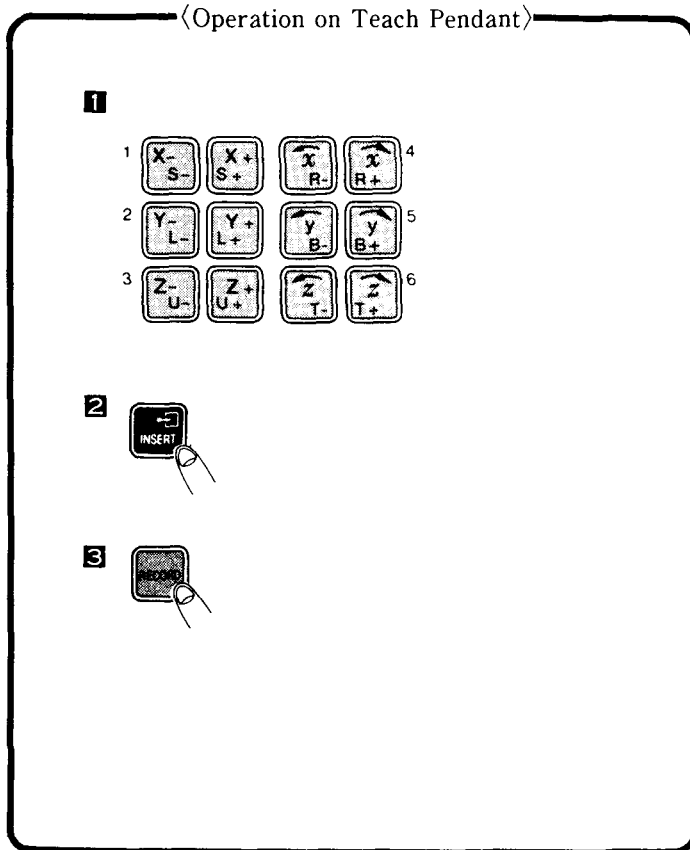
4. 6 PATH CORRECTION

If the taught position is corrected after checking the path, perform the operation as follows.

4. 6. 1 Inserting Position Data

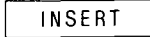
When a step is inserted in the job, be sure to depress  key.

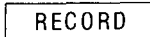
This operation need not to be designated when registering immediately before the END instruction.



〈Description〉

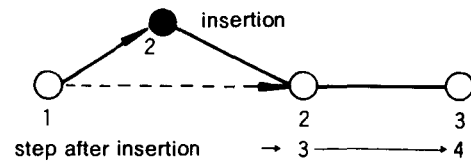
Move the manipulator to the desired position.

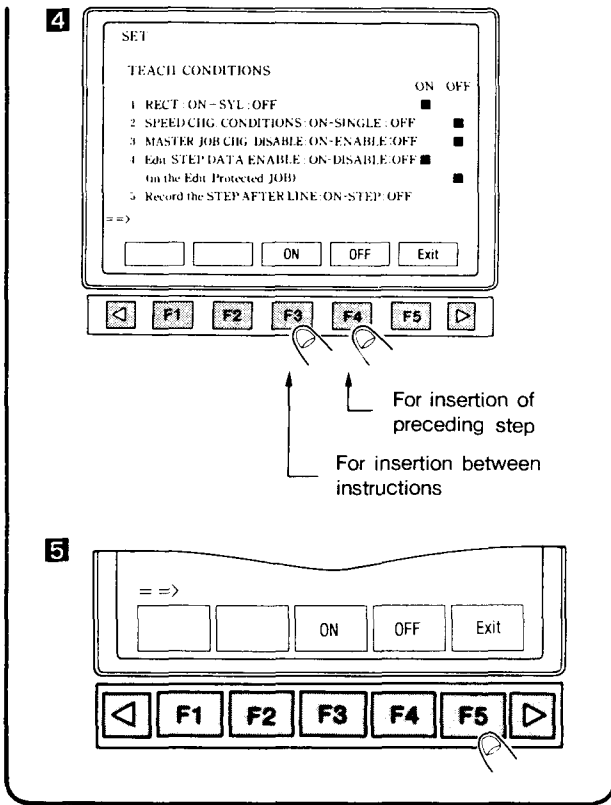
Depress  key.

Depress  key.

The new step is added.

Subsequent steps are increased 1.





- For inserting position data between instructions, depress **ON** soft key.
F3
- For inserting position data in the preceding step, depress **OFF** soft key.
F4

After the setting, depress **Exit** soft key.
F5

〈Example of step insertion〉

Line	Step	Instruction
:	:	:
10	3	MOVL V=100
11		TIMER T=1.00
12		DOUT OT#01=1
13	4	MOVL V=100
:	:	:


- For insertion in preceding step

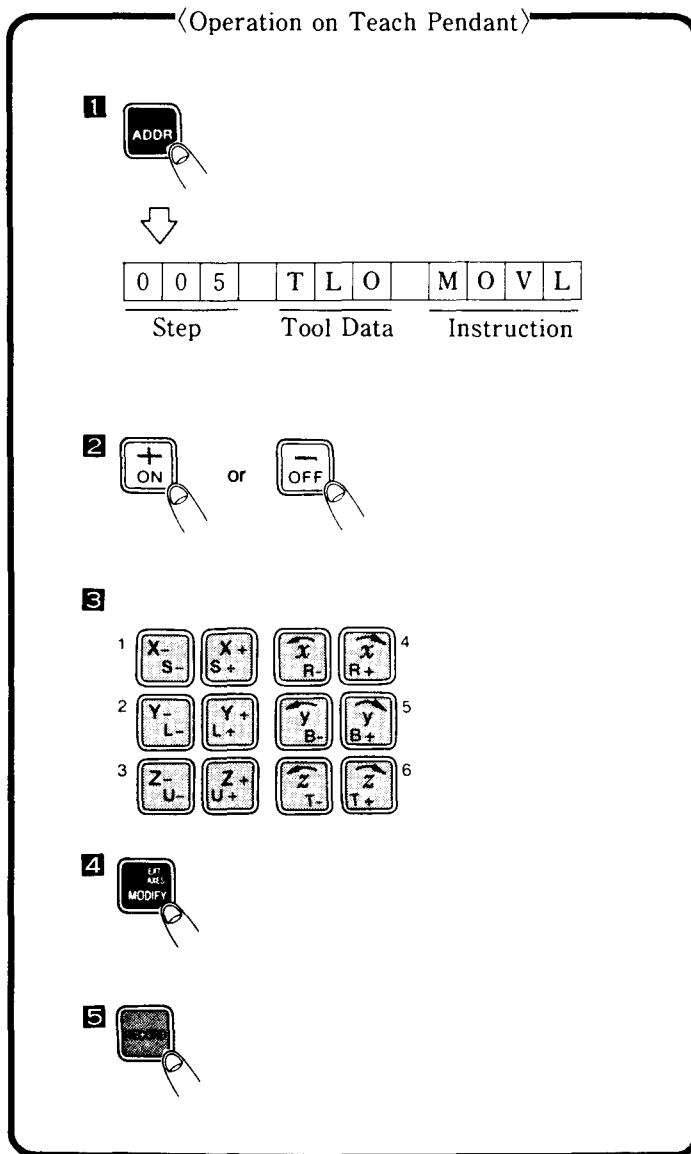
Line	Step	Instruction
:	:	:
10	3	MOVL V=100
11		TIMER T=1.00
12		DOUT OT#01=1
13	4	MOVL V=100
14	5	MOVL V=50
:	:	:

- For insertion between instructions

Line	Step	Instructions
:	:	:
10	3	MOVL V=100
11		TIMER T=1.0
12	4	MOVL V=100
13		DOUT OT#01=1
14	5	MOVL V=50
:	:	:



4. 6. 2 Modifying Position Data

Be sure to depress  key to change the taught position.

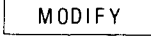


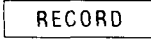
Depress ADDR key.
The lamp will be lit.


Call up the step to modify by using

 or  key.

Move the manipulator to the desired position.

Depress  key.
The lamp will be lit.

Depress  key.
Only position data is modified.
The instruction and PLAY speed aren't modified.






NOTE If  key is depressed, the position data of the manipulator are not changed.

4

4. 6. 3 Deleting Position Data

Position data can be deleted if the following conditions are sufficient :

- (1) The step to be deleted is the same as the step immediately before. (Robot axes only)
- (2) The position data to be deleted is the same as the present manipulator position.
 If it is not same, move the manipulator to the delete position by step forward operation.
 Or. correct the position data to the present position.
 Delete the position data as follows :

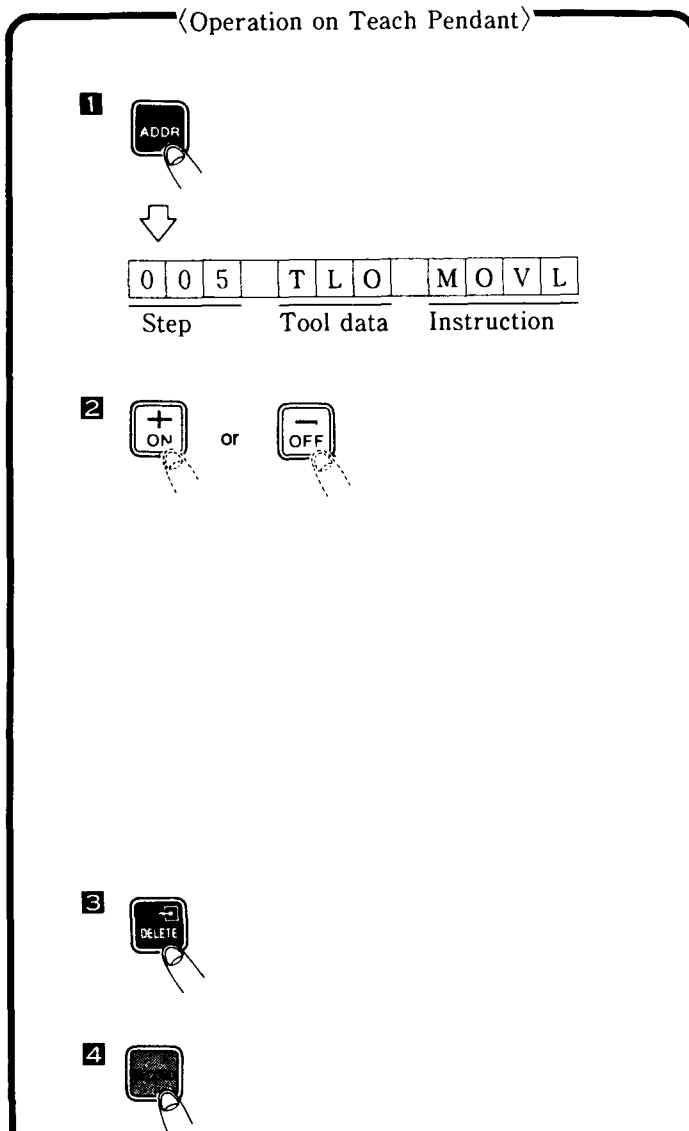
(Operation on Teach Pendant)	(Description)																				
<div style="display: flex; align-items: center; margin-bottom: 20px;"> <div style="margin-right: 10px;">1</div>  </div> <div style="text-align: center; margin-bottom: 20px;">↓</div> <table border="1" style="margin: auto; border-collapse: collapse; text-align: center;"> <tr> <td style="padding: 2px 5px;">0</td> <td style="padding: 2px 5px;">0</td> <td style="padding: 2px 5px;">5</td> <td style="padding: 2px 5px;">T</td> <td style="padding: 2px 5px;">L</td> <td style="padding: 2px 5px;">O</td> <td style="padding: 2px 5px;">M</td> <td style="padding: 2px 5px;">O</td> <td style="padding: 2px 5px;">V</td> <td style="padding: 2px 5px;">L</td> </tr> <tr> <td colspan="3">Step</td> <td colspan="3">Tool data</td> <td colspan="4">Instruction</td> </tr> </table>	0	0	5	T	L	O	M	O	V	L	Step			Tool data			Instruction				<p>Depress ADDR key. The lamp is lit</p>
0	0	5	T	L	O	M	O	V	L												
Step			Tool data			Instruction															
<div style="display: flex; align-items: center; margin-bottom: 20px;"> <div style="margin-right: 10px;">2</div> <div style="margin-right: 10px;">  </div> <div style="margin-right: 10px;">or</div> <div>  </div> </div>	<p>Call up the step to delete by using ON or OFF key.</p>																				
<div style="margin-bottom: 20px;">3</div> 	<p>NOTE When the position is not the same as the position of the manipulator, the step number will blink. Move the manipulator, to the position to be deleted by depressing FWD key.</p>																				
<div style="margin-bottom: 20px;">4</div> 	<p>Depress DELETE key. The lamp is lit.</p> <p>Depress RECORD key. The step will be delete.</p>																				

NOTE MOVE instruction to position variable can not execute the edit operation on the teach pendant.
 If the operation is executed, the error message 2250 "Can't alternate or delete the instuction" is displayed.

4. 6. 4 Modifying Motion Type

Motion type specification cannot be modified directly.

At first, delete the registered MOVE instruction. Then, register it again.



(Description)

Depress key.
The lamp is lit.

Call up the step to be delete by using or key.

NOTE

When the position is not the same as the position of the manipulator, the step number will blink.

Move the manipulator, to the position to be deleted by depressing key.

Depress key.
The lamp is lit.

Depress key.
The step will be delete.

4

Register the step modified the motion mode.

5



MOTION
TYPE
 JOINT
 LNR
 CIRO

The lamps sequentially change at each time this key is depressed.

6



7



or



8 As necessary,



9



10



Select the desired motion type by depressing

MOTION
TYPE key.

Depress PLAY
SPD key.

Set the playback speed by using

+
ON or
-
OFF key.

When the positioning level specification is required, decide the position and depress

POS
LVL key.

Depress INSERT key.


Depress RECORD key.

The new MOVE instruction is registered.

4. 6. 5 Modifying Motion Speed Data

〈Operation on Teach Pendant〉


1



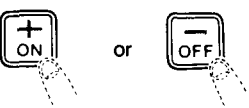
↓

0	0	5		T	L	O		M	O	V	L
Step			Tool data				Instruction				

2




3




• Teach pendant display

1				1	1	.	O	M	M	/	S
↓											
2				2	3	.	O	M	M	/	S
↓											
3				4	6	.	O	M	M	/	S
⋮											
8	1	5	0	0	.	O	M	M	/	S	

4



5



〈Description〉

Depress ADDR key.

Check that present address is MOVE instruction.

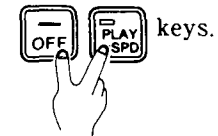
Depress PLAY
SPD key.

The play speed stage selected previously is displayed.

Select the play speed stage from among 8 stages.



1. Even if the manual speed is changed, the play speed stages (for registration) are not changed.
2. The play speed data setting is abbreviated by depressing



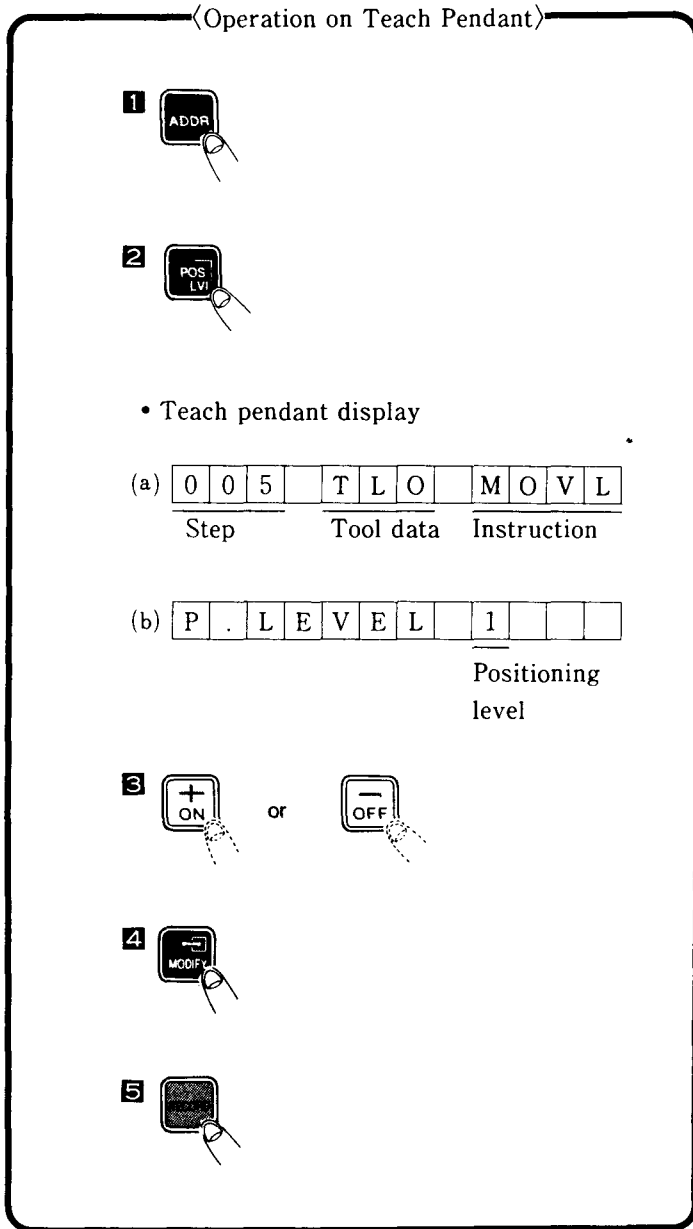
Depress MODIFY key.

Depress RECORD key.

The new motion speed data are registered.

4

4. 6. 6 Modifying Positioning Level



〈Description〉

Depress key.

Check that the present address is the MOVE instruction.

Depress key.

The teach pendant display changes from (a) to (b).

Select the positioning level by using or key.

Depress key.

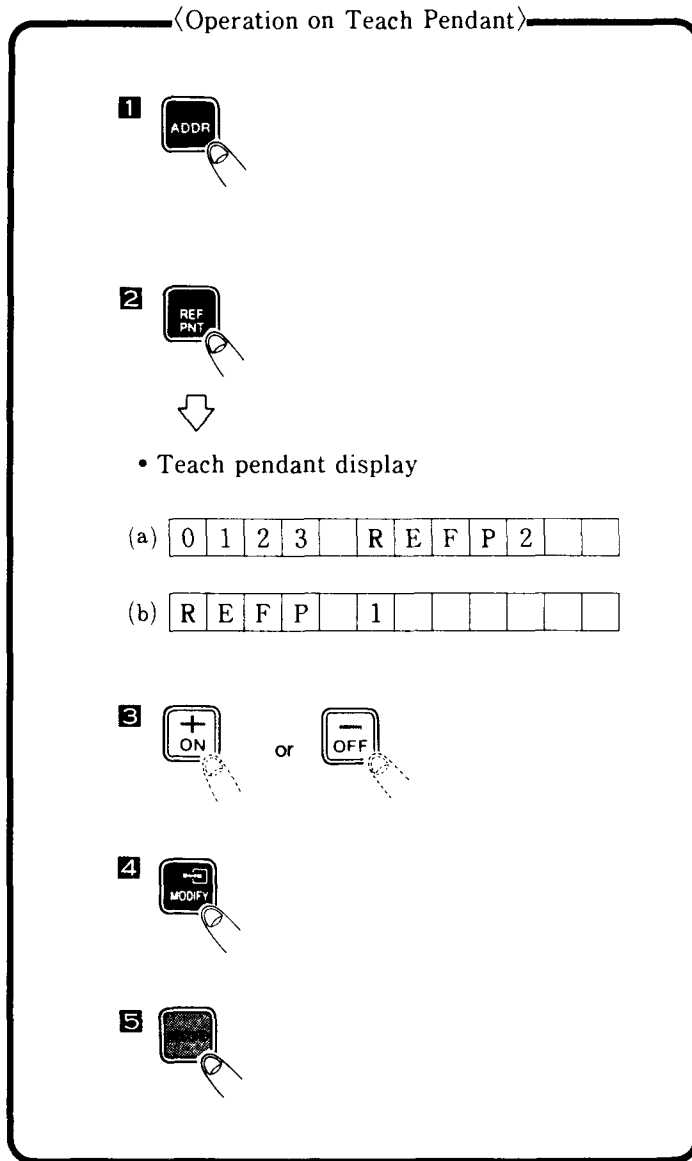
Depress key.

The new positioning level is registered.



NOTE If positioning level specification is deleted, register MOVE instruction again after deleting the MOVE instruction with positioning level.

4. 6. 7 Modifying Reference Point



〈Description〉

Depress key.

Check that the present address is the MOVE instruction.

Depress key.

The teach pendant display changes from (a) to (b).

4

Select the reference point number by using

or key.

Depress key.

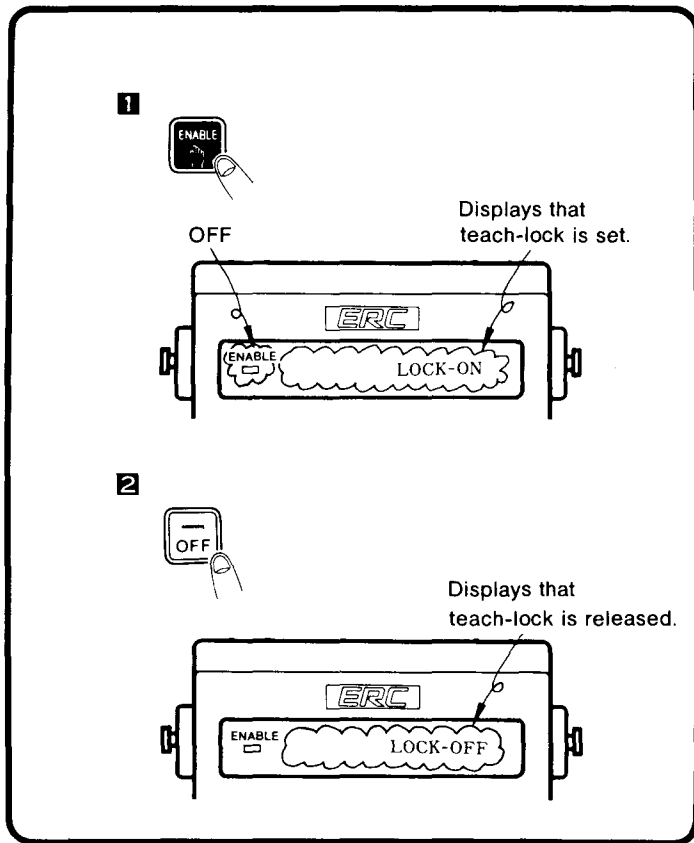
Depress key.

The new reference number is registered.

NOTE The position data are also changed.

4. 7 TEACH LOCK RELEASE

Release the teach-lock after the teaching.



<Description>

Depress key.

The enable lamp on teach pendant display will be turned off, and shown "LOCK-ON."

Depress key.

The display changes from "LOCK-ON" to "LOCK-OFF."

If the teach lock is set again, depress

key.

4. 8 TEMPORARY RELEASE OF SOFT LIMIT CHECK

The working range of manipulator is restricted at the following three soft limits.

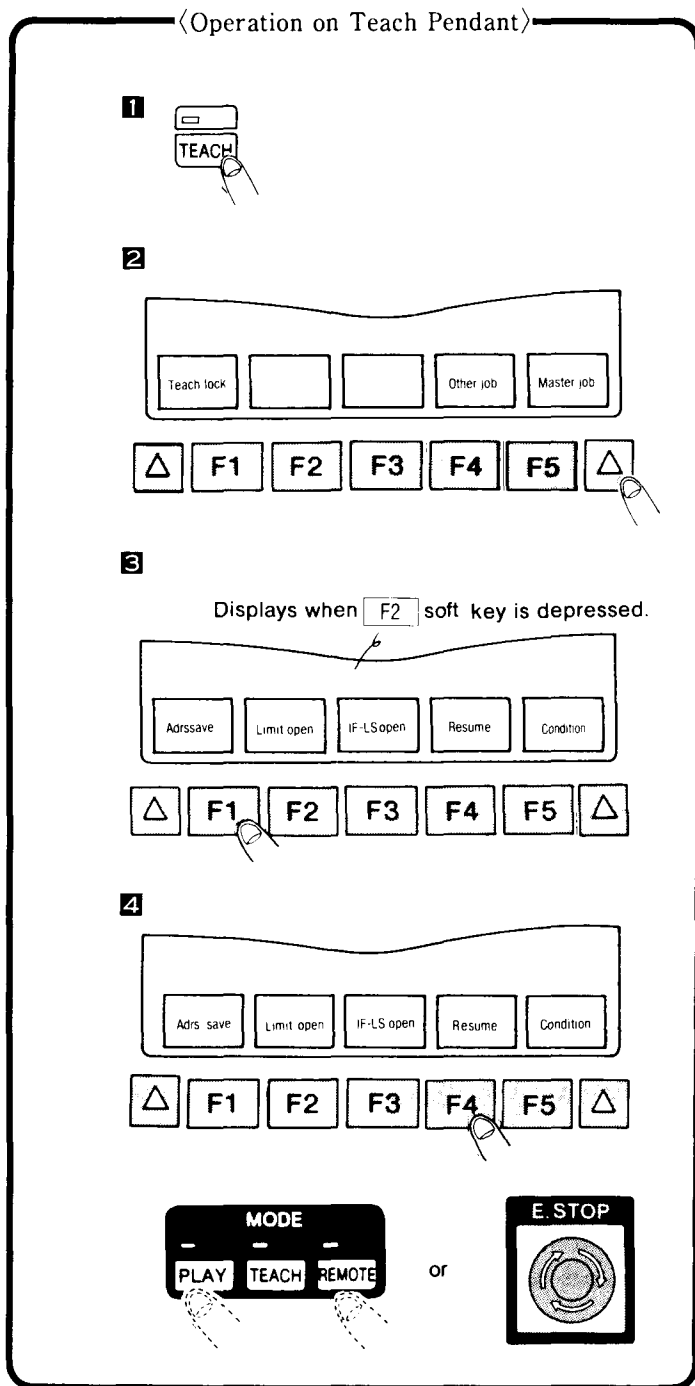
- (1) Maximum working range each axis
- (2) Mechanical interference area between axes
- (3) Allowable working area in rectangular parallelepiped, which is set parallel to the robot-coordinate system.

These soft limits are always monitored on the system.

If the manipulator (control point) reaches to any soft limits, the manipulator will stop automatically.

Move the manipulator to the reverse direction if the manipulator stops due to soft limit.

Release temporary the soft limit as follows.



〈Description〉

Depress **TEACH** key.

Depress **[Right Arrow]** key to call up the soft key labels for releasing the limit.

4

Depress **Limit open** soft key to release the soft limit.

Move the manipulator to the reverse direction for the operated direction.

Then, depress **Resume** soft key, depress MODE key, or turn the power off to reset the soft limit.

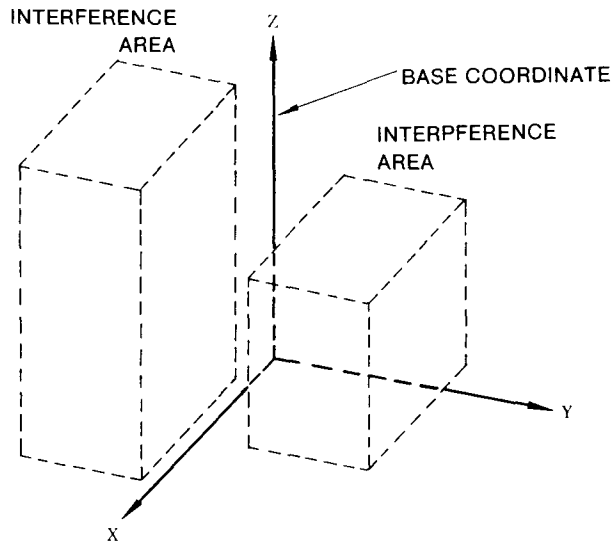


The teaching data cannot be registered during soft limit release.

4. 9 INTERFERENCE PREVENTION FUNCTION IN THE INTERFERENCE AREA

Processing to prevent interference is executed in the I/O processing section. This function is not executed in S-axis area. Because, in the standard system, the interference prevention function only is supported in the cubic interference area (2 places).

In the YASNAC ERC, the rectangular parallelepiped area is set in the manipulator working area, and the status signal is output whether the control point during operation is inside or outside each area. This rectangular parallelepiped area is set parallel to the base coordinate as shown below. For the manipulator only, it is coincided with the robot-coordinate system.



Base-coordinate System and Interference Area

Set in absolute value on base coordinate (in units of 0.1 mm). Travel axis is also included.

The cube interference signal is output as inside cube (1 or 2) signal. This is turned on when the control point is in interference area.

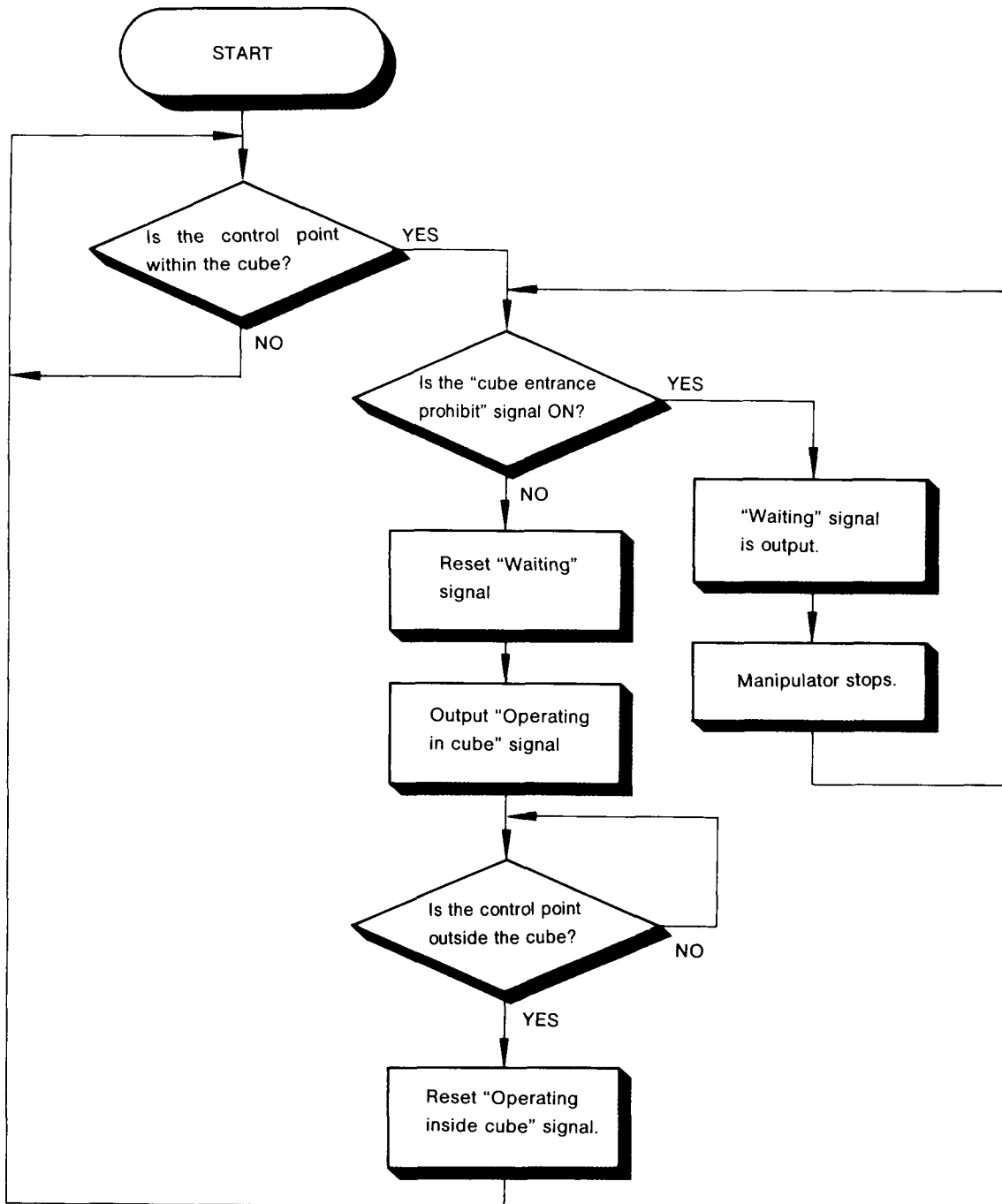
For the external input signal, interference 1 and 2 signals are provided for cube interference. When the input signal is turned on during operation, the manipulator will slow down and stop.

When this signal is turned off, the manipulator will operate again automatically.

Thus, these I/O signals protect plural manipulators with the same working area from the interferences.

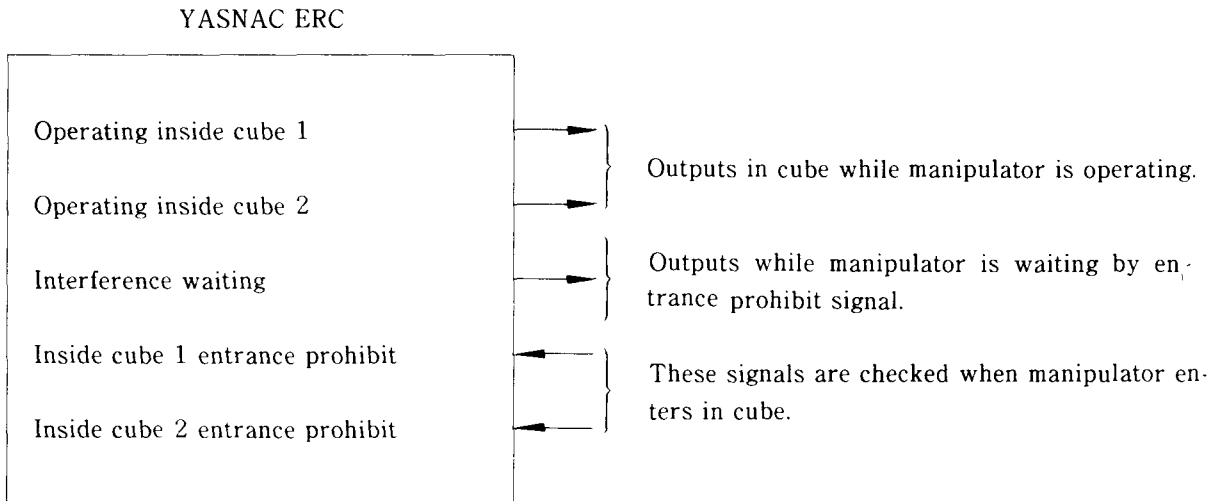
These I/O signals can also be utilized as interlock signal to protect the peripheral jig interferences. For the I/O terminal number, refer to "YASNAC ERC Maintenance Manual" (TOE-C945-130).

The relation between the ERC I/O signal and manipulator operation is as shown below.

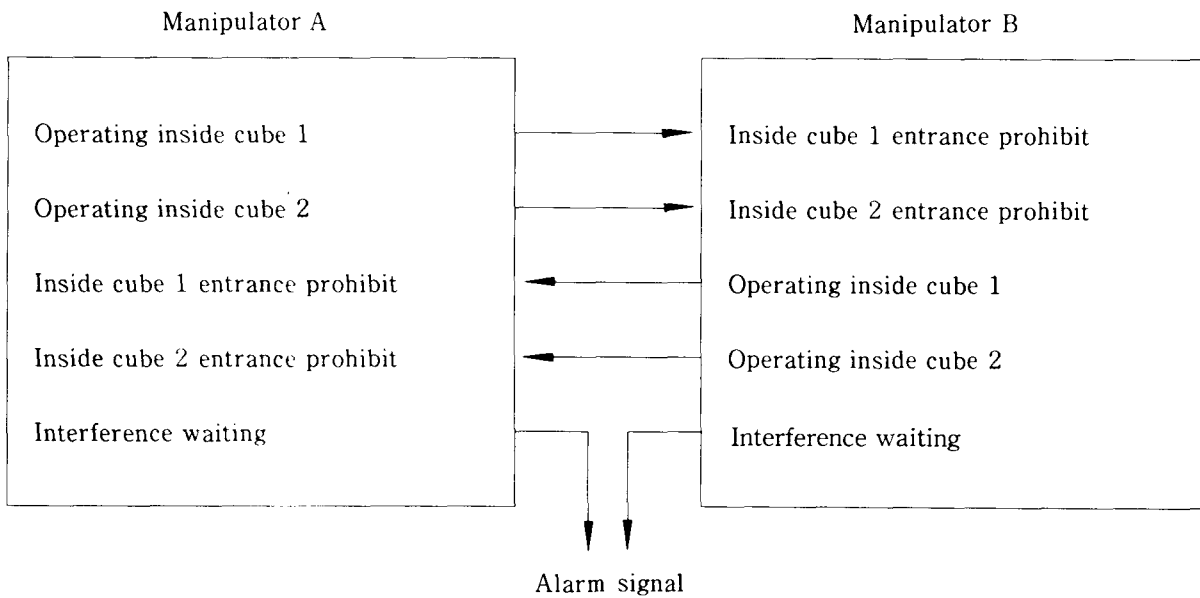


NOTE If in waiting status with the Entrance Prohibit signal, the robot just barely enters the area for speed reduction processing and then stops.

- I/O signals in YASNAC ERC controller



- Example of connection where two manipulators are operated in the same area.

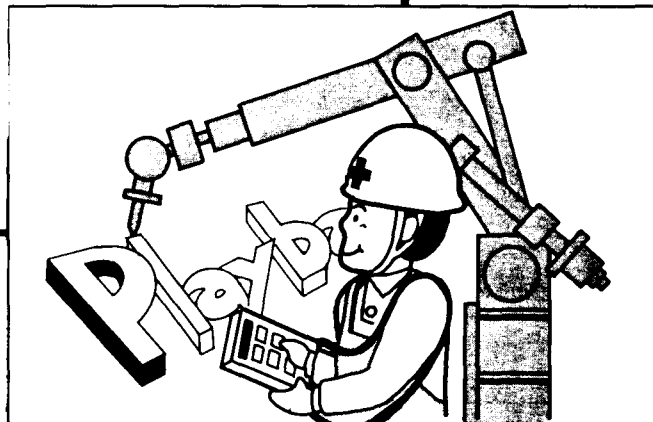


NOTE For the interference area setting, contact your Yaskawa representative.

SECTION 5

PLAYBACK OPERATION

This section describes mainly playback operation (taught job data are played back under specified conditions).

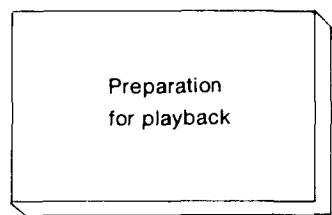


5

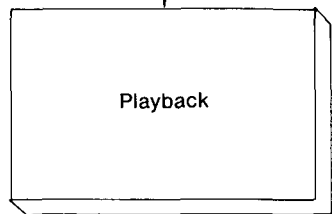
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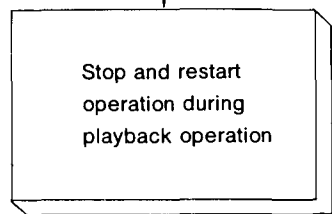
5. 1 PLAYBACK OPERATION FLOWCHART



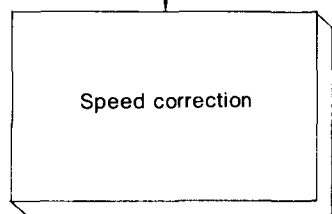
Par. 5. 2



Par. 5. 3



Par. 5. 4



Par. 5. 5

- Registration of master job Par. 5. 2. 1
- Display of job text 5. 2. 2
- Calling up of master job 5. 2. 3

- Start operation 5. 3. 1
 - Specification of start operation 5. 3. 1. 1
- Special operation at PLAY mode 5. 3. 2
 - Speed adjustment operation 5. 3. 2. 1
 - Low speed operation 5. 3. 2. 2
 - Check operation 5. 3. 2. 3
 - Machine lock operation 5. 3. 2. 4

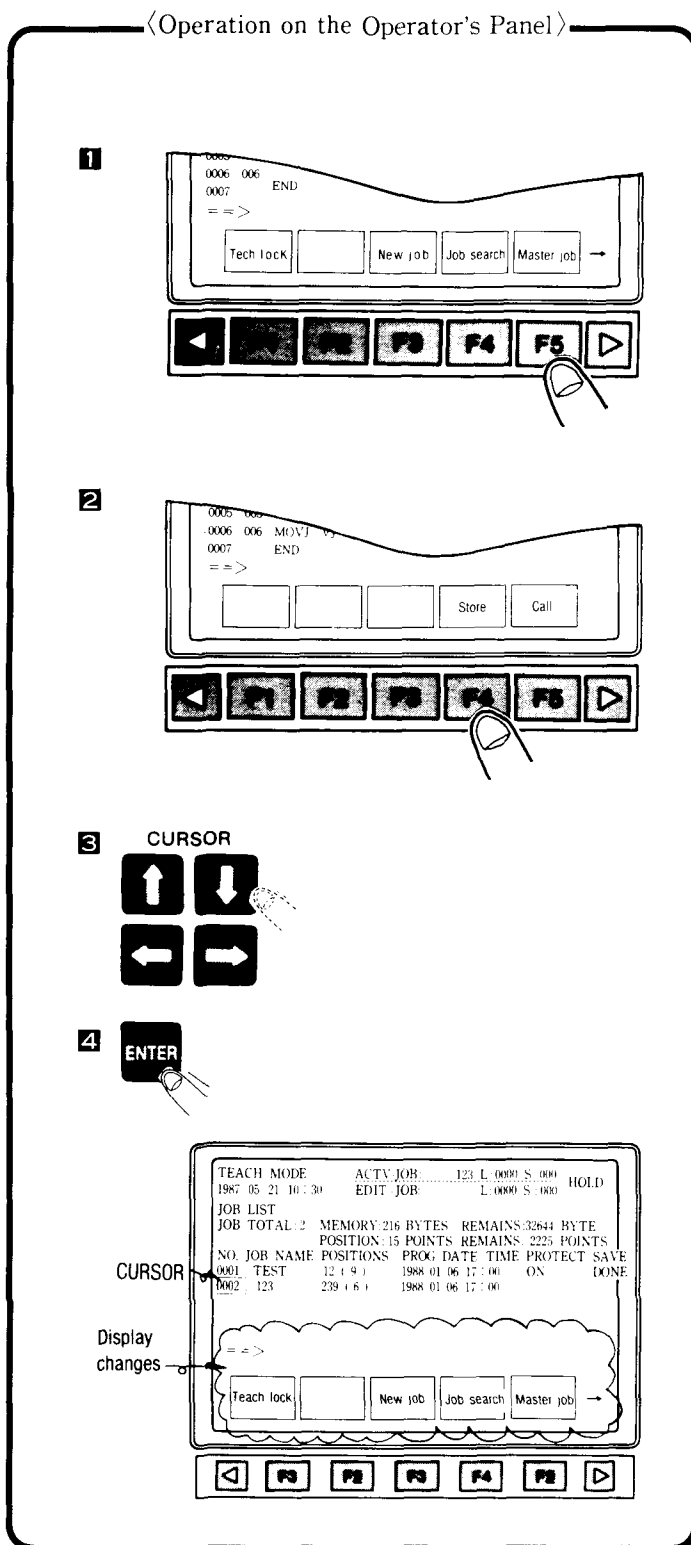
- HOLD(Pause) 5. 4. 1
- Emergency stop 5. 4. 2
- Stop by error/alarm 5. 4. 3
- Stop by wire sticking 5. 4. 4
- Stop during Welding 5. 4. 5
- Other stops 5. 4. 6

- Speed correction by speed override specification at PLAY mode 5. 5. 1
- Speed correction by EDIT operation at TEACH mode 5. 5. 2
- Speed correction by TRT operation at TEACH mode 5. 5. 3

5. 2 PREPARATION FOR PLAYBACK

Before playback operation, specify and call up the job to be executed. When the job is executed continuously, it must be previously registered.

5. 2. 1 Registration of Master Job



〈Description〉

Depress **Master job** soft key.
F5

Depress **Store** soft key.
F4

Specify the job by using CURSOR keys.

Depress **ENTER** key.

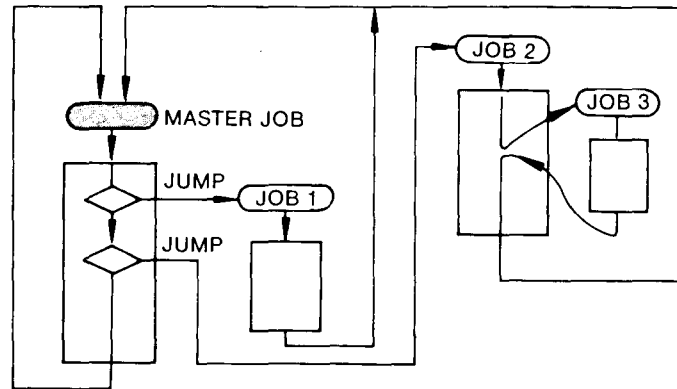
Now, the master job is registered.
The display becomes as shown on the left.

5

Meaning of master job

In automatic operation, the master job is executed repeatedly as shown in the figure below.

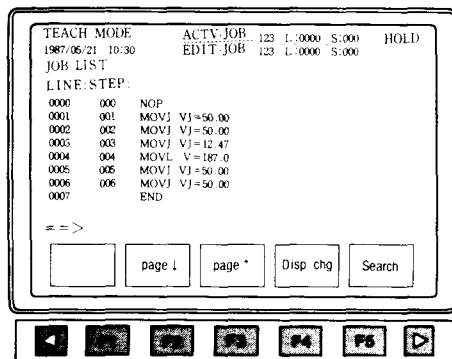
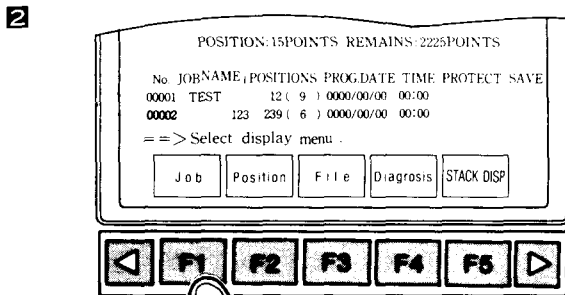
When the job jump and/or job call instructions are registered to the master job, the manipulator executes these jobs (job 1, 2, 3, etc) and returns to the master job. In this respect, the master job means the original job.



5. 2. 2 Display of Job Text

Display the job text before playback.

〈Operation on Operator's Panel〉



〈Description〉

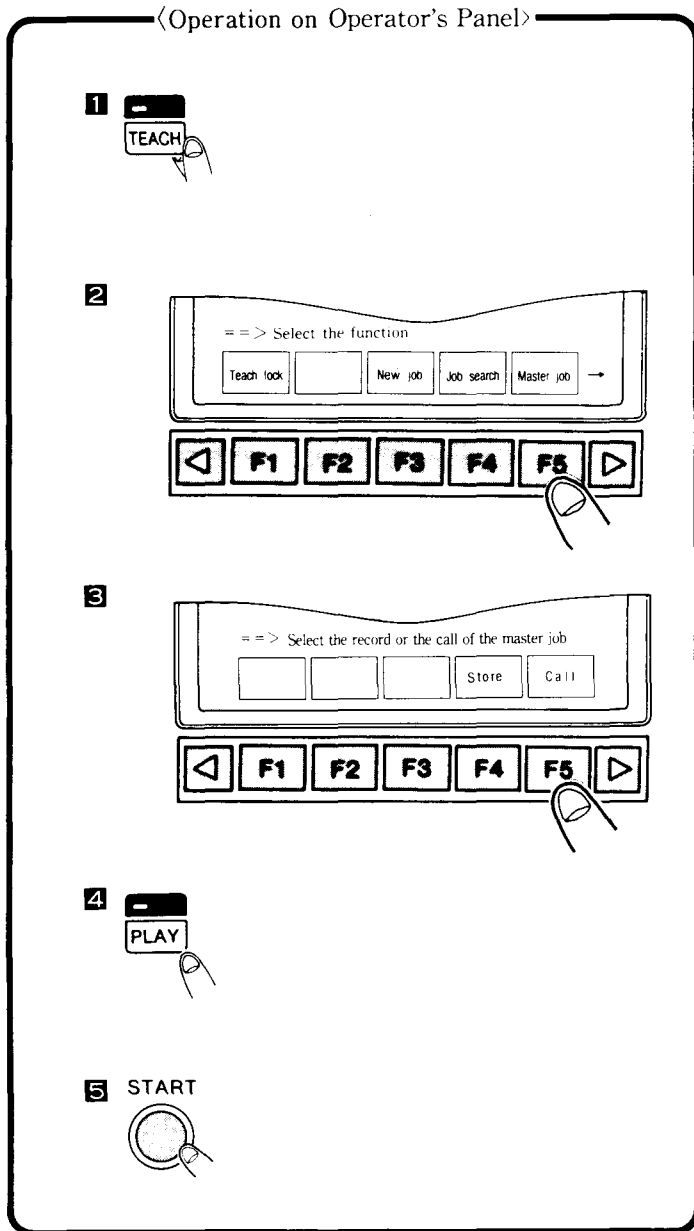
Depress key.

The job list will appear on CRT display.

Depress soft key.

The display of job text will appear.

5. 2. 3 Calling Up of Master Job



〈Description〉

Depress TEACH key.

Depress Master soft key.
F5

Depress Call soft key.
F5

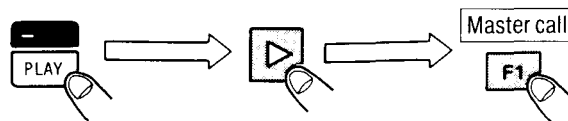
Depress PLAY key.

Depress START button.
The manipulator starts playback operation.

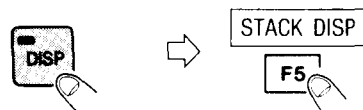
5

NOTE

1. The manipulator should be started at the specified position in play condition display.
2. The master job can also be called up in PLAY mode.

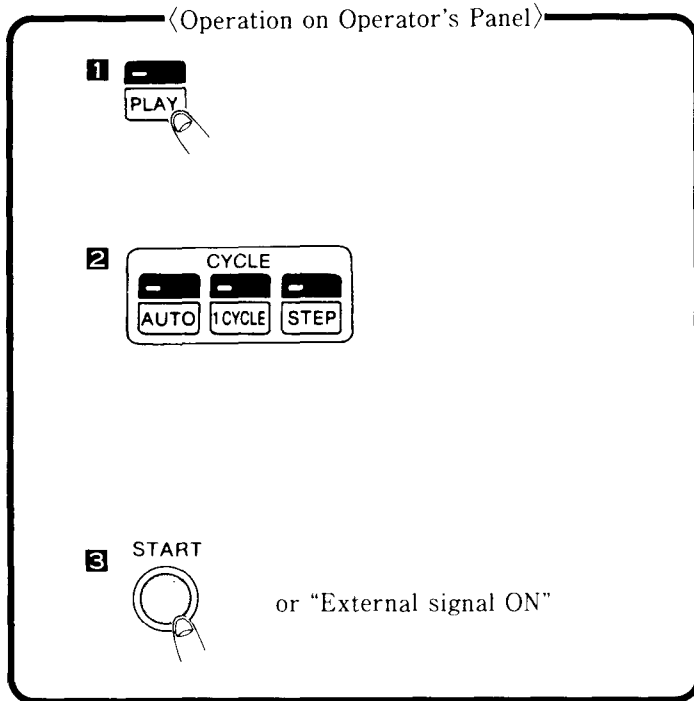


3. The registered master job name and call status of job are confirmed.



5.3 PLAYBACK

Let's operate the manipulator. Make sure that no personnel are within the restricted work envelope of the manipulator.



<Description>

Depress **PLAY** key.

Select the operation cycle by depressing

either **AUTO**, **1CYCLE** or **STEP**

key.

For these key functions, see "★ Operation cycle" below.

See par. 5.3.1.

★ Operation cycle



Executes one instruction each time



button is depressed.



Operates continuously until END instruction is executed. However, if the called job is executing, the manipulator will not stop by END instruction.



AUTO operation is performed by returning to the first part of the master job automatically when the master job END instruction is executed.


The AUTO cycle is effective only with the master job. For other jobs, 1-cycle operation is performed.

NOTE

The selected operation cycle remains until another operation cycle key is depressed.

5. 3. 1 Start Operation

There are two methods of starting PLAYBACK (automatic operation).

- (1) Depress  button on the operator's panel.
- (2) Specify from external input (special input).

Specify either (1) or (2) in the playback condition display in advance.

These operations are interlocked as shown in Fig. 5. 1.

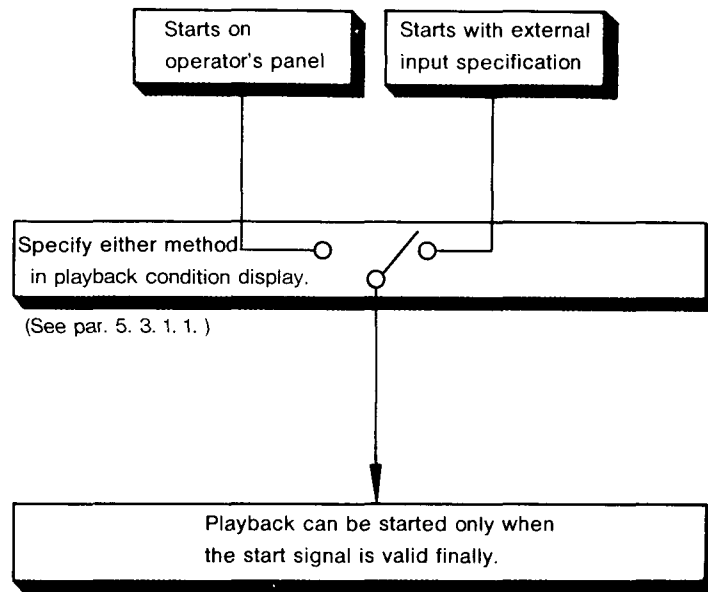
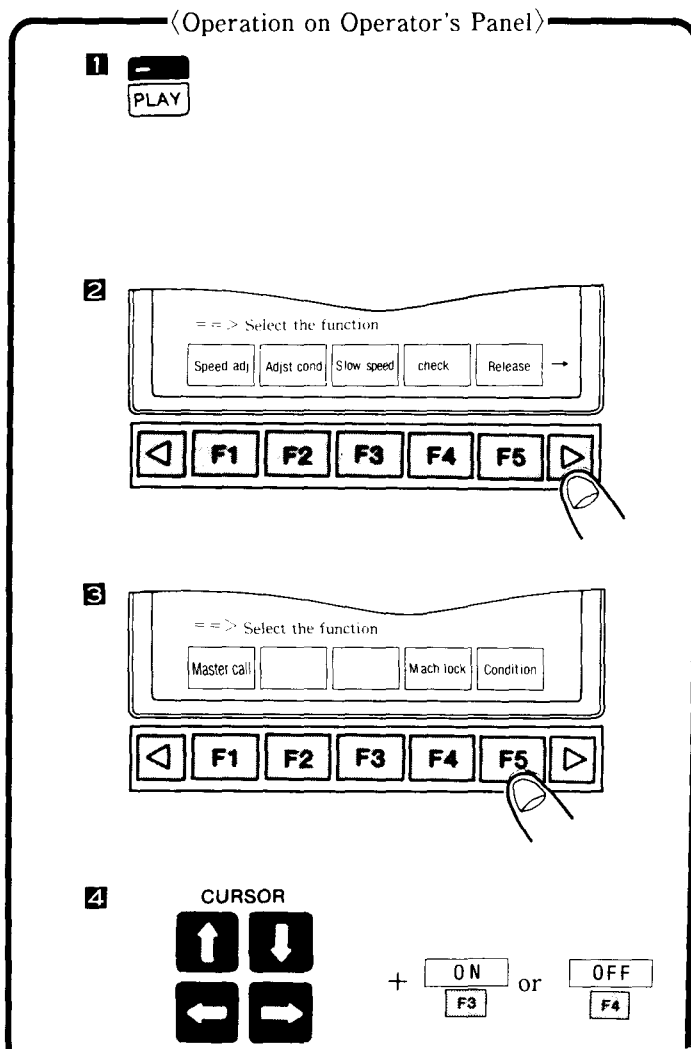


Fig. 5. 1. Start Operation Effective/ineffective

5. 3. 1. 1 Specification of Start Operation



(Description)

Depress key.

The speed adjustment setting status is displayed in the job text (instruction) display.

Depress key.

Depress key.

The playback condition display is called up.

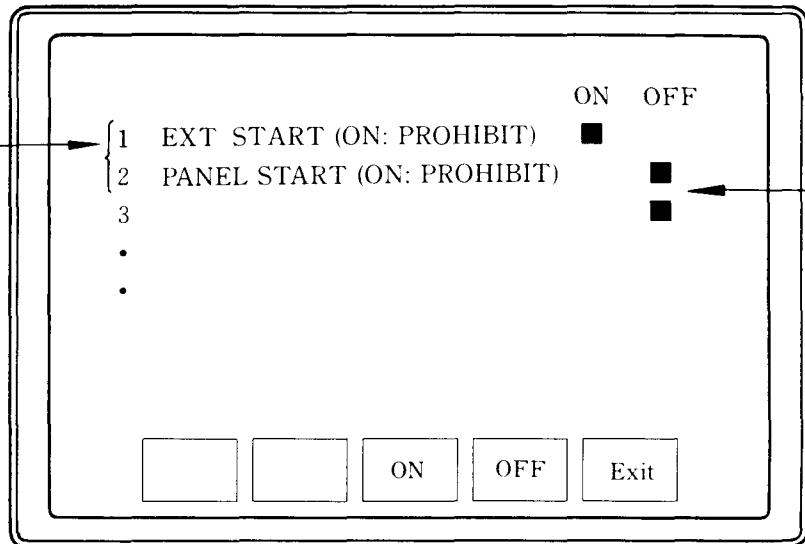
Place the cursor on either "1" or "2".
Set the switch status by depressing

or

CURSOR



Select either one by using CURSOR keys.



SWITCH STATUS



Sets the switch status from OFF to ON.

Sets the switch status from ON to OFF.

5



Depress Exit soft key.



or "External signal ON"

When " 1 " is selected, depress START button.

When " 2 " is selected, turns the external signal ON.

The manipulator will start the playback operation.



This setting can not be performed during EDIT LOCK.

5. 3. 2 Special Operation at PLAY Mode

When the PLAY mode is selected, soft keys are displayed for special function selection in playback. Depress the soft key to be executed. Operations of those functions are explained in each paragraph below.

〈Special functions〉	〈Paragraph〉
(a) Speed adjustment	5. 3. 2. 1
• Dry - run speed	
• In guard - safety speed	
(b) Low speed operation	5. 3. 2. 2
(c) Check operation	5. 3. 2. 3
(d) Machine lock operation	5. 3. 2. 4

5. 3. 2. 1 Speed Adjustment Operation

If loci are checked in playback operation (par. 5. 3. 2. 3), the taught speed can be limited temporarily to operate at a safe speed. Select one of the following two types of limit values.

(1) Dry run speed

Playback operations are performed at a dry-run speed (constant speed), not at the taught speed.

By using dry-run at confirmation of jobs which have much low-speed motion, the confirmation time can be reduced.



For the steps where the taught speed is lower than the dry-run speed, be careful of the moving speed because it is faster than that of taught speed.

(2) In-guard-safety speed

The playback speed is limited to the upper limit value. Therefore, steps designated for speeds faster than the upper limit values are restricted by this limitation. However, operation is performed at actual playback speeds in steps within the limit value and is useful in checking operation in actual work.

In-guard-safety speed is set at 25% of maximum speed.

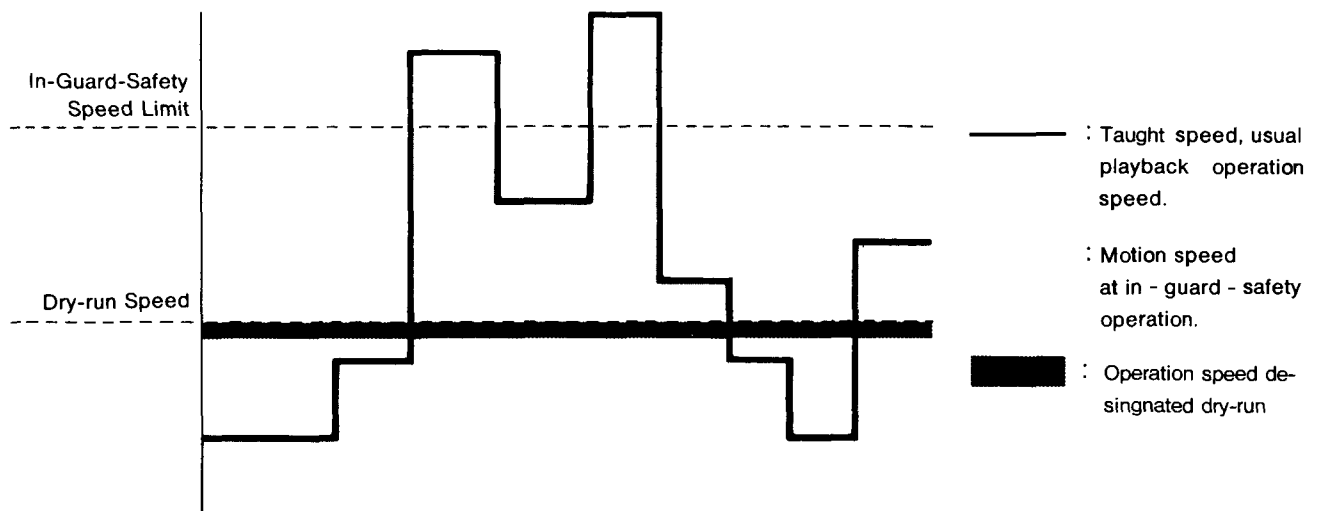
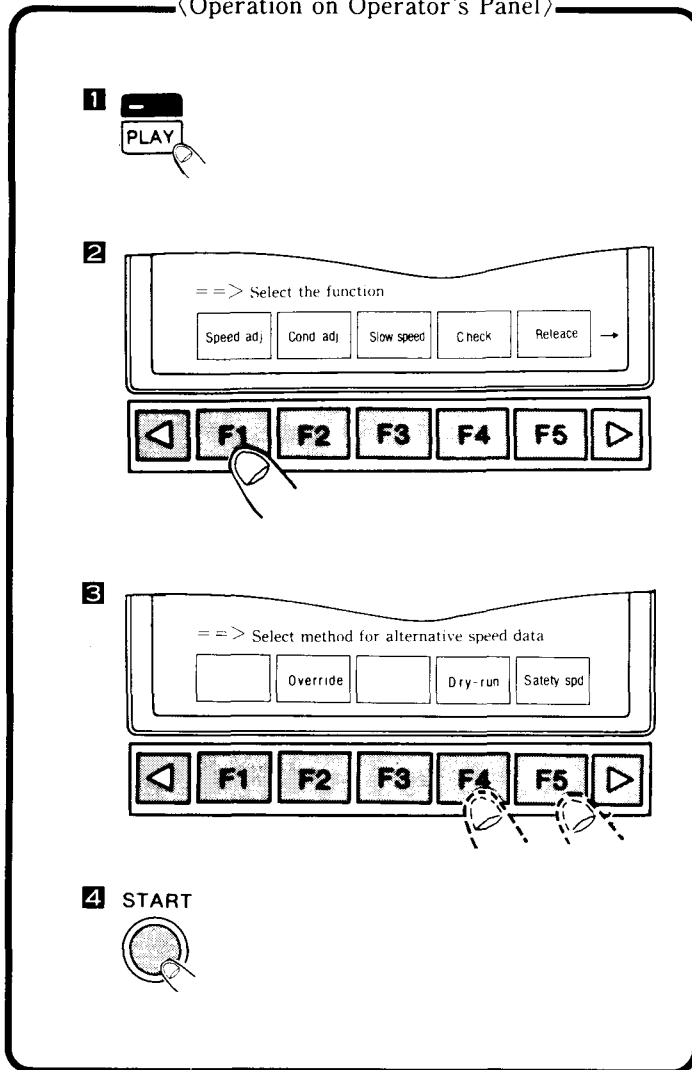


Fig. 5. 2 Dry Run Speed and In-guard-Safety Speed

★ Specification of speed adjustment

〈Operation on Operator's Panel〉



〈Description〉

Depress **PLAY** key.

Depress **Speed adj** soft key.
F1

To select the dry-run speed, depress **Dry-run** soft key.
F4

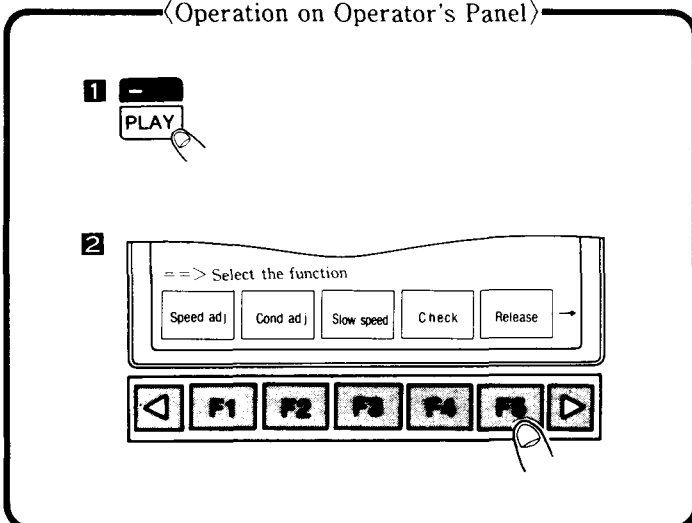
To select the in-guard-safety speed, depress **Safety spd** soft key.
F5

Depress **START** button.

5

★ Release of speed adjustment

〈Operation on Operator's Panel〉



〈Description〉

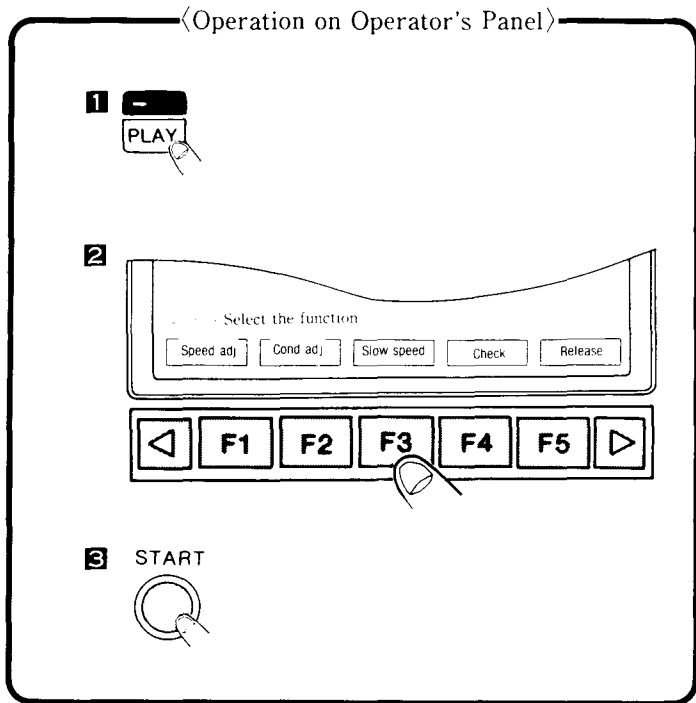
Depress **PLAY** key.

Depress **Release** soft key.
F5

The speed adjustment specification is released.

5. 3. 2. 2 Low Speed Operation

For safety, the manipulator can be moved at low speed during the first section, without regard to the taught speed. From the next section, the manipulator moves at taught speed.



〈Description〉

Depress **PLAY** key.

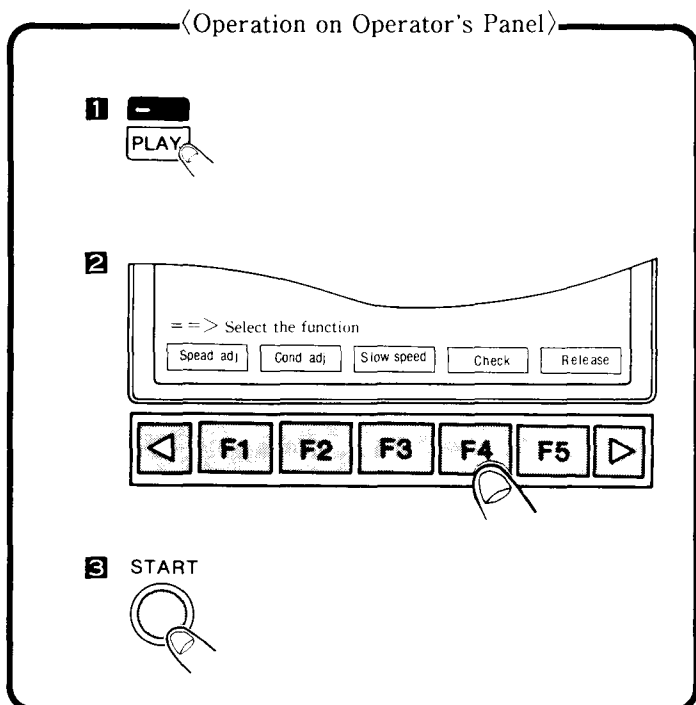
Depress **Slow speed** soft key.
F3

Depress **START** button.

5. 3. 2. 3 Check Operation

This is effective in checking loci in automatic operation. By reserving CHECK OPERATION, work instruction outputs such as the ARC instruction are not executed.

Reserve CHECK OPERATION before performing idle operation in the playback mode.



〈Description〉

Depress **PLAY** key.

Depress **Check** soft key.
F4

Depress **START** button.
The manipulator starts playback operation.



1. For releasing the check operation, depress key and soft key.
2. Check operation reservation is released automatically in the following cases.
 - The mode (except PLAY mode) is selected.
 - The power supply is turned off.

5. 3. 2. 4 Machine Lock Operation

Machine lock is specified when checking the I/O status at the job playback without moving manipulator.

(Operation on Operator's Panel)	(Description)
	Depress mode.
	Depress key.
	Depress soft key.
	Depress START button.

5



1. For releasing the machine lock operation, depress key and soft key.
2. Machine lock is released automatically when the power supply is turned off.

5. 4 STOP AND RESTART OPERATION DURING PLAYBACK OPERATION

The manipulator will stop in the following conditions.

〈Conditions〉	〈Paragraph〉
• HOLD (PAUSE)	5 . 4 . 1
• Emergency stop	5 . 4 . 2
• Stop by error/alarm	5 . 4 . 3
• Stop by wire stick	5 . 4 . 4
• Stop during welding	5 . 4 . 5
• Others	5 . 4 . 6

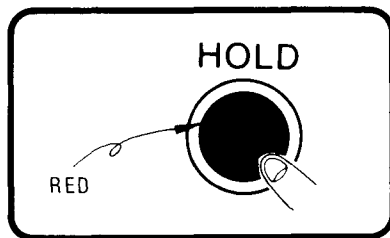
5. 4. 1 HOLD (Pause)

When HOLD is specified, the manipulator stops immediately and START pushbutton lamp is turned off.
HOLD can be specified on operator's panel, teach pendant or external input.

NOTE If HOLD is specified on teach pendant, it can be released only on the teach pendant.

(1) HOLD by operator's panel

• Stop



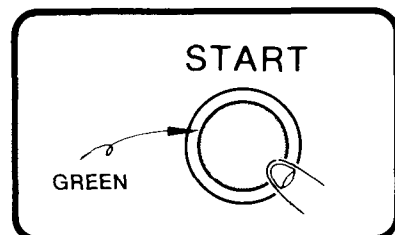
When HOLD push button on operator's panel is depressed, the manipulator stops immediately.

This operation is possible in any mode. The lamp will light in the following cases.

HOLD lamp is lit if :	HOLD lamp is turned out if :
HOLD pushbutton is depressed on operator's panel.	The HOLD pushbutton is released.
HOLD is operated on teach pendant.	HOLD is released by the teach pendant. Refer to par. 5. 4. 1. 1 (2).
HOLD signal is designated through an external input (special input).	The HOLD signal from external input is released.

NOTE By executing the PAUSE instruction, the HOLD lamp is not lit, but only the message "PAUSE" is displayed.

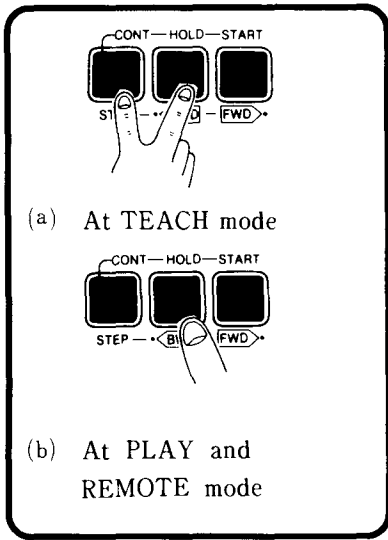
• Restart






Depress START pushbutton on operator's panel to restart the manipulator.

(2) HOLD by teach pendant

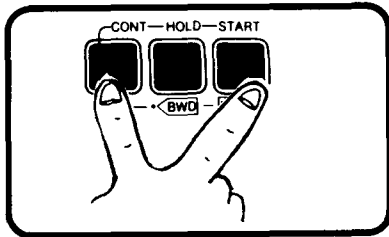
• Stop





While holding down  key on teach pendant, depress  key. The manipulator pauses momentarily.

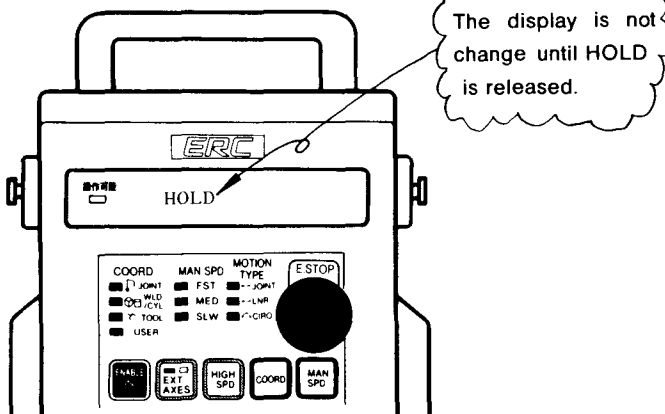
At PLAY or REMOTE mode, only depress  key.

• Restart



Depress  and  keys on teach pendant simultaneously to release HOLD.

NOTE HOLD specified from teach pendant is released only from teach pendant.



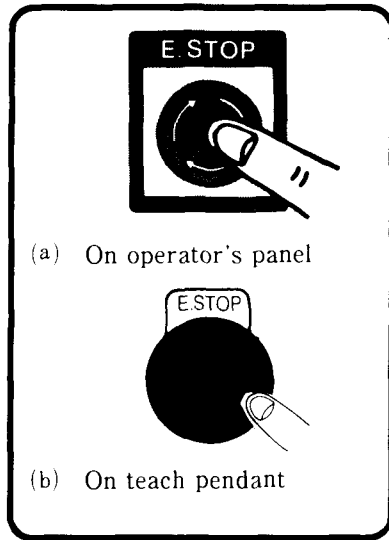
(3) HOLD by external input

Connect HOLD signal to the specified position of external input. When the input signal is OFF (contact is opened), the manipulator stops immediately. The HOLD lamp will light and no start operation can be accepted.

To release the HOLD, turn the external input to ON.

5. 4. 2 Emergency Stop

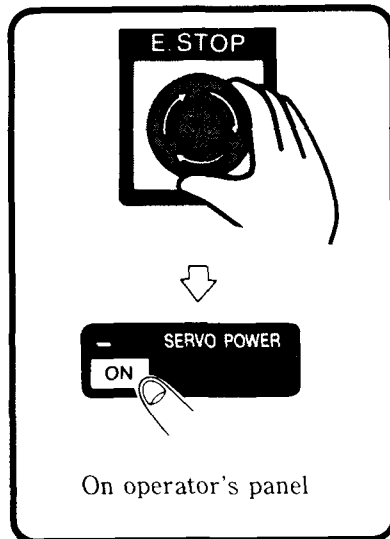
• Stop



The servo power must be cut off and the manipulator stops immediately by depressing the emergency stop button on the operator's panel or on the teach pendant.

This operation can be in effect anytime and in any mode.

• Restart



Turn the emergency stop button on operator's panel in the direction of the arrow to the original position, and depress

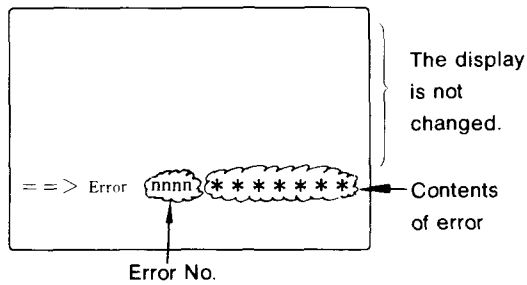
SERVO POWER key. The servo power will turn on.

5. 4. 3 Stop by Error/Alarm

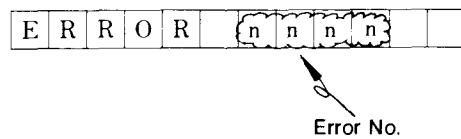
If an error or alarm occurs, the error or alarm code is displayed on CRT display and the manipulator will stop immediately. However, where the error or alarm is not affected in the manipulator motion, the manipulator continues the operation.

(1) Stop by error

• Display



(a) Operator's Panel



(b) Teach Pendant

Fig. 5.3 Error Display

• Usable keys during error

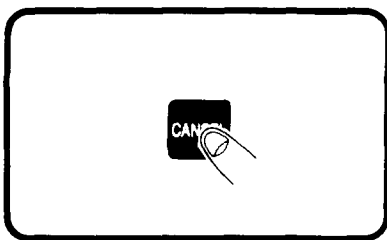



(a) On operator's panel

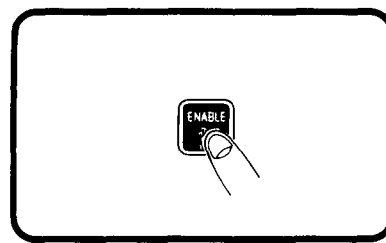



(b) On teach pendant

• Error release



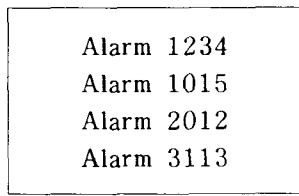
Depress  key on operator's panel.
Error message goes off and error is released.



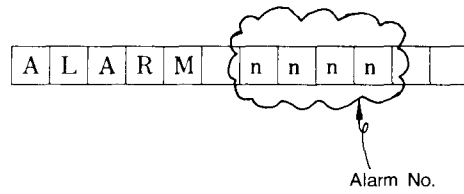
Depress  key on teach pendant.
The lamp will light. Error message goes off and error is released.

(2) Stop by alarm

• Display



The alarms (4 max.) is displayed automatically.

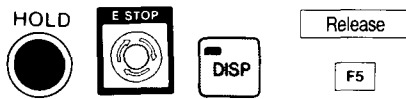


Fifth or subsequent alarms will not be displayed, but will be recorded as alarm history.

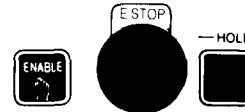
(a) Operator's Panel

(b) Teach Pendant

• Usable keys during alarm



(a) On operator's panel

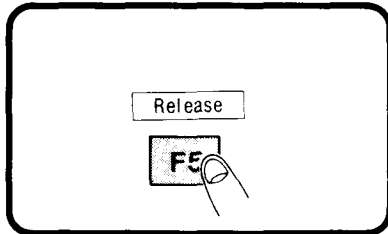


(b) On teach pendant



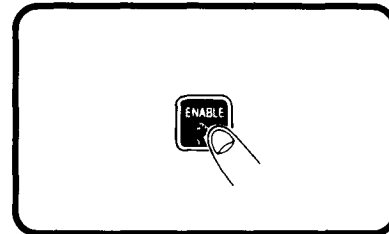
NOTE Servo power is automatically turned off if a critical alarm occurs such as a hardware failure. If resetting is not possible, no function is possible. Then turn off main power and correct the trouble.


• Alarm release



Depress  soft key.

The CRT display returns the status before the alarm occur.




Depress  key on teach pendant.

The lamp is turned on again and the alarm is released.



1. The alarm can also be released by an external signal.
2. If the CRT display is changed during alarm, the alarm display reappears even if following operations are executed.

- When the mode is changed.
- When START is specified.
- When  key is depressed.

5. 4. 4 Stop by Wire Sticking

Wire sticking is a status where welding wire and bead are connected under no welding. The manipulator monitors the wire sticking status when ARC OFF is executed in PLAY mode and **START** button is depressed in PLAY or CHECK mode.

- Stop

When wire sticking is detected, **HOLD** lamp on operator's panel is lit automatically and the manipulator stops immediately. The external output relay [wire sticking] is activated. (The contact is closed.)

- Restart

When the stuck wire is cut, **HOLD** lamp goes off and the external output relay [wire sticking] is released. (The contact is opened.)

In this status, depress **START** button on operator's panel. The manipulator moves again from the position.

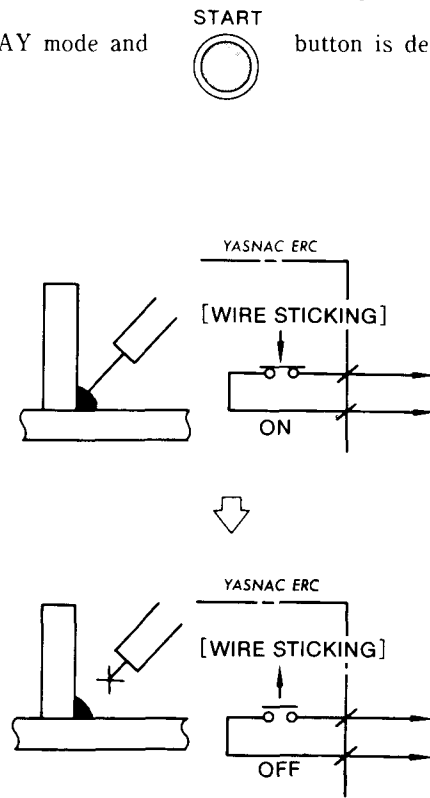



Fig. 5. 5

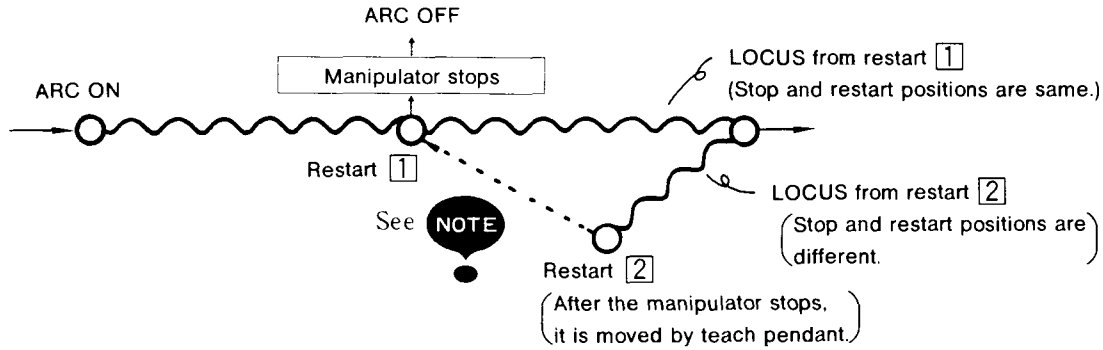
5

5. 4. 5 Stop during Welding

If the manipulator stops during welding, the ARC OFF is executed automatically.

- Restart **START**

Depress  button on operator's panel. The ARC ON is executed and the manipulator moves to the displayed step. At this time, the welding conditions (current, voltage, etc.) are those of the last executed instruction VWELD/□□□□□□/AWELD/□□□□□□.



NOTE Be sure to restart the manipulator at stopped position because it executes ARC ON from the restarted position. If the manipulator is moved, put it back to the stopped position by using teach pendant.

Fig. 5.6 Stop and Restart during Welding

NOTE For circular operating or weaving, the manipulator is restricted as follows.

Stop Method	Operation	Restart Method
HOLD	Circular interpolation and Weaving	When the stop and restart positions are the same, ARC ON is executed from the position and circular interpolation or soft weaving operation is resumed.
Stop except HOLD	Circular interpolation	The operation is not possible.
	Soft weaving	ARC ON is executed without weaving operation.

5. 4. 6 Other Stops

- (1) Pause by changing the mode

When the mode is changed during operation, the manipulator stops immediately.

- (2) Pause by executing PAUSE instruction

When the condition is satisfied in PAUSE instruction, the manipulator stops. When the **START**



button is depressed, the manipulator starts from the next instruction.

5. 5 SPEED CORRECTION

The registered speed correction is executed by any method below.

- At PLAY mode, correct by "speed override" specification Par. 5. 5. 1
- At TEACH mode, correct by EDIT operation Par. 5. 5. 2
- At TEACH mode, correct by TRT operation Par. 5. 5. 3

5. 5. 1 Speed Correction by Speed Override Specification at PLAY Mode

This speed correction can be executed with the manipulator motion and without alteration of the taught job contents. By using this function, the job can be played back with varied speed until the actual operation speed is adjusted.

Where the speed data correction is specified, only speed data of actual moved step are corrected for each step when the manipulator has reached the taught position of each step.

NOTE

1. If the override specification becomes ineffective during manipulator motion, the speed data of the step cannot be corrected.
2. The corrected speed is limited by max/min speed of the manipulator.

In override specification, the actual playback speed is varied at specified ratio to the taught motion speed.

The setting range of override ratio is 50 to 150% (in units of 1%).

The override specification can be executed on operator's panel and teach pendant under the following conditions.

- Operator's panel : The setting is possible only when the manipulator stops.
- Teach pendant : Even if the manipulator is moving, the setting is possible.

5. 5. 1 Speed Correction by Speed Override Specification at PLAY Mode (Cont'd)

(1) Override specification on operator's panel

〈Operation on Operator's Panel〉

1

2

3

4

5

For numerical value input

NOTE

1. The setting range is 50 to 150 %.
2. The override can also be set on teach pendant.

〈Description〉

Depress key.

Depress soft key.

Depress soft key.

Depress soft key when the taught speed data is required correction.

(When correction is not needed, depress soft key.)

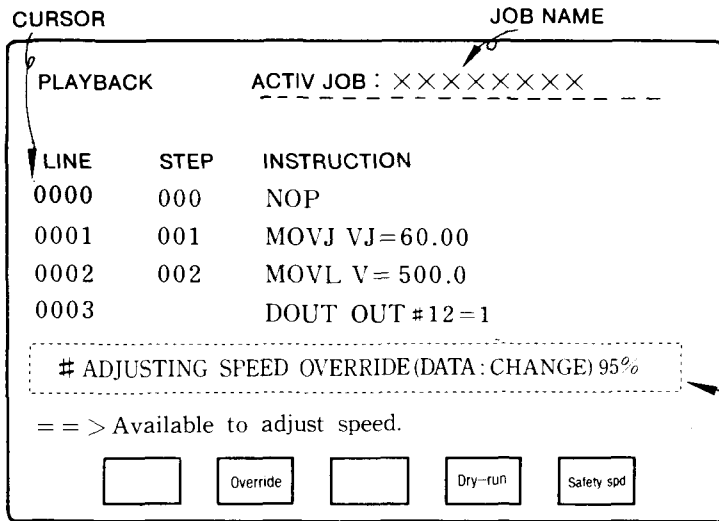
The soft key labels for numerical value input will appear.

Input the override ratio by using these

soft keys and key.

DATA		
7	8	9
4	5	6
1	2	3
-	0	.

Depress key.



The input data are registered as reservation value of override ratio.

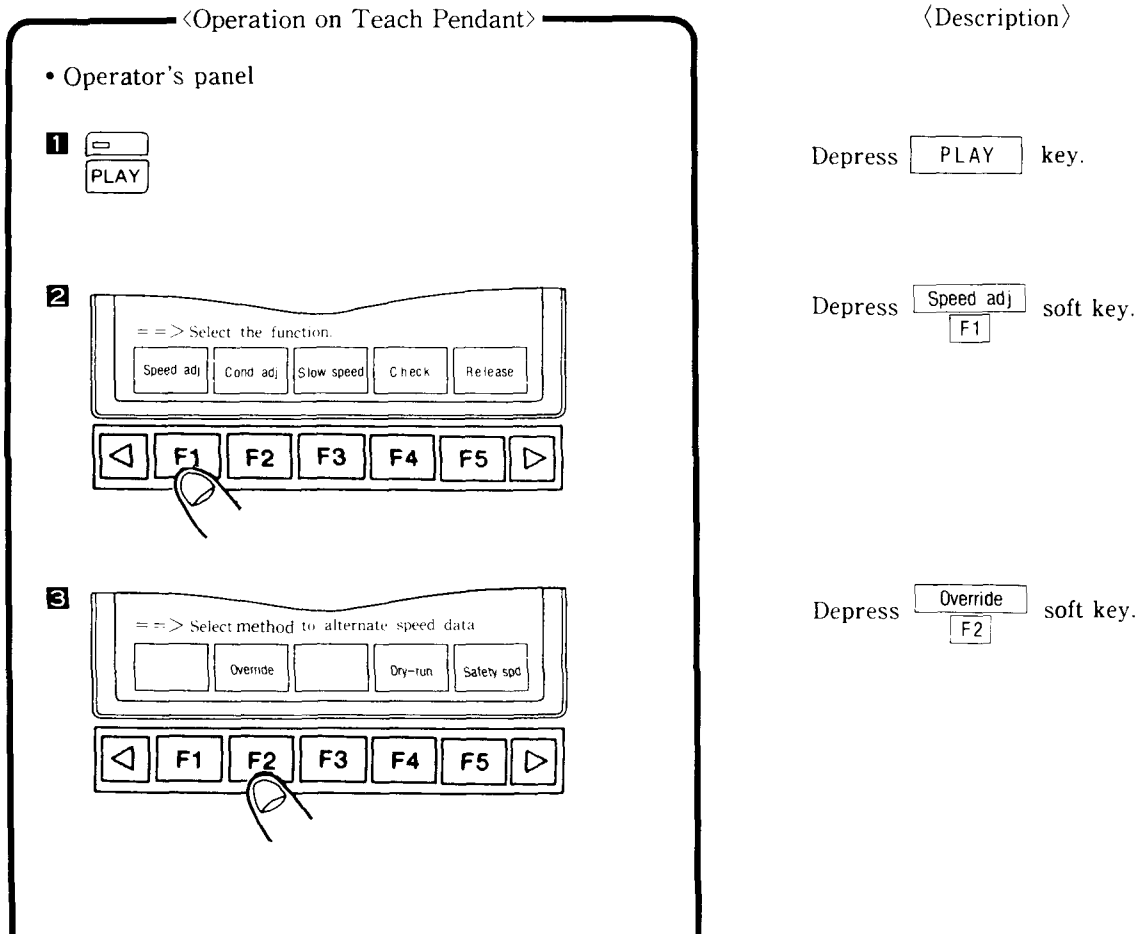
Where the correction is executed, the new data are registered, and are checked on the playback CRT display as shown in Fig. 5.7.

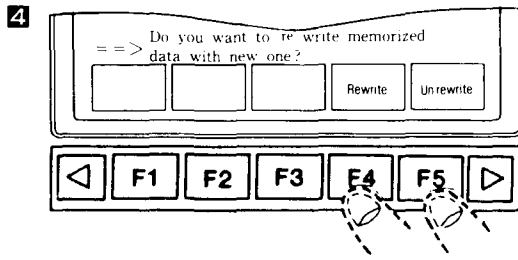
Reservation status is displayed.

Fig. 5. 7 Display of Override Reservation Status

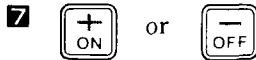
5. 5. 1 Speed Correction by Speed Override Specification at PLAY Mode (Cont'd)

(2) Override specification on teach pendant





• Teach pendant



1. The setting range is 50 to 150%.
2. If the in-guard-safety operation is specified simultaneously, the manipulator motion speed is limited to the safe speed.

However, the specified speed data are corrected in memory.

• Operator's panel



Depress soft key when the taught speed data is required correction.

(When the correction is not needed.)
depress soft key.

Depress key.

Depress key.

The lamp is lit.

5

Change the override ratio by using

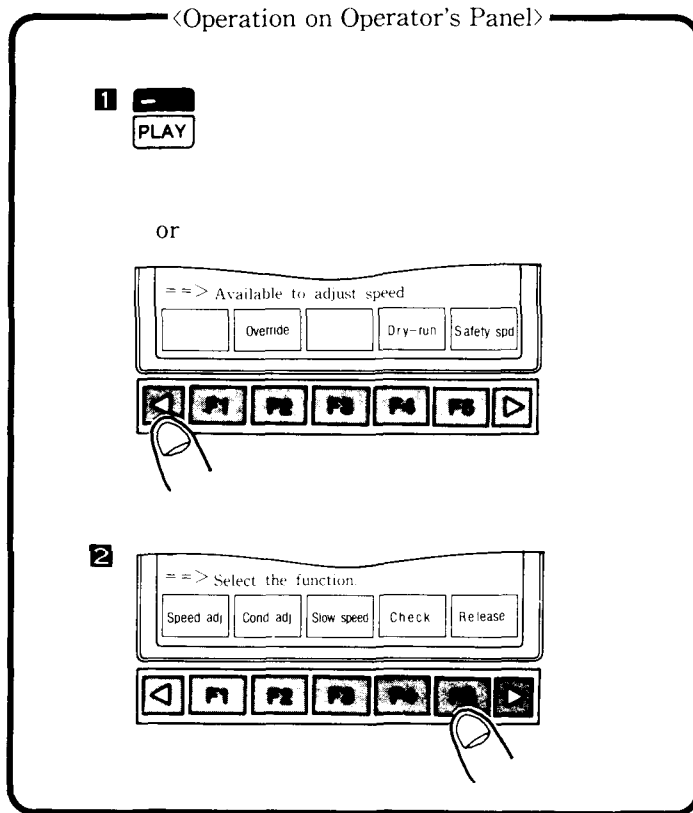
or key.

If and keys are depressed simultaneously, the ratio is input at 100%.

Depress key.

5. 5. 1 Speed Correction by Speed Override Specification at PLAY Mode (Cont' d)

(3) Override release



<Description>

Depress **PLAY** or **<** key.

Depress **Release** soft key.

The override specification will be cancelled.



It can also be released under the following cases.

- Dry-run is specified.
- One cycle has been completed by END instruction.
- Mode is changed.
- Power supply is cut.
- Alarm or error occurs.

5. 5. 2 Speed Correction by EDIT Operation at TEACH Mode

Speed data correction has two methods on operator's panel

- (1) In link speed (VJ), TCP speed (V), wrist-angle speed (VR) and external-axis speed (VE), only desired speed data are changed to the specified value.
- (2) Without regard to the kind of speed data (VJ, V, VR and VE), speed data of job can be corrected by specified ratio (2 to 200%).

This method is called "relative correct" operation.

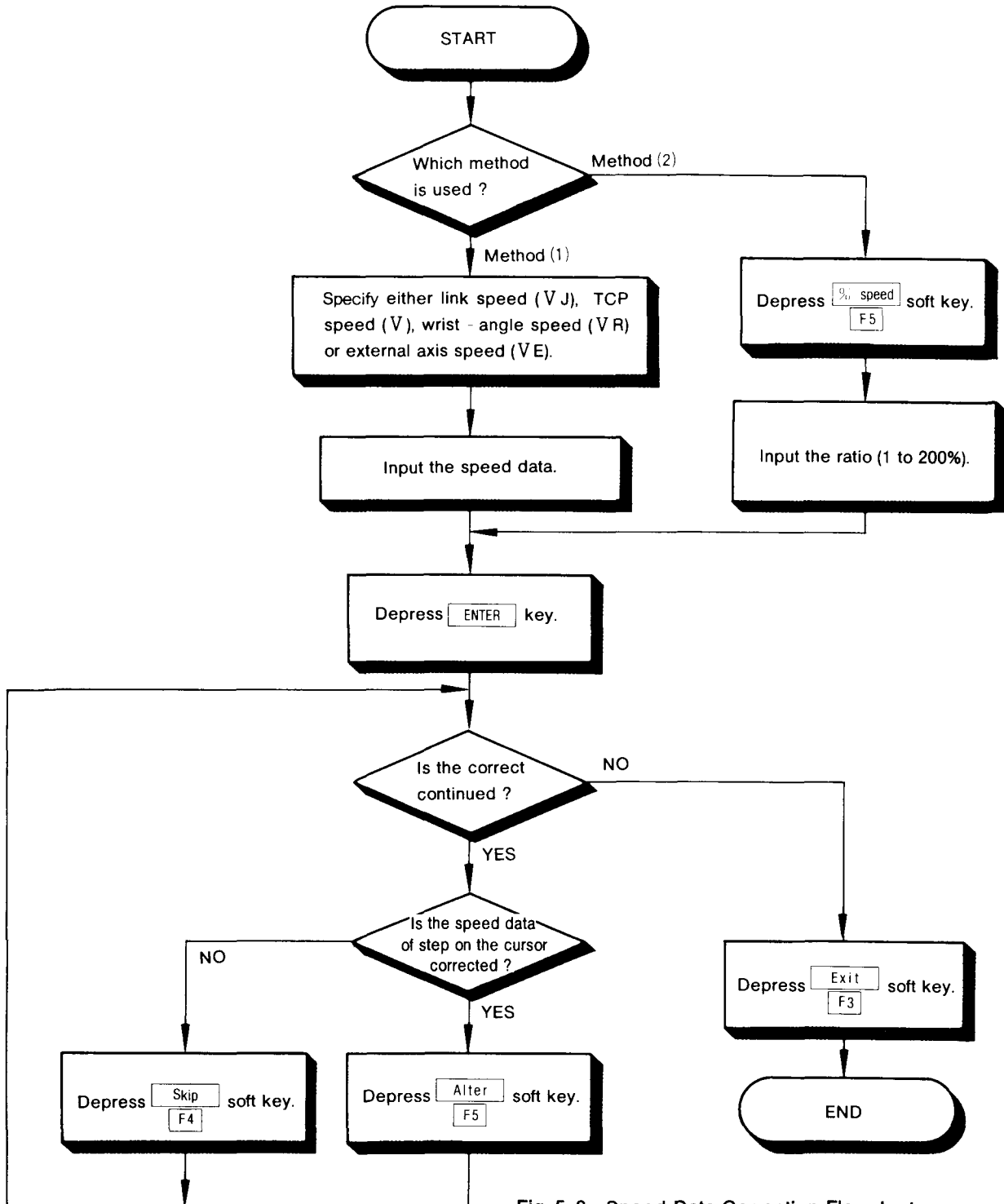
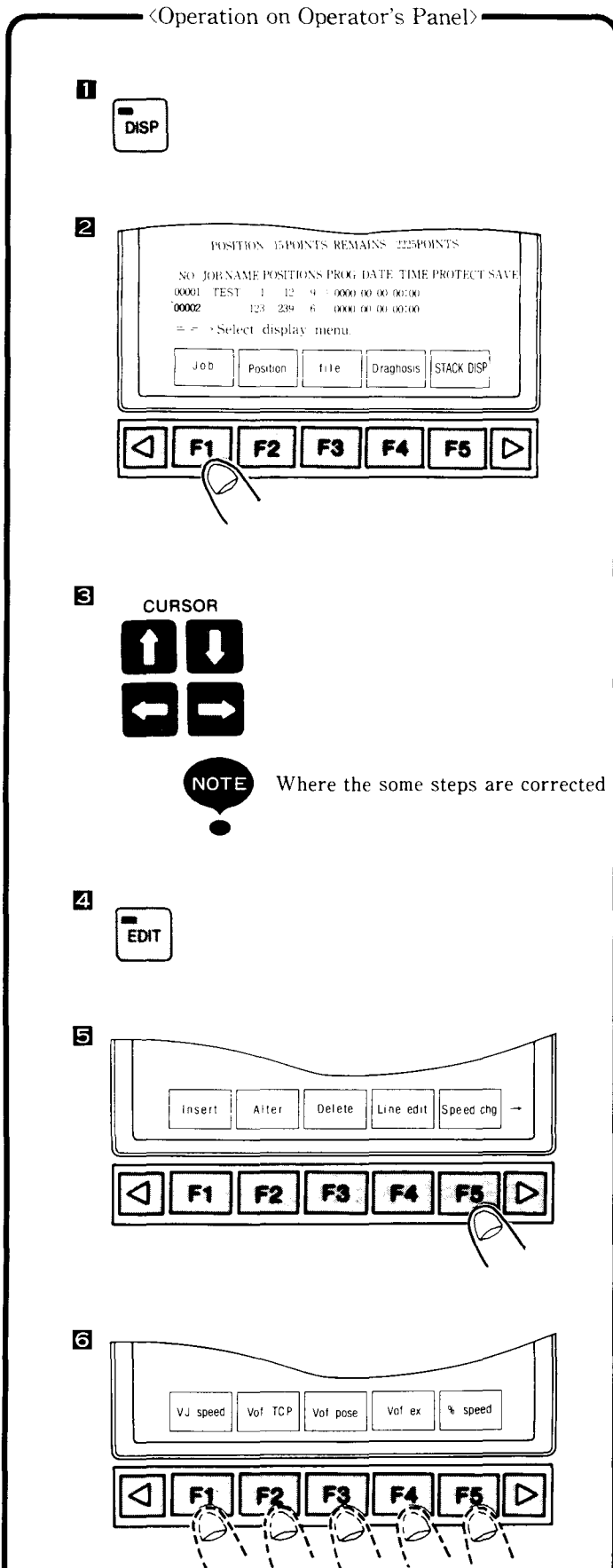


Fig. 5. 8 Speed Data Correction Flowchart

5. 5. 2 Speed Correction by EDIT Operation at TEACH Mode (Cont'd)



〈Description〉

Depress key.

Depress soft key.

Place the cursor on the step to be corrected by using CURSOR keys.

Depress key.

Depress soft key.

Depress desired soft key.

7 DATA



Input the desired speed data by using DATA keys or soft keys.

NOTE

The speed setting range may differ in manipulator.

When the speed data are corrected by soft key, the setting range is limited by max/min speed of the manipulator.

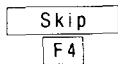
8



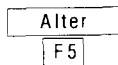
Depress key.

9

• Where the correction is continued :



: Speed data of step on the cursor is not changed.

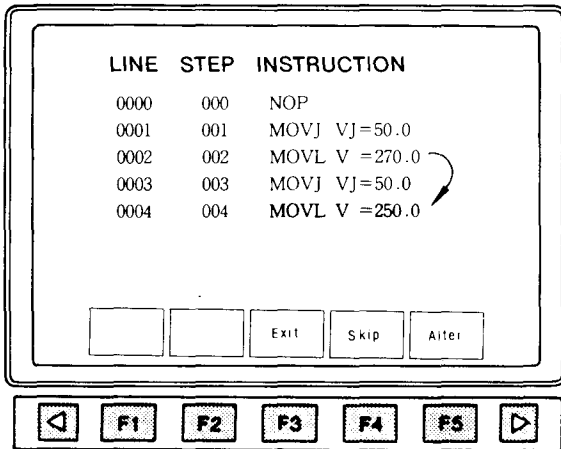


: Speed data of step on the cursor is changed.

5

Depress or soft key.

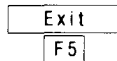
soft key.



NOTE

1. The cursor moves to the next object step of correct at every or soft key depression.
2. The cursor skips the different kind speed specification.

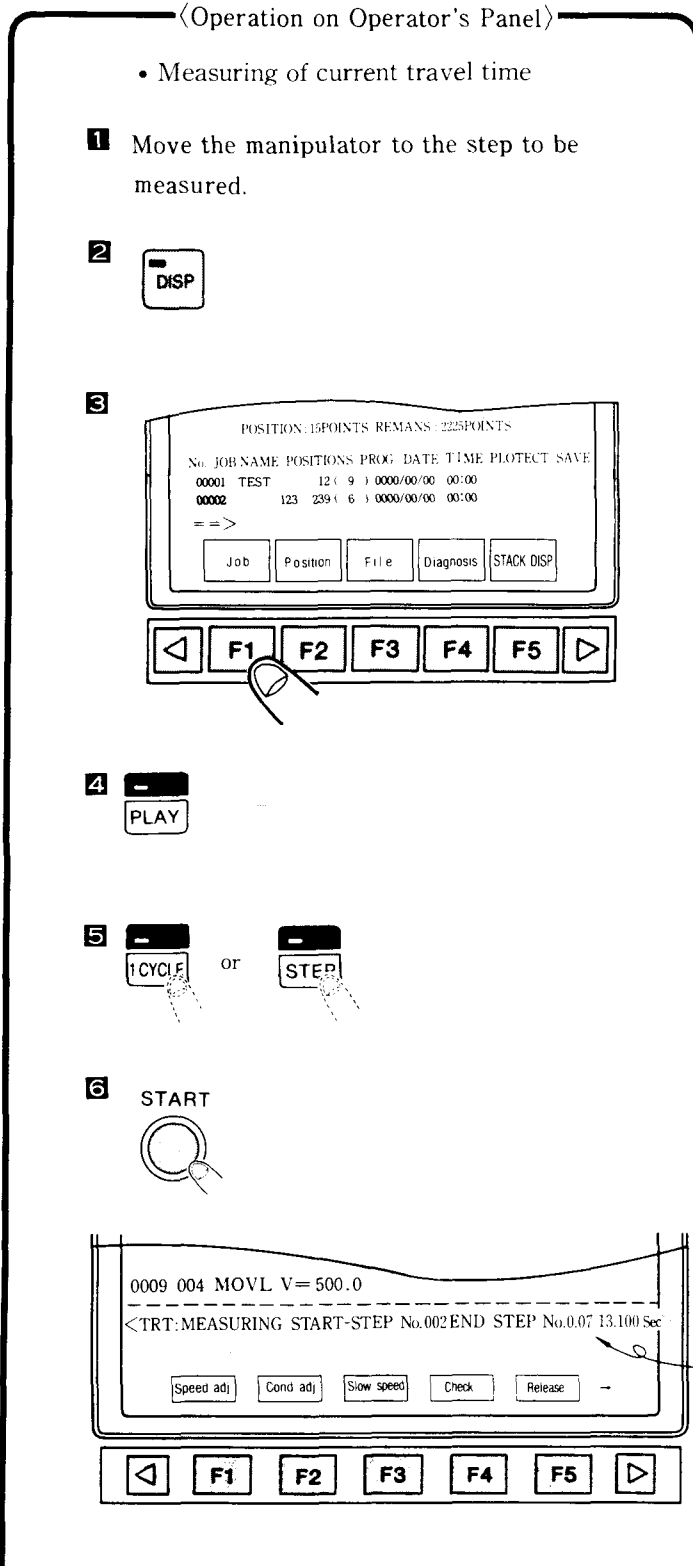
• Where the correction is ended :



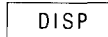
Depress soft key.

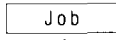

5. 5. 3 Speed Correction by TRT Operation at TEACH Mode


Execute speed correction by TRT operation at TEACH mode so that the manipulator is moved at newly set travel time in accordance with measuring travel time in playback.



〈Description〉

Depress  key.

Depress  soft key.


Depress  key.

The playback display appears.

Depress either  or  key.

Play back the manipulator in the interval to be measured.

NOTE Move the manipulator to the measuring end position.

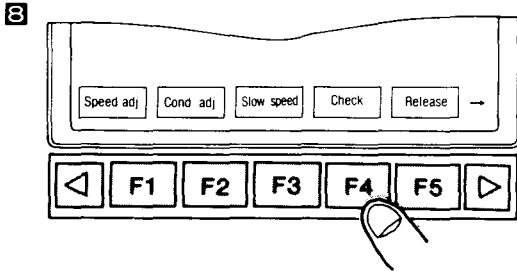
During playback, the travel time is displayed in playback display.

If the display is other than playback display, the travel time is not shown.

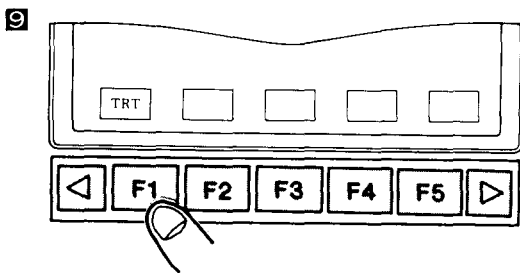
• Speed correction by resetting travel time



Depress key.



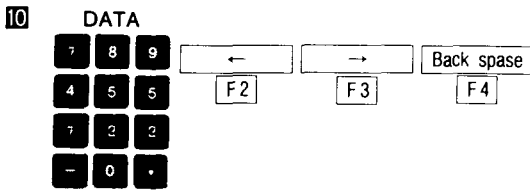
Depress soft key.



Depress soft key.

The soft keys for numerical value input will appear.

5



Input desired travel by using DATA keys or soft keys.



Depress key.

The speed data for each step has corrected according to the set travel time between measuring-start step No. and measuring-end step No.

$$*TRT \text{ setting speed} = \text{Travel speed} \times \frac{\text{Travel time}}{\text{Set time}}$$

If you make a mistake on the input, begin again from **8**

NOTE For step omitted the speed or step with only speed instruction, speed data correction cannot be executed.

SECTION 6

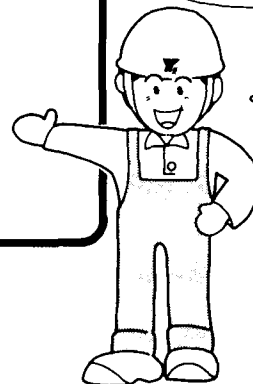
MANIPULATOR MOTION (COORDINATES)

This section describes manipulator motion on various coordinate system in TEACH mode and TCP fixed/change function.

<Coordinate system>

- Link
- Rectangular/Cylindrical
- Tool/User

Manipulator motion is changed in various coordinates.




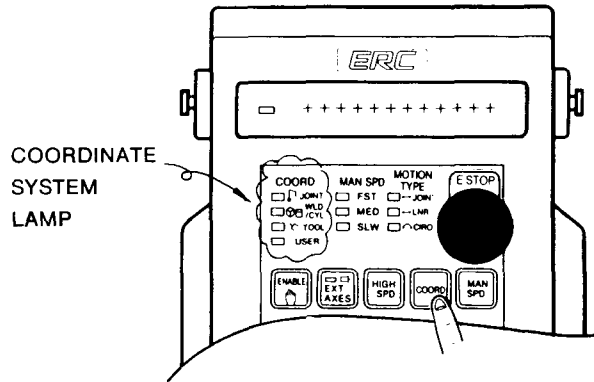
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6. 1 COORDINATES SELECTION

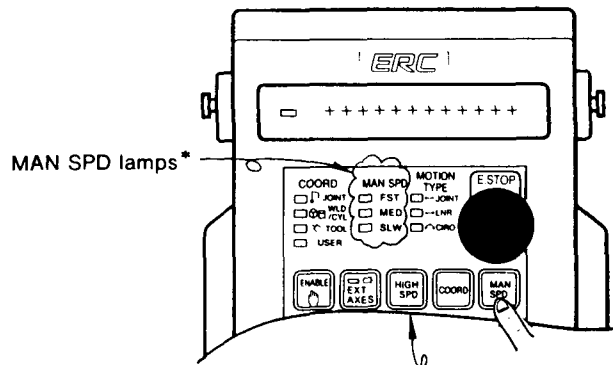
Manipulator motion by using teach pendant varies according to the coordinate system selected. Select it by depressing  key until desired lamp of coordinate system is lit.




6. 2 MOTION SPEED SPECIFICATION (TEACH PENDANT)

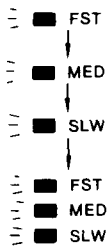
4 - stages of motion speed are selected by depressing  key.

Plus, one motion speed for higher speed motion can be selected by depressing  key.



* Shifted down every time  key is **HIGHER SPEED MOTION KEY**

depressed as follows:



(Three lamps are lit.)


Inching operation

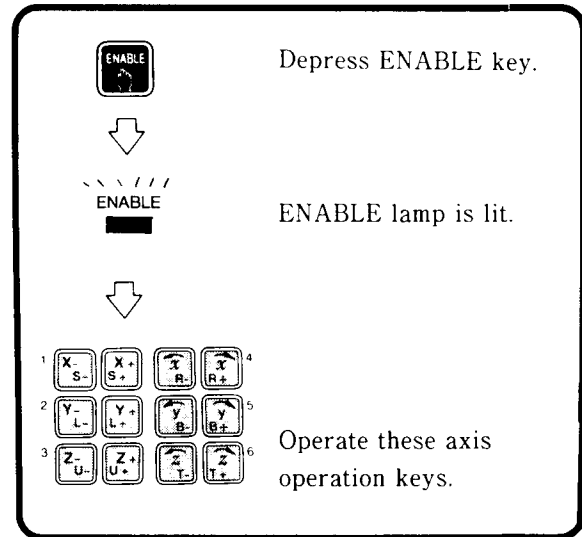
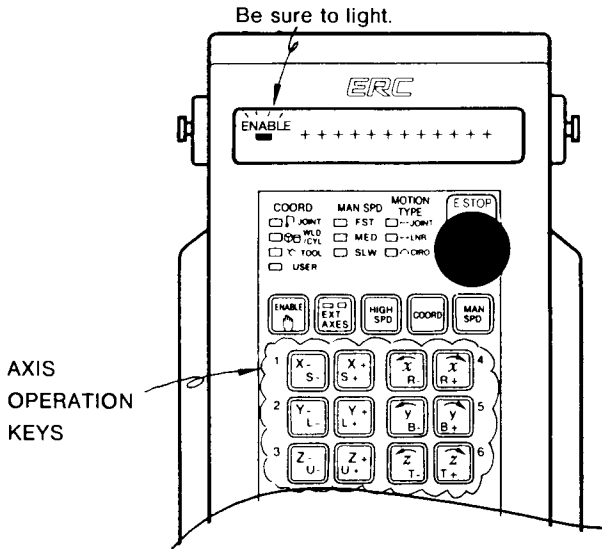


This key is effective while it is depressed, but ineffective during inching even if it is depressed.

6. 3 AXIS OPERATION


Manipulator operates in TEACH mode only while the axis operation key is depressed.
 Manipulator motion varies according to the coordinate system selected.

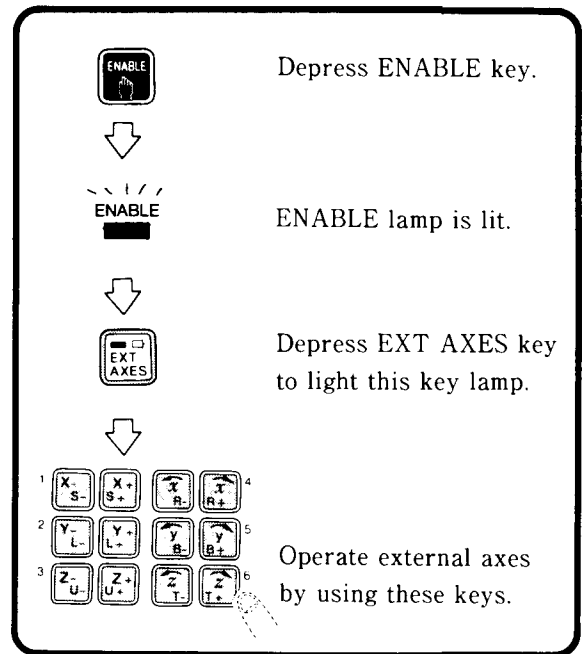
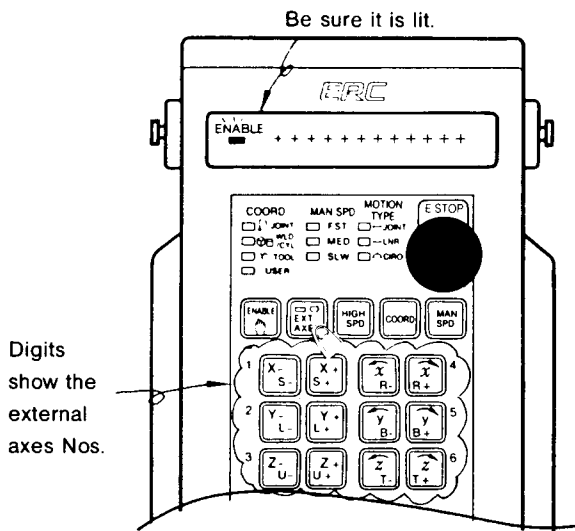
NOTE The external axes can also be operated by the same axis operation keys while  key is lit. Be careful operating manipulator axes.



6

6. 4 EXTERNAL AXES SWITCHING

Depress  key on teach pendant to select the external axes operation. Each time this key is depressed, the key lamp is changed ON or OFF. While selecting the external axes, the lamp is lit.



6. 5 LINK COORDINATE SYSTEM

If a link coordinate is selected, each axis of the manipulator operates independently. In the link coordinate motion, depressing more than two keys results in the mixture of motion corresponding to the keys depressed.

None of the axes operate when two direction keys in one axis are depressed simultaneously. (e. g.)

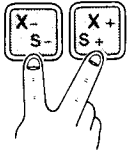














Table 6. 1 Axis Operation Key and Motion on Link Coordinate System

	Axis Operation Key	Axis Name	Motion
Main Axes	¹  	S - axis	Rotates to right and left.
	²  	L - axis	Moves forward and backward.
	³  	U - axis	Moves up and down.
Wrist Axes	⁴  	R - axis	Rolls to right and left.
	⁵  	B - axis	Bends up and down.
	⁶  	T - axis	Turns to right and left.

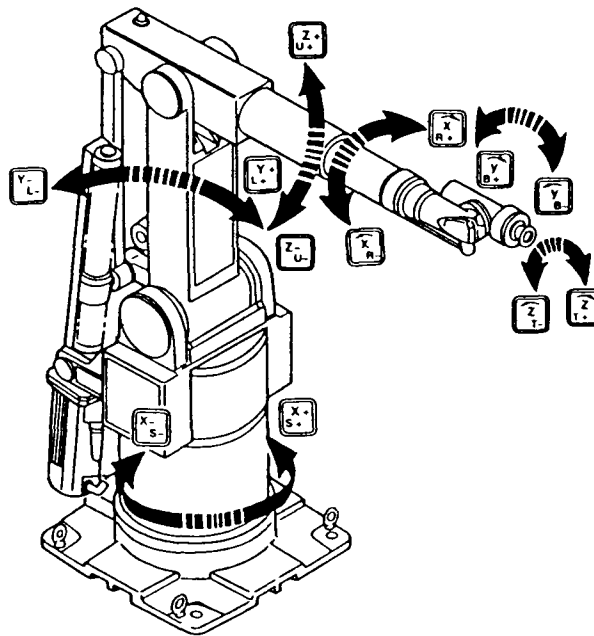


Fig. 6. 1 Operation Axes During LINK Coordinate

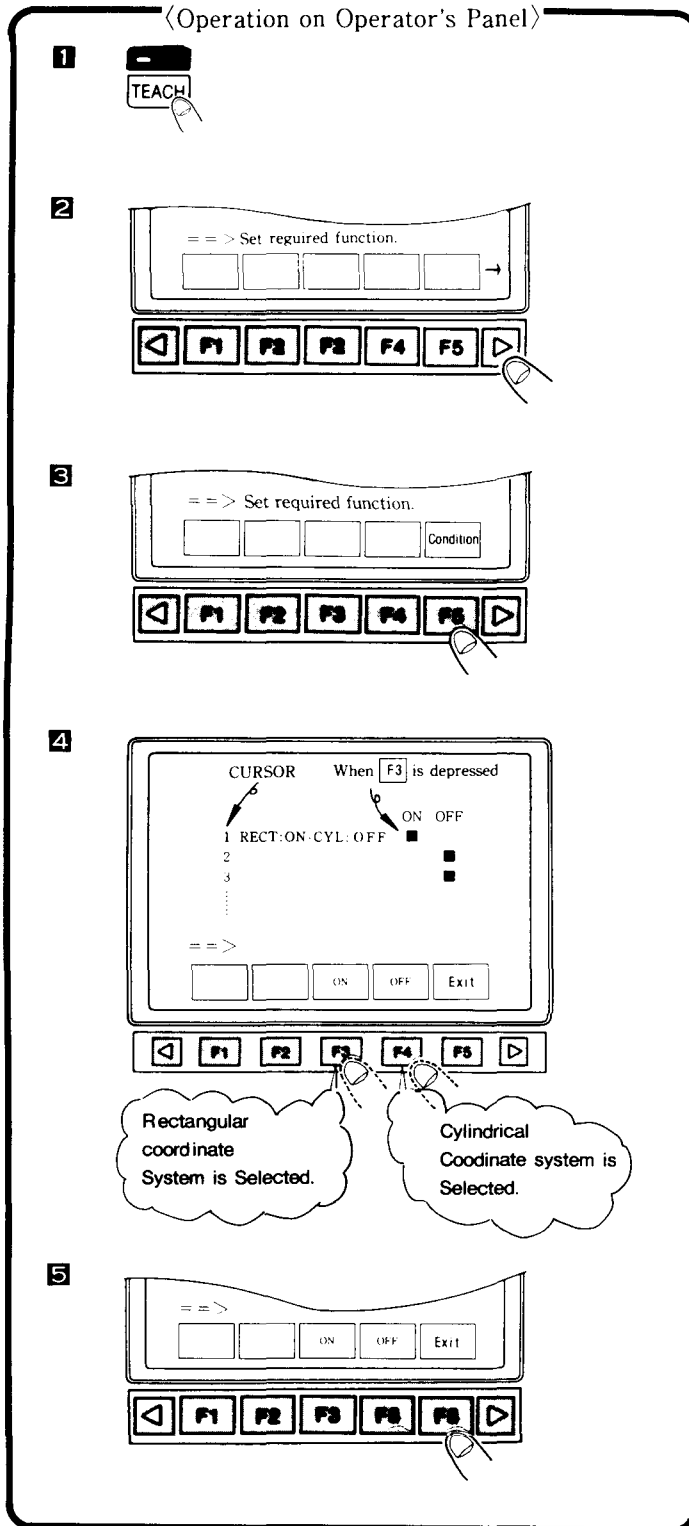


The moving direction of U - axis is different from that of the previous system (YASNAC - RB, RG, RX).

6. 6 RECTANGULAR/CYLINDRICAL COORDINATE SYSTEM MOTION

6. 6. 1 Rectangular/Cylindrical Coordinate System Selection

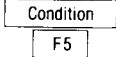
Select the rectangular or cylindrical coordinate system as follows. The cylindrical coordinates have been preset at the factory.



<Description>

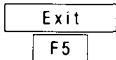
Depress TEACH key.

Depress  key.

Depress  soft key.

Condition display for teaching will appear.

Select coordinate system by using cursor keys.

Depress  soft key

to complete this operation.

6

6. 6. 2 Rectangular Coordinate System Motion

The rectangular coordinate system is defined as three dimensional (X-, Y-, Z- axis) coordinate axes, as shown in Fig. 6. 2.

In this case, the manipulator always moves parallel to X-, Y- and Z- axis.

Depressing more than two keys results in the mixture of motions corresponding to the keys depressed.

None of the axes operate while keys in two directions are depressed simultaneously. (e. g.)

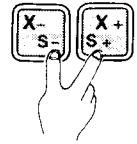








Table 6. 2 Axis Operation Key and Motion on Rectangular Coordinate System

	Axis Operation Key	Axis Name	Motion
Main Axes	¹  	X- axis	Moves parallel to X axis
	²  	Y- axis	Moves parallel to Y axis
	³  	Z- axis	Moves parallel to Z axis
Wrist Axes	TCP control motion is executed. The details of this motion are described in par. 6. 8.		

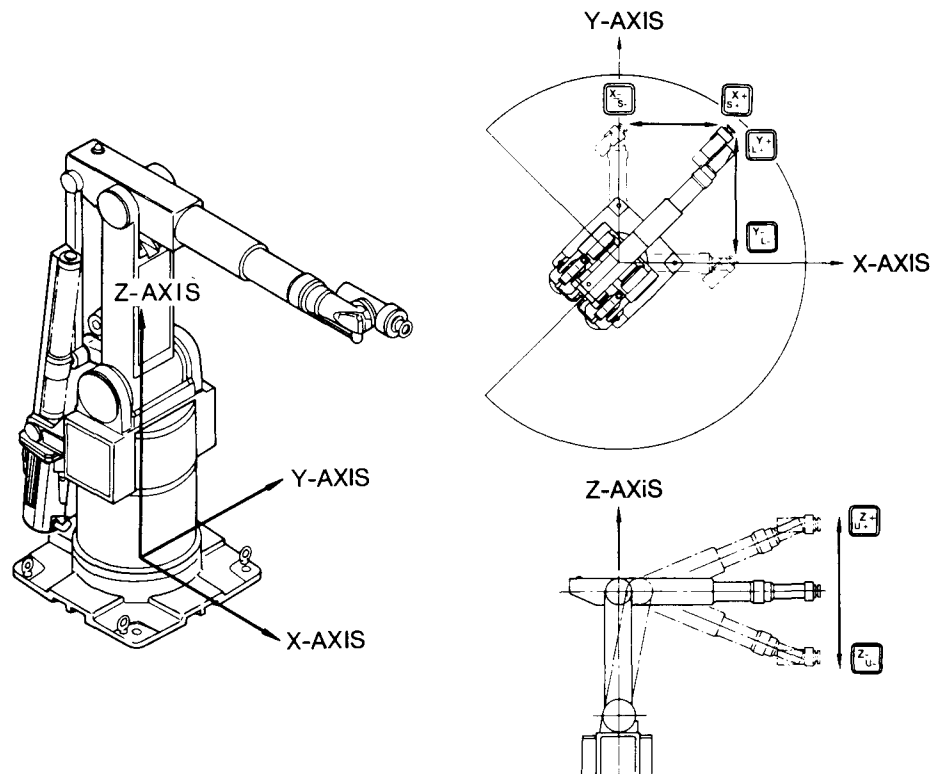


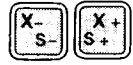


Fig. 6. 2 Motion on Rectangular Coordinate System

6. 6. 3 Cylindrical Coordinate System Motion

The cylindrical coordinate system is special coordinate only during axis operation and that is prepared to match sensitively with manipulator mechanism and operation. This is defined as cylindrical three-dimensional coordinate axes, as shown in Fig. 6. 3.

In this case, θ , r and Z axes move as follows.

Table 6. 3 Axis Operation Key and Motion on Cylindrical Coordinate System

	Axis Operation Key	Axis Name	Motion
Main Axes	1 	θ axis	Rolls around S axis. (The same motion as link coordinate system motion.)
	2 	r axis	Moves perpendicular Z axis. (Moves parallel to L axis.)
	3 	Z axis	Moves parallel to Z axis. (The same motion as rectangular coordinate system motion.)
Wrist Axes	TCP control motion is executed. The details of this motion are described in par. 6. 8.		

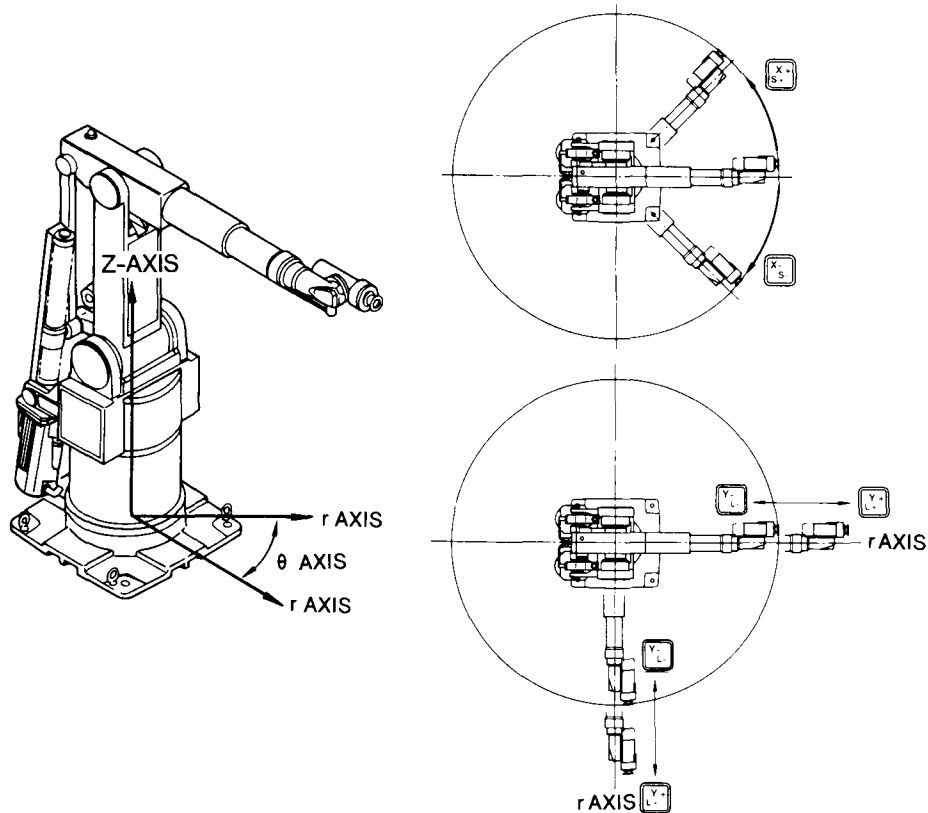

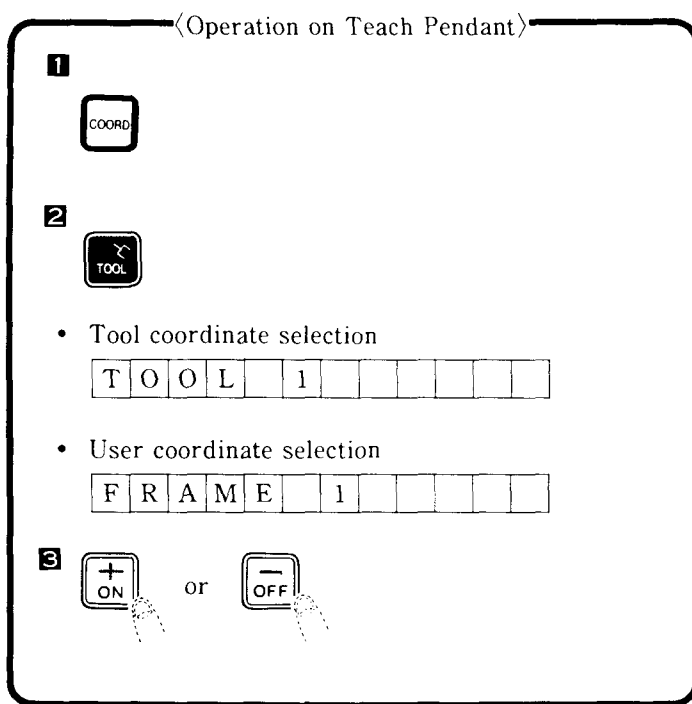


Fig.6. 3 Motion on Cylindrical Coordinate System

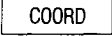
6. 7 TOOL/USER COORDINATE SYSTEM MOTION


6. 7. 1 Selecting Tool/User Coordinate Number

While  key lamp is lit, up to 8 coordinates can be selected in tool and user coordinates respectively. These coordinates should be registered in coordinate file in advance. For details, refer to par. A 4 in appendix.





〈Description〉

Depress  key.

Depress  key.

The latest specified coordinate No. is displayed.

Select the coordinate No. by using

 or  key.

NOTE

This function is optional.

For details of user coordinates, contact your Yaskawa representative.

6. 7. 2 Tool Coordinate System

The tool coordinates are defined at the tip of the tool, assuming that effective direction of tool mounted on the manipulator wrist flange is Z-axis. Therefore, the tool-coordinate-axis direction moves together with the wrist.

In tool coordinate system motions, the manipulator can be moved using the tool effective direction as a reference regardless of the manipulator position or orientation. These motions are best suited when the manipulator is required to move parallel while maintaining the tool orientation toward workpieces.

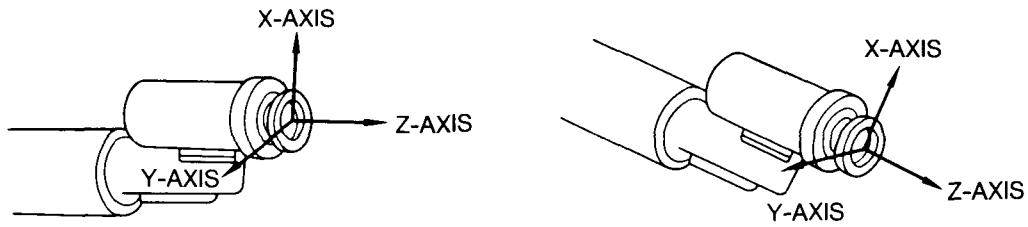


Fig. 6. 4. Tool Coordinate System

6

Table 6. 4. Axis Operation Key and Motion on Tool Coordinate System

	Axis Operation Key	Axis Name	Motion
Main Axes	¹	X-axis	Moves parallel to X-axis
	²	Y-axis	Moves parallel to Y-axis
	³	Z-axis	Moves parallel to Z-axis
Wrist Axes	TCP control motion is set. The details of this motion are described in par. 6. 8.		

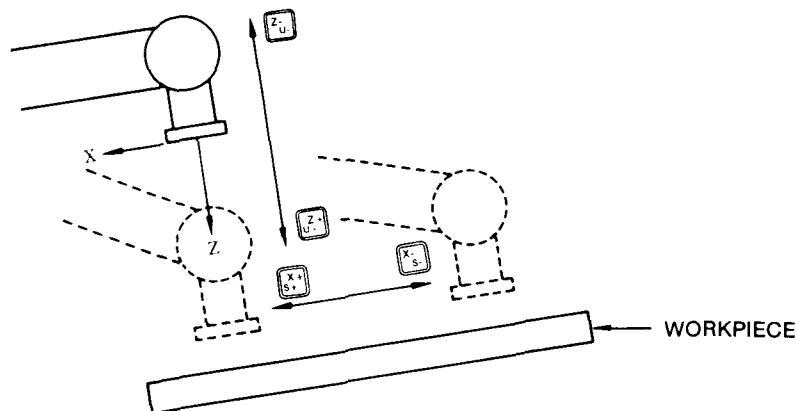


Fig. 6. 5. Tool Coordinate System Motion

6. 7. 3 User Coordinate System

The coordinate system for users will be defined so as to select objects other than the manipulator such as workpieces and fixtures. A maximum of 8 kinds of coordinates (origins and orientation) can be set in the user coordinate system.

In user coordinate motions, the manipulator moves parallel to each axis of the designated user coordinate system.

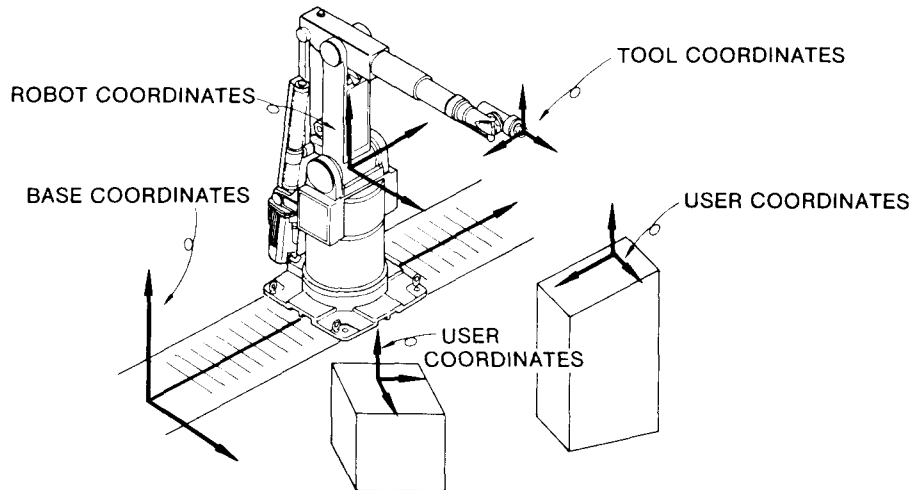


Fig. 6. 6. User Coordinate System

Table 6. 5. Axis Operation Key and Motion on User Coordinate System

	Axis Operation Key	Axis Name	Motion
Main Axes	1	X-axis	Moves parallel to X axis
	2	Y-axis	Moves parallel to Y axis
	3	Z-axis	Moves parallel to Z axis
Wrist Axes	TCP control motion is set. The details of this motion are described in par. 6. 8.		

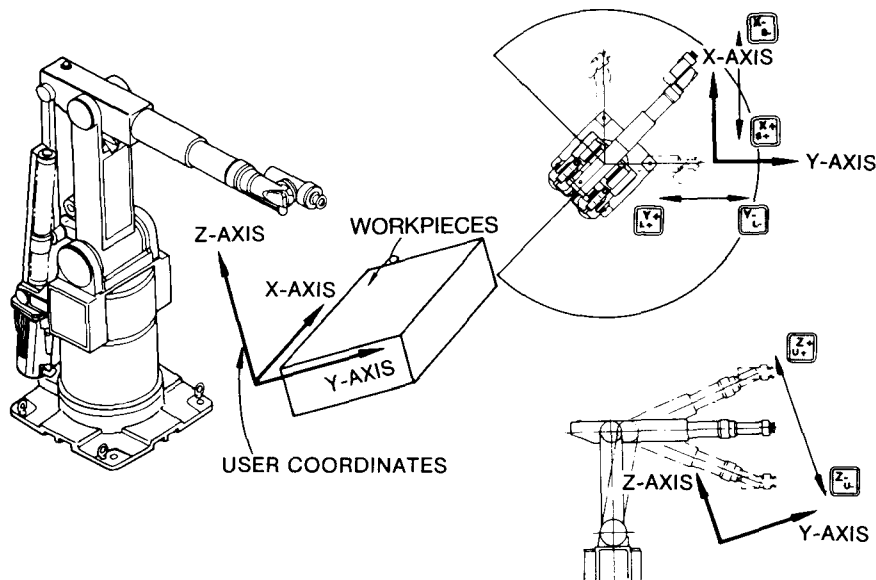


Fig. 6. 7. User Coordinate System Motion













6. 8 TCP FIXED FUNCTION

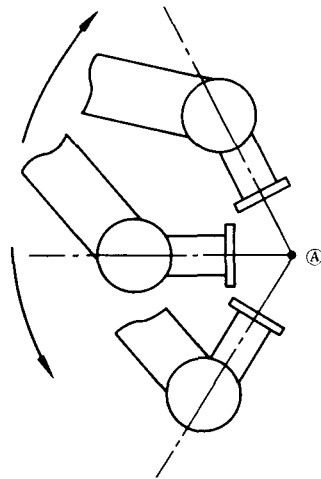
TCP fixed function is possible to change only wrist orientation at a fixed TCP position in any coordinate system. As shown in Fig. 6. 8, only wrist orientation is changed with TCP ④ maintained.

This motion is possible by depressing wrist axis (R-, B- or T-axis) in system other than link coordinates. When main axis (S-, L- or U-axis) is depressed simultaneously with wrist axis key, only TCP control motion is available.

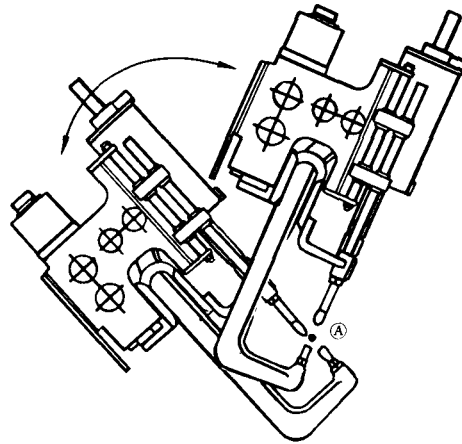
only TCP control motion is available. Fig. 6. 9 shows axis rotary motion with TCP maintained in each coordinate system.

Table 6. 6 Axis Operation Key and Motion

	Axis Operation Key	Motion
Main Axes	¹  	TCP shift
	²  	
	³  	
Wrist Axes	 	Turning around X-axis
	 	Turning around Y-axis (TCP fixed)
	 	Turning around Z-axis



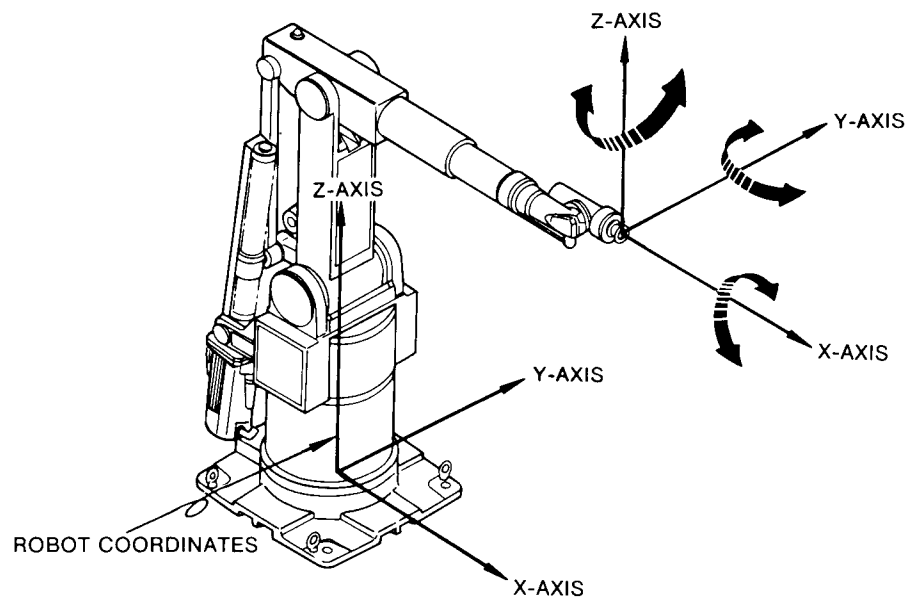
(a) For using torch



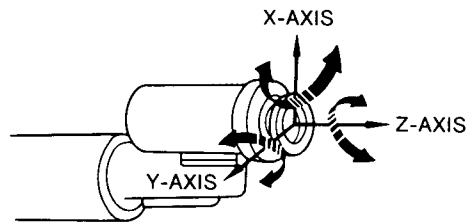
(b) For using gunspot

Fig. 6. 8. TCP Control Motion

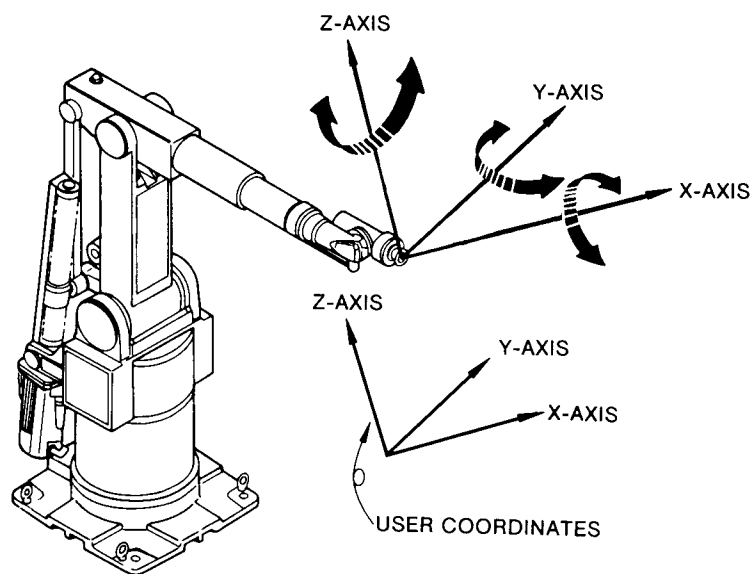
6. 8 TCP FIXED FUNCTION (Cont'd)



(a) On Rectangular/cylindrical Coordinate System



(b) On Tool Coordinate System



(c) User Coordinate System

Fig. 6. 9 Axis Rotary Motion with TCP Maintained

6. 9 TCP CHANGE FUNCTION

TCP change function is very useful for following cases.

- (1) Where multiple tool is attached on manipulator wrist flange and TCP is changed for each tool.

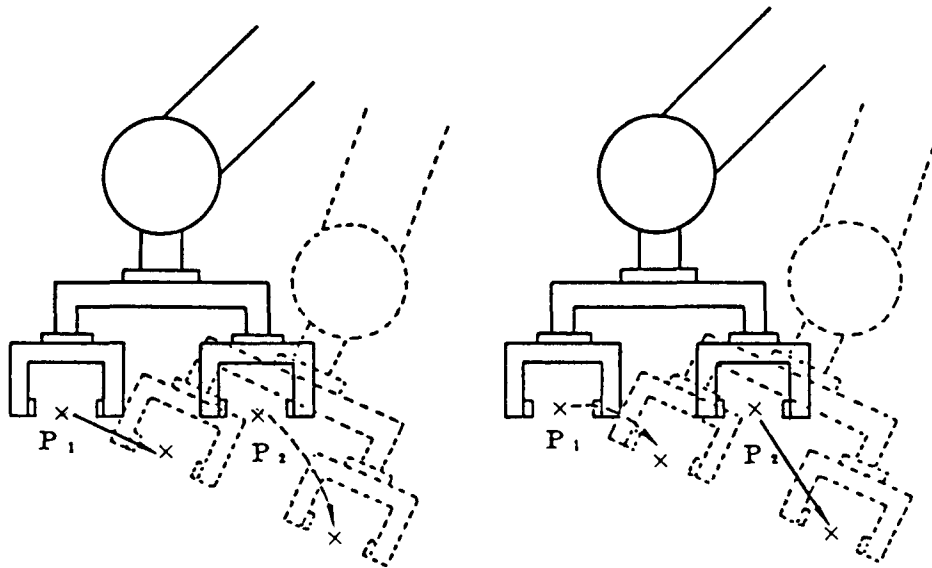


Fig. 6.10 Top Change for Each Tool

- (2) Where TCP is changed in a tool.

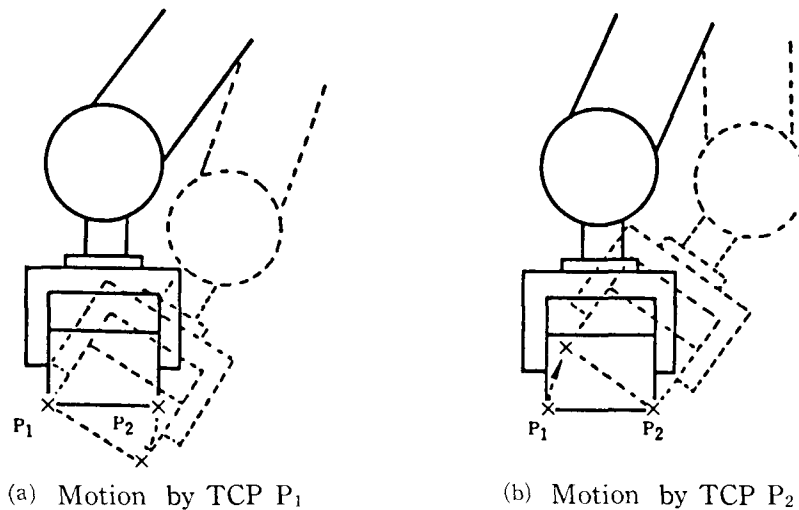


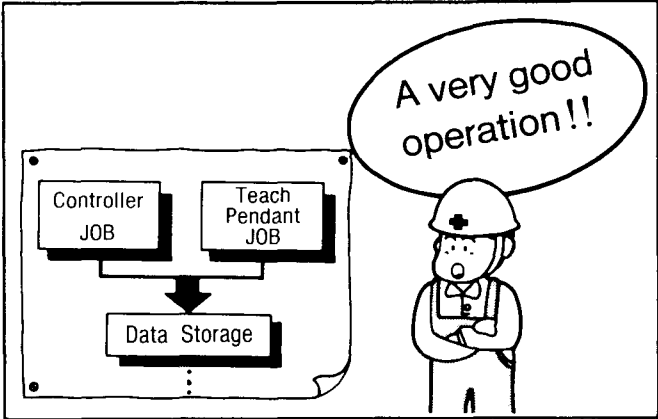
Fig. 6.11 TCP Change in a Tool

APPLIED OPERATION

SECTION 7

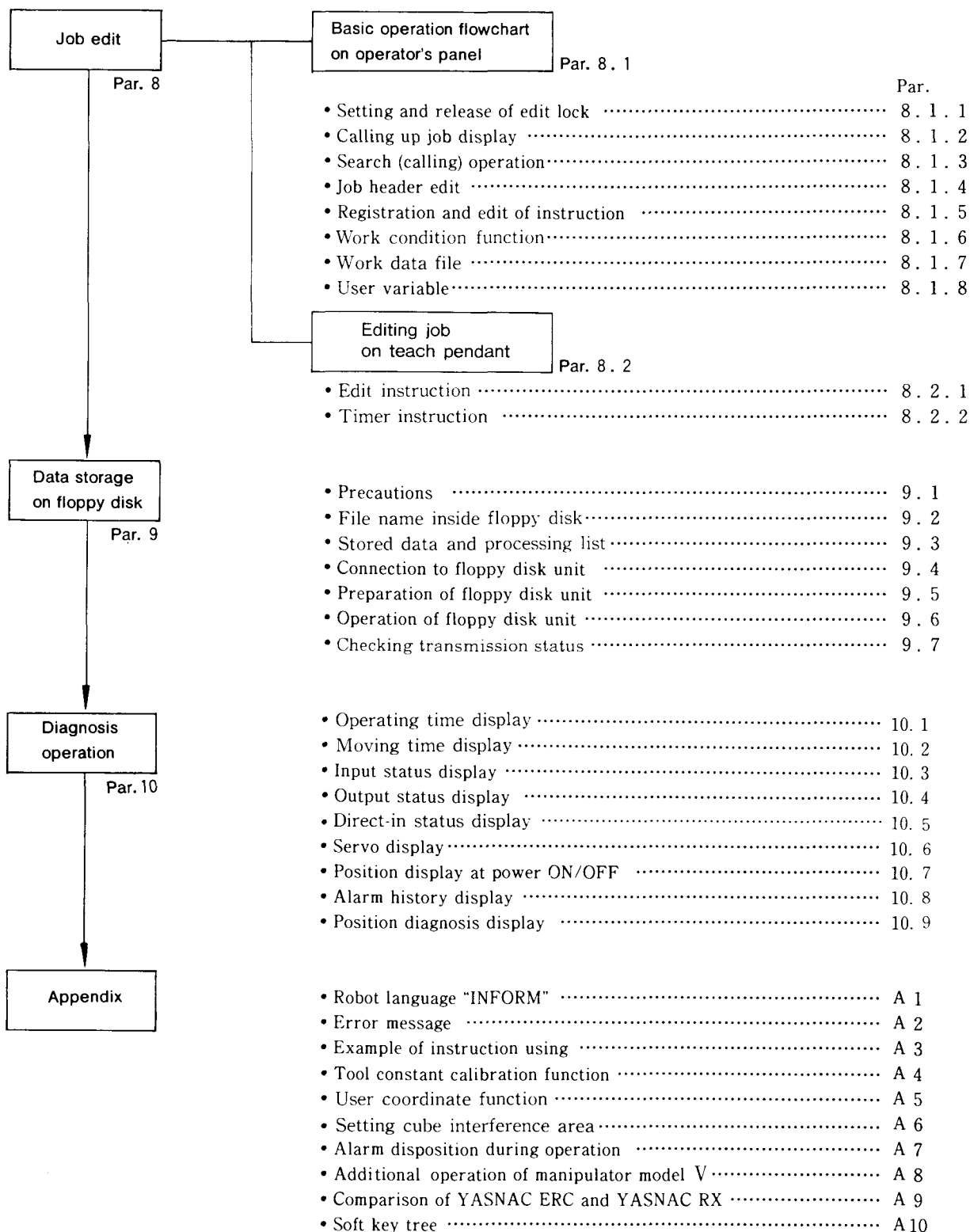
APPLIED OPERATION SEQUENCE

This section describes the applied operation flowchart for the controller in order to understand the operation easily.



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7. 1	APPLIED OPERATION FLOWCHART	158

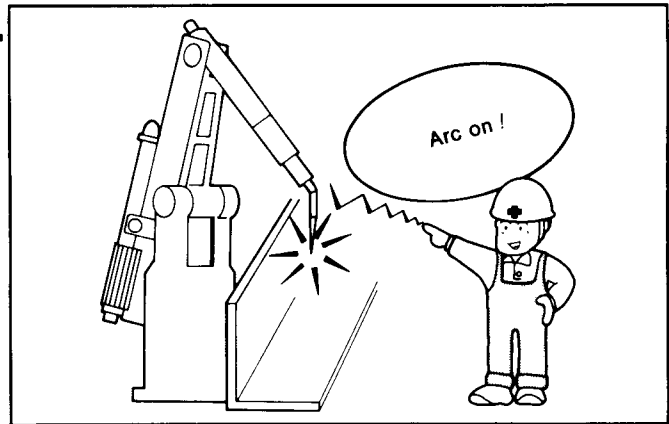
7. 1 APPLIED OPERATION FLOWCHART



SECTION 8

JOB EDIT

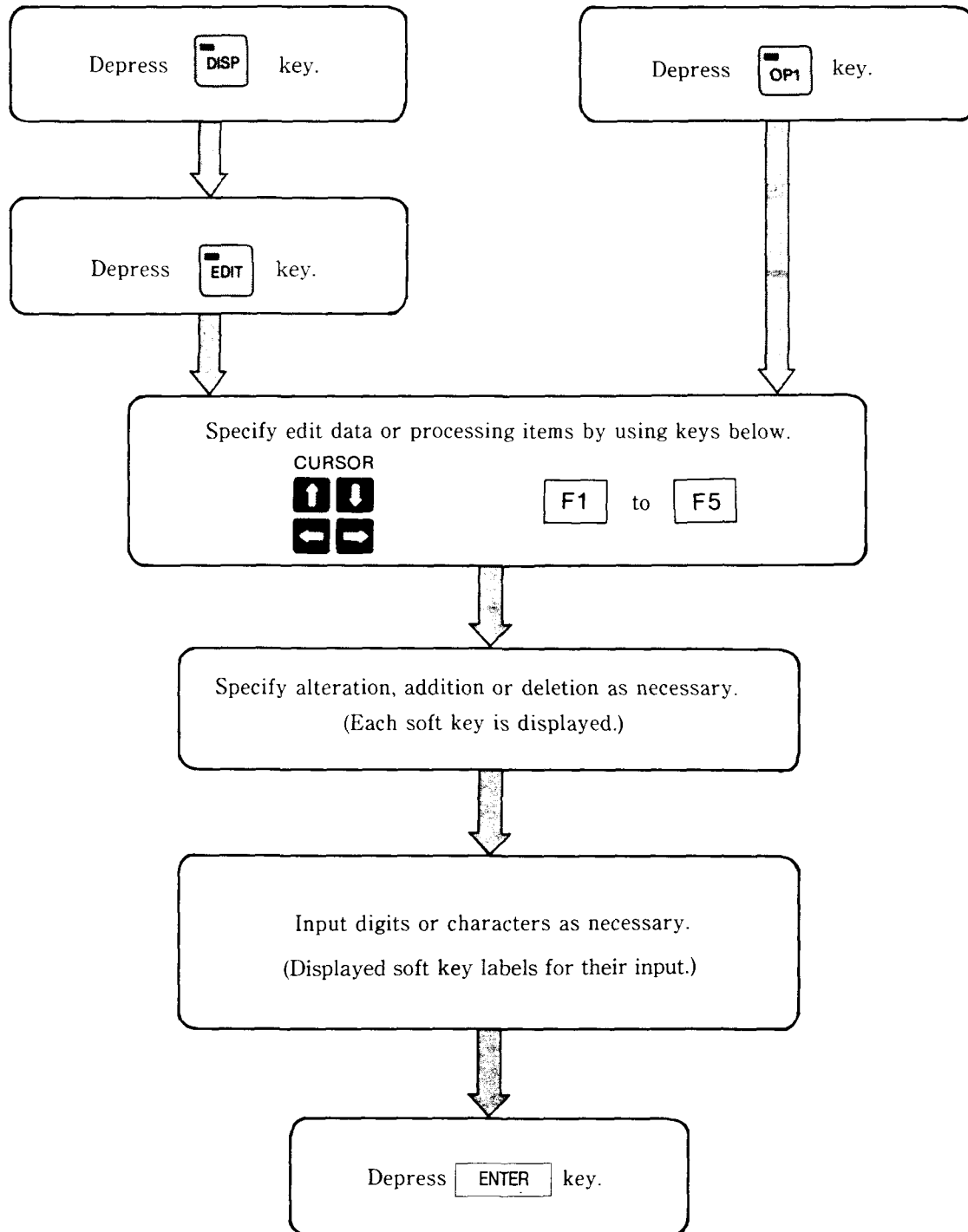
This section describes the basic operation of data editing on the operator's panel and teach pendant.



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	169		Position Variable
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8. 1 BASIC OPERATION FLOWCHART ON OPERATOR'S PANEL



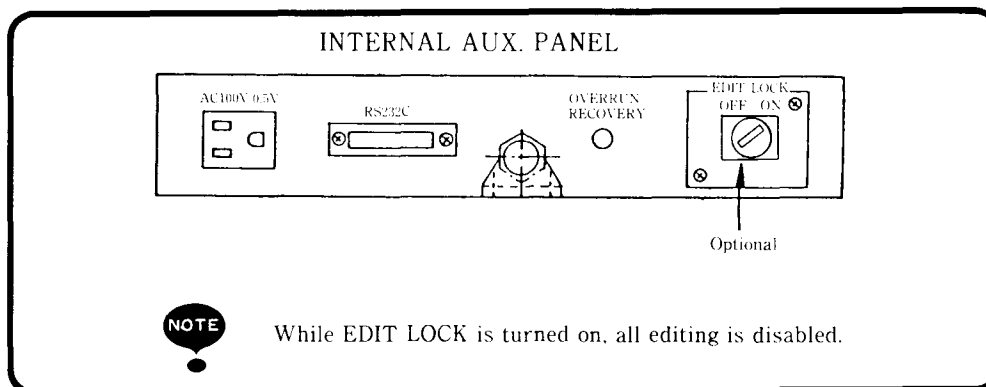
8. 1. 1 Setting and Release of Edit Lock

EDIT LOCK can be set to prevent taught jobs (working programs) and data from being changed by mistake.

8. 1. 1. 1 EDIT LOCK Key (Optional)

An EDIT LOCK switch with a key is provided inside the subpanel of the operator's panel. The key can be removed if the switch is set to the EDIT LOCK ON position. All editing operations by the operator's panel and by the teach pendant are protected during EDIT LOCK.

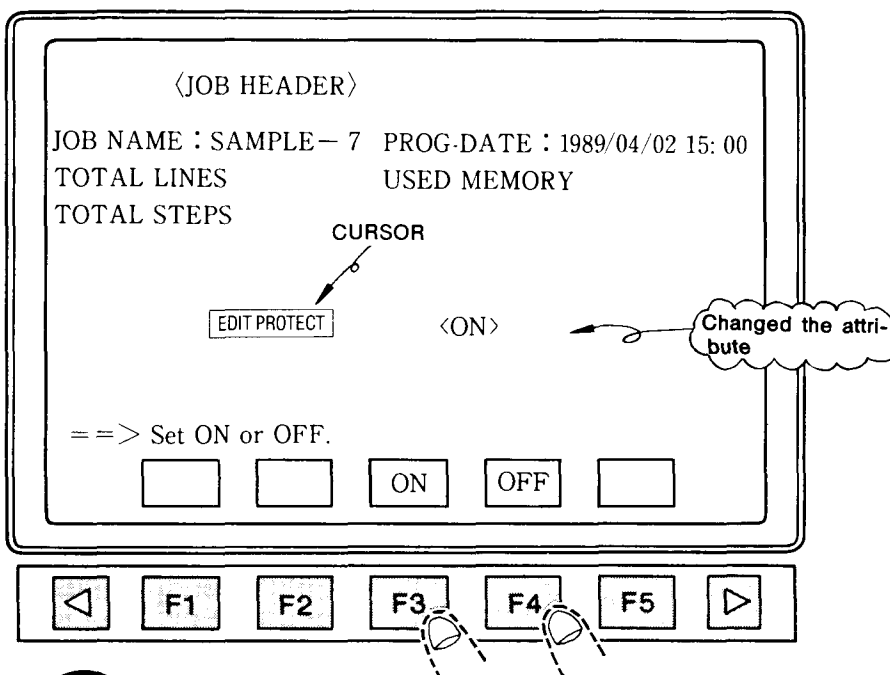
Selection of the CRT display and floppy disk operation can be continued even during EDIT LOCK. This switch can be installed as an option upon request.



8. 1. 1. 2 Edit Protect of Each job

EDIT LOCK setting can be registered with each job as attributes.

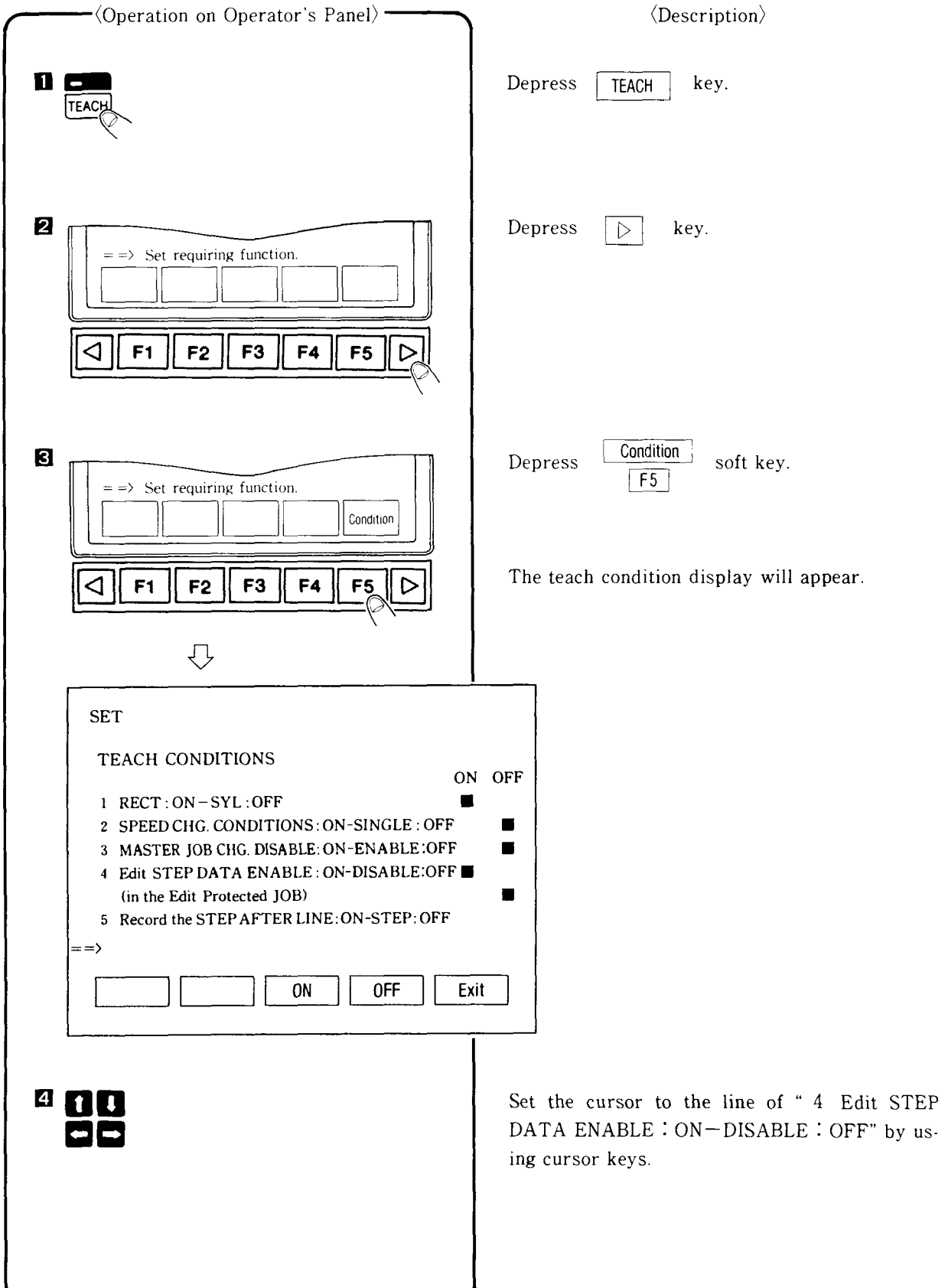
The setting condition can be checked on the header display of each job. (Fig. 8. 1). The settings are also possible through the header display by using or soft key. See par. 8. 5. 2 for details.

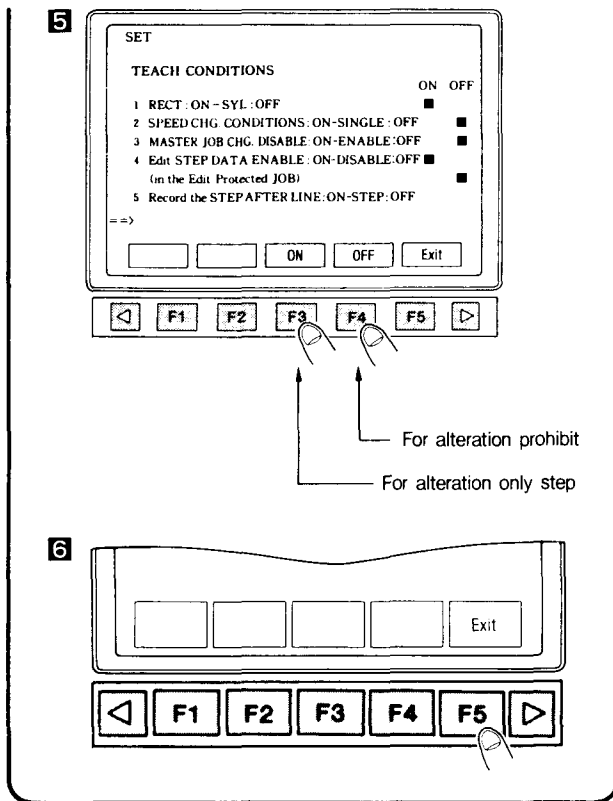


- NOTE**
1. While EDIT LOCK is turned on, the setting cannot be performed.
 2. When EDIT LOCK is set, job deletion is protected.

Fig. 8. 1 Edit Lock of Each Job

Even if the job is set at EDIT prohibit, execute the following operation to correct only the position.
The deletion and addition can not be executed.





- When selecting alteration only step, depress **ON** soft key.
F3
- When selecting alteration prohibit, depress **OFF** soft key.
F4

Depress **Exit** soft key after completing selection.
F5





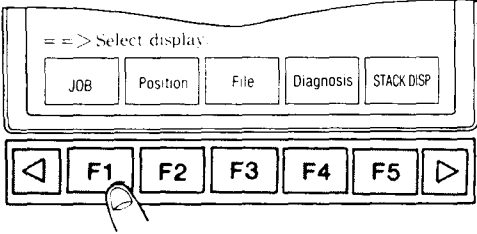


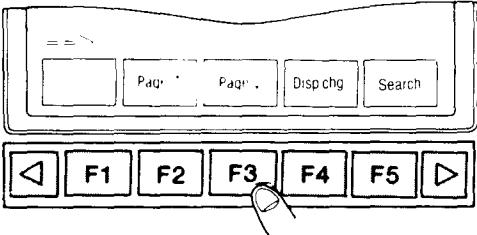


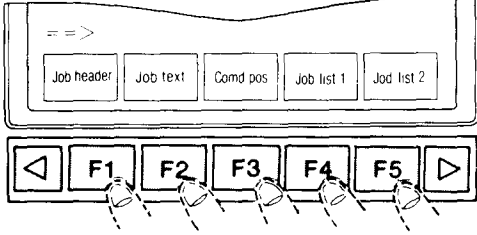
1. When the control power is turned on, alteration prohibit (OFF) is always set.
2. Whenever the control power is turned off, the setting above is ineffective. Therefore, when the alteration only step is required, set the setting to ON again.

8. 1. 2 Calling up job Display

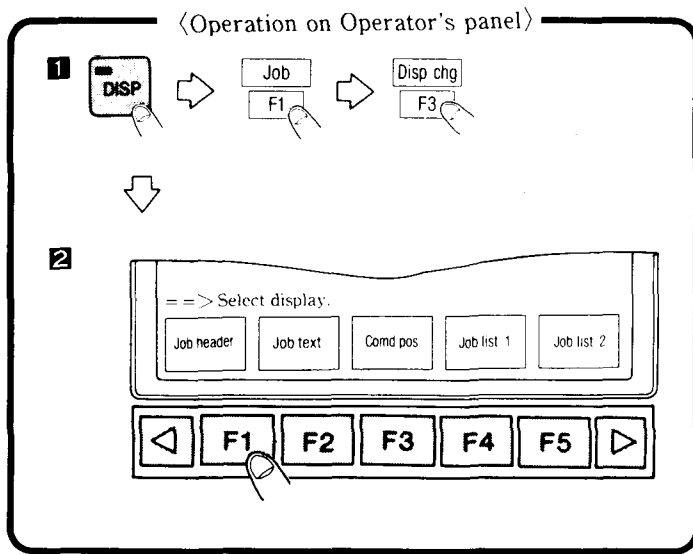
First, the method of calling up job to be edited on the display is described. The following menu display is available for the job display group.

Job Display (Group)	Display Items
Job Header	Programing date, used memory, attributes
Job Text	Registered instructions
Command Position	Taught position data
Job List 1 (Job Registering Order)	Jobs in registration sequence (Used for job search)
Job List 2 (Sort)	Job in character sort sequence

Each display can be called up as follows :

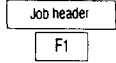
(Operation on Operator's Panel)	(Description)
<p>1</p> 	<p>Depress  key.</p>
<p>2</p> 	<p>Depress   key.</p> <p>If the edit job is registered, Job Text display will appear.</p>
<p>3</p> 	<p>Depress   soft key.</p>
<p>4</p> 	<p>Depress desired soft key, and the designated display appears.</p>

8. 1. 2. 1 Job Header Display

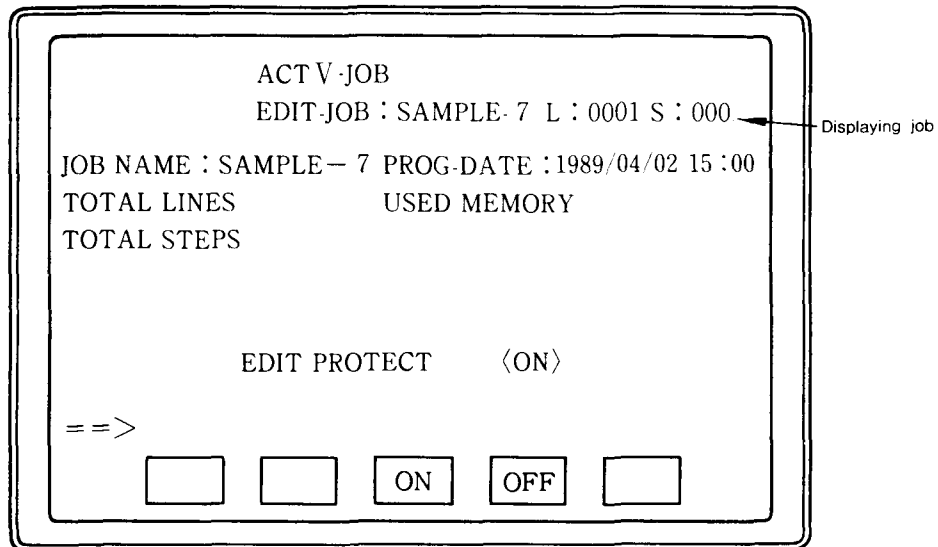


〈Description〉

Call up soft key labels shown in **2**.

Depress  soft key. Job header display will appear.

Job Header Display



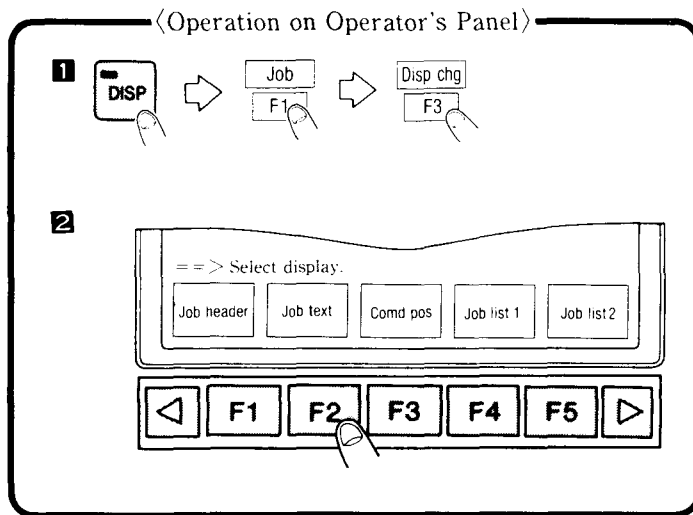
8. 1. 2. 1 Job Header Display (Cont' d)

The item and meaning on JOB HEADER display (universal display area) is as follows.

Display Item	Meaning
Job NAME*	Displaying job name. Job name can be changed on this display.
PROG DATE	Date and time of latest edit of this job are displayed.
TOTAL LINE	Total instructions registered in this job is displayed.
TOTAL STEP	Total move instructions registered in this job is displayed.
USED MEMORY	Capacity of the memory registered in this job is displayed.
EDIT PROTECT*	Edit protect status of this job is displayed.

*The contents of the setting can be changed according to the edit operation.

8. 1. 2. 2 Job Text (Instruction) Display



<Description>

Call up soft key labels shown in **2**.

Depress soft key.

Job text (instruction) display will appear.

Job Text Display


ACTV-JOB
EDIT-JOB: SAMPLE-7 L : 0126 S : 102


LINE	STEP	INSTRUCTION
0123	100	MOVJ VJ=50.0
0124	101	MOVL V=123
0125		DOUT OT# 01=1
0126	102	MOVL V=560
0127		WAIT IN# 01=0


CURSOR

==> [] [page ↓] [page ↑] [Disp chg] [Search-]

LINE No. and STEP No. in JOB TEXT (instruction) display are named INSTRUCTION ADDRESS. This instruction address can be selected by operating the cursor key.

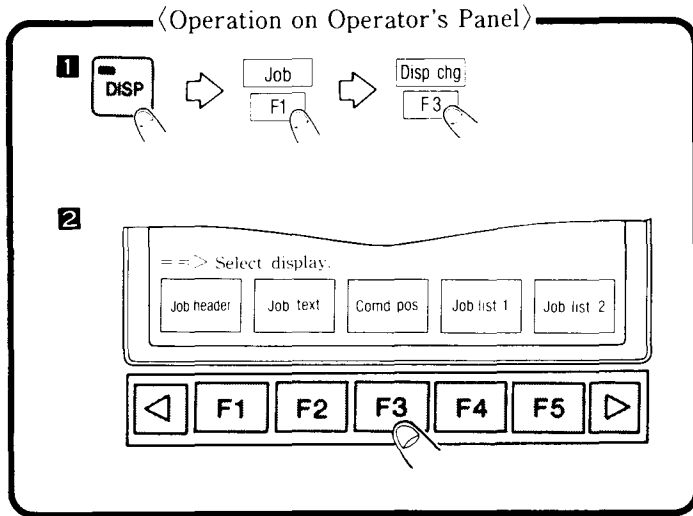
- 

Moves the cursor upward.
The instruction address also changes simultaneously to the matching address No.
- 

Moves the cursor downward.
The instruction address also changes simultaneously to the matching address No.
When the cursor moves to the center of the display, the cursor stops and the instruction addresses are scrolled up to the next higher place by one.
- 

Not used.

8. 1. 2. 3 Command Position Display



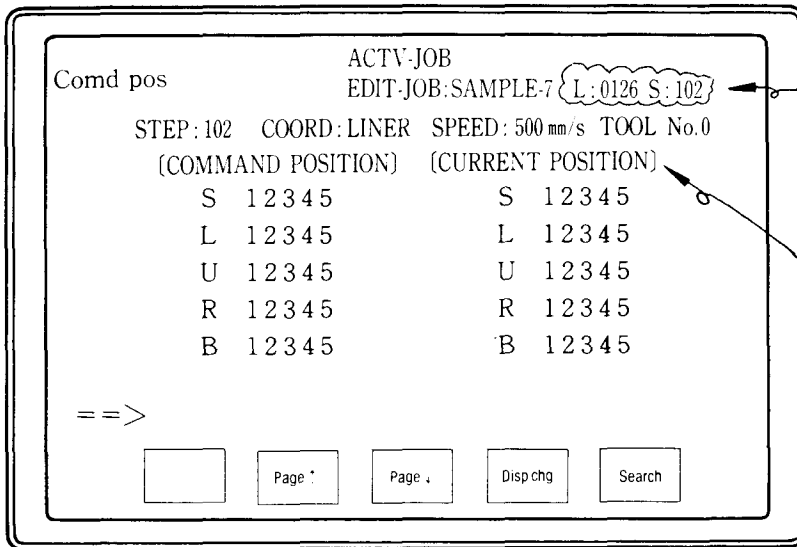
〈Description〉

Call up soft key labels shown in **2**.

Depress Comp pos
F3 soft key.

Command position display will appear.

Command Position Display



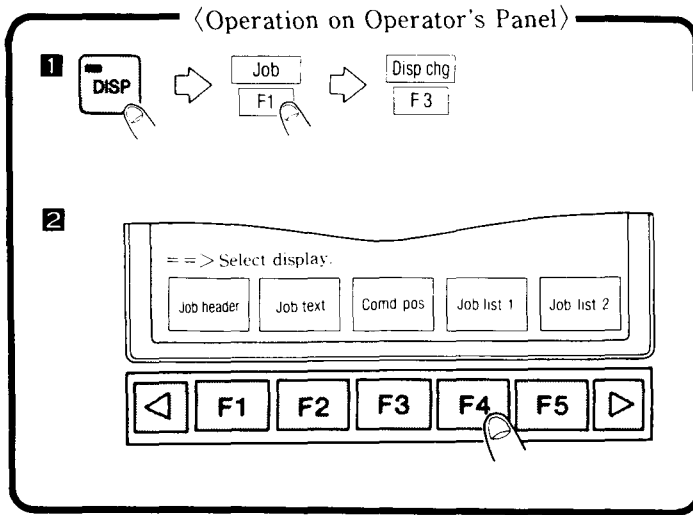
The command position (taught position) of this Step No. is shown.

The current position of the manipulator also displayed simultaneously.

NOTE

1. While the command position is displayed, the cursor on the display doesn't appear.
2. EDIT key does not respond.

8. 1. 2. 4 Job List 1 (Job Registering Order)



<Description>

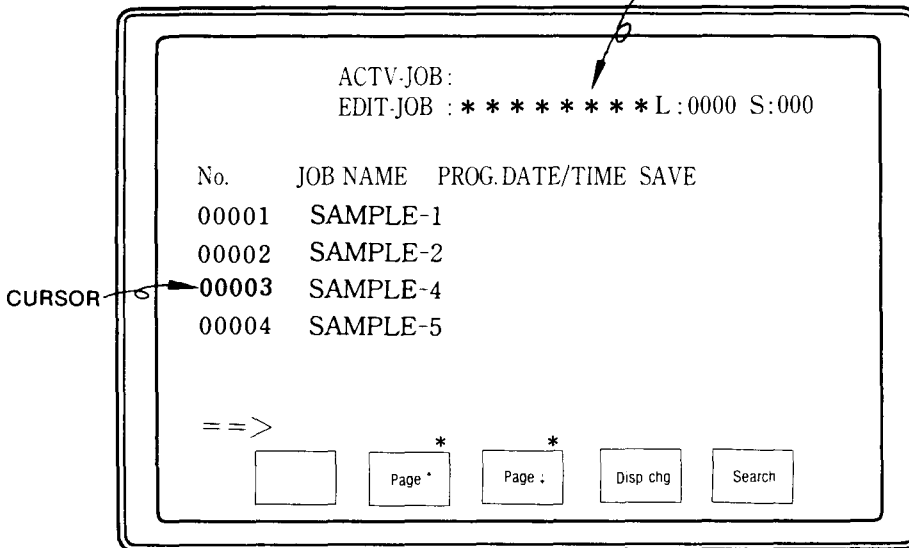
Call up soft key labels shown in 2.

Depress Job list 1
F4 soft key.

Job registering order display will appear.

Job List 1 (Job registering order display)

These marks mean there is no EDIT JOB.



* The page is changed by using these keys. when the cursor is on the lowest line or highest line, the page is changed by using

↑ or ↓ key.

<Display Description>

JOB NAME : Displays in the order registered to the controller memory.

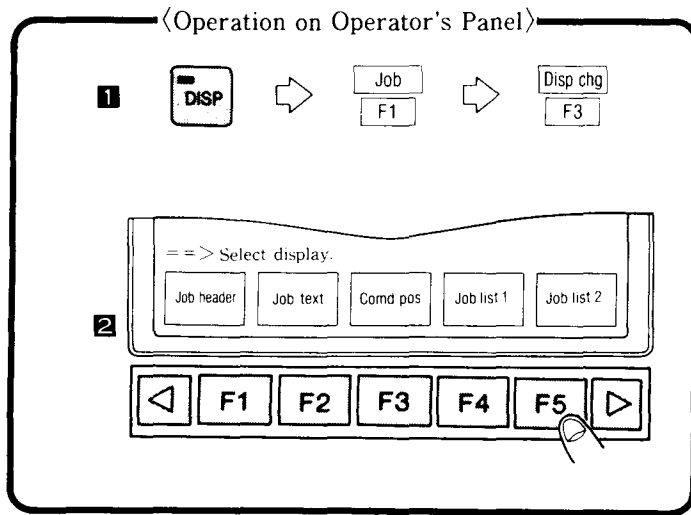
PROG. DATE/TIME : Shows final editing. Therefore, there is no time correlation between the registered order and programmed date/time. However, they will be useful in knowing the history of each job.

PROTECT : Shows the setting status of protection of each job. ON is displayed for protection of setting job. Perform the setting in each job header display, referring to par. 8. 1. 4. 2.

NOTE

If the job text is faulty, the displayed job name blinks.
The blinking job cannot be used.

8. 1. 2. 5 Job List 2 (Sort)



<Description>

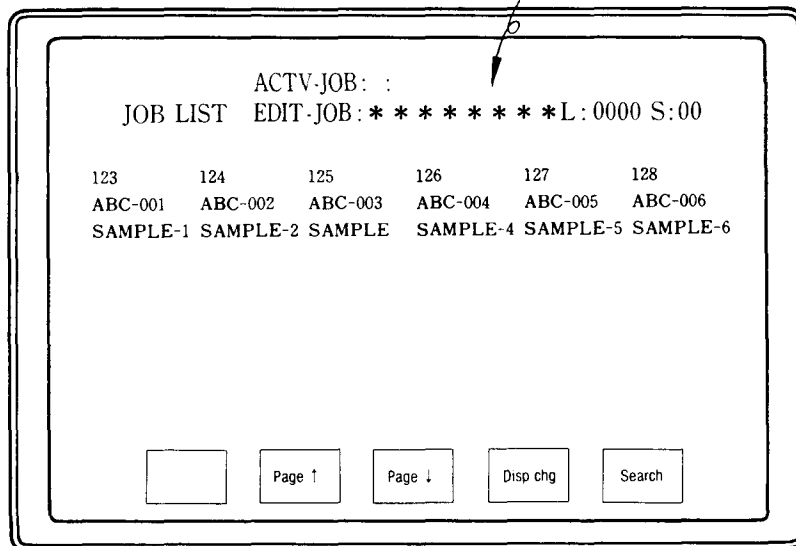
Call up soft key labels shown in **2**.

Depress **Job list 2 F5** soft key.

The following display will appear.

↓
Job List 2 (Sort)

These marks mean there is no EDIT JOB.



This display shows register job names in the character sort (code) order. Use this display to check registered job names. Editing is not possible through this display.



If the job text is faulty, the displayed job name blinks.
The blinking job cannot be used.


8. 1. 3 Search (Calling up) Operation

Search operation calls up directly displays of registered jobs or desired steps in the jobs. The soft keys for the search operation appear in various operation steps. Here, the basic methods are described.

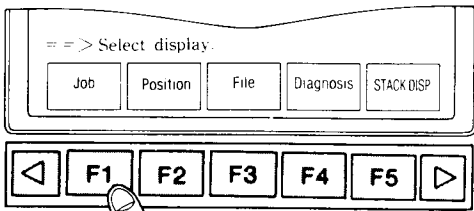
NOTE No operation in PLAY mode.

〈Operation on Operator's Panel〉

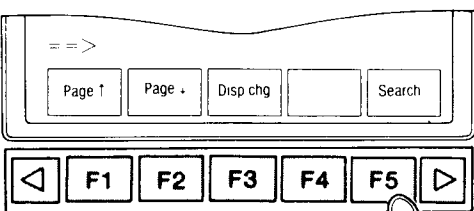
1




2







3



〈Description〉

Depress  key.

Depress 
 soft key.

Depress 
 soft key.

The display below appears.

==> Select item to be searched.

Line

Step

Label

Master job

Job

◀

F1

F2

F3

F4

F5

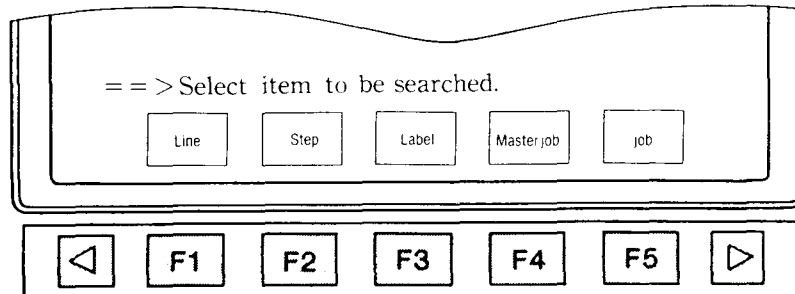
▶

The search operation in each operation step goes as follows.

8. 1. 3. 1 Job Search

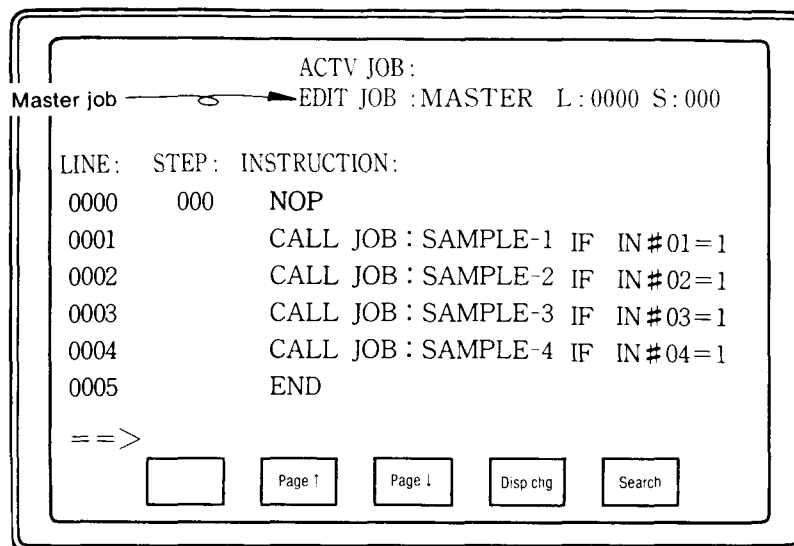
The method of master job searching is different from that of non-master job searching. Each operation is described below.

Call up the following soft keys by depressing key, and soft keys.



(1) Searching Master job :

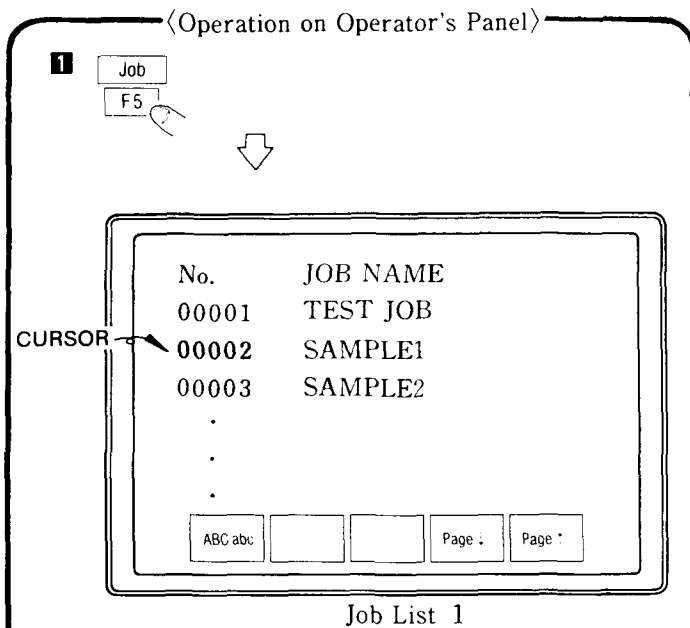
Depress soft key. The JOB TEXT display registered as master job appears on the display by one operation.



JOB TEXT Display (Master Job)

(2) Searching the job (except master job)

Depress key, JOB LIST 1 (job registering order) display appears. Designate the desired job by cursor.



〈Description〉

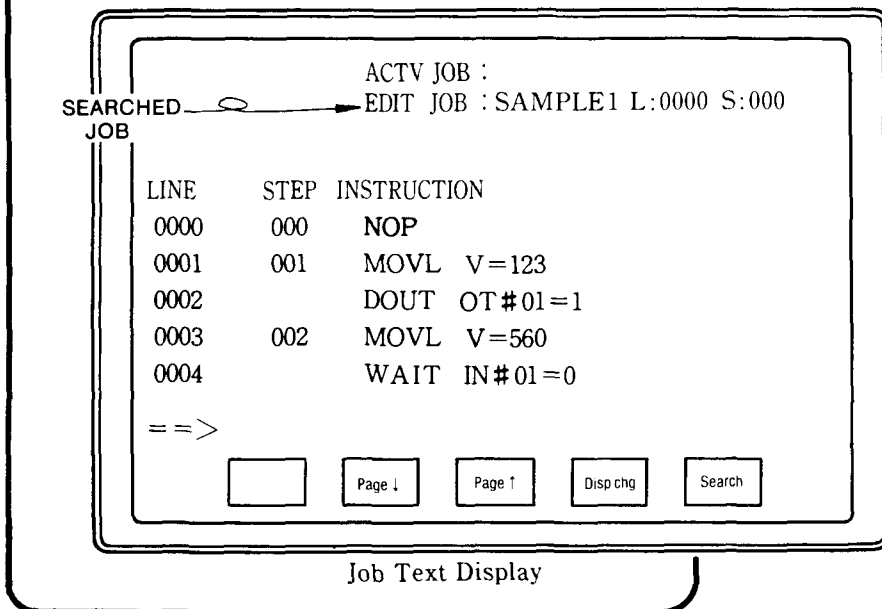
Depress soft key.

Job List 1 appears.



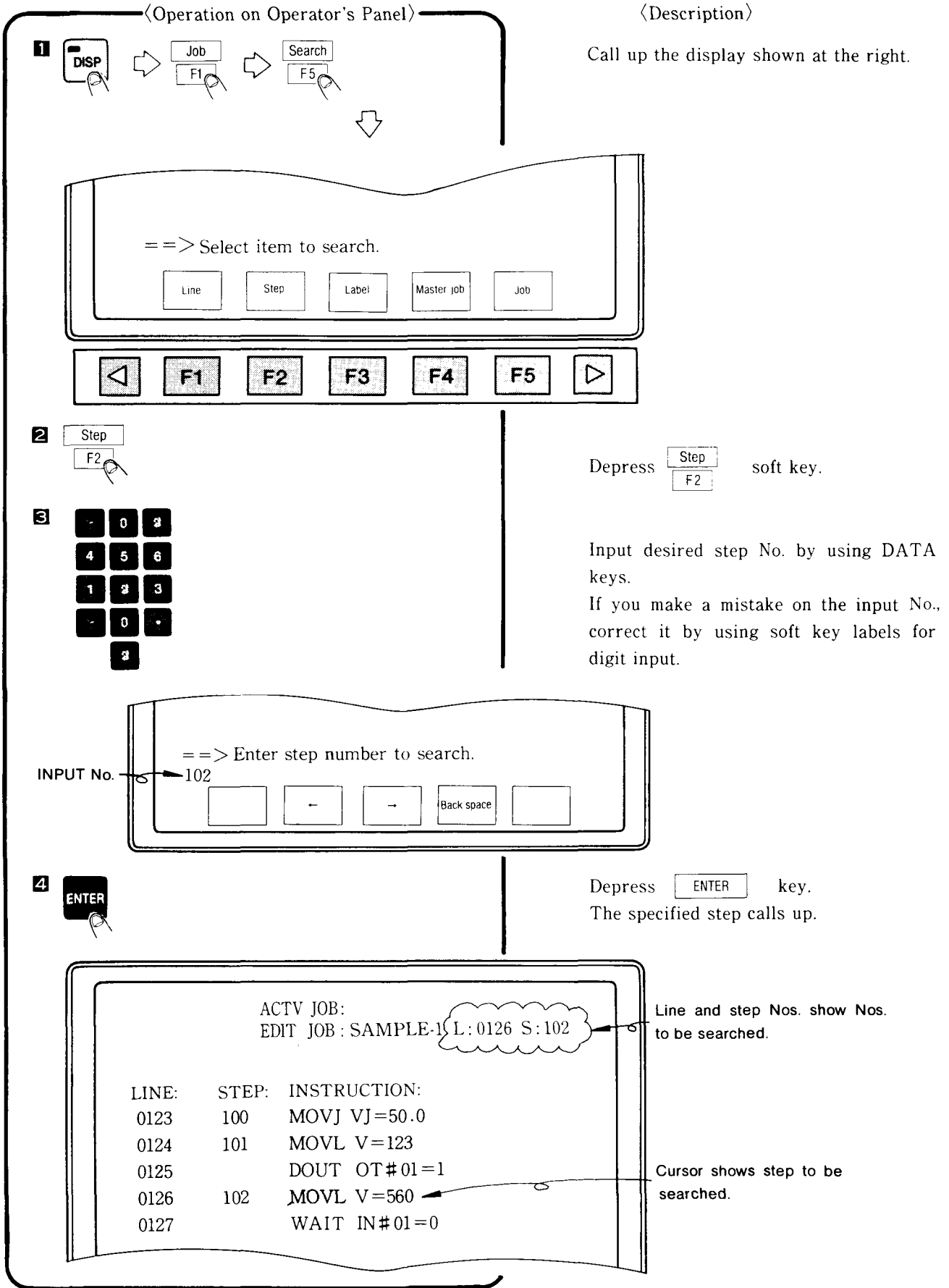
Place the cursor to desired job by using CURSOR keys.

Depress key.



Designated job calls up.

8.1.3.2 Step Search



==> Select item to search.

Line Step Label Master job Job

◀ F1 F2 F3 F4 F5 ▶

Step (F2)

0 1 2 3 4 5 6 7 8 9 -

INPUT No. 102

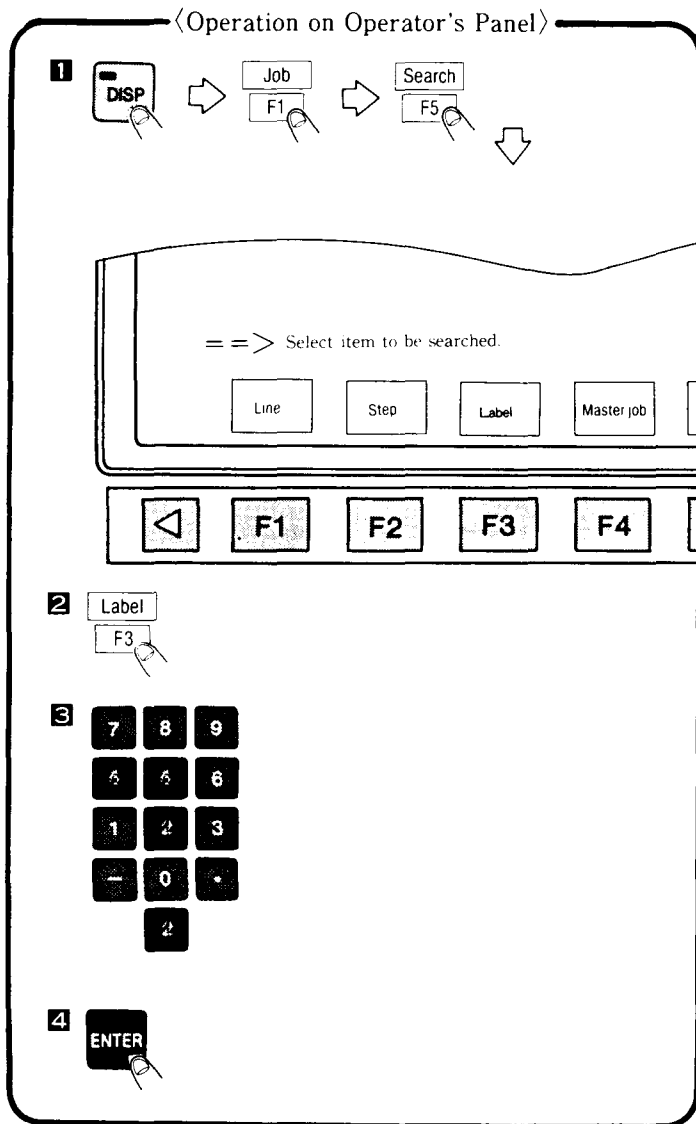
==> Enter step number to search.

Back space

ACTV JOB:
EDIT JOB : SAMPLE-1 L: 0126 S: 102

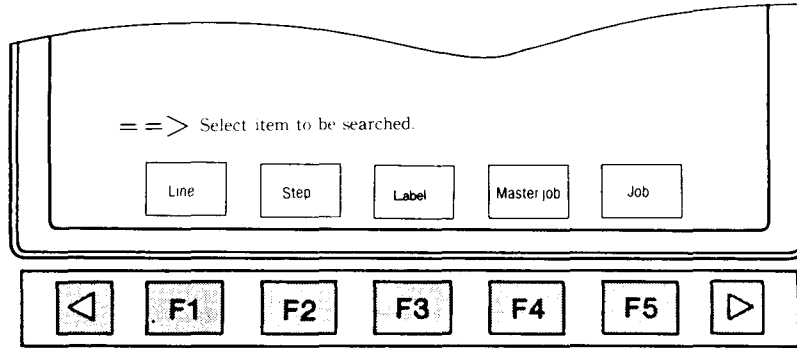
LINE:	STEP:	INSTRUCTION:
0123	100	MOVJ VJ=50.0
0124	101	MOVL V=123
0125		DOUT OT#01=1
0126	102	MOVL V=560
0127		WAIT IN#01=0

8. 1. 3. 3 Label Search



〈Description〉

Call up the display shown at the right.



Depress

Label
F3

 soft key.

Input desired label No. by using DATA keys.

Use soft key labels to correct input label No.

Depress

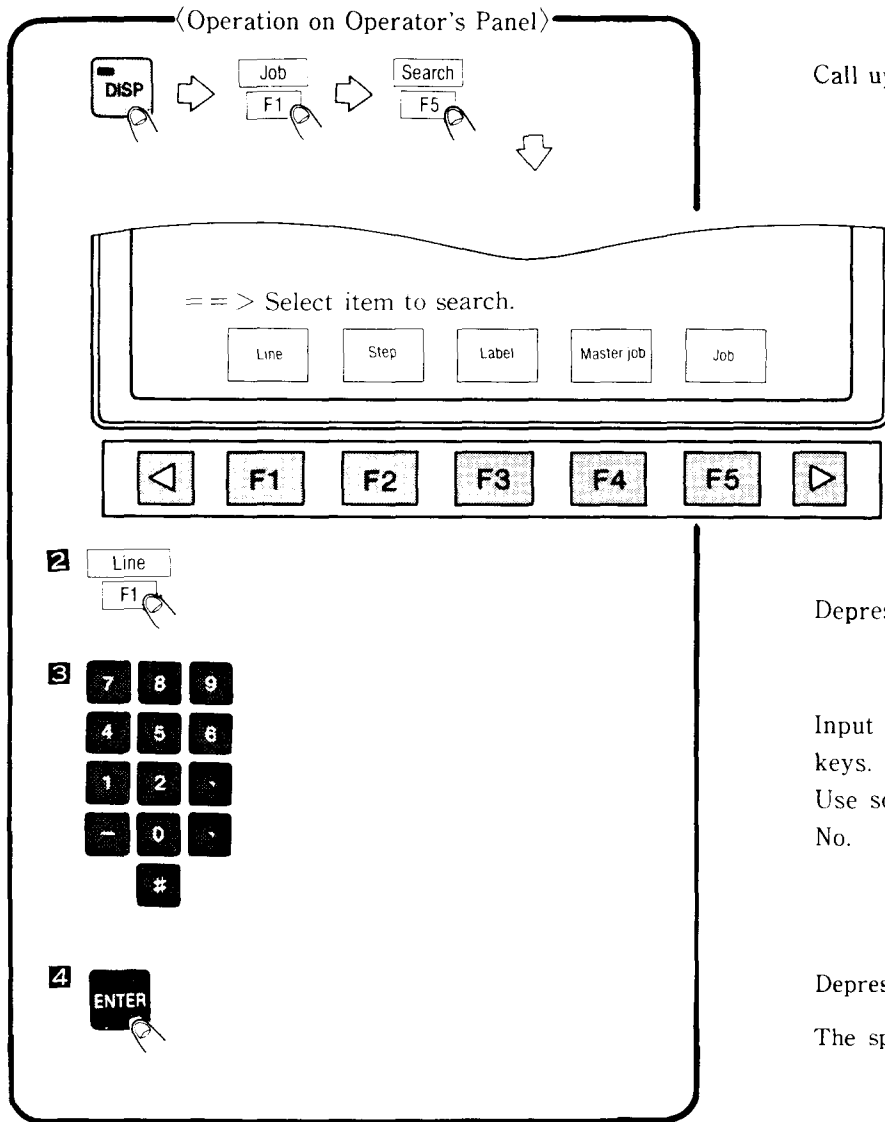
ENTER

 key.

The specified label calls up.


8

8. 1. 3. 4 Line No. Search




〈Description〉

Call up the display shown at the right.

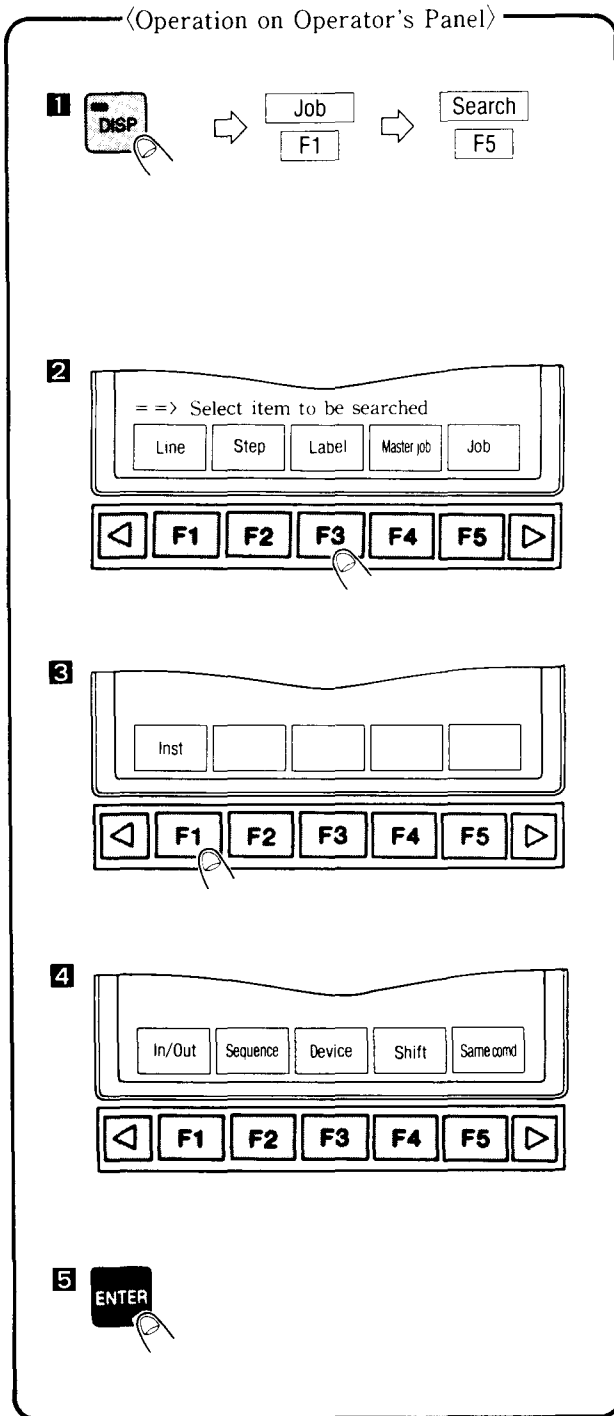
Depress  soft key.

Input desired line No. by using DATA keys.
Use soft key labels to correct input line No.

Depress  key.

The specified line calls up.

8. 1. 3. 5 Instruction Search



〈Description〉

Depress key.

Then, depress and soft keys.

Depress key.

Depress soft key.

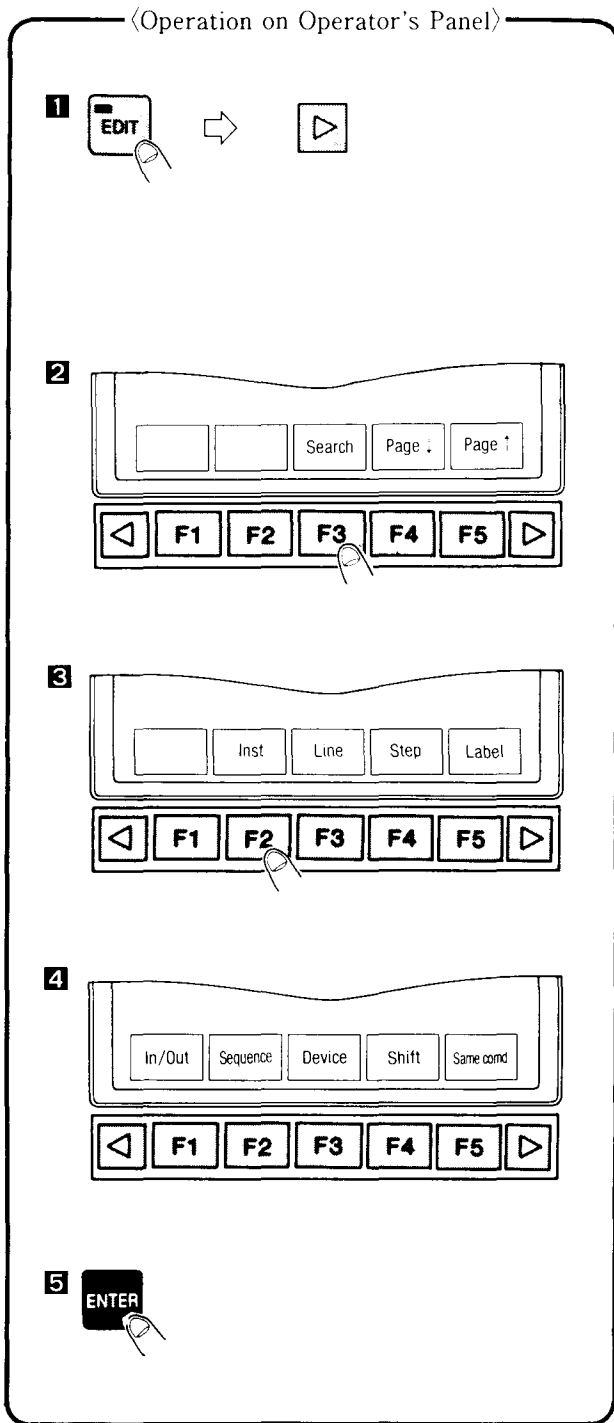
Select soft key to be searched.

Depress key.



The specified instruction for the current cursor setting line and onward will be displayed.



If the specified instruction is not found, error 2210 "Undefined address to be searched" is displayed.



- Instruction search in job edit mode
Instruction search can also be executed in job edit mode.



〈Description〉

Depress  and  keys.

Depress  soft key.


Depress  soft key.


Select soft key to be searched.


Depress  key.

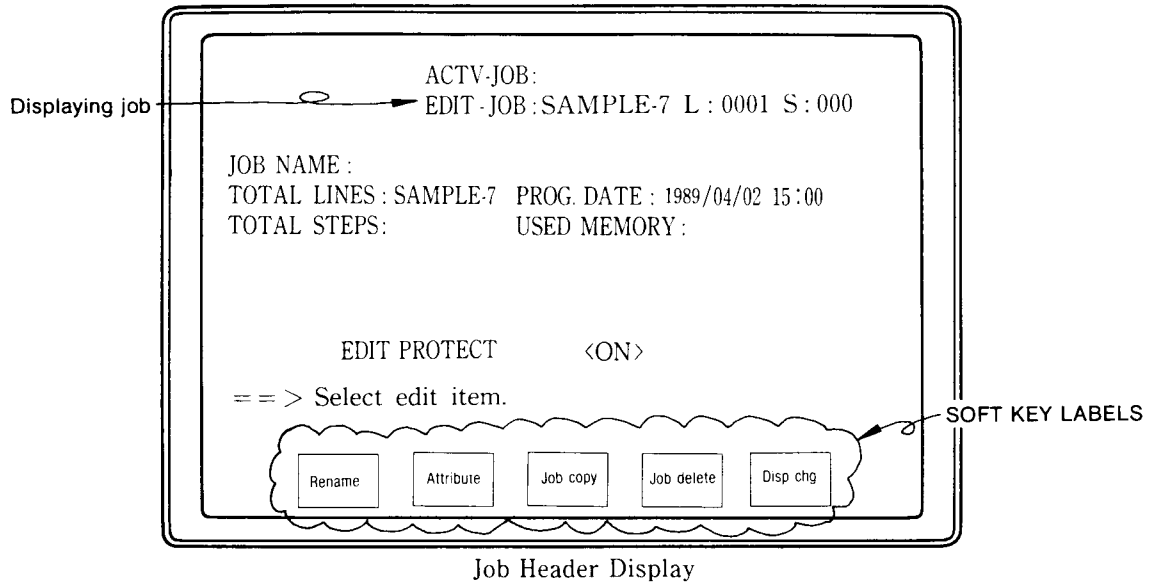
The specified instruction for the current cursor setting line and onward will be displayed.

8. 1. 4 Job Header Edit

The following editing operations are possible on JOB HEADER display.

- (1) Renaming
- (2) Setting of edit protection.
- (3) Copy of job
- (4) Deletion of job

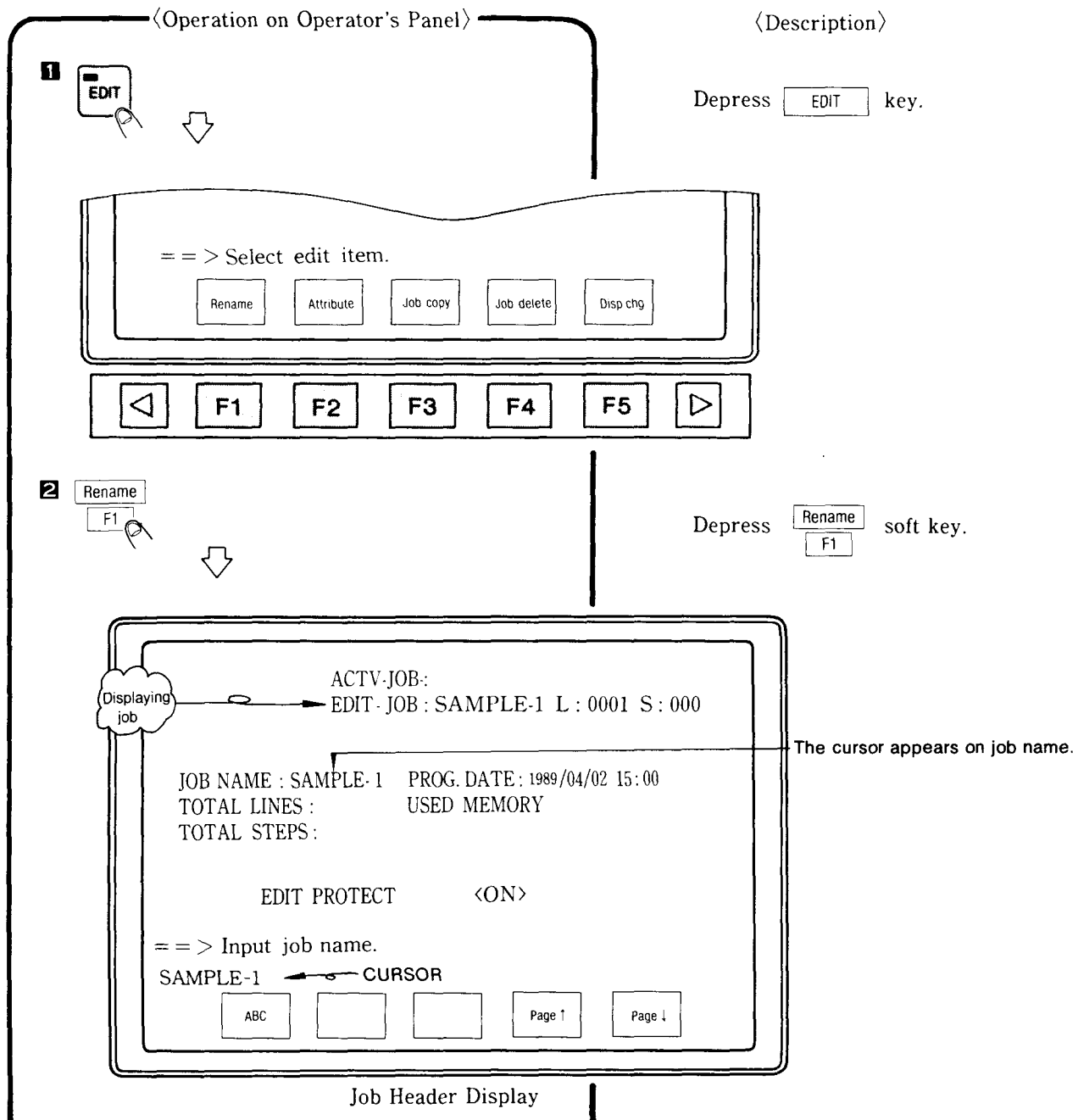
1 Depress  key to call up the soft key for editing.



2 Soft key labels to specify the edit operation will appear.
Depress desired soft key labels.

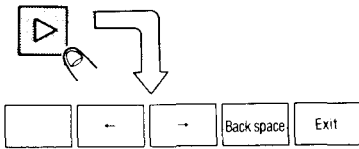
The each edit operation goes as follows.

8. 1. 4. 1 Job Rename



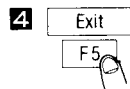
3 Input the new job name by using soft key labels for character input.

- Partial correction



Soft key Labels for Character Edit

- No required partial correction.



The original name is displayed in the input line beforehand.

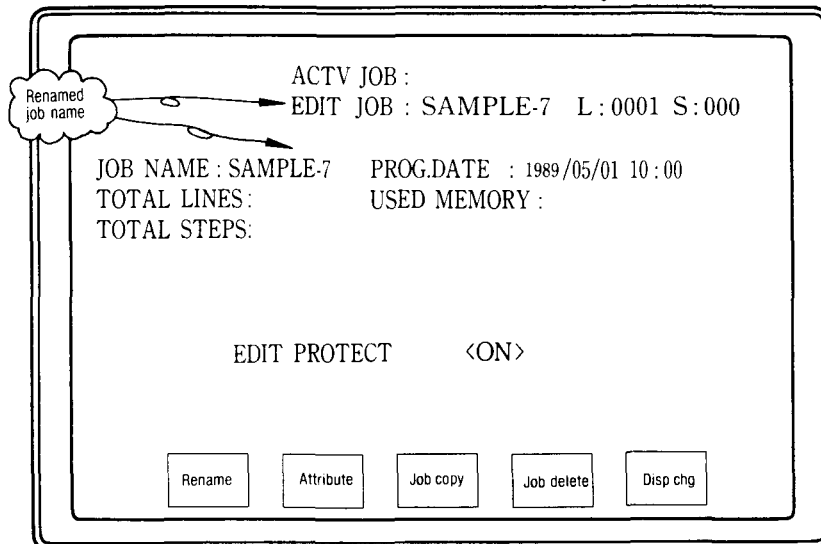
Perform partial correction by using soft key labels for character edit.

If partial correction is not needed, depress **CANCEL** key and input the desired characters.

After character input is completed, depress **Exit** soft key to return the previous display.

NOTE Job name cannot be registered on character display.

Depress **ENTER** key. The job name is changed to new name.



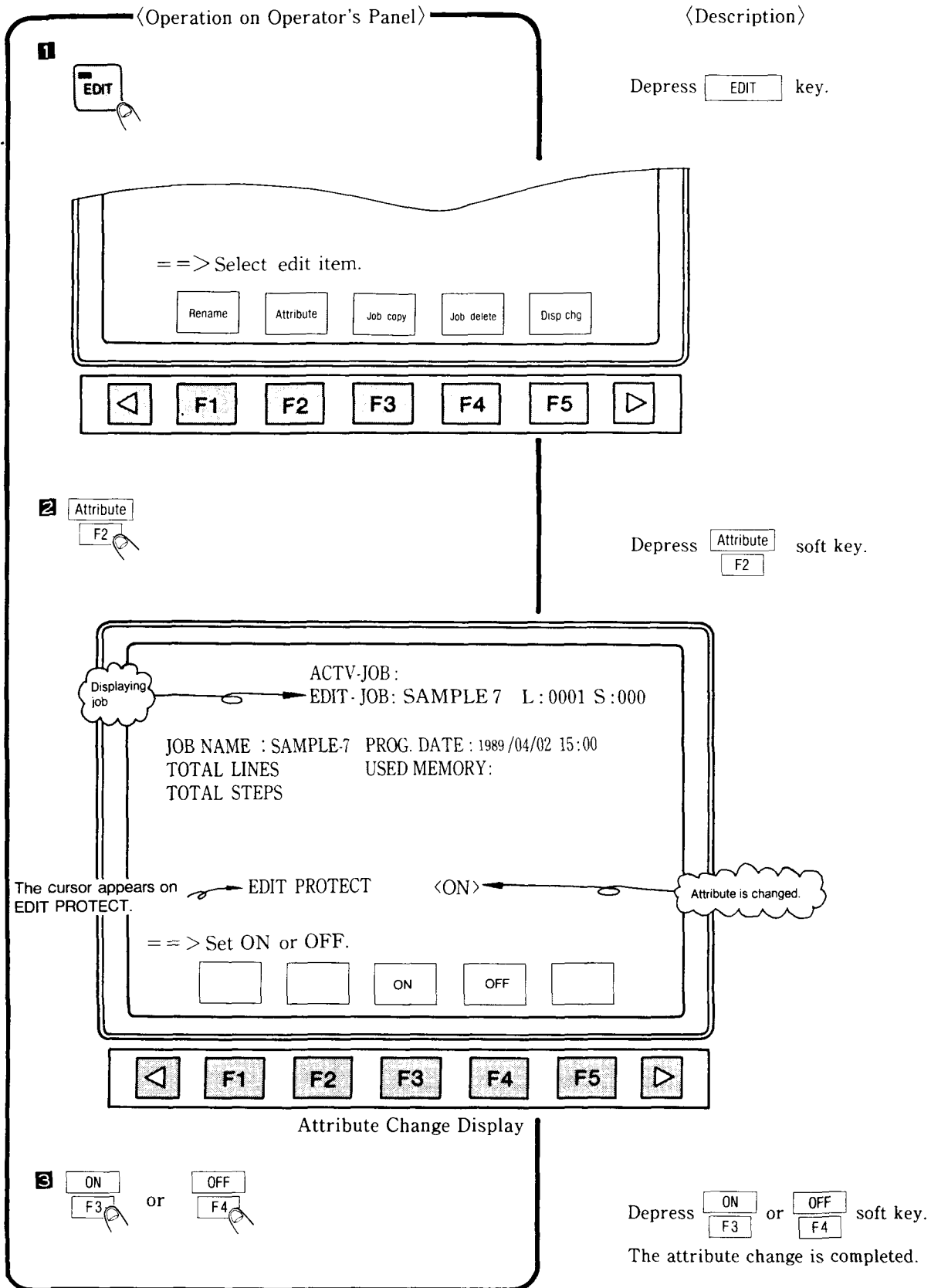
(e.g.) SAMPLE-1

↓
SAMPLE-7


8

NOTE 1. The following characteres cannot be for registration of job name.
 (SPACE) (") (*) (+) (,) (.) (/) (:) (;)
 (<) (=) (>) (?) ([) (¥) (]) (|)

8. 1. 4. 2 Attribute (Edit Protect) Setting



8. 1. 4. 3 Job Copy

1  **EDIT**

Depress **EDIT** key.

==> Select edit item.

Rename **Attribute** **Job copy** **Job delete** **Disp chg**



F1 **F2** **F3** **F4** **F5**

2 **Job copy**

F3

Depress **Job copy** soft key.

- 3 Input the new job name by using soft key labels for character input.
- Partial correction

← **→** **Back space** **Exit**

Soft key Labels for Character Edit

- No required partial correction

CANCEL

NOTE Job name can also be input digit by using DATE keys.

The original name is displayed in the input line beforehand.
Perform partial correction by using soft key labels for character edit.

If partial correction is not needed, depress **CANCEL** key and input the desired characters.

EDIT JOB : SAMPLE-1 L: S:

SOURCE FOR COPY ADDRESS

SAMPLE-1 → *****

==> Enter new job name.

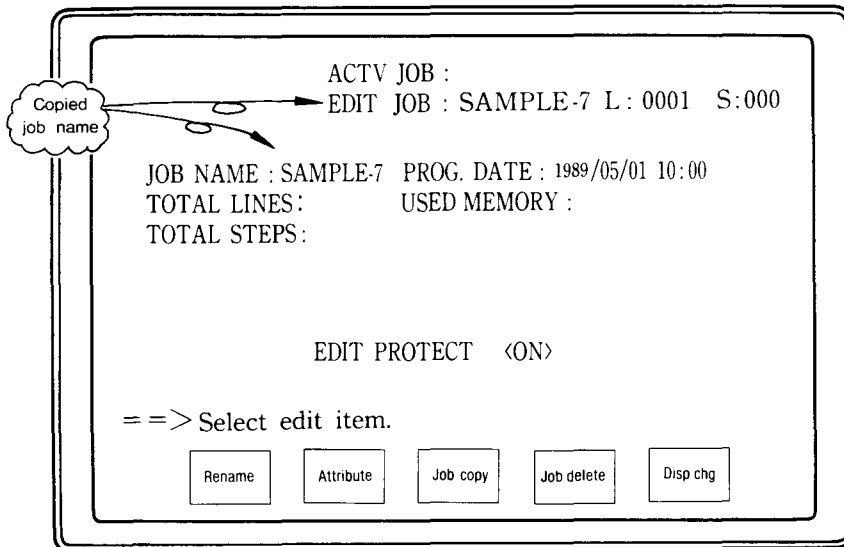
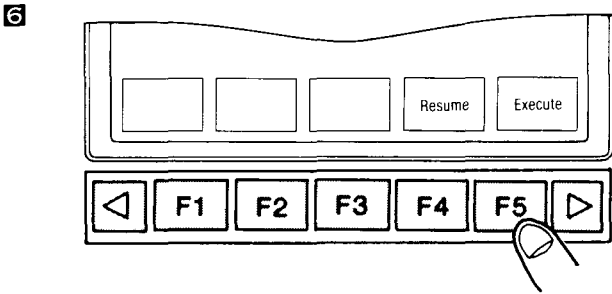
SAMPLE-1

ABC **Page ↑** **Page ↓**

Copy Display

4 Exit
F5

5 ENTER



New Job Header Display

NOTE

1. The following characteres cannot be used for registration of job name.

(SPACE) (") (*) (+) (,) (.) (/) (:) (;)
(<) (=) (>) (?) ([) (¥) (]) (|)

After character input is completed, depress

soft key to return the previous display.

NOTE

Job name cannot be registered on character display.

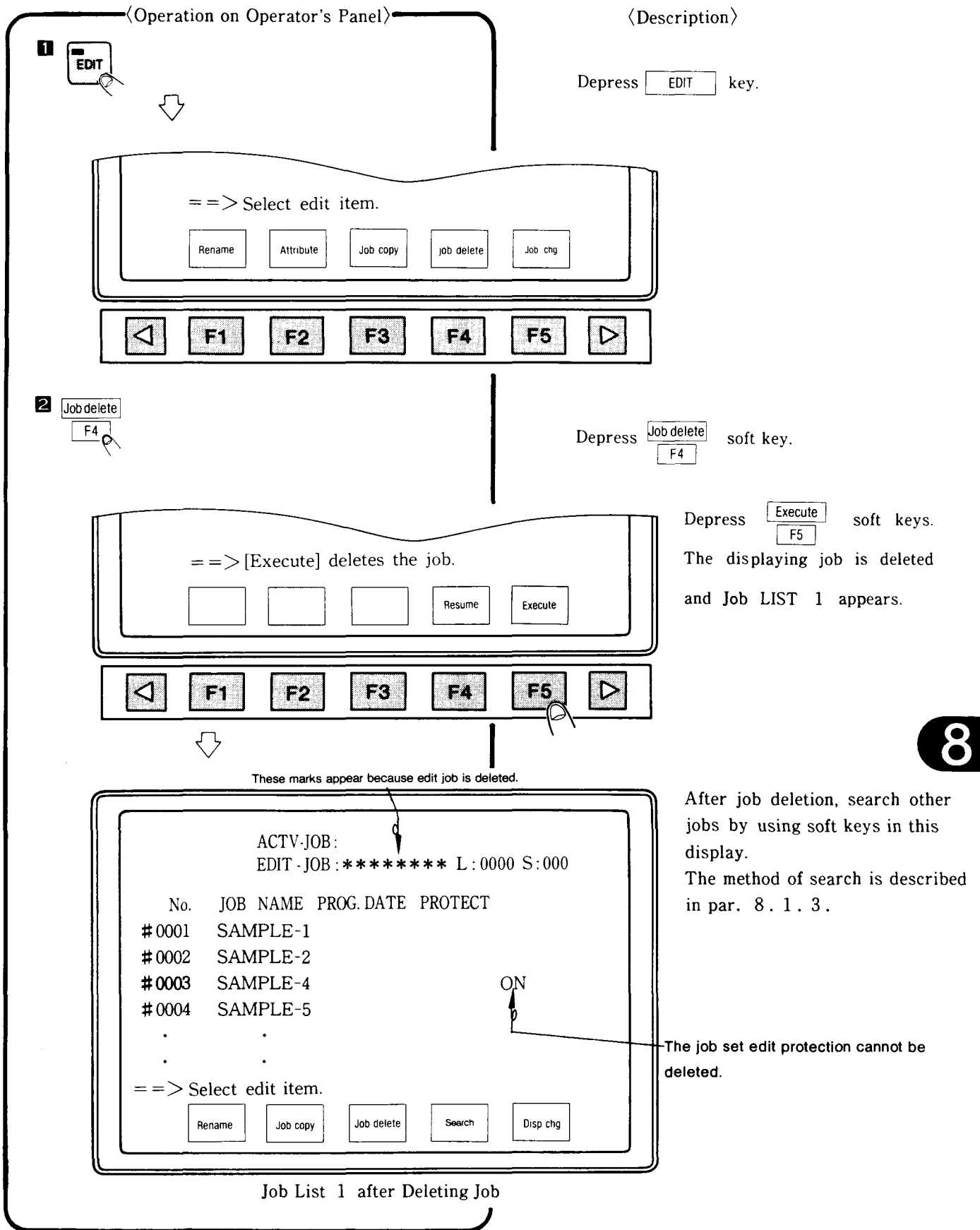
Depress key. The job to be copied is registered.

Depress soft key.

The copy starts. In this case, SAMPLE 1 is copied as SAMPLE 7.

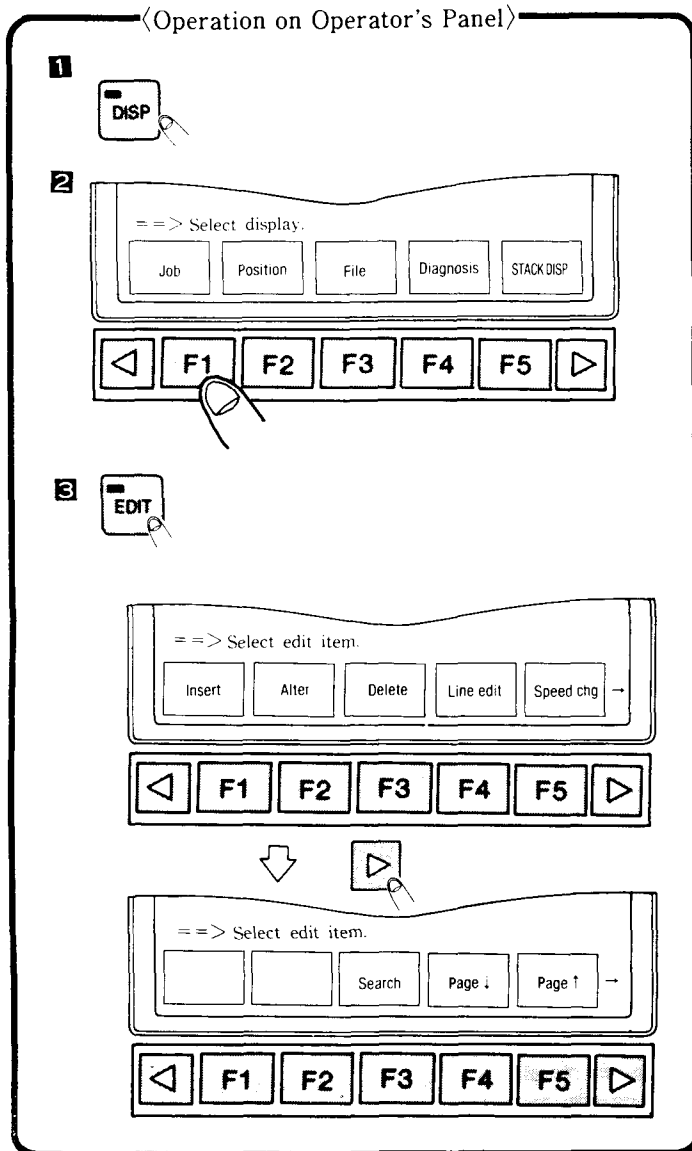
When the copy is completed, the new job header display appears.

8. 1. 4. 4 Job Deletion



8. 1. 5 Registration and Edit of Instruction

First, Call up soft key labels for edit.



〈Description〉

Depress **DISP** key.

Depress **Job** soft key.
F1

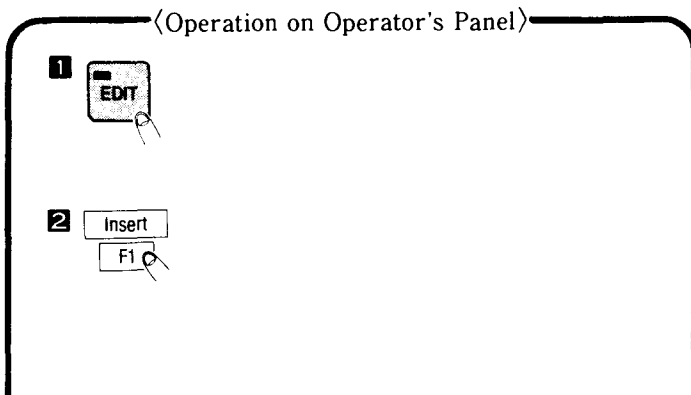
Depress **EDIT** key.

Soft key labels for edit is ten.
Therefore, depress **▶** key to display more than five labels.

Each soft key function as follows.

- Insert** : The new instruction is inserted after the line designated by the cursor.
F1
- Alter** : The instruction designated by the cursor is changed to another instruction.
F2
- Delete** : The instruction designated by the cursor can be deleted.
F3
- Line edit** : The addition item and numerical data inside the instruction of the line designated by the cursor can be corrected.
F4
- Speed chg** : Only speed data is changed.
F5
- Search** : The display designated by either one of Step No., Line No., or Label No. is called up directly.
F3
- Page ↓** : The page of the display is updated.
F4
- Page ↑** : The page of the display is updated.
F5

8. 1. 5. 1 Inserting Instruction

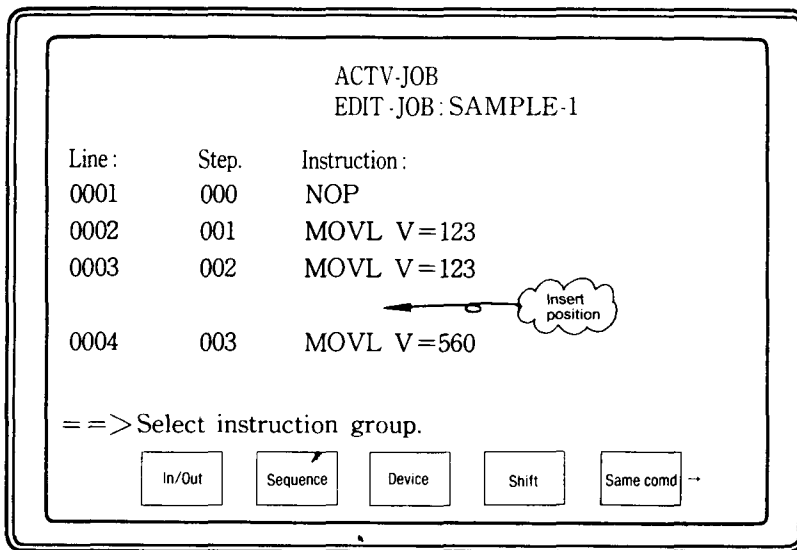


〈Description〉

Depress key and set the cursor to instruction position to be inserted.

Depress
 soft key.

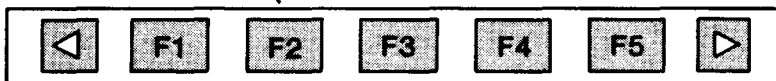
The new instruction is inserted after the line designated by the cursor.



The display shown at the right will appear.

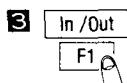
Designate the desired instruction group.

To give an example, insert the I/O instruction on the position designated by the cursor.

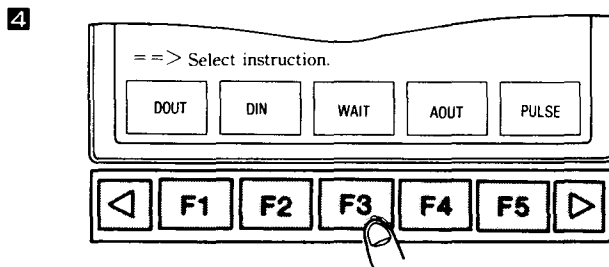


Inserting Instruction Display

〈Example〉

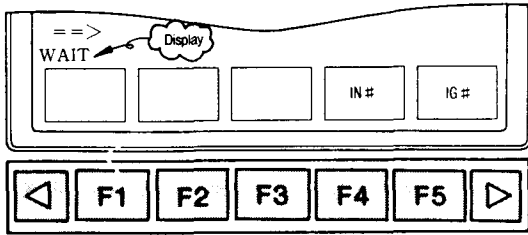


Depress
 soft key.



Depress
 soft key.

5

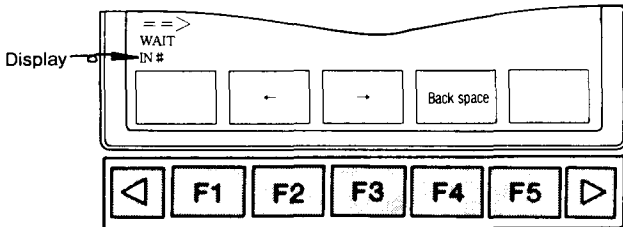


WAIT is displayed on input line.

Depress

IN #
F4

 soft key.



IN # is displayed on input line.

6

Input No. +

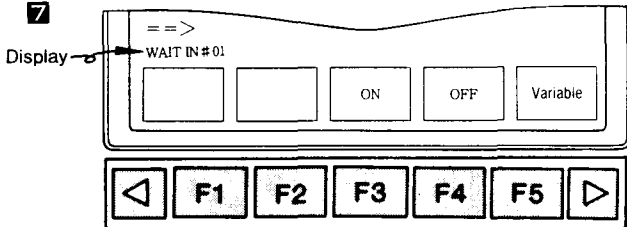
ENTER

Enter the input No. by using DATA keys and depress

ENTER

 key.

7

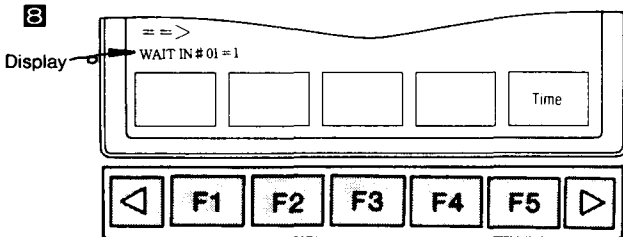


Depress

ON
F3

 soft key.

8

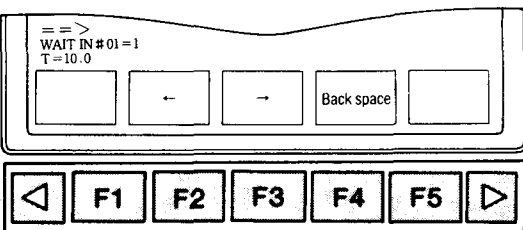


If you want to set the time, depress

Time
F5

 soft key.

9



Set the time by using DATA keys.



Depress key.

The new instruction is inserted after the line designated by the cursor.

Line:	Step :	Instruction :
0001	000	NOP
0002	001	MOVL V=123
0003	002	MOVL V=123
0004		WAIT IN# 01=1 T=10.0
0005	003	MOVL V=560
.	.	
.	.	

==> Select instruction group.

IN/OUT	Sequence	Device	Shift	Same Comd. →
--------	----------	--------	-------	--------------

Navigation buttons: < F1 F2 F3 F4 F5 >

Note: A callout bubble labeled "Insert position" points to the instruction "WAIT IN# 01=1 T=10.0" in the table above.

Registration of Inserting Instruction Display

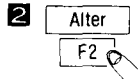
8. 1. 5. 2 Altering Instruction

〈Operation on Operator's Panel〉

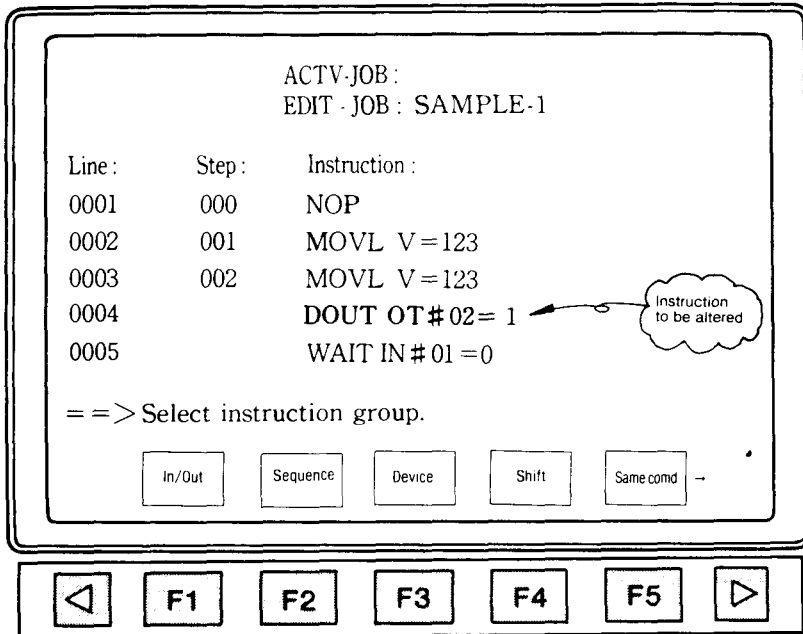
〈Description〉



Depress key and set the cursor to instruction position to be altered.



Depress soft key.

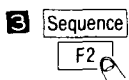


This display appears.

Designate the desired instruction group.

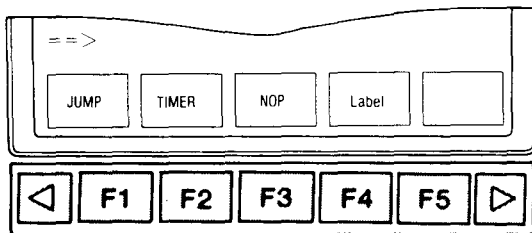
To give an example, alter DOUT (external output) instruction on line 0004 to TIMER instruction.

Altering Instruction Display

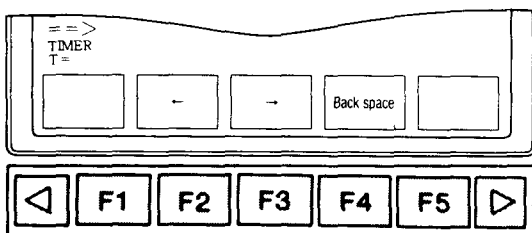


Depress soft key.

4



Depress soft key.

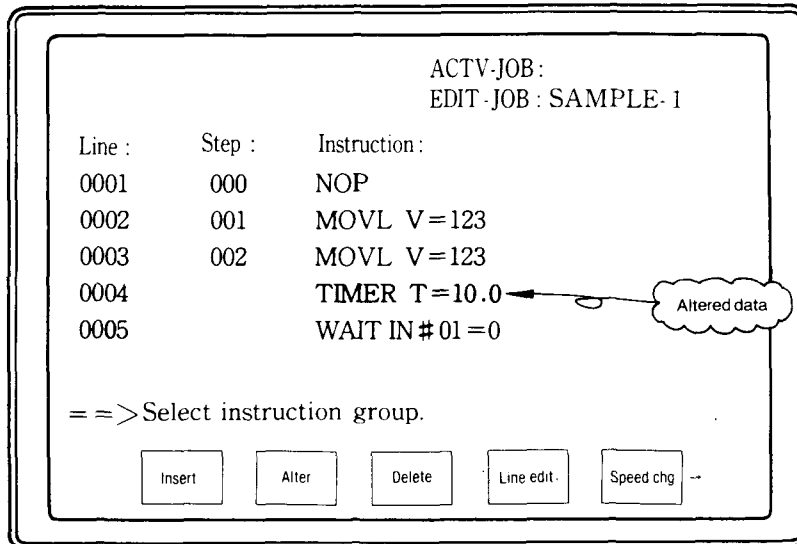


5

5 Timer +



Enter the timer value by using DATA keys and depress key.



Line :	Step :	Instruction :
0001	000	NOP
0002	001	MOVL V=123
0003	002	MOVL V=123
0004		TIMER T=10.0
0005		WAIT IN# 01=0

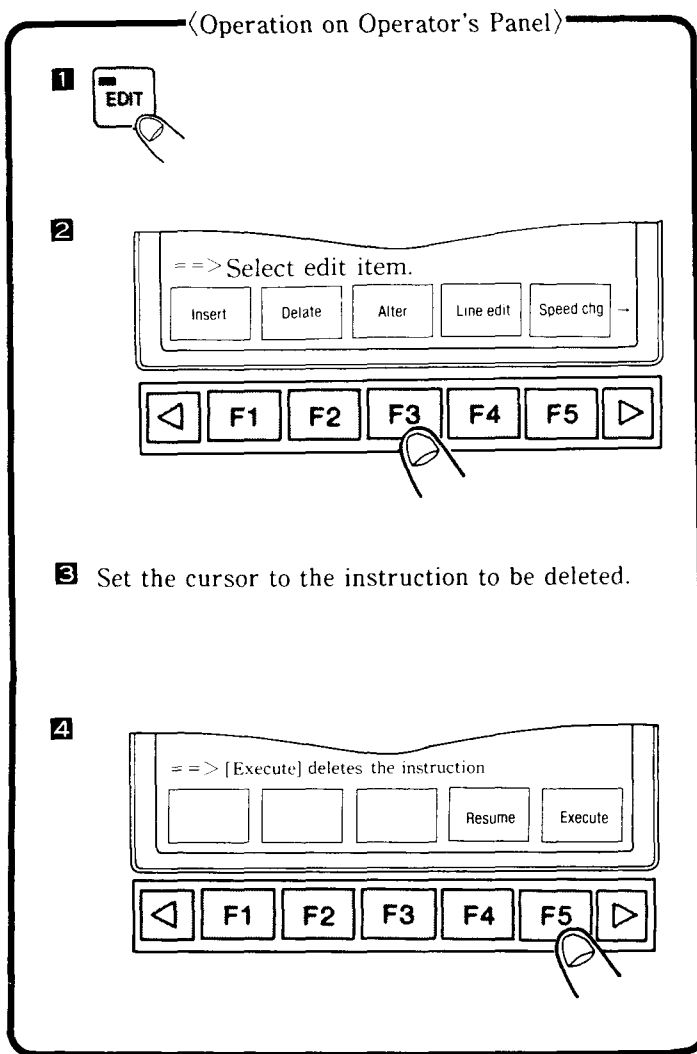
==> Select instruction group.

--

The instruction is altered and this display appears.

Display after Altering Instruction

8. 1. 5. 3 Deleting Instruction



〈Description〉

Depress key.

Depress soft key.

Depress soft key.

NOTE

Move instruction cannot be deleted.

8. 1. 5. 4 Correcting Line

<Operation on Operator's Panel>

<Description>

1



Depress key.

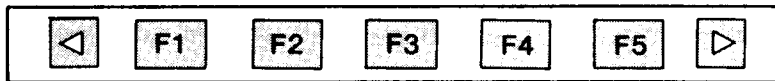
ACTV-JOB:
EDIT-JOB: SAMPLE-1

LINE :	STEP :	INSTRUCTION :
0001	000	NOP
0002	001	MOVL V=123
0003	002	MOVL V=123
0004		WAIT IN#01=0 T=10.0
0005		DOUT OT#01=1

==> Select edit item.

Set the cursor to the instruction to be corrected.

Alteration of Data on Instruction



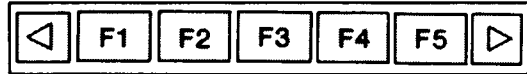
2

Line edit



==> Specify the distinct items and correct them.

WAIT IN#01=0 T=10.0



Set the cursor to the instruction to be corrected and depress soft key.



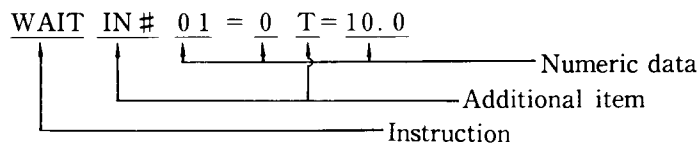
One instruction line designated by cursor is copied in the input buffer.

The following editing is possible in the input buffer.

- (1) The only numeric data of instructions can be changed.
- (2) The additional item can be inserted in the instruction.
- (3) The only unnecessary additional item is deleted.

NOTE

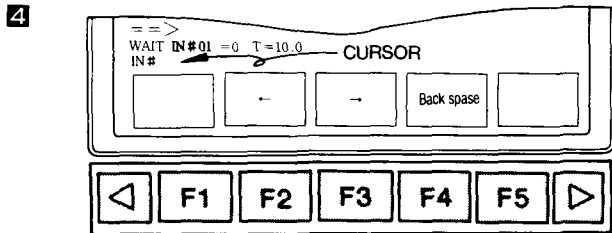
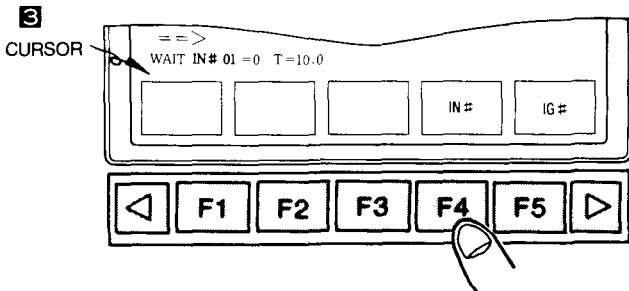
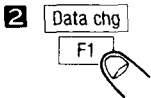
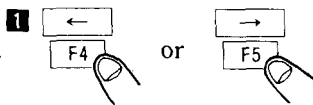
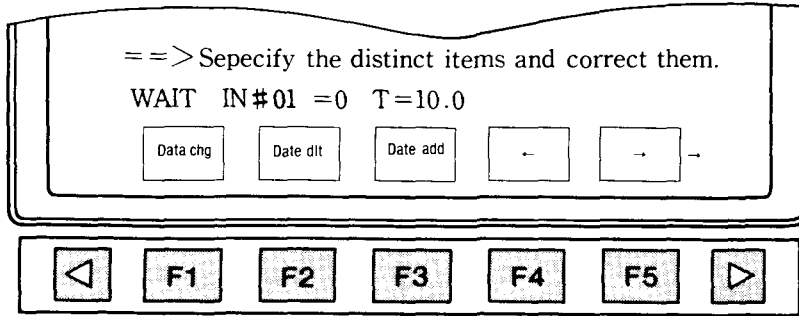
One line is classified as follows.



8

(1) Altering only numeric value data in instruction

〈Operation on Operator's Panel〉



- 1 st depression : Input data is registered to the input buffer line.
- 1 st depression : Instruction on the cursor is altered to the instruction on input buffer line.

Specify data to be altered by the cursor using or soft keys.

Depress soft key.

Soft key labels for input unit selection are displayed.

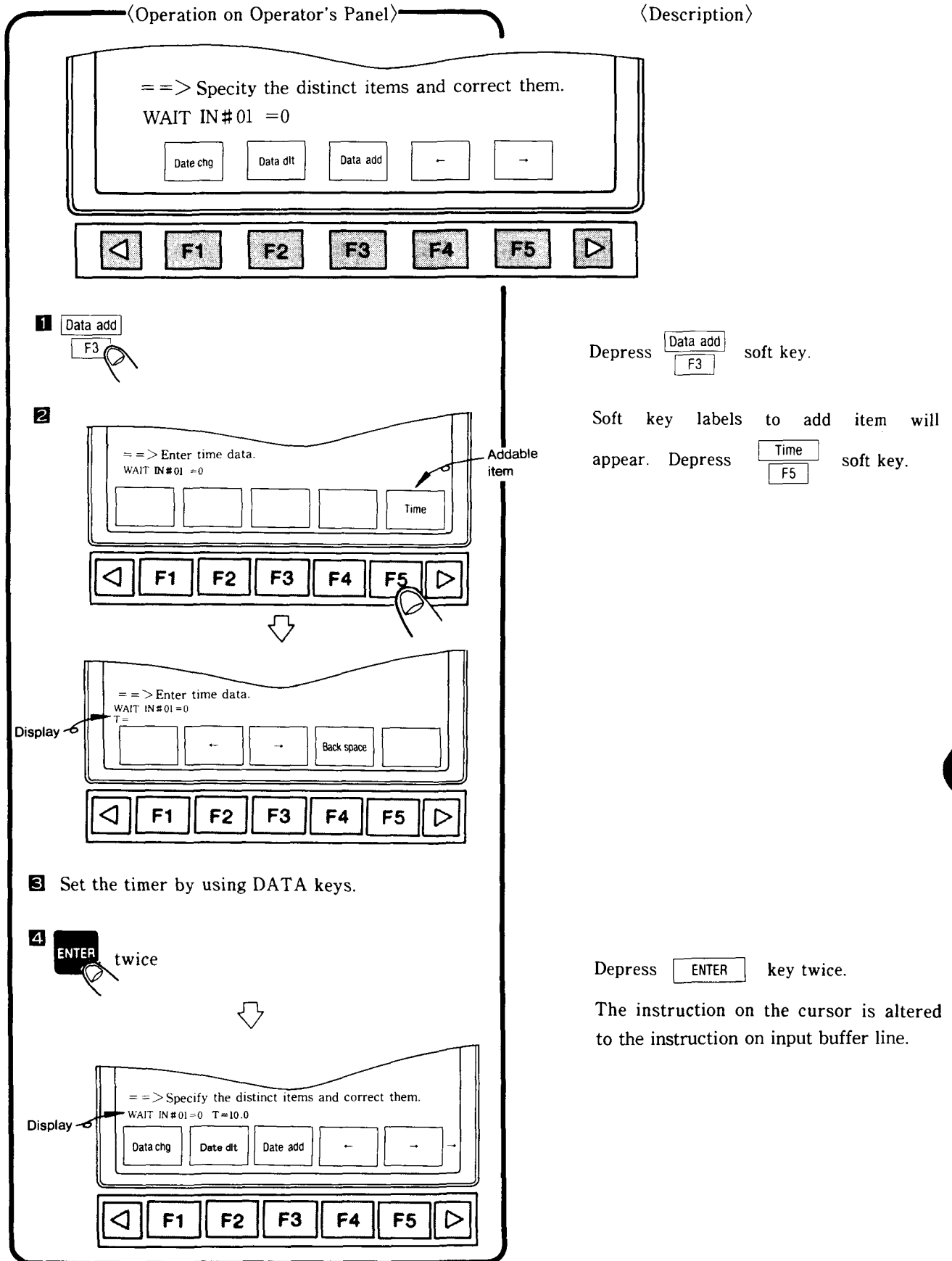
Specify the same key that is registered already.

In this case, depress soft key.

Input new data by using DATA keys. Use displaying soft key labels to correct input data.

Depress key twice to complete the alteration.

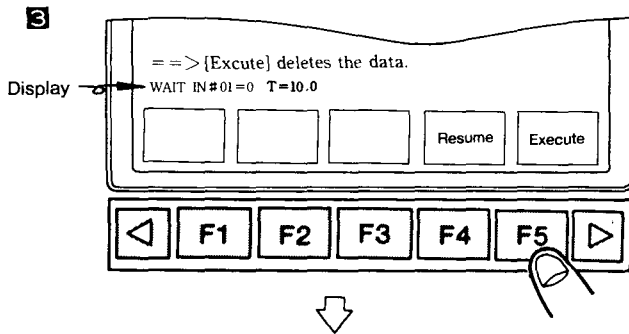
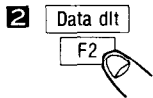
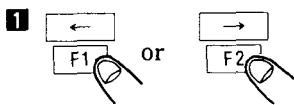
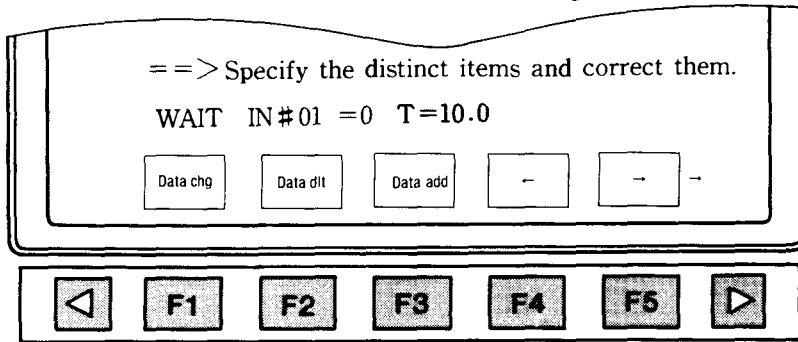
(2) Inserting additional item in instructions



(3) Deleting additional in instruction

<Operation on Operator's Panel>

<Description>

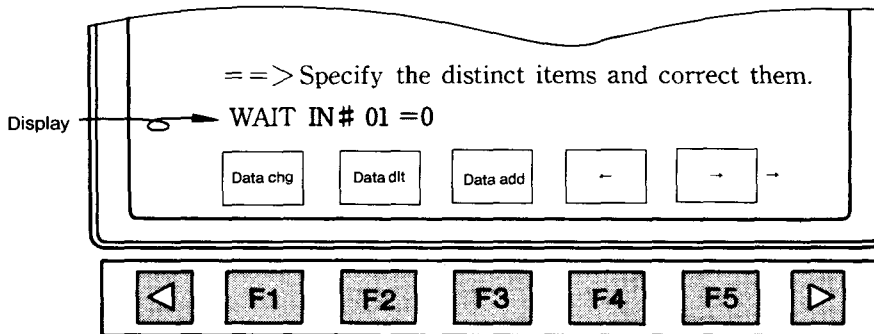


Specify the item to be deleted by the cursor using or soft keys.

Depress soft key.

Depress soft key.

The specified item is deleted and display changed as follows.



The line edit operation can be continued.

• If line edit is completed, depress key.
The instruction on cursor is changed to the instruction in input buffer line.



Error occurs if the item which is impossible to be deleted is specified.

8. 1. 5. 5 Editing for MOVE Instruction

The move instructions are basically registered (taught) by the teach pendant. Therefore, they cannot be added, registered or deleted through the operator's panel. Only for move instructions registered through the teach pendant, various additional items can be edited. Operation is possible the same as operation for other instructions. Refer to appendix 3 for the additional items.

〈Items that can be edited by the operator's panel〉

- Change of move instruction (motion designation)
- Change of moving speed.
- Change of speed designation items (Selection either TCP move speed, orientation change speed or external axis speed.)
- Change and deletion of positioning level
- Setting, change and deletion of interrupt conditions by input signal.
- Setting and deletion of NWAIT (not wait) function.

8. 1. 6 Work Condition Function

This function is used if the work sequence becomes an important element in work conditions.

The work condition function registers work conditions, and job names are reserved by application . The internal construction is treated in exactly the same way as that of a normal job. Therefore instructions for work conditions can be registered as if a normal job is created.

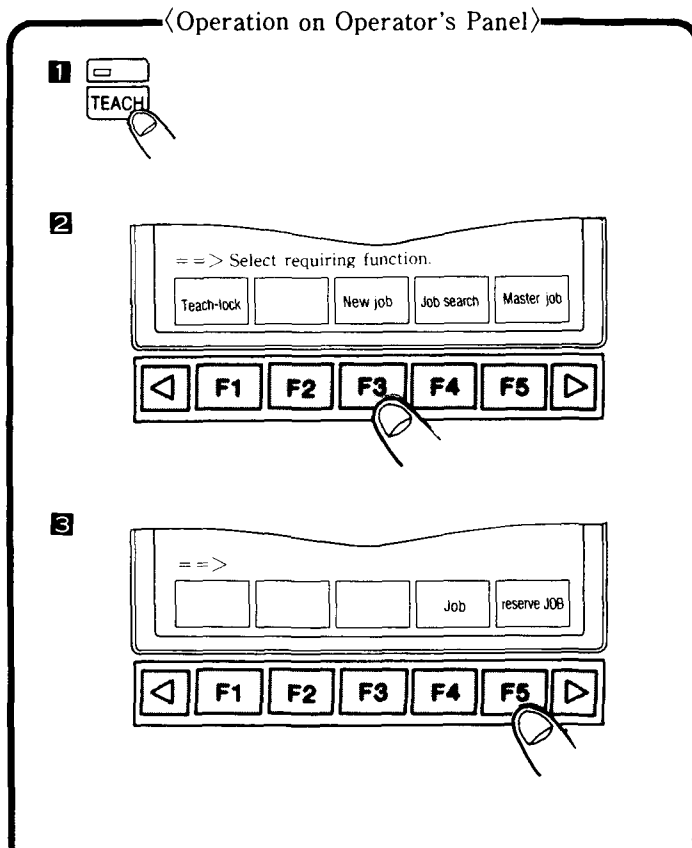
For welding operation, following job names are reserved.

- ARCON XX : for conditions during ARC ON
 - ARCOFF XX : for conditions during ARC OFF
- ↑
Condition No. (01 to 99)

8. 1. 6. 1 Creation (Registration) of Work Condition

The work condition can be created as in a normal job. A job name can be registered by using the name of the work condition reserved.

Register the job name as follows, referring to par. 8. 1. 5.



〈Description〉

Depress key.

Depress soft key.

Depress soft key.

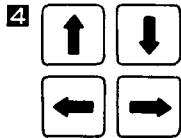
Teach Mode ACTV-JOB:
 EDIT-JOB :SAMPLE-1 L:0000 S:000

Reserve job

NO.	JOB NAME	NO.	JOB NAME
1	ARCON**	6	
2	ARCOFF**	7	
3		8	
4		9	
5		10	

==>

Reserve job display appears.



5 Input the condition No. by using DATA keys.



Set the cursor to the desired job name by using cursor keys.

Depress key.

The work job is created and job list display appears.

This display has two instructions (No. 9 and END).

<Example of condition job registration>

(1) Arc on

0000	NOP		
0001	VWELD	□□□	} Initial welding condition
0002	AWELD	□□□	
0003	ARCON		
0004	TIMER	T=□.□□	
0005	VWELD	□□□	} Welding condition
0006	AWELD	□□□	
0007	END		

(2) Arc off

0000	NOP		
0001	VWELD	□□□	} Creater condition
0002	AWELD	□□□	
0003	TIMER	T=□.□□	
0004	ARCOF		
0005	END		

(3) Spot welding

0000	NOP		
0001	DOUT	OT#□□□=□□	} Setting of timer condition
0002	DOUT	OT#□□□=□□	
0003	DOUT	OT#□□□=□□	...Spot gun, clamp instruction
0004	WAIT	IN#□□□=□□	...Clamp check signal wait
0005	DOUT	OT#□□□=□□	...Spot gun, unclamp instruction
0006	DOUT	OT#□□□=□□	} Release of timer condition
0007	DOUT	OT#□□□=□□	
0008	END		

(4) Hand on

0000	NOP		
0001	WAIT	IN#□□□=□□	Catch OK signal wait
0002	DOUT	OT#□□□=□□	Hand on instruction output
0003	TIMER	T=□.□□	
0004	DOUT	OT#□□□=□□	Catch complete signal output
0005	WAIT	IN#□□□	Catch check signal wait
0006	DOUT	OT#□□□=□□	Catch complete signal release
0007	END		

(5) Hand off

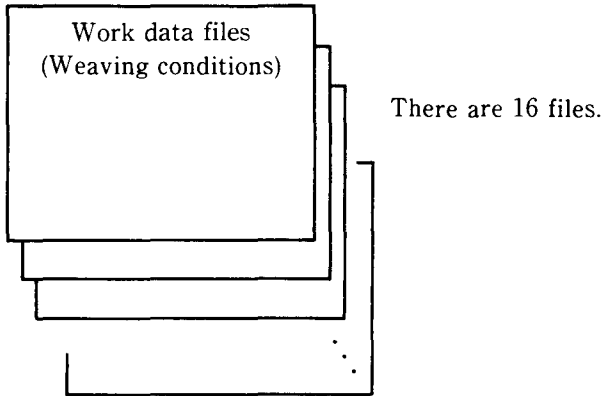
0000	NOP		
0001	DOUT	OT#□□□=□□	Hand-off prepare signal output
0002	WAIT	IN#□□□=□□	Hand-off OK signal wait
0003	DOUT	OT#□□□=□□	Hand-off instruction output
0004	TIMER	T=□.□□	
0005	DOUT	OT#□□□=□□	Hand-off complete signal output
0006	WAIT	IN#□□□=□□	Hand-off check signal wait
0007	DOUT	OT#□□□=□□	Hand-off complete signal release
0008	END		

8. 1. 7 Work Data Files

Work data files are used where work conditions are set by data.

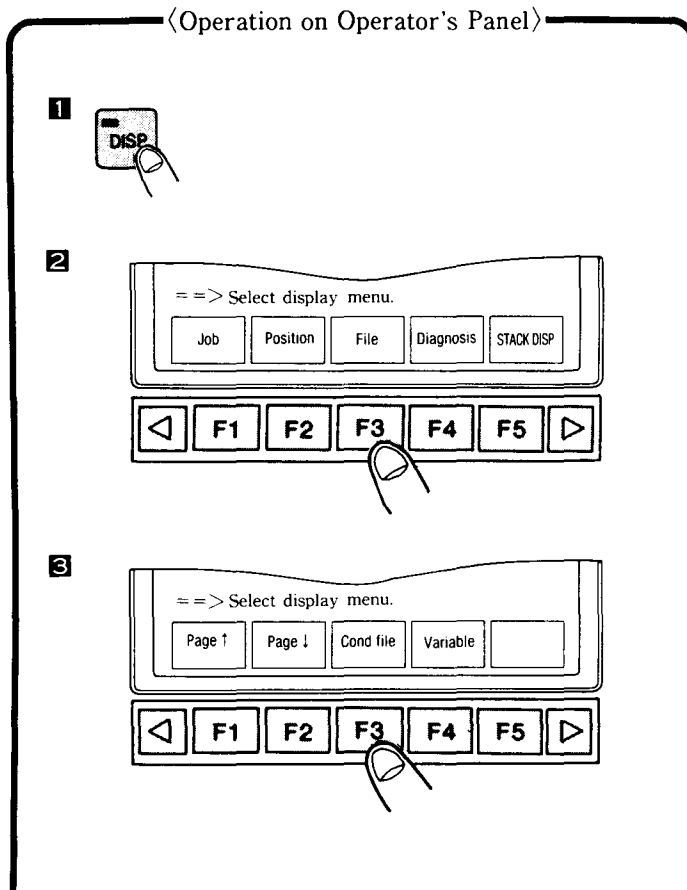
In the case of arc welding, use this file for "Weaving Condition". The designated file are referenced by the weaving start instruction for the jobs.

〈Example of arc welding〉



The registration and editing of each file are described as follows. For the details, see par. 10. 1. 4.

8. 1. 7. 1 Selecting Condition File Display



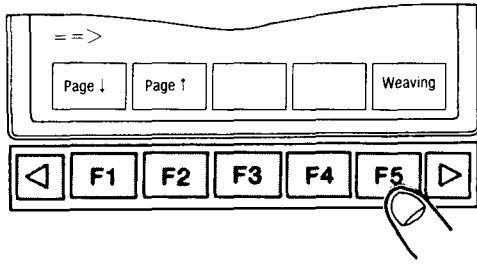
〈Description〉

Depress **DISP** key.

Depress **File** soft key.
F3

Depress **Cond file** soft key.
F3

4



Depress Weaving
F5 soft key.

The weaving condition display appears.

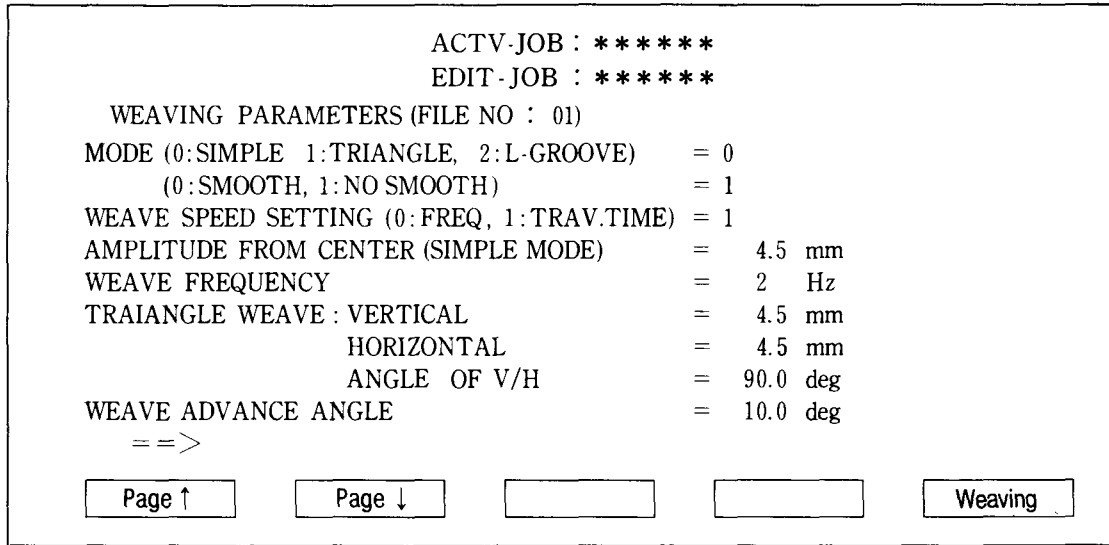
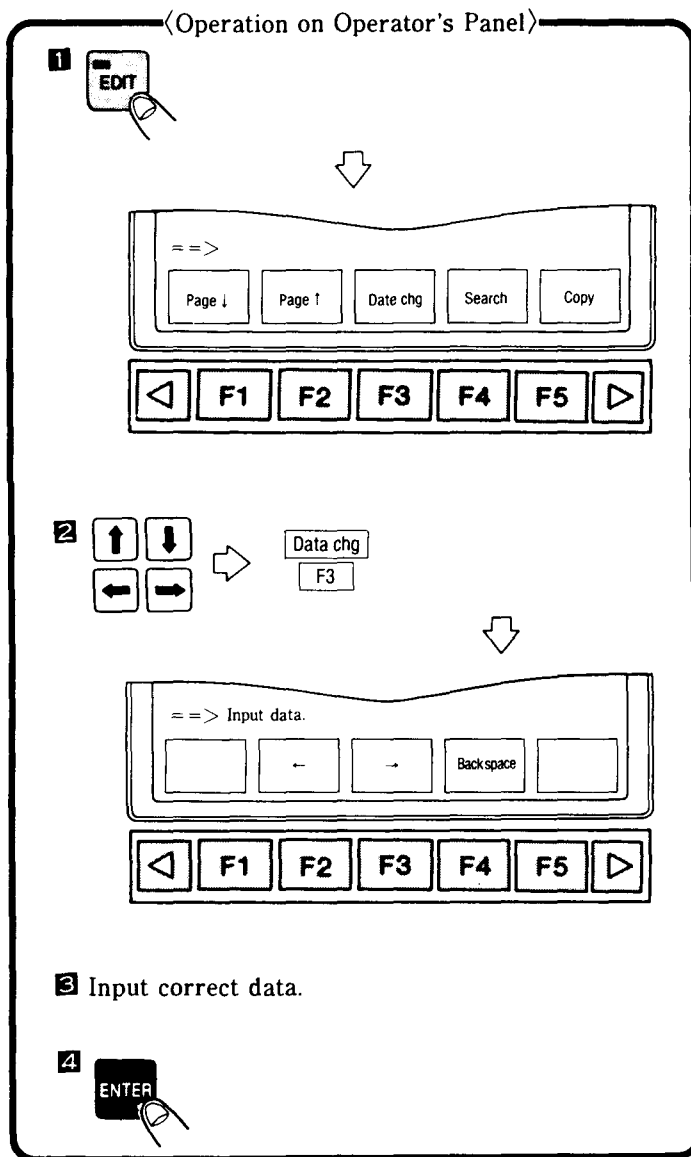


Fig. 8 . 24 Weaving Condition Display

8. 1. 7. 2 Registering and Correcting Condition File



(Description)

Depress **EDIT** key while condition file is displayed.

Soft keys for editing appears.

Specify the data to be corrected and depress **Data chg** soft key.

F3

Depress **ENTER** key.

The new data are registered.

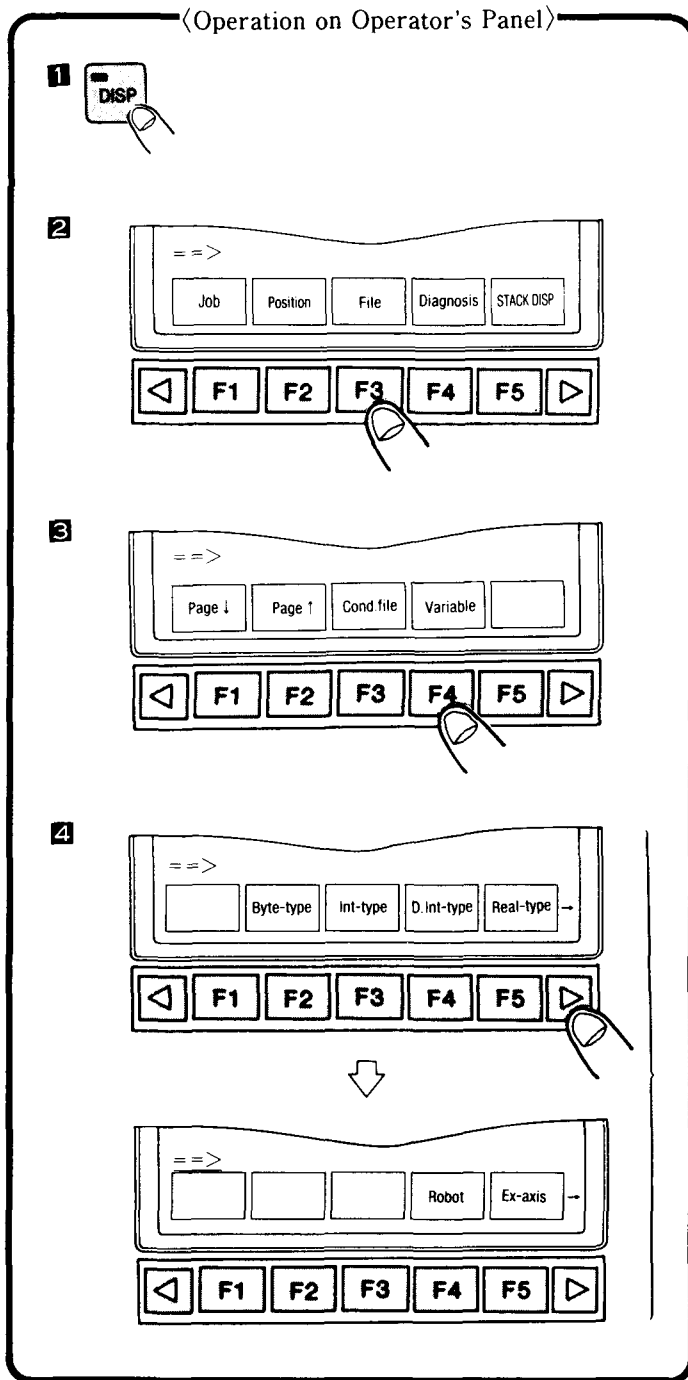
8. 1. 8 User Variable

User variable is classified into five data types as show in Table 8. 1 .

Table 8. 1

User Variable Type		Code	Function
Byte		B00 to B99	Stores I/O status. Logical operation (AND, OR, etc.) is possible.
Integer		I00 to I99	Stores numerical values with sign.
Double-precision Integer		D00 to D99	Stores large numerical values with sign.
Real		R00 to R99	Stores numerical values with decimal point.
Position	Robot Axis	P00 to P63	Stores position data at pulse-type or XYZ-type. (For external axis, only for pulse type) Used as parallel shift file.
	External Axis	EX00 to EX63	

8. 1. 8. 1 Calling up of User Variable Display



〈Description〉

Depress DISP key.

Depress File
F3 soft key.

Depress Variable
F4 soft key.

(Soft keys for user variable are six.
All keys can be displayed by de-
pressing ▶ key.)

Select desired variable and depress the soft key.

〈Example of user variable display〉

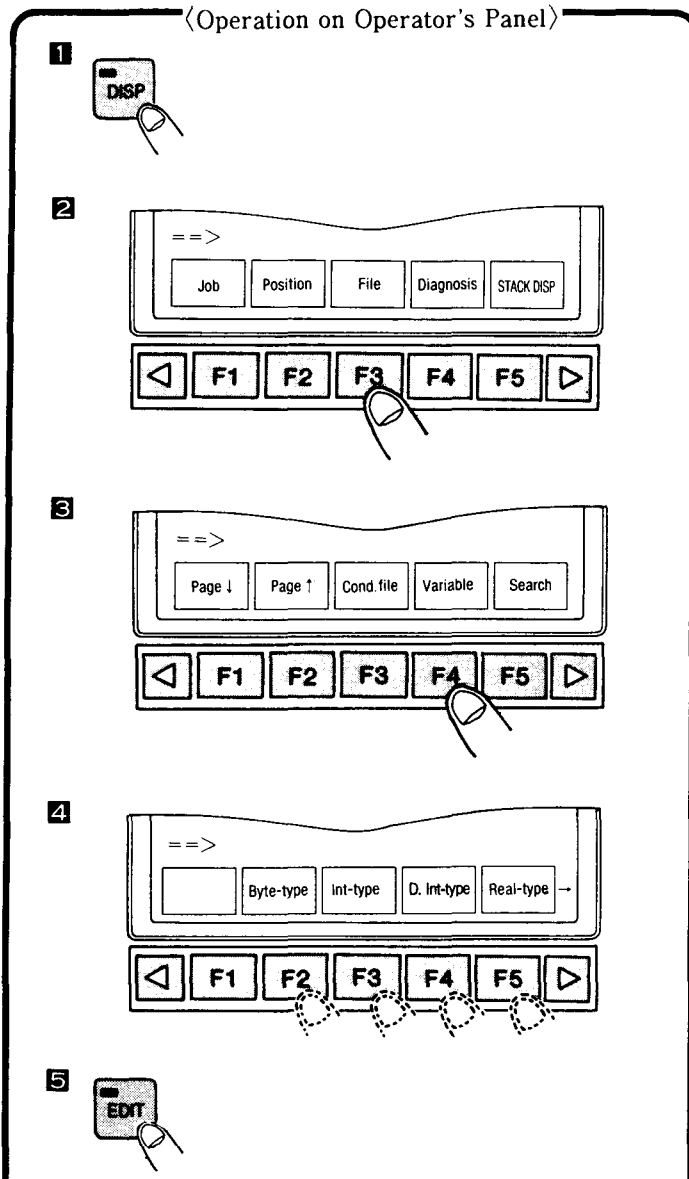
Integer-type Variable			
〈Variable No.〉	〈Contents〉	〈Variable No.〉	〈Contents〉
I00	0	I10	0
I01	0	I11	0
I02	0	I12	0
.	.	.	.
.	.	.	.
I09	0	I19	0

Fig. 8. 25 Integer-type Variable Display

Position variable (P)					
#P00	S	0	#P02	S	0
	L	0		L	0
	U	0		U	0
	R	0		R	0
	B	0		B	0
	T	0		T	0
#P01	S	0	#P03	X	0.000
	L	0		Y	0.000
	U	0		Z	0.000
	R	0		TX	0.00
	B	0		TY	0.00
	T	0		TZ	0.00

Fig. 8. 26 Position Variable (Robot Axis) Display

8. 1. 8. 2 Data Setting of Variable (Byte, integer, double-integer and real types)



〈Description〉

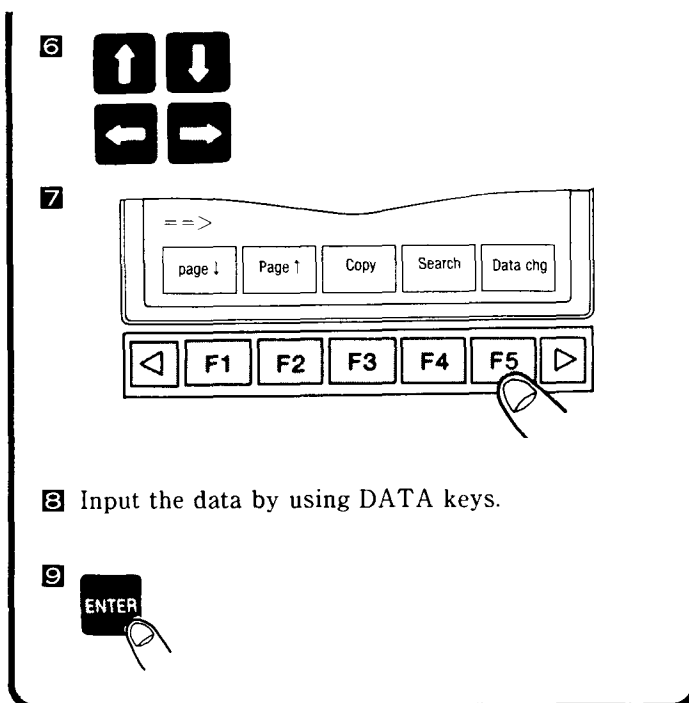
Depress **DISP** key.

Depress **File** soft key.
F3

Depress **Variable** soft key.
F4

Display the desired variable display by depressing the soft key.

Depress **EDIT** key.



Set the cursor on the position to be changed by using cursor keys.

Depress **Data chg** soft key.
F5

Depress **ENTER** key.

Input data are registered.



1. Repeat steps 6 to 9 if necessary.
2. Data setting range is different depends on each variable type.
See appendix A 1. 2.

8. 1. 8. 3 Data Setting of Variable (Position type)

Variable data can be set on operator's panel or teach pendant.


Table 8. 2 Position Variable Setting and Data Type

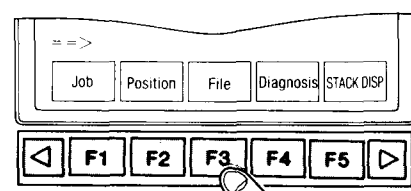
Setting Method	Operator's panel	Input directly the numerical value.
	Teach pendant	Teach desired position by operating the manipulator.
Data Type	Pulse type	Set pulse value of each axis.
	XYZ type	Set TCP position at absolute or incremental value.

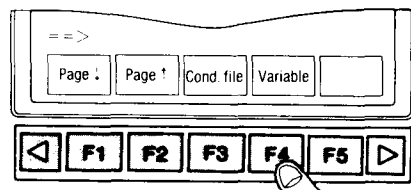
Each operation describes below.

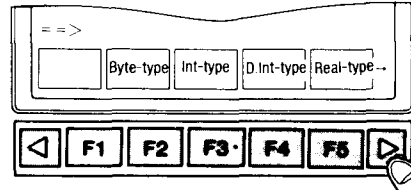
(1) Setting of data type

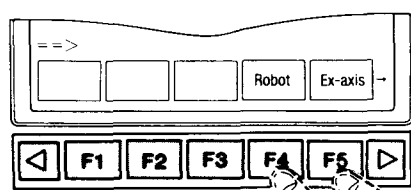
〈Operation on Operator's Panel〉


1 

2 

3 

4 

5 



6 

7 Set the cursor in position variable.

〈Description〉


Depress  key.





Depress  soft key.


Depress  soft key.


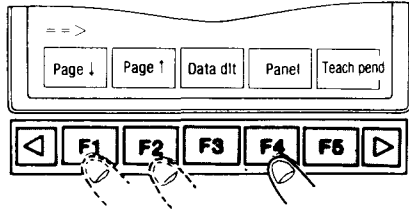
Depress  key.

Select desired position variable.

Depress  key.

Use ,  or cursor
  keys.

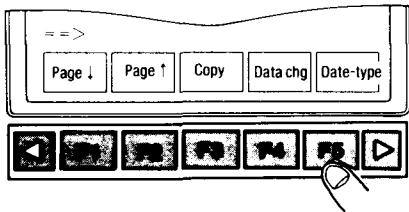
8



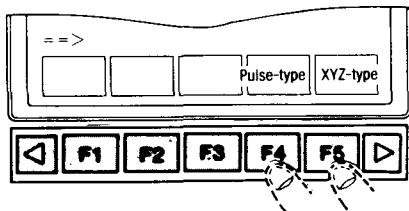
9

Set the cursor on the position variable to be set.

10



11



Depress

Panel
F4

 soft key.

〈Example〉

Position Variable			CURSOR		
# P00	S	123	# P02	S	*
	L	1000		L	*
	U	800		U	*
	R	1200		R	*
	B	1500		B	*
	T	13		T	*
# P01	S	*	# P03	S	*
	L	*		L	*
	U	*		U	*
	R	*		R	*
	B	*		B	*
	T	*		T	*

If new registration is performed, set the cursor on mark * (no registration).

Fig. 8.27 Position Variable setting at New Registration.

Depress

Data-type
F5

 soft key.

Depress

Pulse-type
F4

 or

XYZ-type
F5

 soft key.

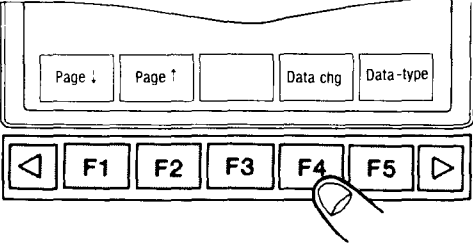
(2) Data setting on operator's panel

After setting data type [(1) in par. 8. 1. 8. 3], perform data setting.

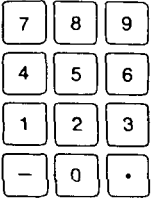
〈Operation on Operator's Panel〉

1 Set the cursor to the axis to be set by using cursor keys.

2




3





Input desired data by using DATA keys.

4



〈Description〉

Depress  soft key.

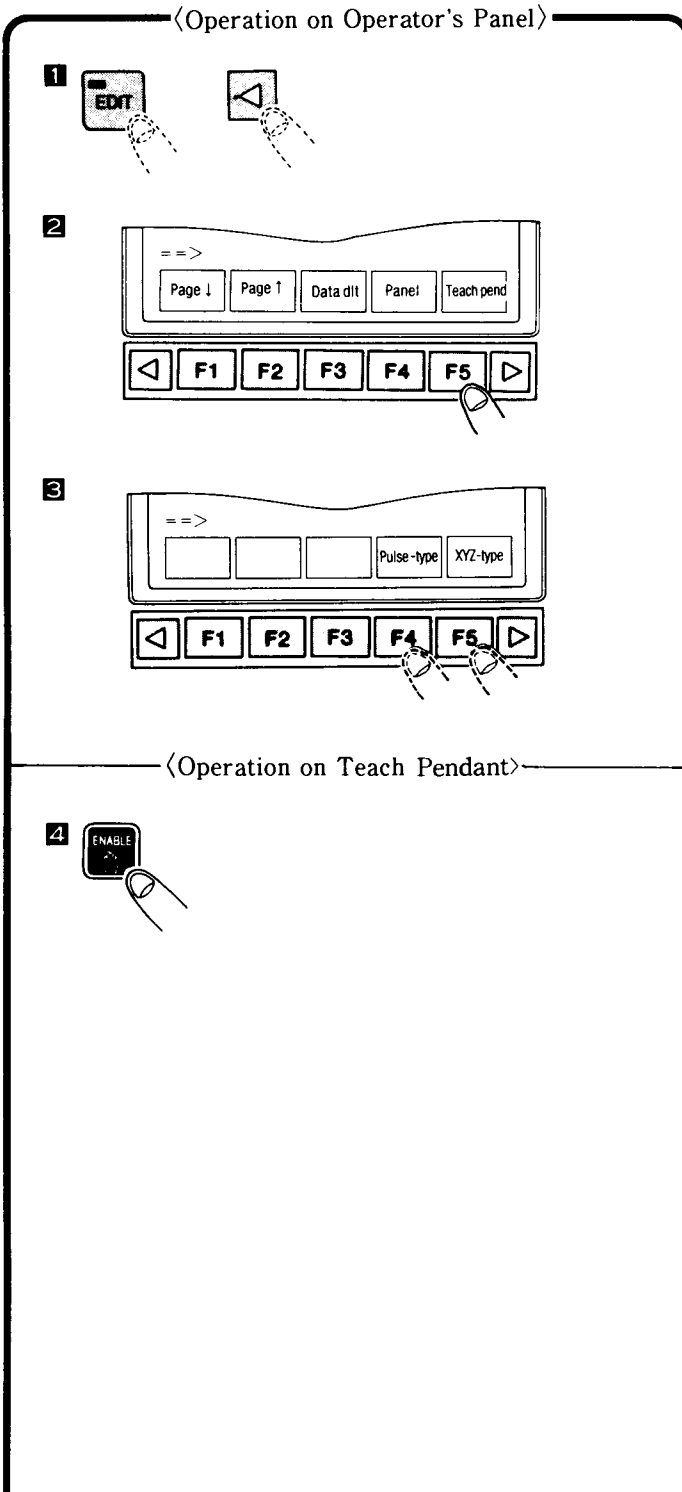
Depress  key.



1. Repeat steps **1** to **4** as necessary.
2. When data are set to the first axis, mark * on the axis data position becomes 0 automatically.

(3) Data setting on teach pendant.

After setting data type [4 of (1) in par. 8. 1. 8. 3], perform data setting.



<Description>

Depress or key.

Depress soft key.

Depress or soft key.

Depress key.

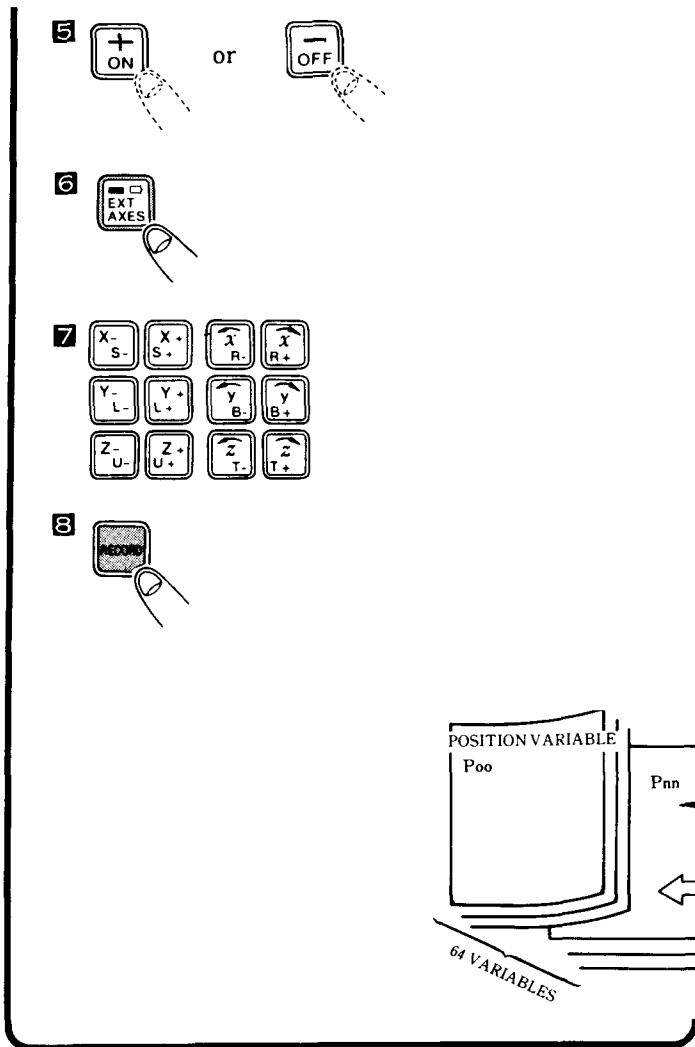
The display on teach pendant becomes either displays below.

They are changed by depressing key.

- no light : for robot axis.
P O O P U L S E

- light : for external axis.
P X O O P U L S E

* Changed by depressing or key.



Set the desired position variable No. by using or key.

Select either robot axis or external axis by depressing key.

Move the manipulator to the position to be set by using AXIS keys.

Depress key to set the position variable data.
(See Fig. 8.28)

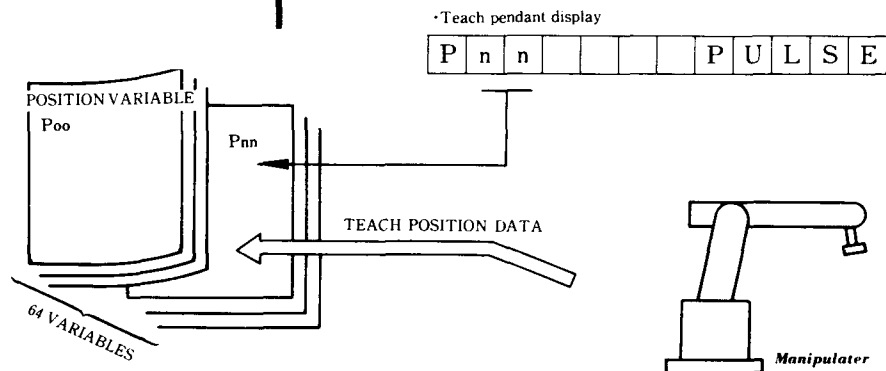


Fig. 8.28 Registering Manipulator Taught Position Data to Position Variable



1. Repeat steps 4 to 7 as necessary.
2. Position correction method :

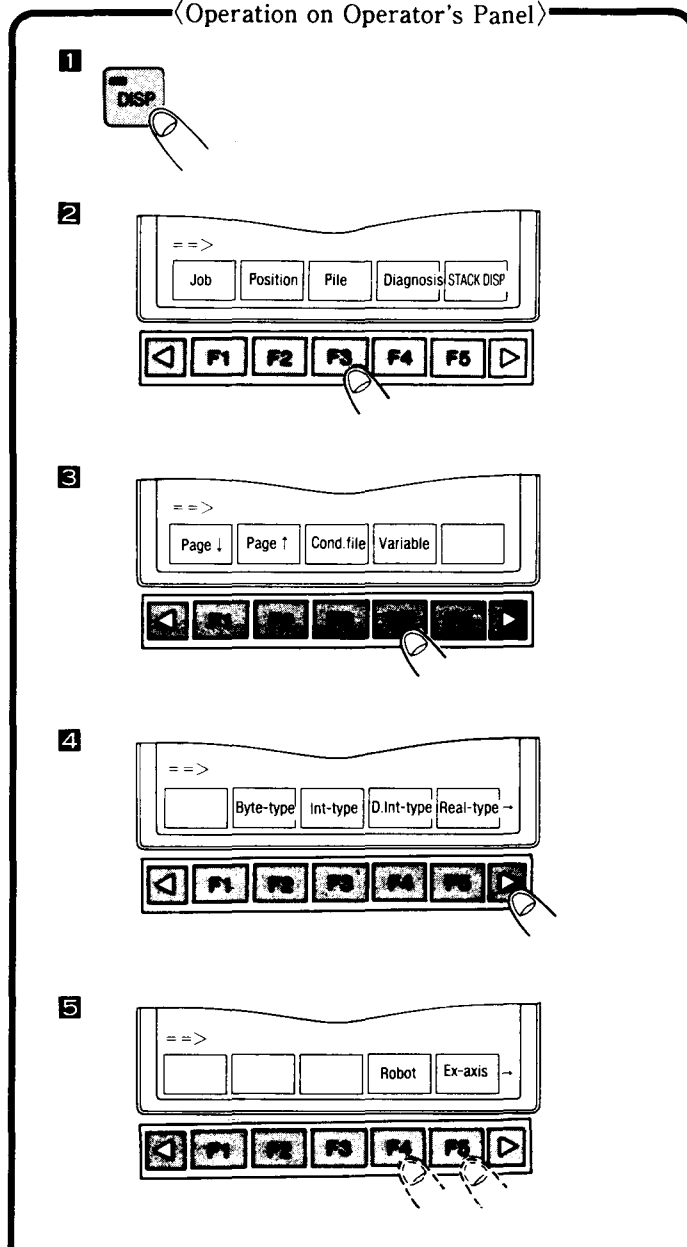
Depress → key.

3. Set-mode at TEACH mode is released in the following cases.

- Any mode keys or any function keys is depressed.
- is depressed.
- Alarm occurs.
- The power supply is turned off.

8. 1. 8. 4 Confirmation of Position Registered in Position Variable

〈Operation on Operator's Panel〉



Depress **DISP** key.

Depress **File** soft key.
F3

Depress **Variable** soft key.
F4

Depress **▶** key.

Select either robot-axis or external-axis by depressing the soft key.

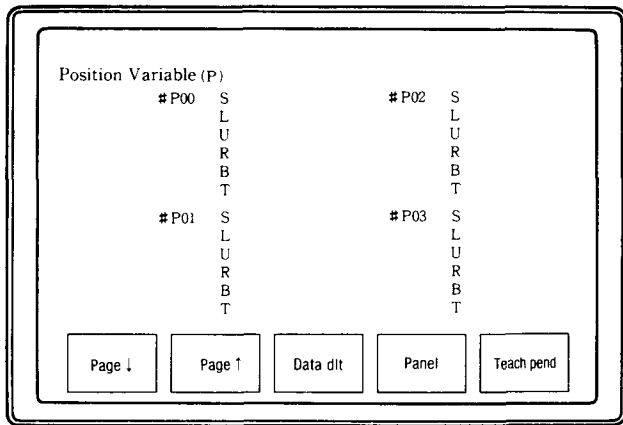
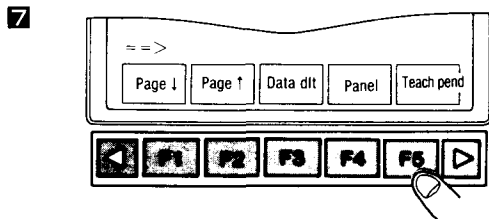



Fig. 8.29 Position Variable (Robot-axis) Display

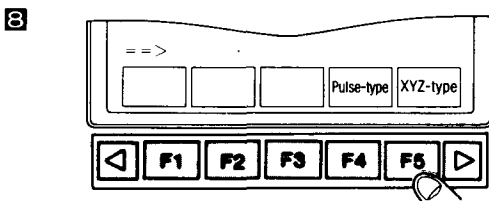
Selected position variable display will appear.




Depress  key.

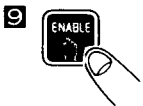



Depress  soft key.

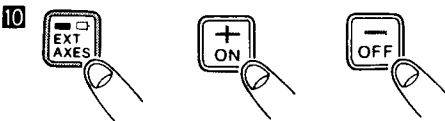


Depress  soft key.

〈Operation on Teach Pendant〉



Depress  key.

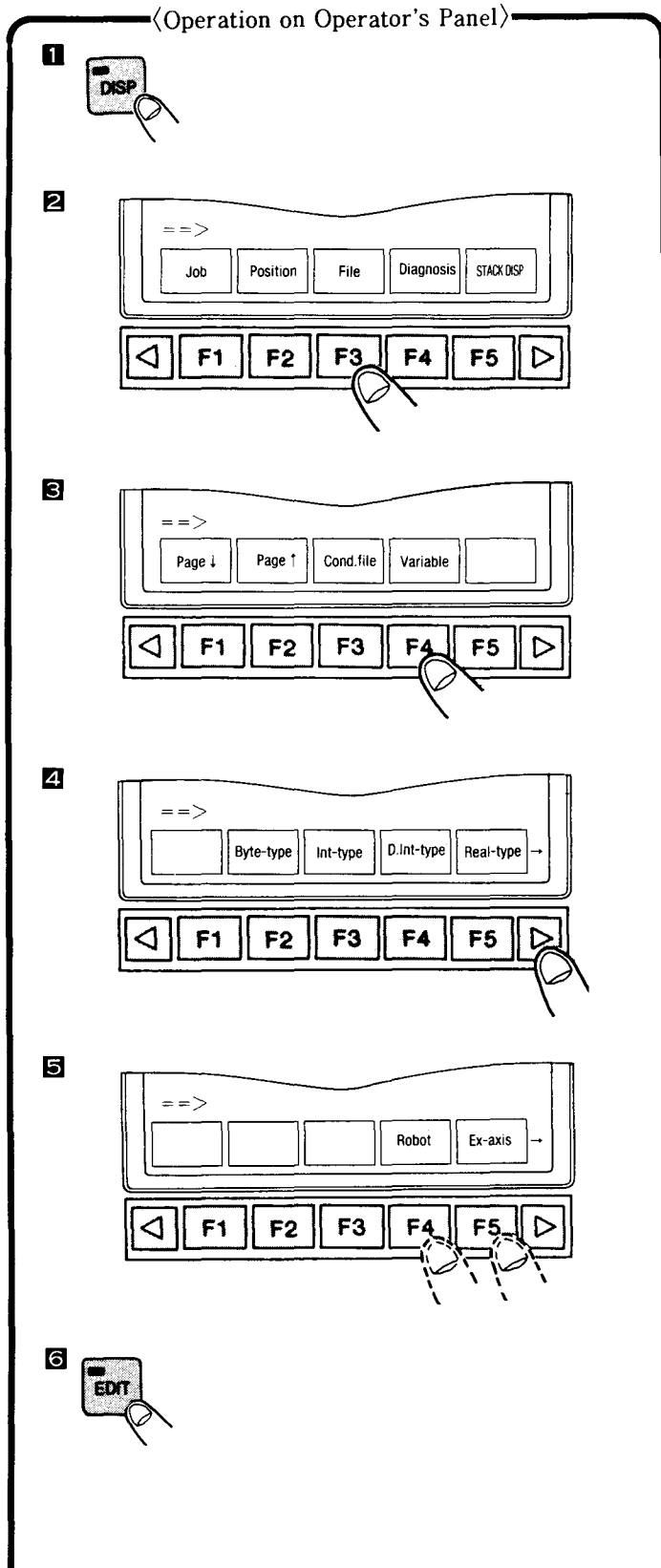


Depress these keys as necessary.



The manipulator moves to the registered position in position variable which is displaying on teach pendant.

8. 1. 8. 5 Deletion of Data Registered in Position Variable



〈Description〉

Depress **DISP** key.

Depress **File** soft key.
F3

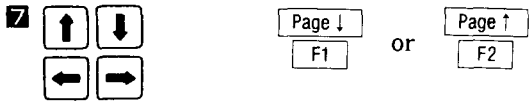
Depress **Variable** soft key.
F4

Depress **◀** key.

Select either robot-axis or external-axis by depressing the soft key.

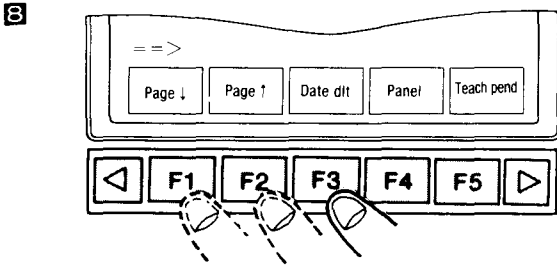
Depress **EDIT** key.

8



Place the cursor on axis in following position variable by using cursor keys or page soft keys.

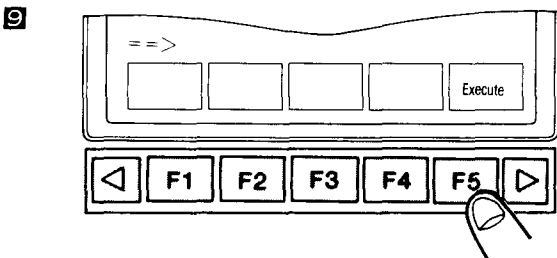
- Axes in position variable :
S, L, U, R, B, T or W 1, W 2, W 3, W 4, W 5, W 6.



Depress

Data dlt
F3

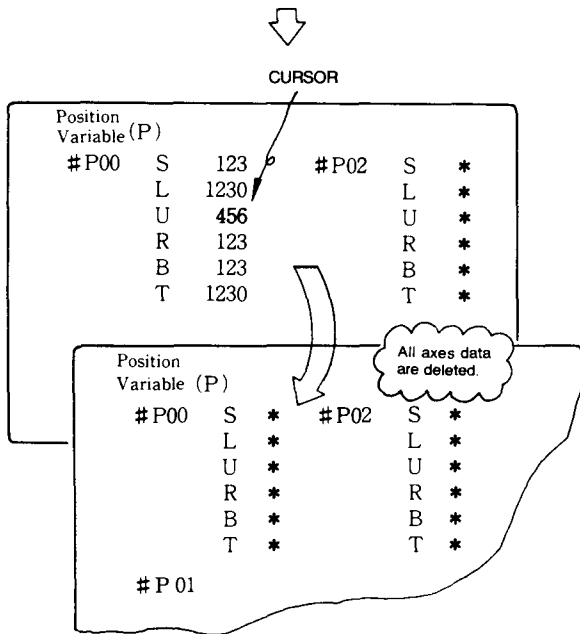
 soft key.



Depress

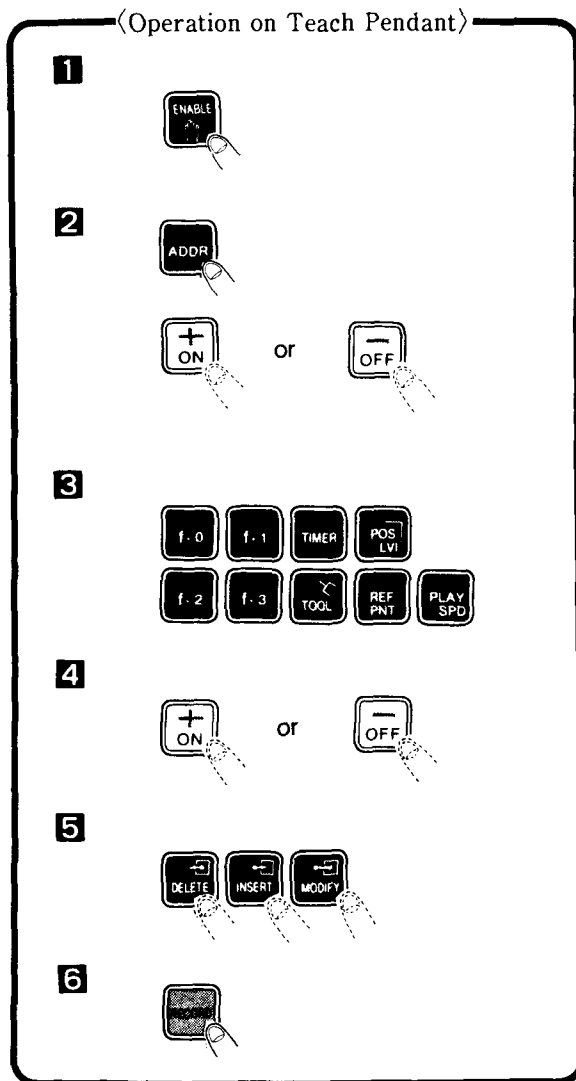
Execute
F5

 soft key.



8. 2 EDITING JOB ON TEACH PENDANT

Basic operation of job edit on teach pendant shows below.



〈Description〉

Depress key.

Depress key and call up desired instruction by depressing or key.

Depress desired key.

Change the data by depressing

or key.




Depress any key.

Depress key.

8. 2. 1 Edit Instruction on Teach Pendant

The following instructions can be edited on teach pendant.




(1) Move instructions (MOVJ, MOVL, MOV C)

Key	Display Contents	Editable Instruction
	Line, step, instruction	MOV J : on link specification MOV L : on linear specification MOV C : on arc specification MOV□EX : with external
	Play speed setting value	MOV□ MOV□EX : with external axis
	Positioning level	MOV□ PL=n MOV□EX PL=n : with external axis






NOTE

□ is applied to J, L or C according to interpolation specification.

(2) Instructions related to manipulator motion

Key	Display Contents	Editable Instruction
	Reference number	REFPn
	Tool number	TLn : registered when step is registered
	Timer setting value	TIMER nnn. nn : See par. 8. 2. 1. 1

(3) Other Instructions

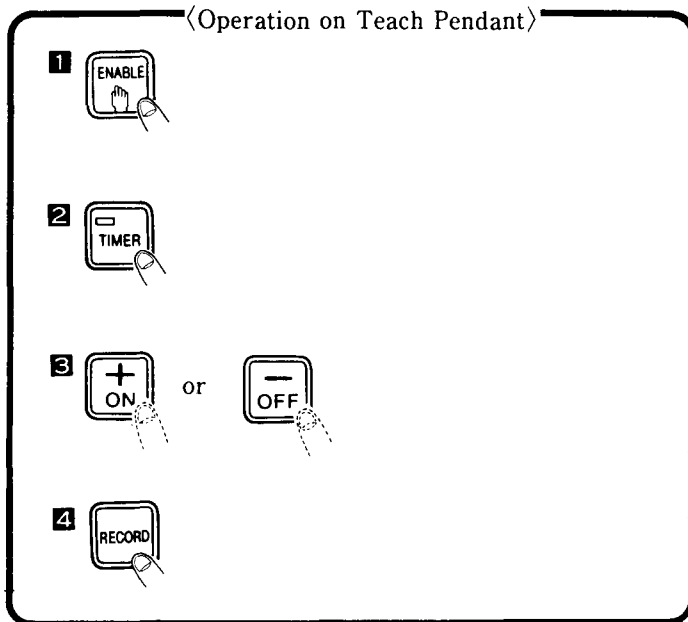
Key	Display Contents	Edit Instruction
 *	File number	ARCON (Arc ON instruction) or CALL ARCON nn
 *	File number	ARCOF (Arc OFF instruction) or CALL ARCOF nn
 *	Welding voltage setting value	VWELD nn (Welding voltage instruction)
 *	Welding current setting value	AWELD nn (Welding current instruction)
	Output status	None (cannot be registered.)

NOTE

These functions vary according to the application.
In table above, example of arc welding is shown.

8. 2. 1. 1 Timer Instruction

(1) Registration



〈Description〉

Depress **ENABLE** key.

Depress **TIMER** key. The light is turned on. The display below is shown.

			1	2	.	0	0	S	E	C
--	--	--	---	---	---	---	---	---	---	---

Timer setting value

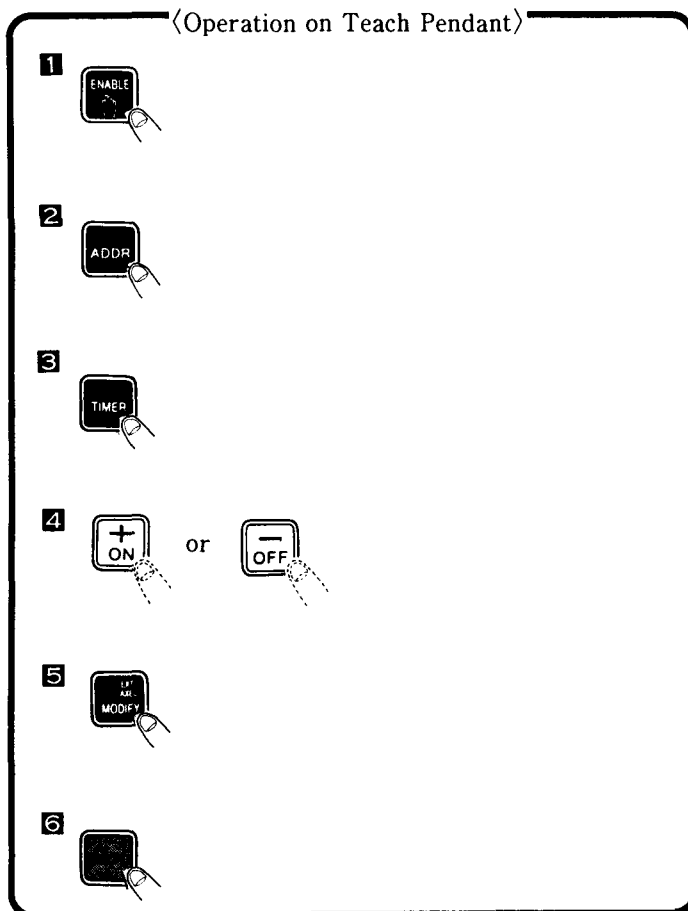
Set the timer by using **+ ON** or **- OFF** key.

The setting range is 0.01 to 327.67 seconds.

Depress **RECORD** key.

Timer instruction is registered.

(2) Correction



〈Description〉

Depress **ENABLE** key.

Confirm that the current address is timer instruction.

Depress **TIMER** key. The light is turned on. The display below is shown.

			1	.	0	0	S	E	C
--	--	--	---	---	---	---	---	---	---

Timer setting value

Set the desired timer value by using **+ ON** or **- OFF** key.

Depress **MODIFY** key.

Depress **RECORD** key. The new timer value is registered.

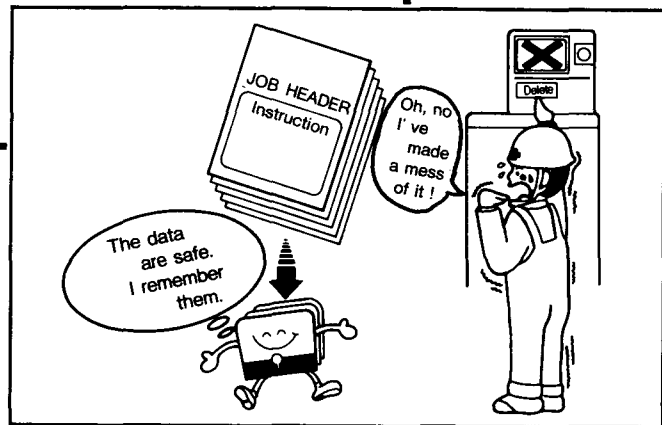
8

SECTION 9

DATA STORAGE (FLOPPY DISK UNIT OPERATION)

For an external memory unit, 3.5-inch floppy disk unit is provided as optional.

Store the various registered data, parameters, etc. in a controller to the floppy disk unit. If you should delete the data, you can recover them by the floppy disk.



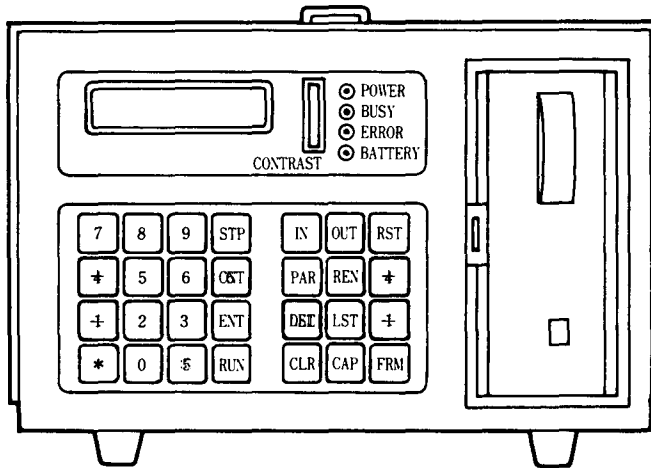
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9. 1 PRECAUTIONS

9. 1. 1 Save and Storage of Floppy Disk Unit

Floppy disk unit is precise mechanical and magnetic recording equipment. Do not subject the unit to any kind of impact, shock, etc.

Do not leave it in an environment which contains a large amount of iron filings, etc., for a long time because its reliability is greatly reduced. Store in an area without iron filings, etc. after operating the unit.



Note: Prepare 3.5-inch MFD
2DD floppy disk by user.

Fig. 9. 1 Floppy Disk Unit

9. 1. 2 Handling and Storing Floppy Disk

Handle the disk with maximum care to store valuable data safely.

Basic precautions as minimum requirements in handling a floppy disk are as follows:

- A floppy disk is a magnetic recording device. Stored data may be destroyed if a strong magnetic field (e. g. a magnet) is brought close to it.
- A protective cover slides on the magnetically-coated recording device of the 3.5-inch floppy disk to avoid direct exposure. Do not open this part or touch it.
- Dust may accumulate on the floppy disk if it is placed in one's pocket or is placed on the control equipment without a case. A failure may occur if a contaminated floppy disk is inserted in the floppy disk drive.
- The 3.5-inch floppy disk is stored in a hard case and does not bend easily. However, handle it with care by storing it in a specified storage box or in another suitable container to avoid subjecting it to undue force.

9. 2 FILE NAME INSIDE FLOPPY DISK

The data transferred from the controller is stored in the floppy disks as files. Each of these files has a file name for identification.

Contents		* 1 File Name	* 2 File Name
Batched CMOS memory		CMOS. HEX	CMOS. HEX
Batched User memory		JOB. HEX	JOBS. HEX
Job	Single job Master (related) job	<Job name> .JOB <Job name> .JOS	<File Name> .JBI <File Name> .JBR
Condition	Weaving data Tool data Conveyor data Sensor data (Path correction condition data COM- ARC II condition data Position compensation data)	WEAV. DAT TOOL. DAT CV. DAT SENSOR. DAT COMARC 2. DAT PCIPC 2. DAT	WEAV. DAT TOOL. DAT CV. DAT SENSOR. DAT COMARC 2. DAT PCIPC 2. DAT
Batched all parameters		PARAM. DAT	PARAM. DAT
Parameter	Robot fixed parameter System definition parameter Coordinate origin (A) Coordinate origin (B) System matching parameter Communication (general-purpose serial port) Welding Maintenance Sensor Communication (option)	RCPRM. DAT SDPRM. DAT RAPRM. DAT RBPRM. DAT SCPRM. DAT RSPRM. DAT WEPRM. DAT MEPRM. DAT SEPRM. DAT CMPRM. DAT	RCPRM. DAT SDPRM. DAT RAPRM. DAT RBPRM. DAT SCPRM. DAT RSPRM. DAT WEPRM. DAT MEPRM. DAT SEPRM. DAT CMPRM. DAT
I/O system data	Concurrent I/O program I/O signal name Internal data Absolute data System information	CIO. PRG IONAME. DAT STATE. DAT ABSO. DAT SYSTEM. DAT	CIO. PRO IONAME. DAT ISTATE. DAT ABSO. DAT SYSTEM. DAT

* 1 For ROM version 1.2□/1.2□ and before.

* 2 For ROM version 2.00/2.10 and after.

User alarm and user message are loaded/saved with concurrent I/O program.



9. 3 STORED DATA AND PROCESSING LIST

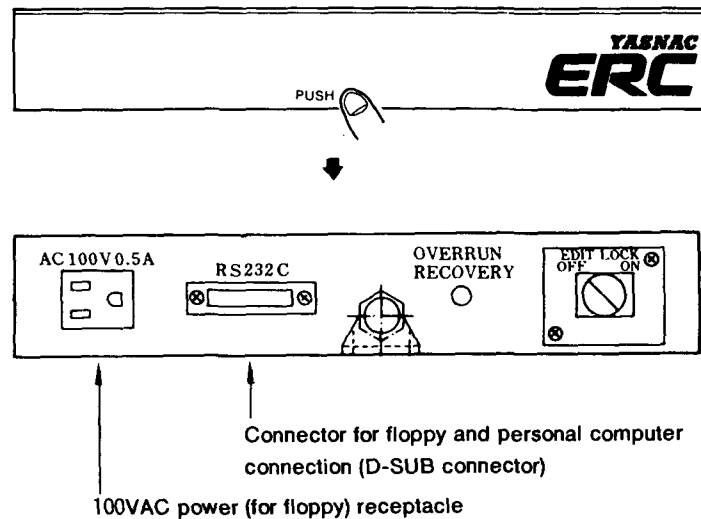
Data registered in the user memory of controller can be stored on floppy disks. Information inside the system such as parameters can be saved similarly on floppy disks as an additional safety measure. The following items are stored on floppy disks and can be reloaded in the user memory of controller.

- (1) Job
- (2) Condition file
- (3) Tool coordinate data/User coordinate data
- (4) Parameter
- (5) Concurrent I/O program
- (6) I/O name/User message
- (7) Interior data (Variable, etc.)
- (8) System Information (System No, Alarm history, etc)

9. 4 CONNECTING METHOD

Use the special cable to connect the floppy disk unit and controller. A floppy connector and floppy power plug socket are installed on the operator's panel below.

To open, lightly push the small area printed "PUSH". The cable may be connected while power to the controller is turned ON.



NOTE

Do not use a 100VAC power supply inside the auxiliary panel for purposes other than the floppy disk unit.

Fig. 9. 2 Internal Auxilliary Panel

9. 5 PREPARATION OF FLOPPY DISK UNIT

9. 5. 1 Turning Power On

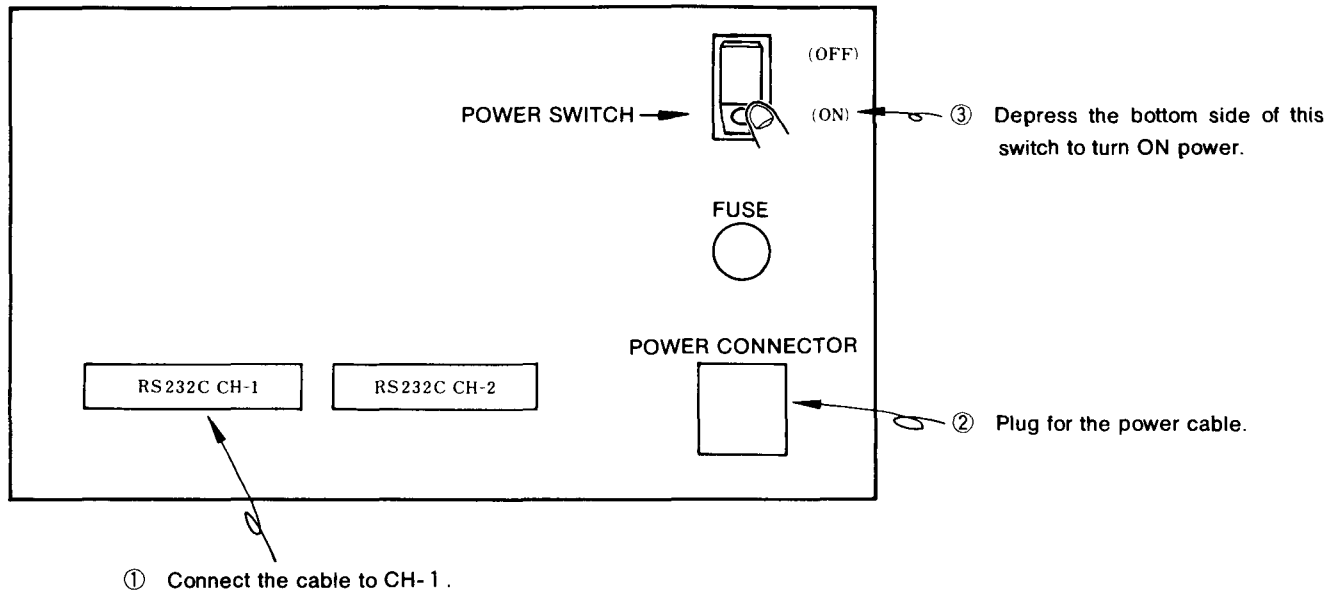


Fig. 9. 3 Floppy Disk Unit (Rear Panel)

- ① Connect the cable to the controller to RS232C CH- 1 on the rear panel of the floppy disk unit.
- ② Plug the power cable socket into the specified connector securely.
- ③ Turn on power to floppy disk unit by depressing the bottom side of power switch on the rear panel.
- ④ The POWER lamp on the front panel lights.
- ⑤ Self-diagnosis begins simultaneously and "FX" will be displayed on the screen if the drive operates properly.

The floppy disk is automatically set to the control mode when power to it is turned ON. No selecting operation is required.

NOTE

1. When the floppy disk is being inserted, do not turn the power ON/OFF.
2. Avoid touching the key on the front panel of the floppy disk drive inadvertently. Unnecessary touching of the keys may change the floppy disk unit operation mode and disable data transfer with the controller.

If a key is touched accidentally and data transfer with the controller is disabled, turn OFF power to the floppy disk unit momentarily and then turn ON power again.

9. 5. 2 Inserting Floppy Disk

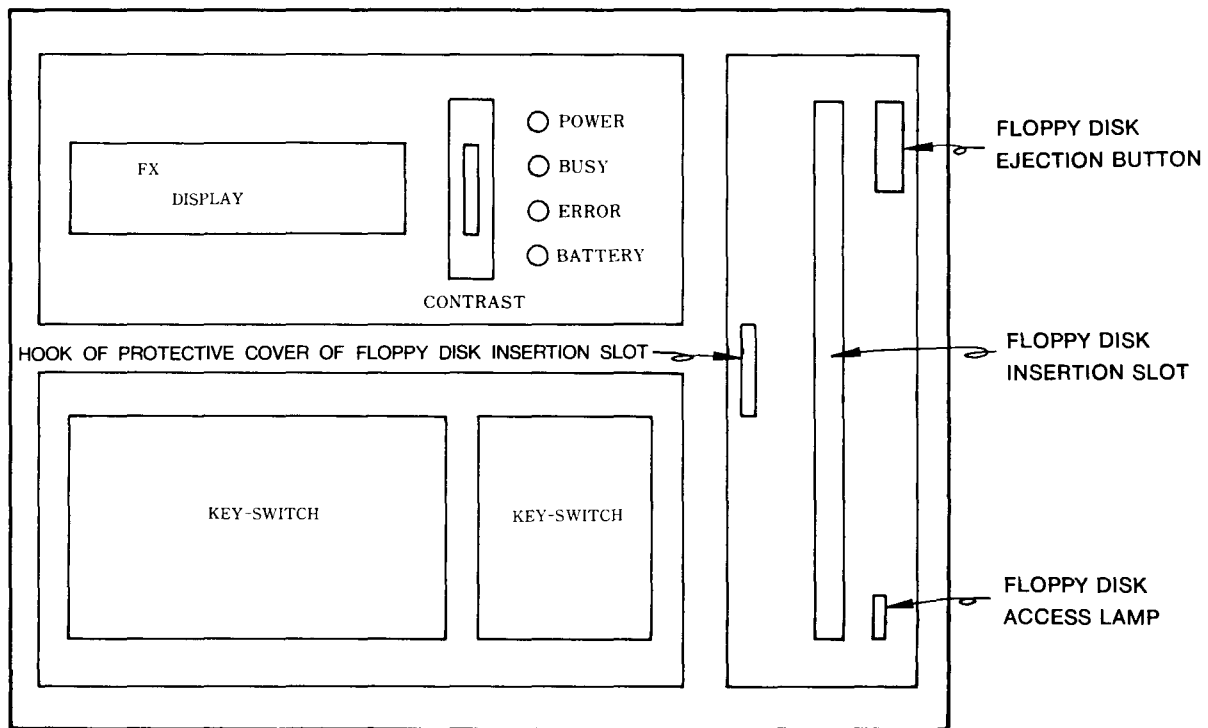


Fig. 9. 4 Floppy Disk Unit (Front Panel)

<Inserting>

- ① Floppy disk insertion slot has a cover.
Lightly depress the hook to open the cover.
- ② Insert the floppy disk straight through the insertion slot.

NOTE

1. Do not force it.
2. Insert it in the correct direction.

When the disk is firmly in place, a click can be heard.

<Removing>

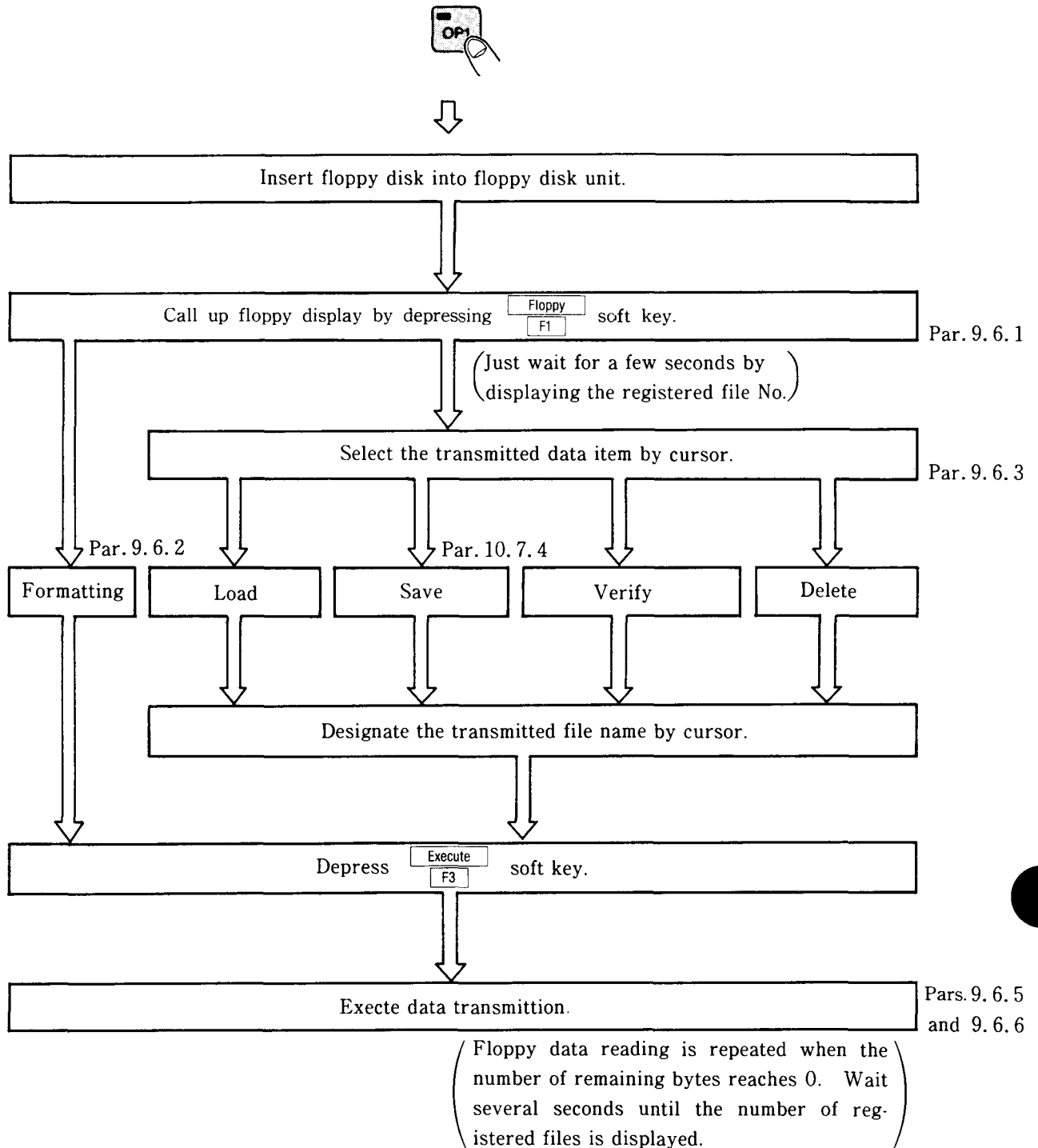
- ① Push the floppy disk ejection button on the upper right of the front panel. The lock is released and it is ejected.

NOTE

Never push the EJECT button while data is being transferred with the controller. The data will be destroyed.

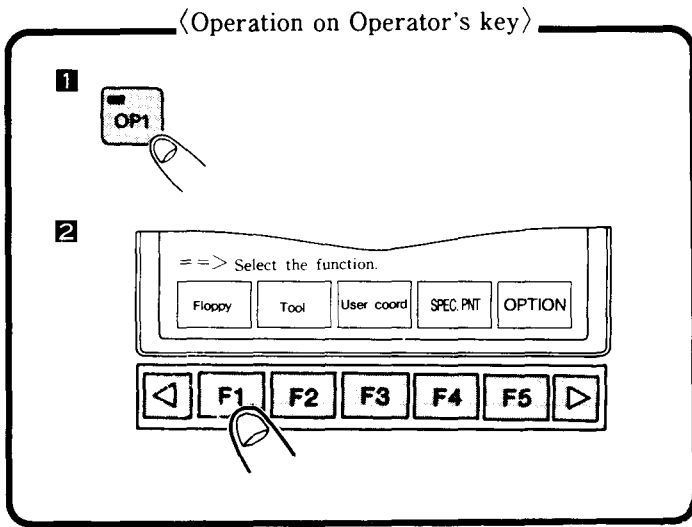
9. 6 FLOPPY DISK UNIT OPERATION

Operate the floppy disk as follows at TEACH MODE.



9. 6. 1 Calling up Floppy Disks

The soft keys for operating floppy disk can be called up by OP1 function key.



<Description>

Depress key.

Depress soft key.


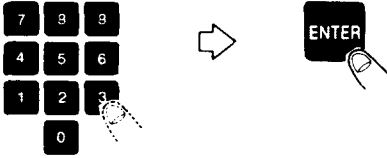
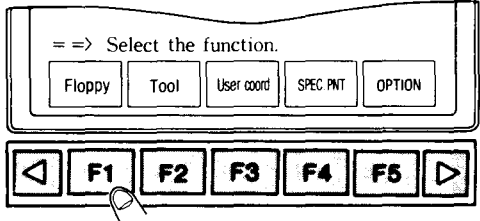
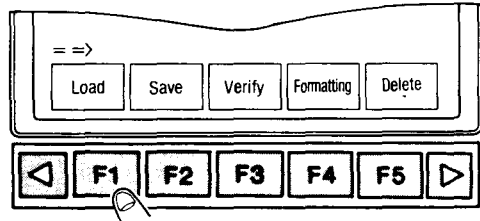
The display below is shown.

DATA IN THE FLOPPY DISK	UN-USED MEMORY	30%
CLASSIFIED DATA	NOS OF FILE (FLOPPY)	
<input type="checkbox"/> JOBS		12
<input type="checkbox"/> CONDITIONAL PROGRAM DATA		2
<input type="checkbox"/> ALL USER'S PROGRAMS		0
<input checked="" type="checkbox"/> PARAMETERS		1
<input checked="" type="checkbox"/> I/O SYSTEM DATA		0
<input checked="" type="checkbox"/> ALL DATA IN CMOS		0
<input checked="" type="checkbox"/> OTHERS		0

CAUTION : CAN NOT LOAD
=> Floppy disk drive is working

Fig. 9. 5 Floppy Display

- Floppy load operation for batch CMOS and batch parameter

(Operation on Operator's key)	(Description)																					
<p>1 </p>	Depress OP1 key.																					
<p>2 </p>	After depressing U. ID number, depress ENTER key.																					
<p>3 </p>	Depress Floppy soft key. The display below is shown.																					
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">DATA IN THE FLOPPY DISK CLASSIFIED DATA</th> <th style="text-align: right;">UN-USED MEMORY 30% NOS OF FILE (FLOPPY)</th> </tr> </thead> <tbody> <tr> <td><input type="checkbox"/> JOBS</td> <td style="text-align: right;">100</td> </tr> <tr> <td><input type="checkbox"/> CONDITIONAL PROGRAM DATA</td> <td style="text-align: right;">0</td> </tr> <tr> <td><input type="checkbox"/> ALL USER'S PROGRAMS</td> <td style="text-align: right;">0</td> </tr> <tr> <td><input type="checkbox"/> PARAMETERS</td> <td style="text-align: right;">0</td> </tr> <tr> <td><input type="checkbox"/> I/O SYSTEM DATA</td> <td style="text-align: right;">0</td> </tr> <tr> <td><input type="checkbox"/> ALL DATA IN CMOS</td> <td style="text-align: right;">1</td> </tr> <tr> <td><input checked="" type="checkbox"/> OTHERS</td> <td style="text-align: right;">0</td> </tr> </tbody> </table> <p>***CAUTION*** <input checked="" type="checkbox"/> : CAN NOT LOAD</p> <p>=></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">Load</td> <td style="text-align: center;">Save</td> <td style="text-align: center;">Verify</td> <td style="text-align: center;">Formatting</td> <td style="text-align: center;">Delete</td> </tr> </table>		DATA IN THE FLOPPY DISK CLASSIFIED DATA	UN-USED MEMORY 30% NOS OF FILE (FLOPPY)	<input type="checkbox"/> JOBS	100	<input type="checkbox"/> CONDITIONAL PROGRAM DATA	0	<input type="checkbox"/> ALL USER'S PROGRAMS	0	<input type="checkbox"/> PARAMETERS	0	<input type="checkbox"/> I/O SYSTEM DATA	0	<input type="checkbox"/> ALL DATA IN CMOS	1	<input checked="" type="checkbox"/> OTHERS	0	Load	Save	Verify	Formatting	Delete
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<input type="checkbox"/> ALL DATA IN CMOS	1																					
<input checked="" type="checkbox"/> OTHERS	0																					
Load	Save	Verify	Formatting	Delete																		
<p>4 </p>	Depress Load soft key to execute load operation.																					

9. 6. 2 Formatting

Newly-purchased floppy disk (MFD 2DD. 3.5 inches) must be formatted to register the proper recording format in the floppy disk.

The floppy disk for the controller ERC is formatted to the MS-DOS recording format.

Control (ERC) data cannot be saved in a floppy disk which has not been formatted or in a floppy disk of another recording type.

(Operation on Operator's Panel)

(Description)

Depress OP1 key.

Depress Floppy
F1 soft key.

In this column, "?" mark is displayed.

"Error" is displayed
Depress CANCEL key to clear the Error.

Depress Formatting
F4 soft key.
The floppy disk is formatted.

Depress Execute
F5 soft key.
The floppy disk is formatted.

NOTE

All data in the floppy disk are deleted by formatting.

9. 6. 3 Selecting Transimission and Processing

The data stored in the floppy disk are classified in 7 groups as follows.
Designate by cursor which data group is to be transferred.

CLASSIFIED DATA		NOS OF FILE (FLOPPY)
Data to be registered in floppy disk	<input type="checkbox"/> JOBS	12
	<input type="checkbox"/> CONDITIONAL PROGRAM DATA	2
	<input type="checkbox"/> ALL USER'S PROGRAMS	0
	<input checked="" type="checkbox"/> PARAMETERS	1
	<input checked="" type="checkbox"/> I/O SYSTEM DATA	0
	<input checked="" type="checkbox"/> ALL DATA IN CMOS	0
	<input checked="" type="checkbox"/> OTHERS	0

CAUTION : CAN NOT LOAD
=> Cursor on data group to be transmitted and select the soft key

Fig. 9. 6 Floppy Disk

〈Operation on Operator's Panel〉

1 CURSOR

↑ ↓
← →

2
F1 F2 F3

()
F4 F5

3 CURSOR

↑ ↓
← →

4
F5

〈Description〉

Designate the desired data group by cursor.

Depress one of the soft keys.
The list of the file name in designated data group appears on the display.

NOTE The display data of the file name list differs depending on the designated data group. See "★List of file name" on the next page.

Designate desired file name by cursor.

NOTE To interrupt the data transmission, depress soft key.
F4

Depress soft key.
F5

Data transmission starts.

★ List of file names

The display data of the file name list differs depending on the designated data group. One of the following two display formats will be displayed.

- (1) When there are more than two files and file names are not established :

The menu will show only the registered file names.

Designate the desired file by moving the cursor.

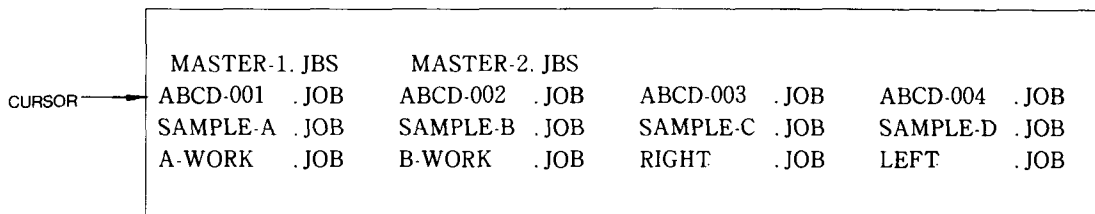


Fig. 9. 7

- (2) When the file menu of data groups with data and file name matching 1-to-1 :

The menu will display all the file names in the groups, indicating whether or not the files are registered in the floppy disk. (Registered : ●, not registered : ○)

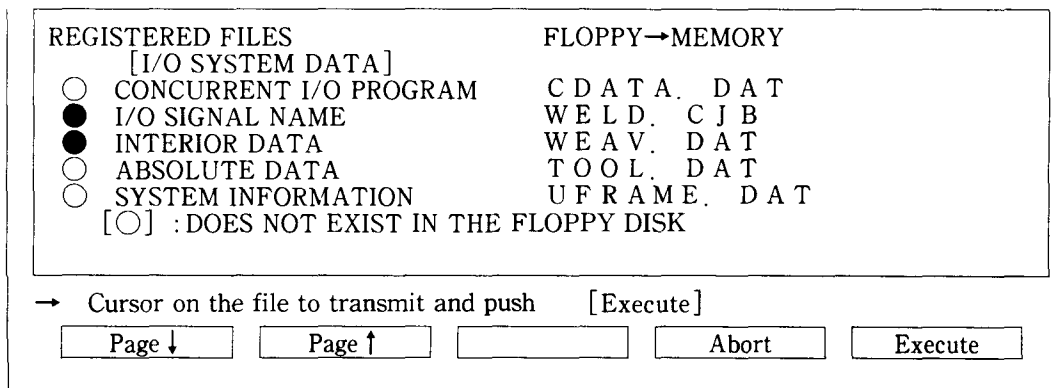
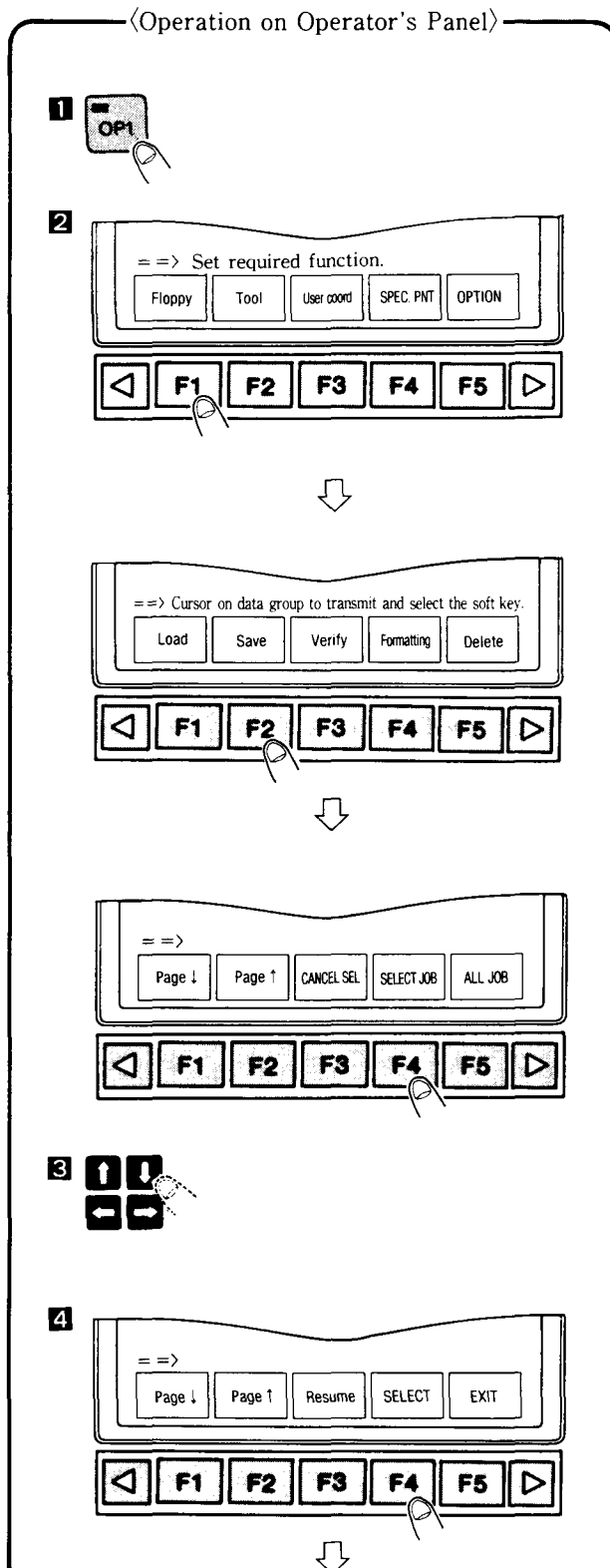


Fig. 9. 8

9. 6. 4 Related Jobs Save

When saving jobs in a floppy disk, selection can be made either to save only designated jobs independently, or to save related jobs, condition data, etc. simultaneously.

Select job to be saved in advance by the following operation.



<Description>

Depress **OP1** key.

Depress **Floppy**, **Save** and **F1**, **F2** and **SELECT JOB** soft keys. **F4**

NOTE If **ALL JOB** **F5** is depressed, all registered jobs are selected.

Select the job to be saved.

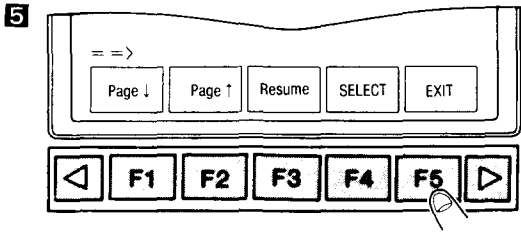
Depress **SELECT** soft key. **F4**



The job at the cursor is selected and mark ☆ is added to the job.

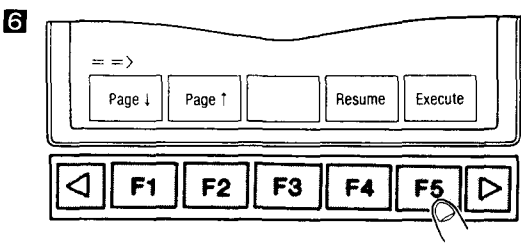
```



Master job : SAMPLE-A. JBR

☆ABCD-001 .JBI ABCD-002 .JBI ABCD-003 .JBI ☆ABCD-004 .JBI
SAMPLE-A .JBI SAMPLE-B .JBI SAMPLE-C .JBI SAMPLE-D .JBI
A-WORK .JBI B-WORK .JBI RIGHT .JBI LEFT .JBI
  
```







After completing the setting, depress  soft key. 



Depress  soft key to start data transmission. 



- When the all selected jobs must be cancelled, depress  soft key. 
 For canceling the job at the cursor, depress  soft key. 
- The total of saved jobs is 112 maximum in one floppy disk.

(1) When saving job independently :

Designate the job name displayed on CRT by cursor.

	MASTER-1. JBS	MASTER-2. JBS		
CURSOR →	ABCD-001 .JOB	ABCD-002 .JOB	ABCD-003 .JOB	ABCD-004 .JOB
	SAMPLE-A .JOB	SAMPLE-B .JOB	SAMPLE-C .JOB	SAMPLE-D .JOB
	A-WORK .JOB	B-WORK .JOB	RIGHT .JOB	LEFT .JOB

Fig. 9. 9 Job Name Specification

(2) When saving related job :

Designate the master job displayed on CRT by cursor.

Master : SAMPLE-A. JOB				
ABCD-001	ABCD-002	ABCD-003	ABCD-004	ABCD-005
SAMPLE-A	SAMPLE-B	SAMPLE-C	SAMPLE-D	SAMPLE-E

Fig. 9. 10 Master Job Specification

NOTE

The job registered in master job can save the related job simultaneously.

Therefore, when the related job is saved simultaneously, previously register the related job in master job.

Always verify after saving jobs.

9. 7 CHECKING TRANSMITTING STATUS

When data transmission starts, transmitting status can be monitored by the status display during transmission.

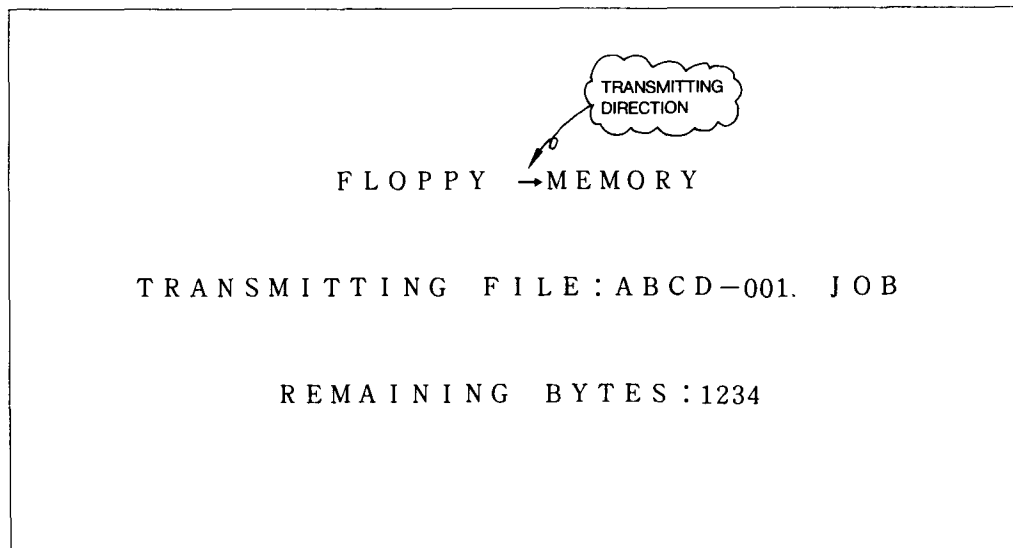


Fig. 9. 10 Data Transmitting Status

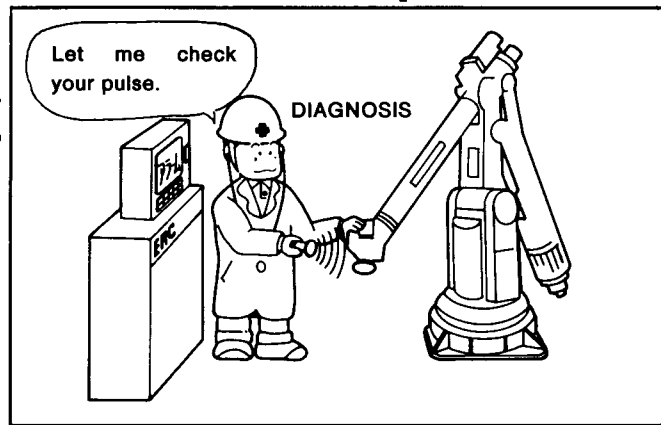
NOTE

Remaining bytes show the capacity of memoried data. But there is a little difference between the displayed numeric value and the actual capacity of the job.

SECTION 10

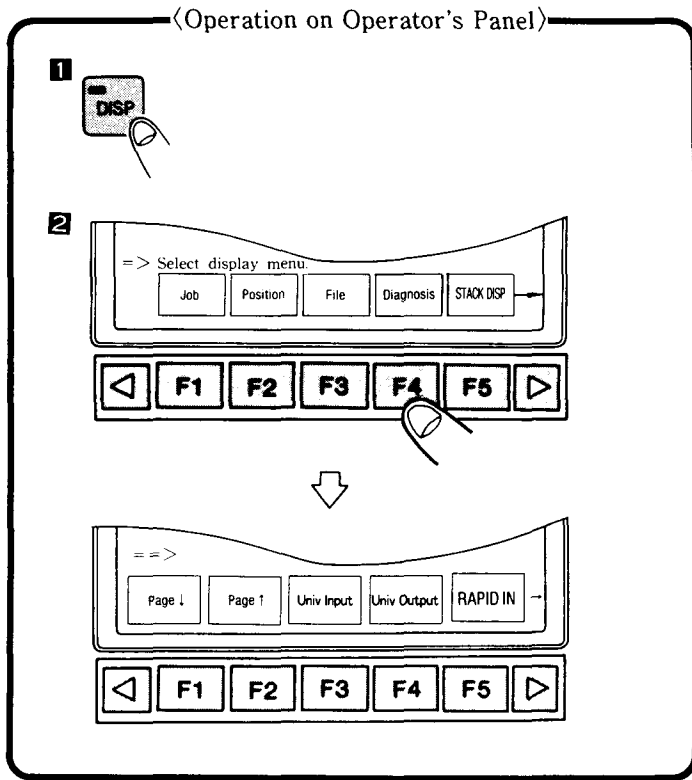
DIAGNOSIS OPERATION

I/O status diagnosis and motion/time confirmation for reference or servo system are possible on diagnosis operation. This section describes each diagnosis display.



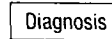

	CONTENTS	PAGE
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10. 2	MOVING TIME DISPLAY	240
10. 3	INPUT STATUS DISPLAY	241
10. 4	OUTPUT STATUS DISPLAY	242
10. 5	DIRECT-IN STATUS DISPLAY	243
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10. 7	POWER ON/OFF POSITION DISPLAY	245
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At first, call up the diagnosis display.



〈Description〉

Depress  key.

Depress  soft key.


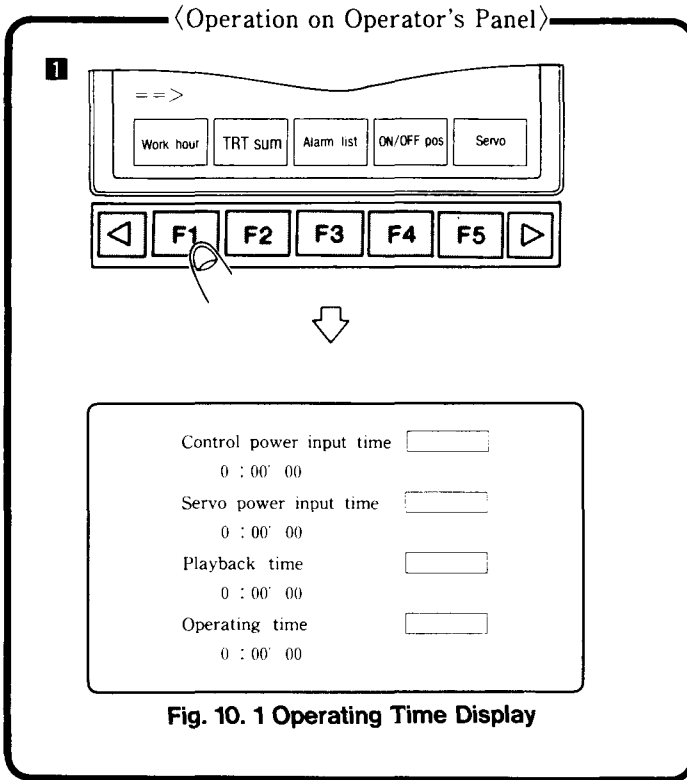
There are eight diagnosis displays as follows.
Depress  key to display soft keys corresponding these diagnosis displays.

★ Diagnosis displays

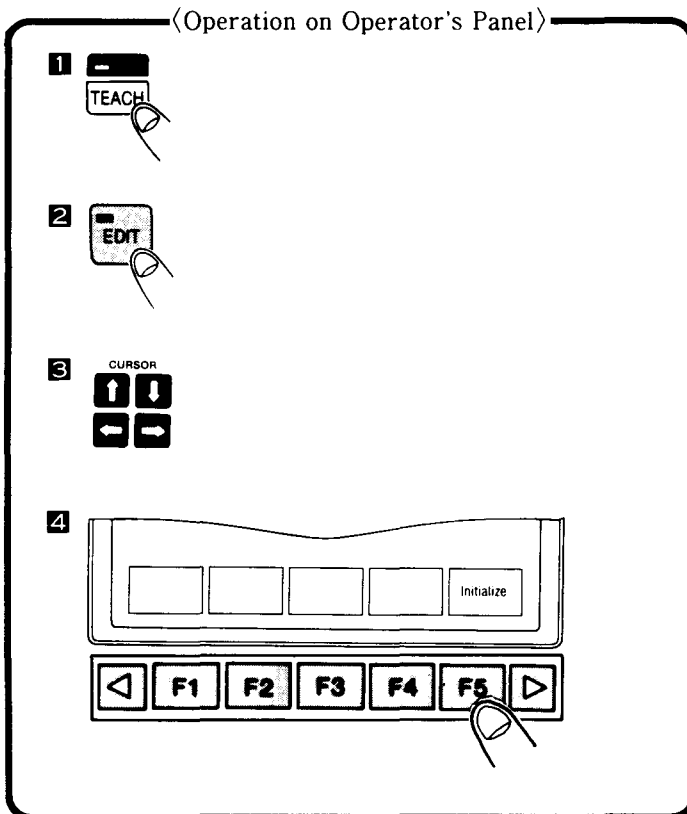
- Operating time (par. 10. 1)
- Moving time (par. 10. 2)
- Input status (par. 10. 3)
- Output status (par. 10. 4)
- Servo (par. 10. 5)
- Power ON/OFF position (par. 10. 6)
- Alarm history (par. 10. 7)
- Position (par. 10. 8)

10.1 OPERATING TIME DISPLAY

- Calling up operation time display



- Initial time setting



〈Description〉

Depress Work hour soft key.
F1

The initial setting date is registered in
 Operating times is time during arc on for arc welding.

〈Description〉

Depress TEACH key.

Depress EDIT key.

Place the cursor on operating time to be set by using cursor keys.

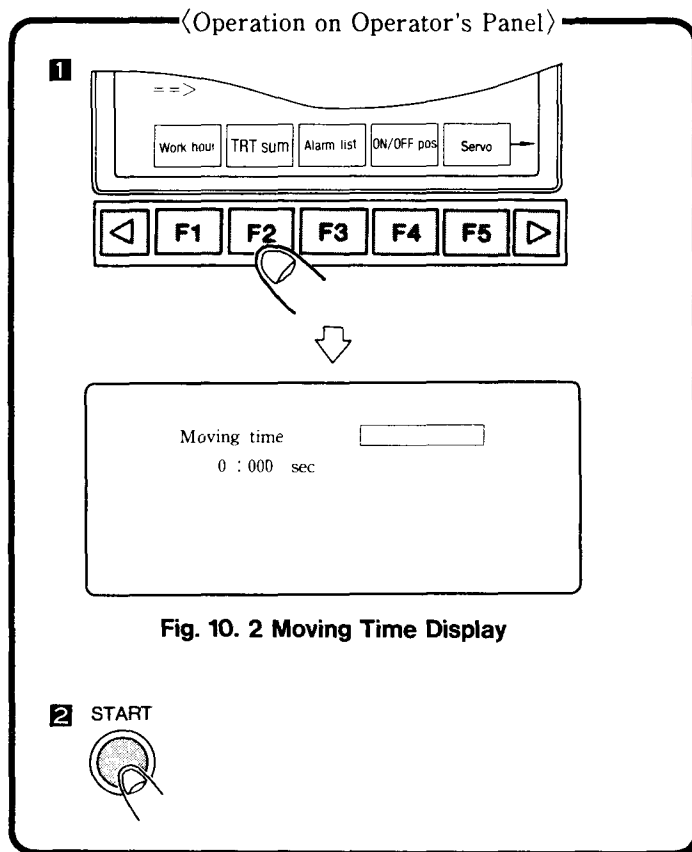
Depress Initialize
F5 soft key.

10

10.2 MOVING TIME DISPLAY

Moving time display shows actual moving time of manipulator while integrating data. This time cannot be registered when waiting the input signal in playback or when stopping the manipulator in timer instruction.

- Calling up moving time display



〈Description〉

Depress TRT sum
F2 soft key.

The initial setting date is registered in

Depress START button.

Moving time between moving start and stop is displayed while integrating data.

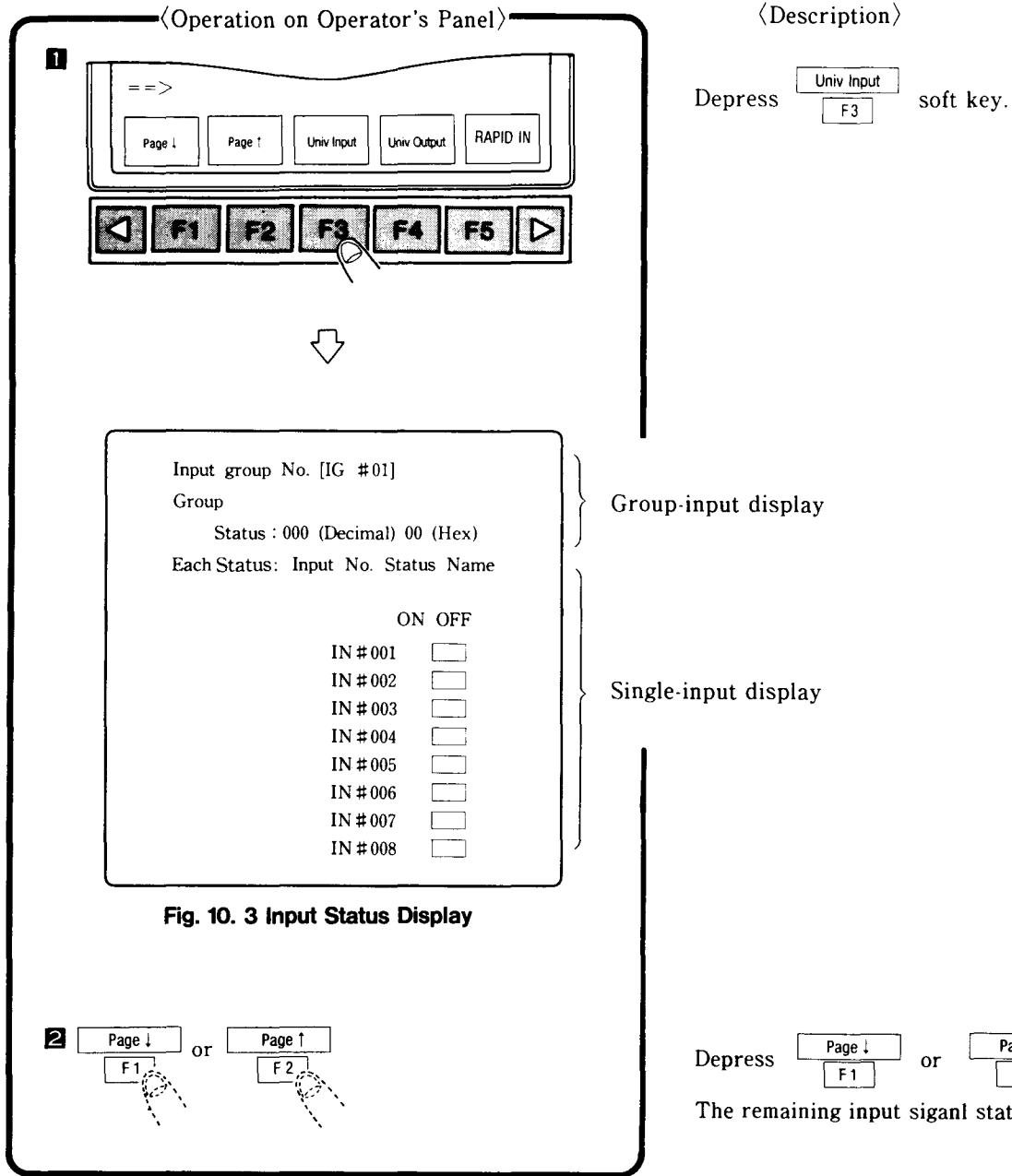
The moving time interval is the difference between display time before start and display time after stop.

To start the manipulator motion at moving time 0 by initial setting, depress Initialize
F5 soft key.

10.3 INPUT STATUS DISPLAY

Either external input signal is input (ON) or not input (OFF) is confirmed in input status display.

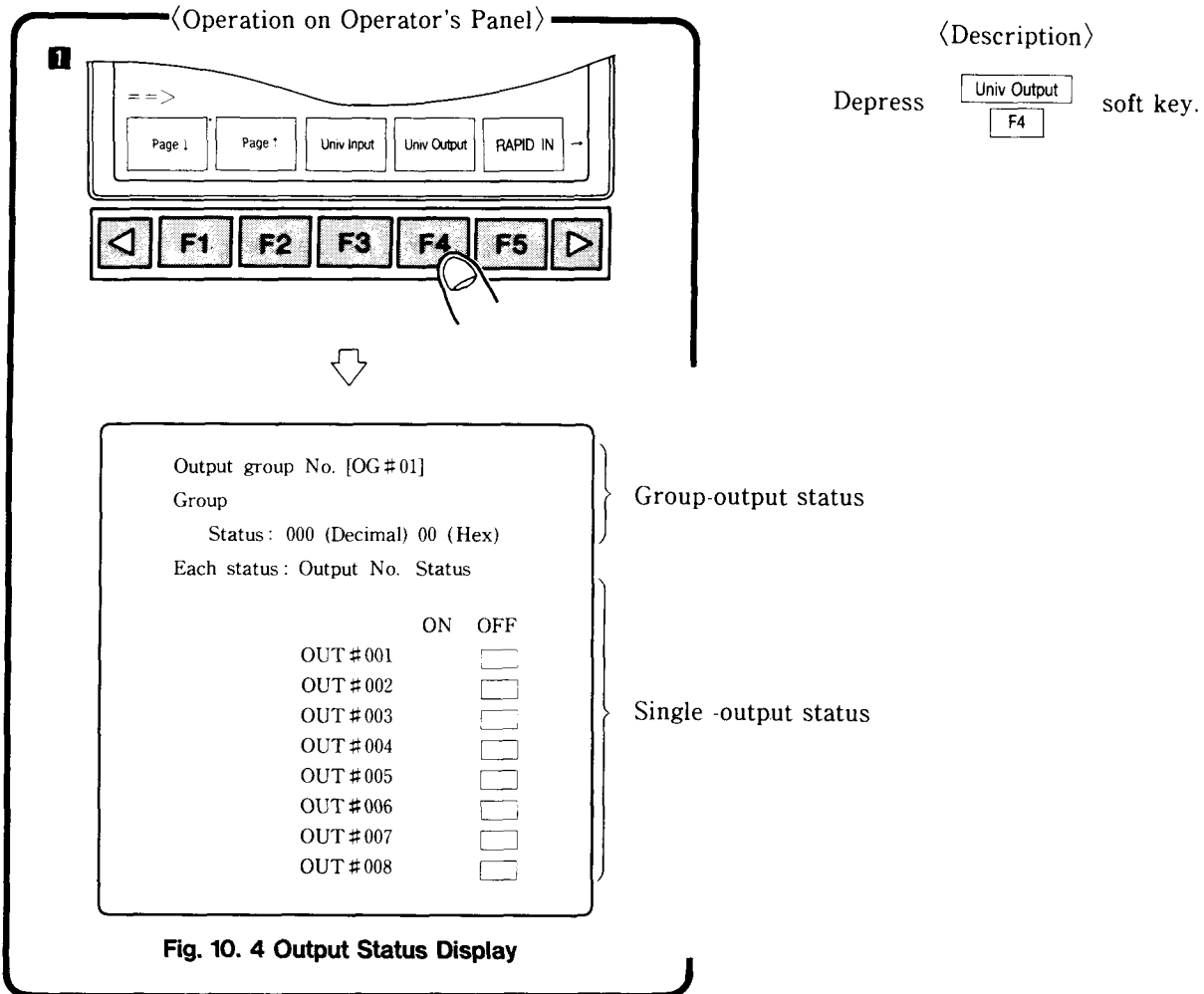
- Calling up input status display



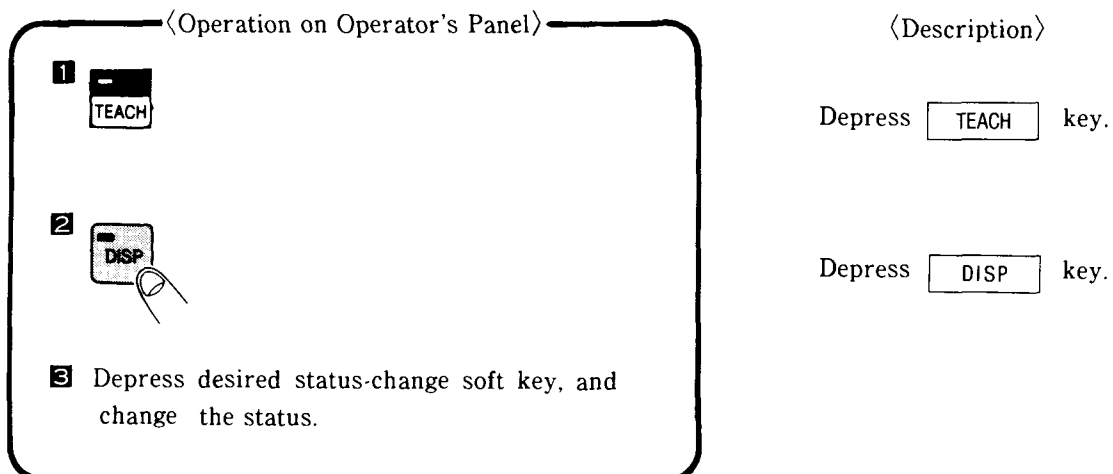
10.4 OUTPUT STATUS DISPLAY

Output status set by output instruction can be checked in this display.

- Calling up output status display

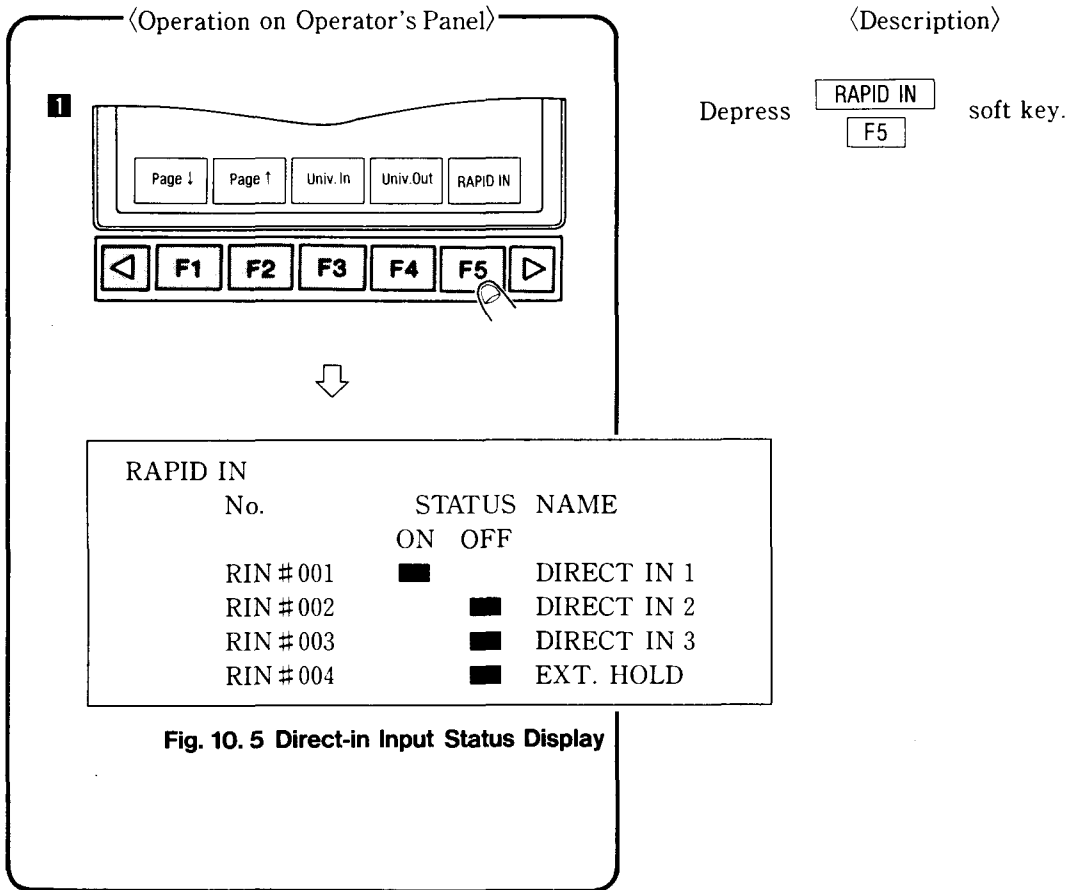


- Output signal status change



10.5 DIRECT-IN STATUS DISPLAY

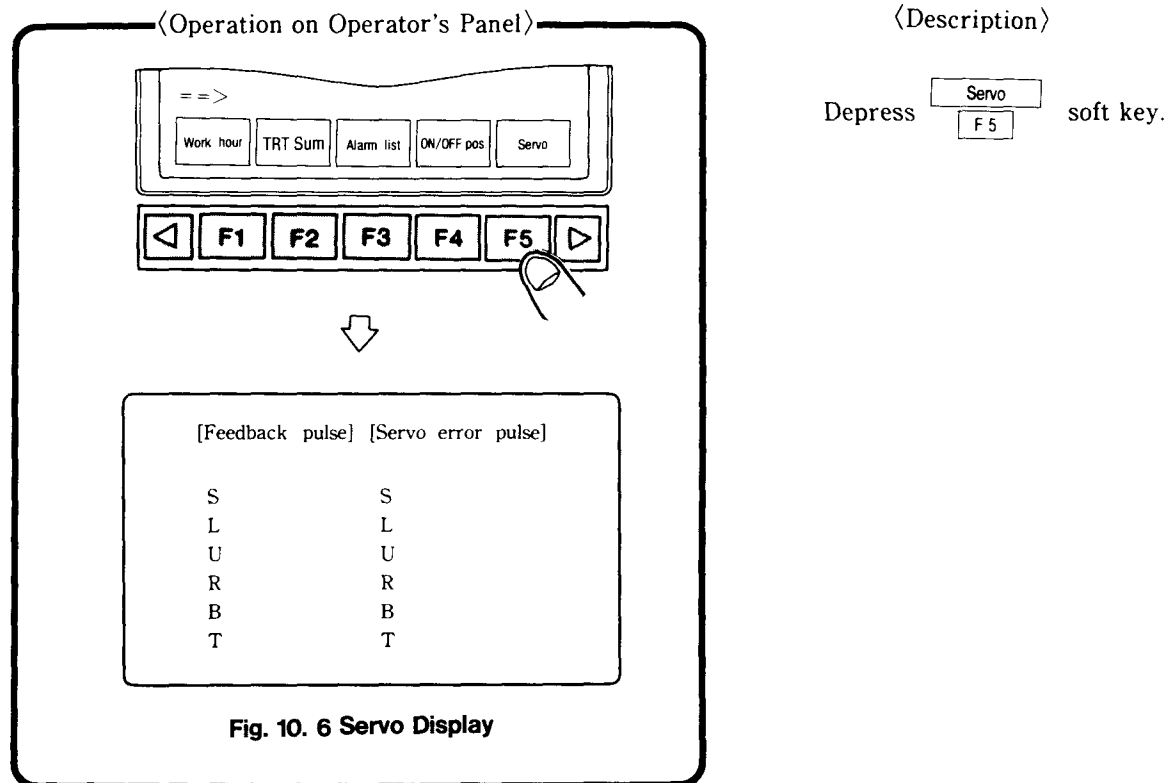
In RIN (direct-in) input status display, the confirmation of whether the direct-in signal from external is received (ON) or not received (OFF) can be executed.



10.6 SERVO DISPLAY

Feedback pulse and servo follow-up error pulse for each axis are displayed in servo display.

- Calling up servo display

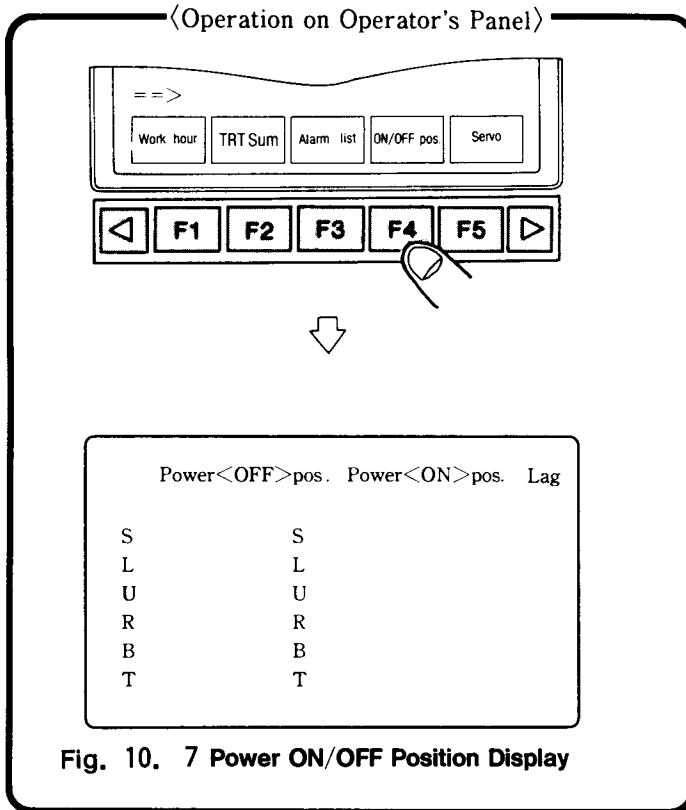


If alarm 1390 (positioning error) occurs, check the servo follow-up error pulse in this display. Servo follow-up error pulse is the range between -2 and $+2$ in stop.

10.7 POWER ON/OFF POSITION DISPLAY

Manipulator current values at main power interruption and at main power input are displayed in this display.

- Calling up power ON/OFF position display



〈Description〉

Depress

ON/OFF pos.
F4

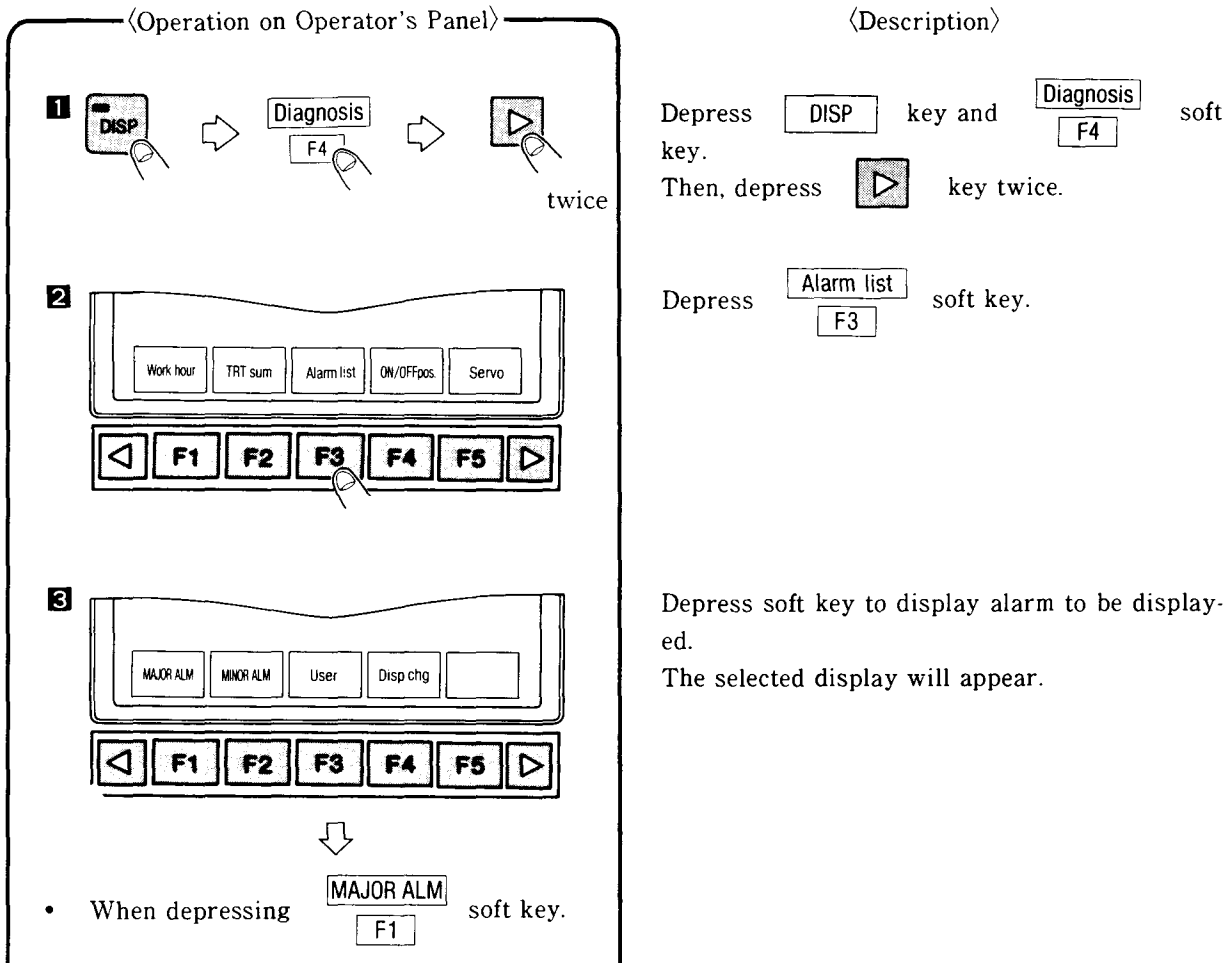
 soft key.

If alarm 1290 or 1291 (Allowable range error of absolute data) occurs, error value of error axis can be checked.

10.8 ALARM HISTORY DISPLAY

The alarm history display has three displays for major alarms (10 alarms), minor alarms (10 alarms) and user alarms (10 alarms). Each display shows the job name, step No., line No., year, month, day, hour and minute for an alarm.

- Calling alarm history display



MAJOR ALARM						
	ALARM	JOB NAME	STEP	LINE	DATE	TIME
1	0060	SAMPLE_1	0001	0001	1989/05/12	09 : 30
2	0013	SAMPLE_2	0013	0298	1989/05/13	10 : 50
3	0022	SAMPLE_3	0003	0045	1989/06/20	09 : 23
4	0120	SAMPLE_4	0123	0013	1989/06/21	10 : 01
5						
6						
7						
8						
9						
10						
	ALARM 0060 : DESTROYED JOB DATA					

Detailed content of alarm code

Fig. 10. 8 Major Alarm History Display

- When depressing **MINOR ALM** **F2** soft key.

MINOR ALARM						
	ALARM	JOB NAME	STEP	LINE	DATE	TIME
1	1290	SAMPLE_1	0001	0001	1989/05/12	09 : 30
2	1000	SAMPLE_2	0013	0298	1989/05/13	10 : 50
3	1000	SAMPLE_3	0003	0045	1989/06/20	09 : 23
4	1020	SAMPLE_4	0123	0013	1989/06/21	10 : 01
5						
6						
7						
8						
9						
10						

Detailed content of alarm code → Alarm 1290 : OUT OF RANGE (ABS DATA)

Fig. 10. 9 Minor Alarm History Display

- When depressing **User** **F3** soft key.

USER ALARM						
	ALARM	JOB NAME	STEP	LINE	DATE	TIME
1	2020	SAMPLE_1	0001	0001	1989/05/12	09 : 30
2	2040	SAMPLE_2	0013	0298	1989/05/13	10 : 50
3	2080	SAMPLE_3	0003	0045	1989/06/20	09 : 23
4	2030	SAMPLE_4	0123	0013	1989/06/21	10 : 01
5						
6						
7						
8						
9						
10						

Detailed content of alarm code → Alarm 2020 : FAULTY SERVOPACK [SLURBT]

Fig. 10. 10 User Alarm History Display



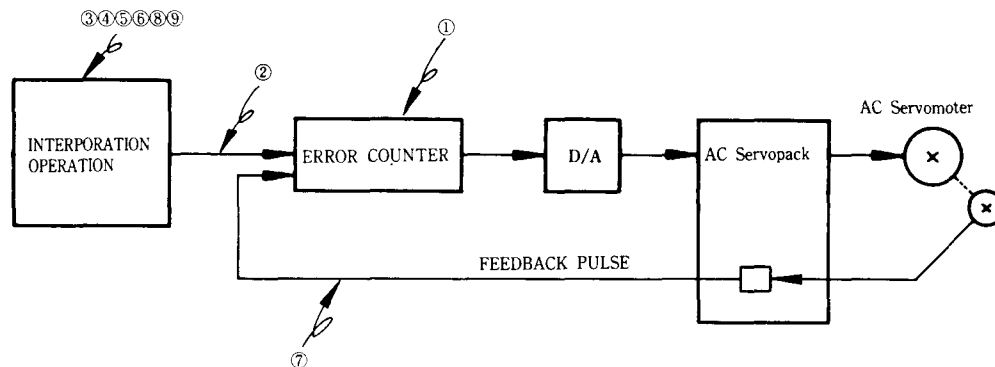
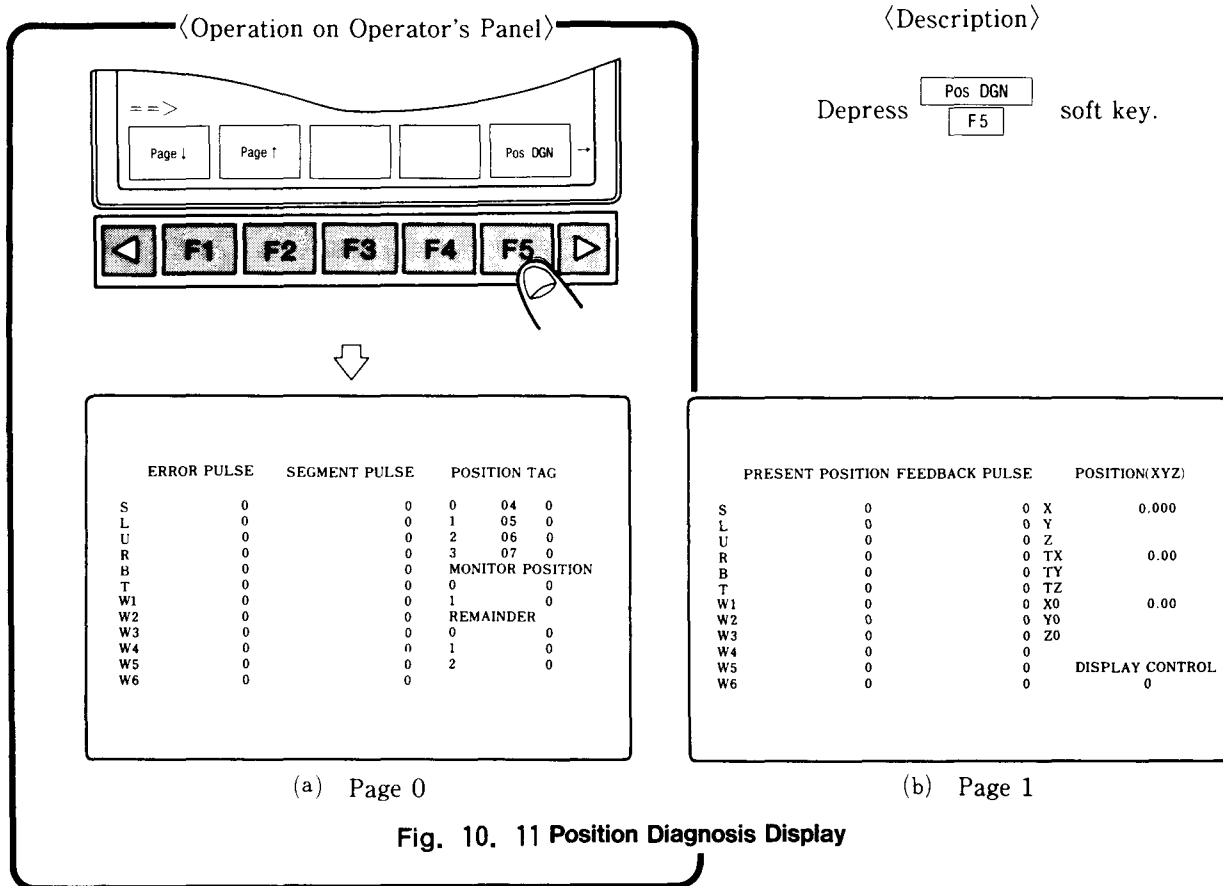
- For displaying detailed contents of each alarm, set the cursor at the desired alarm code by using cursor keys. The contents are displayed at the bottom of the CRT display.
- Clearing of alarm history :

Depress **EDIT** key during alarm history display and depress **Initialize** **F5** soft key. Now, the history is cleared.

10.9 POSITION DIAGNOSIS DISPLAY

The detailed contents of servo system status displayed in this display.

- Calling up position diagnosis display

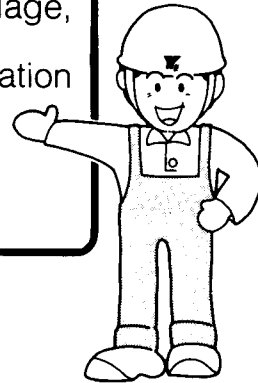














★ Meaning of each signal

- ① ERROR PULSE Servo error pulse of each axis
- ② SEGMENT PULSE Reference value for each unit of time
- ③ POSITION TAG Tag status using internal operation
- ④ MOTOR POSITION Motor position of wrist (same value as feedback)
- ⑤ REMAINDER Offset operation status of wrist
- ⑥ PRESENT POSITION Current value (pulse)
- ⑦ FEEDBACK PULSE Feedback pulse value
- ⑧ POSITION (XYZ) Current value (XYZ)
- ⑨ DISPLAY CONTROL Coordinate system of current value (XYZ)

APPENDIX

Appendix describes the different points between controller YASNAC RX and YASNAC ERC, such as robot language, error message, example of instruction using, calibration function, etc.



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A1. ROBOT LANGUAGE "INFORM"

A1. 1 LIST OF INSTRUCTIONS

NOTATION

1. { } : Setting range
2. _____ : Selection item (Select one.)
3. < > : Specification part by user

Table A1. 1 Move Instructions

Instruction	Function	Format	Example
MOVJ (Move, Joint)	Moves to the teach point by joint interpolation. [VJ=0.001 to 100.00%] [PL=0 to 4]	MOVJ<Position><Ext. axis position> VJ=<Link speed> PL=<Positioning level>, <CONT><UNTIL sentence> <NWAIT>	MOVJ(EX) VJ=64.5 PL=2 UNTIL IN#16=1 NWAIT
MOVL (Move, Linear)	Moves to the teach point by linear interpolation. (V=0.1 to 1200.00mm/s) (VR=0.1 to 180.0°/s) (VE=0.001 to 100.00%)	MOVL<Position><Exit. axis position> V=<Speed> VR=<Wrist orientation speed> VE=<Ext. axis speed> PL=<Positioning level>, <CONT> <UNTIL Sentence><NWAIT>	MOVL(EX)V=120.0 PL=2 UNTIL IN#16=1 NWAIT
MOVC (Move, Circular)	Moves to the teach point by circular interpolation.	MOVC<Position><Exit. axis position> V=<Speed> VR=<Wrist orientation speed> VE=<Ext. axis speed> <CONT> <NWAIT>	MOVC V=120.0 NWAIT
MOVS	Moves to the teach point by parabolic path.	MOVS<Position><Ext. axis position>, V=<Speed> VR=<Wrist orientation speed> VE=<Ext. axis speed> <CONT> <NWAIT>	MOVS V=120.0
REFP (Reference, Point)	Wall point of weaving	REFP<Position><Exit. axis position> <No.> ↑ (Wall point 1 of weaving=1, Wall point 2 of weaving=2)	REFP1
SPEED	Speed data setting	SPEED V=<Speed> VR=<Wrist orientation speed> VJ=<Link speed>, VE=<Ext. axis speed>	SPEED VJ=50.00 V=250.0 VR=45.0
IMOV (Increment, Move)	Moves specified increment from current position by linear interpolation.	IMOV P<Variable No.> RF, TF, UF#<User frame No.> RF: Robot coord. TF: Tool coord. UF#: User coord. EX<Variable No.> V=<Speed>, VR=<Wrist orientation speed> VE=<Ext. axis speed> PL=<Positioning level> <UNTIL><NWAIT>	IMOV P012 V=120.0

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Table A1. 2 I/O Instructions

Instruction	Function	Format	Example
DOUT (Digital, Out)	Output relay is turned ON/OFF.	DOUT OT#<Output No.> OG#<Output No.> <u><Status>B<Variable No.></u> ↑ [Status: 0=OFF, 1=ON]	DOUT OT#12=1 (DOUT OG#02=24)
PULSE	Pulses are output to output relay.	PULSE OT#<Output No.> T=<Time> ↑ [0.1 to 3.0s] Note: If no specification, 0.3s is set.	PULSE OT#10T=0.6
DIN (Digital, In)	Input signal is read.	DIN B<Variable No.> IN#<Input No.> (1 to 96) <u>IG#<Input group No.></u> (1 to 12) OT#XX:Univ. Output (1 to 64) OG#XX:Univ. Output group (1 to 4) SIN#XX:special input (1 to 40) SOT#XX:special output (1 to 80)	DIN B16 IN#16 (DIN B02 IG#02)
WAIT	Waits until input relay coincides with specified status.	WAIT <u>IN#<Input No.></u> <u>IG#<Input group No.></u> <u><Status>B<Variable No.></u> T=<Time>	WAIT IN#12=1 T=10.0 (WAIT IN#12=B02)
AOUT (Analog, Out)	Voltage setting value is output to general-purpose output port.	AOUT AO#<Output port No.> <Voltage output value> ↑ [-14.1V to +14.0V]	AOUT AO#1 12.7
POSOUT (Position, Out)	Any teaching position is regarded as a monitoring position. When this instruction is executed, the specified universal output (no robot interference signal) is turned on. If the manipulator is moved from the monitoring position, the output is turned off automatically.	POSOUT PM# <Data file No. for position monitoring> (1 to 8)	POSOUT PM#01
NWAIT (No. Wait)	Next instruction starts before completing the MOVE instruction.	MOVL <Position> <Ext. position> V = <Speed> NWAIT TIMER T = <Time>	MOVL V =100.0 NWAIT TIMER T =0.5 DOUT OT #01 = 1



Table A1. 3 Control Instructions


Instruction	Function	Format	Example
JUMP	Jumps to specified label or job.	JUMP<Label No.> <Job name> IG#<Input group No.> B<Variable No.><IF syntax>	JUMP JOB:HARA IF IN#14=0
* (Asterisk)	Label indicated position to be jump	*<8 characters (half-size)>	*123
CALL	Call up specified job.	CALL JOB:<Job name> IG#<Input group No.> B<Variable No.><IF syntax>	CALL JOB:ABC123 IF IN#24=1
RET (Return)	Returns to the called job.	RET<IF syntax>	RET IF IN#12=0
END	End of job	END	END
NOP	No operation	NOP	NOP
TIMER	Manipulator stops during specified time.	TIMER T=<Time> ↑ (0.01 to 327.67s)	TIMER T=12.5
CWAIT	Waits the execution of move instruction.	CWAIT	CWAIT
IF Syntax	A variety of conditions are determined.	<Instruction> IF<Comparison element 1> =, < , <=, >=, < , > <Comparison element>	JUMP #12IF IN#12=0
UNTIL	Input condition is determined during operation.	<Instruction> UNTIL IN#<Input No.>=<Status> ↑ (status:0=OFF, 1=ON)	MOVL V=300 UNTIL IN#10=1
PAUSE	Temporary stop	PAUSE <IF syntax>	PAUSE IF IN#12=0
STOP	Servo-off stop	STOP <IF syntax>	STOP IF IN#12=0

Table A1. 4 Shift Instructions

Instruction	Function	Format	Example
SFTON (Shift, On)	Starts the shift operation.	SFTON P<Variable No.> RF, TF, FU#<User frame No.> RF:Robot coordinate TF:Tool coordinate UF#:User coordinate EX<Variable No.>	SFTON P12
SFTOF (Shift, Off)	Stops the shift operation.	SFTOF	SFTOF

Table A1. 5 Operating Instructions

Instruction	Function	Format	Example
ADD	Adds two data, and stores the result in data 1*.	ADD<Data 1><Data 2>	ADD I12 I13
SUB	Subtracts between two data, and stores the result in data 1*.	SUB<Data 1><Data 2>	SUB I12 I13
 MUL	Multiplies two data, and stores the result in data 1*.	MUL<Data 1><Data 2>	MUL I12 I13
 DIV	Divides two data, and stores the result in data 1*.	DIV<Data 1><Data 2>	DIV I12 I13
INC	Adds one to the contents of specified variable.	INC <u>B<Variable No.></u> <u>I<Variable No.></u>	INC I43
DEC	Subtracts one from the contents of specified variable.	DEC <u>B<Variable No.></u> <u>I<Variable No.></u>	DEC I43
AND	Calculates AND between two specified data, and stores the result in data 1.	AND B<Variable No.> B<Variable No.>	AND B11 B20
OR	Calculates OR between two specified data, and stores the result in data 1.	OR B<Variable No.> B<Variable No.>	OR B12 B20

 Position-type variables (element specification) is specified in <Data 1> of MUL and DIV instructions.

Instruction	Function	Format	Example
MUL	Multiplies two items of data, and stores the result in data 1*.	MUL<Data 1><Data 2>	MUL P000(3)2 (P000=(Zdata)*2)
DIV	Divides two items of data, and stores the result in data 1*.	DIV<Data 1><Data 2>	DIV P000(3)2 (P000=(Zdata)/2)

The element of position-type variables is as follows.

Pxxx(0)	All axis data	Pxxx(4)	Tx data
Pxxx(1)	X-axis data	Pxxx(5)	Ty data
Pxxx(2)	Y-axis data	Pxxx(6)	Tz data
Pxxx(3)	Z-axis data		

*Data 1 should be variables.





Table A1. 5 Operating Instructions (Cont'd)

Instruction	Function	Format	Example
NOT	Calculates NOT between two specified data, and stores the result in data 1.	NOT B<Variable No.> B<Variable No.>	NOT B12 B20
XOR	Calculates XOR between two specified data, and stores the result in data 1.	XOR B<Variable No.> B<Variable No.>	XOR B12 B20
SET	Sets data 2 in specified variable(data 1*)	SET <Data 1><Data 2>	SET 112 112
SETE	Sets the data in elements of position type variable.	SETE <u>P<Variable No.></u> <u>(<Element No.>)</u> <u>EX<Variable No.></u> <u>D<Variable No.><Double-</u> <u>precision integer No.></u>	SETE P012(3) D05
GETE	Extracts the elements of position type variable.	GETE D<Variable No.> <u>P<Variable No.></u> <u>(<Element No.>)</u> EX<Variable No.>	GETE D06 P012(4)
CNVRT*	Converts pulse-type position variables or system variables to cartesian data of each coordinate system. When coordinate designation is omitted, conversion is performed by the job coordinate under execution (normally base coordinate).	CNVRT P <Variable No.> P <Variable No.> <u>BF, RF, UF# <User frame No.></u> BF : Base coordinate RF : Robot coordinate UF# : User coordinate	CNVRT P000 \$P13 BF

* : When the robot system variables (current value, reference point) are changed to cartesian data, a coordinate to convert the value can be specified. (Effective from V4.20)



Table A1. 6 Working Instructions for Welding

Instruction	Function	Format	Example
CLEAR	<ul style="list-style-type: none"> Data are cleared on variable data specified at Tag 1 and onward. The cleared number is the setting number in Tag 2. When ALL is set in Tag 2, all variables following the specified variable in Tag 1 are cleared. When STACK is set at Tag 1, all job call stacks are cleared. 	CLEAR B<Variable No.> I<Variable No.> D<Variable No.> R<Variable No.> STACK <Number data>, ALL	CLEAR BOO ALL CLEAR STACK
 SIN (Sine)	Calculate sine of Data 2, and store the result in Data 1.	SIN<Data 1><Data 2>	SIN ROO RO1 (ROO=SINRO1)
 COS (Cosine)	Calculate cosine of Data 2, and store the result in Data 1.	COS<Data 1><Data 2>	COS ROO RO1 (ROO=COSRO1)
 ATAN (Tangent)	Calculate tangent of Data 2, and store the result in Data 1.	ATAN<Data 1><Data 2>	ATAN ROO RO1
 Sqrt($\sqrt{\quad}$) (Square root)	Calculate square root of Data 2, and store the result in Data 1.	SQRT<Data 1><Data 2>	SQRT ROO RO1 (ROO= $\sqrt{RO1}$)
ARCON (Arc on)	Outputs arc ON instruction.	ARCON	ARCON
ARCOF (Arc off)	Outputs arc OFF instruction.	ARCOF	ARCOF
VWELD	Outputs the voltage instruction for welding.	VWELD<Voltage instruction value> [-14.1V to + 14.0V]	VWELD 2.5
AWELD	Outputs the current instruction for welding.	AWELD<Current instruction value> [-14.1V to + 14.0V]	AWELD 12
WVON (Weave On)	Starts the weaving operation.	WVON<File No.>	WVON 12
WVOF (Weave Off)	Stops the weaving operation.	WVOF	WVOF


 For these four instructions, the object of the arithmetic calculation is only real-type variables (R) and constant.

Table A1. 7 Others Instructions

Instruction	Function	Format	Example
(Apostrophe)	The element describing the partial contents of jobs, can be registered.	<32 characters max. (half-size)>	—

A 1. 2 USER VARIABLES

The user variables are used for temporary storage of counter, operation, input signals, etc. These variables retain the contents even if the power is cut off. Define the usage of variable by user.

Example of usage

- Control for number of works
 - Control for number of working times
 - Information delivery between jobs.
- } Be sure to perform the initial setting before using.
When many jobs are created, determine the usage of variables.

Variable type

1. Integer type: I <00 to 99>

Usable variables	_____	100 variables from I00 to I99
Storable range	_____	−32768 to +32767

2. Double-precision integer type: D 00 to 99

Usable variables	_____	100 variables from D00 to D99
Storable range	_____	−2147483648 to +2147483647

3. Real type: R <00 to 99>

Usable variables	_____	100 variables from R00 to R99
Storable range	_____	−1.70141E +38 to 1.70141E +38

4. Byte type: B <00 to 99>

Usable variables	_____	100 variables from B00 to B99
Storable range	_____	0 to 255

This variable is used for storing I/O status, and can be executed by logical operation. For storing I/O status, there are two types :

- Single I/O (Setting value is 0 or 1.)
- Group I/O (One group is 8 points.)

A 1. 2 USER VARIABLES (Cont'd)

5. Position type (Robot axis): P <00 to 63>

Usable variables ————— 64 variables from P00 to P63

This variable has enough area to store the six elements which indicate manipulator position and wrist orientation.

Set either joint coordinates (pulse position) or rectangular coordinates.

For shift instructions, set rectangular coordinates because element data can be stored as incremental values (shift data) for each element.

6. External position type(External axis): EX <00 to 63>

Usable variables ————— 64 variables from EX00 to EX63

Each variable has storage area for a number of external axis.

For normal external axis, each piece of element data is set as pulse position.

For external axis, forming base coordinates, set as position data in rectangular coordinate system.

These position data are also used as shift data of external axis.

A 1. 3 SYSTEM VARIABLES

The system variables can be referred by specified instructions in job (operating program). However, it cannot be changed by user because it is controlled by the system.

The type and meaning of the variables are determined by the system.

System variable type

1. Position type

P00: Current positions (pulse type) of robot axis are stored.

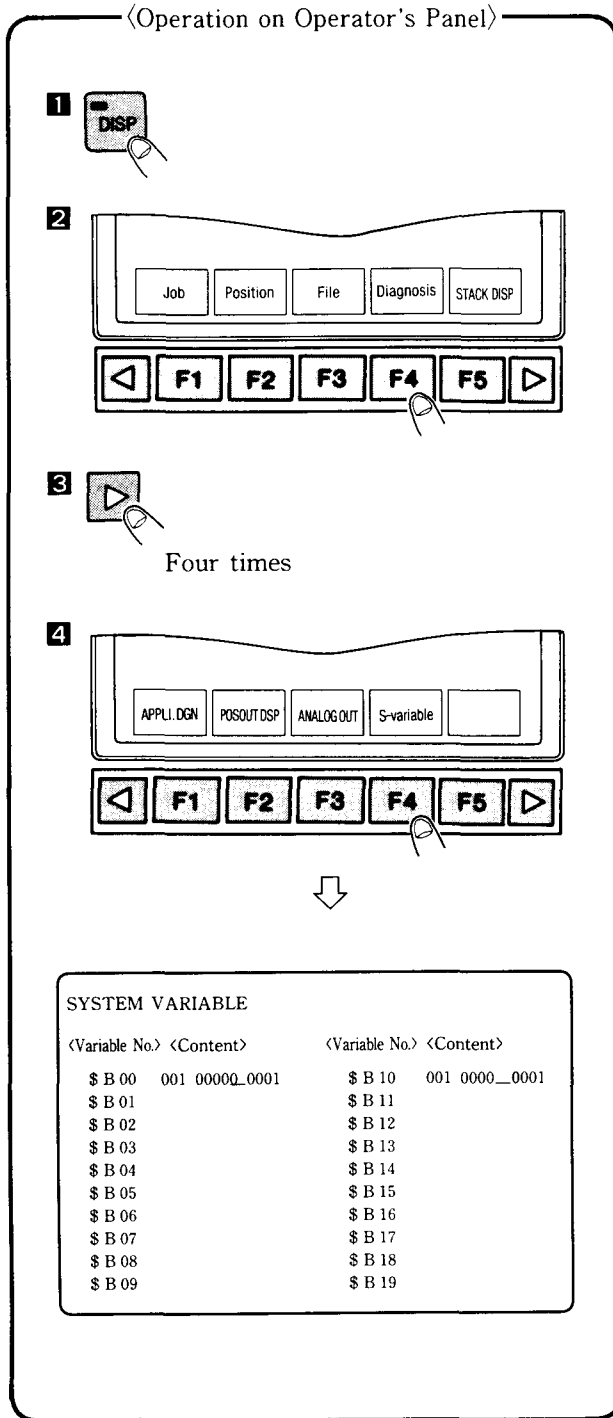
P01: Current positions (XYZ type) of robot axis are stored.

2. External axis position type

This variable is used only for adding the external axis.

SXE00: Current positions (pulse type) of external axis are stored.

<Display Method of Byte-type system variables>



<Description>

Depress DISP key.

Depress Diagnosis soft key.
F4

Depress ▶ key four times.

Depress S-variable soft key.
F4

The display for list of byte-type variables will appear.



These data are only referenced and it can not be altered.

A

A2. ERROR MESSAGE

Error messages are classified for each group of error Nos.

Table A2. 1 Classification of Error Messages

Group of Error No.	Classification of Error Messages
0xxx	System and operation (Table A2. 2)
1xxx	Editing (Table A2. 3)
2xxx	Job registration (Table A2. 4)
3xxx	Teach pendant operation (Table A2. 5)
4xxx	Floppy disk operation (Table A2.6)
5xxx	—
6xxx	Concurrent I/O editing (Table A2. 7)
7xxx	—
8xxx	—
9xxx	System (software) error (Table A2. 8)

Table A2. 2 Error Messages for System and Operation

Error No.	Message	Causes
0010	Turn on the servo-on key.	Servo power not supplied
0020	Depress PLAY mode key.	Out of specified mode operation
0030	Depress TEACH mode key.	Out of specified mode operation
0040	Try HOME CALIBRATION.	Home position not set.
0050	Start from TEACH PENDANT.	Starting available only for teach pendant
0060	Release softlimit.	Soft limit not reset
0070	Not completed (current position)	Current value not created
0080	No specified axis	(basic axis)
0081	No specified axis	When setting the parameter, an external axis which does not exist in block-axis setting parameter is set.
0090	Ladder data are fault.	Total check error of ladder intermediate code
0100	Check permitted conditions of start operation.	—
0110	Loading from floppy disk	—
0120	On initialization	—

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Error No.	Message	Causes
0130	OVERRIDE cannot execute in DRY RUN MODE.	Override speed cannot be set by the operator's panel.
0140	Undefined manipulator position variable.	Position type variable cannot be used.
0150	—	—
0160	Operating from TEACH PENDANT.	While the ENABLE key lamp is lit, editing or start from operator's panel cannot be executed.
0170	Undefined USER FRAME FILE	—
0180	Undefined points (OGR, XX, XY)	ORG, XX and XY point on user coordinates not taught.
0190	Move the manipulator at the taught step pos. (EXT AXIS)	External axis position was changed during teaching three basic points on user coordinates.
0200	Under transmitting data	—
0210	External SERVO-OFF signal is in.	—
0220	External inhibit Mode-change signal is on.	—
0230	External inhibit-Start signal is in.	—
0240	Push the SERVO-OFF button before the operation.	Servopower is turning on when the compilation of concurrent I/O is executed.
0250	The C. 10 program does not run.	—

Table A2. 3 Error Messages for Editing

Error No.	Message	Causes
0260	Same position in the 3 points for User FRAME.	When registering three basic points (ORG, XX, XY) of user coordinates, the same positions are registered.
0280	Different Tool between prog. and current Tool.	When deleting (altering) MOVE instruction, the numbers shown below are not matched. <ul style="list-style-type: none"> • Registered tool No. • Tool No. selected in teach pendant
0290	Selecting disable MASTER JOB CHANGE MODE.	At teach condition display, the setting of master job alteration should be on permission (OFF).
0310	On inhibit-initialization.	The parameter of concerned integrating time is set on initialization prohibit.
0320	Selecting disable in CHECK MODE.	The concerned operation is set to permission (0) at playback condition display.
0330	Selecting disable in MACHINE LOCK MODE.	
0340	Selecting disable in M-JOB CALLING MODE.	
0360	Not completed to check the SPECIFIED Point.	Perform the check operation of the SPEC PNT (second home position).
1010	Edit-lock mode.	Editing prohibition
1020	Enter correct value.	Incorrect input data was set.
1030	Unauthorized ID number.	OP2 key operation not possible
1040	Input the value with eight digits.	Lack of number of input data digits

A

Error No.	Message	Causes
1050	Impossible alternation due to system reserved.	Change of job name reserved by the system not possible
1060	Not available to change TRT-TIME.	—
1080	Illegal character in message.	When registering User alarm messages, unusable characters as messages are tried as key-inputs to register.
1090	Illegal DATA in the file.	When completing welder condition file setting, the check is performed for number of set data (3 or more) and the contents. If there is an error, this alarm will occur.

Table A2. 4 Error Messages for Job Registering

Error No.	Message	Causes
2010	Not enough memory available.	Lack of job registering memories
2011	Not enough memory available.	Lack of instruction file memories
2012	Not enough memory available.	Lack of position file memories
2020	The JOB within the protect area for edit.	JOB block editing prohibit
2021	The JOB within the protect area for edit.	JOB editing prohibit
2030	Duplicated job name.	The same name already registered.
2040	Undefined job.	No specified job
2041	Undefined job.	No specified job block
2050	Enter job name to edit.	JOB for editing not specified
2060	Enter job name to operate.	JOB to be executed not specified
2070	Move the manipulator at the taught step pos. exactly.	When Move instruction is erased, current robot position and teaching position do not coincide.
2080	No command is acceptable within circular steps.	In circular interpolation, accuracy level cannot be specified.
2090	Display the instruction to edit.	Sequence Nos. do not coincide.



Error No.	Message	Causes
2100	Not register the step no more in the JOB.	Overflow step Nos.
2110	Not possible to edit the END command.	Edit disable after END instruction
2120	Position data are fault.	Memories are destroyed.
2130	Not register position data.	File is not registered.
2140	Depress INSERT or ALTERNATE key.	—
2150	Undefined master job.	Master job not registered.
2160	Depress INSERT to record step as same previous step.	—
2170	Instruction file is fault.	Memories are destroyed.
2180	Alternate it with DELETE and INSERT keys.	Change disable instructions in jobs for welding (teach pendant).
2190	Illegal character in job name	—
2200	Illegal character in label	—
2210	Undefined address to be searched	—
2220	Depress ALTERNATE key.	—

Error No.	Message	Causes
2230	Unacceptable instruction	—
2240	Syntax error	Instruction syntax error
2250	Can't alternate or delete the instruction	—
2260	Can't omit the operand	—
2270	Duplicated the label name	—
2280	Not registered the name	—
2290	Did not program the relative job.	—
2300	Did not program CA, CB, CC points.	—
2310	There are same position in CA, CB, CC.	—
2320	Wrong data in the converted job.	—
2590	Wrong set type of POSITION VARIABLE (MODPS Func.).	Be sure to use XYZ-type position variables for parallel shift.
2600	Not selected POSITION VARIABLE (MODPS Func.).	Before executing single alteration or batch alteration, specify the file.



Table A2. 5 Error Messages for Teach Pendant Operation

Error No.	Message	Causes
3010	Can't teach position while softlimit released	—
3030	This axis does not work under EXT-AXES BLOCK.	At teaching, the external axis which is set at "No move," the move operation is tried by using teach pendant.

Table A2. 6 Error Messages for Floppy Disk Operation

Error No.	Message	Causes
4010	Connect cable of floppy disk drive.	Cable Connection fault of floppy disk drive or power not supplied (No response from floppy disk drive)
4020	Insert floppy disk.	—
4030	The floppy disk is protected from WRITE operation	The floppy disk is set to write prohibit.
4040	Undefined file in the floppy disk	—
4050	The file already exists in the floppy disk.	—
4060	Not enough memory available in the floppy disk.	No space in storage area in floppy disk.
4070	Not enough file available in the floppy disk	—
4080	I/O error in floppy disk	Excess allowance number of retransmissions.
4090	Transmission error with floppy disk drive	Framing error (Abnormal number of data bits)
4091	Transmission error with floppy disk drive	Data overrun error (Abnormal data receive processing)
4092	Transmission error with floppy disk drive	Parity error
4093	Transmission error with floppy disk drive	Data code error (Unspecified data code is included.)



Table A2. 6 Error Messages for Floppy Disk Operation (Cont'd)

Error No.	Message	Causes
4094	Transmission error with floppy disk drive	Wrong reading out from floppy disk
4095	Transmission error with floppy disk drive	Wrong writing into floppy disk
4096	Transmission error with floppy disk drive	No response command or data from floppy disk drive during allowance time
4097	Transmission error with floppy disk drive	Interruption cannot be executed from serial I/O controller.
4098	Transmission error with floppy disk drive	Floppy disk drive error except for error No. 4090 to 4097
4100	Total check error	Total values of Intel HEX code are different.
4110	Syntax error	Syntax error of instructions
4114	Error in INTEL HEX FORMAT	Specification error of data record
4115	Error in INTEL HEX FORMAT	Specification error of EOF record
4116	Error in INTEL HEX FORMAT	Record type error
4117	Error in INTEL HEX FORMAT	Total check error of record
4120	Error in JOB DATA RECORD	Exceeds soft limit, Position type variable No. over, Number error of shafts, etc.
4130	No NOP or END inst. in the job	No NOP instruction at the beginning and no END instruction at the end

Error No.	Message	Causes
4121	Error in INTEL HEX RECORD	NPOS record is wrong for the format.
4122	Error in INTEL HEX RECORD	Date record is wrong for the format.
4123	Error in INTEL HEX RECORD	FRAME record is wrong for the format.
4124	Error in JOB DATA RECORD	Tool record is wrong for the format.
4125	Error in JOB DATA RECORD	Record on the position data section is wrong for the format.
4126	Error in JOB DATA RECORD	Record on the instruction section is wrong for the format.
4127	Error in JOB DATA RECORD	Syntax error of instruction
4128	Error in JOB DATA RECORD	Tag error of instruction
4140	Syntax error	There is an instruction which is not construed.
4141	Error in concurrent I/O RECORD	Specification error of channel No. (Numeric on 2nd and 3rd digits of relay No.)
4142	Error in concurrent I/O RECORD	Specification error of bit No. (Numeric on 1st digit of relay No.)
4143	Error in concurrent I/O RECORD	Specification error of timer No.
4144	Error in concurrent I/O RECORD	Timer value error

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Error No.	Message	Causes
4145	Error in concurrent I/O RECORD	Specification error of operation code No.
4150	Ladder program is too long.	Exceeds program capacity
4160	There is no Ladder program.	No program in editing area.
4170	Format error	Not adapted for the format.
4180	Illegal number of data	—
4200	Data range over	Exceeds the range of the data. (Except soft limit)
4210	Illegal file name	—
4220	A file is fault.	—
4230	Verify error	Verification error (Date > Number of records)
4240	Can't load during robot motion.	—
4250	The file is not allowed to load.	—

Table A2. 7 Error Messages for Concurrent I/O Editing

Error No.	Message	Causes
6010	Illegal relay number	Specification error of relay (Line No. display)
6011	Illegal relay number	Exceeds block No. (Line No. display)
6012	Illegal relay number	Exceeds channel No. (Line No. display)
6013	Illegal relay number	Exceeds bit No. (Line No. display)
6014	Illegal relay number	Exceeds timer No. (Line No. display)
6020	Illegal instruction	Improper instruction is input.
6030	Duplicated relay number	Plural output are instructed to the relay. (Line No. display)
6040	The relay is not used.	There is a disconnected relay. (Block No. display)
6050	Too many STR(-NOT) instructions	(Line No. display)
6060	Too many AND(OR)-STR instructions	(Line No. display)
6070	Syntax error in CRT instructions	CTR instruction construction error (Line No. display)
6080	Enter STR(-NOT) at the head of the block	No STR(-NOT) instruction at the head of block

A

Table A2. 7 Error Messages for Concurrent I/O Editing (Cont'd)

Error No.	Message	Causes
6090	Not enough memory available	Exceeds memory capacity (Line No. display)
6100	Duplicate relay in TMR and CNT	Timer and counter are used twice.
6110	Ladder processing failure	CIO program transfer is interrupted.
6120	Ladder Scan-Time over	Ladder scan time needs 5 ms or more.
6130	Wrong Ladder program (NODE etc.)	Position and number of NODE instruction are wrong.
6140	Memory over (Ladder program)	Exceeds memory capacity
6150	This command is not to edit or erase.	—

Table A2. 8 Error Messages for System (Software)

Error No.	Message	Contents
9010	File Management System (FMS) error	Serial circuit open is not required. Program error.
9011	FMS error	Open is required twice. Program error.
9012	FMS error	One line exceeds max. capacity of text.
9013	FMS error	Specification error of device. Program error.
9014	FMS error	No specified text.
9015	FMS error	Access Method failure.
9016	FMS error	Parameter error. Program error.
9017	FMS error	Others
9018	—	—
9019	—	—
9020	Floppy task interface error	Partition error
9021	Floppy task interface error	PROC error

A

Table A2. 8 Error Messages for System (Software) (Cont'd)

Error No.	Message	Contents
9022	Floppy task interface error	CMOS error
9023	—	—
9024	—	—
9025	—	—
9026	Floppy task interface error	—
9027	—	—
9028	—	—
9029	—	—
9030	JMS error	OVER
9031	JMS error	POOR
9032	JMS error	FOUND
9033	JMS error	NOT_FOUND

Error No.	Message	Contents
9034	JMS error	BAD_BLOCK
9035	JMS error	BAD_STRING
9036	JMS error	BAD_REC_NO
9037	JMS error	BAD_SEQ_NO
9038	JMS error	EDIT_DISABLE
9039	JMS error	BAD_ATTRIBUTE
903A	JMS error	ALREADY_EXISTS
903B	JMS error	NON_CODE
903C	JMS error	NON_STRING
903D	JMS error	NORMAL_END
903E	JMS error	BROKEN
903F	JMS error	LOSE_POINTER

A

Table A2. 8 Error Messages for System (Software) (Cont'd)

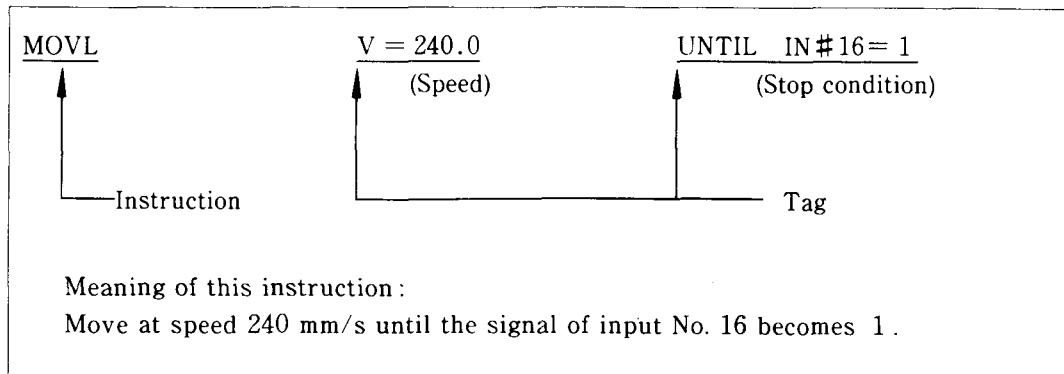
Error No.	Message	Contents
9040	Instruction control error	ILLEGAL_CODE
9041	instruction control error	RANGE_OVER
9042	Instruction control error	TOO_MANY_OPERAND
9043	Instruction control error	SYNTAX_ERROR
9044	Instruction control error	CONTINUE
9045	Instruction control error	SHORT_OPERAND
9046	—	—
9047	—	—
9048	—	—
9049	—	—
9050	PMS error	Position date file is destroyed. Instruction control failure.
9051	—	—
9052	PMS error	—

Error No.	Message	Contents
9053	—	—
9054	—	—
9055	—	—
9056	—	—
9057	—	—
9060	JMS and PMS error	Undefined error is detected.

A 3. EXAMPLE OF INSTRUCTION USING

A 3. 1 INSTRUCTION STRUCTURE

Instruction structure is described below by using an example of move Instruction. Instruction consists of Instruction Code and Additional Item (Tag).

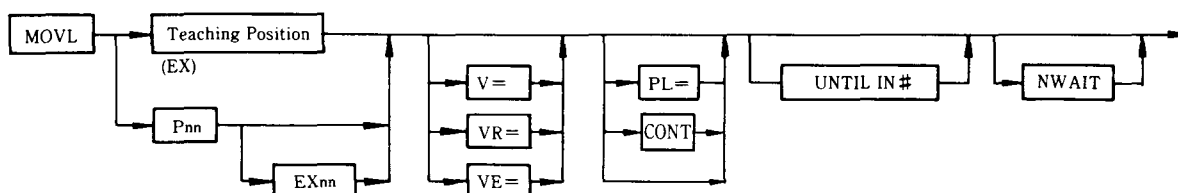


Move instruction is prepared in tags as shown in Table A 3. 1.

Table A3. 1 Meaning of Tags

Tag	Meaning	Setting Value
EX	With ext. axis data	No data
VJ=	Speed (Link speed only for MOVJ)	0.01 to 100.00%
V=	Speed (Absolute move speed)	0.1 to (1500.00)mm/s
VR=	Speed (Wrist orientation speed)	0.1 to (180.0)degree/s
VE=	Speed (Ext. axis speed)	0.01 to 100.00%
PL=	Positioning specification	0.1 to 4
UNTIL IN #	Interruption condition	Input No. & status (0 , 1)
NWAIT	No wait until completion	No data
P	Position type variable (For robot axis)	00 to 63
EX	Position type variable (For ext. axis)	00 to 63
SPECIAL	Special linear	No data

For normal teaching, only "V=" is added as tag after MOVL instruction. According to the requirements, other tags can be added the MOVL instruction with tag "V=". However, some tags cannot be added. Select by items as follows.

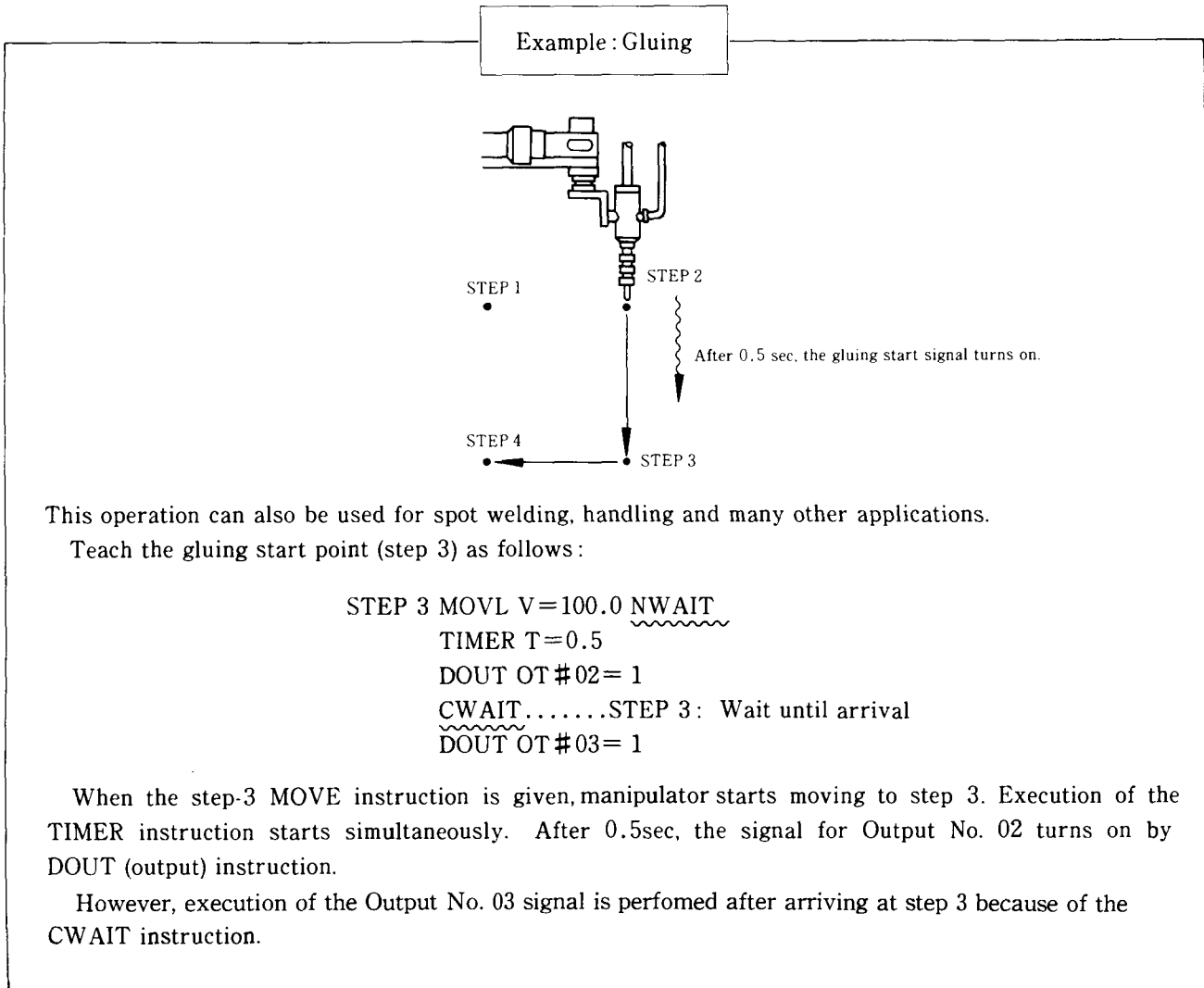


A 3. 2. 2 Operating Example of NWAIT in MOVE Instruction (MOV □)

When positioning to the specified position by the MOVE instruction is finished, the execution of MOVE instruction is completed and the next instruction is executed.

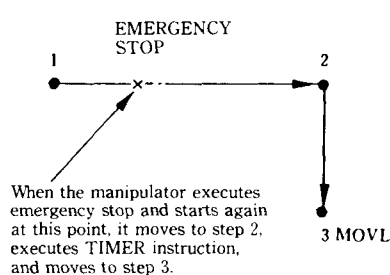
By adding NWAIT, execution of the next instruction starts without waiting for the completion of the MOVE instruction. The next instruction is executed while moving.

Manipulator outputs the output signal before reaching the specified position.



If the manipulator executes emergency stop during operation in step having NWAIT and it starts the continuous operation, the manipulator moves as follows.

```
0 0 NOP
1 1 MOVJ
2 2 MOVJ NWAIT
3 3 DOUT OT #01= 1
4 4 DOUT OT #02= 1
5 5 TIMER T=0.05
6 3 MOVL
...
END
```



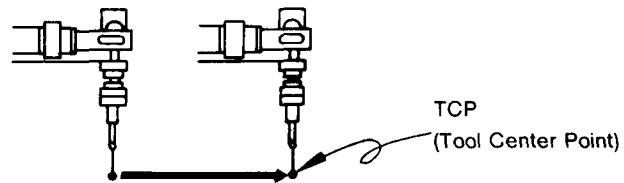
```
MOVJ NWAIT
DOUT OT #01= 1
DOUT OT #02= 1
TIMER T=0.05
```

A 3. 2. 3 Selection of Speed Specification

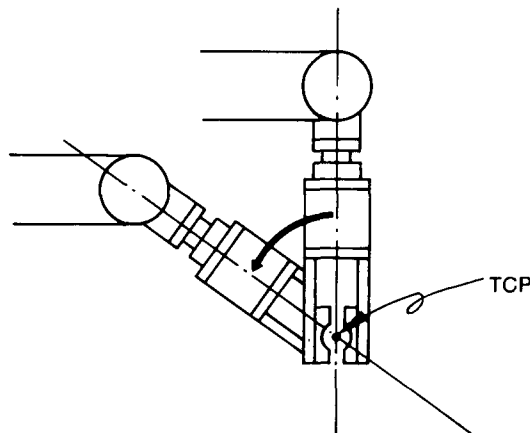
For MOVL and MOVC instructions, three-speed type are selected.

Example: Speed selection

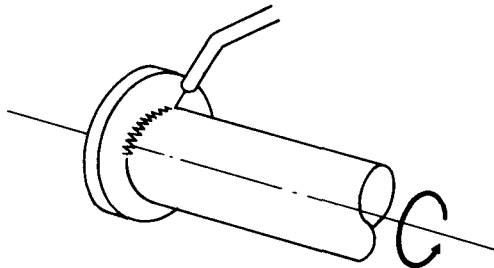
V = : Used to control the TCP move speed.



VR = : Used to control the change speed of wrist orientation.



VE = : Used to control the rotation speed of external axis.



A

A 3. 2. 4 Selection of Positioning Level

Positioning level specification is added to the MOVJ and MOVL instructions. Set either perfect positioning or inward positioning (4-level). In inward turning positioning, manipulator moves circularly, and changes speed smoothly.

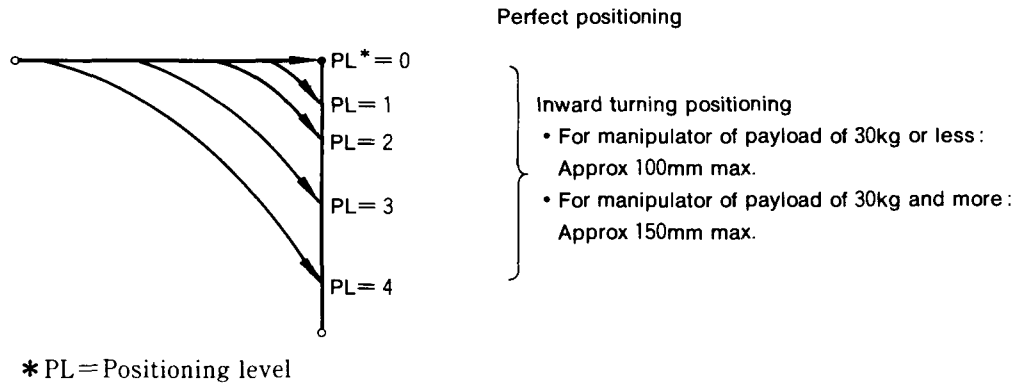
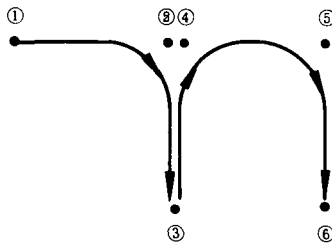


Fig. A3. 1 Positioning Level

Example : Positioning level selection



Steps ①, ②, ④, and ⑤ are merely passing points and accurate positioning is not necessary. By adding PL = 1 to 4 to the MOVE instruction of these steps, inward turning results to shorten the cycle time.

If perfect positioning is necessary as in steps ③ and ⑥, add PL = 0.

- Passing point: `MOVL V=500.0 PL= 1 to 4`
- Positioning point: `MOVL V=100.0 PL= 0`

A 3. 2. 5 MOVE Instruction for Specified Distance (Linear Operation)

From registered position of IMOV (move instruction for specified distance) instruction, linear interpolation is operated by specified position type variable (increment value).

Example : IMOV instruction operation

Line	Step		Meaning of this instruction :
0128	102	MOVJ VJ=60.000	Manipulator shift down specified height (ΔZ) from step 102, pick up a workpiece, then return to its former position.
0129	123	IMOV P026* V=120.0	
0130		DOUTOT #12 1	
0131		TIMER 0.5	
0132	104	IMOV PO27** V=120.0	* Set- ΔZ (the specified height) to PO26.
0133	105	MOVJ VJ=60.00	** Set ΔZ to PO27.

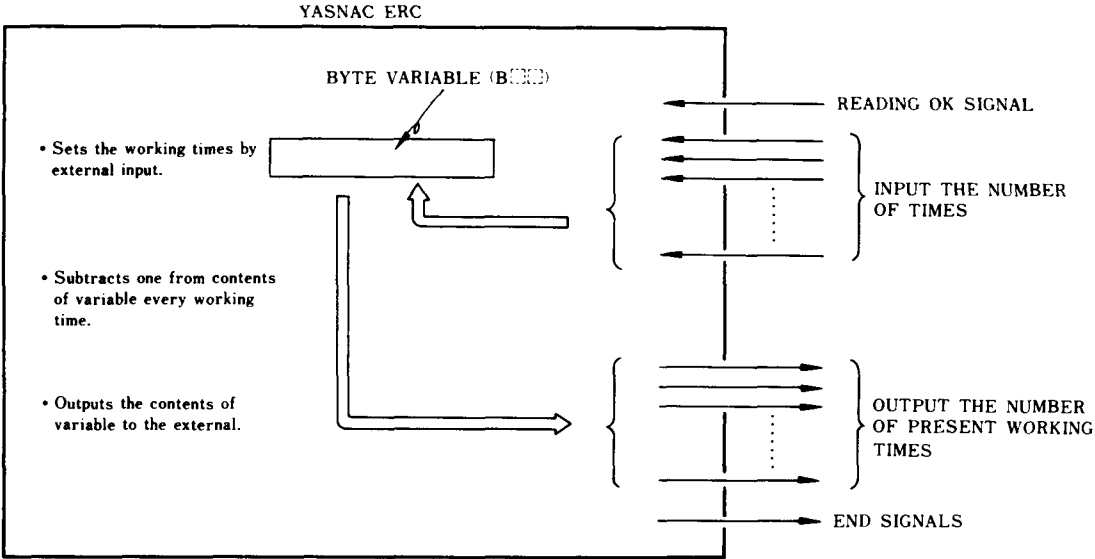
A3. 2. 6 Setting of Working Times (Utilization of byte variable)

By using byte variable, the working times are set from the external, and present working times are output to the external.

Example: Setting of working times

```

    ⋮
    WAIT  IN # [ ] = [ ] ----- Waits reading OK signal
    DIN   B [ ] IG # [ ] ----- Reads working time and stores it
    ⋮                                           to the byte variable.
    * 2
    JUMP  * 3 IF B [ ] <= 0 ----- Ends if byte variable (working
    CALL  JOB: Working                                           times) is 0 or minus.
    DEC   B [ ] ----- Subtracts one from working times.
    DOUT  OG # [ ] B [ ] ----- Outputs the contents of byte
    JUMP  * 2                                           variable (working times)
    * 3
    DOUT  OT # [ ] = [ ] ----- Outputs and signal.
    END
  
```

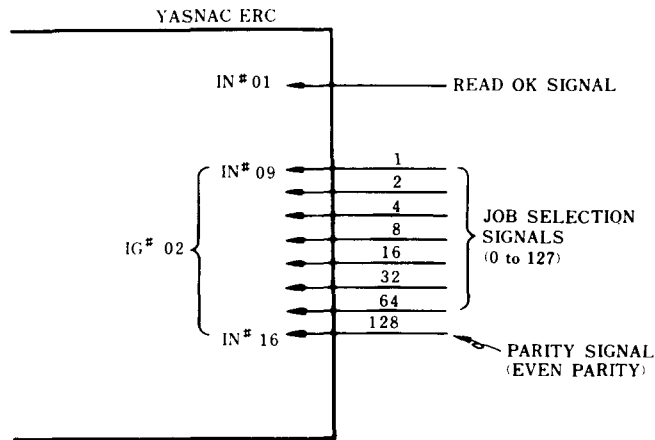


A3. 2. 7 Job Selection by Pattern Input

Multiple jobs are selected by external signal. For pattern input with parity signal, the signal effectiveness is also changed as follows:

Example: Job selection by pattern input

1. Where pattern job jump instruction is not used:



```

WAIT   IN # 01 = 1
DIN    B00 IG # 02 } Signal reading
SET    B02 B00

AND    B00 127
SET    B01 B00 } Separates parity signals and
AND    B02 128 } other signals

SET    B03 7 } Number of checks (Number of signals)

* 1
MUL    B01 2
XOR    B02 B01 } Execute exclusive OR for all bits.
DEC    B03 } If signal 1 is even-numbered signal,
JUMP   * 1 IF B03 <= 0 } the result becomes 0.

AND    B02 128
JUMP   JOB: Parity error IF B02 = 128 } Parity error detection

JUMP   JOB: Working A IF B00 = 0 } Selection of specification
JUMP   JOB: Working B IF B00 = 1 } job (CALL instruction is
JUMP   JOB: Working C IF B00 = 2 } also possible.)
:
:

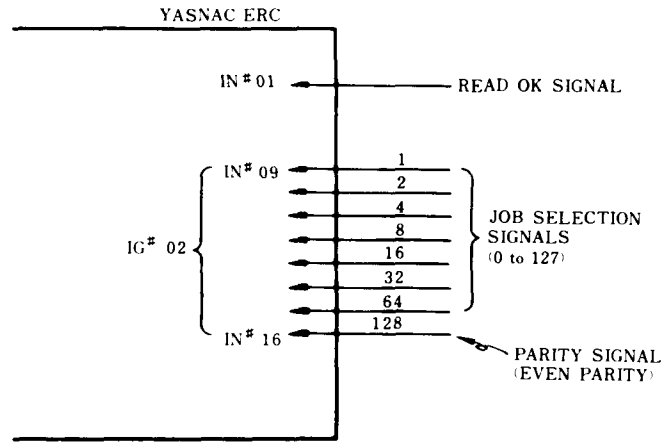
```

Without parity signal, these settings are not necessary.



Example: Job selection by pattern input (Cont'd)

2. Where pattern job jump instruction is used:



```

WAIT  IN # 01 = 1 }
DIN   B00 IG # 02 } Signal reading
SET   B02 B00    }

JUMP  IG# [ ]    Selection of specification job
                    (CALL instruction is also possible.)
    
```

(1) Pattern job jump instruction

```

JUMP IG# [ ]
    |
    | Input group No.
    |
By specifying the conditions, pattern job jump with conditions is also set.
JUMP IG# [ ] IF IN# [ ] = [ ]
    |           |           |
    |           |           | 0:OFF
    |           |           | 1:ON
    |           |           | Input No.
    |           |           |
    |           |           |
    |           |           | Input group No.
    
```

(2) Correspondence with input group No. and input No.

Table A3.2 Input Group No. and Input No.

Input Group No.	Input No.
IG # 1	IN # 1 to IN # 8
IG # 2	IN # 9 to IN # 16
IG # 3	IN # 17 to IN # 24
IG # 4	IN # 25 to IN # 32
IG # 5	IN # 33 to IN # 40
IG # 6	IN # 41 to IN # 48

(3) Instruction execution

Example: JUMP IG # 1 IF IN # 9 = 1

Description of instruction above :

- When IN # 9 is OFF status, the instruction on next line is executed.
- When IN # 9 is ON status, input status of IG # 1 (IN # 1 to IN # 8) is checked.
- When all inputs of IG # 1 (IN # 1 to IN # 8) are OFF, the next instruction is executed.
- When inputting to any IG # 1 (IN # 1 to IN # 8), jumps to the job name where the input status is ON.

For the job name where the input status is ON, no parity check or binary specification is set normally. However, the job names differ according to selection of parity check yes/no and binary/BCD specification.

Input Group No.	Input No.	Binary Type	BCD Type	Input Status (Example)					
IG # 1	IN # 1	$2^0 = 1$	$2^0 = 1$	} $\times 1$	ON				
	IN # 2	$2^1 = 2$				$2^1 = 2$	OFF		
	IN # 3	$2^2 = 4$						$2^2 = 4$	ON
	IN # 4	$2^3 = 8$							
	IN # 5	$2^4 = 16$	$2^0 = 1$	ON					
	IN # 6	$2^5 = 32$			$2^1 = 2$	OFF			
	IN # 7	$2^6 = 64$					$2^2 = 4$	ON	
	IN # 8	$2^7 = 128$							$2^3 = 8$

In this example, the instruction jumps to job name below.

- At binary specification: Job 85
- At BCD specification: Job 55

Pattern job jump (call) instruction can be used with the job name below.

Parity Check	Binary/BCD Specification	Job Name
Yes	Binary	1 to 127
	BCD	1 to 79
No	Binary	1 to 225
	BCD	1 to 99



1. Use only digits for job name. Alphabet, symbols, etc. are ineffective.
2. Job name 01 and 1 are different. Use job name 1 of half-size for pattern job call instruction.



A3. 2. 8 Example of TOP and ADV in Jump/Call Instruction (Effective from V 4.00)

(1) Searching method of label jump

The label-searching start point can be specified by using tag.

- when registering tag "TOP" in JUMP instruction, the searching starts from the head of the jobs.
- when not registering it, the searching starts from the current cursor position (on JUMP instruction).

The effective method is shown below.

```

JOB : Master
0  NOP
1  [*START]
2  MOVJ
3  DOUT
4  DOUT
5  MOVJ
6  DOUT
  ...
50 JUMP*EXIT IN#12=ON
51 JUMP*START TOP
52 [*EXIT]
53 CALL JOB : RESET
54 MOVJ
55 DOUT
56 DOUT
57 MOVJ
58 TIMER
59 PULSE
60 MOVJ
61 JUMP *START
62 END
  
```

Not specify tag "TOP".

The searching time is reduced less than the instruction with tag "TOP".

Specify tag "TOP".

The searching time is reduced less than the instruction without tag "TOP".

There is no difference in the searching time even if tag "TOP" is specified or not.

(2) Operating method of Jump/Call instructions with condition job

Jump/call instructions with condition take approx. 100 ms or more up to the time of objective job execution. To reduce this time, register tag "ADV" in instruction with condition.

When tag "ADV" is registered, the objective job is decoded when the condition is established at look-ahead operation. When the instruction is executed, YASNAC ERC controller checks the condition again.

At this time, if the condition is established, the objective job is executed instantly. If it is not established, it takes approx. 100 ms or more up to the time of objective job execution.

The effective method is shown below.

```

JOB : Master
0  NOP
1  [*START]
2  JUMP JOB : 001 IF IN #01=ON ADV
3  JUMP JOB : 002 IF IN #02=ON ADV
4  JUMP JOB : 003 IF IN #03=ON ADV
5  JUMP JOB : 004 IF IN #04=ON ADV
6  JUMP JOB : 005 IF IN #05=ON ADV
7  JUMP JOB : 006 IF IN #06=ON ADV
8  JUMP JOB : 007 IF IN #07=ON ADV
  ...
29 JUMP JOB : 028 IF IN #28=ON ADV
30 JUMP JOB : 029 IF IN #29=ON
31 JUMP JOB : 030 IF IN #30=ON
32 JUMP *START
33 END
  
```

When the condition has already been established before executing master job, add tag "ADV" to JUMP instruction. The execution time is reduced.

When the condition is established after executing master job, do not add tag "ADV" to JUMP instruction.

A 3. 2. 9 POSITION MONITORING FUNCTION BY FEEDBACK PULSE (Effective from V 4.00)

When the interlock is required for external peripheral equipment, cube signals are used up to 4. However, these cube signals are not enough for requiring interlock in many teaching points.

To solve the problem, this function is improved.

By registering monitoring position in step by instruction and executing it, the controller executes position monitoring in any specified teach position (step), and controls the inter-lock signal for external peripheral devices.

(1) Function

This function is operated as follows.

1. Any teaching position is regarded as a monitoring position. (Register in step by instruction.)
2. Turns on general-use output (robot pause position signal) registered by executing instruction.
3. Where the manipulator is moved from monitoring position, the output is turned off automatically.

This output is not turned on unless the instruction is executed again.

(2) Instruction

⟨Name⟩ Position monitoring output function
(Group in I/O instruction)

⟨Format⟩ POSOUT PM# 1 (Input range 1 to 8)

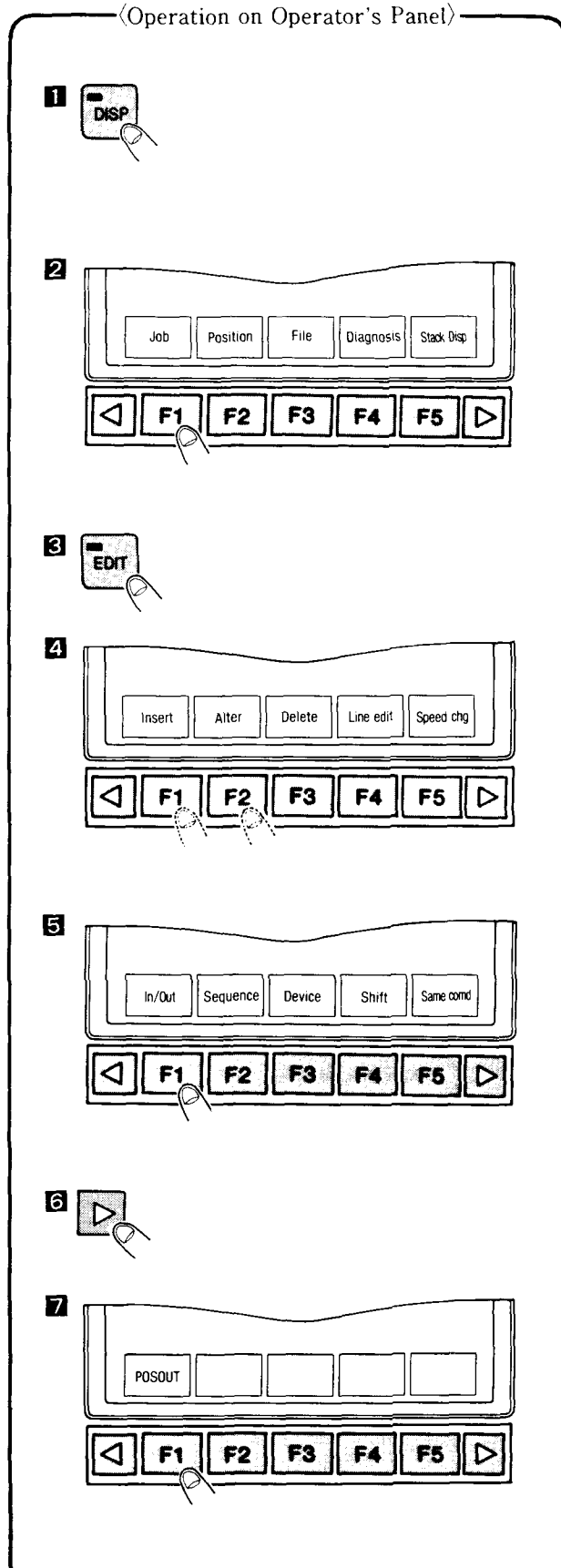
↑
Data file No. for position monitoring

POSOUT FILE				
FILE No.01	ZONE PULSE (+)	ZONE PULSE (-)		
	S	50	S	50
	L	50	L	50
	U	50	U	50
GEN. OUT	R	50	R	50
	B	50	B	50
	T	50	T	50
	W1	50	W1	50
	W2	50	W2	50
	W3	50	W3	50
	W4	50	W4	50
	W5	50	W5	50
	W6	50	W6	50


Fig. A 3. 3 Position Monitoring Condition Display





(3) Registering POSOUT instruction







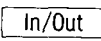

(Description)

Depress  key after setting cursor on the step of pause position.

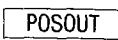

Depress  soft key.


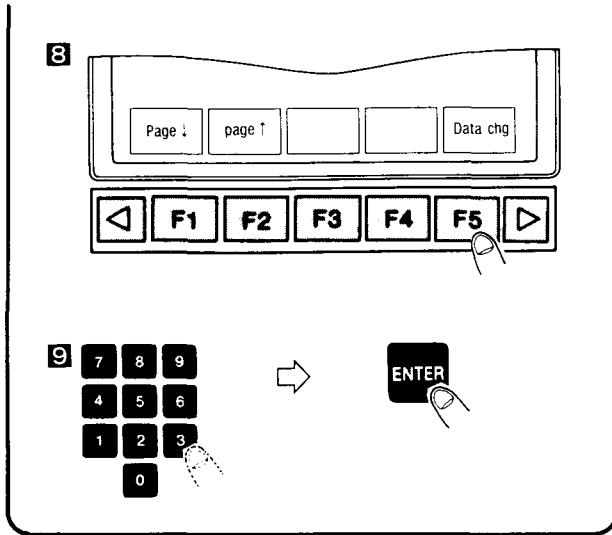
Depress  key.

Depress  or  soft key.
 or 

Depress  soft key.


Depress  key.

Depress  soft key.




After setting cursor on desired position, depress **Data chg** soft key.

F5

Input digits to be altered and depress **ENTER** key.

(4) Operation

When the instruction is executed, position monitoring starts after the output relay (pause position signal) in specified file is turned on. If the manipulator position (checked by feedback pulse) is shifted in excess of allowable pulses of the file specified by the instruction execution step position. This pause position signal is not turned on unless the position monitoring output instruction is executed again.



The manipulator position is always monitored by using feedback pulse while control power is turned on.

The position monitoring status is checked in the diagnosis display.

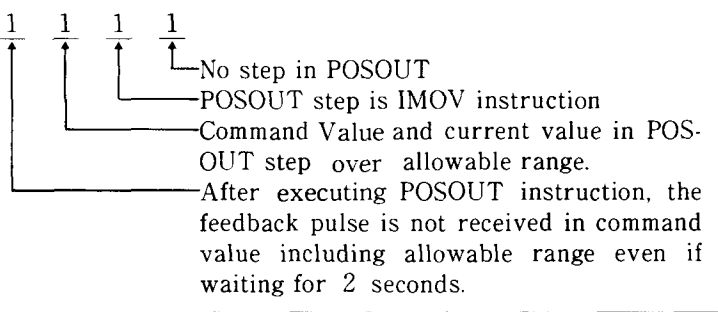
DIAGNOSIS (POSOUT)					
PROG. POS.	PULSE	FEEDBACK PULSE	ZONE(+)	ZONE(-)	
S	1000	S	2000	S	S 50
L	1000	L	2000	L	L 50
U	1000	U	2000	U	U 50
R	1000	R	2000	R	R 50
B	1000	B	2000	B	B 50
T	1000	T	2000	T	T 50
W1	1000	W1	2000	W1	W1 50
W2	1000	W2	2000	W2	W2 50
W3	1000	W3	2000	W3	W3 50
W4	1000	W4	2000	W4	W4 50
W5	1000	W5	2000	W5	W5 50
W6	1000	W6	2000	W6	W6 50
CUR. FILE NO.		GENERAL OUT NO.		ON OFF	
01		01		■	

Fig. A3. 4 Position Monitoring Diagnosis Display



If POSOUT instruction is executed in a position that is different from step registered POSOUT instruction, alarm 1690 "POSOUT inst execution error" will occur. The pause position output is not turned on.

(5) Alarm error

Error Code	1690
Displayed Message	<p>POSPUT INST. EXECUTION ERROR</p> <p>0 0 0 0 1 1 1 1</p>  <p>No step in POSOUT</p> <p>POSOUT step is IMOV instruction</p> <p>Command Value and current value in POS-OUT step over allowable range.</p> <p>After executing POSOUT instruction, the feedback pulse is not received in command value including allowable range even if waiting for 2 seconds.</p>
Cause	POSOUT instruction is not executed thoroughly.
Action	After resetting the alarm, check the POSOUT instruction and reset it.

A 3. 2. 10 FREE CURVE INTERPOLATION FUNCTION (Effective from V 4.00)

For workpieces having free curves in various applications such as welding, cutting, plasma coating, etc., this function is developed to ease teaching and to improve the path accuracy.

(1) Operation

The path for three points specified free curve interpolation describes a parabola passing three points.

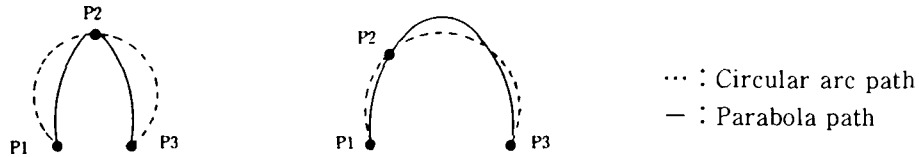


Fig. A 3. 5 Difference between Circular Arc Path and Parabola Path

When the paths consist of consecutive points specifying free curve interpolation, the overlapped parabola paths become paths (as shown heavy line) by synthesizing them.

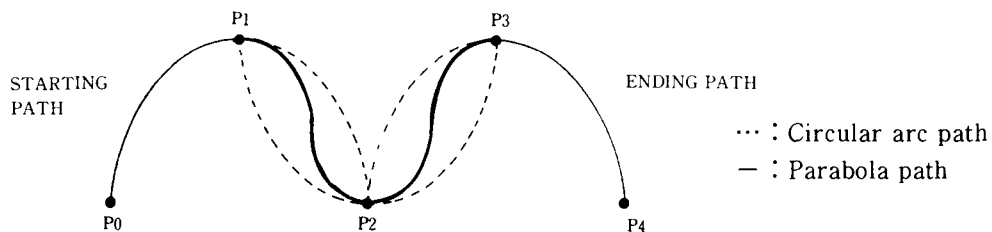


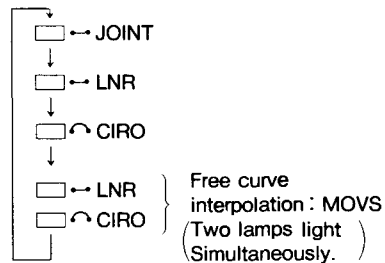
Fig : A 3. 6 Path for Consecutive Free Curve Interpolation

(2) Teaching

Specify free curve interpolation (MOV5) by depressing MOTION TYPE key.

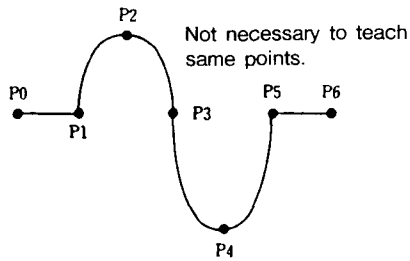
NOTE

The light is shifted down every time MOTION TYPE key is depressed as shown on the right. MOV5 specification should light “ ↔LNR” and “ ↔CIRO”



A

(Example)



Teach P 1 to P 5 successively in free curve interpolation specification.

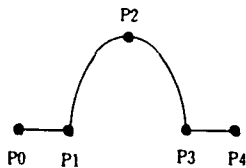
Fig. A 3. 7



1. In MOV5 specification, be sure to register three points or more consecutively.
2. The distance among points should be almost equal. If this is not done, an alarm may occur during operation.

(3) Speed

(Example)



Between P 1 and P 2 : Operates at speed of P 2 .
Between P 2 and P 3 : Operates at speed of P 3 .

Fig. A 3. 8



The actual operating speed is a little faster than the setting speed.

(4) Notes

When operating the jobs taught free curve (MOV5), be careful of the following points.

- The manipulator moves straight to the starting point of free curve specification.
- When the manipulator is operated between P 2 and P 3 as follows, three paths are different.

- ① The manipulator works at NEXT operation.
- ② It stops at P 3 and backs up from P 3 to P 2 .
- ③ It works again at NEXT operation.

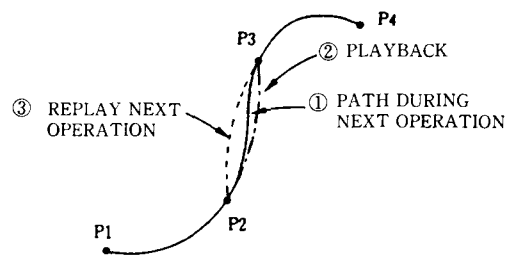


Fig. A 3. 9

- Alarm “The distance between teaching points not equal” may occur according to the position executed NEXT or BACK operation. If this alarm occurs, operate NEXT or BACK operation again after resetting it and calling up the step by depressing

+
ON

 or

-
OFF

 key. The manipulator moves straight to displayed step. For inching operation of NEXT or BACK operation, take care of the manipulator motion because the path is changed.

- ① The manipulator moves straight to P 2 when it is executed in AXIS operation during free curve interpolation.
- ② The following motion differs from path at PLAY operation in some distance. After that, the motion is the same as path at PLAY operation.

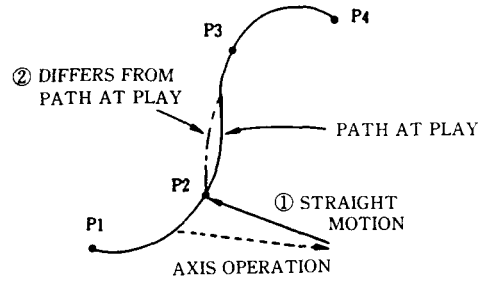


Fig. A 3 . 10

- When the manipulator is executed cursor shift or search operation, it moves in the same path as shown in Fig. A 3 . 10.

(5) Inform instruction

Instruction	Function	Format	Example
MOVS	Moves at free curve interpolation to the teaching position	MOVS <Position> <Ex. axis pos.> V= <Speed> , VR <Posture speed> VE= <Ex. axis speed> <NWAIT>	MOVS V=120.0

(6) Alarm code

Code	Message	Contents
AL-1331	Not enough step for free curve (3 steps)	Three steps or more are not registered in free interpolation specification.
AL-1740	Free curve teaching error	The points among the teaching points do not have equal distance.
AL-1021	TWO STEPS SAME POS. (Free curve)	A manipulator can not be operated at position registered at two points in the same position.



A3. 2. 11 Parallel Shift Function for Manipulator with 6 Axes (Effective from V 4.00)

A3. 2. 11. 1 Outline of parallel shift function

The parallel shift function is for equidistant shifting of each point on the workpiece from a specific position.

The shift value in Fig. A 3.2 can be defined by distance ℓ (coordinate displacement in three dimensions).

The teaching procedure for the manipulator is simplified by parallel-shifting the taught loci or positions.

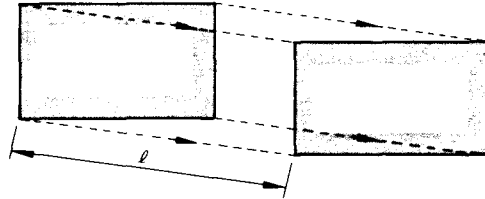


Fig. A 3. 11 Example of Parallel Shift

When the taught position \textcircled{A} is shifted by distance ℓ (displacement of X, Y or Z direction in a coordinate system, which the robot can recognize), the work taught at point \textcircled{A} can be performed at the shifted positions \textcircled{B} to \textcircled{G} .

See Fig. A 3. 3.

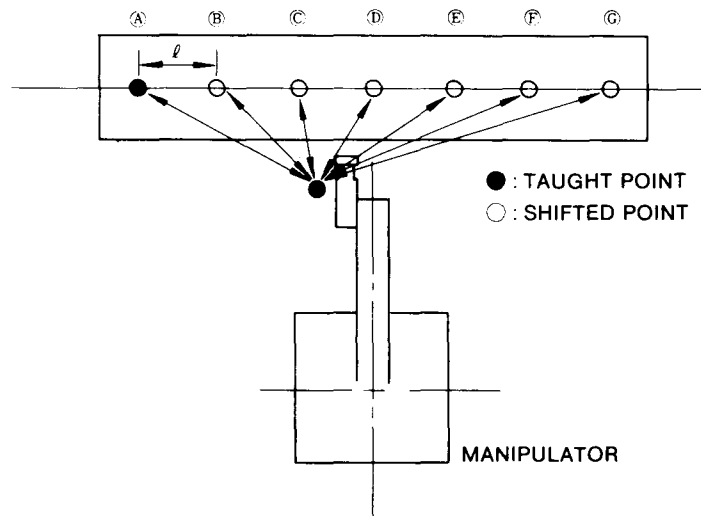


Fig. A 3. 12 Example of Parallel Shift

A3. 2. 11. 2 Composition of parallel shift value

(1) Position-type variable

The position-type variable is used for definition of parallel-shift function. YASNAC ERC has 64 position-type variable (P00 to P63).

Before using a parallel shift function, measure the difference between taught positions and positions to be shifted (displacement of X, Y or Z direction in each coordinate system), and register the difference in position-type variable.

In playback operation, when a parallel shift instruction is executed, the taught position is shifted by the shift value which is registered in the position-type variable.

POSITION VARIABLE(P)					
#P00	X	0.000	#P02	X	0.000
	Y	0.000		Y	0.000
	Z	0.000		Z	0.000
	TX	0.00		TX	0.00
	TY	0.00		TY	0.00
	TZ	0.00		TZ	0.00
#P01	X	0.000	#P03	X	0.000
	Y	0.000		Y	0.000
	Z	0.000		Z	0.000
	TX	0.00		TX	0.00
	TY	0.00		TY	0.00
	TZ	0.00		TZ	0.00

Fig. A3. 13 Configuration of Position-type Variable

(2) Definition of coordinate system and wrist orientation

The shift value is the increment value of X, Y or Z in each coordinate system; base, robot, tool and user coordinate systems (Fig. A3. 13).

For the system without running axis, base and robot coordinate systems are the same.

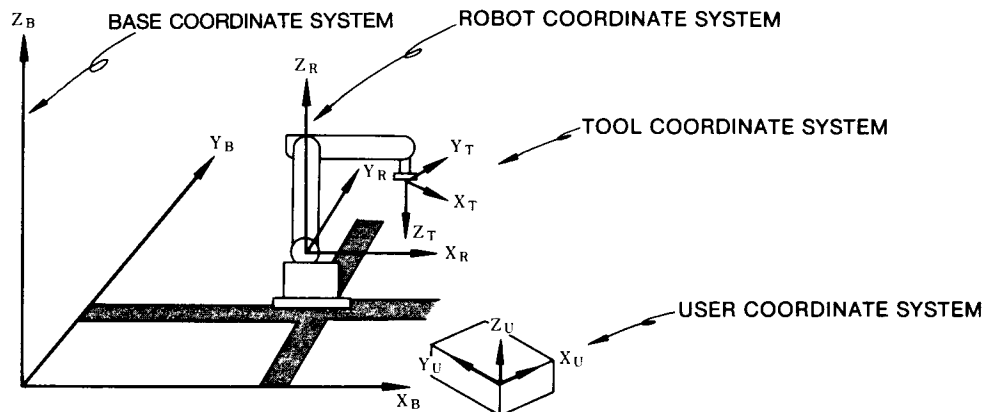


Fig. A3. 14 Coordinate Systems



A3. 2. 11. Composition of parallel shift value (Cont'd)

(3) Composition of parallel shift value

The current position data of manipulator on CRT display are utilized for shift value to be set in position-type variable.

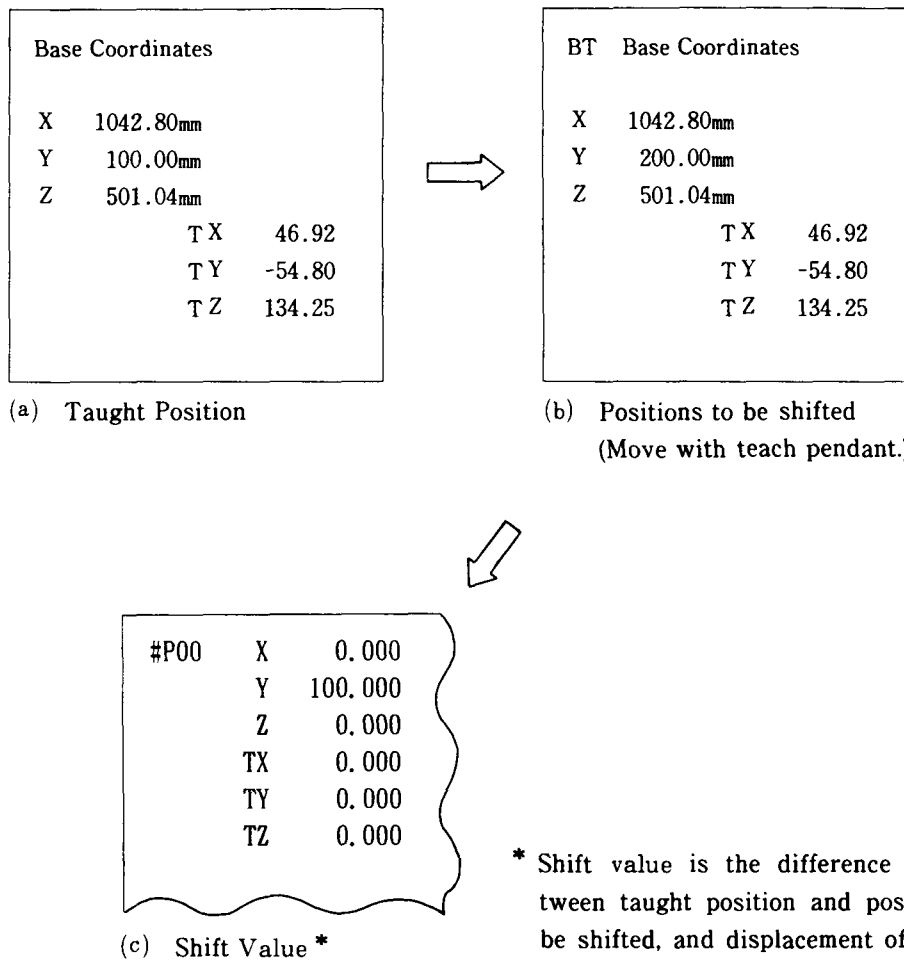


Fig. A3. 15 Determining Shift Value with CRT Display

The shift value is the difference of X, Y or Z on coordinate system between taught position and position to be shifted, and displacement of degree TX, TY and TZ (normally, "0").

Where the shift by the name interval is executed, calculate the difference between taught position and end shifting position. Divide this difference (L) by the number of pitches to obtain shift value (l). See Fig. 9. 6.

Use the position data display to be shifted coordinate system. Normally, use the position data display on base coordinate system. For the system without running axis, base and robot coordinate systems are the same.

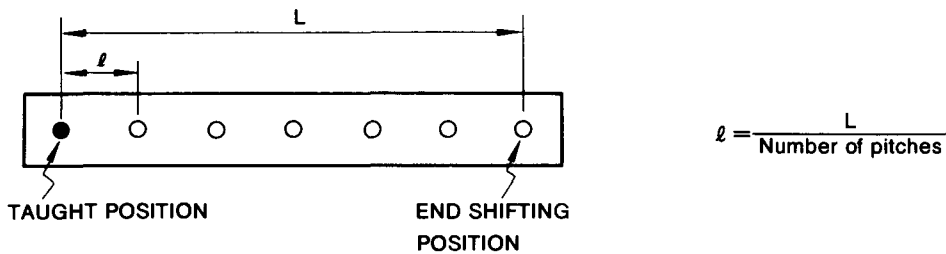


Fig. A3. 16 Calculation of Shift Value

Wrist orientation is defined by displacement of degree in tool coordinates. If the shift value is registered by only increments in X, Y or Z ($\Delta T_x, \Delta T_y, \Delta T_z = 0$), the shift is executed at the same wrist orientation as that taught. Therefore, displacement of wrist orientation does not have to be registered.

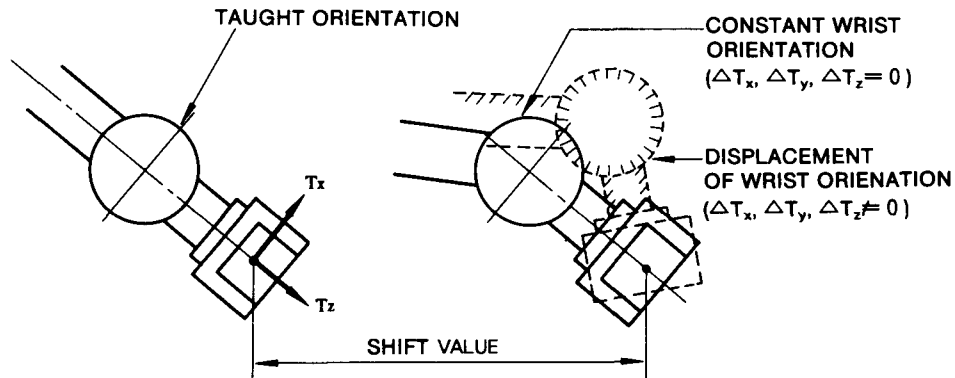


Fig. A3. 17 Wrist Orientation

Use the position-data display to be shifted as the coordinate system. Normally, use the position-data display on base coordinate system. For the system without running axis, base and robot coordinate systems are the same.

Base coordinate system	
X	1042.80 mm
Y	100.00 mm
Z	500.50 mm

Fig. A3. 18 Position-data Display



A3. 2. 11. 2 Composition of parallel shift value (Cont'd)

(4) Input of instruction

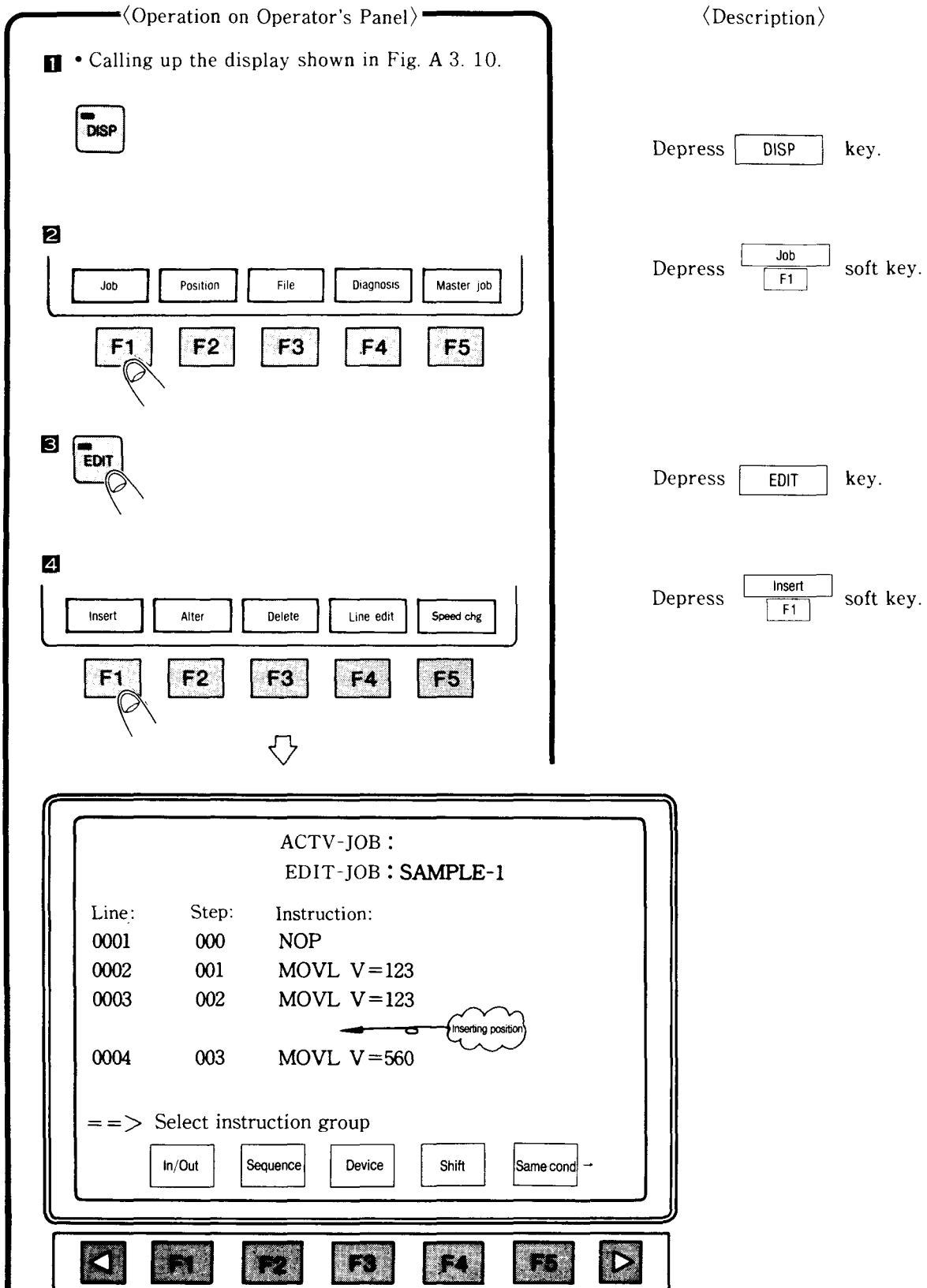
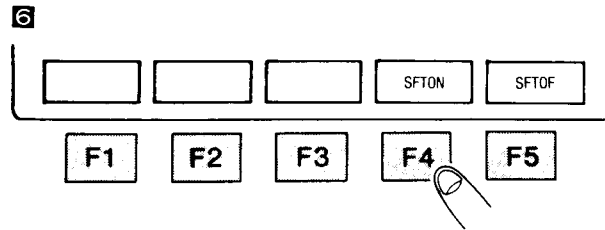
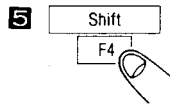
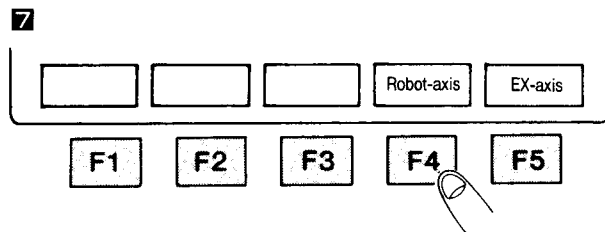


Fig. A 3. 10 Shift Instruction Display

• Instruction Input



NOTE If you want to stop the shift instruction,
depress soft key and key.



8 Input the No. of position-type variable and depress key.

9 The soft keys * appear.
Specify the coordinate system to be shifted by depressing soft key.



Depress soft key to select shift instruction.

Depress soft key.

Depress soft key.

(Example)

When using position-type variable "P01", depress and keys.

*For specifying the base coordinate system, only depress key.

A3. 2. 11. 3 Parallel Shift Instruction

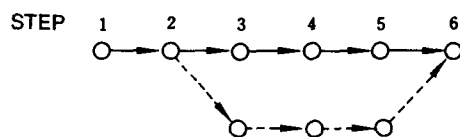
Table A3. 3 List of Parallel Shift Instructions

Instruction	Function	Format	Example
SFTON (Shift on)	Starts the shift operation.	SFTON P<Variable No.> RF, TF, UF#<User frame No.> { RF : Robot coordinate system TF : Tool coordinate system UF# : User coordinate system }	SFTON P12
SFTOF (Shift off)	Stops the shift operation.	SFTOF	SFTOF

A3. 2. 11. 4 Application example of Parallel Shift

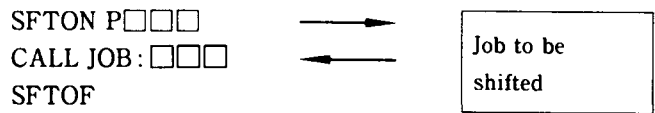
(1) Partial shifting

LINE	STEP	INSTRUCTION	
0000	000	NOP	
0001	001	MOVJ VJ=50.00	
0002	002	MOVL V=100.0	
0003		SFTON P□□	
0004	003	MOVL V=100.0] Steps 003 to 005 located between SFTON and SFTOF are shifted.
0005	004	MOVL V=100.0	
0006	005	MOVL V=100.0	
0007		SFTOF	
0008	006	MOVL V=100.0	

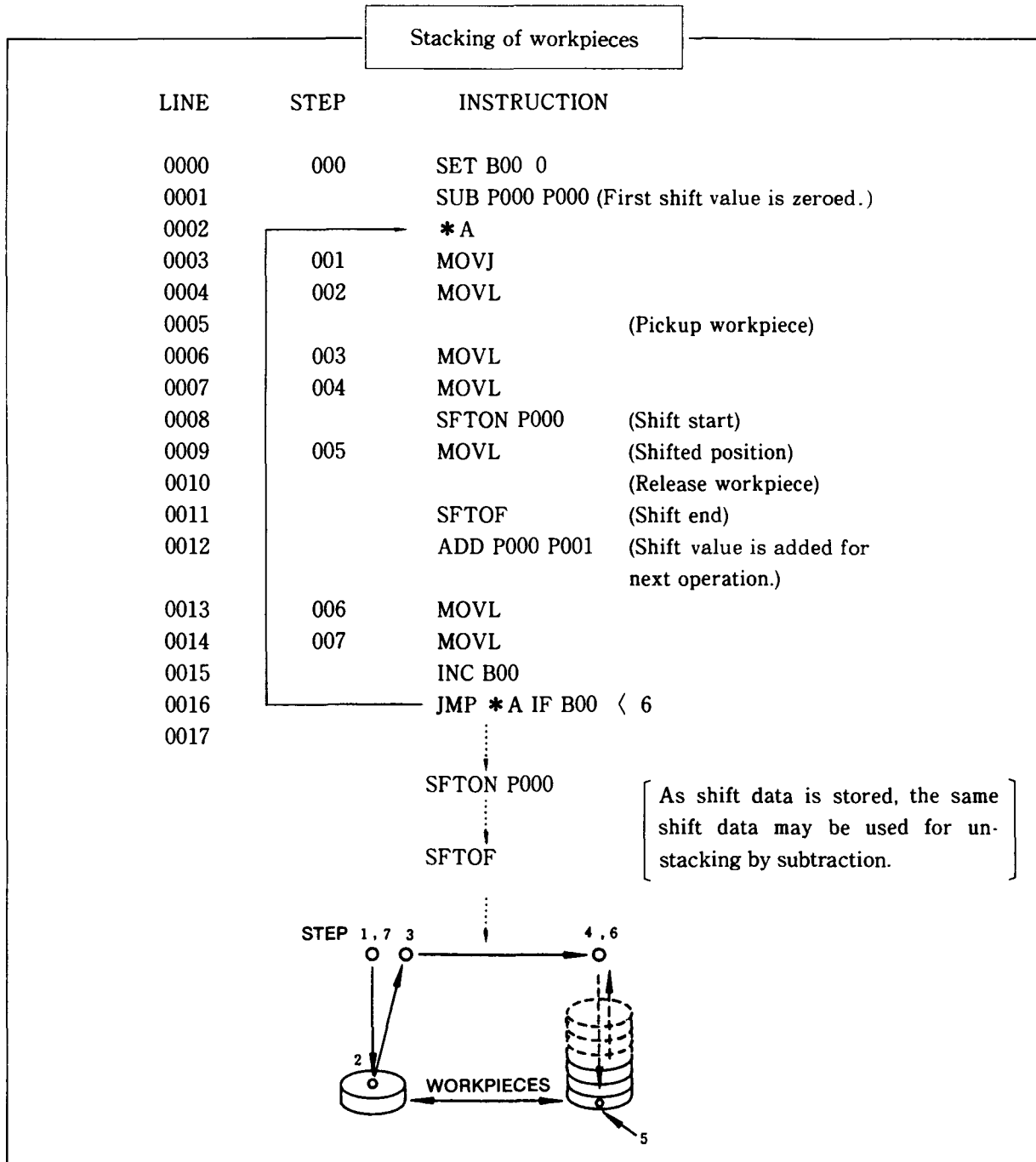


(2) Shifting the entire job motions

The portions to be shifted may be specified by shift instructions as in (1). Partial Shifting, but the to-be-shifted portion may also be designated as a separate job, as follows:



(3) Use of shift addition/subtraction



A

A 3. 2. 11. 5 Continuous Operation of Parallel Shift

After parallel shift instruction is executed, shift function is canceled at the following operations.

- Edit operation of jobs (Alteration, deletion, addition)
- Movement of cursor position in step or line of job
- Alteration of job copy or job name
- Alteration of new job registration, job deletion or selected job



1. Where the shift function is canceled by operations above :

When the manipulator is operated again, use low speed operation to stop it instantly in case of danger.

In this case, the manipulator will stop after reaching displayed step without regard to the cycle.

If the manipulator is stopped during low speed operation, it moves at teaching speed when restarting.

2. If control power is turned off, the parallel shift will be continued.

A3. 2. 12 Parallel Shift Job Conversion Function (Effective from V 4.00)

When the jig or manipulator's position is shifted for the workpiece completed teaching, the job is must be to corrected.

To decrease the correcting time, use this function.

A3. 2. 12. 1 Function

Parallel shift job conversion function converts job to new job by shifting deviation distance of workpiece, remaining manipulator's position. (In conventional method, the movement of teaching point + shift value is executed by SFTON and SFTOF instructions. In this function, the job is converted by shifting teaching point.)

NOTE After job positioning data is executed shift operation, it is converted to shifted position data. Before converting it, save the job to floppy disk or create the same job by copying.

- (1) Be sure to specify the coordinate system executed in the shift.

Usable coordinate systems are shown below.

- Base coordinate system
- Robot coordinate system
- Tool coordinate system
- User coordinate system (8 types)

The shift for only external axes is fixed on robot coordinate system.

- (2) There are two conversion methods as follows.

- Single conversion : Normally, this is used.
- Batched conversion : Used when workpieces are taught by dividing in multiple jobs.

- (a) Single conversion

Even if the job to be converted has JUMP or CALL instruction and it is related to multiple jobs, only the job to be converted is shifted.

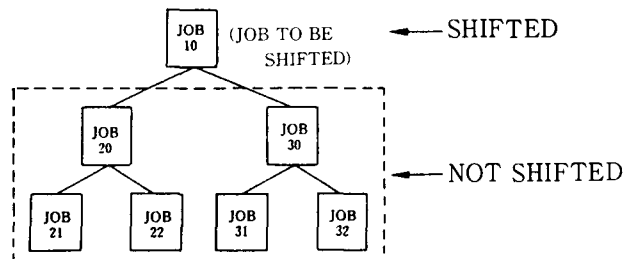


Fig. A3. 19 Single Conversion

- (b) Batched conversion

The job to be converted is shifted with related jobs.

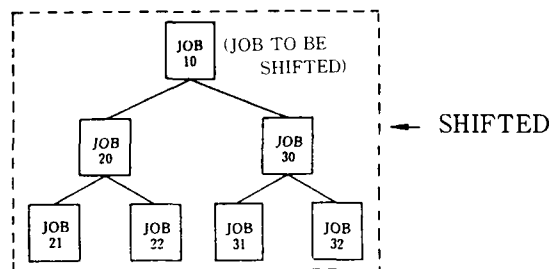
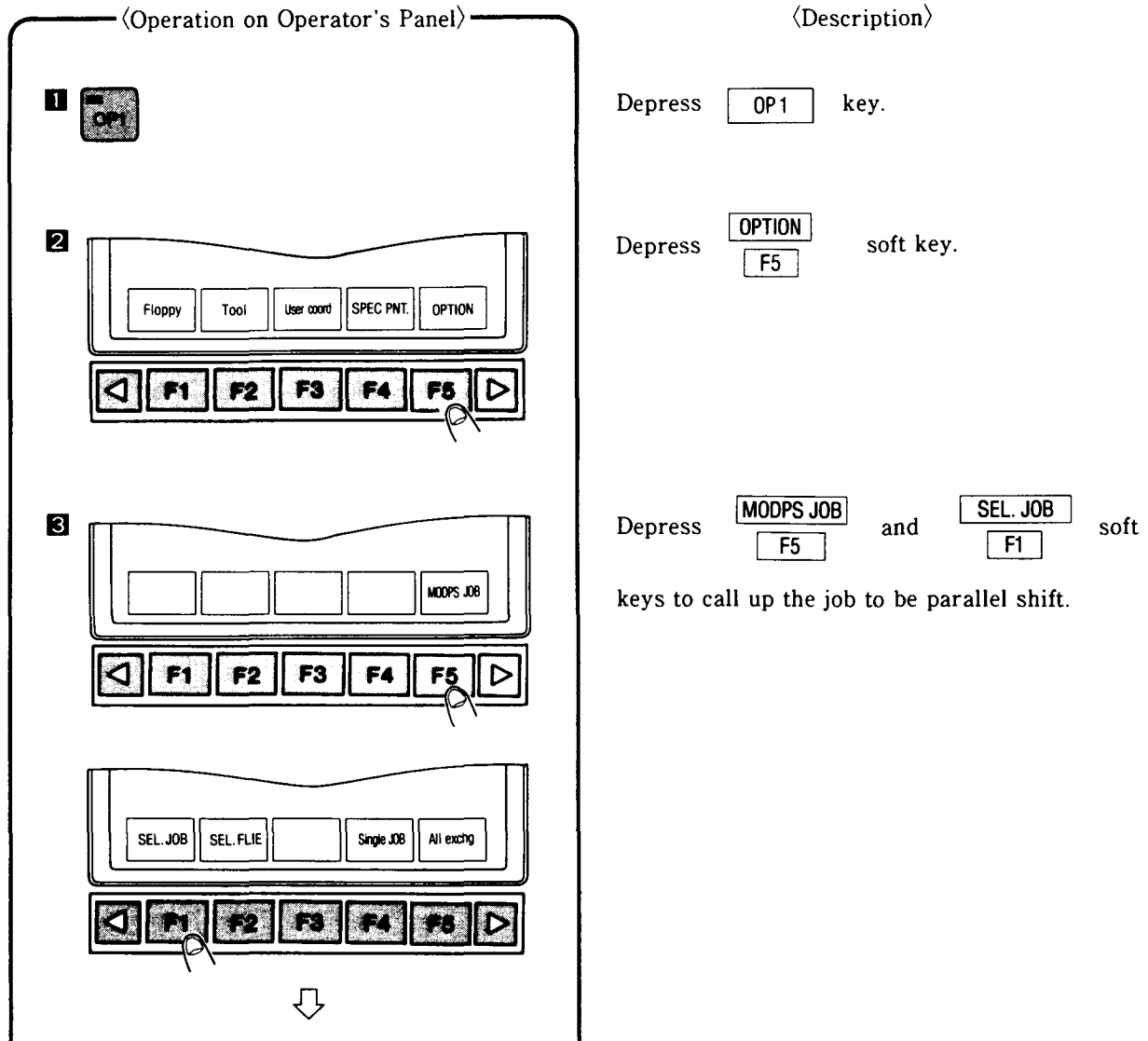


Fig. A3. 20 Batched Conversion

A3. 2. 12. 1 Function (Cont'd)

- (3) After parallel shift conversion, “/0V” is displayed in step which is positioned out of the manipulator's working envelope. “0 V” display goes out after correcting the position.
When the job is collated after the job including the step exceeded working envelope is saved to floppy disk, a collation error will occur.
When it is loaded, the step exceeded working envelope is not displayed “/0V”. Be careful of this.
- (4) The position variables are not object of parallel shift conversion.

A3. 2. 12. 2 Operation



```

TEACH MODE ACTIVE JOB:*****L:****S:*** PAUSE
1990/04/17/12 : 20-----
JOB LIST EDIT JOB : SAMPLE L : 0000 S : 000

JOB TOTAL : 12 MEMORY : 1470 BYTES REMAINS : 31390BYTES
POSITION : 112 POINTS REMAINS : 2128POINTS

No. JOB NAME POSITIONS PROG.DATE/TIME PROTECT SAVE TYPE
00001 : SAMPLE 264(27) 1990/04/17 10 : 14
00002 : SAMPLE1 192(18) 1990/04/17 10 : 18
00003 : SAMPLE2 110( 5) 1990/04/17 10 : 20
00004 : SAMPLE3 129(10) 1990/04/17 10 : 21
00005 : SAMPLE4 96( 6) 1990/04/17 10 : 23
00006 : SAMPLE5 72( 3) 1990/04/17 10 : 26
00007 : SAMPLE6 120( 9) 1990/04/17 10 : 30
00008 : SAMPLE7 112( 8) 1990/04/17 10 : 32
00009 : SAMPLE8 104( 7) 1990/04/17 10 : 35
00010 : SAMPLE9 80( 4) 1990/04/17 10 : 37
=> Cursor on job name to search.
> ■

```






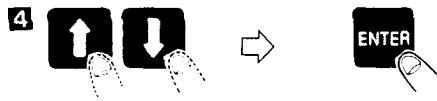
    

Fig. A3. 21 List of Jobs



A3. 2. 12. 2 Operation (Cont'd)



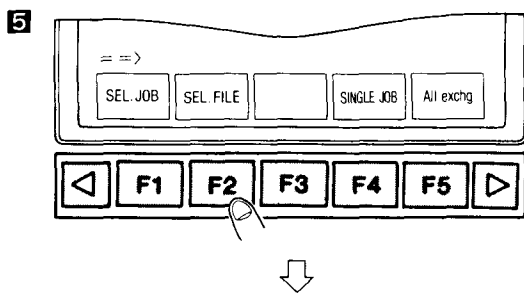
Set the cursor on the job to be parallel shifted by using or key, and depress key.

The job to be parallel shifted can also be called up by inputting the job name directly.



This operation is not required when the job to be shifted and the edit job coincide.

〈Specification of position variable to be shift〉



Depress soft key.

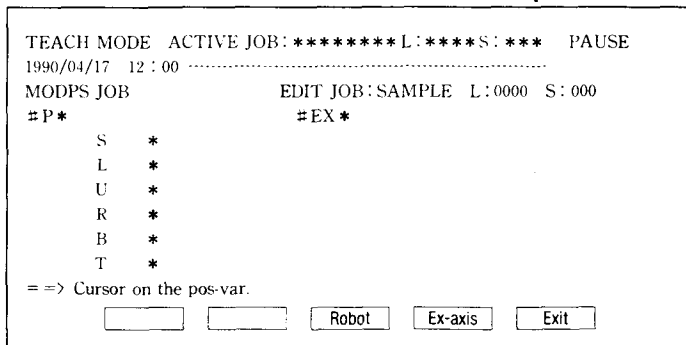
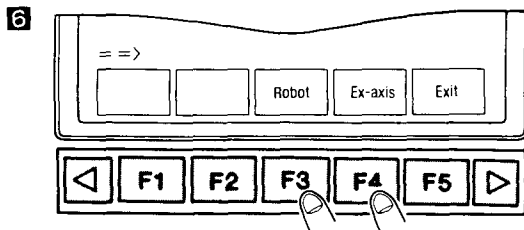
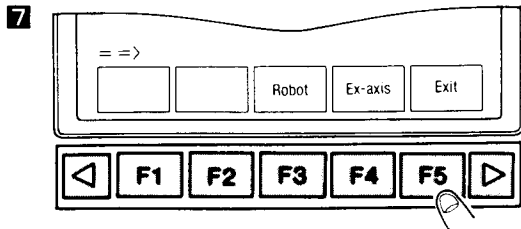


Fig. A3. 22 Position Variable Specification Display



Specify the position variable (shift value) by depressing and soft keys. and

The specified data are displayed.



⟨Specification of conversion mode⟩

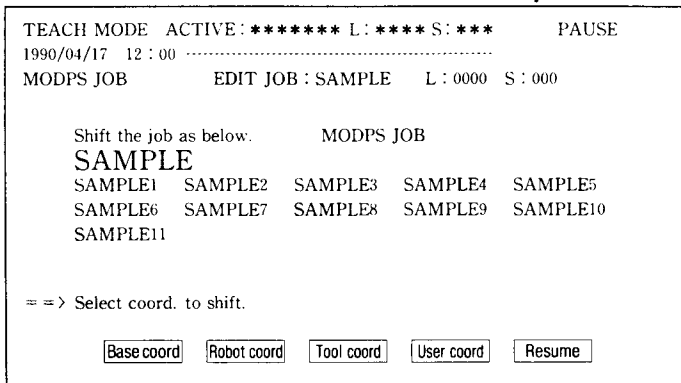
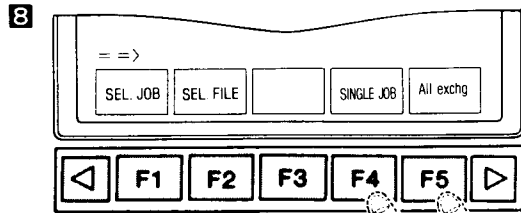
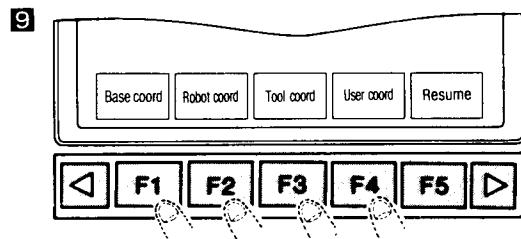


Fig. A3. 23 List of Conversion Job



After checking the data, depress soft key. The soft keys return to initial display.

Depress desired soft key or

NOTE In batched conversion, if non-registered child job exists, the error message "Did not program the relative job." will be displayed on message line.

Select conversion coordinate system.

NOTE When depressing

soft key, input user

coordinate No. to be shifted by using digit keys.



A3. 2. 12. 2 Operation (Cont'd)

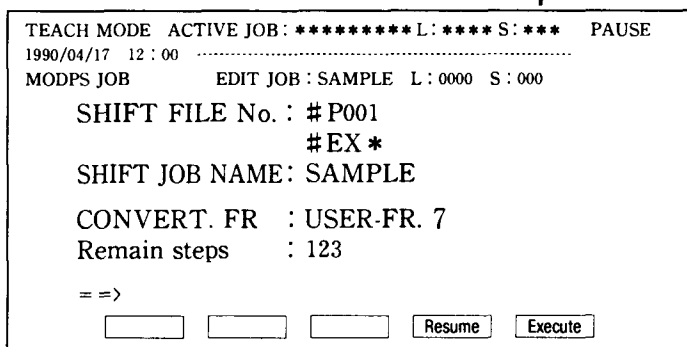
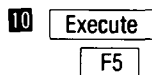
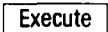



Fig. A3. 24 Parallel Shift Job Execution Display

This display will appear.



After checking the contents, depress  soft key to execute parallel shift job conversion. 

After completing the conversion, the display is changed automatically to job contents display.

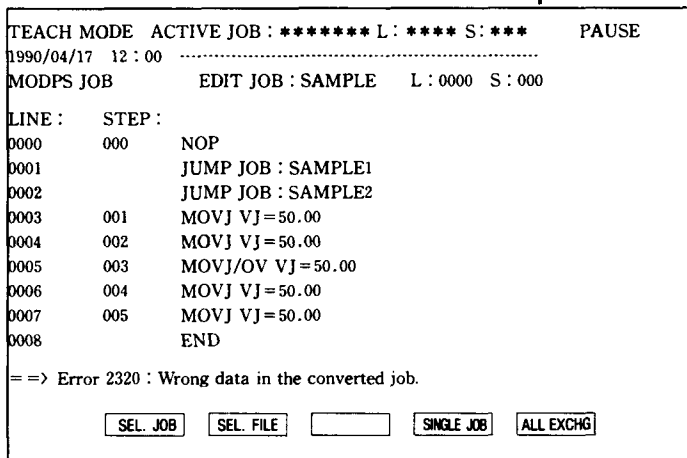


Fig. A3. 25 Job Contents Display



1. Key input is not accepted during this conversion.
2. When executing batched conversion, the search of child job will take a few minutes.
3. If an alarm is generated, this conversion will be interrupted.

A3. 2. 13 External-axis Block Function (Effective from V 4.00)

YASNAC ERC can control up to 12 axes simultaneously.

The system consisting of robot axes and external axes (travel and rotation axes) is very complex. Therefore, the teaching while paying attention to all axes operations is very difficult. If external axes are operated erroneously, the tool may be broken and the operator may be injured.

To ease the teaching and prevent hazardous conditions, use this function.

A3. 2. 13. 1 Function

This function limits external axes operation by using external input signals. This is applied to a system which divides external axes into two groups, as shown below.

When the manipulator is operated in group 1, the external axes in group 2 should be taught so that it does not move.

To prevent hazardous conditions such as erroneous operation of external axes in group 2, use this function. This can also limit during PLAYBACK operation.

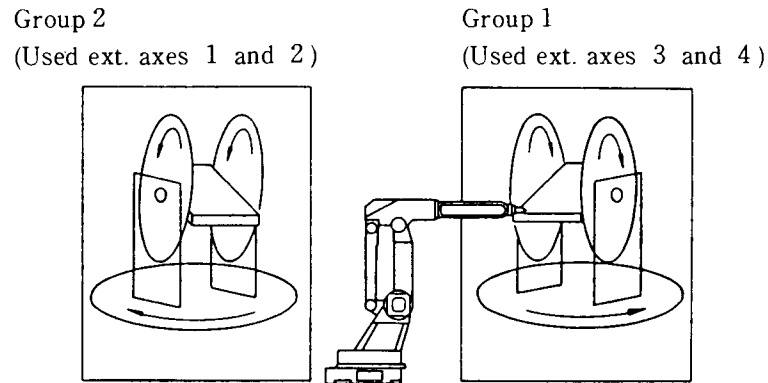


Fig. A3. 26 External Axes Block Function

(1) Contents of setting data

The setting of axis selection and external input signal for each group is set by parameters shown in Table A3. 4.

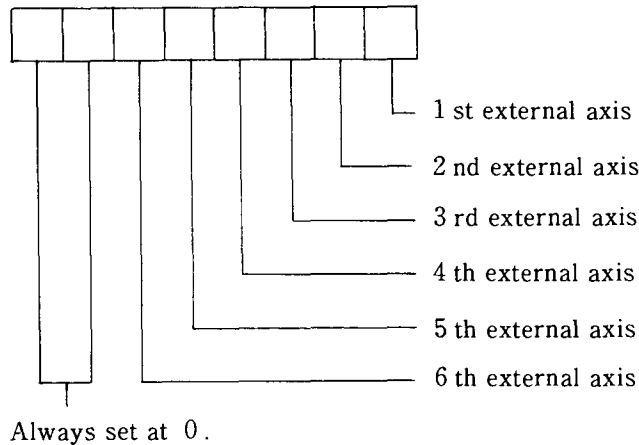
A3. 2. 13. 1 Function (Cont'd)

Table A3. 4 Parameter and Setting Contents

Parameter No.	Setting Contents
SC173 * (Effective from V4.10)	External axis block allowable value (pulse) Initial value : 0
SC284	External axis settings in group 1
SC285	External axis settings in group 2
SC286	Specification of general purpose input No. to block the external axis motions in group 1 (Motion prohibit at OFF)
SC287	Specification of general purpose input No. to block the external axis motions in group 2 (Motion prohibit at OFF)

* : When the external block function is used and emergency stop is performed, an alarm occurs at reactivation. (Because axes which have block designation change some pulses from those at power OFF.)
To solve this problem, the external axis block allowable pulse value is set by this parameter and motion is possible if moving amount of an axis with block designation is within the allowable value range. Set this parameter to any value before using external-axis block function.

In this Table, external axis settings in groups 1 and 2 (SC284 and SC285) are shown below.



- The external axis which limits motion should be set at 1.
- Parameters SC286 and SC287 are set in range of connecting general purpose inputs (96 points max.)
- When this function is not used, set parameters SC286 and SC287 to 0.

A3. 2. 13. 2 Example of Usage

Fig. 3. 27 shows a robot system of 2 groups using 4 external axes.

This is an example in which the operator sets workpieces in group2 while the manipulator is working in group 1.

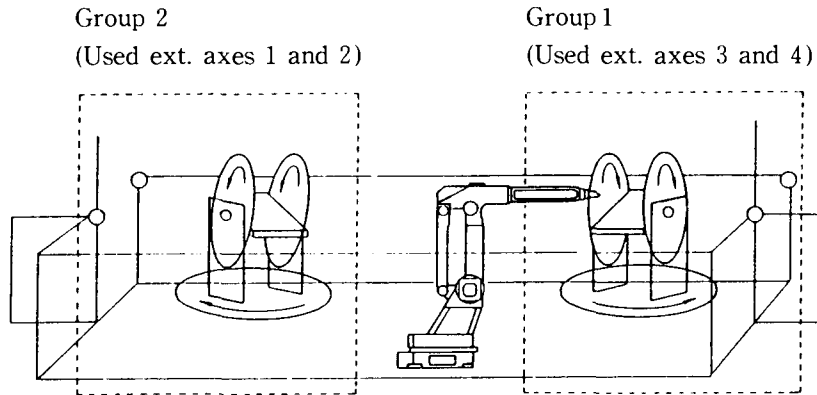


Fig. A3. 27 Example of Usage

(1) Setting data

Group 1 : External axis block group 1

Executes block of group 1 by the signal of general-purpose input No. 1.

Group 2 : External axis block group 2

Executes block of group 2 by the signal of general-purpose input No. 2.

Set the parameters for specification above.

• Group 1

SC 284 : 12 (00001100) Limits external axes 3 and 4 by general-purpose input 1.

SC 286 : 1

• Group 2

SC 285 : 3 (00000011) Limits external axes 1 and 2 by general-purpose input 2.

SC 287 : 2

(2) Operation

• Operation program is taught while external axes regardless of teaching are fixed firmly in the conditions below.

(i) At teaching of program in group 1, set general-purpose input No. 2 to OFF and No. 1 to ON.

(ii) At teaching of program in group 2, set general-purpose input No. 1 to OFF and No. 2 to ON.

If general-purpose Nos. 1 and 2 are set to OFF, the external axes in both groups can not move.

• Set the conditions as shown below during playback operation.



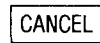
(i) During workpiece installation in group 1, set general-purpose input signal 1 to OFF and 2 to ON.

(ii) During workpiece installation in group 2, set general-purpose input signal 1 to ON and 2 to OFF.


In this case, where the external axis to limit the operation is commanded, an alarm will occur and the external axis will not move. Therefore, operator can install workpieces safely.

A3. 2. 13. 3 Error and alarm

(1) Error

Error Code	3 0 3 0
Display Message (Ext. axis data)	NOT OPERATE UNDER SELECTING EXT-AXES BLOCK (00000002) ← Display of error axis [When multiple axes are in error, an axis is displayed sequentially from the lowest one.]
Cause	At teaching, the external axis which is set at “No move,” the move operation is tried by using teach pendant.
Active	<ul style="list-style-type: none"> • Depress  key on operator's panel only for error release. • Depress  key for the error release from teach pendant. • To operate the external axis, set the general-purpose input No. to ON.
Error Code	0 0 8 1
Displayed Message	No specified axis
Cause	When setting the parameter, an external axis which does not exist in block-axis setting parameter is set.
Active	Depress  key on operator's panel to release the error, and check the data of parameters SC 284 and SC 285.

(2) Alarm

Alarm Code	1 7 6 0
Display Message (Ext. axis data)	UNDER SELECTING EXT-AXES BLOCK (1 2 3 4 5 6) ← The axis No. during alarm is displayed in reverse color.
Cause	YASNAC ERC executes motion command to the external axis which is set so that it does not move.
Active	For only resetting the alarm, depress  soft key. When the manipulator is operated after resetting the alarm, turn on general-purpose input No. to determine motion of external axis.

A3. 2. 14 Position Correction Function During Playback (Effective from V4.20)

The position correction function during playback is used to correct positions by easy operation without making the robot stop when teaching position is changed by checking robot operation status.

This function can correct the following data items by the operator's panel key input:

- Teaching position
- Operation speed
- Positioning level

A3. 2. 14. 1 Function

(1) Contents of data to be changed

The following describes the data required for position change:

- Job name : Input job name to be changed.
- Step No. : Input step No. to be changed.
- Correction amount ΔX : Input incremental value in X direction of coordinate to be changed.
- Correction amount ΔY : Input incremental value in Y direction of coordinate to be changed.
- Correction amount ΔZ : Input incremental value in Z direction of coordinate to be changed.
- Correction amount ΔV : Input incremental value of speed.
- PL/CONT : Input PL (positioning level) or CONT (continuous operation speed)
- Coordinate : Input coordinate system to be changed.

(2) Range of data to be changed

The following shows the input range of data to be changed:

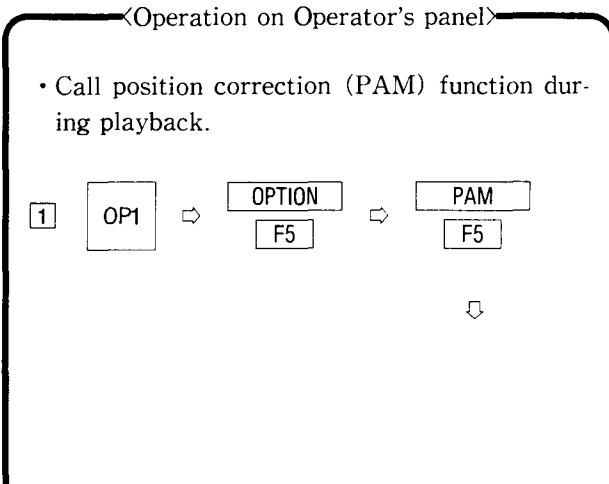
- No. of steps : Up to 10 steps can be changed at once.
- Position changing range (X,Y,Z) : Unit mm, effective down to 3 decimal places,
initial value $\pm 10\text{mm}$
- Speed changing range (V) : Unit %, effective down to 2 decimal places, up to $\pm 50\%$
- PL/CONT changing range : 0 to 4, CONT
- Coordinate : Robot coordinate, base coordinate, tool coordinate,
user coordinate (initial coordinate : robot coordinate)

(3) Precautions

- External axis data are not changed.
- Correction at TCP instruction execution is performed by teach tool data.
- An error occurs if PL or CONT is not provided in the step to be changed.
- An error occurs if teaching in the user coordinate is not performed when the user coordinate is to be changed.
- Steps of position variables and reference points (REFP) are not changed.

A

A3. 2. 14. 2 Operation



<Description>

Depress key.

Depress
 soft key.

Depress
 soft key.

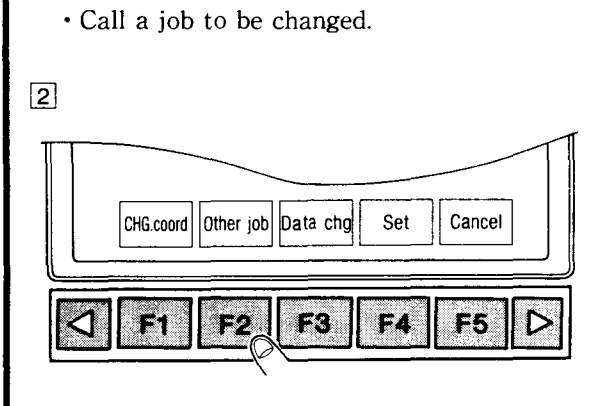
```

TEACH MODE  ACTV-JOB  *****  L:*****  S:***  ON STOP
1990/04/17 12:00  EDIT-JOB  SAMPLE  L:0000  S:000
PAM
JOB NAME : SAMPLE-1  INPUT COORD : ROBOT-FR.1
STEP No.  ΔX(mm)  ΔY(mm)  ΔZ(mm)  ΔV(%)  PL/CONT
000        00.000  00.000  00.000  00.00  -
000        00.000  00.000  00.000  00.00  -
000        00.000  00.000  00.000  00.00  -
000        00.000  00.000  00.000  00.00  -
000        00.000  00.000  00.000  00.00  -
000        00.000  00.000  00.000  00.00  -
000        00.000  00.000  00.000  00.00  -
000        00.000  00.000  00.000  00.00  -
000        00.000  00.000  00.000  00.00  -
000        00.000  00.000  00.000  00.00  -
000        00.000  00.000  00.000  00.00  -
    
```

=>

Correction amount input display appears.

Fig. A3. 28 Correction Amount Input Display



Depress
 soft key.

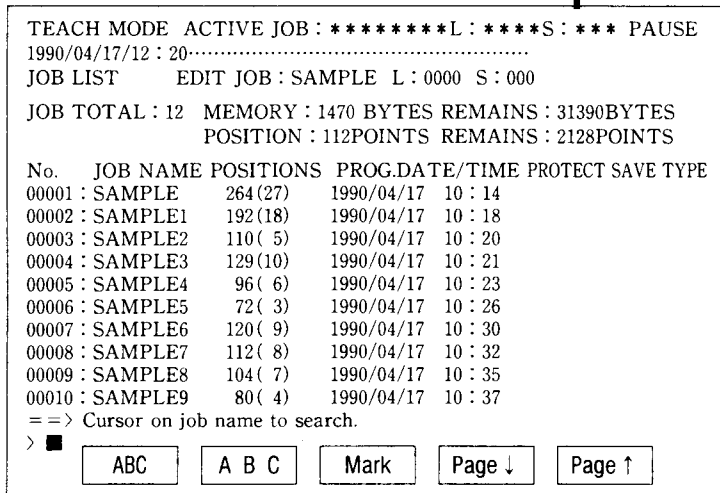


Fig.A3.29 Job List Display

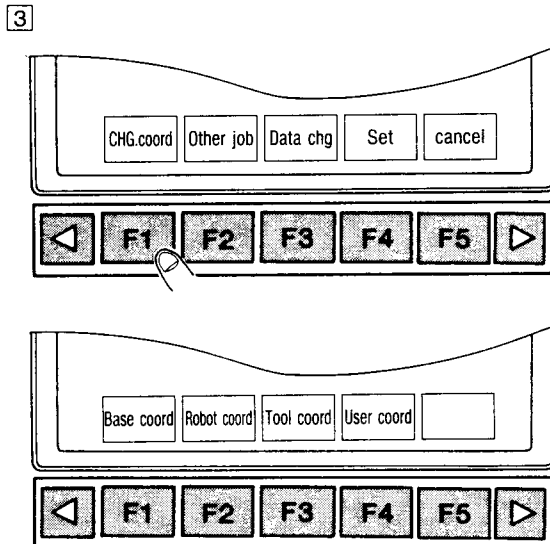
The job list display appears. Move the cursor to a job whose position is to be changed and depress

ENTER key.

Also, the job can be called by inputting the job name directly.

When the job destination is completed, the display is changed to the correction amount input display (Fig.A3.28)

- Specify coordinate system to be changed.



Depress **CHG.coord** **F1** soft key.

The soft keys are changed as shown on the left. Specify the coordinate system to be changed. (Initial coordinate : robot coordinate)

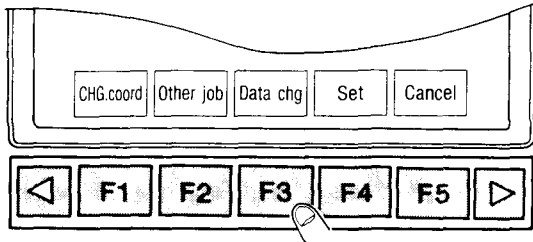
When the coordinate designation is completed, the display is changed to the correction amount input display (Fig A3.28)

A

• Input correction amount.

《Step X, Y, Z, V》

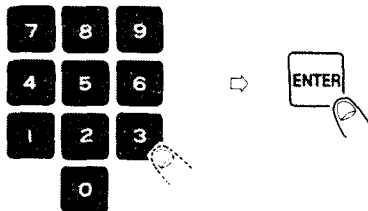
4



Move the cursor to data to be changed.

Depress soft key.

5

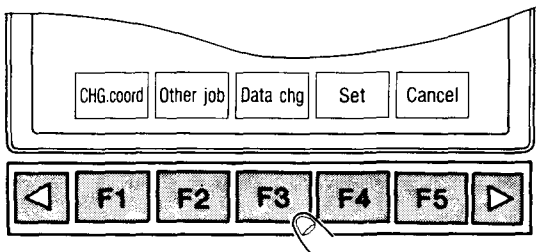


Input correction amount in numerical value and depress key.

NOTE : The maximum value (1 to 255mm) of position changing range (ΔX , ΔY , ΔZ) is set by parameter SC296.
The speed changing range is $\pm 50\%$.

《PL/CONT》

6

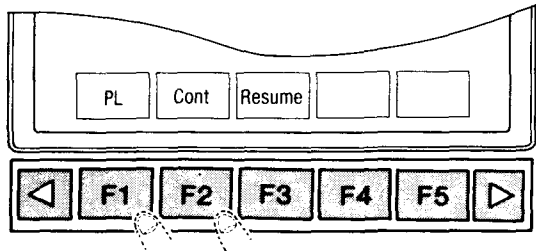


Move the cursor to PL/CONT.

Then depress soft key.

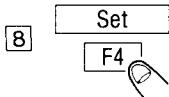
The soft keys are changed.

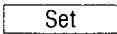

7



Depress or soft key.
 or

When soft key is depressed, input the level in numerical value.

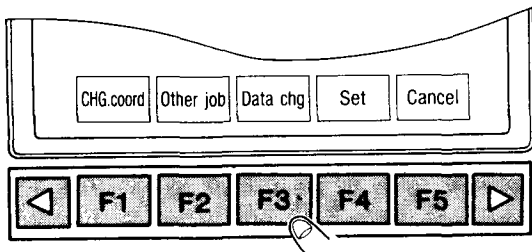


When correction amount input is completed,
depress  soft key.


Then the following items are checked:

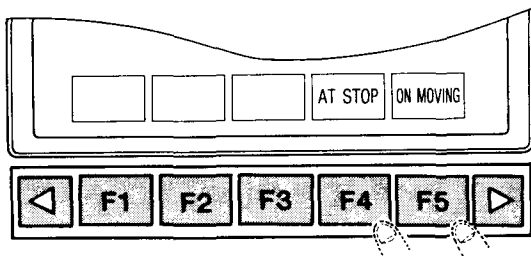
- The job is not prohibited to be changed.
- Any coordinate that is not defined for user coordinate has not been specified.
- No other place is set when the step No. is 0.
(Error mark: st)
- The same step No. is not specified repeatedly.
(Error mark: sd)
- The specified step is not a position variable nor instruction for palletizing. (Error mark: PO)
- The step contains speed. (Error mark: V)

9 <An error occurs>



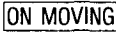

If an error occurs, the error mark is displayed at the left side of the step No. and the soft keys are waiting for input. Set data again.

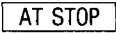

<No error occurs>



When no error occurs, the soft keys on the left appears.

For correction during operation, depress

 soft key.


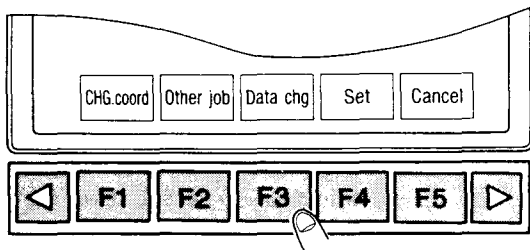
For correction during stop, depress  soft key.


Then the following items are checked:

- Coordinate change limit is not exceeded.
(Error mark: *L)
- Speed change limit is not exceeded.
(Error mark: *V)

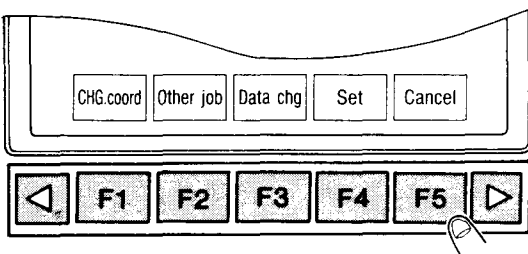


10



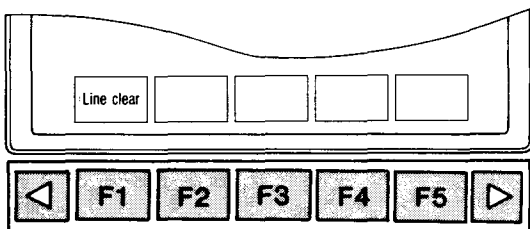
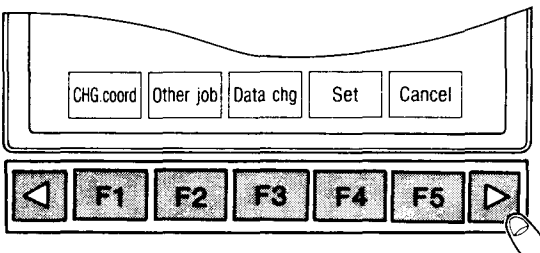
• For cancel of correction

11



• For line clear

12



If an error occurs, the error mark is displayed at the left side of the step No. and the soft keys are waiting for input. Set data again.

When no error occurs and job correction is completed, the data in the correction amount input display (Fig. A3. 28) is cleared.

For cancel of correction, depress

Cancel
F5

 soft key.

If any of the following factors occurs before correction execution, correction is automatically canceled.

- When “mode” is changed
- When an “alarm” or “error” occurs
- When the power supply is turned off

Line clear can be performed when wrong correction amount has been input or when correction is not needed in a certain step.

Depress

▶

 key.

Move the cursor to the line to be cleared and depress

Line clear
F1

 soft key.

A3. 2. 14. 3 Error Message and Contents

“0170 Undefined USER FRAME FILE”

- A coordinate of which user coordinate is not defined has been specified.

“1010 Edit-lock mode.”

- Edit lock has been set.

“1020 Enter correct value.”

- Set value of correction amount ΔX , ΔY , or ΔZ exceeds the specified range.
- Set value of correction amount ΔV , exceeds $\pm 50\%$.
- Set value of PL (positioning level) is not within 0 to 4.
- User coordinate setting is not within 1 to 8.

“2021 The JOB within the protect area for edit.”

- Editing prohibit attribute is set to the job.

“2040 Undefined job.”

- A job that has not been registered is set.

“2050 Enter job name to edit.”

- The job for editing is not set.

“2120 Position data are fault.”

- Position data of setting step fault.

“2320 Wrong data in the converted job.”

- Limit is exceeded at conversion.

“1090 Illegal DATA in the file.”

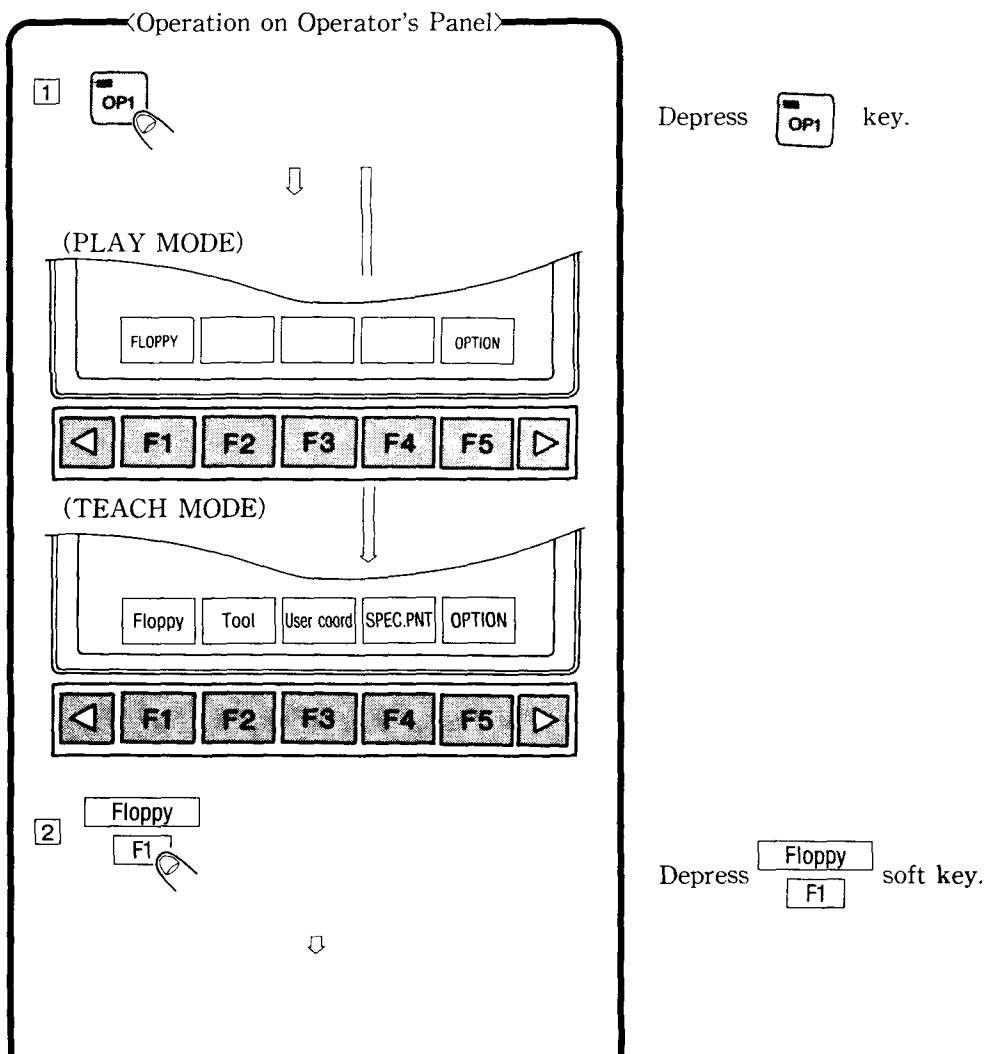
- Step is not set.
- PL/CONT is not set.
- The step uses position variables or reference points (REFP).
- The step does not have speed or PL/CONT designation.
- the same step No. is repeated.

A3. 2. 15 Data Save/Verify Function During Playback (Effective from V4. 20)

Data save/verify function during playback is a function to store/read data for floppy disk in the play mode. Data items related to this function are shown below (the same as those of floppy disk operation in the teach mode).

- Job data
- Conditional program data
- All user's programs
- Parameters
- System data
- All data in CMOS
- Others

A3. 2. 15. 1 Operation



DATA IN THE FLOPPY DISK	UN-USED MEMORY 30%
CLASSIFIED DATA	NOS OF FILE (FLOPPY)
<input type="checkbox"/> JOBS	12
<input type="checkbox"/> CONDITIONAL PROGRAM DATA	2
<input type="checkbox"/> ALL USER'S PROGRAMS	0
<input checked="" type="checkbox"/> PARAMETERS	1
<input checked="" type="checkbox"/> I/O SYSTEM DATA	0
<input checked="" type="checkbox"/> ALL DATA IN CMOS	0
<input checked="" type="checkbox"/> OTHERS	0

=> Cursor on data group to be transmitted and select the soft key.

Save Verify Formatting Delete

◀ F1 F2 F3 F4 F5 ▶

3

4

Save Verify Formatting Delete

◀ F1 F2 F3 F4 F5 ▶

↓

The following procedures are the same as those of floppy operation in the teach mode.

Place the cursor to the data classification item to be transferred by using CURSOR keys.

Depress or soft key.

or

REGISTERED FILES : 2

CONDITIONAL PROGRAM DATA

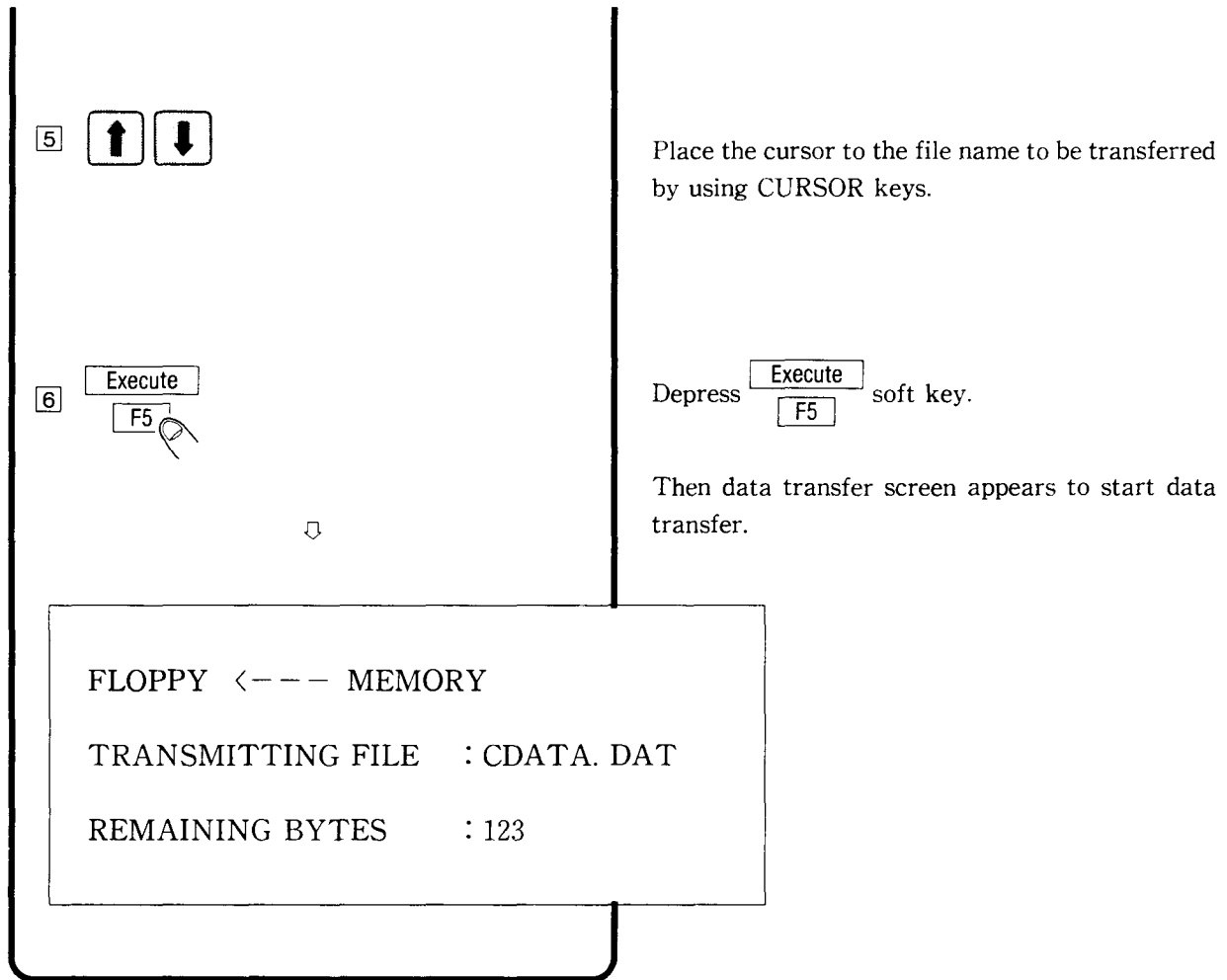
- ALL CONDITIONAL DATA CDATA. DAT
- WEAVING DATA WEAV. DAT
- TOOL DATA TOOL. DAT

===> Cursor on the file to transmit and push [Execute].

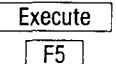
Page ↓ Page ↑ Abort Execute

◀ F1 F2 F3 F4 F5 ▶

A

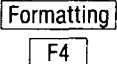
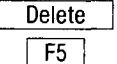

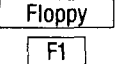


Place the cursor to the file name to be transferred by using CURSOR keys.

Depress  soft key.

Then data transfer screen appears to start data transfer.

[SUPPLEMENT]

- ① The process when  or  soft key is depressed is the same as that in the teach mode.
- ② Process in display change
During data save/verify processing, display can be changed.
- ③ Transfer checking during processing
When  key is depressed again during data save/verify processing, the data transfer screen is displayed at the timing where  soft key is depressed.

A3. 2. 15. 2 Error and Alarm

For details, refer to the error message of floppy operation in the teach mode.

A3. 2. 16 Production Control Diagnosis Display Function (Effective from V4. 20)

This function is used for name registration or data change in the diagnosis display by specifying user variables (number of palletized works, etc.) used for the line control by using parameters. Also a function to change conditions for continuous parallel shift is added.

A3. 2. 16. 1 Production Control Diagnosis Display

TEACH MODE	ACTV-JOB:***** L:**** S:*** ON STOP		
1990/04/17 12 : 00	-----		
Production Data	EDIT-JOB: SAMPLE L:0000 S:000		
Num. of Palletized works	Line1	12	
	Line2	1	
	Line3	1	
	Line4	1	
Total num. of each rot	Line1	123	
	Line2	32767	
	Line3	32767	
	Line4	32767	
Switch of SHIFT ON/OFF	ON		
==> Select edit item			
<input type="button" value="Set data"/>	<input type="button" value="Rename"/>	<input type="text"/>	<input type="text"/>

Fig.A3.30 Typical Production Control Diagnosis Display

- User variable display/setting

By specifying B/I variables used for the line control by parameter (variable designation: ME10, bit designation: ME11 to ME18) in the production control diagnosis display, a name can be set within 16-character full size or 32-character half size and variable data can be changed in the diagnosis display.

- Parallel shift operation condition setting

Conditions for continuous parallel shift operation can be set at the next start in the production control diagnosis display.

In the conventional method, parallel shift value was cleared as a process at accident occurrence which have been out of the operation sequence and made the job cursor position change.

In the new method, [ON/OFF] setting can be performed according to the worker's decision.



A3. 2. 16. 2 Operation

(1) Parameter setting (Refer to Par. A3. 2. 16. 3 “List of Related Parameters”)

B variables/I variables displayed in the production control diagnosis display are designated.

ME10 : Display 1 to 8 variable designation (B/I variables bit designation)

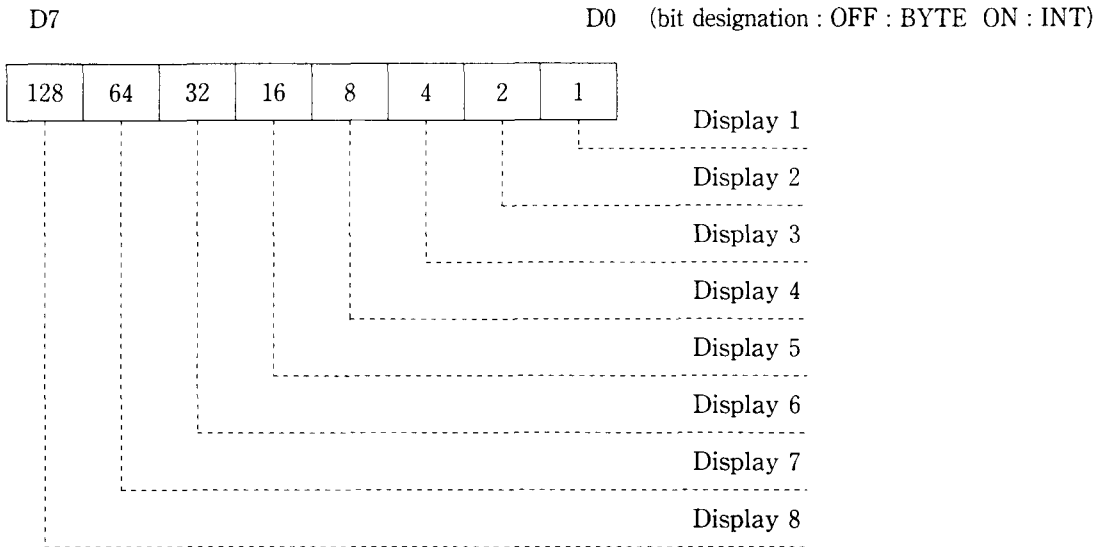
ME11 to 18 : Display 1 to 4 No. designation

The number of variables to be displayed is up to 8 and are displayed at the display lines shown in Fig.

A3. 30 “Num. Of Palletized works Line 1” to “Total num. of each rot Line 4”.

For example, the following describes how to display B01 in the display line 1:

① Set ME10 D0 bit.



② Set 1 to ME11 (variable Nos. 0 to 99).

(2) Name change operation

Move the cursor to the line having the name to be changed, and enter the edit mode. Then depress

Rename
F2 soft key to enter the character input mode.

After inputting the name, depress enter key so that the name will be changed. Names shown in Fig.

A3. 30 are registered at the factory prior to shipping.

(3) Data change

Move the cursor to the data to be changed and depress Set data
F1 soft key, and the data set mode is entered.

(4) Parallel shift operation condition setting

Move the cursor to the parallel shift operation line and depress Set data
F1 soft key, and [ON/OFF] can be set by the soft keys.

A3. 2. 16. 3 List of Related Parameters

The following shows the list of parameters related to this function:

No.	Classification	Contents	Initial Value
ME10	Variable designation in handling diagnosis display	Display variable designation (bit designation) (Display 1 to 8) OFF : B variables ON: I variables	0
ME11	Variable No. designation in handling diagnosis display	Display 1 variable No. designation Specified by 0 to 99.	0
ME12		Display 2 variable No. designation Specified by 0 to 99.	0
ME13		Display 3 variable No. designation Specified by 0 to 99.	0
ME14		Display 4 variable No. designation Specified by 0 to 99.	0
ME15		Display 5 variable No. designation Specified by 0 to 99.	0
ME16		Display 6 variable No. designation Specified by 0 to 99.	0
ME17		Display 7 variable No. designation Specified by 0 to 99.	0
ME18		Display 8 variable No. designation Specified by 0 to 99.	0

A3. 2. 17 Tool Angle Indexing Function (Effective from V4. 20)

Tool angle indexing function can index angle between a tool and a workpiece by easy operation at robot operation program teaching. (For example, angle between a tool and a workpiece can be set to 30° .) Therefore, it is not necessary to measure the angle between a tool and a workpiece by using a leveller as in the conventional method. Operation through robot teaching can be much simplified.

A3. 2. 17. 1 Outline of operation

Operation at tool angle indexing changes the tool position until the specified angle against the X-Y plane in any operation coordinate system can be obtained.

Features

- The angle around Z-axis in the tool operation coordinate does not change before/after angle indexing operation. (It changes within the plane vertical to X-Y plane.)
- Control point position does not change before/after angle indexing operation.
- Axis direction of the tool coordinate used for angle indexing operation is only in Z-axis direction.

NOTE : For angle indexing operation, it is necessary to perform tool setting and coordinate setting for workpieces correctly.

Refer to the following manuals for tool and coordinate setting methods:

- Tool setting
: Appendix 4 "TOOL CONSTANT CALIBRATION FUNCTION" of OPERATOR'S MANUAL (TOE-C945-100)
- Coordinate setting
: Appendix 5 "USER COORDINATE FUNCTION" of OPERATOR'S MANUAL (TOE-C945-100)

Fig. A3. 31 Shows operation when indexing is performed at (0° , 90° and -30°) against the X-Y plane of the operation coordinate system.

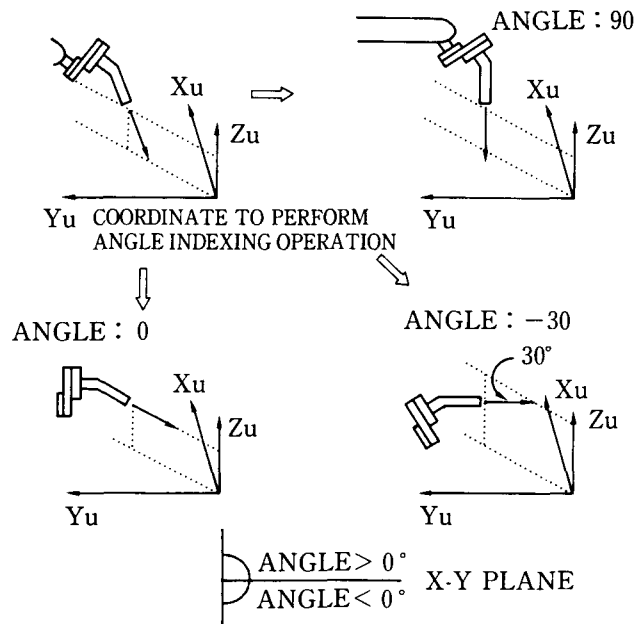


Fig. A3. 31 Tool Angle Indexing Operation



A3. 2. 17. 2 Operation

In order to perform angle indexing operation, set indexing angle by the operator's panel in advance and move the manipulator until the specified angle can be obtained by using the teach pendant.

(1) Indexing angle setting

Indexing angle is set by the operator's panel in advance.





〈Operation on Operator's Panel〉

1  

⇩

Floppy
Tool
User coord

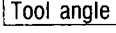


OPTION

2    

⇩

Tool angle

MODPS JOB

3   


⇩



TOOL ANGLE MOTION

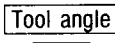
ANGLE_No.	TOOL ANGLE	ANGLE_No.	TOOL ANGLE
1	0.0deg.	5	-10.0deg.
2	30.0deg.	6	-30.0deg.
3	60.0deg.	7	-60.0deg.
4	90.0deg.	8	-90.0deg.

Data chg

〈Description〉

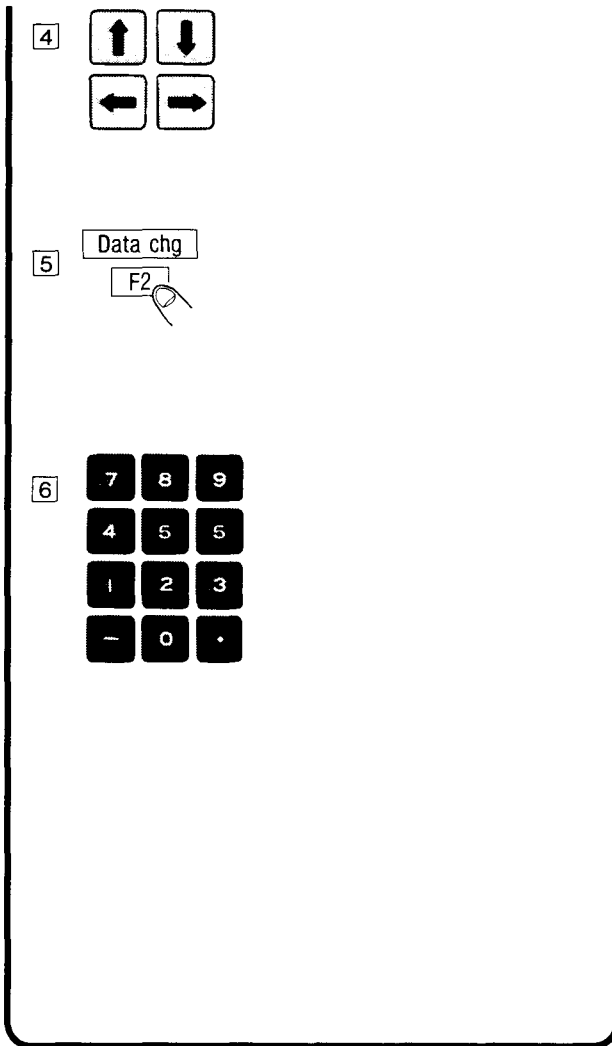
Depress  key.

Depress  and  soft keys.

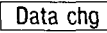

Depress  soft key.

Then the indexing angle setting display screen appears.

A



Place the cursor to the angle to be set by using CURSOR keys.

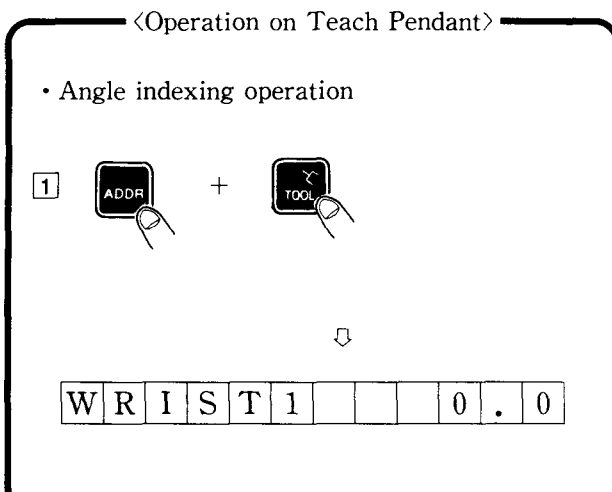
Depress  soft key.




Input a value to be set. Then the data item is changed where the cursor is located.
Up to 8 indexing angles can be set. The setting range is -90° to $+90^\circ$.



NOTE Eight double-precision types variables are used for indexing angle setting. Parameter SC291 specifies which variable is used.
[Example : SC291 (92) → D92 to D99 used for indexing angle setting]


(2) Tool angle indexing operation by teach pendant

Tool angle indexing operation is performed by the teach pendant.



While holding down  key,
depress  key.

2  and 

3 

[Example]







WRIST3 60.0





Select indexing angle No. (1 to 8) by using 
and  keys.

Depress  key.

Then the manipulator starts angle indexing operation.

Depress  key twice.

The display on the left appears.

Depress  key.

Then the manipulator starts angle indexing operation and continues the operation until the inclination between the X-Y plane and tool Z-axis direction becomes 60°.

NOTE

If the manipulator current position and selected indexing angle are different when indexing angle is displayed on the teach pendant, the angle is displayed with blinking.

A

- Designation of coordinate system to perform angle indexing

Angle indexing operation is performed for the coordinate which is specified by the coordinate LED of the teach pendant.

[User] LED lighting : User coordinate currently used

Other LEDs lighting : Base coordinate

For the robot operation coordinate, refer to Par. 6 “MANIPULATOR MOTION (COORDINATES)” of OPERATOR’S MANUAL (TOE-C945-100).

- Motion speed designation

The manipulator moves at a speed specified by the teach pendant manual speed LED.

- Designation of motions

Interpolation specified by the teach pendant motion type LED is performed.

[Link] LED lighting : Joint operation is performed.

Other LEDs lighting : Control point constant operation is performed.

NOTE

When joint operation is performed, the control point does not change before/after indexing operation. However, control points on paths are not always the same.

CAUTION : When angle indexing operation in which B-axis angle sign is reversed as shown in Fig. A3. 32 is performed, the sign of B-axis angle is stored and the manipulator moves to the specified position by rotating R-axis.

In this case, perform angle indexing operation after moving the manipulator to the aimed position where B-axis angle sign will not be reversed in advance.

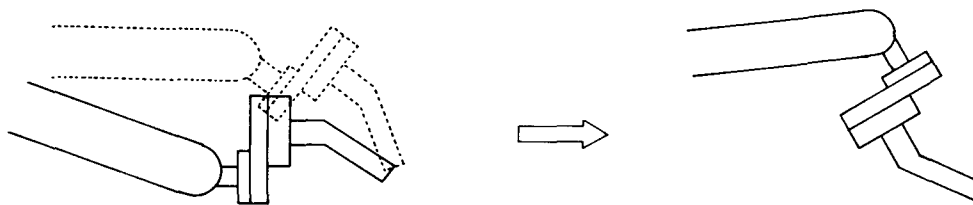


Fig. A3. 32

A3. 2. 17. 3 Error and Alarm

The following alarm occurs if further angle indexing operation is performed when tool position has been indexed to 90° or -90° (or when tool z-axis and operation coordinate z-axis are in parallel).

Alarm 1010 ARITHMETIC PROCESSING ERROR (Data 48)

If this alarm occurs, perform desired angle indexing after resetting the alarm and changing the manipulator position by the teach pendant.

A3. 2. 18 External Axis Endless Rotation Function (Effective from V4.20)

A3. 2. 18. 1 Function

(1) Outline of function

When external rotating axis is required to rotate continuously in the existing YASNAC-ERC, it is necessary to return the external rotating axis current value pulses to the soft limit motion range by rotating the external rotating axis reversely after completion of continuous rotation. (For example, after it is rotated continuously up to the possible + side soft limit and the operation is suspended temporarily, it is necessary to provide teaching by returning the rotating axis up to the possible - side soft limit and continuing the operation again as if the operation continued so as not to exceed the soft limit.) This is not needed for manipulator operation and not practical considering the operation time.

Therefore, in the external axis endless rotating function, after completion of continuous rotation, the external rotating axis revolutions (current value pulses) are controlled and reset to the data within ± 1 revolution by instruction execution or teach pendant operation. In this way, continuous rotation is possible without returning the external rotating axis.

The following will describe the outline of this function with some typical programs.

a) Instructions

Since this function resets external rotating axis revolutions (current value pulses), the next instruction is used.

WRESET 1 (Resets the first external axis.)

b) Instruction registration

External rotating axis current value reset instruction "WRESET" is registered by the operator's panel as follows.

After the JOB to be edited is called, key is selected and the cursor is moved to the step whose external rotating axis current value is to be reset. Then the WRESET instruction is called by the soft key operation to register by key.

(For details, refer to par. A3. 2. 18. 3.(1) "External rotating axis current value reset instruction editing.")

c) Teach pendant operation

When external rotating axis revolutions (current value pulses) are reset by the teach pendant operation, the current value pulses are reset by using functions keys (+ ,).

(For details, refer to par. A3. 2. 18. 3. (2) "External rotating axis current value reset by teach pendant".)

A

d) Typical program

LINE	STEP	INSTRUCTION
0000	000	NOP
0001	001	MOVJ EX VJ=20.00
0002	002	MOVL EX V=375.0
0003	003	MOVL EX V=50.0
0004	004	MOVJ EX VJ=20.00
0005	005	MOVJ EX VJ=25.00
0006	006	MOVJ EX VJ=50.00
0007	007	MOVJ EX VJ=30.00
0008		TIMER T=0.5
0009		WRESET 1
0010	008	MOVL EX V=30.0
0011	009	MOVL EX V=150.0
0012	010	MOVJ EX VJ=25.00
0013	011	MOVJ EX VJ=40.00
0014	012	MOVJ EX VJ=10.00
0015	013	MOVJ EX VJ=80.00
0016		TIMER T=0.5
0017		WRESET 1
0018	014	MOVJ EX VJ=50.00
0019	015	MOVJ EX VJ=30.00
0020		END

<Description of typical program>

Lines 1 to 3 : Normal motion is performed.

Lines 7 to 9 : External rotating current value is reset.

Manipulator stops for 0.5 second at execution of this instruction.

Lines 15 to 17 : External rotating current value is reset.

Manipulator stops for 0.5 second at execution of this instruction.

(2) Limitation

a) Mechanism

Do not provide overrun limit switch (LS) in order to make endless rotation for rotating axis.

b) Hardware (endless rotating axis)

For endless rotation, use a rotating axis of which integral value is a value obtained by dividing motor shaft 100,000 revolutions by reduction ratio.

A3. 2. 18. 2 Instructions

When external rotating axis revolutions (current value pulses) are reset, the following instruction is specified:

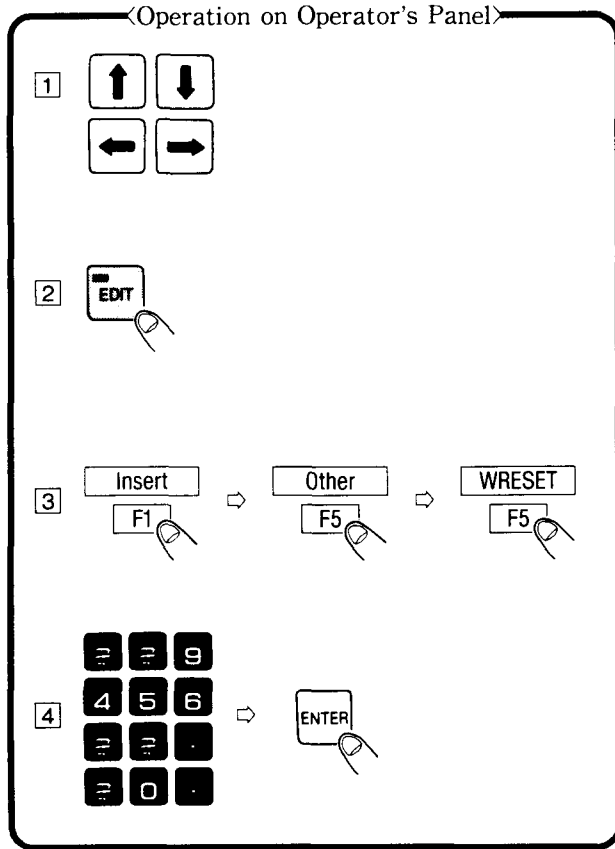
WRESET 1
 ↓
 Indicates first external axis.

When this instruction is executed, specify the instruction in the manipulator stop status for current value pulse reset.

A3. 2. 18. 3 Operation

(1) External rotating axis current value reset instruction editing

a) Registration



〈Description〉

Place the cursor to the step in which WRESET instruction is required to set.

Depress key.

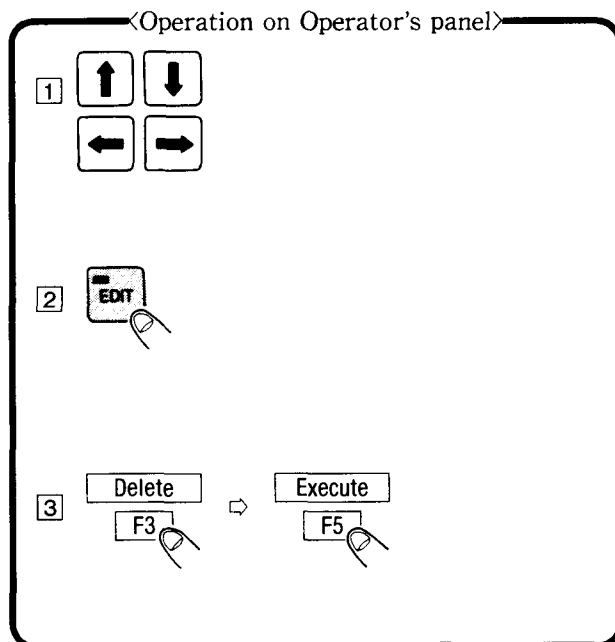
Depress soft key.

Depress soft key.

Depress soft key.

Input the external axis number and depress key.

b) Deletion



〈Description〉

Place the cursor to WRESET instruction.

Depress key.

Depress soft key.

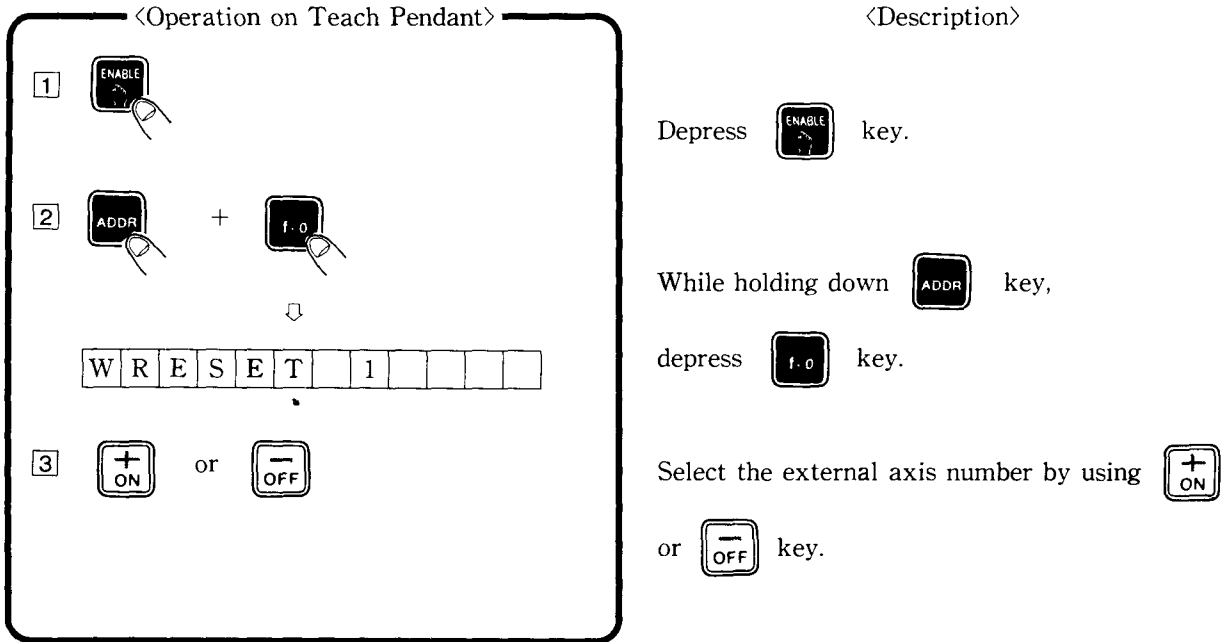
Depress soft key.



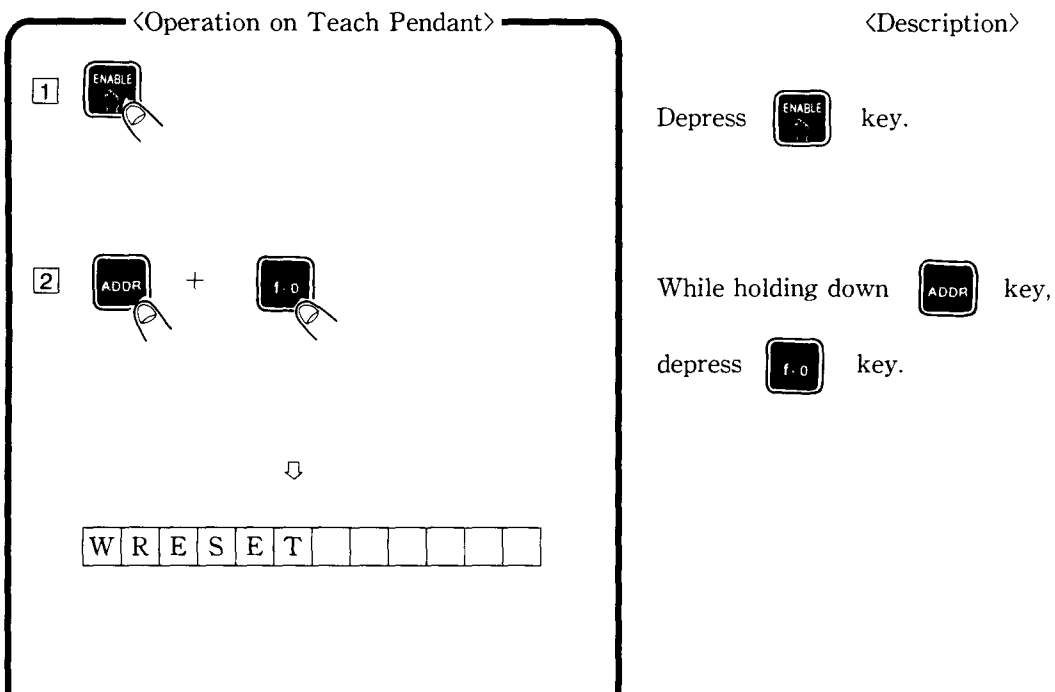
(2) Reset operation method by teach pendant

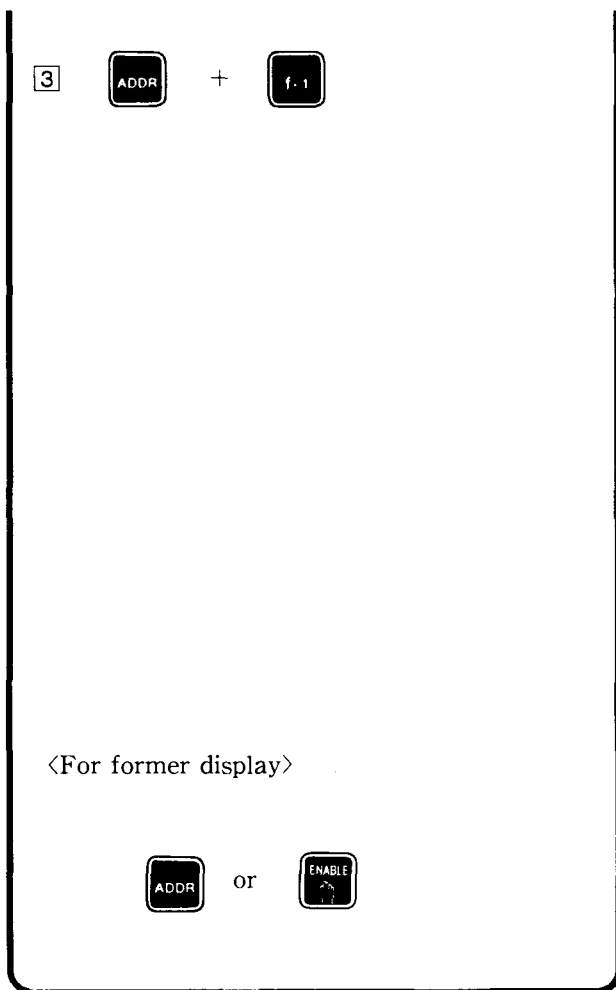
In the external rotating axis endless rotation specifications, position teaching and LNR motion cannot be performed if external rotating axis current value pulses exceed the soft limit at teaching. Therefore, it is necessary to perform WRESET operation before the teach pendant operation.

a) Reset axis selection



b) Reset operation





While holding down key, release key and depress key.

If reset operation is performed when the external rotating axis current value pulses are within one revolution, "WRESET" displayed in the teach pendant remains and will not be changed to the former step display.

NOTE When and keys are depressed after and keys depressed, keep depressing key. If key is released, the reset operation cannot be performed.

When the former display is required, depress

key or key twice.

A3. 2. 18. 4 Precautions

(1) WRESET instruction execution

It is necessary to execute the WRESET instruction when the manipulator stops completely because of the internal processes. (By executing the instruction when the manipulator does not stop completely, external rotating axis dislocation occurs.)

Therefore, execute the TIMER instruction (TIMER time: approx. 0.5 to 1.0 second) before executing the WRESET instruction.



(2) When NWAIT instruction is specified

When the NWAIT instruction is added to the move instruction before execution of the WRESET instruction, the instruction is executed as the manipulator moves. If the manipulator moves during execution of the WRESET instruction, the external rotating axis is dislocated.

Therefore, when the NWAIT instruction is specified, make programming so as to execute the WRESET instruction after setting the CWAIT and TIMER instructions.

A typical program is shown below:

<Typical program>

LINE	STEP	INSTRUCTION
0000	000	NOP
0001	001	MOVJ EX VJ=25.00
0002	002	MOVL EX V =500.0
0003	003	MOVL EX V =300.0
0004	004	MOVJ EX VJ=50.00
0005	005	MOVJ EX VJ=50.00
0006	006	MOVJ EX VJ=30.00
0007		TIMER T=1.5
0008		DOUT OT#01 1
0009		CWAIT
0010		TIMER T=0.5
0011		WRESET 1
0012	007	MOVJ EX VJ=25.00
0013	008	MOVJ EX VJ=50.00
0014		END

<Description of typical program>

Lines 1 to 6 : Normal operation is performed.

Lines 9 to 11 : Advance reading process is stopped by the CWAIT instruction designation and TIMER is executed for 0.5 second. In the meantime, the manipulator stops completely. The WRESET instruction is executed after the manipulator stops.

Lines 12 and 13 : Normal operation is performed.

(3) Check at applicable external axis designation fault

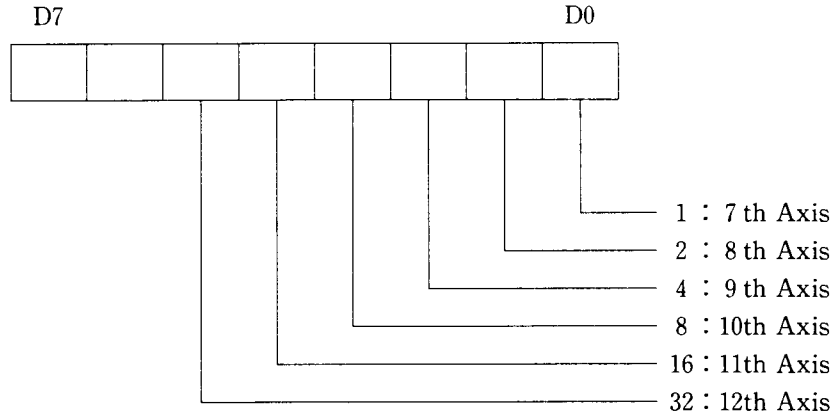
This function can reset only external axes which are specified by SC parameter and set so that they are used as rotating axes.

If a wrong external axis No. other than rotating axes specified by SC parameter and the WRESET is executed an alarm (AL-1660: Process err.(Continues Rotation)) occurs.

However, the reset process from the teach pendant does not cause an alarm but is disregarded.

a) Applicable external axis designation SC parameter

SC 250 : Setting of External Axis (bit designation)



Add the above-mentioned value to an applicable axis and set it to the parameter.

b) 1st to 3rd external axis application designation SC parameter

SC 253 : Use of 1st to 3rd external axes

1st axis	:	2nd axis	:	3rd axis
0	:	Rotating axis	:	Rotating axis
1	:	X-Axis	:	Rotating axis
2	:	Y-Axis	:	Rotating axis
3	:	Z-Axis	:	Rotating axis
4	:	X-Axis	:	Rotating axis
5	:	X-Axis	:	Rotating axis
6	:	Y-Axis	:	Rotating axis
7	:	X-Axis	:	Z-Axis

In order to match applicable external axis function, values from 0 to 7 are set to the parameter.



A3. 2. 19 Shift Amount Creation Function (Effective from V4. 20)

In the existing parallel shift function, when parallel shift was attempted for manipulator position, the manipulator could not always be shifted in parallel to the aimed position in the following cases:

- Position change displacement (Tx, Ty, Tz) was provided for shift value given by user.
- Displacement between two points was calculated by using INFORM operating instruction (ADD instruction, SUB instruction, etc.) and position change displacement (Tx, Ty, Tz) was provided for shift value.

In this function, the user can obtain the optimum shift value for moving to aimed position automatically by INFORM.

A3. 2. 19. 1 Function

Considering cartesian moving amount and position displacement amount according to the reference position and aimed position (shift position) at parallel shift, the shift value between these two positions is obtained in the specified coordinate system and set to the specified position variables.

(1) MSHIFT instruction (Shift amount creation instruction)

Instruction	Configuration	Remarks
MSHIFT	①P□□□ : Position type variables (P000 to P063)	Shift value converted to XYZ type and stored
	②BF : Base coordinate RF : Robot coordinate TF : Tool coordinate UF# : User coordinate (UF#1 to UF#8)	Shift value conversion coordinate systems
	③P□□□ : Position type variables (P000 to P063) \$ P00 : Pulse-type current value \$ P01 : XYZ-type current value \$ P01□ : Reference point pulse-type position data (\$ P011 to \$ P018)	Reference position (Either position variables or system status can be set.)
	④P□□□ : Position type variables (P000 to P063) \$ P00 : Pulse-type current value \$ P01 : XYZ-type current value \$ P01□ : Reference point pulse-type position data (\$ P011 to \$ P018)	Aimed position (Either position variables or system status can be set.)
	⑤BF : Base coordinate RF : Robot coordinate UF# : User coordinate (UF#1 to UF#8)	Setting coordinate system of reference position or aimed position

(2) Typical instruction description

a) When reference position and aimed position are of pulse type

The instruction is described as shown below when reference position and aimed position are of pulse type:

MSHIFT ① P000 ② RF ③ P001 ④ P002 ⑤ (□□)

- ① Position variable in which shift value is stored.
Stored in XYZ type even if ③ and ④ are of pulse type.
- ② Conversion coordinate system of ① shift value
In this case, ① becomes shift value for robot coordinate system.
- ③ Reference position
- ④ Aimed position

When ③ and ④ are of pulse type, ⑤ reference position and aimed position setting coordinate system does not have to be specified.

b) When reference position and aimed position are of XYZ type

The instruction is described as shown below when reference position and aimed position are of XYZ type:

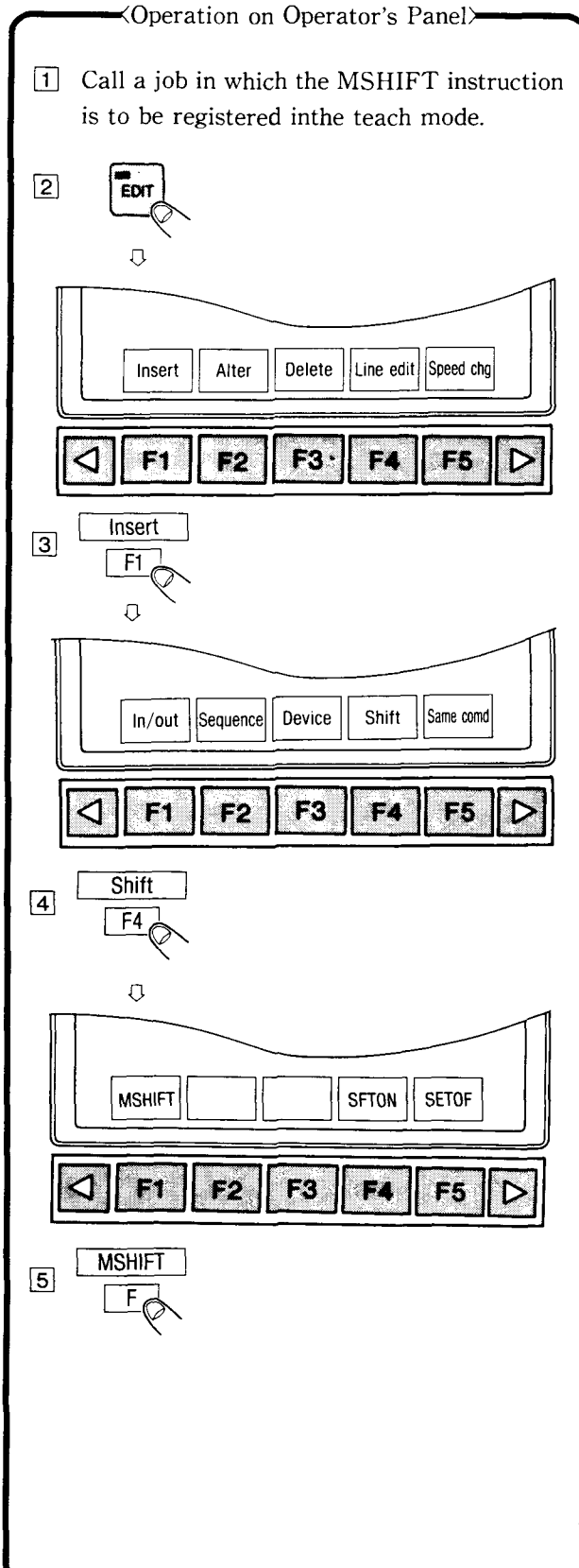
MSHIFT ① P000 ② RF ③ P001 ④ P002 ⑤ RF

- ① Position variable in which shift value is stored.
- ② Conversion coordinate system of ① shift value
In this case, ① becomes shift value for robot coordinate system.
- ③ Reference position
- ④ Aimed position
- ⑤ Setting coordinate system of reference position and aimed position
In this case, ③ and ④ become positions for robot coordinate system.

When ③ and ④ are of XYZ type, do not fail to specify ⑤ reference position and aimed position setting coordinate system.

A3. 2. 19. 2 MSHIFT instruction editing method

(1) Registration



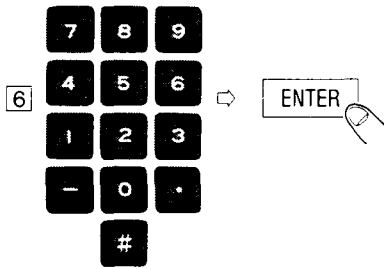
Depress key.

Depress soft key.

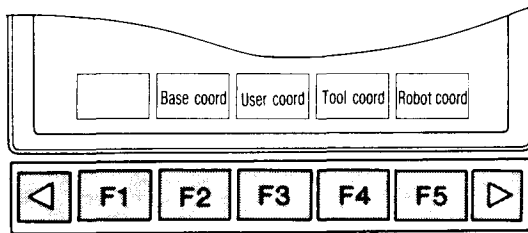
Depress soft key.

Depress soft key.

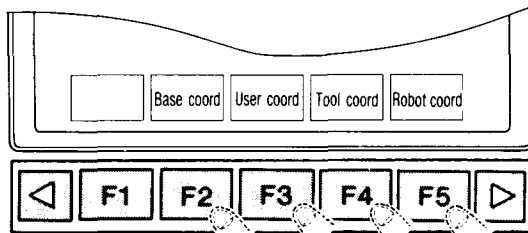
The screen enters the data setting mode to set position variables in the input buffer line.



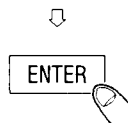
Input the position variable No. in which shift value is to be stored and depress **ENTER** key.



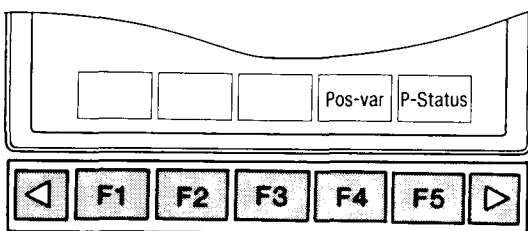
7



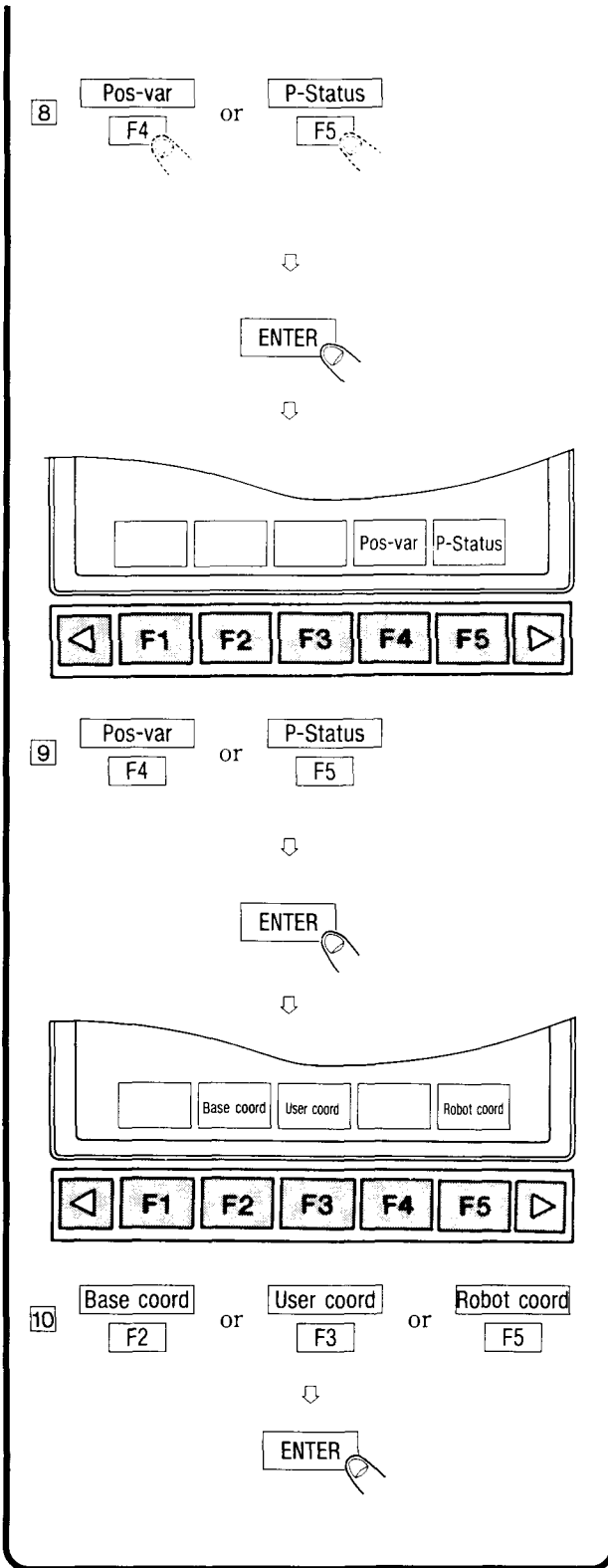
Specify the conversion coordinate system for shift value.



Then depress **ENTER** key.



A



Depress **Pos-var** or **P-Status** soft key to set reference position. Then depress **ENTER** key.

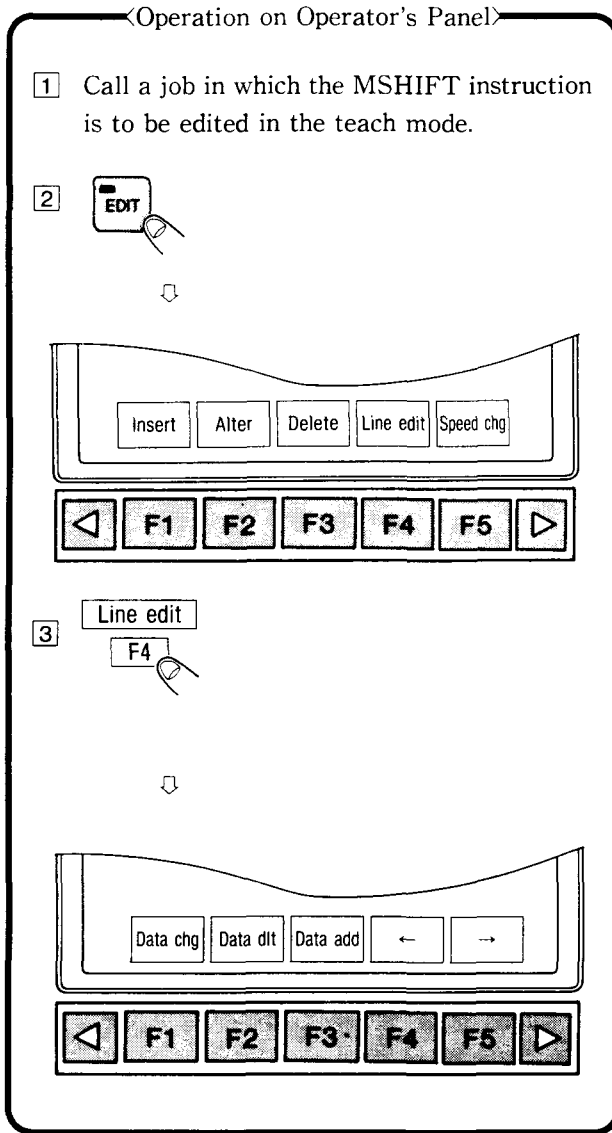
Depress **Pos-var** or **P-status** soft key to set the aimed position. Then depress **ENTER** key.

Specify coordinate system for reference and aimed positions.

Then depress **ENTER** key.

NOTE Perform this coordinate system registration only for reference position and aimed position of XYZ type.

(2) Editing



〈Description〉

Depress **EDIT** key and place the cursor to the MSHIFT instruction.

Depress **Line edit** soft key.
F4

The instruction line specified by the cursor is copied to the input buffer line. The following editing can be performed in the input buffer line:

- Only numerical data in the instruction are changed.
- Additional items are provided for the instruction.
- Only additional items that are not needed are deleted in the instruction.

Edit the MSHIFT instruction for the above procedures.



A3. 2. 19. 3 Typical program

(1) Typical program using position variables

Line:	Step:	Instruction:	
0000	000	NOP	
0001	001	MOVJ VJ=20.00 ;	Move manipulator to reference position.
0002		SET P000 \$ P01 ;	Set reference position to position variable P000.
0003	002	MOVJ VJ=20.00 ;	Move manipulator to aimed position.
0004		SET P001 \$ P01 ;	Set aimed position to position variable P001.
0005		MSHIFT P010 BF P000 P001 BF ;	Create shift value and set it to position variable P010.
0006		END	

(2) Typical program using system status

Line:	Step:	Instruction:	
0000	000	NOP	
0001	001	REFP1 ;	Reference point 1 (Reference position)
0002	002	REFP2 ;	Reference point 2 (Aimed position)
0003		MSHIFT P010 BF \$ P11 \$ P12 ;	Create shift value and set it to position variable P010.
0004		END	

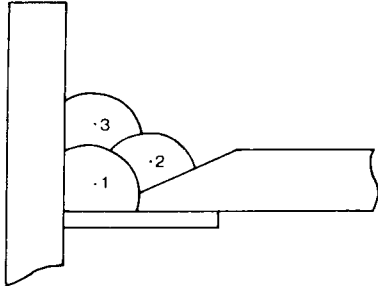
A3. 2. 19. 4 Error and alarm

Alarms occurring at execution of the MSHIFT instruction are described below:

Alarm No.	Message	Cause	Corrective Action
1370	UNDEFINED REFERENCE POINT	Although reference position has not been registered, system status (\$ P11 to \$ P18) was used in MSHIFT instruction.	Register reference point after alarm reset.
1380	ILLEGAL POSITION VARIABLE	MSHIFT instruction was executed when shift value storing position variable was of pulse type. Coordinate was specified when reference position and aimed position were of pulse type.	Change data type of shift amount storing position variable to XYZ type after alarm reset. Delete coordinate designation after alarm reset.
1790	Undefined USER FRAME FILE	User coordinate has not been registered.	Register user coordinate after alarm reset.

A3. 2. 19. 5 Teaching example

The following describes a teaching example using stop weaving multi-layer welding system.



Teaching is performed with starting points of first, second and third layers as reference points (REFP 4, REFP 5, REFP 6).



Register an instruction to call shift value creation job in multi-layer control job.

CALL JOB : OFFMAKE

Set parallel shift value for each layer, after the second layer, using sampling job in the first layer, to perform multi-layer welding.

- 1st layer : REFP 4 (\$ P14)
- 2nd layer : REFP 5 (\$ P15)
- 3rd layer : REFP 6 (\$ P16)

- P010 : Shift value
- P011 : Shift value in 2nd layer
- P012 : Shift value in 3rd layer

JOB:T180circle-2 (Multi-layer Control Job)		
LINE:	STEP:	INSTRUCTION:
0000	000	NOP
0001	001	MOVJ EX VJ=100.00
0002		CALL JOB:TORCH CLEANER
0003		SUB P010 P010
0004		MULTSAM JOB:T180 Circle 1S
0005		MULTMDEY JOB:T180 Circle 2S JOB:T180 Circle 1S
0006	002	REFP EX 4
0007	003	REFP EX 5
0008	004	REFP EX 6
0009		<u>CALL JOB:OFFMAKE</u>
0010		SET P010 P011
0011		SPEED VE=2.50
0012		CALL JOB:T180 Circle 2S
0013		CALL JOB:TORCH CLEANER
0014		SET P010 P012
0015		SPPED VE=3.00
0016		CALL JOB:T180 Circle 2S
0017		END

- Multi-layer control job
→ T180 Circle-2
- 1st layer sampling job
→ T180 Circle 1S
- Multi-layer job in 2nd layer and after
→ T180 Circle 2S
- Offset value creation job
→ OFFMAKE



- Existing typical program obtaining shift value by using operating instruction

```

JOB:OFFMAKE
(Shift Value Creation Job)

LINE: STEP: INSTRUCTION:
0000  000  NOP
0001      CNVRT P000 $ P14
0002      CNVRT P001 $ P15
0003      CNVRT P002 $ P16
0004      SET P010 P000
0005      SET P011 P001
0006      SET P012 P002
0007      SUB P010 P000
0008      SUB P011 P000
0009      SUB P012 P000
0010      RET
0011      END

```

- Typical program to calculate shift value by using operating instruction

To obtain shift value between two points, operating instruction was used. However, "MSHIFT" has been provided as shift value creation instruction so as to simplify programming.

The following shows a program example created by the MSHIFT instruction based on the above job. Change it for use.

```

JOB:OFFMAKE
(Shift Value Creation Job)

LINE: STEP: INSTRUCTION:
0000  000  NOP
0001      MSHIFT P011 RF $ P14 $ P15
0002      MSHIFT P012 RF $ P14 $ P16
0003      RET
0004      END

```

A 4 TOOL CONSTANT CALIBRATION FUNCTION

Tool constant calibration function will automatically calculate the tool constant by using calibrating tool data, and register the calculated values in specified tool files.

The result of this function, or the setting of this detailed tool dimensions are not needed to operate the manipulator, such as linear or circular interpolation, etc.

A 4. 1 MEANING OF TOOL CONSTANT

The tool constant is defined as the TCP* for interpolation operation.

The setting values of tool constant are registered in the tool file as TCP position data on flange coordinates and coordinate system data.

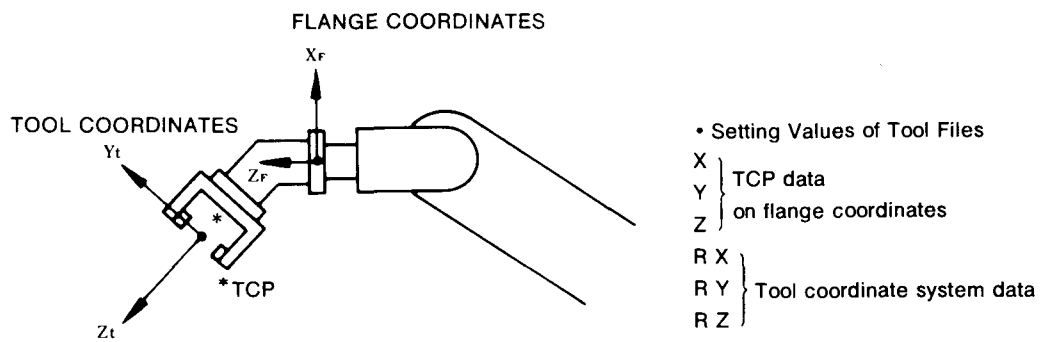


Fig. A4.1

*TCP means a tool center point, such as a tip of arc welding rod, the center of a gripper, or a deburring tool tip.

A 4. 2 DESCRIPTION OF TOOL DATA

The tool data has three types as follows :

- Calibrating tool data : Tool constant as base of TCP calibration (automatic generation) is set.
- Standard tool data : Tool constant of standard tool being used is set.
...Tool No. 0
- Multiple tool data : Eight tool constants except standard tool are set.
These data are effective when multiple TCP control function (optional) is provided in YASNAC ERC.
...Tool Nos. 1 to 8

Calibrating tool data should be set before standard or multiple tool data is set.



A 4. 2. 1 Setting of Calibrating Tool Data

The calibrating tool data is position and direction of TCP from flange coordinates, which is formed on wrist flange. (Fig. A 4. 3)

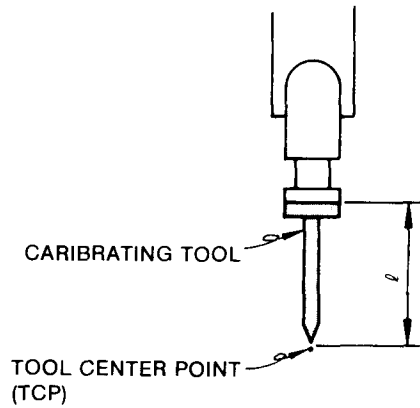


Fig. A 4. 2 Example of Calibrating Tool

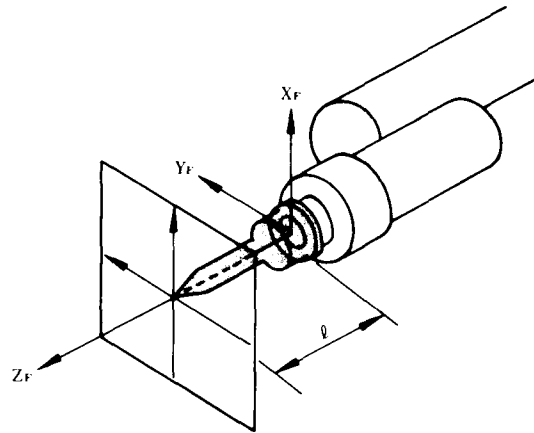
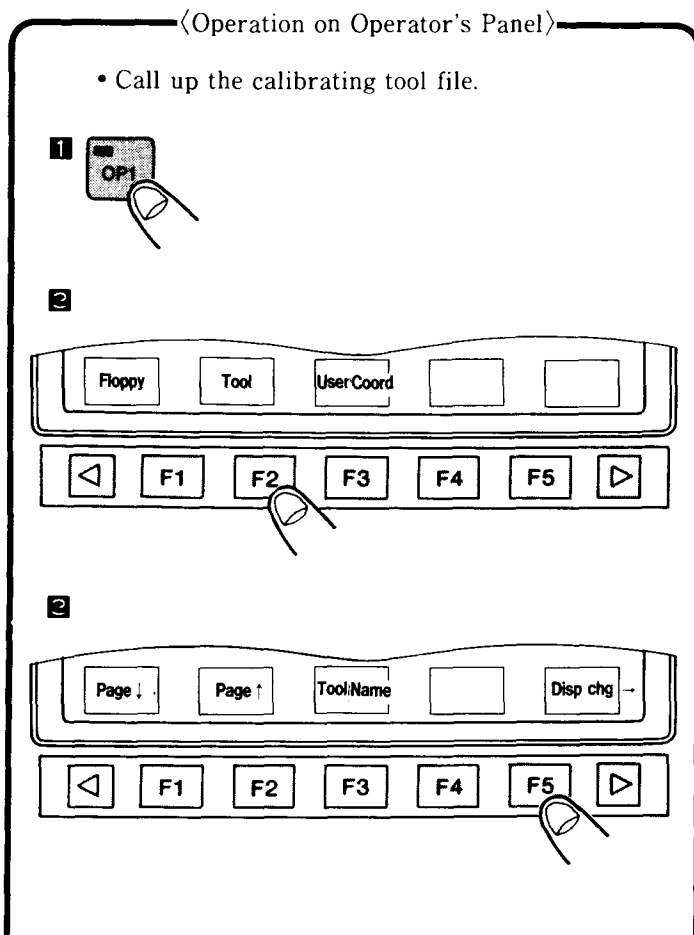


Fig. A 4. 3 Flange Coordinates

Set the calibrating tool data as following sequence.



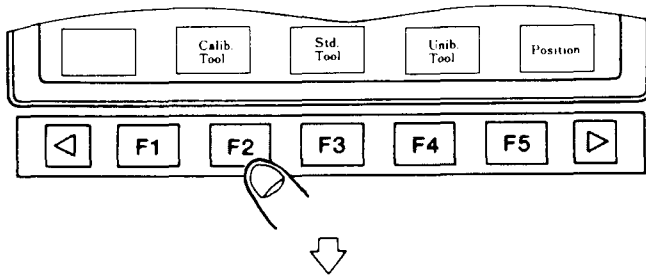
<Description>

Depress key.

Depress soft key.

Depress soft key.

4



Depress

Calib. Tool
F2

 soft key.

Tool file display appears.

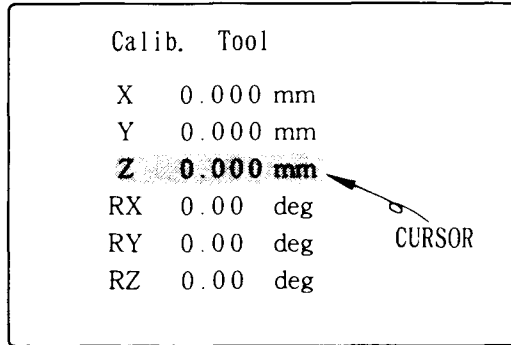
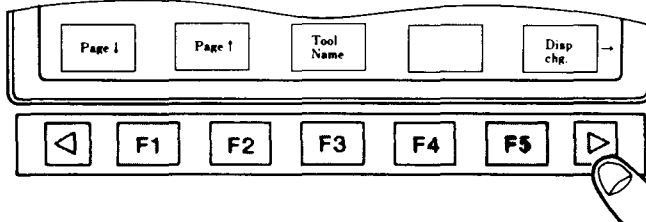


Fig. A4. 4 Tool File Display

• Calibrating tool data input

5

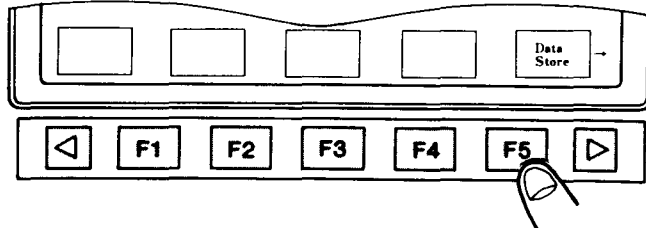


Depress

▶

 key.

6

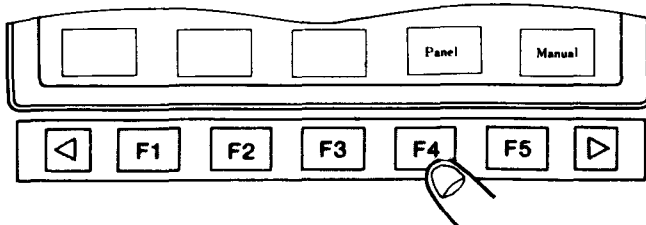


Depress

Data Store
F5

 soft key.

7

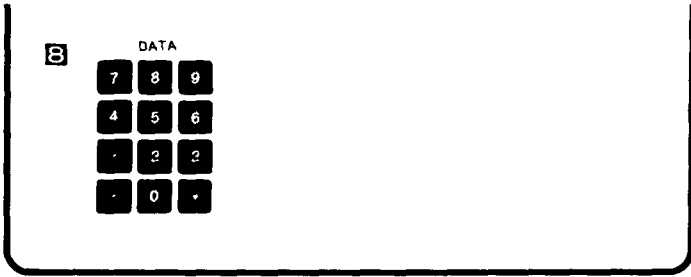


Depress

Panel
F4

 soft key.

A

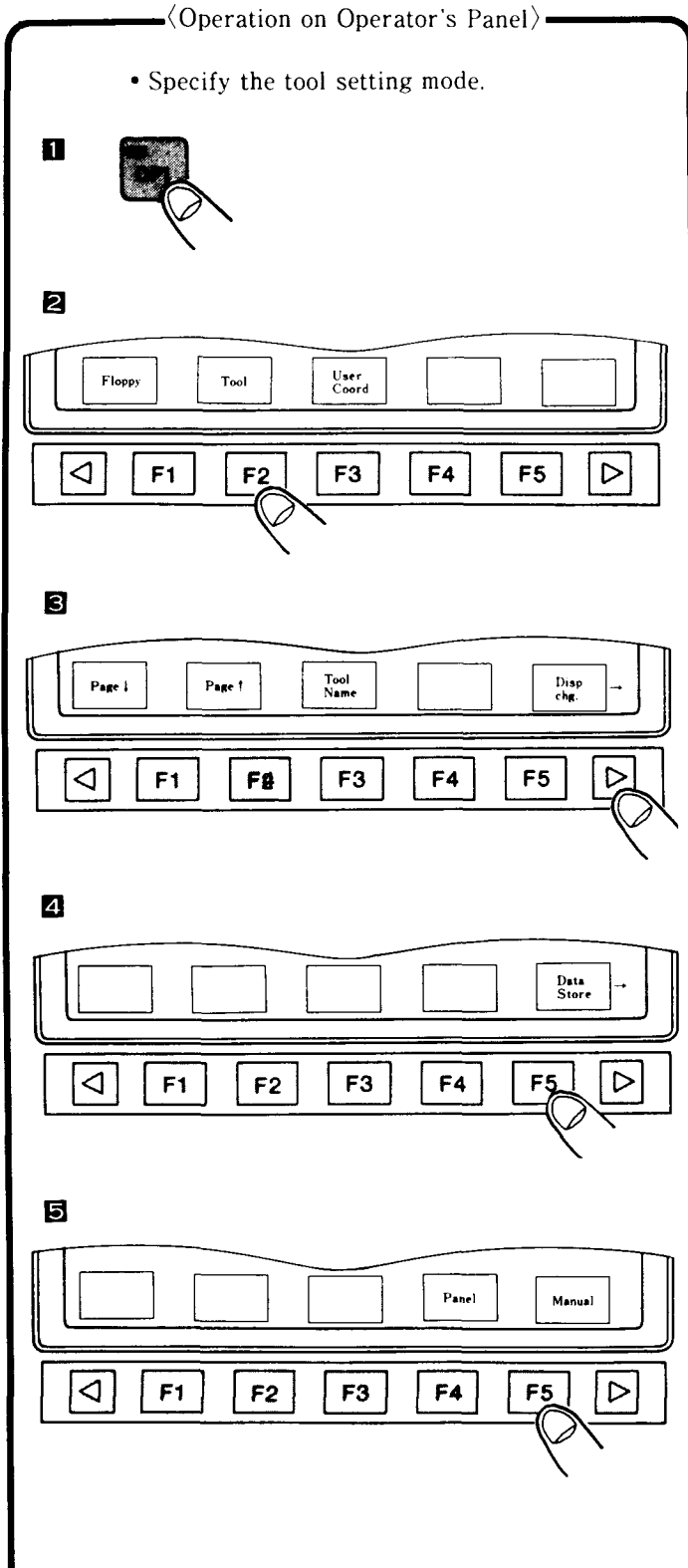


Input the calibrating tool constant to tool file by depressing DATA keys.

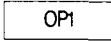
When calibrating tool shown in Fig. A4. 2 in used, the calibrating constant is dimensions ℓ . Therefore, input the dimensions ℓ to Z in tool file. Input 0 for other data.

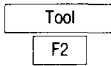
A 4. 2. 2 Setting of Reference Point

The reference point should be set before the standard or universal tool data is set.




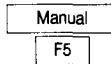
〈Description〉

Depress  key.

Depress  soft key.

Depress  key.

Depress  soft key.

Depress  soft key.

A

〈Operation on Teach Pendant〉



• Register reference point by using calibrating tool.

- 7 Put a reference point on a arbitrary plane, and draw the X-Y coordinates.

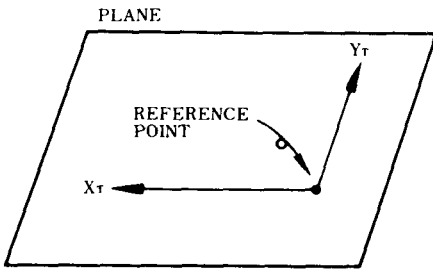


Fig. A 4. 5 X-Y Coordinates

- 8 Place the TCP P of calibrating tool to the reference point.

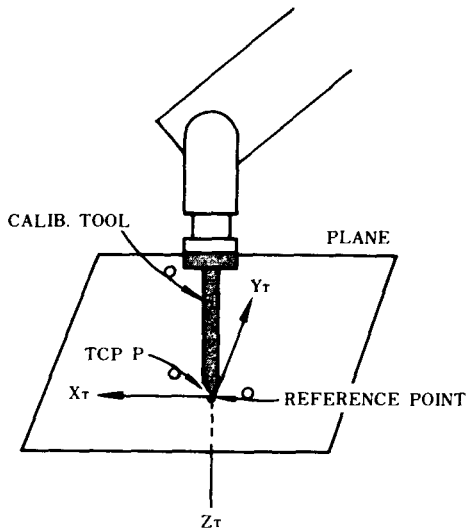
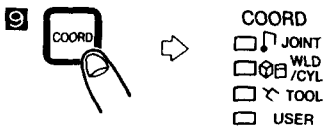


Fig. A 4. 6 Calib. Tool and Reference Point



Depress **ENABLE** and **TOOL** keys.

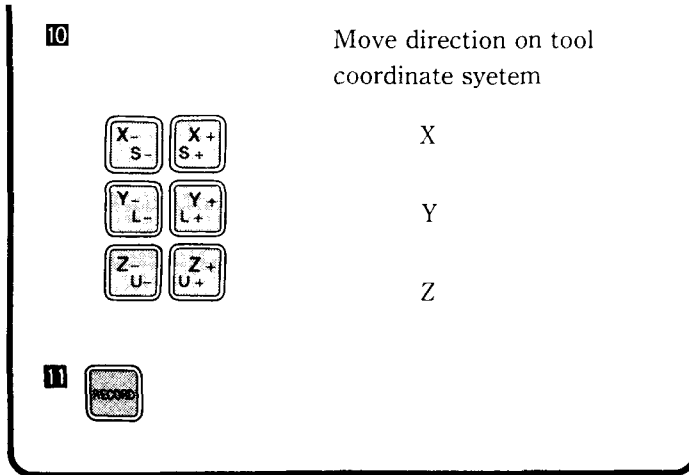
T O O L M A S T E R

will appear on teach pendant.

Be sure to place the calibrating tool perpendicular to the plane.

NOTE The direction is Z_r direction on tool coordinates.

Set the tool coordinate system motion by depressing **COORD** key.



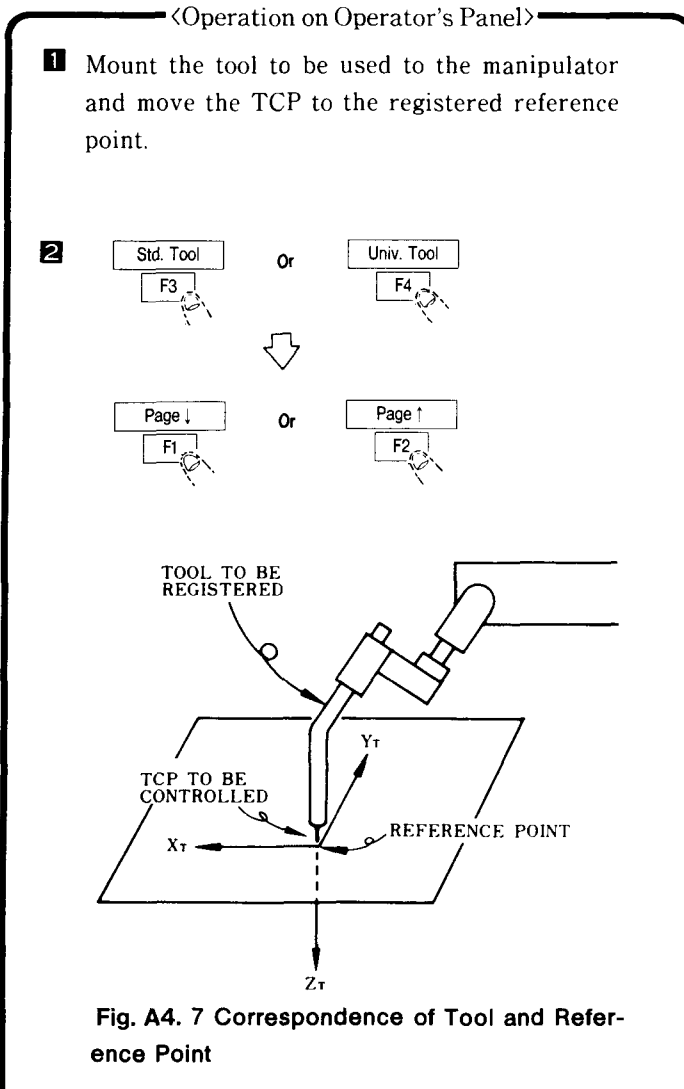
Confirm the move direction of calibrating tool by using axis keys on the left.

If the move direction of the tool is wrong for drawing coordinates on the plane, adjust it by using or key.

Depress key to register the reference point.

A 4. 2. 3 Setting of Standard/Multiple Tool Data

Set the standard/multiple data in the following sequence after registering reference point

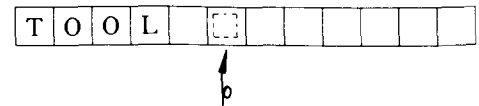


<Description>

Correspond X_T and Y_T direction of the tool to X-Y coordinates on the plane, and set Z_T direction perpendicular to the plane, by using keys on the teach pendant.

Display tool No. to be registered.

• Teach pendant display



Tool No. (1 to 8) to be registered

A

A4. 3 MOVEMENT OF MANIPULATOR AFTER SETTING TOOL DATA

Movement toward setting coordinate direction is available when axis is operated at tool coordinate specifications.

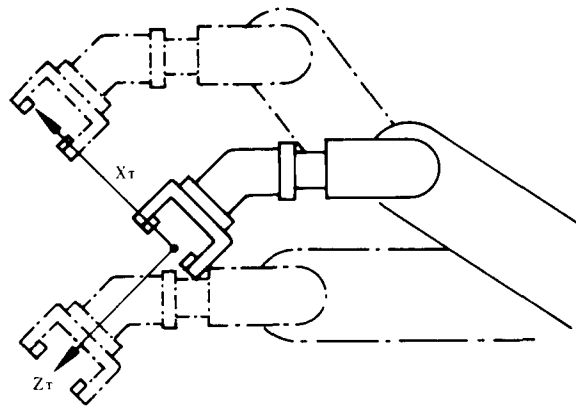


Fig. A4. 8 Movement After Setting The Tool Data

A4. 4 NOTE FOR INTERPOLATION OPERATION

In interpolation operation, tools are controlled so that the tool position and angle are changed equally. The tool angle at each teaching point is recognized as the direction of setting tool coordinates ($X_T - Y_T - Z_T$).

The actual movement of manipulator is shown in Fig. A4.9. When standard/multiple tool data are set, select the movement A or B according to the application. The moving A is convenient for arc welding.

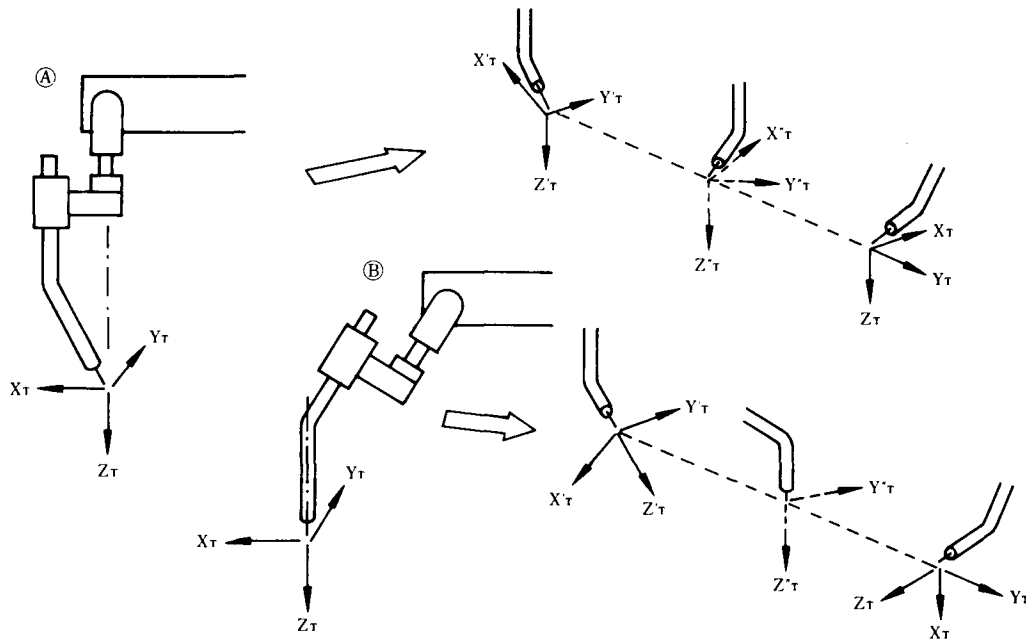


Fig. A4. 9 Interpolation Operation

A4. 5 TOOL FILE STORING

The setting contents in tool file are stored in floppy disk drive (optional). The floppy disk stores data for a calibrating tool, a standard tool and eight universal tools in a batch. Therefore, all tool data are reset collectively by one operation.

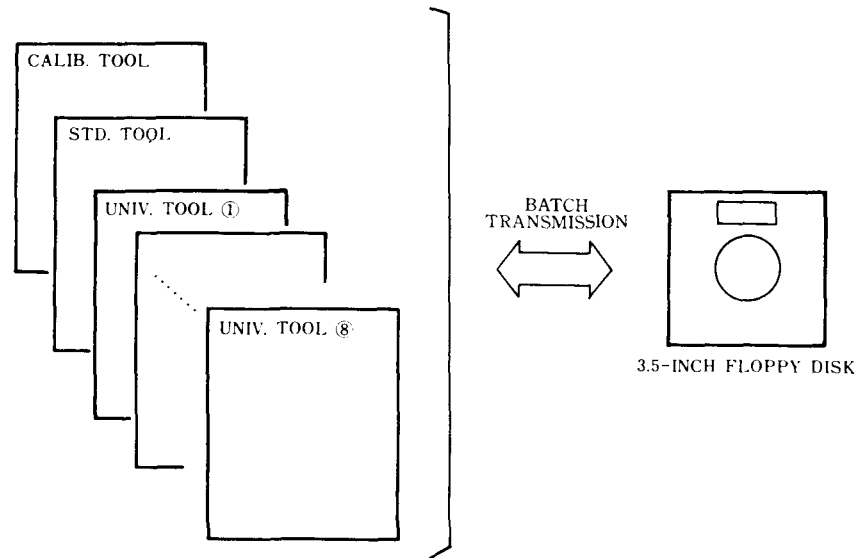


Fig. A4. 10 Tool File Storing

A5 USER COORDINATE FUNCTION

In controller, fixed base and robot coordinates are defined with manipulator. Tool coordinates are also set with tools at tip of the wrist. Manipulator is the subject with all these coordinate systems.

In addition to these coordinate systems, user coordinate system are available allowing the user to freely set coordinate systems. A maximum of eight kinds of user coordinate systems can be registered, and these systems are called Frames 1 to 8.

Each frame can be set in any optional place inside the manipulator operation area, and becomes a fixed coordinate system on the base coordinates.

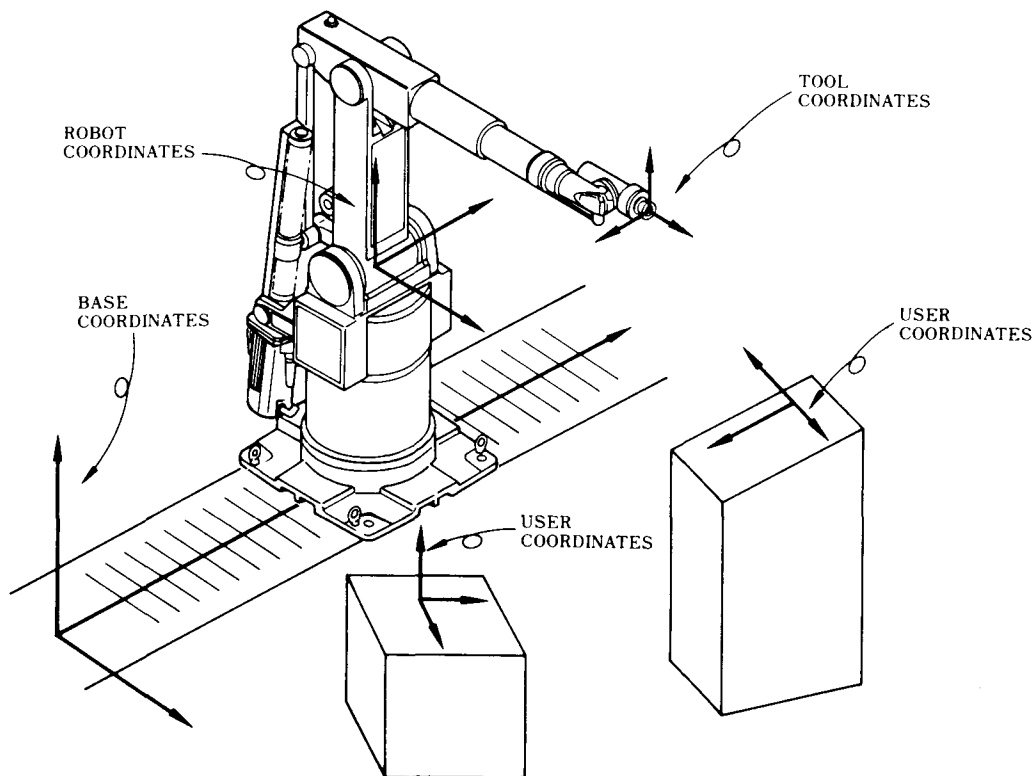


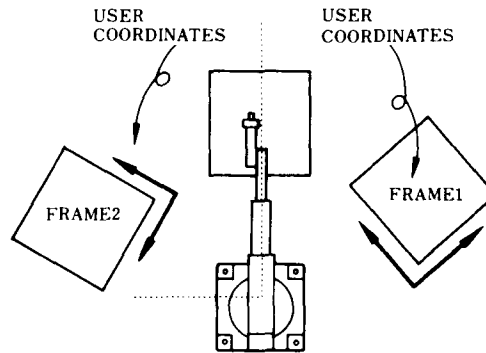
Fig. A5. 1 User Coordinates

A5. 1 USAGE OF USER COORDINATES

The user coordinate settings permit easy teaching in various cases. Some examples are shown below.

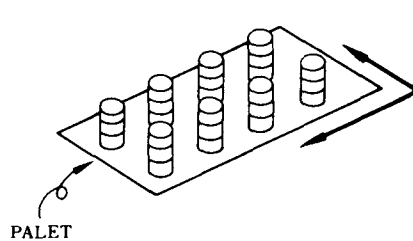
(1) Multiple jig stands

Manual operation can be simplified by setting user coordinates for each jig support.



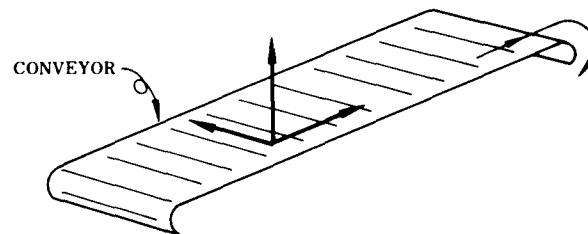
(2) Arranging and stacking operation

The incremental value for shift can be set easily by setting user coordinates on pallet.



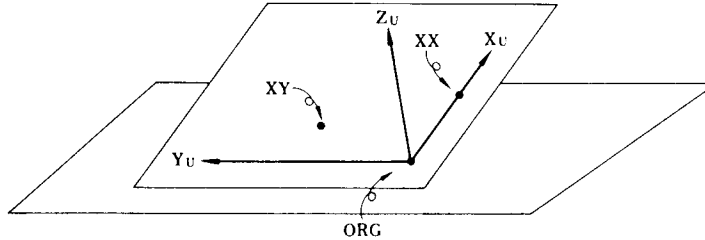
(3) Conveyor synchronizing operation

The moving direction of conveyor is specified. For detailed information, contact your Yaskawa representative.



A5. 2 DEFINITION OF USER COORDINATES

The user coordinates can be defined by operating manipulator using the teach pendant and by teaching the three points shown in Fig. A5.2.



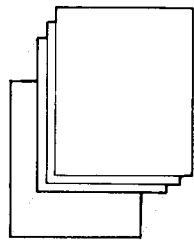
- ORG •••• Definition point of origin position of user coordinates
- XX ••••• Point of X-axis on user coordinates
- XY ••••• Point to show direction of Y-axis on user coordinates



Teach ORG and XX precisely. Directions of Y and Z axes decided by point XY.

Fig A5. 2 Definition of User Coordinates

These set values are registered in the user coordinates inside Controller and can be called up when necessary.



Once registered, it can be used anytime, many times.

FRAME1
to
FRAME8

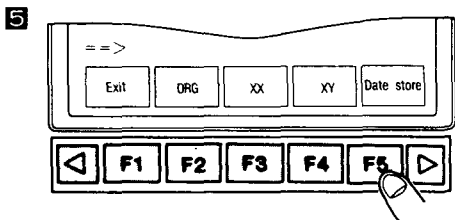
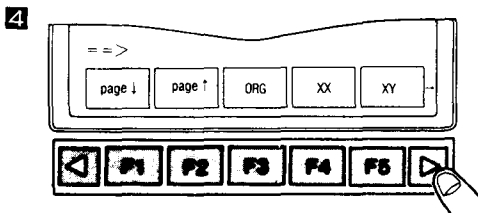
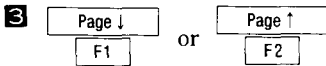
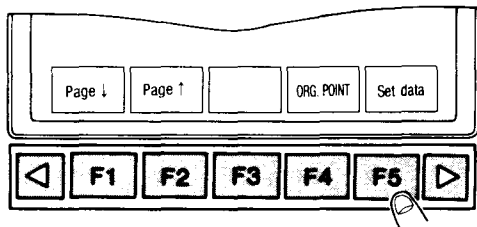
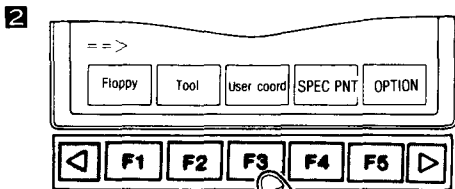
Fig A5. 3 User Coordinate File



A 5. 3 USER COORDINATES SETTING

A 5. 3. 1 User Coordinates Setting

〈Operation on Operator's Panel〉



〈Operation on Teach Pendant〉



- Teach three points: Origin point if user coordinates, point to designate X-axis, and a point on the X-Y plane.

〈Description〉

Depress key.

Depress and soft keys to call up the user coordinate file display.

Call up the desired user frame No.

Depress key.

Depress soft key to specify the user coordinate setting mode.

Depress key.

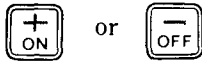
ENABLE lamp lights and the display appears as below.

- Teach Pendant display

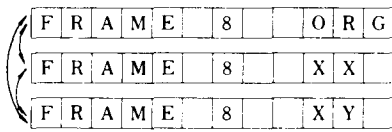
F	R	A	M	E	8					O	R	G
---	---	---	---	---	---	--	--	--	--	---	---	---

~~~~~  
User frame No.

7



• Teach Pendant Display



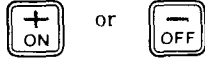
Original point of user coordinates

X-axis

X-Y plane

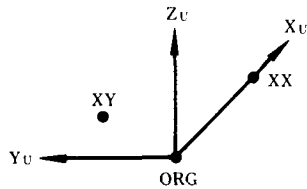


These displays change whenever the



key is depressed.

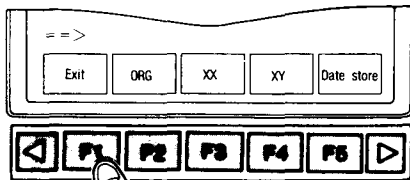
8



When using a system having an external axis, coordinate external axis positions which differ among the three points cannot be registered.

〈Operation on Operator's Panel〉

9



Select the point to be registered from three points by using or key.

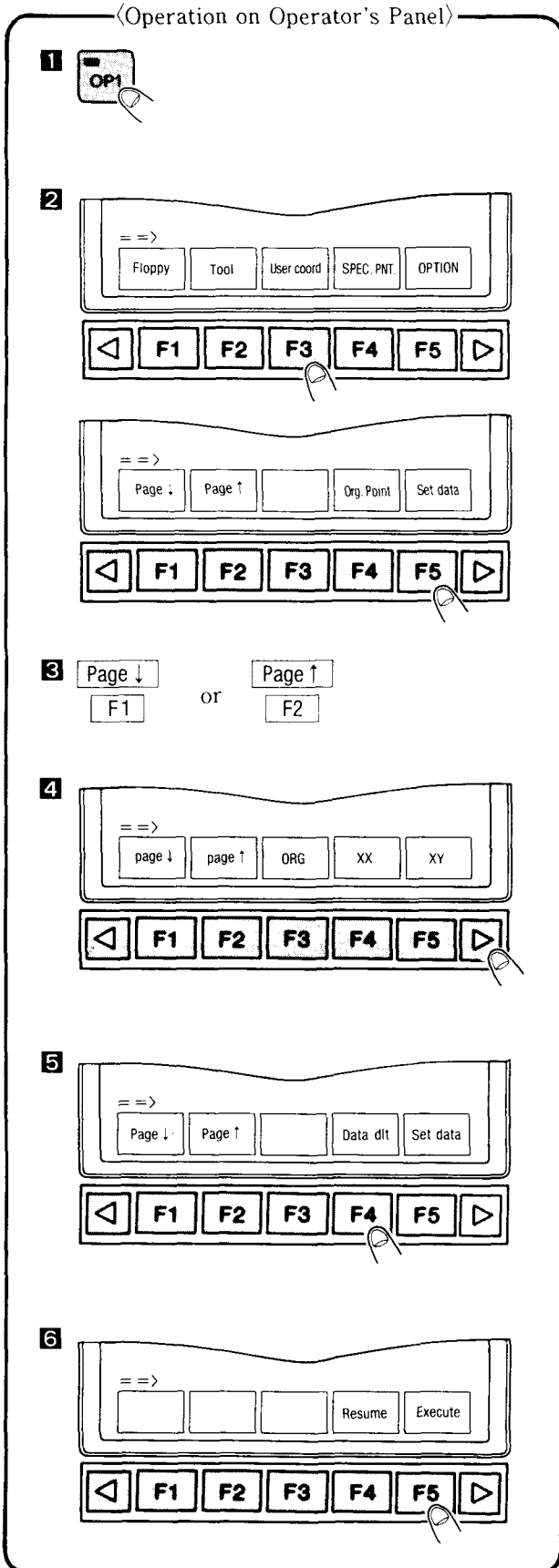
Depress key to register the point. Any of these three points can be taught first.

Depress soft key.

Frame data of the specified user coordinate is created and registered in the displaying file.



### A5. 3. 2 User Coordinates Deleting



(Description)

Depress **OP1** key.

Depress **User coord** and **Set data** soft keys **F3** and **F5** to call up the user coordinate file display.

Call up the user frame No. to be deleted.

Depress  key.

Depress **Data dlt** soft key **F4** to specify the user coordinate deleting mode.



Depress **Execute** soft key **F5**.

The user coordinate data displayed on CRT screen are deleted.

## A5. 4 CONFIRMATION OPERATION OF DEFINITION POINT ON USER COORDINATES



During user coordinate setting mode specification, manipulator moves to a definition point on user coordinates that has already been taught by using teach pendant. Operate as follows:


〈Operation on Teach Pendant〉

**1**  or 

• Teach Pendant Display

|   |   |   |   |   |   |  |  |  |  |   |   |   |
|---|---|---|---|---|---|--|--|--|--|---|---|---|
| F | R | A | M | E | 8 |  |  |  |  | O | R | G |
| F | R | A | M | E | 8 |  |  |  |  | X | X |   |
| F | R | A | M | E | 8 |  |  |  |  | X | Y |   |

NOTE These displays change whenever the  or  key is depressed.

**2** 

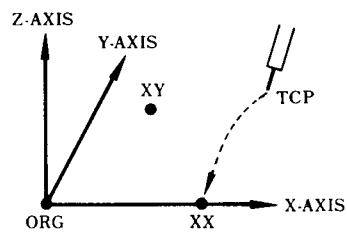
〈Description〉

Specify the point to be confirmed.

While depressing  key, the manipulator moves to the specified position.

When releasing this key, the manipulator will stop.

After positioning is completed, the manipulator stops automatically.



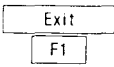
Moves at either link, linear or circular mode, selecting operation by MOTION TYPE LED on teach pendant.

A

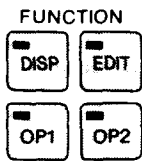
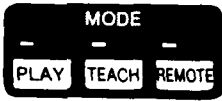



## A 5. 5 RESET OF USER COORDINATE SETTING MODE

When the following keys on operator's panel are depressed, the user setting mode is reset.

- When depressing  soft key :

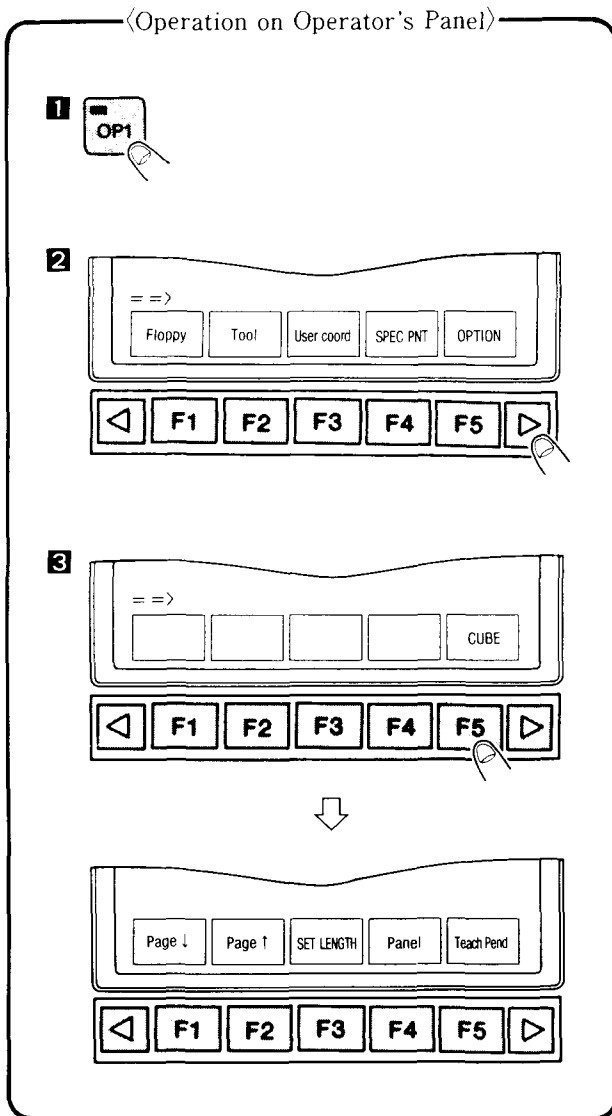
After user coordinate registration is completed, this mode is reset..

- When depressing either  ,  or  keys :

User coordinates executing teach or register become status before teaching or registering. Therefore, teach or register it again.

## A 6 . SETTING CUBE INTERFERENCE AREA

First, call the display for cube interference area.



〈Description〉

Depress OP1 key.

Depress ▶ key.

Depress CUBE  
F5 soft key.

**NOTE**

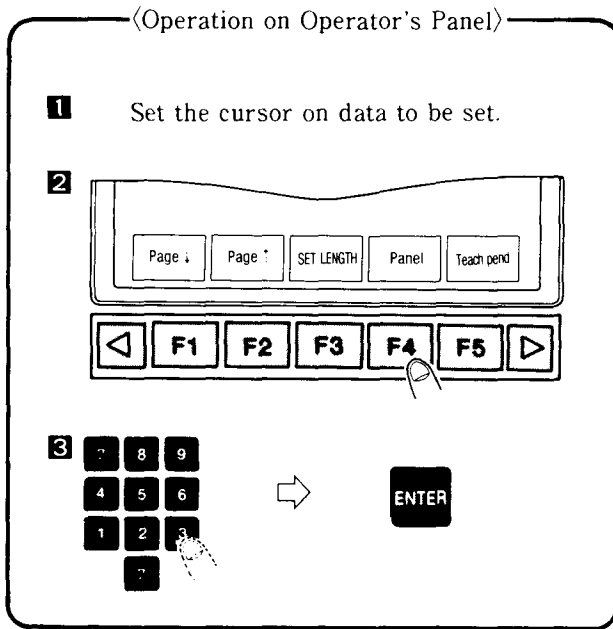
For setting cube interference area, there are three methods.

- (1) Setting from operator's panel.
- (2) Setting from teach pendant (there are two methods.)

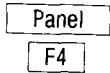
**A**


Next, set the cube interference area by following operations.

(1) Setting from operator's panel.



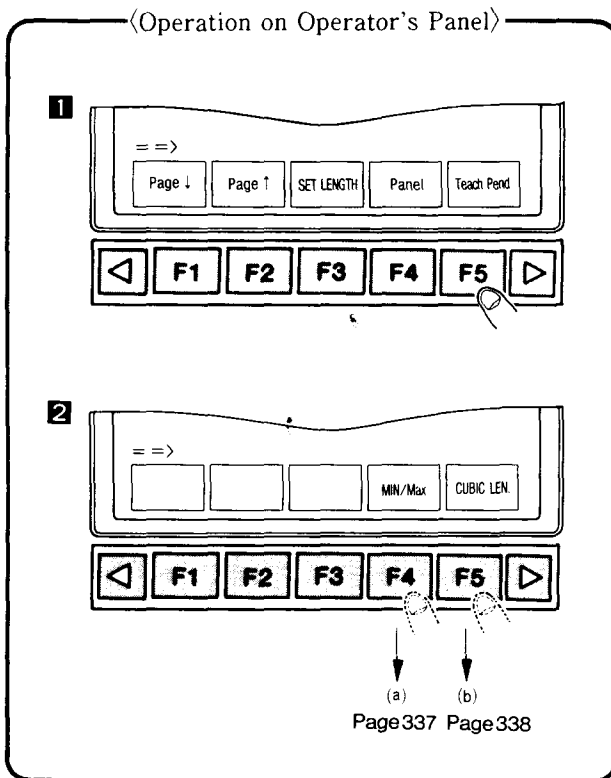
<Description>

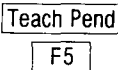
Depress  soft key.

Input the data and depress  key.

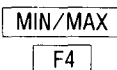
The displayed data are changed.


(2) Setting from teach pendant : two methods



Depress  soft key.

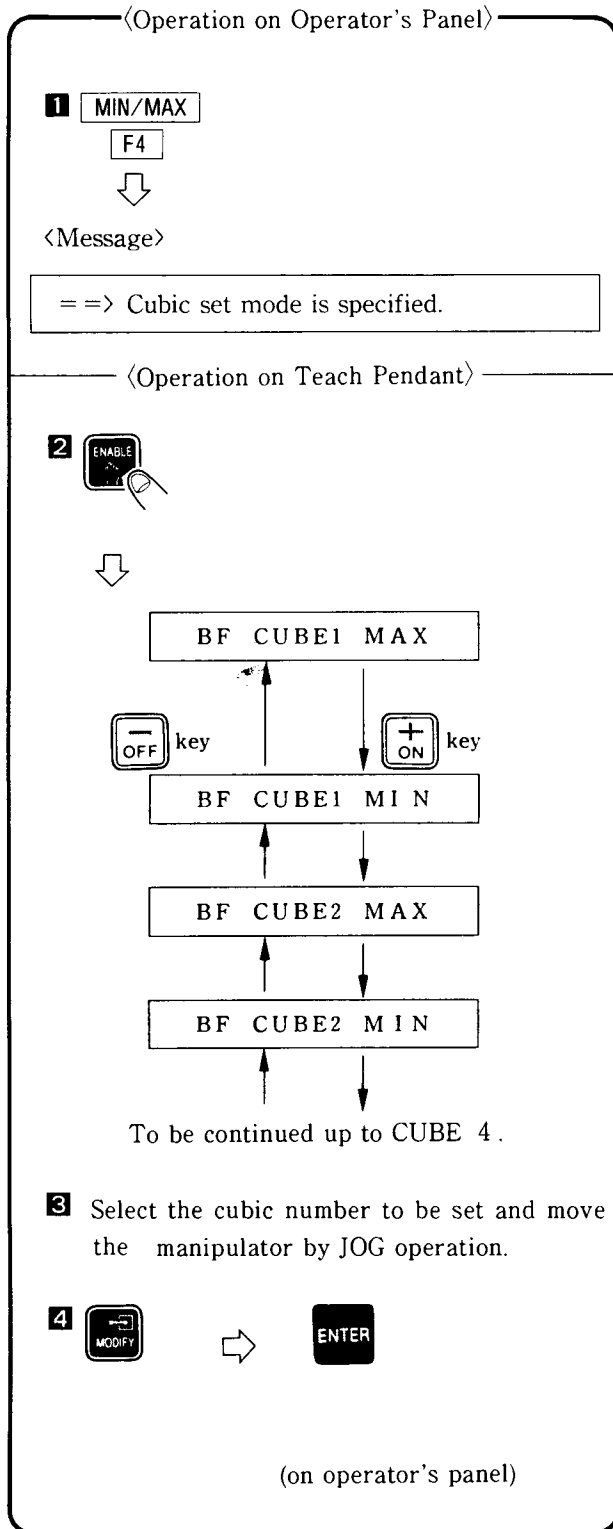
A set mode display will appear.

- For depressing  soft key :  
Set by moving manipulator to max/min position in cube area.

- For depressing  soft key :

After setting the axis length of cubic area in advance, the specified axis length from any manipulator's position (pause position, etc.) is set as cubic area.

(a) For depressing **MIN/MAX** **F4** soft key.



Depress **MIN/MAX** **F4** soft key to change the manipulator's current value to maximum value (X, Y, Z) of cube (1 to 4). The message is displayed on the bottom in the screen.

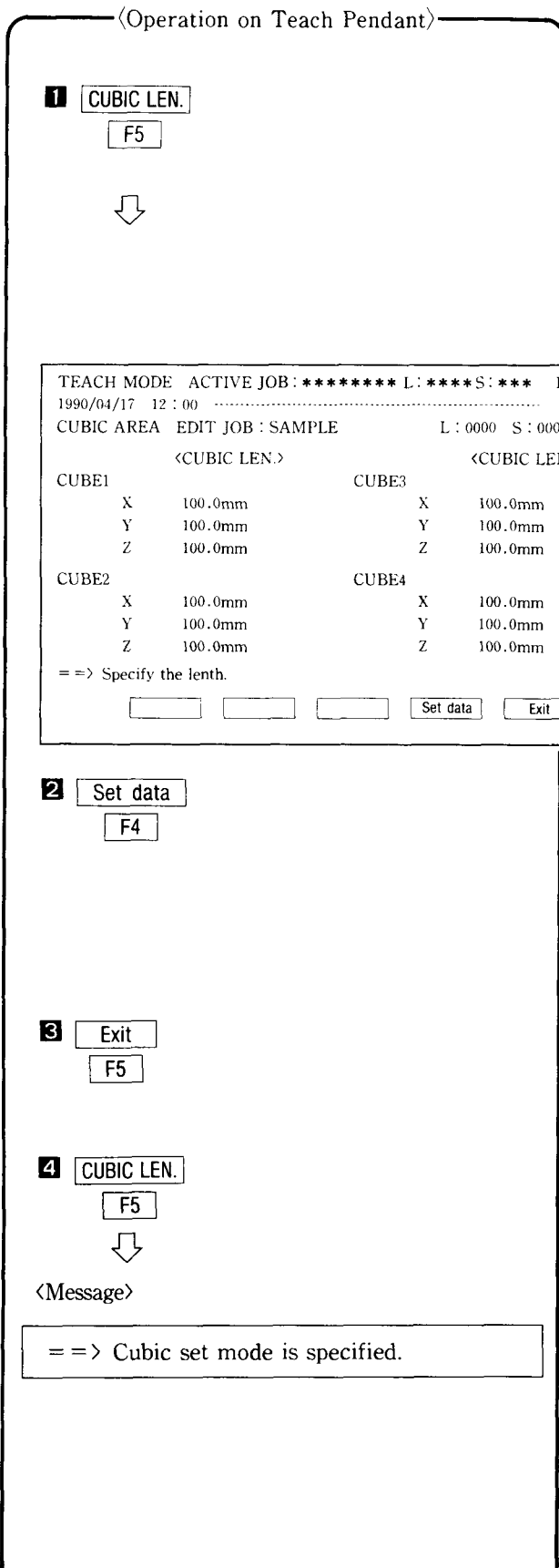
Depress **ENABLE** key after checking the message. The cubic number (1 to 4) and the minimum or maximum value are displayed. The display of minimum and maximum values is changed by depressing **+** **ON** or **-** **OFF** key.

Depress **MODIFY** key and **ENTER** key.

The manipulator's current position (X, Y, Z) is set in the area selected by teach pendant.

A

(b) For depressing **CUBIC LEN.** **F5** soft key.



<Description>

**NOTE** Be sure to check the axis length before executing the following operation.

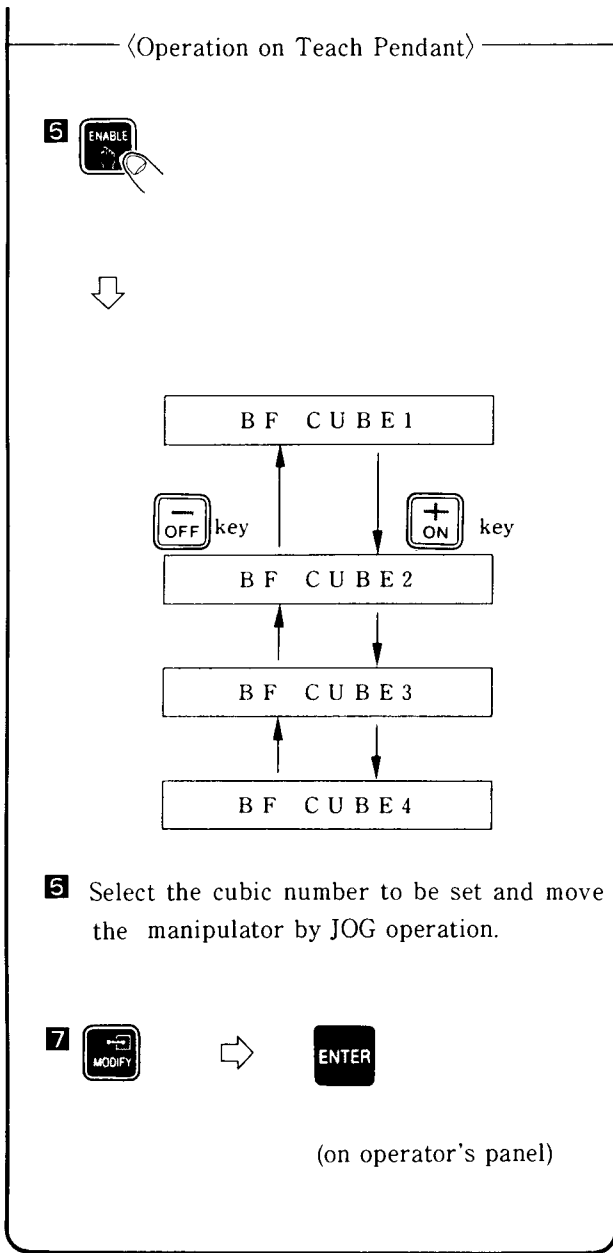
Depress **CUBIC LEN.** **F5** soft key.

The axis length setting display for cubic area is shown.

Place the cursor to axis data to be set. Depress **Set data** **F4** soft key to change the cubic length data.

After setting the data, depress **Exit** **F5** soft key.

The message is displayed by depressing **CUBIC LEN.** **F5** soft key.



〈Description〉

Depress key after checking the message.

The cubic number is displayed.  
The display is changed by depressing

or key.

Depress and keys.


The area selected by step 6 is set by calculating max/min coordinate from manipulator's current position (X, Y, Z) and specified axis length.

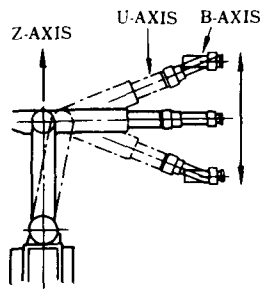


## A 7. ALARM DISPOSITION DURING OPERATION

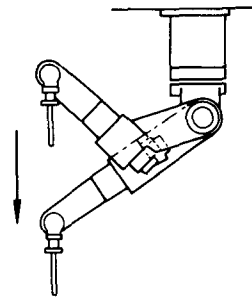
For alarms that occur during manipulator operation, the reason and the disposition are described below.

ALARM 1130 Segment data trouble

If the speed is too fast while operating the teach pendant, this alarm warns before it becomes maximum. This alarm occurs relatively easily when the  keys are operated and manipulator is in the following wrist orientation.




(a) B- and U-axis Align in One Straight Line



(b) U- and L-axis of Manipulator Model V Align in One Straight Line

Fig. A 7. 1 Wrist Orientations that Cause Alarm 1130 Relatively Easily

Depress  key again to release the alarm, then operate after lowering the speed on the teach pendant.

## A 8 ADDITIONAL OPERATION OF MANIPULATOR MODEL V

The alarm code and MOVE instruction (special linear) added to solve special problems in linear interpolation operation of the manipulator model V are described.

### A 8. 1 ALARM AND DISPOSITION

#### Alarm 1060

(1) Alarm cause

If the L- and U-axis wrist orientation differ between steps in linear interpolation operation, manipulator cannot be operated. Therefore, AL-1060 is displayed before it operates between these steps. See Fig. A 8. 1.

(2) Disposition

Reteach the wrist orientation shown in Fig. A 8. 2.

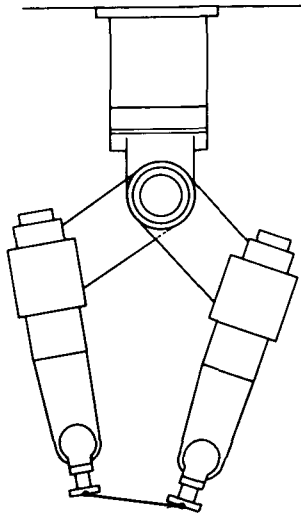


Fig. A 8. 1 Operate Disable

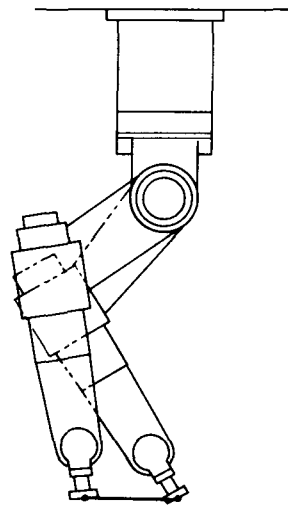


Fig. A 8. 2 Operate Enable



## A 8. 1. 1 Adding SPECIAL (Special Linear) to Move Instruction for Interpolation Operation near S-axis Rotation Center

### 1. Alarm Cause

- (1) When teaching from front side to front side, as shown in Fig. A 8. 3, and performing S-axis interpolation operation while rotating in an operating direction, the S-axis angle speed increases, the alarm (AL-1130) occurs and the operation will not be disabled.
- (2) When teaching from front side to rear side, as shown in Fig. A 8. 4, and performing interpolation operation that manipulator passing through the center line of S-axis (viewed from the side surface), the alarm (AL-1130) occurs and the operation will not be disabled.

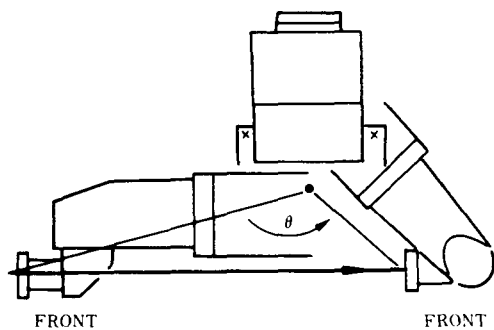


Fig. A 8. 3 Alarm for Increasing S-axis Angle Speed

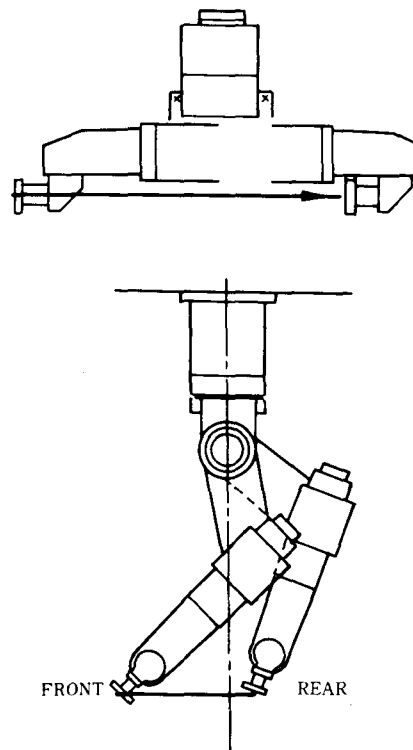


Fig. A 8. 4 Alarm for Passing Manipulator to S-axis Center Line

### 2. Remedy

If an alarm 1130 occurs, add SPECIAL (special linear) to the MOVL instruction. The wrist orientation is not controlled, so it will be changed while moving in a locus.

If the wrist orientation greatly changes or if other alarms AL-1011 or 1070 occur, teach in accordance with the flow shown in Fig. A 8. 5.

## A 8. 2 INSTRUCTION FOR SPECIAL LINEAR INTERPOLATION (SPECIAL LINEAR)

Table A8. 1 Instruction for Special Linear Interpolation

| Instruction    | Display                       | Operation                           |
|----------------|-------------------------------|-------------------------------------|
| Special linear | MOVL V = 500.0 <u>SPECIAL</u> | Operates linearly to specified step |

NOTE.

This instruction cannot be parallel shift or weaving function.

## A 8. 3 ALARM CODE

Table A8. 2 Alarm Code

| Code                  | Contents                    | Operation of Operator                                                             |
|-----------------------|-----------------------------|-----------------------------------------------------------------------------------|
| AL-1011<br>(Data 033) | Operation error             | Interpolation operation in not possible.<br>Change to the MOVJ (joint) operation. |
| AL-1011<br>(Data 035) | Operation error             | Alter the teaching so that move amount<br>or S- or R-axis is small.               |
| AL-1060               | Linear operation<br>disable | Alter the L- and U-axis position.<br>(Refer to par. 7. 1. 1)                      |
| AL-1070               | Special linear<br>disable   | Alter the B-axis position or change to<br>the MOVJ (joint) operation.             |

A

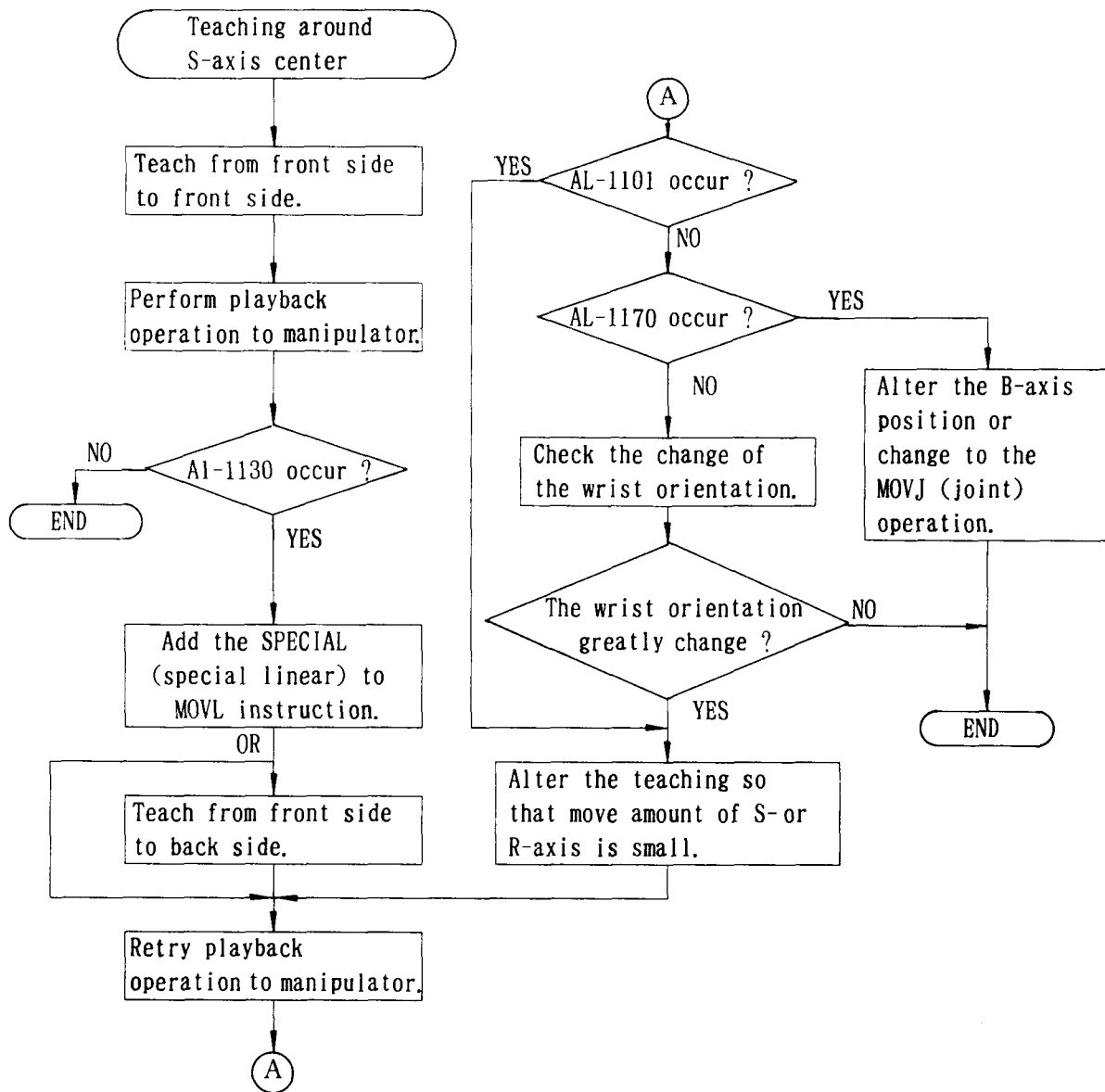


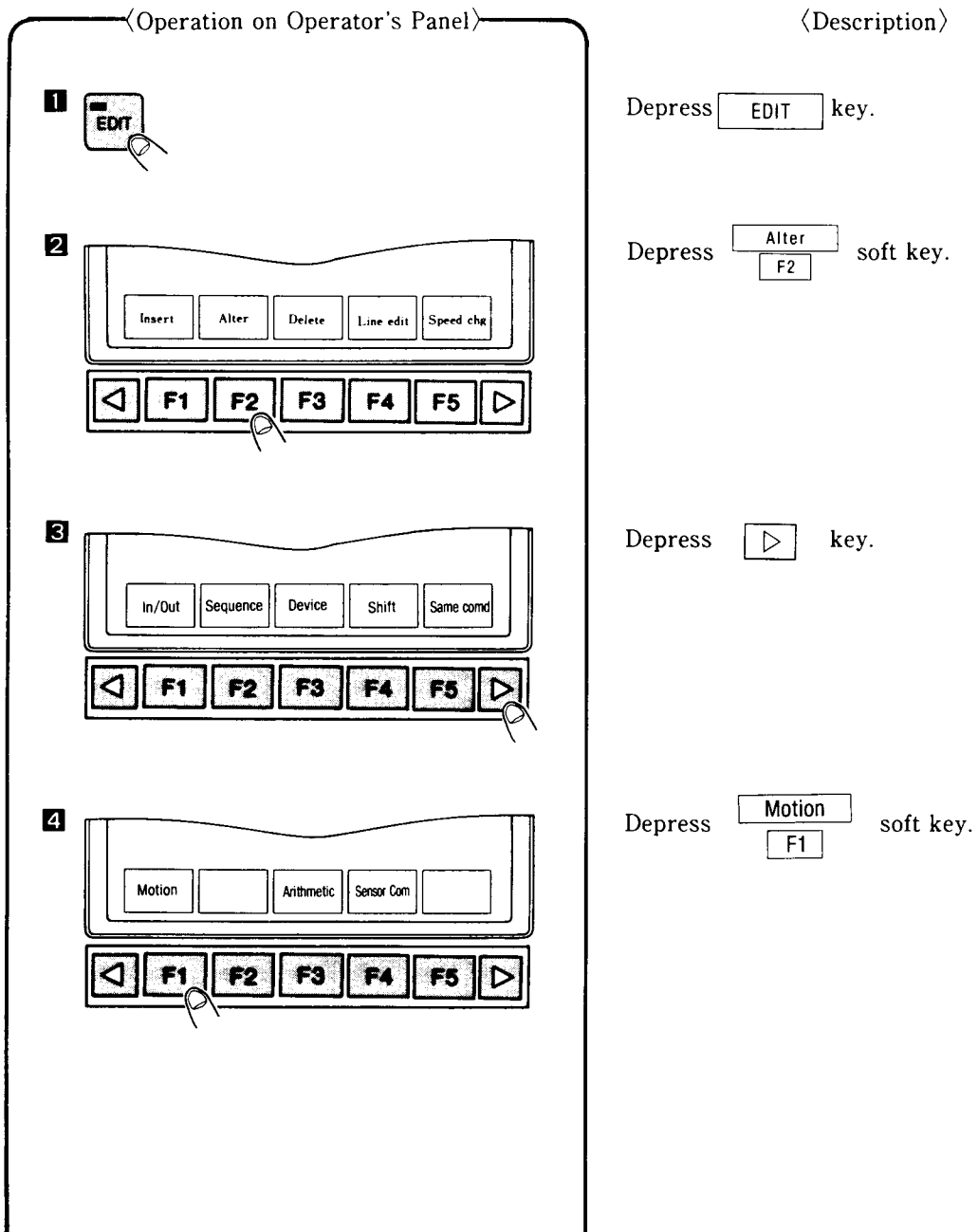
Fig. A 8. 5 Teaching Flowchart when the Wrist Orientation Greatly Changes or when AL-1011/1070 Occurs.

## A8. 4 SETTING METHOD OF SPECIAL LINEAR

INSTRUCTION TO BE ALTERED

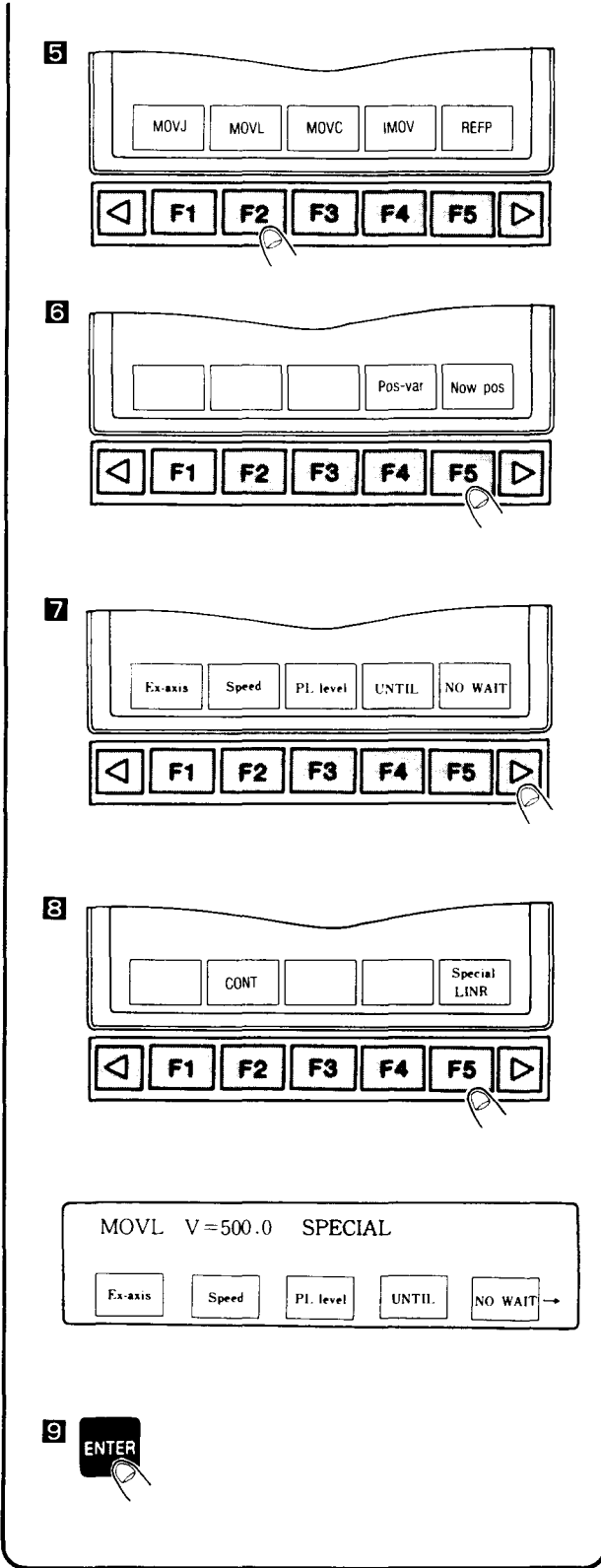
0012 009 MOVL V=500.0



(1) Setting method from operator's panel



A

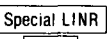

A8. 4 SETTING METHOD OF SPECIAL LINEAR (Cont'd)




Depress  soft key.  


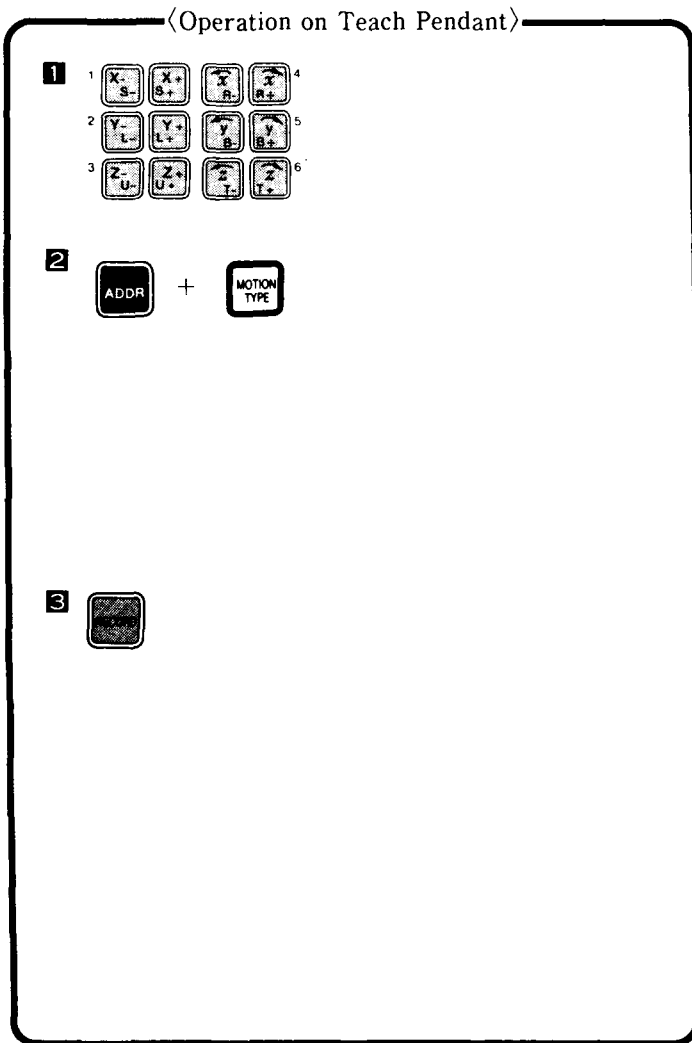
Depress  soft key.  


Depress  key.

Depress  soft key.  


Depress  key.  
 Special linear (SPECIAL) are set.

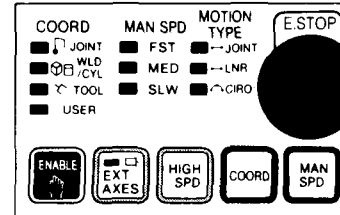
(2) Setting method from teach pendant



〈Description〉

Move the manipulator to step 9 by operating the axis keys.

Depress **MOTION TYPE** while depressing key.



LNR lamp is blinking.

Depress **RECORD** key while  LNR is blinking.

The MOVE instruction designating SPECIAL LINEAR is registered.  LNR blinking stops, but remains lit (steady light) The teach pendant displays become as below.

0 0 9 T L O M O V L L V=500.0  
SPECIAL



LNR does not blink when making a change after registering the MOVE instruction.



## A 9 COMPARISON OF YASNAC ERC AND YASNAC RX

### A 9. 1 COMPARISON OF OPERATIONAL FUNCTION

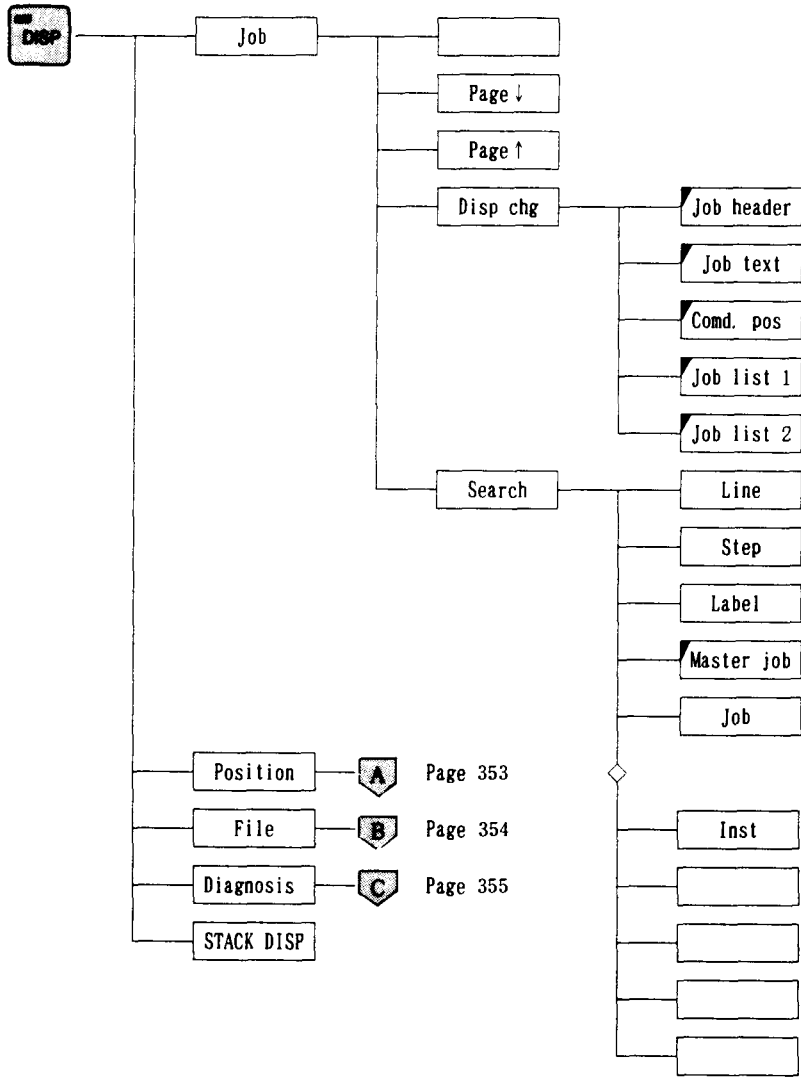
Table A9. 1 Comparison of Operational Function on YASNAC ERC and YASNAC RX

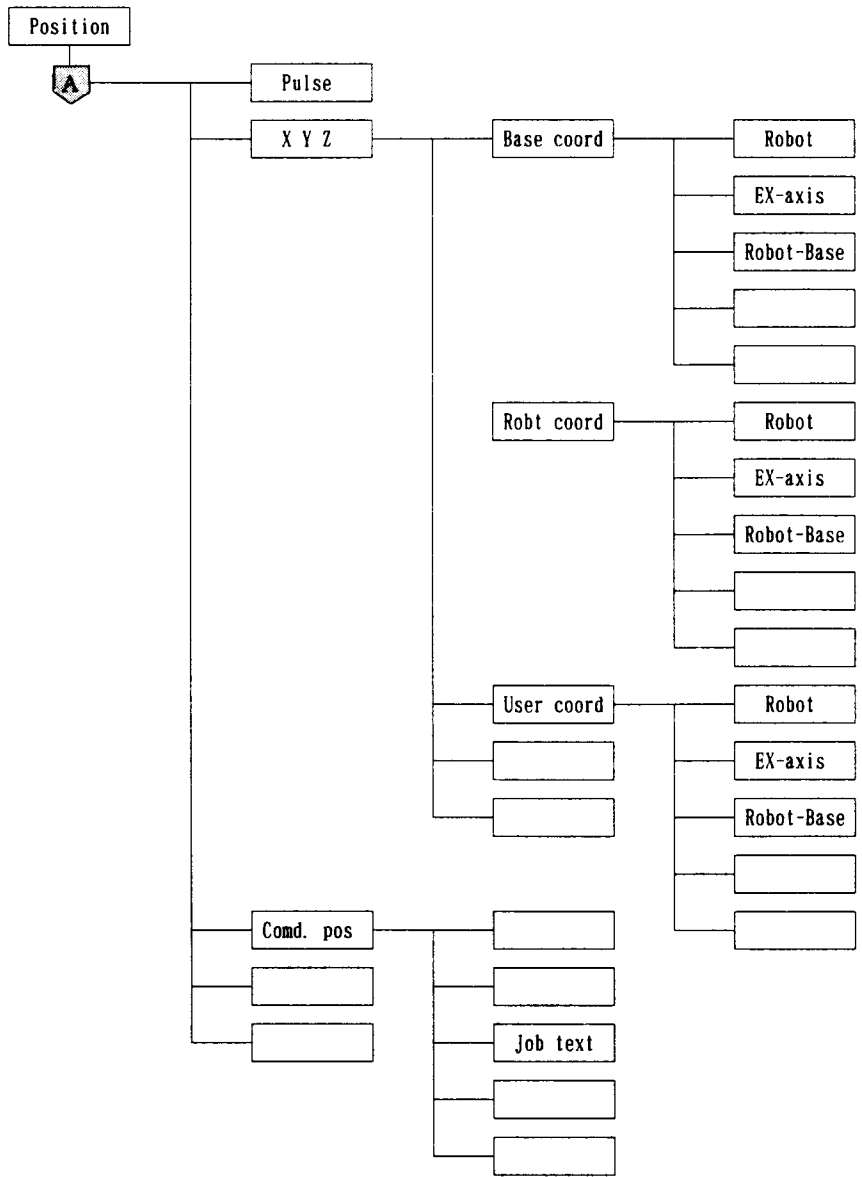
| No | Item                      | YASNAC ERC Function                                                                                                                                                                                                                                                          | YASNAC RX Function                                                                                            |
|----|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| 1  | Ext. memory unit          | 3.5-inch floppy disk drive<br>(Made by Y-E DATA Inc.)                                                                                                                                                                                                                        | Cassette recorder<br>(Made by Sony Crop.)                                                                     |
| 2  | Printer function          | <ul style="list-style-type: none"> <li>• Printer cannot be connected.</li> <li>• Printing output possible personal computer sold on the market.</li> </ul> Comment statement addition and output format change are possible.<br><br>(3.5-inch floppy disk to conform MS-DOS) | <ul style="list-style-type: none"> <li>• Printer can be connected.</li> <li>• Fixed output format.</li> </ul> |
| 3  | Emergency stop            | Message display<br>(resetting not necessary)                                                                                                                                                                                                                                 | Alarm display<br>(resetting not necessary)                                                                    |
| 4  | Home position             | Not necessary<br>(absolute system)                                                                                                                                                                                                                                           | Necessary                                                                                                     |
| 5  | Job name                  | Can be designated by characters<br>(max 8 half-size characters)                                                                                                                                                                                                              | Nos. 1 to 249                                                                                                 |
| 6  | Program selection         | Only one job registered<br>as master job.                                                                                                                                                                                                                                    | P▷J set operation                                                                                             |
| 7  | Auto mode                 | Applicable to master jobs only.<br>For other jobs, only one cycle is operated.                                                                                                                                                                                               | Applicable to all jobs taught.                                                                                |
| 8  | Light method of HOLD lamp | Manipulator cannot be operated if lamp is lit (even if START button is depressed).<br>HOLD lamp is lit while HOLD button is depressed.                                                                                                                                       | When depressing START button, HOLD lamp goes out and manipulator operates.                                    |
| 9  | Batched speed alteration  | <ul style="list-style-type: none"> <li>• Speed override (can be changed during operation)</li> <li>• Batch editing is possible by designating % (moving time can be checked)</li> </ul>                                                                                      | <ul style="list-style-type: none"> <li>• TRT function</li> </ul>                                              |
| 10 | Manual speed selection    | 3 -stage selection<br>(equipped in addition to PLAY speed)                                                                                                                                                                                                                   | 1-to 8 -stage selection<br>(combined with PLAY speed)                                                         |

| No. | Item                              | YASNAC ERC Function                                                                                                                                    | YASNAC RX Function                                                                                                                            |
|-----|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 11  | NEXT operation                    | Execution other than MOVE instruction can be selected on teach pendant.                                                                                | Designate parameter to execute other than MOVE instruction. (Semi-fixed)                                                                      |
| 12  | BACK operation                    | <ul style="list-style-type: none"> <li>• Circular arc backing is possible.</li> <li>• Backing to initial call is possible.</li> </ul>                  | <ul style="list-style-type: none"> <li>• Circular arc backing is not possible.</li> <li>• Backing to initial call is not possible.</li> </ul> |
| 13  | Teaching wall point               | Swinging direction can be taught by 2-point teaching.                                                                                                  | By 1-point teaching, swinging direction can be taught at instruction designation.                                                             |
| 14  | Wall point moving (teach pendant) | Moves only if instructed.                                                                                                                              | Always moving during BACK operation                                                                                                           |
| 15  | Condition file                    | <ul style="list-style-type: none"> <li>• Conditional job (similar to ordinary job)</li> <li>• Conditional file (Japanese prompts displayed)</li> </ul> | <ul style="list-style-type: none"> <li>• Special file (max 10 instructions)</li> <li>• Conditional file (set by instruction)</li> </ul>       |



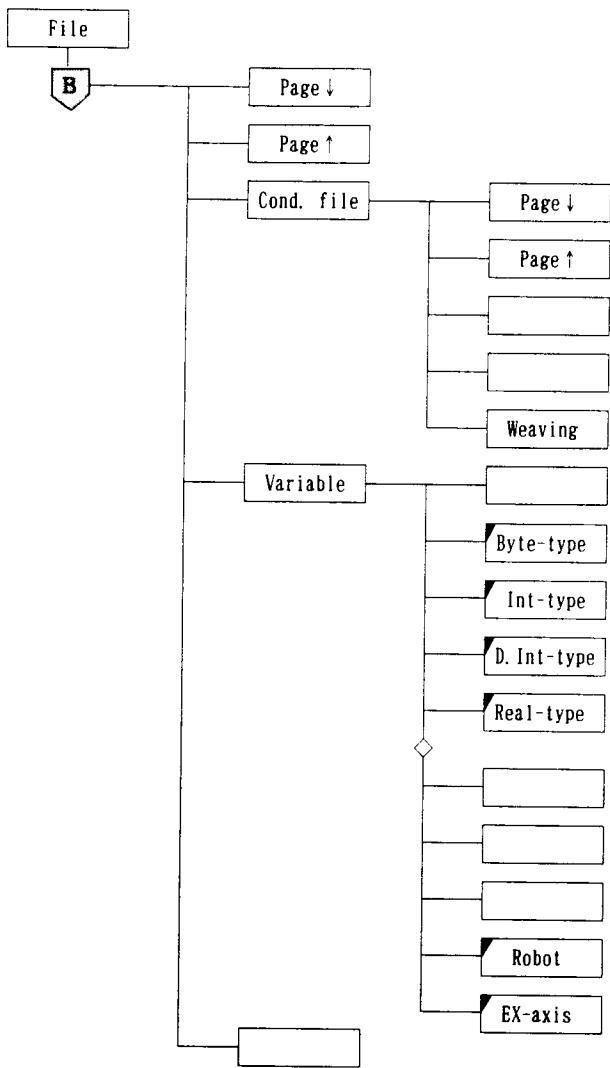
A10. 1 WHERE  KEY IS DEPRESSED

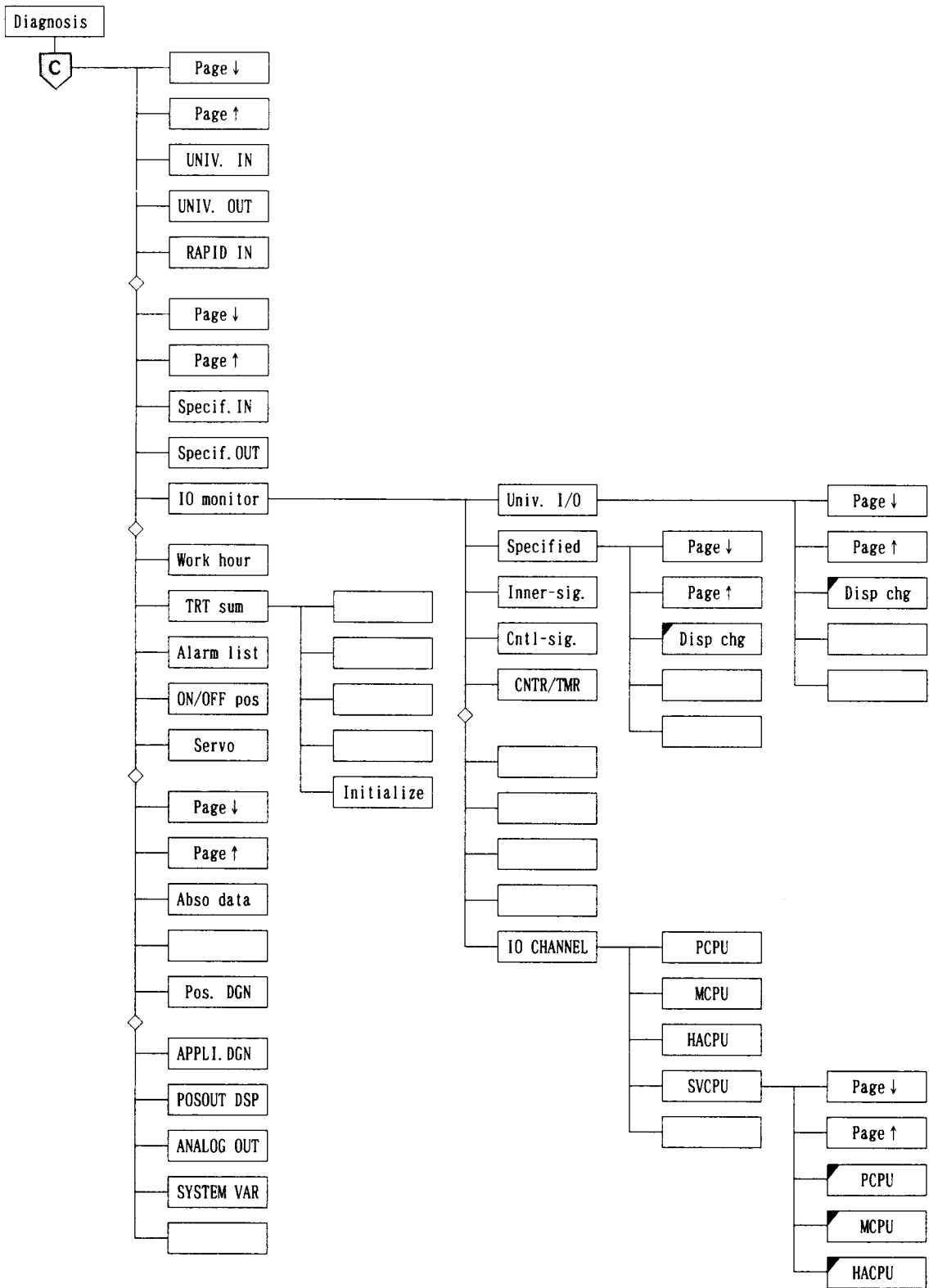




A

A 10. 1 WHERE  KEY IS DEPRESSED (Cont'd)



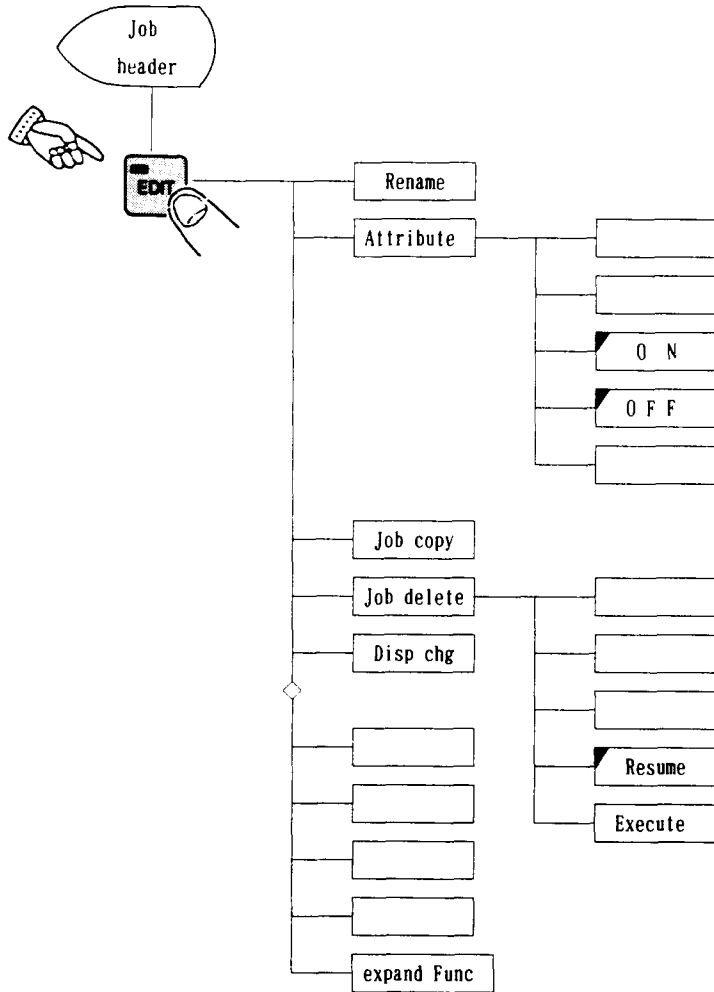


A

A 10. 2 WHERE



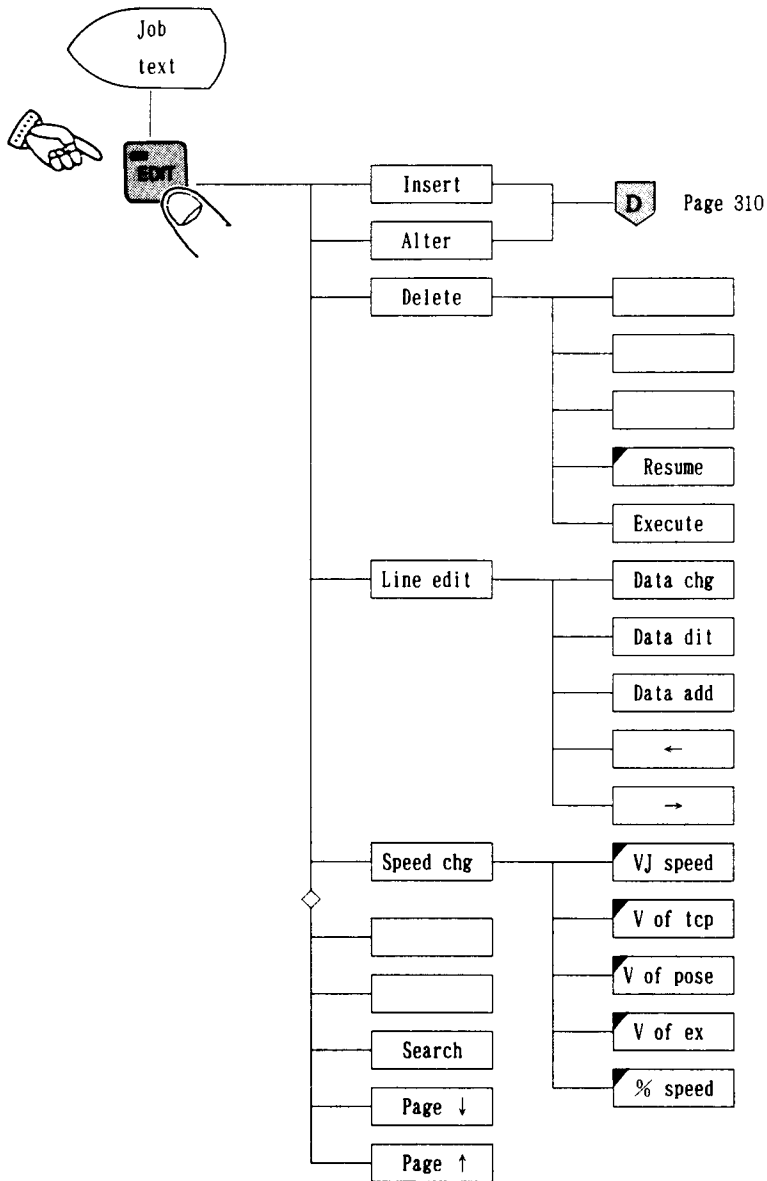
KEY IS DEPRESSED IN JOB HEADER DISPLAY



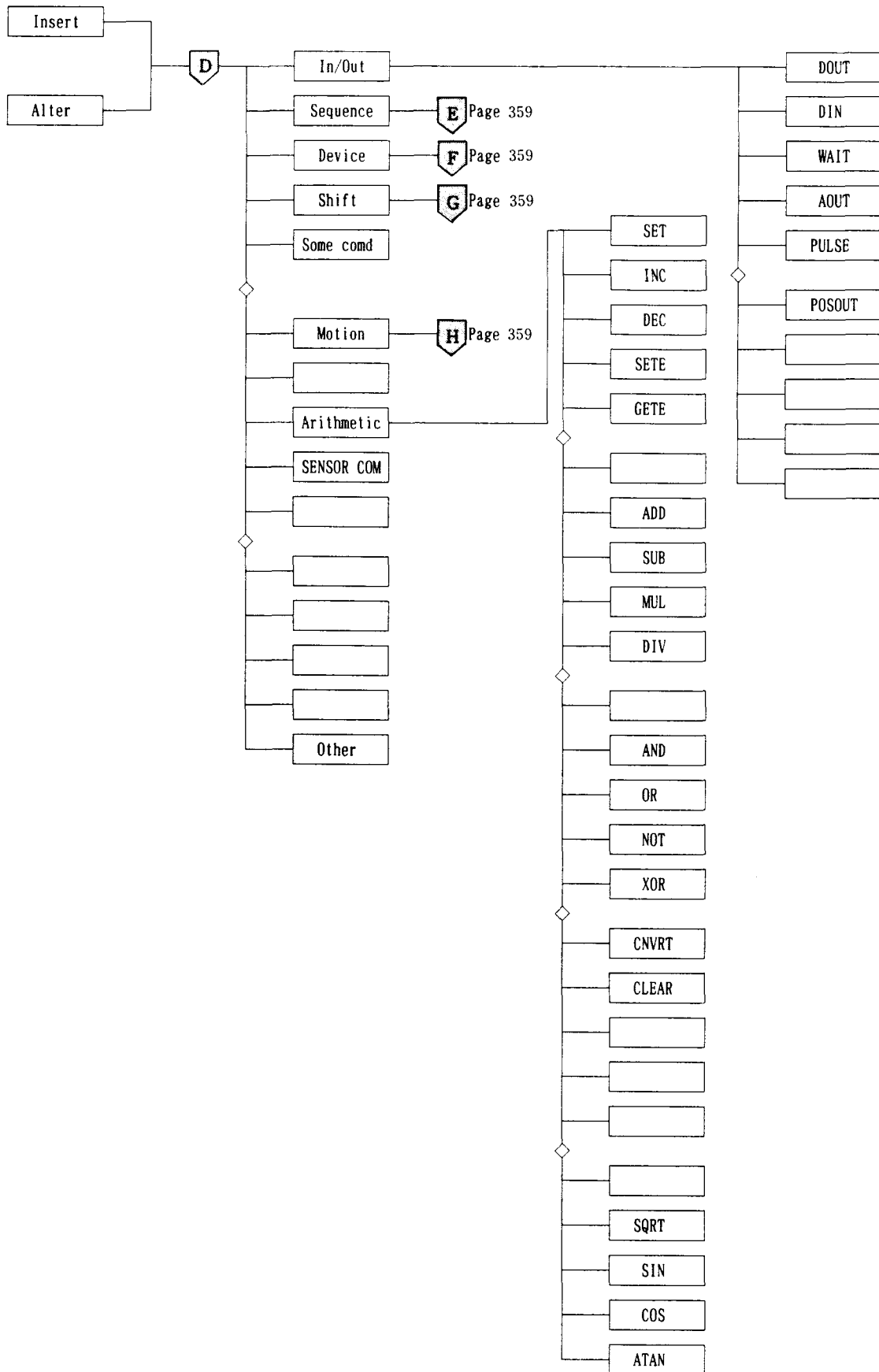
A 10. 3 WHERE

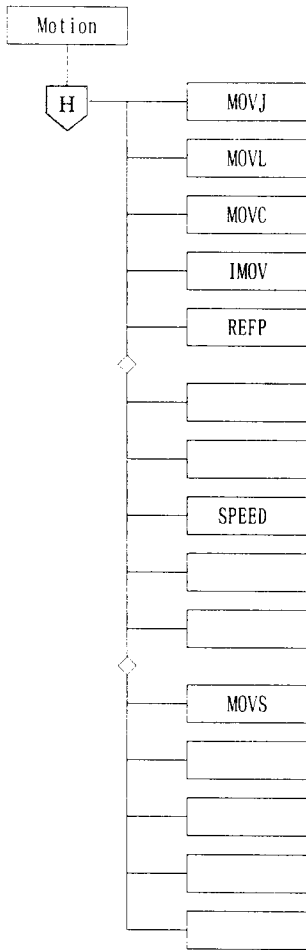
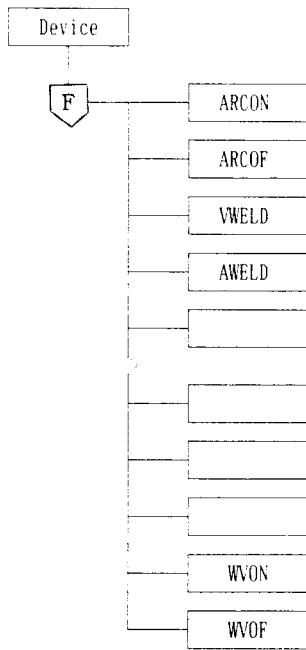
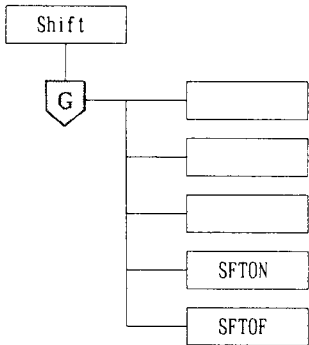
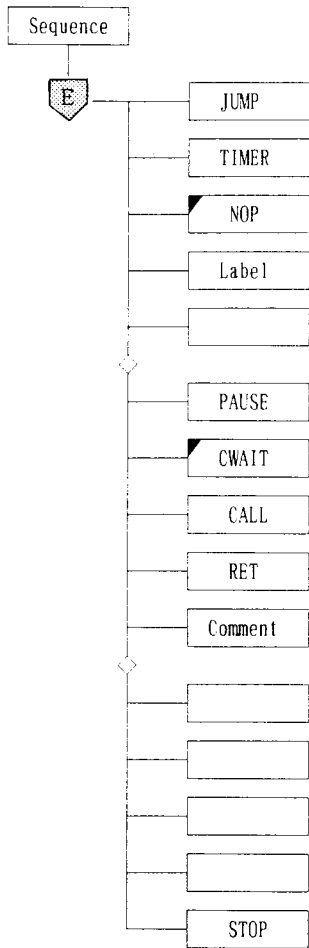


KEY IS DEPRESSED IN JOB TEXT DISPLAY



A 10. 3 WHERE  KEY IS DEPRESSED IN JOB TEXT DISPLAY (Cont'd)

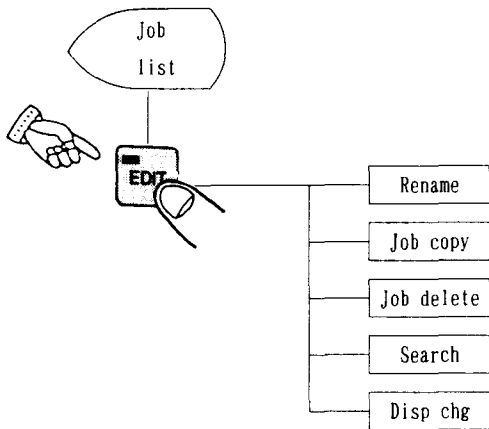




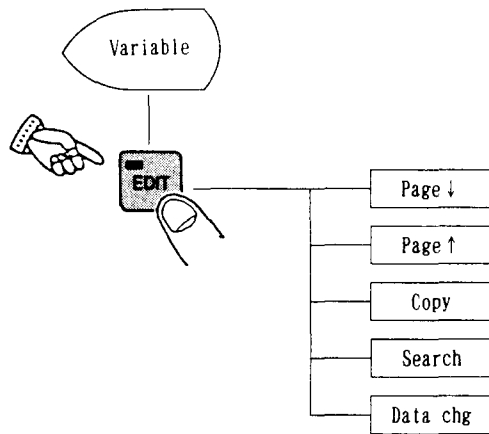
A



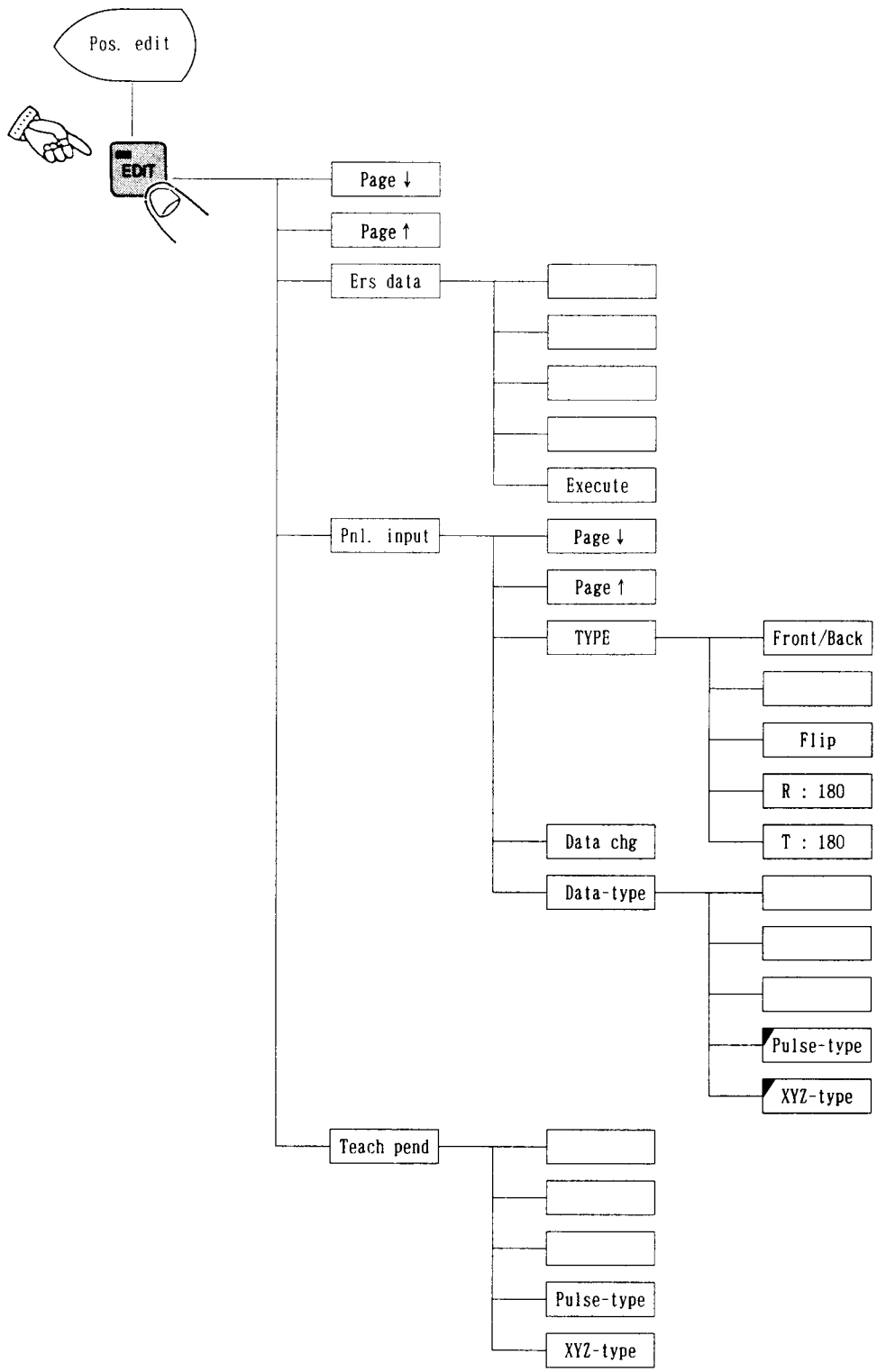
A 10. 4 WHERE  KEY IS DEPRESSED IN JOB LIST DISPLAY



A 10. 5 WHERE  KEY IS DEPRESSED IN VARIABLE DISPLAY

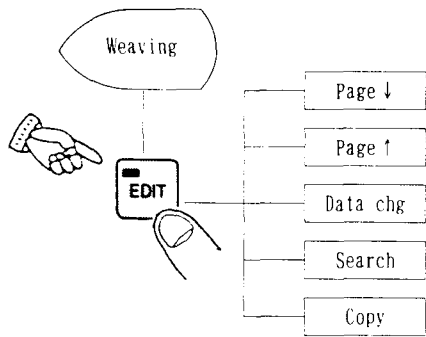


A 10. 6 WHERE  KEY IS DEPRESSED IN POS EDIT DISPLAY

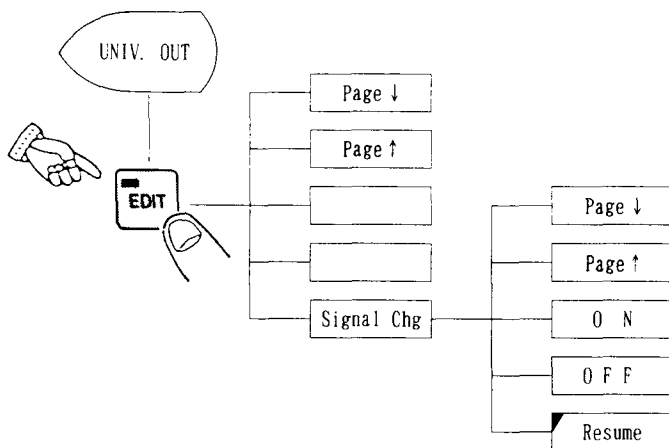


**A**

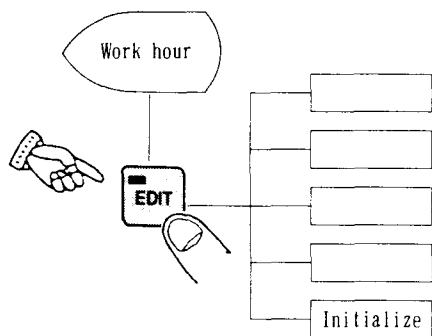
A 10. 7 WHERE  KEY IS DEPRESSED IN WEAVING DISPLAY




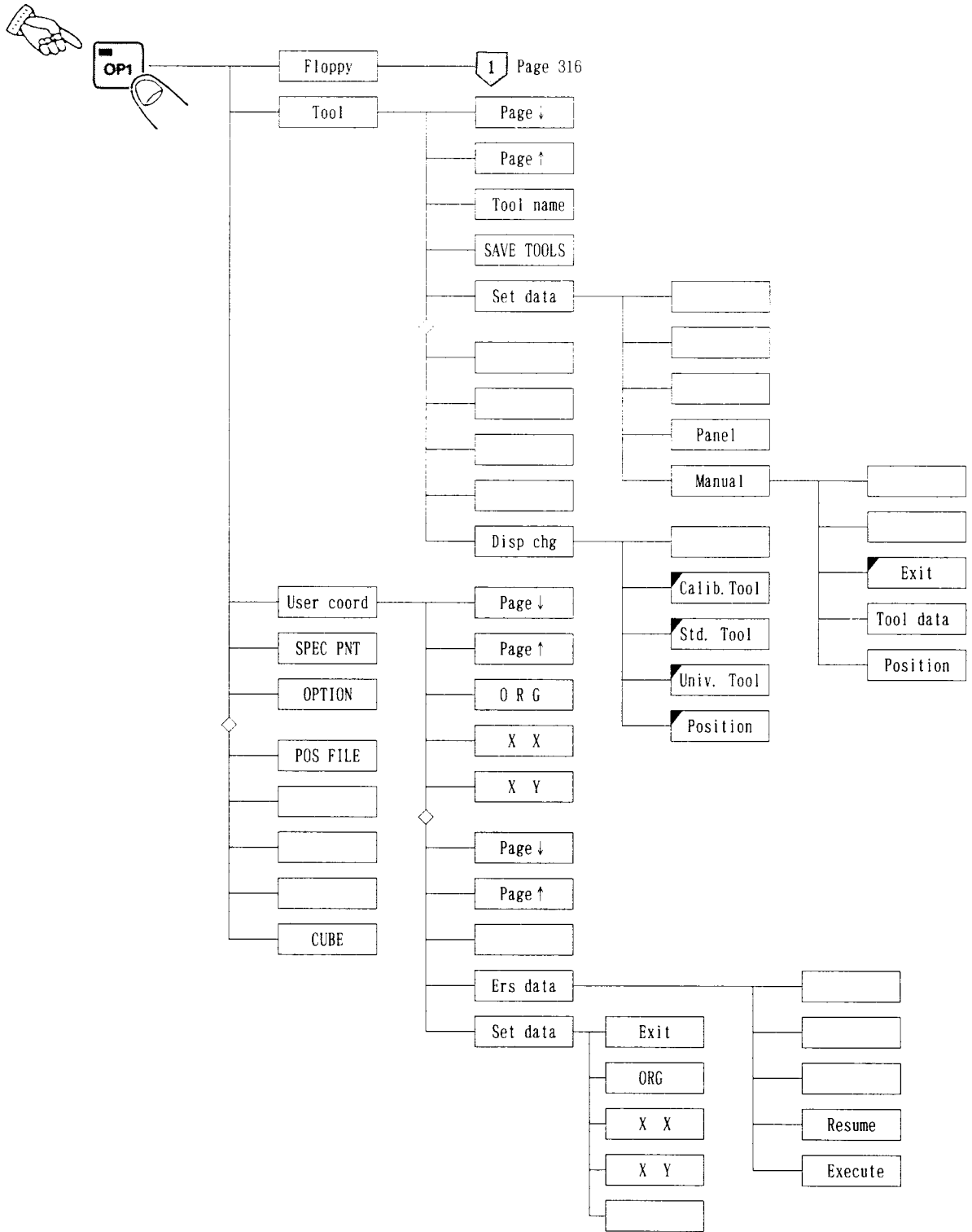
A 10. 8 WHERE  KEY IS DEPRESSED IN UNIV. OUT DISPLAY



A 10. 9 WHERE  KEY IS DEPRESSED IN WORK HOUR DISPLAY

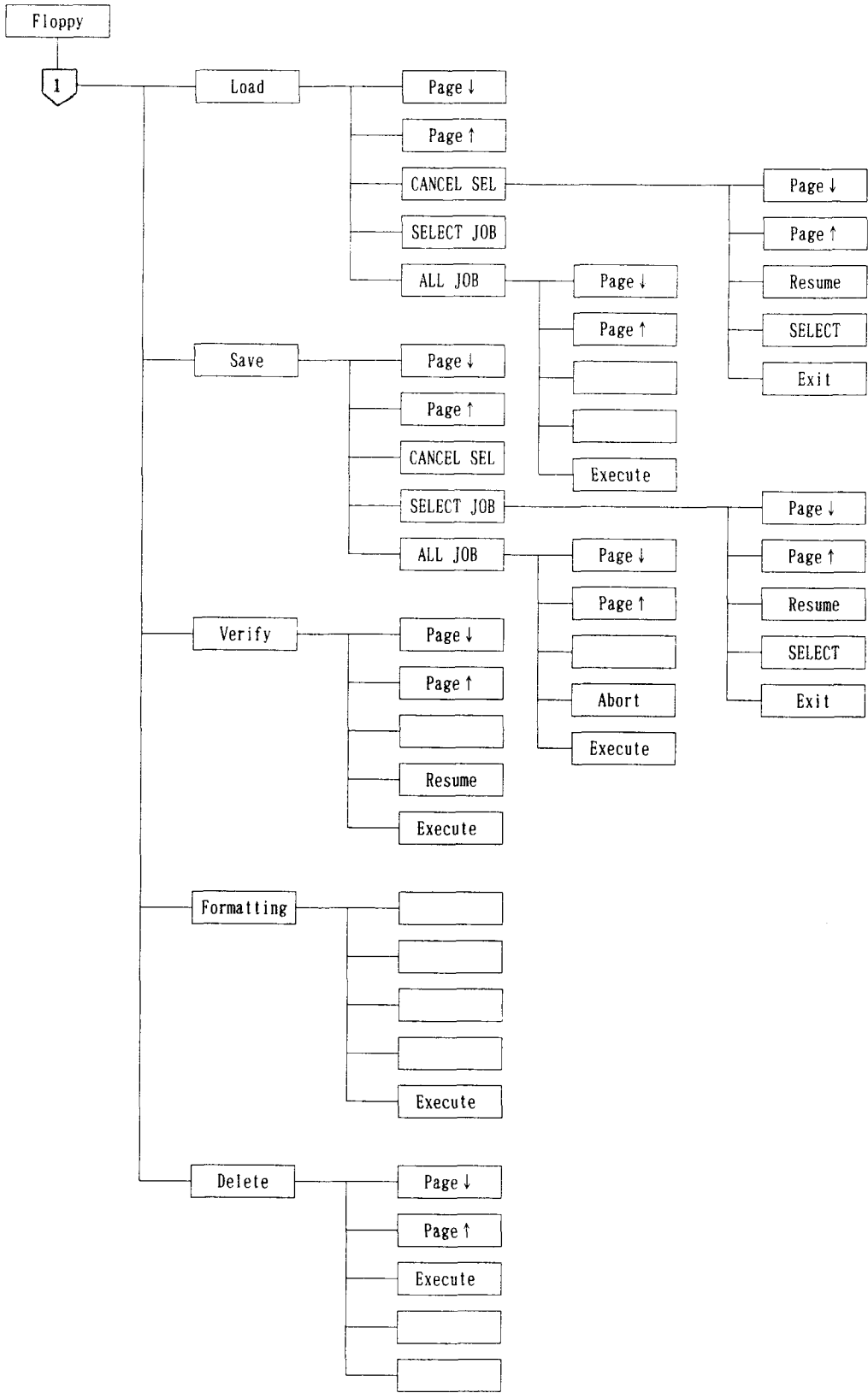


A 10. 10 WHERE  KEY IS DEPRESSED

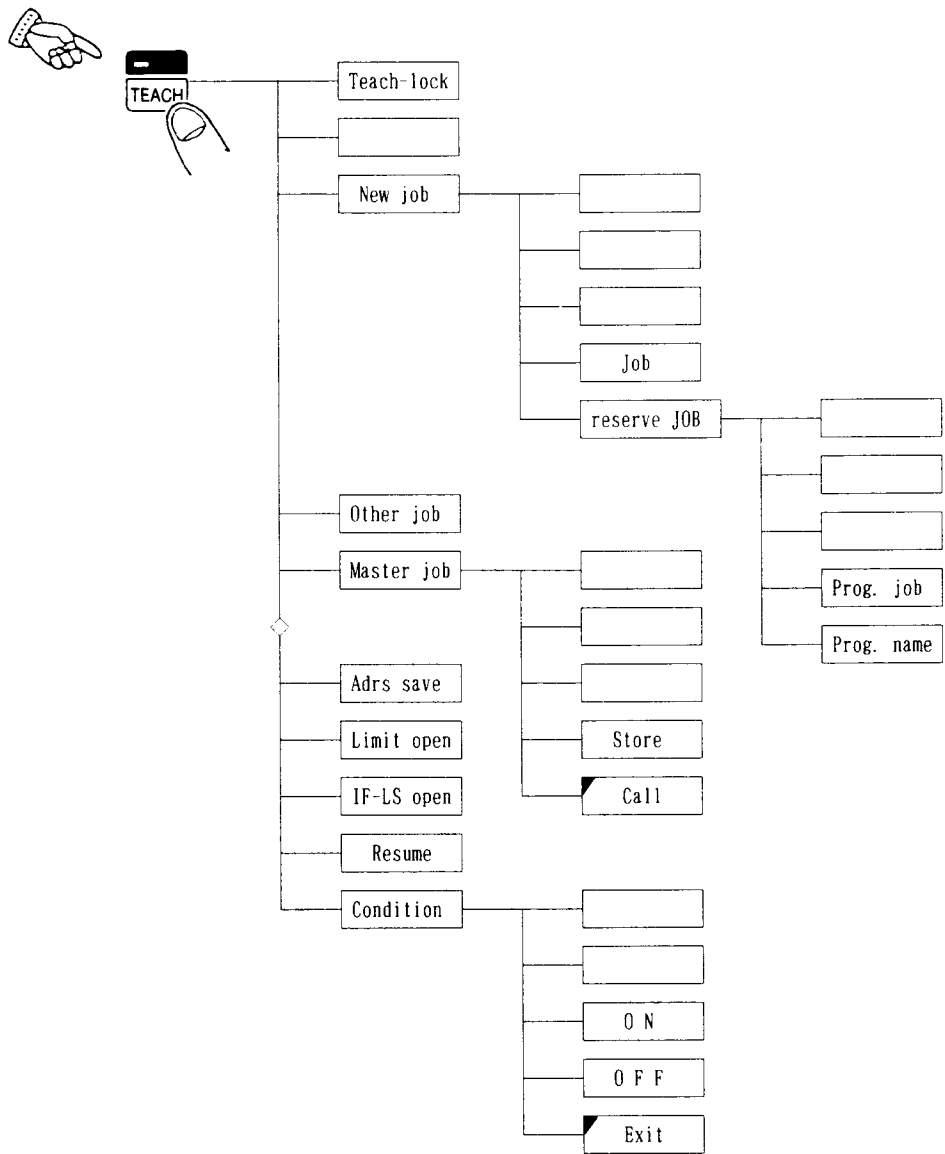


**A**

A 10. 10 WHERE  KEY IS DEPRESSED (Cont'd)

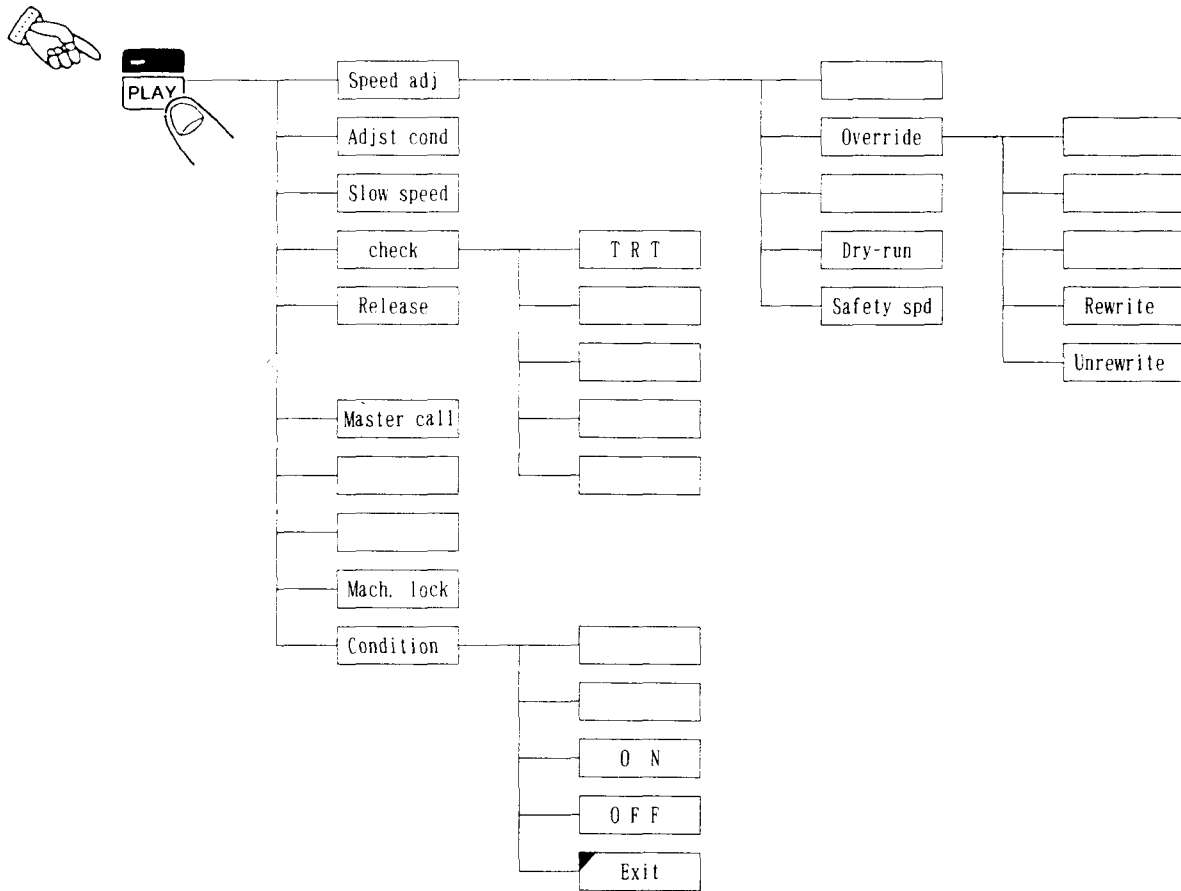


A10. 11 WHERE  KEY IS DEPRESSED



A

A 10. 12 WHERE  KEY IS DEPRESSED



# YASNAC ERC

## CONTROLLER FOR INDUSTRIAL ROBOT MOTOMAN

### OPERATOR'S MANUAL

---

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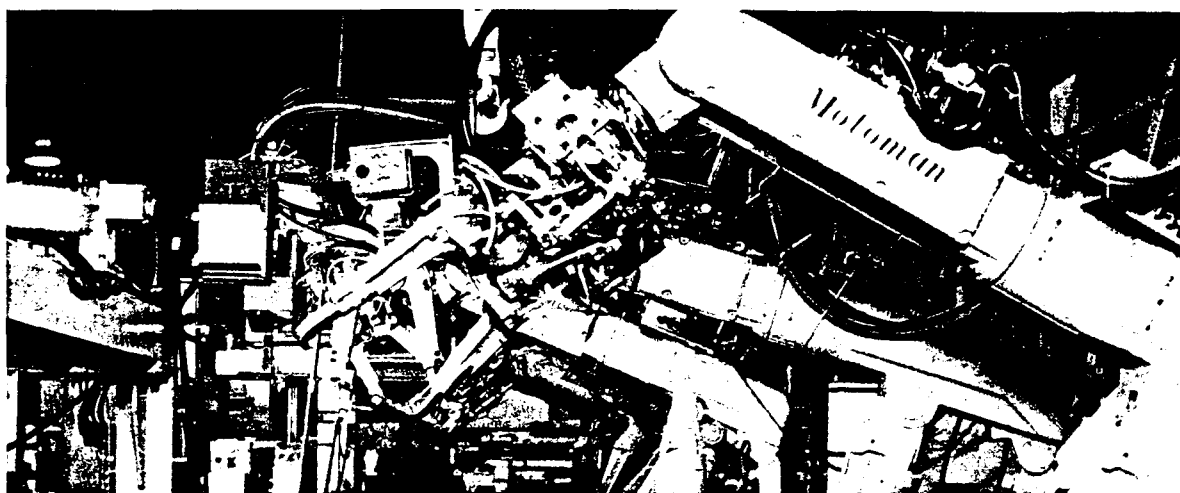


## YASKAWA ELECTRIC CORPORATION



# MOTOMAN SERIES

OPERATOR'S MANUAL FOR EACH APPLICATION



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



YASKAWA

This Operator's Manual describes how to register the work instructions necessary for the operations of each application (arc welding, spot welding, handling, sealing, coating, laser cutting, plasma cutting, machining, general application) and special operations on the teach pendant, prepared for each application.

Motoman is an industrial robot system combining manipulator and YASNAC ERC controller.

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# OUTLINE

Each function according to the application differs as shown in Tables 1 and 2.

**Table 1 List of Work Instruction and Reserve Job Name**

| <b>Function<br/>Application</b>  | <b>Work Start Inst.</b> | <b>Work End Inst.</b>    | <b>Work Condition Inst.</b>        | <b>Reserve Job* Name.</b>   |
|----------------------------------|-------------------------|--------------------------|------------------------------------|-----------------------------|
| <b>Arc Welding</b>               | ARCON                   | ARCOF                    | AWELD (Current)<br>VWELD (Voltage) | ARCON<br>ARCOFF<br>TRAING†  |
| <b>Spot Welding</b>              | GUNON                   |                          | TMWELD                             | GUNON<br>TRAING†            |
| <b>Handling</b>                  | HAND 1 ON<br>HAND 2 ON  | HAND 1 OFF<br>HAND 2 OFF | —                                  | HANDON<br>HANDOF<br>TRAING† |
| <b>Coating, Sealing</b>          | GUNON                   | GUNOF                    | AOUT AO # 1<br>AOUT AO # 2         | GUNON<br>GUNOF<br>TRAING†   |
| <b>Laser Cutting</b>             | LASERON                 | LASEROF                  | AOUT AO # 1<br>AOUT AO # 2         | LSRON<br>LSROF<br>TRAING†   |
| <b>Plasma Cut/Spray</b>          | ARCON                   | ARCOF                    | AOUT AO # 1<br>AOUT AO # 2         | ARCON<br>ARCOFF<br>TRAING†  |
| <b>Machining</b>                 | TOOLON                  | TOOLOF                   | AOUT AO # 1<br>AOUT AO # 2         | TOOLON<br>TOOLOF<br>TRAING† |
| <b>General-purpose<br/>Using</b> | TOOLON                  | TOOLOF                   | AOUT AO # 1<br>AOUT AO # 2         | TOOLON<br>TOOLOF<br>TRAING† |

\* Reserve job means job for which a part of the job name is reserved (registered).

Refer to "Motoman Series OPERATOR'S MANUAL" (TOE-C945-100).

† TRAING : Training job to teach temporarily for Motoman.



**Table 2 Function of Function Key in Teach Pendant**


| Function Key<br>Application          | f0                                                                                                                                  | f1                                                                                                                                  | f2                                                                                                                                                                                                                   | f3                                                                                                                           |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| <b>Arc Welding</b>                   | ARCON inst. or CALL ARCONXX inst. registration                                                                                      | ARCOF inst. or CALL ARCOFFXX inst. registration                                                                                     | <ul style="list-style-type: none"> <li>• VWELDXX inst. registration</li> <li>• Data control</li> </ul>                                                                                                               | <ul style="list-style-type: none"> <li>• AWELDXX inst. registration</li> <li>• Data control</li> </ul>                       |
| <b>Spot Welding</b>                  | GUNON inst. or CALL GUNONXX inst. registration                                                                                      | <ul style="list-style-type: none"> <li>• TMWELDXX inst. registration</li> <li>• Data control</li> </ul>                             | <ul style="list-style-type: none"> <li>• OUT (SC 236) relay control</li> <li>• General-purpose output inst. registration</li> <li>* Use for GUN FULL OPEN instruction when spot gun stroke has two steps.</li> </ul> | OUT (SC 237) relay control<br>* Use for DRY SPOTTING instruction.                                                            |
| <b>Handling</b>                      | <ul style="list-style-type: none"> <li>• HAND 1 ON/OFF inst. registration</li> <li>• (SC 280), (SC 280)+ 1 relay control</li> </ul> | <ul style="list-style-type: none"> <li>• HAND 2 ON/OFF inst. registration</li> <li>• (SC 281), (SC 281)+ 1 relay control</li> </ul> | <ul style="list-style-type: none"> <li>• OUT (SC 236) relay control</li> <li>• General-purpose output inst. registration</li> </ul>                                                                                  | <ul style="list-style-type: none"> <li>• OUT (SC 237) relay control</li> <li>• General-purpose inst. registration</li> </ul> |
| <b>Coating, Sealing</b>              | GONON inst. or CALL GUNONXX inst. registration                                                                                      | GUNOF inst. or CALL GUNOFFXX inst. registration                                                                                     | <ul style="list-style-type: none"> <li>• AOUT # 1XX inst. registration</li> <li>• Data control</li> </ul>                                                                                                            | <ul style="list-style-type: none"> <li>• AOUT # 2XX inst. registration</li> <li>• Data control</li> </ul>                    |
| <b>Laser Cutting</b>                 | LASERON inst. or CALL LSRONXX inst. registration                                                                                    | LASEROF inst. or CALL LSROFFXX inst. registration                                                                                   | <ul style="list-style-type: none"> <li>• AOUT # 1XX inst. registration</li> <li>• Data control</li> </ul>                                                                                                            | <ul style="list-style-type: none"> <li>• AOUT # 2XX inst. registration</li> <li>• Data control</li> </ul>                    |
| <b>Plasma Cut/Spray</b>              | ARCON inst. or CALL ARCONXX inst. registration                                                                                      | ARCOF inst. or CALL ARCOFFXX inst. registration                                                                                     | <ul style="list-style-type: none"> <li>• AOUT # 1XX inst. registration</li> <li>• Data control</li> </ul>                                                                                                            | <ul style="list-style-type: none"> <li>• AOUT # 2XX inst. registration</li> <li>• Data control</li> </ul>                    |
| <b>Machining General-purpose Use</b> | TOOLON inst. or CALL TOOLONXX inst. registration                                                                                    | TOOLOF inst. or CALL TOOLOFFXX inst. registration                                                                                   | <ul style="list-style-type: none"> <li>• AOUT # 1XX inst. registration</li> <li>• Data control</li> </ul>                                                                                                            | <ul style="list-style-type: none"> <li>• AOUT # 2XX inst. registration</li> <li>• Data control</li> </ul>                    |

Note : The machining and general-purpose use differ in the contents of concurrent I/O ladder and I/O allocation.

# 1. ARC WELDING


## 1.1 REGISTRATION AND ALTERATION OF ARC ON/OFF

Specify Arc ON/OFF instruction by using  and  keys.

•  → 

|   |   |   |   |   |   |   |  |  |  |  |  |  |
|---|---|---|---|---|---|---|--|--|--|--|--|--|
| A | R | C | O | N | X | X |  |  |  |  |  |  |
|---|---|---|---|---|---|---|--|--|--|--|--|--|

  
 Condition No. (1 to 99)
 <Function>  
 Without condition No. : ARCON instruction  
 With condition No. : CALL instruction

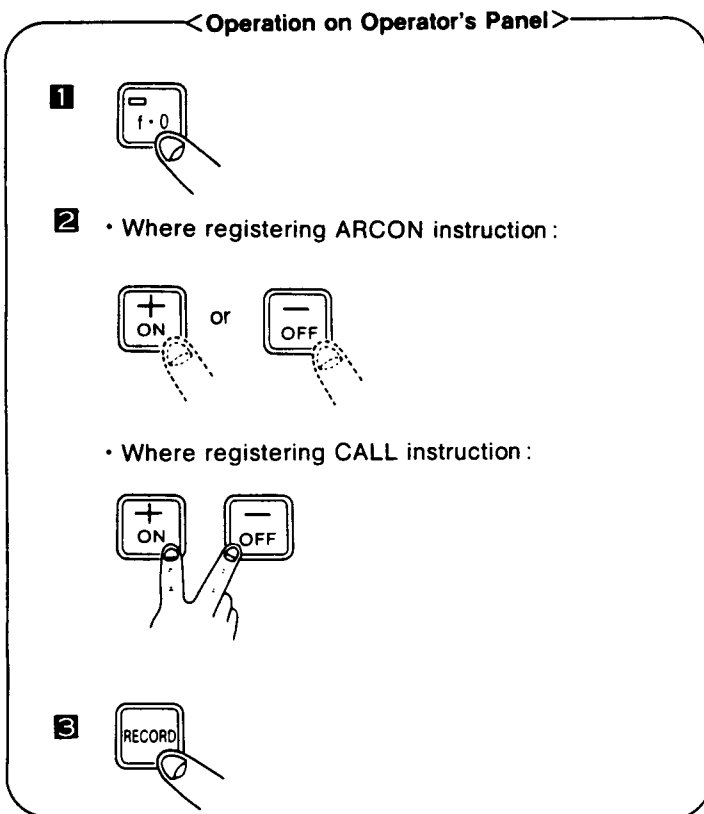
•  → 

|   |   |   |   |   |   |   |   |  |  |  |  |  |
|---|---|---|---|---|---|---|---|--|--|--|--|--|
| A | R | C | O | F | F | X | X |  |  |  |  |  |
|---|---|---|---|---|---|---|---|--|--|--|--|--|

  
 Condition No. (1 to 99)
 <Function>  
 Without condition No. : ARCOF instruction  
 With condition No. : CALL instruction



When Arc ON/OFF instruction is registered, work conditions are also registered. Some required work conditions in welding should be preset as condition job in reserve jobs (job name : ARCON XX or ARCOFF XX) from operator's panel. For detailed operation, see par. 8.

The registration of Arc ON instruction is shown below.  
 Register Arc OFF instruction in the same way.



<Description>



Depress  key.

Update the condition number by using  or  key.

<Teach pendant display>

|   |   |   |   |   |   |   |  |  |  |  |  |  |
|---|---|---|---|---|---|---|--|--|--|--|--|--|
| A | R | C | O | N | X | X |  |  |  |  |  |  |
|---|---|---|---|---|---|---|--|--|--|--|--|--|

Condition Nos. 1 to 99

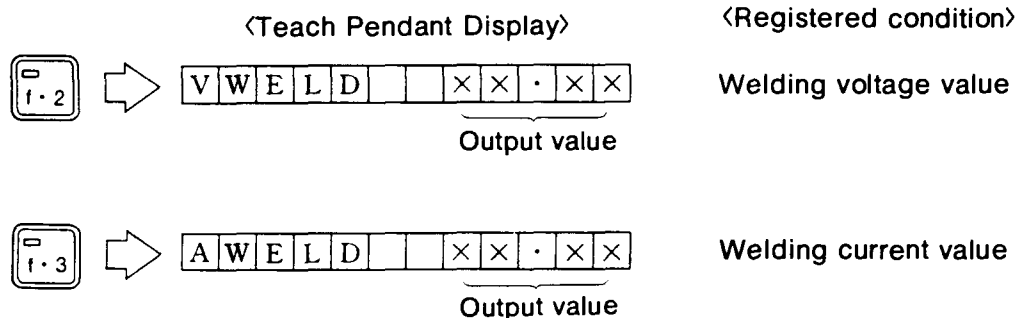
Depress  and  keys simultaneously. The column for condition number goes off.

Depress  key.

Specified welding instruction will be registered.

## 1.2 REGISTRATION AND ALTERATION OF WELDING CONDITION

Normally, the welding conditions are registered as condition job from operator's panel. Only welding voltage/current value can be registered from teach pendant. Register it in the same way as above.



## 1.3 WELDING CONDITIONS INPUT FUNCTION AT ABSOLUTE VALUES

When the welding conditions are changed without this function, command voltage must be adjusted, referring to a correlation table between command voltage to the welder and real welding current/voltage values, so that the optimum welding current/voltage may occur.

But, by using this function, the welding conditions are able to specify at approximate values of real welding current/voltage on the arc welding task after restoring the correlation table in a data file.

In case the welder is changed, you only alter the data file without correcting the taught welding condition correction.

In addition, this function is also utilized effectively for welding condition settings by off-line teaching.

The setting methods are shown below.

(Example)

When the welding at current 250 (A) and at voltage 28 (V) are required.

- Welding condition job without this function

|                |                                                            |
|----------------|------------------------------------------------------------|
| AWELD 7.5..... | Set the welding current at 250 (A) by a correlation table. |
| VWELD 7.5..... | Set the welding voltage at 28 (V) by a correlation table.  |
| TIMER 1.50     |                                                            |
| ARCON.....     | Welding start command                                      |

- Welding condition job with this function

|                                                                                                                                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| ABSCUR 250.....Set the welding current at 250 (A).<br>ABSVOL 28 .....Set the welding voltage at 28 (V).<br>TIMER=1.50<br>ARCON..... Welding start command |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|

### 1.3.1 Instruction

There are two instructions to use in this function.

- (1) Welding voltage output command at absolute value

Format : ABSVOL XXXXX  
(Absolute value welding voltage)  
ABSVOL DXX \*  
(Double-precision integer type variable)

Note : Set the welding voltage file in advance.

- (2) Welding current output command at absolute value



Format : ABSCUR XXXXX  
(Absolute value welding current)  
ABSCUR DXX \*  
(Double-precision integer type variable)

Note : Set the welding current file in advance.

\* On the teach pendant, double-precision integer type variable is not be registered.



### 1.3.2 Condition Settings on Teach Pendant

Tables below show the functions on  and  function keys and the display on the teach pendant.

- When no welding condition file is set :

| Key on Teach Pendant | Function                    | Display and Setting |
|----------------------|-----------------------------|---------------------|
| f 2                  | For welding voltage command | VWELD 14.00         |
| f 3                  | For welding current command | AWELD 14.00         |

- When welding condition file has already been set :

| Key on Teach Pendant | Function                                                                      | Display and Setting                             |
|----------------------|-------------------------------------------------------------------------------|-------------------------------------------------|
| f 2                  | For absolute welding voltage (when welding current file has already been set) | ABSVOL    280<br>Welding voltage absolute value |
| f 3                  | For welding current command (when welding voltage file has already been set)  | ABSCUR    15<br>Welding current absolute value  |

**NOTE** When the setting is zero (command value specification) in the welding-condition input specified parameter (WE04), the display and the setting become VWELD and AWELD.

For the registration, see Par. 8.1.5 "Registration and Edit of Instruction" on Motoman Series OPERATOR'S MANUAL (TOE-C945-100).

### 1. 3. 3 Welder Condition File Setting

To use the welding conditions input function at absolute values, perform on a workpiece under real task conditions such as welder used and wire length, and then restore the measured data between command voltage and welding current/voltage to the welder condition file.

(1) Construction of welder condition file

There are two welder condition files as shown below.

- For welding voltage conditions:  
Condition file for welding voltage command (between CND-3 and -5) of welding command board (EW02)
- For welding current conditions:  
Condition file for welding current command (between CND-15 and -17) of welding command board (EW02)

Depress Disp chg soft key to switch the files.  
F5

**Table 1.1 Data Items and Contents**

| Data Items       | Contents                                  | Description                                                                                                                                                                                       |
|------------------|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Name             | File name                                 | 8 characters max. in full size<br>16 characters max. in half size                                                                                                                                 |
| Command          | Command data                              | Plus: Set when plus voltage (0 to 14 V) is commanded to the welder.<br>Minus: Set when minus voltage ( - 14 to 0 V) is commanded to the welder.                                                   |
| Command Value    | AWELD and VWELD data at measuring         | Set both values of command value and measured value when welding voltage/current is measured.<br>Input point number of measured value must be determined arbitrarily in a range of 3 to 8 points. |
| Measured Value   | Measured value of welding current/voltage |                                                                                                                                                                                                   |
| Correction Value | Correction of output                      | Output value must be correct when the output value differs from welding condition data due to fluctuating error of supply power.<br><br>Input range : 0.8 to 1.2                                  |

The data in Table 1.1 are set, resulting in welding condition setting by approximate value of welding current/voltage.

Fig. 1.1 Shows output character when welder condition absolute values are input.

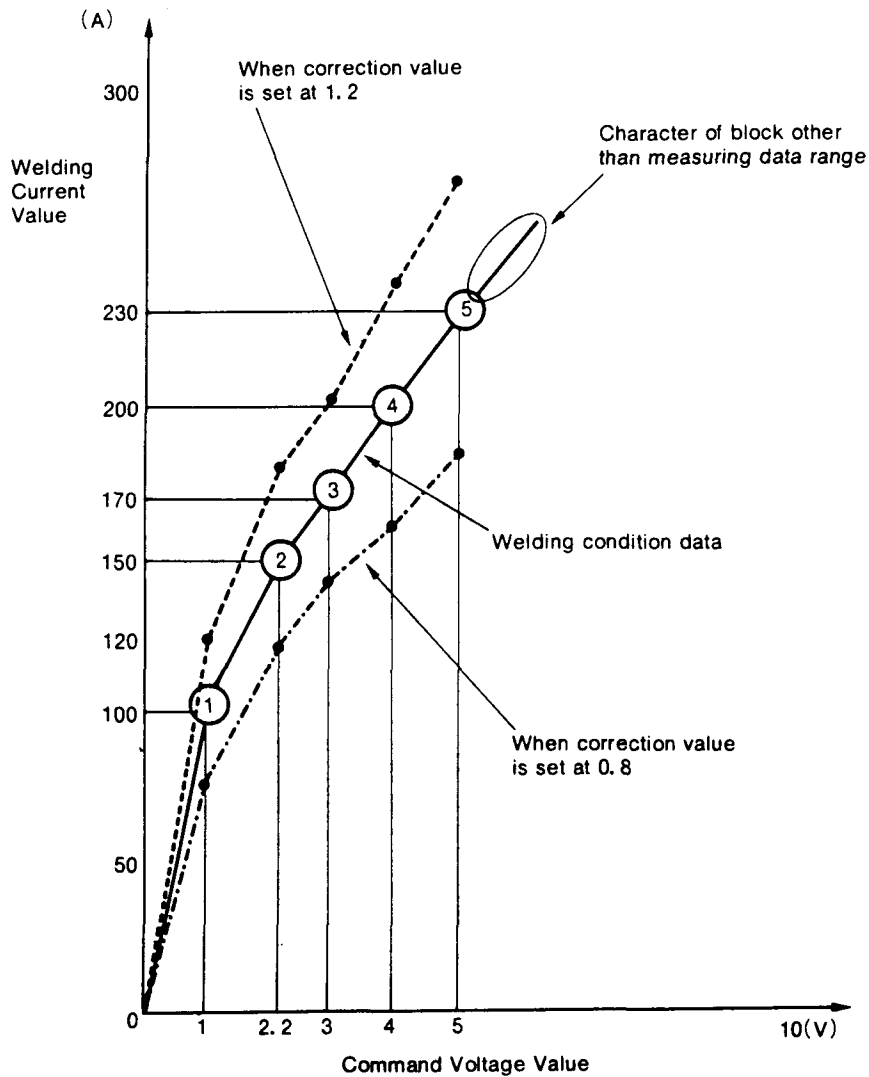


Fig. 1.1 Output Character when Welder Condition Absolute Values are Input

After dividing the measuring points into blocks, interpolate the command voltage values to linear in each block.

When the welding current/voltage is in a block other than measuring data range (it exists in block ⑤ and beyond), interpolate the command voltage value to linear by utilizing the character preceding block (the character between ④ and ⑤).

When the preset welding current/voltage is not output due to fluctuation of power source voltage supplied to the welder, adjust the command voltage value by correction value, as shown in Fig. 1.1.

<Correction Value>

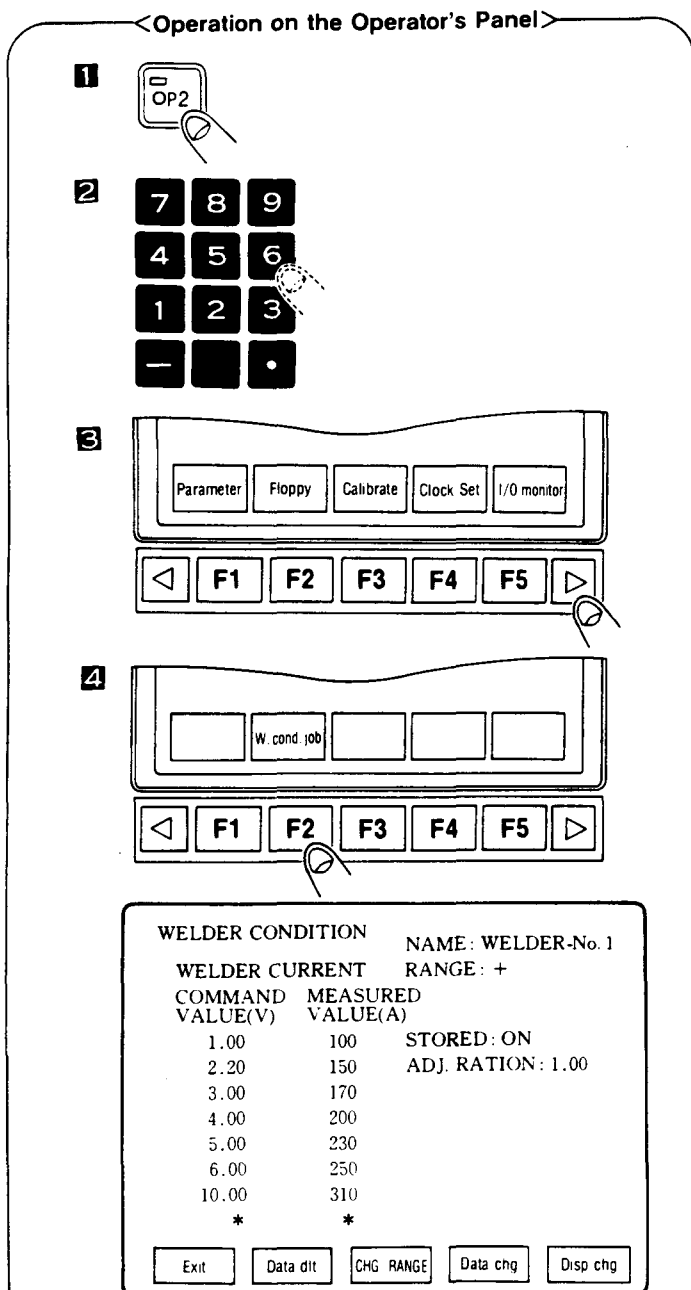
1. When the power source voltage supplied to the welder is low, adjust it at a correction value in the range of 0.80 to 0.99.

(e. g.) When only 180A is output at 200A command,  
set the correction value at 0.90.

2. When the power source voltage supplied to the welder is high, adjust it at a correction value in the range of 1.01 to 1.20.

(e. g.) When 220A is output at 200A command,  
set the correction value at 1.10.

(2) Data setting method



<Description>

Depress key.

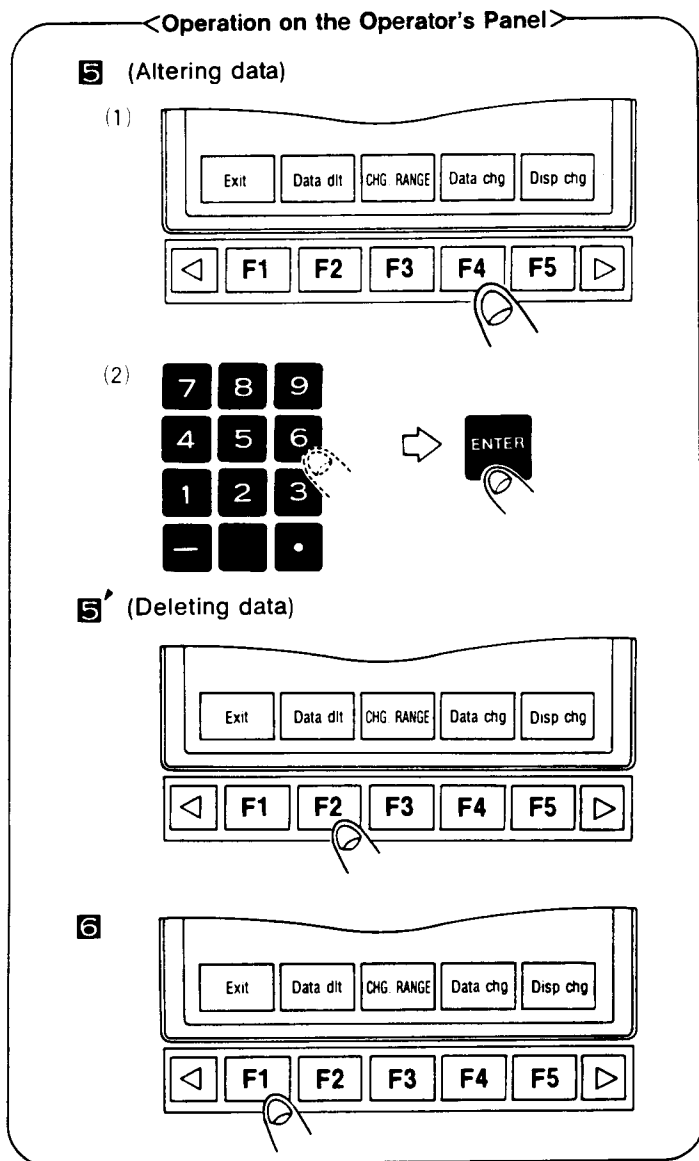
Input the user ID number.

Depress key four times.

Depress soft key.

This display (welder conditions) will appear.

To alter the data, go to step 5.  
 To delete the data, go to step 5'.



<Description>

After moving the cursor to the position to be altered, depress Data chg soft key.  
F4

Input the data and depress ENTER key.  
 The data are altered.

After moving the cursor to the position to be deleted, depress Data dlt soft key.  
F2

The data are deleted and the display at the position is changed to mark\*.

After all setting for welder conditions are completed, be sure to depress Exit soft key.  
F1

Then, check if the item "STORED" on the screen is "ON".

- NOTE**
1. If the item "STORED" on the screen is "OFF", this function can not be executed.
  2. When the contents of data file are changed, the item "STORED" shows "OFF". Therefore, be sure to depress Exit soft key.  
F1

### 1.3.4 Floppy Operation

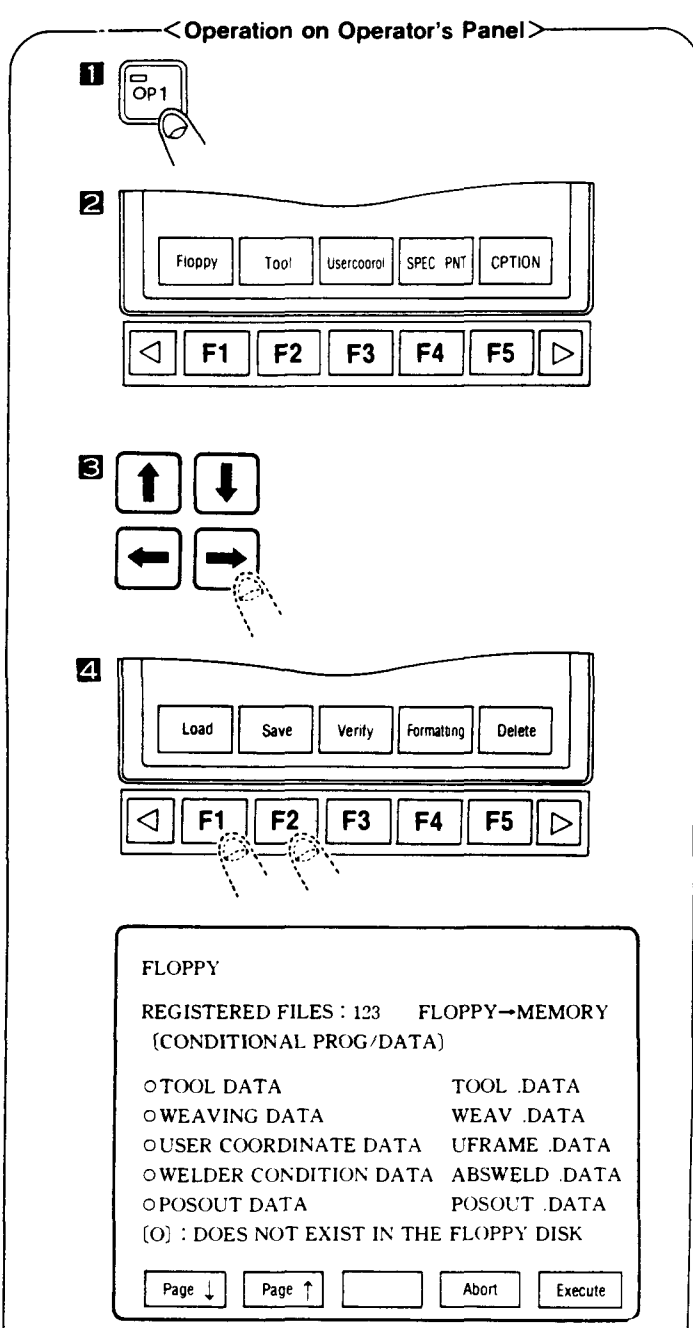
The welder condition data file can be executed load/save by using floppy.

It is contained in the condition program data group.

#### (1) Load/save to the floppy

For detailed floppy operation, see Sec. 9 "Data Storage (Floppy Disk Unit Operation)" in Motoman Operator's Manual (TOE-C945-100).

Perform the load/save operation as follows.



<Description>

Depress key and insert a floppy disk in the floppy disk unit.

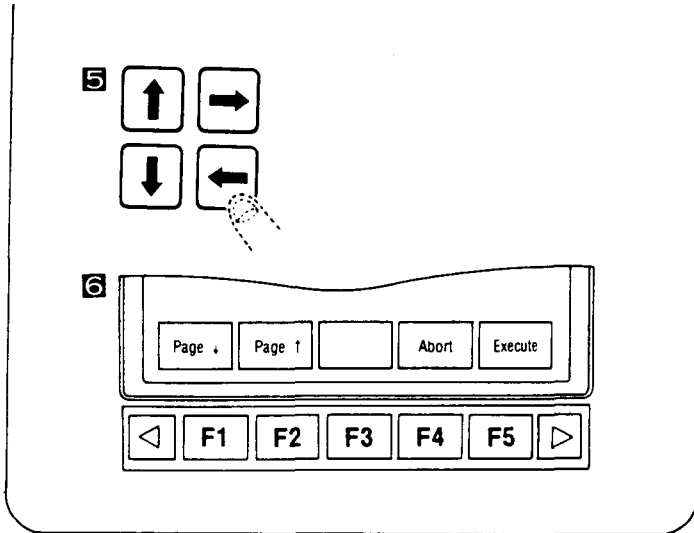
Depress soft key.

Floppy display will appear.

Set the cursor to Condition Program Data.

Depress or soft key.

Load/save display of welder condition file is shown.



Set the cursor to Welder Condition Data.

To execute the load/save, depress

**Execute**  
**F5** soft key.



1. Be sure to use OP2 function to load from floppy.
2. When the welder condition data are load from floppy, the setting may be "OFF."  
After loading, be sure to depress

**Exit**  
**F1** soft key on welder condition

display to complete the setting.  
For details, see Par. 1.3.4 (2)  
"Data setting method".

## (2) Data format at floppy save

When welder condition file is saved to floppy, the format is shown below.

```

//ABSWELD 1                                > Voltage condition file
///NAME WELDER-NO. 1                       > Name
0                                            > Command 0 : + 1 : -
11111110                                   > The number of data. 1 is set data.
100, 150, 170, 200, 230, 250, 310, 0      > Absolute data
1.00 2.20, 3.00, 4.00, 5.00, 6.00, 10.00, 0.00 > Command data
1.00                                        > Correction value

//ABSWELD 2                                > Current condition file
///NAME WELDER-NO. 2                       > Name
0                                            > Command 0 : + 1 : -
11111110                                   > The number of data. 1 is set data.
25, 50, 100, 125, 150, 200, 250, 0       > Absolute data
0.75 1.50, 2.25, 3.00, 4.00, 6.00, 7.50, 0.00 > Command data
1.00                                        > Correction value

```

### 1.3.5 Parameter Setting

Set the parameter as follows.

|                                                      |                                       |
|------------------------------------------------------|---------------------------------------|
| WE04<br>(Welder condition input specified parameter) | 0: Command value<br>1: Absolute value |
|------------------------------------------------------|---------------------------------------|

\* Initial setting is 0.

When "Welding conditions input function at absolute value" is used, set the parameter to

WE04 1 .

### 1.3.6 Alarm and Error Display

#### (1) Alarm display

Table 1.2 Alarm Display

| Alarm No. | Displayed Message                 | Contents                                                                                                     | Remedies                                                                                                                                                                                                                                                                                     |
|-----------|-----------------------------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1530      | DESTROYED FILE (WELDER CONDITION) | 1 0 0 1 0 0 1 1<br>└── Voltage file<br>└── Current file<br>└── Setting not completed<br>└── File destruction | Setting not completed :<br><br>After checking the contents of file (voltage/current) displayed in data, depress <input type="button" value="Exit"/> <input type="button" value="F1"/> soft key.<br><br>File destruction :<br>Contact your Yaskawa representative for maintenance alarm code. |

#### (2) Error display

Table 1.3 Error Display

| Error No. | Displayed Message         | Contents                                                                                                                                                              |
|-----------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1090      | Illegal DATA in the file. | When the setting data are 2 items or below, multiple measuring values are set in the same command value or multiple command value is set in the same measuring value. |

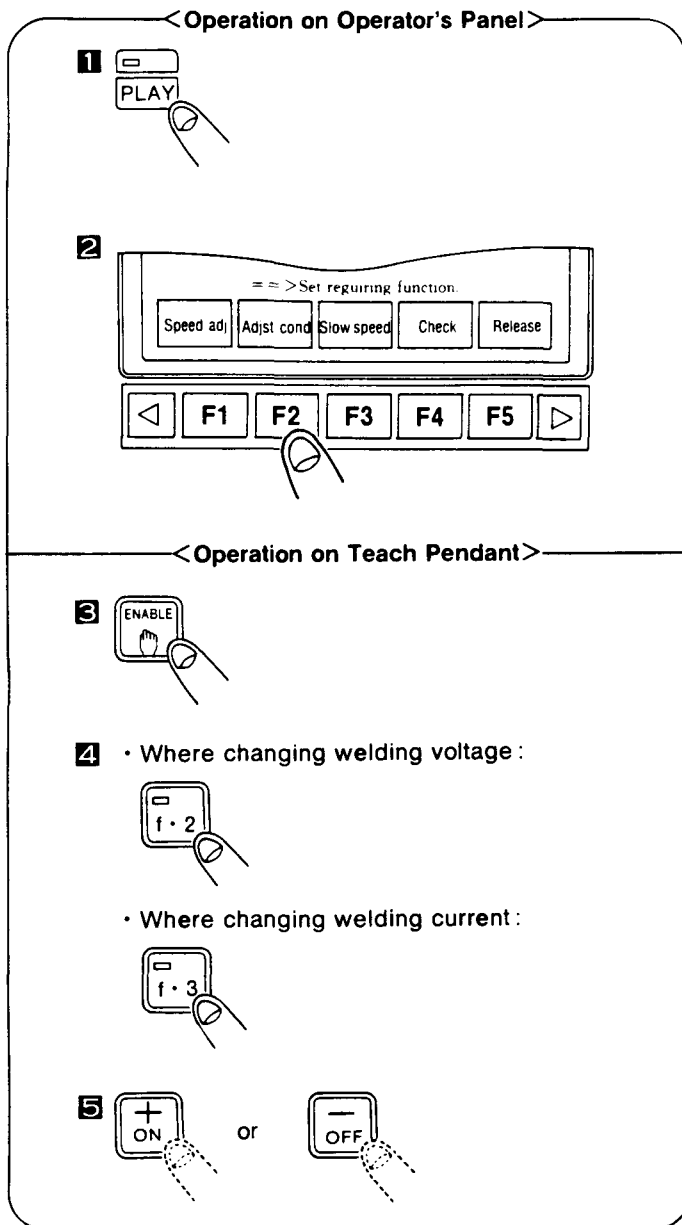


## 1.4 WELDING CONDITION CHANGE DURING OPERATION

While the manipulator is moving, welding condition is changed confirming the actual welding status. The correction data are rewritten automatically at arc off point or at execution of next condition instruction.

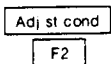
**NOTE**

Be careful when changing the condition because the manipulator is moving.



<Description>

Depress  key.

Depress  soft key.



A condition change operation is possible on teach pendant.

Depress  key.

Depress  key.

Depress  key.

Change the setting value by using

 or  key.



- When the following operation is executed, condition change operation becomes invalid.
  - Any speed adj Check Release soft key is depressed.  

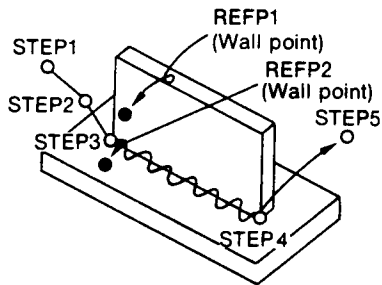
F1
F4
F5
  - Mode is changed.
  - Alarm or error occurs.
  - The power is cut off.
  - Emergency stop button is depressed.
- Execute the data change at actual (Arc ON) status to set the precise data.
- Where the manipulator stops during data change operation, the data of last execution condition instruction cannot be rewritten.

## 1.5 SOFT WEAVING

Weaving is possible by specifying the weaving block and by setting the weaving conditions.

In teaching weaving, specify the weaving block by setting the weaving start and end points. Then, on the next weaving start point, register wall points as reference points to specify the weaving tracking direction.

The required conditions in welding such as amplitudes and frequencies should be registered in weaving condition file which can be used for common utilization.



<Weaving Instruction>

- Weaving start : WVON       
File No.
- Weaving end : WVOF
- Wall point : REFP

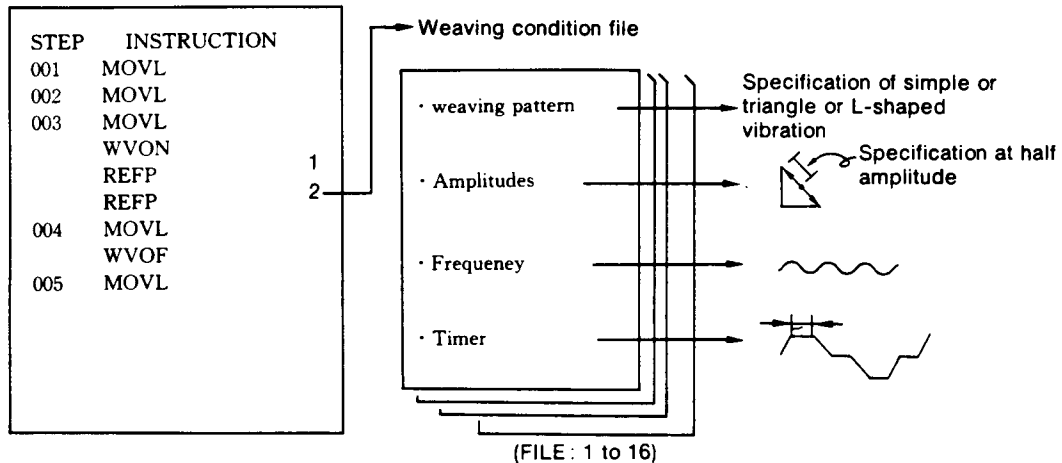


Fig. 1.2 Example for Weaving Setting

### 1.5.1 Registering Weaving Point

Teach two consecutive wall points. They can be specified workpiece wall directions or weaving directions.

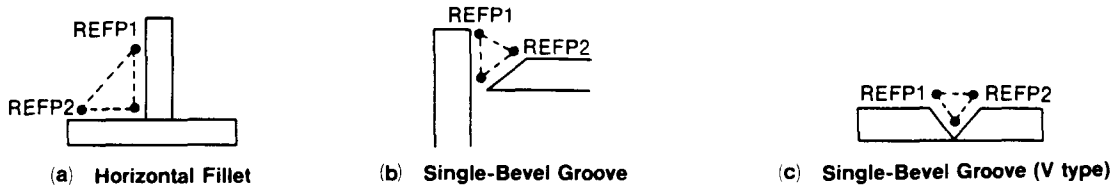
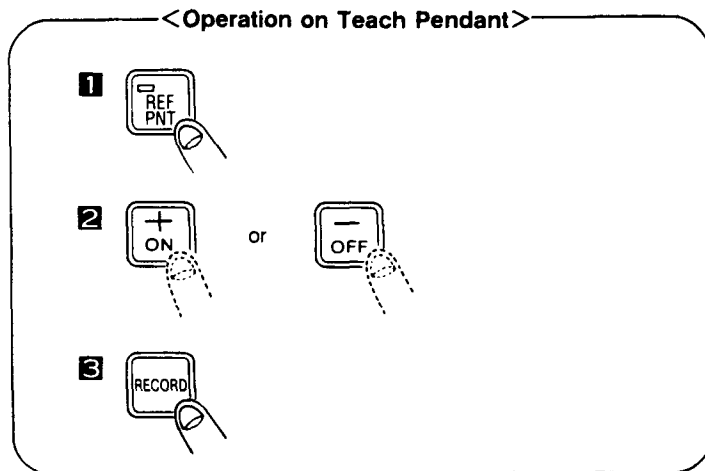


Fig. 1.3 Weaving Point Registration Position

Register wall point as follows.



<Description>

Depress  key.

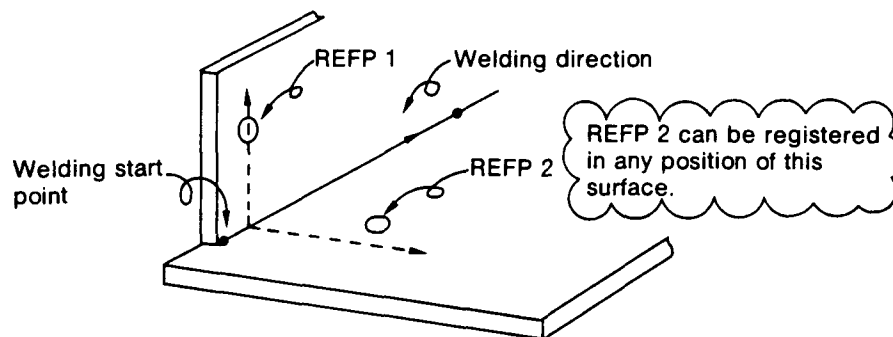
The lamp lights.

Select the reference number 1 or 2.

<Display on teach pendant>

REFP 1

Decide the wall point position and depress  key.

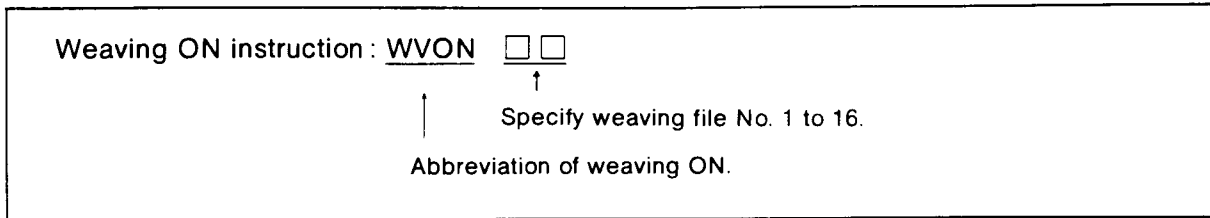


Wall points are position data needed to specify the basic direction of triangular weaving data. The weld line direction and point REFP 1 are standard. Specify REFP 2 on the left or right side of the welding direction.

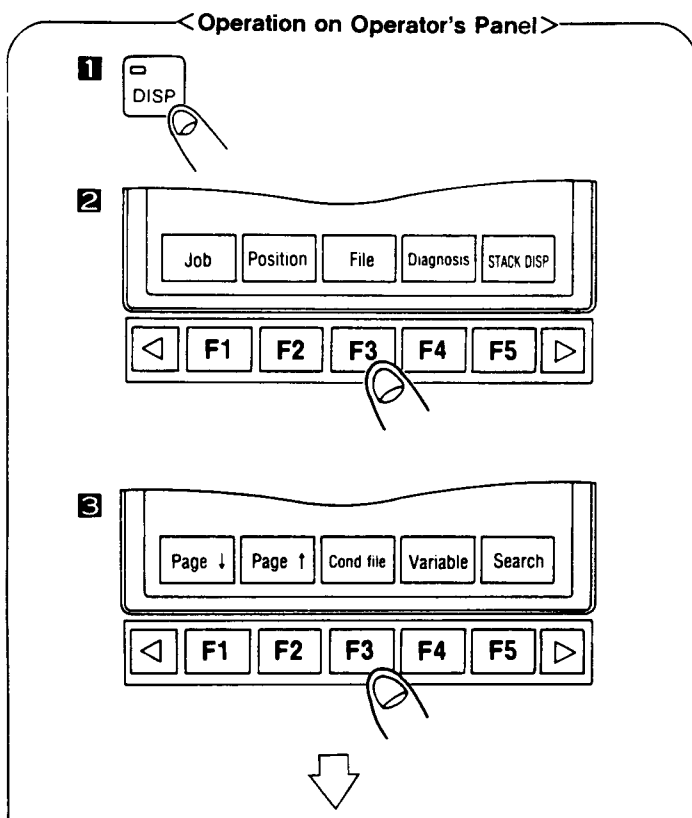
Fig. 1.4 Wall Point Registration

### 1.5.2 Specifying Weaving Condition File and Registering Weaving Condition

Register conditions needed of weaving in files in batch.  
Specify desired file by the weaving ON instruction.



#### ★ Procedure for calling up weaving condition file



#### <Description>

Depress  key.

Depress   soft key.

Depress   soft key.

The weaving condition display (Fig. 1.4) will appear.

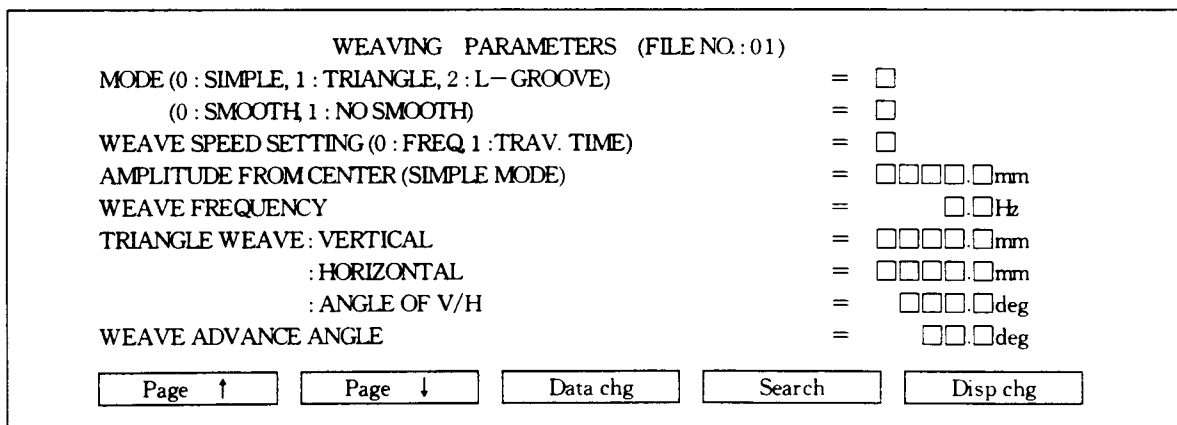
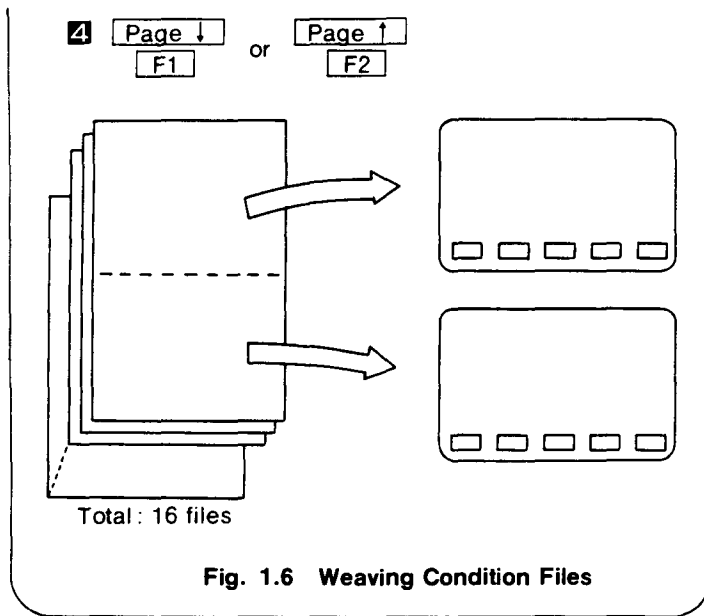


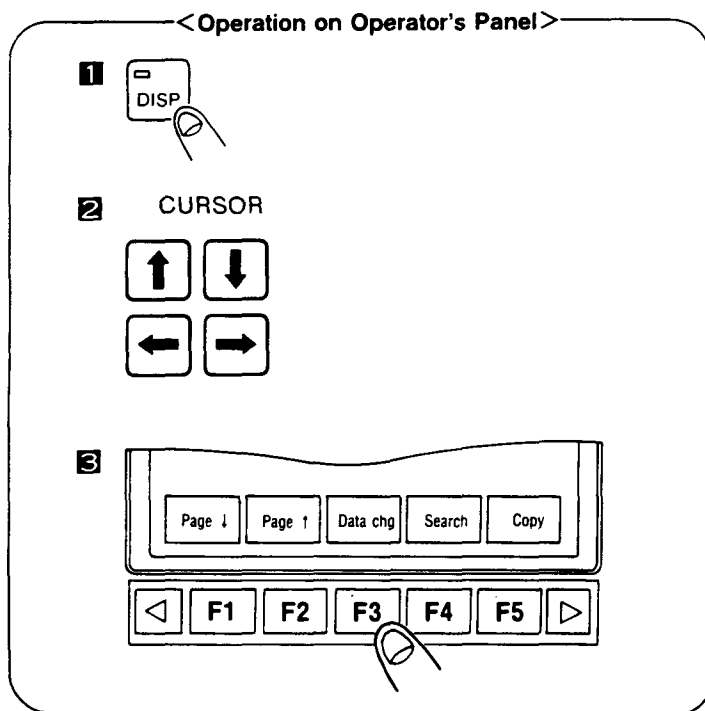
Fig. 1.5 Weaving Condition Display



Call up the desired weaving condition file by using Page ↓  
F1 or Page ↑  
F2 soft key.

There are 16 weaving condition files. The contents of each file are divided and displayed in two displays.

★ Procedure of setting weaving condition data



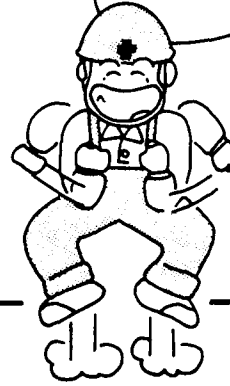
<Description>

Depress DISP key.

Specify the position to be set by cursor.

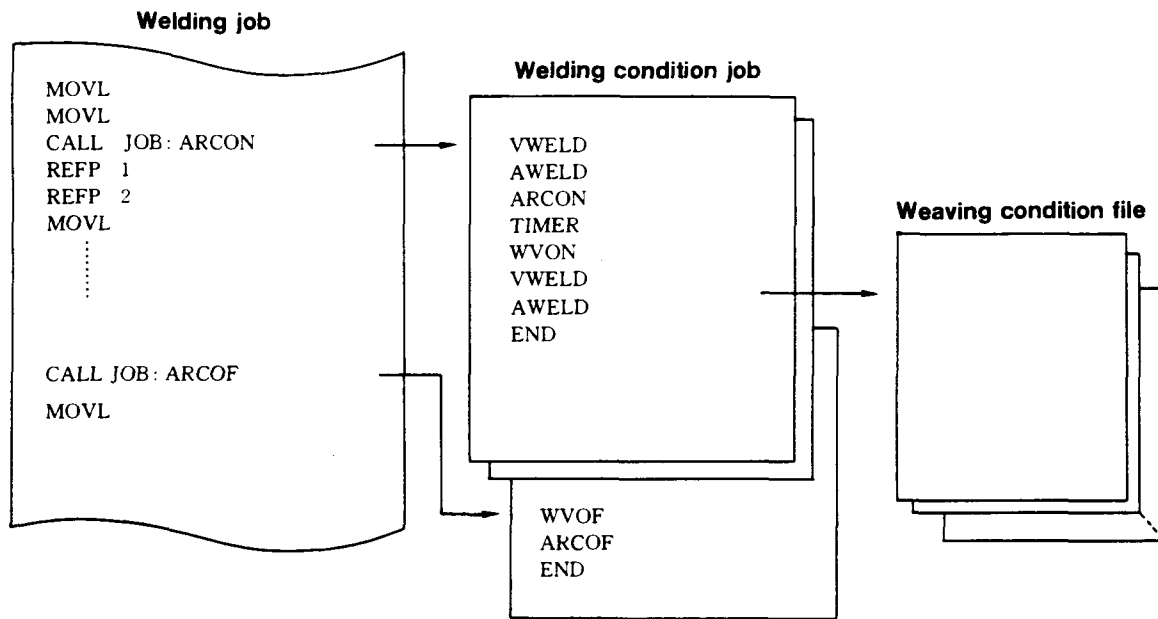
Depress Data chg  
F3 soft key and set the weaving condition data.

Whoops!  
It's very useful.



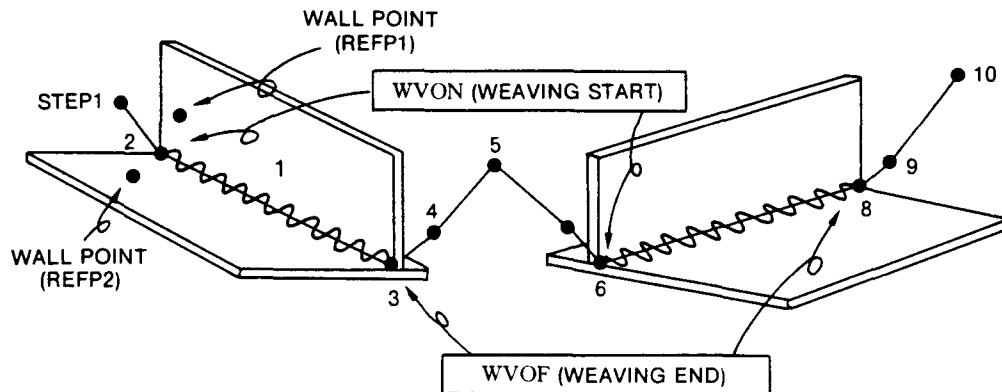
**Effective Teaching Method**

Weaving is performed in arc-on blocks. Registration of weaving instruction in arc welding condition jobs will be useful.



**Fig. 1.7 Example for Effective Teaching Method**

Where the same weaving pattern is executed continuously, register wall points (REFP 1 and 2) only at first start position. By only this registration, the manipulator repeats the same motion.



**Fig. 1.8 Weaving Instruction and Wall Point**

### 1.5.3 Detail of Setting Data

| WEAVING PARAMETERS (FILE NO.:01)                                                                                                                   |                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| (1)                                                                                                                                                | MODE (0 : SIMPLE, 1 : TRIANGLE, 2 : L-GROOVE) = <input type="checkbox"/>  |
|                                                                                                                                                    | (0 : SMOOTH, 1 : NO SMOOTH) = <input type="checkbox"/>                    |
| (2)                                                                                                                                                | WEAVE SPEED SETTING (0 : FREQ, 1 : TRAV. TIME) = <input type="checkbox"/> |
| (3)                                                                                                                                                | AMPLITUDE FROM CENTER (SIMPLE MODE) = <input type="text"/> mm             |
| (4)                                                                                                                                                | WEAVE FREQUENCY = <input type="text"/> Hz                                 |
| (5)                                                                                                                                                | TRIANGLE WEAVE : VERTICAL = <input type="text"/> mm                       |
|                                                                                                                                                    | HORIZONTAL = <input type="text"/> mm                                      |
|                                                                                                                                                    | ANGLE OF V/H = <input type="text"/> deg                                   |
| (6)                                                                                                                                                | WEAVE ADVANCE ANGLE = <input type="text"/> deg                            |
| <input type="button" value="Page ↑"/> <input type="button" value="Page ↓"/> <input type="button" value=""/> <input type="button" value="Weaving"/> |                                                                           |

| WEAVING PARAMETERS (FILE NO.: )                                                                                                                    |                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| (7)                                                                                                                                                | 1 st. TIMER MODE(0 : HALT, 1 : FINISH) = <input type="checkbox"/> Timer = <input type="text"/> sec |
|                                                                                                                                                    | 2 nd. TIMER MODE = <input type="checkbox"/> = <input type="text"/> sec                             |
|                                                                                                                                                    | 3 rd. TIMER MODE = <input type="checkbox"/> = <input type="text"/> sec                             |
|                                                                                                                                                    | 4 th. TIMER MODE = <input type="checkbox"/> = <input type="text"/> sec                             |
|                                                                                                                                                    | 1 st. TRAVERSE TIMER = <input type="text"/> sec                                                    |
|                                                                                                                                                    | 2 nd. TRAVERSE TIMER = <input type="text"/> sec                                                    |
|                                                                                                                                                    | 3 rd. TRAVERSE TIMER = <input type="text"/> sec                                                    |
|                                                                                                                                                    | 4 th. TRAVERSE TIMER = <input type="text"/> sec                                                    |
| <input type="button" value="Page ↑"/> <input type="button" value="Page ↓"/> <input type="button" value=""/> <input type="button" value="Weaving"/> |                                                                                                    |

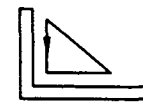
Fig. 1.9 Weaving Condition Displays

#### (1) MODE

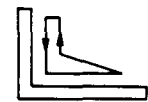
- Select the weaving mode among three types.



0: Simple



1: Triangle



2: L-groove

- Specify smooth or no smooth.



0: Smooth



1: No smooth

Fig. 1.10 Weaving Mode

#### (2) WEAVE SPEED SETTING

Select the method to set the weaving tracking speed from the following :

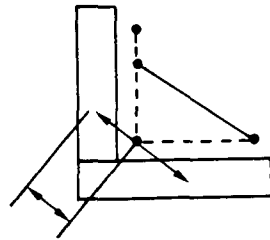
0 : Set by the frequency (FREQ)

1 : Set by the moving time of each weaving block (TRAV. TIME)

(3) **AMPLITUDE FROM CENTER**

These data become effective when the weaving mode is set to "simple mode".

If a triangle as shown in Fig. 1.11 is taught, weaving is performed parallel to the hypotenuse of the triangle at the start point.



AMPLITUDE FROM CENTER

Fig. 1.11 Setting of Amplitude from Center

(4) **WEAVE FREQUENCY**

These data become effective when the weaving speed setting method is specified to "frequency".

Set the frequency within operation limit range since frequencies are limited as shown in Fig. 1.12. However, Fig. 1.12 show data only for manipulators K6SB and K10S.

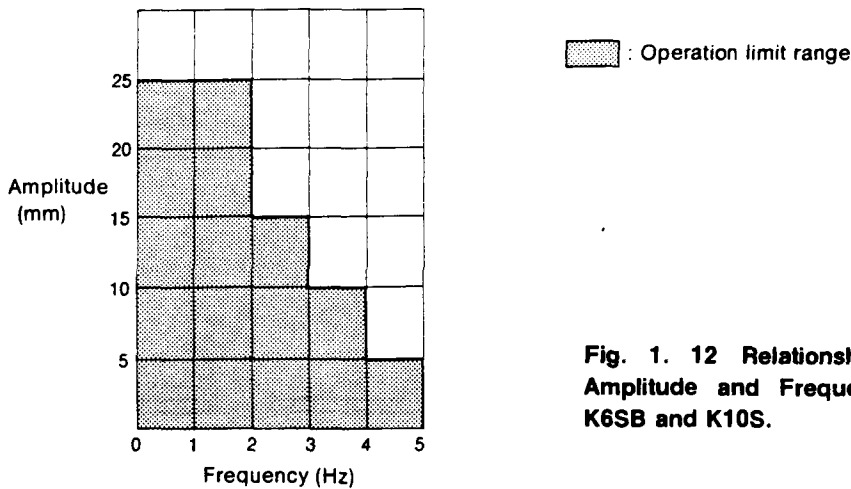
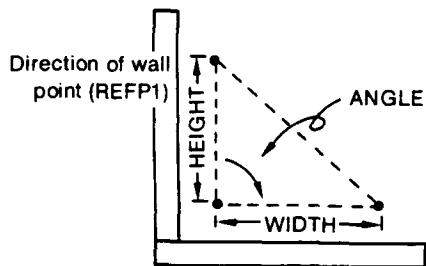


Fig. 1.12 Relationship between Weaving Amplitude and Frequency for Manipulators K6SB and K10S.

(5) **TRIANGLE WEAVE**

Triangle data must be set to define the basic weaving pattern irrespective of the weaving mode. The triangle data are set as shown in Fig. 1.13.



<Range>  
Angle : 0.1 to 180.0 degree  
Height / Width : 1.0 to 25.0mm

Fig. 1.13 Triangle Weaving Data



(6) WAVE ADVANCE ANGLE

The weaving tracking direction for weld line can be set by using these data. The data are set as shown in Fig. 1.14.

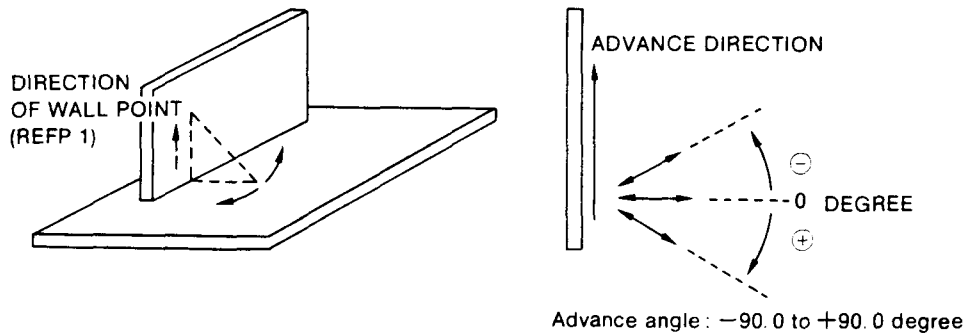


Fig. 1.14 Weaving Advance Angle

(7) TIMER MODE AND TRAVERSE TIME

One weaving period is divided into ① to ④ blocks, as shown in Fig. 1.15. Triangle-wave weaving is blocks ① to ③.

The weaving speed for each block can be set individually by using traverse time. A timer can be set halfway (nodal point) between blocks by using either method; weaving stop (pause) or manipulator stop.

The data are set as shown in Fig. 1.15.

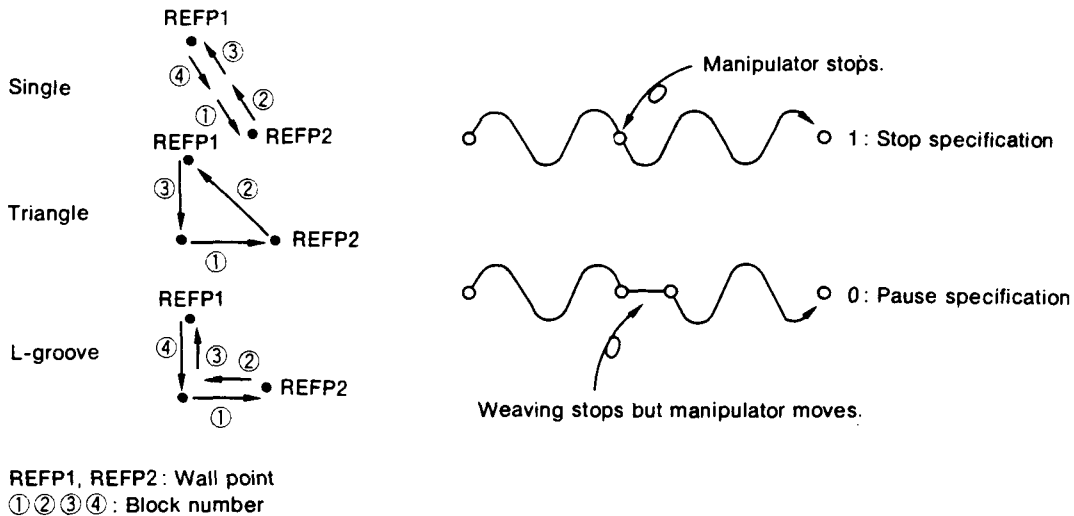
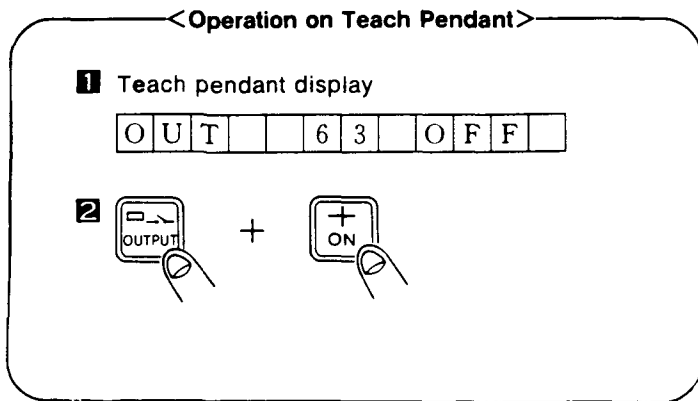


Fig. 1.15 Timer Mode and Traverse Time


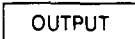
## 1.6 WIRE INCHING OPERATION

Wire inching operation is possible on teach pendant.  
Output number 63 is reserved for wire inching operation.



<Description>

Call up "OUT 63" on teach pendant display.

Depress  key with remaining  key.

Wire inching signal is output during key depression.

The condition for wire inching operation is no arc-on instruction specification in TEACH mode. This is controlled in I/O section.

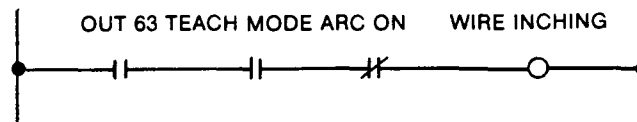




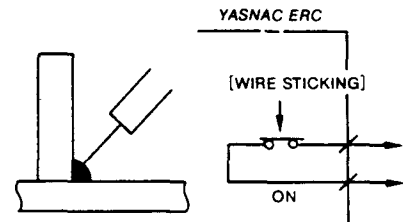
Fig. 1.16 Condition for Wire Inching Operation

## 1.7 STOP BY WIRE STICKING



Wire sticking is a status where welding wire and bead are connected under no welding. The Motoman monitors the wire sticking status when ARC OFF is executed in PLAY mode and  button is depressed in PLAY or CHECK mode.

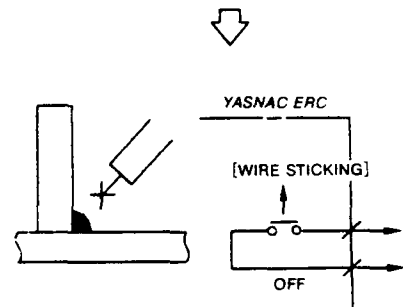
### ● Stop

When wire sticking is detected,  lamp on operator's panel is lit automatically and the manipulator stops immediately. The external output relay [wire sticking] is activated. (The contact is closed.)



### ● Restart

When the stuck wire is cut,  lamp goes off and the external output relay [wire sticking] is released. (The contact is opened.) In this status, depress  button on operator's panel.




The manipulator moves again from the position.

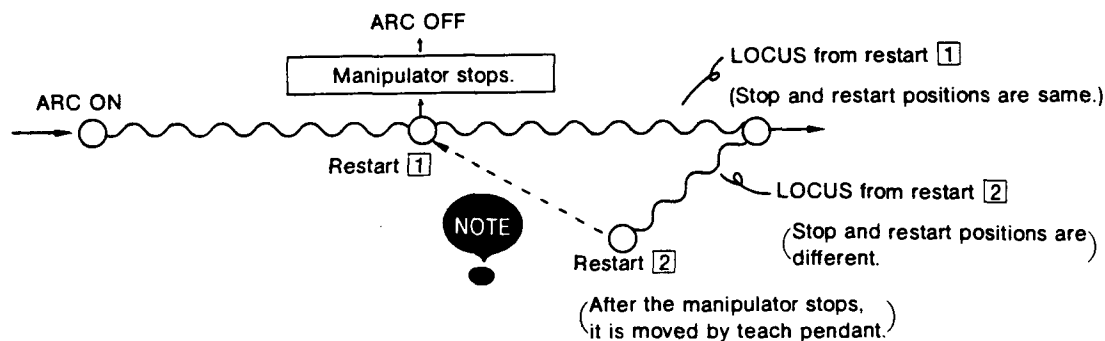
Fig. 1.17

## 1.8 STOP DURING WELDING

If the manipulator stops during welding, the ARC OFF is executed automatically.

### ● Restart

Depress  button on operator's panel. The ARC ON is executed and the manipulator moves to the displayed step. At this time, the welding conditions (current, voltage, etc.) are those of the last executed instruction VWELD/ /AWELD/ .



Be sure to restart the manipulator at stopped position because it executes ARC ON from the restarted position. If the manipulator is moved, put it back to the stopped position by using teach pendant.

Fig. 1.18 Stop and Restart during Welding

## 1.8 STOP DURING WELDING (Cont'd)

**NOTE**

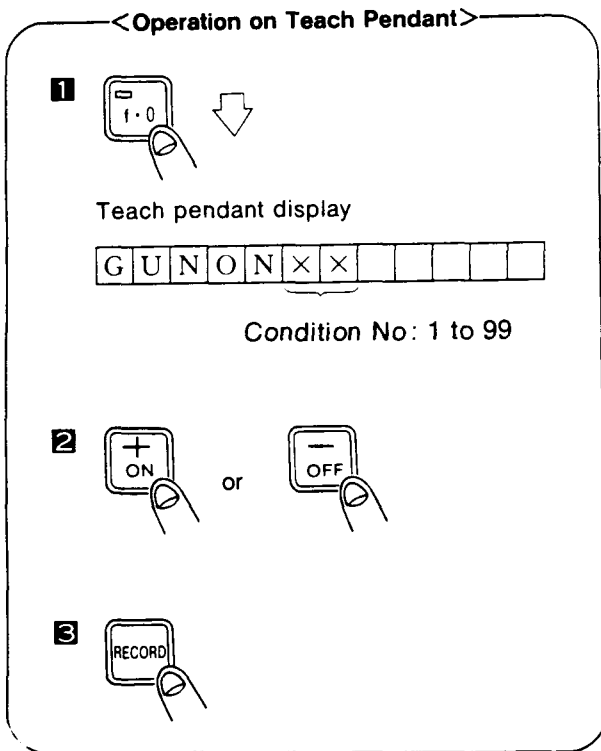
For circular operating or weaving, the manipulator is restricted as follows.

| Stop Method             | Operation                          | Restart Method                                                                                                                                          |
|-------------------------|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>HOLD</b>             | Circular interpolation and Weaving | When the stop and restart positions are the same, ARC ON is executed from the position and circular interpolation or soft weaving operation is resumed. |
| <b>Stop except HOLD</b> | Circular interpolation             | The operation is not possible.                                                                                                                          |
|                         | Soft weaving                       | ARC ON is executed without weaving operation.                                                                                                           |

## 2. SPOT WELDING

### 2.1 SPOT START INSTRUCTION

#### (1) Registration from teach pendant



#### <Description>

Depress key.

#### • Function

Without condition No: GUNON instruction registration

With condition No: CALL instruction registration

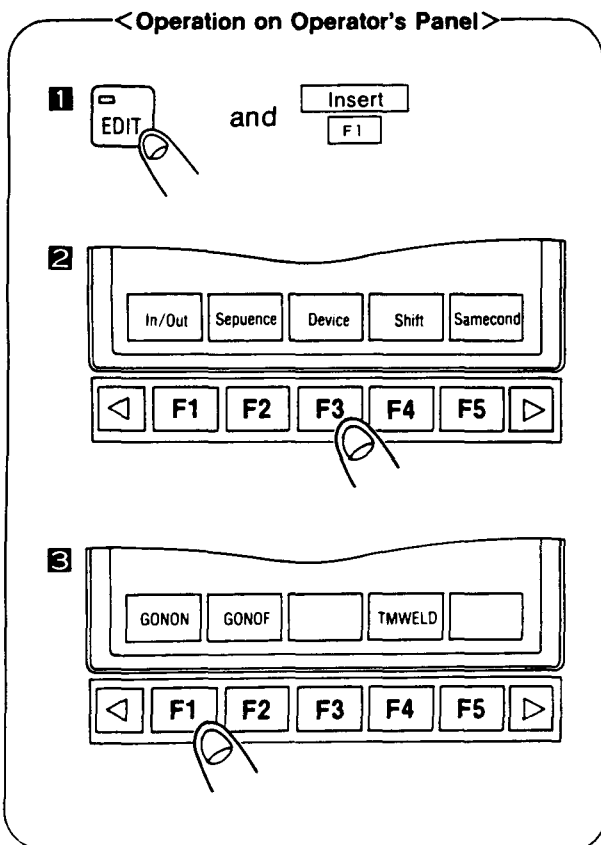
↓  
CALL JOB: GUNON   
↑  
specified condition No.

Call up the desired condition No. by using

or key.

Depress key.

#### (2) Registration from operator's panel



#### <Description>

Depress key and soft key.

Depress soft key.

Depress soft key and key.

GUNON instruction has just registered.

(3) Function

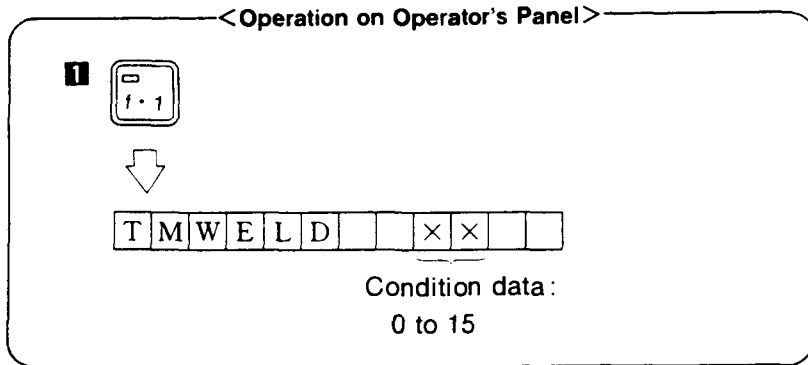
Outputs the spot gun ON instruction (welding instruction).

Turns on the work start instruction (relay # 5050), and waits for the work start response (relay # 4050), to execute the next instruction as soon as the work start response turns on.

The work start response relay is acknowledged by AND between WELDING COMPLETE signal from the spot welding machine and GUN OPEN signal. If GUN OPEN signal is not to be used, short-circuit 6TB-8 and 0V.

## 2.2 SPOT TIMER CONDITION INSTRUCTION (TMWELD XX)

(1) Registration from teach pendant



<Description>

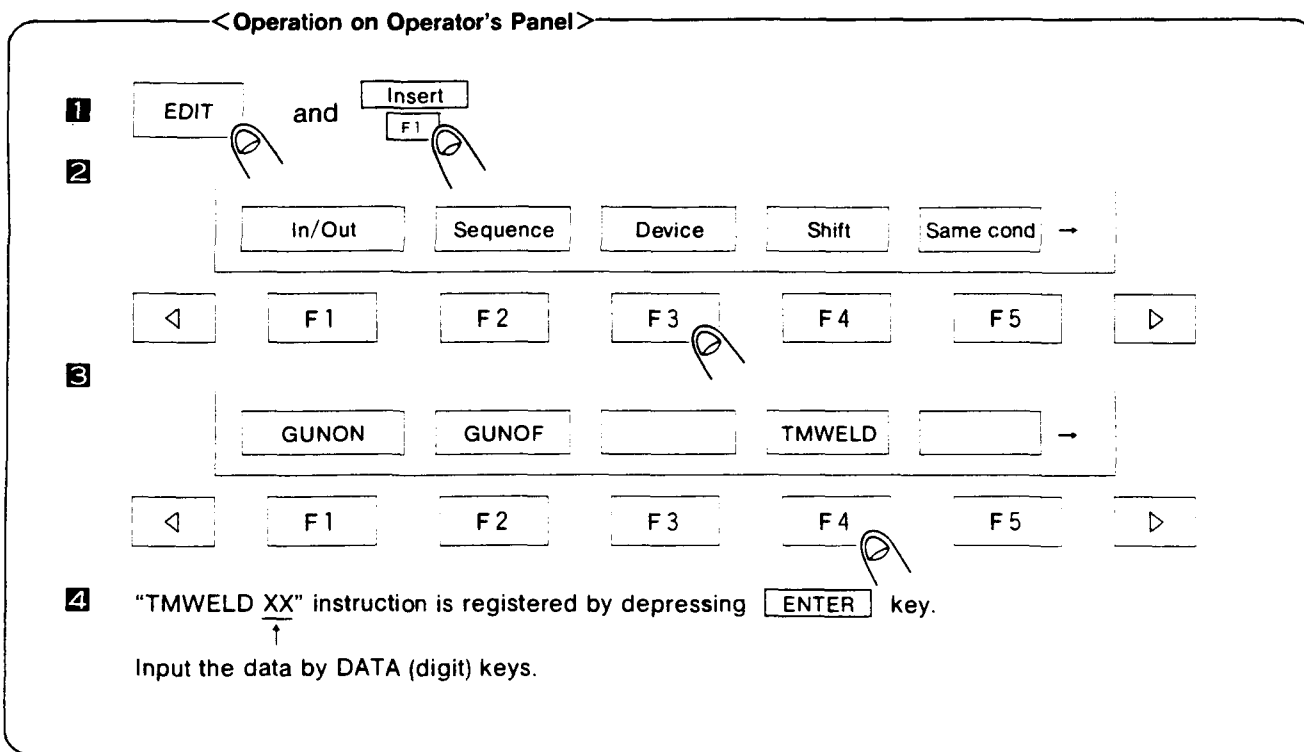
Depress f.1 key.

Set the condition data by using

+  
ON or -  
OFF key, and

depress RECORD key to register the date.

(2) Registration from Operator's Panel



(3) Function

Outputs the spot welding conditions by binary data (0 to 15) against the spot welding timer unit.

The condition output uses the 4 bits of general output OT #9 (relay # 3040) to OT #12 (relay # 3043).

(Example) When TMWELD 10 is executed,

Relay #3040 "off" 0 is output.

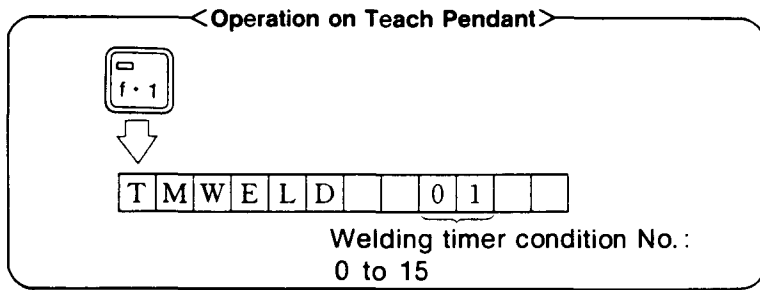
3041 "on" 1

3042 "off" 0

3043 "on" 1

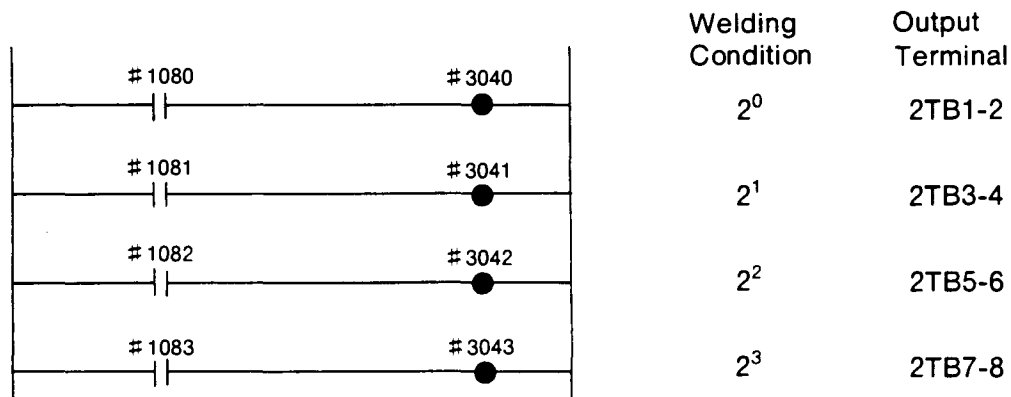
**NOTE**

When welding through the teach pendant, set the welding timer conditions first. Set the welding timer conditions as follows.



The contents of the display data are output to the output relay Nos. 3040 to 3043(4-bit data).

The logical output relay No. 1080 (out57) to 1083 (out60) are actually controlled, and assigned to the output relay Nos. 3040 (between 2TB1 and 2) to 3043 (between 2TB7 and 8), by the I/O ladder.



(Example) When TMWELD 10 is executed,

#1080 → #3040 : OFF(0)  
#1081 → #3041 : ON(1)      $2^1 + 2^3 = 10$   
#1082 → #3042 : OFF(0)  
#1083 → #3043 : ON(1)

For registering this status, depress RECORD key

at teach pendant display 

|   |   |   |   |   |   |  |  |   |   |  |  |
|---|---|---|---|---|---|--|--|---|---|--|--|
| T | M | W | E | L | D |  |  | 1 | 0 |  |  |
|---|---|---|---|---|---|--|--|---|---|--|--|



<Display on Operator's Panel>

:

MOVL VL=300.0 PL=.0 ..... Spot position

TMWELD 10

END

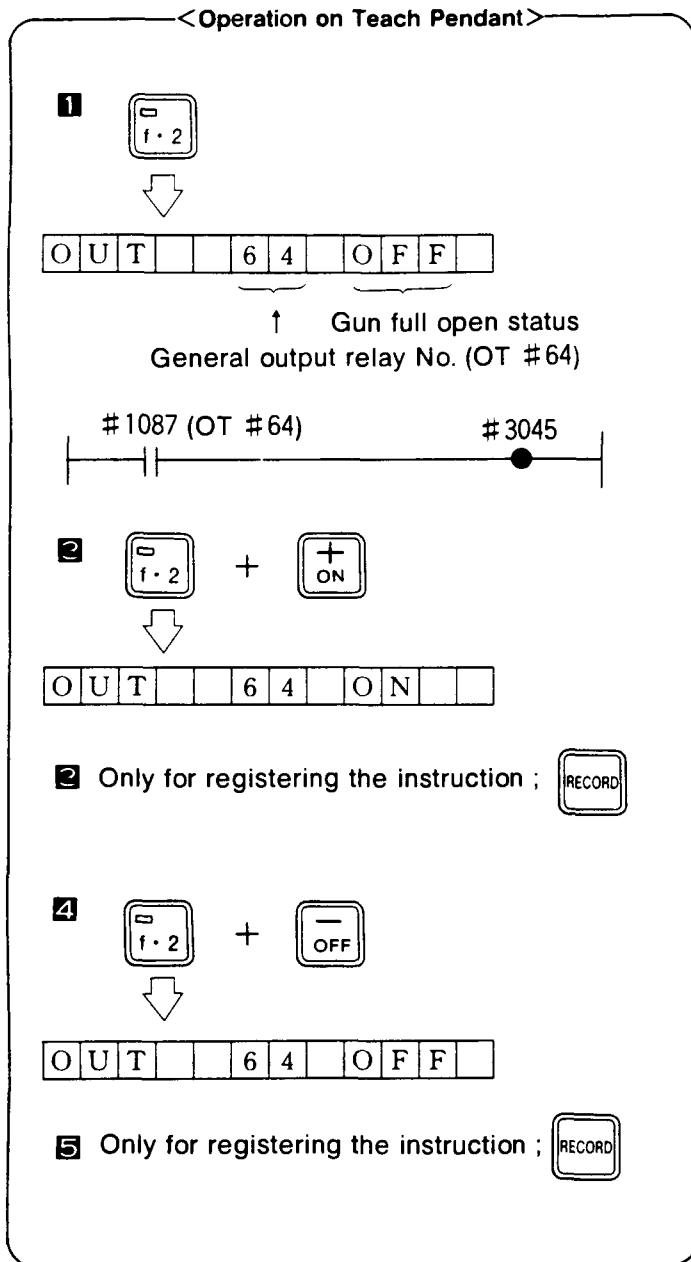


## 2.3 SPOT GUN FULL OPEN (STROKE CHANGE) INSTRUCTION

### (1) Operation from teach pendant

When the spot welding gun stroke has two steps, the gun must be fully opened to make a large move from the spot position. This gun full open instruction uses the general output relay (the relay number set in parameter SC236 ; initial value : 64) and is operated by the  key.

The gun full open instruction is controlled by the general output signal (relay contact output between 3TB 3 and 4 ; relay No. 3045).



<Description>

Depress  key.

Depress  key

remaining  key.

The spot gun is opened fully.

See **NOTE**

Depress  key.

In this case, DOUT OT # 64 1 instruction is registered.

Depress  key remaining

key.

The gun full open instruction is released.

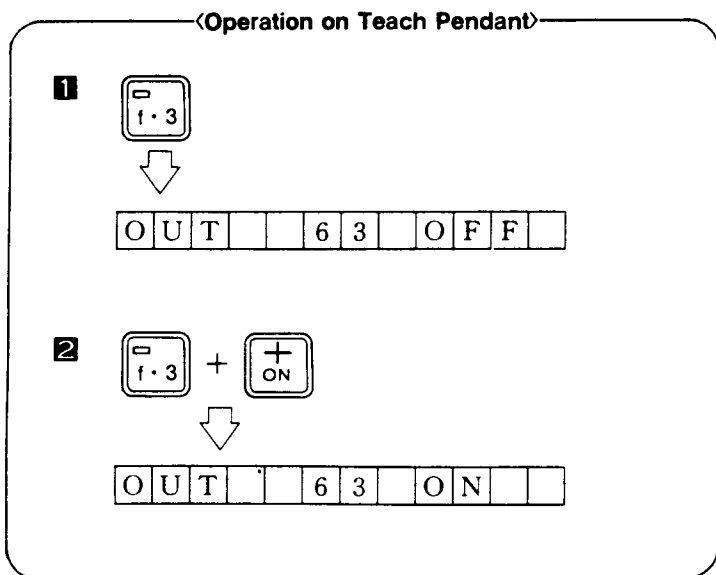
Depress  key.

In this case, DOUT OT # 64 1 instruction is registered.

**NOTE**

After outputting the GUN FULL OPEN instruction, check that the gun is fully open (gun full open LS) by the WAIT, using the general input.

## 2.4 DRY SPOTTING FROM TEACH PENDANT



<Description>

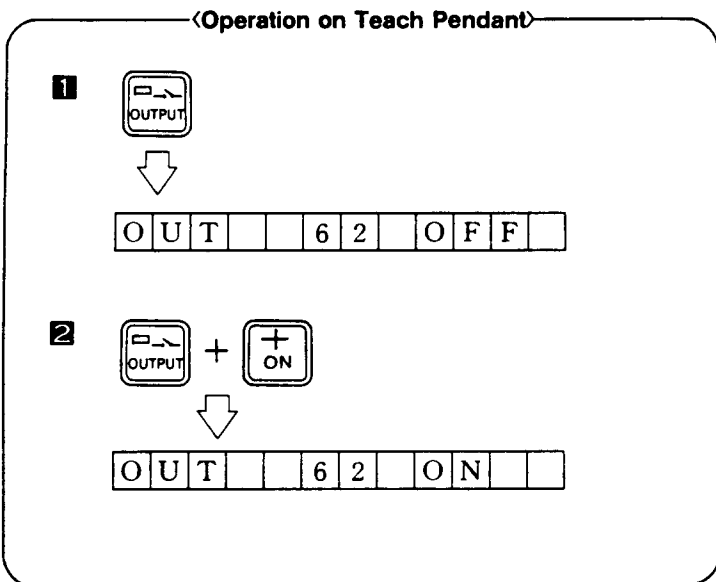
Depress f.3 key.

Dry spotting is performed during depressing f.3 and +  
ON keys.

**NOTE** When f.3 and +  
ON keys are released, the instruction is reset.

OUT    6 3    OFF

When actual welding (not dry spotting) is to be instructed through the teach pendant, perform the following operation before the above operation. This operation holds the welding input signal within the I/O ladder. Welding will actually be accomplished by the spotting operation, because the welding signal is input.



<Description>

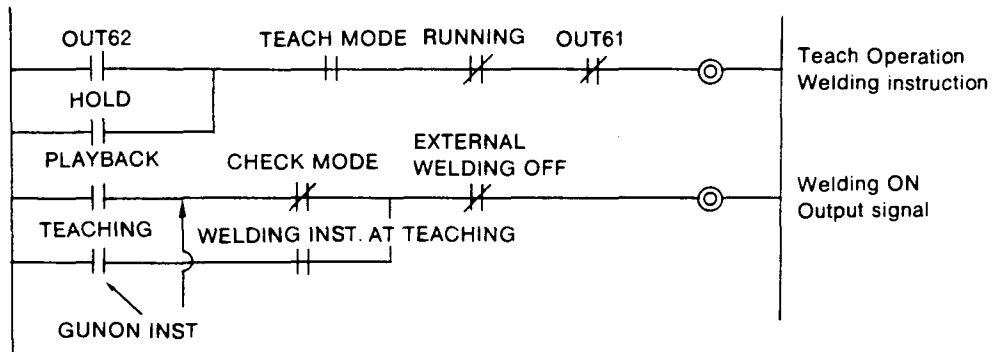
Depress OUTPUT key.

Spot welding is executed during depressing OUTPUT and +  
ON keys.

**NOTE** When these keys are released, the welding will stop. The display will change.

OUT    6 2    OFF

• Ladder for welding ON conditions



Once the welding "on" operation is performed, the welding "on" status is held. The welding "on" status can be reset by changing the mode, or by performing sequential operation under the TEACH mode.

## 2.5 LIST OF OPERATION ON TEACH PENDANT

| key | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | <ul style="list-style-type: none"> <li>Registration of GUNON or CALL <u>GUNON XX</u> instruction<br/>(Reserve job name)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                    |
|     | <ul style="list-style-type: none"> <li>TMWELD <u>XX</u> instruction registering (Set by  or  key.)<br/>(Condition data)</li> <li>Output of teach pendant display data</li> </ul>                                                                                                                                                                                                                                                                                                                                      |
|     | <ul style="list-style-type: none"> <li>Control of spot gun (GUN FULL OPEN instruction) <ul style="list-style-type: none"> <li>(1) The relay (GUN FULL OPEN) in parameter SC 236 is turned on by depressing  and  keys simultaneously.<br/> &lt;Teach Pendant Display&gt;<br/>  ⇒  DOUT OT #64 1 instruction is registered.</li> <li>(2) The relay (GUN FULL OPEN) in parameter SC 236 is turned off by depressing  and  keys simultaneously.<br/>  ⇒  DOUT OT #64 0 instruction is registered.</li> </ul> </li> </ul> |
|     | <ul style="list-style-type: none"> <li>Control of spot gun (GUNON instruction) <ul style="list-style-type: none"> <li>While  and  key are depressed the relay (GUNON inst.) which is set in parameter SC237 is turned on.<br/> </li> <li>When  and  key are released, the relay is turned off.<br/> </li> </ul> </li> </ul>                                                                                                                                                                                           |

## 2.6 SPOT WELDING DIAGNOSIS FUNCTION

The diagnosis display of each application is added in the display shown in Fig. 2.1.

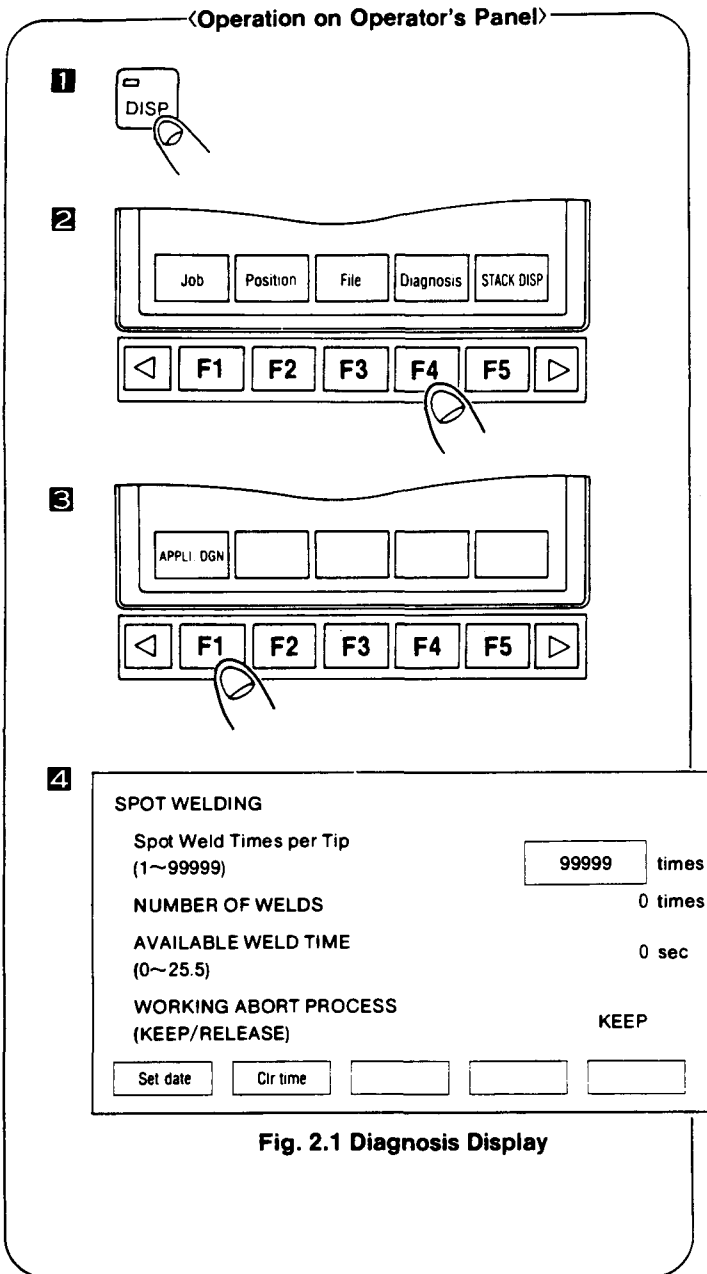


Fig. 2.1 Diagnosis Display

<Description>

Depress  key.

Depress  soft key.

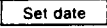
Depress  soft key.

**NOTE** If  soft key is not displayed, depress  key.

This display will appear.

The descriptions of number (1) to (3) are shown the following pages.

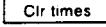
(1) Spot Weld Times per Tip and NUMBER OF WELDS

- “Spot Weld Times per Tip” is set by placing the cursor as shown in Fig. 2. 1, and depressing the  soft key.



(Initial value : 99999)

“Spot Weld Times per Tip” can be reset to “0” by depressing

the  soft key.



- “NUMBER OF WELDS” is 7 digits maximum and incremented by execution of the spot-welding start instruction (GUNON).
- “NUMBER OF WELDS” becomes “0” when the special CHIP CHANGE COMPLETE signal is input.
- “Spot Weld Time per Tip” and “NUMBER OF WELDS” are constantly compared. If it becomes “NUMBER OF WELDS”  $\geq$  “Spot Weld Time per Tip”, “CHIP CHANGE REQUEST” of special output signal (# 5090) is turned on, and set the status in the system byte type variable \$B10.
- The state of the CHIP CHANGE REQUEST signal can be determined by the system byte variable \$B10, so it can jump to the chip change job by giving the necessary instruction when the CHIP CHANGE REQUEST turns on.

(Example) Control Job

NOP

⋮

CALL JOB : CHIP CHANGE

IF \$B10 = 1

⋮

END

Chip change

NOP

MOVJ Move to the chip change position

PAUSE or waiting for input

RET Restart by CHIP CHANGE COMPLETE

END

(2) AVAILABLE WELD TIME

The time from execution of the spot start instruction (GUNON) to the end of the spot is controlled.

- The time allowed for a single spot is set in the display (Fig. 2.1), by moving the cursor to the "AVAILABLE WELD TIME" position and setting optional data.  
(0 to 25.5, Initial value : 0)
- If the spot welding time of a single spot exceeds the preset time, it is regarded as an error and enters the alarm processing cycle.

**NOTE** The weld time control is not performed if the preset time is "0".

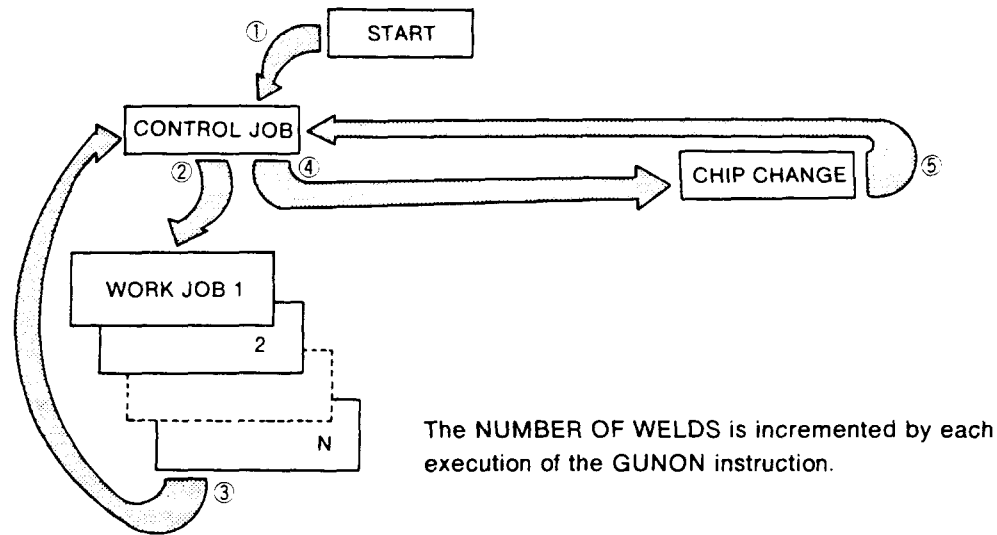
(3) WORKING ABORT PROCESS (KEEP/RELEASE)

If the welding is stopped while the GUNON instruction is output, the GUNON instruction can be specified to be that of restart. The operation is always continued in spot welding, regardless of the designation.

(4) Error check process by concurrent I/O ladder

| User Alarm No.    | Description                                                                                                                                                                                                                                                   | Action                                                                                                                                                |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Alarm 2010</b> | <b>SPOT WELDING ERROR :</b><br>This alarm occurs when WELDING ERROR signal from the spot welding machine (timer unit) turns on.                                                                                                                               | Determine why the WELDING ERROR input signal turned on, and remove the cause.                                                                         |
| <b>Alarm 2020</b> | <b>GUN ON ERROR :</b><br>When data other than "0" are set as the AVAILABLE WELD TIME in diagnosis, this alarm occurs if the welding does not end (AND between welding complete and spot complete) after the specified time from the GUNON instruction output. | Check to make sure the wire is not sticking. If the GUN OPEN signal is not to be used, short-circuit 6TB-8 and OV, to keep the signal on constantly.  |
| <b>Alarm 2030</b> | <b>WIRE STICKING :</b><br>If the WIRE STICKING signal is turned on for 2.0 or more sec. after the spot welding is completed, this alarm will occur.                                                                                                           | Reset the sticking condition. If wire sticking check is not required, find out why the WIRE STICKING input signal is turned on, and remove the cause. |

## 2.7 ROUGH CONFIGURATION OF JOB



- ① The start signal executes the control job (master job). The manipulator moves to the work zero point position, to wait for the workpiece to be set.
- ② When work-set complete signal is input, it jumps to the work job corresponding to the type of workpiece (integers of 1 to N), and performs the welding. The NUMBER OF WELDS is incremented (+ 1) upon each execution of the welding operation (GUNON).
- ③ After all the spot welding is completed, the manipulator moves to the work zero point position, outputs the WELDING COMPLETE signal, and jumps to the control job. Then it waits for the next workpiece to be set.
- ④ The "Spot Weld Times per Tip" preset in the manipulator diagnosis file and the spot count incremented upon each execution of the GUNON instruction are compared. When it becomes "preset count  $\leq$  spot welding count", it jumps to the chip change job.
- ⑤ The manipulator moves to the chip change position, stops, and waits for the chip change job to end. When the chip replacement ends, input the CHIP CHANGE COMPLETE signal as well as the restart signal. The manipulator will return to the control job, and wait for the next workpiece to be set.

### 2.7.1 Editing the Control Job

- ① Register the wait position (work zero position).
- ② Register the necessary instructions from the operator's panel.

(Example) Job name : CONTROL JOB

| <u>Instruction</u>                      | <u>Description</u>                                                                                   |
|-----------------------------------------|------------------------------------------------------------------------------------------------------|
| NOP                                     |                                                                                                      |
| MOVJ VJ=50.0.....                       | Work zero position                                                                                   |
| JUMP JOB : CHIP CHANGE IF \$B10=1 ..... | \$B10 : Chip change<br>request by system byte<br>type variable                                       |
| JUMP IG # 01 IF IN # 09=1 .....         | IG # 01 (IN # 1 to 8) :<br>Type of workpiece=<br>Job number<br>IN # 09 : Work-set<br>complete signal |
| END                                     |                                                                                                      |



## 2.7.2 Editing the Operation Job

- ① Register the wait position (work zero position).
- ② Teach the air-cut operation position by the normal teaching operation.
- ③ Teach the spot gun welding position.
- ④ Register the welding timer condition instruction.
- ⑤ Register the GUNON instruction.
- ⑥ Teach the air-cut operation position to the next spot welding position.
- ⑦ Repeat step ③ through ⑥ for as many times as the spot welding points.
- ⑧ Register the wait position (work zero point position). (Same position as step ①.)

(Example) Job name : 1.....Work job 1 (workpiece A)

| <u>Instruction</u>       | <u>Description</u>                            |
|--------------------------|-----------------------------------------------|
| NOP                      |                                               |
| MOVJ VJ=50.0 .....       | Work zero position                            |
| MOVJ VJ=50.0 NWAIT ..... | Performs air-cut operation with gun full open |
| DOUT OT#64 1             |                                               |
| MOVJ VJ=300.0 PL=0 ..... | 1st spot position                             |
| TMWELD 1 .....           | Welding timer condition data 1                |
| GUNON .....              | GUNON welding instruction                     |
| MOVJ VJ=300.0 .....      | Move to the next spot position                |
| :                        |                                               |
| MOVJ VJ=50.0 NWAIT ..... | Performs air-cut operation with gun full open |
| DOUT OT#64 1             |                                               |
| MOVJ VJ=50.0 .....       | Work zero position                            |
| PULSE OT#01 T=0.5 .....  | Work complete                                 |
| END                      |                                               |

### 3. HANDLING

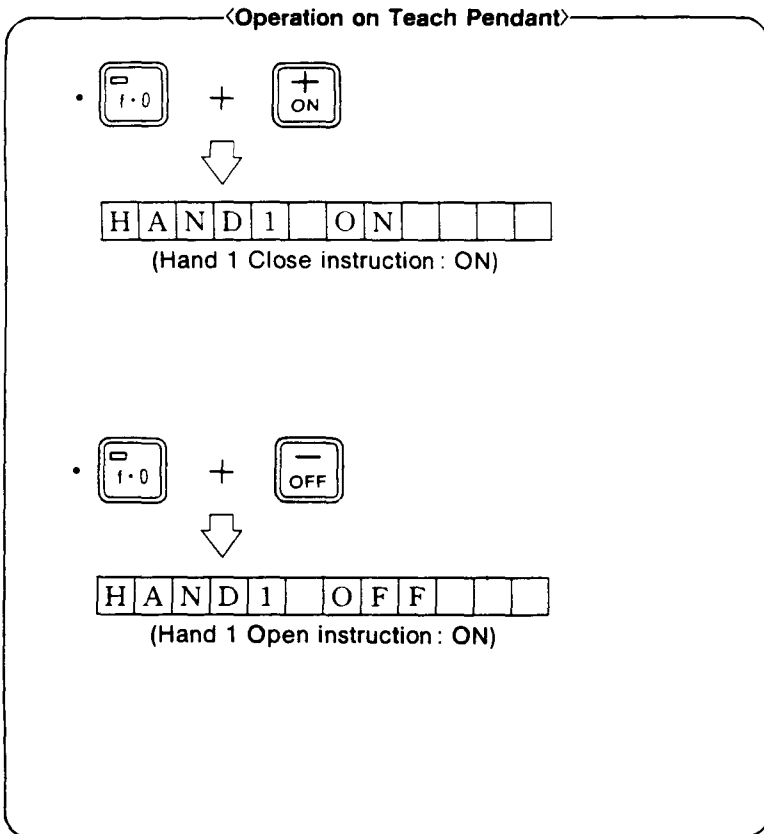
#### 3.1 HAND OPEN (OFF) / CLOSE (ON) INSTRUCTION

This instruction controls the two hands.

(1) Operation and registration for HAND1 from teach pendant

Specify Hand 1 open/close instruction by using  key.

The ON or OFF display on teach pendant shows relay status which is set in parameter SC280.



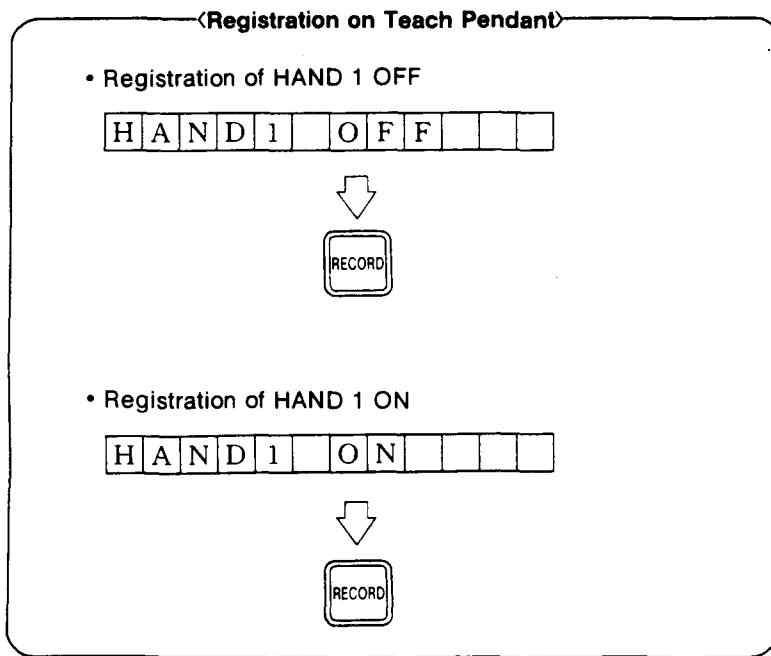
<Description>

- Depress  key with remaining  key.

Parameter SC 280 setting relay is set and parameter SC 280 setting relay No. +1 is reset.

- Depress  key with remaining  key.

Parameter SC280 setting relay No. +1 is set and parameter SC280 setting relay is reset.



<Description>

Depress **RECORD** key  
when this display is shown.

Depress **RECORD** key  
when this display is shown.



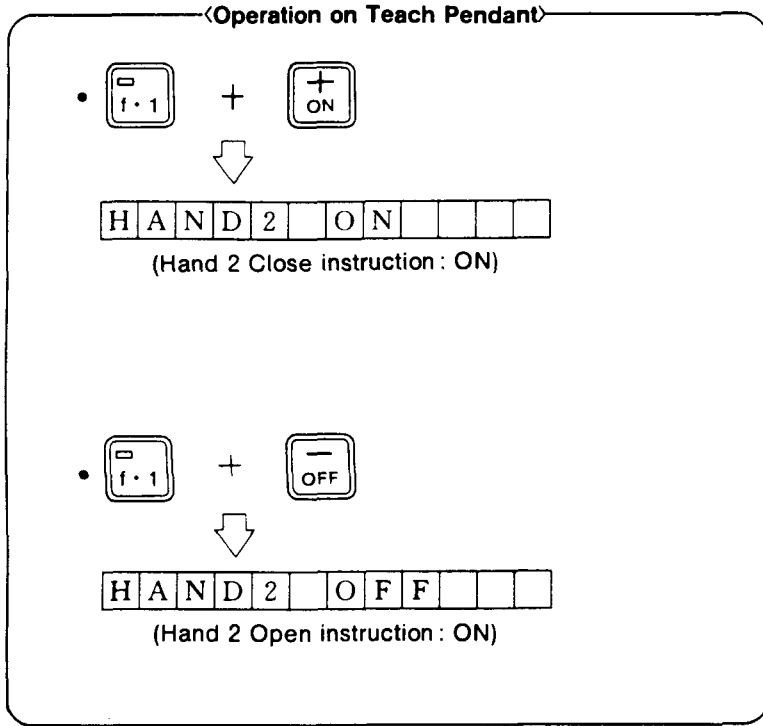
When registering the hand open/close instruction for handling, the job call instruction of the reserve job is disabled on teach pendant, because it can easily be mistaken with the open/close instruction operation.

When job call is required, register from the operator's panel.

(2) Operation and registration for HAND2 from teach pendant

Specify HAND2 open/close instruction by using  key.

The ON or OFF display on teach pendant shows relay status which is set in parameter SC 281.



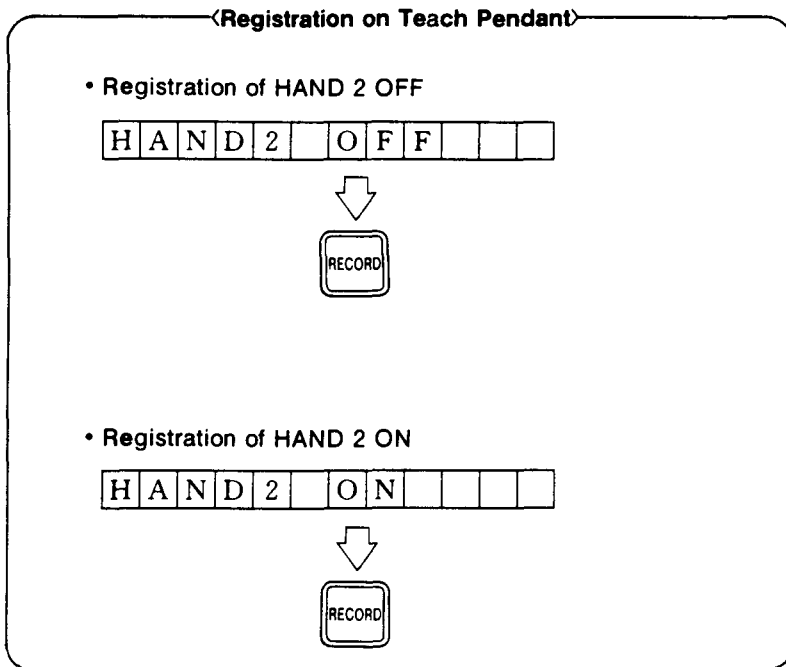
◀Description▶

- Depress  key with remaining  key.

Parameter SC281 setting relay is set and the next relay (Parameter SC281 setting relay No. +1) is reset.

- Depress  key with remaining  key.

Parameter SC281 setting relay is reset, the next relay (parameter SC281 setting relay No. +1) is set.

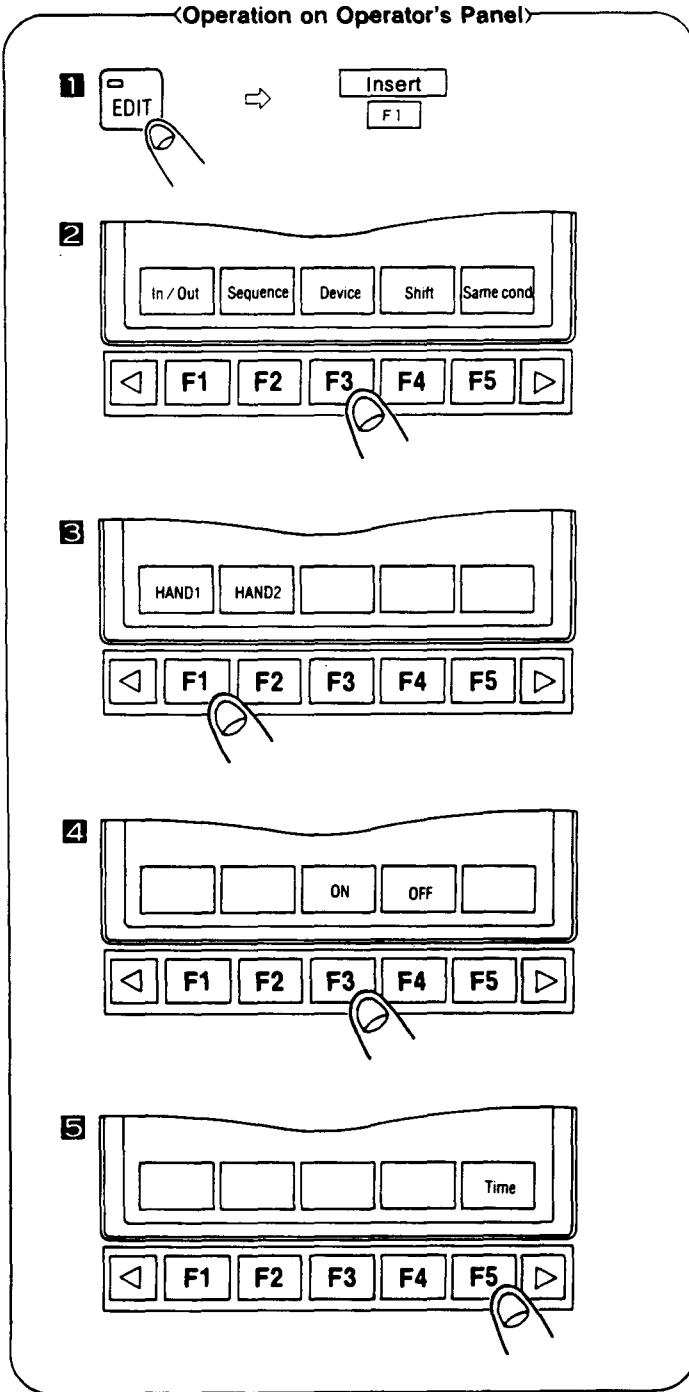


◀Description▶

Depress  key when this display is shown.

Depress  key when this display is shown.

(3) Registration from operator's panel



<Description>

Depress **EDIT** key and **F1** soft key.

Depress **Device** soft key.

Depress **HAND1** soft key.

Depress **ON** soft key.

If necessary, depress **Time** soft key and input the desired time, and then depress **ENTER** key. HAND1 ON (T = 1.0) instruction is registered. e. g.

(4) Function

〈when HAND ON T=1.0 is executed〉

Sets the parameter SC280 setting relay, and resets the next relay.

The input of the parameter SC282 setting relay is checked after 1.0 second on the timer. HAND1 ON instruction is regarded to be completed when it becomes on, and execute the next instruction.

User alarm 2030 "HAND1 CATCH CHECK ERROR" occurs if HAND1 CATCH CHECK signal is not input for more than 3.0 seconds after outputting the HAND1 ON instruction. If the check signal is not used, short-circuit "HAND1 CATCH CHECK" 6TB-5 and 0 V.

〈When HAND1 OFF is executed〉

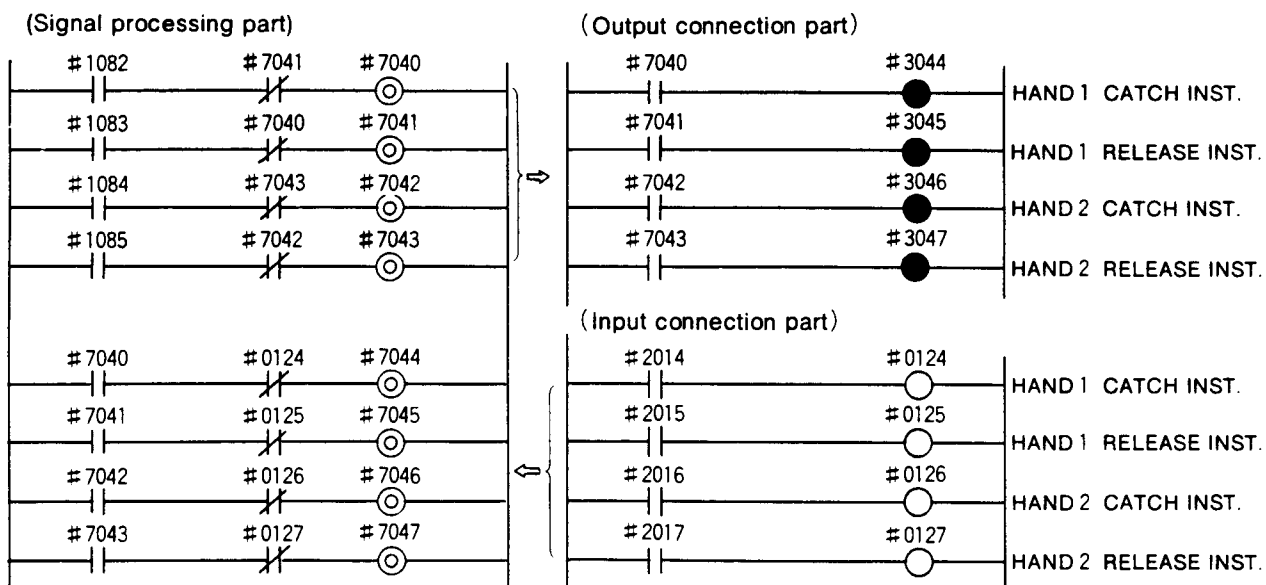
Resets parameter SC 280 setting relay, and sets the next relay.

Checks the next relay with the parameter SC 280 setting relay. And when it becomes on, HAND1 OFF instruction is regarded to be complete to execute the next instruction.

User alarm 2050 "HAND1 RELEASE CHECK ERROR" occurs if HAND1 RELEASE CHECK signal is not input for more than 3.0 seconds after outputting the HAND1 OFF instruction. If the check signal is not used, short-circuit "HAND1 RELEASE CHECK" 6TB-6 and 0 V.

〈Initial value of parameters and I/O signal allocation〉

| Parameters No. | Function               | Initial Value | Remarks                                                              |
|----------------|------------------------|---------------|----------------------------------------------------------------------|
| SC280          | HAND1 inst. work relay | 59            | HAND1 Catch inst # 1082 (out59)<br>HAND1 Release inst # 1083 (out60) |
| SC281          | HAND2 inst. work relay | 61            | HAND2 Catch inst # 1084 (out61)<br>HAND2 Release inst # 1085 (out62) |
| SC282          | HAND1 work check relay | 93            | HAND1 Catch check # 0124 (in93)<br>HAND1 Release check # 0125 (in94) |
| SC283          | HAND2 work check relay | 95            | HAND2 Catch check # 0126 (in95)<br>HAND2 Release check # 0127 (in96) |



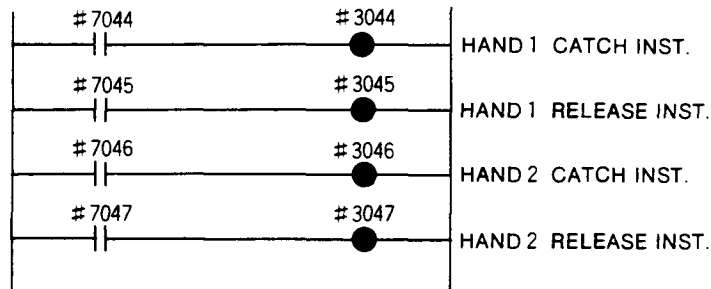
NOTE

1. In the handling application concurrent I/O ladder, catch error and release error processing are performed according to the initial values of parameters SC280 to SC283.


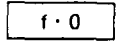

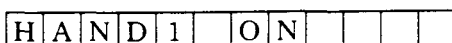
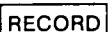
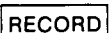
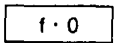

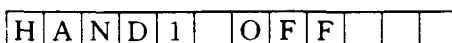


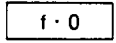

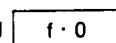


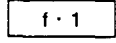

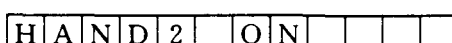
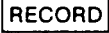
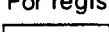
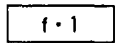

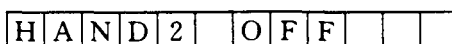

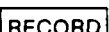
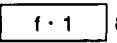

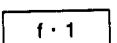



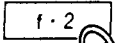
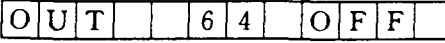
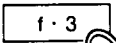
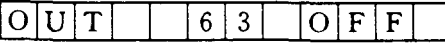
Therefore, the error processing will no longer be able to be performed if the setting values of parameters SC 280 to SC 283 are changed to other relay numbers. Changes in the I/O connection must also be made according to the setting values.

2. The I/O allocation of the handling application is output to # 3044 (3TB1-2) through # 3047 (3TB7-8), so that the two hands can be controlled by the 2-position valve. When control is to be performed by a single valve, use # 3045 (3TB3-4) and # 3047 (3TB7-8).
3. If the instruction must be turned off by the operation confirm input when using the 2-position valve, change # 7040 through # 7043 to # 7044 through # 7047.

(Output connection part)



(5) List of operation on teach pendant

| key                                                                                                                                                                        | Operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                           | <p>• Control and registration of HAND 1</p> <p>①  +  .....<br/>           ↓<br/>           &lt;Teach Pendant Display&gt;<br/>  HAND 1<br/>           CATCH INST.</p> <p>↓<br/>  ..... For registering it, depress<br/>  key.</p> <p>②  +  .....<br/>           ↓<br/>  HAND 1<br/>           RELEASE INST.</p> <p>↓<br/>  ..... For registering it, depress<br/>  key.</p>                     | <p>The parameter SC280 setting relay is set and the next relay is reset by depressing  and  keys.</p> <p>The parameter SC280 setting relay is reset and the next relay is set by depressing  and  keys.</p>         |
|                                                                                          | <p>• Control and registration of HAND 2</p> <p>①  +  .....<br/>           ↓<br/>           &lt;Teach Pendant Display&gt;<br/>  HAND 2<br/>           CATCH INST.</p> <p>↓<br/>  ..... For registering it, depress<br/>  key.</p> <p>②  +  .....<br/>           ↓<br/>  HAND 2<br/>           RELEASE INST.</p> <p>↓<br/>  ..... For registering it, depress<br/>  key.</p> | <p>The parameter SC281 setting relay is set and the next relay is reset by depressing  and  keys.</p> <p>The parameter SC281 setting relay is reset and the next relay is set by depressing  and  keys.</p> |
| <br> | <p>General relay  ⇒  Parameter SC236</p> <p>Control  ⇒  Parameter SC237</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |



### 3.2 PALLETIZING FUNCTION

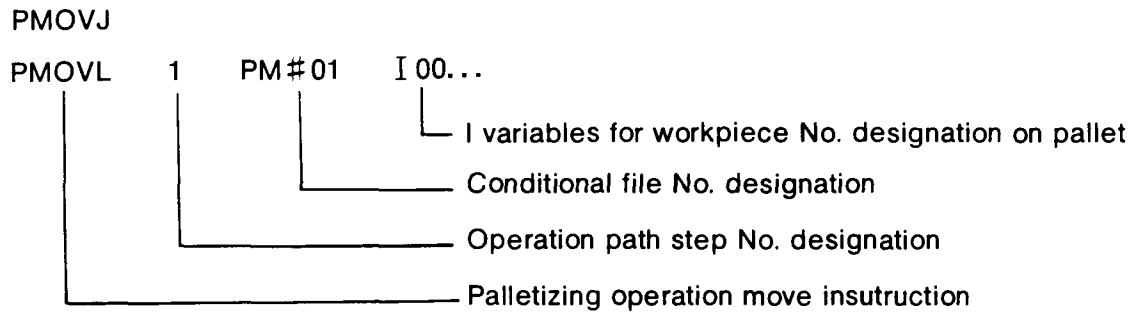
This function reduces teaching procedures of palletizing operation or simplifies operation jobs for workpieces whose loads are easily broken (such as bags) or those which cannot be set at loading position by the parallel shift function.

This function operates the loading path for each workpiece created automatically by teaching workpiece loading path (having more than one position data items) for the first stage (odd-number stage) and second stage (even-number stage) on the pallet, and by creating position data for workpieces automatically at the third stage and after, then specifying the workpiece number at the playback.

Since this function has position data of operation paths for all workpieces, position can be corrected minutely for each workpiece.

#### (1) Instructions

Instructions for palletizing



This move instruction has more than one position data item selecting a target position (target position file) according to workpiece No. and operation path step No. specified by palletizing operation conditional file and I variable for workpiece No. on pallet designation.

The workpiece numbers on the pallet are serial numbers provided for all assembly workpieces from the first step. The path step numbers are serial numbers of operation path positions when one workpiece is loaded.

※ For a system with external axes, the external axis position data are fixed. (External axis position data at palletizing are fixed.)

As shown in Fig. 3.1, palletizing operation sequence is set in the job. Then by changing the contents of I variable, position data are selected for operation.

```

PMOVJ 1 PM$01 I 00..
PMOVL 2 PM$01 I 00..
PMOVL 3 PM$01 I 00..
HAND1 OFF
TIMER 1.00
PMOVL 1 PM$91 I 00..

```

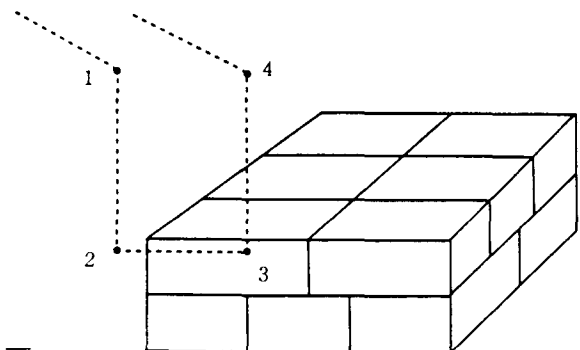
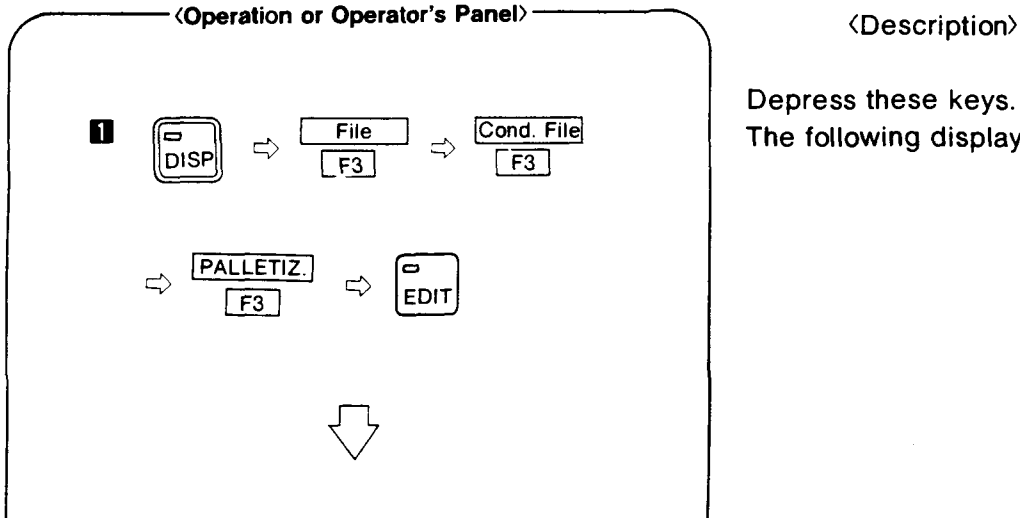


Fig. 3.1 Typical Job Settings

(2) Operation

The following operation can be used for handling or general-purpose applications.

(a) Setting of palletizing operation conditional file



Depress these keys.  
The following display will appear.

|                                          |                  |                    |            |         |
|------------------------------------------|------------------|--------------------|------------|---------|
| TEACH MODE                               | ACTV-JOB: *****  | L: *****           | S: ***     | ON STOP |
| 1990/04/17 12:00                         | EDIT-JOB: SAMPLE | L: 0000            | S: 000     |         |
| Palletizing COND.                        |                  |                    |            |         |
| Palletizing condition file (FILE No.: 1) |                  |                    |            |         |
| (1) Total number of work                 | : 30             | Step number        | : 4        | (2)     |
| Make Palletizing                         |                  |                    |            |         |
| Pattern                                  | : DONE           | Select coord       | : BASE-FR  | (4)     |
| (3) Odd Program                          | : DONE           | Even Program       | : DONE     |         |
| Work num.                                | : 6              | Work num.          | : 5        |         |
| (5) Shift Value X (mm)                   | : 0.000          | Shift Value X (mm) | : 0.000    |         |
| Y                                        | : 0.000          | Y                  | : 0.000    |         |
| Z                                        | : 1000.000       | Z                  | : 500.000  |         |
| Select edit item                         |                  |                    |            |         |
| Page ↓                                   | Page ↑           | Data chg           | SEL. coord | Exit    |

Set the palletizing conditions.  
The descriptions of number (1) to (5) are shown on the following page.

**Fig. 3.2**  
**Palletizing Operation Conditional File Display**

- (1) Total number of work  
Total number of workpiece loading on pallet  
(number of all workpieces)

(2) Step number

Number of position data items required for operation path teaching when one work-piece is loaded. Up to 9 steps.

(3) Odd-number stages, even-number stages

Program: [DONE] when all workpiece operation path teaching for loading quantity in each odd-number stage (first stage) or even-number (second stage) is completed.

Work number: Loading workpiece number (up to 255) in each stage is set.

(4) Select coordinate

The coordinate set with shift value is specified.

- Robot coordinate system
- Base coordinate system
- User coordinate system (8 types)

(5) Shift value

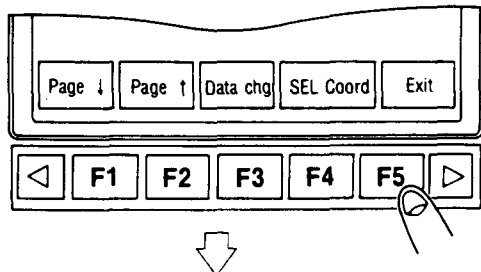
Difference in height (X, Y, Z) between odd-number to odd-number stages and even-number to even-number stages is set with the data of a specified coordinate system.

Each workpiece operation path (position data) at the third stage and after is created by adding this difference to the instructed operation path at the first and second operation paths.

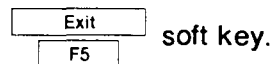
**NOTE**

1. Total number of steps (total number of work and step number) is up to 100.
2. The above data setting is performed by numerical value setting except for coordinate setting. Coordinate setting is performed by soft keys. Setting procedures are the same as the standard setting.

**2**



After setting data, depress



The setting data are checked and if any fault has occurred, an error will be displayed.

Position    Disp chg    PROG. MODE    Ers data    MAKE POS.

When the data are set normally, these soft keys are displayed.

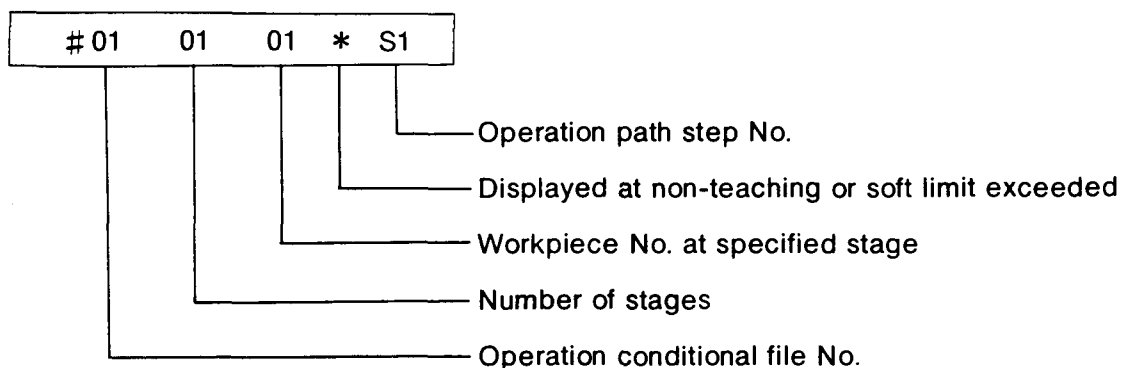
### Description of each soft key

- Position** : Displays current value at specified coordinate system.
- Disp chg** : Displays the palletizing operation conditional display (Fig. 3.2).
- PROG. MODE** : Specifies the palletizing operation conditional teaching mode.
- Era data** : Initializes condition No. file which is displayed currently.
- MAKE DOS** : Creates operation path data for as many workpieces as set in conditional file.

### (b) Teaching of workpieces at first and second stages

After setting required items of the palletizing operation conditional file, depress **PROG. MODE** key. Then the teach pendant display becomes as shown below and the teach mode of odd-number stage/even-number stage is entered.

#### Teach pendant display



- First, position file area of setting quantity (total number of work and step number) is secured. If it cannot be secured, an error occurs.
- When this mode is specified, it becomes possible to teach the first and second stages.

**NOTE** Once the teach mode is entered, no data other than [shift value, select coordinate] can be changed.

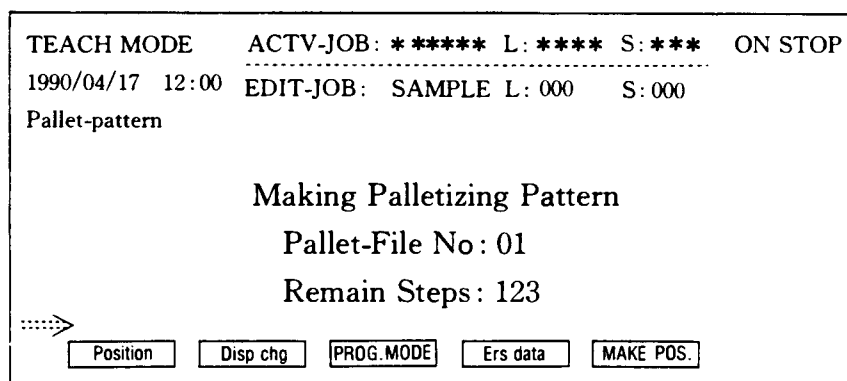
- In the teach mode, it is possible to set only position data of operation path for each workpiece. Setting such as speed, interpolation, etc. cannot be performed.

- Position data teaching can be performed only in **MODIFY** mode. **INSERT** or **DELETE** is not possible.
- Each data No. can be changed by using **+** and **-** keys. When position creation is [not yet], the number of stages is up to 2.
- **[\*]** is displayed for steps in which position data are not instructed or for steps of soft limit. When the instructed position and current position are different, the step No. is displayed, blinking.
- At each teaching completion of the first and second steps, each of odd-number stage and even-number stage on the CRT display changes its teach mode to **[DONE]**.

(c) Operation path data automatic creation for workpieces at third stage and after

Where each teach mode of conditional file odd-number stage and even-number stage is **[DONE]**, depress **MAKE POS** key. The CRT display changes to position data creating display and operation path data for as many workpieces as set in the conditional file at the third stage and after are created.

- Position creation is not performed unless the conditional file odd-number and even-number stage teaching is completed.
- When the display is changed to the position creating display (Fig. 3.3) and position data creation is completed normally, the former conditional file display (Fig. 3.2) is returned and position data creation in the display is changed to **[DONE]** display.
- If any alarm occurs during position data creation, position data creation is interrupted immediately at the alarm occurrence and the CRT display is changed to the alarm display.
- When any of the created position data items exceeds the soft limit, an error occurs and the position data creation continues.



**Fig. 3.3 Palletizing Operation Conditional Position Creation Display**

(d) Position correcting method

In addition to move instructions, next/back operation for palletizing operation instructions (PMOVJ, PMOVL) can be performed by the teach pendant. However, position data cannot be changed in modes other than the teach mode.

For correction of position data, select the number of stages, workpiece No. and step No. by the teach pendant operation and depress **MODIFY** and **RECORD** key after depressing **PROG. MODE** key to enter the position data teaching mode.

**F3**

When the position data display has **[DONE]** in the conditional file, operation path for all workpieces can be corrected.

(e) Conditional file data change

- Change of quantity

Once the teach mode is entered and the position file area is secured, no more change for [total number of work, step number and odd-number stages, even-number stages] can be made.

- Change of shift value

It is necessary to perform position data creation process again if shift value is to be changed after completion of position data creation. Only changing conditional data file is not effective.

(3) Load/Save to Floppy Disk

(a) Palletizing operation conditional file

- Load

By loading a palletizing operation conditional file, all palletizing position data items are loaded at same time.

Since the data are over-written without conditions, do not fail to save palletizing operation conditional files of which position data creation has been already completed.

- Save

By saving a palletizing operation conditional file, all palletizing position data items are saved at the same time.

Only conditional data are saved for files of which position data creation is [NOT YET], while conditional file and position data are saved for those for which position data creation is completed.

(b) Job

- Load/save

Palletizing operation conditional files cannot be saved even if a job in which palletizing move instructions (PMOVJ, PMOVL) are registered is saved by an independent job (JBI).

Only when it is saved by a related job (JBR), palletizing operation conditional file can be saved as conditional file data.

(4) Error/Alarm

In the palletizing function, the following errors or alarms may occur.

• Error

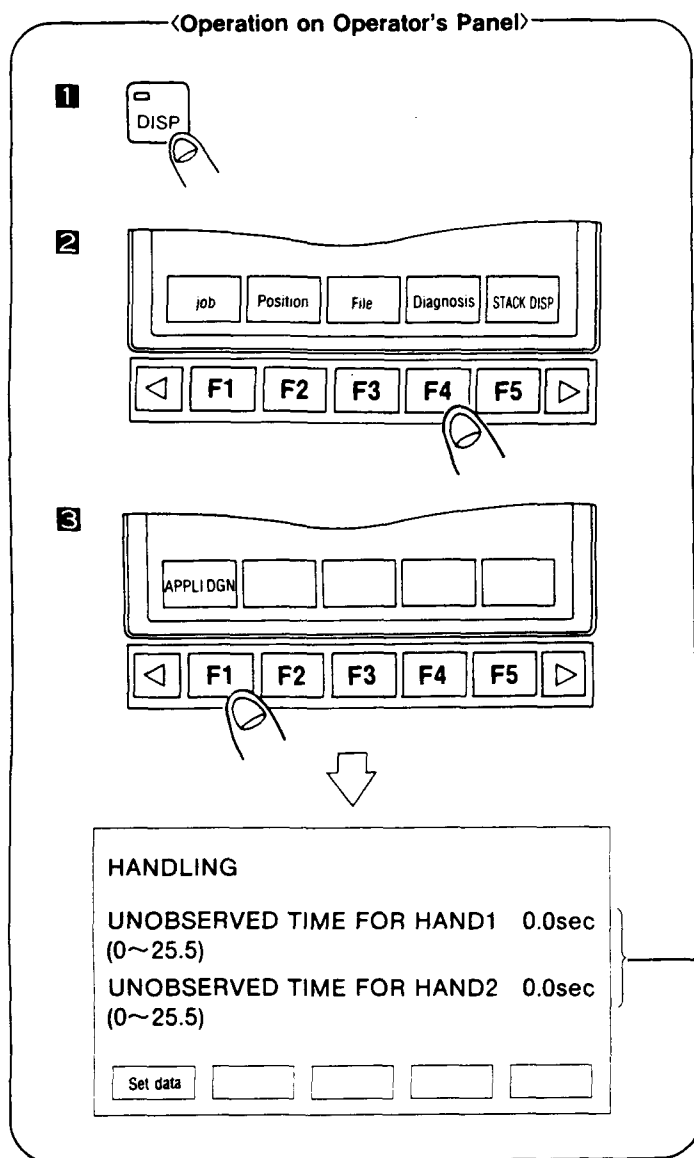
| Code | Error Contents         | Corrective Action                                        |
|------|------------------------|----------------------------------------------------------|
| 1110 | Data setting disabled. | Change the set value so as to secure position file area. |

• Alarm

| Code | Alarm Contents                                    | Corrective Action                                                              |
|------|---------------------------------------------------|--------------------------------------------------------------------------------|
| 3560 | Palletizing operation conditional file fault      | Register a palletizing operation conditional file again from floppy disk, etc. |
| 3570 | Palletizing operation instruction execution fault | Arrange instruction execution conditions.                                      |

### 3.3 HANDLING DIAGNOSIS FUNCTION

#### (1) Catch confirm timer function



<Description>

Depress  key.

Depress  soft key  
  
 and  key.

Depress  soft key.

The following display will appear.

If the hand needs to be more tightened,  
 set the required time.

(The initial value is "0.")

- If the time is set at 0 ;  
 the catch check input is checked im-  
 mediately after outputting the catch  
 instruction.
- If the time is set at other than 0 ;  
 the catch check input is checked  
 after a preset time after outputting the  
 catch instruction.

**NOTE**

If the time is designated by the hand close instruction (HAND1 ON T=1.00), the check in-  
 put is checked after the time registered in the instruction.



(2) Error check process by concurrent I/O ladder

| User Alarm No. | Description                                                                                                                                                         | Action                                                                                                                                               |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Alarm 2010     | <p><b>HAND1 CATCH ERROR :</b><br/>Occurs if the once output catch check is canceled after HAND1 CATCH instruction is output.<br/>The workpiece may have fallen.</p> | <p>Check again the catching force of the workpiece.<br/>Readjust the HAND1 CATCH CHECK instruction.</p>                                              |
| Alarm 2020     | <p><b>HAND2 CATCH ERROR :</b><br/>Occurs if the once output catch check is canceled after HAND2 CATCH instruction is output.<br/>The workpiece may have fallen.</p> | <p>Check again the catching force of the workpiece.<br/>Readjust the HAND2 CATCH CHECK instruction.</p>                                              |
| Alarm 2030     | <p><b>HAND1 CATCH CHECK ERROR :</b><br/>Occurs if the catch check signal is not input 3 seconds after HAND1 CATCH instruction is output.</p>                        | <p>Readjust the HAND1 catch check.<br/>If the catch check signal is not to be used, short-circuit input terminals 6TB-5 and 0 V.</p>                 |
| Alarm 2040     | <p><b>HAND2 CATCH CHECK ERROR :</b><br/>Occurs if the catch check signal is not input 3 seconds after HAND2 CATCH instruction is output.</p>                        | <p>Readjust the HAND2 CATCH CHECK instruction.<br/>If the catch check signal is not to be used, short-circuit input terminals 6TB-7 and 0 V.</p>     |
| Alarm 2050     | <p><b>HAND1 RELEASE CHECK ERROR :</b><br/>Occurs if the release check signal is not input 3 seconds after the HAND1 RELEASE instruction is output.</p>              | <p>Readjust the HAND1 RELEASE CHECK instruction.<br/>If the release check signal is not to be used, short-circuit input terminals 6TB-6 and 0 V.</p> |
| Alarm 2060     | <p><b>HAND2 RELEASE CHECK ERROR :</b><br/>Occurs if the release check signal is not input 3 seconds after the HAND2 RELEASE instruction is output.</p>              | <p>Readjust the HAND2 RELEASE CHECK instruction.<br/>If the release check signal is not to be used, short-circuit input terminals 6TB-8 and 0 V.</p> |

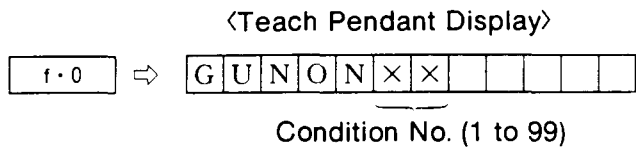
## 4. SEALING AND COATING

The sealing operation is described as an example.

### 4.1 REGISTRATION AND FUNCTION FOR SEALING STRAT INSTRUCTION

#### (1) Registration from teach pendant

Specify sealing start instruction by depressing  key.

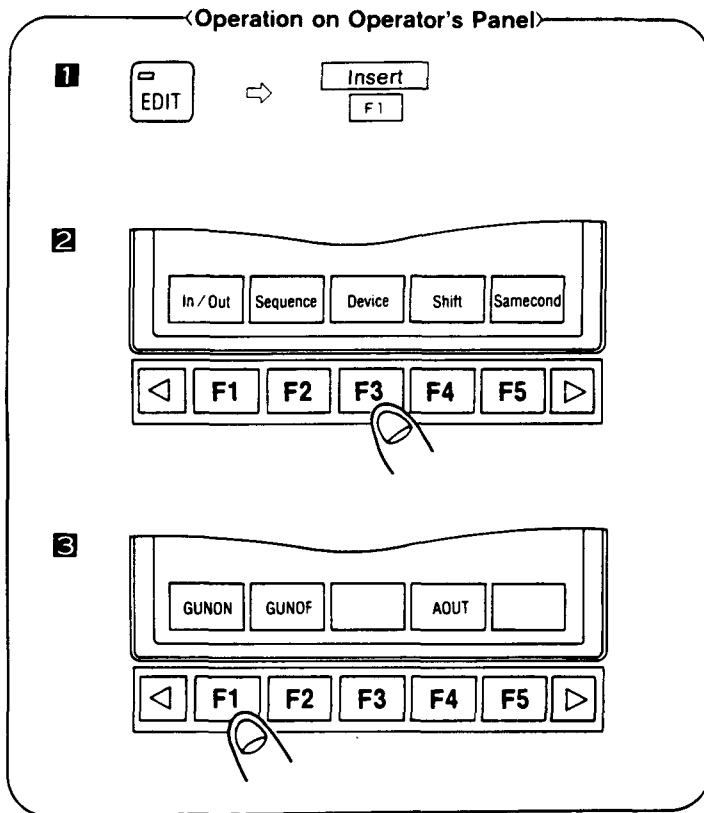


Without condition No.: GUNON instruction registration

With condition No.: CALL instruction registration

(CALL GUNON XX)  
Job name

#### (2) Registration from operator's panel



Depress  key and

soft key.

Depress  soft key.

Depress  soft key and

key.

GUNON instruction is registered.

(3) Sealing start instruction (GUNON) function

Turns on the sealing nozzle GUNON instruction (output relay # 3047).

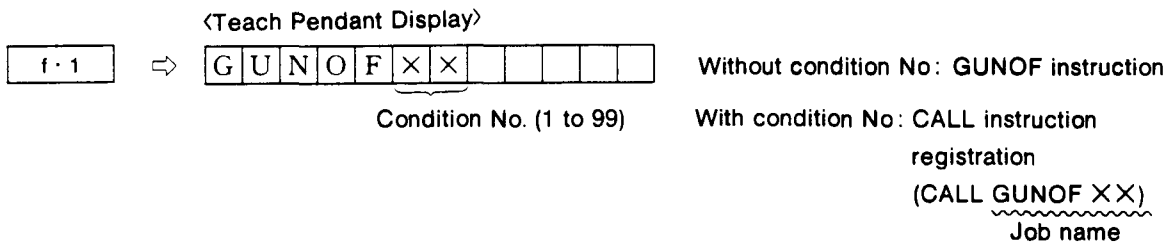
Turns on the WORK START instruction (special output relay # 5050), waits for the WORK START RESPONSE (special input relay # 4050), and executes the next instruction when the work start response turns on.

The work start response relay is checked when the GUNON RESPONSE input signal turns on. If the GUNON RESPONSE signal is not to be used, short-circuit 6TB-8 and 0V to keep the GUNON RESPONSE on constantly.

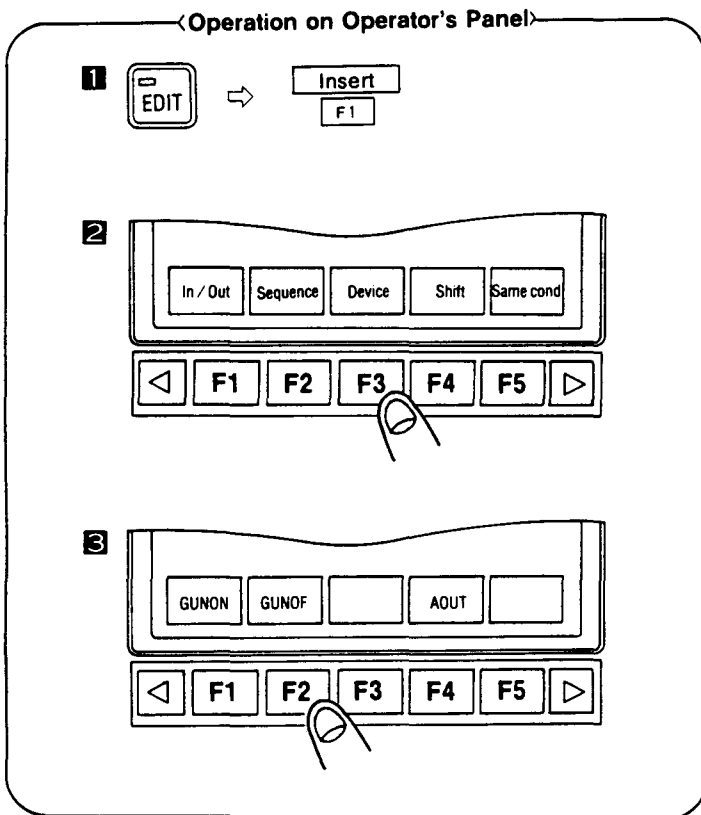
## 4.2 REGISTRATION AND FUNCTION FOR SEALING END INSTRUCTION

(1) Registration from teach pendant

Specify sealing end instruction by depressing f.1 key.



(2) Registration from operator's panel



Depress EDIT key and Insert soft key.  
F1

Depress Device soft key.  
F3

Depress GUNOF soft key and ENTER key.  
F2

GUNOF instruction is registered.

(3) Sealing OFF instruction (GUNOF) function

Turns off the sealing nozzle GUNON instruction (output relay # 3047).

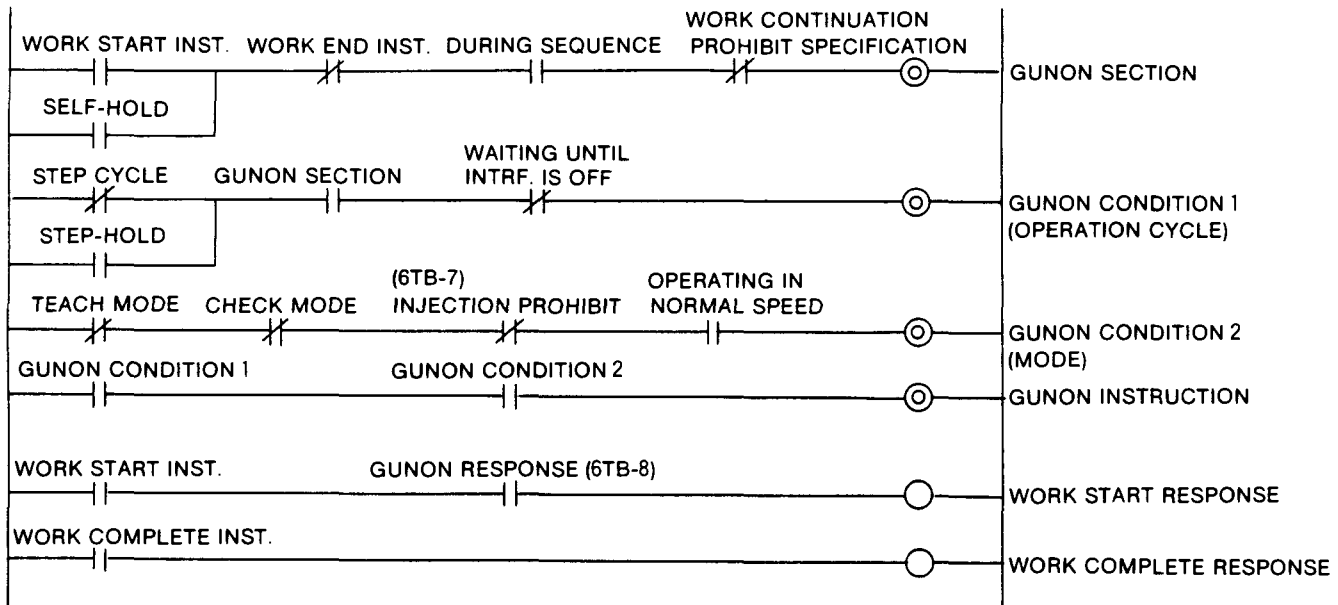
Turns on the WORK COMPLETE instruction (special output relay # 5051), waits for the WORK COMPLETE RESPONSE (special input relay # 4051) and executes the next instruction when the WORK START RESPONSE turns on.

The WORK COMPLETE RESPONSE relay turns on immediately after WORK COMPLETE instruction is output.

The GUNON instruction is controlled so that it self-holds when the WORK START instruction turns on, and turns off when the WORK COMPLETE instruction turns on.

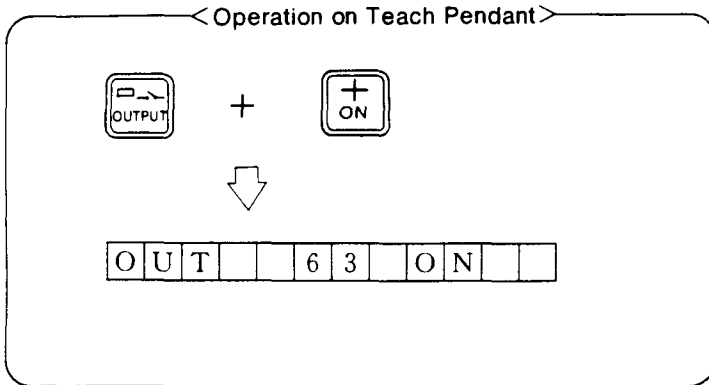
If the work is stopped before completion, the GUNON instruction also turns off. If the operation is restarted later, the GUNON instruction turns on from that position, to allow the work to be continued. However, the work cannot be continued if the "WORK ABORT PROCESS" specification in the diagnosis display is set to disconnect the work (the initial setting is "KEEP").

The work also can not be continued if job editing, job call, cursor operation, or back operation is performed after work is stopped.







(4) Apply inching operation from the teach pendant

Operate as follows to check the applying amount from the teach pendant. OUT 63 is reserved for the apply inching instruction.



<Description>

Injection (GUNON) instruction turns on when  and  keys are depressed.

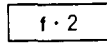
**NOTE** When  and  keys are released, the instruction turns off.

### 4.3 SETTING AND REGISTERING APPLYING CONDITIONS

When the applying conditions are to be controlled by the analog output ( $\pm 14V$ ), check that the EW02 PC board is mounted, and perform the following operation.

(1) Setting and registration from the teach pendant



Specify the analog condition output by using  or  key.

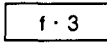
•  ⇒ 

|   |   |   |   |   |   |  |  |   |   |   |   |
|---|---|---|---|---|---|--|--|---|---|---|---|
| A | O | U | T | ± | 1 |  |  | X | . | X | X |
|---|---|---|---|---|---|--|--|---|---|---|---|

 ⇒ AOUT AO #1 X.XX instruction is registered.

Analog output Condition #1      Output data (V):



Set by using  or  key.

•  ⇒ 

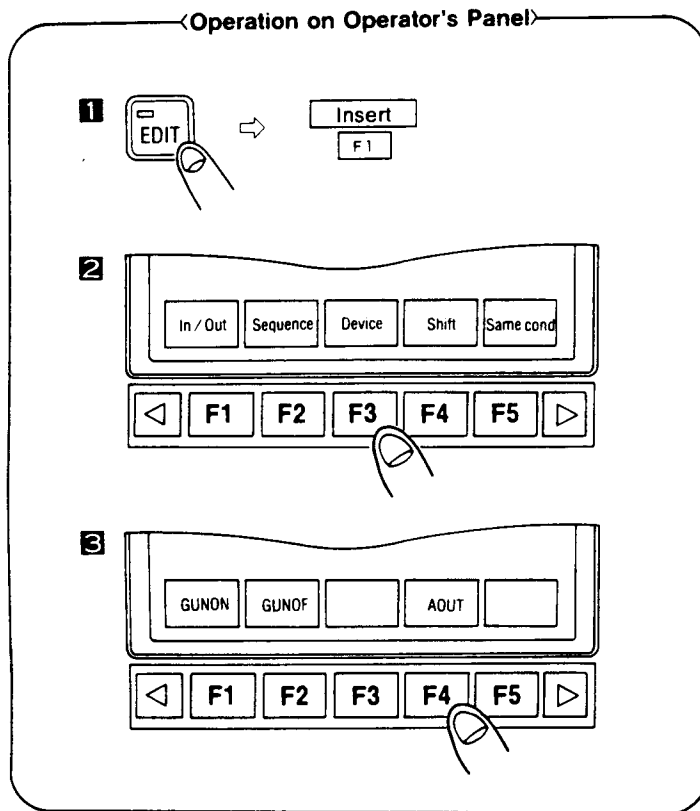
|   |   |   |   |   |   |  |  |   |   |   |   |
|---|---|---|---|---|---|--|--|---|---|---|---|
| A | O | U | T | ± | 2 |  |  | X | . | X | X |
|---|---|---|---|---|---|--|--|---|---|---|---|

 ⇒ AOUT AO #2 X.XX instruction registered.

Analog output condition #2      Output data (V):

Set by using  or  key.

(2) Registration from operator's panel



Depress EDIT key and  
Insert  
F1 soft key.

Depress Device  
F3 soft key.

Depress AOUT  
F4 soft key.  
 AOUT instruction is registered.  
 AOUT AO #1 X.XX  
 Input by DATA (digit) key, and  
 depress ENTER key.

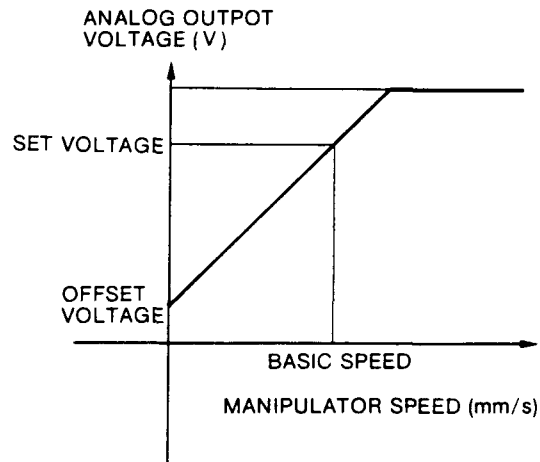
## 4.4 ANALOG OUTPUT FUNCTION CORRESPONDING TO SPEED

The sealing or painting operation is executed by a manipulator, the discharge must be varied corresponding to manipulator operation speed to keep the application thickness, such as sealing compound.

If you use this function, however, the resetting of analog command value is not necessary to correspond to manipulator operation speed when the discharge is controlled by analog command value from manipulator. Drastically reduces programming time.

### 4.4.1 Description of Function

Fig. 4.1 shows analog output voltage character at this function execution.



**Fig. 4.1 Analog Voltage Character when using Analog Output Function Corresponding to Speed**

To use this function, the data, offset voltage, basic speed and analog output voltage, should be set in advance.

- Offset voltage : Analog voltage when the manipulator speed is "0".
- Basic speed : Basic speed for manipulator when outputting set-voltage.
- Set-voltage : Outputting voltage at basic speed.

#### NOTE

1. If analog output voltage corresponding to speed exceeds  $\pm 14.00V$ , it is restricted within  $\pm 14.00V$ .
2. In the analog output function corresponding to speed, linear speed in motion is calculated in accordance with control point moving amount. Therefore, when the manipulator operates at a high speed, linear speed is not stable even in the constant speed area. To make analog output stable in the constant speed area, when this function is used, the speed control method can be changed by setting the following parameter.

Parameter SC289 : Accel/decel process designation for each function

0 : Standard

1 : Other than standard

Use this function after changing the above SC289 setting to "1".

#### 4.4.2 Instruction

Analog output corresponding to speed should be added to the basic speed in AOUT command.

<Format>

AOUT (Analog output (Analog voltage) [Basic speed]  
terminal No.)

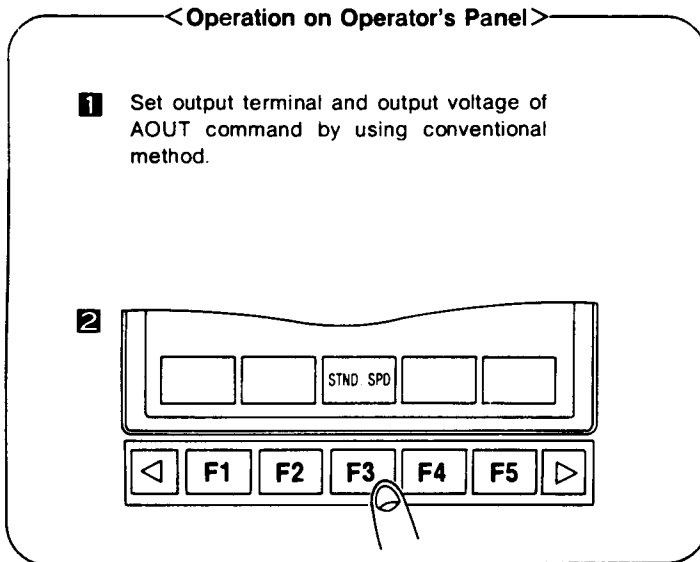
(Example)

AOUT AO # 1 10.00 [V=200.0]

**NOTE** If the basic speed is omitted, analog output is constant.

<Setting method>

<Description>



After setting output voltage, depress **STND. SPD** soft key.  
**F3**  
Then, input the basic speed.

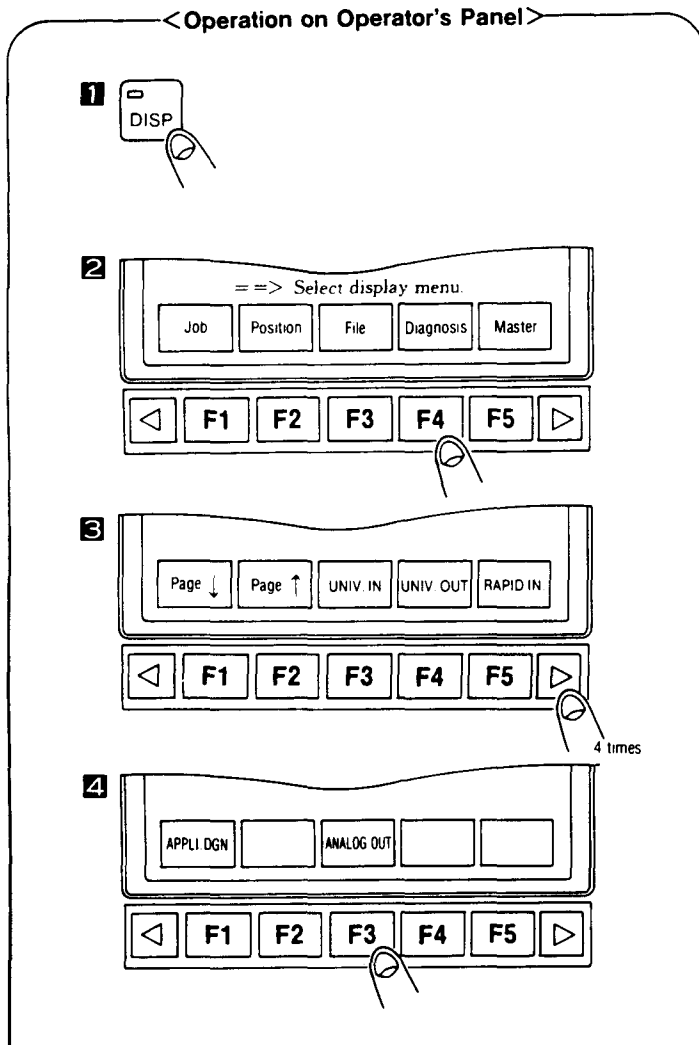
**NOTE** The registration and alteration of basic speed cannot be executed on teach pendant.



### 4. 4. 3 Offset Voltage Setting

Set offset voltage on analog output display for diagnostic display.

<Setting method>



<Description>

Depress DISP key.

Depress Diagnosis  
F4 soft key.

Depress ▶ key four times.

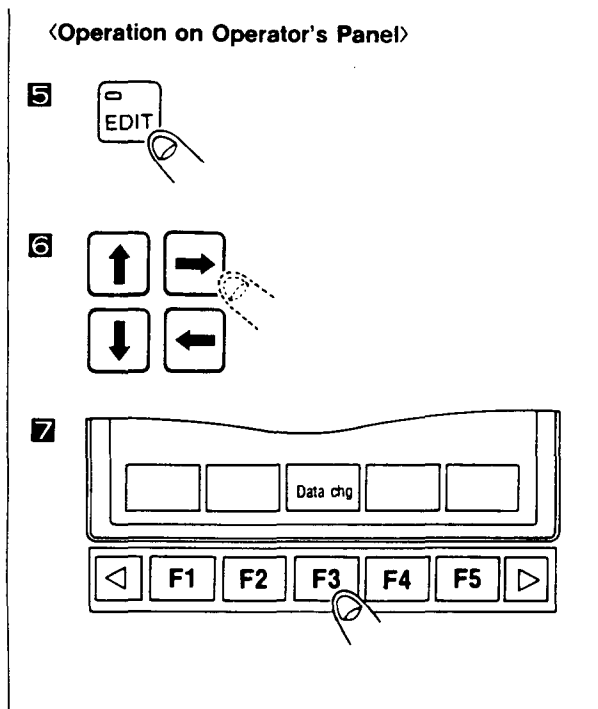
Depress ANALOG OUT  
F3 soft key.

This display will appear.


| ANALOG OUTPUT   |                         |           |        |           |
|-----------------|-------------------------|-----------|--------|-----------|
| OUT PORT        | AOUT1                   | AOUT2     | AOUT3  | AOUT4     |
| OUT VOL. (V)    | -10.00                  | -14.00    | -10.00 | -14.00    |
| REF. VOL. (V)   | 0.00                    | 0.00      | 0.00   | 0.00      |
| CONTROL         | SPD RATIO               | SPD RATIO | FIXED  | SPD RATIO |
| OFFSET VOL. (V) | 0.00                    | 0.00      | 0.00   | 0.00      |
| STND. SPD       | 1200.0                  | 1500.0    | ***    | 1500.0    |
|                 | ACTUAL SPD 100.0 (mm/s) |           |        |           |

APPLI DGN

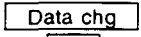

ANALOG OUT



**<Description>**

Depress  key on this display.

Set the cursor to offset voltage data to be altered.

Depress  soft key.  


The offset voltage will be altered.

**4.4.4 Description of Operation**

- (1) Output character at each polarity

The polarity of each output terminal (AO # 1 to AO # 4) can be set by WE parameter setting. For the parameter, see Table 4.1.

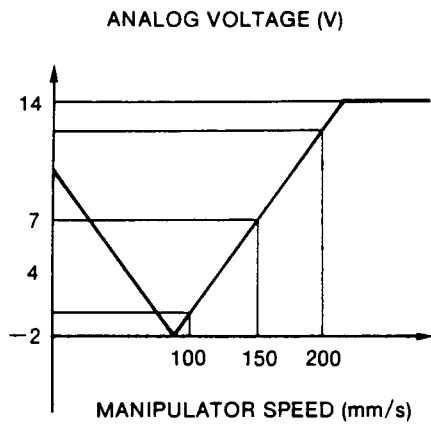
**Table 4.1 WE Parameter**

| Parameter | Output Terminal | Contents of data                         |
|-----------|-----------------|------------------------------------------|
| WE00      | AO # 1          | 0: Bipolar<br>1: Positive<br>2: Negative |
| WE01      | AO # 2          |                                          |
| WE02      | AO # 3          |                                          |
| WE03      | AO # 4          |                                          |

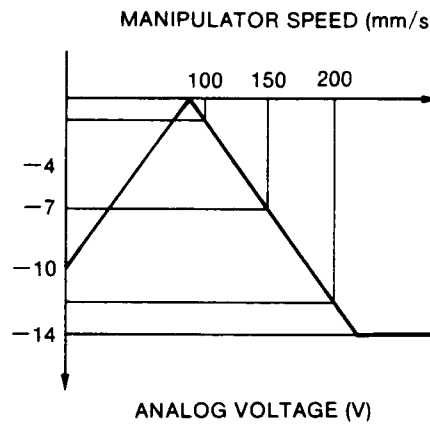
Figs. 4.2 to 4.4 show the output character for each porarity when job of example is executed at offset voltage setting  $-10V$ .

**(Example 1)**

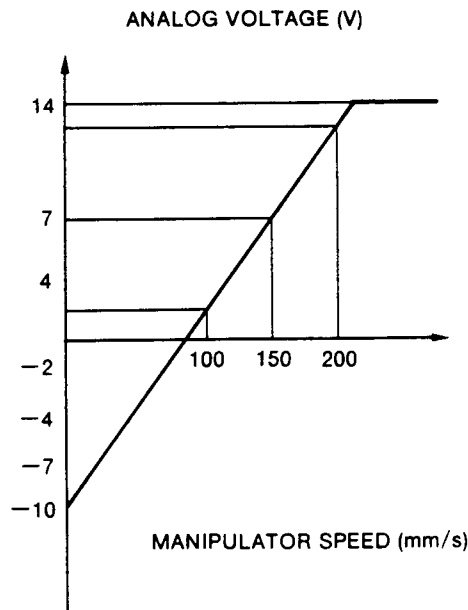
| Jobs                    | Output Voltage (V) |          |          |
|-------------------------|--------------------|----------|----------|
|                         | Bipolar            | Negative | Positive |
| MOVJ VJ=50.0            |                    |          |          |
| AOUT AO # 17.00 V=150.0 | 7.00               | -7.00    | 7.00     |
| MOVL V=50.0             | -4.33              | -4.33    | 4.33     |
| MOVC V=100.0            | 1.33               | -1.33    | 1.33     |
| MOVC V=100.0            | 1.33               | -1.33    | 1.33     |
| MOVC V=100.0            | 1.33               | -1.33    | 1.33     |
| MOVC V=200.0            | 12.67              | -12.67   | 12.67    |



**Fig. 4.2 Positive Character**



**Fig. 4.3 Negative Character**



**Fig. 4.4 Bipolar Character**

(2) Conditions of execution, interruption, and continuous operation for analog output function corresponding to speed

(a) Execution condition

After executing AOUT command with basic speed, this function is executed during arc interpolation (MOVC) or linear interpolation (MOVL) operation.

This function is executed in playback operation and next operation; it is not executed in jog operation.

(b) Interruption condition

| <b>Interruption Condition</b>                                 | <b>Interrupted Output Terminal</b>                                                                                        |
|---------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| After the manipulator is stopped, edit operation is executed. | All output terminals are interrupted, analog voltage preceding interruption is output constantly in each output terminal. |
| AOUT command without basic speed is executed.                 | Only output terminal set by AOUT command is interrupted, and analog voltage set by AOUT command is output constantly.     |



When conditions other than the conditions above exist, analog output function correspondence to speed is continued.

(3) Relationship between manipulator speed including accel/decel speed and analog output value

(Example 2) Offset voltage is set at  $-2V$ .

```

MOVL V=200.0 ..... ①
AOUT AO#1 10.00 V=200.0
MOVC V=150.0 ..... ②
MOVC VR=20.0 ..... ③ (at control speed 100mm/s)
MOVC V=150.0 ..... ④
MOVL V=180.0 ..... ⑤
MOVL ..... ⑥ (at control speed 180mm/s)
AOUT AO#1 10.0 ..... ⑦
  
```

Fig. 4.5 shows variation of analog voltage correspondence to accel/decel speed when jobs in example 2 are executed.

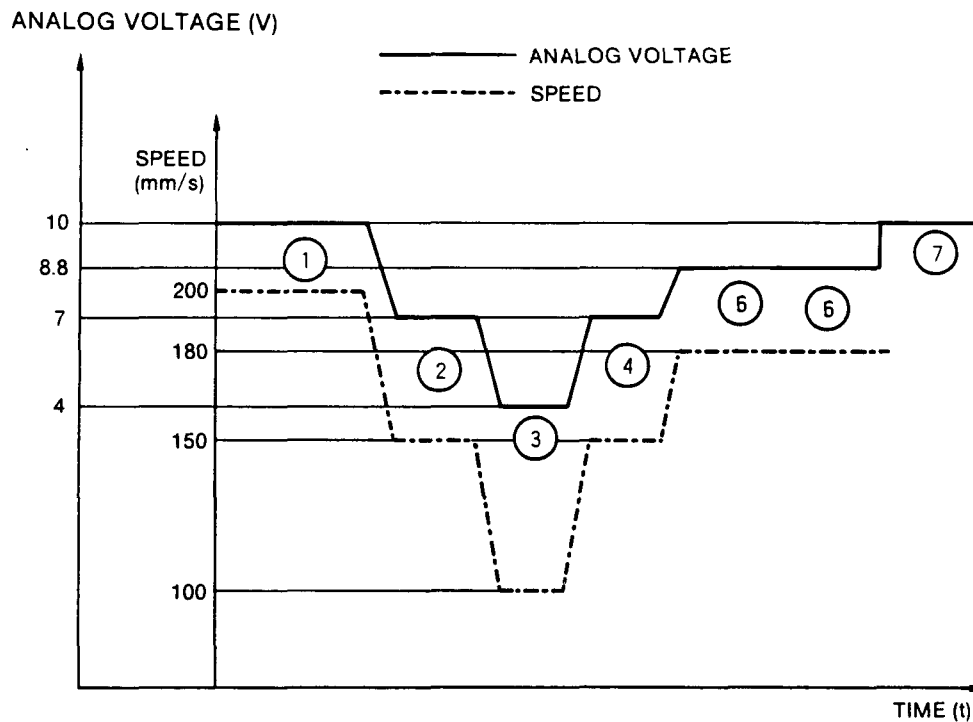









Fig. 4.5 Variation between Accel/decel Speed of Manipulator and Analog Voltage



Manipulator speed contains a few errors due to output correspondence to operating speed. When the attitude angle is specified, the output corresponds to absolute speed of control point at that time.

#### 4.5 LIST OF OPERATION ON TEACH PENDANT

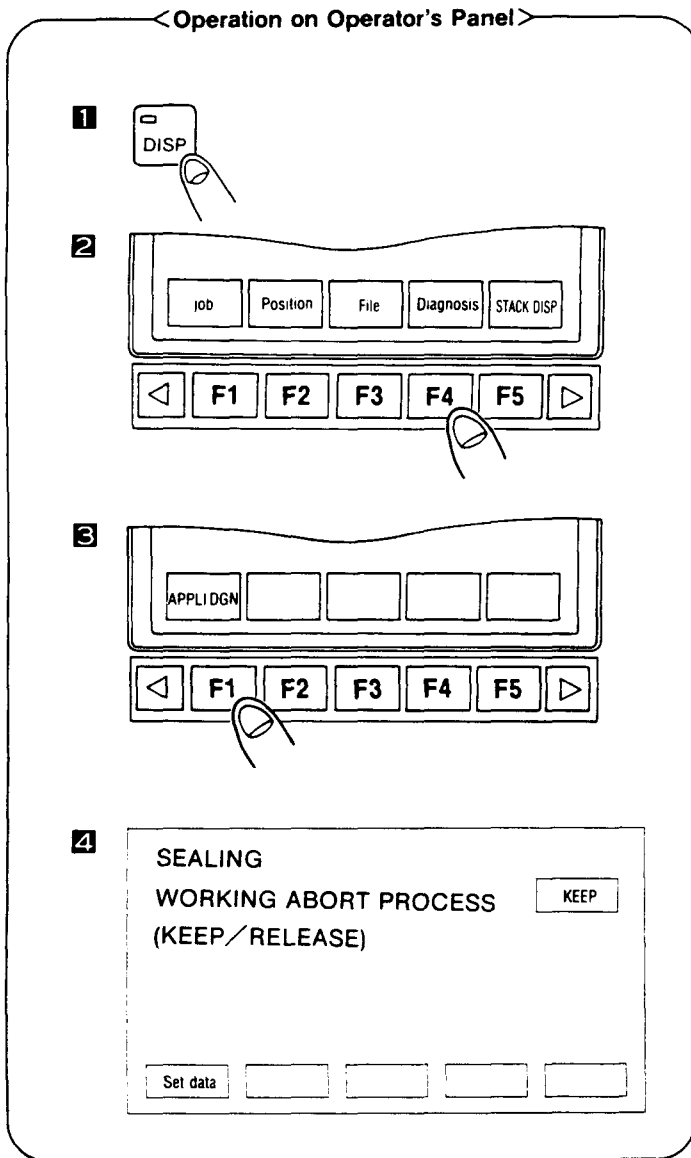
| key                                                                               | Contents                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Registration of GUNON or CALL <u>GUNONXX</u> instruction<br>(reserved job name)                                                                                                                                                                                                                                   |
|  | Registration of GUNOF or CALL <u>GUNOFXX</u> instruction<br>(reserved job name)                                                                                                                                                                                                                                   |
|  | For analog condition output #1 :<br>Registration of AOUT #1 <u>XX</u> instruction<br>(data)                                                                                                                                                                                                                       |
|  | For analog condition output #2 :<br>Registration of AOUT #2 <u>XX</u> instruction<br>(data)                                                                                                                                                                                                                       |
|  | Instruction of coating inching (OUT63)<br>while  and  keys are depressed, the relay (GUNON inst.) which is set in parameter SC220 is turned on. |

## 4.6 SEALING DIAGNOSIS FUNCTION

### (1) Setting the "WORK ABORT PROCESS" specification

If the sealing work (while the GUNON instruction is on) is stopped before completion, the GUNON instruction also turns off.

Specify whether to continue the GUNON instruction upon restart, as follows.



### <Description>

Depress **DISP** key.

Depress **Diagnosis** soft key.  
**F4**

**NOTE** If **Diagnosis** soft key is not displayed, depress **▷** key.

Depress **APPLI. DGN** soft key.  
**F1**

The following display will appear.

The initial setting in the sealing application is "KEEP", so the work is continued when restarted after stopping.

Set "RELEASE" by the **Set data** soft key in this display, if the work is not to be continued.  
**F1**

(2) Error check process by concurrent I/O ladder

| User Alarm No. | Contents                                                                                                                                         | Action                                                                                                                                                         |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Alarm 2010     | APPLYING ERROR:<br>This alarm occurs when the applying error input signal turns on.                                                              | Determine the reason for the error, and remove the cause.                                                                                                      |
| Alarm 2020     | GUNON RESPONSE ERROR:<br>This alarm occurs if the GUNON RESPONSE input signal does not turn on 3.0 seconds after the GUNON instruction turns on. | Determine why the GUNON RESPONSE signal does not turn on.<br>If the GUNON signal is not to be used, short-circuit 6TB-8 and 0 V, to keep the signal always on. |

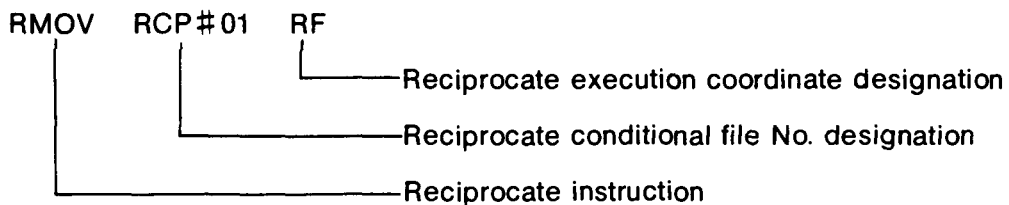
## 4.7 PAINTING RECIPROCATATE FUNCTION

This function is used for easy operation of teaching of simple painting work such as net painting.

In this function, painting reciprocate conditions (amplitude, speed, etc.) are registered in the reciprocate conditional files (16 sheets) and reciprocate is performed by automatic creation of operation data according to the specified reciprocate conditional file contents at execution of reciprocate instruction (RMOV).

### (1) Instructions

#### Reciprocate instructions



This instruction repeats incremental value moves, calculating incremental value according to the data file contents, without having any position data. (Same motion as IMOV repeat)

- Reciprocate execution coordinate designation  
Specifies in which coordinate system the reciprocate conditional file is executed. Base, robot, tool or user coordinate (1 to 8) can be selected.
- Reciprocate conditional file No. designation  
Conditional file No. to execute the RMOV instruction is specified (1 to 16).



(2) Contents of reciprocate conditional file

|                                             |                |                 |              |
|---------------------------------------------|----------------|-----------------|--------------|
| Reciprocate Cond.                           |                |                 |              |
| Reciprocating Condition File (FILE NO.: 16) |                |                 |              |
| Pattern                                     | : Rect.        | Recipro times   | : 15         |
| Amp-direction                               | : X            | Pitch-direction | : Y          |
| Full Amplitude                              | : 500.000mm    | Full Amplitude  | : 300.000mm  |
| Speed                                       | : 900cm/min    | Speed           | : 9000cm/min |
| Start timing                                | : Ampli.       | End timing      | : Ampli.     |
| Times of paint                              | : 3            | Painting Pause  | : Use        |
| GUN Orient                                  | : Use          | Pause distance  | : 10.000mm   |
| Speed (VR)                                  | : 180.0deg/sec | PL-Function     | : Non use    |
| Page ↓                                      |                | Page ↑          | Recipro      |
|                                             |                |                 | Weaving      |

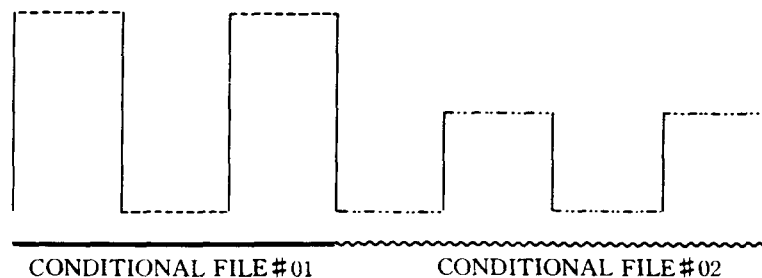
Fig. 4.6 Reciprocate Conditional File

(a) Description of data

- Motion pattern  
Rectangular or triangular can be selected for reciprocate motion form.
- Amplitude/pitch  
Direction, moving amount and moving speed can set independently.
- Starting/ending direction designation  
Condition for phase matching when reciprocate motions with different condions are performed continuously are specified.  
As described below, when amplitude is to be changed during reciprocate, set each condition in the conditional file and register the reciprocate instruction.

[Example]

```
RMOV RCP#01 TL
RMOV RCP#02 TL
Reciprocate conditional file 1
  Start timing: Ampli.  End timing: Ampli.
Reciprocate conditional file 2
  Start timing: Pitch  End timing: Ampli.
```



- Times of paint

Sets how many times motions in the amplitude direction are repeated when a rectangular wave is specified. For example, when 3 is specified, painting in rectangular wave-form as shown in the following diagram is performed three times in the amplitude direction before pitching motion starts.

- Painting Pause

Sets when paint is to be cut off at both ends while moving in the amplitude direction during reciprocate execution.

When "Use" is specified: GUNOFF status is entered in the section where both ends while moving in the amplitude direction and the pitching motion section.

When "Non use" is specified: GUNOFF status is entered in the pitching motion section without any conditions.

- Gun Orient

When "Non use" is specified, gun position at reciprocate starting point is held.

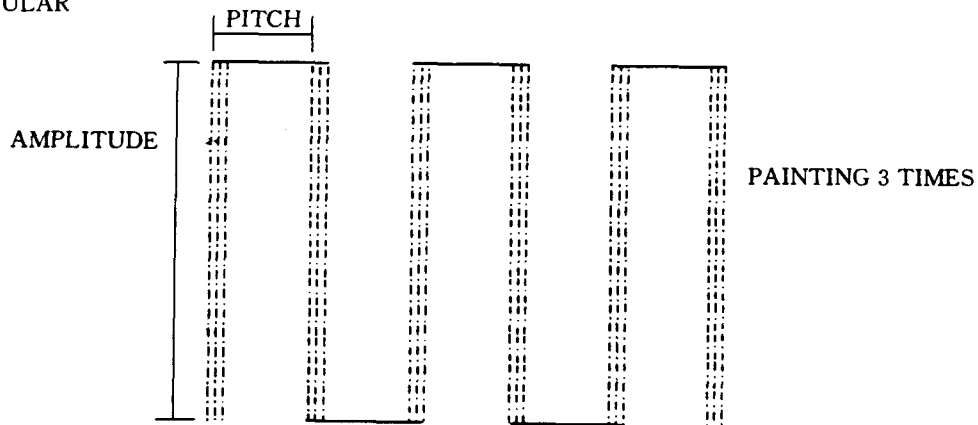
When "Use" is specified, outward amplitude motion position is instructed in reference point No. 5 (REFP5) and homeward amplitude motion position is instructed in reference point No. 6 (REFP6). Gun can be changed during pitching motion.

- PL-Function

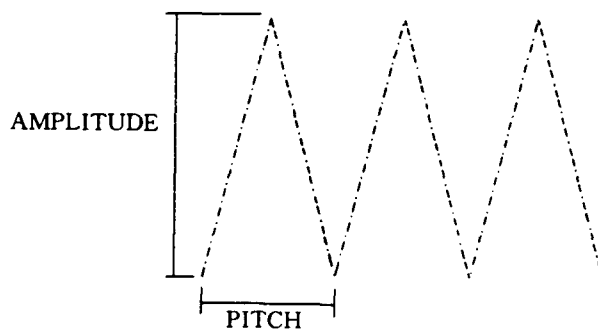
0 (none) to 4 (sets) or "Non use" can be specified.

When "Non use" is specified, the same motion as normal move instruction [CONT] is performed.

RECTANGULAR



TRIANGULAR



[Limit conditions at reciprocate in triangular waveform]

The following is the limit conditions for triangular waveform setting :

- Position change control is not performed (disregarding file conditions).
- Recoating is not possible (disregarding file conditions).
- Amplitude direction is applied for moving speed.
- Start/end motion direction is not specified (disregarding file conditions).

(3) Outline of Operation

Reciprocate instruction can check each position and motion by using the teach pendant

and  keys as well as normal moving instructions.

NOTES : 1. Since this instruction does not have any position data, no position can be corrected.

2. This instruction can be used together with TCP or PMT function. However, speed override or speed correction by using TRT function is not possible.

(4) Error/Alarm

The following alarms may occur in the reciprocate function :

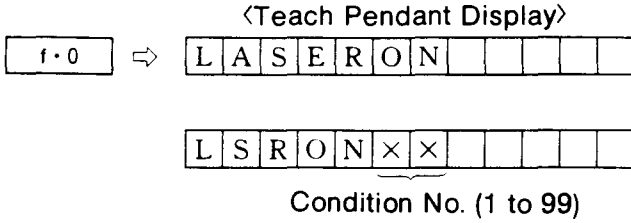
| <b>Code</b> | <b>Alarm Contents</b>                   | <b>Corrective Action</b>                      |
|-------------|-----------------------------------------|-----------------------------------------------|
| 3550        | Reciprocate conditional file fault      | Set the reciprocate conditional file again.   |
| 3580        | Reciprocate instruction execution fault | Arrange the instruction execution conditions. |

# 5. LASER CUTTING

## 5.1 REGISTRATION AND FUNCTION FOR LASER ON INSTRUCTION

(1) Registration from teach pendant

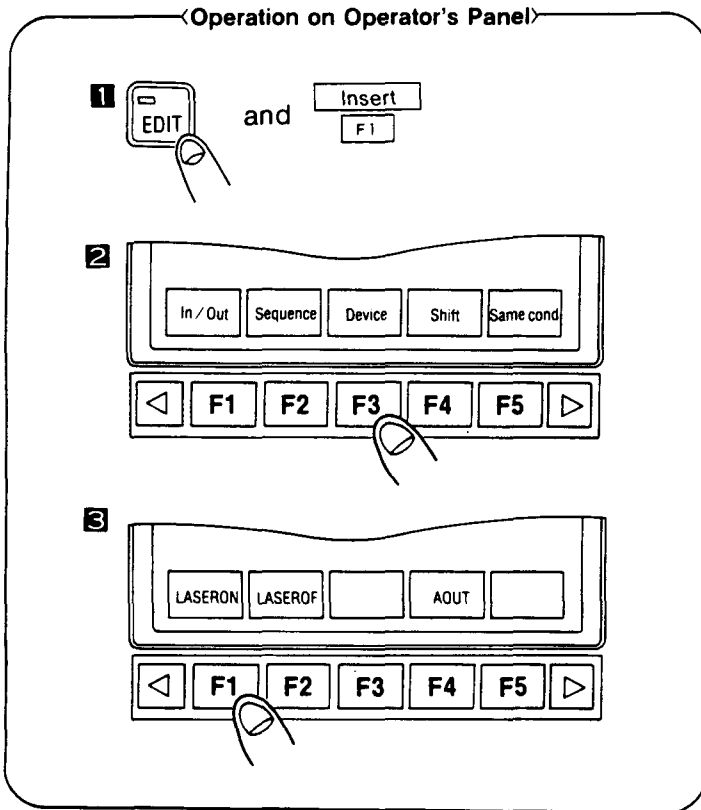
Specify cutting start instruction by depressing f·0 key.



Without condition No:  
LASERON instruction registration.

With condition No:  
CALL instruction registration  
(CALL LSRON XX)  
Job name

(2) Registration from operator's panel



Depress EDIT key and  
depress Insert  
F1 soft key.

Depress Device  
F3 soft key.

Depress LASERON  
F1 soft key and  
ENTER key.

LASERON instruction is registered.

- (3) Laser ON instruction (LASERON) function  
Turns on the LASERON instruction (output relay # 3087).

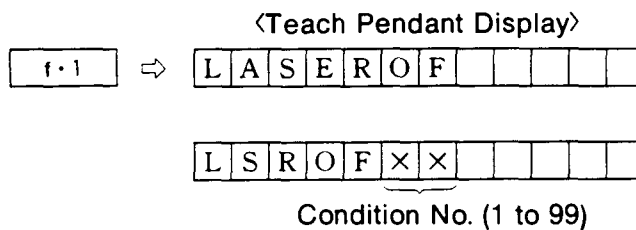
Turns on the WORK START instruction (special output relay # 5050), waits for the WORK START RESPONSE (special input relay (# 4050), and executes the next instruction when the WORK START RESPONSE turns on.

The work start response relay is checked when the LASERON RESPONSE input signal turns on. If the LASERON RESPONSE signal is not to be used, short-circuit 6TB-8 and 0V, to keep the laser "on" response on constantly.

## 5.2 REGISTRATION AND FUNCTION FOR LASER OFF INSTRUCTION

- (1) Registration from teach pendant

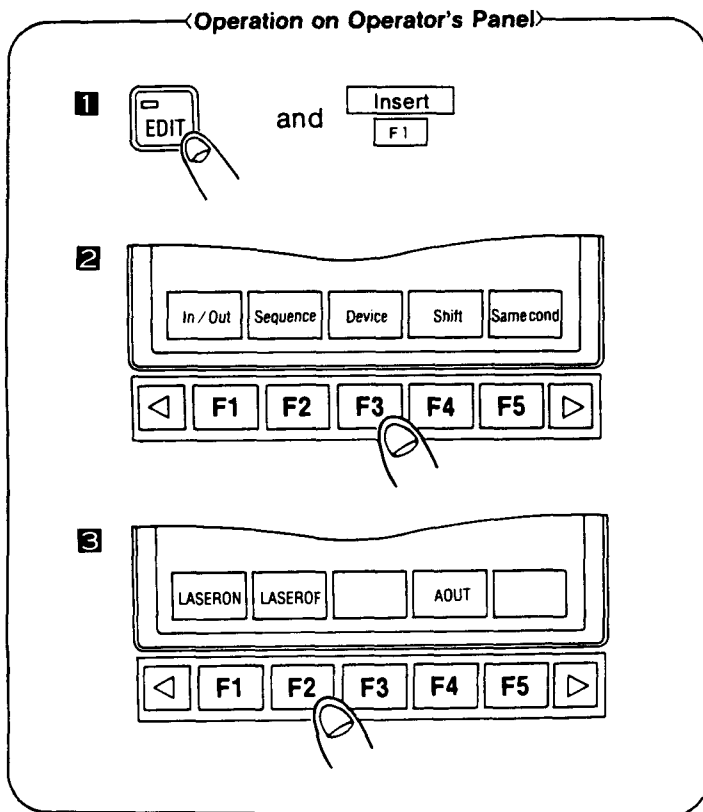
Specify laser off instruction by depressing f.1 key.



Without condition No:  
LASEROF instruction registration

With condition No:  
CALL instruction registration  
(CALL LSROF XX)  
Job name

- (2) Registration from operator's panel



Depress EDIT key and  
depress Insert  
F1 soft key.

Depress Device  
F3 soft key.

Depress LASEROF  
F1 soft key and  
ENTER key.

LASEROF instruction is registered.

(3) Laser OFF instruction (LASEROF) function

Turns off the LASEROF instruction (output relay #3087) of the laser power source.

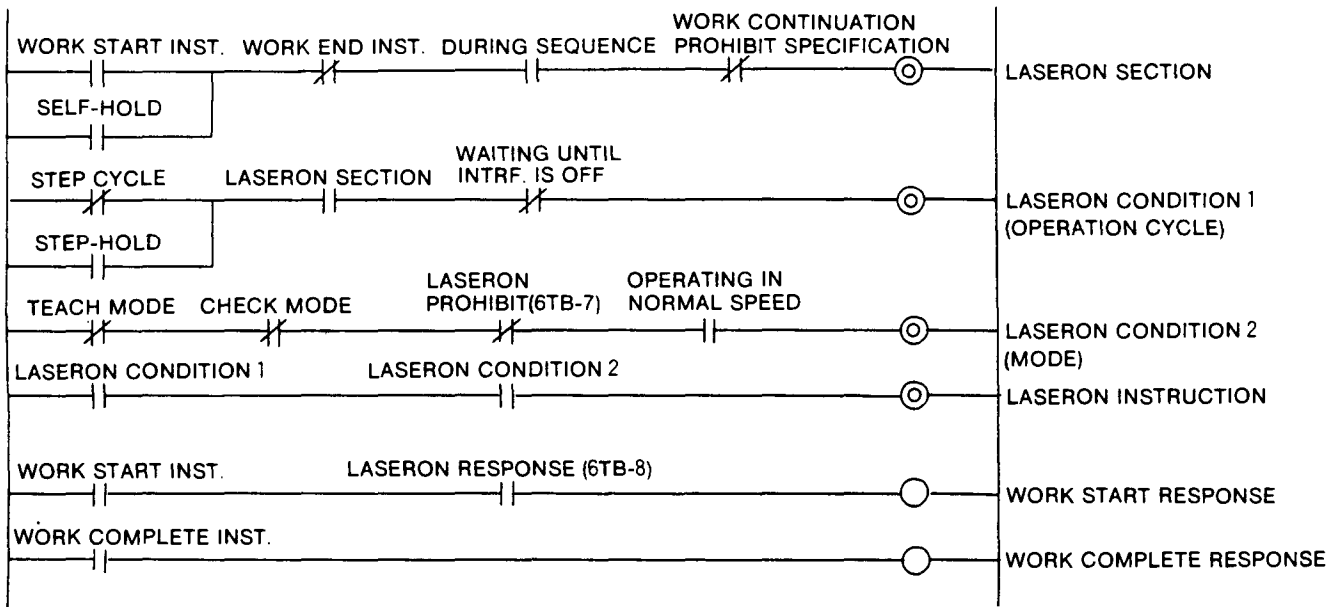
Turns on WORK COMPLETE instruction (special output relay #5051), waits for the WORK COMPLETE RESPONSE (special input relay #4051), and executes the next instruction when the WORK START RESPONSE turns on.

The WORK COMPLETE RESPONSE relay turns on immediately after the WORK COMPLETE instruction is output.

The LASERON instruction is controlled so that it self-holds when the WORK START instruction turns on, and turns off when the WORK COMPLETE instruction turns on.

If the work is stopped before completion, the LASERON instruction also turns off. If the operation is restarted later, the LASERON instruction turns on from that position, to allow the work to be continued. However, the work cannot be continued if the "WORKING ABORT PROCESS" specification in the diagnosis display is set to "RELEASE" (the initial setting is "KEEP").

The work also can not be continued if job editing, job call, cursor operation, or back operation is performed after work is stopped.



### 5.3 SETTING AND REGISTERING LASER CUTTING CONDITIONS

When the cutting conditions are to be controlled by the analog output ( $\pm 14\text{V}$ ), check that the EW02 PC board is mounted, and perform the following operation.

(1) Setting and registration from the teach pendant

Specify the analog condition output by using the  or  key.

⇒ 

|   |   |   |   |   |   |  |  |   |   |   |   |
|---|---|---|---|---|---|--|--|---|---|---|---|
| A | O | U | T | ⊖ | 1 |  |  | × | . | × | × |
|---|---|---|---|---|---|--|--|---|---|---|---|

 ⇒ AOUT AO #1 X.XX instruction is registered.

Analog output condition #1
Output data (V):  
 Set by using  or  key.

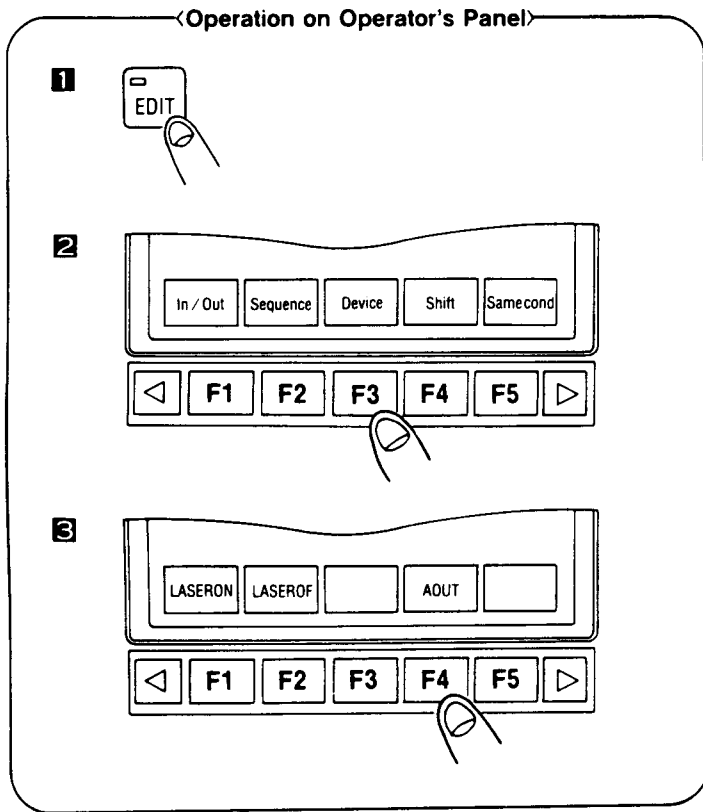
⇒ 

|   |   |   |   |   |   |  |  |   |   |   |   |
|---|---|---|---|---|---|--|--|---|---|---|---|
| A | O | U | T | ⊖ | 2 |  |  | × | . | × | × |
|---|---|---|---|---|---|--|--|---|---|---|---|

 ⇒ AOUT AO #2 X.XX instruction is registered.

Analog output condition #2
Output data (V):  
 Set by using  or  key.

(2) Registration from operator's panel



Depress key.

Depress soft key.

Depress soft key, and depress key.

AOUT AO # 1 X. XX instruction is registered.  
 ↑  
 Input by DATA (digit) keys.

### 5.4 LIST OF OPERATION ON TEACH PENDANT

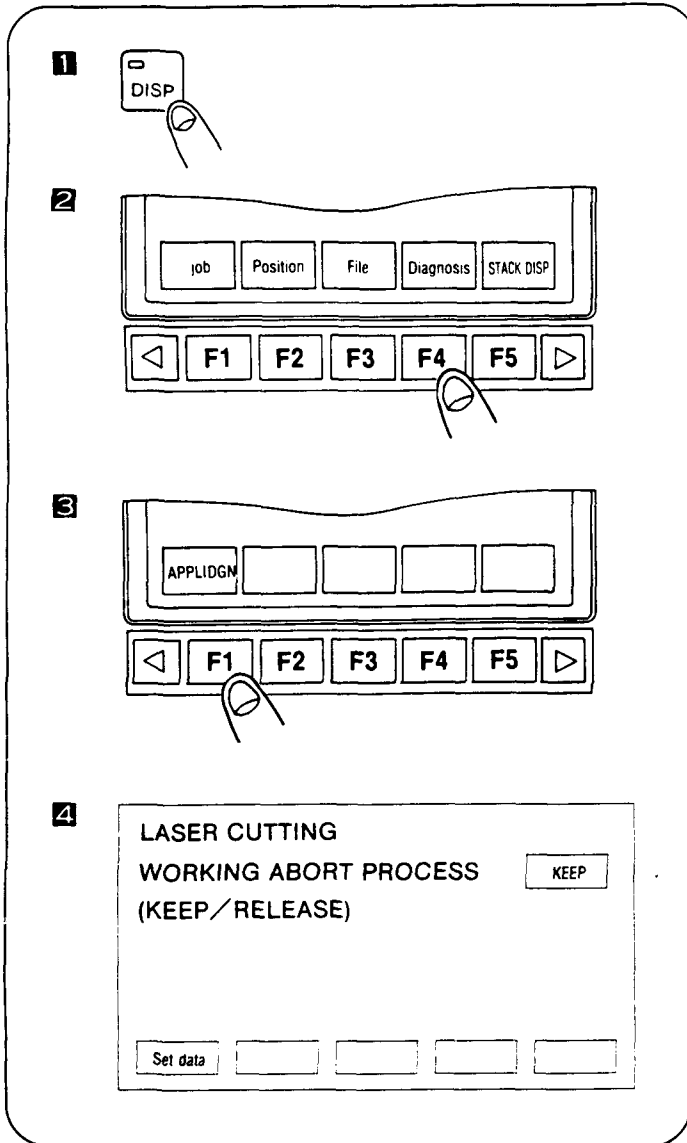
| key | Contents                                                                                      |
|-----|-----------------------------------------------------------------------------------------------|
|     | Registration of LASERON or CALL <u>LSRONXX</u> instruction<br>(reserved job name)             |
|     | Registration of LASEROF or CALL <u>LSROFXX</u> instruction<br>(reserved job name)             |
|     | For analog condition output # 1 :<br>Registration of AOUT # 1 <u>XX</u> instruction<br>(data) |
|     | For analog condition output # 2 :<br>Registration of AOUT # 2 <u>XX</u> instruction<br>(data) |



## 5.5 LASER CUTTING DIAGNOSIS FUNCTION

If the cutting work (while the LASERON instruction is on) is stopped before completion, the LASERON instruction also turns off.

Specify whether to continue the LASERON instruction upon restart, as follows.



<Description>

Depress  key.

Depress   soft key.

Depress   soft key.

**NOTE** If  soft key is not displayed, depress  key.

The initial setting in the laser cutting application is "KEEP", so the work is continued when restarted after stopping.

Set "RELEASE" by the   soft key in this display, if the work is not to be continued.

**(2) Error check process by concurrent I/O ladder**

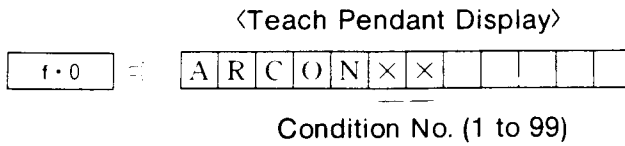
| User Alarm No. | Contents                                                                                                                                                       | Action                                                                                                                                                                                            |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Alarm 2020     | <b>LASERON RESPONSE ERROR :</b><br>This alarm occurs if the LASERON RESPONSE input signal does not turn on 3.0 seconds after the LASERON instruction turns on. | <b>Determine why the LASERON RESPONSE signal does not turn on.</b><br>If the LASERON signal is not to be used, short-circuit 6TB-8 and 0 V, to keep the signal always on.                         |
| Alarm 2030     | <b>NOZZLE SHORT-CIRCUIT :</b><br>This alarm occurs when the nozzle touches the workpiece to turn on the nozzle short-circuit input signal.                     | <b>Correct the teaching so that the nozzle does not touch the workpiece.</b> If the teaching has no problem, determine why the workpiece and the nozzle touched each other, and remove the cause. |
| Alarm 2050     | <b>LASER ERROR :</b><br>Indicates that the laser power source has failed. This alarm occurs when the laser error input signal turns on.                        | <b>Determine why the laser error occurred, and remove the cause.</b>                                                                                                                              |

## 6 PLASMA CUTTING

### 6.1 REGISTRATION AND FUNCTION FOR ARC ON (ARCON) INSTRUCTION

(1) Registration from teach pendant

Specify plasma start instruction by depressing f·0 key.

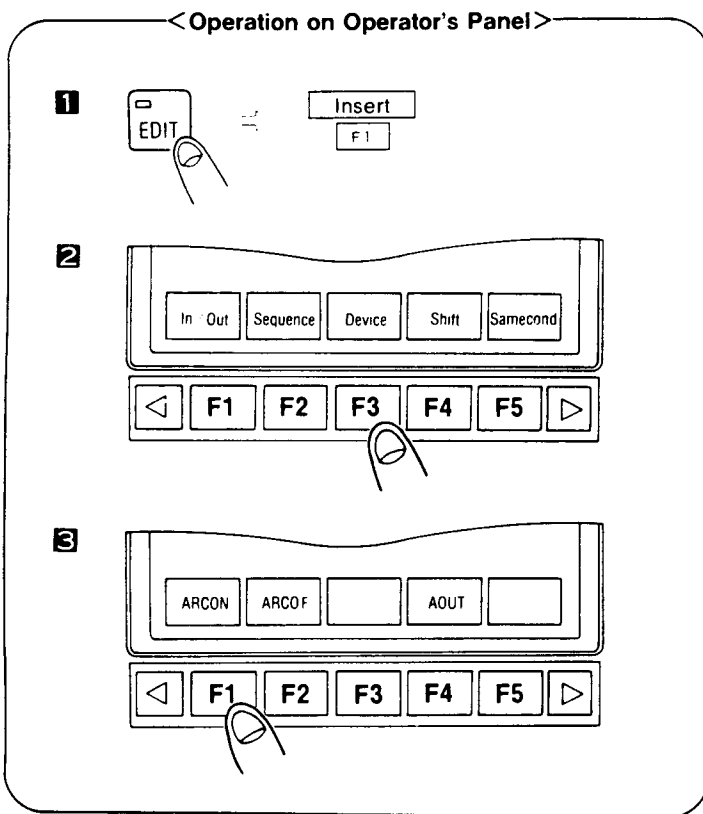


Without condition No: ARCON instruction registration

With condition No: CALL instruction registration

(CALL ARCON XX)  
Job name

(2) Registration from operator's panel



Depress EDIT key and Insert  
F1 soft key.

Depress Device  
F3 soft key.

Depress ARCON  
F1 soft key and ENTER key.  
ARCON instruction is registered.

(3) Arc "ON" instruction (ARCON) function

Turns on the PLASMA ARCON instruction (output relay # 3087).

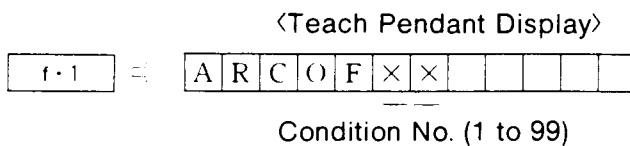
Turns on the WORK START instruction (output relay # 5050) , waits for the WORK START RESPONSE (special input relay ( # 4050), and executes the next instruction when the WORK START RESPONSE turns on.

The WORK START RESPONSE relay is checked when the ARCON RESPONSE input signal turns on. If the ARCON RESPONSE signal is not to be used, short-circuit 6TB-8 and 0V, to keep the ARCON RESPONSE on constantly.

## 6.2 REGISTRATION OF ARC OFF (ARCOF) INSTRUCTION

(1) Registration from teach pendant

Specify ARCOF instruction by depressing f.1 key.

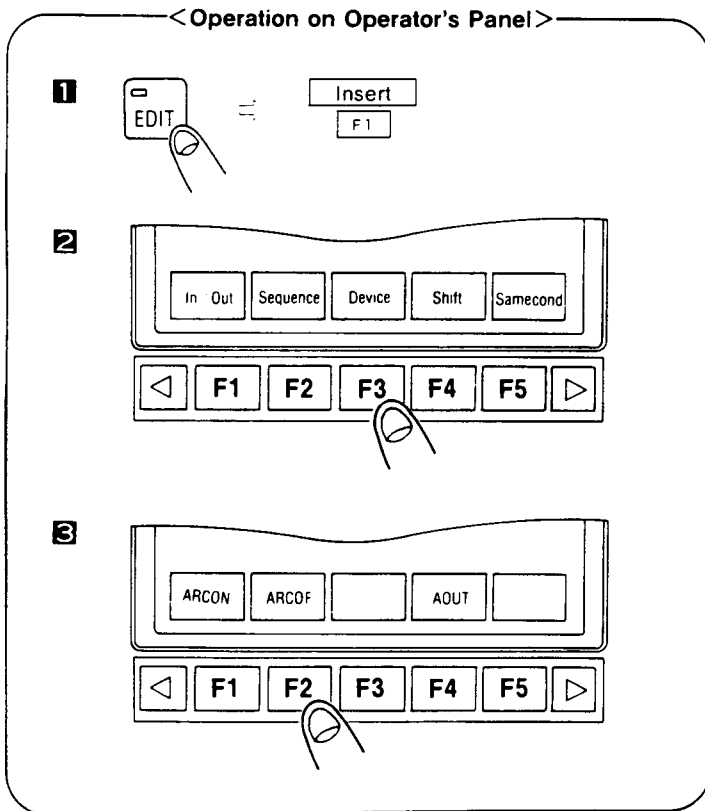


Without condition No: ARCOF instruction registration

With condition No: CALL instruction registration

(CALL ARCOF X X)  
Job name

2 Registration from operator's panel



Depress EDIT key and Insert / F1 soft key.

Depress Device / F3 soft key.

Depress ARCOF / F2 soft key and ENTER key.

ARCOF instruction is registered.

(3) Arc OFF instruction (ARCOF) function

Turns off the plasma arc "on" command (output relay # 3087).

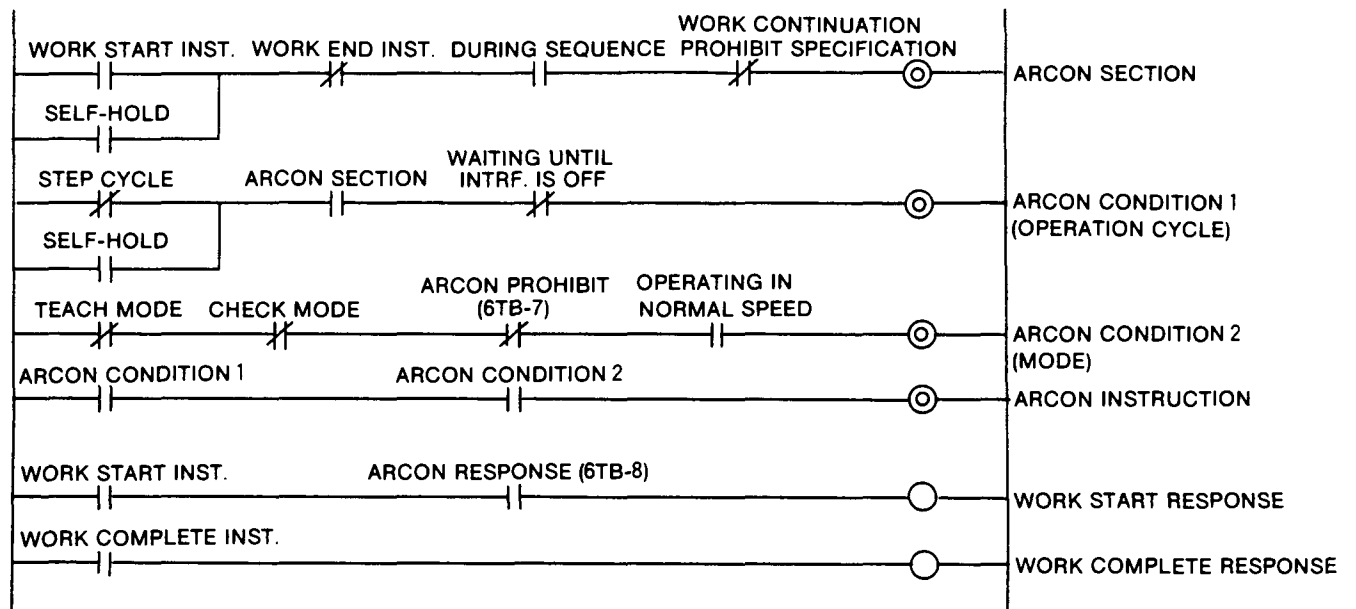
Turns on the WORK COMPLETE instruction (special output relay # 5051), waits for the WORK COMPLETE RESPONSE (special input relay # 4051), and executes the next instruction when the WORK START RESPONSE turns on.

The WORK COMPLETE RESPONSE relay turns on immediately after the WORK COMPLETE instruction is output.

The ARCON instruction is controlled so that it self-holds when the WORK START instruction turns on, and turns off when the WORK COMPLETE instruction turns on.

If the work is stopped before completion, the ARCON instruction also turns off. If the operation is restarted later, the ARCON instruction turns on from that position, to allow the work to be continued. However, the work cannot be continued if the "WORKING ABORT PROCESS" in the diagnosis display is set to disconnect the work (the initial setting is "KEEP").

The work also can not be continued if job editing, job call, cursor operation, or back operation is performed after work is stopped.



### 6.3 SETTING AND REGISTRERING THE PLASMA CUTTING CONDITIONS

When the injection conditions are to be controlled by the analog output ( $\pm 14V$ ), check that the EW02 PC board is mounted, and perform the following operation.

(1) Setting and registration from the teach pendant

Specify the analog condition output by using the  or  key.

⇒ 

|   |   |   |   |   |   |  |  |   |   |   |   |
|---|---|---|---|---|---|--|--|---|---|---|---|
| A | O | U | T | ⊖ | 1 |  |  | × | . | × | × |
|---|---|---|---|---|---|--|--|---|---|---|---|

 ⇒ AOUT AO #1 X. XX  
instruction is registered.

Analog output Condition #1      Output data (V):  
Set by using  or  key.

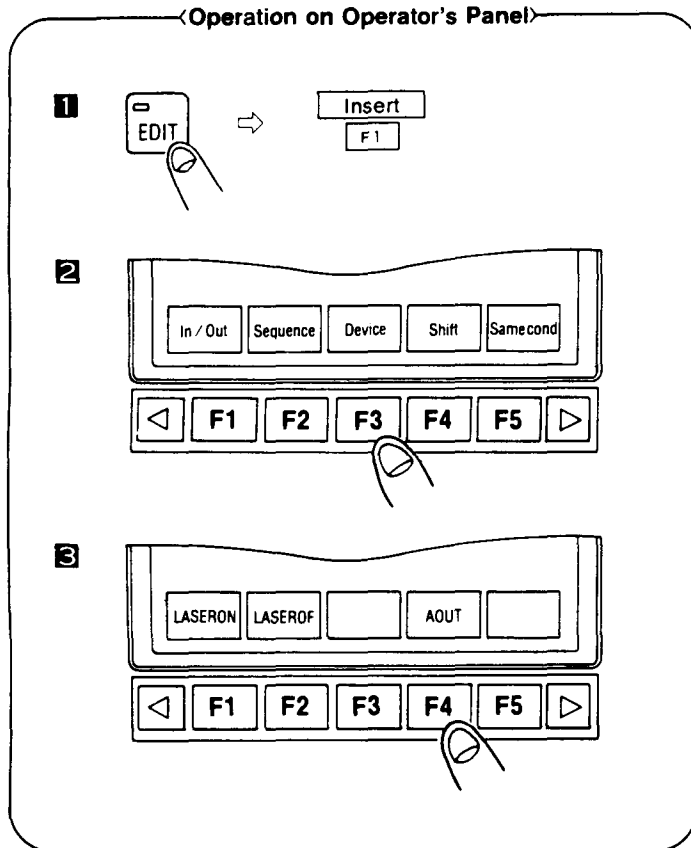
⇒ 

|   |   |   |   |   |   |  |  |   |   |   |   |
|---|---|---|---|---|---|--|--|---|---|---|---|
| A | O | U | T | ⊖ | 2 |  |  | × | . | × | × |
|---|---|---|---|---|---|--|--|---|---|---|---|

 ⇒ AOUT AO #2 X. XX  
instruction is registered.

Analog output Condition #2      Output data (V):  
Set by using  or  key.

(2) Registration from operator's panel



Depress key and soft key.

Depress soft key.

Depress soft key, and depress key.

AOUT AO # 1 XX. XX instruction is registered.  
 ↑  
 Input by DATA (digit) keys.

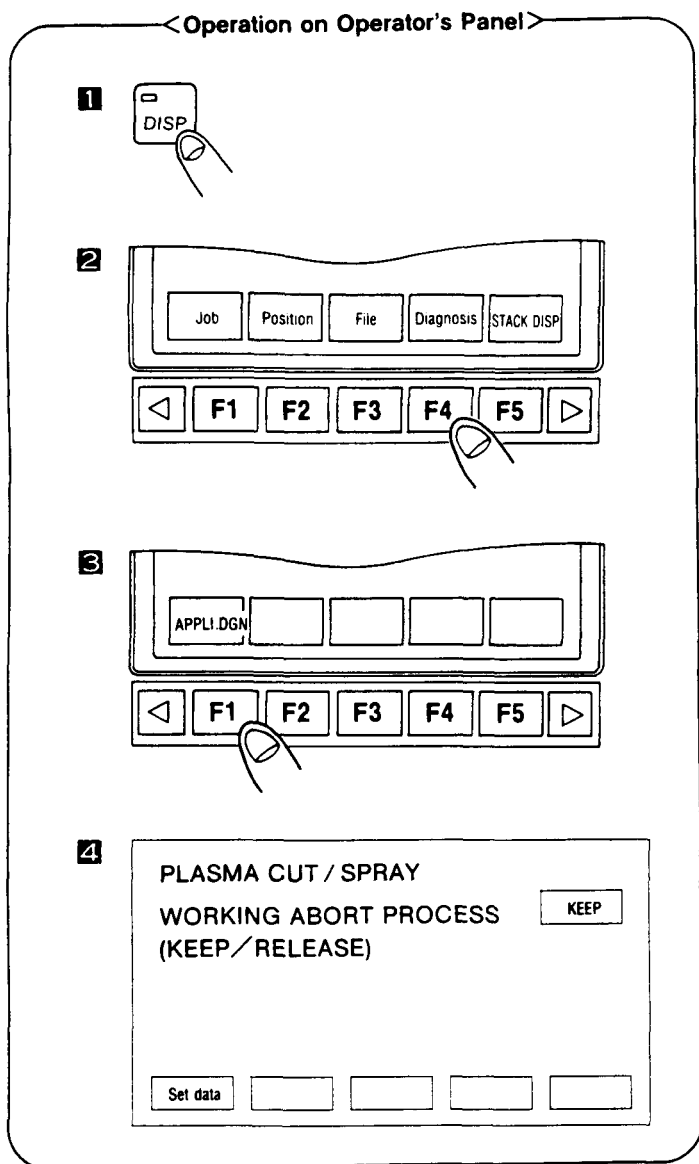
### 6.4 LIST OF OPERATION ON TEACH PENDANT

| key | Contents                                                                                   |
|-----|--------------------------------------------------------------------------------------------|
|     | Registration of ARCON or CALL <u>AIRCONXX</u> instruction<br>(reserved job name)           |
|     | Registration of ARCOF or CALL <u>ARCOFXX</u> instruction<br>(reserved job name)            |
|     | For analog condition output #1:<br>Registration of AOUT #1 <u>XX</u> instruction<br>(data) |
|     | For analog condition output #2:<br>Registration of AOUT #2 <u>XX</u> instruction<br>(data) |

## 6.5 PLASMA CUTTING DIAGNOSIS FUNCTION

### (1) Setting the work continuation specification

If the cutting work (while the ARCON instruction is on) is stopped before completion, the ARCON instruction also turns off. Specify whether to continue the ARCON instruction upon restart, as follows.



<Description>

Depress **DISP** key.

Depress **Diagnosis** soft key.  
**F4**

Depress **APPLI.DGN** soft key.  
**F1**

**NOTE** If **APPLI.DGN** soft key is not displayed, depress **▶** key.

The initial setting in the plasma cutting application is "KEEP", so the work is continued when restarted after stopping.

Set "RELEASE" by the **Set data** soft key in the above display, if the work is not to be continued.



**(2) Error check process by concurrent I/O ladder**

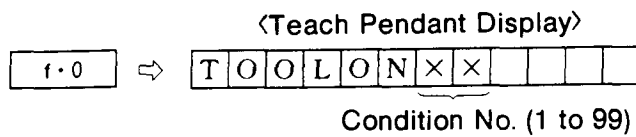
| <b>User Alarm No.</b> | <b>Contents</b>                                                                                                                                            | <b>Action</b>                                                                                                                                                  |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Alarm 2020            | ARCON RESPONSE ERROR :<br>This alarm occurs if the ARCON RESPONSE input signal does not turn on 3.0 seconds after the ARCON instruction turns on.          | Determine why the ARCON RESPONSE signal does not turn on.<br>If the ARCON signal is not to be used, short-circuit 6TB-8 and 0 V, to keep the signal always on. |
| Alarm 2030            | ARC SHORTAGE :<br>This alarm occurs when the plasma arc becomes short during the cutting work.                                                             | Determine the cause of arc shortage, and remove the cause.                                                                                                     |
| Alarm 2050            | PLASMA POWER ERROR :<br>Indicates that the plasma cutting unit power source has failed. This alarm occurs when the plasma arc error input signal turns on. | Determine why the error signal turned on, and remove the cause.                                                                                                |

## 7. MACHINING

### 7.1 REGISTRATION AND FUNCTION FOR WORK START INSTRUCTION

(1) Registration from teach pendant

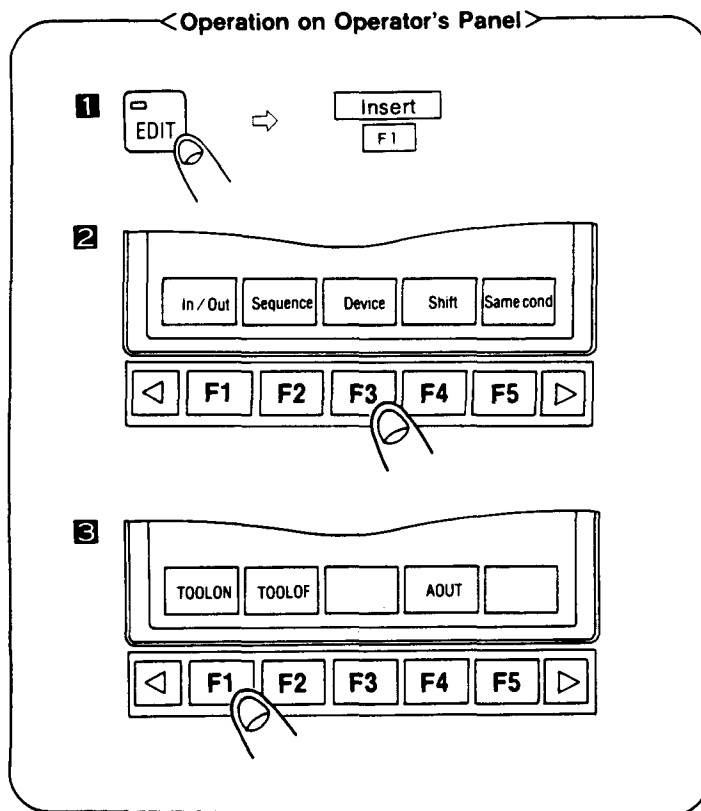
Specify work start instruction by depressing f·0 key.



Without condition No. : TOOLON instruction registration

With condition No. : CALL instruction registration  
 (CALL TOOLON XX)  
 Job name

(2) Registration from operator's panel



Depress EDIT key and  
Insert  
F1 soft key.

Depress Device  
F3 soft key.

Depress TOOLON  
F1 soft key and  
ENTER key.  
 TOOLON instruction is registered.

(3) Work start instruction (TOOLON) function

Turns on the TOOLON instruction (output relay # 3047).

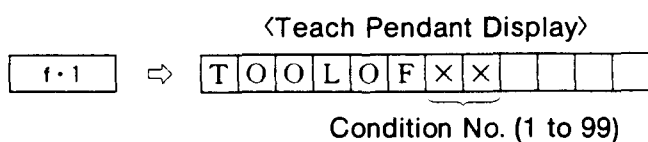
Turns on the TOOLON instruction (special output relay # 5050), waits for the WORK START RESPONSE (special input relay # 4050), and executes the next instruction when the WORK START RESPONSE turns on.

The WORK START RESPONSE relay turns on immediately after the WORK START instruction is output.

## 7.2 REGISTRATION AND FUNCTION FOR WORK COMPLETE INSTRUCTION

(1) Registration from teach pendant

Specify work complete instruction by depressing f.1 key.

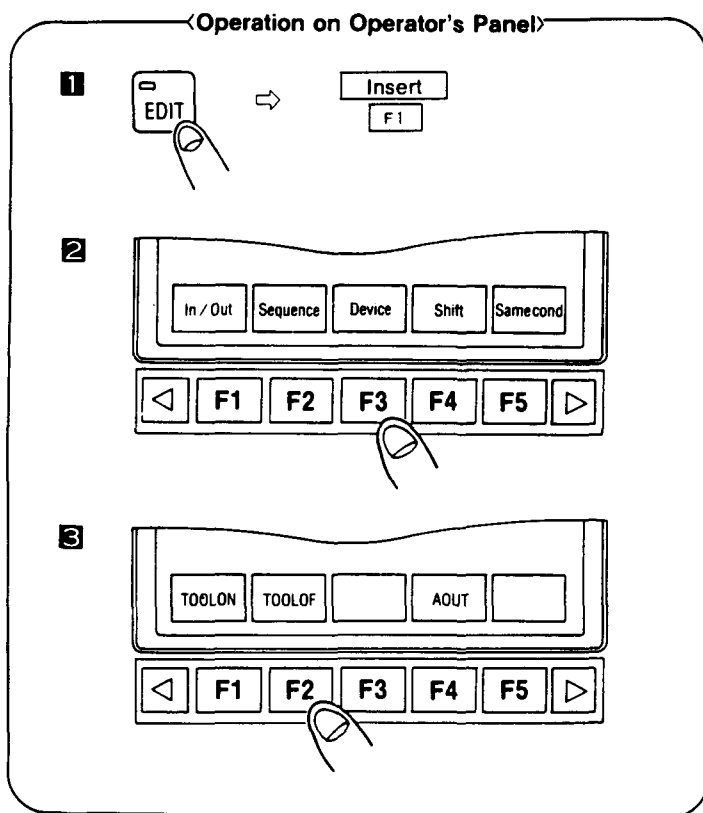


Without condition No.: TOOLOF instruction registration

With condition No.: CALL instruction registration

(CALL TOOLOF XX)  
Job name

(2) Registration from operator's panel



Depress EDIT key and Insert F1 soft key.

Depress Device F3 soft key.

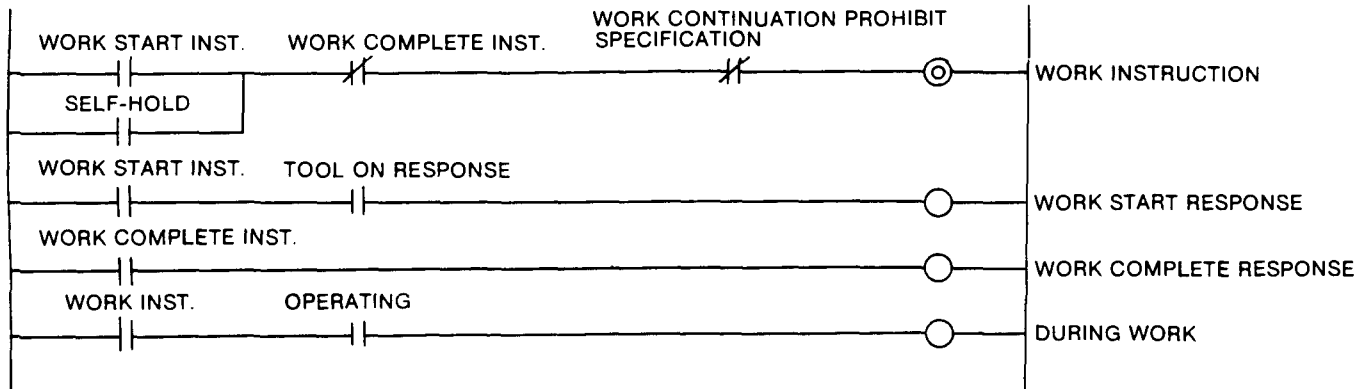
Depress TOOLOF TOOLOF F2 soft key and ENTER key. TOOLOF instruction is registered.

(3) Work complete instruction (TOOLOF) function

Turns off the TOOLON instruction (output relay # 3047) .

Turns on the WORK COMPLETE instruction (special output relay # 5051), waits for the WORK COMPLETE RESPONSE (special input relay # 4050), and executes the next instruction when the WORK START RESPONSE turns on.

The work COMPLETE RESPONSE relay turns on immediately after the WORK COMPLETE instruction is output.







1. The work instruction is controlled so that it self-holds when the WORK START instruction turns on, and turns off when the WORK COMPLETE instruction turns on.

If the work is stopped before completion, the work instruction also turns off. The work instruction does not turn off even when the manipulator stops, if the "WORKING ABORT PROCESS" specification in the diagnosis display is set for "KEEP".

2. When the "WORKING ABORT PROCESS" specification is set for "RELEASE", the work instruction turns off when the manipulator stops, and does not turn on when the operation is restarted. If the work instruction must turn off when the manipulator stops, and turn on when the manipulator restarts, specify the "WORKING ABORT PROCESS" for "KEEP", and change the output connection during work.

### 7.3 LIST OF OPERATION ON TEACH PENDANT

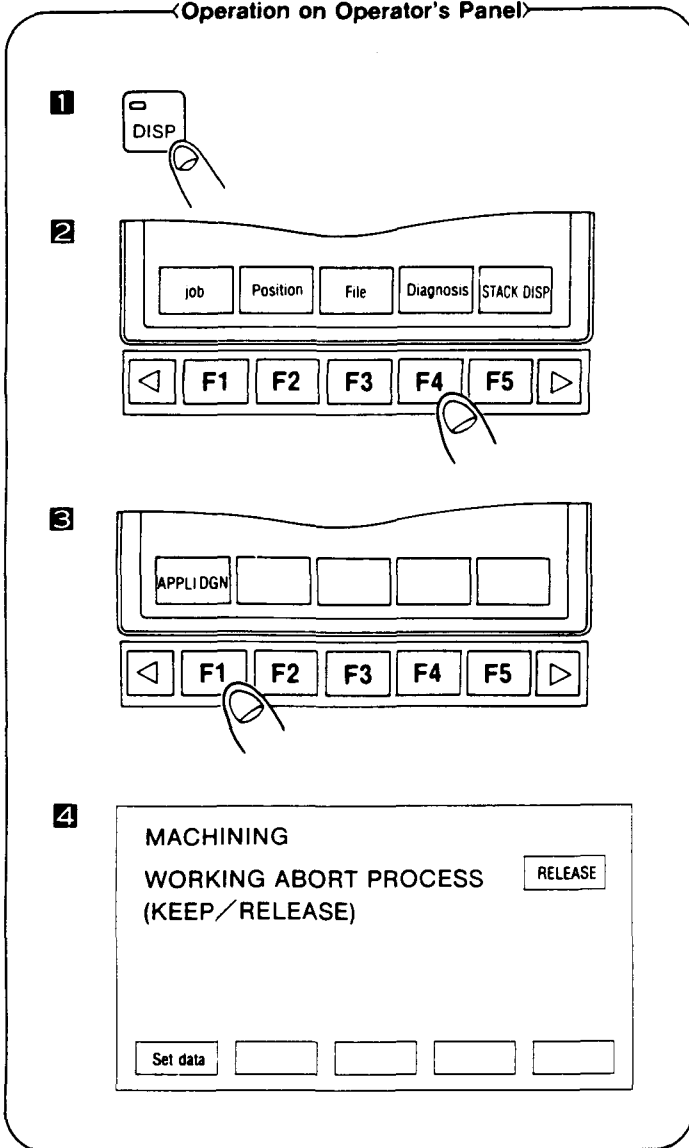
| key                                                                               | Contents                                                                                          |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
|  | Registration of TOOLON (work start) or CALL <u>TOOLONXX</u> instruction<br>(reserved job name)    |
|  | Registration of TOOLOF (work complete) or CALL <u>TOOLOFXX</u> instruction<br>(reserved job name) |
|  | For analog condition output #1 :<br>Registration of AOUT #1 <u>XX</u> instruction<br>(data)       |
|  | For analog condition output #2 :<br>Registration of AOUT #2 <u>XX</u> instruction<br>(data)       |

### 7.4 MACHINING DIAGNOSIS FUNCTION

(1) Setting of work continuation specification

The work instruction can be specified to be turned off when the operation (while the work instruction is on) is stopped before completion. Set "KEEP" to keep the state, and "RELEASE" to turn off the work instruction.

<Operation on Operator's Panel>



<Description>

Depress  key.

Depress   soft key.

Depress   soft key.

**NOTE** If  soft key is not displayed, depress  key.

The initial setting in the machining application is "RELEASE", so work instruction is turned off if the manipulator is stopped during work instruction.

If the work is to be continued, set "KEEP" by the   soft key in this display.

**(2) Error check process by concurrent I/O ladder**

| <b>User Alarm No.</b> | <b>Contents</b>                                                                                                                                             | <b>Action</b>                                                                                                                                                    |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Alarm 2010            | <b>MACHINING ERROR :</b><br>This alarm occurs when the machining error input signal turns on.                                                               | Determine why the error signal turns on, and remove the cause.                                                                                                   |
| Alarm 2020            | <b>TOOLON RESPONSE ERROR :</b><br>This alarm occurs if the TOOLON RESPONSE input signal does not turn on 3.0 seconds after the TOOLON instruction turns on. | Determine why the TOOLON RESPONSE signal does not turn on.<br>If the TOOLON signal is not to be used, short-circuit 6TB-8 and 0 V, to keep the signal always on. |

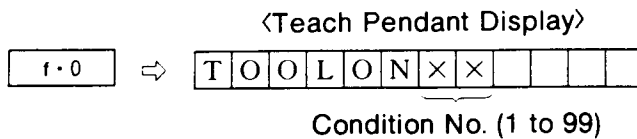
## 8. GENERAL-PURPOSE USE

Application other than the previous arc welding, spot welding, handling, etc. is operated as general application.

### 8.1 REGISTRATION AND FUNCTION FOR WORK START INSTRUCTION

(1) Registration from teach pendant

Specify work start instruction by depressing f·0 key.



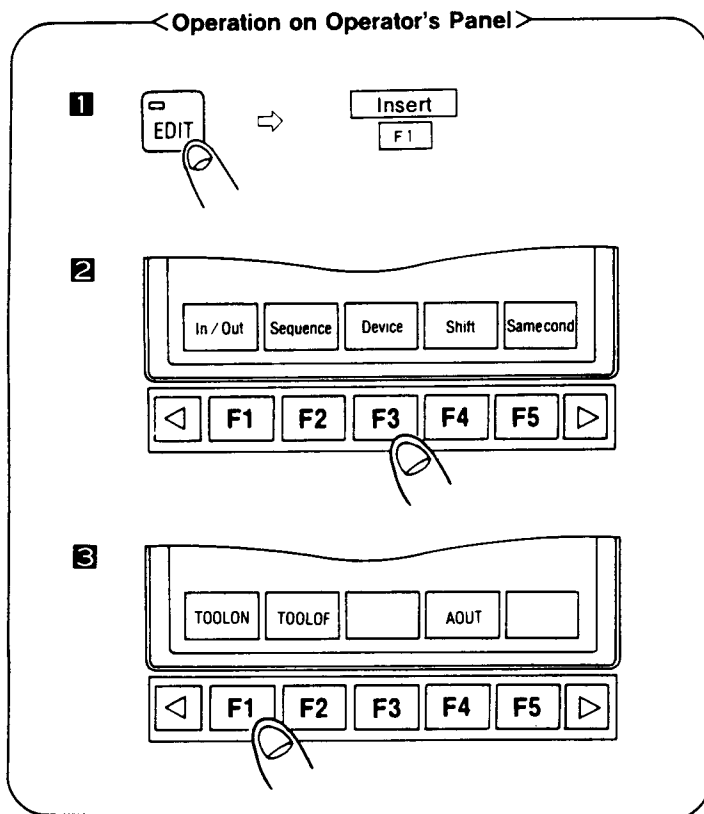
Without condition No:

TOOLON instruction Registration

With condition No: CALL instruction registration

(CALL TOOLONXX)  
Job name

(2) Registration from operator's panel



Depress EDIT key and

Insert  
F1 soft key.

Depress Device  
F3 soft key.

Depress TOOLON  
F1 soft key.

TOOLON instruction is registered.



- (3) Work start instruction (TOOLON) function  
Turns on the TOOLON instruction.

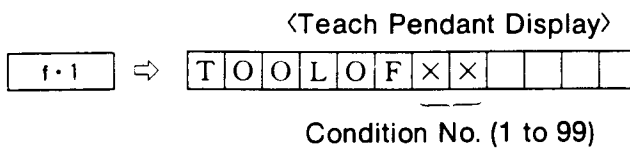
Turns on the TOOLON instruction (special output relay # 5050), waits for the WORK START RESPONSE (special input relay # 4050), and executes the next instruction when the WORK START RESPONSE turns on.

The WORK START RESPONSE relay turns on immediately after the WORK START instruction is output.

## 8.2 REGISTRATION AND FUNCTION FOR WORK COMPLETE INSTRUCTION

- (1) Registration from teach pendant

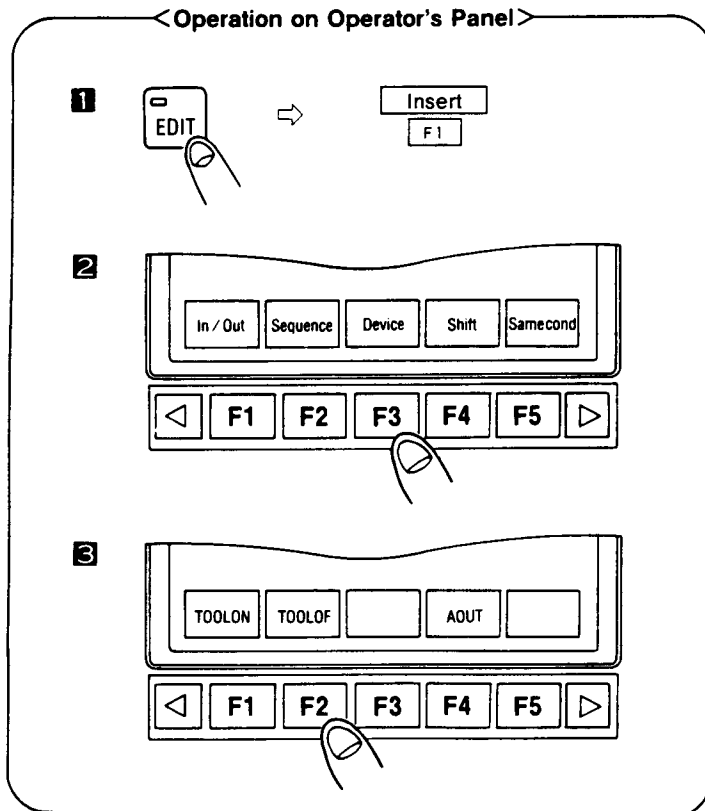
Specify work complete instruction by depressing f.1 key.



Without condition No: TOOLOF instruction  
Registration

With condition No: CALL instruction  
registration  
(CALL TOOLOFX X)  
Job name

- (2) Registration from operator's panel



Depress EDIT key and  
Insert  
F1 soft key.

Depress Device  
F3 soft key.

Depress TOOLOF  
F2 soft key.

TOOLOF instruction is registered.

(3) WORK COMPLETE instruction (TOOLOF) function

Turns off the work instruction.

Turns on the TOOLOF instruction (special output relay # 5051), waits for the WORK COMPLETE RESPONSE (special input relay # 4050), and executes the next instruction when the WORK START RESPONSE turns on.

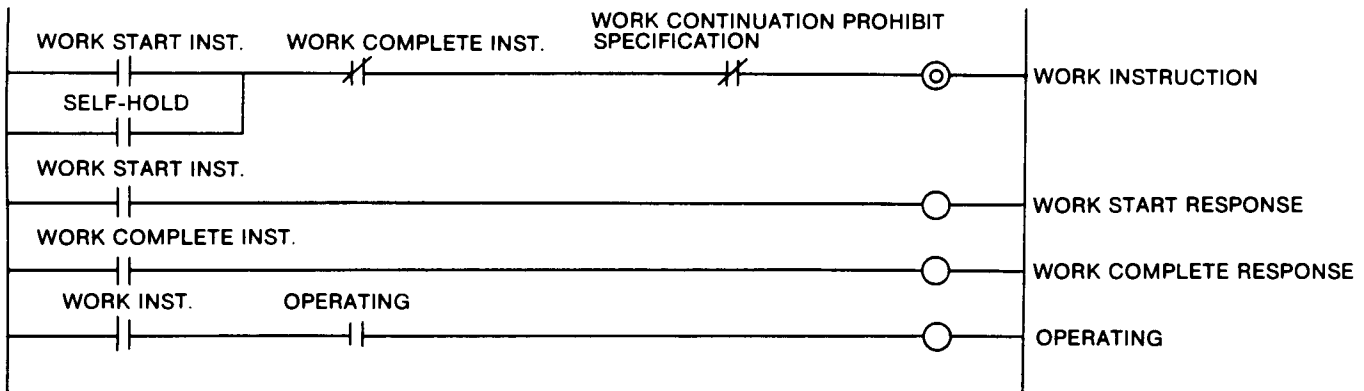
The WORK COMPLETE RESPONSE relay turns on immediately after the WORK COMPLETE instruction is output.

The work instruction is controlled so that it self-holds when the TOOLON instruction turns on, and turns off when the TOOLOF instruction turns on.





If the work is stopped before completion, the work instruction also turns off. The work instruction does not turn off even when the manipulator stops, if the "WORK ABORT PROCESS" specification in the diagnosis display is set for "KEEP".

When the "WORK ABORT PROCESS" specification is set for "RELEASE", the work instruction turns off when the manipulator stops, and does not turn on when the operation is restarted. If the work instruction must turn off when the manipulator stops, and turn on when the manipulator restarts, specify the "WORK ABORT PROCESS" for "KEEP", and change the output connection so that the work instruction output is "KEEP".

The work instruction is not specially assigned in the general application ladder. Therefore, when the operation is to be controlled by the TOOLON, TOOLOF instructions, change the output connection so that the work instruction is output to the used general output relay.



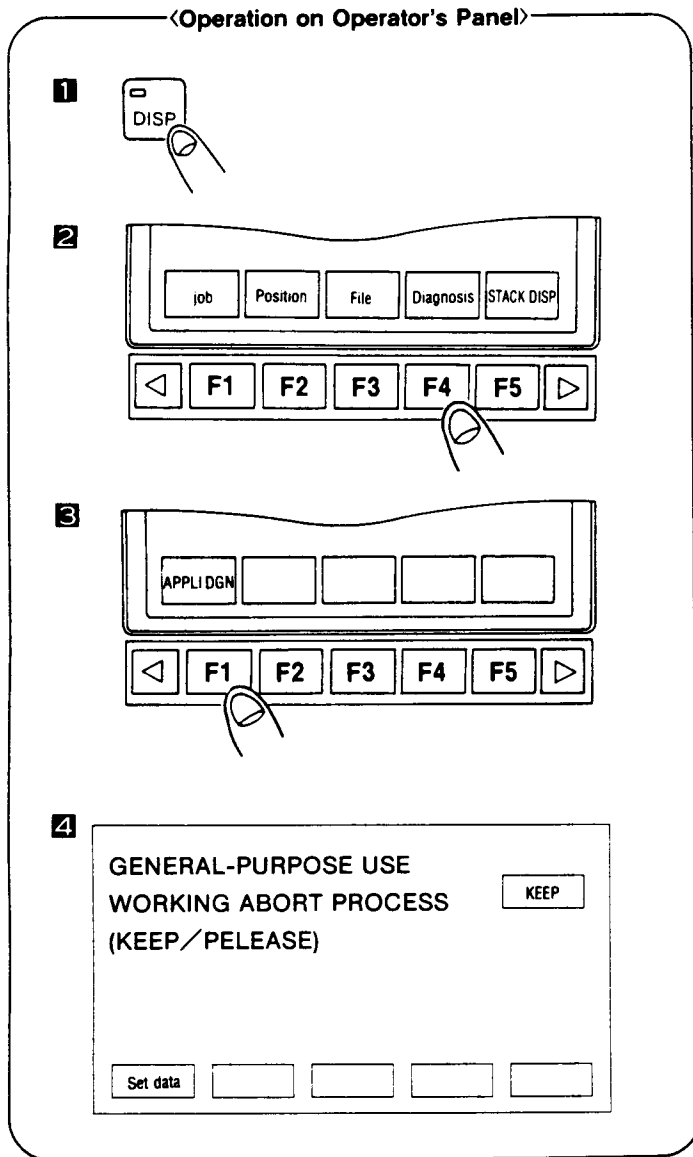
### 8.3 LIST OF OPERATION ON TEACH PENDANT

| key                                                                               | Contents                                                                                |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
|  | Registration of TOOLON (work start) or CALL TOOLONXX instruction<br>(reserved job name) |
|  | Registration of TOOLOF (work end) or CALL TOOLOFXX instruction<br>(reserved job name)   |
|  | For analog condition output #1:<br>Registration of AOUT #1 XX instruction<br>(data)     |
|  | For analog condition output #2:<br>Registration of AOUT #2 XX instruction<br>(data)     |

## 8.4 GENERAL-PURPOSE DIAGNOSIS FUNCTION

If the work (while the TOOLON instruction is on) is stopped before completion, the TOOLON instruction also turns off.

Specify whether to continue the TOOLON instruction upon restart, as follows.



<Description>

Depress key.

Depress soft key.

Depress soft key.

**NOTE** If soft key is not displayed, depress key.

The initial setting is "RELEASE", so the work is continued when restarted after stopping.

Set "KEEP" by the soft key in this display, if the work is to be continued.

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OPERATOR'S MANUAL FOR EACH APPLICATION

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YASKAWA ELECTRIC CORPORATION

# **ERC DEDICATED I/O GUIDELINES**

**Part Number 479236-14**

*July 7, 1993*

## **MOTOMAN**

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*West Carrollton, OH 45449*

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# 1.0 INTRODUCTION

The Motoman ERC / K-series robots contain many dedicated inputs and outputs located on the I/O03 board inside the ERC controller. The actual number and use of some of them can change based on how the robot is configured and its application. These dedicated inputs and outputs are useful for controlling and interfacing the robot to external equipment. This manual discusses and shows example electrical connections for some of these dedicated inputs and outputs. Some connection points are located on terminal blocks, some on 50 pin Honda connectors and some on both. Refer to the Motoman "ERC Controller I/O Structure" manual (479236-4) for more information on inputs and outputs.

*NOTE: The 50 pin Honda connectors have both input and output connections. Most dedicated input and output signals (EXTERNAL HOLD input or ARC START output) appear on the connector CN01 (O1C). The common "+24 VU" appears on pins 44 through 46 on each connector. The common "0 VU" appears on Pins 47 through 49 on each Honda connector.*

## 1.1 GENERAL SPECIFICATIONS

- The ERC relay dry contact outputs are rated at 200 VAC / 1/2 A or 48 VDC / 1/2 A.
- The transistor outputs are rated at 24 VDC / 50mA (sinking).
- The transistor inputs are rated at 24 VDC / 5mA (pull low to activate).
- All transistor inputs and outputs must share a common DC ground connection for proper operation.
- Isolation must always be provided from high voltage and from high frequency electrical noise/interference.
- All changes made to the robot and/or system must be checked for proper operation with the robot at slow speed.

*NOTE: TB designates a terminal block and CN designates a connector.*



### **DANGER!**

***Improper wiring can cause severe personal injury or death and damage to the equipment! Only trained personnel familiar with the robot manuals, electrical design and equipment interconnections should be permitted to modify the system.***





## **DANGER!**

***All parameter modifications and I/O modifications made to the ERC controller will change the way the robot operates and can cause severe personal injury or death, and damage to the robot. This includes ERC parameters and NODES 1, 2 or 3. Recheck and test all changes at slow speed.***



## **WARNING!**

***Do not apply any voltage to the robot input connections! This will damage the input module and cause serious and costly damage to the I/O 03 board.***



## **CAUTION!**

***Improper operation can damage equipment! Only trained personnel familiar with the operation of this Motoman robot, the operator manuals, the system equipment, options, and accessories should be permitted to operate this robot system.***



## **CAUTION!**

***Improper connections can damage the robot! Check all connections for proper voltages and currents before making connections.***



## **NOTICE**

***Back up all your programs and jobs on a floppy disk whenever program changes are made. A backup must always be made before any servicing or changes are made to options, accessories or equipment to avoid loss of system information, programs and jobs.***

## 2.0 EMERGENCY STOP INPUT

The external emergency stop (E-STOP) input enables an external device such as a normally closed **EMERGENCY STOP** button to put the ERC in an emergency stop condition and turn the servo power OFF. When external emergency stop devices are not connected to the ERC, these connection points must be connected with a jumper wire.

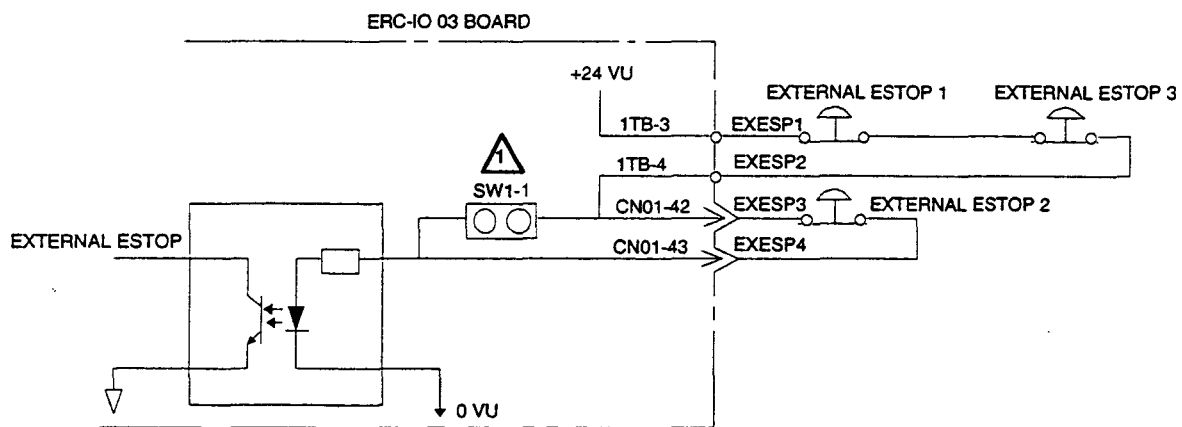
There are two pairs of connection points for the external emergency stop input; one pair is located on Terminal Block 1TB (1TB-3 and 1TB-4), the other is located on the Honda Connector CN01 (pins 42 and 43). Additional information about these and other connection points can be found in the operator's manual, operator's manual appendix, OP2 Key manual, and the maintenance manual.

Any number of external emergency stop devices can be connected to the ERC. The jumper wire between 1TB-3 and 1TB-4 must be removed and the external emergency stop devices must be hard-wired in series between 1TB-3 and 1TB-4 or CN01-42 and CN01-43 as shown in Figure 2-1.



### **CAUTION!**

**Check all safety equipment frequently for proper operation!**



**Figure 2-1 External Emergency Stop Input Connection**

**NOTE:** Remove SW1-1 jumper if the Honda plug E-STOP connection (CN01-42 and CN01-43) is used.

## **3.0 EMERGENCY STOP OK OUTPUT**

The EMERGENCY STOP OK output is used to stop other equipment external to the robot. It is a normally open relay contact on the I/O03 board inside the ERC. The connection points for the emergency stop OK contact are 1TB-7 and 1TB-8. The EMERGENCY STOP OK contact is closed when the ERC is not in E-STOP.

This contact is opened when any one of the following conditions occurs:

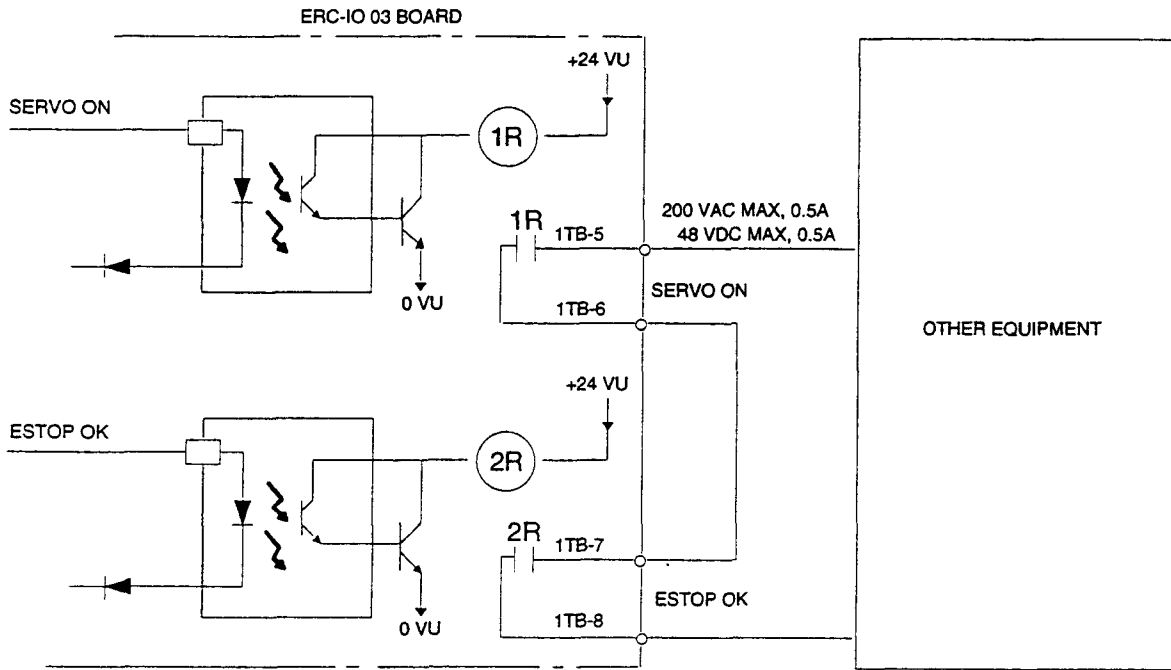
- The **EMERGENCY STOP** button on the ERC front panel is pressed.
- The **EMERGENCY STOP** button on the ERC teach pendant is pressed.
- The connection between 1TB-3 and 1TB-4 is opened (external emergency stop).
- The connection between CN01-42 and CN01-43 is opened.
- ERC power is turned OFF.
- The tool mount shock sensor is impacted (optional).

The ERC emergency stop OK output signal is usually hard-wired in series with the SERVO POWER ON output signal as shown in Figure 3-1.



### ***CAUTION!***

***Check all safety equipment frequently for proper operation!***



**Figure 3-1 Emergency Stop OK Output Connection**  
 (See NOTE under Figure 6-1 regarding a "flyback diode")

## **4.0 SERVO POWER ON OUTPUT**

The SERVO POWER ON output contact is used to signal external equipment that the robot is ready. It is a normally open relay contact on the I/O03 board inside the ERC. The connection points for the SERVO POWER ON contact are 1TB-5 and 1TB-6. The SERVO POWER ON contact is closed **ONLY** when servo power is turned ON. This output is **NOT** the same as the E-STOP.

This contact is opened when any one of the following conditions occur:

- The **EMERGENCY STOP** button on the ERC front panel is pressed.
- The **EMERGENCY STOP** button on the ERC teach pendant is pressed.
- The connection between 1TB-3 and 1TB-4 is opened (external emergency stop).
- The connection between CN01-42 and CN01-43 is opened.
- ERC power is turned OFF.
- The tool mount shock sensor is impacted (optional).
- Servo power is OFF.

The emergency stop OK output signal and the SERVO POWER ON contacts are usually hard-wired in series as shown in Figure 3-1.



### **CAUTION!**

***The SERVO POWER ON output must NOT be used as an E-STOP!***



### **CAUTION!**

***Check all safety equipment frequently for proper operation!***

## 5.0 EXTERNAL HOLD INPUT

The external hold inputs enable external devices (switches, relays, etc.) to put the ERC in a hold condition. There are two types on the ERC. One pair of external hold inputs (normally closed) are located at 5TB-7 and 5TB-8. The other single external hold input (normally open) is located at 8TB-3. If no external hold devices are connected to the ERC, 4TB-3 (+24 VDC) and 5TB-7 are connected with a jumper wire. However, if an external hold device is connected to the ERC, the jumper wire must be removed and the external hold device (normally closed) must be hard-wired in series between 4TB-3 and 5TB-7 as shown in Figure 5-1.



### **WARNING!**

***The robot and other equipment can move unexpectedly which can cause severe personal injury or death, and damage to the robot!***



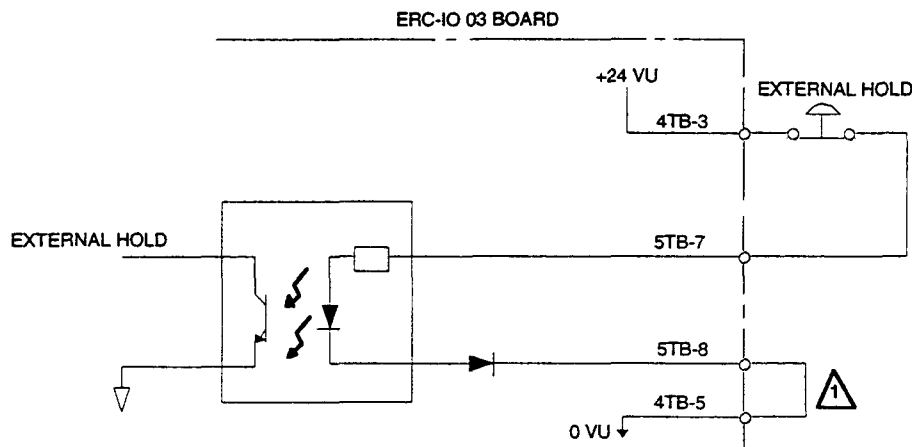
### **WARNING!**

***E-STOP the robot before entering the robot cell! Robot hold does not remove servo power.***



### **CAUTION!**

***The hold condition only stops the robot motion! It does NOT remove servo power. Use E-STOP to cut servo power.***



**Figure 5-1 External HOLD Input Connection**

**NOTE:** The jumper connection from 4TB-5 (DC common) to 5TB-8 must NOT be changed.

## 6.0 HOLDING OUTPUT

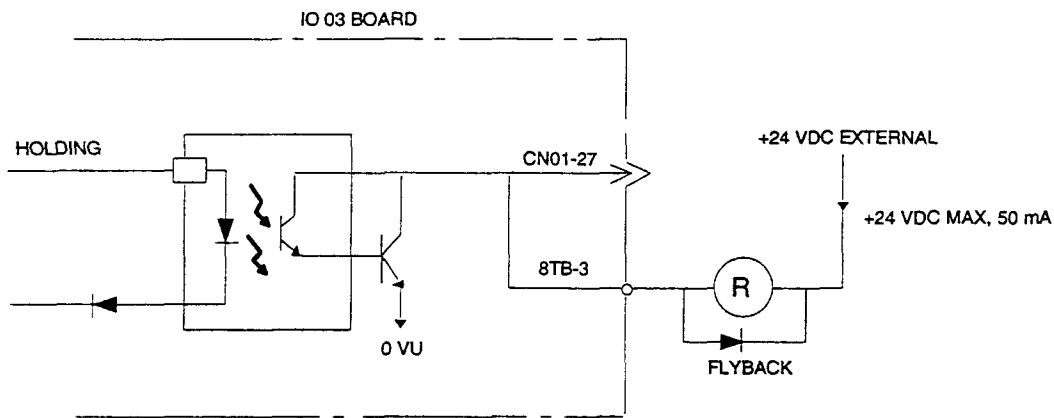
The hold output is used to signal external equipment that the robot is in hold mode.

This output is turned ON when any of the following condition occur:

- The ERC **HOLD** button is pushed momentarily.
- The robot is in hold mode due to an alarm occurrence.
- The robot is in hold mode due to external hold.

**NOTE:** Releasing the conditions listed above turns the hold output OFF.

Figure 6-1 shows an example of connecting the hold output to an external device.



**Figure 6-1 Hold Output Connection**

**NOTE:** A "flyback diode" must be placed across the DC load (DC relay coil, for example) that is driven by an output sinking transistor. The sinking transistor can easily be damaged by DC relay high voltage transients caused by inductive relay coils (see Figure 4). Damage to a transistor will cause the loss of the entire block of output transistors and require expensive repair. See Figure 4 for proper connections and polarity for the diode. The maximum output of the sinking transistor is .050 amp or 50 mA. Do not exceed 0.050 Ampere or serious damage will result to the I/O 03 board. Use Motoman Part Number ICZ-93B diode (Motorola 1N5395). Typically, a 200 PRV 1/2 amp diode will work in this application.

## 7.0 IN-GUARD SAFETY INPUT

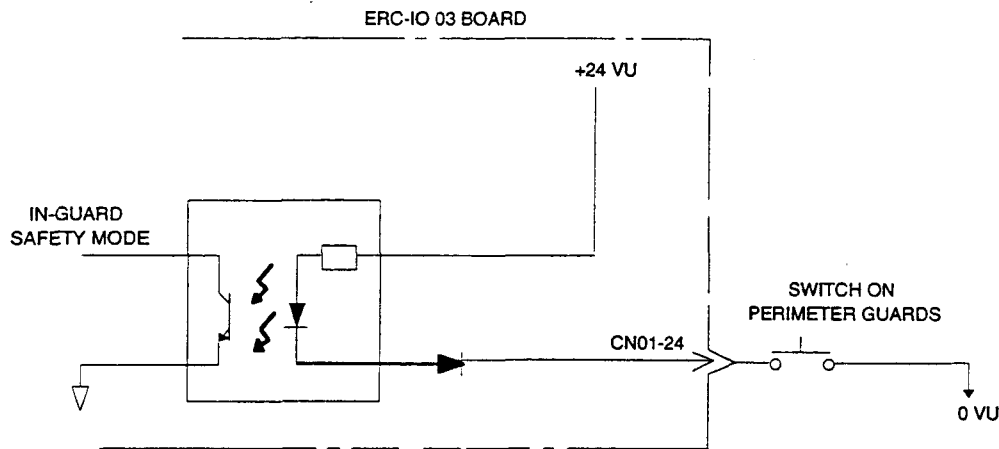
The in-guard safety input temporarily forces all robot moves to a preset slower speed. This input is usually wired to a safety mat or safety fence door switch and slows the robot move speeds **only** while the switch is activated. The robot resumes full speed motion immediately after the switch is de-activated.

Figure 7-1 shows an example of connecting a switch to the in-guard safety input.



### **CAUTION!**

**Check all safety equipment frequently for proper operation!**



**Figure 7-1 IN-GUARD SAFETY Connection**



# **ERC CONTROLLER I/O STRUCTURE**

**Part Number 479236-4**

*July 7, 1993*

**MOTOMAN**

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# 1.0 INTRODUCTION

## 1.1 INPUTS AND OUTPUTS

**Total Standard Inputs:** 54 (some dedicated based on robot application).

**Total Standard Outputs:** 36 (some dedicated based on robot application).

**Optional Expansion Board Inputs:** 48 (some dedicated based on robot application).

**Optional Expansion Board Outputs:** 32 (some dedicated based on robot application).

**Input Type:** LED (Light Emitting Diode) photo isolated transistor with indicator LED.

**Output Type:** Eight-1/2 amp 24 volt DC or 1/2 amp 200 volt AC normally open dry relay contacts. All other outputs are transistor sinking drivers (50 mA @ 24 volt DC) with LED indicators.

## 1.2 POWER SUPPLY

24 volt DC 1/2 amp maximum internal to ERC controller. When using loads that exceed the 1/2 amp, use an external 24 volt DC regulated linear transistor power supply. **Do not use switching regulator type power supplies due to switching noise.** External 24 volt power supply connections are made at the terminal strip 4TB and jumper changes must be made on the IO03 board.

*NOTE: If an external PLC (Programmable Logic Controller) is used, it must be capable of processing transistor sinking inputs and outputs. Check with the supplier of the Programmable Logic Controller. A "Sinking Input" is a condition where the input signal to the IO03 board is connected to ground to indicate a logical true state of the PLC. A "Sinking Output" is one which "sinks" the load to ground to activate the device.*



### **WARNING!**

***Improper wiring can cause severe personal injury or death, and possible equipment damage! Only trained personnel familiar with the robot manuals, electrical design and equipment interconnections should be permitted to modify the system.***



## **DANGER!**

**All parameter modifications and I/O modifications made to the ERC controller will change the way the robot operates and can cause severe personal injury or death, and possible equipment damage. This includes ERC parameters and NODES 1, 2 or 3. Recheck and test all changes at slow speed.**

NOTE:

The 50 pin Honda connectors have both input and output connections. Most dedicated input and output signals (EXTERNAL HOLD input or ARC START output) appear on the connector CN01 (01C). The common "+24 VU" appears on pins 44 through 46 on each connector. The common "0 VU" appears on pins 47 through 49 on each Honda connector.



## **WARNING!**

**Do not apply any voltage to the robot to input connections! This will damage the input module and cause serious and costly damage to the I003 board.**



## **CAUTION!**

**Improper operation can damage equipment! Only trained personnel familiar with the operation of this Motoman robot, the operator manuals, the system equipment, options, and accessories should be permitted to operate this robot system.**



## **CAUTION!**

**Improper connections can damage the robot! Check all connections for proper voltages and currents before making connections.**

NOTE:

Back up all your programs and jobs on a floppy disk whenever program changes are made. A backup must always be made before any servicing or changes are made to options, accessories or equipment to avoid loss of system information, programs, and jobs.

# 2.0 TRANSISTOR INPUTS

## 2.1 INPUT CONNECTIONS

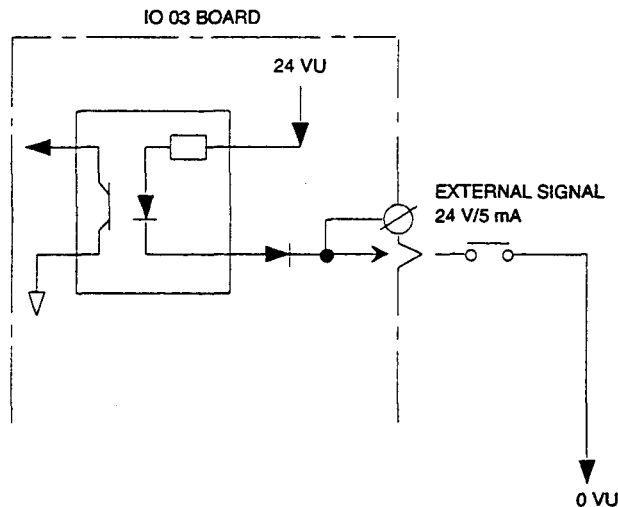
Some input connections are made at both the 50 pin Honda connectors (CN01 (01C) and CN02 (02C)) and screw terminal strips, while others are dedicated to only the Honda connectors or terminal strips. See Appendix B for further details.

## 2.2 INPUT CONDITIONS

The input condition must remain stable for a minimum of .020 seconds. The ERC scans the inputs and if there is a change in logic, it scans a second time to confirm the change. This eliminates relay contact bounce that might occur and give false indications. When the input terminal, 02C-17 for example (see Figure 2-1), is brought to ground potential by either a switch, a contact, or a PLC, the LED on the IO03 board will light and the input confirmed 40 ms later. There are red LED indicator lamps on each input.

### **CAUTION!**

***Improper connections can damage the robot! Check all connections for proper voltages and currents before making connections.***



**Figure 2-1 Input Connections**

## 3.0 RELAY OUTPUTS

### 3.1 OUTPUT RELAYS CONNECTIONS

The output relays (OUT #9 through OUT #16) on the I/O board have a rating of 1/2 amp 48 volt DC or 1/2 amp 200 volt AC. Even though the rating is 1/2 amp, the contact can be damaged by high voltage transients caused by the inductive kick of relay coils. It is necessary to apply a "flyback" diode across a DC relay coil or an RC network or MOV for an AC coil to suppress the high voltage when the relay coil is de-energized. Each relay has an LED indicator lamp that lights when the coil is energized. See Figure 3-1 for suppression of the DC relay coil.

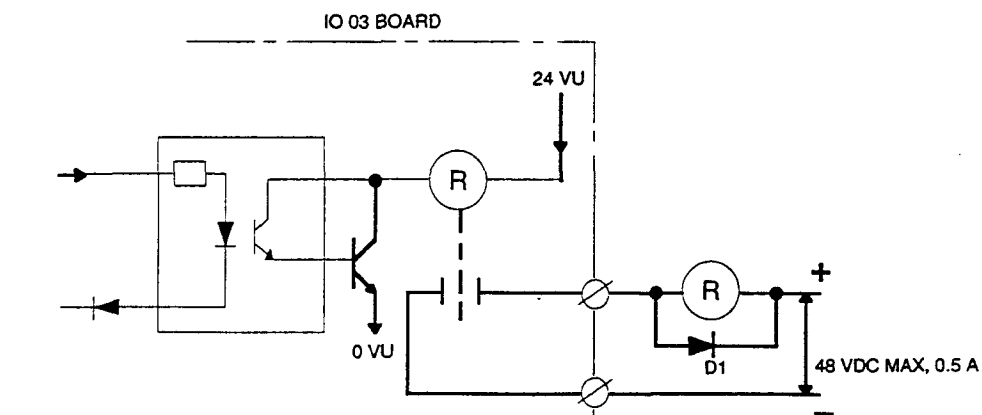
### 3.2 OUTPUT CONNECTIONS

Some output connections are made at both the 50 pin Honda connectors (CN01 (01C) and CN02 (02C)) and terminal strips, while others are dedicated to only the Honda connectors or terminal strips. See Appendix B for further details.



### CAUTION!

**Improper connections can damage the robot! Check all connections for proper voltages and currents before making connections.**



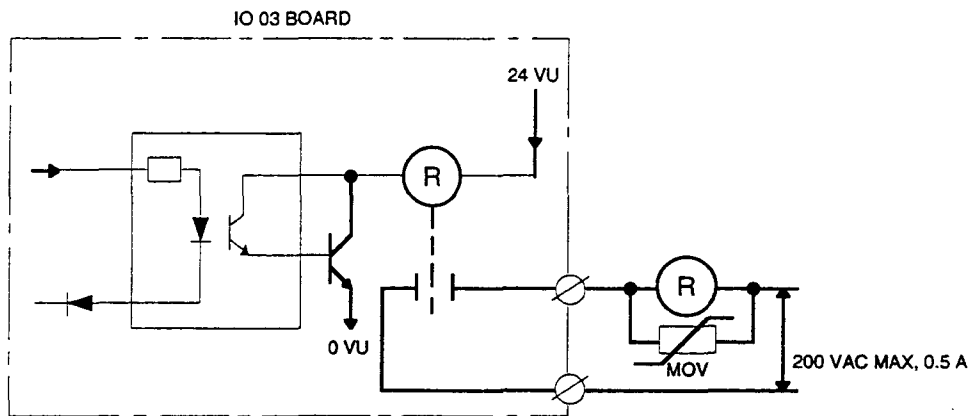
**Figure 3-1 Output with DC Relay Coil**

Typically, higher rated 24 volt DC relays are connected to the internal hard relay contacts (OUT #9 through OUT #16) and the transistor sinking outputs on the IO03 board. Relays should be selected from a reputable manufacturer and should have good life expectancy with the voltage and current rating based on application and typical loads.

Use Motoman Part Number 470108 (4PDT) relay with 24 volt coil (37 mA, 680 ohm) and DIN rail mounting for relay socket #471628. The relay may be obtained from Motoman or other sources (Omron type MY4Z or equivalent).

**NOTE:** *If the relay has an LED indicator, add 5-10 mA to total relay current draw and observe the coil and LED polarity.*

When an isolated Normally Open relay contact (OUT #9 for example) is used to actuate external AC relays or devices, a suppresser must be used across the load (see Figure 3-2). If the voltage is 125 volts AC, use Motoman suppresser Part Number 403955-10 (General Electric Part Number V150LA10A rated at 150 volts AC). If the supply is 24 volt AC, use the 40 volt RMS suppresser Motoman Part Number 403955-2 (General Electric Part Number V40LA10A). The suppresser should be placed directly across the load and as close as possible. This device is a General Electric Metal Oxide Varister (MOV) and can be obtained in both higher and lower voltages and current ratings. See the General Electric literature for more details.

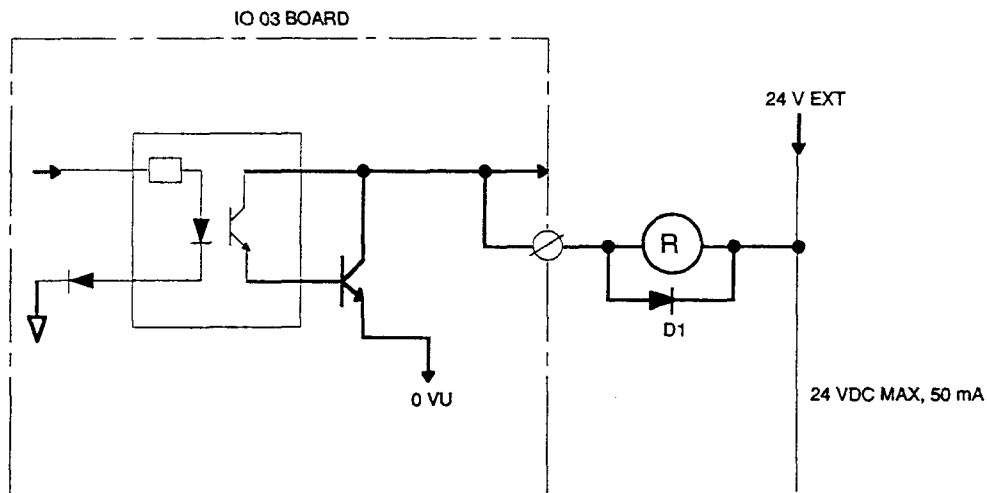


**Figure 3-2 Output with AC Relay Coil**

## 4.0 TRANSISTOR SINKING OUTPUTS

A "flyback diode" must be placed across the DC load (DC relay coil, for example) that is driven by an output sinking transistor. The sinking transistor can easily be damaged by DC relay high voltage transients caused by inductive relay coils (see Figure 4-1). Damage to a transistor will cause the loss of the entire block of output transistors and require expensive repair. See Figure 4-1 for proper connections and polarity for the diode. The maximum output of the sinking transistor is .050 amp or 50 mA. Do not exceed 0.050 Ampere or serious damage will result to the IO03 board.

Use Motoman Part Number 1CZ-93B diode (Motorola 1N5395). Typically, a 200 PRV 1/2 amp diode will work in this application.



**Figure 4-1 Transistor Sinking**



## **5.0 INCANDESCENT LAMP LOADS**

In some cases, transistor sinking outputs may be used to drive an incandescent lamp directly. It is recommended however, that the transistor output be used to drive a Light Emitting Diode (LED) if a low level indicator is needed or a separate relay if more output current is required. Using the output transistor to drive an incandescent lamp may cause failure of the transistor due to the inherent low "COLD" resistance of the lamp. The incandescent lamp must not draw more than 50 mA inrush.

A GE #757 24 volt incandescent bulb used in many panel indicators draws .080 amperes. This is too much current for the output transistor. A GE #1819 incandescent lamp has an operating current of .040 amperes, but a cold inrush current of .25 ampere. Even though the bulb is within the "HOT" rating, the "COLD" resistance of the lamp will cause excessive inrush current. The GE #1819 lamp has a "COLD" resistance of 100 ohms and a hot resistance of 600 ohms. The 6:1 ratio of "HOT to COLD resistance" is typical of incandescent lamps.

In some cases, the use of a "keep alive resistor" may allow operation of an incandescent lamp. The "keep alive resistor" is placed in parallel with the operating device (transistor or relay contact) to pass a portion of the current through the lamp continuously to reduce the "Cold Inrush" current.

Since the selection of a keep alive resistor is dependent on a specific incandescent lamp rating, it is better to use LED lamp replacements. Incandescent lamp replacements use clusters of LEDs, and while not as bright as incandescent lamps, their life is over 100,000 hours. Replacement lamps LED clusters in T3 1/4 miniature bayonet configuration (B328 CW R 6 28V/20-D) may be obtained from Motoman Part Number 479494 or Ledtronics, Inc. in California (213) 676-7996. Both Square D and GE also make LED panel lamps.

## **6.0 OPTIONAL EXPANSION I/O BOARD**

The optional expansion I/O board (IO04) adds additional input and output connections (see Appendix A). All input and output connections are made by two 50 pin Honda connectors (OC3 and OC4) with the board mounting below the existing I/O board.

*NOTE: This IO04 mounting area is typically used for other interface relay panels and may interfere with the board mounting if added later.*

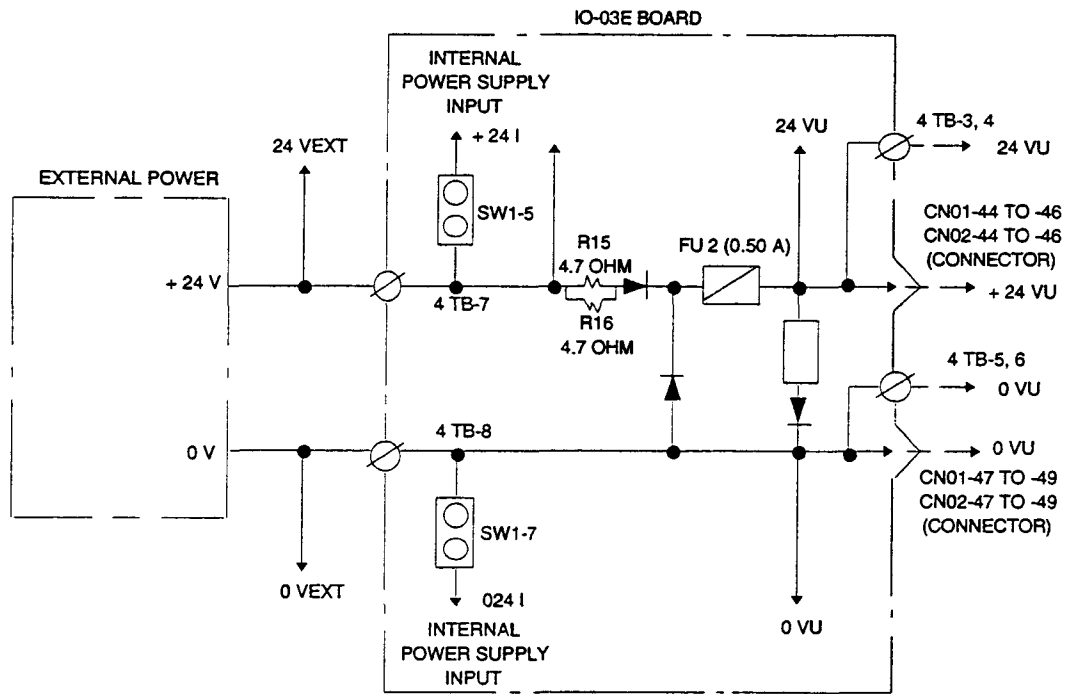
### **6.1 INPUTS AND OUTPUTS**

**Inputs:** 48 (some dedicated based on robot application)

**Outputs:** 32 (some dedicated based on robot application) All outputs are transistor sinking type. No hard isolated relay contacts are on the IO04 board.

### **6.2 POWER SUPPLY**

Optional, based on load. The board draws its logic power from connections on the IO03 and the ERC 24 volt supply. Keep in mind that extra outputs can draw up to 50 mA each, and inputs 5 mA each. The additional load to the ERC power supply can be as much as .78 ampere DC. If an additional power supply is required, use Motoman Part Number 471907-2 (Power One Part Number HB24-1.2-A) or equivalent. This power supply is rated at 1.2 ampere, 24 volt DC. Use only linear regulators, since switching regulators can cause problems with switching noise and high frequency ripple. See Figure 6-1 for installation of an additional 24 volt DC power supply. Note that the additional power supply is connected to 4TB-7 and 4TB-8. Jumper pins SW1-5 and SW1-7 must be removed. Do not change the value of the 1/2 ampere fuse on the IO03 board. A separate fuse should be added for the external power supply.



**Figure 6-1 Added 24 Volt DC Power Supply**

**NOTE:**

The 50 pin Honda connectors have both input and output connections. Most dedicated input and output signals (EXTERNAL HOLD input or ARC START output) appear on the connector CN01 (01C). The common "+24 VU" appears on pins 44 through 46 on each connector. The common "0 VU" appears on pins 47 through 49 on each Honda connector.

### ERC Default Input and Output Assignments for Each Application

| In<br>O-Out                                                                      | Input<br>Term. # | Connector<br>Number | Relay<br>Number | WELDING<br>I/O<br>Name | SPOT WELD<br>I/O<br>Name | HANDLING<br>I/O<br>Name | SEALING<br>I/O<br>Name | LASER CUT<br>I/O<br>Name | PLASMA CUT<br>I/O<br>Name | CUTTING<br>I/O<br>Name | GENERAL<br>I/O<br>Name |
|----------------------------------------------------------------------------------|------------------|---------------------|-----------------|------------------------|--------------------------|-------------------------|------------------------|--------------------------|---------------------------|------------------------|------------------------|
| <b>TOTAL INPUTS</b>                                                              |                  |                     |                 | 54                     | 54                       | 54                      | 54                     | 54                       | 54                        | 54                     | 54                     |
| <b>DEDICATED INPUTS</b>                                                          |                  |                     |                 | 22                     | 22                       | 22                      | 22                     | 22                       | 22                        | 22                     | 14                     |
| <b>USER INPUTS AVAILABLE</b>                                                     |                  |                     |                 | 32                     | 32                       | 32                      | 32                     | 32                       | 32                        | 32                     | 40                     |
| <b>TOTAL OUTPUTS</b>                                                             |                  |                     |                 | 36                     | 36                       | 36                      | 36                     | 36                       | 36                        | 36                     | 36                     |
| <b>DEDICATED OUTPUTS</b>                                                         |                  |                     |                 | 20                     | 28                       | 24                      | 21                     | 20                       | 21                        | 21                     | 12                     |
| <b>USER OUTPUTS AVAILABLE</b>                                                    |                  |                     |                 | 16                     | 8                        | 12                      | 15                     | 16                       | 15                        | 15                     | 24                     |
| <b>Optional EXPANDED I/O-04 BOARD (add to above input and output quantities)</b> |                  |                     |                 |                        |                          |                         |                        |                          |                           |                        |                        |
| <b>TOTAL INPUTS</b>                                                              |                  |                     |                 | 48                     | 48                       | 48                      | 48                     | 48                       | 48                        | 48                     | 48                     |
| <b>DEDICATED INPUTS</b>                                                          |                  |                     |                 | 0                      | 0                        | 0                       | 0                      | 0                        | 0                         | 0                      | 0                      |
| <b>USER AVAILABLE INPUTS</b>                                                     |                  |                     |                 | 48                     | 48                       | 48                      | 48                     | 48                       | 48                        | 48                     | 48                     |
| <b>TOTAL OUTPUTS</b>                                                             |                  |                     |                 | 32                     | 32                       | 32                      | 32                     | 32                       | 32                        | 32                     | 32                     |
| <b>DEDICATED OUTPUTS</b>                                                         |                  |                     |                 | 2                      | 1                        | 1                       | 1                      | 1                        | 1                         | 1                      | 1                      |
| <b>USER AVAILABLE OUTPUTS</b>                                                    |                  |                     |                 | 30                     | 31                       | 31                      | 31                     | 31                       | 31                        | 31                     | 31                     |

## ERC Default Input and Output Assignments for Each Application

| I=In  | Input   | Connector | Relay  | WELDING       | SPOT WELD     | HANDLING       | SEALING       | LASER CUT     | PLASMA CUT    | CUTTING       | GENERAL       |
|-------|---------|-----------|--------|---------------|---------------|----------------|---------------|---------------|---------------|---------------|---------------|
| O=Out | Term. # | Number    | Number | I/O<br>Name   | I/O<br>Name   | I/O<br>Name    | I/O<br>Name   | I/O<br>Name   | I/O<br>Name   | I/O<br>Name   | I/O<br>Name   |
| I     | 1TB-1   |           |        | Cont. pwr off | Cont. pwr off | Cont. pwr off  | Cont. pwr off | Cont. pwr off | Cont. pwr off | Cont. pwr off | Cont. pwr off |
| I     | 1TB-2   |           |        | Cont. pwr off | Cont. pwr off | Cont. pwr off  | Cont. pwr off | Cont. pwr off | Cont. pwr off | Cont. pwr off | Cont. pwr off |
| I     | 1TB-3   |           |        | ESTOP         | ESTOP         | ESTOP          | ESTOP         | ESTOP         | ESTOP         | ESTOP         | ESTOP         |
| I     | 1TB-4   |           |        | ESTOP         | ESTOP         | ESTOP          | ESTOP         | ESTOP         | ESTOP         | ESTOP         | ESTOP         |
| O     | 1TB-5   |           |        | Servo pwr on  | Servo pwr on  | Servo pwr on   | Servo pwr on  | Servo pwr on  | Servo pwr on  | Servo pwr on  | Servo pwr on  |
| O     | 1TB-6   |           |        | Servo pwr on  | Servo pwr on  | Servo pwr on   | Servo pwr on  | Servo pwr on  | Servo pwr on  | Servo pwr on  | Servo pwr on  |
| O     | 1TB-7   |           |        | Estop OK      | Estop OK      | Estop OK       | Estop OK      | Estop OK      | Estop OK      | Estop OK      | Estop OK      |
| O     | 1TB-8   |           |        | Estop OK      | Estop OK      | Estop OK       | Estop OK      | Estop OK      | Estop OK      | Estop OK      | Estop OK      |
| O     | 2TB-1   | 3040      |        | Out #9        | Weld Timer    | Out #9         | Out #9        | Out #9        | Out #9        | Out #9        | Out #9        |
| O     | 2TB-2   | 3040      |        | Out #9        | binary bit 0  | Out #9         | Out #9        | Out #9        | Out #9        | Out #9        | Out #9        |
| O     | 2TB-3   | 3041      |        | Out #10       | Weld Timer    | Out #10        | Out #10       | Out #10       | Out #10       | Out #10       | Out #10       |
| O     | 2TB-4   | 3041      |        | Out #10       | binary bit 1  | Out #10        | Out #10       | Out #10       | Out #10       | Out #10       | Out #10       |
| O     | 2TB-5   | 3032      |        | Out #11       | Weld timer    | Out #11        | Out #11       | Out #11       | Out #11       | Out #11       | Out #11       |
| O     | 2TB-6   | 3042      |        | Out #11       | Binary bit 2  | Out #11        | Out #11       | Out #11       | Out #11       | Out #11       | Out #11       |
| O     | 2TB-7   | 3043      |        | Out #12       | weld timer    | Out #12        | Out #12       | Out #12       | Out #12       | Out #12       | Out #12       |
| O     | 2TB-8   | 3043      |        | Out #12       | Binary bit 3  | Out #12        | Out #12       | Out #12       | Out #12       | Out #12       | Out #12       |
| O     | 3TB-1   | 3044      |        | Out #13       | Pres chg Inst | Hnd1 catch Ins | Out #13       | Out #13       | Out #13       | Out #13       | Out #13       |
| O     | 3TB-2   | 3044      |        | Out #13       | Pres chg Inst | Hnd1 catch Ins | Out #13       | Out #13       | Out #13       | Out #13       | Out #13       |
| O     | 3TB-3   | 3045      |        | Out #14       | Gun Full open | hand1rel Ins   | Out #14       | Out #14       | Out #14       | Out #14       | Out #14       |
| O     | 3TB-4   | 3045      |        | Out #14       | Gun full open | hand rel Ins   | Out #14       | Out #14       | Out #14       | Out #14       | Out #14       |
| O     | 3TB-5   | 3046      |        | Out #15       | Welding on    | Hnd2 catch Ins | Out #15       | Out #15       | Out #15       | Out #15       | Out #15       |
| O     | 3TB-6   | 3046      |        | Out #15       | Welding on    | Hnd2 catch Ins | Out #15       | Out #15       | Out #15       | Out #15       | Out #15       |
| O     | 3TB-7   | 3047      |        | Out #16       | Gun on Instr  | Hand2 rel Ins  | Gun on Instr  | Out #16       | Out #16       | Tool On Instr | Out #16       |
| O     | 3TB-8   | 3047      |        | Out #16       | Gun On Instr  | Hand2 rel Ins  | Gun on Instr. | Out #16       | Out #16       | Tool On Instr | Out #16       |
|       | 4TB-1   |           |        | PDIN          | PDIN          | PDIN           | PDIN          | PDIN          | PDIN          | PDIN          | PDIN          |
|       | 4TB-2   |           |        | PDIN          | PDIN          | PDIN           | PDIN          | PDIN          | PDIN          | PDIN          | PDIN          |
|       | 4TB-3   |           |        | +24 VDC       | +24 VDC       | +24 VDC        | +24 VDC       | +24 VDC       | +24 VDC       | +24 VDC       | +24 VDC       |
|       | 4TB-4   |           |        | +24 VDC       | +24 VDC       | +24 VDC        | +24 VDC       | +24 VDC       | +24 VDC       | +24 VDC       | +24 VDC       |
|       | 4TB-5   |           |        | "0" VDC       | "0" VDC       | "0" VDC        | "0" VDC       | "0" VDC       | "0" VDC       | "0" VDC       | "0" VDC       |
|       | 4TB-6   |           |        | "0" VDC       | "0" VDC       | "0" VDC        | "0" VDC       | "0" VDC       | "0" VDC       | "0" VDC       | "0" VDC       |
| I     | 4TB-7   |           |        | Ext. DC pwr   | Ext. DC pwr   | Ext. DC pwr    | Ext. DC pwr   | Ext. DC pwr   | Ext. DC pwr   | Ext. DC pwr   | Ext. DC pwr   |
| I     | 4TB-8   |           |        | Ext. DC pwr   | Ext. DC pwr   | Ext. DC pwr    | Ext. DC pwr   | Ext. DC pwr   | Ext. DC pwr   | Ext. DC pwr   | Ext. DC pwr   |
|       | 5TB-1   |           |        | DIN 1         | DIN 1         | DIN 1          | DIN 1         | DIN 1         | DIN 1         | DIN 1         | DIN 1         |
|       | 5TB-2   |           |        | DIN 1         | DIN 1         | DIN 1          | DIN 1         | DIN 1         | DIN 1         | DIN 1         | DIN 1         |

### ERC Default Input and Output Assignments for Each Application

| In  | Input   | Connector | Relay  | WELDING      | SPOT WELD    | HANDLING       | SEALING       | LASER CUT     | PLASMA CUT    | CUTTING        | GENERAL       |
|-----|---------|-----------|--------|--------------|--------------|----------------|---------------|---------------|---------------|----------------|---------------|
| Out | Term. # | Number    | Number | I/O Name     | I/O Name     | I/O Name       | I/O Name      | I/O Name      | I/O Name      | I/O Name       | I/O Name      |
|     | 5TB-3   |           |        | DIN 2        | DIN 2        | DIN 2          | DIN 2         | DIN 2         | DIN 2         | DIN 2          | DIN 2         |
|     | 5TB-4   |           |        | DIN 2        | DIN 2        | DIN 2          | DIN 2         | DIN 2         | DIN 2         | DIN 2          | DIN 2         |
|     | 5TB-5   |           |        | Wire stick   | DIN 3        | DIN 3          | DIN 3         | DIN 3         | DIN 3         | DIN 3          | DIN 3         |
|     | 5TB-6   |           |        | Wire stick   | DIN 3        | DIN 3          | DIN 3         | DIN 3         | DIN 3         | DIN 3          | DIN 3         |
|     | 5TB-7   |           |        | SHOCK SENS.  | SHOCK SENS.  | SHOCK SENS.    | DIN 4         | DIN 4         | SHOCK SENS.   | SHOCK SENS.    | SHOCK SENS.   |
|     | 5TB-8   |           |        | SHOCK SENS.  | SHOCK SENS.  | SHOCK SENS.    | DIN 4         | DIN 4         | SHOCK SENS.   | SHOCK SENS.    | SHOCK SENS.   |
| I   | 6TB-1   | 01C-1     | 2010   | SERVO ON     | SERVO ON     | SERVO ON       | SERVO ON      | SERVO ON      | SERVO ON      | SERVO ON       | SERVO ON      |
| I   | 6TB-2   | 01C-2     | 2011   | START        | START        | START          | START         | START         | START         | START          | START         |
| I   | 6TB-3   | 01C-3     | 2012   | HOLD         | HOLD         | HOLD           | HOLD          | HOLD          | HOLD          | HOLD           | HOLD          |
| I   | 8TB-4   | 01C-4     | 2013   | ALARM RESET  | ALARM RESET  | ALARM RESET    | ALARM RESET   | ALARM RESET   | ALARM RESET   | ALARM RESET    | ALARM RESET   |
| I   | 6TB-5   | 01C-5     | 2014   | CUBE INTF #1 | CUBE INTF #1 | Hnd1 catch chk | CUBE INTF #1  | CUBE INTF #1  | CUBE INTF #1  | CUBE INTF #1   | CUBE INTF #1  |
| I   | 6TB-6   | 01C-6     | 2015   | CUBE INTF #2 | CUBE INTF #2 | Hnd1 rel chk   | CUBE INTF #2  | CUBE INTF #2  | CUBE INTF #2  | CUBE INTF #2   | CUBE INTF #2  |
| I   | 6TB-7   | 01C-7     | 2016   | ARC PROHIBIT | Gun Open     | Hnd2 catch chk | Apl pnt proh. | Lsr strt proh | Plasma proh.  | Mach. Prohibit | Play/Auto sel |
| I   | 6TB-8   | 01C-8     | 2017   | ARC ON RESP  | Gun Open     | Hnd2 rel chk   | Gun on Resp   | Laser on resp | Plasma arc on | Tool on Resp   | Teaching      |
| I   | 7TB-1   | 01C-9     | 2020   | Input #1     | Input #1     | Input #1       | Input #1      | Input #1      | Input #1      | Input #1       | Input #1      |
| I   | 7TB-2   | 01C-10    | 2021   | Input #2     | Input #2     | Input #2       | Input #2      | Input #2      | Input #2      | Input #2       | Input #2      |
| I   | 7TB-3   | 01C-11    | 2022   | Input #3     | Input #3     | Input #3       | Input #3      | Input #3      | Input #3      | Input #3       | Input #3      |
| I   | 7TB-4   | 01C012    | 2023   | Input #4     | Input #4     | Input #4       | Input #4      | Input #4      | Input #4      | Input #4       | Input #4      |
| I   | 7TB-5   | 01C-13    | 2024   | Input #5     | Input #5     | Input #5       | Input #5      | Input #5      | Input #5      | Input #5       | Input #5      |
| I   | 7TB-6   | 01C-14    | 2025   | Input #6     | Input #6     | Input #6       | Input #6      | Input #6      | Input #6      | Input #6       | Input #6      |
| I   | 7TB-7   | 01C-15    | 2028   | Input #7     | Input #7     | Input #7       | Input #7      | Input #7      | Input #7      | Input #7       | Input #7      |
| I   | 7TB-8   | 01C-16    | 2027   | Input #8     | Input #8     | Input #8       | Input #8      | Input #8      | Input #8      | Input #8       | Input #8      |
| I   |         | 01C-17    | 2030   | Input #9     | Input #9     | Input #9       | Input #9      | Input #9      | Input #9      | Input #9       | Input #9      |
| I   |         | 01C-18    | 2031   | Input #10    | Input #10    | Input #10      | Input #10     | Input #10     | Input #10     | Input #10      | Input #10     |
| I   |         | 01C-19    | 2032   | Input #11    | Input #11    | Input #11      | Input #11     | Input #11     | Input #11     | Input #11      | Input #11     |
| I   |         | 01C-20    | 2033   | Input #12    | Input #12    | Input #12      | Input #12     | Input #12     | Input #12     | Input #12      | Input #12     |
| I   |         | 01C-21    | 2034   | Input #13    | Input #13    | Input #13      | Input #13     | Input #13     | Input #13     | Input #13      | Input #13     |
| I   |         | 01C-22    | 2035   | Input #14    | Input #14    | Input #14      | Input #14     | Input #14     | Input #14     | Input #14      | Input #14     |
| I   |         | 01C-23    | 2036   | Input #15    | Input #15    | Input #15      | Input #15     | Input #15     | Input #15     | Input #15      | Input #15     |
| I   |         | 01C-24    | 2037   | Input #16    | Input #16    | Input #16      | Input #16     | Input #16     | Input #16     | Input #16      | Input #16     |
| O   | 8TB-1   | 01C-25    | 3010   | PLAY/AUTO    | PLAY/AUTO    | PLAY/AUTO      | PLAY/AUTO     | PLAY/AUTO     | PLAY/AUTO     | PLAY/AUTO      | PLAY/AUTO     |
| O   | 8TB-2   | 01C-26    | 3011   | TEACHING     | TEACHING     | TEACHING       | TEACHING      | TEACHING      | TEACHING      | TEACHING       | TEACHING      |
| O   | 8TB-3   | 01C-27    | 3012   | HOLDING      | HOLDING      | HOLDING        | HOLDING       | HOLDING       | HOLDING       | HOLDING        | HOLDING       |
| O   | 8TB-4   | 01C-28    | 3013   | BATT LOW     | BATT LOW     | BATT LOW       | BATT LOW      | BATT LOW      | BATT LOW      | BATT LOW       | BATT LOW      |
| O   | 8TB-5   | 01C-29    | 3014   | WORK INTF#1  | WORK INTF#1  | WORK INTF#1    | WORK INTF#1   | WORK INTF#1   | WORK INTF#1   | WORK INTF#1    | WORK INTF#1   |
| O   | 8TB-6   | 01C-30    | 3015   | WORK INTF#2  | WORK INTF#2  | WORK INTF#2    | WORK INTF#2   | WORK INTF#2   | WORK INTF#2   | WORK INTF#2    | WORK INTF#2   |

## ERC Default Input and Output Assignments for Each Application

| In    | Input   | Connector | Relay  | WELDING      | SPOT WELD      | HANDLING       | SEALING        | LASER CUT     | PLASMA CUT     | CUTTING       | GENERAL      |
|-------|---------|-----------|--------|--------------|----------------|----------------|----------------|---------------|----------------|---------------|--------------|
| O=Out | Term. # | Number    | Number | I/O Name     | I/O Name       | I/O Name       | I/O Name       | I/O Name      | I/O Name       | I/O Name      | I/O Name     |
| O     | 8TB-7   | 01C-31    | 3016   | OPERATING    | OPERATING      | OPERATING      | OPERATING      | OPERATING     | OPERATING      | OPERATING     | OPERATING    |
| O     | 8TB-8   | 01C-32    | 3017   | ALARM OCCUR  | ALARM OCCUR    | ALARM OCCUR    | ALARM OCCUR    | ALARM OCCUR   | ALARM OCCUR    | ALARM OCCUR   | ALARM OCCUR  |
| O     |         | 01C-33    | 3020   | OPER. RDY    | START READY    | START READY    | START READY    | OPER. RDY     | START READY    | START READY   | Out #17      |
| O     |         | 01C-34    | 3021   | INGAURD SFTY | In-guard safty | In-guard safty | In-guard safty | INGAURD SFTY  | INGAURD SFTY   | INGAURD SFTY  | Out #18      |
| O     |         | 01C-35    | 3022   | ARC ON OUT   | Play/1 cycle   | Play/1 cycle   | Play/1 cycle   | Laser on      | ARC ON         | Play/1 cycle  | Out #19      |
| O     |         | 01C-36    | 3023   | ARC SHORTAGE | Wait Intf off  | Wait Intf off  | Wait Intf off  | Wait Intf off | Wait Intf off  | Wait Intf off | Out #20      |
| O     |         | 01C-37    | 3024   | GAS OUT      | Cont pwr ok    | Cont pwr ok    | Cont pwr ok    | Cont pwr ok   | Contr pwr ok   | Contr pwr ok  | Out #21      |
| O     |         | 01C-38    | 3025   | WIRE OUT     | Servo On       | Servo On       | Servo On       | Contr pwr on  | Servo on       | Servo on      | Out #22      |
| O     |         | 01C-39    | 3026   | ARC MISSING  | Chip Replace   | Catch Error    | Glue shortage  | Lsr noz short | ARC MISSING    | Tool Wear     | Out #23      |
| O     |         | 01C-40    | 3027   | WIRE STICK   | Spot wld error | Release error  | Apl glue error | Lsr pwr error | Pls pwr error  | Mach. Error   | Out #24      |
|       |         | 01C-41    | .      | Cntr pwr off | Contr pwr off  | Contr pwr off  | Contr pwr off  | Cntr pwr off  | Cntr pwr off   | Cntr pwr off  | Cntr pwr off |
|       |         | 01C-42    | .      | ESTOP        | ESTOP          | ESTOP          | ESTOP          | ESTOP         | ESTOP          | ESTOP         | ESTOP        |
|       |         | 01C-43    | .      | .            | .              | .              | .              | .             | .              | .             | .            |
|       |         | 01C-44    | .      | +24 VDC      | +24 VDC        | +24 VDC        | +24 VDC        | +24 VDC       | +24 VDC        | +24 VDC       | +24 VDC      |
|       |         | 01C-45    | .      | +24 VDC      | +24 VDC        | +24 VDC        | +24 VDC        | +24 VDC       | +24 VDC        | +24 VDC       | +24 VDC      |
|       |         | 01C-46    | .      | +24 VDC      | +24 VDC        | +24 VDC        | +24 VDC        | +24 VDC       | +24 VDC        | +24 VDC       | +24 VDC      |
|       |         | 01C-47    | .      | "0" VDC      | "0" VDC        | "0" VDC        | "0" VDC        | "0" VDC       | "0" VDC        | "0" VDC       | "0" VDC      |
|       |         | 01C-48    | .      | "0" VDC      | "0" VDC        | "0" VDC        | "0" VDC        | "0" VDC       | "0" VDC        | "0" VDC       | "0" VDC      |
|       |         | 01C-49    | .      | "0" VDC      | "0" VDC        | "0" VDC        | "0" VDC        | "0" VDC       | "0" VDC        | "0" VDC       | "0" VDC      |
|       |         | 01C-50    | .      | .            | .              | .              | .              | .             | .              | .             | .            |
| I     |         | 02C-1     | 2040   | Input #17    | Input #17      | Input #17      | Input #17      | Input #17     | Input #17      | Input #17     | Input #17    |
| I     |         | 02C-2     | 2041   | Input #18    | Input #18      | Input #18      | Input #18      | Input #18     | Input #18      | Input #18     | Input #18    |
| I     |         | 02C-3     | 2042   | Input #19    | Input #19      | Input #19      | Input #19      | Input #19     | Input #19      | Input #19     | Input #19    |
| I     |         | 02C-4     | 2043   | Input #20    | Input #20      | Input #20      | Input #20      | Input #20     | Input #20      | Input #20     | Input #20    |
| I     |         | 02C-5     | 2044   | Input #21    | Input #21      | Input #21      | Input #21      | Input #21     | Input #21      | Input #21     | Input #21    |
| I     |         | 02C-6     | 2045   | Input #22    | Input #22      | Input #22      | Input #22      | Input #22     | Input #22      | Input #22     | Input #22    |
| I     |         | 02C-7     | 2046   | Input #23    | Input #23      | Input #23      | Input #23      | Input #23     | Input #23      | Input #23     | Input #23    |
| I     |         | 02C-8     | 2047   | Input #24    | Input #24      | Input #24      | Input #24      | Input #24     | Input #24      | Input #24     | Input #24    |
| I     |         | 02C-9     | 2050   | Input #25    | Input #25      | Input #25      | Input #25      | Input #25     | Input #25      | Input #25     | Input #25    |
| I     |         | 02C-10    | 2051   | Input #26    | Input #26      | Input #26      | Input #26      | Input #26     | Input #26      | Input #26     | Input #26    |
| I     |         | 02C-11    | 2052   | Input #27    | Input #27      | Input #27      | Input #27      | Input #27     | Input #27      | Input #27     | Input #27    |
| I     |         | 02C-12    | 2053   | Input #28    | Input #28      | Input #28      | Input #28      | Input #28     | Input #28      | Input #28     | Input #28    |
| I     |         | 02C-13    | 2054   | Input #29    | Input #29      | Input #29      | Input #29      | Input #29     | Input #29      | Input #29     | Input #29    |
| I     |         | 02C-14    | 2055   | Input #30    | Input #30      | Input #30      | Input #30      | Input #30     | Input #30      | Input #30     | Input #30    |
| I     |         | 02C-15    | 2056   | Input #31    | Input #31      | Input #31      | Input #31      | Input #31     | Input #31      | Input #31     | Input #31    |
| I     |         | 02C-16    | 2057   | Input #32    | Input #32      | Input #32      | Input #32      | Input #32     | Input #32      | Input #32     | Input #32    |
| I     |         | 02C-17    | 2060   | Arc Occ. Chk | Weld Complete  | Cube1 Intf     | Glue shortage  | Laser on chk  | Plsm arc occur | Tool Wear     | Input #33    |
| I     |         | 02C-18    | 2061   | Arc shortage | Welding Error  | Cube2 Intf     | Apl Glue error | Lsr on Rdy    | Plsm pwr rdy   | Cutting Error | Input #34    |

### ERC Default Input and Output Assignments for Each Application

|       |         |           | WELDING | SPOT WELD      | HANDLING       | SEALING       | LASER CUT     | PLASMA CUT     | CUTTING        | GENERAL        |           |
|-------|---------|-----------|---------|----------------|----------------|---------------|---------------|----------------|----------------|----------------|-----------|
| I=In  | Input   | Connector | I/O     | I/O            | I/O            | I/O           | I/O           | I/O            | I/O            | I/O            |           |
| O=Out | Term. # | Number    | Name    | Name           | Name           | Name          | Name          | Name           | Name           | Name           |           |
| I     |         | 02C-19    | 2062    | Gas out        | Wire sticking  | Play/1 cycle  | Play/ 1 cycle | Lsr Noz short  | Arc Short      | Play/1 cycle   | Input #35 |
| I     |         | 02C-20    | 2063    | wire out       | Chip repl Done | Mstr job call | Mstr job call | Lsr pwr error  | Pis pwr error  | Mstr job call  | Input #36 |
| I     |         | 02C-21    | 2064    | Pnl. Prohibit  | Pnl Prohibit   | Pnl Prohibit  | Pnl Prohibit  | Pnl. Prohibit  | Pnl Prohibit   | Pnl Prohibit   | Input #37 |
| I     |         | 02C-22    | 2065    | Teach Mode Sel | Teach Mode     | Teach Mode    | Teach Mode    | Teach Mode Sel | Teach Mode Sel | Teach Mode Sel | Input #38 |
| I     |         | 02C-23    | 2066    | Play/Auto      | Play/Auto      | Play/Auto     | Play/Auto     | Play/Auto      | Play/Auto      | Play/Auto      | Input #39 |
| I     |         | 02C-24    | 2067    | In-guard Sfty  | In-guard Sfty  | In-guard sfty | In-guard sfty | In-guard Sfty  | In-guard Sfty  | In-guard Sfty  | Input #40 |
| O     |         | 02C-25    | 3030    | OUT #1         | OUT #1         | OUT #1        | OUT #1        | OUT #1         | OUT #1         | OUT #1         | OUT #1    |
| O     |         | 02C-26    | 3031    | OUT #2         | OUT #2         | OUT #2        | OUT #2        | OUT #2         | OUT #2         | OUT #2         | OUT #2    |
| O     |         | 02C-27    | 3032    | OUT #3         | OUT #3         | OUT #3        | OUT #3        | OUT #3         | OUT #3         | OUT #3         | OUT #3    |
| O     |         | 02C-28    | 3033    | OUT #4         | OUT #4         | OUT #4        | OUT #4        | OUT #4         | OUT #4         | OUT #4         | OUT #4    |
| O     |         | 02C-29    | 3034    | OUT #5         | OUT #5         | OUT #5        | OUT #5        | OUT #5         | OUT #5         | OUT #5         | OUT #5    |
| O     |         | 02C-30    | 3035    | OUT #6         | OUT #6         | OUT #6        | OUT #6        | OUT #6         | OUT #6         | OUT #6         | OUT #6    |
| O     |         | 02C-31    | 3036    | OUT #7         | OUT #7         | OUT #7        | OUT #7        | OUT #7         | OUT #7         | OUT #7         | OUT #7    |
| O     |         | 02C-32    | 3037    | OUT #8         | OUT #8         | OUT #8        | OUT #8        | OUT #8         | OUT #8         | OUT #8         | OUT #8    |
|       |         | 02C-33    | .       | .              | .              | .             | .             | .              | .              | .              | .         |
|       |         | 02C-34    | .       | .              | .              | .             | .             | .              | .              | .              | .         |
|       |         | 02C-35    | .       | .              | .              | .             | .             | .              | .              | .              | .         |
|       |         | 02C-36    | .       | .              | .              | .             | .             | .              | .              | .              | .         |
|       |         | 02C-36    | .       | .              | .              | .             | .             | .              | .              | .              | .         |
|       |         | 02C-37    | .       | .              | .              | .             | .             | .              | .              | .              | .         |
|       |         | 02C-38    | .       | .              | .              | .             | .             | .              | .              | .              | .         |
|       |         | 02C-39    | .       | .              | .              | .             | .             | .              | .              | .              | .         |
|       |         | 02C-40    | .       | .              | .              | .             | .             | .              | .              | .              | .         |
|       |         | 02C-41    | .       | .              | .              | .             | .             | .              | .              | .              | .         |
|       |         | 02C-42    | .       | .              | .              | .             | .             | .              | .              | .              | .         |
|       |         | 02C-43    | .       | .              | .              | .             | .             | .              | .              | .              | .         |
|       |         | 02C-44    | .       | +24 VDC        | +24 VDC        | +24 VDC       | +24 VDC       | +24 VDC        | +24 VDC        | +24 VDC        | +24 VDC   |
|       |         | 02C-45    | .       | +24 VDC        | +24 VDC        | +24 VDC       | +24 VDC       | +24 VDC        | +24 VDC        | +24 VDC        | +24 VDC   |
|       |         | 02C-46    | .       | +24 VDC        | +24 VDC        | +24 VDC       | +24 VDC       | +24 VDC        | +24 VDC        | +24 VDC        | +24 VDC   |
|       |         | 02C-47    | .       | 0" VDC         | 0" VDC         | 0" VDC        | 0" VDC        | 0" VDC         | 0" VDC         | 0" VDC         | 0" VDC    |
|       |         | 02C-48    | .       | 0" VDC         | 0" VDC         | 0" VDC        | 0" VDC        | 0" VDC         | 0" VDC         | 0" VDC         | 0" VDC    |
|       |         | 02C-49    | .       | 0" VDC         | 0" VDC         | 0" VDC        | 0" VDC        | 0" VDC         | 0" VDC         | 0" VDC         | 0" VDC    |
|       |         | 02C-50    | .       | .              | .              | .             | .             | .              | .              | .              | .         |



## ERC Expanded I/O-04 Default Input and Output Assignments for Each Application

| I/O | In<br>Out | Term. # | Input<br>Connector<br>Number | Relay<br>Number | WELDING     | SPOT WELD   | HANDLING    | SEALING     | LASER CUT   | PLASMA CUT  | CUTTING     | GENERAL   |
|-----|-----------|---------|------------------------------|-----------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------|
|     |           |         |                              |                 | I/O<br>Name | I/O<br>Name | I/O<br>Name | I/O<br>Name | I/O<br>Name | I/O<br>Name | I/O<br>Name |           |
| I   |           |         | 03C-1                        | 2070            | Input #33   | Input #33   | Input #33   | Input #33   | Input #33   | Input #33   | Input #33   | Input #41 |
| I   |           |         | 03C-2                        | 2071            | Input #34   | Input #34   | Input #34   | Input #34   | Input #34   | Input #34   | Input #34   | Input #42 |
| I   |           |         | 03C-3                        | 2072            | Input #35   | Input #35   | Input #35   | Input #35   | Input #35   | Input #35   | Input #35   | Input #43 |
| I   |           |         | 03C-4                        | 2073            | Input #36   | Input #36   | Input #36   | Input #36   | Input #36   | Input #36   | Input #36   | Input #44 |
| I   |           |         | 03C-5                        | 2074            | Input #37   | Input #37   | Input #37   | Input #37   | Input #37   | Input #37   | Input #37   | Input #45 |
| I   |           |         | 03C-6                        | 2075            | Input #38   | Input #38   | Input #38   | Input #38   | Input #38   | Input #38   | Input #38   | Input #46 |
| I   |           |         | 03C-7                        | 2076            | Input #39   | Input #39   | Input #39   | Input #39   | Input #39   | Input #39   | Input #39   | Input #47 |
| I   |           |         | 03C-8                        | 2077            | Input #40   | Input #40   | Input #40   | Input #40   | Input #40   | Input #40   | Input #40   | Input #48 |
| I   |           |         | 03C-9                        | 2080            | Input #41   | Input #41   | Input #41   | Input #41   | Input #41   | Input #41   | Input #41   | Input #49 |
| I   |           |         | 03C-10                       | 2081            | Input #42   | Input #42   | Input #42   | Input #42   | Input #42   | Input #42   | Input #42   | Input #50 |
| I   |           |         | 03C-11                       | 2082            | Input #43   | Input #43   | Input #43   | Input #43   | Input #43   | Input #43   | Input #43   | Input #51 |
| I   |           |         | 03C-12                       | 2083            | Input #44   | Input #44   | Input #44   | Input #44   | Input #44   | Input #44   | Input #44   | Input #52 |
| I   |           |         | 03C-13                       | 2084            | Input #45   | Input #45   | Input #45   | Input #45   | Input #45   | Input #45   | Input #45   | Input #53 |
| I   |           |         | 03C-14                       | 2085            | Input #46   | Input #46   | Input #48   | Input #46   | Input #46   | Input #46   | Input #46   | Input #54 |
| I   |           |         | 03C-15                       | 2086            | Input #47   | Input #47   | Input #47   | Input #47   | Input #47   | Input #47   | Input #47   | Input #55 |
| I   |           |         | 03C-16                       | 2087            | Input #48   | Input #48   | Input #48   | Input #48   | Input #48   | Input #48   | Input #48   | Input #56 |
| I   |           |         | 03C-17                       | 2090            | Input #49   | Input #49   | Input #49   | Input #49   | Input #49   | Input #49   | Input #49   | Input #57 |
| I   |           |         | 03C-18                       | 2091            | Input #50   | Input #50   | Input #50   | Input #50   | Input #50   | Input #50   | Input #50   | Input #58 |
| I   |           |         | 03C-19                       | 2092            | Input #51   | Input #51   | Input #51   | Input #51   | Input #51   | Input #51   | Input #51   | Input #59 |
| I   |           |         | 03C-20                       | 2093            | Input #52   | Input #52   | Input #52   | Input #52   | Input #52   | Input #52   | Input #52   | Input #60 |
| I   |           |         | 03C-21                       | 2094            | Input #53   | Input #53   | Input #53   | Input #53   | Input #53   | Input #53   | Input #53   | Input #61 |
| I   |           |         | 03C-22                       | 2095            | Input #54   | Input #54   | Input #54   | Input #54   | Input #54   | Input #54   | Input #54   | Input #62 |
| I   |           |         | 03C-23                       | 2096            | Input #55   | Input #55   | Input #55   | Input #55   | Input #55   | Input #55   | Input #55   | Input #63 |
| I   |           |         | 03C-24                       | 2097            | Input #56   | Input #56   | Input #56   | Input #58   | Input #56   | Input #56   | Input #56   | Input #64 |
| O   |           |         | 03C-25                       | 3050            | OUT#17      | OUT#17      | OUT#17      | OUT#17      | OUT#17      | OUT#17      | OUT#17      | OUT#25    |
| O   |           |         | 03C-26                       | 3051            | OUT#18      | OUT#18      | OUT#18      | OUT#18      | OUT#18      | OUT#18      | OUT#18      | OUT#26    |
| O   |           |         | 03C-27                       | 3052            | OUT#19      | OUT#19      | OUT#19      | OUT#19      | OUT#19      | OUT#19      | OUT#19      | OUT#27    |
| O   |           |         | 03C-28                       | 3053            | OUT#20      | OUT#20      | OUT#20      | OUT#20      | OUT#20      | OUT#20      | OUT#20      | OUT#28    |
| O   |           |         | 03C-29                       | 3054            | OUT#21      | OUT#21      | OUT#21      | OUT#21      | OUT#21      | OUT#21      | OUT#21      | OUT#29    |
| O   |           |         | 03C-30                       | 3055            | OUT#22      | OUT#22      | OUT#22      | OUT#22      | OUT#22      | OUT#22      | OUT#22      | OUT#30    |
| O   |           |         | 03C-31                       | 3056            | OUT#23      | OUT#23      | OUT#23      | OUT#23      | OUT#23      | OUT#23      | OUT#23      | OUT#31    |
| O   |           |         | 03C-32                       | 3057            | OUT#24      | OUT#24      | OUT#24      | OUT#24      | OUT#24      | OUT#24      | OUT#24      | OUT#32    |
| O   |           |         | 03C-33                       | 3060            | OUT#25      | OUT#25      | OUT#25      | OUT#25      | OUT#25      | OUT#25      | OUT#25      | OUT#33    |
| O   |           |         | 03C-34                       | 3061            | OUT#26      | OUT#26      | OUT#26      | OUT#26      | OUT#26      | OUT#26      | OUT#26      | OUT#34    |
| O   |           |         | 03C-35                       | 3062            | OUT#27      | OUT#27      | OUT#27      | OUT#27      | OUT#27      | OUT#27      | OUT#27      | OUT#35    |
| O   |           |         | 03C-36                       | 3063            | OUT#28      | OUT#28      | OUT#28      | OUT#28      | OUT#28      | OUT#28      | OUT#28      | OUT#36    |
| O   |           |         | 03C-37                       | 3064            | OUT#29      | OUT#29      | OUT#29      | OUT#29      | OUT#29      | OUT#29      | OUT#29      | OUT#37    |
| O   |           |         | 03C-38                       | 3065            | OUT#30      | OUT#30      | OUT#30      | OUT#30      | OUT#30      | OUT#30      | OUT#30      | OUT#38    |

## ERC Expanded I/O-04 Default Input and Output Assignments for Each Application

|     |         |           | WELDING | SPOT WELD | HANDLING  | SEALING   | LASER CUT | PLASMA CUT | CUTTING   | GENERAL   |
|-----|---------|-----------|---------|-----------|-----------|-----------|-----------|------------|-----------|-----------|
| In  | Input   | Connector | Relay   | I/O       | I/O       | I/O       | I/O       | I/O        | I/O       | I/O       |
| Out | Term. # | Number    | Number  | Name      | Name      | Name      | Name      | Name       | Name      | Name      |
| O   |         | 03C-39    | 3066    | OUT#31    | OUT#31    | OUT#31    | OUT#31    | OUT#31     | OUT#31    | OUT#39    |
| O   |         | 03C-40    | 3067    | OUT#32    | OUT#32    | OUT#32    | OUT#32    | OUT#32     | OUT#32    | OUT#40    |
|     |         | 03C-41    | .       | .         | .         | .         | .         | .          | .         | .         |
|     |         | 03C-42    | .       | .         | .         | .         | .         | .          | .         | .         |
|     |         | 03C-43    | .       | .         | .         | .         | .         | .          | .         | .         |
|     |         | 03C-44    | .       | +24 VDC   | +24 VDC   | +24 VDC   | +24 VDC   | +24 VDC    | +24 VDC   | +24 VDC   |
|     |         | 03C-45    | .       | +24 VDC   | +24 VDC   | +24 VDC   | +24 VDC   | +24 VDC    | +24 VDC   | +24 VDC   |
|     |         | 03C-46    | .       | +24 VDC   | +24 VDC   | +24 VDC   | +24 VDC   | +24 VDC    | +24 VDC   | +24 VDC   |
|     |         | 03C-47    | .       | 0 VDC     | 0 VDC     | 0 VDC     | 0 VDC     | 0 VDC      | 0 VDC     | 0 VDC     |
|     |         | 03C-48    | .       | 0 VDC     | 0 VDC     | 0 VDC     | 0 VDC     | 0 VDC      | 0 VDC     | 0 VDC     |
|     |         | 03C-49    | .       | 0 VDC     | 0 VDC     | 0 VDC     | 0 VDC     | 0 VDC      | 0 VDC     | 0 VDC     |
|     |         | 03C-50    | .       | .         | .         | .         | .         | .          | .         | .         |
| I   |         | 04C-1     | 2100    | Input #57 | Input #57 | Input #57 | Input #57 | Input #57  | Input #57 | Input #65 |
| I   |         | 04C-2     | 2101    | Input #58 | Input #58 | Input #58 | Input #58 | Input #58  | Input #58 | Input #66 |
| I   |         | 04C-3     | 2102    | Input #59 | Input #59 | Input #59 | Input #59 | Input #59  | Input #59 | Input #67 |
| I   |         | 04C-4     | 2103    | Input #60 | Input #60 | Input #60 | Input #60 | Input #60  | Input #60 | Input #68 |
| I   |         | 04C-5     | 2104    | Input #61 | Input #61 | Input #61 | Input #61 | Input #61  | Input #61 | Input #69 |
| I   |         | 04C-6     | 2105    | Input #62 | Input #62 | Input #62 | Input #62 | Input #62  | Input #62 | Input #70 |
| I   |         | 04C-7     | 2106    | Input #63 | Input #63 | Input #63 | Input #63 | Input #63  | Input #63 | Input #71 |
| I   |         | 04C-8     | 2107    | Input #64 | Input #64 | Input #64 | Input #64 | Input #64  | Input #64 | Input #72 |
| I   |         | 04C-9     | 2110    | Input #65 | Input #65 | Input #65 | Input #65 | Input #65  | Input #65 | Input #73 |
| I   |         | 04C-10    | 2111    | Input #66 | Input #66 | Input #66 | Input #66 | Input #66  | Input #66 | Input #74 |
| I   |         | 04C-11    | 2112    | Input #67 | Input #67 | Input #67 | Input #67 | Input #67  | Input #67 | Input #75 |
| I   |         | 04C-12    | 2113    | Input #68 | Input #68 | Input #68 | Input #68 | Input #68  | Input #68 | Input #76 |
| I   |         | 04C-13    | 2114    | Input #69 | Input #69 | Input #69 | Input #69 | Input #69  | Input #69 | Input #77 |
| I   |         | 04C-14    | 2115    | Input #70 | Input #70 | Input #70 | Input #70 | Input #70  | Input #70 | Input #78 |
| I   |         | 04C-15    | 2116    | Input #71 | Input #71 | Input #71 | Input #71 | Input #71  | Input #71 | Input #79 |
| I   |         | 04C-16    | 2117    | Input #72 | Input #72 | Input #72 | Input #72 | Input #72  | Input #72 | Input #80 |
| I   |         | 04C-17    | 2120    | Input #73 | Input #73 | Input #73 | Input #73 | Input #73  | Input #73 | Input #81 |
| I   |         | 04C-18    | 2121    | Input #74 | Input #74 | Input #74 | Input #74 | Input #74  | Input #74 | Input #82 |
| I   |         | 04C-19    | 2122    | Input #75 | Input #75 | Input #75 | Input #75 | Input #75  | Input #75 | Input #83 |
| I   |         | 04C-20    | 2123    | Input #76 | Input #76 | Input #76 | Input #76 | Input #76  | Input #76 | Input #84 |
| I   |         | 04C-21    | 2124    | Input #77 | Input #77 | Input #77 | Input #77 | Input #77  | Input #77 | Input #85 |
| I   |         | 04C-22    | 2125    | Input #78 | Input #78 | Input #78 | Input #78 | Input #78  | Input #78 | Input #86 |
| I   |         | 04C-23    | 2126    | Input #79 | Input #79 | Input #79 | Input #79 | Input #79  | Input #79 | Input #87 |
| I   |         | 04C-24    | 2127    | Input #80 | Input #80 | Input #80 | Input #80 | Input #80  | Input #80 | Input #88 |
| O   |         | 04C-25    | 3070    | OUT#33    | OUT#33    | OUT#33    | OUT#33    | OUT#33     | OUT#33    | OUT#41    |

## ERC Expanded I/O-04 Default Input and Output Assignments for Each Application

| I=In  | Input   | Connector | Relay  | WELDING   | SPOT WELD | HANDLING | SEALING | LASER CUT | PLASMA CUT | CUTTING | GENERAL       |
|-------|---------|-----------|--------|-----------|-----------|----------|---------|-----------|------------|---------|---------------|
| O=Out | Term. # | Number    | Number | I/O       | I/O       | I/O      | I/O     | I/O       | I/O        | I/O     | I/O           |
|       |         |           |        | Name      | Name      | Name     | Name    | Name      | Name       | Name    | Name          |
| O     |         | 04C-26    | 3071   | OUT#34    | OUT#34    | OUT#34   | OUT#34  | OUT#34    | OUT#34     | OUT#34  | OUT#42        |
| O     |         | 04C-27    | 3072   | OUT#35    | OUT#35    | OUT#35   | OUT#35  | OUT#35    | OUT#35     | OUT#35  | OUT#434       |
| O     |         | 04C-28    | 3073   | OUT#36    | OUT#36    | OUT#36   | OUT#36  | OUT#36    | OUT#36     | OUT#36  | OUT#44        |
| O     |         | 04C-29    | 3074   | OUT#37    | OUT#37    | OUT#37   | OUT#37  | OUT#37    | OUT#37     | OUT#37  | OUT#45        |
| O     |         | 04C-30    | 3075   | OUT#38    | OUT#38    | OUT#38   | OUT#38  | OUT#38    | OUT#38     | OUT#38  | OUT#46        |
| O     |         | 04C-31    | 3076   | OUT#39    | OUT#39    | OUT#39   | OUT#39  | OUT#39    | OUT#39     | OUT#39  | OUT#47        |
| O     |         | 04C-32    | 3077   | OUT#40    | OUT#40    | OUT#40   | OUT#40  | OUT#40    | OUT#40     | OUT#40  | OUT#48        |
| O     |         | 04C-33    | 3080   | OUT#41    | OUT#41    | OUT#41   | OUT#41  | OUT#41    | OUT#41     | OUT#41  | OUT#49        |
| O     |         | 04C-34    | 3081   | OUT#42    | OUT#42    | OUT#42   | OUT#42  | OUT#42    | OUT#42     | OUT#42  | OUT#50        |
| O     |         | 04C-35    | 3082   | OUT#43    | OUT#43    | OUT#43   | OUT#43  | OUT#43    | OUT#43     | OUT#43  | OUT#51        |
| O     |         | 04C-36    | 3083   | OUT#44    | OUT#44    | OUT#44   | OUT#44  | OUT#44    | OUT#44     | OUT#44  | OUT#52        |
| O     |         | 04C-37    | 3084   | OUT#45    | OUT#45    | OUT#45   | OUT#45  | OUT#45    | OUT#45     | OUT#45  | OUT#53        |
| O     |         | 04C-38    | 3085   | OUT#46    | OUT#46    | OUT#46   | OUT#46  | OUT#46    | OUT#46     | OUT#46  | OUT#54        |
| O     |         | 04C-39    | 3088   | Wire Inch | OUT#47    | OUT#47   | OUT#47  | OUT#47    | OUT#47     | OUT#47  | OUT#55        |
| O     |         | 04C-40    | 3087   | Arc On    | OUT#48    | OUT#48   | Gun On  | Laser On  | Plasma On  | Tool On | Opr Instruct. |
|       |         | 04C-41    | .      | .         | .         | .        | .       | .         | .          | .       | .             |
|       |         | 04C-42    | .      | .         | .         | .        | .       | .         | .          | .       | .             |
|       |         | 04C-43    | .      | .         | .         | .        | .       | .         | .          | .       | .             |
|       |         | 04C-44    | .      | +24 VDC   | +24 VDC   | +24 VDC  | +24 VDC | +24 VDC   | +24 VDC    | +24 VDC | +24 VDC       |
|       |         | 04C-45    | .      | +24 VDC   | +24 VDC   | +24 VDC  | +24 VDC | +24 VDC   | +24 VDC    | +24 VDC | +24 VDC       |
|       |         | 04C-46    | .      | +24 VDC   | +24 VDC   | +24 VDC  | +24 VDC | +24 VDC   | +24 VDC    | +24 VDC | +24 VDC       |
|       |         | 04C-47    | .      | 0 VDC     | 0 VDC     | 0 VDC    | 0 VDC   | 0 VDC     | 0 VDC      | 0 VDC   | 0 VDC         |
|       |         | 04C-48    | .      | 0 VDC     | 0 VDC     | 0 VDC    | 0 VDC   | 0 VDC     | 0 VDC      | 0 VDC   | 0 VDC         |
|       |         | 04C-49    | .      | 0 VDC     | 0 VDC     | 0 VDC    | 0 VDC   | 0 VDC     | 0 VDC      | 0 VDC   | 0 VDC         |
|       |         | 04C-50    | .      | .         | .         | .        | .       | .         | .          | .       | .             |

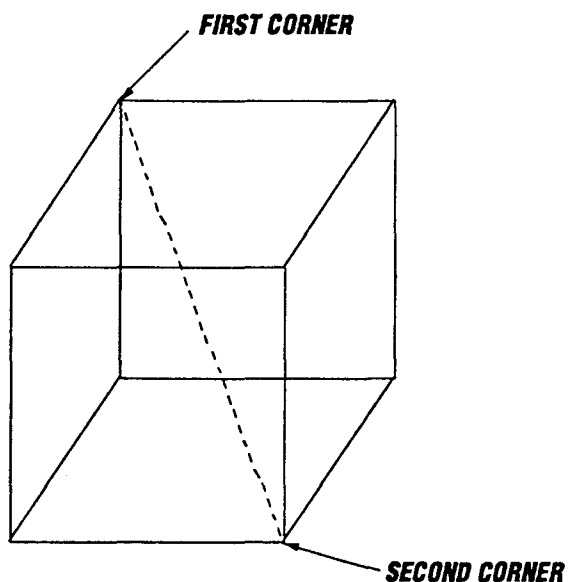
# **CUBE FUNCTION**

The Cube Function (CF) defines a three-dimensional space which can be used to prevent the robot from colliding with another robot or positioner. Before the robot enters this space, it reads a specified input on the I/O board. If the input is ON, the robot stays outside the CUBE until this input is turned off. When the robot enters the cube, it turns on a specified output. When the robot exits the cube, it turns off this output.

The K-Series robot has four cubes, two of them come with the robot and two can be purchased as an option.

|        | <b>ADDRESS</b> | <b>TERMINAL STRIP</b> |
|--------|----------------|-----------------------|
| CUBE 1 | SOUT #3014     | 8TB-5                 |
| CUBE 2 | SOUT # 3015    | 8TB-6                 |
| CUBE 1 | SIN # 2014     | 6TB-5                 |
| CUBE 2 | SIN #2015      | 6TB-6                 |

Specify the cube by defining two corners using the following procedure:



**Cube Definition**

1. Press the DISP function key on the ERC controller.
2. Select POSITION on the menu by pressing the F2 key. This will display a different menu.
3. Select the XYZ on the menu by pressing the F2 key again; this will display a different menu.
4. Select the ROBOT-COORD on the menu by pressing the F1 key. This will display the XYZ coordinates of the robot.
5. Teach the robot the first corner of the desired cube.
6. Record the XYZ values from the screen on a piece of paper for this position.
7. Repeat Steps 5 and 6 for the second corner of the desired cube.
8. Compare the X coordinate values for both corners and assign the most positive value to MAX X (ex. -4130 is more positive than -5500) and the most negative value to MIN X (ex. -5500 is more negative than -4130).
9. Repeat Step 8 for the Y and Z coordinates.
10. Press OP1.
11. Press the right arrow key.
12. Press CUBIC.

The following screen is displayed:

|               | MAX POSITION | MIN POSITION |
|---------------|--------------|--------------|
| <b>CUBE 1</b> |              |              |
| <b>BASE</b>   | X 3500.0 mm  | X 3500.0 mm  |
|               | Y 3500.0 mm  | Y 3500.0 mm  |
|               | Z 3500.0 mm  | Z 3500.0 mm  |
| <b>CUBE 2</b> |              |              |
| <b>BASE</b>   | X 3500.0 mm  | X 3500.0 mm  |
|               | Y 3500.0 mm  | Y 3500.0 mm  |
|               | Z 3500.0 mm  | Z 3500.0 mm  |

13. Enter the MAX and MIN XYZ values. Use the cursor key to move the cursor to the axis you wish to change.
  14. Press PANEL.
  15. Press CANCEL.
  16. Enter XXX.XX.
  17. Repeat for the rest of the data.
  18. Power down and power up.
- Cube is now established

# ***TOOL CENTER POINT DEFINITION***

A well defined Tool Center Point, or TCP, is necessary for most applications - especially any type of process work. It will allow easier teaching and the speed of travel will be much more accurate. This is a must for welding, sealing, and cutting.

The ERC is capable of storing up to nine different tool center points. The first TCP is called the Standard Tool, or Tool 0. Robots with one tool are only concerned with the Standard Tool. The remaining eight tools are called Universal Tools, or Tools 1-8. Robots with multiple tools (such as two-handed grippers) use Universal Tools along with the Standard Tool. There are two methods for defining the TCP: Manual TCP definition, and automatic tool center point calibration.

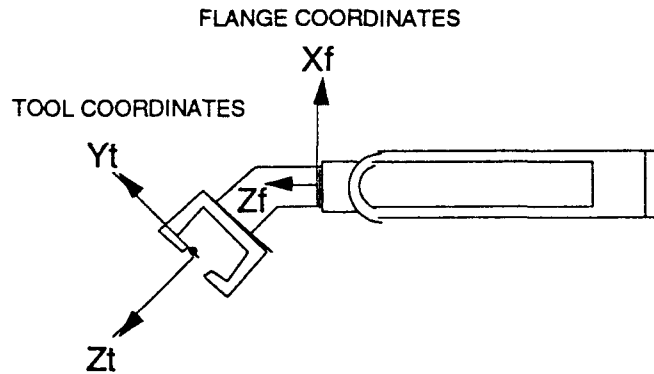
## ***Manual TCP Definition***

In most material handling applications, the gripping device is of definite dimensions and orientation. It is possible to enter this data directly into the ERC.

***OP1 ➔ TOOL ➔ (➤) ➔ DISP CHG ➔ choose STANDARD TOOL or UNIVERSAL TOOL ➔ DATA STORE ➔ PANEL***

1. Press OP1.
2. Press TOOL.
3. Press right arrow soft key.
4. Press DISP. CHG.
5. Choose either STANDARD TOOL or UNIVERSAL TOOL.
6. Press DATA STORE.
7. Press PANEL.

Enter the dimensions of the tool relative to the wrist flange.



### ***Material Handling TCP***

The tool will now be defined to the ERC and the robot should move about the TCP when rolling, bending, or twisting from the teach pendant.

### ***Automatic TCP Calibration***

In most process applications, the tool has a more complex geometry - torches are angled, plasma heads are off-center, etc. If this is the case, entering the dimensions and rotations of the tool manually will not be straightforward. The preferred approach is to use the Automatic Tool Center Point Calibration function. A tool center point probe is needed to use this function.

1. Attach the probe to the robot. In most cases it is attached at the breakaway.
2. Put a punch mark on the work table or fixture. Be sure the table is sturdy - the punch mark should not move.
3. Bring the tip of the probe down to the punch mark. It is necessary to align the probe with the T-axis. To do this, put the Teach Pendant in Joint Coordinates and drive the T-axis. If the probe is aligned, the tip will stay in the punch mark. If it processes out of the punch mark, use the probe thumbscrews to bring it in line with the T-axis.
4. Create a new job called TCP. This job will have two points, one will be in the punch mark, the other will be up high enough to detach the probe and reattach the tool. These points will be taught in linear motion.

5. The first point will be with the probe in the punch mark. The probe is to be vertically plumb. Use a level to ensure that the probe is not rolled or bent out of plumb. Also, the T-axis must be at 0 pulse counts. Display the robot's position:

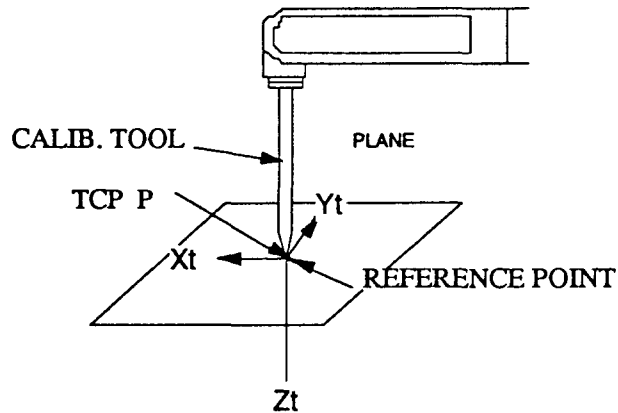
**DISP ➡ POSITION ➡ PULSE**

1. Press DISP.
  2. Press POSITION.
  3. Press PULSE
6. With the Teach Pendant in Joint Coordinates, drive the T-axis to 0 pulse counts. Check that the probe is still in the mark. If it is not, make the necessary adjustments.
  7. With the probe in the punch mark, vertically plumb, and the T-axis at 0 pulses, record the point.
  8. Record the second point after raising the robot up to where the probe can be detached.
  9. Take the robot back to the first step in the program. At the OpPanel:

**OP1 ➡ TOOL ➡ (⇨) ➡ DISP CHG ➡ CALIB. TOOL ➡  
DATA STORE ➡ MANUAL**

1. Press OP1.
  2. Press TOOL.
  3. Press right arrow soft key.
  4. Press DISP. CHG.
  5. Press CALIB. TOOL.
  6. Press DATA STORE.
  7. Press MANUAL.
10. Enable the TP. It will read TOOL MASTER. Press Record. The Display will blink.
  11. Return to the OpPanel and hit Exit.
  12. Now, measure the distance from the robot wrist flange to the punch mark.



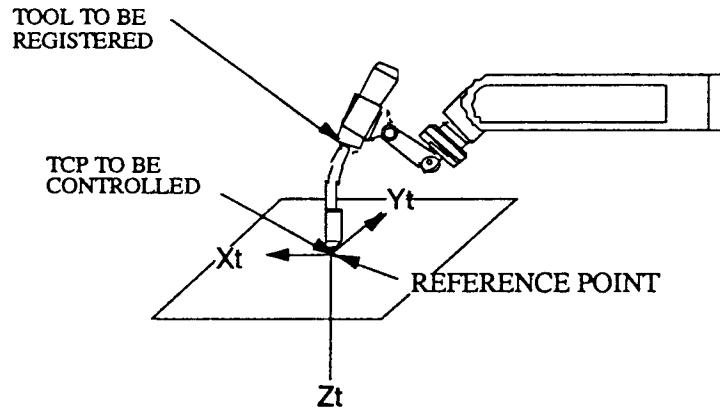


### ***Automatic TCP***

13. This measurement is to be entered in the Z dimension of the Tool File. At the OpPanel:

***(Cursor to Z) ➡ DATA STORE ➡ PANEL ➡ (enter measurement) ➡ ENTER***

1. Cursor to Z.
  2. Press DATA STORE.
  3. Press PANEL.
  4. Enter measurement.
  5. Press ENTER.
14. Now move the robot up, detach the probe and reattach the tool. Move the robot straight down (World Coordinates -Z) toward the punch mark. If the tool's desired TCP is not in the punch mark, move it there using the axes keys. For process work, rotate the tool so that it is plumb in the mark.



### ***Correspondence of Tool and Reference Point***

15. It is best to align the Tool Coordinate system with the World Coordinate system. Check X and Y of the World system. Now put the robot in Tool Coordinates and check X and Y. If they do not act the same, adjust the Tool by using the T-axis keys until X and Y act the same in both World and Tool Coordinates. At the OpPanel:

***OP1 ➔ TOOL ➔ DISP CHG ➔ STD TOOL ➔ DATA STORE  
➔ MANUAL***

1. Press OP1.
  2. Press TOOL.
  3. Press DISP. CHG.
  4. Press STD. TOOL.
  5. Press DATA STORE.
  6. Press MANUAL.
16. Enable the TP. It will read Tool 0. Press Record. The display will blink and the Tool File on the OpPanel will generate all the dimensions and rotations of the tool. Return to the OpPanel and press Exit.

The tool is now defined. To check the accuracy, put the robot in World Coordinates and drive the R, B, and T axes. The TCP should hold point.