YRC1000micro 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

YRC1000micro INSTRUCTIONS
YRC1000micro OPERATOR'S MANUAL
YRC1000micro MAINTENANCE MANUAL
YRC1000micro ALARM CODES (MAJOR ALARMS) (MINOR ALARMS)

The YRC1000micro alarm codes above consists of "MAJOR ALARMS" and "MINOR ALARMS".

Please have the following information available when contacting Yaskawa Customer Support:
- System
- Primary Application
- Software Version (Located on Programming Pendant by selecting: {Main Menu} - {System Info} - {Version})
- Robot Serial Number (Located on robot data plate)
- Robot Sales Order Number (Located on controller data plate)

Part Number: 181281-CD
Revision: 0
DANGER

• This manual explains the 4 point teaching function of the YRC1000micro system. Read this manual carefully and be sure to understand its contents before handling the YRC1000micro. Any matter not described in this manual must be regarded as “prohibited” or “improper”.
• General information related to safety are described in “Chapter 1. Safety” of the YRC1000micro INSTRUCTIONS. To ensure correct and safe operation, carefully read “Chapter 1. Safety” of the YRC1000micro INSTRUCTIONS.

CAUTION

• In some drawings in this manual, protective covers or shields are removed to show details. Make sure that all the covers or shields are installed in place before operating this product.
• YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids the product warranty.

NOTICE

• 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.
Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the YRC1000micro.

In this manual, the Notes for Safe Operation are classified as “DANGER”, “WARNING”, “CAUTION”, or “NOTICE”.

- **DANGER** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. Safety Signs identified by the signal word DANGER should be used sparingly and only for those situations presenting the most serious hazards.

- **WARNING** Indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury. Hazards identified by the signal word WARNING present a lesser degree of risk of injury or death than those identified by the signal word DANGER.

- **CAUTION** Indicates a hazardous situation, which if not avoided, could result in minor or moderate injury. It may also be used without the safety alert symbol as an alternative to “NOTICE”.

- **NOTICE** NOTICE is the preferred signal word to address practices not related to personal injury. The safety alert symbol should not be used with this signal word. As an alternative to “NOTICE”, the word “CAUTION” without the safety alert symbol may be used to indicate a message not related to personal injury.

Even items described as “CAUTION” may result in a serious accident in some situations. At any rate, be sure to follow these important items.

**NOTE**

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

**NOTE**
Before operating the manipulator, make sure the servo power is turned OFF by performing the following operations. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.

- Press the emergency stop button on the programming pendant or on the external control device, etc.
- Disconnect the safety plug of the safety fence.
  (when in the play mode or in the remote mode)

If operation of the manipulator cannot be stopped in an emergency, personal injury and/or equipment damage may result.

*Fig. : Emergency Stop Button*

Before releasing the emergency stop, make sure to remove the obstacle or error caused the emergency stop, if any, and then turn the servo power ON.

Failure to observe this instruction may cause unintended movement of the manipulator, which may result in personal injury.

*Fig. : Release of Emergency Stop*

Observe the following precautions when performing a teaching operation within the manipulator’s operating range:

- Be sure to perform lockout by putting a lockout device on the safety fence when going into the area enclosed by the safety fence. In addition, the operator of the teaching operation must display the sign that the operation is being performed so that no other person closes the safety fence.
- View the manipulator from the front whenever possible.
- Always follow the predetermined operating procedure.
- Always keep in mind emergency response measures against the manipulator’s unexpected movement toward a person.
- Ensure a safe place to retreat in case of emergency.

Failure to observe this instruction may cause improper or unintended movement of the manipulator, which may result in personal injury.

Confirm that no person is present in the manipulator’s operating range and that the operator is in a safe location before:

- Turning ON the YRC1000micro power
- Moving the manipulator by using the programming pendant
- Running the system in the check mode
- Performing automatic operations

Personal injury may result if a person enters the manipulator’s operating range during operation. Immediately press an emergency stop button whenever there is a problem. The emergency stop button is located on the right of the programming pendant.

- Read and understand the Explanation of the Warning Labels before operating the manipulator.
**DANGER**

- In the case of not using the programming pendant, be sure to supply the emergency stop button on the equipment. Then before operating the manipulator, check to be sure that the servo power is turned OFF by pressing the emergency stop button.
  - Connect the external emergency stop button to the 4-14 pin and 5-15 pin of the Safety connector (Safety).
- Upon shipment of the YRC1000micro, this signal is connected by a jumper cable in the dummy connector. To use the signal, make sure to supply a new connector, and then input it.

If the signal is input with the jumper cable connected, it does not function, which may result in personal injury or equipment damage.

**WARNING**

- Perform the following inspection procedures prior to conducting manipulator teaching. If there is any problem, immediately take necessary steps to solve it, such as maintenance and repair.
  - Check for a problem in manipulator movement.
  - Check for damage to insulation and sheathing of external wires.
- Return the programming pendant to a safe place after use.

If the programming pendant is left unattended on the manipulator, on a fixture, or on the floor, etc., the Enable Switch may be activated due to surface irregularities of where it is left, and the servo power may be turned ON. In addition, in case the operation of the manipulator starts, the manipulator or the tool may hit the programming pendant left unattended, which may result in personal injury and/or equipment damage.
Definition of Terms Used Often in This Manual

The MOTOMAN is the YASKAWA industrial robot product.

The MOTOMAN usually consists of the manipulator, the YRC1000micro controller, manipulator cables, the YRC1000micro programming pendant (optional), and the YRC1000micro programming pendant dummy connector (optional).

In this manual, the equipment is designated as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>YRC1000micro controller</td>
<td>YRC1000micro</td>
</tr>
<tr>
<td>YRC1000micro programming pendant</td>
<td>Programming pendant (optional)</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator cable</td>
</tr>
<tr>
<td>YRC1000micro programming pendant dummy connector</td>
<td>Programming pendant dummy connector (optional)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Pendant</td>
<td></td>
</tr>
<tr>
<td>Character Keys /Symbol Keys</td>
<td>The keys which have characters or symbols printed on them are denoted with [ ], ex. [ENTER]</td>
</tr>
<tr>
<td>Axis Keys /Number Keys</td>
<td>[Axis Key] and [Numeric Key] are generic names for the keys for axis operation and number input.</td>
</tr>
<tr>
<td>Keys pressed simultaneously</td>
<td>When two keys are to be pressed simultaneously, the keys are shown with a “+” sign between them, ex. [SHIFT]+[COORD]</td>
</tr>
<tr>
<td>Mode Key</td>
<td>Three kinds of modes that can be selected by the mode key are denoted as follows: REMOTE, PLAY, or TEACH</td>
</tr>
<tr>
<td>Button</td>
<td>Three buttons on the upper side of the programming pendant are denoted as follows: HOLD button, START button, EMERGENCY STOP button</td>
</tr>
<tr>
<td>Displays</td>
<td>The menu displayed in the programming pendant is denoted with ( ). e.g. {JOB}</td>
</tr>
<tr>
<td>PC Keyboard</td>
<td>The name of the key is denoted. e.g. Ctrl key on the keyboard</td>
</tr>
</tbody>
</table>
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 [SELECT] is pressed, or that the item is directly selected by touching the screen.

Registered Trademark

In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or brand names for each company or corporation. The indications of (R) and ™ are omitted.
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1 The 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 The 4 Taught Points

![Diagram of 4 Taught Points](image1)

1.2.0.2 Single Coat with Linear Interpolation

![Diagram of Single Coat with Linear Interpolation](image2)

1.2.0.3 Single Coat with Circular Interpolation

![Diagram of Single Coat with Circular Interpolation](image3)
1.2.0.4 Double Coat with Linear Interpolation

1.2.0.5 Double 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 pitch × (1/2), the turn-back is limited to the length: pitch × (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

![Square/Rectangular Shapes Diagram]

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

![Quadrangular Shapes Diagram]

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

![Crossed Shapes Diagram]
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
2 The 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.

NOTE
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.

NOTE
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.

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.
2 The 4 Point Teaching Operation
2.2 Execution

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 Execution

2.2.0.1 NOTES

(1) 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.

(2) 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.

(3) 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.

(4) 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.
If there is “a edit-lock line” or “a line setting as a comment” in the original points ① to ④, the following error massage will be displayed, and it is unable to execute the development.

Error 1011: This line is setting as edit-lock.
Error 1012: This line is setting as a comment.
When set the established original point, be sure not to include “the edit-lock line” and “the setting as a command”.
(Refer to “YRC1000micro OPERATOR'S MANUAL (RE-CSO-A058) 3.7.6 Commenting Out a Line, and 3.7.7 Prohibiting Editing Line-by-Line” for more details.)
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 50 mm.

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 50 mm.
HEAD OFFICE
2-1 Kurosakishiroishi, Yahatanishi-ku, Kitakyushu 806-0004, Japan
Phone +81-93-645-7703 Fax +81-93-645-7802

YASKAWA America Inc. (Motoman Robotics Division)
100 Automation Way, Miamisburg, OH 45342, U.S.A.
Phone +1-937-847-6200 Fax +1-937-847-6277

YASKAWA Europe GmbH (Robotics Division)
Yaskawastrasse 1, 85391 Allershausen, Germany
Phone +49-8166-90-100 Fax +49-8166-90-103

YASKAWA Nordic AB
Verkstadsgatan 2, Box 504, SE-385 25 Torsas, Sweden
Phone +46-480-417-800 Fax +46-486-414-10

YASKAWA Electric (China) Co., Ltd.
22F, One Corporate Avenue, No.222, Hubin Road, Huangpu District, Shanghai 200021, China
Phone +86-21-5385-2200 Fax +86-21-5385-3299

YASKAWA SHOUGANG ROBOT Co. Ltd.
No7 Yongchang North Road, Beijing E&T Development Area, China 100176
Phone +86-10-6788-2858 Fax +86-10-6788-2878

YASKAWA India Private Ltd. (Robotics Division)
#426, Udyog Vihar, Phase- IV, Gurgaon, Haryana, India
Phone +91-124-475-8500 Fax +91-124-475-8542

YASKAWA Electric Korea Corporation
35F, Three IFC, 10 Gukjegeumyung-ro, Yeongdeungpo-gu, Seoul, Korea 07326
Phone +82-2-784-7844 Fax +82-2-784-8495

YASKAWA Electric Taiwan Corporation
12F, No.207, Sec. 3, Beishin Rd., Shindian District, New Taipei City 23143, Taiwan
Phone +886-2-8913-1333 Fax +886-2-8913-1513

YASKAWA Electric (Singapore) PTE Ltd.
151 Lorong Chuan, #04-02A, New Tech Park, Singapore 556741
Phone +65-6282-3003 Fax +65-6289-3003

YASKAWA Electric (Thailand) Co., Ltd.
59,1st-5th Floor, Flourish Building, Soi Ratcadapisek 18 , Ratchadapisek Road, Huaykwang, Bangkok 10310, THAILAND
Phone +66-2-017-0099 Fax +66-2-017-0199

PT. YASKAWA Electric Indonesia
Secure Building-Gedung B Lantai Dasar & Lantai 1 Jl. Raya Protokol Halim Perdanakusuma, Jakarta 13610, Indonesia
Phone +62-21-2982-6470 Fax +62-21-2982-6741

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