Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.
MANDATORY

• This manual explains the PMT function (Position Modification Function for Tool Deformation) 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

- 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.
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 [ ].</td>
</tr>
<tr>
<td></td>
<td>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</td>
</tr>
<tr>
<td></td>
<td>with a small picture.</td>
</tr>
<tr>
<td></td>
<td>ex. PAGE key</td>
</tr>
<tr>
<td></td>
<td>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</td>
</tr>
<tr>
<td>Numeric Keys</td>
<td>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</td>
</tr>
<tr>
<td></td>
<td>“+” sign between them,</td>
</tr>
<tr>
<td></td>
<td>ex. SHIFT key</td>
</tr>
<tr>
<td></td>
<td>+ 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:</td>
</tr>
<tr>
<td></td>
<td>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:</td>
</tr>
<tr>
<td></td>
<td>HOLD button</td>
</tr>
<tr>
<td></td>
<td>START button</td>
</tr>
<tr>
<td></td>
<td>EMERGENCY STOP button</td>
</tr>
<tr>
<td>Displays</td>
<td>The menu displayed in the programming pendant is denoted with { }.</td>
</tr>
<tr>
<td></td>
<td>ex. {JOB}</td>
</tr>
<tr>
<td>PC Keyboard</td>
<td>The name of the key is denoted</td>
</tr>
<tr>
<td></td>
<td>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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2. Data Conversion by PMT Function .................................................................................. 2-2
   2.1 Outline ....................................................................................................................... 2-2
      2.1.1 PMT data conversion by instruction ................................................................. 2-2
      2.1.2 PMT data conversion by programming pendant ............................................. 2-3
   2.2 PMT Data Conversion by Instruction ......................................................................... 2-5
      2.2.1 Registering GETTOOL Instruction ................................................................. 2-5
      2.2.2 Registering SETTOOL Instruction ................................................................. 2-6
      2.2.3 Registering PMT Instruction ............................................................................ 2-7
   2.3 PMT Data Conversion by Programming Pendant .................................................... 2-10

3. Tool Data Backup History .............................................................................................. 3-1
   3.1 Tool Backup Window ............................................................................................... 3-1

4. Instruction List for PMT Function .................................................................................. 4-1

5. Parameter ......................................................................................................................... 5-1

6. Alarm List ......................................................................................................................... 6-1
The PMT function corrects the position data when the tool is deformed during operation (PMT: Position Modification for Tool Deformation). When a tool inadvertently collides with peripheral jigs or walls during operation and is deformed, the tool center point will be dislocated and the taught position of the job programmed would be shifted; it requires a great deal of time and effort for correction. In such a case, the PMT function can be used to correct the position data easily and accurately.

By specifying the desired job, the position data of the taught tool dimensions before deformation are converted automatically to the position data of the tool dimensions after deformation.

In the PMT function, the tool before deformation is called “the original tool” and the tool after deformation is called “the orientation tool”.

**NOTE**

- For a job in which teaching is performed by using several types of tools, only the position data obtained by the specified original tool is converted.
- The position variables are not converted in the PMT function.
2 Data Conversion by PMT Function

2.1 Outline

When the PMT function is used, the tool dimensions and the job taught position data are rewritten. In order to secure the data, prepare the backup files beforehand.

The data can be converted by the PMT function using instructions or the programming pendant.

2.1.1 PMT data conversion by instruction

The following window is a job example (PMT0) to convert the data by instructions.

Carry out Job PMT0 to convert the data using the PMT function.

Refer to chapter 2.2 “PMT Data Conversion by Instruction” for the programming of each instruction, GETTOOL, SETTOOL, and PMT. Before converting the data, prepare a job, like TOOL0 in the preceding example, to obtain the amount of tool deformation by using a touch sensor or other device.

- Before converting the data by a PMT instruction, be sure to save the data of the original tool by using a GETTOOL instruction.
- For a system with the independent control function enabled, do not use PSTART, an independent control instruction, to start a job that includes a PMT instruction.
2.1.2 PMT data conversion by programming pendant

The following outline describes how to convert the data by using the programming pendant.

Refer to chapter 2.3 “PMT Data Conversion by Programming Pendant” for more information.

1. Select {PMT} under {UTILITY} in JOB CONTENT window.

2. Save the tool constants used before the tool deformation as the original tool data.
3. Set the new tool constants to be used after the tool's deformation.

4. Convert the data of WORK1 using the PMT function.
2.2 PMT Data Conversion by Instruction

2.2.1 Registering GETTOOL Instruction

1. Press [INFORM LIST]
2. Select the instruction group “ARITH”
3. Select “GETTOOL”

   – The instruction appears, with the same additional items that were previously set, in the input buffer line.

4. Select any additional items in the DETAIL EDIT window
   (1) Press [SELECT] two times, and the DETAIL EDIT window of the GETTOOL instruction appears.
   (2) Move the cursor to “PUT TO” and press [SELECT]. The selection dialog box appears.
   (3) Select “PMT DATA,” and the following window appears.

5. Press [ENTER]

   – The GETTOOL instruction with the additional items is added to the program for the job.
   – To cancel these settings, press [CANCEL], and the JOB CONTENT window reappears.
2.2.2 Registering SETTOOL Instruction

1. Press [INFORM LIST]
2. Select the instruction group “ARITH”
3. Select “SETTOOL”
   – The instruction appears, with the same additional items that were previously set, in the input buffer line.
4. Select any additional items in the DETAIL EDIT window
   (1) Press [SELECT] two times, and the DETAIL EDIT window of the SETTOOL instruction appears.
   (2) Set the TOOL FILE and the P-VAR ROBOT.
5. Press [ENTER]
   – The SETTOOL instruction is registered with the additional items.
   – To cancel these settings, press [CANCEL], and the JOB CONTENT window reappears.
### 2.2.3 Registering PMT Instruction

**NOTE**

Add PMT instructions for the number of jobs to be converted.

1. Press [INFORM LIST]
2. Select the instruction group “ARITH”
3. Select “PMT” instruction
   - The instruction appears, with the same additional items that were previously set, in the input buffer line.
4. Select any additional items
   - (1) Move the cursor to the tool file number and push [Select]. Then, it becomes possible to input the number by "Numeric Value."

---

**Table:**

<table>
<thead>
<tr>
<th>JOB CONTENT</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>J-PMT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONTROL GROUP: R1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0000: NOP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0001: SET TOOL NAMES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0002: GET TOOL PMT DATA TL0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003: CALCULATES TOOL VALUES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0004: CALL JOB-TOOL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0005: GET TOOL TL0(1)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:**

Add PMT instructions for the number of jobs to be converted.
(2) Move the cursor to the name of the job of which data is to be converted, and press [SELECT]. A list of jobs appears.

(3) Select the job subject to conversion for PMT function.
   – Push "Page." Then, the screen changes to a text input screen. It is also possible to input a job name in the text input screen.

(4) Move the cursor to the name of the job to save the data, and press [SELECT]. A list of jobs appears.
   – Push "Page." Then, the screen changes to a text input screen. It is also possible to input a job name in the text input screen.
When the name of the job to save the data does not have to be specified, move the cursor to "PMT," and press [SELECT]. The DETAIL EDIT window appears.

1) For the “BACKUP JOB,” select “UNUSED”.

5. Press [ENTER]
   – The PMT instruction with the additional items is added to the program.
2.3 PMT Data Conversion by Programming Pendant

NOTE

When the PMT function is used, the tool dimensions and the job taught position data are rewritten.

In order to secure the data, prepare the backup files beforehand.

1. Select {UTILITY} from the main menu in the job contents window in teach mode

   – The JOB CONTENT window appears.

2. Select {PMT}

   – The PMT window appears.
3. Select No. of the tool for conversion

- The confirmation dialog to save the tool dimensions before deformation appears.

(1) Select "NO" if the tool dimensions after deformation are already registered.
Select "YES" if the tool dimensions after deformation are not registered yet.

4. Register and confirm tool dimensions

(1) Set the tool dimensions by inputting with the Numeric Keys or by selecting {TOOL CALIBRATION} of {UTILITY}.

- For details of methods to set tool dimensions, refer to “8.3 Tool Data Setting” of the FS100 Instruction manual.

(2) Confirm the tool dimensions before and after the PMT conversion (ORIGINAL TOOL and ORIENTATION TOOL), then select “EXECUTE”.

The indication of "●" would appear on the display if the registered tool dimensions are the ones before deformation.
5. Select “CONVERSION MODE”.

   – The following three methods are available for selecting a job.

   - Method 1: SINGLE
     When only the specified job is to be converted, select “SINGLE” from “CONVERSION MODE”.

   - Method 2: RELATED
     When the jobs related to the specified job are to be converted together, select “RELATED” from “CONVERSION MODE”.

   - Method 3: ALL
     When all the jobs registered in FS100 are to be converted, select “ALL” from “CONVERSION MODE”.

6. Select the job for conversion

   – Select “JOB NAME” to display the Job List, then select the job to be converted.

7. Select “EXECUTE”

   – Job conversion is performed based on the settings of conversion mode.

   – The window returns to the JOB CONTENT window when the conversion is completed.
For a job after conversion, be sure to confirm the path after conversion by performing FWD/BWD operations.

If the steps beyond the manipulator's range of motion are created, "/0V" will be indicated in the corresponding step as shown in the following window. The "/0V" will disappear by correcting the positions.

However, if any step beyond the scope of operation is created at the time of conversion, it is also possible to indicate an error and not to allow conversion by setting Parameter S2C390. (Refer to chapter 5 “Parameter” at page 5-1)

In this case, "Error 2790: Step exceeding operation range (J: Job name, L: Line number)" is indicated.
3 Tool Data Backup History

The modification history of the tool constants can be viewed in the TOOL BACKUP window.

The history of the tool data backup is updated when a GETTOOL instruction with “PMTDATA” added is carried out.

When a GETTOOL instruction is carried out and the data of the original tool and the orientation tool are the same, only the execution date and time in the backup history are updated.

The backup history would be also updated when the original tool is saved in operating PMT function with the programming pendant.

3.1 Tool Backup Window

1. Select “ROBOT” under the main menu
2. Select {TOOL BACKUP}
   – The TOOL BACKUP window appears.

![Tool Backup Window Image]
### 4 Instruction List for PMT Function

<table>
<thead>
<tr>
<th>Function</th>
<th>Gets the data from a tool file.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GETTOOL</strong></td>
<td></td>
</tr>
<tr>
<td>Additional items</td>
<td>Tool data storage directory P, PMTDATA&lt;sup&gt;1)&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Tool file TL# (&lt;Tool file number&gt;) 0 to 15</td>
</tr>
<tr>
<td>Example</td>
<td>GETTOOL PMTDATA TL# (0) GETTOOL P000 TL# (0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Rewrites the data in the tool file.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SETTOOL</strong></td>
<td></td>
</tr>
<tr>
<td>Additional items</td>
<td>Tool file TL# (&lt;Tool file number&gt;) 0 to 15</td>
</tr>
<tr>
<td></td>
<td>Adjustment method +, -</td>
</tr>
<tr>
<td></td>
<td>Position variable robot P</td>
</tr>
<tr>
<td>Example</td>
<td>SETTOOL TL# (0) P000 SETTOOL TL# (0) +P000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Converts the data.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PMT</strong></td>
<td></td>
</tr>
<tr>
<td>Additional items</td>
<td>Tool file TL# (&lt;Tool file number&gt;) 0 to 15</td>
</tr>
<tr>
<td></td>
<td>Name of the job of which data is subjected to conversion JOB:</td>
</tr>
<tr>
<td></td>
<td>Name of the job where the data is to be saved&lt;sup&gt;2)&lt;/sup&gt; JOB:</td>
</tr>
<tr>
<td>Example</td>
<td>PMT TL# (0) JOB:WORK1 PMT TL# (0) JOB:WORK1 JOB:WORK0</td>
</tr>
</tbody>
</table>

1. When “PMTDATA” is selected for the storage destination of the tool data, the specified data from the tool file is saved as the data of the backup tool.

2. When the name of the job specified as the job to save the data does not exist, the job used before converting the data (the job of which data is to be converted) is saved with the specified job name (JOB COPY).

When the name of the job specified as the job to save the data already exists, the specified job is rewritten by the job used before converting the data.
### Parameter

<table>
<thead>
<tr>
<th>Parameter No.</th>
<th>Meaning</th>
<th>Units</th>
<th>Initial Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>S3C1192</td>
<td>The allowable difference (values of X, Y, and Z) between the present tool constant and the tool data automatic setting in the operation of a SETTOOL instruction.</td>
<td>0.001mm</td>
<td>20000</td>
</tr>
<tr>
<td>S2C390</td>
<td>0 : Conventional mode (conversion by /OV)</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1 : Conversion after confirmation of limit checks at once (no conversion by /OV)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## 6 Alarm List

<table>
<thead>
<tr>
<th>Alarm No.</th>
<th>Message</th>
<th>Meaning</th>
<th>Corrective Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>4605</td>
<td>SETTOOL ERROR</td>
<td>An error occurred when executing a SETTOOL instruction. The difference between the current tool constant and a new set value exceeded the allowable range (parameter set value).</td>
<td>(1) Check if the tag set value is correct. (2) Check if the parameter is set correctly. Refer to chapter 5 “Parameter” at page 5-1</td>
</tr>
<tr>
<td>4126</td>
<td>CANNOT EXECUTE AUTO PMT [decimal data]</td>
<td>1,2 : SYSTEM error 3 : Prohibition of editing of jobs subject to conversion 4 : Prohibition of editing of jobs saved 5 : Memory shortage in job area 6 : No job subject to conversion 7 : Memory shortage in position area</td>
<td>1,2 : Please contact YASKAWA representative. 3,4 : Please check the job header. 5,7 : Please delete unnecessary jobs. 6 : Please check the name of job subject to PMT conversion.</td>
</tr>
</tbody>
</table>
FS100 OPTIONS
INSTRUCTIONS
FOR PMT FUNCTION

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