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: 159656-1CD
Revision: 0
MANDATORY

- This manual explains the macro command function of the FS100 system. 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

- Confirm that no person is present in the manipulator’s operating range and that you are in a safe location before:
  - Turning ON the FS100 power.
  - Moving the manipulator with the programming pendant.
  - Running the system in the check mode.
  - Performing automatic operations.

Injury may result if anyone enters the manipulator’s operating range during operation. Always press the emergency stop button immediately if there is a problem. The emergency stop button is located on the right of the programming pendant.

- Observe the following precautions when performing teaching operations within the manipulator’s operating range:
  - 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.

- 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 button does 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 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.
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>
</table>
| Programming Pendant      | Character Keys: The keys which have characters printed on them are denoted with [].
|                          | e.g. [ENTER]                                                                      |
| Symbol Keys              | The keys which have a symbol printed on them are not denoted with [] but depicted with a small picture.
|                          | e.g. 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.
|                          | e.g. SHIFT key + 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 {.}
|                          | e.g. {JOB}                                                                        |
| PC Keyboard              | The name of the key is denoted.                                                   |
|                          | e.g. 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.

Registered Trademark

In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or bland names for each company or corporation. The indications of (R) and TM are omitted.
1 Outline ............................................................................................................................................ 1-1
   1.1 Features .................................................................................................................................... 1-1

2 Creation of Macro Commands ............................................................................................................. 2-1
   2.1 Creating Macro Job .................................................................................................................. 2-1
   2.2 Teaching Macro Job ................................................................................................................ 2-3
       2.2.1 GETARG Instruction ........................................................................................................ 2-3
           2.2.1.1 Function .................................................................................................................. 2-3
           2.2.1.2 Format .................................................................................................................... 2-3
           2.2.1.3 Job Example .......................................................................................................... 2-4

3 Registration of Macro Commands ...................................................................................................... 3-1
   3.1 Setting Execution Macro Job .................................................................................................... 3-2
   3.2 Setting Contents of Argument Tag Added to Macro Command .............................................. 3-4
   3.3 Setting Interruption Macro Job ............................................................................................... 3-7
1 Outline

The macro command function registers a prepared job as a macro command and then carries out the job by the macro command.

With the macro command function, system integrators who apply various MOTOMAN robot systems can freely create INFORM (a robot programming language used in FS100) that corresponds to each system.

The macro command function enables an easier robot system with use of the key customize function. (Refer to “8.15 Numeric Key Customize Function” in “FS100 INSTRUCTIONS” for details.)

1.1 Features

• A job prepared with the macro command function by user is registered as a macro command.

• The contents of macro command can be prepared with INFORM, which is the same manner as the normal job data.

• An argument tag can be added to a macro command like a normal instruction. Macro commands and their argument tags can be easily programmed at will in the job data display.

< Example > Macro command for sealing

```
SEALON WIDTH=8
```

Argument tag to specify the sealing width
Macro command to start sealing

• The macro commands can be used in the same way as the other instructions. Unlike the CALL instruction, end users do not have to consider the restarting method in case of a job interruption.

• The macro command function enables settings for post-processing of the job interruption, such as the cancellation of current work instruction, etc.

• If a macro command is interrupted during the execution, the interrupted macro command is reexecuted from the beginning when the operation is restarted.

NOTE The macro command function is enabled only when the security mode is in the management mode.
2 Creation of Macro Commands

The execution sequence of a macro command is registered as a macro job.

**NOTE**
The macro command function is enabled only when the security mode is in the management mode.

2.1 Creating Macro Job

Depending on the applications, there are three types of macro jobs as follows:

- Robot macro job with a designated control group
  A move instruction can be registered in a macro command. A macro command prepared as a robot macro job can be used only in the jobs configured for the same control groups. For example, the macro command prepared as a robot macro job for R1 cannot be used in a job for R2.

- Robot macro job without a control group
  Can be used for all robot jobs. Since the control group is not designated, no move instruction can be registered.

- Concurrent macro job
  Can be used in a concurrent job. Since the control group is not designated, no move instruction can be registered.

1. Select “Management Mode” for the security mode.
2. Select {JOB} from the top menu.
3. Select {NEW JOB CREATE}.
4. Enter the job name.

The macro command function is enabled only when the security mode is in the management mode.
5. Point the cursor to “JOB TYPE”, and press [SELECT].
   – A selection list appears.

   ![Selection List]

   – Select “ROBOT MACRO” or “CONCURRENT MACRO”.

   ![Selection List]

6. Select “EXECUTE”.
   – A macro job is prepared, and the JOB CONTENT window appears.
2.2 Teaching Macro Job

Teach a macro job which is prepared as a macro command in the same manner as normal jobs.

A maximum of sixteen argument tags can be added to a macro command. Since the data of the argument tag is stored in a local variable to be used, the required number of local variables must be set in a “JOB HEADER” before teaching the macro job.

2.2.1 GETARG Instruction

2.2.1.1 Function

The GETARG instruction is an instruction to receive an argument for macro command. When a macro command is executed, the GETARG instruction gets the data of the argument tag which is added to the macro command, and stores it in a local variable to be used in the macro job.

2.2.1.2 Format

\[
\text{GETARG LB000 IARG#(1)}
\]

Stores the data of the first argument in the local variable LB000.

1 Designation of the local variable as the storage destination of the argument data

The following types of local variables can be used for storage destination:
- Byte-type
- Integer-type
- Double-precision integer type
- Real-number type
- Robot-axis-position type
- Base-axis-position type
- Station-axis-position type

2 Designation of argument data

Specifies the number of the argument data to be taken.

For the setting procedure of the local variables, refer to “3.9.10 Editing Local Variables” in “FS100 OPERATOR’S MANUAL”.

NOTE

In a macro job, job execution instructions such as JUMP, CALL, and PSTART cannot be registered.
2.2.1.3 Job Example

Robot Job

- NOP
- MOVJ VJ=100.00
- WAIT IN#(1)=ON
- MOVJ VJ=50.00
- SEALON WIDTH=8
- MOVL V=125
- MOVL V=95

Macro Job: SEALON

- NOP
- GETARG LI000 IARG#(1)
- DOUT OT#(10) ON
- MUL LI000 10
- WAIT IN#(10)=ON
- AOUT AO#(1) LI000
- END

Stores the first argument data "8" in the local variable LI000.

Outputs the analog voltage according to the first argument data.
### 3 Registration of Macro Commands

To register the macro job prepared in chapter 2.1 “Creating Macro Job” as a macro command, display the MACRO (ROBOT) window or MACRO (CONCURRENT) window following the procedure below.

1. Select "Management Mode" for the security mode.
2. Select (SETUP) from the top menu.
3. Select (MACRO INST.).
   - The macro command setting window appears.
   - Press the page key to alternately display the MACRO (ROBOT) window and the MACRO (CONCURRENT) window.

NOTE: The macro command function is enabled only when the security mode is in the management mode.
3 Registration of Macro Commands

3.1 Setting Execution Macro Job

The execution macro jobs are macro jobs in which the operations to be carried out by a macro command are programmed. Note that the JOB CONTENT window of a macro command displays the names of the jobs which are specified as execution macro jobs.

1. Point the cursor to the “EXECUTE JOB” to be set in the macro command setting display, and press [SELECT].
   – A list box appears.

2. Select “SETTING MACRO JOB”.
   – The MACRO JOB NAME window appears.
3. Select the desired macro job.
- The selected macro job is registered as an execution macro job.

<table>
<thead>
<tr>
<th>MACRO</th>
<th>IDLE</th>
<th>EXECUTE JOB</th>
<th>SUSPEND JOB</th>
</tr>
</thead>
<tbody>
<tr>
<td>MACRO1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MACRO2</td>
<td></td>
<td></td>
<td></td>
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<td>MACRO3</td>
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<td>MACRO4</td>
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<td>MACRO5</td>
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<td>MACRO7</td>
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<td>MACRO8</td>
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<td>MACRO10</td>
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<td>MACRO11</td>
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<td>MACRO12</td>
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<td>MACRO13</td>
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<tr>
<td>MACRO14</td>
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<tr>
<td>MACRO15</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.2 Setting Contents of Argument Tag Added to Macro Command

Set the contents of argument tag to be added to the registered macro command.

This setting is not necessary for the macro command with no argument.

1. Point the cursor to the macro number to which the argument is to be set.

2. Press [SELECT].
   (Continued on the next page.)

   – The macro ARGUMENT DEFINITION window appears. There are two windows to define the macro argument. Press the page key to switch the windows.

   📌 Argument number (ARG. 1 to 16)
   Point the cursor to the desired argument number, and press [SELECT].
   Select “USE” or “NOT USE” from the list box.
   For the unused argument numbers, the window displays “------”.

3-4
3 Registration of Macro Commands
3.2 Setting Contents of Argument Tag Added to Macro Command

② COMMENT 1 (up to 16 characters)
Point the cursor to COMMENT 1 and press [SELECT]. A character input window appears.
Enter the contents of the argument tag added to the macro command in the “COMMENT 1” column. These contents are displayed as the comment for the argument tag in the detail editing window of the macro command.

③ TYPE
Point the cursor to TYPE and press [SELECT]. A dropdown list appears.
Select the data type of the argument tag. The following types of data are available for the setting:

<Constants or variables>
- Byte-type
- Integer-type
- Double-precision integer type
- Real-number type

<Variables or teaching points>
- Robot-axis-position type
- Base-axis-position type
- Station-axis-position type

④ COMMENT 2 (up to 8 characters)
Point the cursor to COMMENT 2 and press [SELECT]. A character input window appears.
Enter the unit for inputting data in the argument tag to be added to the macro command in “COMMENT 2”. The units are displayed as the comment for the argument tag data input units in the detail editing window of the macro command.
3. Registration of Macro Commands

3.2 Setting Contents of Argument Tag Added to Macro Command

③ DISPLAY
Select whether to display the expression in the EXPRES’N column. Pressing [SELECT] displays “ON” and “OFF” alternately: “ON” displays the expression; “OFF” hides the expression.
When the teaching point for the robot position, base position, or station position is set in “TYPE”, the screen does not display the tag set for the teaching point even if “ON” is selected.

⑥ EXPRES’N (up to 8 characters)
Point the cursor to EXPRES’N and press [SELECT]. The character input box appears.
Enter the expression for the argument tag.

3. Perform the settings for each item.
3.3 Setting Interruption Macro Job

If a post-processing is required when a macro command is interrupted, add an interruption macro job (SUSPEND JOB) to the program.

The interruption macro job is carried out when a macro command that includes an interruption macro job (SUSPEND JOB) is interrupted by being put on a status such as hold, emergency stop, or mode switching.

1. Point the cursor to the “SUSPEND JOB” column of the macro job for which an interruption macro job is to be added, and press [SELECT].
   – A list box appears.

2. Select “SETTING macro JOB”.
   – The MACRO JOB NAME window appears.

NOTE

Only a robot job without a designated control group can be added to the interruption macro job of the robot macro command.

3-7
3. Select the desired macro job.
   - The selected macro job is registered as the interruption macro job.

NOTE

If the following infinite loop is programmed in the interruption macro job, the start lamp stays lit but no operation is carried out. Do not add such a job to the program. Also note that the TIMER and WAIT instructions are not carried out in the interruption macro job.

**JOB example**

```
NOP
*LOOP
DOUT OT#(1) OFF
AOUT AO#(1) 10.00
JUMP *LOOP IF IN#(1)=ON
END
```