

FS100 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
- FS100 INSTRUCTIONS
- FS100 OPERATOR'S MANUAL
- FS100 MAINTENANCE MANUAL

Part Number: 159658-1CD

Revision: 0



MANDATORY

- This manual explains the functions of the FS100 external reference point control. Read this manual carefully and be sure to understand its contents before handling the FS100.
- General items related to safety are listed in Chapter 1: Safety of the FS100 Instructions. To ensure correct and safe operation, carefully read the FS100 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.

Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the FS100.

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 when the emergency stop button on the programming pendant is pressed.

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



- 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 5-6 pin and 16-17 pin of the robot system signal connector (CN2).
- Upon shipment of the FS100, this signal is connected by a jumper cable in the dummy connector. To use the signal, make sure to prepare 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.

- 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 EM



- 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.
 - Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

The emergency stop button is located on the programming pendant.



WARNING

- 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 FS100.
 - Moving the manipulator with the programming pendant.
 - Running the system in the check mode.
 - Performing automatic operations.

Injury may result if anyone enters the working envelope of the manipulator during operation. Always press an emergency stop button immediately if there are problems.



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 FS100 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 FS100 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 FS100 controller, manipulator cables, the FS100 programming pendant (optional), and the FS100 programming pendant dummy connector (optional).

In this manual, the equipment is designated as follows:

Equipment	Manual Designation
FS100 controller	FS100
FS100 programming pendant	Programming pendant
Cable between the manipulator and the controller	Manipulator Cable
FS100 programming pendant dummy connector	Programming pendant dummy connector

FS100

Descriptions of the programming pendant keys, buttons, displays and keyboard of the PC 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 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. SHIFTkey  +COORD key 
	Mode Key	Three kinds of modes that can be selected by the mode key are denoted as follows: REMOTE, PLAY, or TEACH
	Button	Three buttons on the upper side of the programming pendant are denoted as follows: HOLD button START button EMERGENCY STOP button
	Displays	The menu displayed in the programming pendant is denoted with { }. ex. {JOB}
PC Keyboard		The name of the key is denoted ex. Ctrl key on the keyboard

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.

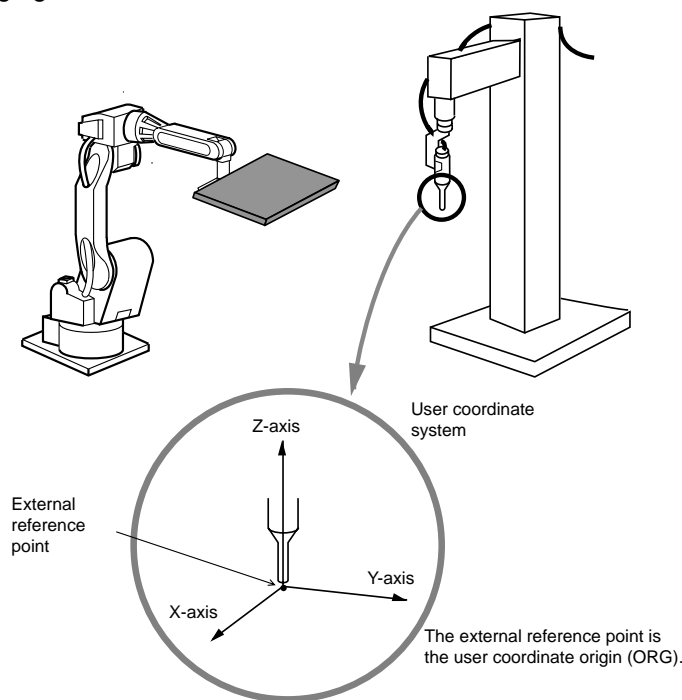
For interpolation during playback, the speed of an external reference point is controlled in relation to the speed of the workpiece.

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 16 user coordinates can be stored in memory, up to 16 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 “2.3.5 User Coordinates” in the FS100 operator’s manual.


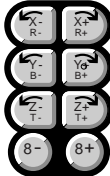


NOTE The external reference point control is not available with the coordinated job.

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.

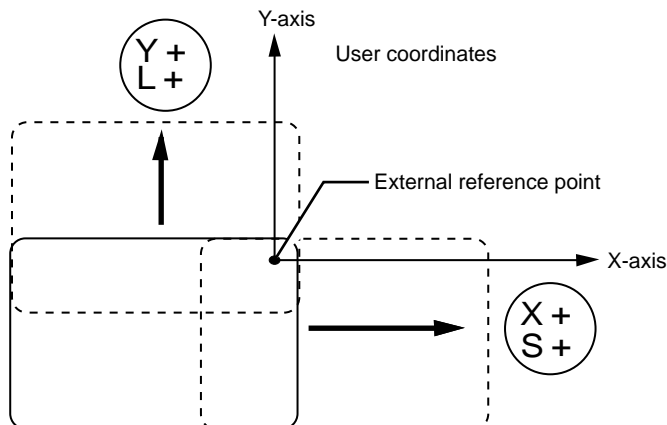
Axis	Axis Keys	Motion
Major Axes		Moves parallel to the X-, Y-, and/or Z-axis of the selected user coordinate.
Wrist Axes		Executes the motion about TCP. (The external reference point is set as the TCP.)



For details, refer to “2.3.5 User Coordinates” and “2.3.7 Control Point Operation” in the FS100 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

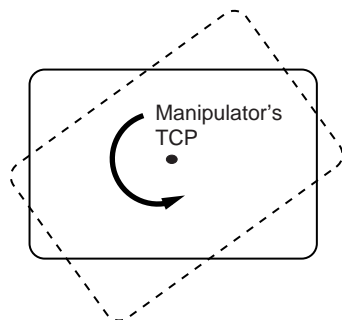
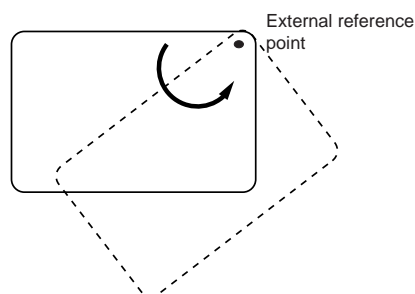
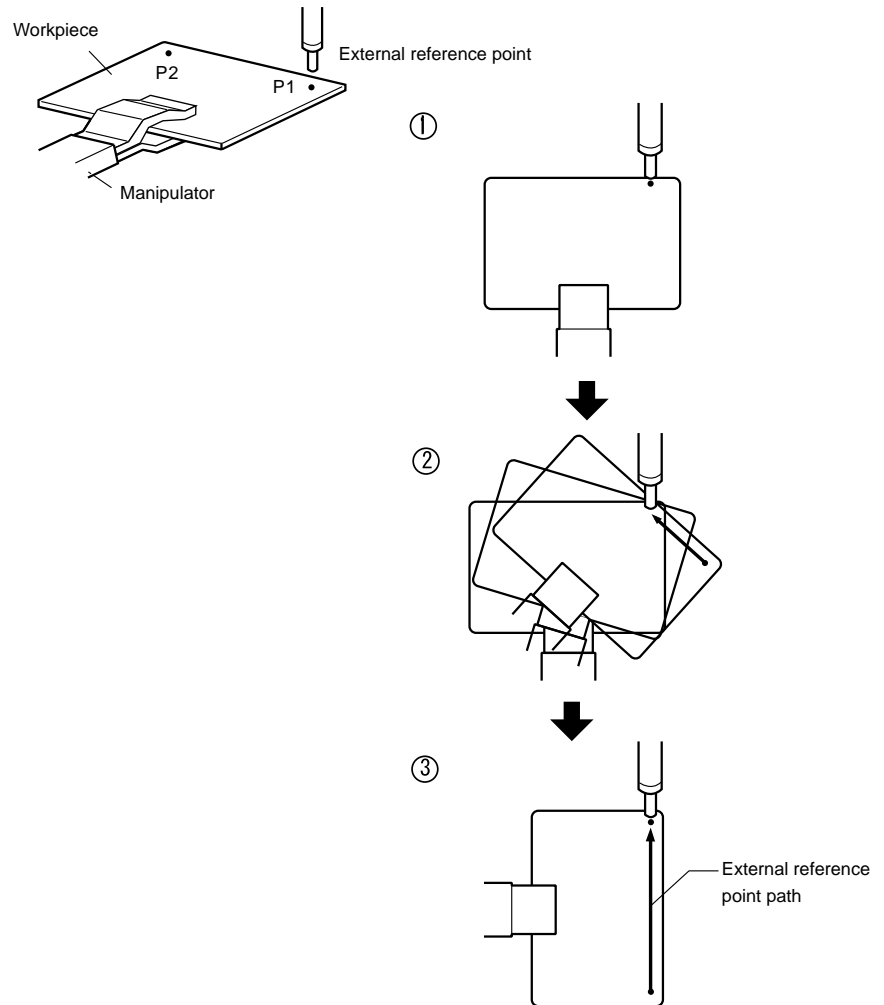


Fig. 1-2: With the External Reference Point Control Function



1.2 Operation at Playback

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



FS100	1	External Reference Point
	1.3	Preparations for External Reference Point Control

1.3 Preparations for External Reference Point Control

To perform the external reference point control for teaching, user coordinates must be registered.

1.3.1 Registration of User Coordinates

For registration of user coordinates, refer to "2.7 User Coordinates" in the FS100 operator's manual.

1.4 Move Instructions

1.4.1 Type

There are two move instructions for external reference point control.

EIMOV L : Used for external linear interpolation.

EIMOV C : Used for external circular interpolation.

1.4.2 Play Speed

The setting procedure is the same as that for linear or circular motions.

1.4.3 User Coordinate No.

When a move instruction for the external reference point control is registered, the user coordinate number of the external reference point selected at the time is automatically registered.

EIMOV L	V=100	UF#(1)
	Play speed	User coordinate No.

<Examples of instruction registration and movement>

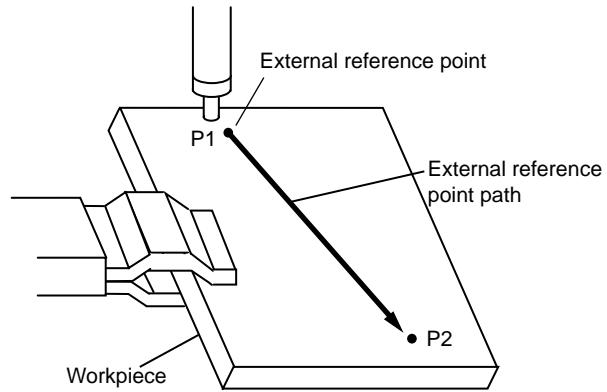
- An example of instruction registration for EIMOVL

```

0000 NCP
0001 MOVJ VJ=50.00
0002 EIMOVL UF#(5) V=138
0003 EIMOVL UF#(5) V=66
0004 MOVJ VJ=50.00
0005 END
    
```

Move instruction for manipulator's TCP
 P1
 P2

Fig. (a): EIMOVL (Linear interpolation)



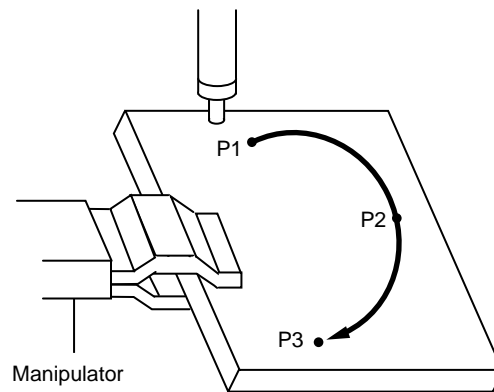
- An example of instruction registration for EIMOVC

```

0000 NCP
0001 MOVJ VJ=50.00
0002 TIMER T=1.00
0003 EIMOVC UF#(4) V=138
0004 EIMOVC UF#(4) V=66
0005 EIMOVC UF#(4) V=66
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 key  to set the external reference points'

 coordinates.




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



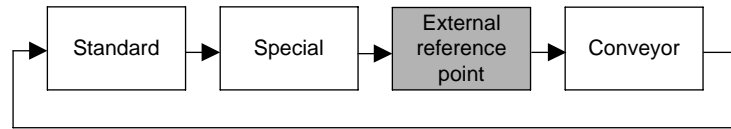
4. Move the cursor to the desired user coordinate file No., and then press [SELECT]



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

6. Press SHIFT key  + [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 key  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 FS100 operator’s manual.

2.3 Modifying Paths

If the paths need to be modified, refer to the following sections in the FS100 operator’s manual.

- 3.4.2 Inserting Move Instructions
- 3.4.3 Deleting Move Instructions
- 3.4.4 Modifying Move Instructions

FS100 OPTIONS INSTRUCTIONS

FOR EXTERNAL REFERENCE POINT CONTROL FUNCTION

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