FS100 OPTIONS
INSTRUCTIONS
FOR SEARCH FUNCTION IN CONTINUOUS MOTION

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
MANDATORY

• This manual explains the search function in continuous motion of the FS100 system and general operations. 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

**NOTE**
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 programing pendant is pressed. When the servo power is turned off, the SERVO ON LED on the programing 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 programing pendant.
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:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS100 controller</td>
<td>FS100</td>
</tr>
<tr>
<td>FS100 programming pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator Cable</td>
</tr>
<tr>
<td>FS100 programming pendant dummy connector</td>
<td>Programming pendant dummy connector</td>
</tr>
</tbody>
</table>
Descriptions of the programming pendant keys, buttons, displays and keyboard of the PC 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</td>
<td>The keys which have characters printed on them are denoted with [ ]. ex. [ENTER]</td>
</tr>
<tr>
<td>Symbol Keys</td>
<td>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.</td>
</tr>
<tr>
<td>Axis Keys</td>
<td>“Axis Keys” and “Numeric Keys” are generic names for the keys for axis operation and number input.</td>
</tr>
<tr>
<td>Numeric Keys</td>
<td></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. SHIFTkey 🖥 +COORD key 🖥</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 { }. ex. {JOB}</td>
</tr>
<tr>
<td>PC Keyboard</td>
<td>The name of the key is denoted ex. 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 the SELECT key 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 TM are omitted.
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1 Search Function in Continuous Motion

The search function in continuous motion holds the data of positions where the FS100 detects signals from sensors during job execution.
Output signals of the sensor used in the system are connected to the FS100 input port for direct-input signals. The signals that are input from this port are called direct-in signals.

The output signals of the sensor used in the system can be connected via a sequencer to the direct-in signal input port, however, processing variations may result due to scanning timing of the sequencer.

It is therefore recommended to connect the output signal of the sensor directly to the FS100 input port.

Connect the part inside when the I/O relay circuit board (CSTR-FBBCA8R03CAA) of the slave for coordinated control is present.

Connect a jumper cable.
2.1 Confirmation of Direct IN Signal Status

Check the status of direct-input signal on the RIN INPUT window.

2.1.1 RIN INPUT Window

1. Select {IN/OUT} under the main menu

2. Select {RIN}
   - The RIN INPUT window appears.
   - "●" indicates the ON status of direct IN signal.
   - "○" indicates the OFF status of direct IN signal

NOTE
In case the system consists of multiple manipulators, every pressing of the page key changes the title of general-purpose display area as "RIN INPUT 1", "RIN INPUT 2" and so forth, and switches the window.

For example, the RIN INPUT 1 window shows the direct-in signals for manipulator 1, and the RIN INPUT 2 window shows the direct-in signals for manipulator 2.
3 Functions

3.1 Starting the Search Function

• The search function will start with the execution of NSRCHON instruction.

• The search function is activated even while the robot is not moving, such as being under the statement of WAIT instruction.

3.2 Exiting from the Search Function

• The search function will be end up with the execution of NSRCHOF instruction.

3.3 Intermittent and Restarting the Search Function During the Operation

The search function will be discontinued upon the intermission of the executing of a JOB due to the following operations and factors. Restart the JOB to restart the search action.

• Hold, External Hold
• Emergency Stop, External Emergency Stop
• Mode switching operation
• When switching the operating cycle to step
• Occurrence of minor failure alarm

In case of the intermission due to the following operations and factors, the search function will not start again upon the restart of the JOB.

• Moving the cursor
• Selecting JOB
• Editing the condition file
4 Instructions on the Search Function in Continuous Motion

4.1 NSRCHON (Search ON Instruction)

The NSRCHON is an instruction to start the search function. The followings are the additional items for the NSRCHON instruction:

- NSRCHON RIN # (Direct-in No.) = <Status>
- ORRIN (Specified Direct-in No.) = <Status>

<Direct-in No.>: 1 to 6

>Status>: Status of Direct-in No. (Common in all signals.)
  ON/OFF, or B type variable.

NOTE

Up to any three of six signals (1 to 6) can be specified as the direct-in number in ORRIN().

For example, specify 1 and 2 with "3" and 1, 2 and 3 with "7."

If a value specifying four or more signals is set, the following alarm is generated when NSRCHON is executed.
AL4446 : OVER VARIABLE LIMIT [0]

4.2 NSRCHOF (Search OFF Instruction)

The NSRCHOF is an instruction to end the search function. The followings are the additional items for the NSRCHOF instruction.
### 4.3 GETS (System Variable Fetch Instruction)

The GETS is an instruction to fetch the system variable ($ variable) as a user variable.

The FS100 cannot use system variables directly for operating instructions. Use the GETS instruction to fetch the values as a user variable.

Format: GETS <user variable> <system variable>

- The user and the system variables must be of the same type.
- <Example> GETS B000 $B000
- The position type variable can be specified by only PX variables.
- The PX variables are the position type variables that are defined in a job. In a job for a single manipulator, PX000 equals to P000.

#### 4.3.1 System Variables

The system variables can be referred only by the GETS instruction which are written by the controller system.

<table>
<thead>
<tr>
<th>System Variable</th>
<th>Type</th>
<th>Explanation</th>
</tr>
</thead>
</table>
| $B type | $B type | $B002: Specifies detected/not detected of the NSRCHON instruction.  
0: Not detected    1: Detected  
$B016: Numbers detected by NSRCHON.  
(Corresponding to RIN#(1))  
$B017: Numbers detected by NSRCHON.  
(Corresponding to RIN#(2))  
$B018: Numbers detected by NSRCHON.  
(Corresponding to RIN#(3))  
$B019: Numbers detected by NSRCHON.  
(Corresponding to RIN#(4))  
$B020: Numbers detected by NSRCHON.  
(Corresponding to RIN#(5))  
$B021: Numbers detected by NSRCHON.  
(Corresponding to RIN#(6)) |
**4 Instructions on the Search Function in Continuous Motion**

### FS100

#### 4.3 GETS (System Variable Fetch Instruction)

**System Variable** | **Type** | **Explanation**
--- | --- | ---

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse</td>
<td>PX type Positions detected by NSRCHON (Maximum detectable number: 50)</td>
<td>Pulse</td>
<td>Cartesian Data (Base Coordinated)</td>
<td>Pulse</td>
<td>Cartesian Data (Base Coordinated)</td>
<td>Pulse</td>
</tr>
<tr>
<td>1st</td>
<td>$PX_{100}$</td>
<td>$PX_{150}$</td>
<td>$PX_{200}$</td>
<td>$PX_{250}$</td>
<td>$PX_{300}$</td>
<td>$PX_{350}$</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>50th</td>
<td>$PX_{499}$</td>
<td>$PX_{549}$</td>
<td>$PX_{599}$</td>
<td>$PX_{649}$</td>
<td>$PX_{699}$</td>
<td>$PX_{749}$</td>
</tr>
</tbody>
</table>

* The position detected in the 51st will not be set in the system variable.
4.4 **CNVRT (Position Type Variable Conversion Instruction)**

The CNVRT is an instruction to convert a pulse data position type variable into a Cartesian data position type variable using a specified coordinate system.

Format: CNVRT *<PX variable>*  *<PX variable>*  *<Coordinate system>*

- `<PX variable (A)>`: Pulse data only.
- `<PX variable (B)>`: Cartesian data (the converted Cartesian data are stored).
- `<Coordinate system>`: Base coordinate system: BF
  - Robot coordinate system: RF
  - Tool coordinate system: TL
  - User coordinate system: UF
  - Master tool coordinate system: MTF

Specifying the master tool coordinate system is to convert into a relative position with the master manipulator only when the coordinated system is set.

### 4.4.1 PX Variables

The PX variables are a group of position type variables that are defined by the control group specified in the job header.

- When the control group is R1, PX000 indicates P000.
- When the control group is R1 + B1, PX000 indicates P000 and BP000.
- When the control group is R1 + B1 + ST1, PX000 indicates P000, BP000 and EX000.
- When the control group is R1 + R2 + B1 + B2, and the master in the coordinated job is R1 + B1, PX000 indicates the following variables.

```
P000 : R2 (Slave)
P001 : R1 (Master)
BP000 : B2 (Slave)
BP001 : B1 (Master)
```
5 Registration of Instructions

The instructions are to be registered when the cursor is in the address area in the JOB CONTENT window during the teach mode.

1. Select {JOB} under the main menu.

2. Select {JOB} under the submenu.
   – The JOB CONTENT window appears.

3. Move the cursor to the address area.
5 Registration of Instructions

5.1 NSRCHON Instruction (To Start Search Function)

1. Move the cursor to the address area.

   - The INFORM LIST dialog box appears
   - Cursor moves to the INFORM LIST dialog box, and the cursor of address area is highlighted.

3. Select {OTHER}.
4. Select \{NSRCHON\}.
   – The NSRCHON instruction appears on the input buffer line.

![Image of input buffer line with NSRCHON instruction highlighted]

5. Press [SELECT] to set the data for each item on the DETAIL EDIT window.
   – Move the cursor to each setting item and press [SELECT].
   Enter desired value/data into each setting item and press [ENTER].

6. Press [ENTER]
   – The entered value/data are registered in the job.
5.2 NSRCHOF Instruction (To Exit from Search Function)

1. Move the cursor to the address area.

   - The INFORM LIST dialog box appears.
   - Cursor moves to the INFORM LIST dialog box, and the cursor of address area is highlighted.

3. Select {OTHER}.
4. Select {NSRCHOF}.
   - The NSRCHOF instruction appears on the input buffer line.

5. Press [ENTER].
   - The entered value/data are registered in the job.
5.3 GETS Instruction

1. Move the cursor to the address area.

   - The INFORM LIST dialog box appears.
   - Cursor moves to the INFORM LIST dialog box, and the cursor of address area is highlighted.

3. Select {ARITH}.
4. Select the {GETS} instruction.
   - The GETS instruction appears on the input buffer line.

5. Press [SELECT] to set the data for each item on the DETAIL EDIT window.
   - Move the cursor to each setting item and press [SELECT].
   - Enter desired value/data into each setting item and press [ENTER].

6. Press [ENTER].
   - The entered value/data are registered in the job.
5.4 CNVRT Instruction

1. Move the cursor to the address area.

   – The INFORM LIST dialog box appears.
   – Cursor moves to the INFORM LIST dialog box, and the cursor of address area is highlighted.

3. Select {ARITH}. 
4. Select the {CNVRT} instruction.
   - The CNVRT instruction appears on the input buffer line.

5. Press [SELECT] to set the data for each item on the DETAIL EDIT window.
   - The DETAIL EDIT window appears.
   - Move the cursor to each setting item and press [SELECT].
   - Enter desired value/data into each setting item and press [ENTER].

   - the entered value/data are registered in the job.
The following table shows a simple job example. The applied job types are further developed based upon the job sample below.

<table>
<thead>
<tr>
<th>Registered Instruction</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>MOVJ</td>
<td>Moves to the standby position.</td>
</tr>
<tr>
<td>MOVL</td>
<td>Moves to the starting position for search detection.</td>
</tr>
<tr>
<td>NSRCHON RIN#(1)=ON</td>
<td>Search activating instruction. Detects the start of DIN1. Instruction to start search detection.</td>
</tr>
<tr>
<td>MOVL</td>
<td>Search detecting section.</td>
</tr>
<tr>
<td>NSRCHOF</td>
<td>Search exit instruction. Instruction to exit from search detection.</td>
</tr>
<tr>
<td>GETS B002 $B002</td>
<td>Specifies detected/not detected of the search detection. Transfers the contents of the system variables $B002 to B002. B002=1: Detected. B002=0: Not detected.</td>
</tr>
<tr>
<td>JUMP *NG IF B002=0</td>
<td>Jumps to the label [*NG] in case of B002=0, which comes out to be NOT DETECTED.</td>
</tr>
<tr>
<td>GETS B003 $B016</td>
<td>Transfers the contents of the system variables $B016, which are corresponding to RIN#(1), to B003.</td>
</tr>
<tr>
<td>GETS P001 $PX150</td>
<td>Transfers the contents of the system variables $P150 (which indicate the detecting position pulse) to P001 (the pulse data position type variables). *If B003 shows 2 or more detections, transfers the contents above $P150 to the Cartesian data position type variable.</td>
</tr>
<tr>
<td>CVNRT P002 P001 BF</td>
<td>Converts P001 (the pulse data position type variables) to P002 (the Cartesian data position type variables).</td>
</tr>
<tr>
<td>MOVL P002</td>
<td>Moves to the position type variables (P002).</td>
</tr>
<tr>
<td>*NG</td>
<td>Jumps to this destination in case of no detection is found.</td>
</tr>
<tr>
<td>MOVJ</td>
<td>Moves to the standby position; finishes the current instruction.</td>
</tr>
<tr>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>
7 Instruction List

Numbers or character data are indicated within the "< >". When there are more than one item in the additional item, choose one of them.

### NSRCHON
- **Function**: Executes a search function.
- **Additional Item**:
  - RIN# (<Direct IN No.>) = <Status>
    - Direct IN No.: 1 to 6
    - Status: ON, OFF, B<variable No.>
  - ORRIN# (<Specified direct IN No.>) = <Status>
    - Specified direct IN No.: (applicable unit: bit): 1 to 63 (Do: RIN#(1), D1: R IN#(2), D2: RIN#(3), D3: RIN#(4), D4: RIN#(5), D5: RIN#(6))
    - Status: ON, OFF, B<variable No.>

#### Example
- NSRCHON RIN#(1)=ON
- MOVL V=50
- MOVL V=50

### NSRCHOF
- **Function**: Exit from the search function.

#### Example
- NSRCHOF

### GETS
- **Function**: Saves the system variable ($ variable) as a user variable.
- **Additional Item**:
  - B <Variable No.>, I <Variable No.>, D <Variable No.>, R <Variable No.>, PX <Variable No.>
  - $B <Variable No.>, $I <Variable No.>, $D <Variable No.>, $R <Variable No.>, $PX <Variable No.>

#### Example
- GETS B000 $B000
- GETS I001 $I[1]
- GETS PX001 $PX001

### CNVRT
- **Function**: Converts the data 2 (position type variable) into a specified Cartesian data position type variable, and store in the data 1.
- **Format**: CNVRT <Data 1> <Data 2> <Coordinate system>
  - Data 1 PX <Variable No.>
  - Data 2 PX <Variable No.>
  - BF, RF, TF, UF# (<User coordinate system No.>), MTF
    - BF: Base coordinate system
    - RF: Robot coordinate system
    - TF: Tool coordinate system
    - UF: User coordinate system
    - MTF: Master tool coordinate system

#### Example
- CNVRT PX000 PX001 BF
- CNVRT LPX000 LPX001 TF
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