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NSK

Robot Modules System

- Module Main Unit
- EXC Controller

User's Manual 2

= Programming and Operation =

[1] Product Description and Installation

1. Introduction
2. Safety Precautions
3. System Configuration
4. Reference Number · Name of the Parts
5. Specifications and Dimensions
6. Transportation, Storage and Unpacking
7. Installation
8. Assembly
9. Wiring
10. Start Up
11. Initial Setting
12. Trial Running

[2] Programming and Operation

13. Programming
14. Operation
15. Remote Control Operation
16. Pulse Train Output Function and Operation
17. Memory Card Specifications and Operation

[3] Maintenance

18. Protection and Safety
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20. Alarms
21. Trouble Shooting

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Appendix 1: CN5 Encoder and Over Travel Sensor Connector
Appendix 2: CN2 Motor and Brake Connector
Appendix 3: Wiring for Remote Control
Appendix 4: Regeneration Processing

NSK Ltd.

Precision Machinery & Parts Technology Centre

Mechatronics Product Engineering Dept.

Document Number: K20011-01

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Programming and Operation - Introduction

- This is [2] Programming and Operation of the instruction manual for the robot module system.
- This part of the instruction manual describes teaching, programming, operation, and special functions (remote control, pulse train output, memory cards).
- Be sure to read also the other two manuals below.
  - [1] Product Description and Installation
  - [3] Maintenance

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13. Programming

14. Operation

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16. Pulse Train Output Function and Operation

17. Memory Card Specifications and Operation

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13. Programming

- To operate the robot module automatically as intended, it is necessary to program the details of the operation in advance. On receiving a start-up signal, the robot module operates automatically in accordance to the program.

- Programming refers to preparing a program covering a series of operation by combining program command (robot language) provided for EXC controller.

- Among the program commands, the movement command designates the point register as the destination. Preparing the coordinate data of the point register is called "teaching." Performing teaching defines the destination of the robot module.

Example MOV P000 : Linear movement to a Point of P000.
= Moves linearly to the point having the coordinates written in the point register P000.

Linear movement instruction

Designates the point register P000 as the destination

13.1. Teaching

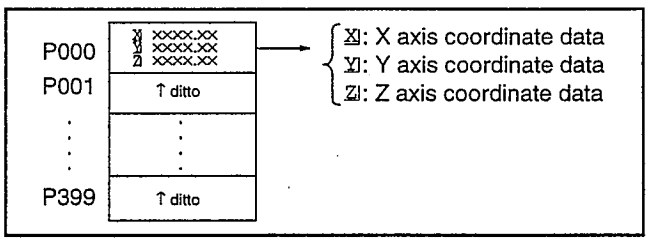
- Teaching refers to a job to prepare in advance the coordinate data of a positioning point (= point register data) for programmed operation.

- The unit is mm. The resolution is 0.01 mm.

  Example : X 0200.05 · · · X axis coordinate data 200.05mm

- The point register has the coordinates of P000 - P399, allowing you to input up to 400 points.

Figure 13-1



- You can use the three following methods to prepare data.
  ① To designate a point by directly moving the slider through jog operation (programming at sight).
  ② To determine the coordinates by entering numerical values. (MDI: Manual Data Input)
  ③ To prepare data during programming by programmed operation command. This is used to change the positioning point coordinates during programming. For details, see "13.2.4.2. How to Use Data Register and Point Register."

- To rewrite already prepared teaching data, select the number of the point register you want to rewrite, and teach it again. New data will be overwritten.

Data in the point register can be used for all the programs and are backed up when power is off.

For simplification, "point register" will be written "Point" hereafter.

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13.1.1. Teaching by Jog Operation

- Teach positioning points by actually moving the slider with the jog keys [+X] [–X], [+Y] [–Y], [+Z] [–Z] in the teaching box.
- In this operation, the moving speed and acceleration/ deceleration follows Max speed (L) and Max accel in "11.3.3. Jog-Operation Parameters.

Note: If the response of the slider (move/stop) to ON/OFF is slow when you have pushed on or replaced your finger from the jog key in jog operation, raise the jog operation acceleration/deceleration. It increases the follow-up capability. Slider will overshoot if the acceleration/deceleration is too high. Set the speed to almost equal to that for programmed operation. (See "11.3.1.3. Acceleration/Deceleration in Programmed Operation").

(Danger) : *If the robot module performed an unexpected action due to the failure or malfunction of the robot module itself or EXC controller, or when moved at high speeds in normal operation, it would collapse, nip, or catch a person within its working range.*

- ○ When you go beyond the safety fence for teaching, be sure to stay at a place out of the robot module's working range and where you can watch the movement of the robot. In such a case, select a safety speed (250mm/s) or less.
- * The speed for jog operation and teaching operation has been factory-set to 50 mm/s.
- ○ Before teaching, jog the robot to check that it moves more slowly than the safety speed.

- Before teaching by jog operation, be sure to return the robot to the home position by referring to "14.3.1. Home Return Operation by the Teaching Box".

◆ Teaching procedure by jog operation

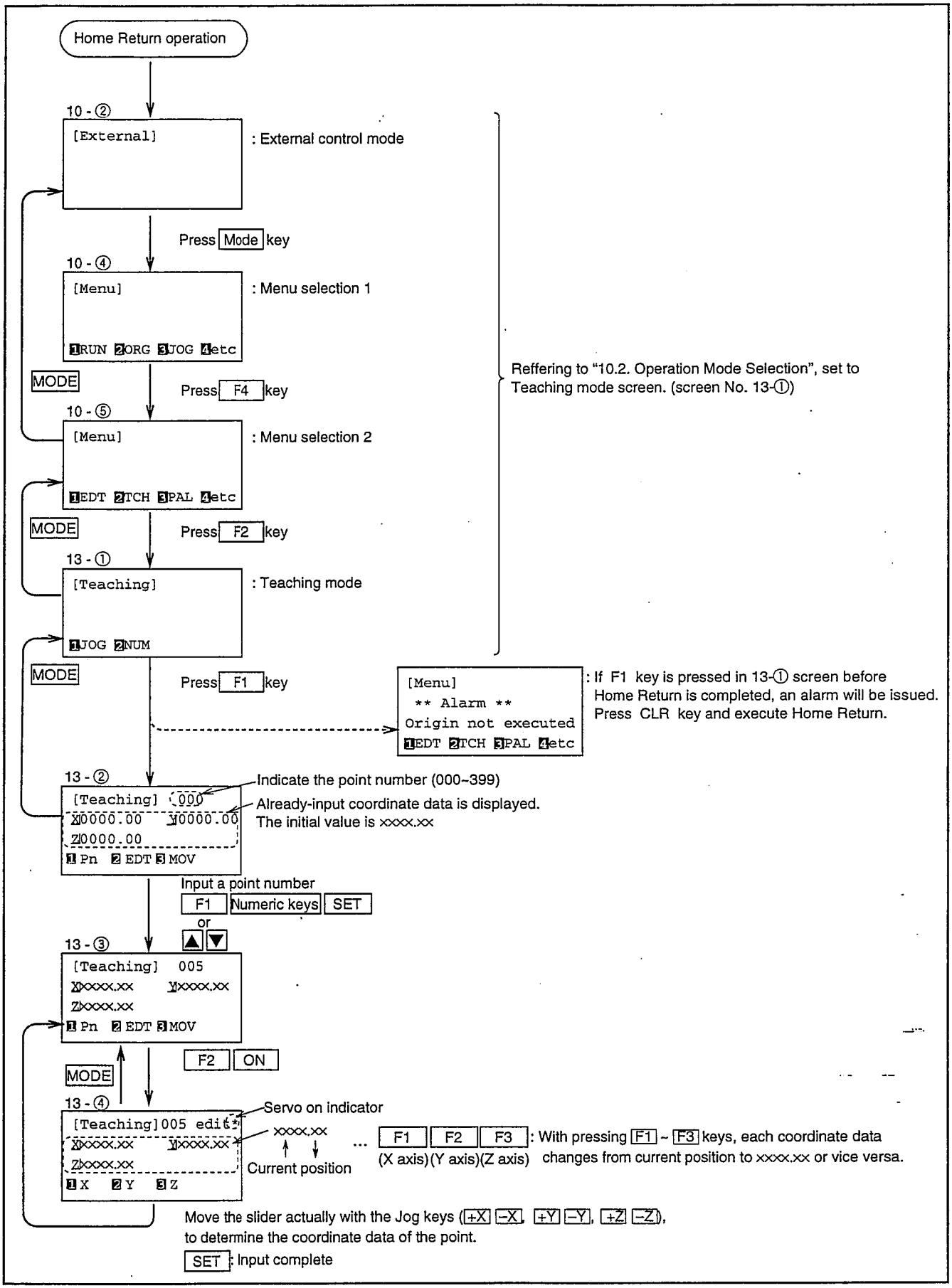
(1) To select the teaching operation by jogging, push F1 key in the teaching mode (13-① screen). An alarm will be issued if the robot has not been returned to the home position yet.

(2) On the 13-② screen, set the point number where you want to teach.

- ○ Pushing F1 key allows you to set the point number with numeric keys.
- ○ Each push on ▲ key and ▼ key increases and decreases the point number by 1.

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Figure 13-2



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(3) Teaching

- Push F2 on the 13-③ screen. (When the coordinate data have already been set by teaching, the display indicates the current position. In the untouched initial state, the coordinate display is kept to ××××.××(unchanged).
- Press ON key to have a state of Servo ON. A Servo ON mark * will be displayed on the right top of the screen. (13-④ screen).
- Pressing F1 key on 13-④ screen will change the X-axis coordinate value to the current position. Determine the point coordinate by actually moving the slider with +X key and -X key. (Another press on F1 key changes X-axis coordinate value to ××××.××.)
- Pressing F2 key will change the Y-axis coordinate value to the current position. Determine the point coordinate by actually moving the slider with +Y key and -Y key. (Another press on F2 key changes X-axis coordinate value to xxxx.xx.)
- Pressing F3 key will change the Z-axis coordinate value to the current position. Determine the Point coordinate by actually moving the slider with +Z key and -Z key. (Another press on F3 key changes Z-axis coordinate value to ××××.××.)
- After determining all the data, push SET key. The controller stores the coordinate data to complete teaching. The screen will return to 13-③. The coordinate data on the screen represent the entered data.
- Set the next point number and perform teaching by the same procedure as above.
- To discontinue teaching, press MODE key before pressing SET key. You will have the immediately preceding screen.
- Pressing F3 key on 13-② screen will move the slider to the coordinate point being displayed. (the Servo ON mark must be on the screen) You can check by moving the slider whether the point coordinate prepared by teaching is correct. The moving speed and acceleration/deceleration follows Max speed (L) and Max accel in "11.3.3. Jog-Operation Parameter.

Note: Coordinate data ××××.×× means that no movement will occur.

- Point data

```
P000:X 500.00
     Y 300.00
     Z 100.00

P001:X ××××.××
     Y 1000.00
     Z   50.00
```

- Command

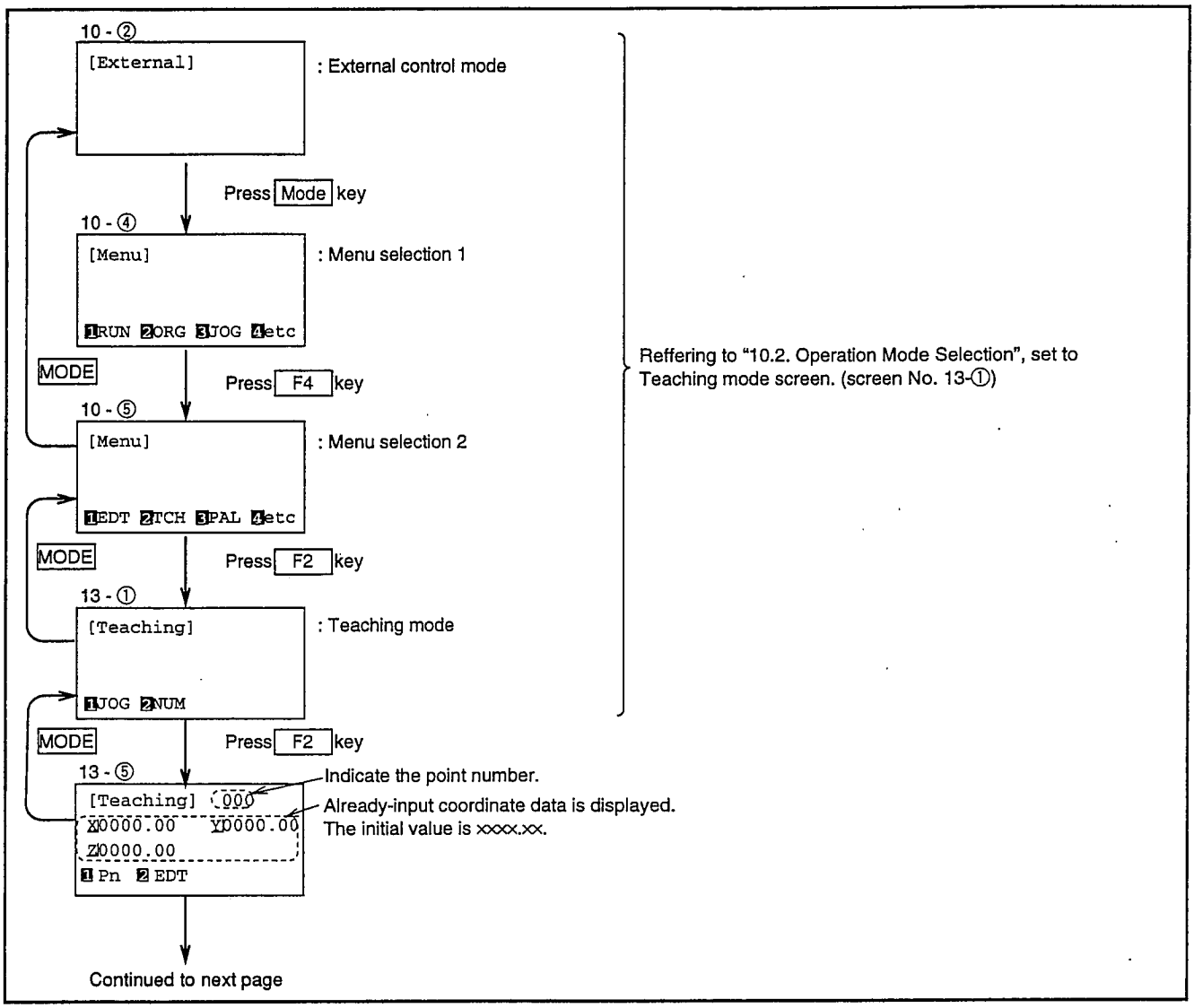
```
  .
  .
  .
Step No. n  MOV P000 : Moves to P000 point  ... X-axis coordinate 500.00mm
                                               Y-axis coordinate 300.00mm
                                               Z-axis coordinate 100.00mm
    n+1     MOV P001 : Moves to P001 point  ... X-axis does not move (500.00mm unchanged),
  .                                            Y-axis coordinate 1000.00mm,
  .                                            Z-axis moves to 50.00mm
  .
```


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13.1.2. Teaching by Entering Numeric Values.

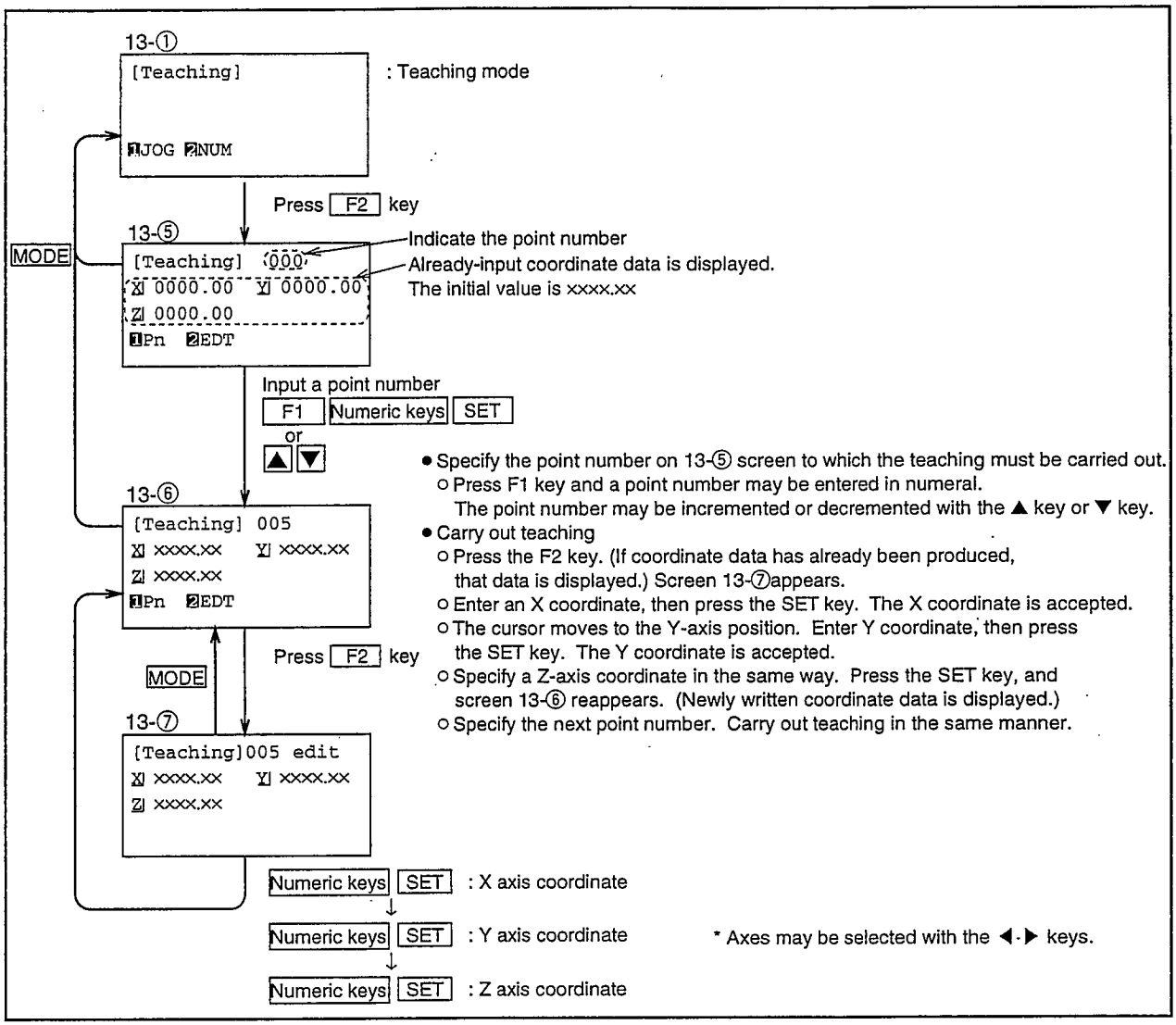
- This is the teaching inputting the coordinate data of a point with the numeric keys of the teaching box.
- Home Return operation is not necessary for this teaching.

Figure 13-3



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Figure 13-4



Note: If the CLR key is pressed when entering coordinate data, the coordinate data xxxx.xx is displayed. It means that the slider does not move.

- Point data

```
P000:X 500.00
     Y 300.00
     Z 100.00

P001:X xxxx.xx
     Y 1000.00
     Z  50.00
```

- Command

```
      :
      :
      :
```

Step No. n MOV P000 : Moves to P000 point ... X-axis coordinate 500.00mm
Y-axis coordinate 300.00mm
Z-axis coordinate 100.00mm

n+1 MOV P001 : Moves to P001 point ... X-axis does not move (500.00mm unchanged),
Y-axis coordinate 1000.00mm,
Z-axis moves to 50.00mm

```
      :
      :
      :
```


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13.2. Programming

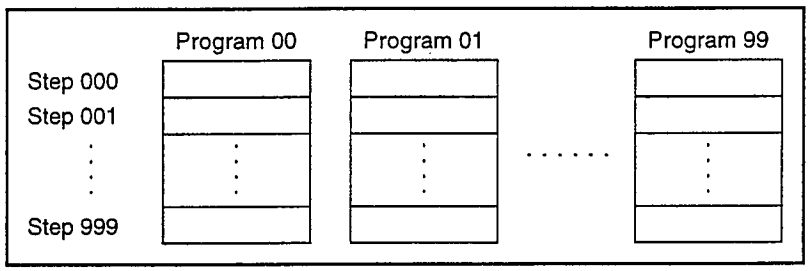
- Preparing robot programs by combining the robot languages = program command provided for EXC controller.

> For the meanings and functions of the program command, read the following items carefully.
>
> "13.2.4. Functions of Program Command and Notes" :
> Describes typical program functions including examples of programs.
> "13.2.5. Program Commands" :
> Explains all program commands in alphabetical order.

13.2.1. Programming Area

- Area to write program instructions in.
- 100 of programs are available ranging from No. 00 to 99.
- Program numbers nay be selected directly from CN2 control I/O and start the programs.
- Each program can comprise up to 1000 (000 ~ 999) steps.
- The maximum total number of steps of all the programs is 5,000.*
- Write one program command per step.
- When you have selected a program number and started programmed operation, the selected program will be executed sequentially from step 000.

Figure 13-5



*** Note: What "the maximum 5,000 steps" means.**

- It means that the maximum total number of steps used by every program is 5,000.
- "Maximum" means that the code length of one program command differs from another, and that you can use up to about 5,000 steps depending on the setup (details of programs) of commands.
  → If you use only commands of the longer code lengths, you can use less steps. Programs with only commands of the maximum code lengths allow you to use up to 900 steps.
- Code lengths (unit: word) of program commands are given in "13.2.5. Program Commands". Use them for calculating exact number of steps available.

  Number of steps available = n

  $$\sum_{1}^{n} \text{[Code length of program commands used] (unit: word)} \leq \text{Memory capacity of the program area}$$

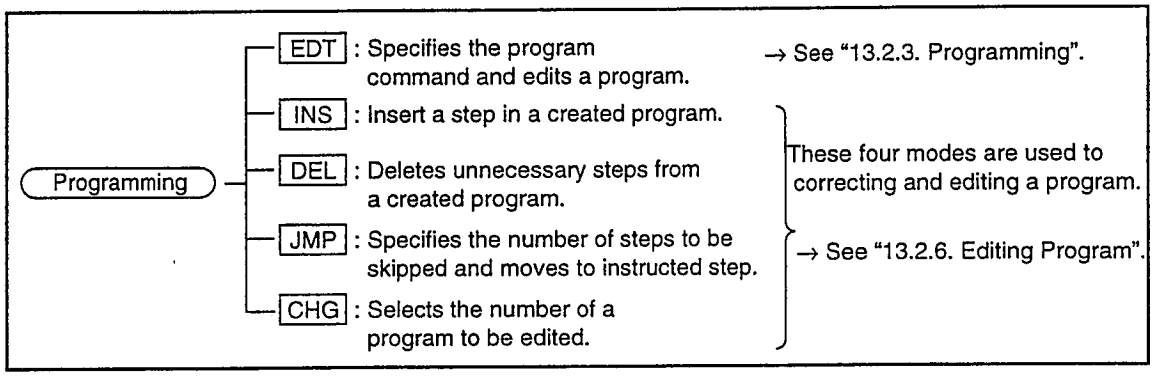
  = 10173 (unit: word)

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13.2.2. Programming Mode

- There are five programming modes as shown below.

Figure 13-6



13.2.3. Create Program

- This section describes how to create the program with combining provided commands.

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13.2.3.1. Command List

- Table 13-1 shows the command.
- See "13.2.5. Program Commands" for more details.

Table 13-1

Grouping	Command		Description
Motion/Interpolation	MOV	move	Linear interpolation movement EXC20: 2 axes, EXC30: 3 axes
	VEL	velocity	Travel velocity setting
	ACC	acceleration	Travel acceleration setting
	ARC	arc	Circular interpolation movement (2 axes arc motion)
	CIR	circle	Circle movement (2 axes circling motion)
	HOM	home	Home Return operation
	SRV	servo	Turns the servo on or off for each axis.
Data Processing	LD	load	Data loading: Writes data in the point coordinate and data register.
	ADD	add	Data addition: Adds data and stores.
	SUB	subtract	Data subtraction: Subtracts data and stores.
General Output	OUT	out	Outputs data to the general-purpose output port.
Dwell Timer	TIM	timer	Sets the timer.
Palletize	PAL	palletizing	Call an already-specified palletization program.
Subroutine/Jump	CALP	call program	Calls a program of another number. A subroutine call command between programs.
	RETP	return program	A return command set at the end of a program called by the CALP command.
	TAG	tag	Specifies a label number. Used to specify a destination of jumping or calling a subroutine in the same program.
	JMP	jump	Jumps unconditionally to a specified label number in the same program.
	CMP	compare	Compares data and holds the result.
	JEQ	jump if equal	Jumps to a specified label number in the same program if the result of comparison by the CMP command is '='.
	JGE	jump if greater than or equal	Jumps to a specified label number in the same program if the result of comparison by the CMP command is '≥.'
	JLE	jump if less than or equal	Jumps to a specified label number in the same program if the result of comparison by the CMP command is '≤.'
	JNE	jump if not equal	Jumps to a specified label number in the same program if the result of comparison by the CMP command is '≠.'
	JGT	jump if greater than	Jumps to a specified label number in the same program if the result of comparison by the CMP command is '>.'
	JLT	jump if less than	Jumps to a specified label number in the same program if the result of comparison by the CMP command is '<.'
	CALL	call subroutine	Calls a subroutine in the same program.
	RET	return subroutine	A return command set at the end of a subroutine called by the CALL command.
	CHG	change program	Changes programs. Jumps to a program of a specified number.
Repeat	REP	repeat loop	Specifies the beginning of a repetition loop and the number of loops.
	NXT	next loop	Specifies the end of a repetition loop.
End of Program	END	end	End of a program
Interruption	INT	interrupt	Specifies the interruption conditions and starting and discontinuing of interruption polling (i.e., calling an interruption program when the conditions are met).
Restart	IRET	return interrupt	A return command set at the end of an interruption program.
Continuous Pass	RSTA	restart program	Calls "restart initializing program" when resuming the programmed operation.
	CPS	continuous pass start	Specifies the start of continuous pass.
	CPE	continuous pass end	Specifies the end of continuous pass.

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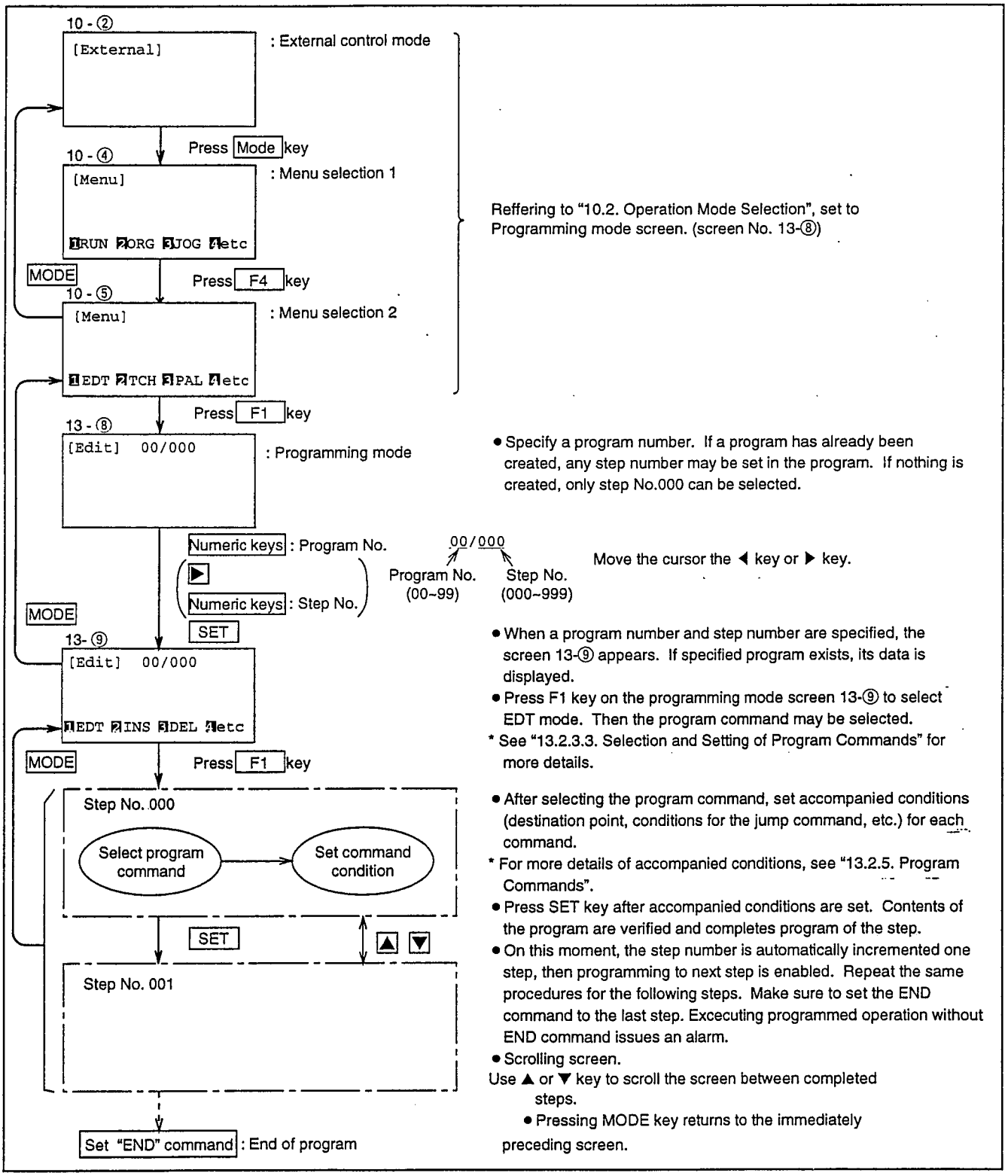
13.2.3.2. Programming Procedures.

- Make the program as shown below.

Programming Mode → EDT mode → Select/Set Program Command

- Repetition of selecting and setting of proper control commands will lead to the desired program.
- When correcting the inputted program, specify the step number and input a program again. New program may be over-written.

Figure 13-7

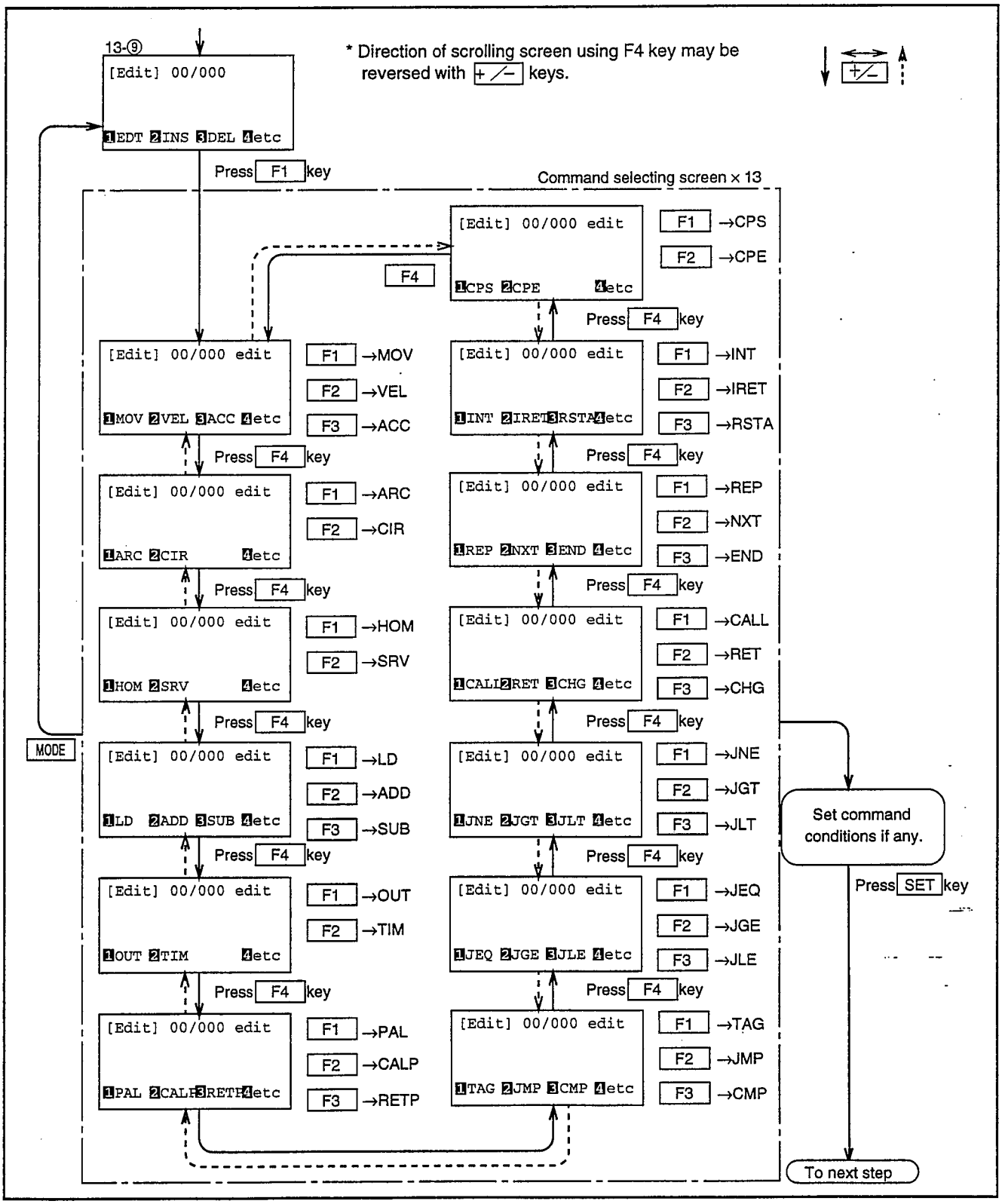


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13.2.3.3. Selecting and Setting of Command

- Selecting EDT mode (press F1 key on 13-⑨ screen) gets into the program command selecting screen.
- There are 13 screens for the command selection. Scroll them with F4 key.
- On each screen, press F1 , F2 or F3 to select desired program commands.

Figure 13-8



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13.2.4. Functions of Program Command and Notes

- This section will explain the functions of typical program commands and notes on programming.

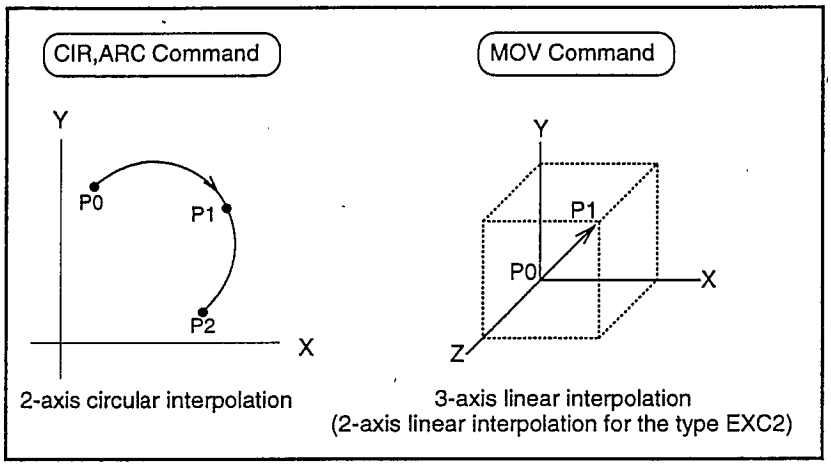
13.2.4.1. Move Command

Move commands : MOV ··· Linear interpolation
: ARC ··· Circular interpolation (Arc)
: CIR ··· Circle movement

Interpolation movement

- All the movement by programmed operation with EXC controller is interpolation movement.

Figure 13-9



Travel speed, acceleration/deceleration

- Movement speed and movement acceleration/deceleration are not to be determined for each axis separately, but set by the resultant speed and acceleration/deceleration on all the axes during interpolation movement. (HOM command excluded)
  - For details, see "11.3.1.2. Travel Speed in Programmed Operation" and "11.3.1.3. Acceleration and Deceleration in Programmed Operation."

Designation of destination

- You can designate the destination in two ways below.

(1) Designation by point number.

Example MOV P000 ··· Moving to P000

Designating destination by Point No. (example: Point 0000):
You can set up to 400 points from P000-P399.

Linear interpolation movement command

* Actual coordinate data (Point register data) corresponding to Point No. are prepared by teaching. See "13.1. Teaching."

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(2) Designation by coordinate data (unit: mm, minimum set point: 0.01mm)

Example 1

```
MOV X 0000.00   ··· movement to X axis 0mm
    Y 0100.00       movement to Y axis 100mm
    Z 0010.05       movement to Z axis 10.05mm
```

} movement to the point

Example 2 When setting a numeric value, pushing CLR key will give xxxx.xx. This means that the robot does not move when a movement command executed.

example:

```
MOV X 0000.00
    Y 0000.00
    Z xxxx.xx
```

Z axis does not move (stay at the current position). Only X and Y axes move to 0000.00.

Selecting movement mode

- You can select the three following modes by movement commands.

Table 13-2

Item	Selection	Setting code
Coordinate system	Absolute coordinate	Default
	Incremental coordinate	I
Acceleration/ Deceleration pattern	Trapezoidal	Default
	Smooth sine	S
In-position output	Move after In-position	Default
	Continuous movement	N

◆ Selecting coordinate system

- Absolute coordinate system and incremental coordinate system are available.
  (1) Absolute coordinate system: Based on the Home position (Home=0) established by Home return operation.
  (2) Incremental coordinate system: Based on the current position (0).

Example

Command : `MOV P000(I)` ← Designating incremental coordinates.

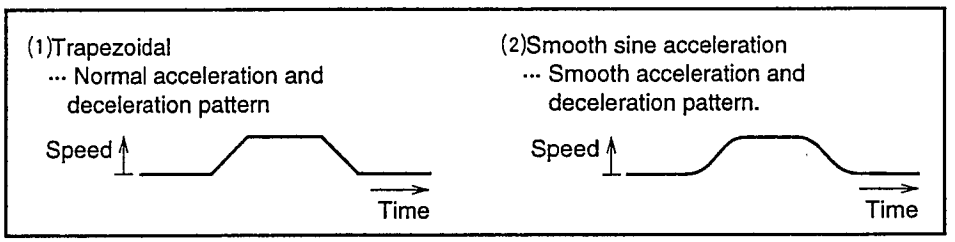
- Executing MOV command under this setting moves Y axis by 100mm in the positive direction from where it is.

P000 coordinate : X-axis 0000.00
Y-axis 0100.00
Z-axis 0000.00

◆ Selecting acceleration/deceleration pattern

- Trapezoidal acceleration/deceleration and smooth sine acceleration/deceleration are available.

Figure 13-10



* Commands containing circular interpolation: CIR does not allow you to select a smooth sine acceleration/deleration.

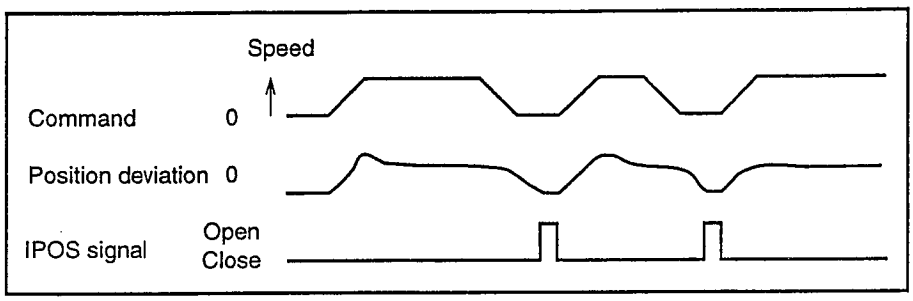
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◆ Selecting In-position output signal

- You can select whether to have an In-position output (CN2: IPOS signal) during positioning.

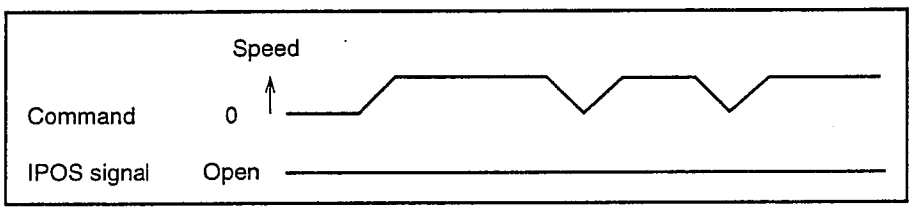
  (1) Move after In-position ··· Moving to the next step after checking In-position output signal (IPOS) (position deviation has decreased to below the preset value).

Figure 13-11



(2) Continuous movement ··· Moving to the next step, without waiting until positioning is completed (IPOS signal), when commands have been completed.

Figure 13-12

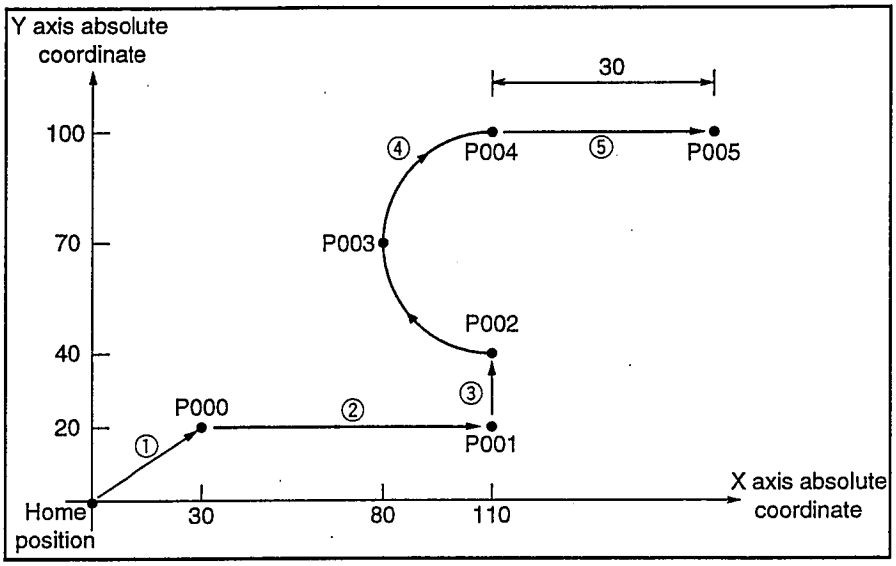


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Program example: Movement command

- **Operating pattern**

Figure 13-13



- **Data of the point registers**

```
P000:X 0030.00    P001:X 0110.00    P002:X 0110.00
     Y 0020.00         Y 0020.00         Y 0040.00

P003:X 0080.00    P004:X 0110.00    P005:X 0030.00
     Y 0070.00         Y 0100.00         Y 0000.00
```

Program

```
STEP 000   HOM X1 Y1      : Execute Home Return operation
STEP 001   MOV P000 S     : ① Move to point P000 (absolute coordinate). Smooth sine accel/deceleration.
                            IPOS signal output
STEP 002   MOV P001 N     : ② Move to point P001 (absolute coordinate). Trapezoidal accel/deceleration.
                            IPOS signal default.
STEP 003   MOV P002 SN    : ③ Move to point P002 (absolute coordinate). Smooth sine accel/deceleration.
                            IPOS signal default.
STEP 004   VER 10           Speed 10%
STEP 005   ARC P002 P003  : ④ Arc movement P002→P003→P004.
           P004             IPOS singnal output.
STEP 006   MOV P005 I     : ⑤ Move to point P005 (incremental coordinate=only x axis moves 30mm from
                            current point. (to point P005). IPOS signal output.
STEP 007   END            : End of program.
```


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13.2.4.2. How to Use Data Register and Point Register

Move commands: LD ··· Data loading
CMP ··· Compare data
ADD ··· Data addition
SUB ··· Data subtraction

- You can use the two following registers on the program.

Data register

Dn n = 00 ~ 99 ··· Handles integer variables. Data range is 000000 ~ ±999999.

Can be commonly used in the same program only and can register up to 100 types of data. Can operate LD, CMP, ADD, SUB between data registers, and between a register and numeric values (integer).

Note: Data registers are valid in the same program only, and are reset when the program is completed (or END command has been executed). Data registers are also reset when programs are switched by CHG command. When executing subroutine call between programs by CALP command, the registers are held on because programs are continuous until END command is executed.

* Generally, data resisters are reset when the power is off, but are held on at the state of immediately before the power has been turned off, when halfway resuming conditions for program operation have been established and the halfway resuming operation is executed.

Point register

Pn n = 00 ~ 399 ··· Used as a destination or a pass-through point by a movement command. It has coordinate data of each axis.

Designed to be commonly used by all programs, being able to have coordinate data of up to 400 points of 000 ~ 399.

Generally, prepares data by teaching. Can prepare data also during programming using LD, ADD, or SUB command.

Note: Point registers are backed up after the power is turned off. When coordinate data have been changed by LD, ADD, or SUB command, however, changed data will be backed up and data before changing will be deleted.

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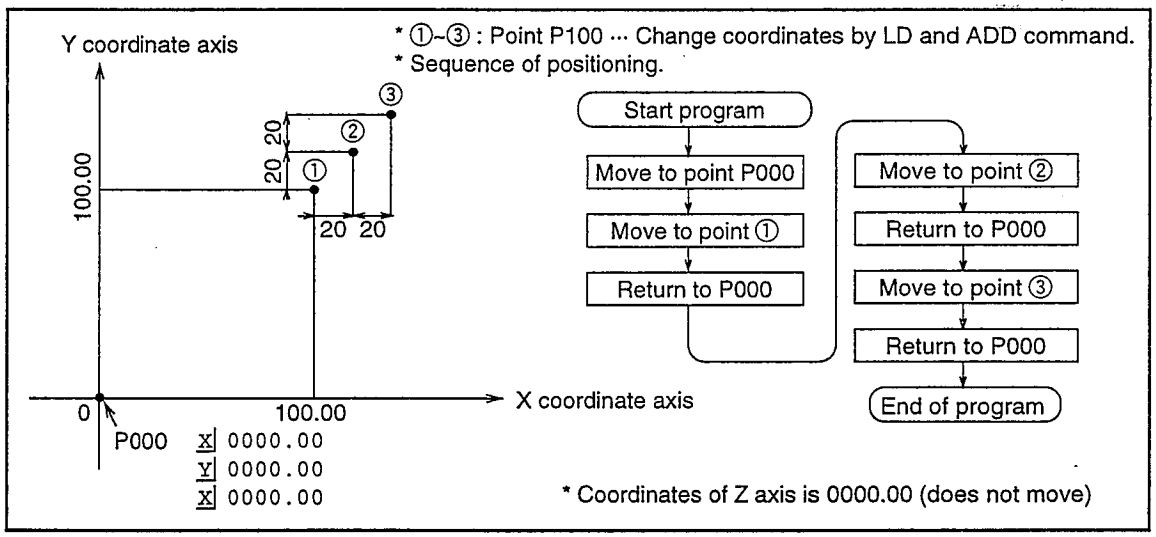
Program example: Data register and point register

- This example is a simple palletizing program using LD, CMP and SUB commands.

Program

```
STEP 000   LD   P000   X 0000.00: Load (write) the coordinates (X:0000.00, Y:0000.00, Z:0000.00)
                       Y 0000.00  to a point register P000.
                       Z 0000.00
STEP 001   LD   P100   X 0100.00: Load (write) the coordinates (X:0100.00, Y:0100.00, Z:0000.00)
                       Y 0100.00  to a point register P100.
                       Z 0000.00
STEP 002   LD   D00    3          : Load "3" to a data resister D00.
STEP 003   TAG  00                : Specify a label No.00 as an destination of the jump command.
STEP 004   MOV  P000              : Move to the point P000.
STEP 005   MOV  P100              : Move to the point P100.
STEP 006   ADD  P100   X 0020.00: Add the coordinate value [X:0020.00] to each coordinate of point P100.
                       Y 0020.00                          [Y:0020.00]
                       Z 0000.00                          [Z:0000.00]
STEP 007   SUB  D00               : Subtract "1" from the data register D00.
STEP 008   CMP  D00               : Compare data register D00 and "0".
STEP 009   JNE   00               : If data register D00 is not "0" jump to label No.00 (TAG00).
STEP 010   MOV  P000              : If data register D00 is "0", move to point P000.
STEP 011   END                    : End of program.
```

Figure 13-14



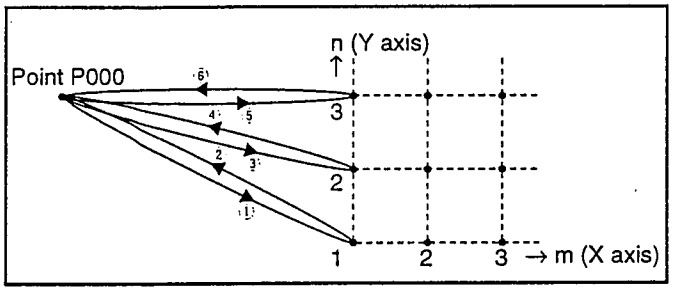
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13.2.4.3. Palletize

Move Command : PAL ··· palletize operation command

- You can program palletize operation easily using PAL command.
- Palletize command on a two-dimensional plane of X and Y axes.

Figure 13-15



- Executes the 4 following types of palletize operations in accordance with palletize initial settings to be defined in advance and palletize operation designation numbers set in PAL command.

PAL 00 01

Palletize command — Type of pallet — Palletize operation designation number

Table 13-3

Palletize operation	Outline of operation during execution of command	Palletize operation designation No.
Initialization	● Performing operation up to loading after initializing internal flags on palletize. ● Be sure to set initialization at the top of the palletize program.	00
Loading	● Calling and executing the loading program. ● Prepare loading programs of different program numbers in advance. ● Define the programs numbers in palletize initial setting as load program numbers in advance. * Loading operation is valid after one cycle of pallet positioning is completed (in the above example, when a point of m×n is positioned). Before one cycle of pallet positioning is completed, you can do no operation by setting loading operation to execute a preset step.	01
Pallet positioning	● Performing positioning according to the pallet status (mesh of m×n in the above example) defined by palletize initialization.	02
Hand operation (End effector)	● Calling and executing hand operation (= operation to be made after positioning at pallet point). Example: Z-axis lowering → Hand opening → Z-axis lifting. ● Prepare hand operation programs of different program numbers in advance. ● Define the program numbers in palletize initial setting as hand operation program in advance. (* You can prepare two types of hand operations.)	03 04

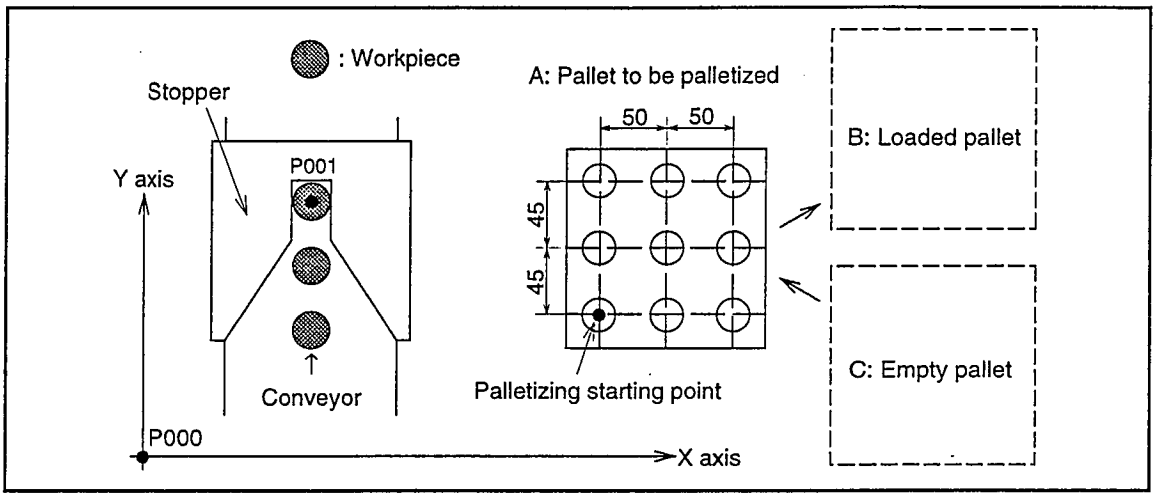
Note: (1) To be used in X-Y two-dimensional planes only.
(2) Define the pallet status in advance by palletize initial setting. See "13.3. Palletize Initial setting."
(3) You can define only two types of pallets by palletize initial setting.
(4) Program error will result during program execution if the initialization command is not set at the top of the palletize program.

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Program example: Palletize program by PAL command

- **Outline of operation**

Figure 13-16



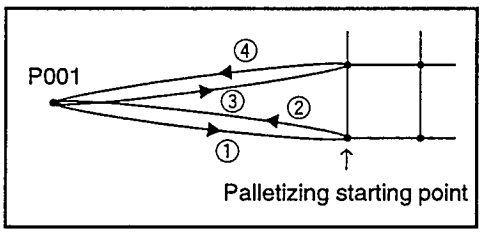
(1) Loading: Preparation for palletize

- ○ Carrying a palletized pallet from A to B, and an empty pallet from C to A.
- ○ This operation is to be made by another system and EXC type controller is to output a start signal for another system.

(2) Palletize movement

- ○ Picking up a stopping workpiece after moving on the conveyor, and palletizing it on the pallet A.

Figure 13-17



(3) Hand operation

- ○ Performing hand operation at points during palletize movement.

①Hand operation 1 ··· Lowering in Z axis at P0001 point, and rising in Z axis after chucking a workpiece. Checking whether the hand has chucked a workpiece, lighting warning lamp if no workpiece is found, and waiting at P000 point.

②Hand operation 2 ··· Lowering in Z axis at a pallet point (a point on the pallet), and raising in Z axis after releasing a workpiece.

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- **Palletizing initial setting**

  - In this program, use pallet No.00. Execute the pallet No.00 initial setting.
  - See "13.3. Palletizing Initial Setting"

  (1) Setting pallet condition

  Dimension : Number of palletizing points for each axis.

  X] 03 Y] 03

  Start position Coordinates of start position

  X] 0150.00 Y] 0050.00

  Move width Palletizing pitch and direction

  X] 0050.00 Y] 0045.00

  Move pattern Operation pattern

  X] 0 Y] 0

  Axis sequence Operation pattern

  X] 1 Y] 0

  (2) Setting program numbers

  Loading : Loading program → Program N0.01

  01

  Hand 1 : Hand operation program No.1 → Program No.02

  02

  Hand 2 Hand operation program → Program No.03

  03

  - General purpose I/O function assignment (wiring) [provided by the customer]

  (1) General Output port 0 00000000

  Bit 0 : Hand ON/OFF
  Bit 1 : Start signal to loading system
  Bit 2 : Warning lamp ON

  (2) General Input port 0 00000000

  Bit 0 : Chucking sensor.
  Bit 1 : Completion signal from loading system

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- **Point data**

```
P000 : X  0000.00    P001 : X  0080.00
       Y  0000.00           Y  0100.00
       Z  0000.00           Z  0000.00

P100 : X  xxxx.xx    P101 : X  xxxx.xx    P102 : X  xxxx.xx
       Y  xxxx.xx           Y  xxxx.xx           Y  xxxx.xx
       Z  0000.00           Z  0150.00           Z  0200.00
```

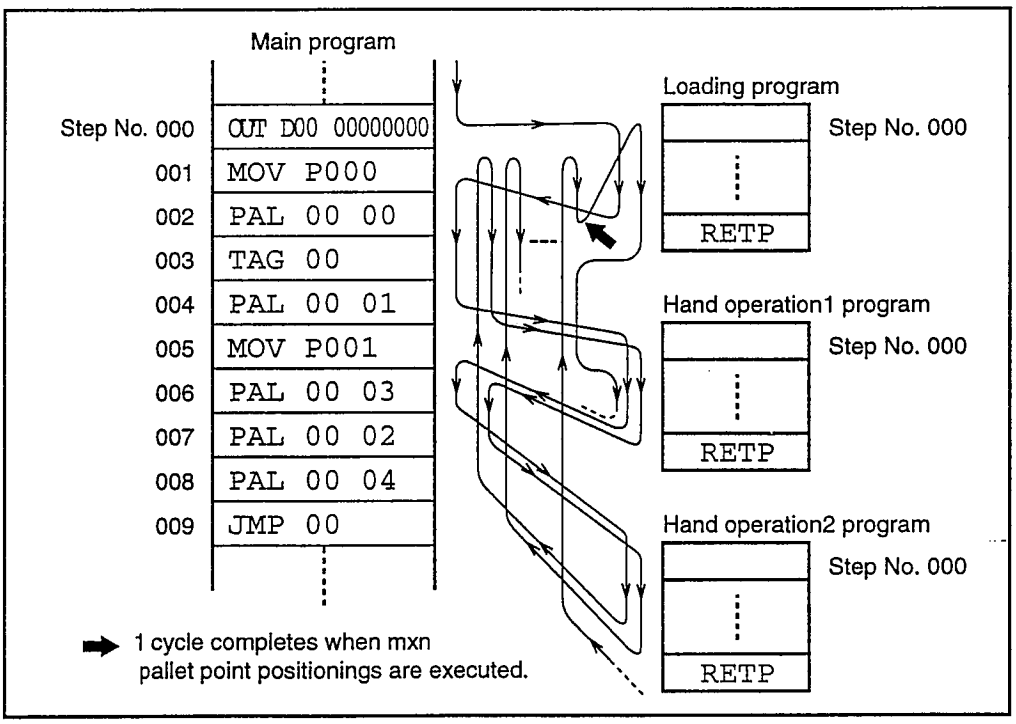
- **Program**

Program 00 : Main program

```
STEP 000   OUT D00 00000000 : General output port: all bit open = Reset general output
STEP 001   MOV P000         : Move to P000
STEP 002   PAL 00 00        : Initialize Pallet 00 = Reset palletizing internal flag.
                              + Start loading program.
STEP 003   TAG 00           : Specify Tag No.00.
STEP 004   PAL 00 01        : Loading program start. (Valid after one cycle of palletize move is completed.)
STEP 005   MOV P001         : Move to P001
STEP 006   PAL 00 03        : Start program of Hand operation1
STEP 007   PAL 00 02        : Paletize move.
STEP 008   PAL 00 04        : Start program of Hand operation2.
STEP 009   JMP 00           : Jump to TAG00
```

- **Flow of executing program**

Figure 13-18



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Program 01: Loading program

```
STEP 000   OUT DO0 xxxxxx1x : Close the bit 1 of the general output port0
                              = Start the other system's loading operation.
STEP 001   TAG 00           : Set Tag No.00.
STEP 002   CMP DI0 xxxxxx1x : Verify the bit1 is "ON".
                              (the generatl input port0)
STEP 003   JEQ              : If the bit1 is not "ON", Jump to Tag00.
STEP 004   OUT DO0 xxxxxx0x : Open the bit1 of the general output port0
                              = Return the loading start signal to former state.
STEP 005   RETP             : Completion of loading program → Return to main program.
```

Wait for the signal of completion of loading. After the loading is completed, procede to next step.

Program 02: Hand operation 1

```
STEP 000   MOV P102         : Move to P102 = Down Z axis 200mm
STEP 001   OUT DO0 xxxxxxx1 : General output port0.  Bit 0 open = Close the Hand. (Chuck the workpiece)
STEP 002   TIM 1.0          : Wait for 1 second.
STEP 003   MOV P100         : Move to P100 = Z axis up.
STEP 004   CMP DI0 xxxxxxx1 : Verify the bit1 is "ON"
                              (the general input port0)
STEP 005   JEQ              : If the bit1 is "ON", Jump to Tag00.
STEP 006   MOV P000         : Move to P000
STEP 007   OUT DO0 xxxxx1xx : General input port0, close the bit2.
STEP 008   END              : End of the program.
STEP 009   TAG 00           : Set Tag No.00.
STEP 010   RETP             : End of loading program → Return to main program.
```

Verify a workpiece is chucked.

If a workpiece is not chucked, move to P000,turn on the warning lamp and complete the program.

Program 03: Hand operation 2

```
STEP 000   MOV P101         : Move to P101 = Down Z axis 150mm.
STEP 001   OUT DO0 xxxxxxx0 : General output port0, open the bit0 = Open the Hand. (Release a workpiece.)
STEP 002   TIM 1.0          : Wait for 1second.
STEP 003   MOV P100         : Z axis up
STEP 004   RETP             : End of loading program → Return to main program.
```

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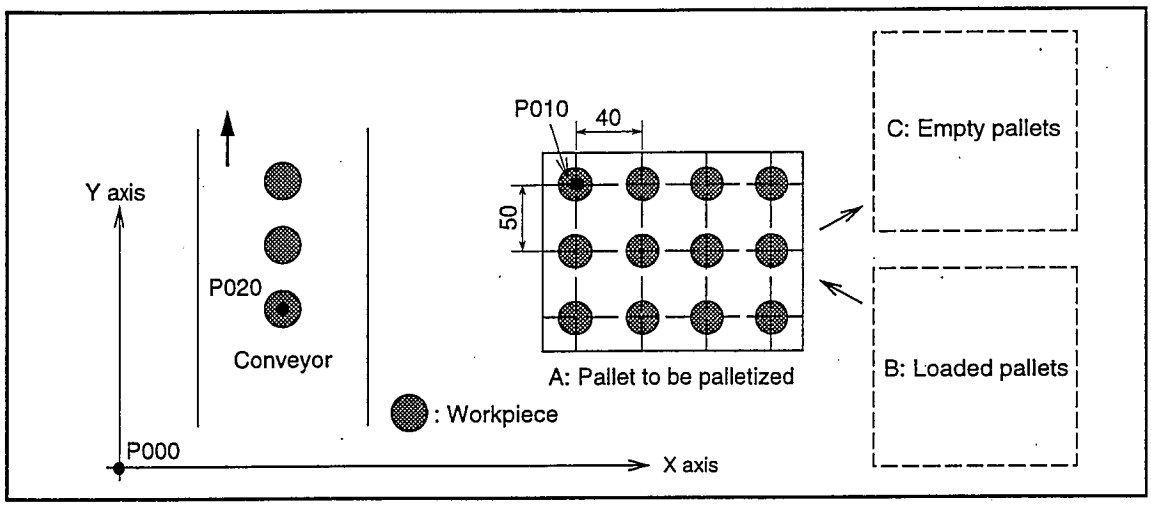
Program example: Palletizing without using PAL command

- PAL command is simplified palletize operation.
- To perform more flexible palletize operation, use a data register to prepare palletize programs.

* Palletize initial setting is not needed when you do not use PAL command.

• Outline of operation

Figure 13-19



• Operation

(1) Loading operation :To be done by a separate system. EXC controller outputs a start signal for a separate system, and waits until a loading operation is completed.

- Putting palletized (in this case, palletize means putting workpieces from a pallet onto the conveyor; it is also called de-palletize) pallet A (empty) onto the pallet station C.
- Taking out a pallet from the pallet station B, and putting it onto palletizing station.

(2) Palletize operation:

- Taking out workpieces from pallet A at point P010.
- Checking whether the hand has securely chucked a workpiece, moving to P010 in case of NG, and waiting with the lamp lighting.
- Checking that a workpiece has been chucked securely, taking out the next workpiece from pallet A, and putting it on the conveyor (P020).

* Repeating the above operation.

• Data of the point registers

```
P000 : X  0000.00     P010 : X  0050.00
       Y  0000.00            Y  0200.00
       Z  0000.00            Z  0000.00

P020 : X  0300.00     P021 : X  xxxx.xx
       Y  0100.00            Y  xxxx.xx
       Z  0000.00            Z  0000.00
```


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- **Assign general I/O bit. (Wiring must be provided by customer.)**

(1) General output port 0 00000000

Bit 0 : Hand open/close	0: open, 1: close
Bit 1 : Warning lamp	0: OFF, 1: ON
Bit 7 : Start loading system	1: Start

(2) General input port 0 00000000

Bit 0 : Workpiece chucked	0: NG, 1: OK
Bit 7 : Loading complete	0: Not yet, 1: Complete

- **Program example**

Program00 : Main program

```
STEP 000   TAG 00              : Set Tag No.00
STEP 001   LD P010 X| 0050.00 : P010 coordinates initial setting
                   Y| 0200.00
                   Z| 0000.00
STEP 002   MOV P000            : Move to P000
STEP 003   OUT DO0  00000000  : General output 0, open all bits.      ... Reset general output port0.
STEP 004   OUT DO0  1xxxxxxx  : General output 0, close bit7.        ... Start loading system.
STEP 005   TAG 01              : Set Tag No.01.                       ]
STEP 006   CMP DI0  1xxxxxxx  : General input port 0, Verify bit7 is ON. ... Wait for completion of loading.
STEP 007   JNE 01              : If not "ON" jump to TAG01.           ]
STEP 008   LD  D00  000003    : Load 3 onto data register 00.
STEP 009   TAG 02              : Set Tag No.02
STEP 010   REP 04              : Repeat 4 times to NXT.
STEP 011   MOV P010            : Move to P010.
STEP 012   CALP 01             : Call program No.01.
STEP 013   NXT                 : Set the end of repetition.
STEP 014   SUB P010 X| 0160.00: From coordinates of P010,
                   Y| 0050.00 subtract X: 160  ] (Z remains same)
                   Z| xxxxx.xx        Y: 50   ]
STEP 015   SUB D00  000001    : Subtract 1 from data register 00.
STEP 016   CMP D00  000000    : Check if data register 00 is 0.
STEP 017   JNE 02              : If not 0, jump to TAG02.
STEP 018   JMP 00              : If 0, jump to TAG00.
```

Program 01 : Subroutin

```
STEP 000   MOV X| xxxx.xx      : Down Z axis 100mm ---------- Down to pallet position.(100mm)
               Y| xxxx.xx
               Z| 0100.00
STEP 001   OUT DO0 xxxxxxx1    : General output port0, bit0 open  ----- Hand close.
STEP 002   TIM 0.5             : Wait for 0.5 second.
STEP 003   MOV P021            : Move to P021. ---------------- Z axis up.
STEP 004   CMP DI0 xxxxxxx1    : General input port 0: Verify bit0 is ON. - Verify chuck
STEP 005   JNE 00              : If not ON, jump to TAG00.                 ]
STEP 006   MOV P020            : If ON, move to P020.  --------- Moto onto coveyor   <-- OK
STEP 007   MOV X| xxxx.xx      : Down Z axis 150mm. ---------- Down to releasing point to coveyor.
               Y| xxxx.xx                                     (150mm)
               Z| 0150.00
STEP 008   OUT DO0 xxxxxxx0    : General output port 0, Open bit0. ----- Open the Hand=Release a workpiece.
STEP 009   TIM 0.5             : Wait for 0.5 second
STEP 010   MOV P021            : Move to P021. ---------------- Z axis up.
STEP 011   ADD P010 X| 0040.00: To P010 coordinates
                   Y| xxxx.xx  add X=40mm
                   Z| xxxx.xx  (Y,Z unchanged)
STEP 012   RETP                : Return to program.  ---------- End of subroutin.
STEP 013   TAG 00              : Set Tag No.00.                    <-- NG
STEP 014   MOV P000            : Move to P000.
STEP 015   OUT DO0 xxxxx1x     : General output port 0: close bit1 ----- Warning lamp ON.
STEP 016   END                 :END
```


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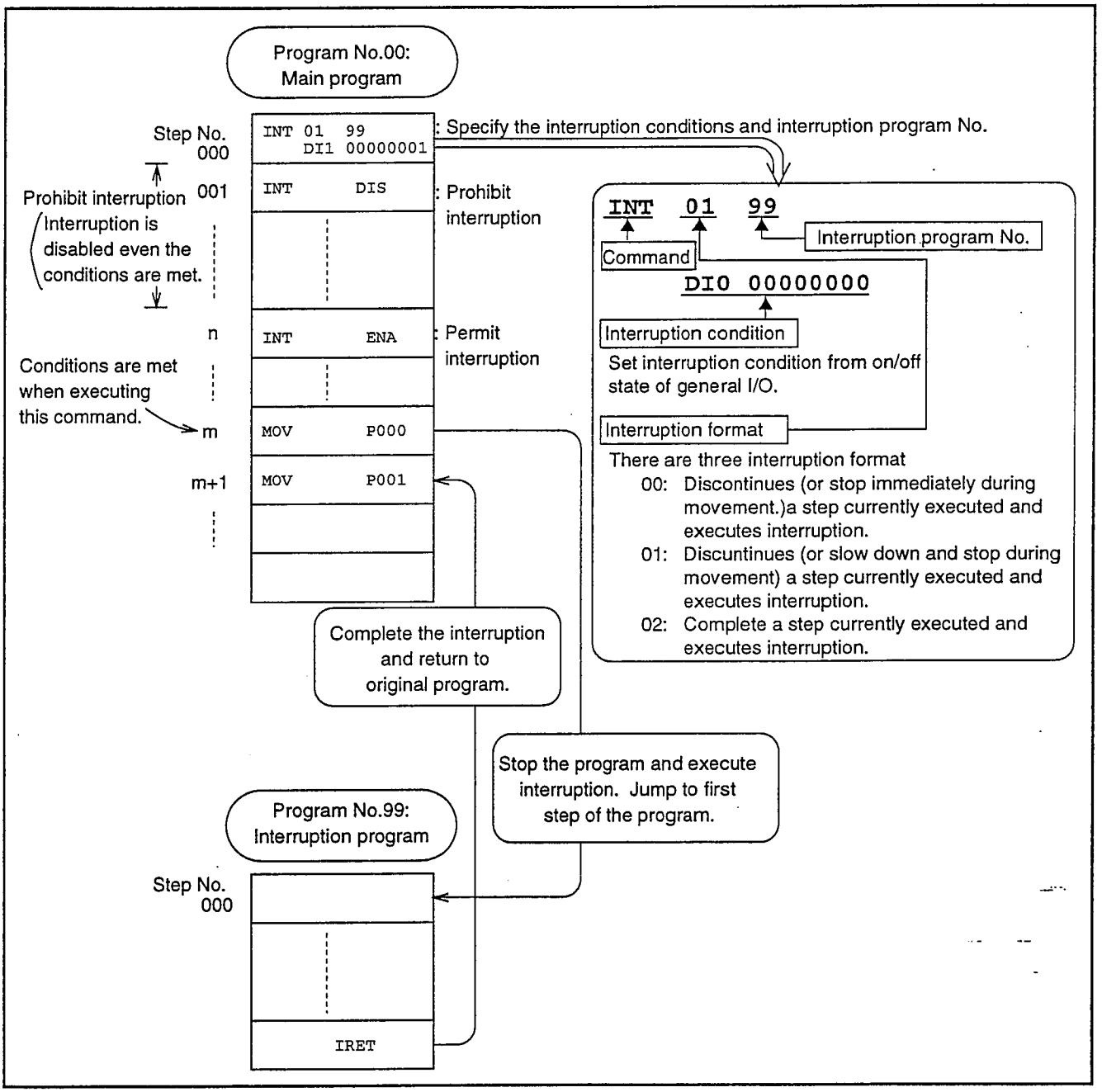
13.2.4.4. Interruption

Interruption commands: INT ··· ①Specifies the interruption conditions and number on an interruption program.
②Permit to interrupt and specifies prohibited area.

IRET ··· Return from an interrupted program.

- Set INT command to the first step (step No.000) of the program to be interrupted. When the conditions are met, the command stops the program int the middle of execution and starts the interruption.

Figure 13-20: Interruption example



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Note: (1) Note that, if you have set an interruption format to 00 or 01, steps jumped for interruption will not be completed.

In Fig. 13-20, during execution of step No. m (on the half way to P000 point), the program is interrupted and the interruption processing program is executed. Then, step No. m+1 (move to P001) is executed. Positioning to P000 point is left uncompleted.

(2) When the interruption format is set to 00 during execution of movement command, the program will stop instantly.

If you stop the program instantly during high speed movement, an over current alarm may be issued. In such a case,

- Set the interruption format to 01, and decelerate and stop the program.
- Operate the program at a low speed in an area where an interruption occurs.

(3) Interruption condition input detects the timing of change.

In Figure. 13-20, interruption processing is carried out when an input to the input port has changed from a non-00000001 state to 00000001. No interruption occurs when the input has no change and is in the state of 00000001 from the start.

(4) Set IRET command at the end of the interruption processing program.

Set END command instead of IRET command when you do not have to return to the original program. If neither of the above programs is set, a program trouble alarm will be issued.

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Program example: Interruption

- **Outline of operation**

(1) Definition of interruption

When the bit 0 of the general purpose input port 0 changes from OFF to ON, an interruption occurs. (when the liquid level sensor touches the liquid surface in the bottle, interruption starts.)

(2) Outline of operation

① Moving from the home position P000 to P001, and checking whether a workpiece (bottle) is under it. (checking that bit 0 of the general input port 0 is ON).

② Lowering vertically to P010 when a workpiece is found,

③ At the moment when the liquid level sensor contacts the liquid surface, the sensor changes from OFF to ON and interruption starts. (downward movement stops immediately, and the interruption program starts operating)

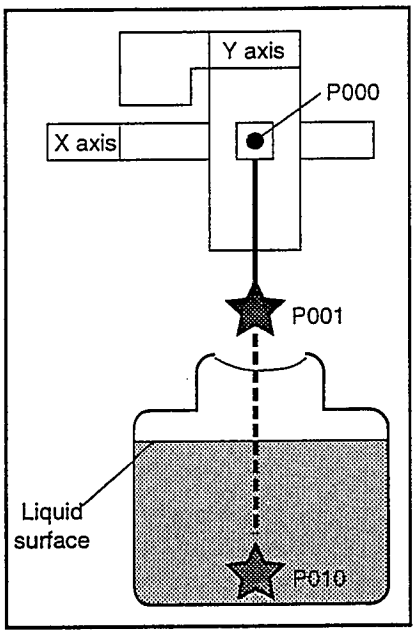
④ Performing the interruption program. (inspection, liquid level measurement, etc.)

⑤ When the interruption processing is completed, you will have the main program, and Y axis rises to P001.

⑥ If the sensor has reached P010 without detecting the liquid level, the program will perform the trouble processing.

- **Equipment**

Figure 13-21



- **Data of point register**

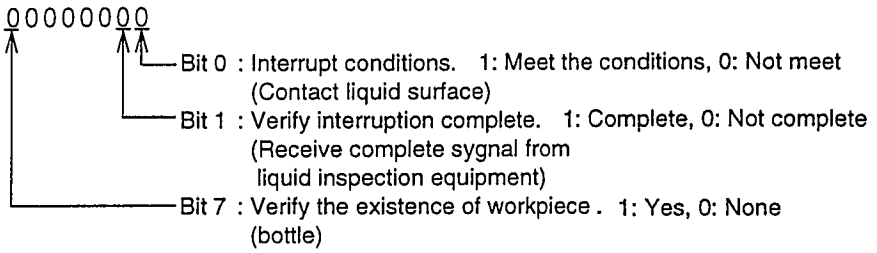
```
P001 : X| xxxx.xx
       Y| 0010.00

P010 : X| xxxx.xx
       Y| 0200.00
```


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- **Assignment of general I/O bit. (Wiring must be provided by customer)**

General Input port 0



- **Program**

Program 00 : Main program

```
STEP 000    INT 00 99          : When the general input port 0 changes to 00000001, stop the
            DIO 00000001         executing step program, then execute interruption program No.99.
STEP 001    INT DIS            : Prohibit interruption.
STEP 002    MOV P001           : Move to P001. (starting point of operation)
STEP 003    TAG 00             } Wait until general input port 0 is ON (verifies existence of a bottle),
STEP 004    CMP DI0 1xxxxxxx   } after the existence confirmed, then procede to next step (STEP007).
STEP 005    JNE 00             }
STEP 006    VEL 10             : Set low speed. ("Max speed" × 10%)
STEP 007    INT ENA            : Interruption enabled.
STEP 008    MOV P010           : Move to P010. → Waiting for an interruption.
STEP 009    CMP DI0 xxxxxx1x   } Completed normally if the interruption is executed, then jump to TAG01.
STEP 010    JEQ 01             } If the interruption is not executed, call program No.90
STEP 011    CALP 90            } to execute the trouble processing.
STEP 012    TAG 01
STEP 013    VEL 100            : Set High speed.
STEP 014    MOV P001           : Return to P001.
STEP 015    END
```

Program 99 : Interruption program

```
STEP   000 INT DIS             : Prohibit interruption. (prohibit multi-interruption.)
           :                   } Interruption (inspecting or measuring)
           :                   } In this process, receive the output for completion from liquid level
           :                   } inspection equipment. (General input port0:bit1)
STEP    n  IRET                : Complete interruption, return to main program.
```

Program 90: Trouble processing program

```
STEP 000
           :                   } Trouble processing.
           :                   }
STEP m     RETP                : Complete trouble processing and return to the main program.
```

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13.2.4.5. Continue Path

Move Command : CPS CPE

- Performing continue path movement at a constant speed without being accelerated or decelerated at the points on the way.
- To be used for applications such as sealing and debarring that require a constant speed path movement, and high-speed pick and place applications.

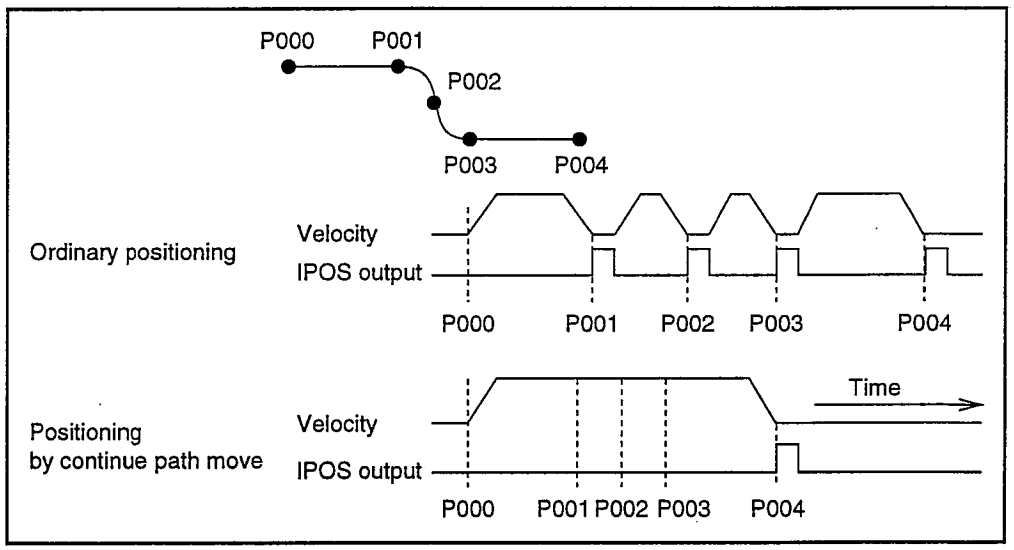
Note: When using this command for high speed pick and place applications, pay attention to the lead of the ball screw for each axis. If the lead of the ball screws differ, the maximum speed of the shortest lead limits the maximum moving speed.

Example: X-axis ball screw lead: 20
Y-axis ball screw lead: 10

- In this case, the maximum moving speed of continue path between X and Z is the maximum speed of the ball screw with a lead of 10 mm: 600 mm/s.
  → When both the X- and Z-axis ball screws have a lead of 20 mm, the maximum speed is 1,200 mm/s.

- Programming of continue path movement have restrictions. Carefully read the following "Restrictions on continue path programming" to perform programming properly.

Figure 13-22



- The two following command are used.
  CPS: continue path start
  CPE: continue path end

- Executes movement command between CPS and CPE at a constant speed.
- Commands you can set between CPS and CPE are as follows:

Table 13-4

Command	Function
MOV	Linear interporation
CIR	Circle movement
ARC	Circular interpolation
OUT	Output command to general output port.

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Restrictions on continue path programming

(1) Acceleration/deceleration

- Set linear movement command (MOV) at the start and end of continue path movement, so that the acceleration/deceleration of continue path movement (resultant acceleration/deceleration) ends during the linear movement.
  - ○ You cannot perform continue path movement that starts with a curve.
  - ○ In the first and the last of the linear movement commands, set a distance longer than the distance that allows you to complete the acceleration/deceleration of continue path movement. (a distance required for the following ◆ acceleration/deceleration)

- A program trouble alarm will be issued if you try to perform a program that does not follow the above (1).

◆ Distance required for acceleration/deceleration

① Calculate the acceleration/deceleration during program operation by referring to "11.3.1.3. Acceleration and Deceleration in Programmed Operation."

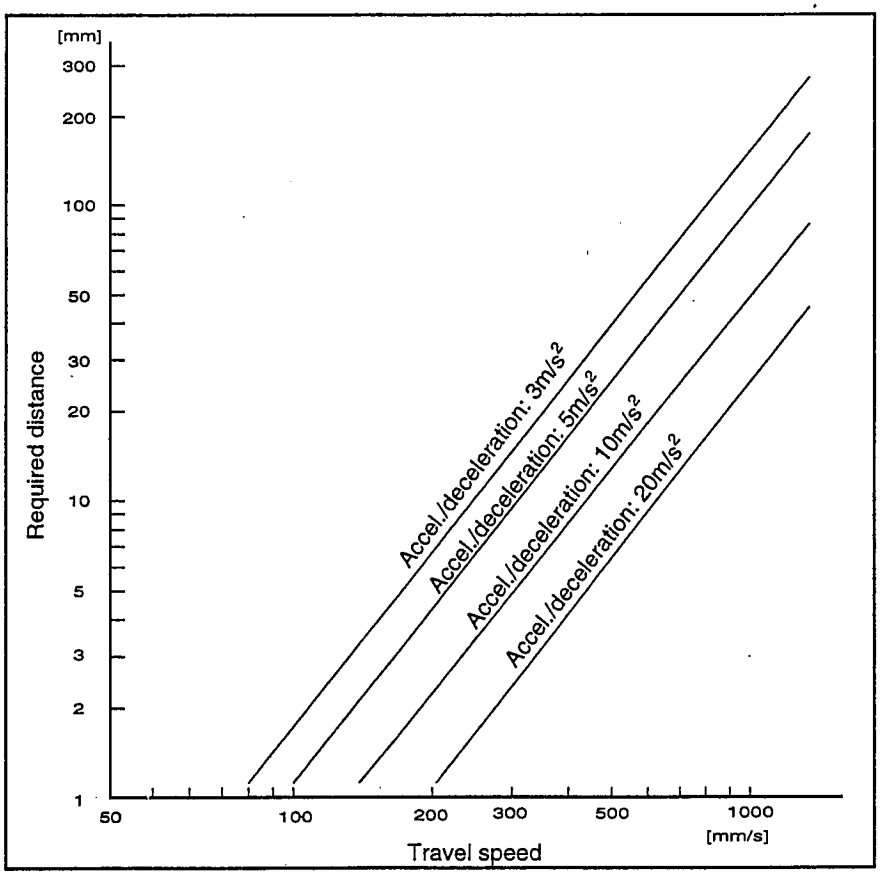
Acceleration/ deceleration [m/s²]	=	Max. accel: [m/s²] Maximum Acceleration/ deceleration specified in initial setting	×	ACC: [%] Command to decide moving accel/ deceleration	$\times\frac{1}{100}$

②Calculate a distance required for the acceleration/ deceleration from the moving speed (*) by applying the acceleration/deceleration calculated in (1) to the acceleration/deceleration in Figure 13-23.

* Moving speed: See "Moving speed during program operation."

Travel speed [mm/s]	=	Max. speed: [mm/s] Maximum travel speed specified in initial setting	×	VEL: [%] Command to decide travel speed	$\times\frac{1}{100}$

Figure 13-23



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(2) Radius to connect linear moves

- When changing the direction of linear move, two linear moves must be connected by a radius (arc) to have a locus as smooth as possible.
  - Because each axis speed changes discontinuously at points at where direction changes, not only an accurate locus cannot be formed with a motor having a limited power, but also a too large motor current command will result due to a too large speed difference at the point, leading to an overcurrent alarm.

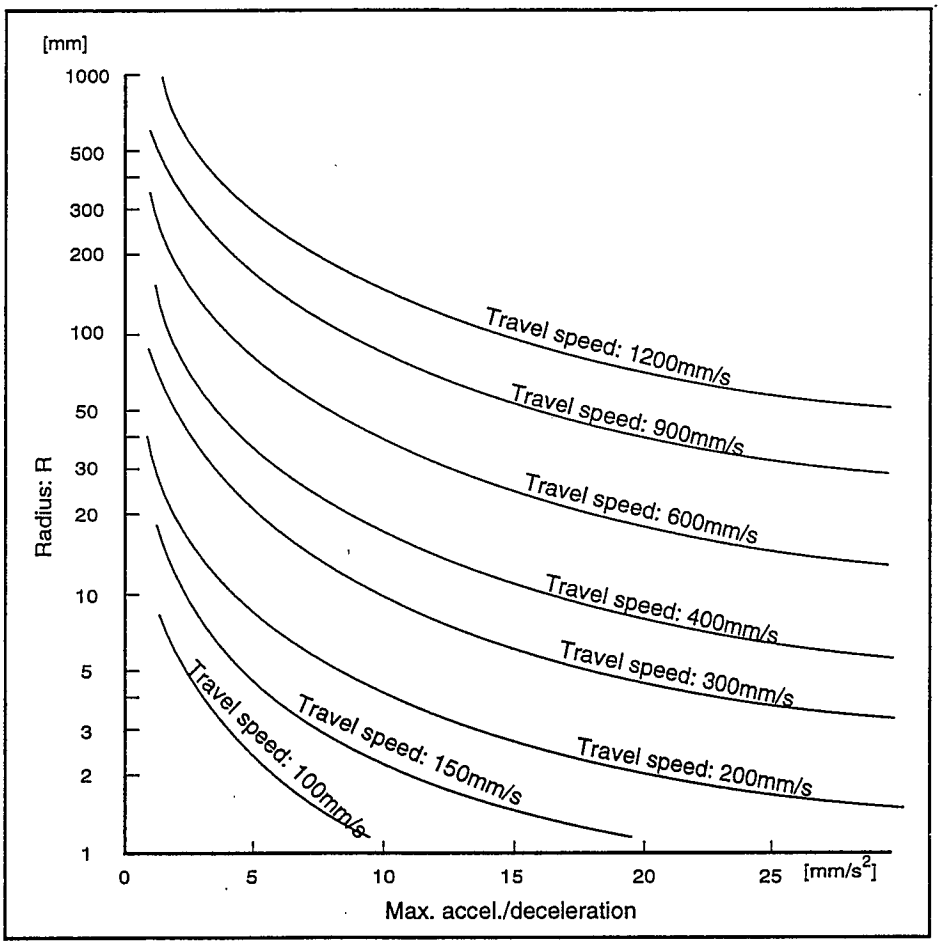
◆ Radius to connect two linear moves

① Calculate the allowable maximum acceleration/ deceleration by referring to "11.3.1.3.Acceleration and Deceleration in Programmed Operation."

② You can find the relationship between a travel speed and the radius (R) by applying the acceleration/ deceleration (*) calculated in (①) to the abscissa in Figure. 13-24.

* Apply the minimum value of the maximum acceleration/deceleration in each axis.

Figure 13-24

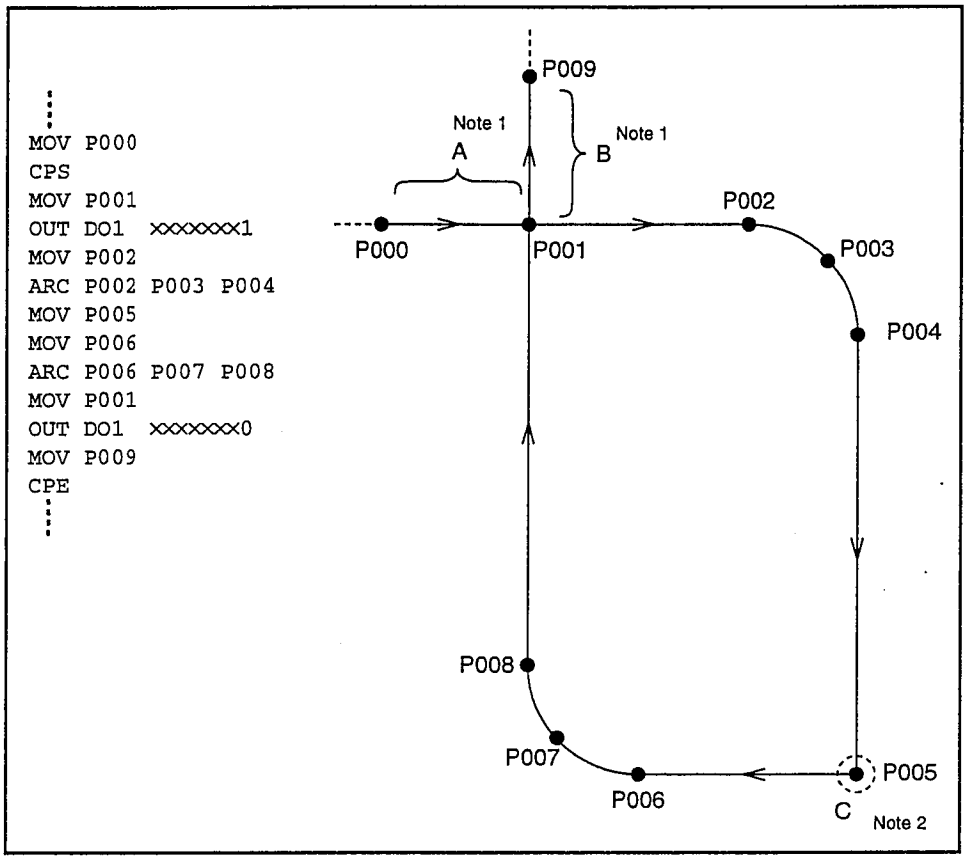


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Restrictions on continue path programming:

(1) **Acceleration/deceleration and** (2) **Connecting two linear moves**

Figure 13-25: Example



Note 1: Program the path in such a way that acceleration ends at A, and deceleration ends at B. See Figure 12-23 for the travel speeds, acceleration/deceleration, and distance required for acceleration/deceleration.

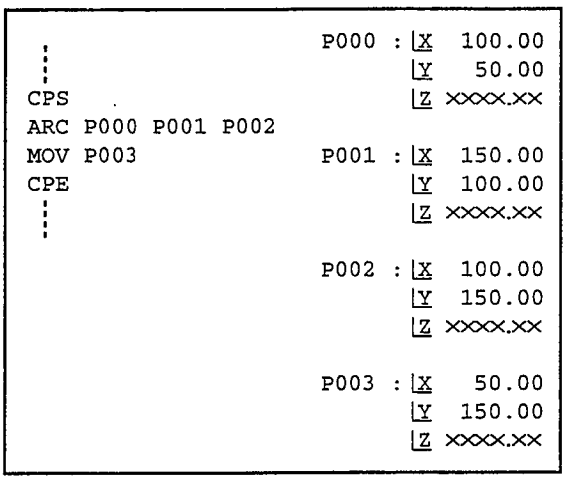
2: Connect point C with an radius (arc). See Figure 13-24 for the size of radius.

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(3) Two-dimensional path movement

- Continue path movement is two dimensional (2-axis plane).
- When programming continue path movement for EXC3 (3-axis controller), set ××××.×× (means no movement) or same data for axes not related to the continue path movement plane.
- A program trouble alarm will be issued if you try to perform a program that does not follow the above comments.

Figure 13-26



(4) You can use up to 100 commands between CPS and CPE. You cannot use continue path of 101 steps or more.

(5) You cannot use five or more OUT commands consecutively. When using OUT commands consecutively, limit them to four or less.

(6) Operation time

- Before starting continue path movement, the controllers calculates the travel of its total path. Time required for the calculation is calculated by:

  $$\frac{\text{Number of continue path steps}^{*}}{5\ \text{ms}}$$

- When too many steps are used, the program looks halting occasionally.

* The number of commands set between CPS and CPE.

(7) Issues output command during continue path movement 5 to 10 ms after passing the immediately preceding point.

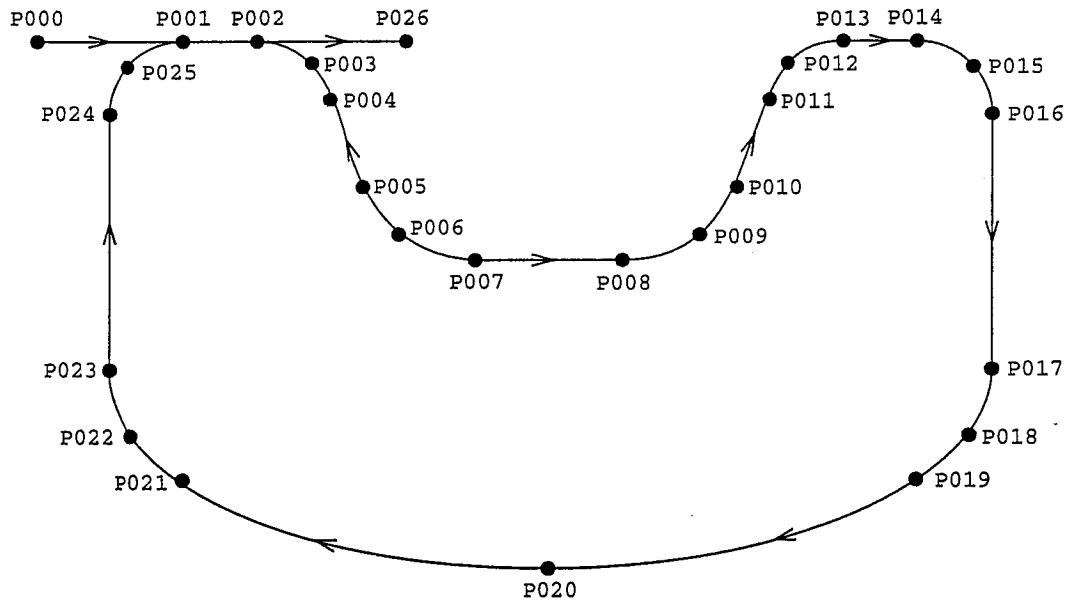
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Continue path program: Example 1

- The example is for sealing operation.

Figure 13-27

```
MOV P000            : Move to P000
CPS                 : Start of continue path
MOV P001            : Move to P001
OUT DO0 xxxxxxx1    : Close general output port 0, bit 0[abhesive starts to flow]
MOV P002            : Move to P002
ARC P002 P003 P004: Arc move through P002, P003 and P004
MOV P005            : Move to P005
ARC P005 P006 P007: Arc move through P005, P006 and P007
MOV P008            : Move to P008
ARC P008 P009 P010: Arc move through P008, P009 and P010
MOV P011            : Move to P011
ARC P011 P012 P013: Arc move through P011, P012 and P013
MOV P014            : Move to P014
ARC P014 P015 P016: Arc move through P014, P015 and P016
MOV P017            : Move to P017
ARC P017 P018 P019: Arc move through P017, P018 and P019
ARC P019 P020 P021: Arc move through P019, P020 and P021
ARC P021 P022 P023: Arc move through P021, P022 and P023
MOV P024            : Move to P024
ARC P024 P025 P001: Arc move through P024, P025 and P001
OUT DO0 xxxxxxx0    : Open general output port 0, bit 0 [abhesive flow stops]
MOV P026            : Move to P026
CPE                 : End of continue path
END                 : End of program
```



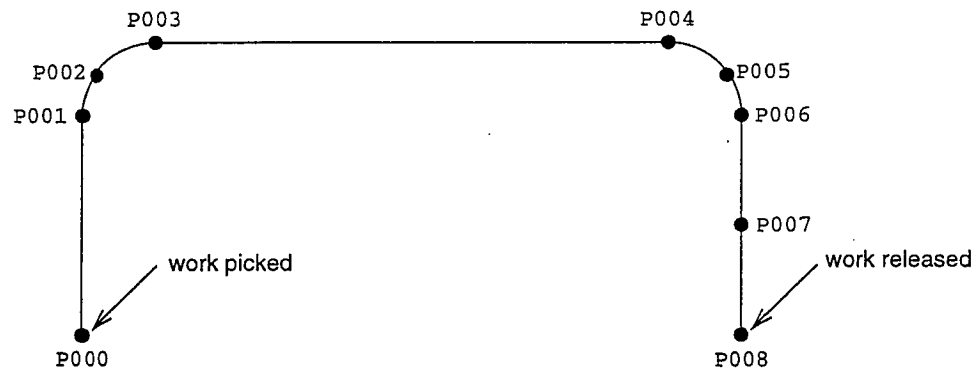
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Continue pass program: Example 2

- This example is for high-speed pick and place operation.

Figure 13-28

```
MOV P001                : Move to P001
OUT DO0  1xxxxxxx       : Close general output port 0, bit 7 [to open work suction valve]
MOV P000                : Move to P000
TAG 00                  : Set Tag No. 00                    ]
CMP DI0  xxxxxxx1       : Verify general input port 0, bit 0  Confirm work picked (connect work
JNE 00                  : If bit 0 is not 1, jump to TAG00  ] sensor to general input  port 0, bit 0)
CPS N                   : Start of continue path
MOV P001                : Move to P001
ARC P001 P002 P003: Arc move through P001, P002 and P003
MOV P004                : Move to P004
ARC P004 P005 P006: Arc move through P004, P005 and P006
MOV P007                : Move to P007
OUT DO0  0xxxxxxx       : Open general output port 0, bit 7 [to close work suction valve]
MOV P008                : Move to P008
CPE                     : End of continue path
TAG 01                  : Set Tag No. 01                    ]
CMP DI0  xxxxxxx0       : Verify general input port 0, bit 0  Confirm work released
JNE 01                  : If bit 0 is not 0, jump to TAG 01 ]
CPS N                   : Start of continue path
MOV P006                : Move to P006
ARC P006 P005 P004: Arc move through P006, P005 and P004
MOV P003                : Move to P003
ARC P003 P002 P001: Arc move through P003, P002 and P001
OUT DO0  1xxxxxxx       : Close general output port 0, bit 7 [to open work suction valve]
MOV P000                : Move to P000
CPE                     : End of continue path
JMP 00                  : Jump to TAG 00
```



* To shorten the cycle time, the work suction valve is turned on and off at P001 and 007, respectively. (Work is not sucked and released quickly if you turn the valve on and off at P000 and P008, respectively.)

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13.2.5. Program Commands

- This section describes the program commands in alphabetical order.

ACC	acceleration : Movement acceleration/deceleration	Command code length:4

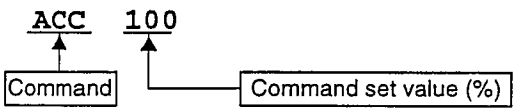
- The ACC command specifies the moving acceleration in a percentage with respect to the maximum acceleration specified in initial setting.

$$\text{Travel acceleration/deceleration}\ [m/s^2] = \text{Max accel: Initial setting}\ [m/s^2] \times \text{ACC: Command set value}\ [\%] \times \frac{1}{100}$$

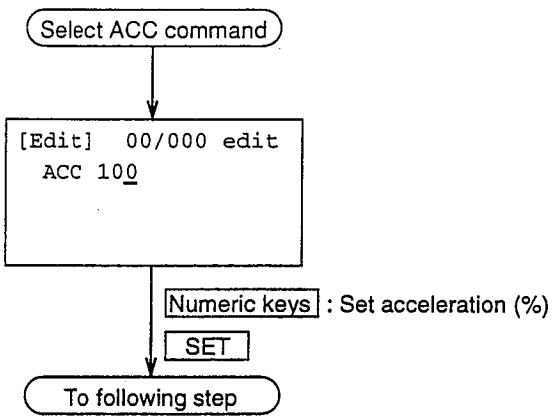
* See "11.3.1.3. Acceleration and Deceleration in Programmed Operation"

- Once the ACC command is specified, movement is performed at the specified moving acceleration until another ACC command is specified.

- Setting range: 001 to 100



- **Setting procedures**



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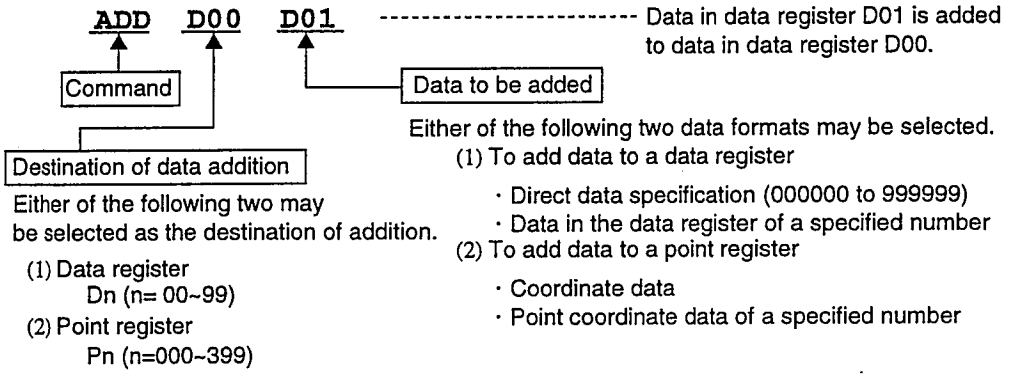
ADD

add : Data addition

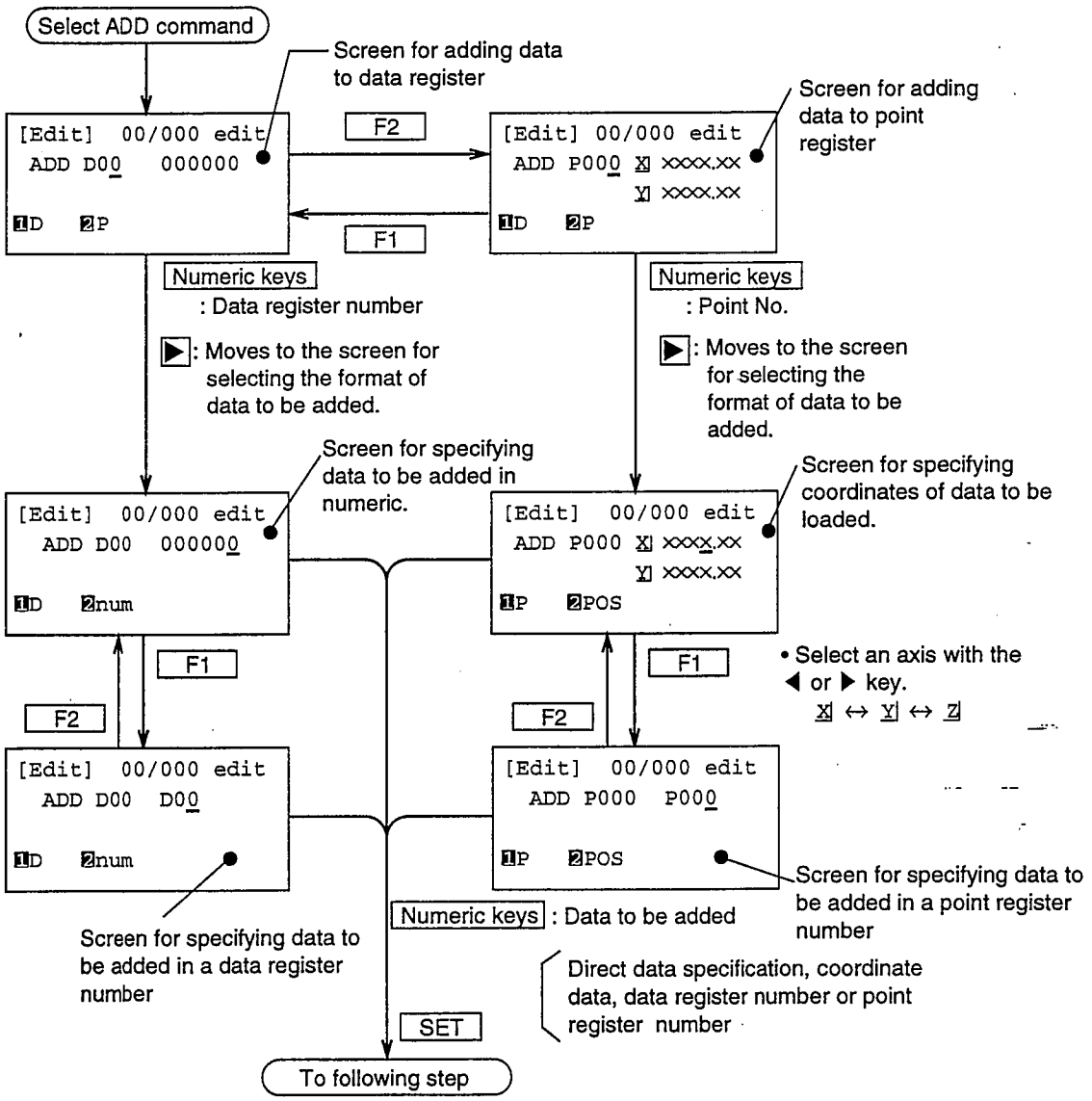
Command code length

ADD Dn	Numeric data	: 5
ADD Dn	Dm	: 3
ADD Pn	Pm	: 3
ADD Pn	Coordinates data	: 14

- The ADD command adds data to a point register or data register.



• Setting procedures

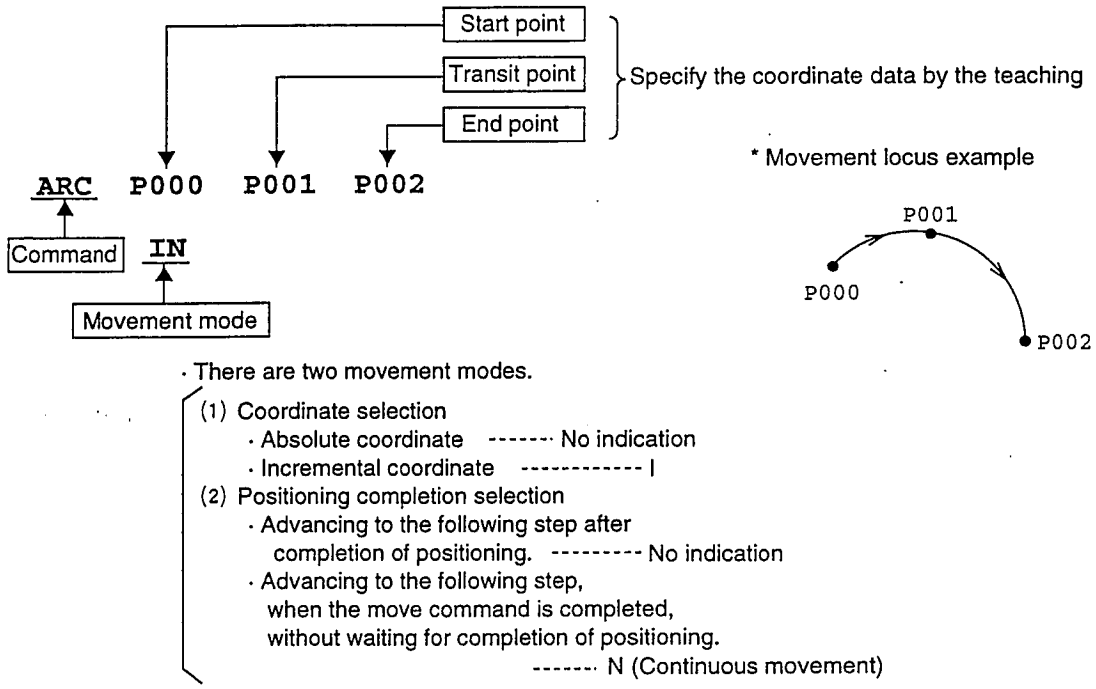


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ARC

arc : Circular interpation movement (2 axes arc motion) Command code length : 5

- The ARC command is used for circular interpolation between any two axes (except the pulse train output axis).
- The ARC command is specified as folloes:



· There are two movement modes.

(1) Coordinate selection
- · Absolute coordinate ------- No indication
- · Incremental coordinate ---------- I

(2) Positioning completion selection
- · Advancing to the following step after completion of positioning. --------- No indication
- · Advancing to the following step, when the move command is completed, without waiting for completion of positioning. ------- N (Continuous movement)

- When travel speed is high, and arc of 10mm or less radius has slightly lower accuracy. The maximum arc is 5000mm. An arc of which radius is very close to the minimum or maximum value may be disabled due to internal calculating error.
- The smooth sine accel/deceleration can not be applied to the ARC command.
- Directly specifying coordinate data can not be applied. (Coordinate data must be specified through the teaching.)
- The ARC command is to have a circular interpolation between selected 2 axes. Specify coordinates data of the point register for 2 axes only. If a program for three or more axes is to be created, specify the same data for the start point, transit point and end point of axes no concern with circular interpolation or specify xxxx.xx (which means no movement).

Example 1: Circular interpolation between X and Z axes.

Command	ARC P000 P001 P002			
Point coordinate*	P000	X axis: 0000.00	Y axis: 0300.00	Z axis: 0000.00
	P001	X axis: 0100.00	Y axis: 0300.00	Z axis: 0050.00
	P002	X axis: 0020.00	Y axis: 0300.00	Z axis: 0100.00

Example 2: Circular interpolation between X and Y axes.

Command	ARC P000 P001 P002			
Point coordinate*	P000	X axis: 0000.00	Y axis: 0000.00	Z axis: xxxx.xx
	P001	X axis: 0100.00	Y axis: 0050.00	Z axis: xxxx.xx
	P002	X axis: 0020.00	Y axis: 0100.00	Z axis: xxxx.xx

* Specify through the teaching.

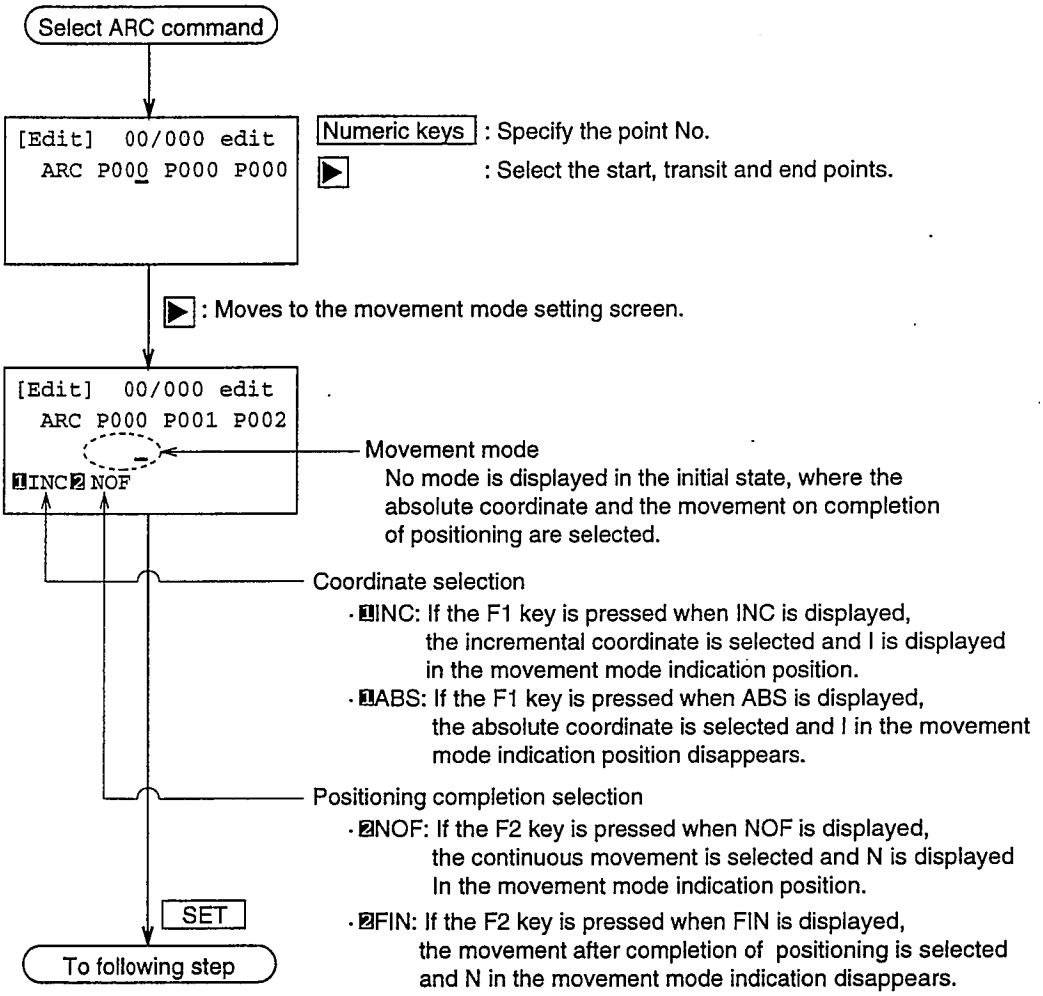
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- If the current position is different from the start point, move the axes to the start point with the MOV command.

```
Right example  : MOV  P099                  : P099 is the current position.
                 MOV  P000                  : Move to the start point once.
                 ARC  P000  P001  P002
Wrong example  : MOV  P099
                 ARC  P000  P001  P002
```

→ A program error alarm "can't make cir" will be issued if the execution of this program is intended.

- **Setting procedures**



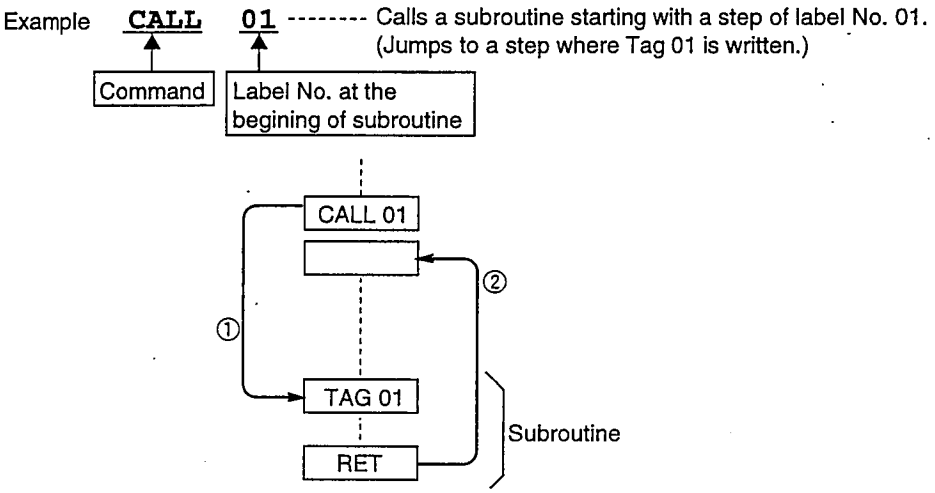
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- The CALL command jumps to a step of a label No. (the beginning of a subroutine) specified with the CALL command.
- The RET command returns to the step with the CALL command. This command declares the end of a subroutine.

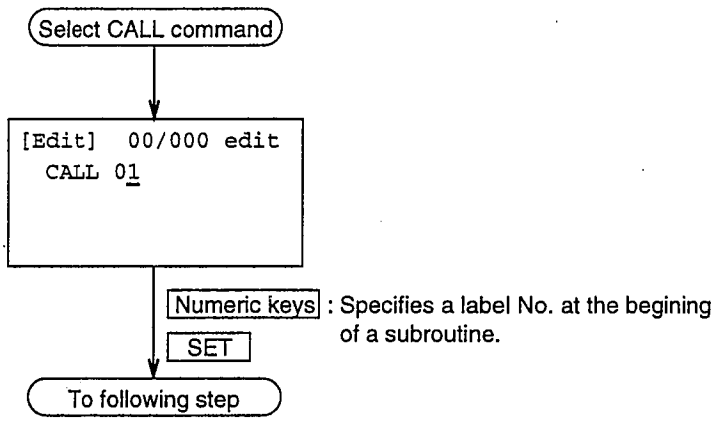
* Valid in the same program. (Program 00 in the following example)

* Be sure to specify the RET command at the end of a subroutine. To complete the program with the subroutine, specify END command, instead of the RET command.

* The maximum number of loops is four.



- **Setting procedures**

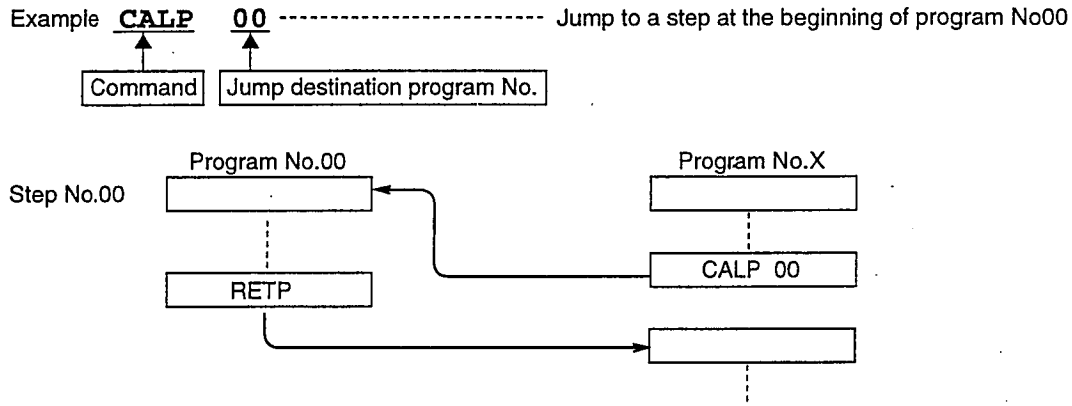


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CALP call program : Subroutine call to different program number Command code length : 2

- The CALP command jumps to a step at the beginning of a program of a specified number.
- The RETP commands returns to the step following a step where the ACLP command is specified.

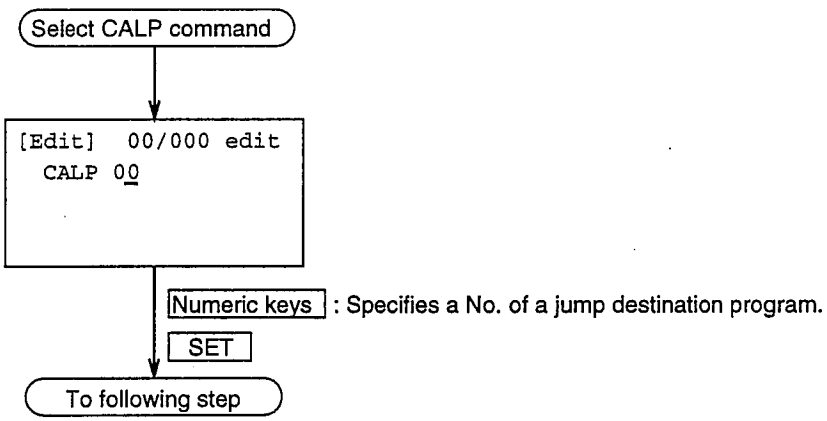
* The CALL and RET commands are used to call a subroutine in the same program and returning from it. The CALP and RETP commands are used to call a subroutine in a different program (having a different program number) and returning from it.



* Be sure to specify the RETP command at the end of a program called by the CALP command. To call a program and terminate operation with the program, specify the END command, instead of the RETP command.

* The maximum number of loops is four.

- **Setting procedures**



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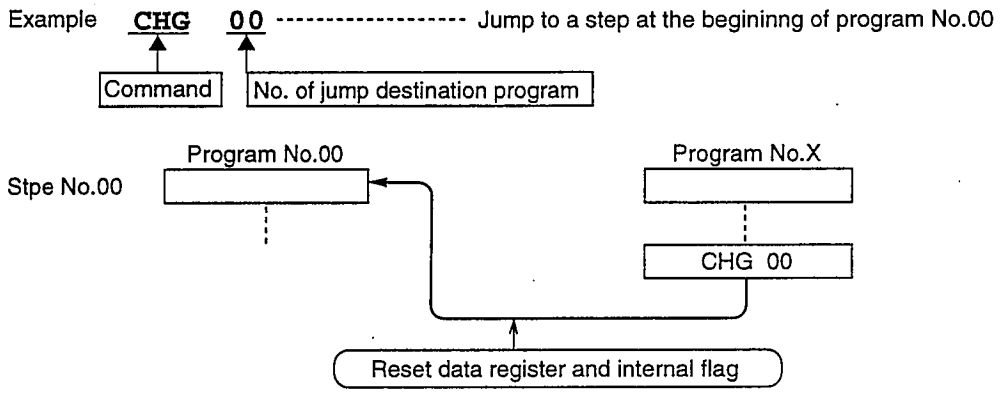
- The CHG command jumps to a step at the beginning of another program (i.e., a program of another program number).

Note: Changing a program corresponds to executing a new program. Keep the following in mind.

(1) The data registers D00 to D99 are all reset.

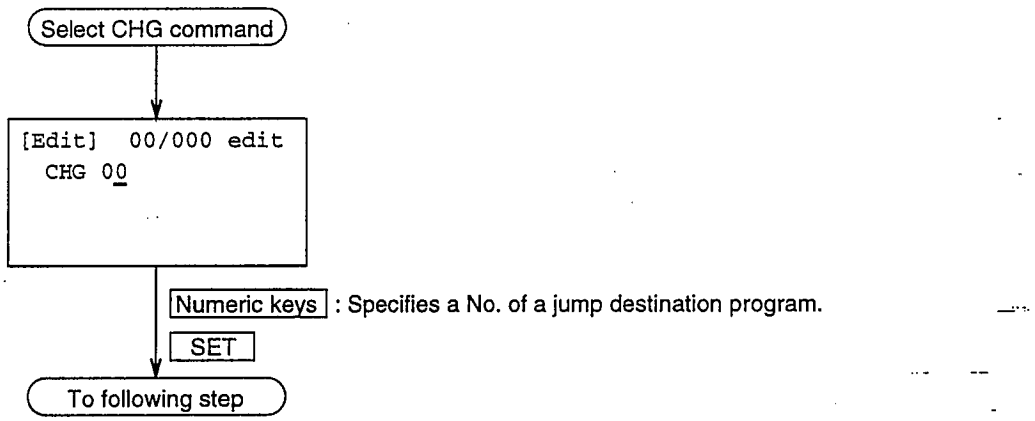
(2) Internal flags of concern to the repeat command and subroutine call command are initialized. Thus, do not set a CHG command in a loop containing a repeat command, palletize command, CALL/RET command, or CALP/RETP command.

(3) The interruption condition is also initialized. To maintain interruption processing valid, set another interruption condition at the beginning of a new program following a CHG command.



- Use CALP command to jump to another program without initializing the data registers and internal flags.

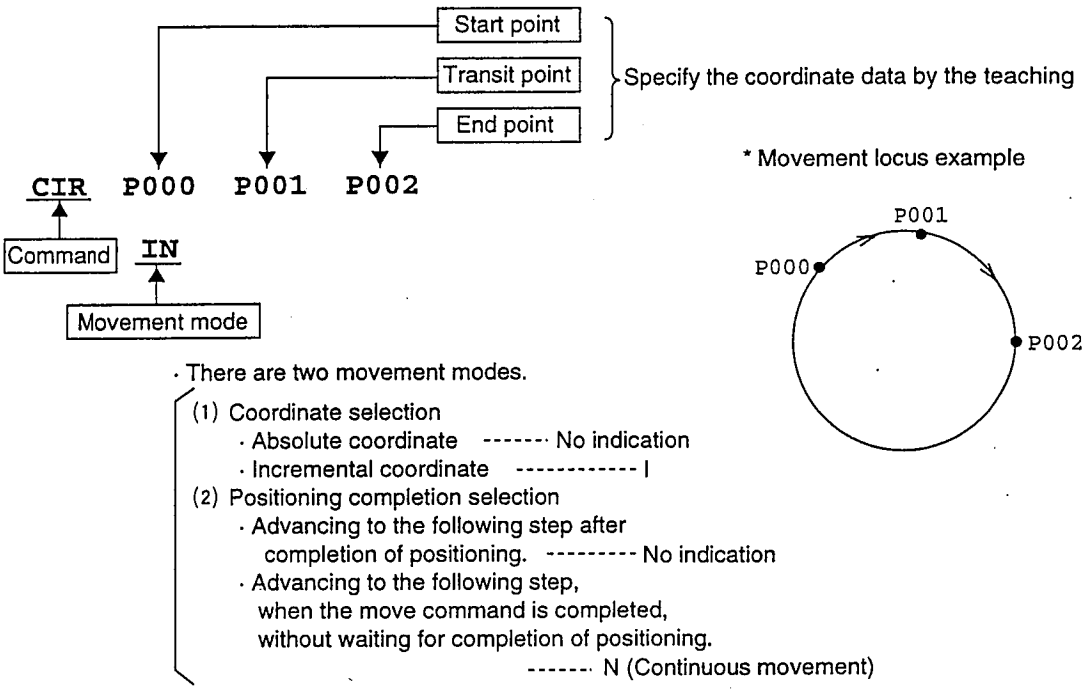
- **Setting procedures**



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- The CIR command is used for circling command between any two axes (except the pulse train output axes).

- The CIR command is specified as follows:



· There are two movement modes.

(1) Coordinate selection
- · Absolute coordinate ------- No indication
- · Incremental coordinate ---------- I

(2) Positioning completion selection
- · Advancing to the following step after completion of positioning. --------- No indication
- · Advancing to the following step, when the move command is completed, without waiting for completion of positioning. ------- N (Continuous movement)

- When travel speed is high, and arc of 10mm or less redius has slightly lower accuracy. The maximum arc is 5000mm. An arc of which radius is very close to the minimum or maximum value may be disabled due to internal calculating error.

- The smooth sine accel/deceleration can not be applied to the CIR command.

- Directly specifying coordinate data can not be applied. (Coordinate data must be specified through the teaching.)

- The CIR command is to have a circular interpolation between selected 2 axes. Specify coordinates data of the point register for 2 axes only. If a program for three or more axes is to be created, specify the same data for the start point, transit point and end point of axes no concern with circular interpolation or specify xxxx.xx (which means no movement).

Example 1: Circular interpolation between X and Z axes.

Command	ARC P000 P001 P002			
Point coordinate*	P000	X axis: 0000.00	Y axis: 0300.00	Z axis: 0000.00
	P001	X axis: 0100.00	Y axis: 0300.00	Z axis: 0050.00
	P002	X axis: 0020.00	Y axis: 0300.00	Z axis: 0100.00

Example 2: Circular interpolation between X and Y axes.

Command	ARC P000 P001 P002			
Point coordinate*	P000	X axis: 0000.00	Y axis: 0000.00	Z axis: xxxx.xx
	P001	X axis: 0100.00	Y axis: 0050.00	Z axis: xxxx.xx
	P002	X axis: 0020.00	Y axis: 0100.00	Z axis: xxxx.xx

* Specify through the teaching.

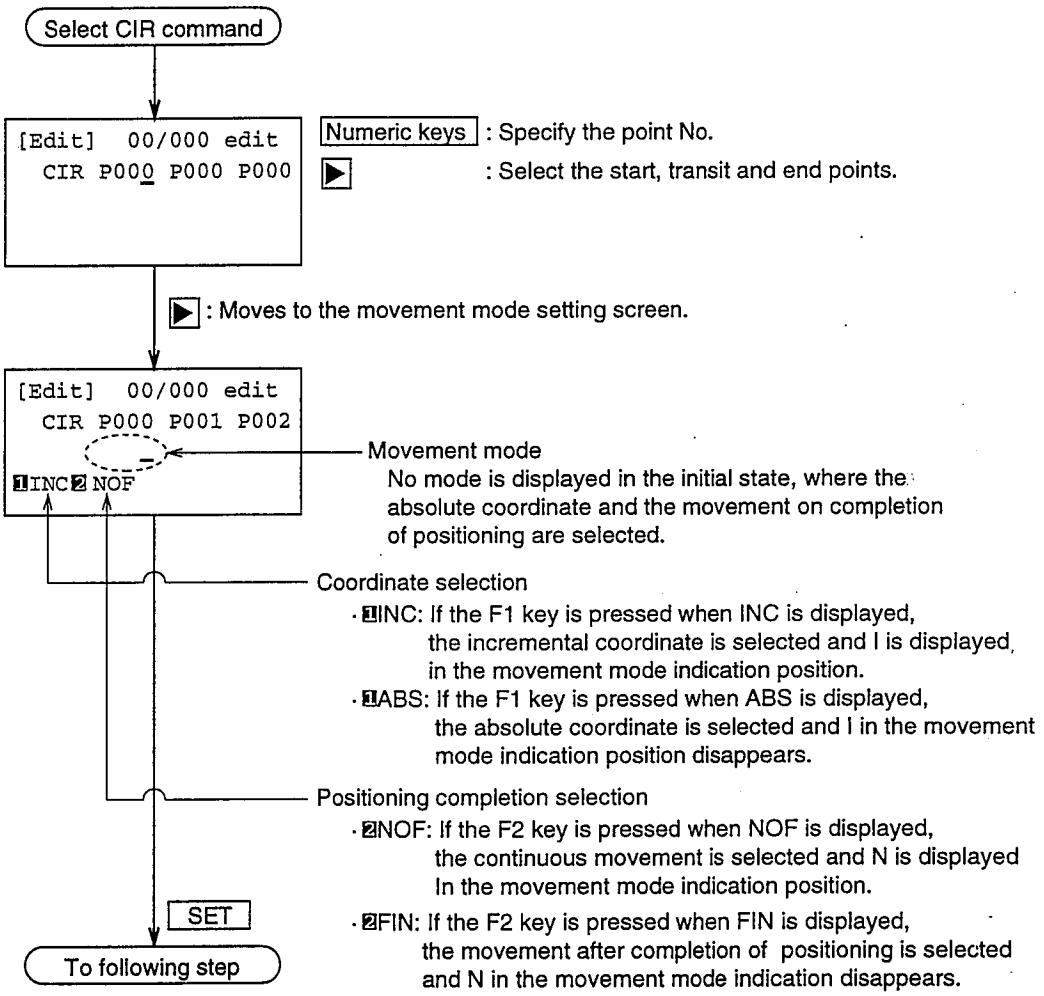
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- If the current position is different from the start point, move the axes to the start point with the MOV command.

```
Right example  : MOV  P099              : P099 is the current position.
                 MOV  P000              : Move to the start point once.
                 CIR  P000  P001  P002
Wrong example  : MOV  P099
                 CIR  P000  P001  P002
```

→ A program error alarm "can't make cir" will be issued if the execution of this program is intended.

- **Setting procedures**



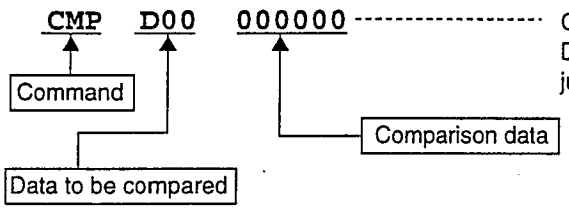
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CMP

compare : Data comparison

Command code length: CMP Dn Numeric data : 5
CMP Dm Dn : 3
CMP DIn Numeric data : 5

- The CMP command compares data in a data register or input through a general input port and maintains a judgment flag.
- A flag is used as a condition of the conditional jump command.



Compares data in data register D00 with 000000 and maintains a judgment flag.

Either of the following two may be specified as data to be compared.

(1) Data register
Dn (n 00 to 99)

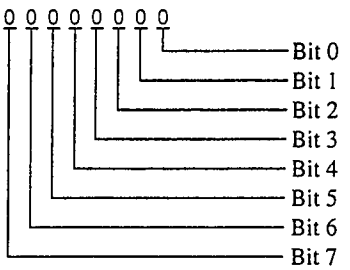
(2) General input
DI0: General input port 0 (CN4)
DI1: General input port 1 (CN4)
DI2: General input port 2 (CN7)
DI3: General input port 3 (CN7)

* Generated judgment flags
A: Data to be compared
B: Comparison data
If A = B, '='
If A ≥ B, '≥'
If A ≤ B, '≤'
If A ≠ B, '≠'
If A > B, '>'
If A < B, '<'

The format of comparison data is as shown below.

(1) To compare with data in a data register
- Direct data specification (000000 to 999999)
- Data in the data register of a specified number

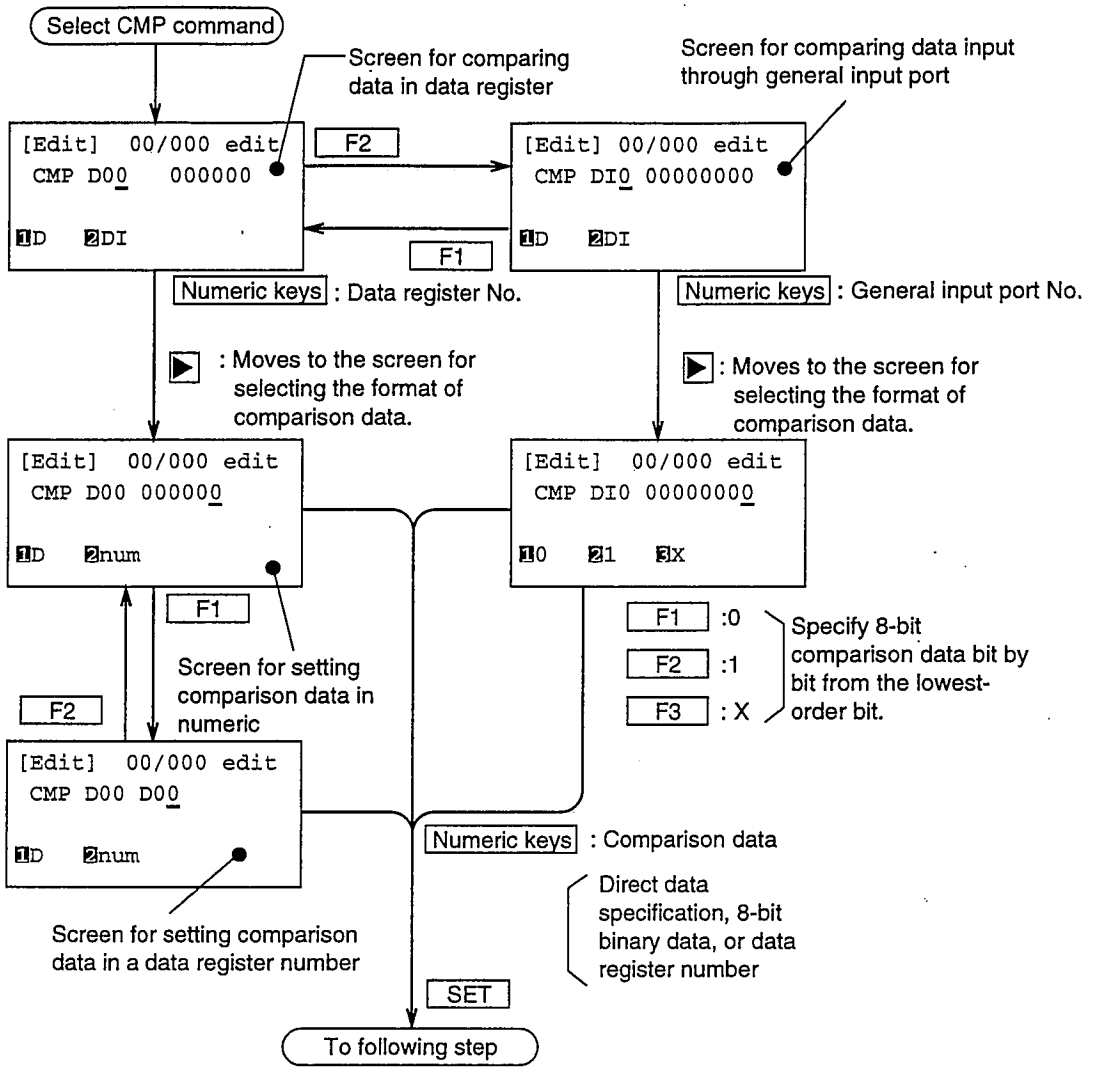
(2) To compare with data input through a general input port
- 8-bit binary data



- Relationship between data and input status
  0: Input inactive
  1: Input active
  x: Either
  (If one of 8-bit binary data is x, the data will be omitted from the data to be compared.)

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- **Setting procedures**

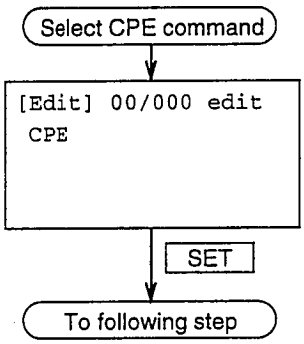


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CPE continuous pass end : End of continue path — Command code length: 1

- Executes continue path movement at a constant speed for the movement commands specified between CPS and CPE.
- This command is used with CPS in pair.

• Setting procedures

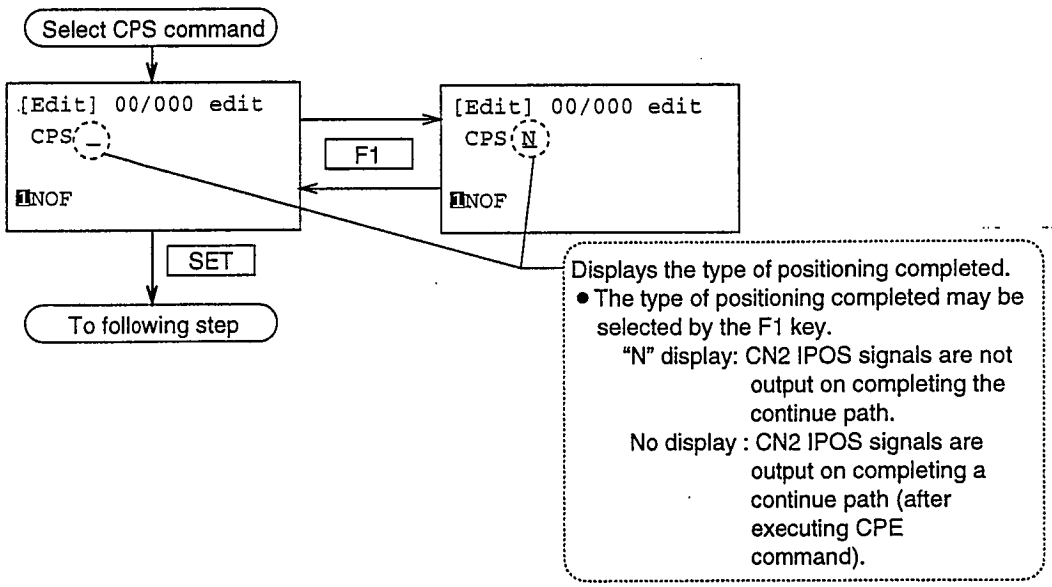


CPS continuous pass start : Stant of continue path — Command code length: 2

- Executes continue path movement at a constant speed for the movement commands specified between CPS and CPE.
- This command is used with CPE in pair.

* The continue path command has certain limitations for programming. Refer to "13.2.4.5. Continue Path" for more details.

• Setting procedures



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END

end : End of program

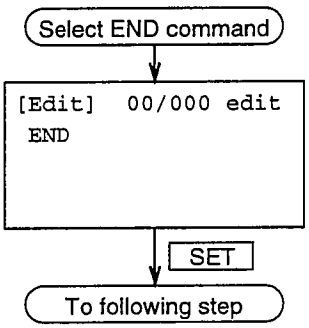
Command code length: 1

- The END command terminates the program.
- Be sure to specify the END command at the end of the program. If the END command is not specified, and alarm is output.
- When the END command is executed, the contents of data registers and flags resulted by CMP command in the program are reset. The contents of point registers are secured.

Example **END** ---------- End of a Program

Command

- **Setting procedures**



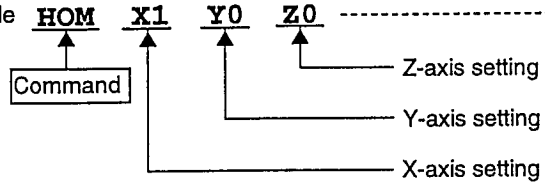
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- Use the HOM command to perform Home Return during programmed operation.
- The HOM command may be set for a each axis independently

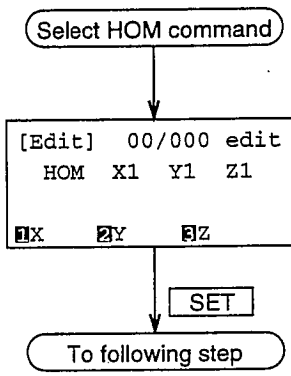
  1: Performs Home Return

  0: No motion

Example **HOM X1 Y0 Z0** ---------- Only X-axis returns to the home position.



- **Setting procedures**



F1 Changes X-axis setting (0⇆1)

F2 Changes Y-axis setting (0⇆1)

F3 Changes Z-axis setting (0⇆1)*

* Z axis is not provided for the EXC2. (2 axes controller.)

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INT

interrupt : Interruption

Command code length: INT x y Numeric data : 7
DIn
INT DIS : 2
INT ENA : 2

- The INT command specifies the interruption conditions, number of an interruption program (i.e., a program to be interrupted when the interruption conditions are met), and disabling or enabling interruption.

[Setting interruption conditions and interruption program number]

- If 8 bits of the general input port 0 are set to 00000000 (all are OFF) while executing a step following the step where the INT command is specified, processing of the step being executed is discontinued (or stopped immediately during movement) and operation jumps to the step at the beginning of program No. 00.

Example 1: INT 01 00

Command

Interruption program No. : Selection renge: 00~99

Interruption format

DI0 00000000

Interruption conditions

Specify the interruption conditions in the ON and OFF states of the general input ports as shown below.

(1)Input ports

DI0 : General input port 0 (CN4)
DI1 : General input port 1 (CN4)
DI2 : General input port 2 (CN7)
DI3 : General input port 3 (CN7)

Three types of interruptions shown below are available.

00 : Discontinues (or stops immediately during movement) a currently-executed step and executes interruption.
01 : Discontinues (or slows down during movement) a currently-executed step and executes inperruption.
02 : Terminates a currently-executed step and executes interruption.

(2) Bit status

0 0 0 0 0 0 0 0

Bit 0
Bit 1
Bit 2
Bit 3
Bit 4
Bit 5
Bit 6
Bit 7

0 : Input OFF
1 : Input ON
x : Either
(If one of 8-bit binary data is x, the data will be omitted from the data to be compared.)

* Input status is checked by the dege, not by the level. (In the example, interruption is executed when a status other than 00000000 changes into 00000000.)

* Be sure to specify IRET command (return from interruption) to the end of interruption program. If returning is not necessary, specify the END command.

[Disabling and enabling interruption]

- Use this command to disable some part of a program where interruption should be disabled.

Example 2 INT DIS -------- If the interruption command as shown in example 1 is specified, this command disables interruption in the following steps.

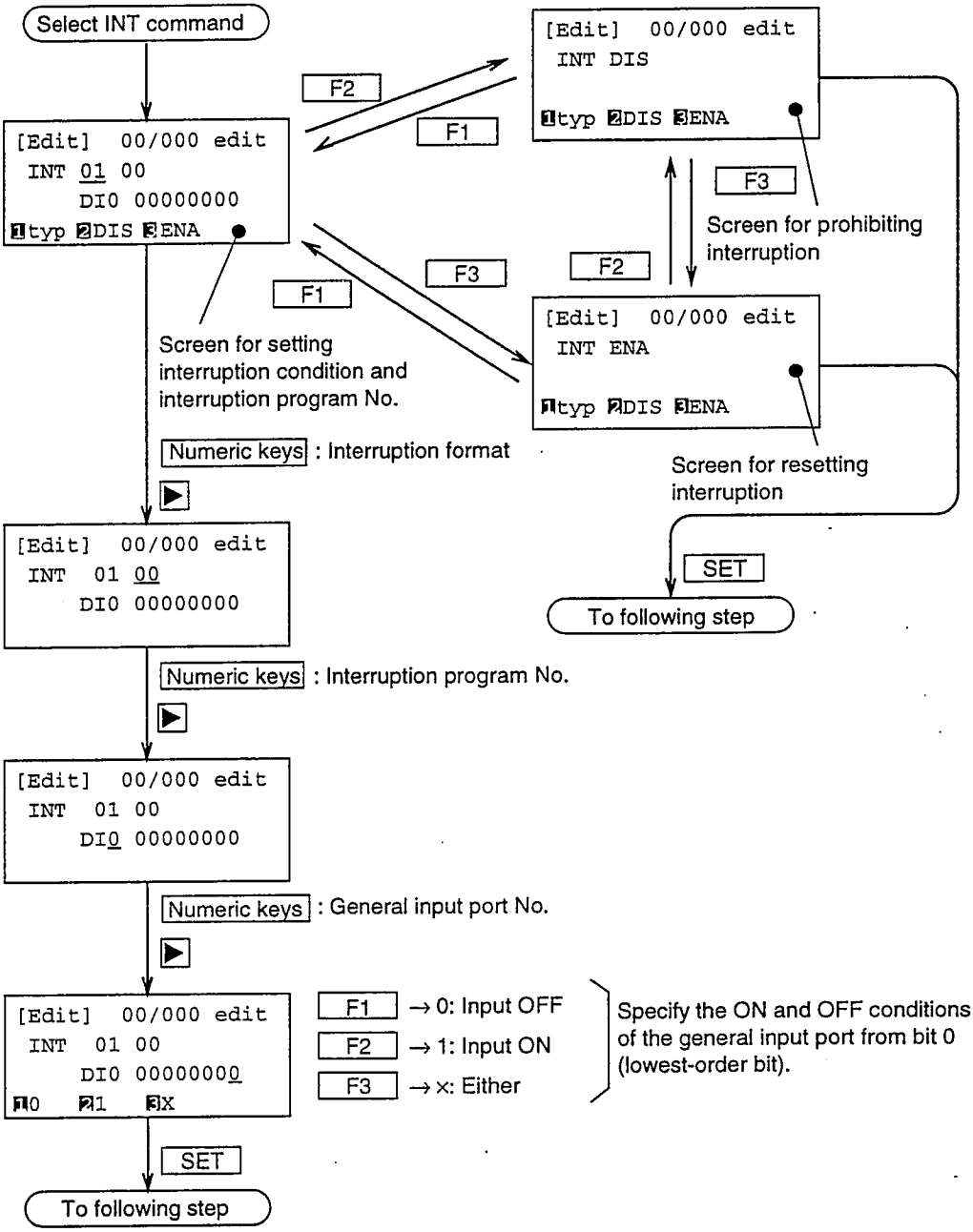
Command

Example 3 INT ENA -------- If interruption is disabled by the INT DIS command, this command enables interruption in the following steps.

Command

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• **Setting procedures**



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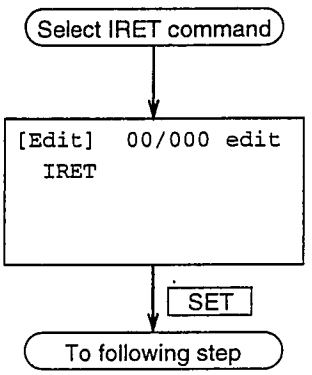
[Returning from interruption program]

- The IRET command is a return command which should be specified at the end of an interruption program. If returning from an interruption program is needless, use the END command, instead of the IRET command.

Example **IRET** ---------- This command specifies the end of an interruption program.
Program returns to the step following the step at which interruption began (or, from which operation jumped to the interruption program after the interruption conditions are met).

Command

- **Setting procedures**



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JEQ

jump if equal : Conditional jump in the same program

Command code length: 2

- The JEQ command causes a jump on the result of comparison executed by CMP command.
- Jumps if comparison result is '='.
- If a lot of CMP commands are used, the previous command is valid.
- If the conditions are not met, executes the following step without jumping.

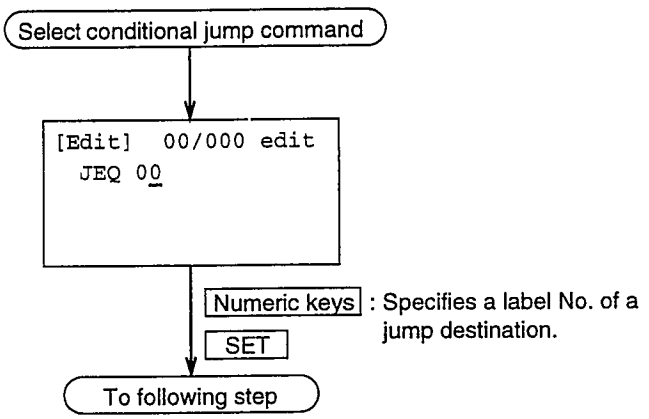
Example JEQ 00 ---------- Jump to a step of label No.00 (where TAG00 is written) if the flag generated as a result of comparison by using the CMP command is '='

Command | Jump destination label No.

* Valid in the same program. (Program No.00 in following example)

* Be sure to specify the command CMP before the conditional jump command

- **Setting procedures**



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JGE jump if greater than or equel : Conditional jump in the same program Command code length: 2

- The JGE command causes a jump on the result of comparison executed by CMP command.
- Jumps if comparison result is '≥'.
- If a lot of CMP commands are used, the previous command is valid.
- If the conditions are not met, executes the following step without jumping.

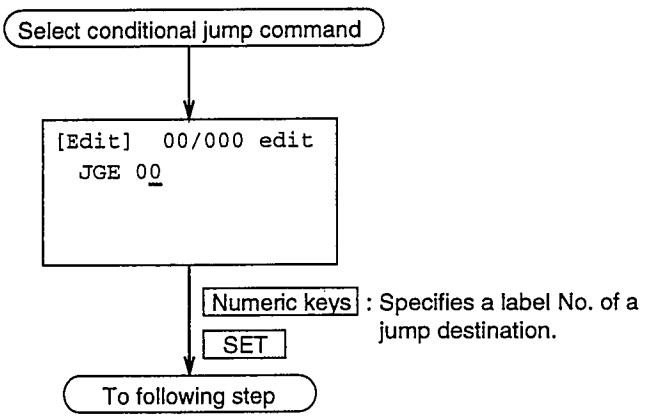
Example **JGE** **00** ---------- Jump to a step of label No.00 (where TAG00 is written) if the flag generated as a result of comparison by using the CMP command is '≥'

Command | Jump destination label No.

* Valid in the same program. (Program No.00 in following example)

* Be sure to specify the command CMP before the conditional jump command

- **Setting procedures**



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JGT jump if greater than : Conditional jump in the same program Command code length: 2

- The JGT command causes a jump on the result of comparison executed by CMP command.
- Jumps if comparison result is '>'.
- If a lot of CMP commands are used, the previous command is valid.
- If the conditions are not met, executes the following step without jumping.

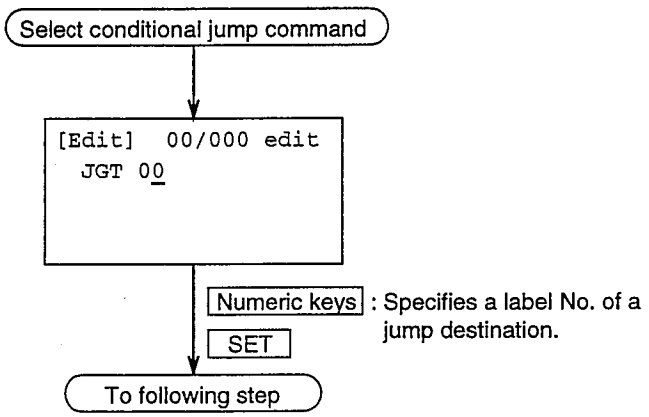
Example **JGT** **00** ---------- Jump to a step of label No.00 (where TAG00 is written) if the flag generated as a result of comparison by using the CMP command is '>'

Command | Jump destination label No.

* Valid in the same program. (Program No.00 in following example)

* Be sure to specify the command CMP before the conditional jump command

- **Setting procedures**



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JLE jump if less than or equal : Conditional jump in the same program Command code length: 2

- The JLE command causes a jump on the result of comparison executed by CMP command.
- Jumps if comparison result is '≤'.
- If a lot of CMP commands are used, the previous command is valid.
- If the conditions are not met, executes the following step without jumping.

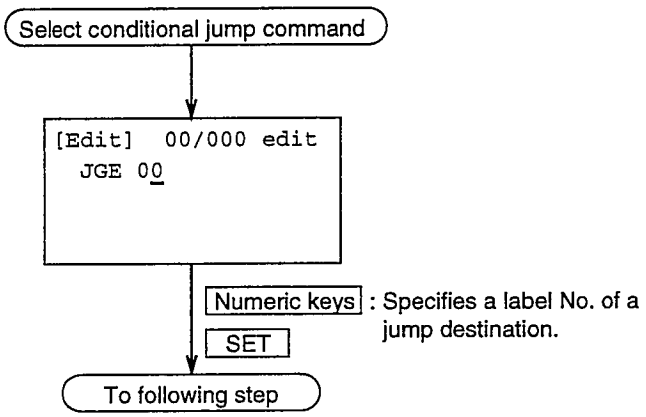
Example **JLE** **00** ---------- Jump to a step of label No.00 (where TAG00 is written) if the flag generated as a result of comparison by using the CMP command is '≤'

Command | Jump destination label No.

* Valid in the same program. (Program No.00 in following example)

* Be sure to specify the command CMP before the conditional jump command

- **Setting procedures**



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- The JLT command causes a jump on the result of comparison executed by CMP command.
- Jumps if comparison result is '<'.
- If a lot of CMP commands are used, the previous command is valid.
- If the conditions are not met, executes the following step without jumping.

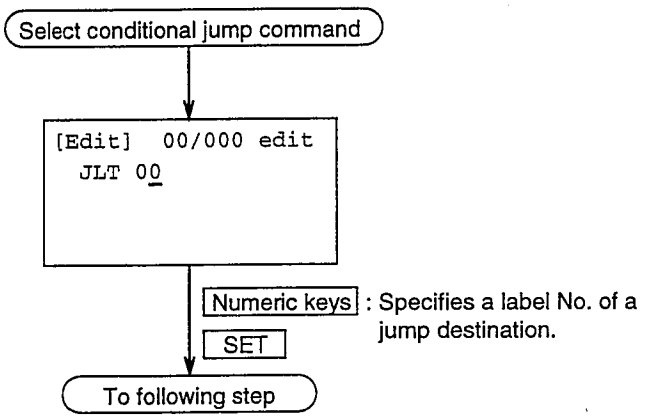
Example **JLT** **00** ---------- Jump to a step of label No.00 (where TAG00 is written) if the flag generated as a result of comparison by using the CMP command is '<'

Command | Jump destination label No.

* Valid in the same program. (Program No.00 in following example)

* Be sure to specify the command CMP before the conditional jump command

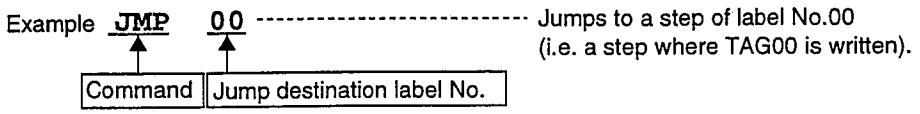
- **Setting procedures**



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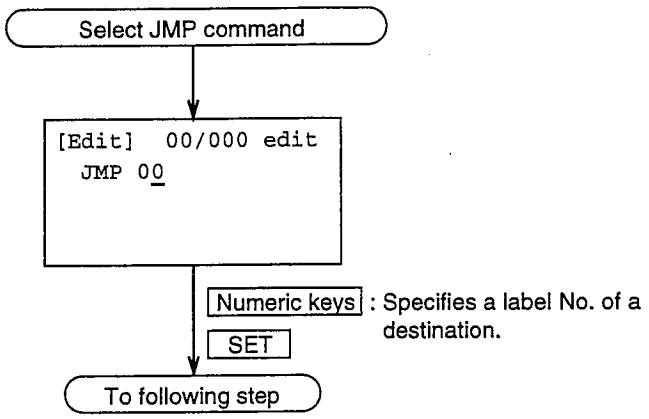
JMP — jump : Unconditional jump in the same program — Command code length: 2

- The JMP command jumps to a step of a specified label number.



* Valid in the same program (program 00 in the following example).

- **Setting procedures**



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JNE jump if not equal : Conditional jump in the same program Command code length: 2

- The JNE command causes a jump on the result of comparison executed by CMP command.
- Jumps if comparison result is '≠'.
- If a lot of CMP commands are used, the previous command is valid.
- If the conditions are not met, executes the following step without jumping.

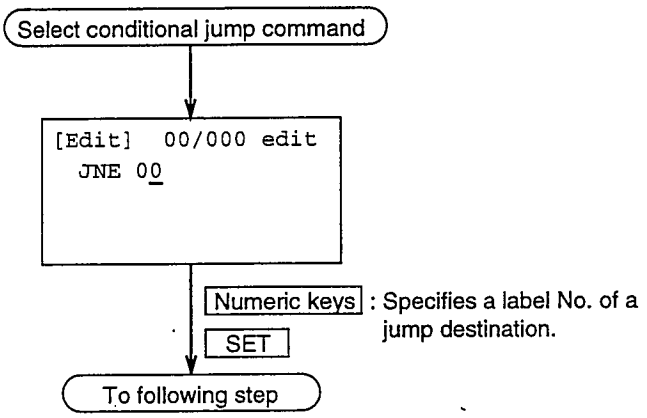
Example **JNE** **00** ---------- Jump to a step of label No.00 (where TAG00 is written) if the flag generated as a result of comparison by using the CMP command is '≠'

Command | Jump destination label No.

* Valid in the same program. (Program No.00 in following example)

* Be sure to specify the command CMP before the conditional jump command

- **Setting procedures**



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LD

load : Data load

Command code length: LD Dn Numeric data : 5
LD Dm Dn : 3
LD Pm Pn : 3
LD Pn Coordinate data : 14

- The LD command loads data in the data register and point register.

Example **LD D00 000000** ---------- Loads 000000 in data register D00.

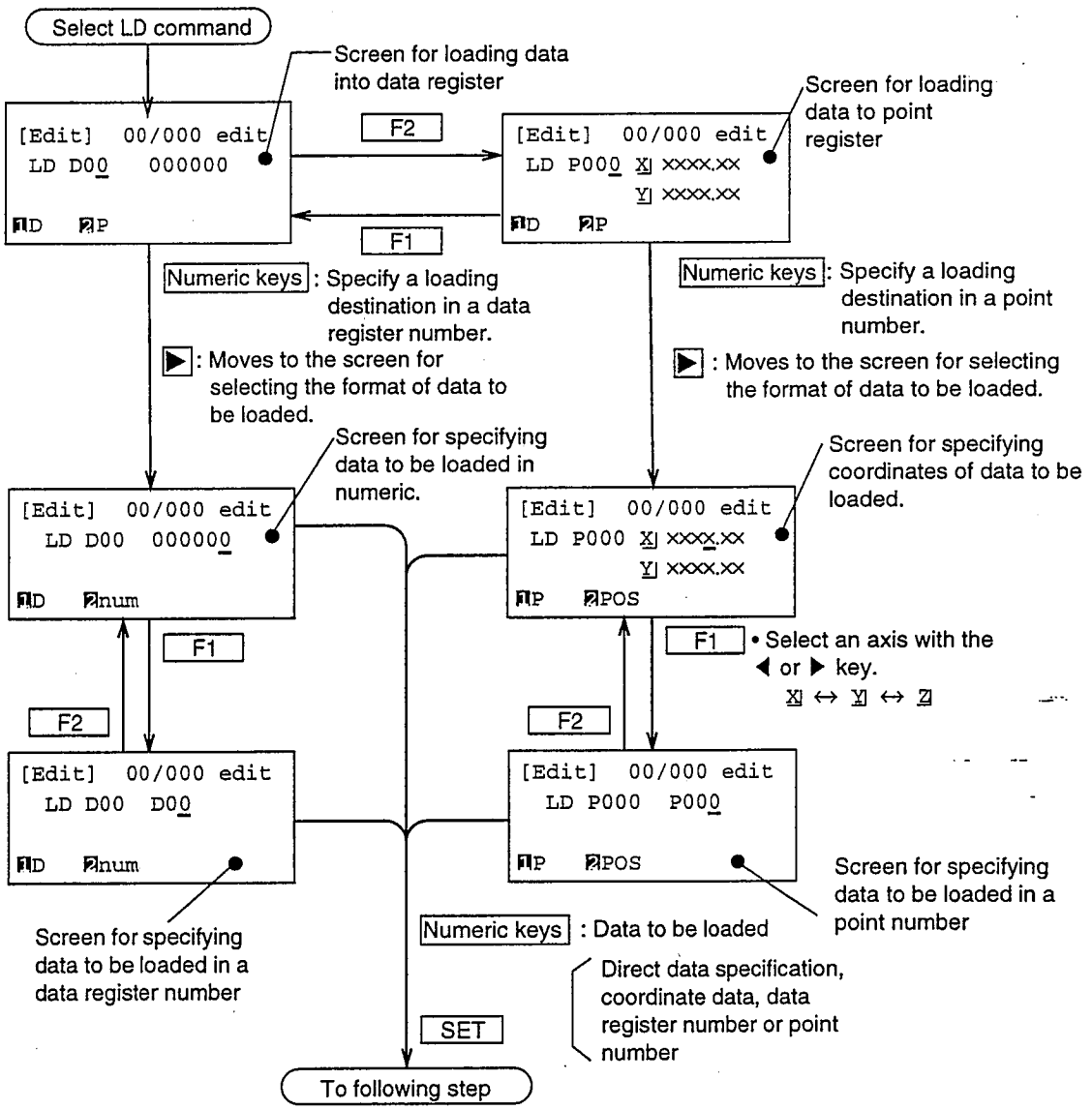
- Command
- Data to be loaded
- Loading destination

Either of the two loading destinations may be selected:
(1) Data register
Dn (n= 00~99)
(2) Point register
Pn (n=000~399)

Either of the two data formats may be selected:
(1) Loading into a data register
- Data (000000 to 999999) is loaded directly.
- A number of a data register is specified, and data in the register is loaded.

(2) Loading to a point register
- Coordinate data is loaded directly.
- A point number is specified, and coordinate data at the point is loaded.

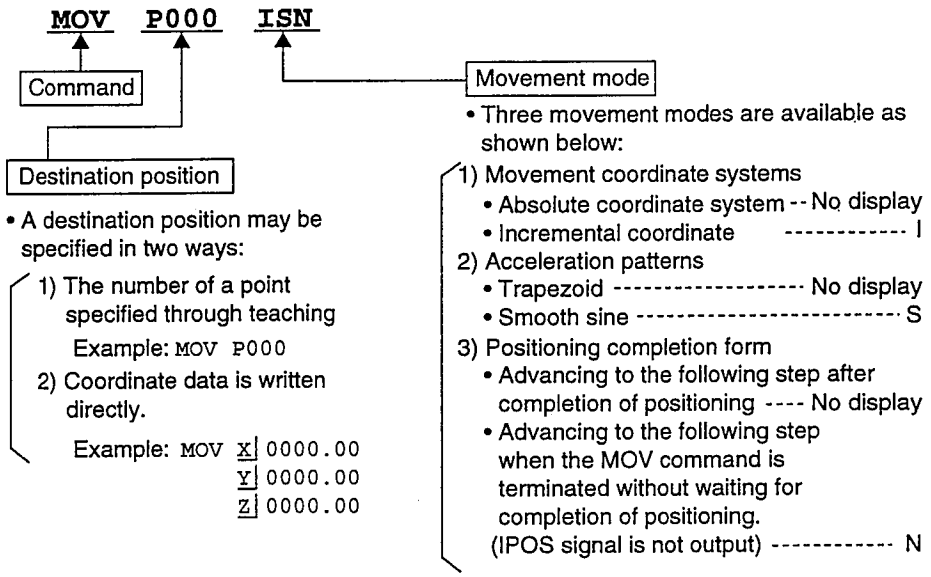
- **Setting procedures**



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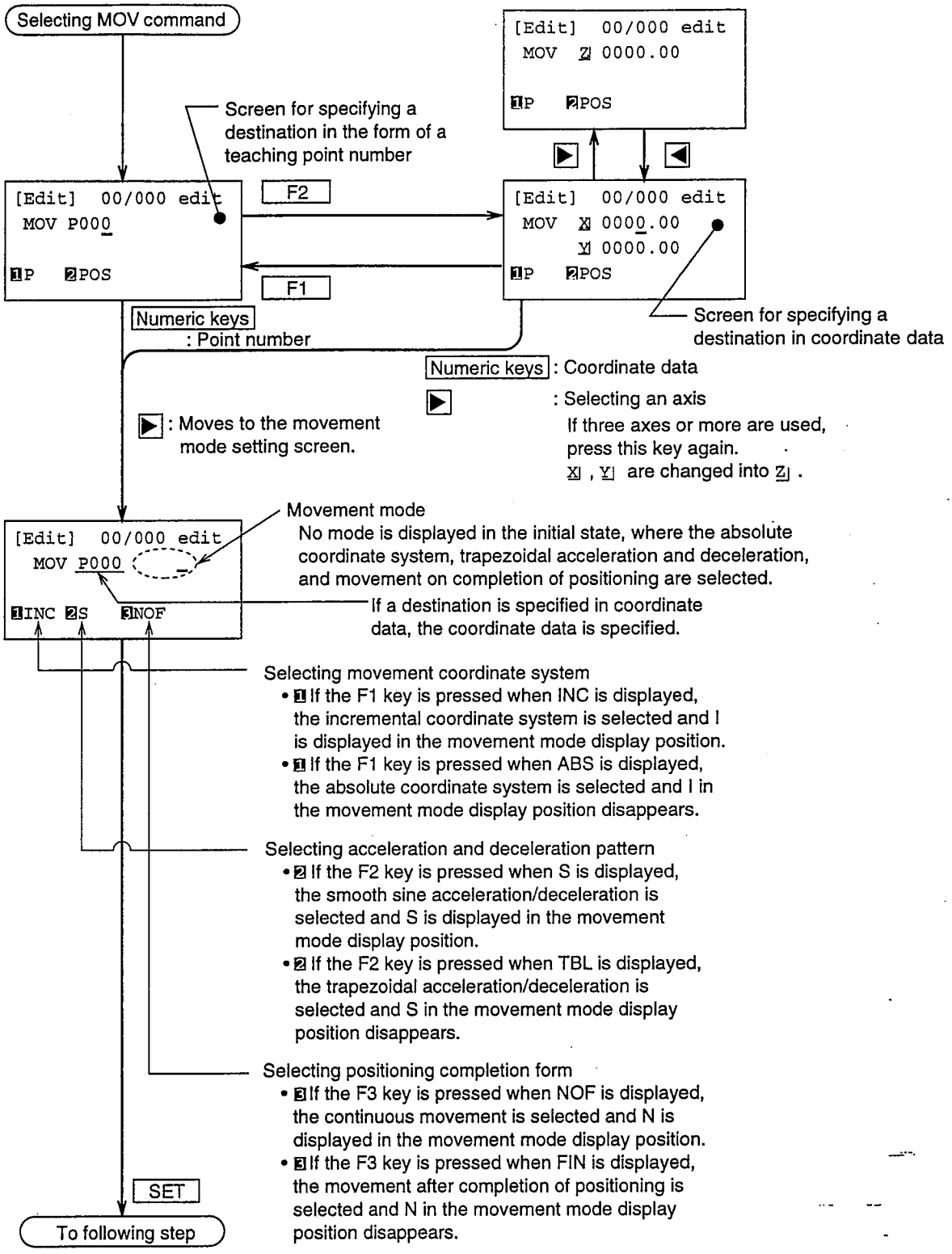
- The MOV command is used for linear interpolation of three axes. (The MOV command causes 2-axis linear interpolation for the type EXC2.)
- The MOV command causes three-dimensional (EXC3) or two-dimensional (EXC2) linear motion between 2 points. (From the current point to a destination.)
- The MOV command is specified as shown below.

• Structure



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- **Setting procedures**



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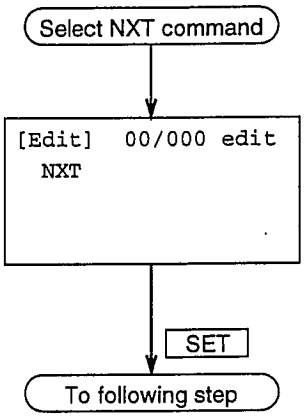
- The NXT command specifies the end of a part to be repeated.

Example **NXT** ---------- Set the end of a part to be repeated

Command

- It is used with REP command in a pair.

- **Setting procedures**



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OUT

out : General output

command code length: 6

- The OUT command outputs data through the general output ports (CN4 and CN7).
- Immediately after the power is turned on, all bits are set to 0 (0 : output open). Once the OUT command is issued, the output data is maintained until the OUT command is issued next time.

Note: Output data is stored even after completion of a program. It is also stored even after an emergency stop, forced stop, or during cycle stop. To reset the output data, set all bits to 0 by issuing an OUT command again, or turn the power off once and then turn it on.

Example **OUT** **DO0 00000000** ---------- 00000000 (8 bits open) is output through the output port 0.

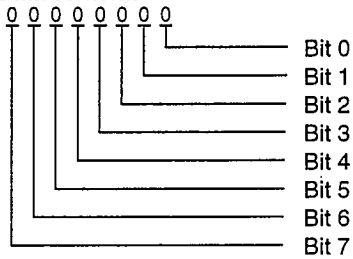
Command

Output data

(1) Output port No.
DO0: Output port 0 (CN4)
DO1: Output port 1 (CN4)
DO2: Output port 2 (CN7)
DO3: Output port 3 (CN7)

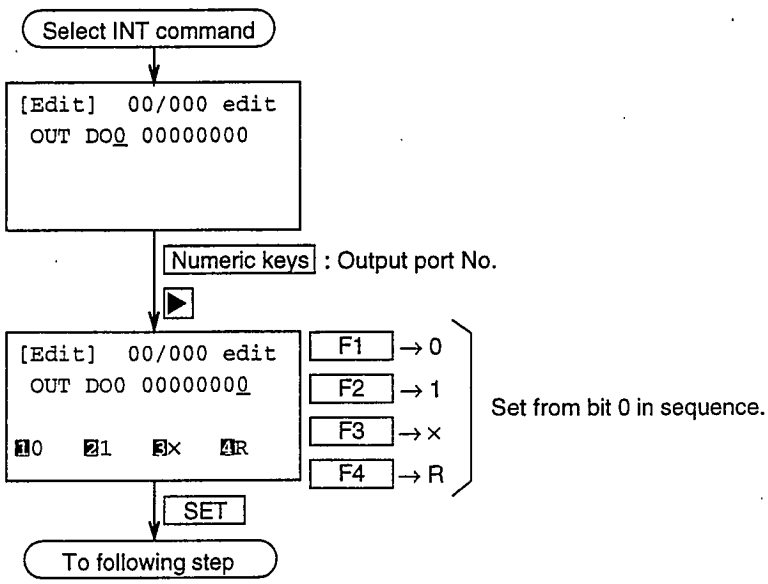
* Each output port has 8 bits, amounting to 32 data in all.

(2) Data contents



0: Open
1: Close
×: No change ··· Open or close status before the OUT command is issued is maintained.
R: Reverse ··· Open or close status before the OUT command is issued is reversed.

- **Setting procedures**

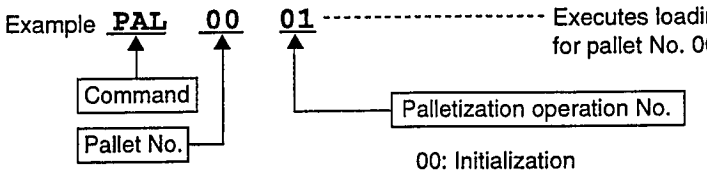


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PAL palletizing : Palletizing

Command code length: PAL m 00 ISN : 4
PAL m n : 3

- The PAL command executes palletization according to preset data.



- Two types of pallets may be specified in advance.
  00 or 01
- Loading, pallet points and hand operation may be specified for each type of pallet.

00: Initialization
- 00 shall be specified at the beginning of a palletization program.

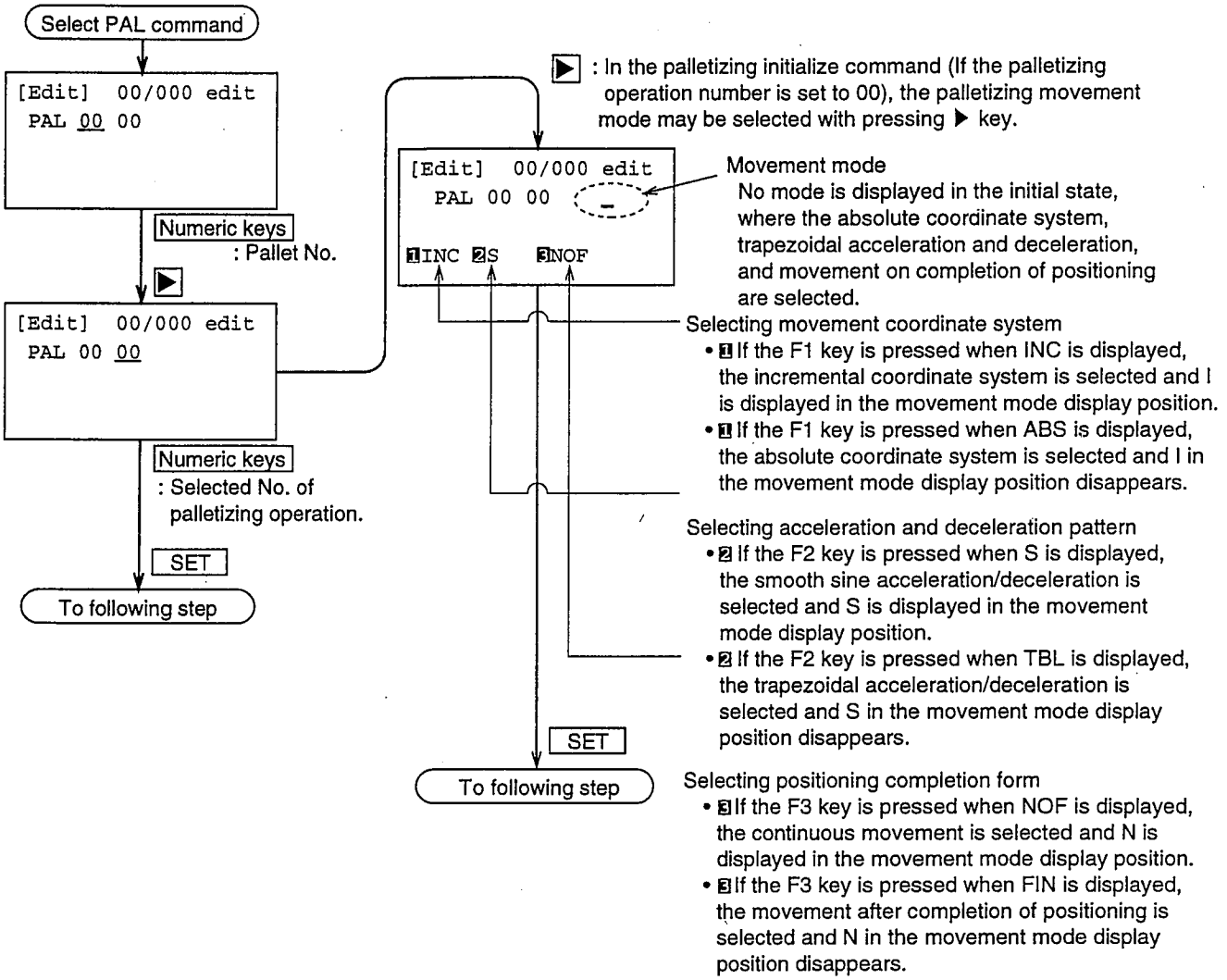
01: Loading
- A loading program is called from another program. Specify a loading program No. in pallet initialization.
- Valid after a cycle of pallet positioning is complete.

02: Pallet positioning
03: Hand operation 1
04: Hand operation 2
- Two types of hand operations may be programmed.
- A hand operation program is called from another program.

* See "13.2.4.2. Palletizing" for more details.

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• **Setting procedures**



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- The REP command specifies the beginning of a part to be repeated and the number of repetitions.

Note: If the number of repetition is set to '0', the repetition loop is executed once.

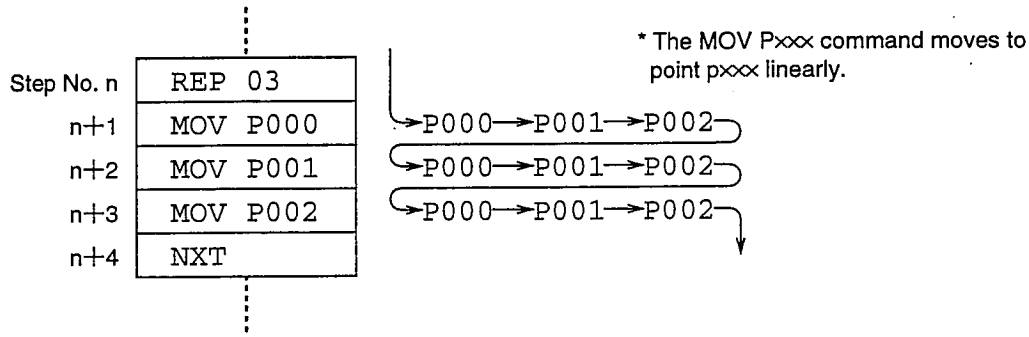
- The NXT command specifies the end of a part to be repeated.

* If two or more REP commands are used (e.g., two or more REP-NXT commands are used between REP-NXT commands), the maximum number of the REP commands should be four.

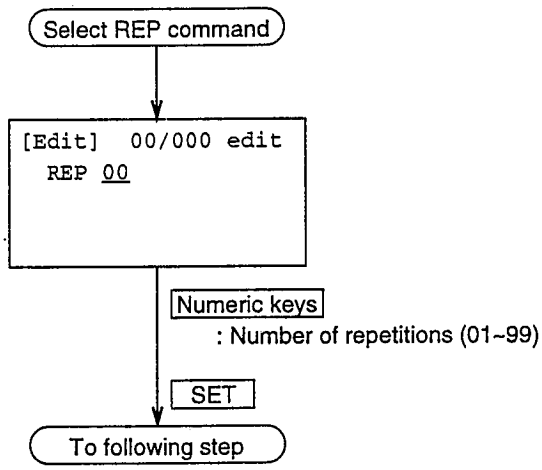
Example **REP** **03** ---------- Repeats the program between the step following the step with the REP command and the step before the step with the NXT command three times, and advances to the step following the step with the NXT command.

Command | Number of repetition

- **Repetition program example**



- **Setting procedures**



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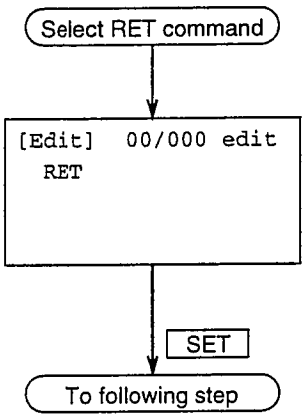
RET return subroutine : Return from a subroutine in the same program. Command code length: 1

- The RET command is the return command from the subroutine in the same program.
- It is used with CALL command in pair.

Example **RET** ---------- Specifies the end of a subroutine.
(Rturns to the step following the CALL command)

Command

- **Setting procedures**



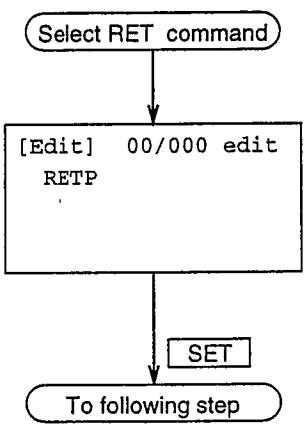
RETP return program : Return from a subroutine in a different program Command code length: 1

- The RETP command is the return command from the subroutine in a different program.
- It is used with the CALP command in pair.

Example **RETP** ---------- Specifies the end of a subroutine.
(Returns to the step following the CALL command)

Command

- **Setting procedures**

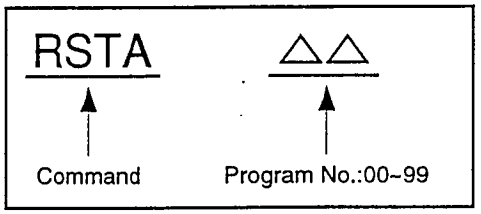


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- Executing "Break (cycle stopping) of a program in which RSTA command is set → Turning on power supply again → Re-starting the program in the half way calls the program (re-start initialization program) specified by RSTA command, and executes it before executing halfway re-start.

Note: If RSTA command is not set at the top, you may not be able to call re-start initialization program. Set RSTA command at the top of the program.

- **Command structure**



- Executing "Break (cycle stopping) of a program to which RSTA command is set → Turning on power supply again → Re-starting the program in the half way performs the re-start initialization program (program No. △△) before performing halfway re-start.

- Prepare re-start initialization program separately in advance.

* When the Home Return command is set in the re- start initialization program, Home Return will be executed automatically in halfway re-start operation. Also, the re-start initialization program enables special processing, allowing you to return the general output status to what it was before program break, and to re-start program operation at the point of program break.

- **Special processing in re-start initialization program**

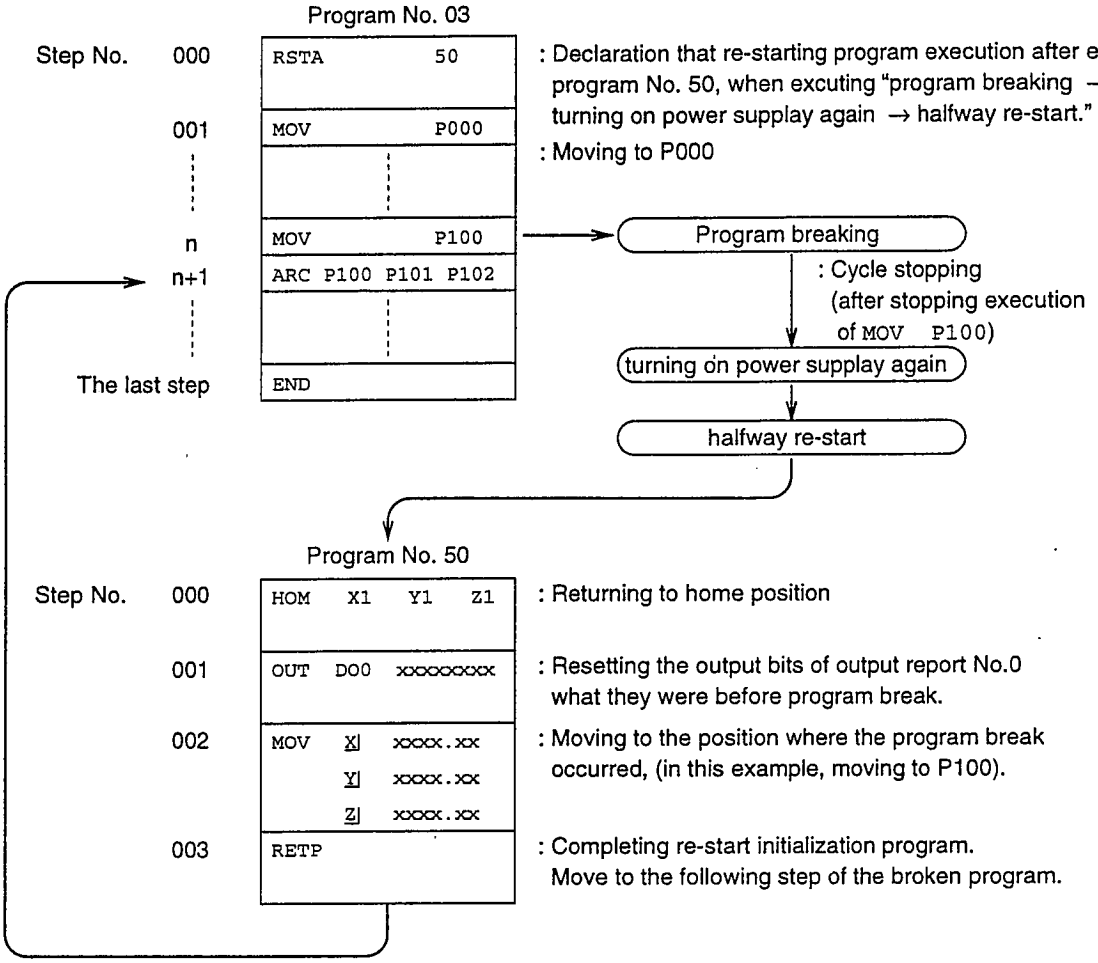
- In the program (re-start initialization program) to be called by RSTA instruction program, process the following command in a manner different from ordinary.

Note: Note that a program called by RSTA instruction must be processed in a manner different from when it is called by non-RSTA command (e.g., CAL command).

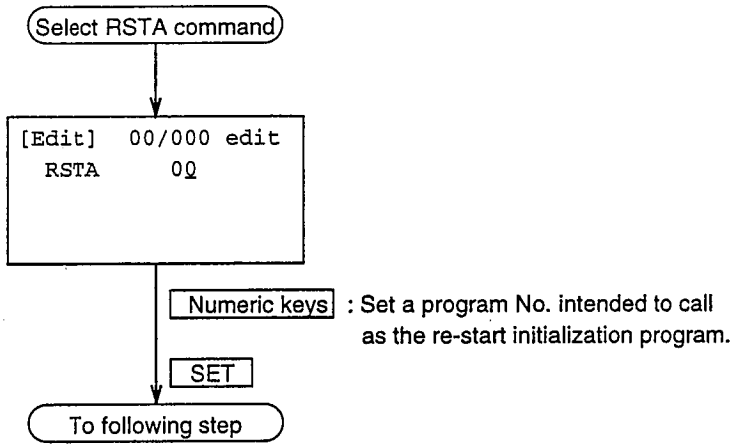
Command format	Special processing in re-start initialization program	Ordinary processing
OUT DO0 ×××××××× Output port No. 0~3 Output data	• Returning all bits in output port No. 0 to what they were during program breaking.	• No change to all bits in output port No. 0. × ··· Unchanged
MOV X ××××.×× Y ××××.×× Z ××××.××	• Moving to the point where it was before program break.	• Do no move. ××××.×× ··· Do not move

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• Example of programming and execution

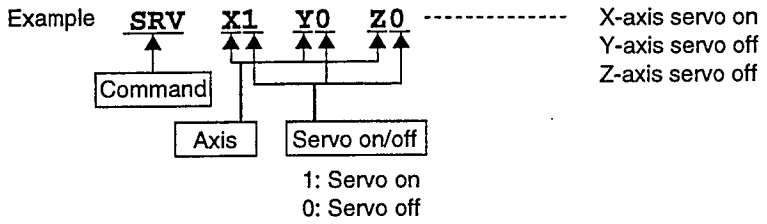


• Setting procedures

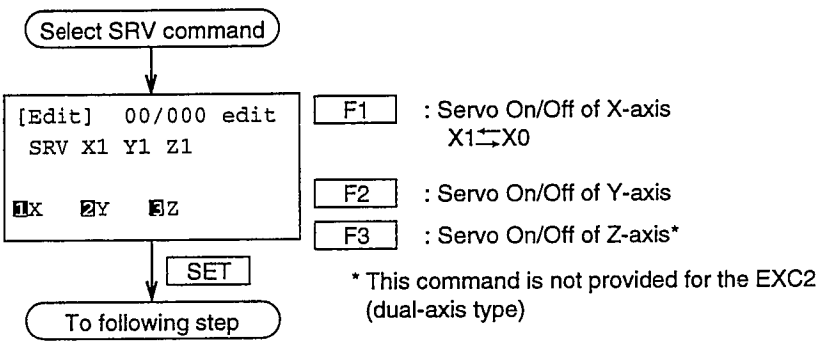


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- The SRV command specifies activation or deactivation of the servo in a program of each axis.
- The SRV command is valid when the following conditions are met.
  (1) In the external operation mode (Operation through the exclusive I/O port CN2) : SVON of CN2 should be active.
  (2) Operation with the teaching box : The servo should be activated by pressing the ON key.



- **Setting procedures**



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SUB

subtract : Data subtraction

Command code length: SUB Dn Numeric data : 5
SUB Dm Dn : 3
SUB Pm Pn : 3
SUB Pn Coordinate data : 14

- The SUB command subtracts data from a data register or a point register.

Example **SUB D00 D01** ---------- Data in data register D01 is subtracted from data in data register D00 and set to data register D00.

Command

Data to be subtracted

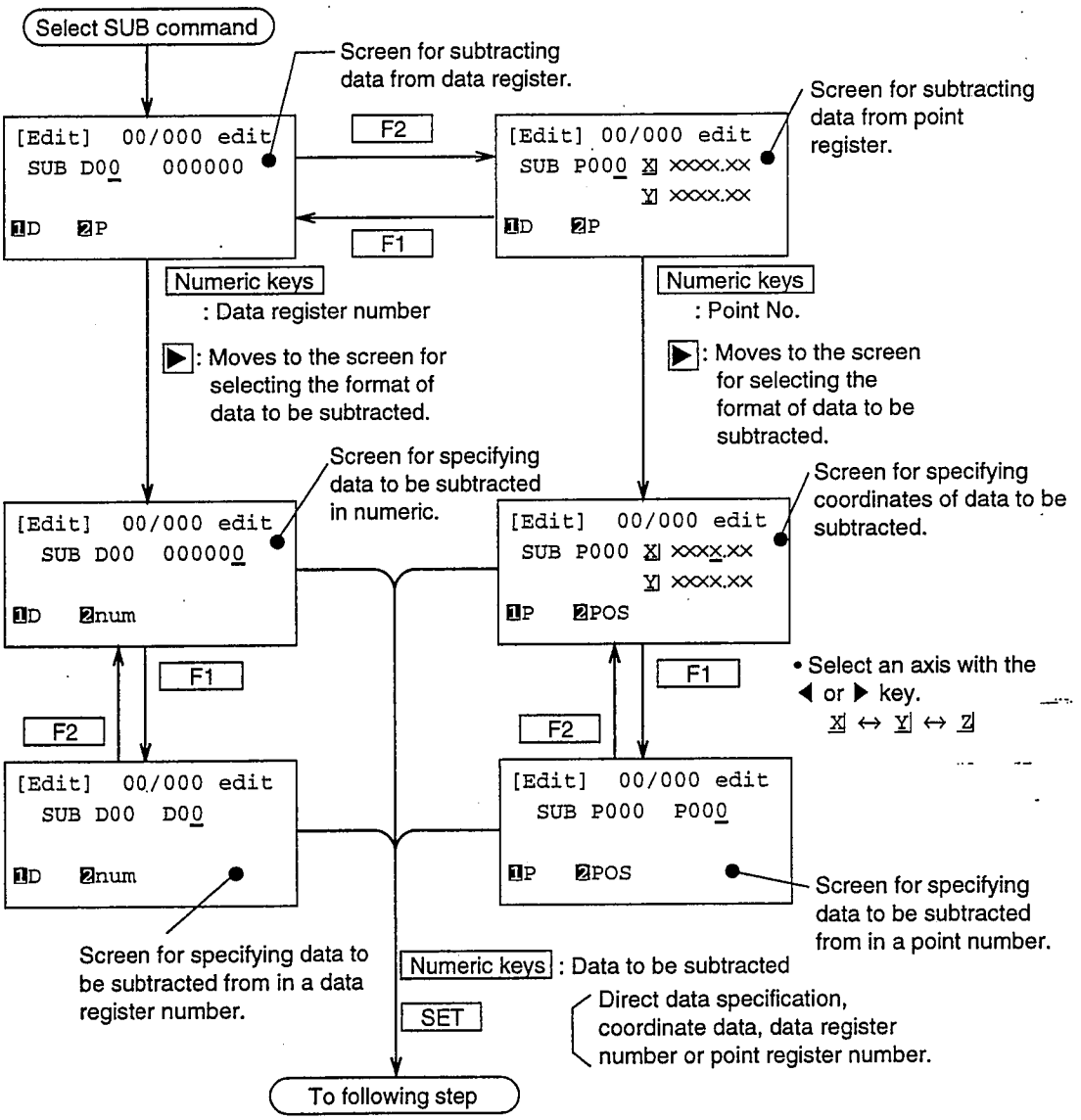
Destination of data subtraction

Either of the following two may be selected as the destination of subtraction.
(1) Data register
Dn (n= 00~99)
(2) Point register
Pn (n=000~399)

Either of the following two data formats may be selected.
(1) To subtract from a data register.
- Direct data specification (000000~999999)
- Data in the data register of a specified number.

(2) To subtract from a point register.
- Coordinate data
- Data in the point register of a specified number.

- **Setting procedures**



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TAG — tag : Set label number in the same program — Command code length: 2

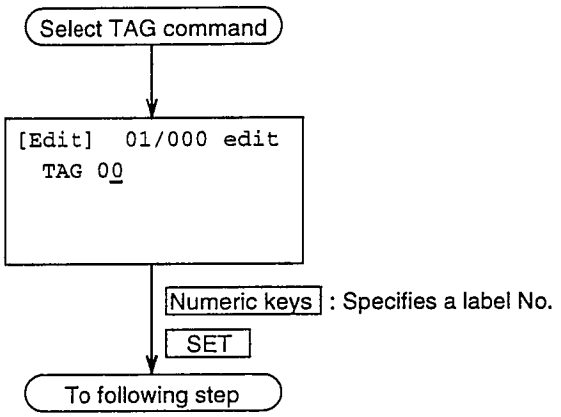
- The TAG command sets a label number in a program.
- The TAG command is used to specify a destination of a jump command or a subroutine call command.

* Valid in the same program. (Program 01 in the following example)

Example **TAG** **00** ---------- Label number 00 is given to the step where this command is written.

Command | Label No. : 00~99 (100 label numbers may be set in the same program.)

- **Setting procedures**



TIM — timer : Set timer — Command code length: 4

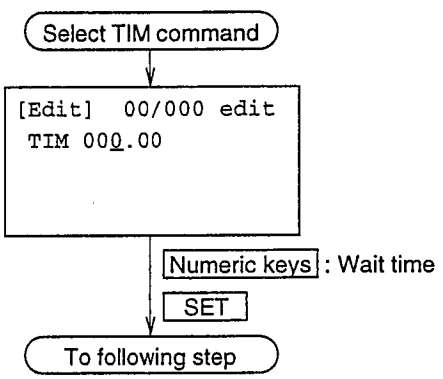
- The TIM command waits for set time and advances to the following step then.

Example **TIM** **001.00** ---------- Stops for a second and advances to the following step then.

Command | Wait time

- Unit : Second
- Setting range : 0.01 to 999.99 seconds

- **Setting procedures**



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- The VEL command specifies the travel speed in the programmed operation in a percentage with respect to the maximum speed specified in initial setting or a parameter related to the programmed operation.

$$\underset{[mm/s]}{\boxed{\text{Travel speed in programmed operation}}} = \underset{[mm/s]}{\boxed{\text{Maximum speed (set value)}}} \times \underset{[\%]}{\boxed{\text{VEL command set value}}} \times \frac{1}{100}$$

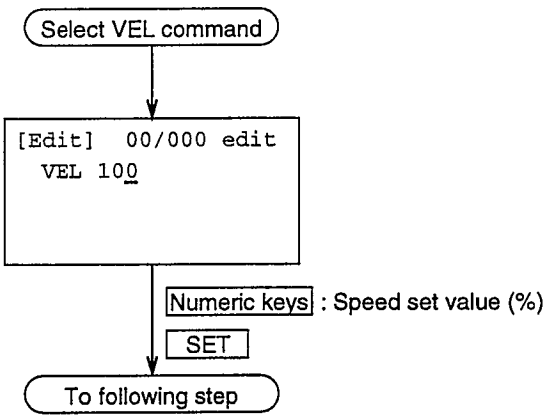
* See also "11.3.1.2. Travel Speed in Programmed Operation".

- Once the VEL command is specified, traveling is performed at specified speed until another VEL command is specified.
- The initial speed is 100% if the VEL command is not used.
- Setting range: 001~100

Example **VEL** **100**

Command — Set value (%)

- **Setting procedures**



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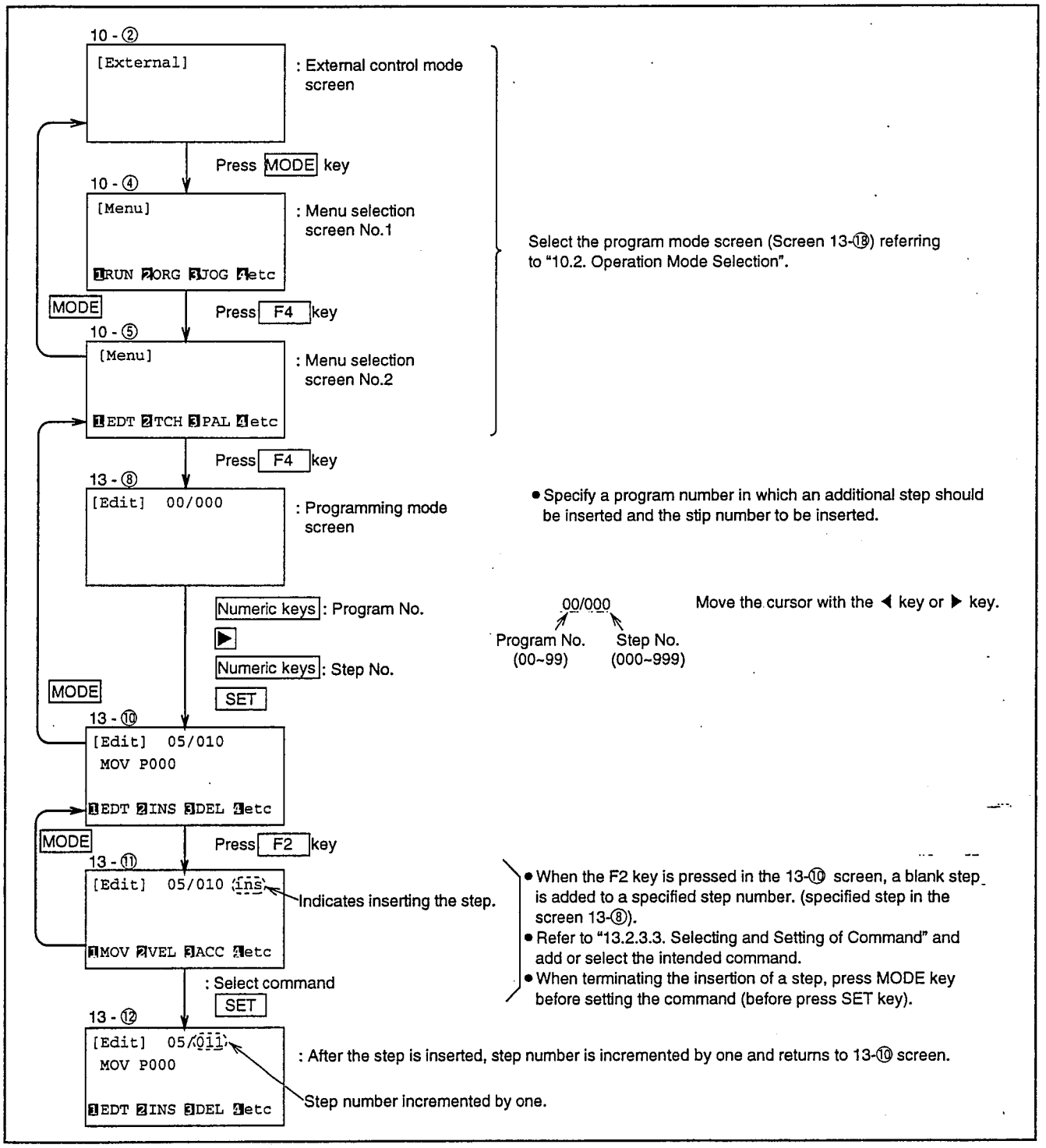
13.2.6. Editing Program

- The following functions are used to edit and confirm a created program.

13.2.6.1. Step Insertion: INS

- This command is to insert a command in a created program.
- Select a program number in which an additional step (specified step number) should be inserted as shown in the following procedures.
- When a step is inserted, the following step numbers are incremented by one each.

Figure 13-29

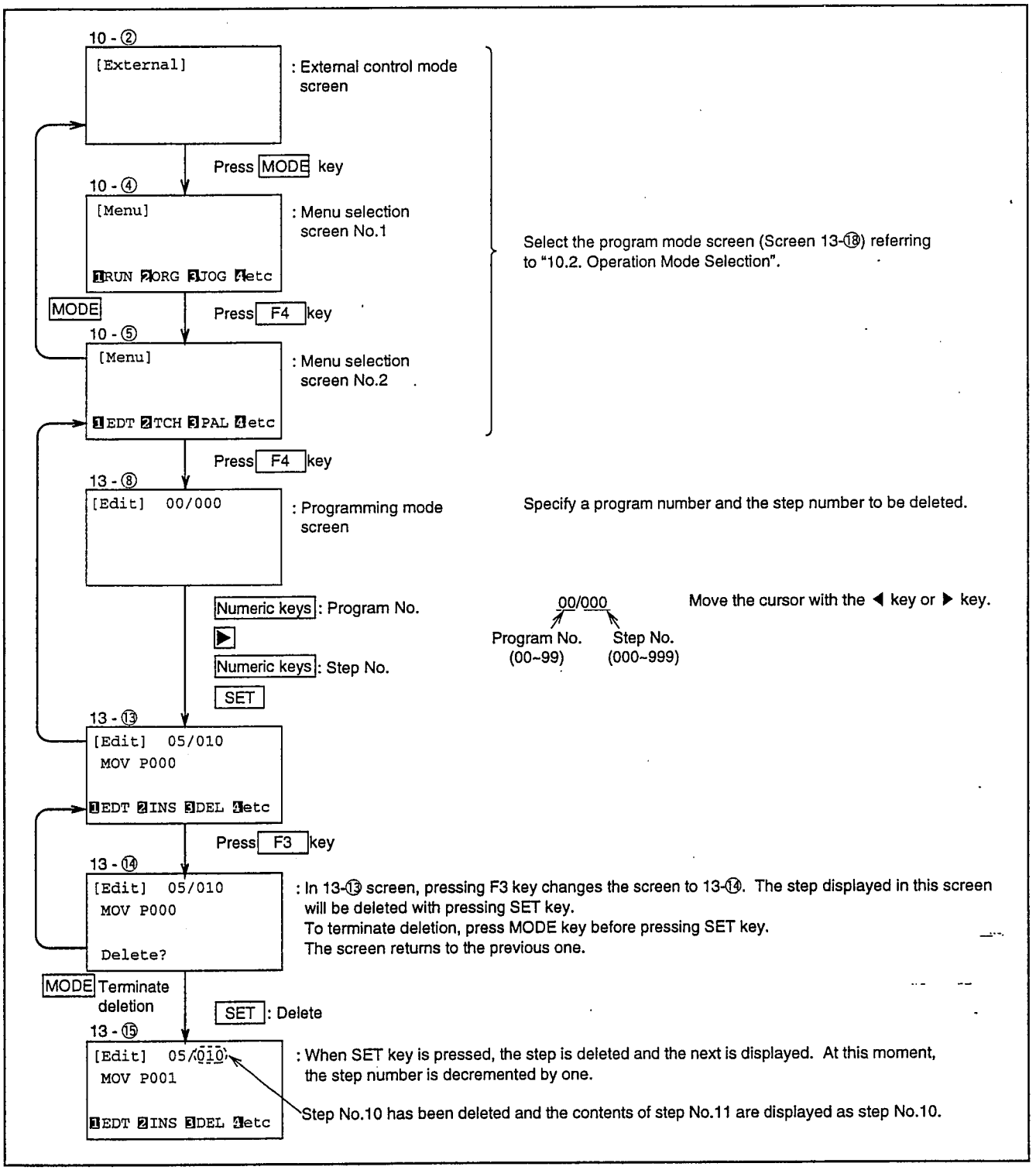


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13.2.6.2. Step Deletion: DEL

- This command is used to delete a command from a created program.
- Select a program number and its step number to be deleted.
- When a step is deleted, the following step numbers are decremented by one.

Figure 13-30

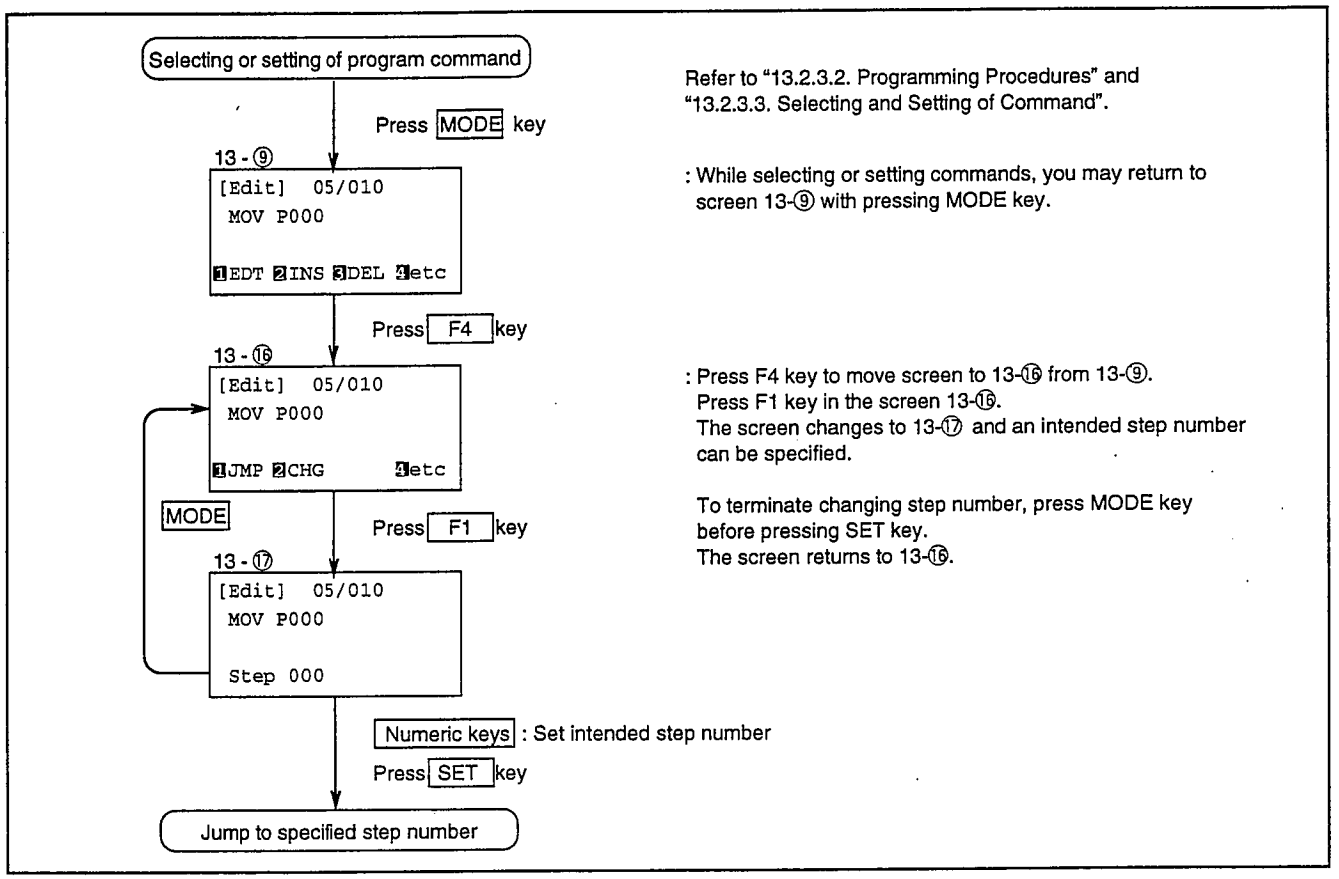


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13.2.6.3. Changing Step Number

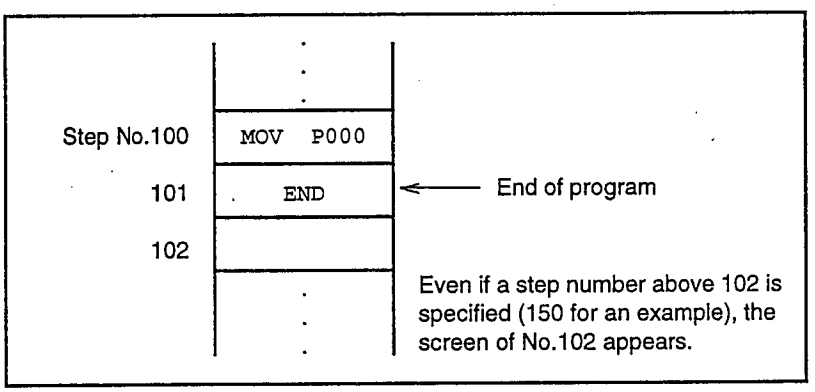
- This command is used to check a created program in process of programming.
- Even in a process of editing (selecting and setting of commands) of a program, specify any intended step number to check the contents. Follow procedures described in Figure 13-31.

Figure 13-31



* Any step number with no program can not be specified. If such a step number is specified, the screen changes to the initial step of an area where no program is written.

Figure 13-32

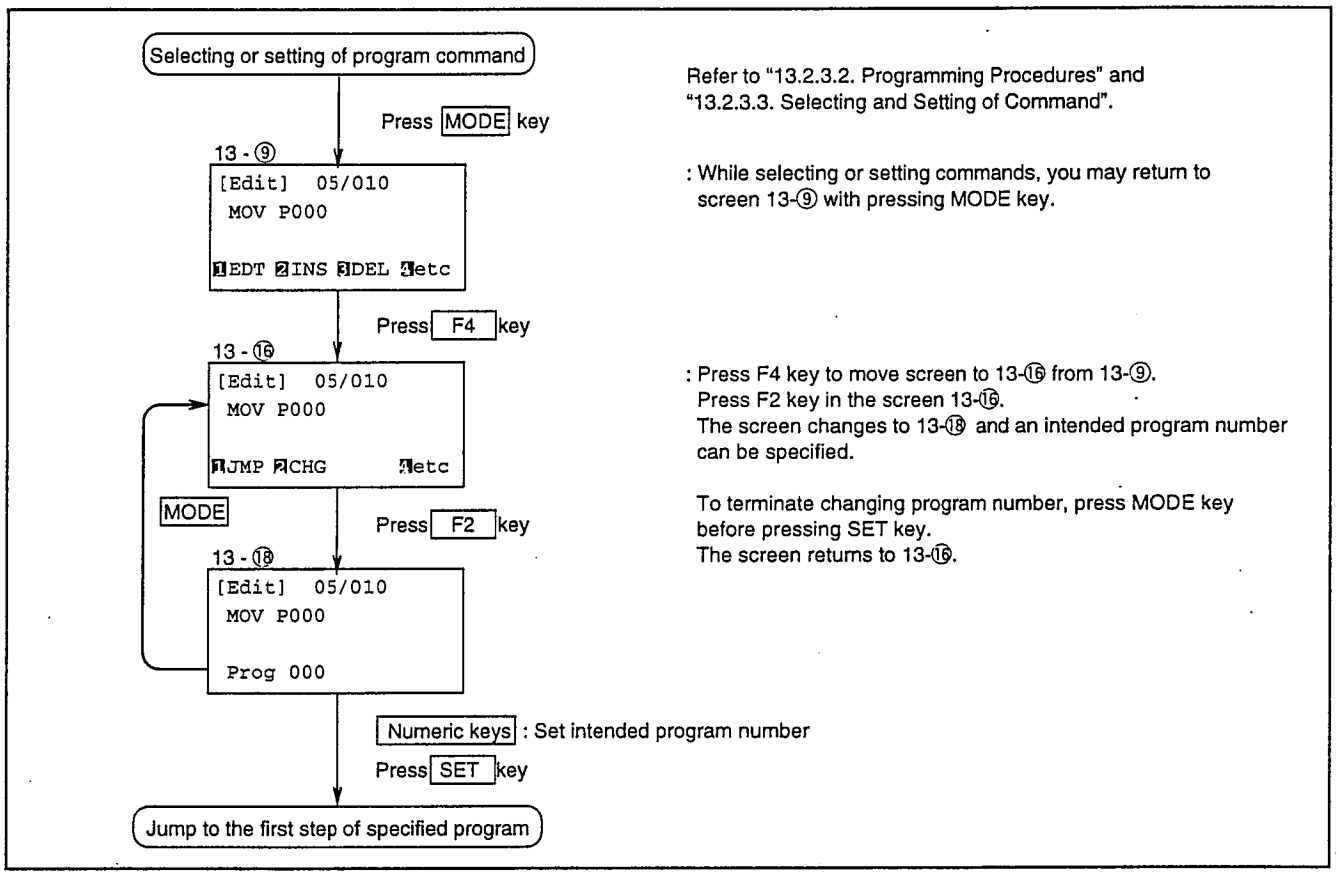


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13.2.6.4. Changing Program Number

- This program is used to check other program while editing a program (setting or selecting program command). Specify any intended program number and you may check the its content. Follow procedures described in Figure 13-33.

Figure 13-33

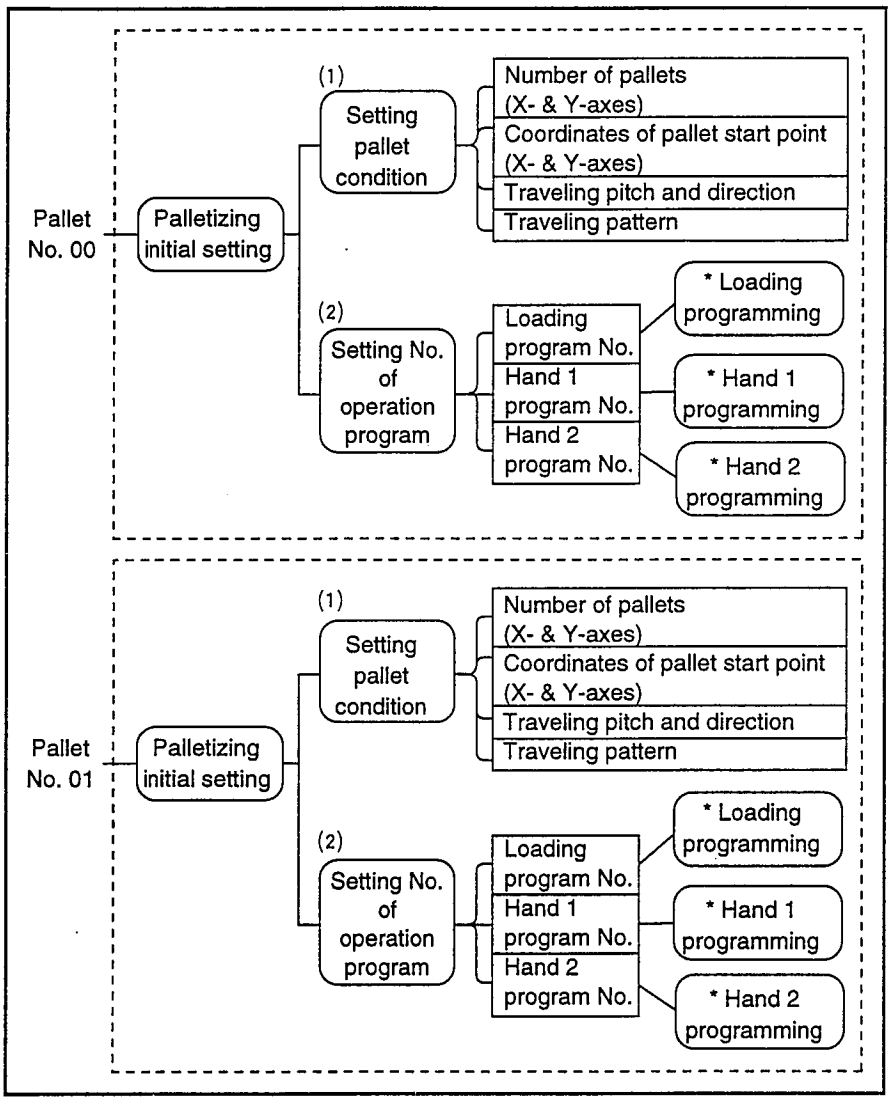


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13.3. Palletizing Initial Setting

- Carry out initial setting of a palletizing program.
- For details of the palletization program, see "13.2.4.3. Palletizing".
- Initial setting has two items shown below.
  (1) Pallet condition setting ----- Specify pallet points and their order for positioning of palletizing.
  (2) Palletizing operation
  Setting program No. -------- Specify the number of a program containing loading and hand operations 1 and 2.
- Initial setting of two pallets is allowed (pallet No.00 and 01). Specify (1) and (2) mentioned above for each pallet.

Figure 13-34

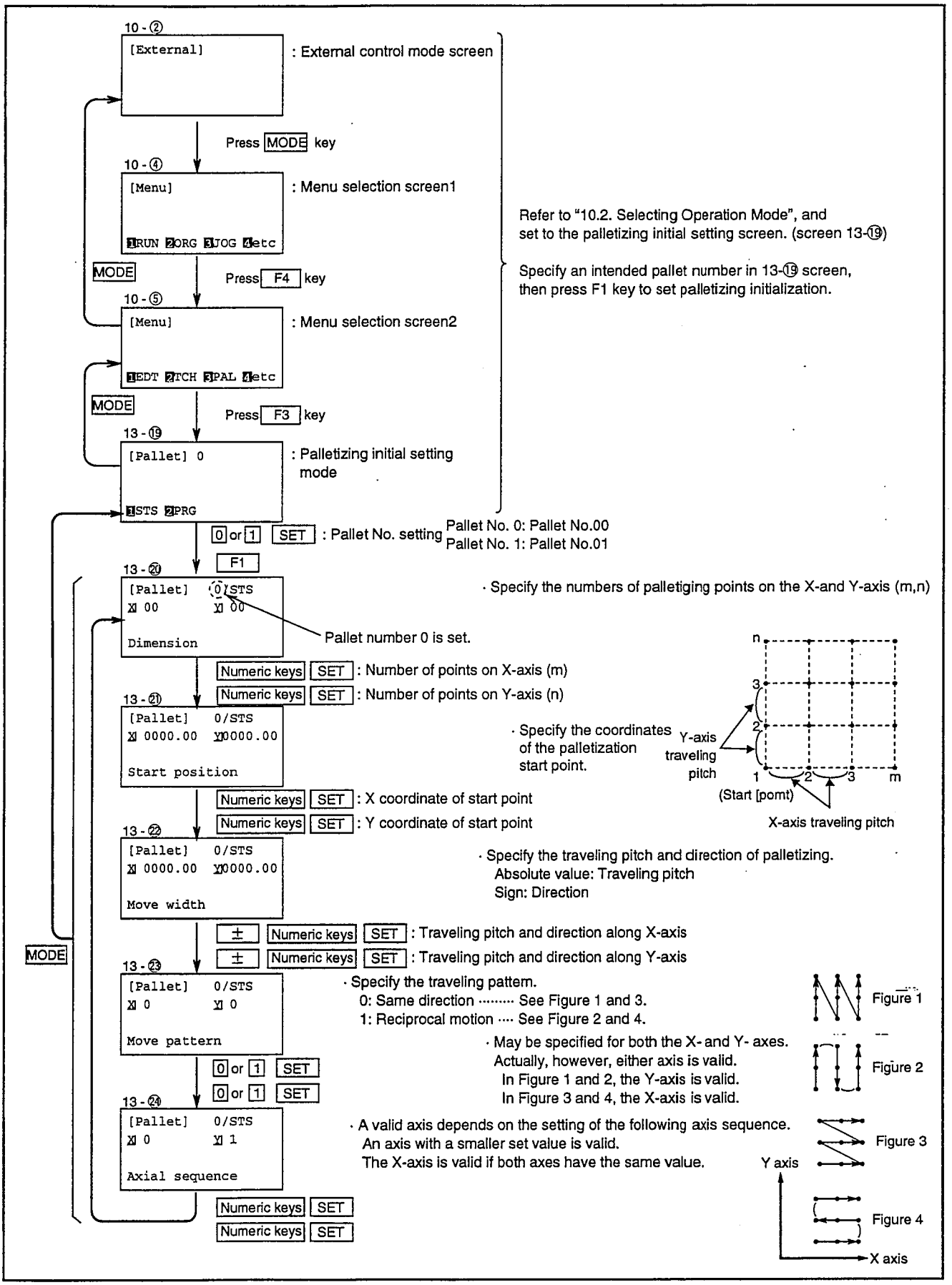


* Make these programs in same manner as an ordinal program. These programs are simply held for being called by palletizing operation.

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13.3.1. Setting Pallet Conditions

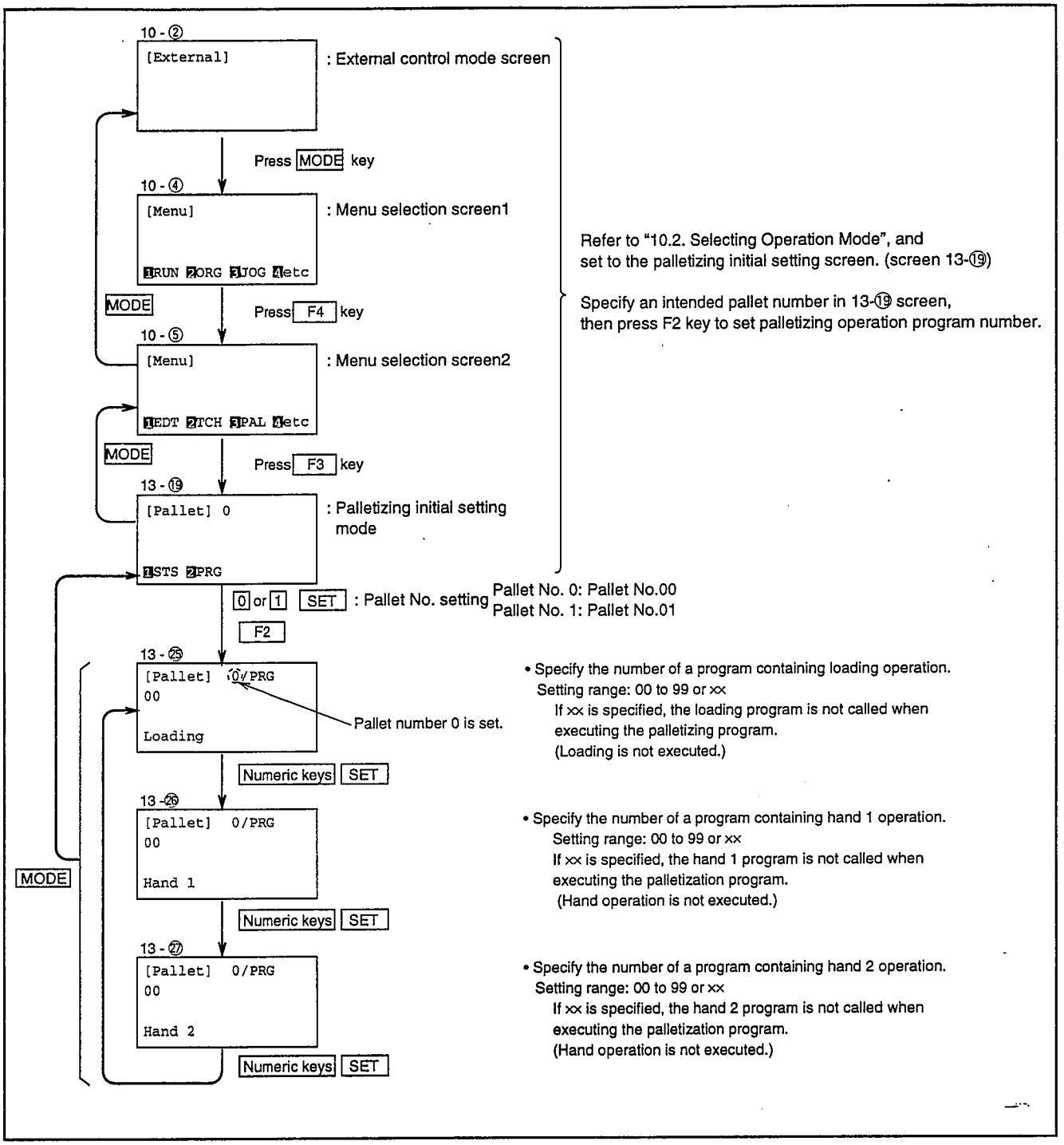
Figure 13-35



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13.3.2. Setting Palletizing Operation Program Number

Figure 13-36



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14. Operation

- This section is to explain how to operate the robot module. Operational functions are also described in this section because it is necessary to understand them before actual operation.

Danger : *If you go beyond the safety fence for operation, be sure to stay at a place out of the robot module's working range. Also, select a safety speed (250 mm/sec) or less. Otherwise, the module could collapse, nip, or catch you.*

Caution : *When you have prepared a new program or changed a program, make its trial run to check whether it works as you have intended. Use care, in the trial run, to prevent workpiece, end effectors, etc. from being damaged by unexpected movement of the robot module. If the robot module is operated for actual service by a program not in accordance with your intention, it could damage workpieces and end effectors. If the program does not work as intended, re-program it until it works properly.*

14.1. Power ON/OFF

◉ Power ON

- See "10.1. Power ON" before turning on your robot module for starting up or when the robot module system has been modified.
- Here, we will explain the procedures for turning on the module for daily operation.

(1) Check the cables and connectors for:
  - ○ Loose or disconnected connectors. Deteriorated or damaged cables.
  - ○ Error in axis connection.

(2) Check the main unit for:
  - ○ Loose bolts
  - ○ End effector (to be prepared by the customer)

(3) Check that no person nor device that could be injured or damaged by the module, is within the robot module working area.

(4) When everything is normal, turn on the EXC controller. (for a rack-mount EXC controller, turn on the 24 VDC power first).
  - ○ Stand-alone EXC controller: Turn on the power SW on the front panel.
  - ○ Rack-mount EXC controller: Turn on the power SW to be prepared by the customer.

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◉ Power OFF

(1) Stop operation of the module.

- ○ During operation by teaching : Push STOP key.
- ○ During external control : Input STOP signal.
- ○ During remote control : Enter STOP command.

(2) Check that the slider (or the main unit when it is moving).

- ○ During operation by teaching : Push OFF key.
- ○ During external control operation: Turn off SVON input.
- ○ During remote control : Enter SVOF command.

(3) Turn off the power supply

- ○ Stand-alone EXC controller: Turn off the power SW on the front panel.
- ○ Rack-mount EXC controller: Turn off the power SW to be prepared by the customer on the front panel.

Caution : (1) The slider (or the main unit when it is moving) will run idly if the servo is turned off while the slider or main unit is in operation.

(2) If the power is turned off with the servo turned on, the vertical axis slider (or main unit when it is moving) may drop by 5 to 10 mm due to the time lag in brake engagement.

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14.2. Pre-run Checks

- Make pre-run check before operation.
- Determine the check items centering on safety items in accordance with the applications (usage) at the Customer.

Danger : Be sure to check the two following items by including them in the check items. Should the failure of the emergency stop function and forced stop function be not noticed through omission of checks, serious danger could result, because the stop function would not work in an emergency.

(1) Execute jog operation by referring to "14.3.2. Jog Operation by Teaching Box."

- o This check item is to check that the controller system and motor system work properly. If the jog operation cannot be made due to your applications in which the teaching box is not used, check the above systems by an alternative means such as execution of the programs for trial operation.

  → Do the systems work properly? If not, take necessary measures by referring to "21. Troubleshooting."

(2) Check the functions of the stopping devices.

- o Emergency stop functions: Emergency stop key on the teaching box, EMST input on CN2, Emergency stop button SW on the front panel (stand-alone type only), EMST command (remote control only).

  → When applied during Home Return operation, the emergency stop function must work instantly.

* For the emergency stop operation and emergency stop status, see "18.3.1 Emergency Stop."

- o Forced stop function: STOP key on the teaching box (during operation by the teaching box)
  STOP on CN2 (in external control)
  STOP command (during remote control)

  → When applied during Home Return operation, the forced stop function must work instantly.

★ Be sure to check that the stop function work properly before starting the operation.

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14.3. Operation Procedures by Teaching Box

- Teaching box allows you to execute Home Return operation, jog operation, and programmed operation.
- Followings are the operation procedures using the teaching box.

(Caution) : *During operation by the teaching box, control input (CN2), excluding EMST input, is invalid.*

→ If EMST input (b contact, normally closed) is not ON, emergency stop cannot be canceled, and operation by the teaching box cannot be made.

→ Other input is invalid.

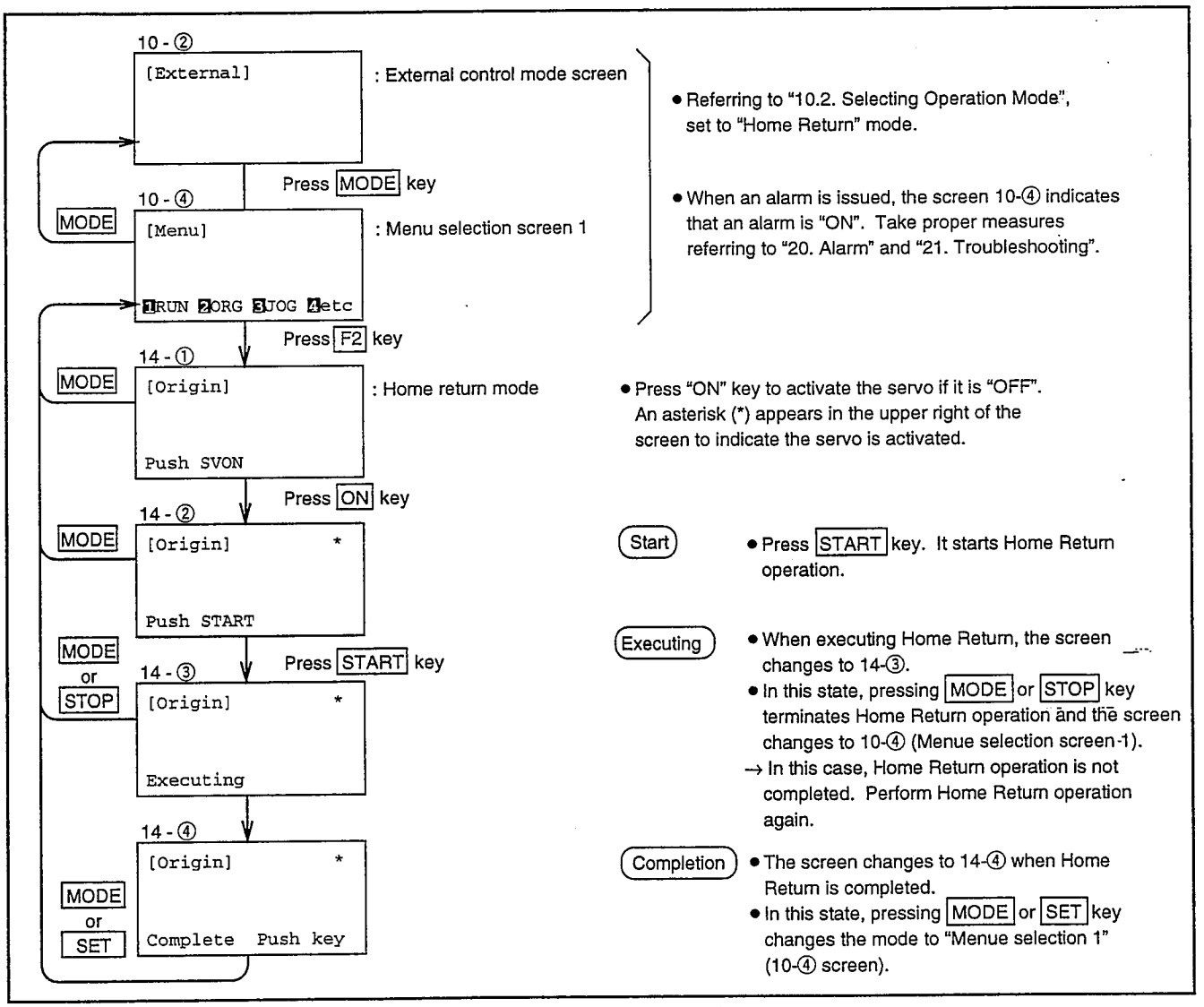
For example: The system does not stop when STOP is input.

* Control output is fed in the same way as in the external control mode.

14.3.1. Home Return Operation by Teaching Box

- Be sure to perform "Home Return operation" each time you turn on the power supply. Otherwise, you cannot perform programmed operation nor teaching by jog operation, because the system cannot identify the coordinate home position.

Figure 14-1



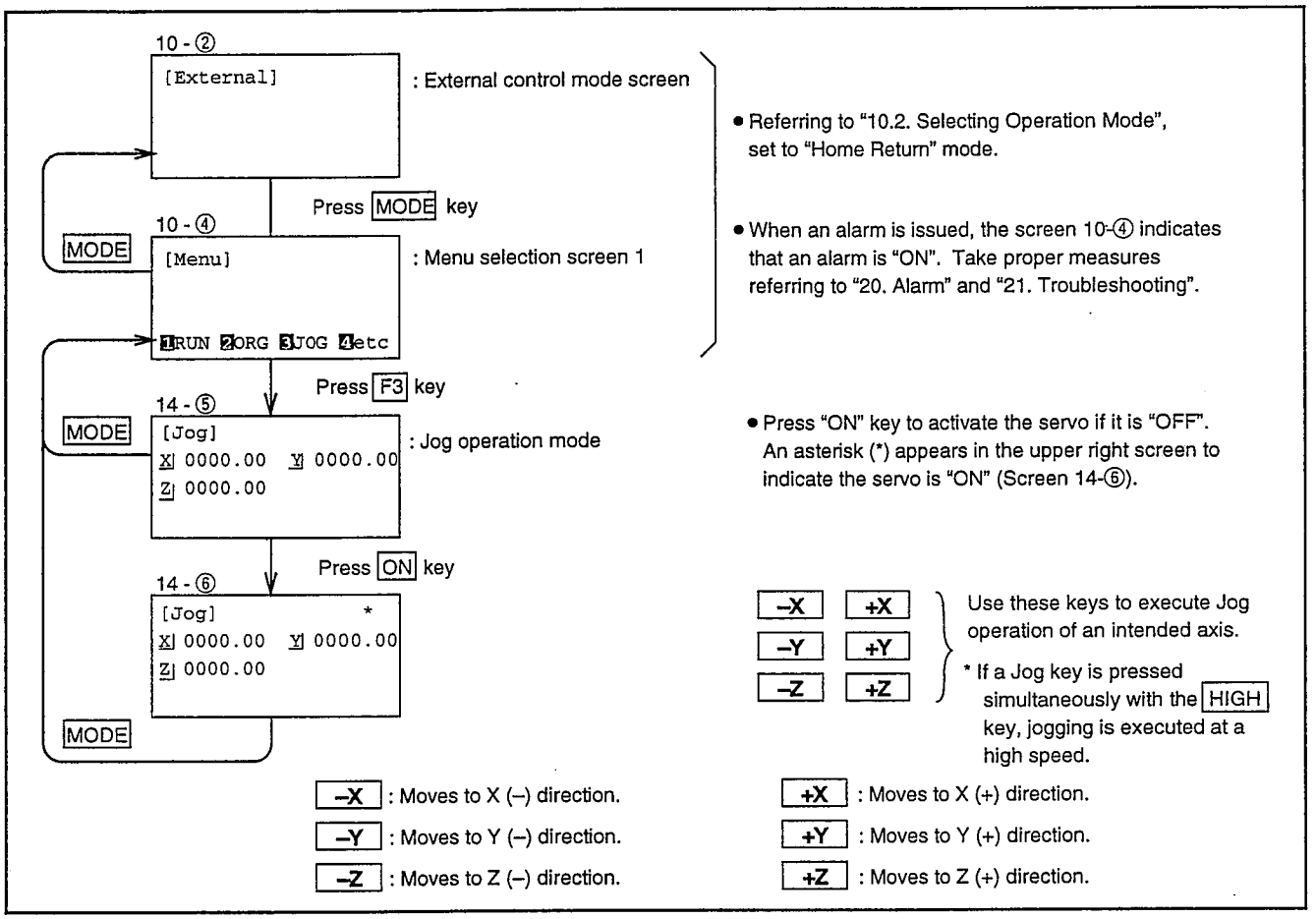
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14.3.2. Jog Operation by Teaching Box

Jog operation can be made by teaching box only.

- Jog operation is made while jog keys [-X] [+X], [-Y] [+Y], [-Z] [+Z] are being pushed. It stops when your fingers are released from the above keys.
- You cannot perform jog operation on two or more axes simultaneously. Jog each axis separately.
- After completing jog operation, push MODE key. You will return to the menu select screen 1.

Figure 14-2



Caution : Direction of jog operation: motor side: minus, counter-motor: plus. Note that the direction is reversed in the following cases.

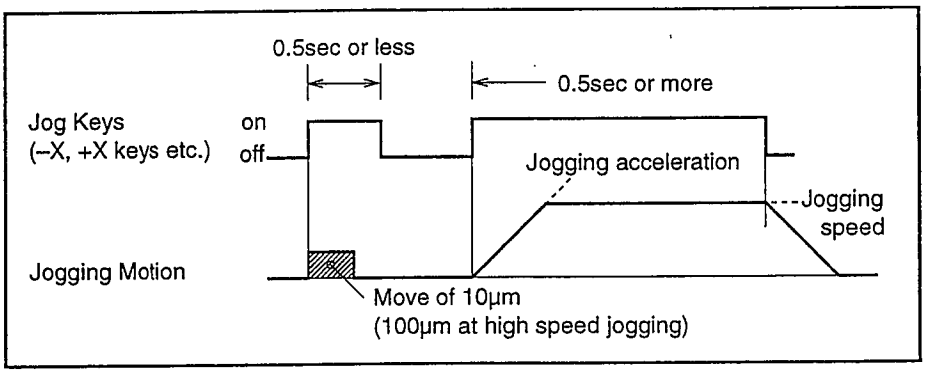
① When the coordinate direction is reversed in initial setting (see "11.5.1. Position and Coordinate Parameters").

② Motor mounting parameters for initial setting (direct/indirect coupling) do not agree with the specifications of the main unit.

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14.3.2.1. Jog Operation Timing

Figure 14-3



- If a jog key is pressed for 0.5 second or less, the feeding pitch is 10µm. If the HIGH key is pressed simultaneously, the feeding pitch is 100µm.
- The jogging acceleration, jogging operation speed, and high jogging speed are specified in the initial setting step. See "11.3.3. Jogging Parameters".

Note : If the response of the slider (move/stop) to the ON/OFF of the jog key is slow in jog operation, increase the jog operation acceleration/deceleration to raise the follow-up capability of the slider. The slider will overshoots if the acceleration/deceleration is too high. Set the acceleration /deceleration to about equal to that for program operation. See "11.3.1.3. Acceleration/ Deceleration for Programmed Operation."

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14.3.3. Programed Operation by Teaching

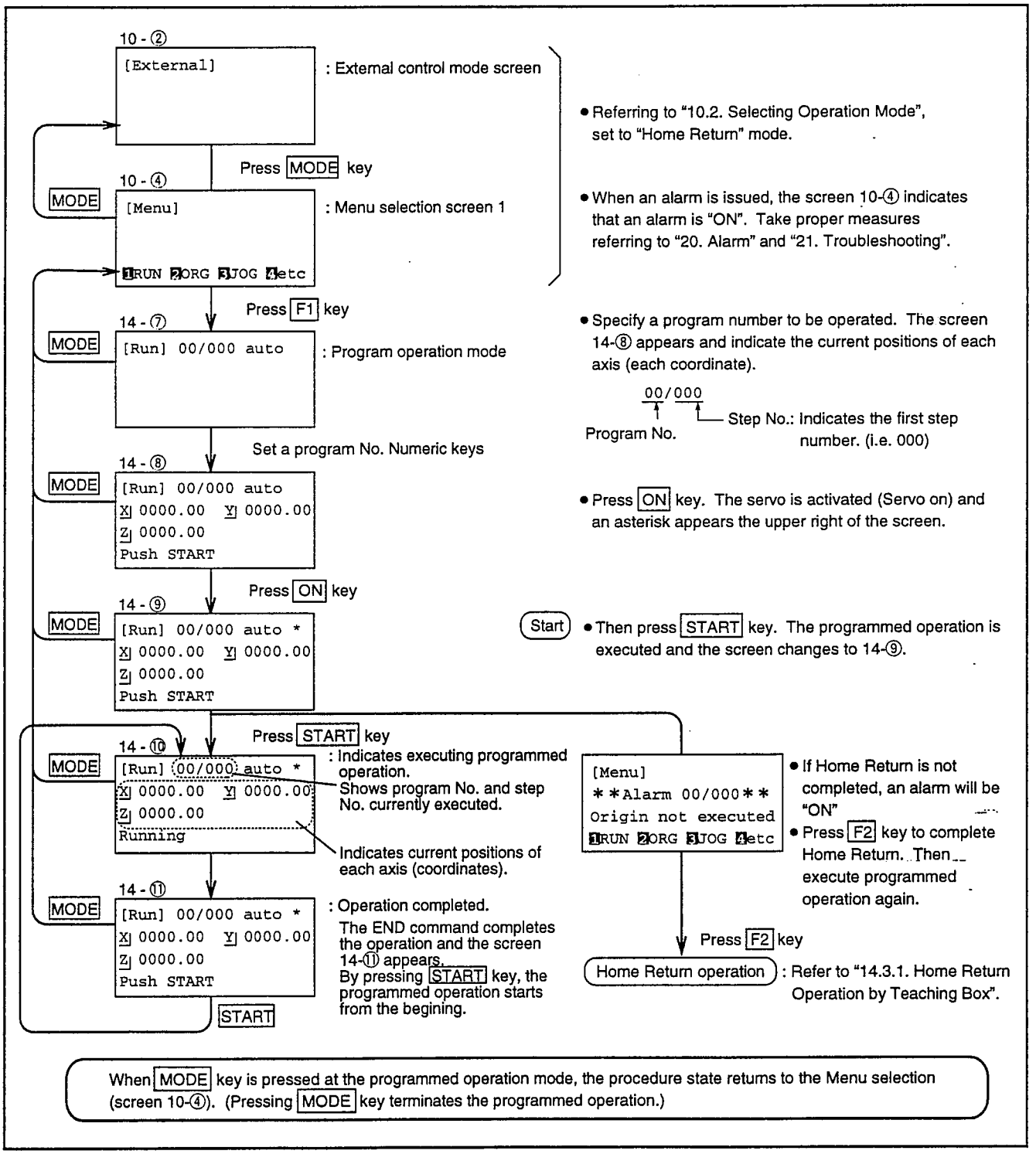
- Turn on the power supply, and return to home. You cannot execute programmed operation unless the home position is determined. Once completed, the home position is valid until power is turned off.

14.3.3.1. Sequential Programmed Operation

- The robot module, once moved, executes programmed operation continuously until the end of the program (until END command is executed).

Procedures of sequential programmed operation.

Figure 14-4



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Termination of sequential programmed operation

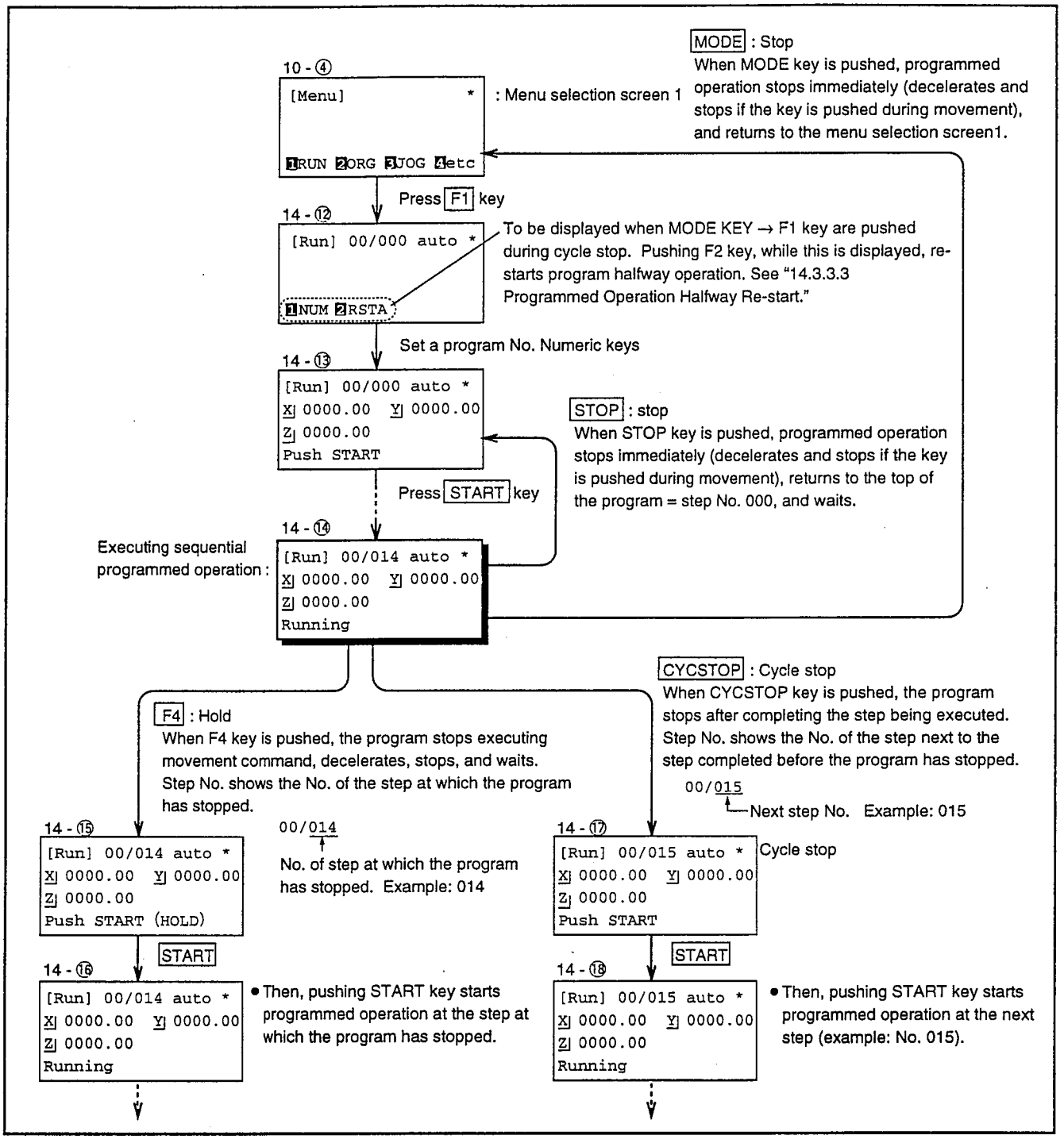
- The following types of functions can be used to stop sequential programmed operation.

Table 14-1

Function	Description of function	Operation
Emergency stop	• Stops programmed operation immediately, setting motor to servo off. * For emergency stop function, see "18.3.1 Emergency Stop."	Push EMG key
Forced stop	• Stops programmed operation immediately (decelerates and stops the program if applied during movement), and waits at the top of the program. • Motor is servo-locked. • Pushing START key starts operation at the top of the program again.	Push STOP key
	• Stops programmed operation immediately (decelerates and stops the program if applied during movement), and returns to the menu select screen. (10-<4>) • Motor is servo-locked.	Push MODE key
	Note : When "forced stop" is applied, data register and internal flag data excluding the following items are reset. ○ Point coordinate data (P000 - P399) ○ General output data by OUT command.	
Cycle stop	• Stops after completing the step being executed. • Motor is servo-locked. • Pushing START key re-starts programmed operation at the next step. Note : (1) If an alarm is issued, or STOP or EMG key is pushed during cycle stop, the program is released from cycle stop, and programmed operation cannot be re- started. (2) The following commands do not stop under cycle stop operation. They stop after the subsequent command have been executed. CALP/RETP/TAG/JMP/JEQ/JGE/JLE/JNE/JGT/JLT/CALL/RET/CHG/REP/NXT/END/IRET/PAL except PAL02 (Caution) *: Cycle does not stop during continue path execution. It stops when the continue path is completed.*	Push CYCLE STOP key
Hold	• Movement hold instruction = Decelerates and stops, and waits at the position where hold command is received. • Motor is servo-locked. • Pushing START key re-starts operation at the position where program stopped, executes the remaining movement, and then re-starts program operation. Note : (1) If an alarm is issued, or STOP, EMG, or MODE key is pushed during hold, the program is released from hold, and program operation cannot be re-started. (2) Executes commands except movement command, and stops before executing the subsequent commands. Movement command: MOV/ARC/CIR/HOM/PAL02 Consecutively executes the following commands if they follow. CALP/RETP/TAG/JMP/JEQ/JGE/JLE/JNE/JGT/JLT/CALL/RET/CHG/REP/NXT/END/IRET/PAL except PAL02 (3) If Hold is executed during continue path execution, the remaining path after hold does not become continue path, but is executed by ordinary movement command.	Push F4 key.

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Figure 14-5



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14.3.3.2. Programmed Step Operation

- Programmed operation is to execute one step each time START key is pushed.

Note : (1) After executing a step, the system consecutively executes the following commands if they follow the step.

CALP / RETP / TAG / JMP / JEQ / JGE / JLE / JNE / JGT / JLT / CALL / RET / CHG / REP / NXT / END

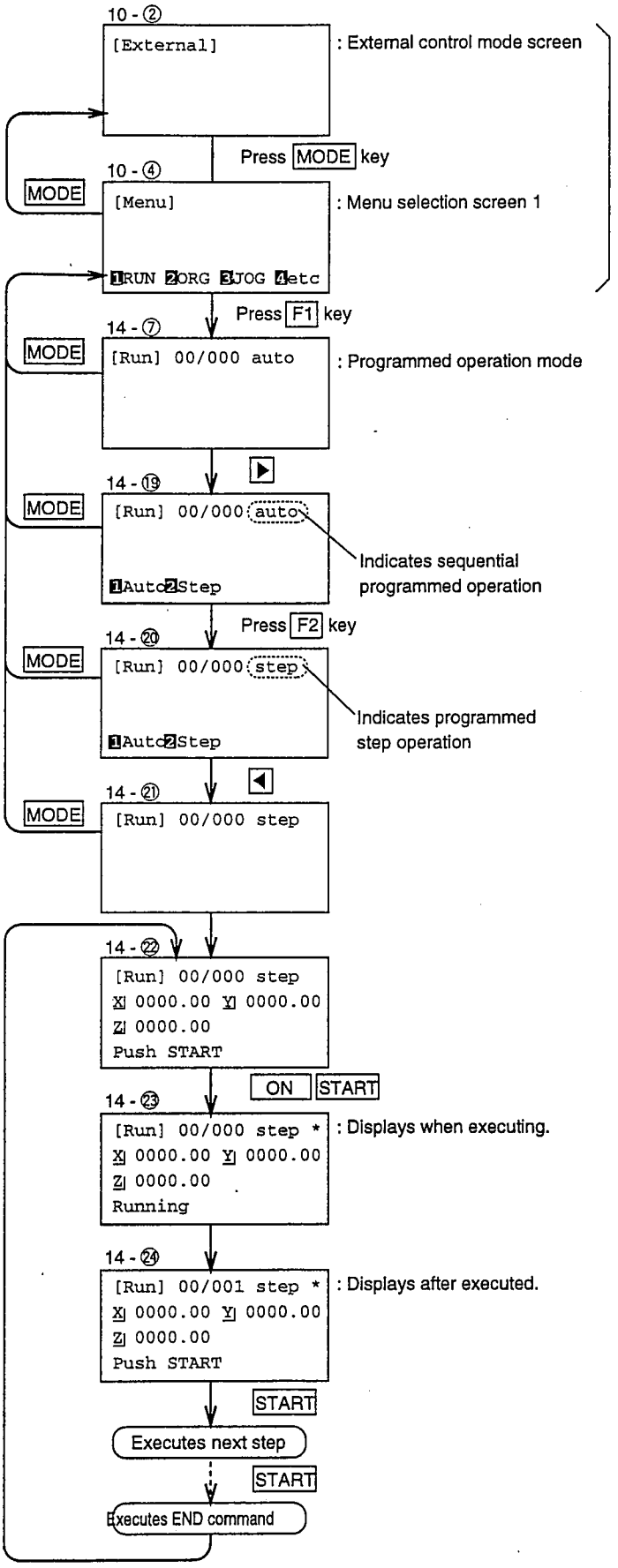
(2) Continue path executes the whole as one step.

→ Pushing START key executes CPS through CPE consecutively.

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Procedures to start programmed step operation

Figure 14-6



- Referring to "10.2. Selecting Operation Mode", set to "Home Return" mode.
- When an alarm is issued, the screen 10-④ indicates that an alarm is "ON". Take proper measures referring to "20. Alarm" and "21. Troubleshooting".

- Pressing ▶ key in the programmed operation mode (screen 14-⑦) changes to 14-⑲ screen and enables to select sequential programmed operation / programmed step operation.
- Press F2 key to specify programmed step operation. (Screen 14-⑳).
- Press ◀ key to change the screen to 14-㉑. (Selecting program screen)

- Specify a program number. Screen 14-㉒ appears.

  00/000
  ↑
  Specify program number.

- Press ON key to activate the servo. An asterisk (*) appears in the upper right of screen.
- Then, press START key to execute the first step (=000). (Screen 14-㉓)

- After execution of the first step, step number changes to next step. (000 → 001)
- Pressing START key executes next programmed step operation.

- After completion of the program (execution of END command), returns to the begining of the program, and waits.

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Stopping programmed step operation

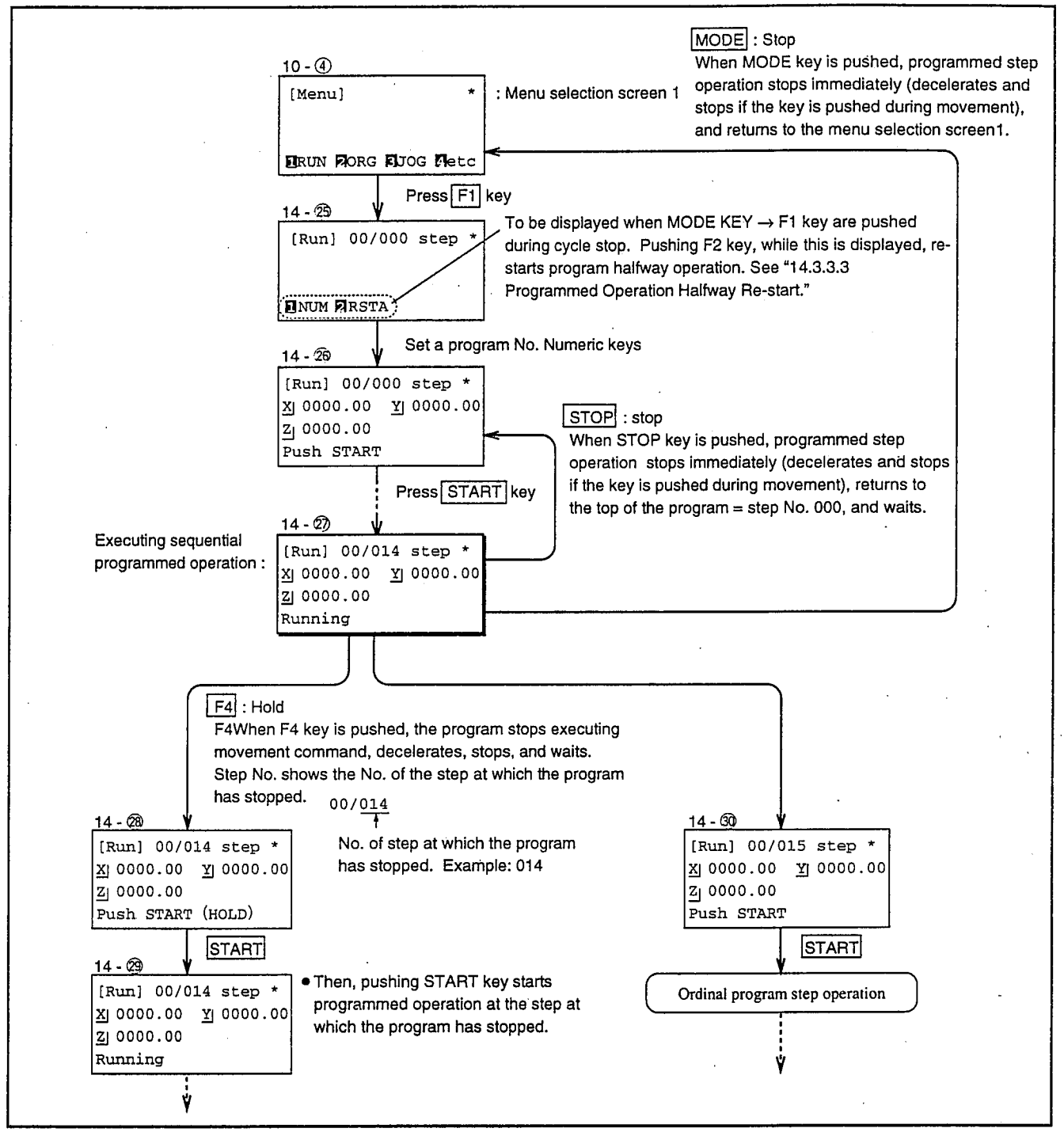
- The following types of functions can be used to stop programmed step operation.

Table 14-2

Function	Description of function	Procedure
Emergency stop	• Stops programmed step operation immediately, setting motor to servo off. * For emergency stop function, see "18.3.1 Emergency Stop."	Push EMG key
Forced stop	• Stops programmed step operation immediately (decelerates and stops the program if applied during movement), and waits at the top of the program. • Motor is servo-locked. • Pushing START key starts operation at the top of the program again.	Push STOP key
	• Stops programmed step operation immediately (decelerates and stops the program if applied during movement), and returns to the menu select screen. (10-<4>) • Motor is servo-locked.	Push MODE key
	Note : When "forced stop" is applied, data register and internal flag data excluding the following items are reset. ○ Point coordinate data (P000 - P399) ○ General output data by OUT command.	
Hold	• Movement hold instruction = Decelerates and stops, and waits at the position where hold command is received. • Motor is servo-locked. • Pushing START key re-starts operation at the position where program stopped, executes the remaining movement, and then re-starts program operation. Note : (1) If an alarm is issued, or STOP, EMG, or MODE key is pushed during hold, the program is released from hold, and program operation cannot be re-started. (2) Executes commands except movement command, and stops before executing the subsequent commands. Movement command: MOV/ARC/CIR/HOM/PAL02 Consecutively executes the following commands if they follow. CALP/RETP/TAG/JMP/JEQ/JGE/JLE/JNE/JGT/JLT/CALL/RET/CHG/REP/NXT/END/IRET/PAL except PAL02 (3) If hold is executed during continue path execution, the remaining path after hold does not become continue path, but is executed by ordinary movement command.	Push F4 key.

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Figure 14-7



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14.3.3.3. Programmed Operation Halfway Re-start

- If the power supply is turned off after steps are completed by programmed operation, the system re-starts the programmed operation, when the power is turned on again, at the step following the last executed step.

◉ Programmed operation halfway re-start procedures

(1) Turn off servo after completing step execution.

- ○ Sequential programmed operation: Push OFF key after cycle stop has been completed.
- ○ Programmed step operation: Push OFF key after steps have been completed.

Note : You cannot perform halfway re-start if the step execution has not been completed.

Caution : *If the power is turned off with the servo turned on, the vertical axis slider (or the main unit when the main unit is moving) could drop by 5 to 10 mm.*

(2) Turn off the power supply.

(3) Turn on the power supply again.

(4) Execute Home Return operation. See "14.3.1 Home Return Operation by Teaching Box." The Home Return can be executed by also re-start initialization program(*).

Note : If you try to execute movement command without completing Home Return operation after turning on the power supply, an alarm will be issued and you cannot perform halfway re-start.

(5) After completing Home Return operation, execute programmed operation.

- ○ You can select halfway re-start from 14-㉟ screen.
- ○ Push F2 key → SET key. 14-㊳ screen will appear. Push START key to start halfway re-start operation.
- ○ You can execute programmed operation from the top of the program by selecting the program No. without pushing F2 key on 14-㉟ screen.

- At the start of halfway re-start operation, the data register and palletize-related flags are kept at the state of before halfway re-start operation (or before power off).
- When RSTA instruction (*) is set at the top of an interrupted program, programmed operation will re-start after the execution of the re-start initialization program (*) specified by RSTA instruction.
- You can return the general output and operation re- start position to the state of before interruption by the re-start initialization program (*).

* For the re-start initialization program and RSTA instruction, see "13.2.5 Program Commands ."

Note : (1) If an alarm is issued during halfway re-start operation, you cannot continue halfway re-start by resetting the alarm.

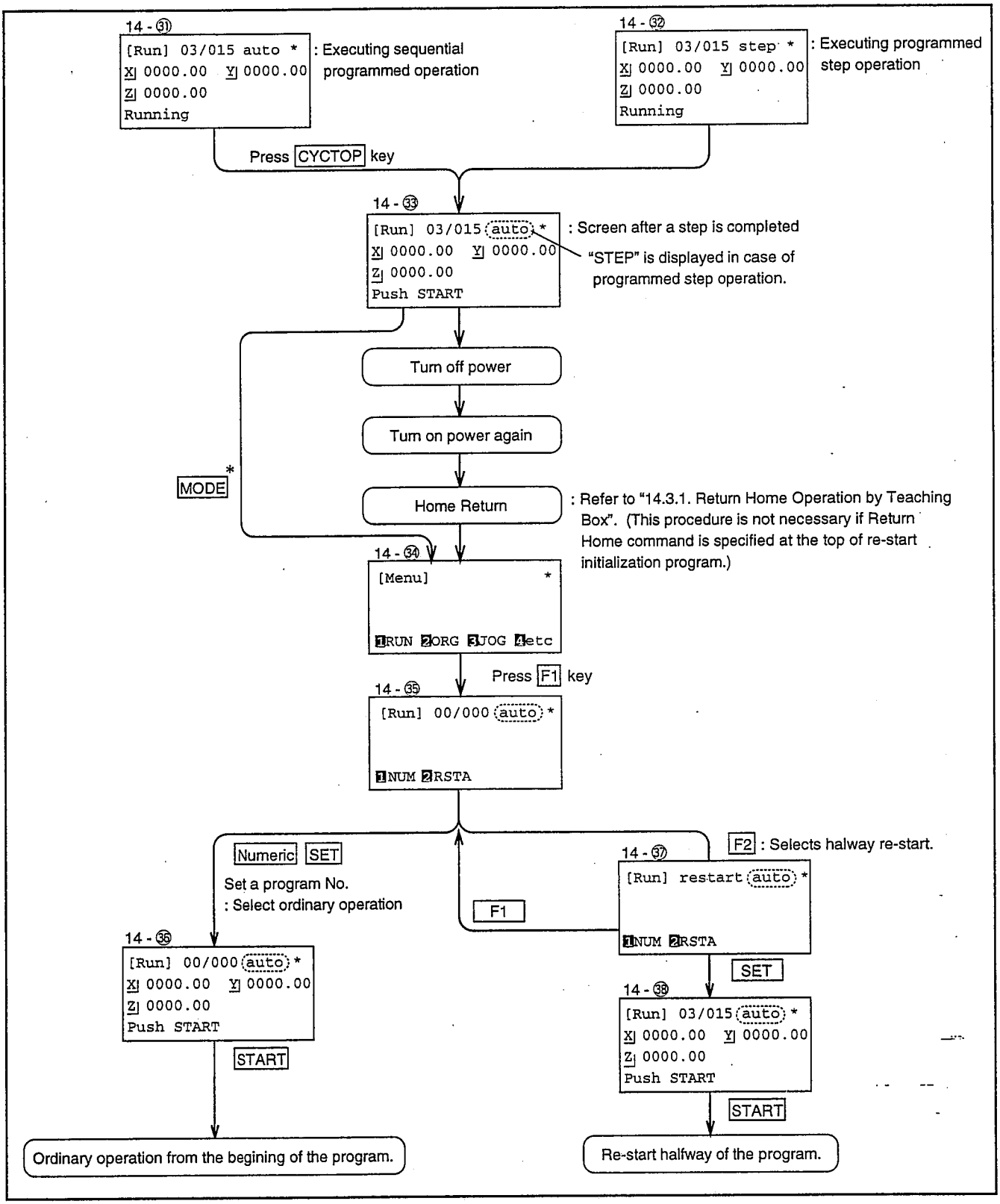
(2) If an emergency stop has worked during halfway re-start operation, you cannot continue halfway re-start by releasing from the emergency stop.

(3) Do not perform any halfway re-start operation not specified above.

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Procedures of program halfway re-start operation

Figure 14-8



- After execution of a step, stopping a program with pressing MODE key, without turning off power, halfway restart may be possible.

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14.4. Operation in External Control Mode

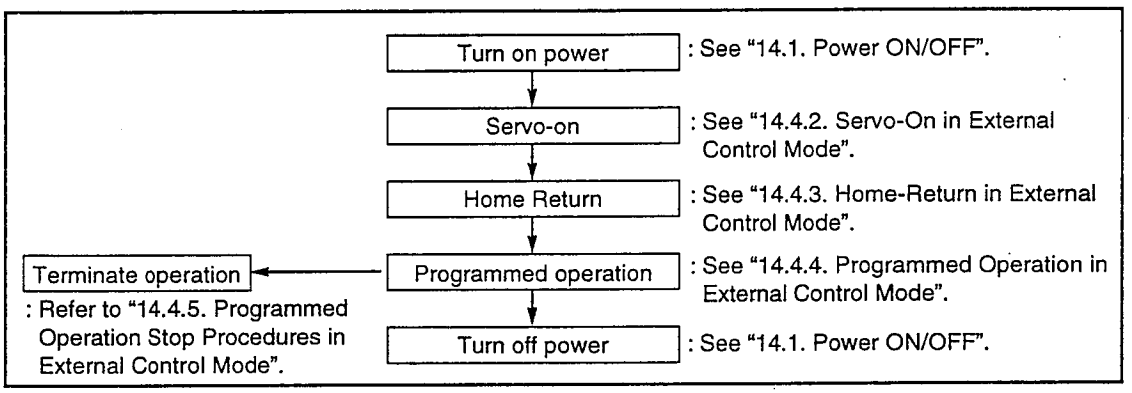
- In the external control mode, you can operate the system by control input/output (CN2).
- When the power is turned on, you will have this mode automatically.

Caution : In the external control mode, the teaching box does not work except the following.

① Emergency stop	:	Push EMG key to emergency stop the system. For details, see "18.3.1. Emergency Stop."
② Mode switching	:	Use MODE key to switch to the teaching box operation. If you switch modes during operation in the external control mode, the module will stop operation instantly (decelerates and stops if modes are switched during module movement), and stops in a state of servo-lock.
③ Programmed operation monitor	:	Push F1 key to monitor the programmed operation status. * For the monitor, see "21.4.5.2. Functions of Monitor."

14.4.1. Operation Procedures in External Control Mode

Figure 14-9



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14.4.2. Servo-On in External Control Mode

◉ Servo on Input/Output

Table 14-3

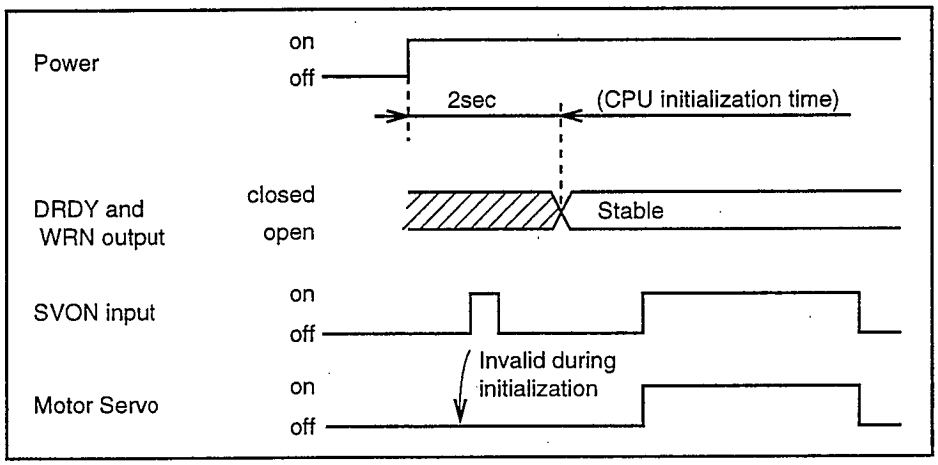
Signal	Pin No.	Description	
SVON	2	Servo on input	ON: Servo on, OFF: Servo off
DRDY	8, 9	Driver ready output	Normally close, Opens at serious error.
WRN	20	Alarm warning output	Normally open, Closes at unserious error.

- The alarm outputs (DRDY and WRN) are stabilized when a certain period of time (approx. 2 seconds for initializing the CPU) has passed since turning the power on. Make sure that they are proper, then activate the SVON input. The motor servo is activated and is ready to receive an operation command.

Caution : When an alarm is issued, take proper countermeasures referring to "20. Alarm" and "21. Troubleshooting".

- If the SVON input is inactive, the position error counter is cleared.

Figure 14-10



Note : (1) In the external control mode, the servo cannot be activated and deactivated with the ON and OFF keys on the teaching box.

(2) If the servo off command is executed in a program while the SVON input is active, the servo is deactivated. The servo on command in a program is invalid while the SVON input is inactive. (The servo on or off command in a program SRV command is valid only when the SVON input is active.)

(3) If SVON input is turned off in the positioning operation (Home Return or execution of MOV commands in programmed operation), the positioning operation is terminated, the servo is off then an alarm is issued.

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14.4.3. Home Return in External Control Mode

- Be sure to perform "Home Return operation" each time you turn on the power supply. Otherwise, you cannot perform programmed operation, because the coordinate home position cannot be specified.

◉ Input/output relating to Home Return operation

Table 14-4

Signal	Pin No.	Description	
SVON	2	Servo On input	ON: Servo ON, OFF: Servo OFF
HOS	5	Home Return start input	Starts Home Return operation by OFF -> ON
HOME	11	Home Return completion input	Closes when Home Return operation is completed
IPOS	10	In position input	Closes when positioning operation is completed or when Home Return operation is completed.
PEND	32	Programmed operation completion input	Opens during programmed operation. While PEND output is closed (not during programmed operation), Home Return operation can start.
HLD	17	Hold input	Decelerates and stops if HLD is ON during Home Return operation. With HLD is kept ON, Home Return operation start is not accepted.
STOP	4	Forced stop input	Decelerates and stops if STOP is ON during Home Return operation. With STOP kept ON, Home Return operation start is not accepted.

◉ Home Return operation procedures

(1) Set the system to servo ON by referring to "14.4.2. Servo ON in External Control Mode."

(2) Check that STOP and HLD inputs are OFF, and that PEND output is closed. If STOP or HOLD is ON, you cannot start Home Return operation. Also, you cannot start Home Return operation if PEND output is open (= during programmed operation).

→ Wait until programmed operation ends, or forcibly end programmed operation by STOP input. After ending programmed operation, turn off STOP input.

(3) Set HOS input to ON to start Home Return operation.

★ Motor will decelerate and stop if STOP input is ON during Home Return operation. In this case, Home Return operation has not been completed (HOME output is kept open). Return STOP input to OFF, and perform Home Return operation again.

★ Motor will decelerate and stop if HLD input is ON during Home Return operation. In this case, Home Return operation has not been completed (HOME output is kept open). Return HLD input to OFF, and perform Home return operation again.

★ If EMST input is OFF during Home Return operation, the system will be set to emergency stop and Home Return operation will stop.

* For the state of emergency stop, see "18.3.1. Emergency Stop."

(4) When Home Return operation is completed, HOME output will be closed. Simultaneously with it, IPOS output will be closed, too.

Note : (1) HOS input is to detect a start-up edge, being valid at the changing point from OFF to ON. If it is originally kept to ON, Home Return operation does not start.

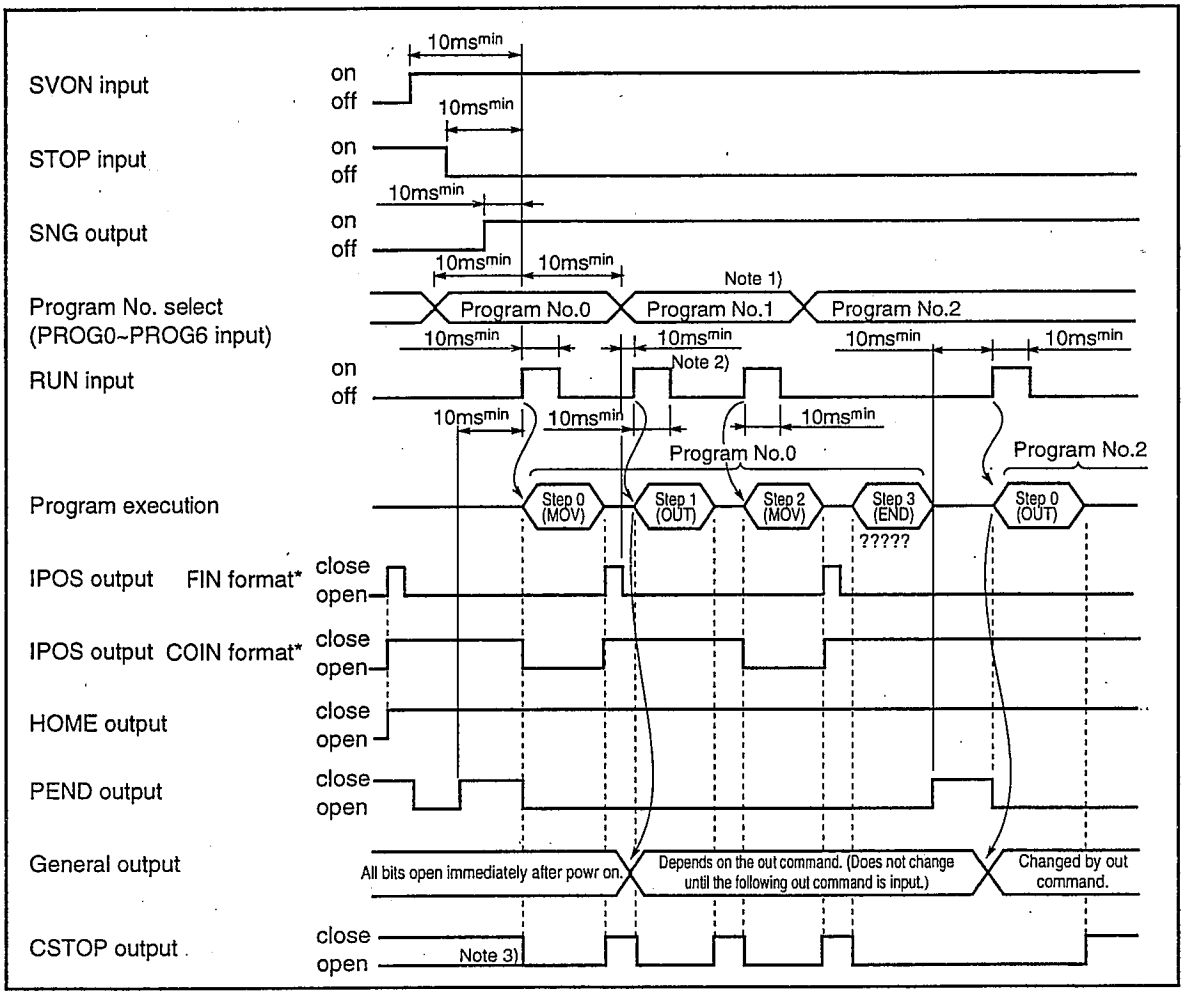
(2) HOME output is not a home position area signal, but a Home Return operation completion signal. It opens when the next operation command is received, and closes when the module has returned to home position by Home Return operation. It does not close if the module has returned to home by any movement command other than Home Return operation.

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Control input/output signal for step programmed operation

- Be sure to follow the timing shown in Figure 14-13.

Figure 14-13



* IPOS signal output is available in FIN and COIN format. Refer to "14.5.2. Position completion Output".

Note 1) Program number select input becomes invalid once programmed operation starts (= while PEND output is open).

Note 2) RUN input is invalid during step execution. After a step is completed, set RUN input to ON.

- Because you cannot check whether a step has been completed in the following commands, insert a timer (50 ms or more) before the next input of RUN. Check movement command step completion by IPO output.

  LD / SRV / VEL / ACC / ADD / SUB / OUT / INT / RSTA / TIM

Note 3) CSTOP output starts from "open" when END command has been executed in the preceding program. It starts from "closed" when it has been forcibly stopped in a state of cycle stop or power has been turned off in the preceding program.

Note : (1) The following instructions are automatically executed following the preceding commands even when RUN input is no set to ON.

CALP / RETP / TAG / JMP / JEQ / JGE / JLE / JNE / IRET / JGT / JLT / CALL / RET / CHG / REP / NXT / END / PAL except PAL02.

(2) Continue path is executed as one step. When RUN input is set to ON, commands from CPS through CPE are executed consecutively.

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14.4.5. Stopping Programmed Operation in External Control Mode

- You can use the following functions to stop programmed operation in external control mode.
  - ① Emergency stop
  - ② Forced stop
  - ③ Cycle stop during sequential operation
  - ④ Hold

Emergency stop Stop procedure: EMST off

- Stops programmed operation immediately, setting motor to servo off.
  * For emergency stop function, see "18.3.1. Emergency Stop."

Forced stop Stop procedure: STOP on

- Stops programmed operation immediately (decelerates and stops the program if STOP is on during movement), and waits at the top of the program.
- Motor is servo-locked.
- Setting RUN input to ON after setting STOP to OFF starts operation at the top of the program again.
- RUN input is invalid if STOP input is kept to OFF.

Note : When "forced stop" is applied, data register and internal flag data excluding the following items are reset.

- ○ Point register data (P000 - P399)
- ○ General output data by OUT command.

Cycle stop during sequential operation Stop procedure: SNG on

- Stops after completing the step being executed.
- CSTOP output is closed during cycle stop.
- Motor is servo-locked.
- Setting RUN input to ON after setting SNG input to OFF starts a sequential programmed operation at the next step.
- Setting RUN input to ON with SNG input kept to ON starts a programmed step operation at the next step.

Note : (1) Step operation has no cycle stop function.

(2) If an alarm is issued, or STOP input is turned on or EMG output is turned off during cycle stop, the program is released from cycle stop (PEND output is closed because program is held), and programmed operation cannot be re- started. If you try to re-start operation in this state (after releasing program from emergency stop in the case of emergency stop), program will be again operated from the top.

(3) The following commands do not stop under cycle stop operation. The operation stops after the subsequent commands have been executed.

CALP / RETP / TAG / JMP / JEQ / JGE / JLE / JNE / IRET / JGT / JLT / CALL / RET / CHG / REP / NXT / END / PAL except PAL02.

(4) Cycle does not stop during continue path execution. It stops when continue path is completed.

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Hold Stop procedure: HLD on

- Hold movement command = Decelerates and stops, closes HIDA output, and waits at the position where HLD command is received.
- Motor is servo-locked.
- During hold (when HLDA output is closed and PEND output is open), after HLD input is off, setting RUN input to ON re-starts operation at the position where the program stopped, executes the remaining movement, and then re-starts the programmed operation.
- While HLD input is kept to ON, RUN input is invalid.
- If you perform cycle stop operation during hold, cycle stops after re-starting (stops after executing the step which has been held).
- If you perform hold operation during deceleration before positioning completion, the system decelerates, stops, and holds. After re-start, it closes IPOS output and moves to the next step.

Note : (1) If an alarm is issued, or STOP input is turned on, or EMG output is turned off, or MODE key is pushed during hold, the program is released from hold (= because the program is held, PEND output is closed) and programmed operation cannot be re-started. If you try to re- start operation in this state (after releasing the program from emergency stop in the case of emergency stop), the program will be again operated from the top.

(2) Executes commands except movement command, and stops before executing the subsequent commands.

Movement command: MOV / ARC / CIR / HOM / PAL02

Consecutively executes the following commands if they follow.

CALP / RETP / TAG / JMP / JEQ / JGE / JLE / JNE / IRET / JGT / JLT / CALL / RET / CHG / REP / NXT / END / PAL except PAL02.

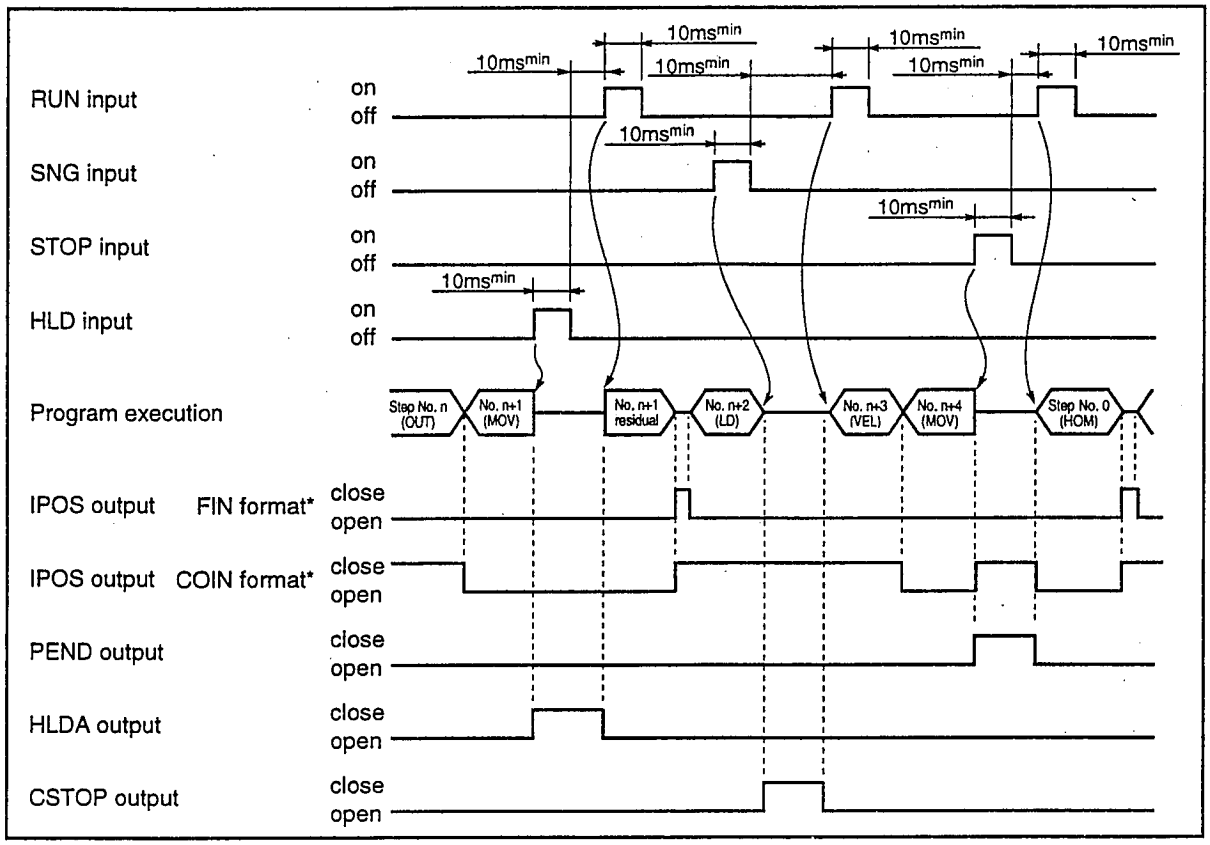
(3) If hold is executed during continue path execution, the remaining path after hold does not become continue path, but is executed by ordinary movement command.

(4) If you set SVON input to OFF during hold under movement command execution, servo off will result, leading to alarm (program error).

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Timing to stop sequential programmed operation

Figure 14-14

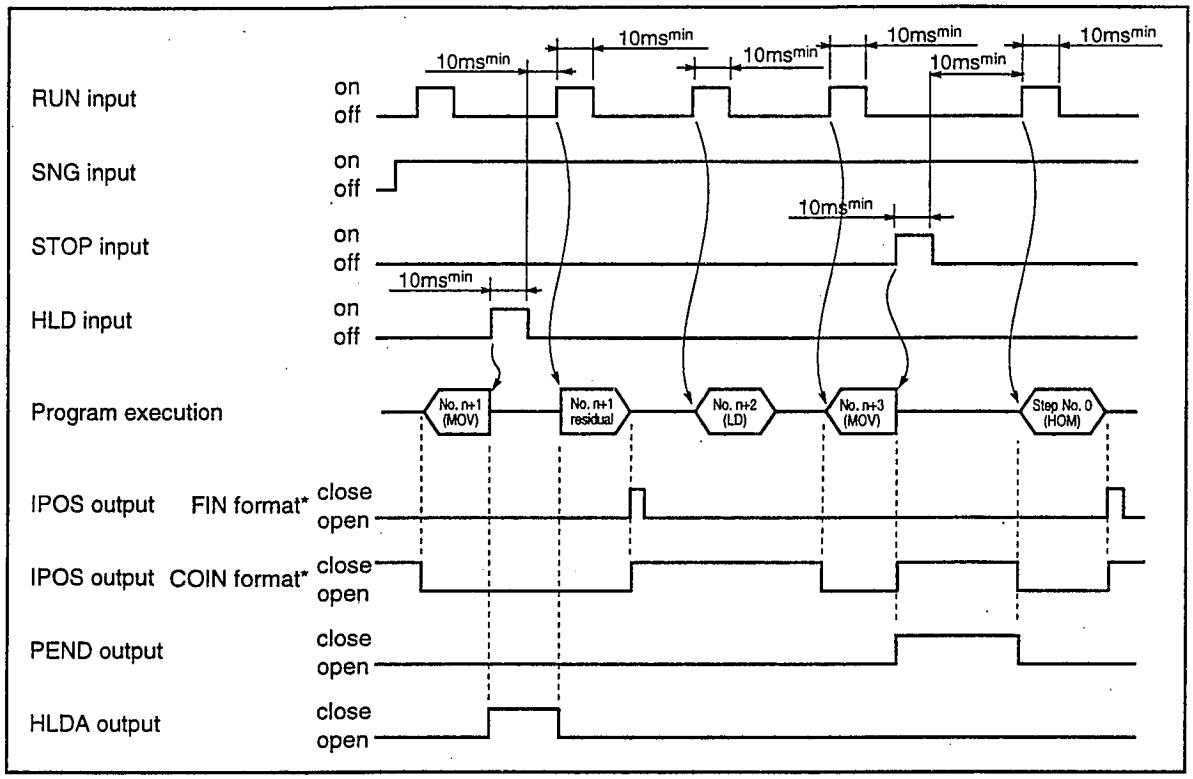


* IPOS output is available in FIN and COIN format. Refer to "14.5.2. Position Completion Output".

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Timing to stop programmed step operation

Figure 14-15



* IPOS output is available in FIN and COIN format. Refer to "14.5.2. Position Completion Output".

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14.4.6. Halfway Re-start of Programmed Operation in External Control Mode

- If the power supply is turned off during programmed operation after steps are completed, the system re-starts programmed operation, when the power is turned on again, at the step following the last executed step.

◉ Input/Output for halfway re-start of programmed operation

Table 14-6

Signal	Pin No.	Description	
SVON	2	Servo on input	ON: Servo-on OFF: Servo-off
HOS	5	Home Return Start input	OFF → ON, starts Home Return.
RUN	6	Start programmed operation input	OFF → ON, starts programmed operation.
RSTA	16	Re-start programmed operation selecting input	When a step is completed and the power is turned on again, setting RUN input on after RSTA input is set to on starts the halfway re-start of programmed operation.
HOME	11	Home Return completion output	Closes when Home Return is completed.
PEND	32	End of programmed operation output	● Opens during a programmed operation, closes when a programmed operation is completed. ● Halfway re-start input is valid when PEND is closed.
SNG	14	Sequential/step selection of programmed operation input	● Switches sequential/step of programmed operation. ○ SNG input off : Sequential programmed operation ○ SNG input on : Programmed step operation ● Cycle stops if SNG is on during sequential programmed operation.
CSTOP	7	Cycle stop output	● Closes during cycle stop. ● Halfway-restart input is valid when CSTOP output is closed.

◉ Programmed operation halfway re-start procedures

(1) Turn off servo after completing step execution.

- ○ Sequential programmed operation: Set SNG input to ON. After cycle stop has been completed (= CSTOP output is closed), set SVON input to off, and turn off the power supply. (when cycle stop has been completed, set SNG input to OFF).
- ○ Programmed step operation: After steps have been executed (= CSTOP output is closed), set SVON input to off, and turn off the power supply.

Note : If you set STOP input to ON or turn off the power supply without completing step execution (= with CSTOP output open), you cannot perform halfway re-start.

Caution : If the power is turned off with SVON input set to ON, the vertical axis slider (or the main unit when it is moving) may drop by 5 to 10 mm.

(2) After turning on the power supply again, set SVON input to ON, and then perform Home Return operation (you can perform Home Return operation by also re-start initialization program(*)).

Note : If you try to execute movement command without completing Home Return operation after turning on the power supply, an alarm will be issued and you cannot perform halfway re-start.

* For the re-start initialization program, see "1.3.2.5. Program Commands."

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(3) When CSTOP output and PEND output are closed, after completing Home Return operation, set RSTA input to ON, and then RUN input to ON. The system will re-start programmed operation from the step following the step completed before the power is turned on again.

Note : With CSTOP output and PEN output not closed, if you execute re-start operation during programmed operation, an alarm will be issued and you cannot perform halfway re-start.

o When step execution is completed before the power is turned off, CSTOP output will be closed also after the power is turned on again.

o If you perform halfway re-start operation without turning off the power supply during cycle stop, PEND output will be kept open, resulting in an alarm.

- If you set RUN input to ON without setting RSTA input to ON, programmed operation will re-start from the top of the program in an ordinary manner.
- At the start of halfway re-start operation, the data register and palletize-related flags are kept at the state of before halfway re-start operation (or before power off).
- When RSTA command* is set at the top of an interrupted program, programmed operation will re-start after the execution of the re-start initialization program * specified by RSTA command.
- You can return the general output and operation re- start position to the state of before interruption by the re-start initialization program *.

* For the re-start initialization program and RSTA instruction, see "13.2.5 " Program Command."

Note : (1) If an alarm is issued during halfway re-start operation, you cannot continue halfway re-start by resetting the alarm.

(2) If an emergency stop has worked during halfway re-start operation, you cannot continue halfway re-start by releasing from the emergency stop.

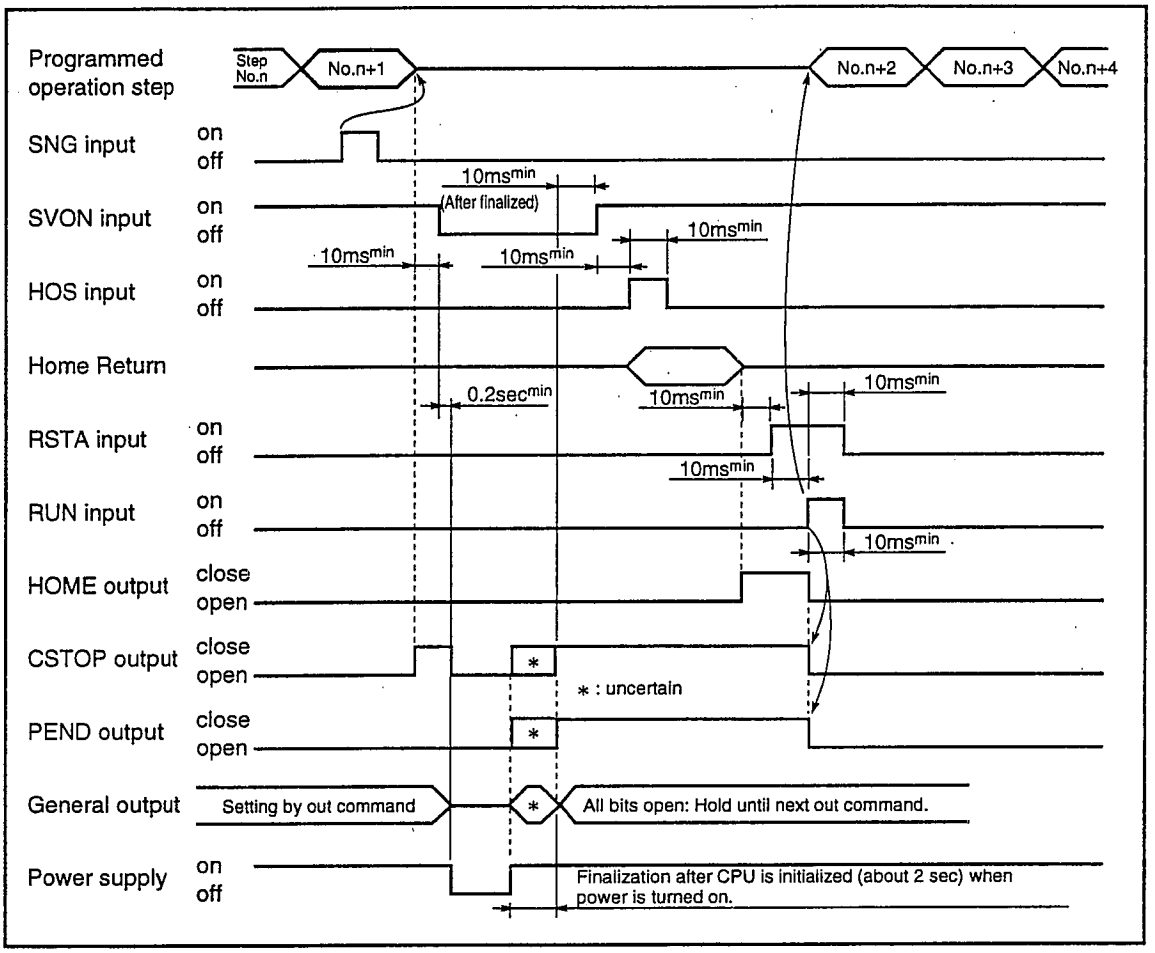
(3) Do not perform any halfway re-start operation not specified above.

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14.4.6.1. Timing of Programmed Operation Halfway Re-start in External Control Mode

Sequential operation • without RSTA (restart program) command

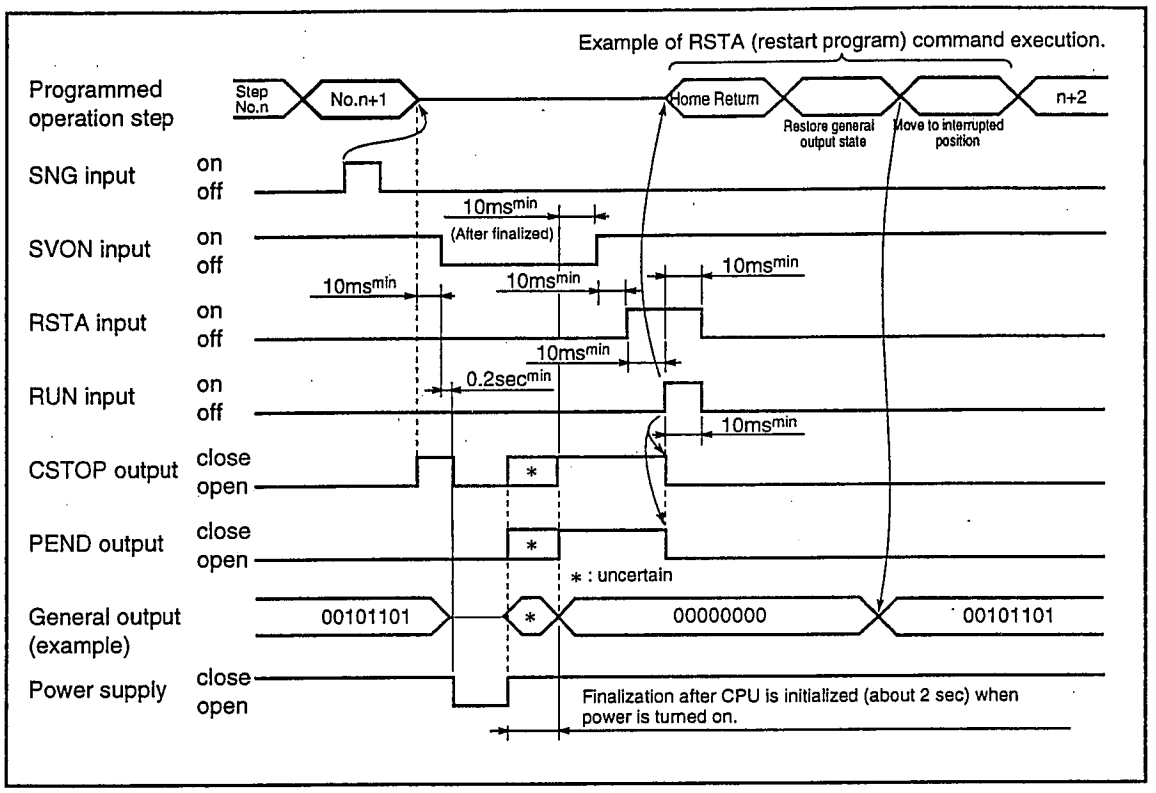
Figure 14-16



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Sequential operation • RSTA (restart program) command

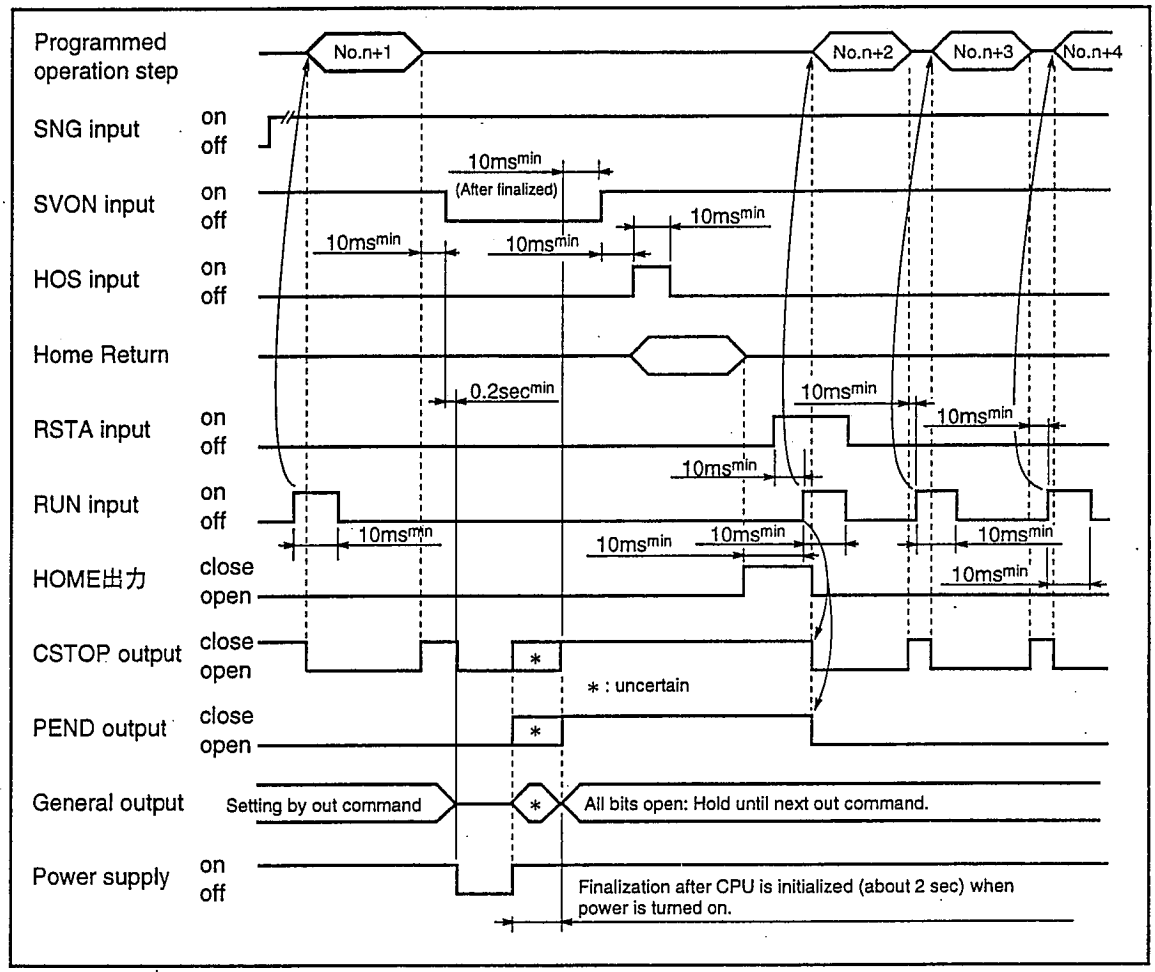
Figure 4-17



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Programmed step operation • without RSTA (restart program) command

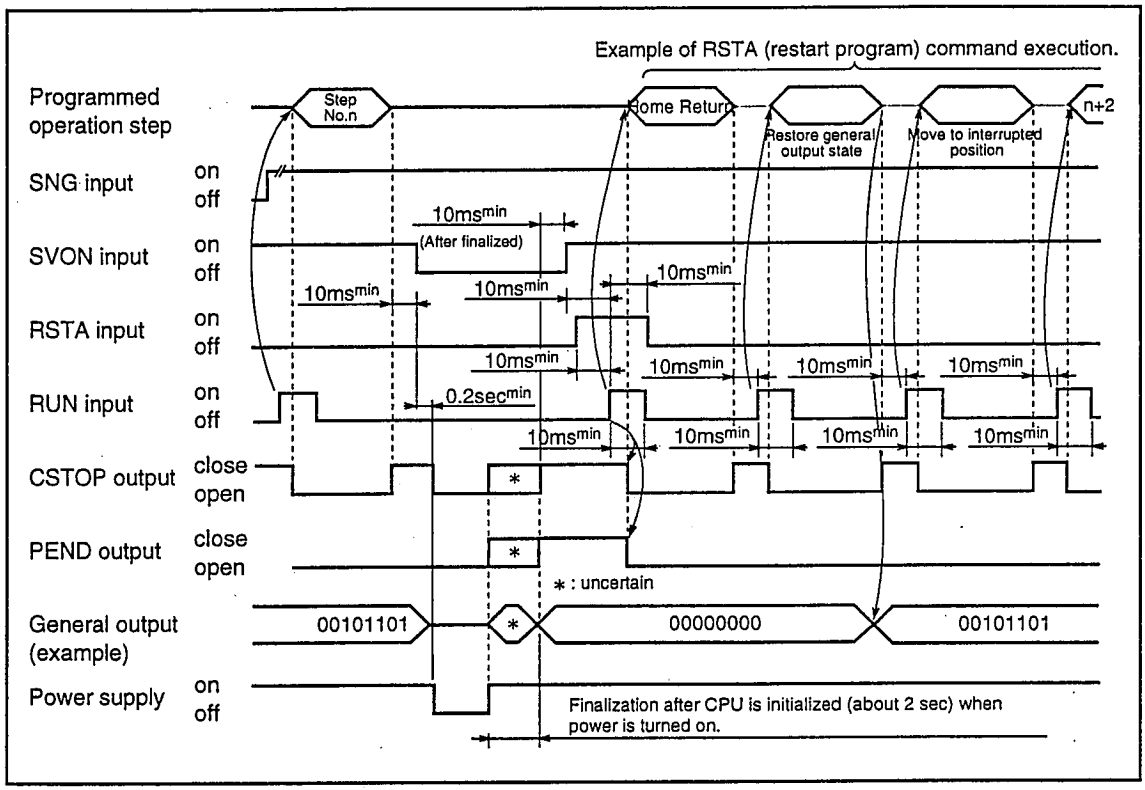
Figure 14-18



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Programmed step operation • RSTA (restart program) command

Figure 14-19



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14.5. Operation Function

14.5.1. Home Return Operation

14.5.1.1. Home Return Operation Function

- The following shows Home Return functions.

Table 14-7: Home Return function list

Item	Setting	Description
*Reversing home return direction	11.3.2. Parameters for Home Return	• Specify the direction of the home return sequence (i.e., toward the motor or reverse). The factory-setting is the direction toward the motor.
Home position offset	11.3.2. Parameters for Home Return	• If a home position offset has been set, the specified offset is used as an absolute coordinate of the stop point of home return motion. In other words, the home position shifts by the specified offset. Example: If -100 mm is specified as the home offset, the home return motion stops at the -100 mm point (absolute coordinate), which means that the home position shifts by +100 mm from the stop point. • The factory setting is 0.
*Reversing coordinate direction	11.5.1. Position and Coordinate Parameters	• Specify + or - of the coordinates. • The direction against the motor is the plus direction and the direction toward the motor is the minus direction by default.
Order of returning axes to home position	11.3.2. Parameters for Home Return	• The axes return to home positions one by one. • Specify from which axis to return to the home position. The default order is the Z-axis, Y-axis, and X-axis.
Home returning speed and acceleration	11.3.2. Parameters for Home Return	• The speed and acceleration of returning to the home positions is variable. • Default setting Speed: 20 mm/s Acceleration: 0.5 m/s^2

* Refer to "14.5.1.4. Home Return and Coordinates".

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14.5.1.2. Outline of Home Return Operation

- When Home Return starts*, the slider moves toward the motor** and reverses at a point where the overtravel sensor*** is turned off. The slider stops at a point where the encoder Z -phase signal**** first rises after the sensor is turned on again, thus completing Home Return operation.

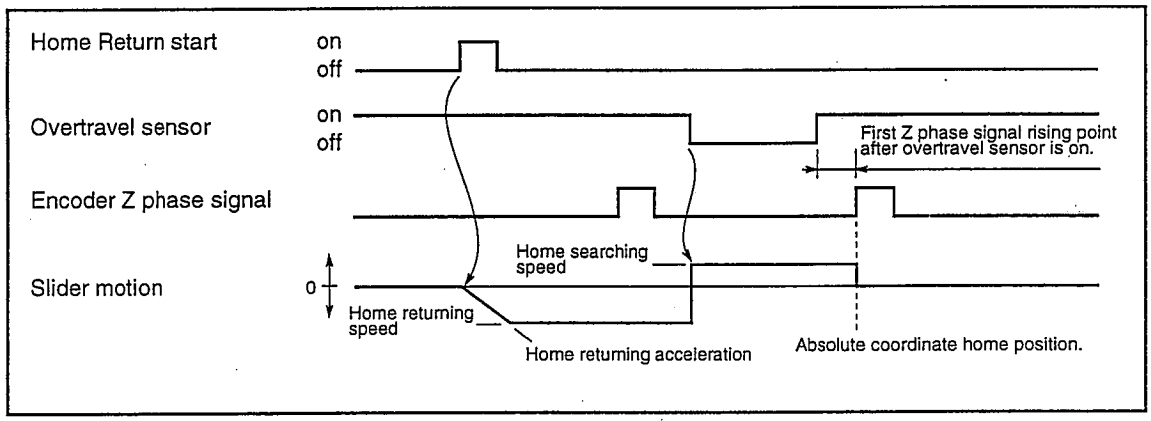
* For Home Return operation, see "14.3.1. Home Retunn Operation" by Teaching Box, "14.4.1. Home Return Operation in External Operation Mode", and HOM command in "15.4 Remote Control Operation Command."

** The slider moves away from the motor when setting is made to reverse Home Return direction or motor mount parameters (direct or indirect) are different from that on the main unit.

*** Overtravel sensors are mounted on both sides of the main unit inside. Signals are transmitted from CN5 to EXC controller. Signal specification is b contact (normally closed).

**** Home signal from the encoder built in the motor. Outputs 1 pulse per revolution and is transmitted to EXC controller through CN5.

Figure 14-20: Home Return sequence of each axis



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14.5.1.3. Home Return Timing

- For Home Return operation for each axis, see "14.5.1.2 Outline of Home Return Operation." Sequence Home Return operation of the axes combined in multi-axis is as follows.

Example in which 3-axis assembly returns to home in the sequence of Z axis → Y axis → X axis

① Z axis starts operation, and stops at a point where the Z-axis overtravel sensor is OFF.

② Y axis starts operation, and stops at a point where the Y-axis overtravel sensor is OFF.

③ X axis starts operation, and stops at a point where the X-axis overtravel sensor is OFF.

After all the axes have stopped at the respective overtravel sensor points, encorder Z-phase signal search operation starts from Z axis in the reversed direction at where the overtravel sensors have detected.

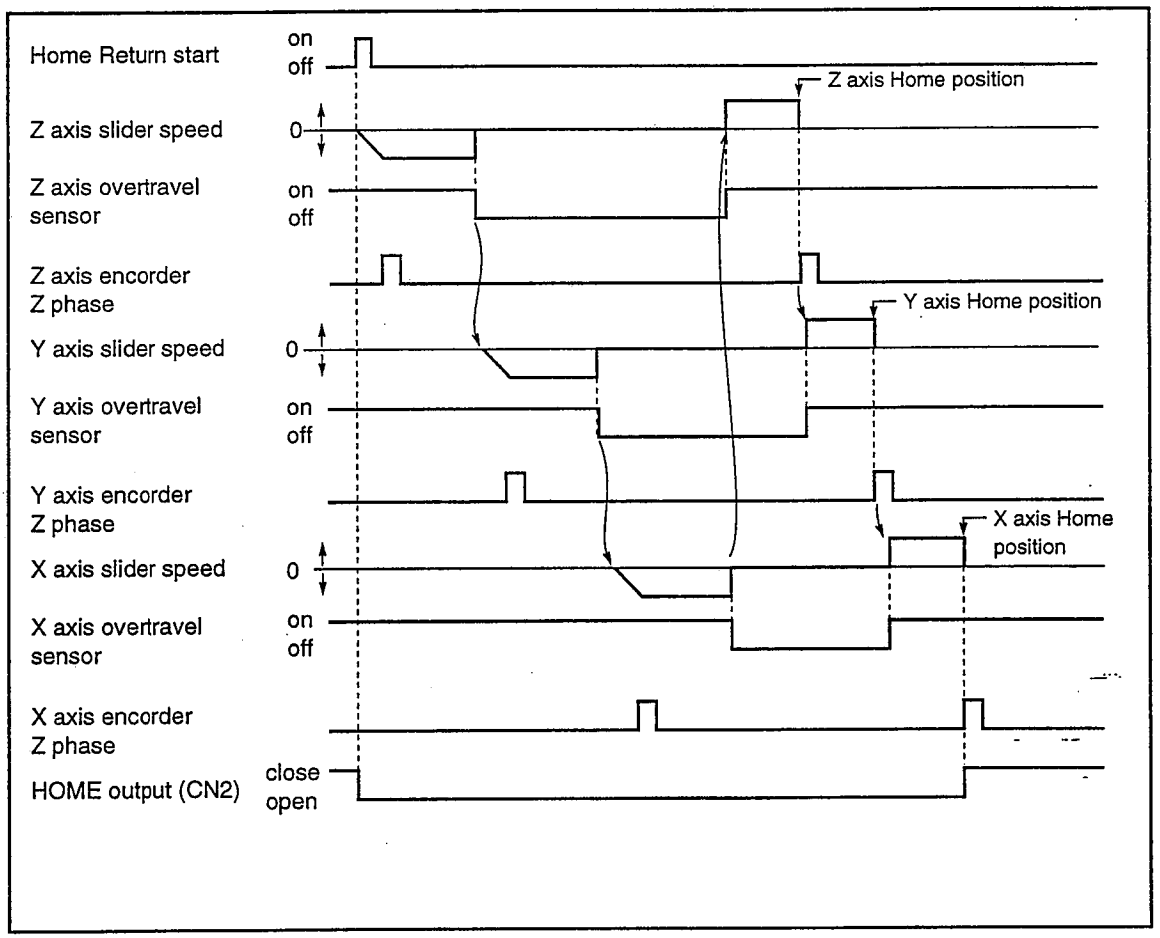
④ Z phase stops at a point where the Z-phase signal of Z-axis encoder rises to determine the home of Z phase.

⑤ Y axis starts search operation. Y axis stops at a point where the Z-phase signal of Y-axis encoder rises, thereby determining the home of Y axis.

⑥ X axis starts search operation. X axis stops at a point where the Z-phase signal of X-axis encoder rises, thereby determining the home of X axis.

When the home position of all the axes are determined, CN2: HOME output is closed to complete Home Return operation.

Figure 14-21: Example: Sequential Home Return (Z axis → Y axis → X axis)



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14.5.1.4. Home Return Coordinates

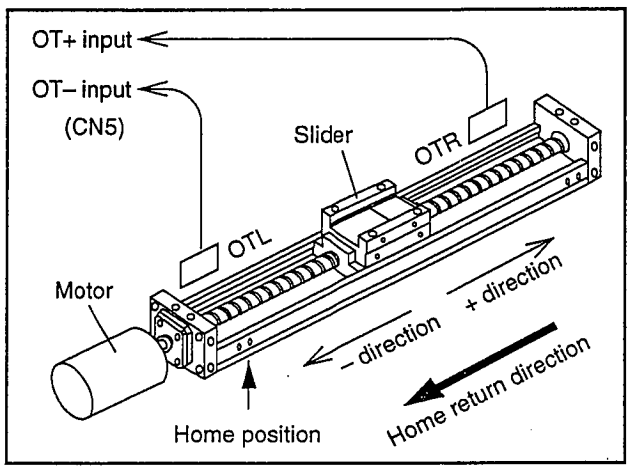
Caution : *Specify the motor mount parameter according to a main unit. If not, the direction of motion may be opposite.*

◉ Motor mount: Direct

Type 1

- Motor mount ---------- Direct
- Coordinate direction -------- Factory setting
- Home Return direction ----- Factory setting

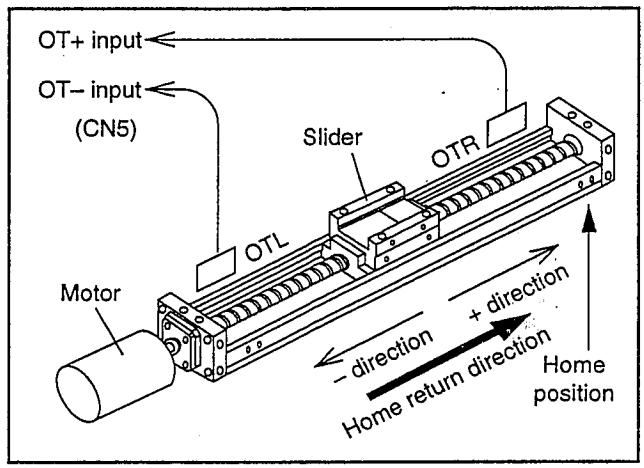
Figure 14-26



Type 2

- Motor mount ---------- Direct
- Coordinate direction -------- Factory setting
- Home Return direction ----- Reversed

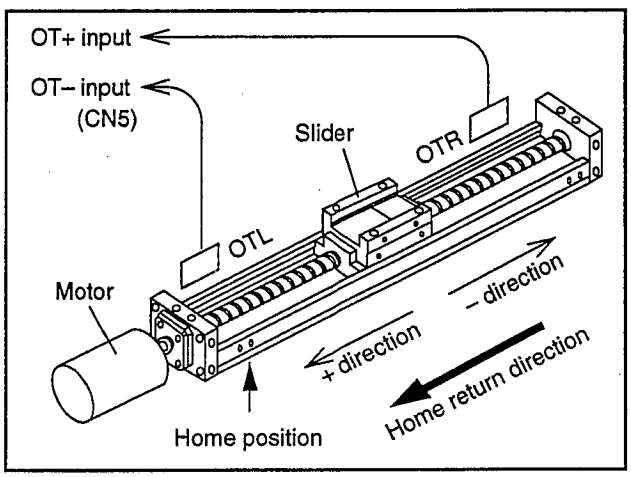
Figure 14-27



Type 3

- Motor mount ---------- Direct
- Coordinate direction -------- Reversed
- Home Return direction ----- Factory setting

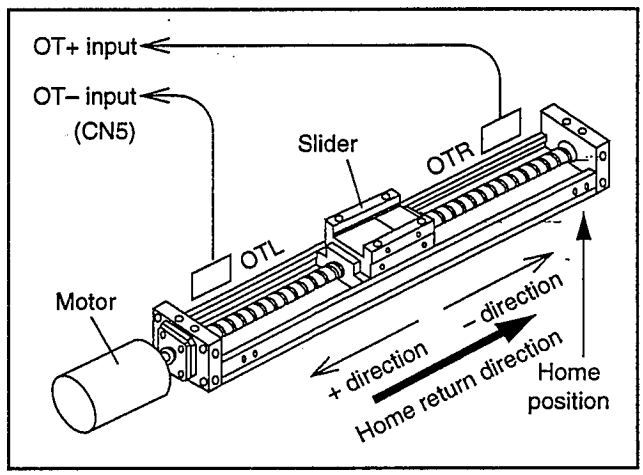
Figure 14-28



Type 4

- Motor mount ---------- Direct
- Coordinate direction -------- Reversed
- Home Return direction ----- Reversed

Figure 14-29



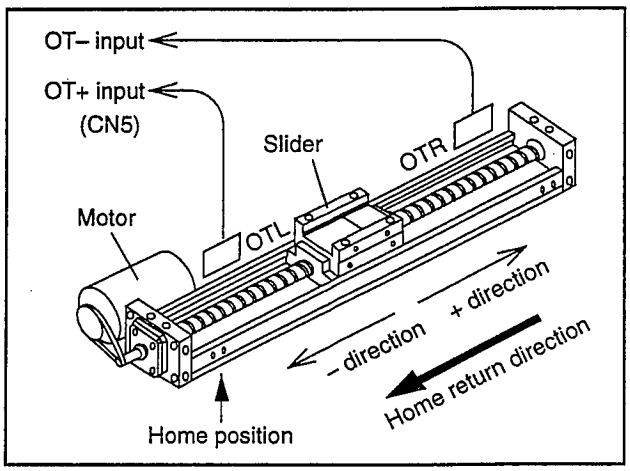
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◉ Motor mount: Indirect

Type 5

- Motor mount ---------- Indirect
- Coordinate direction -------- Factory setting
- Home Return direction ----- Factory setting

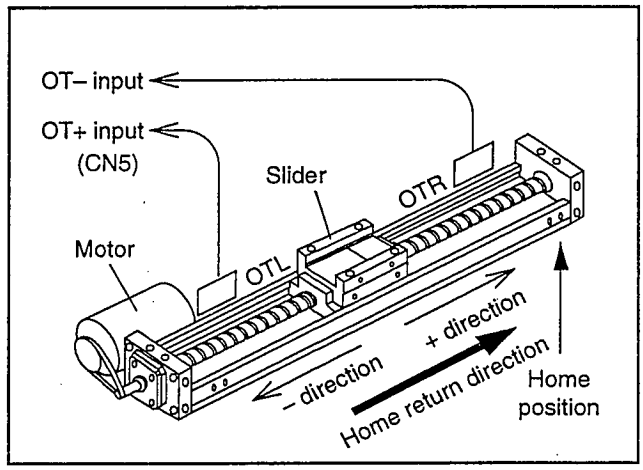
Figure 14-30



Type 6

- Motor mount ---------- Indirect
- Coordinate direction -------- Factory setting
- Home Return direction ----- Reversed

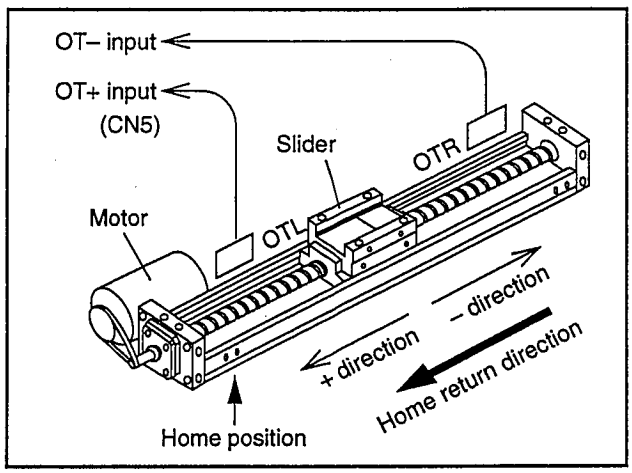
Figure 14-31



Type 7

- Motor mount ---------- Indirect
- Coordinate direction -------- Reversed
- Home Return direction ----- Factory setting

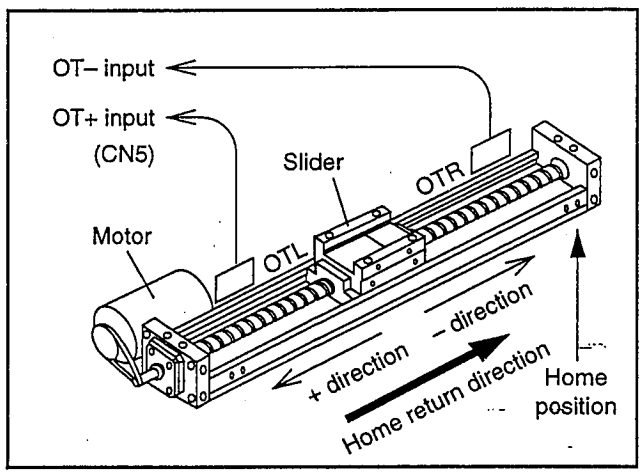
Figure 14-32



Type 8

- Motor mount ---------- Indirect
- Coordinate direction -------- Reversed
- Home Return direction ----- Reversed

Figure 14-33



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14.5.2. Positioning Completion Output (IPOS)

- Positioning completion signal (In-position) is output from CN2 IPOS.
- Positioning completion signal output is available in FIN specification and COIN format.

Table 4-8

Format	Function	Selection	Factory-setting
FIN	One-shot output format that closes for a preset time width (FIN out time) after positioning is completed.	IPOS signal output time width setting (FIN out time): other than xx.xx	○ (0.1)
COIN	Opens during movement; Closed after positioning completion where, IPOS signal output time width (FIN out time) is set to xx.xx	IPOS signal output time width setting (FIN out time): xx.xx	—

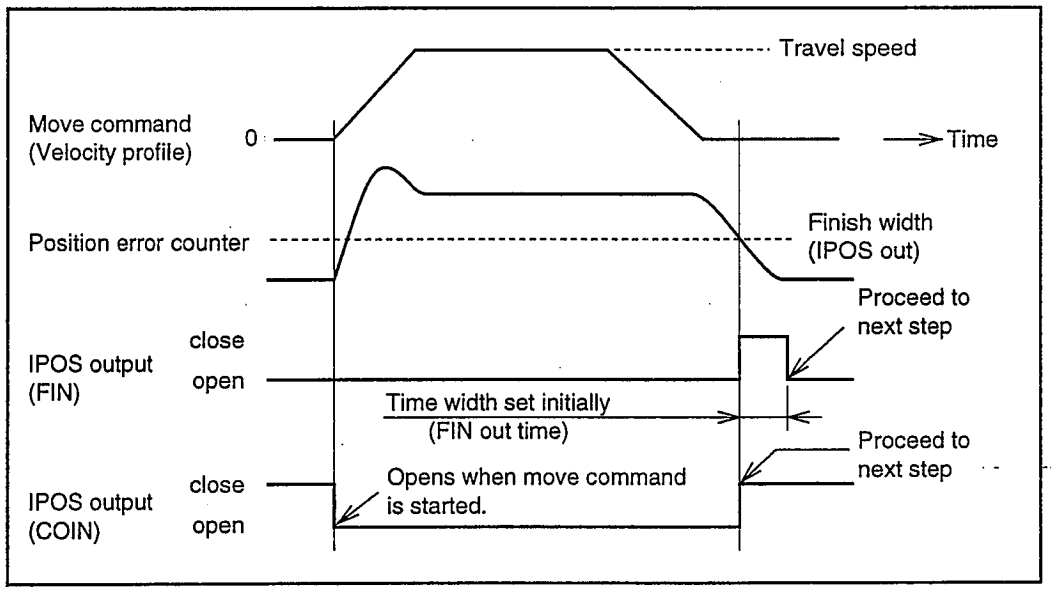
Note : (1) IPSO output does not change under any commands. (example: Jump command, general-output, etc.) other than movement commands.

- ○ Fin out time: xx.xx (COIN format) -- kept closed
- ○ Not xx.xx (FIN format) ---------- kept open

(2) In continue path movement, positioning completion signal is output after all of a series of movement commands are completed. IPOS output does not vary for each movement command in continue path.

- When movement commands are completed and the count of the position error counter has become smaller than the finish width after positioning completion, IPOS output closes for the FIN out time. After completing IPOS output, processing moves to the next step.
- Set finish width and FIN out time during initial setting. See "11.3.1. Programmed Operation Parameters."

Figure 14-30

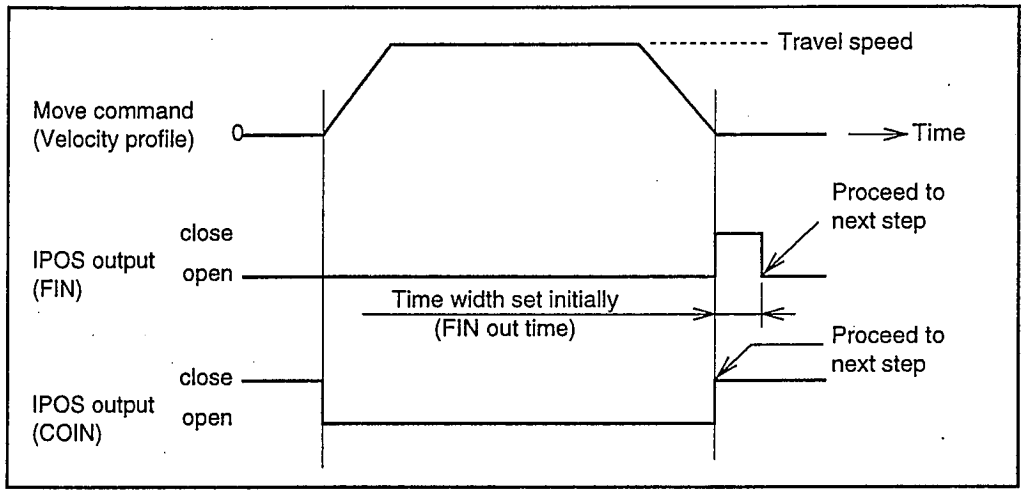


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◉ Special positioning completion output

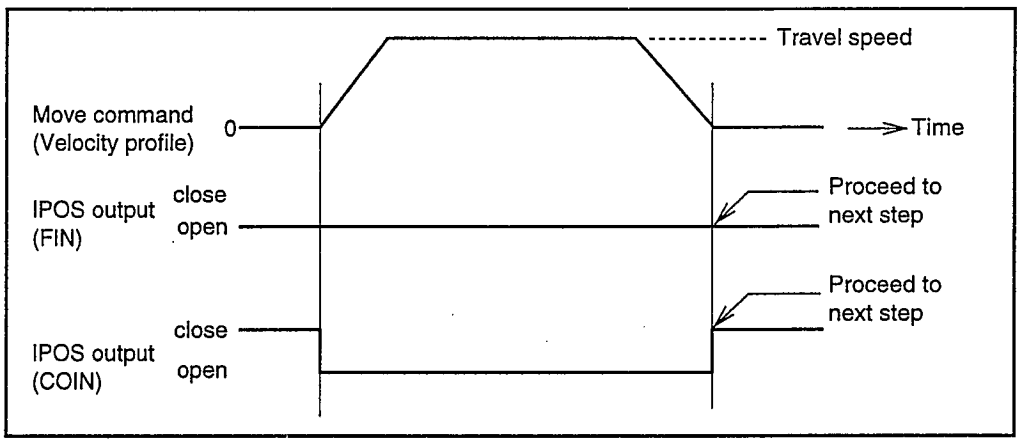
(1) When the Finish width is specified to ××.××, IPOS output follows timing of movement command disregarding position error counter.

Figure 14-31



(2) When executing the move commands (MOV, ARC, CIR), it proceeds to next step after the move command is executed in continuous movement mode (mode selection code "N" is added to each commands).

Figure 14-32



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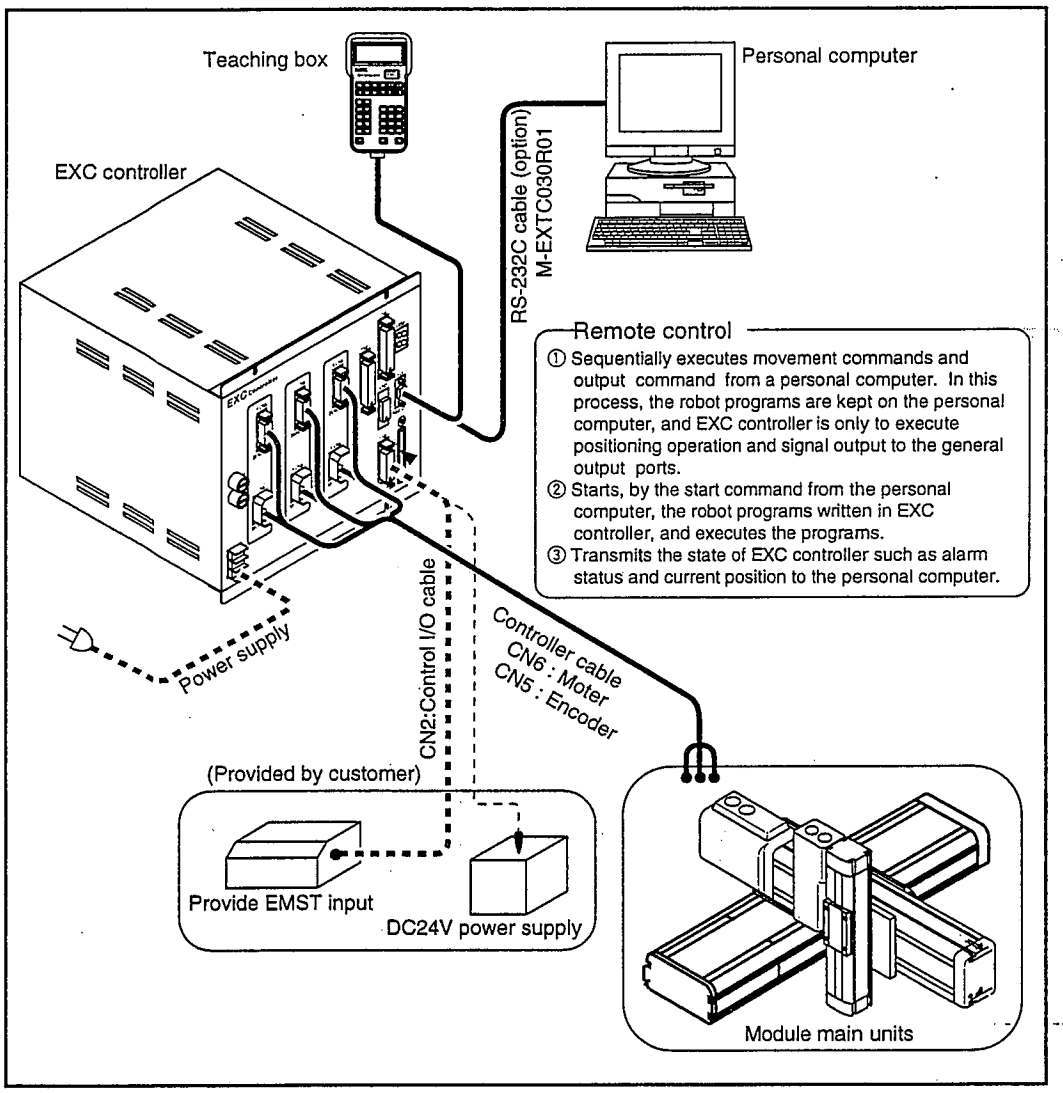
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15. Remote Control Operation

- You can control EXC controller directly by commands from personal computers, etc. through RS-232C interface. This operation mode is called "remote control."

- By receiving commands for remote control, EXC controller:
  - ① sequentially executes movement commands and output command from a personal computer. In this process, the robot programs are kept on the personal computer, and EXC controller is only to execute positioning operation and signal output to the general output ports.
  - ② Starts by the start command from the personal computer the robot programs (programs prepared in "13. Programming") written in EXC controller, and executes the programs.
  - ③ Transmits the state of EXC controller such as alarm status and current position to the personal computer.

Figure 15-1



- RS-232C interface uses the connector CN1 for the teaching box.

Note: (1) You cannot use the remote control and teaching box operation at the same time, because they commonly use CN1. Either of them is effective.

(2) You cannot perform initialization by remote control operation. Initialize the system by the teaching box before remote control operation.

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15.1. Interface Specifications

Table 15-1

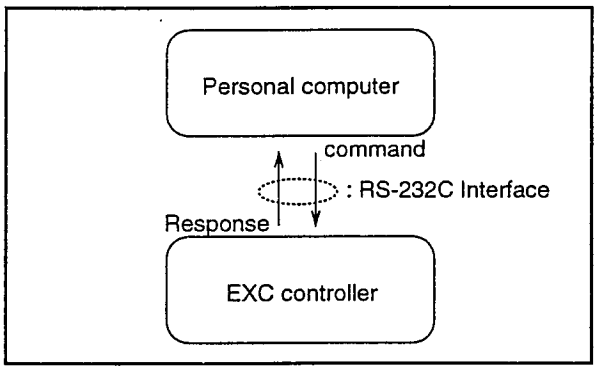
Communication Method	Full Duplex
Communication Speed	9600 bps
Data length	8 bits
Stop bits	2 bits
Parity	None
X ON/OFF	None
Handshaking	RTS/CTS

15.2. Outline of Remote Control

15.2.1. Outline

- In the remote control mode provided by "15.3. Starting Remote Control," the system is "ready to accept commands" as described in "15.4. Remote Control Command."
- Receiving a commands from the personal computer in the remote control mode , EXC controller responds to the command.

Figure 15-2



- Commands and responses are made in ASCII coded character. For details of the commands and responses, see "15.4.2. Description of Commands."
- Put *CR* (Carriage Return) code to the end of a command. *CR* code defines the command.
- EXC controller's response has a prompt at the end. The three following types of prompts are used. The prompt also is to restrict commands allowed to follow.

Table 15-2

Prompt	Function	Command to be accepted after the prompt
* *CR*	• Denotes the status of initialization or operation is completed.	ACC, ACLR, ALM, ARC, CIR, HIST, HOM, LD, MOV, OUT, VEL, VER, RUN (however, restart is invalid after hold and cycle stop), DISP (only when verification is valid or not), EMST, ERR, IO, POS, SVON, SVOF.
# *CR*	• Executing move command. • Executing a programmed operation called by RUN command.	CSTOP, STOP, HLD, DISP (during programmed operation only), EMST, ERR, IO, POS, SVON, SVOF.
$ *CR*	• During hold or cycle stop.	STOP, DISP (during programmed operation only), RUN (during re-start only), EMST, ERR, IO, POS, SVON, SVOF.

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15.2.2. Notes on Remote Control

◉ CN2, control I/O

- In remote control, all CN2 control inputs are invalid except EMST input. Control outputs are fed in the same manner as in external operation mode.

◉ Servo ON/OFF

- When executing a movement command or movement command in a program initiated by RUN command, the motor must be in servo ON. Set the motor to servo ON by SVON command before entering the above command or instruction.

Note: If you enter the above commands when the motor is in servo OFF, the system will give abnormal response and EXC controller will be kept under alarm.

◉ Abnormal response is given:

(1) When a character not specified in the commands or a command not allowed to enter is fed.

→ ? will be displayed.

(2) In case of alarm on EXC controller during operation, or alarm on EXC controller when an invalid command is entered.

→ ! will be displayed.

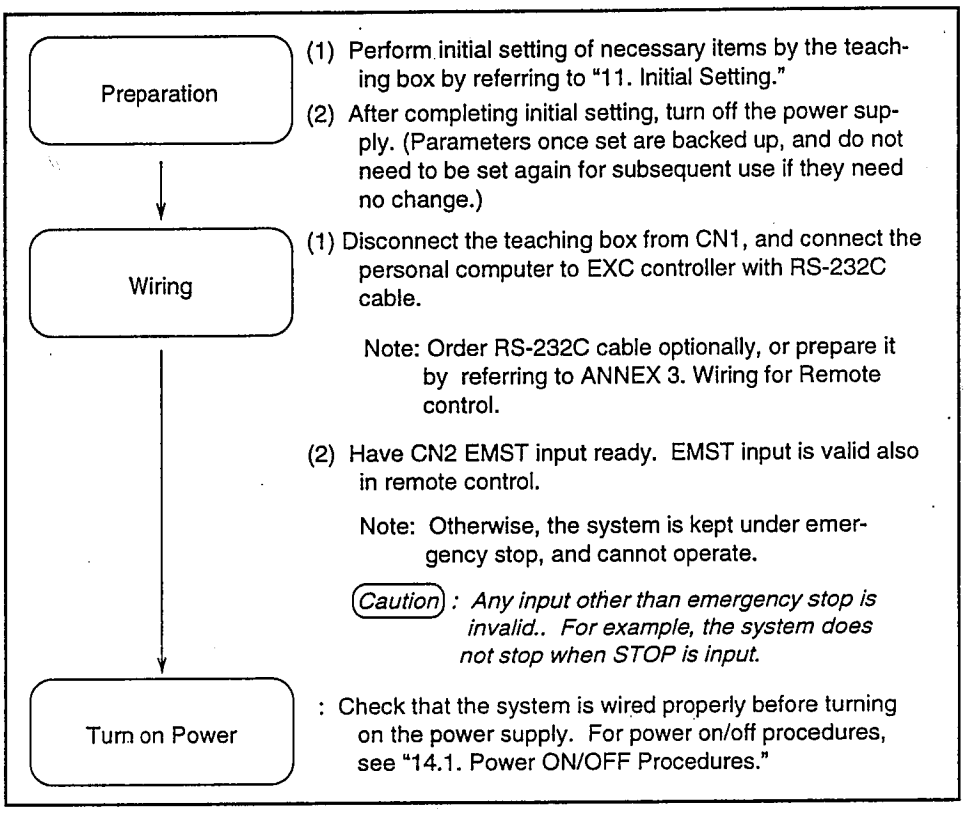
* For details of abnormal response, see "15.4.3. Abnormal Response."

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15.3. Starting Remote Control

15.3.1. Starting Procedures

Figure 15-3



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15.3.2. Switching to Remote Control

- When turned on, the system is in external control mode.
- To switch from external control mode to remote control mode, enter code "8Fh"
- In remote control mode, the system outputs *CR code and waits for instruction.

[Command from personal computer]

Character		Switching to remote control
Code (ASCII)	8	
	F	

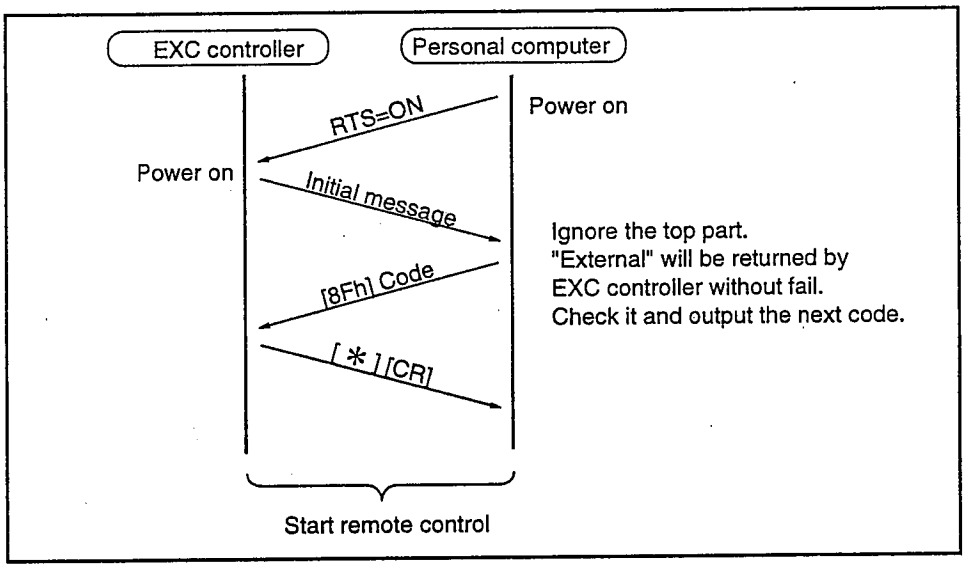
[Response from EXC controller]

Character	* CR	Outputs prompt
Code (ASCII)	2 0	
	A D	

Note: When the power is turned on, EXC control outputs an initial message. Communication data of one system differ from another, but have "External" at the end. Make your personal computer to ignore the initial message to be output from EXC controller, except External.

- Switching procedure to remote control is given below. Note, however, that you cannot move to remote control when EXC controller is issuing an abnormal memory alarm.

Figure 15-4



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15.3.3. Ending Remote Control

- Input [EXIT]code to return to external control mode from remote control.

Note: (1) [EXIT] command is invalid during the execution of operation command (prompt indication: [#CR]) or cycle stop [prompt indication: $CR]).

○ When [EXIT] code is input during operation command execution or cycle stop, an abnormal response will occur.

Abnormal response: [?CR]→[#CR]or[$CR]

(2) Followings show one example of responding data from EXC controller. All data are not output in the same manner, however, [External] is always output at the end.

[Command from personal computer]

Character	E	X	I	T	CR															Command to end remote control
Code (ASCII)	4	5	4	5	0															
	5	8	9	4	D															

[Response from EXC controller]

Character	BL																			Output
Code (ASCII)	0																			
	7																			

↓

Character	ESC	[	>	5	h	SC														Output
Code (ASCII)	1	5	3	3	6	1														
	B	B	F	5	8	A														

↓

Character	ESC	[	1	;	1	H														Output
Code (ASCII)	1	5	3	3	3	4														
	B	B	1	B	1	8														

↓

Character	ESC	[	2	K																Output
Code (ASCII)	1	5	3	4																
	B	B	2	B																

↓

Character	[	E	x	t	e	r	n	a	l	]										Output
Code (ASCII)	5	4	7	7	6	7	6	6	6	5										
	B	5	8	4	5	2	E	1	C	D										

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15.4. Remote Control Command

15.4.1. Command List

Table 15-3

Grouping	Command	Function
Operational command	SVON	• Switches the motor to Servo-on. • Movement command can not be executed when it is off.
	SVOF	• Switches the motor to Servo-off.
	HOM	• Starts Home Return.
	MOV	• Linear motion command (input directly from personal computer).
	CIR	• Circular motion command (input directly from personal computer).
	ARC	• Arc motion command (input directly from personal computer).
	VEL	• Specify travel speed for MOV, CIR and ARC commands.
	ACC	• Specify acceleration/deceleration for MOV, CIR and ARC commands.
	RUN	• Calls and starts a program stored in EXC controller. • Re-starts a programmed operation held by HLD or CSTOP. • Re-starts an interrupted programmed operation.
Interruption command	EMST	• Emergency stop to EXC controller.
	STOP	• Decelerates and stops executing motion commands (MOV, CIR, ARC and HOM). • Forcedly stops a programmed operation initiated by Run command. (When the slider is moving it decelerates and stops).
	CSTOP	• Executes cycle stop of programmed operation initiated by Run command. Cycle stop: Pauses a programmed operation after currently executing step is completed.
	HLD	• Hold a programmed operation initiated by Run command. Hold: The slider decelerates and stops in the middle of operation. It re-starts from the position where it stopped. • When executing a motion command (MOV, CIR, ARC and HOM), HLD command is invalid.
Data output/setting	OUT	• Output data to the general output port.
	LD	• Specifies or changes coordinate data of a teaching point.
Report EXC controller status	VER	• Displays system reference number. (Shows about main unit configuration and software version number).
	HIST	• Displays a command history. A maximum of 9 of the previous commands entered can be seen.
	POS	• Displays current position data. • Displays coordinate data of teaching point.
	IO	• Shows on/off status of general output port.
	DISP	• When executing a programmed operation initiated by Run command, DISP command is to show step number, program command and information of data register, which are currently executed.
	ERR	• Shows error status which is related communication in the remote control mode.
	ALM	• Shows all alarm status currently issued in EXC controller.
Alarm clear	ACLR	• Clears an alarm currently issued.

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15.4.2. Description of Command

- This section is to explain the functions of commands and communication data.
- Description of commands are given in alphabetical order.

ACC	Acceleration/deceleration setting

- ACC command is to specify the acceleration/deceleration of movement commands: MOV, ARC, CIR.
- ACC command has the same functions as ACC of program command, but is valid for the above movement commands of MOV, ARC, and CIR only.
  - → ○ "Parameters for initial setting and Home Return" are valid for acceleration/deceleration of Home Return operation by HOM command.
  - → ○ For acceleration/deceleration during progrmmed operation called by RUN command, ACC command written in the programs are valid.
- Acceleration/deceleration in MOV, ARC and CIR movement command execution is restricted by the rate (%) against the Max Accel set in the parameters related to the initial setting or programmed operation.

$$\underset{[m/s^2]}{\boxed{\text{Acceleration/Deceleration in motion command}}} = \underset{[m/s^2]}{\boxed{\text{Max accel: Specified value}}} \times \underset{[\%]}{\boxed{\text{ACC: Command setting value}}} \times \frac{1}{100}$$

- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  - ○ Abnormal response will be given if this command is entered during operation command execution or cycle stop.

    Abnormal response: [?CR] → [#CR] or [$CR]
- Acceleration/deceleration once set by ACC command is valid until the end of remote control or the next ACC command is input.
- 100% when this command is not used.

Caution : Moment force by an acceleration/deceleration on a main unit varies depending on the combination of the main unit. Some types of multi-axis combination's acceleration/deceleration apply an excessive moment force to the main unit.

- Use a suitable acceleration/deceleration by referring to "11.3.1.3. Acceleration/Deceleration in Programmed Operation."

[Command from personal computer]

Character	A	C	C	␣	5	0	CR											Example-of travel speed setting (50%)
Code (ASCII)	4	4	4	2	3	3	0											
	1	3	3	0	5	0	D											

[Response from EXC controller]

Character	*	CR																Outputs prompt
Code (ASCII)	2	0																
	A	D																

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- Two types of alarm clear commands are available.
  ALCR : Clears light trouble alarms
  ALCR △ ALL : Clears all the clearable alarms.
- For details of alarms to be cleared by commands, see "20.5. Alarm Resetting Functions."
- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  - Abnormal response will be given if this command is entered during operation command execution or cycle stop.
    Abnormal response: [?CR] → [#CR] or [$CR]

① ACLR command

[Command from personal computer]

Character	A	C	L	R	CR															Clear light trouble alarm command
Code (ASCII)	4	4	4	5	0															
	1	3	C	2	D															

[Response from EXC controller]

Character	*	CR																		Outputs prompt
Code (ASCII)	2	0																		
	A	D																		

② ACLR △ ALL command

[Command from personal computer]

Character	A	C	L	R	CR	△	A	L	L											Alarm clear command
Code (ASCII)	4	4	4	5	0	2	4	4	4											
	1	3	C	2	D	0	1	C	C											

[Response from EXC controller]

Character	*	CR																		Outputs prompt
Code (ASCII)	2	0																		
	A	D																		

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- This command helps you to know the details of a current alarm on EXC controller.
- When no alarm has occurred, only prompt is output.
- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  - Abnormal response will be given if this command is entered during operation command execution or cycle stop.

    Abnormal response: [?CR] → [#CR] or [$CR]

[Command from personal computer]

Character	A	L	M	CR																												
Code (ASCII)	4	4	4	0																												
	1	C	D	D																												

"Report alarm status" command

[Response from EXC controller]

Character	0	F	0	4	CR																											
Code (ASCII)	3	4	3	3	0																											
	0	6	0	4	D																											

Example of alarm output (Emergency stop)

↓

Character	*	CR																														
Code (ASCII)	2	0																														
	A	D																														

Outputs prompt

- Uses the same alarm display as the 7-segment LED display pattern(*) on the EXC controller front panel.

* For details of alarms, see "20.5. Alarms."

Character	0	F	0	5	[	1	2	]	CR																							
Code (ASCII)	3	4	3	3	5	3	3	5	0																							
	0	6	0	5	B	1	2	D	D																							

Example of memory trouble (When servo-off)

↓

Character	*	CR																														
Code (ASCII)	2	0																														
	A	D																														

Outputs prompt

- Detailed codes for program trouble are as follows:

Figure 15-5

01	No program data	11	Unable to make circle, arc
02	No subsequent step data	12	Servo OFF
03	Axis data do not agree	13	No axis
04	Data range over	14	No pallet data
05	No TAG number	15	CALP command exceeded 4-fold loop
06	Two or more same TAG numbers	16	RET command provided, no CAL-command
07	CALL commnd exceeded 4-fold loop	17	Data register overflowed
08	RET command provided, no CALL-command	18	Different data format
09	RET command exceeded 4-fold loop	19	Home Return uncompleted
10	NXT command provided, no REP-command	20	IRET command input without interruption
		21	No interruption subroutine

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- ARC command is basically the same as ARC command of program command. See also "13.2.5. Command."
- ARC command cannot move the module by directly designating the coordinate data.
- Use teaching points. You can designate up to 400 points of P000 ~ P399.
- ARC command cannot execute smooth sine acceleration/deceleration. You can designate only two movement modes of I and N.
- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  - ○ Abnormal response will be given if this command is entered during operation command execution or cycle stop.

    Abnormal response: [?CR] → [#CR] or [$CR]
- If you input this command during servo off, abnormal response will result, and EXC controller will be put under alarm.

  Abnormal response: [!CR] → [*CR]

[Command from personal computer]

Character	A	R	C	▵	P	1	2	3	▵	P	1	2	4	▵	P	1	2	5	CR	Example of Arc motion command
Code (ASCII)	4	5	4	2	5	3	3	3	2	5	3	3	3	2	5	3	3	3	0	
	1	2	3	0	0	1	2	3	0	0	1	2	4	0	0	1	2	5	D	

[Response from EXC controller]

Character	#	CR																	Outputs executing operation
Code (ASCII)	2	0																	
	3	D																	

↓

Character	*	CR																	Outputs prompt (Operation completed: reports after Arc motion is completed)
Code (ASCII)	2	0																	
	A	D																	

- Example: Specify movement mode. (Incremental coordinate)

[Command from personal computer]

Character	A	R	C	▵	P	1	2	3	▵	P	1	2	4	▵	P	1	2	5	▵	I	CR	Example: Arc motion (Incremental coordinate)
Code (ASCII)	4	5	4	2	5	3	3	3	2	5	3	3	3	2	5	3	3	3	2	4	0	
	1	2	3	0	0	1	2	3	0	0	1	2	4	0	0	1	2	5	0	9	D	

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- In servo on, enter CR command to execute circular motion.
- CIR command is basically the same as CIR command of program command. See also "13.2.5 Command."
- CIR command cannot move the module by directly designating the coordinate data.
- Use teaching points. You can designate up to 400 points of P000 - P399.
- CIR command cannot execute smooth sine acceleration/ deceleration. You can designate only two movement modes of I and N.
- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  - Abnormal response will be given if this command is entered during operation command execution or cycle stop.

    Abnormal response: [?CR] → [#CR] or [$CR]
- If you input this command during servo off, abnormal response will result, and EXC controller will be put under alarm.

  Abnormal response: [!CR] → [*CR]

[Command from personal computer]

Character	C	I	R	▵	P	0	0	1	▵	P	0	0	2	▵	P	0	0	3	CR	Circle motion command
Code (ASCII)	4	4	5	2	5	3	3	3	2	5	3	3	3	2	5	3	3	3	0	
	3	9	2	0	0	0	0	1	0	0	0	0	2	0	0	0	0	3	D	

[Response from EXC controller]

Character	#	CR																		Executing
Code (ASCII)	2	0																		
	3	D																		

↓

Character	*	CR																		Outputs prompt
Code (ASCII)	2	0																		
	A	D																		

- Example: Specify movement mode. (Incremental coordinate)

[Command from personal computer]

Character	C	I	R	▵	P	0	0	1	▵	P	0	0	2	▵	P	0	0	3	▵	I	CR	Example: Circular motion (Incremental coordinate)
Code (ASCII)	4	4	5	2	5	3	3	3	2	5	3	3	3	2	5	3	3	3	2	4	0	
	3	9	2	0	0	0	0	1	0	0	0	0	2	0	0	0	0	3	0	9	D	

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CSTP	Cycle stop

- When CSTP command is input during sequential programmed operation (prompt: [#CR]), the program will stop after completing the step being executed.

- Then, outputs cycle stop (outputs [$CR] code), and waits for re-start.

- You cannot stop the system by entering CSTP command during execution of movement command (HOM, MOV, ARC, CIR) other than programmed operation. After movement command is completed, prompt [*CR] will be output.

- When CSTP command is input during execution of operation command (prompt: [#CR]), the system will provide abnormal response.

  Abnormal response: [?CR] → [*CR] or [$CR]

[Command from personal computer]

Character	C	S	T	P	CR	Cycle stop
Code (ASCII)	4	5	5	5	0	
	3	3	4	0	D	

[Response from EXC controller]

Character	#	CR	Outputs only when CSTOP is input during execution of movement command.
Code (ASCII)	2	0	
	3	D	

↓

Character	$	CR	Outputs cycle stop (waits for re-start command)
Code (ASCII)	2	0	
	4	D	

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DISP | Data report during operation

- While programmed operation is executed by RUN command, DISP command provides you with programmed operation status.
- This command is valid during operation (prompt: [#CR]) or cycle stop (prompt: [$CR]) only.
- If you try to execute this command when operation has completed (prompt: [#CR]), the system will provide abnormal response.

  Abnormal response: [?CR] → [*CR]

① To know currently executing step.

[Command from personal computer]

Character	D	I	S	P	▵	S	T	E	P	CR									Otuput executing step
Code (ASCII)	4	4	5	5	2	5	5	4	5	0									
	4	9	3	0	0	3	4	5	0	D									

[Response from EXC controller]

Character	0	1	/	1	2	3	CR												Outputs executing step: First 2 digits: Program No. Next 3 digits: Step No.
Code (ASCII)	3	3	2	3	3	3	0												
	0	1	F	1	2	3	D												

↓

Character	#	CR																	Outputs prompt
Code (ASCII)	2	0																	
	3	D																	

② To know currently executing operation command.

[Command from personal computer]

Character	D	I	S	P	▵	C	M	D	CR										Output operation command
Code (ASCII)	4	4	5	5	2	4	4	4	0										
	4	9	3	0	0	3	D	4	D										

[Response from EXC controller]

Character	M	O	V	▵	P	0	0	1	CR										Outputs operation command
Code (ASCII)	4	4	5	2	5	3	3	3	0										
	D	F	6	0	0	0	0	1	D										

↓

Character	#	CR																	Outputs prompt (when executing operation)
Code (ASCII)	2	0																	
	3	D																	

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③ To know data in data register.

[Command from personal computer]

Character	D I S P ␣ D 1 2 CR	Report data in data resister (D12: resister No.)
Code (ASCII)	4 4 5 5 2 4 3 3 0	
	4 9 3 0 0 4 1 2 D	

[Response from EXC controller]

Character	1 2 3 4 5 6 7 8 CR	Reports data in data register
Code (ASCII)	3 3 3 3 3 3 3 3 0	
	1 2 3 4 5 6 7 8 D	

↓

Character	$ CR	Outputs prompt (during cycle stop)
Code (ASCII)	2 0	
	4 D	

④ To know whether it is possible halfway re-start programmed operation.

- You can know whether you can perform halfway re-start programmed operation.
  - * For halfway re-start programmed operation, see "15.4.3 Re-starting Halfway Programmed Operation".
- This command is valid only when operation is completed (prompt: [*CR]).
- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  - ○ Abnormal response will be given if this command is entered during operation command execution or cycle stop.

    Abnormal response: [?CR] → [#CR] or [$CR]

[Command from personal computer]

Character	D I S P ␣ R S T A CR	Report possibility of halfway re-start.
Code (ASCII)	4 4 5 5 2 5 5 5 4 0	
	4 9 3 0 0 2 3 4 1 D	

[Response from EXC controller]

- When it is possible.

Character	E N A B L E	
Code (ASCII)	4 4 4 4 4 4	
	5 E 1 2 C 5	

↓

Character	* CR	
Code (ASCII)	2 0	
	A D	

- When it is impossible.

Character	D I S A B L E	
Code (ASCII)	4 4 5 4 4 4 4	
	4 9 3 1 2 C 5	

↓

Character	$ CR	
Code (ASCII)	2 0	
	4 D	

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EMST Emergency stop

- When you enter EMST command, all the operations will stop (motor will be servo off) and will be put under emergency stop. For emergency stop, see "18.3.1. Emergency Stop".

[Command from personal computer]

Character	E	M	S	T	*CR*															Emergency stop
Code (ASCII)	4	4	5	5	0															
	5	D	3	4	D															

[Response from EXC controller]

Character	*	*CR*																		Outputs prompt
Code (ASCII)	2	0																		
	A	D																		

ERR Error status output

- If the system does not follow the command, use this command to know the error status.
- Reports error status in 4-digit figures.

Figure 15-6

0000	No error
0100	Alarm issued in EXA controller
02××	Invalid command input
01	No applicable command
02	Execution impossible
03	Grammatical error
04	Out of data range
05	Character train too long
03××	Data transmission error
01	Check-sum error
02	Character other than hexadecimal notation
03	Record not specified
04	Data length abnormal
05	Different version
06	Time out (5sec)
07	Data comparison error
08	Axis combination data error

* Data transmission error does not occur under ordinary operation. In case of transmission error, initialize the system because the internal data cannot be guaranteed. (For system initialization, see "21.3.1. Memory Initialize.")

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[Command from personal computer]

Character	E R R CR	Report error starus
Code (ASCII)	4 5 5 0	
	5 2 2 D	

[Response from EXC controller]

Character	0 0 0 0 CR	Example: Error status (No error)
Code (ASCII)	3 3 3 3 0	
	0 0 0 0 D	

↓

Character	* CR	Outputs prompt
Code (ASCII)	2 0	
	A D	

HIST | Output command history (output up to 10 commands history)

- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  - ○ Abnormal response will be given if this command is entered during operation command execution or cycle stop.

    Abnormal response: [?CR] → [#CR] or [$CR]

- If there is no data to report, only [CR] is output.

[Command from personal computer]

Character	H I S T CR	Report history
Code (ASCII)	4 4 5 5 0	
	8 9 3 4 D	

[Response from EXC controller]

Character	H I S T CR	Outputs current command
Code (ASCII)	4 4 5 5 0	
	8 9 3 4 D	

↓

Character	V E R CR	Outputs one before
Code (ASCII)	5 4 5 0	
	6 5 2 D	

↓

		Outputs 2~8 commands befpre
⋮		

↓

Character	D I S P CR	Outputs 9 commands before
Code (ASCII)	4 4 5 5 0	
	4 9 3 0 D	

↓

Character	* CR	Output prompt
Code (ASCII)	2 0	
	A D	

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- When you enter HOLD command during programmed operation started by RUN command (prompt: [#CR]), the program will hold.
  - Hold: Stops the system immediately if it is executing movement command. When re-started (by RUN command) after hold, the system will execute the remaining part of the program from the point where it has stopped. Any command other than movement command will cause cycle stop (stopping after completing the step being executed).

- When HOLD command is entered except during a programmed operation started by RUN command , the system will provide abnormal response.

  Abnormal response: [?CR] → [#CR] (during movement command execution)
  [$CR] (during cycle stop)
  [*CR] (during stop)

- If you perform emergency stop or enter STOP command during hold, the system will be released from hold and unable to be re-started.

- In case of alarm during hold, the system will be released from hold and unable to be re-started.

Caution : *During execution of movement commands such as HOM, MOVE, CIR, or ARC, you cannot stop the system by entering HLD command.*

Note : When you enter HLD command during continue path movement by programmed operation, the system will hold. When re-started after hold, the system will follow the remaining path, not by continue path movement, but by ordinary positioning operation.

[Command from personal computer]

						Hold command
Character	H	L	D	CR		
Code (ASCII)	4	4	4	0		
	8	C	4	D		

[Response from EXC controller]

						Outputs that system is decelerating (only when HLD is entered during execution of movement command)
Character	#	CR				
Code (ASCII)	2	0				
	3	D				

↓

						Outputs in hold (waits for re-start)
Character	$	CR				
Code (ASCII)	2	0				
	4	D				

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HOM | Starting Home Return operation

- When you enter HOM command during servo on, the system will start Home Return operation. For Home Return operation, see "14.5.1. Home Return Operation."
- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  - ○ Abnormal response will be given if this command is entered during operation command execution or cycle stop.

    Abnormal response: [?CR] → [#CR] or [$CR]
- If you enter this command during servo on, the system will provide abnormal response, and EXC controller is put under alarm.

  Abnormal response: [!CR] → [*CR]

[Command from personal computer]

Character	H	O	M	CR																Home Return command
Code (ASCII)	4	4	5	0																
	8	F	D	D																

[Response from EXC controller]

Character	#	CR																		Outputs: executing
Code (ASCII)	2	0																		
	3	D																		

↓

Character	*	CR																		Outputs promtp (Operation completed)
Code (ASCII)	2	0																		
	A	D																		

IO | General input status output

- You can select general input from DIO (port No. 0) to DI3 (port No. 3),
- You can execute this command any time.

[Command from personal computer]

Character	I	O	␣	D	I	0	CR													Report general input status (port No.0)
Code (ASCII)	4	4	2	4	4	3	0													
	9	F	0	4	9	0	D													

[Response from EXC controller]

Character	0	0	1	0	0	1	0	1	CR											Example: Outputs input status
Code (ASCII)	3	3	3	3	3	3	3	3	0											
	0	0	1	0	0	1	0	1	D											

↓

Character	*	CR																		Outputs prompt
Code (ASCII)	2	0																		
	A	D																		

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- Can rewrite coordinate data and set new data in the teaching point.
- To designate teaching point No. and write necessary coordinate data.
- An axis in which you have not written coordinate data has coordinate data of xxxx.xx.
  → Example: When you have set data by LD command on only X axis of a 2-axis controller, Y-axis coordinate of the data is xxxx.xx.
  * xxxx.xx means "the slider is stationary." When you execute a command to move to a point with only X-axis data, only X axis moves (Y axis does not move).
- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  ○ Abnormal response will be given if this command is entered during operation command execution or cycle stop.
  Abnormal response: [?CR] → [#CR] → [$CR]
- You cannot set data on the data register by LD command.
- You cannot read data on the general input port by LD command.

[Command from personal computer]

Character	L	D	△	P	0	0	1	△	X	0	1	0	0	.	0	0	CR			Setting point data (P001: X=0100.00, other axis=xx)
Code (ASCII)	4	4	2	5	3	3	3	2	5	3	3	3	3	2	3	3	0			
	C	4	0	0	0	0	1	0	8	0	1	0	0	E	0	0	D			

[Response from EXC controller]

Character	*	CR																		Outputs prompt
Code (ASCII)	2	0																		
	A	D																		

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- When you enter MOV command during servo on, the module moves linearly to the designated point.
- MOV command is basically the same as MOV command of program command. See also "13.2.5. Program Command."
- Linear motion command allows you to select two methods designating the destination.
  - ○ Designating the destination by point data prepared by teaching.
    Example: MOV P000
  - ○ Movement by directly designating coordinate data.
    Example: MOV X300.00, Y100.00
- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  - ○ Abnormal response will be given if this command is entered during operation command execution or cycle stop.
    Abnormal response: [?CR] → [#CR] or [$CR]
- If you enter this command during servo off, the system will provide abnormal response. EXC controller will be put under alarm.
    Abnormal response: [!CR] → [*CR]

① Designating destination by point data

- You can designate point data from P000 to P399. For details, see "13.1. Teaching."

[Command from personal computer]

Character	M	O	V	␣	P	0	0	1	CR		MOV command
Code (ASCII)	4	4	5	2	5	3	3	3	0		
	D	F	6	0	0	0	0	1	D		

[Response from EXC controller]

Character	#	CR									Executing command
Code (ASCII)	2	0									
	3	D									

↓

Character	*	CR									Outputs prompt (Movement completed: after moved to P001)
Code (ASCII)	2	0									
	A	D									

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② Moving by directly designating coordinate data

[Command from personal computer]

Character	M	O	V	△	X	3	0	0	.	0	0	△	Y	1	0	0	.	0	0	CR	MOV command (coordinate data)	
Code (ASCII)	4	4	5	2	5	3	3	3	2	3	3	2	5	3	3	3	2	3	3	0		
	D	F	6	0	8	3	0	0	E	0	0	0	9	1	0	0	E	0	0	D		

[Response from EXC controller]

Character	#	CR																			Executing command	
Code (ASCII)	2	0																				
	3	D																				

↓

Character	*	CR																			Outputs prompt (Execution completed: outputs after moved to X300.00 Y100.00)	
Code (ASCII)	2	0																				
	A	D																				

- The above example is for two-axis controllers. Set data on necessary axis (axes) only when operating one axis on a two-axis controller, or one or two axes on a three-axis controller.
- When operating Y axis only on a two- or three-axis controller (other axis (axes) are kept to the current position), enter data as follows:

[Command from personal computer]

Character	M	O	V	△	Y	1	0	0	.	0	0	CR									MOV command	
Code (ASCII)	4	4	5	2	5	3	3	3	2	3	3	0										
	D	F	6	0	9	1	0	0	E	0	0	D										

③ When adding movement mode to MOV command

- You can add movement mode just like MOV command of program command.

  Movement mode: I---------- Incremental coordinate

  S --------- Smooth sine acceleration/deceleration

  N--------- Movement without IPOS output

- Example of designating smooth sine acceleration/deceleration in incremental coordinate.

[Command from personal computer]

Character	M	O	V	△	P	0	0	1	△	I	S	CR									MOV command with I and S mode	
Code (ASCII)	4	4	5	2	5	3	3	3	2	4	5	0										
	D	F	6	0	0	0	0	1	0	9	3	D										

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OUT | Data output to general output port

- Specify a general output port No. and open/close the 8- bit output of the designated port in accordance with pre-set data.

  Preset data: 1: Close, 0: Open

  X: Does not change, R: Reverse

- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  - Abnormal response will be given if this command is entered during operation command execution or cycle stop.

    Abnormal response: [?CR] → [#CR] or [$CR]

[Command from personal computer]

Character	O	U	T	␣	D	0	1	␣	0	1	0	1	1	1	0	0	CR			Output example (Outpu 01011100 to port No. 0.)
Code (ASCII)	4	5	5	2	4	4	3	2	3	3	3	3	3	3	3	3	0			
	F	5	4	0	4	F	1	0	0	1	0	1	1	1	0	0	D			

[Response from EXC controller]

Character	*	CR																		Outputs prompt
Code (ASCII)	2	0																		
	A	D																		

POS | Output position and position data

- You can execute this command anytime.

① Position output

- Outputs current position by POS command. The current position is the position immediately after CR of POS CR is input.

[Command from personal computer]

Character	P	O	S	CR																Output current position
Code (ASCII)	5	4	5	0																
	0	F	3	D																

[Response from EXC controller]

Character	X	0	0	0	0	.	0	0	␣	Y	0	0	0	0	.	0	0	CR		Reports current position
Code (ASCII)	5	3	3	3	3	2	3	3	2	5	3	3	3	3	2	3	3	0		
	8	0	0	0	0	E	0	0	0	9	0	0	0	0	E	0	0	D		

↓

Character	*	CR																		Outputs prompt
Code (ASCII)	2	0																		
	A	D																		

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② Position data output

- You can check the coordinate data of teaching point No. xxxx.xx by POS Pxxx command. When teaching point data have been re-written during programming, you will be checking data immediately after CR of POS CR has been entered.

[Command from personal computer]

Character	P	O	S	␣	P	1	2	3	CR									Output position data
Code (ASCII)	5	4	5	2	5	3	3	3	0									
	0	F	3	0	0	1	2	3	D									

[Response from EXC controller]

Character	X	1	2	3	4	.	5	6	␣	Y	-	7	8	9	0	.	1	2	CR
Code (ASCII)	5	3	3	3	3	2	3	3	2	5	2	3	3	3	3	2	3	3	0
	8	1	2	3	4	E	5	6	0	9	D	7	8	9	0	E	1	2	D

Position data example (for 2 axes)

↓

Character	*	CR																	Outputs prompt
Code (ASCII)	2	0																	
	A	D																	

RUN | Starting programmed operation

- RUN command is a command to start programs prepared in EXC controller.
- Use RUN command to re-start a held program during execution of movement commands (MOV, ARC, CIR).
- RUN command has the following functions.
  - ○ Starting sequential programmed operation : When you input RUN command, the system executes the program from the top to the end (until END instruction is executed) continuously.
  - ○ Starting programmed step operation : Each time you input RUN command, the system executes one step after another sequentially from the top of the program.
  - ○ Re-starting programmed operation : When you input RUN command during hold of programmed operation or cycle stop, the system executes the remaining program.
  - ○ Re-starting halfway programmed operation : Can continue programmed operation from the step next to a step at which the power supply is turned on again, after stopping the cycle of programmed operation and turning off the power supply.

Note: Set the system to servo on by SVON command before entering RUN command. If you start a program containing movement commands during servo off, the system will provide abnormal response at the start of movement command execution, and EXC controller will be put under alarm, stopping operation.

Abnormal response: [!CR] —> [*CR]

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① Starting sequential programmed operation

- Enter program No. to be executed next to RUN command.
- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  - Abnormal response will be given if this command is entered during operation command execution or cycle stop.

    Abnormal response: [?CR] → [#CR] or [$CR]
- Executing RUN command without entering the program No. during operation command execution (prompt: [#CR] or during cycle stop (prompt: [$CR]) is the same in effect as re-starting programmed operation. See "③ Re-starting programmed operation and cycle stop."

[Command from personal computer]

Character	R U N ␣ 1 2 CR	Start programmed operation (Program No.12)
Code (ASCII)	5 5 4 2 3 3 0	
	2 5 E 0 1 2 D	

[Response from EXC controller]

Character	# CR	Executing command
Code (ASCII)	2 0	
	3 D	

↓

Character	* CR	Outputs prompt (Programmded operation completed: outputs after END command)
Code (ASCII)	2 0	
	A D	

② Starting programmed step operation

- Enter RUN command, program No. and step No. you want to start.
- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  - Abnormal response will be given if this command is entered during operation command execution or cycle stop.

    Abnormal response: [?CR] → [#CR] or [$CR]

[Command from personal computer]

Character	R U N ␣ 0 1 ␣ S T E P CR	Start operation (program No.01)
Code (ASCII)	5 5 4 2 3 3 2 5 5 4 5 0	
	2 5 E 0 0 1 0 3 4 5 0 D	

[Response from EXC controller]

Character	# CR	Executing command
Code (ASCII)	2 0	
	3 D	

↓

Character	$ CR	Outputs cycle stop (after completing step, waits for RUN command)
Code (ASCII)	2 0	
	4 D	

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③ Re-starting programmed operation and cycle stop

- When you enter RUN command during hold of programmed operation (prompt: #CR) or cycle stop (prompt: $CR), the system executes the remaining program.

- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  - Abnormal response will be given if this command is entered during operation command execution or cycle stop.

    Abnormal response: [?CR] → [#CR] or [$CR]

[Command from personal computer]

Character	R	U	N	CR															Re-start programmed operaion
Code (ASCII)	5	5	4	0															
	2	5	E	D															

[Response from EXC controller]

Character	#	CR																	Executing operation
Code (ASCII)	2	0																	
	3	D																	

↓

Character	*	CR																	Outputs prompt (when completing operation after execution of re-start)
Code (ASCII)	2	0																	
	A	D																	

or

Character	$	CR																	Outputs cycle stop (in case of programmed step operation)
Code (ASCII)	2	0																	
	4	D																	

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④ Re-starting halfway programmed operation

- When you enter RUN command during halfway re-start of programmed operation, halfway re-start operation will start.

* For halfway re-start operation, see "15.4.3. Re-starting Halfway Programmed Operation."

- This command is valid only when the conditions for halfway re-start of programmed operation are met.

* You can check by DISP command whether the conditions are met= whether programmed operation can be re-started.

- If you enter DISP command when the conditions are not met, the system will give abnormal response.

Abnormal response: [!CR] → [$CR] : Under hold or cycle stop
[#CR] : In operation
[*CR] : Program has been completed or must be ended completely due to alarm, etc., or has been ended completely due to error in halfway re-start procedure.

[Command from personal computer]

Character	R	U	N	␣	R	S	T	A	CR										Re-start halfway sequential programmed operation
Code (ASCII)	5	5	4	2	5	5	5	4	0										
	2	5	E	0	2	3	4	1	D										

or

Character	R	U	N	␣	R	S	T	A	␣	S	T	E	P	CR					Re-start halfway programmed step operation
Code (ASCII)	5	5	4	2	5	5	5	4	2	5	5	4	5	0					
	2	5	E	0	2	3	4	1	0	3	4	5	0	D					

[Response from EXC controller]

Character	#	CR																	Starts operation
Code (ASCII)																			

↓

Character	*	CR																	Completed sequential operation
Code (ASCII)	2	0																	
	A	D																	

or

Character	$	CR																	Outputs "step" completed (waits for RUN command)
Code (ASCII)	2	0																	
	4	D																	

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STOP | Forced stop of operation

- If you enter STOP command during execution of operation command (after ([#CR] is output) or during cycle stop (after ([$CR] is output), the system will stop operation immediately or will decelerate and stop if the command is entered during execution of movement command). The motor wiill be in servo-locked.
- When you re-start a program that has been stopped by entering STOP command during programmed operation, the program will start operation from the top, because the program has been forcedly completed by STOP command during programmed operation.
- STOP command is valid only when executing operation command or cycle stop, otherwise the system will give abnormal response.

  Abnormal response: [?CR] → [*CR]

[Command from personal computer]

Character	S	T	O	P	CR	Stop operation
Code (ASCII)	5	5	4	5	0	
	3	4	F	0	D	

[Response from EXC controller]

Character	#	CR	Outputs "decelerating and stopping" (only when 'STOP' is input during execution of movement command)
Code (ASCII)	2	0	
	3	D	

↓

Character	*	CR	Outputs prompt (operation stopped)
Code (ASCII)	2	0	
	A	D	

SVON | Servo ON

- When executing positioning operation by remote control, the system must be in servo ON. Be sure to enter SVON command to set the system to servo ON before entering an operation command.

[Command from personal computer]

Character	S	V	O	N	CR	Servo ON command
Code (ASCII)	5	5	4	4	0	
	3	6	F	E	D	

[Response from EXC controller]

Character	*	CR	Outputs prompt
Code (ASCII)	2	0	
	A	D	

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SVOF Servo OFF

- Enter Servo OFF command to set to servo OFF the system which has been set to servo ON by SVON command.
- When set to servo OFF, EXC controller will stop operation and will be kept under alarm (program trouble).

[Command from personal computer]

Character	S	V	O	F	CR														Servo OFF command
Code (ASCII)	5	5	4	4	0														
	3	6	F	6	D														

[Response from EXC controller]

Character	*	CR																	Outputs prompt
Code (ASCII)	2	0																	
	A	D																	

VEL Travel speed setting

- VEL command is to specify the travel speed of movement commands of MOV, ARC and CIR.
- VEL command has the same functions as VEL command of program command, but it is valid for the above movement commands of MOV, ARC and CIR only.
  - → ○ "Parameters for initial setting and Home Return" are valid for the speed of Home Return operation by HOM command.
  - → ○ For the speed during programmed operation called by RUN command, VEL command written in the programs are valid.
- Travel speed in MOV, ARC and CIR movement command execution is restricted by the rate (%) against the Max Speed set in the parameters related to the initial setting or programmed operation.

$$\underset{[m/s]}{\boxed{\text{Travel speed in movement command}}} = \underset{[m/s]}{\boxed{\text{Max speed: Setting value}}} \times \underset{[\%]}{\boxed{\text{VEL: command setting value}}} \times \frac{1}{100}$$

* Also, see "11.3.1.2. Travel Speed in Programmed Operation."

- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  - ○ Abnormal response will be given if this command is entered during operation command execution or cycle stop.

    Abnormal response: [?CR] → [#CR] or [$CR]
- Travel speed once set by VEL command is valid until the end of remote control or the next VEL command is input.
- 100% when this command is not used.

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[Command from personal computer]

Character	V	E	L	▵	3	0	CR												Set speed (30%)
Code (ASCII)	5	4	4	2	3	3	0												
	6	5	C	0	3	0	D												

[Response from EXC controller]

Character	*	CR																	Outputs prompt
Code (ASCII)	2	0																	
	A	D																	

VER Output system software vesion number

- This command is not acceptable during operation command execution (prompt: #CR) or cycle stop (prompt: $CR).
  - ○ Abnormal response will be given if this command is entered during operation command execution or cycle stop.

    Abnormal response: [?CR] → [#CR] or [$CR]

[Command from personal computer]

Character	V	E	R	CR															Report version No.
Code (ASCII)	5	4	5	0															
	6	5	2	D															

[Response from EXC controller]

Character	T	y	p	.	E	X	C	2	CR										Reports EXC type (example: 2 axes)
Code (ASCII)	5	7	7	2	4	5	4	3	0										
	4	9	0	E	5	8	3	2	D										

Character	V	e	r	.	1	A	0	0	_	5	0	3	3	CR					Reports CPU version No.
Code (ASCII)	5	6	7	2	3	4	3	3	5	3	3	3	3	0					
	6	5	2	E	1	1	0	0	F	5	0	3	3	D					

Character	▵	▵	▵	▵	1	A	2	0	_	5	0	0	7	▵	CR				Reports DSP software version No.
Code (ASCII)	2	2	2	2	3	4	3	3	5	3	3	3	3	2	0				
	0	0	0	0	1	1	2	0	F	5	0	0	7	0	D				

Character	*	CR																	Outputs prompt
Code (ASCII)	2	0																	
	A	D																	

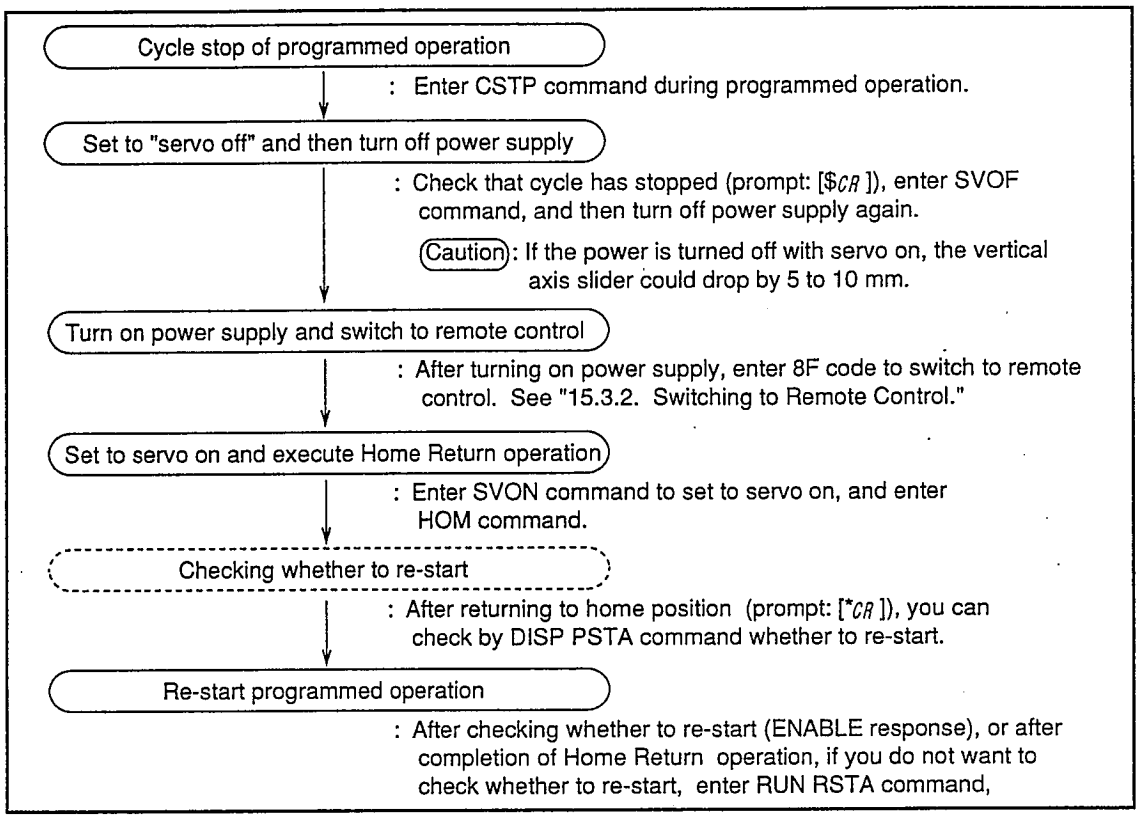
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15.4.3. Re-starting Halfway Programmed Operation

- You can re-start programmed operation, which was initiated by RUN command, from the step next to the step at which the cycle stopped. The procedures are described bellow.

● Operation procedures

Figure 15-7



● Notes on halfway re-start operation

- For command entering, see "15.4.2. Description of Command."
- If you try to execute movement command without executing Home Return after turning on power supply, ERROR will result.

  Abnormal program: Home Return uncompleted.
- If an alarm has been issued during halfway re-start operation, you cannot execute halfway re-start even after when you have cleared the alarm.
- At the start of halfway re-start operation, the data register and palletize-related flags hold the state of before halfway re-start (before power off).
- If RSTA instruction is set in an interrupted program, the system will re-start programmed operation after executing the start initialization program. See "13.2.5. Program Command."
- If you enter an ordinary program start command (RUN01, etc.) without RSTA after completing Home Return, the system will execute not halfway re-start, but ordinary programmed operation from the top.

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15.5. Abnormal Response

- If you enter a command which is restricted to enter in remote control (e.g., MOVE) at a restricted time point, EXC controller will give an abnormal response. The following are examples in which an additional operation command is entered during operation. If you enter ERR command in such a state, 0202 (unexecutable) will be displayed.

[Command from personal computer]

Character	M	O	V	▵	P	0	0	1	*CR*															Movement command
Code (ASCII)	4	4	5	2	5	3	3	3	0															
	D	F	6	0	0	0	0	1	D															

[Response from EXC controller]

Character	?	*CR*																						Outputs abnormal response
Code (ASCII)	3	0																						
	F	D																						

↓

Character	#	*CR*																						Outputs promtp (in operation)
Code (ASCII)	2	0																						
	3	D																						

- An executable command may cause alarm when EXC controller tries to execute it. The following are examples in which an operation command is entered when EXC controller is in servo off (always servo off when entering to remote control mode). If you enter ERR command in such a state, 0100 (alarm occurred) will be output. If you further enter ALM command, 0F05 [12] (servo OFF) is output to indicate the contents of alarm.

- If an alarm occurs during operation, similar response will be given.

[Command from personal computer]

Character	A	R	C	▵	P	1	2	3	▵	P	1	2	4	▵	P	1	2	5	*CR*					Movement Command
Code (ASCII)	4	5	4	2	5	3	3	3	2	5	3	3	3	2	5	3	3	3	0					
	1	2	3	0	0	1	2	3	0	0	1	2	4	0	0	1	2	5	D					

[Response from EXC controller]

Character	!	*CR*																						Outputs abnormal response (alarm issued)
Code (ASCII)	2	0																						
	1	D																						

↓

Character	*	*CR*																						Outputs command
Code (ASCII)	2	0																						
	A	D																						

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16. Pulse Train Output Function and Operation

16.1. Outline of Pulse Train Output Function and Notes

- EXC controller is provided with pulse train output function.
- Can program up to 4 axes including the number of axes of the built-in servo-driver, and can operate up to 4 axes when the pulse train input unit is connected (a unit which operates in proportion to the pulse train output from EXC controller).

Note :The pulse train input unit cannot operate synchronously with the built-in servo-driver axis. Use it as an additional axis.

- Basically the same in operation and programming as the built-in servo-driver.
- Generally, does not display pulse train output axis in programming, teaching, and initial setting. Displays pulse train output axis after the pulse train output function has be validated. See "16.3.2· Pulse Train Output Function Setting."
- Axis configuration of the pulse train output function and axis symbol of the pulse train output axis are as follows:

Table 16-1

Controller type	Axis configuration	Axis code of teaching box and axis code in programs		Pulse train output axis Nos. of CN3 & CN7
		Axes of built-in servo driver	Pulse train output axes	
EXC20 EXC21	Dual-axis servo driver + single-axis pulse train output	X Y	* Z R	• Pulse train is output from the third axis (in case of Z-axis) or fourth axis (in case of R-axis).
	Dual-axis servo driver + dual-axis pulse train output	X Y	Z	• Pulse train is output from the third axis.
			R	• Pulse train is output from the fourth axis.
EXC30 EXC31	Triple-axis servo driver + single-axis pulse train output	X Y Z	R	• Pulse train is output from the fourth axis.

* Select either axis by referring to "16.3.2. Pulse Train Output Function Setting ."

- Control I/O function of the pulse train output axis is assigned to the general I/O port (CN7). This decreases I/O port by 8 each. For details, see "16.2 Specification of Signals Related to Pulse Train Output."
- The servo-motor (in particular, NSK Megatorque Motor system) is assumed to be a pulse train input unit. Use utmost care to the following.
  - Check whether the interface specification matches the pulse train input unit you intend to use.

* See "16.2. Specification of Signals Related to Pulse Train Output."

Caution :*The pulse train output of EXC controller is not compatible with the step motor. If you use a step motor as a pulse train input unit, step-out could occur.*

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16.2. Specifications of Signals Related to Pulse Train Output

- Use connectors CN3 and CN7 for pulse train output.
- Since CN7 connector is used for control I/Os of pulse train output, eight each of input and output ports are reduced.(32each → 24 each)

16.2.1. Specifications List

Table 16-2 : Specification List

Connector	Signal type				Description
CN3	Pulse train output	Output type			Open collector output, 5 V, 30 mA max.
		Signal type			CW pulse or CCW pulse
		Speed setting range			0.1 kpps to 200 kpps
		Acceleration/deceleration setting range			0.01 Mpps² to 35 Mpps²
	Over-travel limit input				24 VDC, photo-coupler input B contact (Normally closed)
	PROX input				24 VDC, photo-coupler input
	Home position (Z-phase) input				Line receiver AM26LS32AC made by TI or equivalent
CN7	Control I/O	Input		Signal name	Alarm, positioning completion, & Home Return completion
				Input type	24 VDC, photo-coupler input * Alarm input only B contact (Normally closed)
		Output		Signal name	Servo on, emergency stop, deviation clear, & Home Return start
				Output type	Photo-coupler output Max. open/close capacity: 24VDC, 100 mA

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16.2.2. Signal Specifications

16.2.2.1. CN3 Signal Specifications

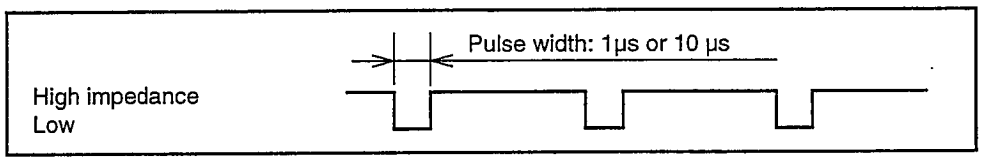
Pulse train output

- Pins in Table 16-3 output pulse train.

Table 16-3

Symbol	Pin No.	Function
CWP 3	1	CWP3: CW pulse train output to the third axis
CCWP 3	2	CCWP3: CCW pulse train output to the third axis
CWP 4	17	CWP4: CW pulse train output to the fourth axis
CCWP 4	18	CCWP4: CCW pulse train output to the fourth axis
+5V	10, 11	—

Figure 16-1



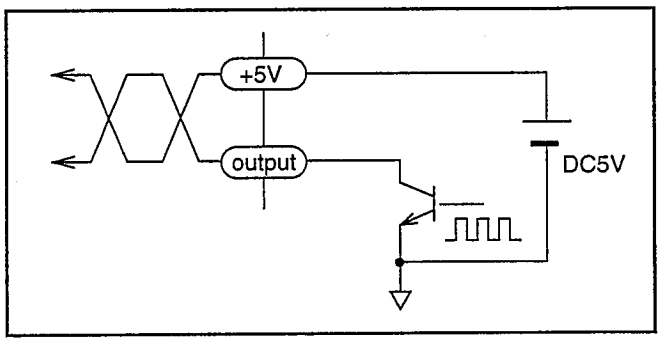
* The pulse width, 1µs or 10µs, is selectable. If 10µs is selected, the maximum output frequency is limited to 50 kpps. For the selection method, see "16.3.2. Pulse Train Output Function" above. (Default value: 10µs)

◉ Pulse train output specifications

Table 16-4

Item	Specification
Output voltage	5V±10%
Output current	30 mA or less
Saturation voltage	0.2 V at output current of 10 mA

Figure 16-2



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Over-travel input

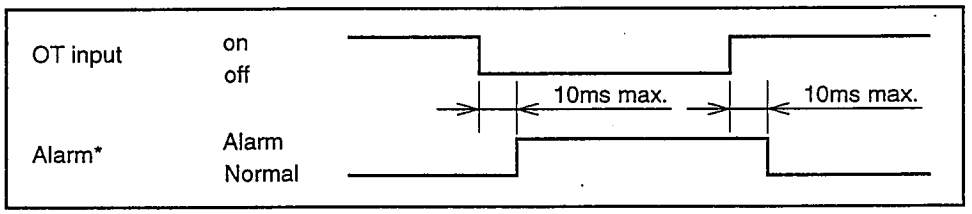
- Connect over travel output of pulse train input unit.

Table 16-5

Symbol	Pin No.	Function
OT– 3	6	OT-3: CCW over-travel input of the third axis
OT+ 3	7	OT+3: CW over-travel input of the third axis
OT– 4	22	OT-4: CCW over-travel input of the fourth axis
OT+ 4	23	OT+4: CW over-travel input of the fourth axis

- The over-travel input signal is a B contact (normally closed) signal.
- When the CCW over-travel input signal goes inactive, CCW pulse train output stops and an alarm is given.
- When the CW over-travel input signal goes inactive, CW pulse train output stops and an alarm is given.
- If the over-travel sensors are controlled by the pulse train input unit, the OT inputs should always be kept active.

Figure 16-3



* For alarms, see "20. Alarms".

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Home position proximity

- Connect the Home position proximity sensor output of pulse train input unit.

Table 16-6

Symbol	Pin No.	Function
PROX 3	5	PROX3: Home position proximity input of the third axis
PROX 4	21	PROX4: Home position proximity input of the fourth axis

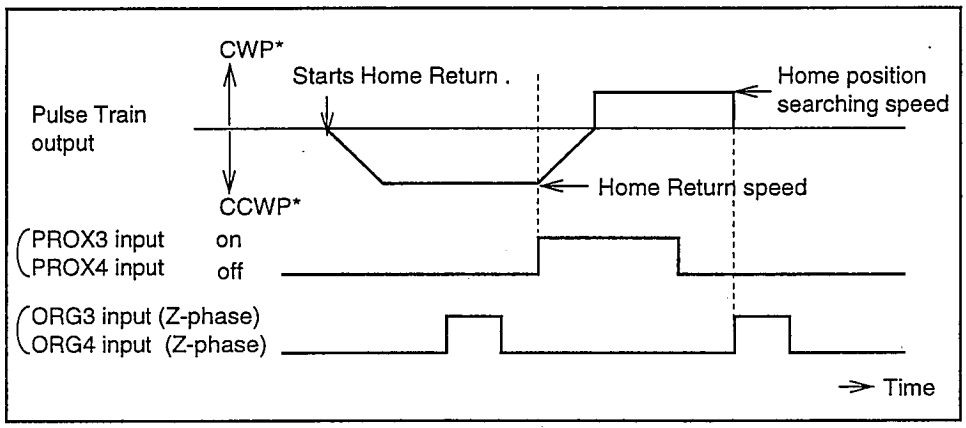
- No connection is needed if the Home Return operation is controlled by the pulse train input side unit.(Home Return Type Ⅳ)

- If PROX is selected not to be used *(and the OT- input is used instead of it) in an application where the Home Return operation is controlled by the EXC controller, no connection is needed.

✱ Refer to " 16.3.3.2. Parameters of Home Return."

✱ For details of the Home Return operation, see " 16.5.2. Home Return of Pulse Train Output Function."

Figure 16-4



① Once Home Return operation is initiated, CCWP outputs a pulse train at the Home Return speed.

② When the PROX input goes active, the motor decelerates, stops and reverses its motion at the Home position searching speed.

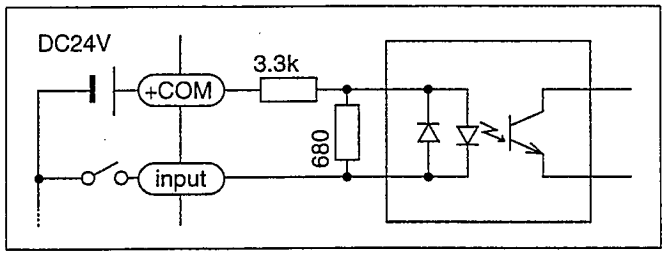
③ The motor stops at the point where the ORG input (Z-phase) changes for the first time after the PROX input goes inactive. The Home Return operation is completed.

◉ Over-travel and Home position proximity input signal specification

Table 16-7

Item	Specification
Input voltage	24 VDC ±10%
Input impedance	3.3 kΩ
Input current Max.	10 mA (Per one point)

Figure 16-5



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Home position input

- Connect the encoder Z-phase signal of the pulse train input axis.
- Differential type line receiver input.

Table 16-8

Symbol	Pin No.	Function
ORG+ 3	3	ORG3+: Positive side of the Z-phase input of the third axis
ORG– 3	4	ORG3–: Negative side of the Z-phase input of the third axis
ORG+ 4	19	ORG4+: Positive side of the Z-phase input of the fourth axis
ORG– 4	20	ORG4–: Negative side of the Z-phase input of the fourth axis
SG	12	SG : Signal ground

- The Home Return operation is completed at the point where the ORG input changes for the first time after the PROX input goes inactive when return to Home position.

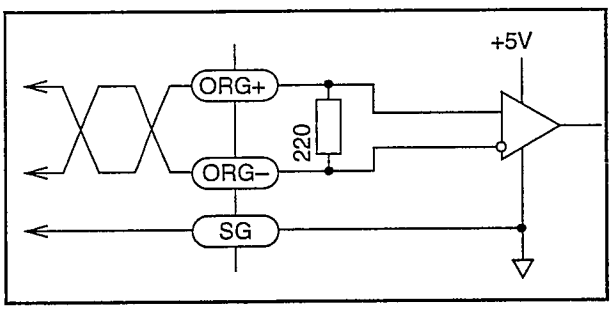
* Refer to " 16.5.2 Home Return of Pulse Train Output function" for Home Return operation.

◉ Home position input signal specifications

Table 16-9

Item	Specification
Input type	Differential type line receiver
Line receiver used	AM26LS32AC made by TI or equivalent
Differential input threshold voltage	±0.2V
Impedance	220Ω
Max. common phase input voltage	±7V

Figure 16-6



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16.2.2.2. CN7 Signal Specifications

Control Input

- Connect the alarm outputs of pulse train input unit.

Table 6-10

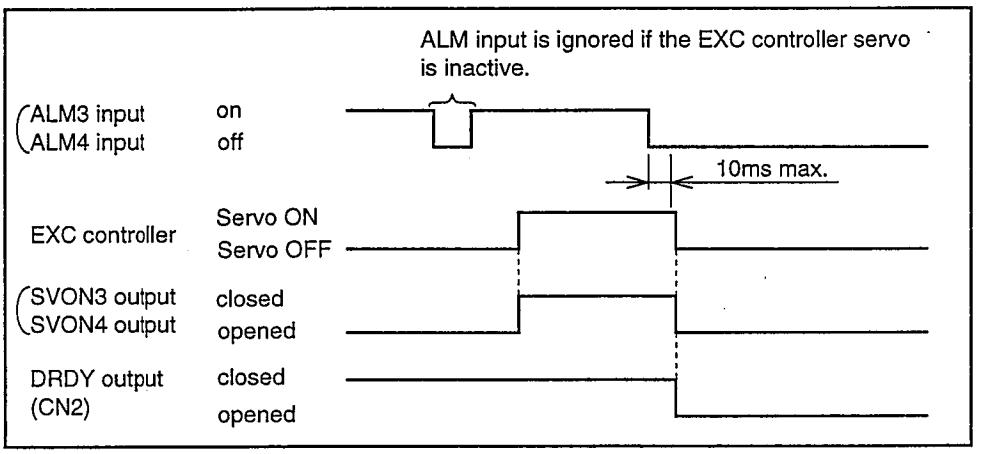
Symbol	Pin No.	Function
ALM 3	36	ALM3: Alarm input of the third axis
ALM 4	22	ALM4: Alarm input of the fourth axis

- B contact (normally closed).

- If the ALM input goes inactive with the Servo of the EXC controller active, the EXC controller servo goes inactive, SVON output (of CN7) goes inactive, and all operations stop. At this time, the DRDY output of CN2 opens. (EXC controller is also in the alarm* state.)

* See " 20. Alarms" for more details.

Figure 16-7



- Connect the imposition output (positioning completed signal) of the pulse train input unit.

Table 16-11

Symbol	Pin No.	Function
IPOS 3	38	IPOS3: Positioning completion input of the third axis
IPOS 4	24	IPOS4: Positioning completion input of the fourth axis

- When it is made sure that the IPOS input goes active after completion of pulse train output, positioning of the axis in question is considered to be completed. (When all axes including built in servo driver axis have been positioned, operation advances to the following step.)

- When the continuous movement of the movement mode is selected **in movement command in programmed operation, operation advances to the following step after completion of pulse train output, regardless of the IPOS input.

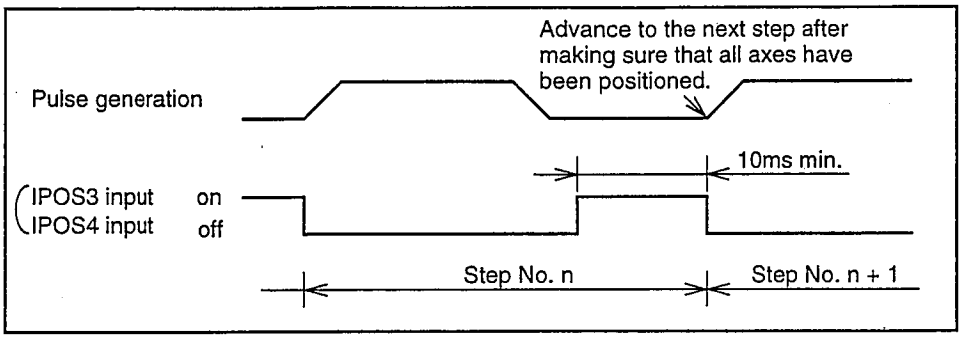
Example: **MOV P000 N

Continuous pulse generation is selected.

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- If a pulse input unit with no positioning completion output function is used, keep the IPOS input active at all times.

Figure 16-8



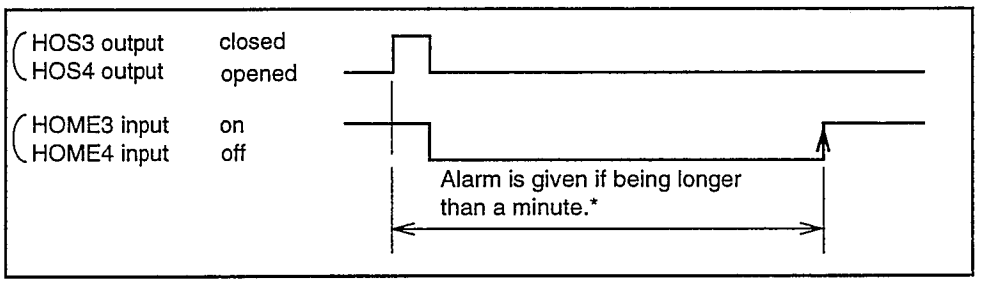
- If Home Return operation is executed by the pulse train input unit, connect HOME output signal.

Table 16-12

Symbol	Pin No.	Function
HOME 3	37	HOME3: Origin return completion input of the third axis
HOME 4	23	HOME4: Origin return completion input of the fourth axis

- An alarm is given if the HOME input is not active within a minute after HOS signal (start Home Return) is output.

Figure 16-9



- HOME input is detected at the leading edge.

*See " 20. Alarm" for more details.

✱ No connection is needed if Home Return operation (Home Return Type Ⅰ, Ⅱ and Ⅲ) is controlled by the EXC controller.

✱ Refer to " 16.5.2. Home Return of Pulse Train Output Function."

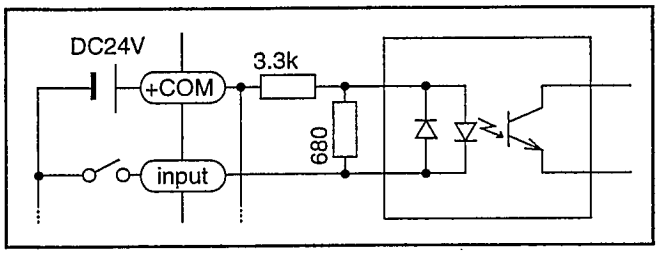
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◉ CN7 input specifications

Table 16-13

Item	Specification
Input voltage	24VDC ±10%
Input impedance	3.3kΩ
Input current Max.	10 mA (per one point)

Figure 16-10



Control output

- Connect to the servo on input of the pulse train input unit.

Table 16-14

Symbol	Pin No.	Function
SVON 3	44	SVON3: Servo on output to the third axis
SVON 4	48	SVON4: Servo on output to the fourth axis

- The SVON output is closed when EXC controller goes active*(servo on).

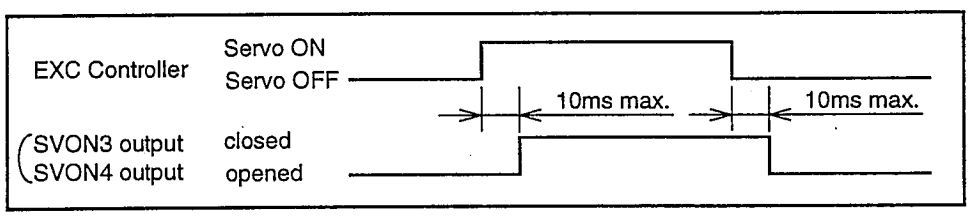
*Srevo ON/OFF status of the EXC controller depends on the following.

①In the external control mode ---------- SVON input of CN2
②Operation with Teaching box ---------- ON key of Teaching box
③Programmed operation ---------- SRV command

- The SVON output opens in any of the following cases.

①The EXC controller servo is inactive.
②An alarm in the EXC controller deactivates the servo.
③The ALM input of CN7 is deactivated.
④The EXC controller stops in emergency.

Figure 16-11



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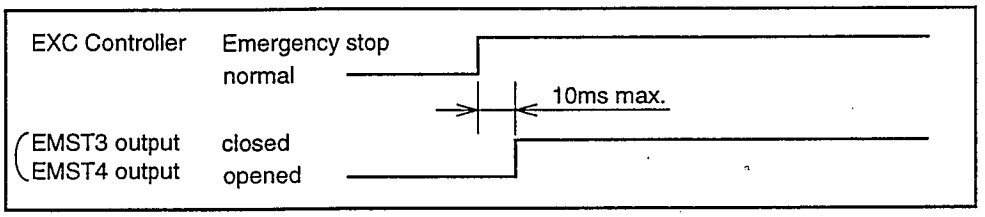
- EMST (emergency stop) output closes when EXC controller stops in emergency. (A contact: Normally open)

Table 16-15

Symbol	Pin No.	Function
EMST 3	41	EMST3: Emergency stop output to the third axis
EMST 4	45	EMST4: Emergency stop output to the fourth axis

* See " 18.3.1. Emergency Stop " for more details.

Figure 16-12



- Connect to the clear input (CLR) of position error counter of the pulse train input unit.

Table 16-16

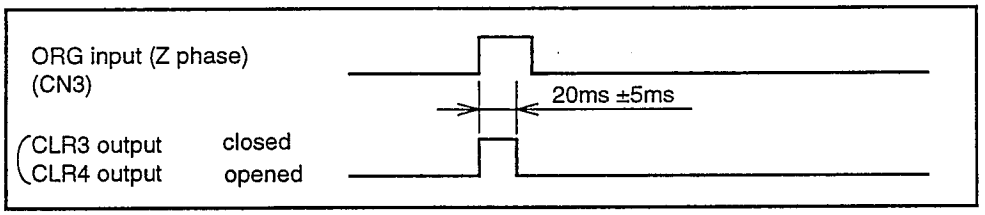
Symbol	Pin No.	Function
CLR 3	42	CLR3: Position error counter clear output to the third axis
CLR 4	46	CLR4: Position error counter clear output to the fourth axis

- When the ORG input (Z phase) changes during returning to HOME position, the CLR output is closed and Home Return operation of the axis in question is completed.

* No connection is needed if Home Return operation is executed by the pulse train input unit.

* Refer to "16.5.2. Home Return of Pulse Train Output Function" for Home Return operation.

Figure 16-13



- HOS initiates the Home Return operation of the pulse train input unit.

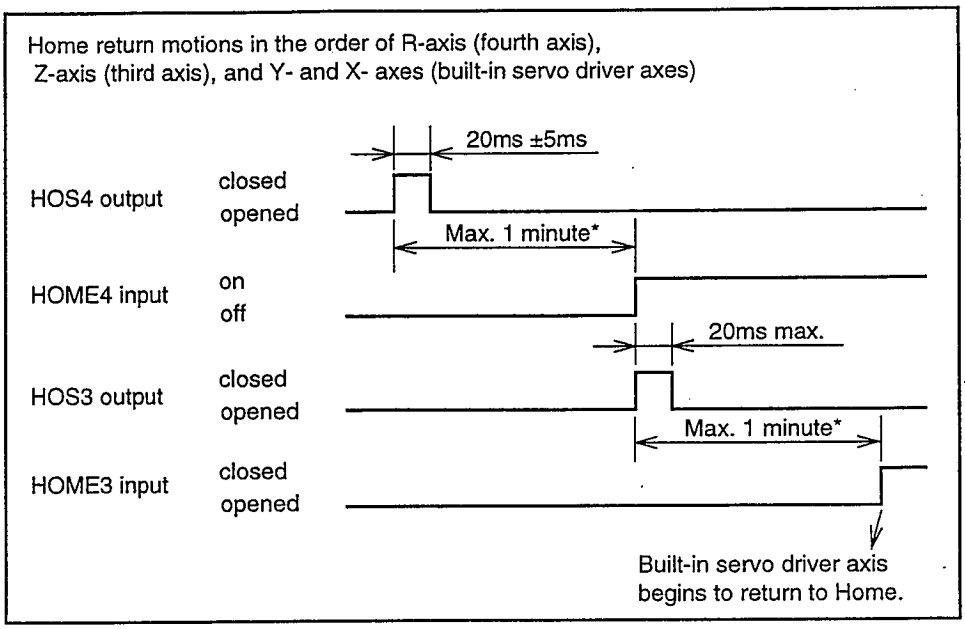
- When EXC controller starts Home Return operation, HOS signals are output in the specified order of Homer Return sequence in initial setting.

Table 16-17

Symbol	Pin No.	Function
HOS 3	43	HOS3: Home return start output to the third axis
HOS 4	47	HOS4: Home return start output to the fourth axis

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Figure 16-14



* If it takes a minute or more to return Home position, an alarm (Home Return abnormal) is given. For alarms, see " 20. Alarms."

✱ No connection is needed if Home Return operation is executed by EXC controller (Home Return type Ⅰ, Ⅱ and Ⅲ).

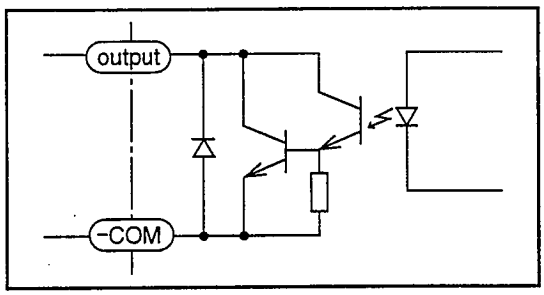
✱ Refer to "16.5.3. Home Return of Pulse Train Output Function" for Home Return operation.

◉ CN7 Output specification

Table 16-18

Item	Specification
Max. open/close capacity	24 VDC, 100 mA
Saturation voltage	2 V or less

Figure 16-15



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16.2.3. Connector Specification

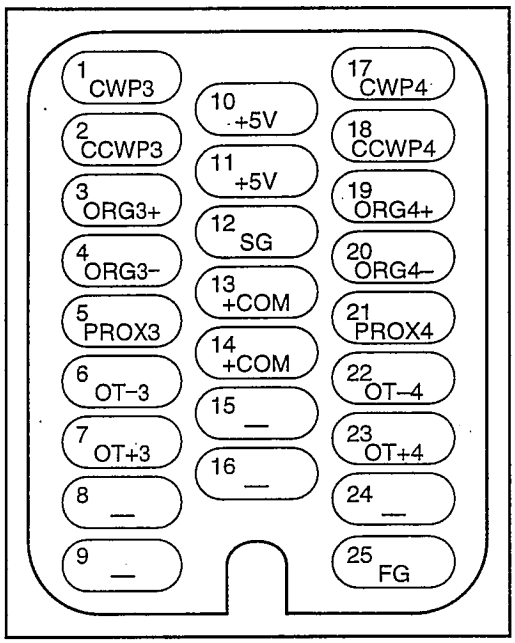
16.2.3.1. CN3 : Connector for Signals Related to Pulse Train Output (EXC20 and EXC30 type controller)

Table 16-19

Connector on EXC controller	MR-25SRFA made by HONDA COMMUNICATION CO.
Applicable connector (Prepared by user)	MR-25M made by HONDA COMMUNICATION CO.
Applicable cover (Prepared by user)	MR-25NSA made by HONDA COMMUNICATION CO.

◉ CN3 : Pin assignment (EX20 and EXC30)

Figure 16-16: Pin assignment



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Table 16-20: Name of signals

Pin	Signal name	I/O	Description
1	CWP3	O	CW pulse train output of 3rd axis
2	CCWP3	O	CCW pulse train output of 3rd axis
3	ORG3+	I	Home of 3rd axis. (Encoder signal Z-phase +)
4	ORG3–	I	Home of 3rd axis (Encoder signal Z-phase –)
5	PROX3	I	Home proximity of 3rd axis
6	OT–3	I	CCW over-travel of 3rd axis
7	OT+3	I	CW over-travel of 3rd axis
8	—	—	(Connection disabled)
9	—	—	(Connection disabled)
10	+5V	O	Positive side of 5 VDC power
11	+5V	O	Positive side of 5 VDC power
12	SG	O	Signal ground
13	+COM	I	Positive common of OT & PROX inputs
14	+COM	I	Positive common of OT & PROX inputs
15	—	—	(Connection disabled)
16	—	—	(Connection disabled)
17	CWP4	O	CW pulse train output of 4th axis
18	CCWP4	O	CCW pulse train output of 4th axis
19	ORG4+	I	Home of 4th axis (Encoder signal Z-phase +)
20	ORG4–	I	Home of 4th axis (Encoder signal Z-phase –)
21	PROX4	I	Home proximity of 4th axis
22	OT–4	I	CCW over-travel of 4th axis
23	OT+4	I	CW over-travel of 4th axis
24	—	—	(Connection disabled)
25	FG	—	Frame ground

◉ CN3 : Signal specifications (EXC02 and EXC30 type controller)

Table 16-21

Type	Item	Specification
Pulse train output signal	Output type	Open collector
	Source voltage	5 VDC ±10%
	Max. open/close current	30 mA
	Saturated voltage	1 V or less
Encoder Z-phase	Input type	Differential type line receiver
	Line receiver used	AM26LS32AC made by TI or equivalent
	Differential input threshold voltage	±0.2V
	Input impedance	220Ω
	Max. common phase input voltage	±7V
Over-travel origin proximity	Source voltage	24 VDC ±10%
	Input impedance	3.3 kΩ
	Input current (max.)	10 mA (per input)
	Over-travel signal type	B contact (normally closed), open collector output

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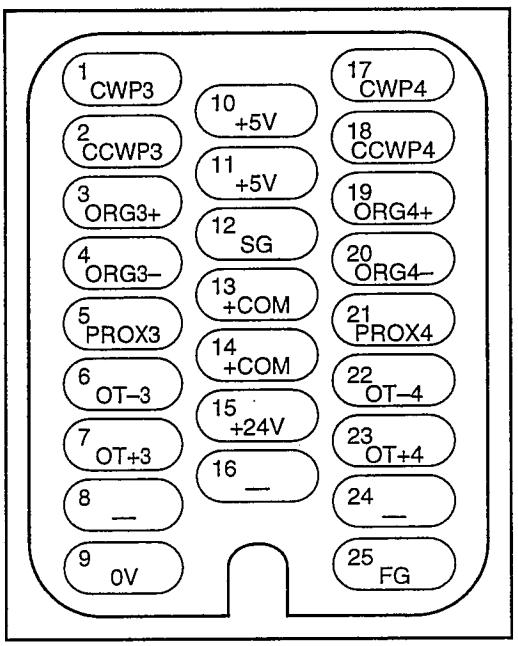
16.2.3.2. CN3 : Connector for Signals Related to Pulse Train Output (EXC21 and EXC31 type controller)

Table 16-22

Connector on EXC controller	MR-25SRFA made by HONDA COMMUNICATION CO.
Applicable connector (Prepared by user)	MR-25M made by HONDA COMMUNICATION CO.
Applicable cover (Prepared by user)	MR-25NSA made by HONDA COMMUNICATION CO.

◉ CN3 : Pin assignment and name of signals (EXC20 and EXC30 type controller)

Figure 16-17: Pin assignment



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Table 16-23: Name of signals

Pin	Signal name	I/O	Description
1	CWP3	O	CW pulse train output of 3rd axis
2	CCWP3	O	CCW pulse train output of 3rd axis
3	ORG3+	I	Home of 3rd axis (Encoder signal Z-phase +)
4	ORG3–	I	Home of 3rd axis (Encoder signal Z-phase –)
5	PROX3	I	Home proximity of 3rd axis
6	OT–3	I	CCW over-travel of 3rd axis
7	OT+3	I	CW over-travel of 3rd axis
8	—	—	(Connection disabled)
9	0V	O	Negative side of 24 VDC power
10	+5V	O	Positive side of 5 VDC power
11	+5V	O	Positive side of 5 VDC power
12	SG	O	Signal ground
13	+COM	I	Positive common of OT & PROX inputs
14	+COM	I	Positive common of OT & PROX inputs
15	+24V	O	Positive side of 24 VDC power
16	—	—	(Connection disabled)
17	CWP4	O	CW pulse train output of 4th axis
18	CCWP4	O	CCW pulse train output of 4th axis
19	ORG4+	I	Home of 4th axis (Encoder signal Z-phase +)
20	ORG4–	I	Home of 4th axis (Encoder signal Z-phase –)
21	PROX4	I	Home proximity of 4th axis
22	OT–4	I	CCW over-travel of 4th axis
23	OT+4	I	CW over-travel of 4th axis
24	—	—	(Connection disabled)
25	FG	—	Frame ground

◉ CN3 : Signal specifications (EXC21 and EXC31 type controller)

Table 16-24

Type	Item	Specification
Pulse train output signal	Output type	Open collector
	Source voltage	5 VDC ±10%
	Max. open/close current	30 mA
	Saturated voltage	1 V or less
Encoder Z-phase	Input type	Differential type line receiver
	Line receiver used	AM26LS32AC made by TI or equivalent
	Differential input threshold voltage	±0.2V
	Input impedance	220Ω
	Max. common phase input voltage	±7V
Over-travel origin proximity	Source voltage	24 VDC ±10%
	Input impedance	3.3 kΩ
	Input current (max.)	10 mA (per input)
	Over-travel signal type	B contact (normally closed), open collector output

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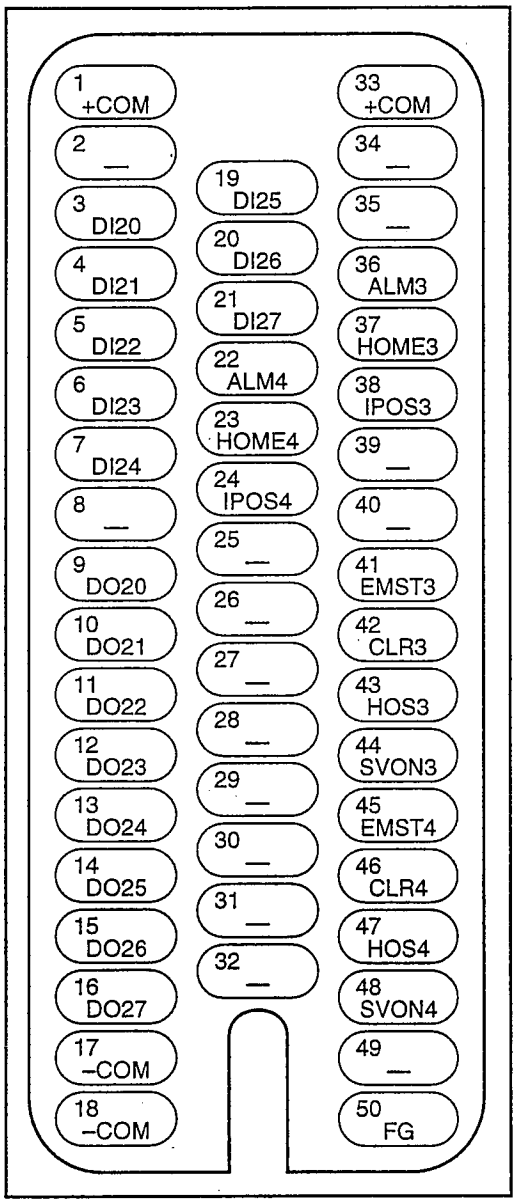
16.2.3.3. CN7 : Connector Specifications for Using Pulse Train Output (EXC20 and EXC30 type controller)

Table 16-25

Connector on EXC controller	MR-50RFA made by HONDA COMMUNICATION CO.
Applicable connector (Prepared by user)	MR-50M made by HONDA COMMUNICATION CO.
Applicable cover (Prepared by user)	MR-50L made by HONDA COMMUNICATION CO.

◉ CN7 : Pin assignment and name of signals (EXC20 and EXC30 type controller)

Figure 16-18: Pin assignment (CN7)



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Table 16-26 : Name of signals (CN7)

Pin	Signal name	I/O	Description
1	+COM	I	Input common
2	—	—	(Connection disabled)
3	DI20	I	Bit 0 of general input port 2
4	DI21	I	Bit 1 of general input port 2
5	DI22	I	Bit 2 of general input port 2
6	DI23	I	Bit 3 of general input port 2
7	DI24	I	Bit 4 of general input port 2
8	—	—	(Connection disabled)
9	DO20	O	Bit 0 of general output port 2
10	DO21	O	Bit 1 of general output port 2
11	DO22	O	Bit 2 of general output port 2
12	DO23	O	Bit 3 of general output port 2
13	DO24	O	Bit 4 of general output port 2
14	DO25	O	Bit 5 of general output port 2
15	DO26	O	Bit 6 of general output port 2
16	DO27	O	Bit 7 of general output port 2
17	–COM	O	Output common
18	–COM	O	Output common
19	DI25	I	Bit 5 of general input port 2
20	DI26	I	Bit 6 of general input port 2
21	DI27	I	Bit 7 of general input port 2
22	ALM4	I	Alarm of 4th axis
23	HOME4	I	Home Return completion of 4th axis
24	IPOS4	I	Positioning completion of 4th axis
25	—	—	(Connection disabled)
26	—	—	(Connection disabled)
27	—	—	(Connection disabled)
28	—	—	(Connection disabled)
29	—	—	(Connection disabled)
30	—	—	(Connection disabled)
31	—	—	(Connection disabled)
32	—	—	(Connection disabled)
33	+COM	I	Input common
34	—	—	(Connection disabled)
35	—	—	(Connection disabled)
36	ALM3	I	Alarm of 3rd axis
37	HOME3	I	Home return completion of 3rd axis
38	IPOS3	I	Positioning completion of 3rd axis
39	—	—	(Connection disabled)
40	—	—	(Connection disabled)
41	EMST3	O	Emergency stop of 3rd axis
42	CLR3	O	Position error counter clear of 3rd axis
43	HOS3	O	Start of home return motion of 3rd axis
44	SVON3	O	3rd axis servo ON
45	EMST4	O	Emergency stop of 4th axis
46	CLR4	O	Position error counter clear of 4th axis
47	HOS4	O	Start of home return motion of 4th axis
48	SVON4	O	4th axis servo ON
49	—	—	(Connection disabled)
50	FG	—	Frame ground

◉ CN7 : Signal specifications (EXC20 and EXC30 type controller)

Table 16-27

Type	Item	Specification
Input signal	Input type	Photo-coupler
	Input voltage	24 VDC ±10%
	Input impedance	3.3 kΩ
	Input current (max.)	10 mA
Output signal	Output type	Photo-coupler
	Max. open/close capacity	24 VDC/100 mA
	Saturation voltage	2 V or less

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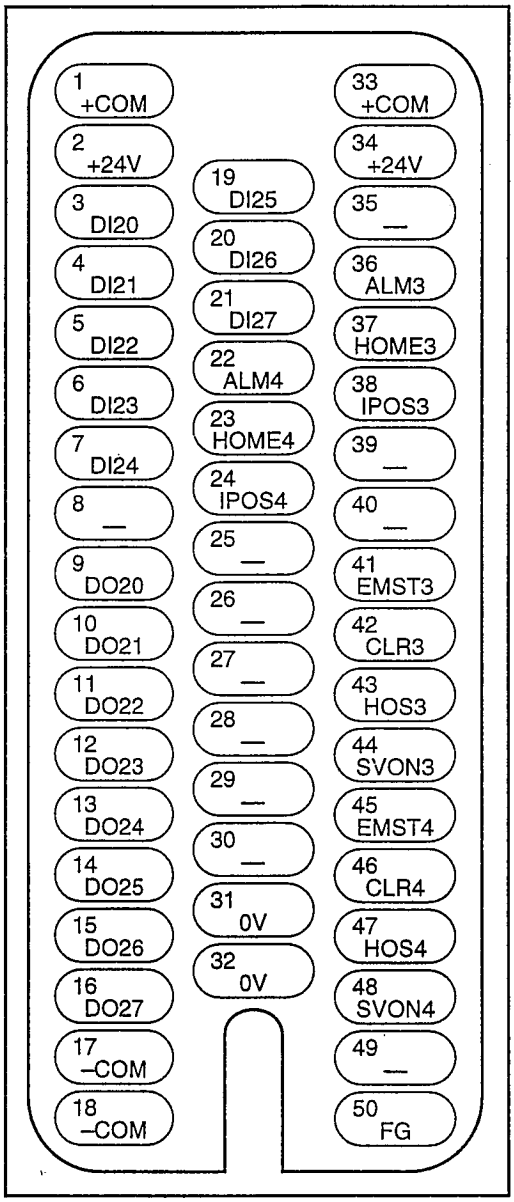
16.2.3.4. CN7 : Connector Specifications for Using Pulse Train Output (EXC21 and EXC31 type controller)

Table 16-28

Connector on EXC controller	MR-50RFA made by HONDA COMMUNICATION CO.
Applicable connector (Prepared by user)	MR-50M made by HONDA COMMUNICATION CO.
Applicable cover (Prepared by user)	MR-50L made by HONDA COMMUNICATION CO.

◉ CN7 : Pin assignment and name of signals (EXC21 and EXC31 type controller)

Figure 16-19: Pin assignment (CN7)



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Table 16-29 : Name of signals (CN7)

Pin	Signal name	I/O	Description
1	+COM	I	Input common
2	+24V	O	Positive output of built-in 24 VDC power
3	DI20	I	Bit 0 of general input port 2
4	DI21	I	Bit 1 of general input port 2
5	DI22	I	Bit 2 of general input port 2
6	DI23	I	Bit 3 of general input port 2
7	DI24	I	Bit 4 of general input port 2
8	—	—	(Connection disabled)
9	DO20	O	Bit 0 of general output port 2
10	DO21	O	Bit 1 of general output port 2
11	DO22	O	Bit 2 of general output port 2
12	DO23	O	Bit 3 of general output port 2
13	DO24	O	Bit 4 of general output port 2
14	DO25	O	Bit 5 of general output port 2
15	DO26	O	Bit 6 of general output port 2
16	DO27	O	Bit 7 of general output port 2
17	–COM	O	Output common
18	–COM	O	Output common
19	DI25	I	Bit 5 of general input port 2
20	DI26	I	Bit 6 of general input port 2
21	DI27	I	Bit 7 of general input port 2
22	ALM4	I	Alarm of 4th axis
23	HOME4	I	Home return completion of 4th axis
24	IPOS4	I	Positioning completion of 4th axis
25	—	—	(Connection disabled)
26	—	—	(Connection disabled)
27	—	—	(Connection disabled)
28	—	—	(Connection disabled)
29	—	—	(Connection disabled)
30	—	—	(Connection disabled)
31	0V	O	Negative output of built-in 24 VDC power
32	0V	O	Negative output of built-in 24 VDC power
33	+COM	I	Input common
34	+24V	O	Negative output of built-in 24 VDC power
35	—	—	(Connection disabled)
36	ALM3	I	Alarm of 3rd axis
37	HOME3	I	Home return completion of 3rd axis
38	IPOS3	I	Positioning completion of 3rd axis
39	—	—	(Connection disabled)
40	—	—	(Connection disabled)
41	EMST3	O	Emergency stop of 3rd axis
42	CLR3	O	Position error counter clear of 3rd axis
43	HOS3	O	Start of Home Return motion of 3rd axis
44	SVON3	O	3rd axis servo ON
45	EMST4	O	Emergency stop of 4th axis
46	CLR4	O	Position error counter clear of 4th axis
47	HOS4	O	Start of Home Return motion of 4th axis
48	SVON4	O	4th axis servo ON
49	—	—	(Connection disabled)
50	FG	—	Frame ground

◉ CN7 : Signal specifications (EXC21 and EXC31 type controller)

Table 16-30

Type	Item	Specification
Input signal	Input type	Photo-coupler
	Input voltage	24 VDC ±10%
	Input impedance	3.3 kΩ
	Input current (max.)	10 mA
Output signal	Output type	Photo-coupler
	Max. open/close capacity	24 VDC/100 mA
	Saturation voltage	2 V or less

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16.2.4. Wiring Examples

- See " 9. Wiring" for details of wiring. This section provides descriptions related to the pulse train output function only.

16.2.4.1. Wiring Example List

Table 16-31 : Wiring example list

EXC controller type	Axes to be controlled	Home position & over-travel control	
		Home return motion and over-travel are controlled by EXC controller.	Home return motion and over-travel are controlled by pulse train input unit.
EXC20 EXC21	Built-in dual-axis drive + single-axis pulse train output	• Single-axis pulse train output is given by the following axis: Third axis: (if the Z-axis is selected) Fourth axis: (if the R-axis is selected) • Selecting the third or fourth axis is shown in "16.3.2. Setting of Pulse Train Output Function." • Refer to wiring example 1 or 2.	• Single-axis pulse train output is given by the following axis: Third axis: (if the Z-axis is selected) Fourth axis: (if the R-axis is selected) • Selecting the third or fourth axis is shown in "16.3.2. Setting of Pulse Train Output Function." • Refer to wiring example 3 or 4.
	Built-in dual-axis servo driver + dual-axis pulse train output	• Dual-axis pulse string output is given by the following axis: Third axis: Z-axis Fourth axis: R-axis • Refer to wiring example 1 or 2.	• Dual-axis pulse train output is given by the following axis: Third axis: Z-axis Fourth axis: R-axis • Refer to wiring example 3 or 4.
EXC30 EXC31	Built-in triple-axis servo driver + single-axis pulse train output	• Single-axis pulse train output is given by the R-axis. • Refer to wring example 2.	• Single-axis pulse train output is given by the R-axis.

16.2.4.2. Precautions for Wiring

Caution : Make sure to follow the precautions described below to avoid the affections of noise.

(1) Be sure to use twisted pair of shielded wires for the pulse train output signals CWP and CCWP. Connect the shields to the FG terminal on the EXC controller normally.

(2) Use shielded wires for control I/O signals of CN7 connector. In general, the shields are connected to the FG terminal on the EXC controller. However, anti-noise performances may be improved by connecting them to the FG terminal on the pulse train input unit in some cases.
(Do not connect them to the FG terminals on both units.)

(3) Make the wiring cable short as much as you can. (at most 2m or less)

- It is possible to select the Home Return operation which does not use the Home position proximity(PROX) input.* In such case, the PROX input need not to be connected.

* It is selected by using "Home mode" which are described in " 16.3.3.2. Parameters of Home Return Operation for Pulse Train Output ."

- The wiring examples shown hereafter are described for the rack mount type controllers EXC20 and EXC30. The stand-alone type controllers EXC21 and EXC31 have built in 24 VDC power supply unit and require no power supply wiring.

Table 16-32

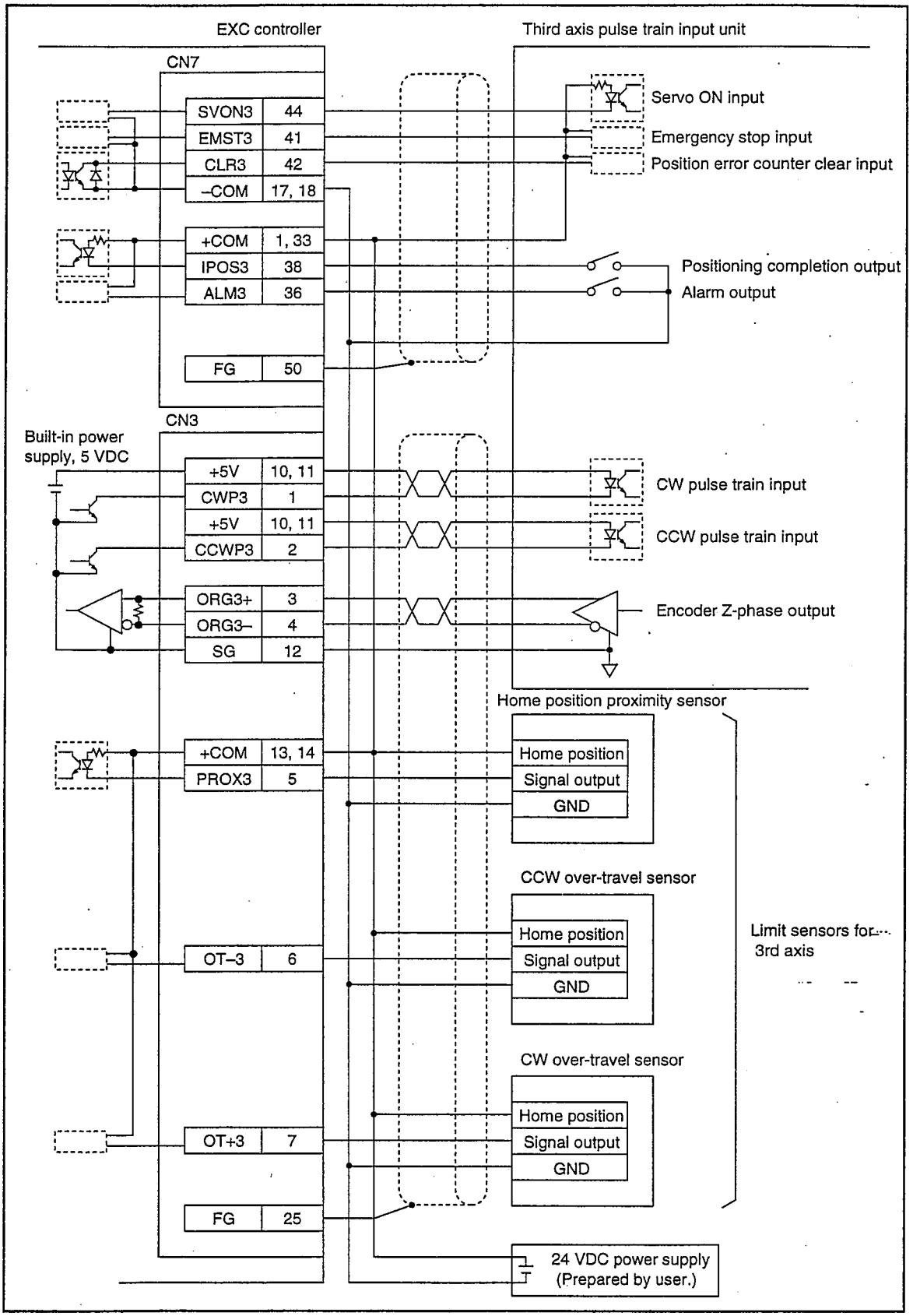
CN7	+24V	Pins 2, 34
	0V	Pins 31, 32
CN3	+24V	Pin 15
	0V	Pin 9

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16.2.4.3. Wiring Example 1

- If the selected Home Return operation does not require the PROX input, the PROX input wiring is needless.
- The stand-alone type controllers EXC21 and EXC31 have built-in 24VDC power supply units and require no power supply wiring.

Figure 16-20 : Wiring Example 1

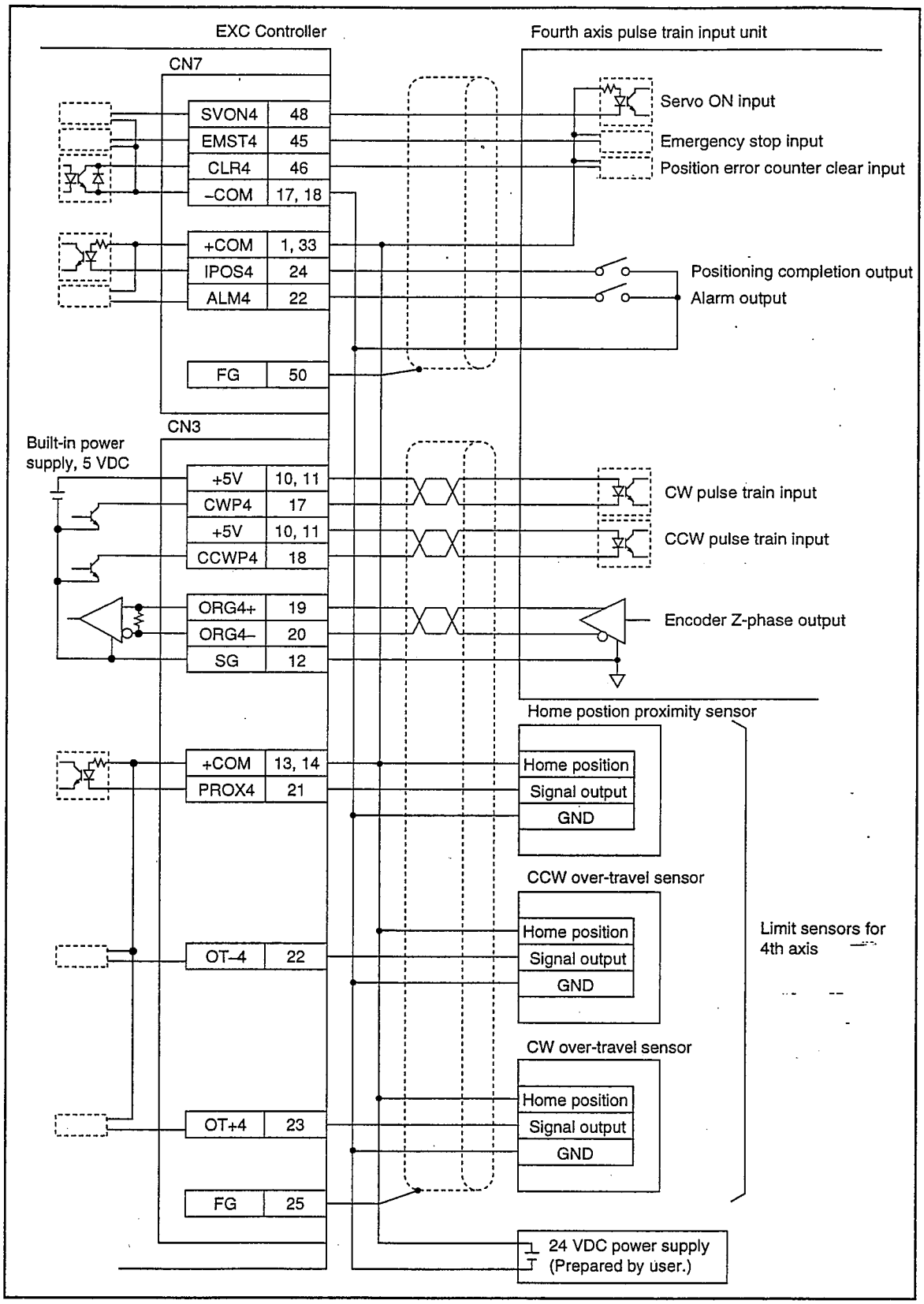


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16.2.4.4. Wiring Example 2

- If the selected Home Return operation does not require the PROX input, the PROX input wiring is needless.
- The stand-alone type controllers EXC21 and EXC31 hove built-in 24VDC power supply units and require no power supply wiring.

Figure 16-21: Wiring example 2

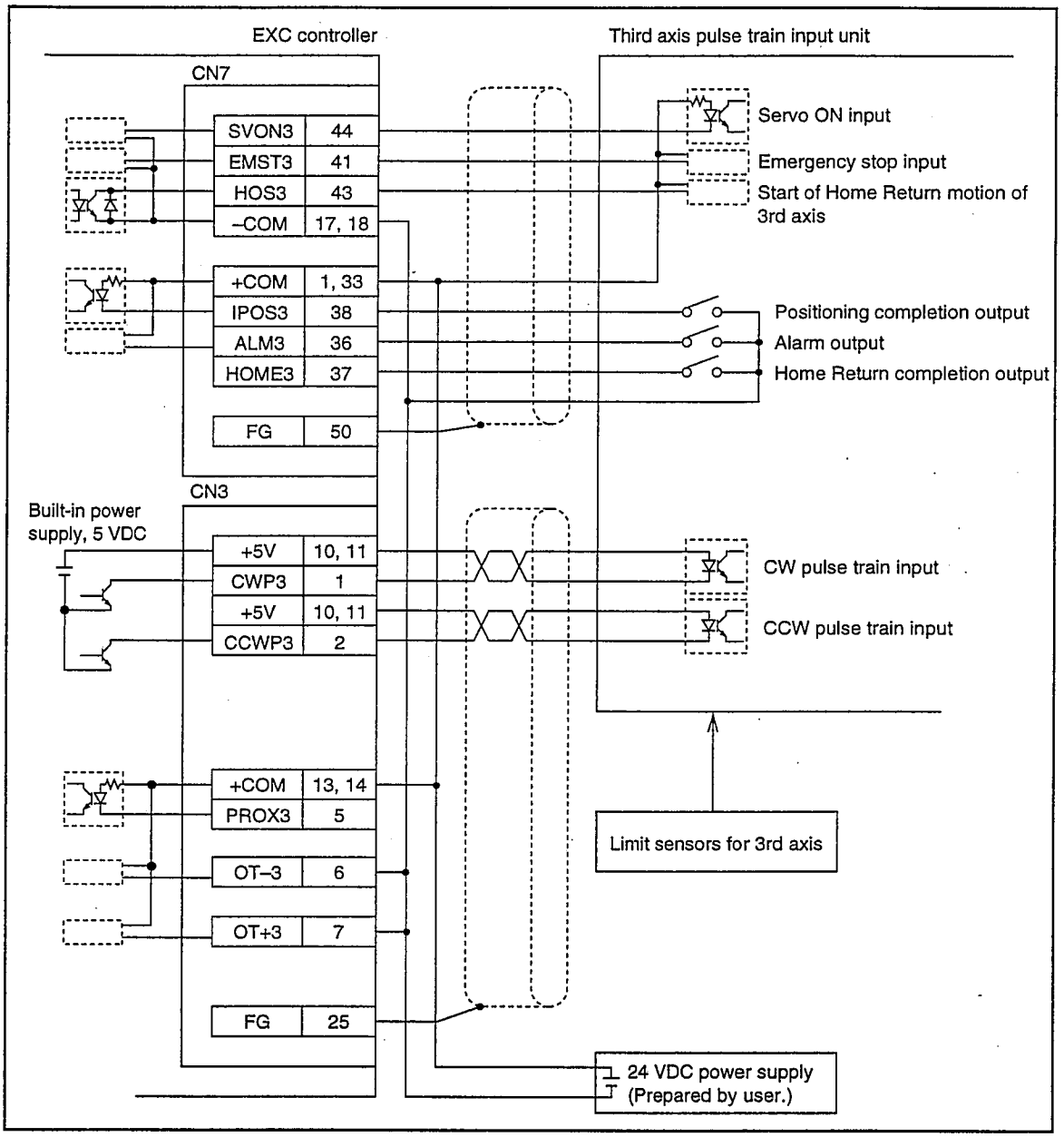


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16.2.4.5. Wiring Example 3

- The stand-alone type controllers EXC21 and EXC31 have built-in 24VDC power supply units and require no power supply wiring.

Figure 16-22 Wiring example 3

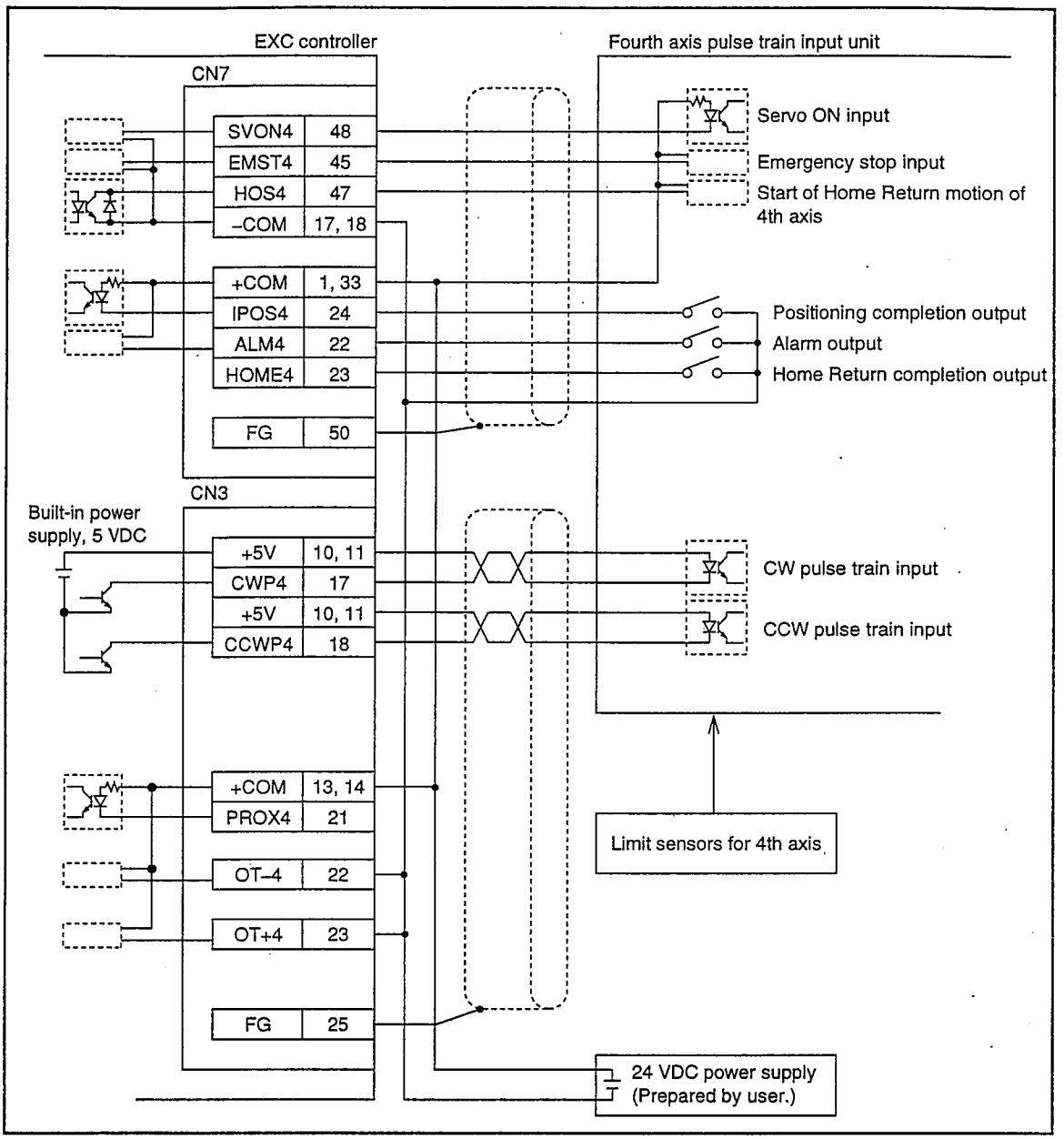


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16.2.4.6. Wiring Example 4

- The stand-alone type controllers EXC21 and EXC31 have built-in 24VDC power supply units and require no power supply wiring.

Figure 16-23 Wiring example 4



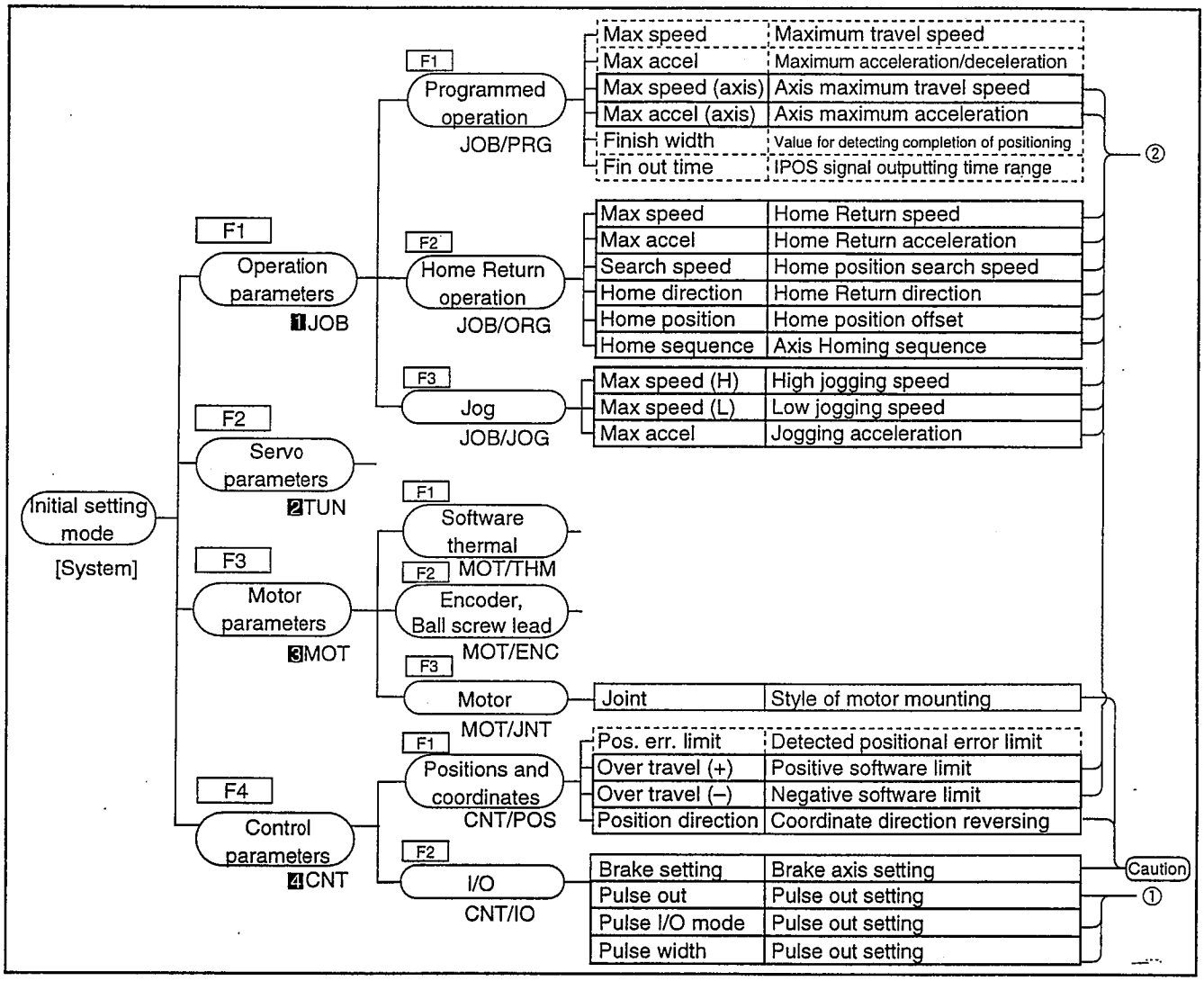
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16.3. Start Up and Initial Setting of Pulse Train Output

- Start up EXC controller by referring to "10. Start Up."
- Initial setting is required for the pulse train output as well as built-in servo-driver axis.
- Servo-parameter of pulse train output axis does not need to be adjusted on EXC controller. Adjust it on the pulse train input unit.

16.3.1. Initial Setting List of Pulse Train Output

Figure 16-24



①First, set the pulse train output functions. Then, you can set the initial setting for the pulse train output.

②Set data of the pulse train output.

Caution : *Keep the three following items unchanged from the factory settings, although you can set for the pulse train output when the pulse train output function is validated. If the settings are changed, unexpected system movement could occur.*

- Joint: Motor mounting direction
- Position direction: Coordinate ± direction reversion
- Brake setting: Setting the axis with brake

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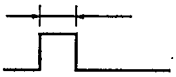
Table 16-33 : Initial setting list of pulse train output

Item 1	Item 2	Item 3	Unit	Setting range	Factory set	Set value	
						Z axis	R axis
Operation parameters (JOB)	Programmed operation (PRG)	Max speed (axis)	kpps	0.1~100.0	50.0		
		Max accel (axis)	Mpps²	0.01~35.00	0.5		
	Home Return operation (ORG)	Max speed	kpps	1~50.0	10.0		
		Max accel	Mpps²	0.01~35.00	0		
		Search speed	kpps	0.1~10.0	1.0		
		Home direction		0 or 1	0		
		Home position	pulse	-9999999 +9999999	0		
		Home sequence		1,2,3,4	– – –		
		Home mode		0,1,2	0		
		Home ORG mode		0,1	0		
	Jog (JOG)	Max speed (L)	kpps	0.1~100.0	20		
		Max speed (H)	kpps	0.1~100.0	40		
		Max accel	Mpps²	0.01~35.00	0		
Motor parameters (MOT)	Motor (POS)	Joint		0 or 1	0	Do not change	
Control parameters (CNT)	Position and coordinates (POS)	Over travel (+)	pulse	-9999999 +9999999	××××.×		
		Over travel (–)	pulse	-9999999 +9999999	××××.×		
		Pos.direction		0,1	0	Do not change	
	Input/Output (IO)	Brake setting		0,1	0	Do not change	
		Pulse out		0,1	0		
		Pulse I/O mode		0,1	0		
		Pulse width	μs	1,10	10		

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16.3.2. Setting of Pulse Train Output Function

Table 16-34

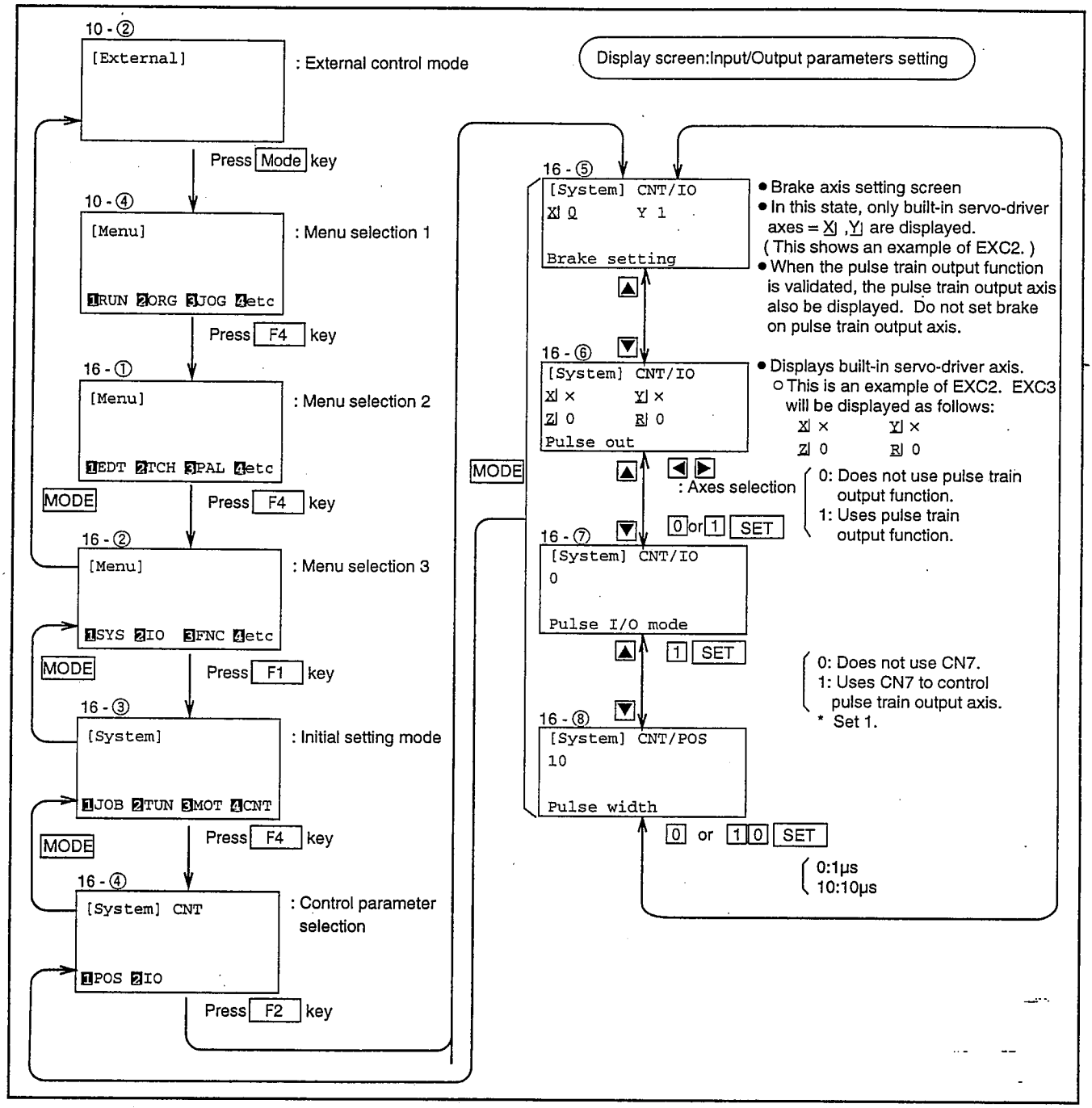
Item	Description	Setting range	Factory set
Pulse out	• Specify whether or not to use the pulse train output function. 0 : Not to use pulse train output function 1 : Use pulse train output function • The pulse train output function is not activated at the time of shipment. Only the axes of the built in servo driver are displayed on the program and teaching screen. • Following procedures activates the function and pulse train output is displayed in the screen.	0, 1	0
Pulse I/O mode	• Specify whether or not to use CN7 connector as the pulse train input unit control I/O. 0 : Not to use CN7 1 : Use CN7 • Proper control is normally impossible if CN7 is not used. Specify 1 to use CN7. • If CN7 is used for pulse train input unit control, each eight general I/O ports are reduced. (32 → 42) • See "16.2. Specifications of Signals Related to Pulse Train Output" for details of CN7 I/O functions.	0, 1	0
Puls width	• Specify the pulse width of pulse train. 1 : μs 10 : 10μs  • If the pulse width is set to 10μs, the maximum frequency of pulse output is limited to 50 kpps. Select 1 μs.	1, 10	10

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◉ Pulse train output function setting procedure

- Get I/O parameter setting screen by referring to "11.5.2.2 Parameter Setting Procedure."
- You can set pulse train I/O function by pushing key ▼ on the brake axis setting screen of the I/O parameter setting screen.

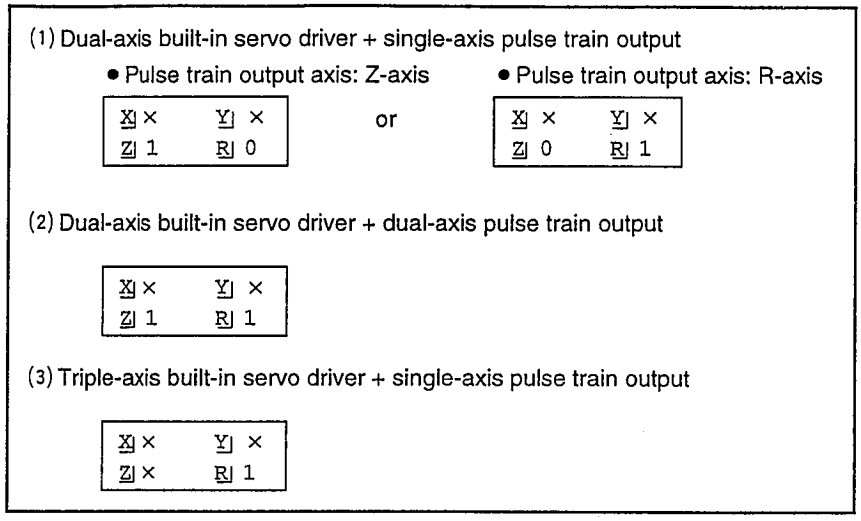
Figure 16-25



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◉ Pulse out parameter setting procedures

Figure 16-26 : Setting example



- Once the pulse train output function is activated, all axes including the pulse train output axis are displayed.

Example

Type EXC2 controller → Additional pulse string output axis is specified.

```
X 0000.00   Y 0000.00        X 0000.00   Y 0000.00
                             Z 0000000
```

* The pulse train output axis is not displayed on the gain setting screen or other screens for which the pulse train output function is meaningless (since the gain of the pulse train output axis is controlled on the pulse train input unit).

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16.3.3. Initial Setting of Pulse Train Output

- Initial setting of the pulse train output is necessary as built-in servo driver. Procedures are same as the built-in servo driver unit. Refer to "11. Initial Setting" for initialization.
- This section provides description related to the pulse train output only.
- The initial setting of pulse train output is disabled unless pulse train output function is activated (i.e., the pulse train output axis is set to 1) in the procedures shown in " 16.3.2. Setting of Pulse Train Output Function."

16.3.3.1. Programmed Operation Parameters

Table 16-35 : Programmed operation parameter

Item	Description	Units	Range	Default value
Max speed	• Not related to the pulse train output.	—	—	—
Max accel	• Not related to the pulse train output.	—	—	—
Max speed (axis)	• Specify the maximum speed of the pulse train output axis. • The speed during programmed operation is found as shown below: * For the VEL command, refer to "13.2.5. Program command". [This set value] × VEL command value* (%) • If a speed higher than 50 kpps is needed, set Pulse width to 1 in the setting shown in "16.3.2. Setting of Pulse Train Output Function".	kpps	0.1 to 200.0	50.0
Max accel (axis)	• Specify the maximum acceleration and deceleration of the pulse train output. • The acceleration and deceleration during programmed operation are found as shown below: * For the ACC command, refer to "13.2.5. Program command".	$Mpps^2$	0.01 to 35.00	0.50
Finish width	• Not related to the pulse train output axis. [This set value] × ACC command value* (%)	—	—	—
Fin out time	• The IPOS output of CN2 is closed for the set time of this parameter when positioning of all axes including the pulse train output axis is completed. • For completion of positioning, see "14.5.2. Positioning Completion Output (IPOS)" and "16.2.2.2. CN7 Signal Specification".	Second	0.00 to 99.99 or XX.XX	0.10

◉ Setting procedures

- The only difference in setting is that the pulse train output function is added (i.e., setting of the pulse train output is also enabled). Refer to "11.3.1. Programmed Operation Parameters".

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16.3.3.2. Home Return Parameters

Table 16-36 : Home Return parameters

Item	Description	Units	Range	Factory setting
Max speed	• Specifies the speed of Home Return.	kpps	0.1 to 50.0	10.0
Max accel	• Specifies the acceleration/deceleration of Home Return.	$Mpps^2$	0.01 to 35.00	0.50
Home direction	• Specifies the direction of Home Return. 0: CCW 1: CW	—	0, 1	0
Home position	• Specifies the Home position data (which corresponds to the offset value).	Pulse	–999999 to +999999	0
Home sequence	• Specifies the order of Home Return of all axes including the pulse train output. • Axes of smaller values move earlier.	—	1 to 4	3 or 4
Home mode	• Specifies the type of Home returning motion as shown below. 0: PROX (proximity to Home position) is not used. 1: PROX is used. 2: Pulse train input unit executes Home Return motion.	—	0, 1, 2	0
Home ORG mode	• Specifies the type of Home returning motion as shown below. 0: ORG input is used. 1: ORG input is not used.	—	0, 1	0

* For the types of home returning motions, see "16.5.2. Home Return Function".

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◉ Setting procedures

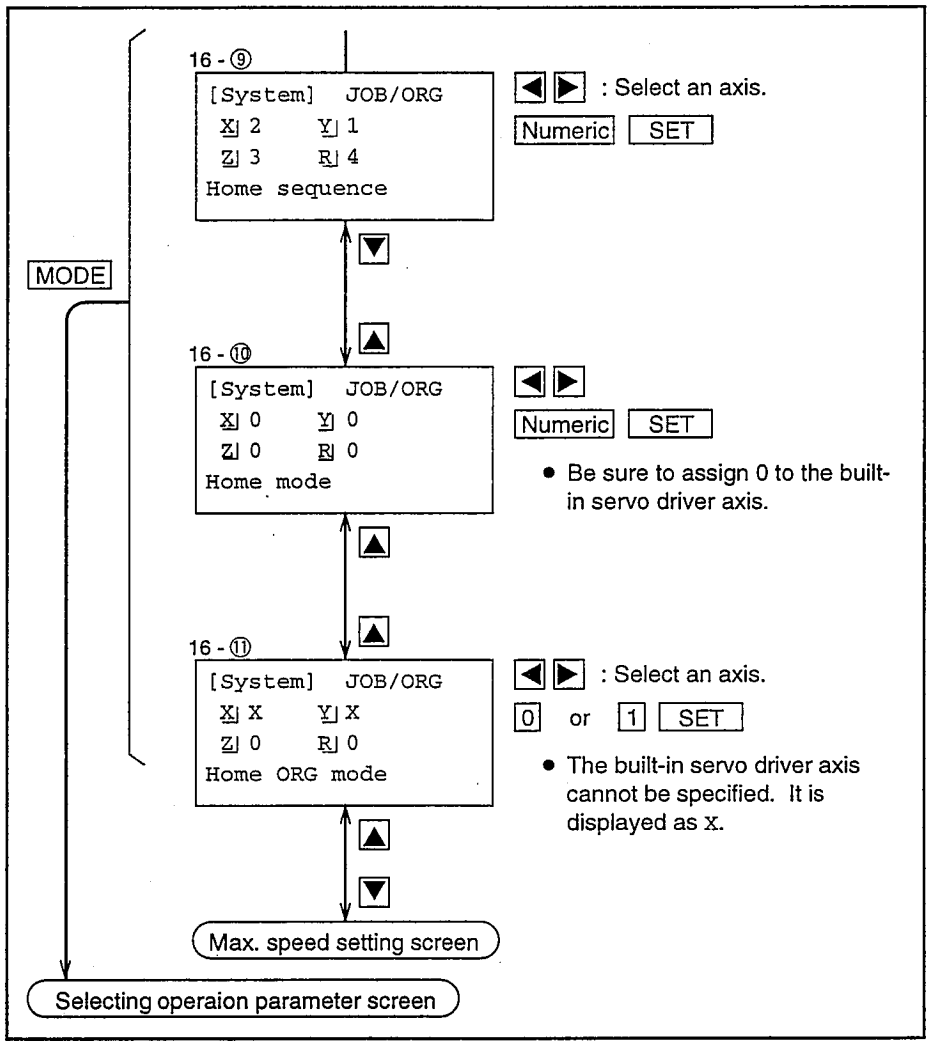
- The Home mode and Home ORG mode setting screens will not appear unless the pulse train output function is activated.

- The setting procedures are shown below.

  (1)Refer to "11.3.2. Parameters for Home Return." Carry out settings up to the Home sequence.

  (2)On 16-⑨ screen, press ▼ key to move to Home mode and Home ORG mode setting screen.

Figure 16-27



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16.3.3.3. Jog Parameters

- Setting items and descriptions are the same as built-in serve driver axes.

Table 16-37 : Jogging parameters list

Item	Description	Units	Range	Default value
Max speed (L)	• Specifies the jog operation speed.	kpps	0.1 to 200.0	20
Max speed (H)	• Specifies the speed when both the jog and HIGH keys are pressed in jogging.	kpps	0.1 to 200.0	40
Max accel	• Specifies the acceleration and deceleration in jogging.	Mpps^2	0.01 to 35.00	0.50

◉ Setting procedure

- The only difference in setting is that the pulse train output axis is added (i.e., setting of the pulse train output is also enabled). Refer to "11.3.2.2. Setting Procedures" in the jog parameters.

16.3.3.4. Position and Coordinate Parameters

- Set the items related to software over travel limit if necessary.

Table 16-38

Item	Description	Unit	Setting range	Factory set
Pos.err.limit	• Not related to the pulse train output.	–	–	–
Over travel (+) Over travel (–)	• Over travel (+) : Specifies the software over travel value in the positive direction. • Over travel (–) : Specifies the software over travel value in the negative direction. • See "18.3.3. Derection of Over Travel."	mm	–9999.99 ~ 9999.99 or ××××.××	××××.××
Position direction	• Specifies the positive or negative direction of coordinates of each axis. • For pules train output, leave this item as the factory set.	–	0 or 1	0

◉ Setting procedure

- The only difference in setting is that the pulse train output axis is added (i.e., setting of the pulse train output is also enabled). Refer to " 11.5.1.2. Setting Procedures" in position and coordinate parameters.

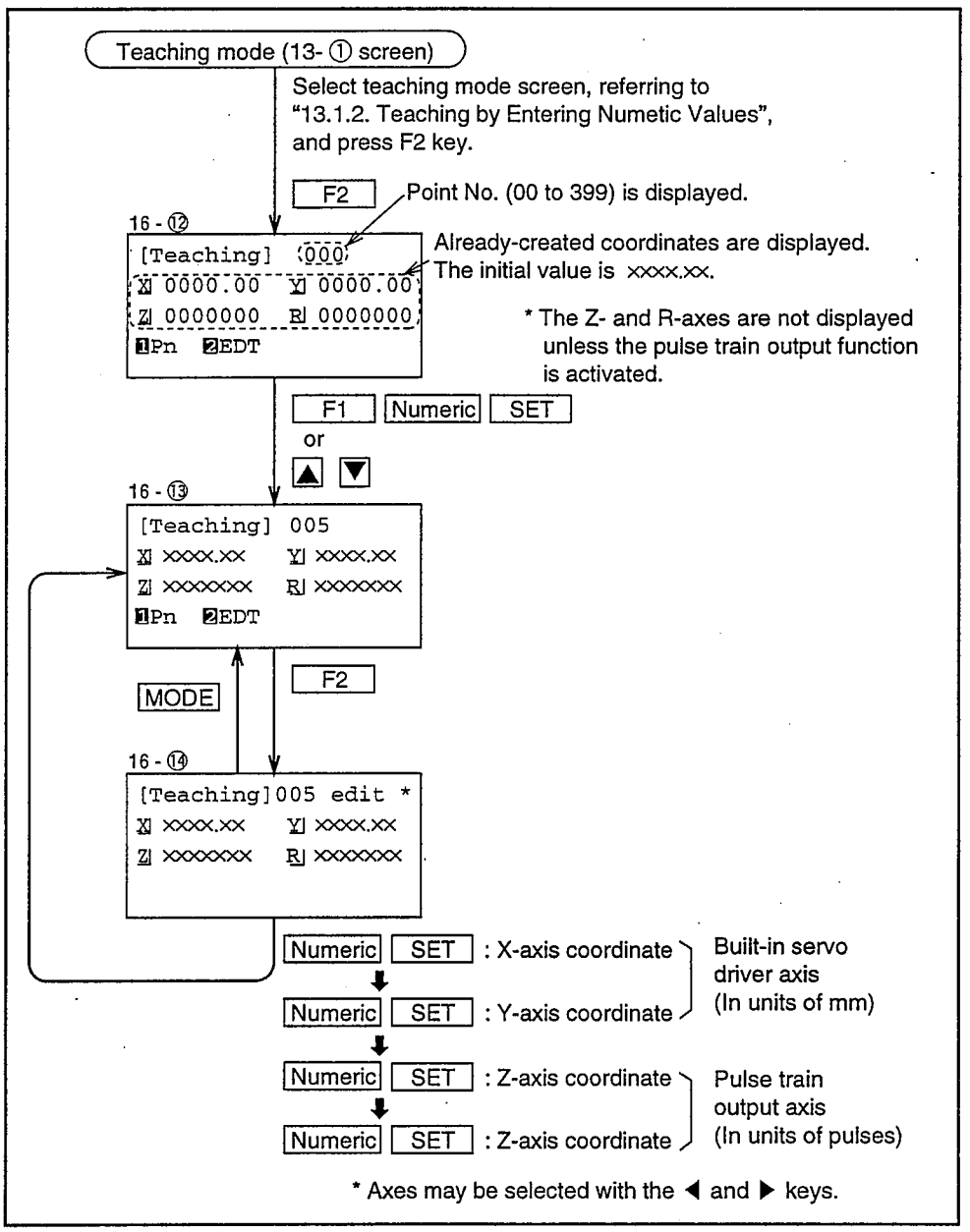
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16.4. Programming and Teaching

- When the pulse train output function is activated, the pulse train output axis is displayed on the teaching box screen, allowing programming and teaching. (See "16.3.2. Setting of Pulse Train Output function.")
- The programming and teaching procedures are the same as those of built-in servo driver axis. Refer to " 13. Programming."
- Programming and teaching are conducted in units of pulses.

◉ Example of teaching : Dual-axis built-in servo driver + dual-axis pulse train output

Figure 16-28 : Teaching



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16.5. Operation of Pulse Train Output

- Start up EXC controller and pulse train input unit.
- For the start up of EXC controller, see "10. Start Up."
  Check also the pulse train output axis for wiring.

Caution : *If the wiring has an error, alarm or unexpected system movement could occur.*

- For the start up of the pulse train input unit. follow the rules on the pulse train input unit side.

16.5.1. Operation Procedure

- Follow the same operation procedure as the axis built in the servo-driver. For details, see "14. Operation."
- For the relationship between pulse train axis and jog key axis symbol in jogging operation procedure by teaching box, see "16.1. Outline of Pulse Train Output Function and Notes."

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16.5.2. Home Return Function of Pulse Train Output

- The EXC controller has the below-shown functions for Home Return of pulse train output.
- For the selection and setting of these function, see " 16.3.3.2. Home Return Parameters."

Table 16-39 : Home Return functions

<table>
<tr><th>Type</th><th>Initial set item</th><th>Description</th></tr>
<tr><td>Home Return speed & acceleration/ deceleration</td><td>Max speed
Max accel</td><td>• Speed and acceleration/deceleration of returning to the Home position are variable.</td></tr>
<tr><td>Home position searching speed</td><td>—</td><td>• Home positions are searched for at 1 kpps.</td></tr>
<tr><td>Home Return direction</td><td>Home direction</td><td>• Home Return direction may be reversed.</td></tr>
<tr><td>Home position data</td><td>Home position</td><td>• Coordinates of the end point of the home return motion may be specified. (The home position is shifted.)
Example: If the home position data is 0 (factory set), the Home Return motion is completed at the Home position. If the Home position data is set to −100 pulses, −100 is set for the end point of the Home Return motion and, as a result, the Home position is shifted by +100 pulses.</td></tr>
<tr><td>Order of Home Return axes</td><td>Home sequence</td><td>• The order of all axes including the built-in servo driver axis which return to the Home position can be specified. Each axis returns to the Home position in sequence. All axes cannot return to the Home position simultaneously. Axes of smaller set values return to the Home position earlier.</td></tr>
<tr><td>Home Return type</td><td>Home mode
Home ORG mode</td><td>• Types of Home Return motions may be selected.
<table>
<tr><th>Home Return control</th><th>PROX</th><th>ORG</th><th>Description</th><th>Type</th></tr>
<tr><td rowspan="4">EXC controller outputs pulse train to return the axes to the Home position.</td><td rowspan="2">Used.</td><td>Used.</td><td>• Normal Home Return motion.</td><td>Type I</td></tr>
<tr><td>Not used.</td><td>• Select this if the pulse train input unit cannot output the ORG (Z-phase) signal.</td><td>Type II</td></tr>
<tr><td rowspan="2">Not used.</td><td>Used.</td><td>• The OT (over-travel) input signal is used instead of the PROX (proximity to origin) signal. This type applies to the Home Return motion of the built-in servo driver axis.</td><td>Type III</td></tr>
<tr><td>Not used.</td><td>• Do not use this type usually.</td><td>—</td></tr>
<tr><td>EXC controller outputs the HOS (Home Return start) signal. The pulse train input unit executes Home Return motion according to the HOS signal.</td><td colspan="3">• This type of Home Return motion applies to NSK Megatorque motor systems and EXA controller systems.</td><td>Type IV</td></tr>
</table></td></tr>
</table>

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16.5.2.1. Home Return Motion Type I

- This is the normal Home Return motion based on the PROX (proximity to Home position) and ORG (Z-phase) input signal.

◉ Motor operation : (Typical operation Example 1 shown in Figure 16-29.)

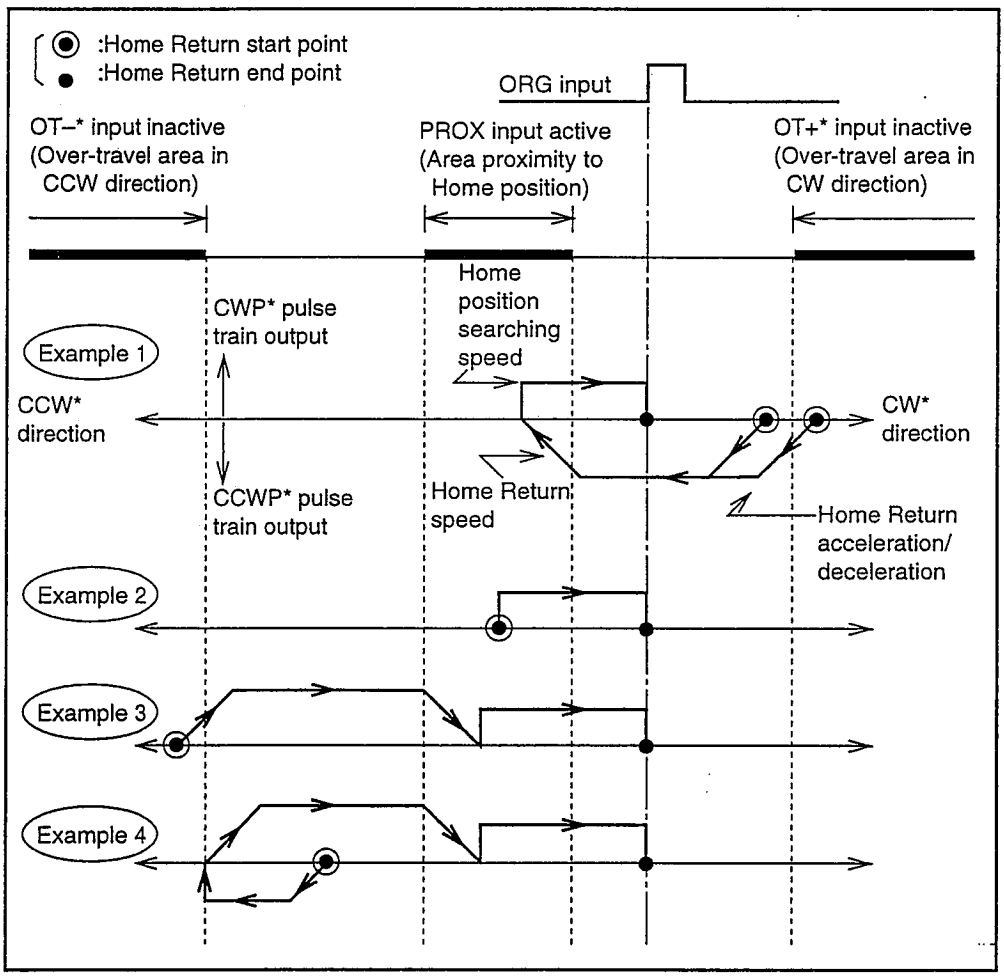
(1)When the Home Return motion is activated, a pulse train is output from the CCWP output. The motor is accelerated at the Home Return acceleration to the Home return speed in the CCW direction.

(2)When the PROX input sigmal goes active, the motor decelerates and stops. Then, it reverses its motion at the Home position speed.

(3)Pulse train output stops at the point where the ORG input signal changes after the PROX input signal goes inactive (i.e., the motor goes out of the proximity area of Home position), the CLR output is closed for 20 ms ± 5 ms, and the Home Return motion is completed.

(4)Operartion sequences differ with the start point of Home Return motions. See Examples 2 to 4 in Figure 16-29

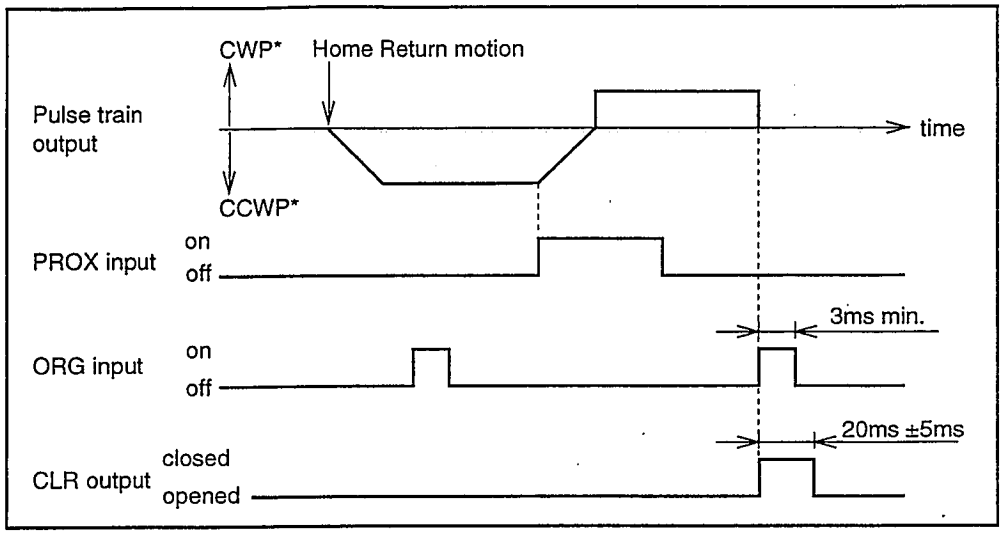
Figure 16-29



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◉ Timing chart (Typical operation example 1 shown in Figure 16-29)

Figure 16-30 : Timing chart



*If the Home Return direction is reversed, signals are also reversed as shown below.

CW⇔CCW, CWP⇔CCWP & OT+⇔OT-

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16.5.2.2. Home Return Motion Type Ⅱ

- Select this type if the pulse train input unit cannot output an ORG (Z-phase) signal. The Home Return motion is completed at the trailing edge of the PROX (proximity to Home position) input signal.

◉ Motor operation : (Typical operation example 1 shown in Figure 16-31)

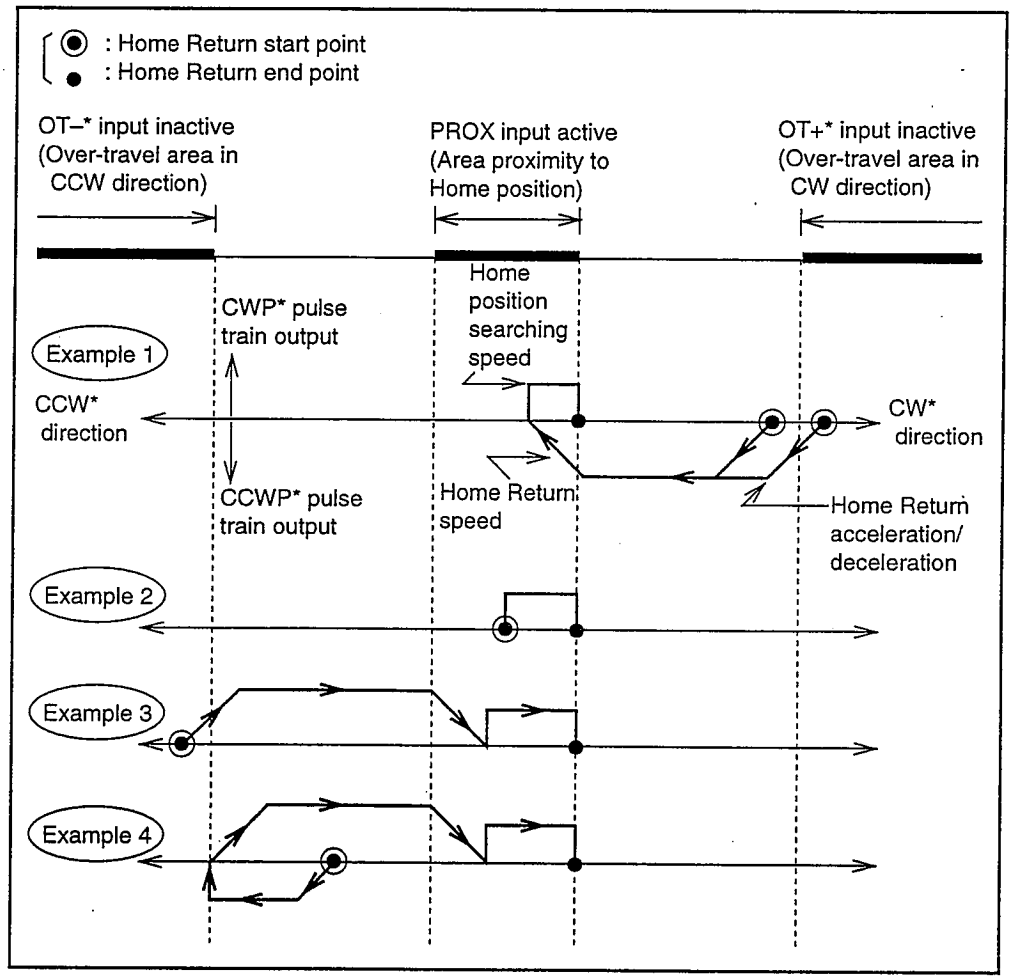
(1)When The Home Return motion is activated, a pulse train is output from CCWP output. The motor is accelerated at the Home Return acceleration to the Home Return speed in the CCW direction.

(2)When the PROX input signal goes active, the motor decelerates and stops. Then, it reverses its motion at the Home position searching speed.

(3)Pulse train output stops at the point where the PROX input signal goes inactive, the CLR output is closed for 20ms ± 5ms, and the Home Return motion is completed.

(4)Operation sequences differ with the start point of Home Return motions. See Examples 2 to 4 in Figure 16-31.

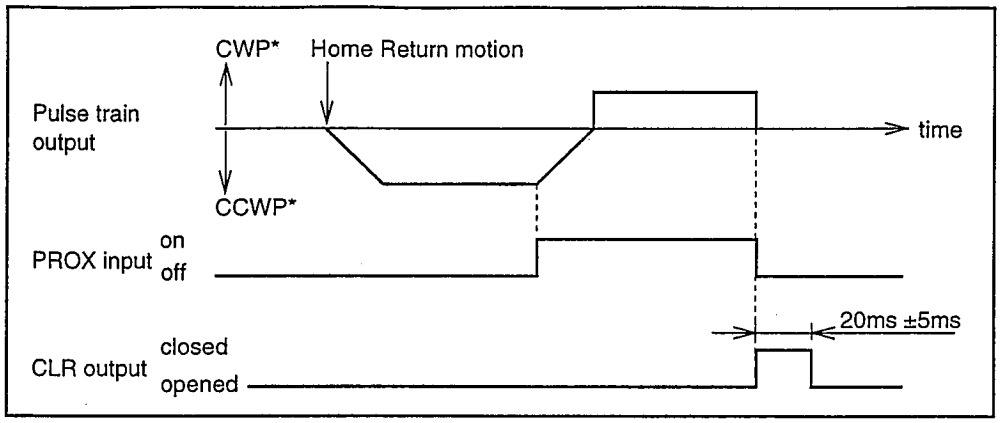
Figure 16-31



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◉ Timing chart (Typical operation example 1 shown in Figure 16-31)

Figure 16-32 Timing chart



*If the Home Return direction is reversed, signals are also reversed as shown below.

CW⇔CCW, CW⇔CCWP & OT+⇔OT–

16.5.2.3. Home Return Motion Type Ⅲ

- This type of Home Return motion uses the OT (over travel) input signal, instead of the PROX (proximity to Home position) input signal. Thus, the PROX sensor and wiring may be omitted.

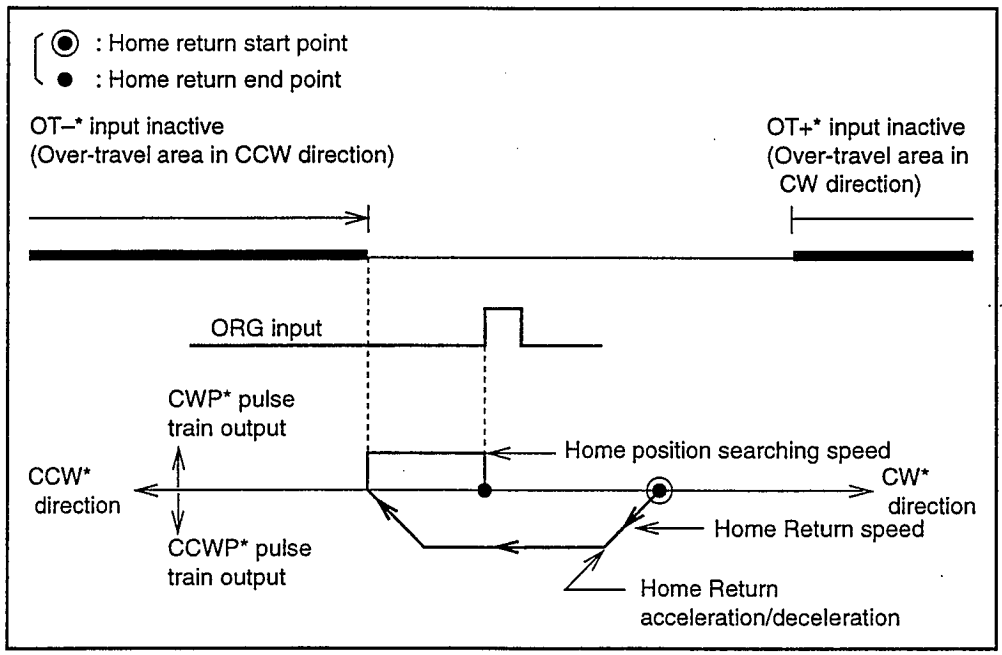
◉ Motor operation

(1)When a Home Return motion is activated, a pulse train from the CCWP output. The motor is accelerated at the Home Return acceleration to the Home Return speed in CCW direction.

(2)When the OT- input goes inactive, the motor stops immediately and reverses its motion at the Home position searching speed. (OT input : Normally closed B contact)

(3)When the ORG (Z-phase) signal changes for the first time after the motor motion is reversed and the OT– input goes active, pulse train output stops, the CLR output is closed for 20ms ± 5 ms, and the Home Return motion is completed.

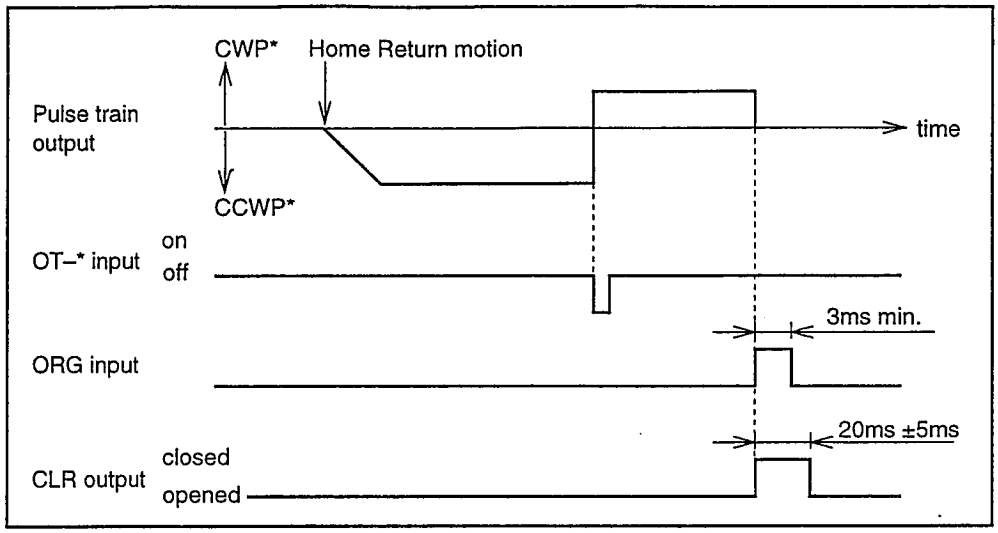
Figure 16-33



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◉ Timing chart

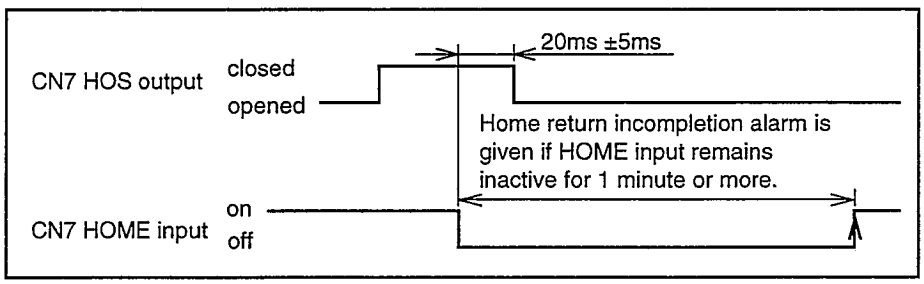
Figure 16-34 : Timing chart



16.5.2.4. Home Return Motion Type Ⅳ

- Use this type when the pulse train input unit has the Home Return function.

Figure 16-35



(1)When the Home Return motion is activated, the HOS output of CN7 is closed.

(2)When the HOS output is closed, the pulse train input unit should start the Home Return motion and should activate the HOME input on completion of the Home Return motion.

(3)When the HOS output is closed, the EXC controller waits until the HOME input goes active. When the HOME input goes active, the Home Return motion is completed. If the HOME input does not go active within a minute, an Home Return alarm is given.

* The HOS output will not be opened if the HOME input remains active. It remains closed for 20 ± 5 ms after the HOS output goes inactive, then it opens. If the HOME input is inactive from the beginning, the HOS output is closed for 20 ± 5ms from the leading edge of the HOS output, then it opens.

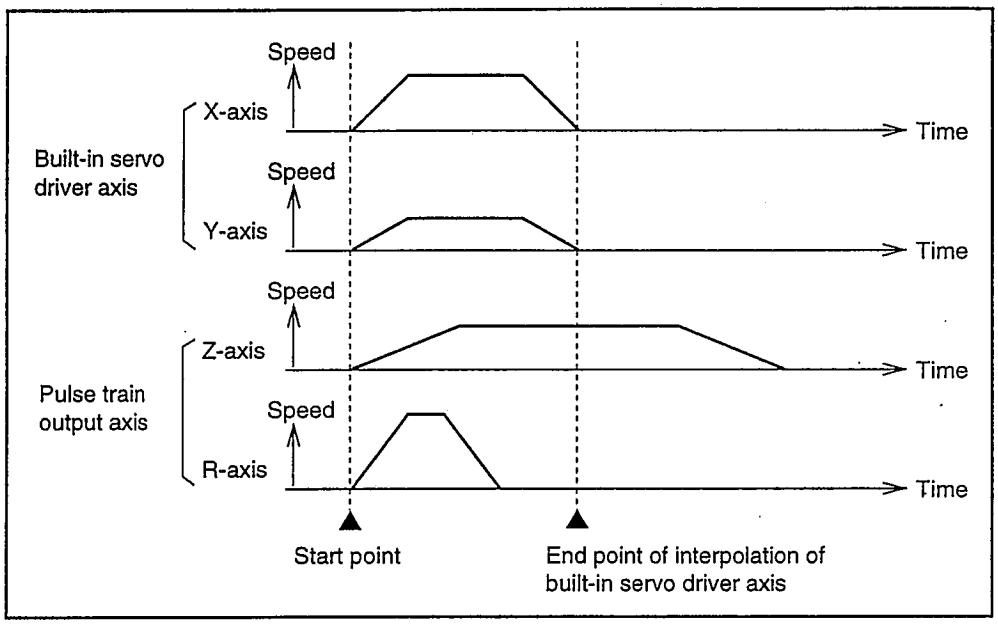
* The HOME input is detected at the leading edge after the HOS is output.

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16.5.3. Interpolation of Pulse Train Output

- Interpolation between the built-in servo driver axes and pulse train output axes or between the pulse train output axes is impossible.

Figure 16-36 : Example



- The pulse train output axis outputs pulse train according to a pattern which is determined by the preset acceleration,speed and programmed number of move pulses.

- Acceleration and speed may be set by Max speed (axis) and Max accel (axis) in "16.3.3.1. Programmed Operation Parameters."

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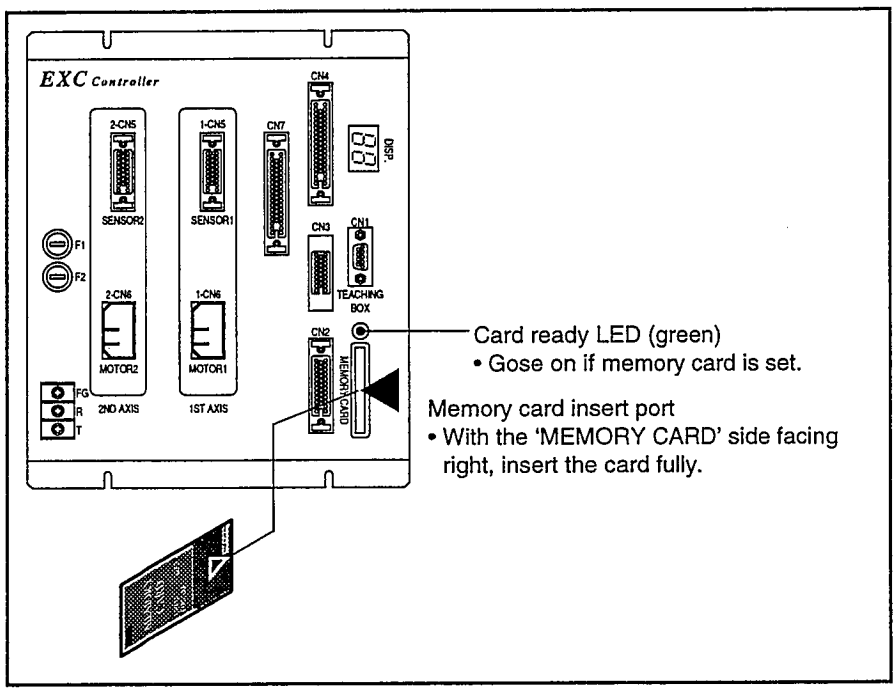
17. Memory Card Specifications and Operation

- Memory card is available as an option of the EXC controller.
- The EXC controller which has the optional memory card function differs from the standard controller in hardware. Please specify it when ordering.
- This section describes the specification of EXC controller memory card option only.
- The memory card uses E^2PROM and the back-up battery is not necessary.

17.1. Appearance

● Rack-mount type

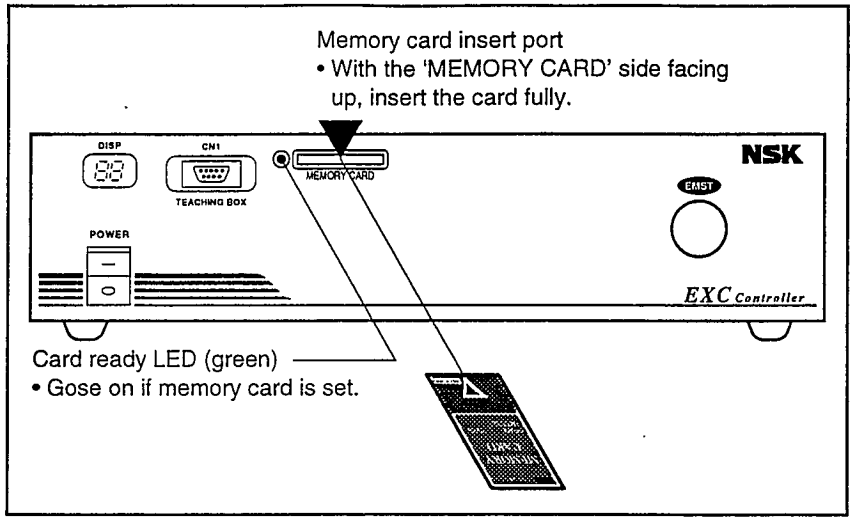
Figure 17-1



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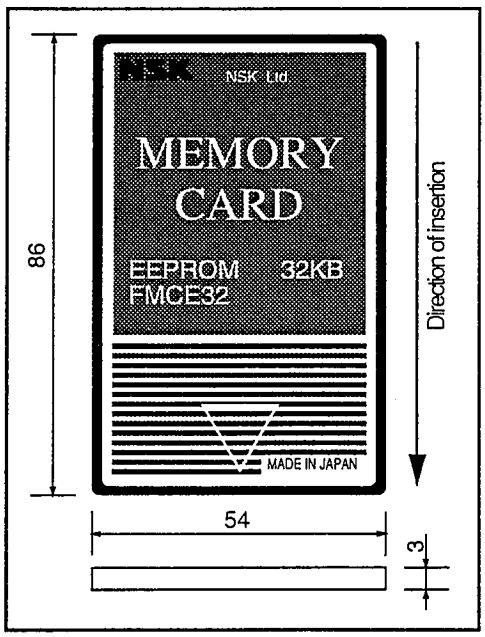
● **Stand-alone type**

Figure 17-2



● **Memory card**

Figure 17-3



17.2. Function

- The following functions are available in EXC controller with memory card option.

①WRT : Write

Writes whole memorized items of EXC controller including internal parameters to the memory card.

②RED : Read

Reads memory card contents, and writes the contents to EXC controller internal memory.

③CMP : Compare

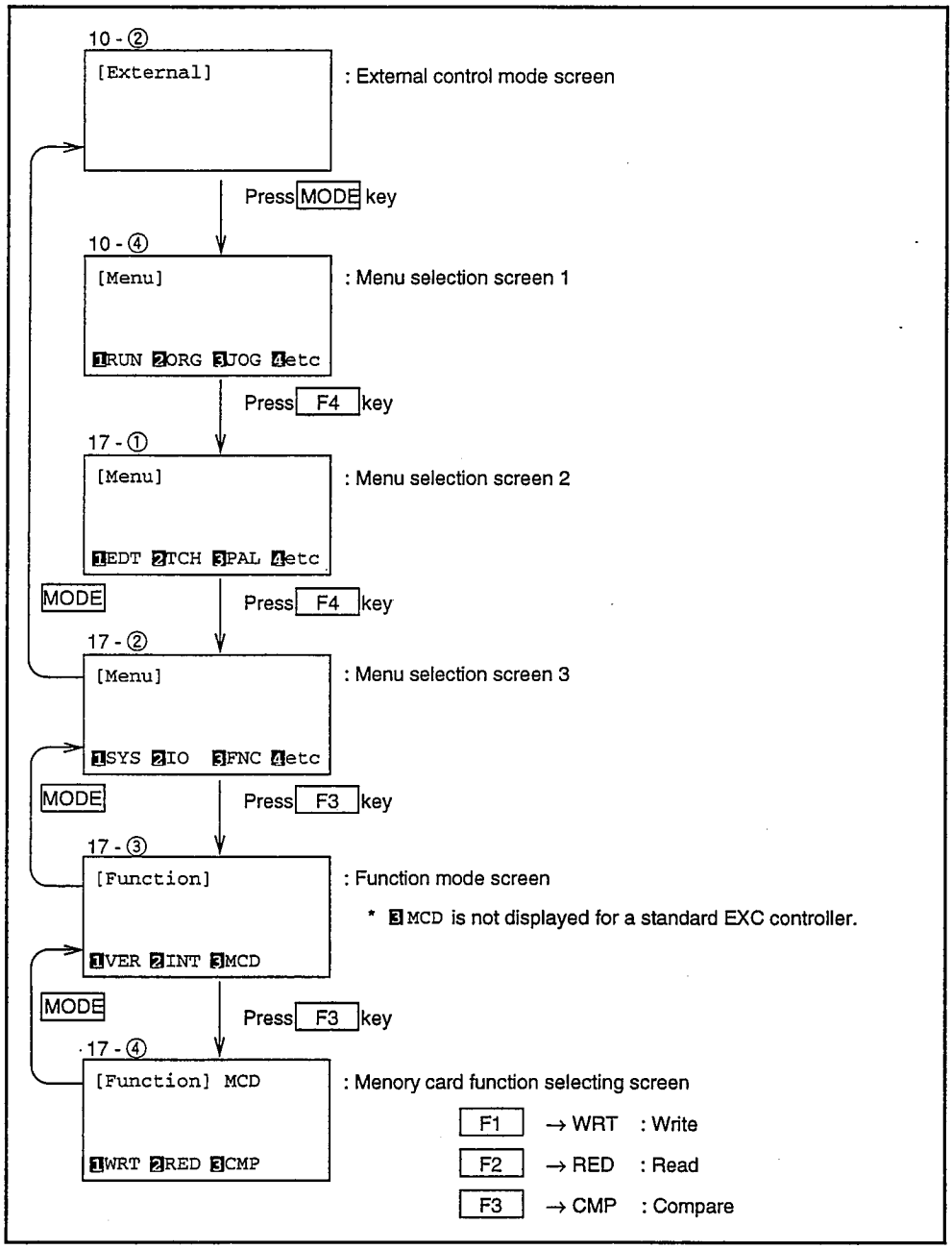
Compares memory card contents and EXC controller internal memory contents.

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17.3. Operation Outline

- Refer to " 10.2. Operation Mode Selection", set EXC controller to function mode following the sequencs below.
- Press F3 key in function mode. Memory card screen appears.
- By pressing F1 key, F2 key and F3 key, you can select "Write", "Read" or "Compare" functions respectively.

Figure 17-4



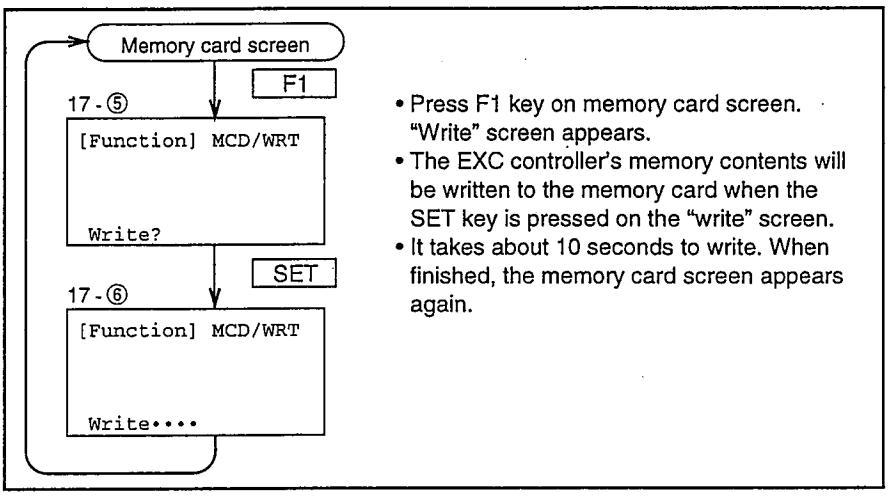
Note : Do not confuse "Read" and "Write" functions. If "Read" is executed when you want to down load the data to the memory card from the EXC controller, data of EXC controller will be changed to the contents of memory card. (All data of the EXC controller will be lost.)

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● Operation procedures

①WRT : Write

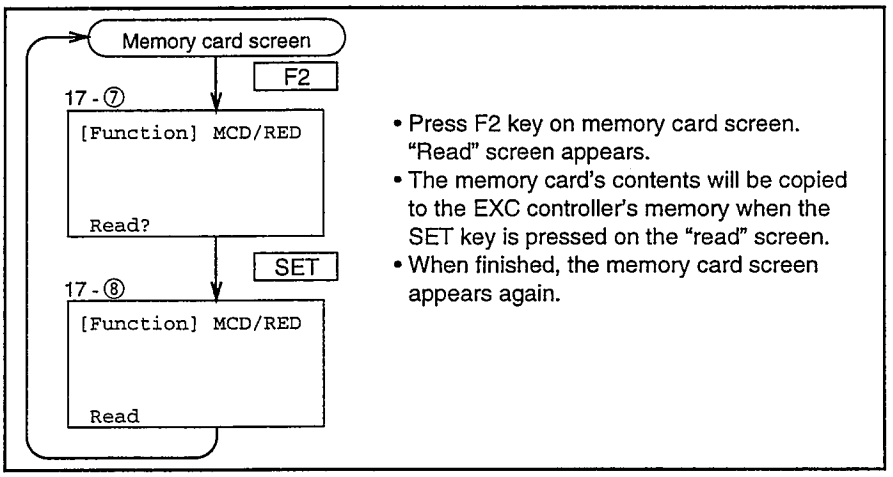
Figure 17-5



- Press F1 key on memory card screen. "Write" screen appears.
- The EXC controller's memory contents will be written to the memory card when the SET key is pressed on the "write" screen.
- It takes about 10 seconds to write. When finished, the memory card screen appears again.

②RED : Read

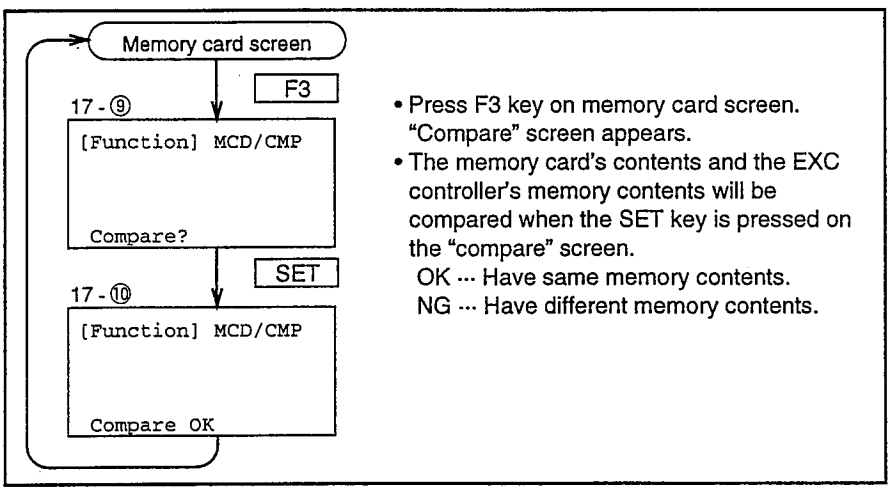
Figure 17-6



- Press F2 key on memory card screen. "Read" screen appears.
- The memory card's contents will be copied to the EXC controller's memory when the SET key is pressed on the "read" screen.
- When finished, the memory card screen appears again.

③CMP : Compare

Figure 17-7



- Press F3 key on memory card screen. "Compare" screen appears.
- The memory card's contents and the EXC controller's memory contents will be compared when the SET key is pressed on the "compare" screen.
  OK ··· Have same memory contents.
  NG ··· Have different memory contents.

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Robot Modules System

- **Module Main Unit**
- **EXC Controller**

User's Manual 2

= Programming and Operation =

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NSK Ltd.
Precision Machinery & Parts Technology Centre
Mechatronics Product Engineering Dept.
78 Toriba-machi, Maebashi-shi, Gunma-ken 371 Japan
Phone: 0272-54-7734 Fax: 0272-52-1197

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