

DX100 OPTIONS INSTRUCTIONS

FOR 4 POINT TEACHING 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: 157856-1CD
Revision: 0





MANDATORY

- This manual explains the details on: teaching, playback, how to edit jobs and files, functions in operation management, etc. of the DX100. 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 DX100 cabinet after use.

The programming pendant can be damaged if it is left in the P-point maximum envelope of the manipulator, 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 manipulator is the YASKAWA industrial robot product.


The manipulator usually consists of 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 DX100	Manipulator Cable

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Descriptions of the programming pendant keys, 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 Numeric Keys	"Axis Keys" and "Numeric 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

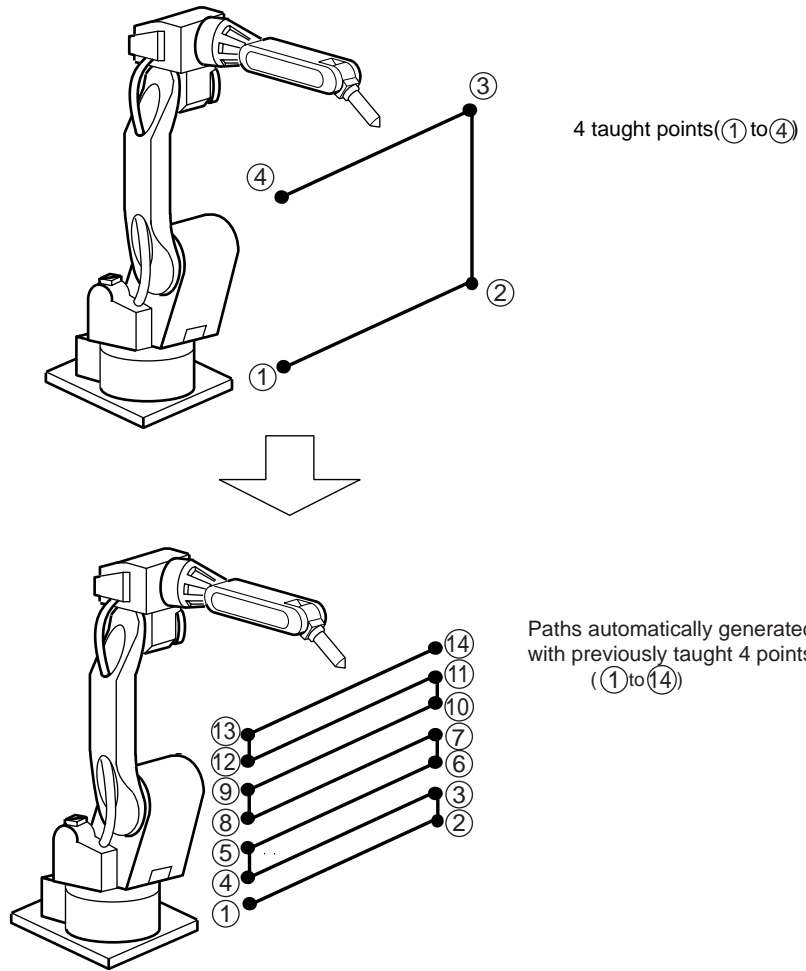
In the explanation of the operation procedure, the expression "Select •••" means that the cursor is moved to the object item and the SELECT key is pressed, or that the item is directly selected by touching the screen.

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1 4 Point Teaching Function

1.1 Function

The 4 Point Teaching Function, as described in the figure below, is the function which automatically generates rectangular shaped paths by any four previously selected taught points.



1.2 Pattern of Development

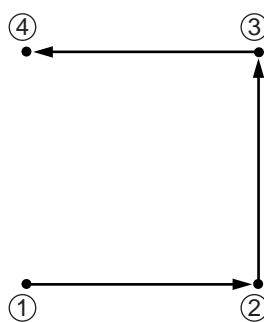
Select any 4 points from previously taught jobs, then generate interim paths using square within the 4 points.

With the above mentioned selected four 4 points, paths are generated for single/double coating and, at the same time, with specified paths frequency /pitch.

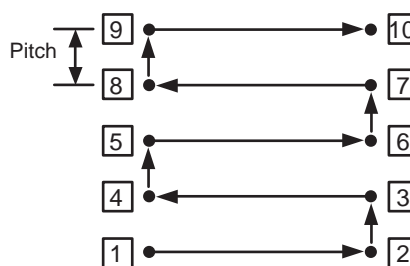
It is also possible to select either the linear or the circular interpolation for the generated path when it turns.

Depending on the specified path pitch, the generated paths by the previously taught 4 points can be single/double coat with linear/circular incorporation as follows:

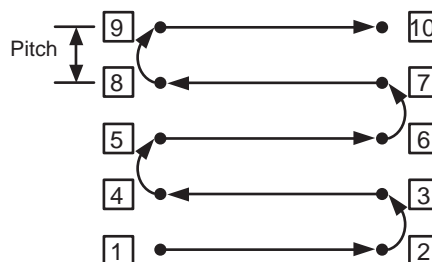
1.2.0.1 4 Taught Points



1.2.0.2 Single Coat with Linear Interpolation



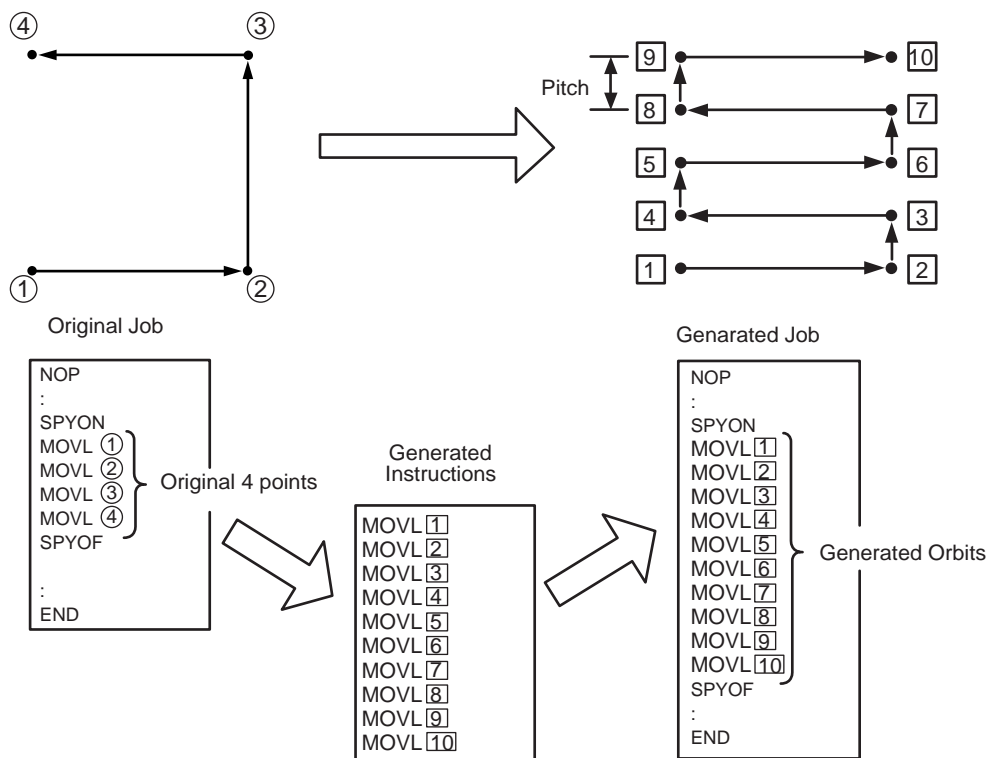
1.2.0.3 Single Coat with Circular Interpolation



1.2.1 Automatically Generated Job

The figure below shows the process on how a job is automatically generated by a pre-taught job.

1.2.1.1 Without Circular Interpolation



As a start, teach the original job including the predetermined points to be developed.

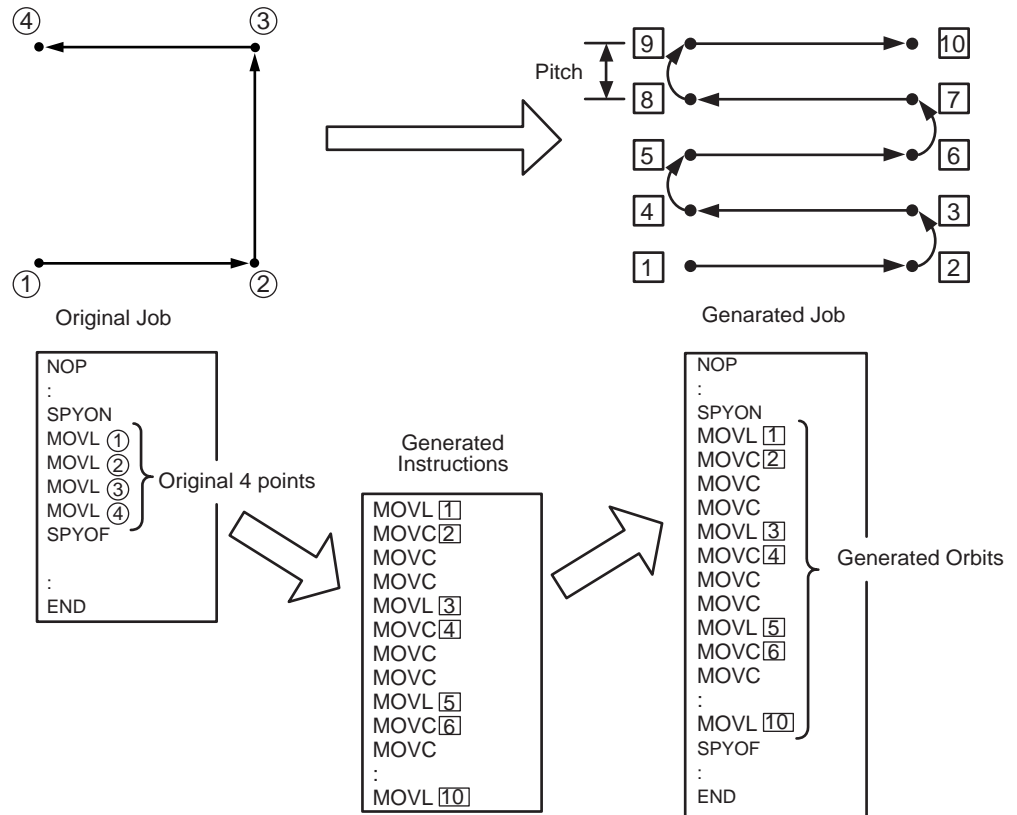
For the next step, specify 4 points from among the taught jobs, then, generate a path with the 4 points and the specified number of paths. After a job is generated, cut the path that were designated in the original job from the 1st point ① to the 4th point ④, then insert the generated instructions.

Although the number of path to be generated is calculated from the initial pitch [S3C1199] which is specified with the parameter beforehand and the designated 1st point ① to the 4th point ④, it is possible to directly input the desired path number. In this case, the pitch is automatically calculated from the input path number and it is displayed as its result.

For the motion speed of MOVL[1] instructions, specify the set speed of the 1st point ①, and specify the set speed of the 2nd point ② to MOVL[2].

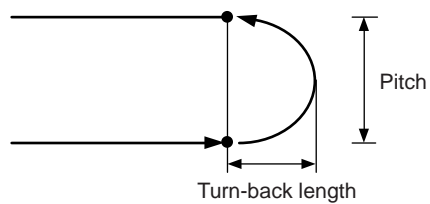
In case of specifying the linear interpolation, all the move instructions become MOVL.

1.2.1.2 With Circular Interpolation



It takes the same operating procedures as in the case without circular interpolation.

However, as to the move instructions, it will be MOVL for path move, and it will be MOVC for turn-back points. The turn-back point during circular interpolation operation is set at [S3C1198] which is parameter's turn-back length during circular interpolation.



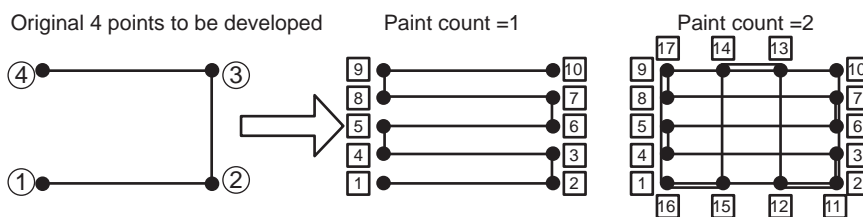
NOTE In case that the turn-back length during circular interpolation, the parameter [S3C1198], is more than $\text{pitch} \times (1/2)$, the turn-back is limited to the length: $\text{pitch} \times (1/2)$.

1.2.1.3 Paths Generated by the 4 Point Teaching Function

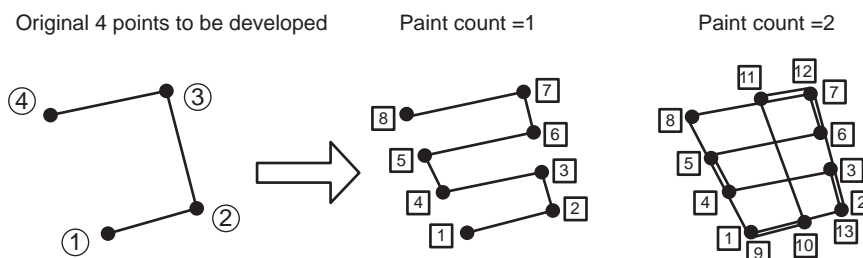
The paths of the 4 points teaching function generated by already-set 4 points generate a path from the 1st point toward the 2nd point. The distance from ② to ③, and from ① to ④ determine the number of paths. Depending on the number of paths, the 3rd or the 4th point can be the final path.

Also, depending on the positions of the 4 taught points, the paths to be generated are developed as follows:

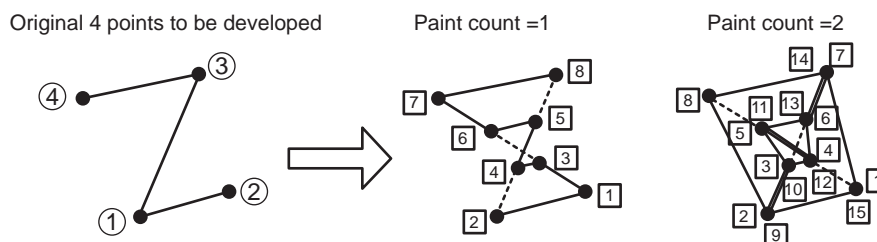
1. In case of square/rectangular shapes formed by the 4 points



2. In case of quadrangular shapes formed by the 4 points



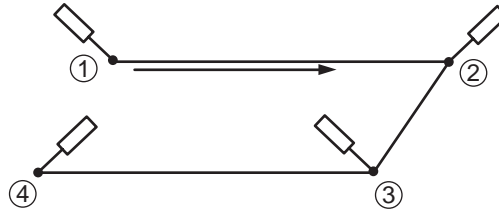
3. In case ① - ④, ② - ③ of the 4 points are crossed



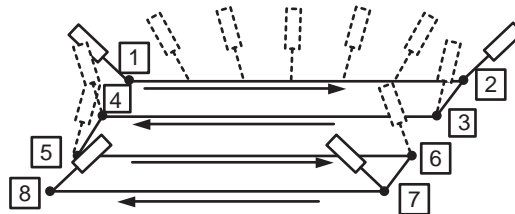
1.2.1.4 Differences in Directions

When the specified 4 points have different angles, the angle of the tool from the start to the end points of the path to be developed will shift as follows.

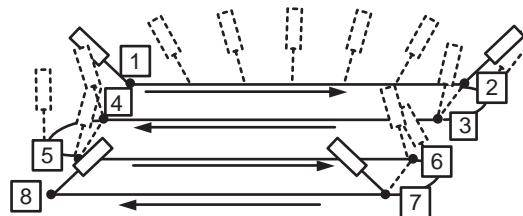
1. 4 Taught Points



2. Without Circular Interpolation



3. With Circular Interpolation



DX100	2	4 Point Teaching Operation
	2.1	Operating Procedure

2 4 Point Teaching Operation

2.1 Operating Procedure

2.1.0.1 Job Display

Display the job content of 4 point teaching function on the screen.

To Display the Current Job

1. Select {JOB} under the main menu.
2. Select {JOB CONTENT}.
 - The job content window appears.

Call and Display the Other Job

1. Select {JOB} under the main menu.
2. Select {SELECT JOB}.
 - JOB LIST appears.
3. Select a job to be called.

2.1.0.2 Development of the 4 Points

1. Select {UTILITY} from JOB displaying window.
2. Select {4 POINT TEACHING}.
 - The 4 point conversion display appears.

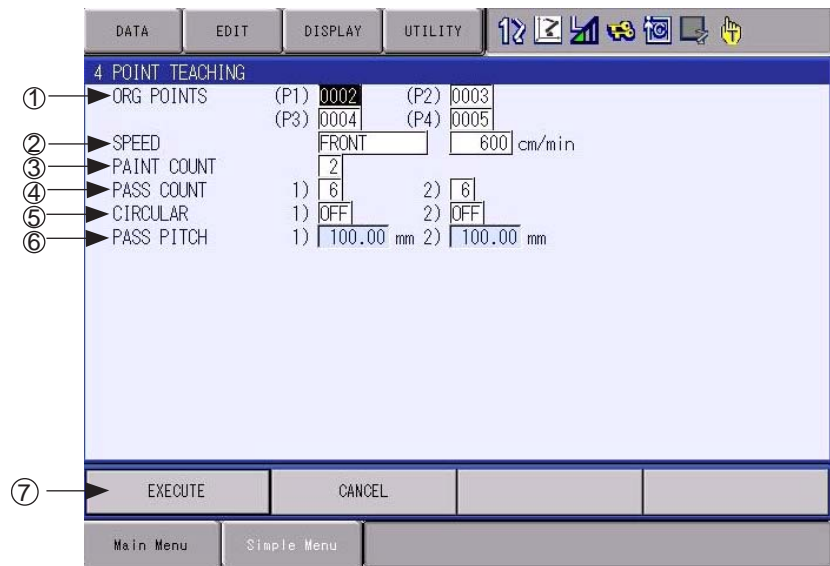


The 4 point teaching will not appear on the display if the cursor is not in the move instruction. Be sure that the cursor is in the move instruction when performing the 4 point teaching.



The 4 point teaching will not appear on the display if there are not four move instructions from the current cursor position to the END instruction. Be sure to teach more than four steps of the 4 point function when performing the 4 point teaching.

2.2 Execution



① ORG POINTS

Specify the original 4 points.

The designated position determined in the JOB CONTENT is displayed as the 1st point. The succeeding serial move instructions after the 1st point are displayed as the 2nd to the 4th point.

It is possible to re-register the step number by moving the cursor to each point and press [SELECT].

② SPEED

Set the speed which the 4 points are developed.

To set the speed, select either [NONE], [FRONT] or [EVERY].

- NONE: No speed tag should be attached to the move instructions after the development.
- FRONT: Specify the speed to the beginning of the developed path with SPEED instruction.
- EVERY: Attach the speed tags to all the developed move instructions.

For the initial value, display the 2nd point speed of the original developed points.

③ PAINT COUNT

Set the frequency of paint. Setting range of the value is 1 to 99; the initial value is 1.

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2 4 Point Teaching Operation
2.2 Execution

④ PATH COUNT

Set the number of paths as follows:

If the PAINT COUNT value is odd number, set the value in 1).

If the PAINT COUNT value is even number, set the value in 2).

Setting range: 2 to 99.

In case of the PAINT COUNT value is 1, 2) will not appear on the display.

⑤ CIRCULAR

Set the circular interpolation as follows:

If the PAINT COUNT value is odd number, set the value in 1).

If the PAINT COUNT value is even number, set the value in 2).

Press [SELECT] for ON/OFF modification.

In case if the PAINT COUNT value is 1, 2) will not appear on the display.

The initial value is [OFF].

⑥ PATH PITCH

The path pitch is calculated from the 4 points, which were set at the original developed point, and PATH COUNT and displayed.

1) indicates the path pitch when painting is executed for odd times, and the path pitch when painting is executed for even times is indicated in 2).

Note that the PATH PITCH cannot be manually set here: it only shows the result.

In case if the PAINT COUNT value is 1, 2) will not appear on the display.

⑦ EXEC

Move the cursor to EXEC and press [SELECT] to automatically generate the paths for paint: the paths are generated from the 4 points which were set in the ORG POINTS.

JOB CONTENT appears on the display upon the completion of the path generation.

2.2.0.1 NOTES

- I) Step number when setting the original points:
 The order of the step number for the original 4 points is ① < ② < ③, ④: If the step number is not in this order, an alarm message will appear on the display as the [EXEC] is pressed. The display will, then show the setting display again.
- II) In case if the position variables are used in the designated original points:
 If the position variables are specified as the move instruction of original points, develop the pulse data from the position variables and also develop the 4 points to make the point information as the pulse data.
- III) The speed of the path developed by 4 point teaching:
 The move instruction tags after the 4 point teaching development depend on the move instruction tags of the original points (P2).

For example, if the original point (P2) is
 MOVL V = 400.00 PL = 0,
 the move instruction for the 2nd and the other developed points all become
 MOVL V = 400.00 PL = 0.

However, if the MOVL is not used for the original point (P2), all the move instructions after the development (excluding turn-back motion in circular interpolation) should be MOVL.

- IV) Also, in case of the conveyor tracking instructions, even if the SYMOVL is not used for the original point (P2), all the move instructions after the development (excluding turn-back motion in circular interpolation) should be SYMOVL.



If the established original 4 points are inconsecutive, cut all the instructions from ① to ④, then insert the new developed instructions. In this case, note that the work instructions included in the original points ① to ④ will be cut in the same way.



If the same number is selected for the original points, an error message [290: Cannot set same No.] appears on the display upon the selection of [EXEC].
 Be sure to select 4 different numbers.



The 4 point teaching may not accurately developed if the position of the R- and B-axes are without the range from -180° to 180° , or if they are close to the singular point (where the R- and B-axes are close to 0°). In this case, execute the development after correcting the directions of 4 points.

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3 Parameter

3 Parameter

3.0.0.1 S2C366: Designation of the 4 Point Teaching Function

Designate the use of the 4 point teaching function as follows:

0: Not in use

1: Designate the 4 point teaching function

3.0.0.2 S3C1198: Turn-back Length of Circular Interpolation

Specify the turn-back length when the circular interpolation is set to [ON].

The initial value is set to 50mm.

3.0.0.3 S3C1199: Initial Path Pitch

Specify the initial path pitch to be displayed when the path pitch is calculated from the distance of the taught points ① to ④.

The initial value is set to 50mm.

DX100 OPTIONS INSTRUCTIONS

FOR 4 POINT TEACHING FUNCTION

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