

DX100 OPTIONS INSTRUCTIONS

FOR EXTERNAL REFERENCE POINT CONTROL FUNCTION

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

MOTOMAN INSTRUCTIONS

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

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

Part Number: 156429-1CD
Revision: 1



MANDATORY

- This manual explains the functions of the DX100 external reference point control. Read this manual carefully and be sure to understand its contents before handling the DX100.
- General items related to safety are listed in Chapter 1: Safety of the DX100 Instructions. To ensure correct and safe operation, carefully read the DX100 Instructions before reading this manual.



CAUTION

- Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating this product.
- The drawings and photos in this manual are representative examples and differences may exist between them and the delivered product.
- YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications.
- If such modification is made, the manual number will also be revised.
- If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.
- YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.

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Notes for Safe Operation

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

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



WARNING

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



CAUTION

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



MANDATORY

Always be sure to follow explicitly the items listed under this heading.



PROHIBITED

Must never be performed.

Even items described as "CAUTION" may result in a serious accident in some situations.

At any rate, be sure to follow these important items



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



WARNING

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

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

Fig. : Emergency Stop Button



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

Injury may result from unintentional or unexpected manipulator motion.

Fig. : Release of Emergency Stop



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

Improper or unintended manipulator operation may result in injury.

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

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an emergency stop button immediately if there is a problem.

The emergency stop buttons are located on the right of front door of the DX100 and the programming pendant.

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**CAUTION**

- Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately, and be sure that all other necessary processing has been performed.
 - Check for problems in manipulator movement.
 - Check for damage to insulation and sheathing of external wires.
- Always return the programming pendant to the hook on the cabinet of the DX100 after use.

The programming pendant can be damaged if it is left in the manipulator's work area, on the floor, or near fixtures.

- Read and understand the Explanation of Warning Labels in the DX100 Instructions before operating the manipulator:

Definition of Terms Used Often in This Manual

The MOTOMAN is the YASKAWA industrial robot product.


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

In this manual, the equipment is designated as follows:

Equipment	Manual Designation
DX100 controller	DX100
DX100 programming pendant	Programming pendant
Cable between the manipulator and the controller	Manipulator cable

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

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

Description of the Operation Procedure

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

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1 External Reference Point

The external reference point function makes it possible to use a point in space as a control point of the manipulator for teaching and playback. This point in space is called the external reference point.

During sealing or spot-welding where the workpiece is held by the manipulator, by defining the tip of a nozzle or the gun as a reference point, the orientation of the workpiece, etc. can be changed.

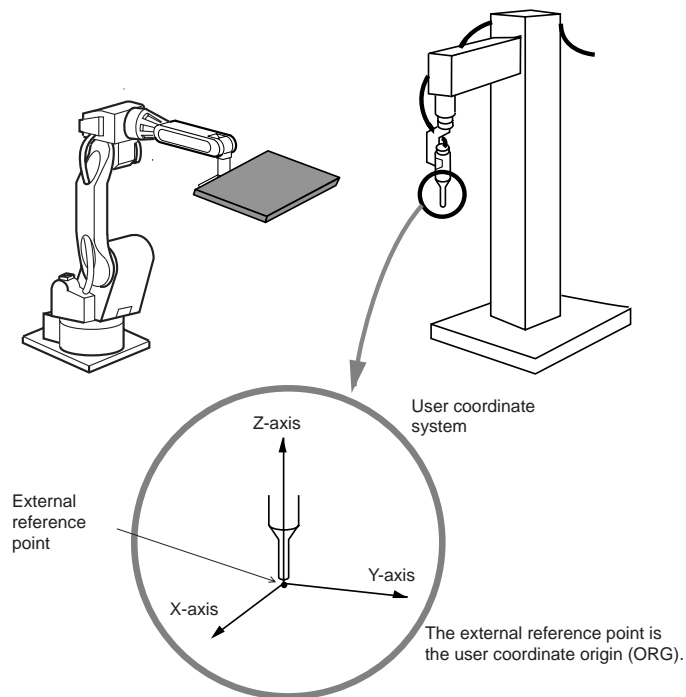
For interpolation during playback, the speed of an external reference point is controlled in relation to the speed of the workpiece.

The external reference point function saves teaching time and makes it easier to control relative speeds of the nozzle and the workpiece.

An external reference point is defined to the user coordinate origin (ORG). Therefore, external reference point control is possible only when user coordinates are registered.

Since up to 63 user coordinates can be stored in memory, up to 63 external reference points can be set up.

An example of sealing by a workpiece-holding manipulator is shown in the following figure.



For the user coordinate system, refer to “2.7 User Coordinates” in the DX100 operator’s manual.



The external reference point control is not available with the coordinated job.

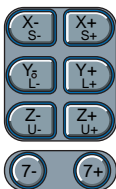
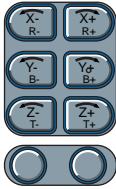
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- 1 External Reference Point
- 1.1 Operation at Teaching

1.1 Operation at Teaching

Teaching must be performed in the user coordinate system. For operations to change to the user coordinate system, refer to *chapter 2.1 “Teaching” at page 2-1*

The “Axis Key” operations are the same as that in a user coordinate system, as explained in the following table.

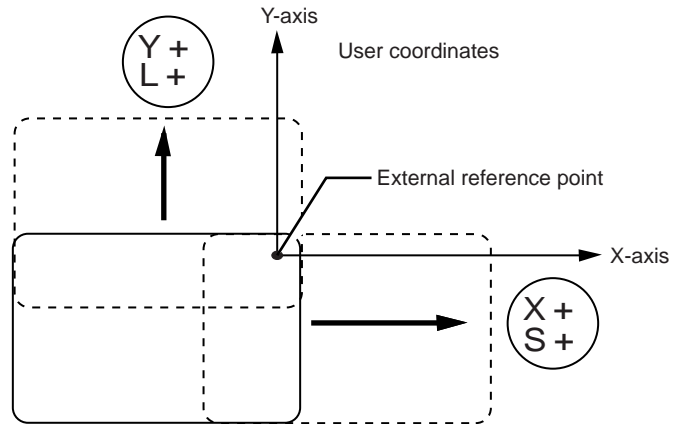
Axis	Axis Keys	Motion
Major Axes		Moves parallel to the X-, Y-, and/or Z-axis of the selected user coordinate.
Wrist Axes		Executes the motion about TCP. (The external reference point is set as the TCP.)



For details, refer to “2.7 User Coordinates” and “2.8 Tool Tip Operations” in the DX100 operator’s manual.

1.1.1 Major Axes

Fig. 1-1: Parallel Movement



1.1.2 Wrist Axes

With a motion about TCP by the wrist axes, the manipulator's posture can be changed without changing the position of the TCP (the external reference point).

Fig. : Motion about TCP

Fig. 1-1: Without the External Reference Point Control Function

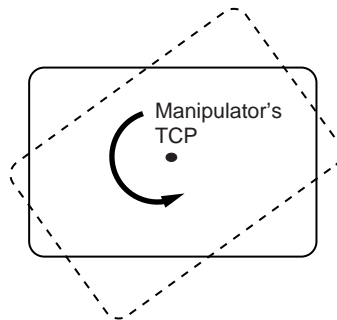
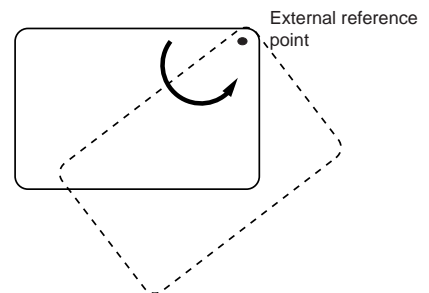


Fig. 1-2: With the External Reference Point Control Function

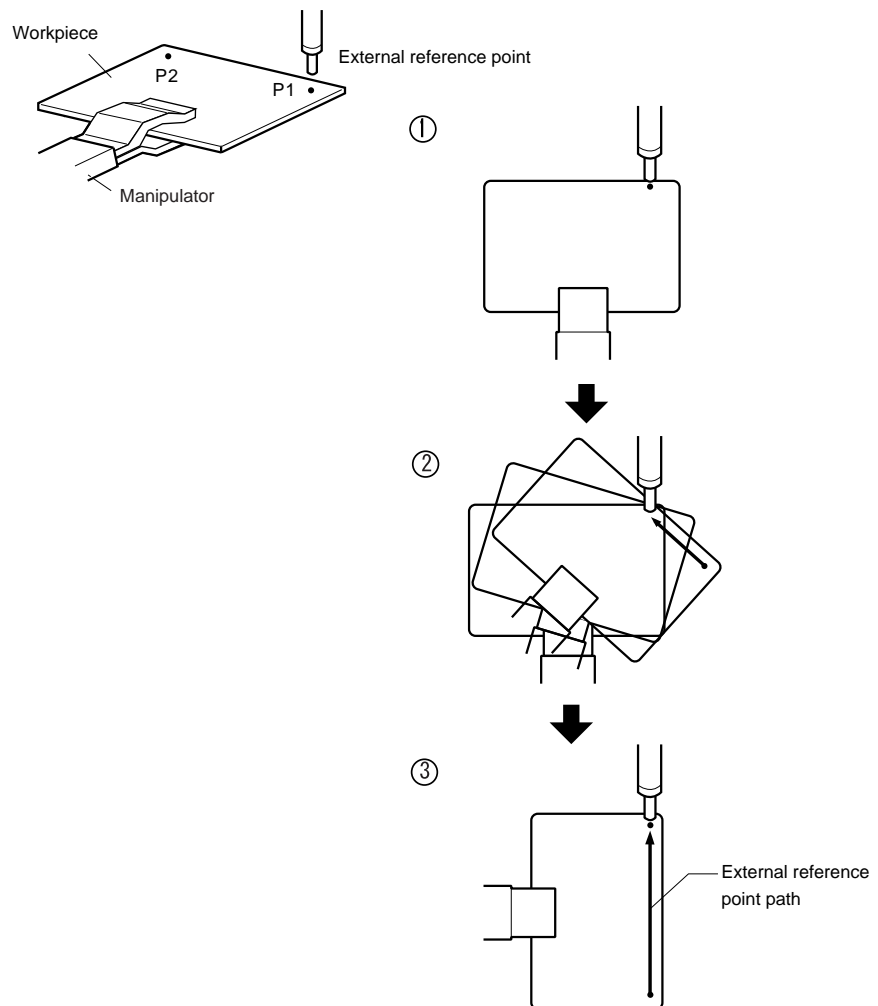


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- 1 External Reference Point
- 1.2 Operation at Playback

1.2 Operation at Playback

External reference point control with linear interpolation between teaching points P1 and P2 is shown in the following figure.



<Examples of instruction registration and movement>

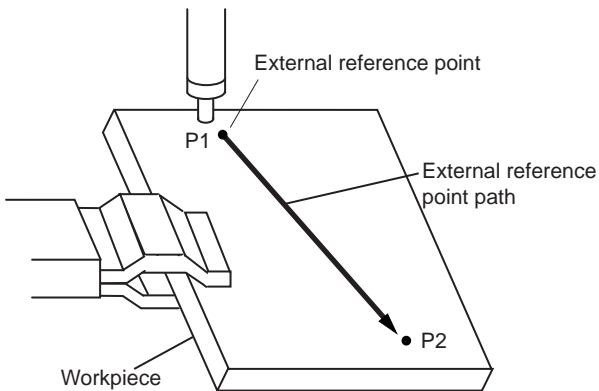
- An example of instruction registration for EIMOVL

```

0000 NOP
0001 MOVJ VJ=50.00
0002 EIMOVL UF#(5) V=138
0003 EIMOVL UF#(5) V=68
0004 MOVJ VJ=50.00
0005 END
    
```

Move instruction for manipulator's TCP
 P1
 P2

Fig. (a): EIMOVL (Linear interpolation)



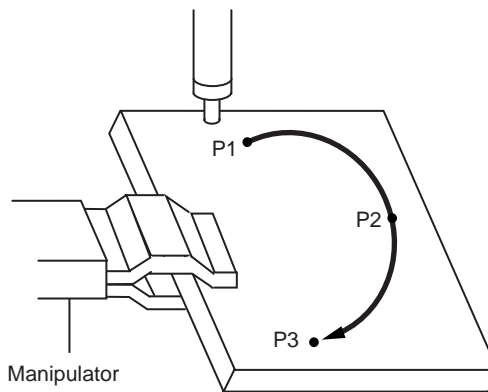
- An example of instruction registration for EIMOVC

```

0000 NOP
0001 MOVJ VJ=50.00
0002 TIMER T=1.00
0003 EIMOVC UF#(4) V=138
0004 EIMOVC UF#(4) V=68
0005 EIMOVC UF#(4) V=68
0006 MOVJ VJ=50.00
0007 END
    
```

P1
 P2
 P3

Fig. (b): EIMOVC (Circular interpolation)



2 Teaching and Modification

After registering user coordinates, move instructions for external reference point control can be taught or modified.

2.1 Teaching

1. Call the JOB CONTENT window.

- (1) Select {JOB} from {JOB} under the main menu.
- (2) Move the cursor to the line above where the move instruction is to be inserted.

```

0000 NOP
0001 MOVJ VJ=0.78
0002 MOVJ VJ=0.78
0003 END
  
```

2. Press [COORD] to set the external reference points'



coordinates.

```

JOB CONTENT
J: TEST
CONTROL GROUP: R1
S:0000
TOOL: **
0000 NOP
  
```

3. When the desired user coordinate file is not shown, press [SHIFT] + [COORD].

```

USER COORD SELECT
1 : JIG1
2 : PAL1
3 :
4 :
5 : PAL2
  
```

4. Move the cursor to the desired user coordinate file No., and then press [SELECT]

```

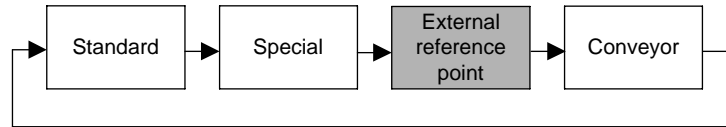
USER COORD SELECT
1 : JIG1
2 : PAL1
3 :
4 :
5 : PAL2
6 :
  
```

5. By pressing the axis key, set the external reference point to the desired position.

2 Teaching and Modification

2.2 Checking Paths

6. Press [SHIFT] + [MOTION TYPE] to select the external reference point interpolation mode.
 - The interpolation mode is switched in the following order. (When the special interpolation mode and the conveyor interpolation mode are invalid, the mode is switched between the standard interpolation mode and the external reference point interpolation mode.)



7. Press [MOTION TYPE] to select either EIMOV L (external linear interpolation) or EIMOV C (external circular interpolation).

EIMOV L UF#(5) V=66

8. With the cursor on the line No., press [SELECT].

EIMOV L UF#(5) V=66

9. Press the right cursor key to move the cursor on the speed indication "V=**."

EIMOV L UF#(5) V=66

- Then hold down [SHIFT] and press the top or bottom of the cursor key to change the play speed.

10. Press [ENTER] to register the move instruction.

2.2 Checking Paths

To check whether the taught step positions are correct, use [FWD] and [BWD] on the programming pendant.

For details, refer to "3.3 Checking Steps" in the DX100 operator's manual.

2.3 Modifying Paths

If the paths need to be modified, refer to the following sections in the DX100 operator's manual.

- 4.4.2 Inserting Move Instructions
- 4.4.3 Deleting Move Instructions
- 4.4 Modifying Move Instructions

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FOR EXTERNAL REFERENCE POINT CONTROL FUNCTION

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Specifications are subject to change without notice
for ongoing product modifications and improvements.