FS100 CONTROLLER
NOTES FOR SAFE OPERATION

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

MOTOMAN INSTRUCTIONS
FS100 INSTRUCTIONS
FS100 OPERATOR’S MANUAL
FS100 MAINTENANCE MANUAL

Part Number: 169271-1CD
Revision: 3
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>

Notes for Safe Operation

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

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 “DANGER”, “WARNING” and “CAUTION”.

MANDATORY

Read this manual and all the electrical data in attached CD-ROM carefully before installation, operation, maintenance, or inspection of the FS100.

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

Note, however, this instruction manual does not sufficiently provide all the safety precautions. For your safety, be sure to ensure safety measures or management before the operation.

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.

DANGER Indicates an imminent hazardous situation which, if not avoided, could result in death or serious injury to personnel.

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.

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”.
1.1 For Your Safety

Explanation of Warning Labels

The following warning labels are attached to the manipulator and FS100. Fully comply with the precautions on the warning labels.

- **DANGER**
  - The label described below is attached to the manipulator. Observe the precautions on the warning labels. Failure to observe this caution may result in injury or damage to equipment. Refer to the manipulator manual for the warning label location.

- The following warning labels are attached to FS100. Observe the precautions on the warning labels. Failure to observe this warning may result in injury or damage to equipment.

1 Safety

1.1 For Your Safety

Robots generally have requirements which are different from other manufacturing equipment, such as larger working areas, high-speed operation, rapid arm movements, etc., which can pose safety hazards. Read and understand the instruction manuals and related documents, and observe all precautions in order to avoid the risk of injury to personnel and damage to equipment.

It is the user’s responsibility to ensure that all local, state, and national codes, regulations rules, or laws relating to safety and safe operating conditions are met and followed.

1.2 Special Training

- **MANDATORY**
  - Teaching maintenance of the robot must conform to:
    - Industrial Safety and Health Law
    - Enforcement Order of Industrial Safety and Health Law
    - Ordinance of Industrial Safety and Health Law
  - Other related laws are:
    - Occupational Safety and Health Act in USA
    - Factory Act (Gewerbeordnung) in Germany
    - Health and Safety at Work, etc. Act in UK
    - EC Machinery Directive 98/37/EC
  - Prepare
    - Safety Work Regulations based on concrete policies for safety management complying with related laws.
  - Observe
    - Robots for Industrial Environments - Safety Requirements (ISO 10218)
    - Manipulating Industrial Robots - Safety (Japan only) (JIS B 8433) for safe operation of the robot.
  - Reinforce the
    - Safety Management System by designating authorized workers and safety managers, as well as giving continuing safety education.
  - Teaching and maintaining the robot are specified as “Hazardous Operations” in the Industrial Safety and Health Law (Japan only).

Workers employed in these above operations are requested to attend special training offered by Yaskawa.

- **MANDATORY**
  - Persons who teach or inspect the manipulator must undergo required training before using the manipulator.
  - For more information on training, inquire at the nearest Yaskawa branch office.
  - The telephone numbers are listed on the back cover of this manual.
1.3 Motoman Manual List

MANDATORY

- It is important to have and be familiar with all manuals concerning the MOTOMAN.
  You should have the four manuals listed below:
  - MOTOMAN-□□□ INSTRUCTIONS
  - FS100 INSTRUCTIONS
  - FS100 OPERATOR'S MANUAL
  - FS100 MAINTENANCE MANUAL
- Confirm that you have all these manuals on hand.
  If any manuals are missing, contact your salesman from Yaskawa's local branch office.
  The relevant telephone numbers are listed on the back cover.

1.4 Personnel Safety

The entire manipulator’s operating range is potentially dangerous.
All personnel working with the MOTOMAN (safety administration, installation, operation, and maintenance personnel) must always be prepared and “Safety First” minded, to ensure the safety of all personnel.

WARNING

- Avoid any dangerous actions in the area where the MOTOMAN is installed.
  Failure to observe this caution may result in personal injury due to contact with the manipulator or peripheral equipment.
- Please take strict safety precautions by placing signs such as “Flammable”, “High Voltage”, “Waiting”, and “Off-limits to Unauthorized Personnel” in necessary areas in the factory.
  Failure to observe this caution may result in fire, electric shock, or personal injury due to contact with the manipulator and other equipment.
- Strictly observe the following items:
  - Always wear approved work clothes (no loose-fitting clothes).
  - Do not wear gloves when operating the MOTOMAN.
  - Do not allow underwear, shirts, or neckties to hang out from the work clothes.
  - Do not wear large jewelry, such as earrings, rings, or pendants.
  Always wear protective safety equipment such as helmets, safety shoes (with slip-proof soles), face shields, safety glasses, and gloves as necessary.
  Improper clothing may result in injury.
- Unauthorized persons should not approach the manipulator or associated peripheral equipment.
  Failure to observe this caution may result in personal injury due to contact with the FS100, controller, workpiece, positioner, etc.
1.5 Motoman Safety

1.5.1 Transporting

1.5.1.1 Transportation of the Manipulator

**CAUTION**

- Operation of the crane, sling, or forklift should only be performed by authorized personnel. Failure to observe this caution may result in personal injury or equipment damage.
- Avoid jarring, dropping, or hitting the controller during handling. Excessive vibration or impacting the FS100 may adversely affect the performance of the FS100.

**CAUTION**

- As a rule, the manipulator should be lifted by a crane.
  - Make sure to fix the manipulator with the shipping bolts and brackets, and lift it in the posture as shown in each manipulator’s instruction manual.
  - Use wire ropes threaded through the shipping bolts and brackets or the attached eyebolts to lift up the manipulator.
  - Be sure to use wire that is strong enough to handle the weight of the manipulator. Failure to observe this caution may cause the manipulator to fall, which may result in personal injury or equipment damage.
- If storing the manipulator temporarily before installation, make sure to place it on a stable and flat surface, and take precautions to prevent unauthorized personnel from touching it. Failure to observe this caution may cause the manipulator to fall, which may result in personal injury or equipment damage.
- Transportation posture of the manipulator

**CAUTION**

1.5.2 Installation

Refer to the MOTOMAN-□□□ Instructions manual and FS100 Instructions for details on installation and wiring. When planning installation, take appropriate measures to ensure safety. Observe the following when installing the manipulator:

To insure safety, be sure to install the safeguarding. It prevents unforeseen accidents with personnel and damage to equipment. The following is quoted for your information and guidance.

(ISO10218)

**Responsibility for Safeguarding**

The user of a manipulator or robot system shall ensure that the safeguarding is provided and used in accordance with Sections 6, 7, and 8 of this standard. The means and degree of safeguarding, including any redundancies, shall correspond directly to the type and level of hazard presented by the robot system consistent with the robot application. Safeguarding may include but not be limited to safeguarding devices, barriers, interlock barriers, perimeter guarding, awareness barriers, and awareness signals.
1.5 Motoman Safety

1.5.2.1 Installation of the Manipulator

**WARNING**

- Select an area such as that described below to install the manipulator: Confirm that the area is large enough so that the fully extended manipulator arm with tool will not reach a side wall, safeguarding, or the controller. Failure to observe this warning may result in personal injury or equipment damage due to unexpected movement of the manipulator.

- Install a safeguarding around the manipulator to prevent any accidental contact with the manipulator while the power is on.
- Equipped with a safety interlock. Be sure the interlock operates correctly before use.
- Perform grounding in accordance with all applicable electrical codes. Failure to observe this warning may result in fire or electric shock.
- Do not start the manipulator or even turn ON the power before it is firmly anchored. The manipulator may overturn and cause injury or damage.
- When mounting the manipulator on the ceiling or wall, the base section must have sufficient strength and rigidity to support the mass of the manipulator. Also, it is necessary to consider countermeasures to prevent the manipulator from falling. Failure to observe these warning may result in injury or damage.

**CAUTION**

- Do not install or operate the manipulator that is damaged or lacks parts. Failure to observe this caution may cause injury or damage.
- Before turning ON the power, check to be sure that the shipping bolts and brackets are removed. Failure to observe this caution may result in damage to the driving parts.
- Install the manipulator using bolts of the size and type specified for each MOTOMAN in the MOTOMAN INSTRUCTION MANUAL. Failure to observe this caution may result in injury or damage to equipment.

1.5.2.2 Installation of the FS100

**WARNING**

- Make sure that there is sufficient room for maintenance on the manipulator, FS100, and other peripheral equipment. Failure to observe this caution may result in personal injury during maintenance.

**CAUTION**

- To ensure safety, make sure to operate the controller from a location where the manipulator is easily visible. Operation by unauthorized personnel may result in personal injury or equipment damage.
- Install the FS100 outside the safeguarding of the manipulator’s safety enclosure. Failure to observe this caution may result in personal injury or equipment damage due to contact with the manipulator.
- Do not get on top of the FS100. Failure to observe this caution may result in personal injury or equipment damage.
1.5 Motoman Safety

1.5.3 Work Area Safety

Carelessness contributes to serious accidents in the work area. To ensure safety, enforce the following precautions:

**WARNING**

- Install a safeguarding around the manipulator to prevent any accidental contact with the manipulator while the power is ON. Post a warning sign stating “Off-limits During Operation” at the entrance of the enclosure. The gate of the safeguarding must be equipped with a safety interlock. Be sure the interlock operates correctly before use. Failure to observe this warning may result in a serious accident due to contact with the manipulator.

**CAUTION**

- Store tools and similar equipment in proper locations outside of the enclosure. Tools and loose equipment should not be left on the floor around the manipulator, FS100, or welding fixture, etc., as injury or damage to equipment can occur if the manipulator comes in contact with objects or equipment left in the work area.
1.5 Motoman Safety

1.5.4 Operation Safety

**MANDATORY**

- Persons operating or inspecting the manipulator should be trained as required by applicable laws and company policies.
  - Refer to section 1.2 “Special Training” on page 3.

- Make sure to incorporate the robot system into the user’s system which has lockout/tagout function. That is to say, supply one or more devices to turn OFF the power supply of the manipulator, servo track, and controller, and install them outside the enclosure in which the manipulator and servo track are installed. The devices must be able to be locked out and tagged out.

  Turning the power ON improperly during work may result in electric shock or personal injury due to unexpected movement of the manipulator.

**WARNING**

- Never exceed the rated capacity of the manipulator described in the specifications section of the manipulator manual.

  Failure to observe this warning may result in personal injury or equipment damage.

- Teach jobs from outside the manipulator’s work area whenever possible.

- Observe the following precautions when performing teaching operations within the manipulator’s operating range:
  - Be sure to use a lockout device to the safeguarding when going inside. Also, display the sign that the operation is being performed inside the safeguarding and make sure no one closes the safeguarding.
  - 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 unintentional manipulator operation may result in injury.

**WARNING**

- Before operating the manipulator, check that the SERVO ON lamp on the programming pendant turns OFF when the emergency stop button on the programming pendant or on the external control device, etc. is pressed.

  Personal injury or equipment damage may result if the manipulator cannot be stopped in case of emergency.

  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.

- 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 Emergency Stop

TURN
1.5 Motoman Safety

1.5.5 Connection

**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 top right of the programming pendant.

- 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.

**MANDATORY**

- Make sure to incorporate the robot system into the user’s system which has lockout/tagout function. That is to say, supply one or more devices to turn OFF the power supply of the manipulator, servo track, and controller, and install them outside the enclosure in which the manipulator and servo track are installed. The devices must be able to be locked out and tagged out.

Turning the power ON improperly during work may result in electric shock or personal injury due to unexpected movement of the manipulator.

**WARNING**

- The system must be grounded.

Failure to ground equipment may result in fire or electric shock.

- Before wiring, make sure to turn OFF the primary power supply, and put up a warning sign. (e.g. DO NOT TURN THE POWER ON)

Failure to observe this warning may result in injury or electric shock.

- Do not touch any board inside the controller for five minutes after turning OFF the power supply.

Capacitors inside the controller store electricity after power is turned OFF. Exercise caution whenever handling circuit boards. Failure to observe this warning may result in injury or electric shock.

- Power cannot be turned ON unless the door is closed. Interlocks prevent power from being turned ON.

Failure to observe this warning may result in fire or electric shock.

- Any occurrence during wiring while the FS100 is in the emergency stop mode is the user’s responsibility. Do an operation check once the wiring is completed.

Failure to observe this warning may result in personal injury or mechanical failure.

- Wiring must be performed only by authorized personnel.

Incorrect wiring may result in fire or electric shock.

- Perform wiring in accordance with the rated capacity as specified in the Instructions.

Incorrect wiring may result in fire or mechanical failure.

- Do not handle the circuit board directly by hand.

The IC board may malfunction due to electrostatics.

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**CAUTION**

- Perform the following inspection procedures prior to conducting manipulator teaching. If a problem is found, correct it and implement all other necessary measures immediately.
  - Check for problems in manipulator movement.
  - Check for damage to insulation and sheathing of external wires.

- Always return the programming pendant to its hook on the FS100 cabinet after use.

If the programming pendant is inadvertently left on the manipulator, on a fixture, or on the floor, the manipulator or a tool may collide with the programming pendant during manipulator movement, which may result in personal injury or equipment damage.
1.6 Notes for Moving and Transferring the MOTOMAN

1.5.5.1 Connecting the Primary Power Supply

**WARNING**

- Make sure to use the supplied connector for the primary power supply connection.
- Tighten the cable clamp to prevent the cable from breaking.

Failure to observe these cautions may result in electric shock or equipment failure.

**NOTE**

Do not connect the ground wire with the wires for the electric power source, the welder, etc. If using metallic ducts, metallic conduits, or cable trays for cabling, perform grounding in accordance with all relevant governmental regulations.

1.5.6 Turning ON the Main Power Supply

**WARNING**

- Confirm that nobody is present in the P-point maximum envelope of the manipulator when turning on FS100 power supply.

Failure to observe this caution could result in injury caused by accidental contact with the manipulator.

Push the emergency stop button immediately if any problems occur.
The emergency stop button is located in the upper left of the door on the FS100 and on the right side of the programming pendant.

**NOTE**

Be sure to remove all items from the area before moving the manipulator.
Refer to the INSTRUCTION MANUAL for the appropriate position of the fixture.

1.7 Notes on MOTOMAN Disposal

**DANGER**

- Do not modify the manipulator or the FS100.

Failure to observe this instruction may cause fire, mechanical failure, or malfunction, which may result in personal injury and/or equipment damage.

**WARNING**

- Take precautionary measures to prevent the manipulator from overturning, such as anchoring it firmly, etc., even when temporarily storing it before disposal.

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

**MANDATORY**

- When disposing of or recycling the MOTOMAN, follow the applicable national/local laws and regulations.

**PROHIBITED**

- This symbol is applicable in some areas.
The wheelie bin symbol on this product, manual or its packaging indicates that at the end of life the product should enter the recycling system. It must be disposed at an appropriate collection point for electrical and electronic equipment (EEE) and should not be put in the normal waste stream.

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1.6 Notes for Moving and Transferring the MOTOMAN

When moving or transferring the Motoman, observe the following safety precautions:

**CAUTION**

- Attach the instructions to the controller cabinet so that all users have access to necessary manuals.
See section 1.3 “Motoman Manual List” on page 4 for a complete list of manuals.
If any manual is missing, contact your Yaskawa representative.
- If the warning labels on the manipulator and FS100 are illegible, clean the labels so that they can be read clearly. Note that some local laws may prohibit equipment operation if safety labels are not in place.
Contact your Yaskawa representative if you require new warning labels.
- When the MOTOMAN is transferred, it is recommended to check with Yaskawa Engineering Co. which is listed on the back cover of this manual.
Incorrect installation or wiring may result in personal injury or equipment damage.
2.1 Contents Confirmation

2 Product Confirmation

2.1 Contents Confirmation

Confirm the contents of the delivery when the product arrives. Standard delivery includes the following four (five or six) items (information for the content of optional goods is given separately):

- Manipulator
- FS100 (including spare parts)
- Manipulator cable (between manipulator and FS100)
- Complete set of manuals
- Programming pendant (optional)
- Programming pendant dummy connector (optional)

Fig. 1-1: Standard Four (Five or Six) Items

2.2 Order Number Confirmation

Confirm that the order number pasted on the manipulator and FS100 match. The order number plates are affixed to the figure below.

<Example>

THE MANIPULATOR AND THE CONTROLLER SHOULD HAVE SAME ORDER NUMBER.

ORDER NO. S78796-1

CAUTION

- Confirm that the manipulator and the FS100 have the same order number. Special care must be taken when more than one manipulator is to be installed. If the numbers do not match, manipulators may not perform as expected and cause injury or damage.
NOTES FOR SAFE OPERATION

For inquiries or after-sales service on this product, contact your local YASKAWA representative as shown below.

YASKAWA ELECTRIC CORPORATION
2-1 Kurotsukishinbashi, Yahatanishi-ku, Kitakyushu, 806-0004, Japan
Phone: +81-93-645-7703 Fax: +81-93-645-7802
http://www.yaskawa.co.jp

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
http://www.motoman.com

YASKAWA EUROPE GmbH (ROBOTICS DIVISION)
Yaskawastrasse 1, 85391, Allershausen, Germany
Phone: +49-8166-90-100 Fax: +49-8166-90-103
http://www.yaskawa.eu.com

YASKAWA NORDIC AB
Verksamhetsplan 2, Box 504, SE-385 25 Torsas, Sweden
Phone: +46-480-417-800 Fax: +46-486-414-10
http://www.yaskawa.se

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
http://www.yaskawa.co.cn

YASKAWA SHOU GANG ROBOT CO., LTD.
No.7 Yongchang North Road, Beijing & Development Area, Beijing 100076, China
Phone: +86-10-6788-2858 Fax: +86-10-6788-2878
http://www.asia.yaskawa.com.cn

YASKAWA ELECTRIC KOREA CORPORATION
35F, Three IPC, 10 Gukjegeumyung-ro, Yeongdeungpo-gu, Seoul, 07326, Korea
Phone: +82-2-784-7844 Fax: +82-2-784-8495
http://www.yaskawa.co.kr

YASKAWA ELECTRIC TAIWAN CORPORATION
12F, No.207, Sec. 3, Beishin Rd., Shinshan District, New Taipei City 23143, Taiwan
Phone: +886-2-8913-1333 Fax: +886-2-8913-1513
http://www.yaskawa.com.tw

YASKAWA ASIA PACIFIC PTE. LTD.
30A Kallang Place, #06/01, 339213, Singapore
Phone: +65-6289-3003 Fax: +65-6289-3003
http://www.yaskawa.com.sg

YASKAWA ELECTRIC (THAILAND) CO., LTD.
59, 1st-5th Floor, Flourish Building, Soi Rachadapisek 18, Rachadapisek Road, Huaykwang, Bangkok 10310, Thailand
Phone: +66-2-017-0099 Fax: +66-2-017-0199
http://www.yaskawa.co.th

PT. YASKAWA ELECTRIC INDONESIA
Secure Building, Gedung B Lantai Dasar & Lantai 1 Jl. Raya Protokol Halim Perdanakusuma, Jakarta 13610, Indonesia
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http://www.yaskawa.co.id

YASKAWA INDIA PRIVATE LIMITED (ROBOTICS DIVISION)
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Phone: +91-124-475-8500 Fax: +91-124-475-8542
http://www.yaskawa.india.in

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