

FS100 INSTRUCTIONS

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

YASKAWA ELECTRIC CORPORATION





- This manual explains setup, diagnosis, maintenance, hardware, etc. 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"*. To ensure correct and safe operation, carefully read the chapter.



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 "DANGER", "WARNING", "CAUTION", "MANDATORY", or "PROHIBITED".



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.



Always be sure to follow explicitly the items listed under this heading.



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".



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:
 - 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 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.



WARNING

 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 Button





CAUTION

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

 Read and understand the Explanation of the Warning Labels before operating the manipulator.

Definition of Terms Used Often in This Manual

The MOTOMAN is the YASKAWA industrial robot product.

The MOTOMAN usually consists of the manipulator, the FS100 controller, manipulator cables, the FS100 programming pendant (optional), and the FS100 programming pendant dummy connector (optional).

In this manual, the equipment is designated as follows:

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

Descriptions of the programming pendant, buttons, and displays are shown as follows:

Equipment		Manual Designation
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.

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Explanation of Warning Labels

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



• 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.

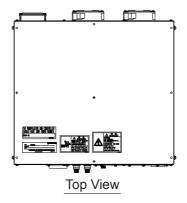


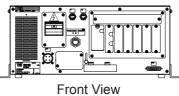
Refer to the manipulator manual for the warning label location.

• 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.







Heavy Object Warning NP



Electric Shock Warning NP



Electric Shock Warning NP

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1.1 For Your Safety

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.



- 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.

FS100

1.2 Special Training

1.2 Special Training



- 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



 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 MAINTENANCE MANUAL
- FS100 OPERATOR'S 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.

FS100

1.4 Personnel Safety

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.

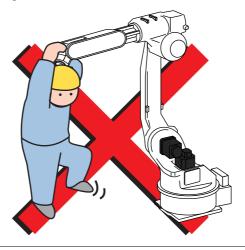
Failure to observe this caution may result in personal injury due to contact with the FS100, controller, workpiece, positioner, etc.

1.4 Personnel Safety



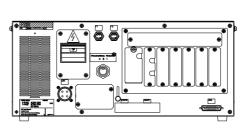
· Never forcibly move the manipulator axes.

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



• Never lean on FS100 or other controllers, and avoid inadvertently pushing buttons.

Failure to observe this caution may result in personal injury or equipment damage due to unexpected movement of the manipulator.





Never allow unauthorized personnel to touch the FS100 during operation.

Failure to observe this caution may result in personal injury or equipment damage due to unexpected movement of the manipulator.

FS100

1.5 Motoman Safety

1.5 Motoman Safety

1.5.1 Installation and Wiring Safety

Refer to the MOTOMAN- $\Box\Box\Box$ Instructions manual and FS100 Instructions for details on installation and wiring.

In planning installation, adapt an easy to observe arrangement to ensure safety. Take safety into consideration when planning the installation. Observe the following when installing the manipulator:

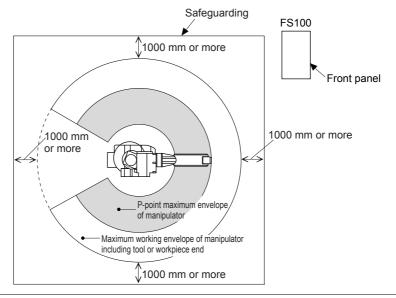


WARNING

 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.



Perform grounding in accordance with all applicable electrical codes.

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



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.



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.

Failure to observe this caution may cause the manipulator to fall, which may result in personal injury or equipment damage.

- Lift, move, or install the FS100 by two or more persons.
 - Approx. mass of FS100: 20 kg per unit
- Use a platform truck to carry the FS100.
 - Avoid jarring, dropping, or hitting the FS100 during handling.

Failure to observe these cautions may cause the FS100 to fall down, which may result in personal injury or equipment damage.

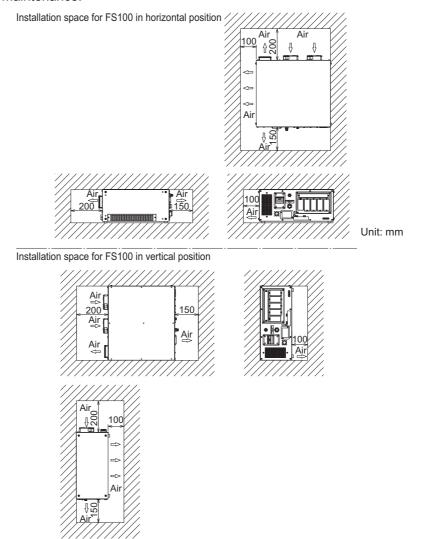
 If storing the manipulator temporarily before installation, make sure to place it on a stable and flat surface, and take precautions to prevent unauthorized personnel from touching it.

Failure to observe this caution may cause the manipulator to fall, which may result in personal injury or equipment damage.



• 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.



• 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.

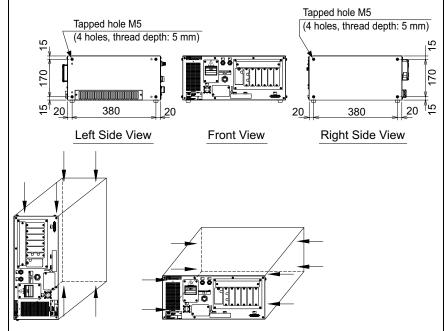


• Install the manipulator using bolts of the size and type specified in each manipulator's instruction manual.

Failure to observe this caution may cause the manipulator to fall, which may result in personal injury or equipment damage.

 After installation, fix the FS100 on the floor or base depending on its way of installation by using the screws shown below.

Failure to observe this caution may cause the FS100 to fall, which may result in personal injury or equipment damage.



 Up to 2 units of the FS100 can be stacked together on the flat floor. Be sure to securely fix the upper and lower FS100s together by using the screws on the left and right sides so that the FS100s do not move apart.

Failure to observe this caution may cause the FS100 to drop or fall, which may result in personal injury or equipment damage.

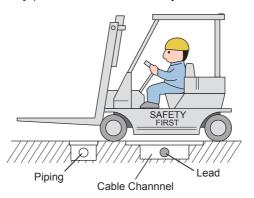
• Be familiar with the connection diagram before wiring the FS100, and perform the wiring in accordance with the connection diagram.

Failure to observe this caution may result in personal injury or equipment damage due to miswiring or unexpected movement of the manipulator.



CAUTION

 Take precautions when wiring and piping between the FS100, manipulator, and peripheral equipment. Run the piping, wiring, or cables through a pit or use a protective cover, so that they are not stepped on by personnel or run over by the forklift.



Operators and other personnel may stumble on exposed wiring or piping. Cable damage may cause unexpected manipulator motion resulting in personal injury or equipment damage.

FS100 1.

1 Safety1.5 Motoman Safety

1.5.2 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.

FS100

1.5 Motoman Safety

1.5.3 Operation Safety



 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.

- 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.



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.

Emergency Stop Button



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.



- 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.



- Persons operating or inspecting the manipulator should be trained as required by applicable laws and company policies.
 - Refer to chapter 1.2 "Special Training" at page 1-2.

FS100

1.6 Notes for Moving and Transferring MOTOMAN

1.6 Notes for Moving and Transferring 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 *chapter 1.3 "Motoman Manual List" at page 1-2* 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.

FS100

1.7 Notes on MOTOMAN Disposal

1.7 Notes on MOTOMAN Disposal



· Never modify the manipulator or FS100.

Failure to observe this may result in personal injury or equipment damage due to fire, power failure, or operation error.



- When disposing of the MOTOMAN, follow the applicable national or local laws and regulations.
- Anchor the manipulator well, even when temporarily storing it before disposal.

Failure to observe this caution may result in injury due to the manipulator falling down.

2.1 Contents Confirmation

2 Product Confirmation

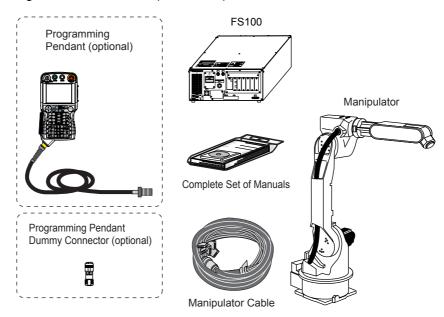
2.1 Contents Confirmation

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. 2-1: Standard Four (Five or Six) Items



2 Product Confirmation

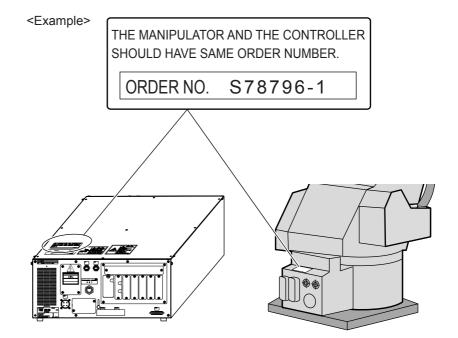
FS100

2.2 Order Number Confirmation

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.



3.1 Handling Procedure

3 Installation

3.1 Handling Procedure



CAUTION

- Lift, move, or install the FS100 by two or more persons.
 - Approx. mass of FS100: 20 kg per unit
- Use a platform truck to carry the FS100.
 - Avoid jarring, dropping, or hitting the FS100 during handling.

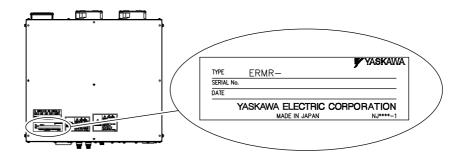
Failure to observe these cautions may cause the FS100 to fall down, which may result in personal injury or equipment damage.

The mass of the FS100 is indicated on the nameplate. The location and content of the nameplate is shown below.

Unpack and move the FS100 by two or more persons.

Use a lifter to lift the FS100 up to or put it down from the rack. Also, use a platform truck to carry the FS100.

If the FS100 must be manually carried, lifted up, or put down, two persons must hold the bottom of the FS100 firmly.



FS100 3.2 Place of Installation

3.2 Place of Installation

The conditions listed below must be met before installing the FS100.

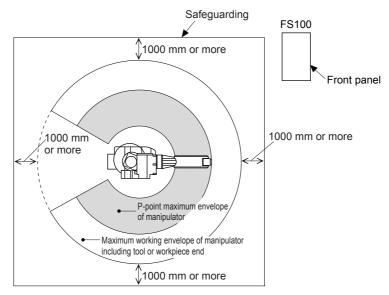
- Ambient temperature: 0° to +40°C during operation, and -10 to +60°C during transportation and maintenance
- Humidity: 10 to 90%RH (non-condensing)
- Free from exposure to dust, soot, oil, or water
- Free from corrosive gas or liquid, or explosive gas or liquid
- Free from excessive vibration (Vibration acceleration: 4.9 m/s² [0.5G] or less)
- Free from large electrical noise (plasma)

3.3 Installation Location

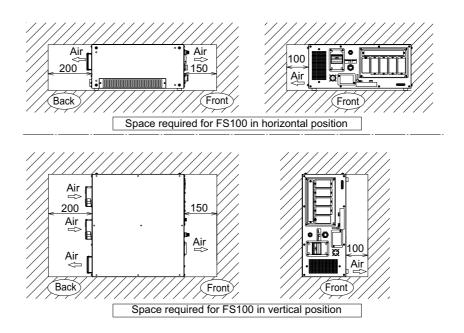
3.3 Installation Location

• Install the FS100 outside of the manipulator's operating range (outside of the safeguarding).

Fig. 3-1: Installation Location of FS100



- Install the FS100 where the manipulator can be clearly seen during operation and can be operated safely.
- Install the FS100 where its front panel can be operated easily.
- Install the FS100 where it can be easily taken out of the rack for maintenance.
- Install the FS100 where it can be inspected easily. (Make sure to secure the maintenance area.)
- Do not place any obstacles in the following:
 - \bullet within 200 mm from the rear panel (air inlet and air outlet) of the FS100
 - within 150 mm from the front panel (air outlet) of the FS100
 - within 100 mm from the side panel (air outlet) of the FS100



3.4 Installation Method

3.4 Installation Method



CAUTION

 The length of the fixing screws for the FS100 must be equal to or shorter than the thickness of the metal fitting + 5 mm.

If the length exceeds the above, the components inside the FS100 may be damaged.

- Required screw size: M5 (length: equal to or shorter than the thickness of the metal fitting + 5 mm)
- Required screw material: mild steel or higher-strength material
- Fix all the 8 fixing points to install the FS100.
- The FS100 is free-standing type. Avoid jarring, dropping, or hitting the FS100 when installing it.

Failure to observe these cautions may result in personal injury or equipment damage.

The FS100 is not dust-proof, drip-proof, or explosion-proof.
 Be sure to use it in the environment free from explosive gas, combustible gas, corrosive gas, condensation, and dust.

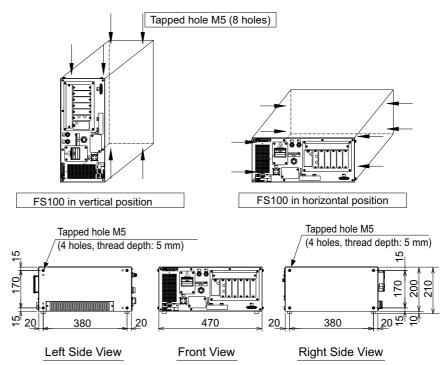
Failure to observe this caution may result in equipment damage.

• Do not get on top of the FS100.

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

Fixing Method

For the FS100 in horizontal position, fix it to the rack by using the tapped holes on the right and left side of it.



4 Connection



 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.



WARNING

· 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.

4.1 Notes on Cable Connection

4.1 Notes on Cable Connection

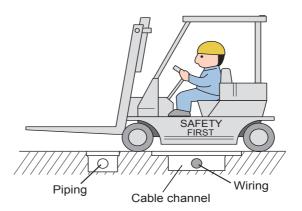
 The cables that connect the FS100 and peripheral devices are low voltage circuits. Keep the cables away from the primary power circuit.

Do not run high voltage power lines in parallel and close to the cables.

If high voltage power lines must be run in parallel and close to the cables due to unavoidable circumstances, use metal ducts or conduit to avoid electrical interference. If the lines and cables must cross, ensure that they cross in a perpendicular fashion.

- Confirm the numbers of the connectors and cables so that there is no misconnection between the manipulator and FS100, and the FS100 and peripheral devices.
 - Misconnection may result in damage to electronic devices.
- Make sure to put the cables in the cable channel. Do not leave the cables uncovered while performing wiring between the manipulator and FS100, or FS100 and peripheral devices. Uncovered cables may get in the way of people, forklifts, etc, and may result in an accident or cable damage.

Fig. 4-1: FS100 Cable Connection Diagram



4.2 Power Supply

4.2 Power Supply

4.2.1 Three-Phase Power Supply



The power failure processing circuit operates when there is a black out or drop in voltage, and the servo power turns OFF.

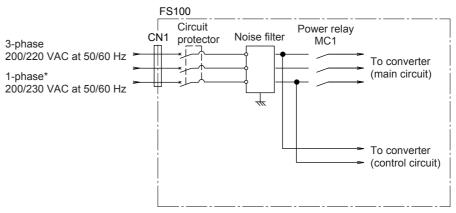
Connect the power supply to a stable power source that is not prone to power fluctuations.

The three-phase power supply comprising 200/220 VAC at 50/60 Hz is used.

The single-phase power supply comprising 200/230 VAC at 50/60 Hz can also be used for the following models:

• MHJ, MH5F, MH5LF, SIA5F, SIA10F, SIA20F, SDA10F, SDA20F

Fig. 4-2: Connection of Input Power



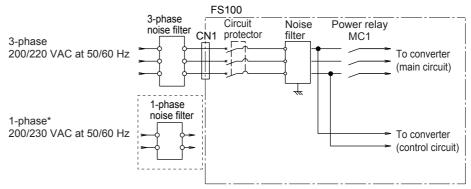
* Models for 1-phase power supply: MHJ, MH5F, MH5LF, SIA5F, SIA10F, SIA20F, SDA10F, SDA20F

4.2.2 Noise Filter Installation

Insert the three-phase noise filter into the primary station of the non-fuse breaker filter if you hear noise coming from the power source.

Seal up each cable opening so that dust does not enter.

Fig. 4-3: Connection of Three-Phase Noise Filter



^{*} Models for 1-phase power supply: MHJ, MH5F, MH5LF, SIA5F, SIA10F, SIA20F, SDA10F, SDA20F

4.2 Power Supply

4.2.3 Leakage Breaker Installation

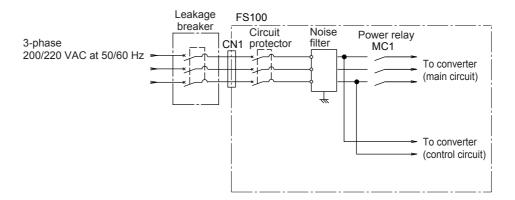
When connecting the leakage breaker to the controller power supply wiring, use a leakage breaker which can handle high frequencies from the FS100 inverter. Leakage breakers which cannot handle high frequencies may malfunction.

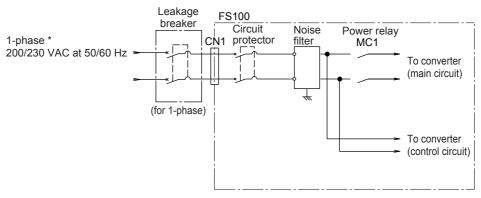
Table 4-1: Example of High Frequency Leakage Breaker

Maker	Model
Mitsubishi Electric Co., Ltd.	NV series (manufactured since 1988)
Fuji Electric Co., Ltd.	EG or SG Series (manufactured since 1984)

Even with a leakage breaker installed, there is still a possibility of some high frequency current leakage from the FS100 inverter. However, this current leakage presents no safety risks.

Fig. 4-4: Connection of the Leakage Breaker





* Models for 1-phase power supply: MHJ, MH5F, MH5LF, SIA5F, SIA10F, SIA20F, SDA10F, SDA20F 4.2 Power Supply

4.2.4 Primary Power Supply Breaker Installation

Install the primary power supply breaker as shown below.



• 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.

Fig. 4-5: Installation of Primary Power Supply Breaker

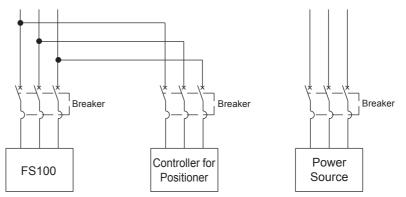


Table 4-2: FS100 Power Capacity, Cable Size, and Circuit Protector

Manipulator	Power capacity (kVA)	Cable size (with Cabtyre cable (three cores)) (mm²)	Capacity of circuit protector in FS100 (A)
MHJ	0.5	3.5	15
MH5F, MH5LF, MH6F, SIA5F	1.0	3.5	15
MPP3, MH12, HP20F, SIA20F, SDA10F	1.5	3.5	15
MPK2F	2.0	3.5	15
SDA20F	3.0	3.5	15

The maximum load value (payload, operation speed, and frequency, etc.) is displayed.

However, the power capacity is different depending on work conditions.

FS100

4 Connection

4.2 Power Supply

When selecting the transformer, contact your Yaskawa representative.



The power capacity shown above is the continuous rating value.

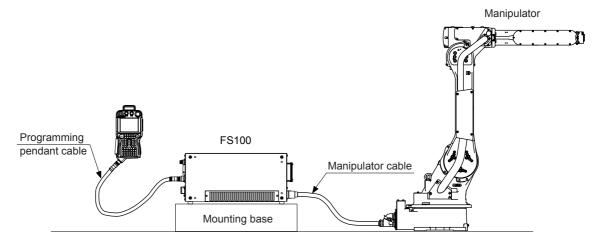
When the robot is rapidly accelerated, the power capacity of several times the continuous rating value may be needed instantly.

4.3 Connection Methods

4.3 Connection Methods

A connection diagram for the manipulator, manipulator cable, primary power cable and programming pendant is shown below.

Fig. 4-6: Connection of Cables



4.3.1 Connecting Primary Power Supply

■ Power Cable Connection

- Prepare the power cable by using the power connector of the FS100. Refer to table 4-3(a) "For Three-Phase Power Supply (CN1)" and table 4-3(b) "For Single-Phase Power Supply (CN1) (Only for MHJ, MH5F, MH5LF, SIA5F, SIA10F, SIA20F, SDA10F, SDA20F)" for the pin assignment of the FS100 power connector (CN1), and prepare the power cable.
- 2. Confirm that the circuit protector of the FS100 is turned OFF.
 - CN1 INPUT AC (for AC power input)
 - Controller-side connector:
 CE05-2A18-10PD-B (manufactured by DDK Ltd.)
 - Cable-side connector (supplied with controller):
 CE05-6A18-10SD-B-BSS (manufactured by DDK Ltd.)

Table 4-3(a): For Three-Phase Power Supply (CN1)

Pin No.	Signal Name	Description
A	L1	AC input (L1/R-phase)
В	L2	AC input (L2/S-phase)
С	L3	AC input (L3/T-phase)
D	P.E.	Protective grounding

Table 4-3(b): For Single-Phase Power Supply (CN1)
(Only for MHJ, MH5F, MH5LF, SIA5F, SIA10F, SIA20F, SDA10F, SDA20F)

Pin No.	Signal Name	Description
Α	L1	AC input (L1/R-phase)
В	N.C.	Not available
С	L3	AC input (L3/T-phase)
D	P.E.	Protective grounding

FS100

- 4 Connection
- 4.3 Connection Methods
- 3. Confirm that the primary power supply is turned OFF.
- 4. Connect the primary power supply cable.



WARNING

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

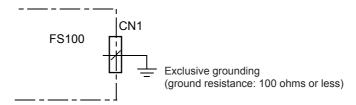
Failure to observe these cautions may result in electric shock or equipment failure.

- (1) Grounding method:
- Perform grounding as countermeasures against noise and electric shock.
- Follow the steps below:
 - I) Connect the ground wire to the D terminal of the FS100 power connector (CN1).
 - II) Perform grounding in accordance with all relevant local and national electrical codes. The size of ground wire must the same as listed on table 4-2 "FS100 Power Capacity, Cable Size, and Circuit Protector" at page 4-6.



The ground wire must be supplied by the user.

Fig. 4-7: Exclusive Grounding





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.

4 Connection

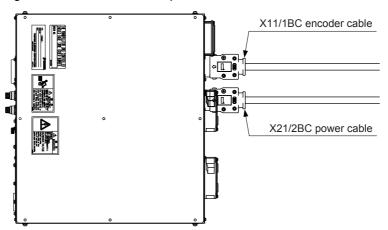
FS100

4.3 Connection Methods

4.3.2 Connecting Manipulator Cable

1. Unpack the manipulator cable. Connect the cable to the connectors on the back side of FS100.

Fig. 4-8: Connection of Manipulator Cable



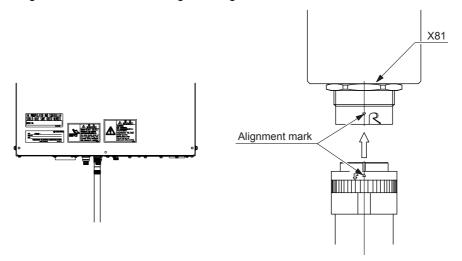
- 2. Connect the manipulator to the FS100.
 - Confirm the number of the manipulator cable connector. Push the manipulator cable connector into the manipulator-side connector firmly, and tighten it securely.

4.3 Connection Methods

4.3.3 Connecting Programming Pendant (Optional)

1. Connect the programming pendant cable to the connector connection (X81) on the front panel of the FS100.

Fig. 4-9: Connection of Programming Pendant Cables



The manipulator, FS100, and programming pendant connections are now complete.



If the programming pendant is not used, connect the programming pendant dummy connector (CBC-FRC063-1) to the connector connection (X81).

5.1 Turning ON Main Power Supply

5 Turning ON and OFF Power Supply

5.1 Turning ON Main Power Supply



 Confirm that nobody is present in the manipulator's operating range when turning ON the FS100 power supply.

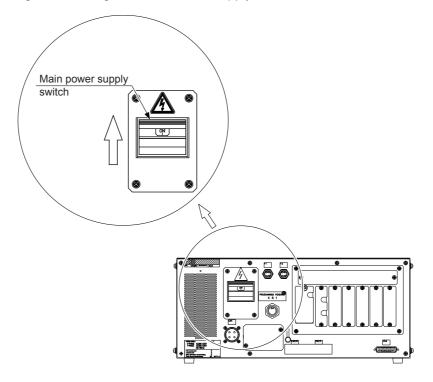
Failure to observe this warning may result in injury caused by accidental contact with the manipulator.

Press the emergency stop button immediately if any problem occurs.

The emergency stop button is located on the right of the programming pendant.

The main power supply is turned ON when the main power supply switch on the front of the FS100 is turned to the "ON" position, and the initial diagnosis and the current position setting begin.

Fig. 5-1: Turning ON Main Power Supply



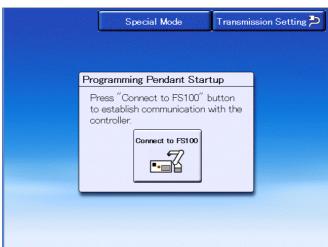
5.1 Turning ON Main Power Supply

5.1.1 Initial Diagnosis

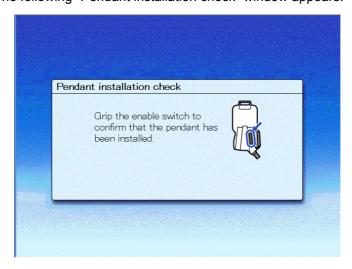
When the programming pendant is connected and the main power is turned ON, the initial diagnosis is performed in the FS100.

- 1. Turn ON the power supply.
 - The screen switches.





- 2. Press the {Connect to FS100} button.
 - The following "Pendant installation check" window appears.



- 5.1 Turning ON Main Power Supply
- 3. Grip the enable switch.
 - The following "Pendant installation check" window appears.



- 4. Release the enable switch.
 - If the connection confirmation of the programming pendant is successful, the communication between the FS100 and the programming pendant is established.
 - If the connection confirmation of the programming pendant is failed, the following window appears.





For details of the messages displayed during the communication connection between the FS100 and the programming pendant, and the network configuration of the programming pendant when connecting the FS100 via network, refer to chapter 1.2 Programming Pendant of "FS100 Operator's Manual".

5.1 Turning ON Main Power Supply

5.1.2 When Initial Diagnosis Is Complete

When the power supply is turned OFF, the FS100 saves all condition data, including:

- Operation mode
- Called job (active job if the FS100 is in the play mode; edit job if the FS100 is in the teach mode) and cursor position in the job.

Fig. 5-2: Initial Window





• Make sure that a system manager stores the key of the mode select switch on the programming pendant.

After operation, the key should be removed and stored by the system manager.

Improper or unintended manipulator operation may result in injury.

Also, the key or the mode select switch may be damaged if the programming pendant is dropped with the key inserted.

FS100

- 5 Turning ON and OFF Power Supply
- 5.2 Turning ON Servo Power

5.2 Turning ON Servo Power

5.2.1 During Play Mode

If the safety plug of safeguarding is turned OFF, the FS100 determines that the worker's safety is not secure.

 When the safeguarding is closed, press [SERVO ON READY] on the programming pendant to turn ON the servo power supply. [SERVO ON] lamp lights when the servo power is turned ON.





When the safeguarding is open, the servo power supply cannot be turned ON.

5.2.2 During Teach Mode

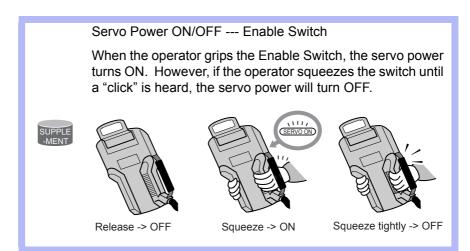
 Press [SERVO ON READY] on the programming pendant to turn ON the servo power supply. [SERVO ON] lamp will blink when the servo power is turned ON.



2. The servo power is turned ON and [SERVO ON] lamp on the programming pendant lights when the operator grips the Enable Switch.



5.2 Turning ON Servo Power





When performing emergency stop on the front door of the FS100, programming pendant, or external signal, the servo power-on operation from the Enable switch is cancelled.

When turning the power back ON, follow the steps 1 and 2 on the previous page.

5.3 Turning OFF Power Supply

5.3 Turning OFF Power Supply

5.3.1 Turning OFF Servo Power (Emergency Stop)

The manipulator cannot be operated when the emergency stop button is pressed and the servo power supply is turned OFF.

- Press the emergency stop button and the servo power supply is turned off.
 - The emergency stop button is located on the right side of the programming pendant.
- The brake operates once the servo power supply is turned OFF, and the manipulator can no longer operate.
 The emergency stop mode can be operated at any mode. (Teach mode, Play mode, Remote mode)



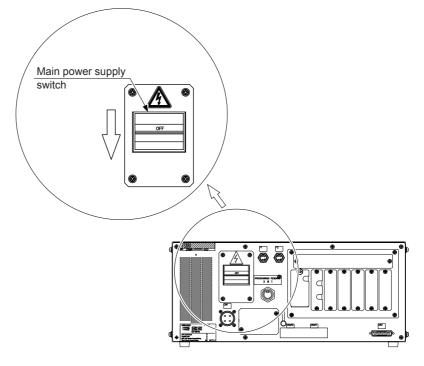
Programming pendant

- 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.

5.3.2 Turning OFF Main Power

After turning OFF the servo power, turn OFF the main power.

1. Turn the main power switch on the front of FS100 to the "OFF" position to turn OFF the main power.



6 Test of Program Operation



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 button does not function.

- Press the emergency stop button immediately if any problem occurs. The emergency stop button is located on the 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.

- 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.

- 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.

6



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 the 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.

 Make sure that a system manager stores the key of the mode select switch on the programming pendant.
 After operation, the key should be removed and stored by the system manager.

Improper or unintended manipulator operation may result in injury. Also, the key or the mode select switch may be damaged if the programming pendant is dropped with the key inserted.

FS100

- 6 Test of Program Operation
- 6.1 Movement of Axes

6.1 Movement of Axes

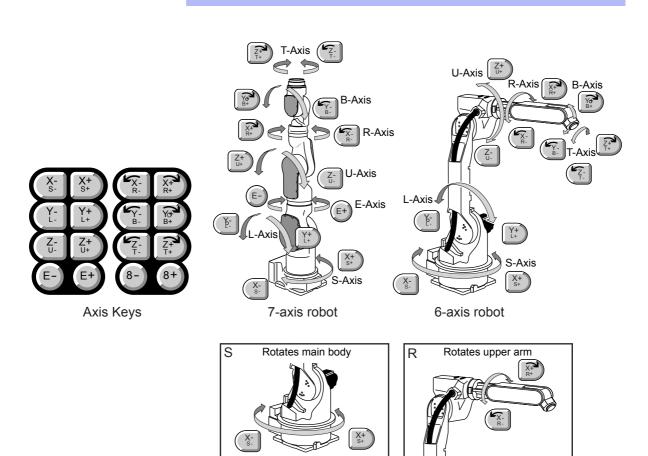
Move each axis of the manipulator by pressing the axis keys on the programming pendant.

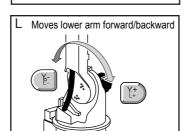
This figure illustrates each axis of motion in the joint coordinates.

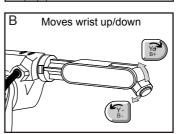


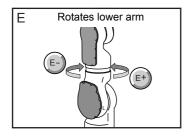
Be sure to remove all items from the area before moving the manipulator.

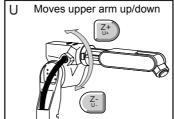
Refer to the INSTRUCTION MANUAL for the appropriate position of the fixture.

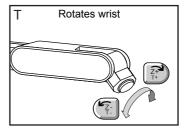












System Up

7.1 Protection Through Security Mode Settings

7 Security System

7.1 Protection Through Security Mode Settings

The FS100 modes setting are protected by a security system. The system allows operation and modification of settings according to operator clearance. Be sure operators have the correct level of training for each level to which they are granted access.

7.1.1 Security Mode

There are three security modes. Editing mode and management mode require a user ID. The user ID consists of numbers and letters, and contains no less than 4 and no more than 8 characters. (Significant numbers and signs: "0 to 9", "-", ".".

Table 7-1: Security Mode Descriptions

Security Mode	Explanation
Operation Mode	This mode allows basic operation of the robot (stopping, starting, etc.) for people operating the robot work on the line.
Editing Mode	This mode allows the operator to teach and edit jobs and robot settings.
Management Mode	This mode allows those authorized to set up and maintain robot system: parameters, system time and modifying user IDs.

Security System Protection Through Security Mode Settings

Table 7-2: Menu and Security Mode (Sheet 1 of 3)

Main Menu	Sub Menu	Allowed Secu	Allowed Security Mode	
		DISPLAY	EDIT	
JOB	JOB	Operation	Edit	
	SELECT JOB	Operation	Operation	
	CREATE NEW JOB ¹⁾	Edit	Edit	
	MASTER JOB	Operation	Edit	
	JOB CAPACITY	Operation	-	
	CYCLE	Operation	Operation	
VARIABLE	BYTE	Operation	Edit	
	INTEGER	Operation	Edit	
	DOUBLE	Operation	Edit	
	REAL	Operation	Edit	
	STRING	Operation	Edit	
	POSITION (ROBOT)	Operation	Edit	
	POSITION (BASE)	Operation	Edit	
	POSITION (ST)	Operation	Edit	
	LOCAL VARIABLE ¹⁾	Operation	-	
IN/OUT	EXTERNAL INPUT	Operation	Edit	
	EXTERNAL OUTPUT	Operation	Edit	
	UNIVERSAL INPUT	Operation	Operation	
	UNIVERSAL OUTPUT	Operation	Operation	
	SPECIFIC INPUT	Operation	-	
	SPECIFIC OUTPUT	Operation	-	
	RIN	Operation	-	
	CPRIN	Operation	-	
	REGISTER	Operation	Management	
	AUXILIARY RELAY	Operation	-	
	CONTROL INPUT	Operation	-	
	PSEUDO INPUT SIG	Operation	Management	
	NETWORK INPUT	Operation	-	
	NETWORK OUTPUT	Operation	-	
	ANALOG OUTPUT	Operation	-	
	SV POWER STATUS	Operation	-	
	TERMINAL	Operation	-	
	LADDER PROGRAM	Management	Management	
	I/O ALARM	Management	Management	
	I/O MESSAGE	Management	Management	

¹⁾ Displayed when "LANGUAGE LEVEL" is "EXPANDED".

7

FS100

Security System Protection Through Security Mode Settings 7.1

Table 7-2: Menu and Security Mode (Sheet 2 of 3)

Main Menu	Sub Menu	Allowed Security Mode	
		DISPLAY	EDIT
ROBOT	CURRENT POSITION	Operation	-
	COMMAND POSITION	Operation	-
	SERVO MONITOR	Management	-
	WORK HOME POS	Operation	Edit
	SECOND HOME POS	Operation	Edit
	DROP AMOUNT	Management	Management
	POWER ON/OFF POS	Operation	-
	TOOL	Edit	Edit
	INTERFERENCE	Management	Management
	SHOCK SENS LEVEL	Operation	Edit
	USER COORDINATE	Edit	Edit
	HOME POSITION	Management	Management
	MANIPULATOR TYPE	Management	-
	ANALOG MONITOR	Management	Management
	OVERRUN&S-SENSOR	Edit	Edit
	LIMIT RELEASE	Edit	Edit
	ARM CONTROL	Management	Management
	SHIFT VALUE	Operation	-
	HAND VIBRATION CONTROL	Operation	Management
SYSTEM INFO	VERSION	Operation	-
	MONITORING TIME	Operation	Management
	ALARM HISTORY	Operation	Management
	I/O MSG HISTORY	Operation	Management
	NETWORK SERVICE	Management	-
	USER DEFINITION MENU	Operation	Operation
	SECURITY	Operation	Operation
FD/CF	LOAD	Edit	-
	SAVE	Operation	-
	VERIFY	Operation	-
	DELETE	Operation	-
	DEVICE	Operation	Operation
	FOLDER	Edit	Management

7 7.1 Security System Protection Through Security Mode Settings

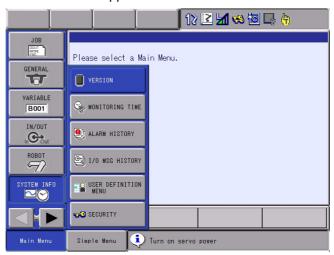
Table 7-2: Menu and Security Mode (Sheet 3 of 3)

Main Menu	Sub Menu	Allowed Security Mode		
		DISPLAY	EDIT	
PARAMETER /	S1CxG	Management	Management	
	S2C	Management	Management	
	S3C	Management	Management	
	S4C	Management	Management	
	A1P	Management	Management	
	A2P	Management	Management	
	RS	Management	Management	
	S1E	Management	Management	
	S2E	Management	Management	
	S3E	Management	Management	
	S4E	Management	Management	
	S5E	Management	Management	
	S6E	Management	Management	
	S7E	Management	Management	
	S8E	Management	Management	
SETUP	TEACHING COND.	Edit	Edit	
	OPERATE COND.	Management	Management	
	OPERATE ENABLE	Management	Management	
	FUNCTION ENABLE	Management	Management	
	JOG COND.	Management	Management	
	PLAYBACK COND.	Management	Management	
	FUNCTION COND.	Management	Management	
	DISPLAYING COLOR COND.	Edit	Edit	
	DATE/TIME	Management	Management	
	GRP COMBINATION	Management	Management	
	RESERVE JOB NAME	Edit	Edit	
	USER ID	Edit	Edit	
	SET SPEED	Management	Management	
	KEY ALLOCATION	Management	Management	
	JOG KEY ALLOC.	Edit	Management	
	RES. START (CNCT)	Management	Management	
	AUTO BACK SET	Management	Management	
	WRONG DATA LOG	Edit	Management	
	ENERGY SAVING FUNCTION	Edit	Management	
	ENCODER MAINTENANCE	Edit	Management	
DISPLAY	CHANGE FONT	Operation	Operation	
SETUP	CHANGE BUTTON	Operation	Operation	
	INITIALIZE LAYOUT	Operation	Operation	
	CHANGE WINDOW PATTERN	Operation	Operation	
GENERAL	GENERAL DIAG.	Operation	Edit	

7.1 Protection Through Security Mode Settings

7.1.1.1 Changing Security Mode

- 1. Select {SYSTEM INFO} under the main menu.
 - The sub menu appears.



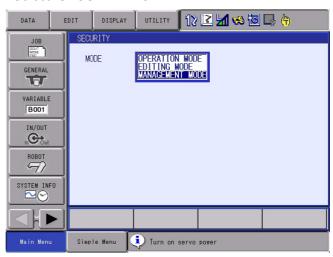
- 2. Select (SECURITY).
 - The selection window of security mode appears.



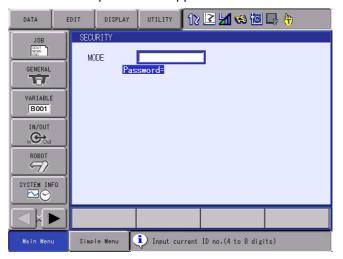
7 Security System

FS100

- 7.1 Protection Through Security Mode Settings
- 3. Press [SELECT].
 - Select "SECURITY MODE".



- 4. Input the user ID.
 - The user ID input window appears.





The following user ID numbers are set by default.

• Editing Mode: [00000000] Management Mode: [99999999]

5. Press [ENTER].

- The input user ID is compared with the user ID of the selected security mode.
- When the correct user ID is entered, the security mode is changed.

7 Security	System
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FS100

7.1 Protection Through Security Mode Settings

7.1.2 User ID

User ID is requested when Editing Mode or Management Mode is operated.

Create the user ID with four to eight numbers and symbols: the numbers 0 to 9; the symbols "-" and ".".

7.1.2.1 Changing User ID

In order to change the user ID, the FS100 must be in Editing Mode or Management Mode. Higher security modes can make changes the user ID of to lower security modes.

- 1. Select {SETUP} under the main menu.
 - The sub menu appears.

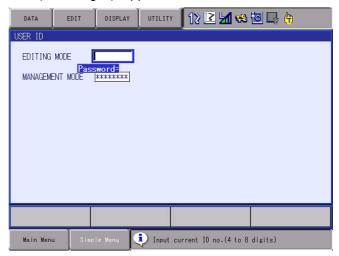


- 2. Select {USER ID}.
 - The USER ID window appears.

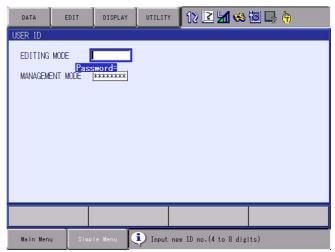


7 Security System

- 7.1 Protection Through Security Mode Settings
- 3. Select the desired ID.
 - The character input line appears, and a message "Input current ID no. (4 to 8 digits)" appears.



- 4. Input the current ID and press [ENTER].
 - When the correct user ID is entered, a new ID is requested to be input. "Input new ID no. (4 to 8 digits)" appears.



- 5. Input new ID and press [ENTER].
 - User ID is changed.

8 System Setup



WARNING

 Data related to the system's basic functions can be changed.
 However, improper change may result in a fatal error or failure of the manipulator or the whole system.

Observe the following warnings to safeguard system settings:

- Change the data under the supervision of the administrator.
- Make sure to save and manage the data each time you create or change it.
 (Supply a USB memory stick or CompactFlash (CF) card recommended by Yaskawa.)
- Yaskawa is not responsible for accidents or failures caused by incorrect data settings.

8.1 Home Position Calibration



WARNING

 Before operating the manipulator, check that the SERVO ON LED is turned OFF when the emergency stop button on the programming pendant is pressed.

Injury or damage to machinery may result if the manipulator cannot be stopped in case of an emergency.

- 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 unintended manipulator operation may result in injury.

- 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.

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.



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 the 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.

 Make sure that a system manager stores the key of the mode select switch on the programming pendant.
 After operation, the key should be removed and stored by the system manager.

Improper or unintended manipulator operation may result in injury. Also, the key or the mode select switch may be damaged if the programming pendant is dropped with the key inserted.

8.1.1 Home Position Calibration



Teaching and playback are not possible before the completion of the home position calibration.

In a system with two or more manipulators, the home position of all the manipulators must be calibrated before starting teaching or playback.

Home position calibration is an operation in which the home position and absolute encoder position coincide. Although this operation is performed prior to shipment at the factory, the following cases require this operation to be performed again.

- Change in the combination of the manipulator and FS100
- Replacement of the motor or absolute encoder
- Clearing stored memory (by replacement of the main CPU board, weak battery, etc.)
- Home position deviation caused by hitting the manipulator against a workpiece, etc.

To calibrate the home position, use the axis keys to calibrate the home position mark on each axis so that the manipulator can take its posture for the home position. There are two operations for home position calibration:

- All the axes can be moved at the same time: Recalibrate the home position by moving all the axes together if changing the combination of manipulator and circuit board.
- Axes can be moved individually: Recalibrate the home position for the individual axes that were affected by the replacement, if replacing the motor or absolute encoder.

If the absolute data of its posture for the home position is already known, set the absolute data again after completing home position registration.

Home Position



The home position is the pulse value "0" for each axis and its posture. See *chapter 8.1.3* "Home Position of Robot" at page 8-12.

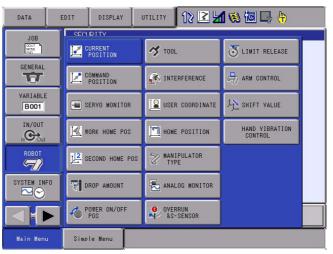
8.1.2 Calibrating Operation



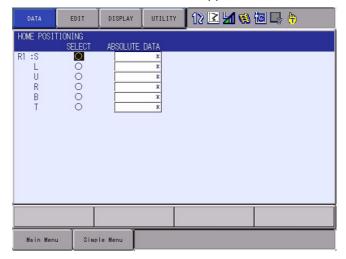
Home position calibration screen is displayed only when the security mode is set to the management mode.

8.1.2.1 Registering All Axes at One Time

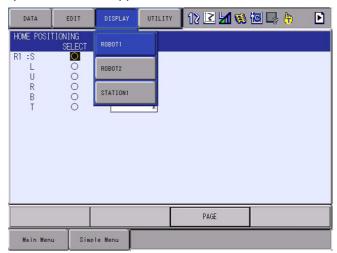
- 1. Select {ROBOT} under the main menu.
 - The sub menu appears.



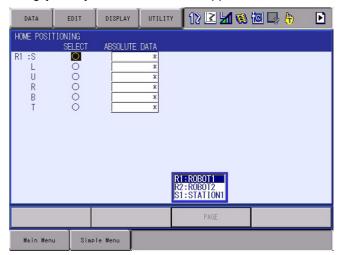
- 2. Select {HOME POSITION}.
 - The HOME POSITIONING window appears.



- Home Position Calibration 8.1
- 3. Select {DISPLAY} under the menu.
 - The pull-down menu appears.



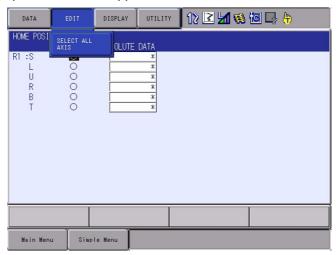
- The same operation as the instruction 3 can also be performed by selecting {PAGE}, and selection box appears.



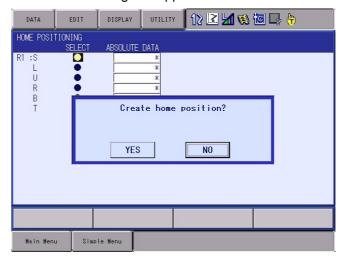
- 4. Select the desired control group.
 - Select the control group for HOME POSITIONING.
 - The control group can also be selected by pressing page key 🖺 .



- 8.1 Home Position Calibration
- 5. Select {EDIT} under the menu.
 - The pull-down menu appears.



- 6. Select (SELECT ALL AXES).
 - The confirmation dialog box appears.



7. Select {YES}.

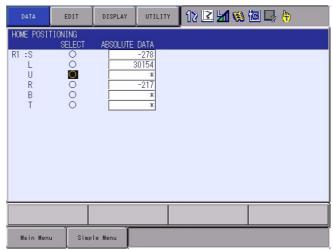
Displayed position data of all axes are registered as home position.
 When {NO} is selected, the registration will be canceled.

FS100

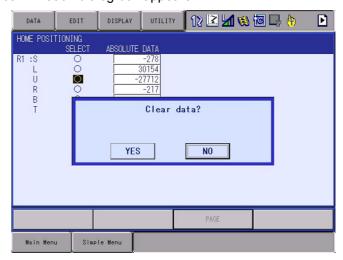
8.1 Home Position Calibration

8.1.2.2 Registering Individual Axes

- 1. Select {ROBOT} under the main menu.
 - The sub menu appears.
- 2. Select {HOME POSITION}.
- 3. Select the desired control group.
 - Perform the steps 3 and 4 of the "Registering All Axes at One Time" to select the desired control group.
- 4. Select the axis to be registered.
 - Move the cursor to the axis to be registered, and select it.



- A confirmation dialog box appears.



- 5. Select {YES}.
 - Displayed position data of the axis is registered as home position.
 When {NO} is selected, the registration will be canceled.

8	System	Setup
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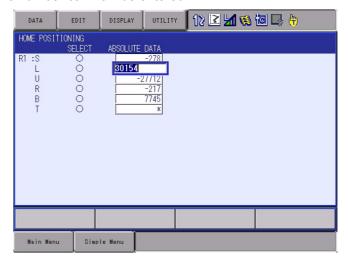
FS100

8.1 Home Position Calibration

8.1.2.3 Changing Absolute Data

To change the absolute data of the axis when home position calibration is completed, perform the following:

- 1. Select {ROBOT} under the main menu.
- 2. Select {HOME POSITION}.
- 3. Select the desired control group.
 - Perform the step 3 and 4 of the "Registering All Axes at One Time" to select the desired control group.
- 4. Select the absolute data to be registered.
 - The number can now be entered.



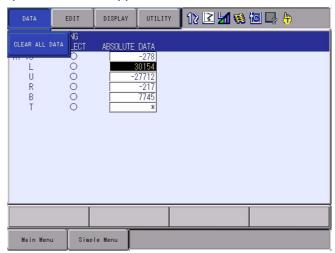
- 5. Enter the absolute data using the numeric keys.
- 6. Press [ENTER].
 - Absolute data is modified.

FS100

8.1 Home Position Calibration

8.1.2.4 Clearing Absolute Data

- 1. Select {ROBOT} under the main menu.
 - The sub menu appears
- 2. Select {HOME POSITION}.
 - Perform the step 3 and 4 of the "Registering All Axes at One Time" to select the desired control group.
- 3. Select {DATA} under the main menu.
 - The pull-down menu appears

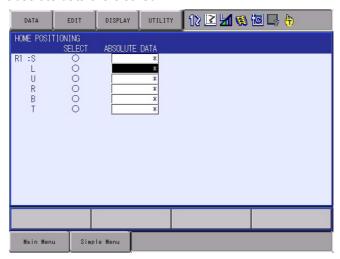


- 4. Select [CLEAR ALL DATA].
 - A confirmation dialog box appears.



FS100

- 8.1 Home Position Calibration
- 5. Select {YES}.
 - All absolute data are cleared.

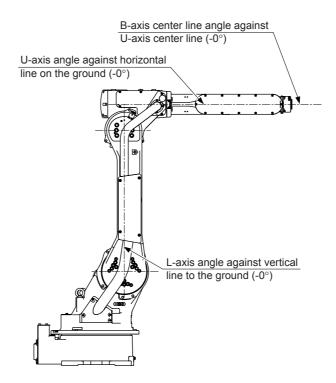


- When {NO} is selected, the registration will be canceled.

8.1 Home Position Calibration

8.1.3 Home Position of Robot

In the case of HP20F, the home position is as follows:





Other manipulator models have different positions. Always refer to "MANIPULATOR INSTRUCTIONS" for the correct manipulator model.

8.2 Setting Second Home Position (Check Point)



WARNING

 Be aware of safety hazards when performing the position confirmation of the second home position (check point).

When "OUT OF RANGE (ABSO DATA)" alarm occurs, abnormality of the PG system may be a cause of the alarm. The manipulator may operate in an unexpected manner, and there is a risk of damage to equipment or injury to personnel.

 Before operating the manipulator, check that the SERVO ON LED is turned OFF when the emergency stop button on the programming pendant is pressed.

Injury or damage to machinery may result if the manipulator cannot be stopped in case of an emergency.

- 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 unintended manipulator operation may result in injury.

- 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.

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.



- 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 the 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.

 Make sure that a system manager stores the key of the mode select switch on the programming pendant.
 After operation, the key should be removed and stored by the system manager.

Improper or unintended manipulator operation may result in injury. Also, the key or the mode select switch may be damaged if the programming pendant is dropped with the key inserted.

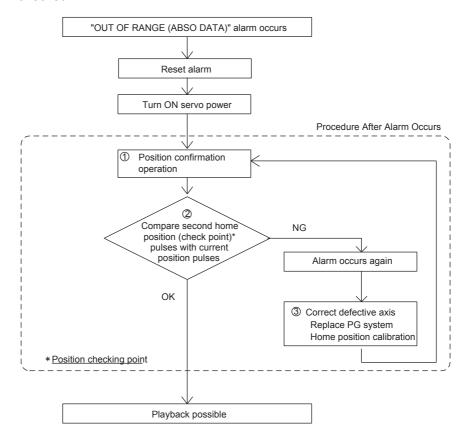
8.2.1 Purpose of Position Check Operation

If the absolute number of rotation detected at power supply ON does not match the data stored in the absolute encoder the last time the power supply was turned OFF, an alarm is issued when the controller power is turned ON.

There are two possible causes of this alarm:

- · Error in the PG system
- The manipulator was moved after the power supply was turned OFF.

If there is an error with the PG system, the manipulator may stall when playback is started. If the absolute data allowable range error alarm has occurred, playback and test runs will not function and the position must be checked.



1 Position Check

After the "OUT OF RANGE (ABSO DATA)" alarm occurs, move to the second home position using the axis keys and perform the position confirmation. Playback, test runs, and FWD operation will not function unless "CONFIRM POSITION" is performed.

(2) Pulse Difference Check

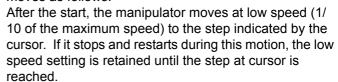
The pulse number at the second home position is compared with that at the current position. If the difference is within the allowable range, playback is enabled. If not, the alarm occurs again.

- The allowable range pulse is the number of pulses per rotation of the motor (PPR data).
- The initial value of the second home position is the home position (where all axes are at pulse 0). The second home position can be changed. For details, refer to chapter 8.2.2 "Procedure for Second Home Position Setting (Check Point)" at page 8-17.

(3) Alarm Occurrence

If the alarm occurs again, there may be an error in the PG system. Check the system. After adjusting the erroneous axis, calibrate the home position of the axis, then check the position again.

- Home position calibration of all the axes at the same time enables playback operations without having to check the position.
- Sometimes in a system with a manipulator with no brake, it is possible to enable playback without position checking after the alarm occurs. However, as a rule, always perform "CONFIRM POSITION". Under the above special conditions, the manipulator moves as follows:



Regardless of cycle setting, the manipulator stops after reaching to the step indicated by cursor. Starting the manipulator again then moves it at the programmed speed and cycle of the job.

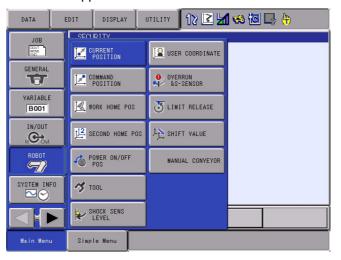


8.2.2 Procedure for Second Home Position Setting (Check Point)

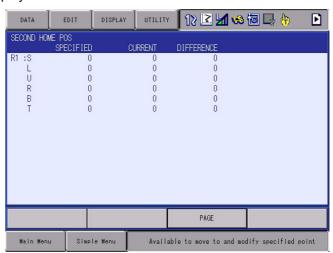
Apart from the "home position" of the manipulator, the second home position can be set up as a check point for absolute data. Use the following steps to set the specified point.

If two or more manipulators or stations are controlled by one controller, the second home position must be set for each manipulator or station.

- 1. Select {ROBOT} under the main menu.
 - The sub menu appears.

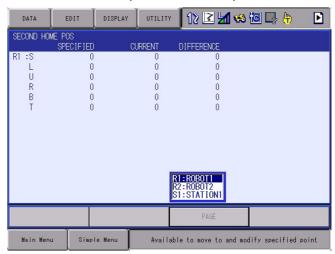


- 2. Select (SECOND HOME POS).
 - The SECOND HOME POS window appears.
 A message "Available to move to and modify specified point" is displayed.



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- 8.2 Setting Second Home Position (Check Point)
- 3. Press the page key , or select {PAGE} to display the selection window for the control group.
 - When there are two or more group axes, select the group axes to which the second home position is to be specified.



- 4. Press the axis keys.
 - Move the manipulator to the new second home position.
- 5. Press [MODIFY], then [ENTER].
 - The second home position is changed.

8.2.3 Procedure After Alarm



WARNING

 Be aware of safety hazards when performing the position confirmation of the specified point.

Abnormality of the PG system may be the cause of the alarm. The manipulator may operate in an unexpected manner, and there is a risk of damage to equipment or injury to personnel.

If the "OUT OF RANGE (ABSO DATA)" alarm occurs:

- · Reset the alarm;
- Turn ON the servo power;

then confirm the second home position. After the confirmation, if the PG system is found to be the cause of the alarm, perform the necessary operation, such as replacing the PG, etc.

The robot current position data when turning main power supply OFF and ON can be confirmed in "POWER ON/OFF POS" window.

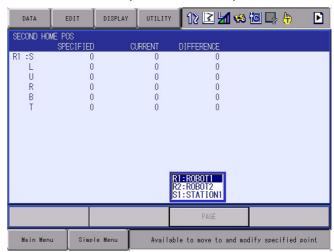


For details on the "POWER ON/OFF POS" window, refer to "8.7 Position Data When Power is Turned ON/OFF" in FS100 MAINTENANCE MANUAL.

- 1. Select {ROBOT} under the main menu.
 - The sub menu appears.
- 2. Select {SECOND HOME POS}.
 - The SECOND HOME POS window appears.



- 8.2 Setting Second Home Position (Check Point)
- 3. Press the page key , or select {PAGE} to display the selection window for the control group.
 - When there are two or more group axes, select the group axes to which the second home position is to be specified.



- 4. Press [FWD].
 - TCP moves to the second home position. The robot moving speed is set as selected manual speed.
- 5. Select {DATA} under the menu.
- 6. Select (CONFIRM POSITION).
 - A message "Home position checked" appears.
 - Pulse data of the second home position and current pulse data are compared. If the compared error is in allowed range, playback operation can be done.
 - If the error is beyond the allowed range, the alarm occurs again.

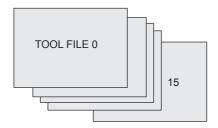
FS100 8.3 System Setup 8.3 Tool Data Setting

8.3 Tool Data Setting

8.3.1 Registering Tool Files

8.3.1.1 Number of Tool Files

There are 16 tool files numbered 0 to 15. Each file is called as a tool file.



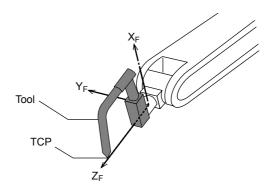
Tool File Extension Function



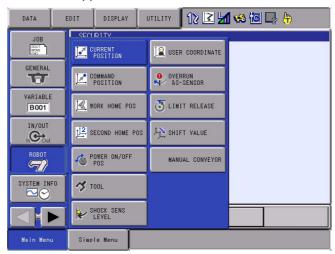
Normally, one robot uses one kind of tool file. The tool file extension function can change many tool files to be used by one robot. Use the following parameter to set this function. S2C333: TOOL NO. SWITCHING (1: enabled; 0: disabled) For more details, refer to "8 Parameter" in FS100 OPERATOR'S MANUAL.

8.3.1.2 Registering Coordinate Data

When the number input operation is used for registering the tool file, input the TCP of the tool on the flange coordinates.

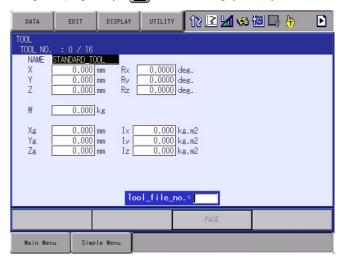


- 1. Select {ROBOT} under the main menu.
 - The sub menu appears.



2. Select {TOOL}.

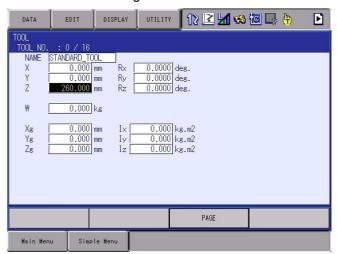
- (1) Move the cursor to the number of the desired tool, and press {SELECT} in the tool list window.
- (2) The tool coordinate window of the selected number appears.
- In the tool coordinate window, the tool number can be changed by pressing the page key or selecting {PAGE}.



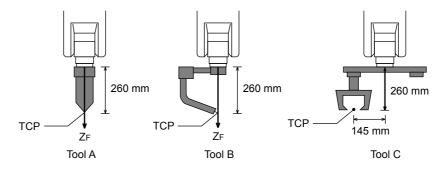
- 8.3 Tool Data Setting
 - To switch the tool list window and the tool coordinate window, press {DISPLAY} → {LIST} or {DISPLAY} → {COORDINATE DATA}.



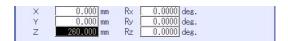
- 3. Select the desired tool number.
- 4. Place the cursor in the part to register the desired coordinate data and press [SELECT].
 - The number is ready to input.
- 5. Input the coordinate data.
- 6. Press [ENTER].
 - The coordinate data is registered.



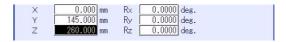
<Setting Example>



• In case of Tool A, B



• In case of Tool C

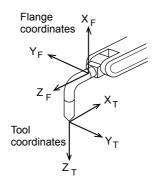


Tool Data Setting 8.3

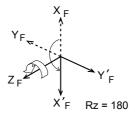
8.3.1.3 Registering Tool Angle

The tool pose data is angle data which shows the relation between the flange coordinates and the tool coordinates. The angle when the flange coordinates are rotated to meet to the tool coordinates becomes an input value. Clockwise toward the arrow is the positive direction. Register in the order of Rz \rightarrow Ry \rightarrow Rx.

In the following case, register Rz=180, Ry=90, Rx=0



- 1. Select {ROBOT} under the main menu.
- 2. Select {TOOL}.
- 3. Select the desired tool number.
 - In the same way as shown in Explanation 2, 3 in chapter 8.3.1.2 "Registering Coordinate Data" at page 8-22, display the desired tool coordinate window.
- 4. Select the desired coordinate axis to modify.
 - First, select Rz.
- 5. Input the tool pose data.
 - Input rotation angle around Z_F of the flange coordinates.

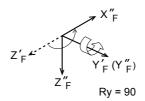


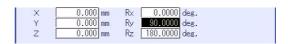


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- 8 System Setup
- 8.3 Tool Data Setting
- 6. Press [ENTER].
 - The rotation angle of Rz is registered.

In the same way, register the angle of Ry, Rx. Ry must be the input rotation angle around Y'_F flange coordinates.





 Rx must be the input rotation angle around X'_F of flange coordinates.



X	0.000	mm	R×	0.0000	deg.
Υ	0.000	mm	Ry	90.0000	deg.
Z	0.000	mm	Rz	180.0000	deg.

8.3.1.4 Setting Tool Load Information

The tool load information includes weight, a center of gravity position, and moment of inertia at the center of gravity of the tool installed at the flange.



For more details on the tool load information, refer to chapter 8.4.3 "Setting Tool Load Information" at page 8-48.

8 System Setup 8.3 Tool Data Setting

FS100 8.3 Tool E

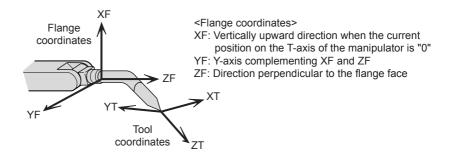
8.3.2 Tool Calibration

8.3.2.1 Tool Calibration

To ensure that the manipulator can perform motion type operations such as linear and circular motion type correctly, accurate dimensional information on tools such as hands must be registered and the position of the TCP must be defined.

Tool calibration is a function that enables this dimensional information to be registered easily and accurately. When this function is used, the TCP is automatically calculated and registered in the tool file.

What is registered in tool calibration is the coordinates of the TCP and the tool posture data in the flange coordinates.



8.3.2.2 Setting of Tool Calibration Method

There are three tool calibration methods, which are selected by setting parameter.

S2C432: Designation of tool calibration method

0: Calibrates only the coordinates.

"Coordinates" calculated from 5 calibration teaching points is registered in the tool file.

In this case "Tool Posture Data" is all cleared to be 0.

1: Calibrates only the posture.

"Tool Posture Data" calculated from the first calibration teaching point is registered in the tool file. In this case, "Coordinates" will not be changed. (the prior value is maintained.)

2: Calibrates the coordinates and the posture.

"Coordinates" calculated from 5 calibration teaching points and "Tool Posture Data" calculated from the first calibration teaching point are registered in the tool file.

 In case of S2C432=0 (only coordinates is calibrated), tool posture data is overwritten with 0.
 (When the coordinates calculated from tool calibration is registered in the tool file in which the tool posture data is already registered, the tool posture data will be deleted.)

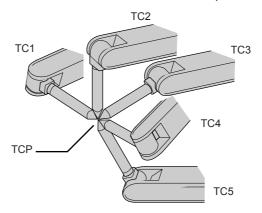


- In case of S2C432=1 (only posture is calibrated), the coordinates are maintained.
- In case of S2C432=1, 5 teaching points need to be registered though only the first point is used for calculation.

8.3.2.3 Teaching of Calibration Point

Teaching for defining coordinates

In order to calibrate coordinates, five different postures (TC1 to 5) must be taught with the TCP as the reference point. The tool dimensions are automatically calculated on the basis of these five points.



Each posture must be arbitrary. Accuracy may decrease when pose setting is rotated in a constant direction

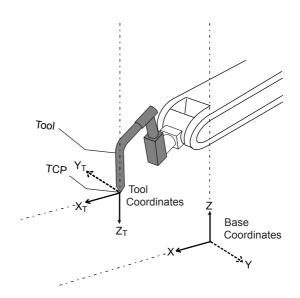
■ Teaching for defining posture

The calibration of tool posture data is performed with the first calibration teaching point (TC1).

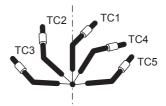
Teach TC1 with Z-axis of the desired tool coordinates downward vertically to the ground. (the Z-axis of the tool coordinates is parallel to the Z-axis of the base tool and points to the opposite direction.)

Tool posture data is automatically calculated with this TC1 posture.

The X-axis of the tool coordinates is defined in the same direction as the X-axis of the base coordinates.

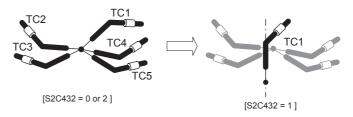


In case of calibrating with S2C432=2, teach TC1 with Z-axis of the desired tool coordinates downward vertically to the ground. Then teach the other calibration teaching points (TC2~TC5) with the all tool points meet at the TC1's tool point as shown in the figure below.



SUPPLE -MFNT

If teaching in one place as the figure above is impossible due to the interference of peripheral equipment and so on, perform calibration of coordinates with S2C432=0 or 2, and then change to S2C432=1, teach only TC1 in a different position and register the tool posture data.



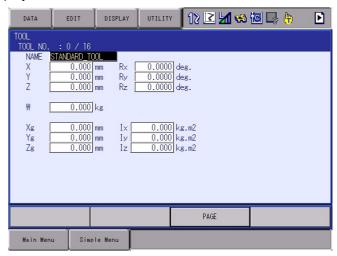
There are 16 tool files numbered 0 to 15.



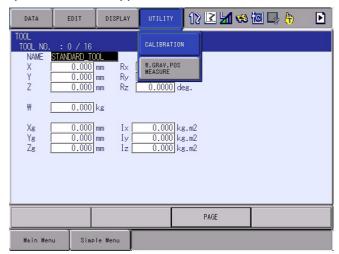
- In a basic system with one manipulator and one tool, the tool file for tool No. 0 is used.
- If there is more than one tool, for example when using a multihand, use the tool numbers in the order of 0, 1, 2, etc.

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- 8.3 Tool Data Setting
- 1. Select {ROBOT} under the main menu.
- 2. Select {TOOL}.
- 3. Select the desired tool number.
 - In the same way as shown in the steps 2 and 3 of the chapter 8.3.1.2 "Registering Coordinate Data" at page 8-22, display the desired tool coordinate window.



- 4. Select {UTILITY} under the menu.
 - The pull-down menu appears.



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- 8.3 Tool Data Setting
- 5. Select {CALIBRATION}.
 - The TOOL CALIBRATION window is shown.



- 6. Select the robot.
 - Select the robot to calibrate.
 (When the robot has already been selected or there is only one of robot, this operation should not be performed.)
 - (2) Select "**" in the TOOL CALIBRATION window and select the robot in the shown selection dialog box.
 - (3) The robot is set.



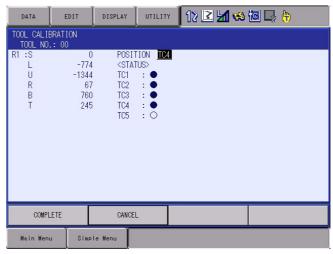
8.3 Tool Data Setting

7. Select "POSITION".

- The selection dialog box is shown.
- (1) Select the teaching point for calibration.



- 8. Move the manipulator using the axis key.
- 9. Press [MODIFY] and [ENTER].
 - Taught position is registered.
 Repeat 7 to 9 operation to teach TC1 to TC5.
 - "•" denotes that teaching is completed and "O" denotes that it is not completed.



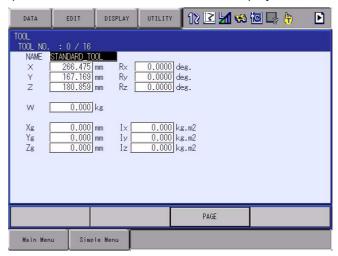
- To check the taught positions, call up the required window among TC1 to TC5 and press [FWD]. The manipulator moves to the set position.
- If there is a difference between the current position of the manipulator and the shown position data, "TC□" next to "POSITION" in the window flashes.

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8.3 Tool Data Setting

10. Select "COMPLETE".

 Calibration data is registered in the tool file. Once the calibration is completed, the tool coordinate window is displayed on the screen.



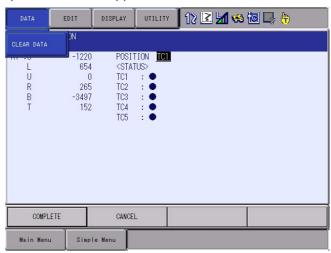
FS100

8.3 Tool Data Setting

8.3.2.4 Clearing Calibration Data

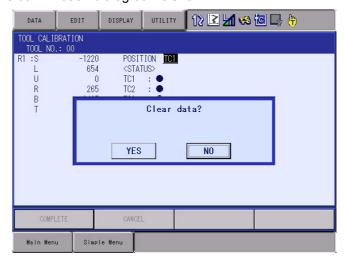
Before the calibration of a new tool, clear the robot information and calibration data.

- 1. Select {DATA} under the pull-down menu.
 - The pull-down menu appears.



2. Select (CLEAR DATA).

- The confirmation dialog box is shown.



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- 8.3 Tool Data Setting
- 3. Select {YES}.
 - All data is cleared.



SUPPLE -MENT If tool angle data is required, input the data number in the tool coordinate window.

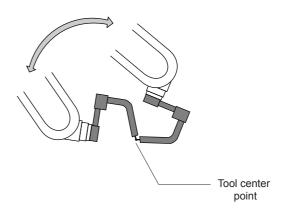
Refer to *chapter 8.3.1.3 "Registering Tool Angle" at page 8-24* for the operating instructions.

8.3 Tool Data Setting

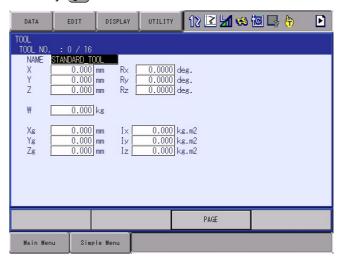
8.3.2.5 Checking TCP

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After registering the tool file, check if the TCP is correctly registered by performing a TCP fixed operation like the one shown below, in any coordinate system other than the joint.



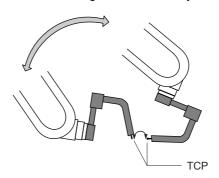
- 1. Press the COORD key .
 - Select any coordinate system except "JOINT" by pressing the
 COORD key .



- 2. Select desired tool number.
 - -Show the tool coordinate window of the desired tool by pressing the page key or selecting it in the tool list window.

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- 8 System Setup
- 8.3 Tool Data Setting
- 3. Move the R, B, or T axes using the axis key.
 - By pressing the axis keys for the R, B, and T axes, change the manipulator pose without changing the TCP position.
 If this operation shows a large TCP error, adjust the tool data.





For details on the TCP fixed operation, see "2.3.7 Control Point Operation" in FS100 OPERATOR'S MANUAL.

8.3.3 Automatic Measurement of Tool Load and Center of Gravity

8.3.3.1 Description of Automatic Measurement of Tool Load and Center of Gravity

With this function, the user can register the load of tool and the position of the tools center of gravity.

The tool load and the position of it's center of gravity are measured and registered in a tool file.

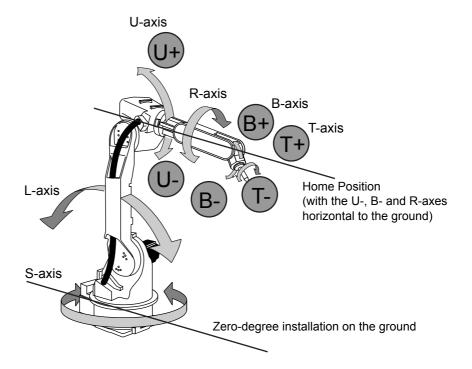


This function can be used where the manipulator is installed level on the ground.

For the conditions required for manipulator installation, refer to *chapter 8.4 "ARM Control"* at page 8-43.

8.3.3.2 Measurement of Tool Load and Center of Gravity

To measure the tool load and the center of gravity, move the manipulator to its home position (with the U-, B- and R-axes horizontal to the ground) and operate the U-, B- and T-axes.





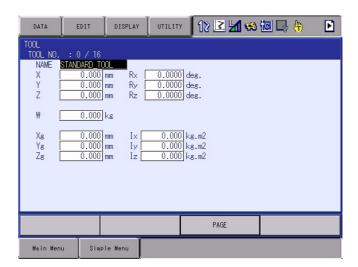
To correctly measure the tool load or the center of gravity, remove the cables or wires connected to the tool.

FS100

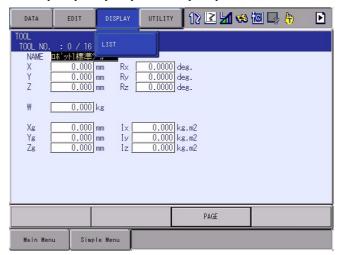
- 8.3 Tool Data Setting
- 1. Select {ROBOT} under the main menu.
- 2. Select {TOOL}.
 - The tool list window appears.
 - The tool list window is called up only when the file extension function is valid.

If the file extension function is invalid, the tool coordinate window appears.

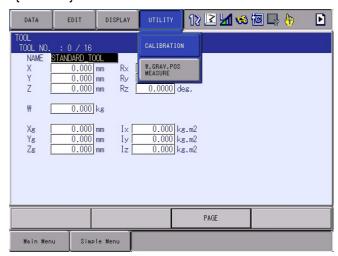




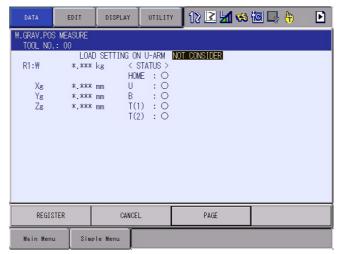
- 8.3 Tool Data Setting
- 3. Select the desired tool number.
 - Move the cursor to the desired number in the tool list window and press [SELECT].
 - The tool coordinate window of the selected number is shown.
 - In the tool coordinate window, the number can be changed by pressing the page key or selecting {PAGE}.
 - To switch the tool list window and the tool coordinate window, press {DISPLAY} → {LIST} or {DISPLAY} → {COORDINATE DATA}.



4. Select {UTILITY} under the menu.



- 8.3 Tool Data Setting
- 5. Select (W.GRAV.POS MEASURE).
 - The window for the automatic measurement of the tool load and the center of gravity is shown.



- 6. Press the page key
 - In a system with several manipulators, use the page key change the group to be controlled.
- 7. Press [FWD].
 - Press [FWD] once, and the manipulator moves to the home position (horizontal to the U-, B- and R-axes).
- 8. Press [FWD] again.
 - Press [FWD] again, and measurement starts. Keep the button pressed until measurement is completed.

The manipulator moves in the order listed below. Once measurement is completed, "O" changes to "●".

- Measurement of the U-axis: U-axis home position +4.5 degrees →
 -4.5 degrees
- ② Measurement of the B-axis: B-axis home position +4.5 degrees → -4.5 degrees
- ③ First measurement of the T-axis: T-axis home position +4.5 degrees

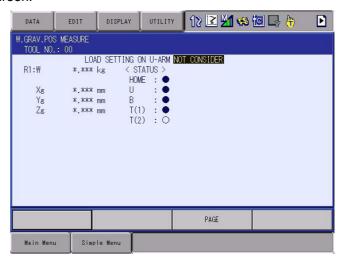
 → -4.5 degrees
- 4 Second measurement of the T-axis: T-axis home position +60 degrees → +4.5 degrees → -4.5 degrees
 - The speed during measurement automatically changes to "Medium".
 - During the measurement, "HOME" or "U" blinks on the screen.

SUPPLE

- During the measurement, the [FWD] button has to be kept pressed. If the button is released during the measurement or if it is released before "O" changes into "●", the measurement is aborted and the following message appears: "Stopped measurement"
- The measurement starts again from the first home position.

8.3 Tool Data Setting

 When all the measurements are completed or when all the "O" marks have changed into "●", the measured data appears on the screen.



9. Select "REGISTER".

- The measured data is registered in the tool file, and the tool coordinate window appears.
- Select "CANCEL" to call up the tool list window without registering the measured data in the tool file.

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8.4 ARM Control

8.4 ARM Control

8.4.1 ARM Control

ARM Control, a control system originally developed by Yaskawa, achieves an enhanced robot motion performance such as improved path accuracy or reduced cycle time.

The moment of inertia and the gravity moment etc. of each axis are calculated by the ARM control function, and FS100 controls robot motion according to the result. It is necessary to set the robot setup condition and the tool load information to request these accurately.

The robot setup condition is robot installation angle relative to ground and the weight and a center of gravity position of the load installed at each part of robot, etc.

The tool load information is weight, a center of gravity position, and moment of inertia at the center of gravity, of the tool installed at the flange.

It is necessary to set these information correctly to do a better operation control by the ARM control.

8.4.2 ARM CONTROL Window



· Correctly set the robot setup condition.

Make sure to avoid any mistake in setting the unit indication or specifying positive and negative values. Failure to observe this caution may lead to improper control of the manipulator, resulting in error occurrence or short life span of speed reducer.

 Confirm the operation path of robot of each job when modifying settings.

Set the robot setup condition when setting up the manipulator.

Confirm the operation path of manipulator of each job afterwards when the setting should be modified after the installation.

Modifying the settings of the ARM control may slightly change the operation path. To avoid injury or damage to machinery caused by collision between tool and positioner, make sure to check the operation path before executing a job.

FS100

8.4 ARM Control

8.4.2.1 Robot Setup Condition

Fulfill the following robot setup condition to enable the ARM control.

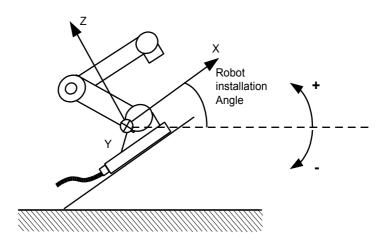
- Robot installation angle
- · S-head payload
- · U-arm payload

■ Robot installation angle

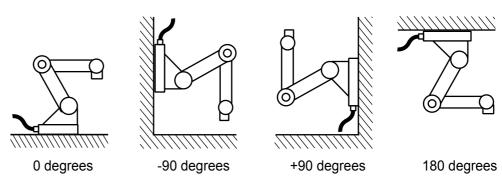
The angle of the manipulator installed relative to ground is set in ANGLE REL. TO GROUND to calculate the gravity moment which loads to each axis of the manipulator.

The robot installation angle sets how much X axis of the robot coordinates has inclined with the ground around Y axis of the robot coordinates. The direction of + in the U-axis operation from the home position posture of the manipulator becomes direction of + of the robot installation angle.

Therefore, the robot installation angle for a vertical downward wall mount specification becomes -90 degrees.



<Example>



If the robot installation angle is not correctly set, the manipulator cannot be properly controlled. Therefore, make sure to set the value correctly, paying special attentions to the direction "+" or "-".



Only rotation angle around Y axis of the robot coordinates can be set in the robot installation angle.

Contact Yaskawa representative when the robot is installed to incline Y axis of the robot coordinates relative to the ground.

■ S-head payload

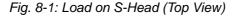
Set the weight and the center of gravity position roughly when a device is installed at the S-head.

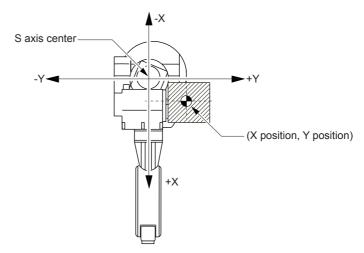
It is not necessary to set these values when there is no installed load on the S-head.

- WEIGHT (unit: kg)
 - The weight of the installed load is set.
 - It is not required to set a correct value, however, it is recommended to set a value slightly larger than the actual load. (Round up the value with each fraction between 0.5 to 1 kg.)
- X (from the S-axis), Y (from the S-axis) (unit: mm)

 The center of gravity position of the installed load is set by the distance in the direction of X and the direction of Y from the S-axis center here. It can be set with a rough value.

The direction of X and Y applies to the robot coordinates. The value is set by a negative number when the position is in "-" direction.





■ U-arm payload

Set the weight and the center of gravity position roughly when a device is installed on the U-arm.

A standard value is set when shipping from the factory.

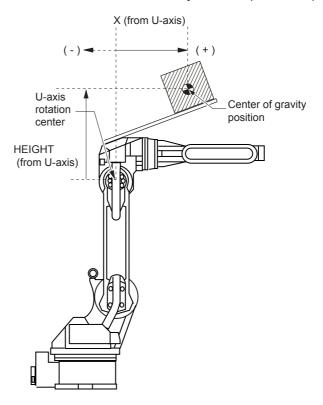
Set the weight in "0" if there is no installing equipment on the U-arm.

- WEIGHT (unit: kg)
 The weight of the installed load is set.

 It is not required to set a correct value, however, it is recommended to set a value slightly larger than the actual load. (Round up the value with each fraction between 0.5 to 1 kg.)
- X (from the U-axis), HEIGHT (from the U-axis) (unit: mm)
 The center of gravity position of the installing load is set here. It does not care by a rough value.
 X (from the U-axis) is horizontal distance from the U-axis rotation center to the center of gravity position of the load. Set negative number when there is mass side in the back from the U-axis rotation center.

HEIGHT (from the U-axis) is height of the vertical direction from the U-axis rotation center to the center of gravity position of the load.

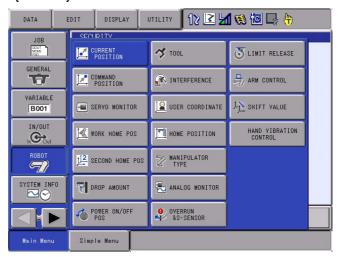
Fig. 8-2: Load on U-Arm: Center of Gravity Position (Side View)



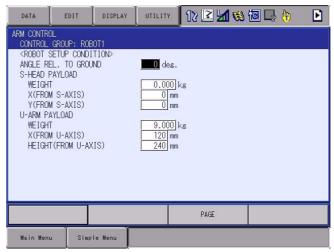


ARM CONTROL window is displayed only when the security mode is set to the management mode.

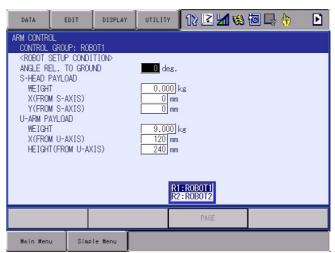
1. Select {ROBOT} under the main menu.



- 2. Select {ARM CONTROL}.
 - The ARM CONTROL window appears.



- 3. Press the page key , or select {PAGE}.
 - Select the desired control group when there are two or more group axes.



- 4. Select the desired item.
- 5. Input the value and press [ENTER].

8.4.3 Setting Tool Load Information



· Set the tool load information correctly.

The speed reducer longevity might decrease or the alarm might occur when the tool load information is not set correctly.

To set the tool load information correctly, following message appears when inputting the information.

"Input correct tool information. Using robot with wrong tool information may result in premature failure of the robot."

 Confirm the operation path of robot of each job which uses the tool file after the tool load information is changed.

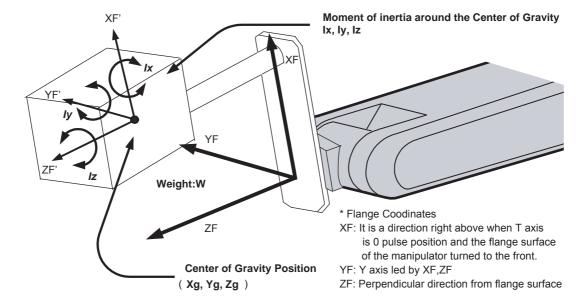
Set the tool load information before teaching the job after the tool is installed.

Confirm the operation path of each job which uses the tool file when the tool load information should be modified after teaching.

Modifying the tool load information may slightly change the operation path. To avoid injury or damage to machinery caused by collision between tool and positioner, make sure to check the operation path before executing a job.

8.4.3.1 Tool Load Information

Tool load information includes weight, a center of gravity position, and moment of inertia at the center of gravity of the tool installed at the flange. These are registered in the tool file.



8.4.3.2 Calculating Tool Load Information

■ Weight: W (Unit: kg)

The total weight of the installing tool is set.

It is not required to set a correct value, however, it is recommended to set a value slightly larger than the actual load. (Round up the value with each fraction between 0.5 to 1 kg.)

■ Position of center of gravity: xg, yg, zg (Unit: mm)

The position of the center of gravity of the installed tool is set as the position in the flange coordinates.

Since it is usually difficult to get a strict position of the center of gravity, it can be set with a rough value. Presume and set a position of the center of gravity roughly from outline of the tool.

Set the value when the position of the center of gravity of the installed tool is clear from specifications, etc.

■ Moment of inertia at the center of gravity: lx, ly, lz (Unit: kg·m²)

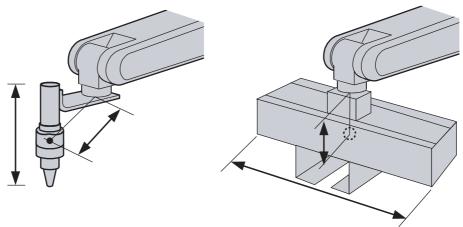
It is an moment of inertia of the tool at the position of the center of gravity.

The value is calculated around the each axis of the coordinates which is in parallel to the flange coordinates and which home position is the position of the center of gravity of the tool.

It is not required to set a correct value, however, it is recommended to set a value slightly larger than the actual value.

This setting is used to calculate the moment of inertia which loads to each axis of the manipulator. However, the moment of inertia at the center of gravity does not need to be set when this data is small enough for the moment of inertia calculated from weight and the position of the center of gravity.

However, the setting is required when the moment of inertia of the tool is large (as a rough guide, the tool is considered to be large when the tool size is about more than 2-times the distance between the flange and the center of gravity).



The size of the tool is not too big. Setting the moment of inertia at center of gravity is not necessary.

The size of the tool is big. Setting the moment of inertia at center of gravity is necessary.

ARM Control 8.4

Rough value of the moment of inertia at the center of gravity can be calculated by the following methods.

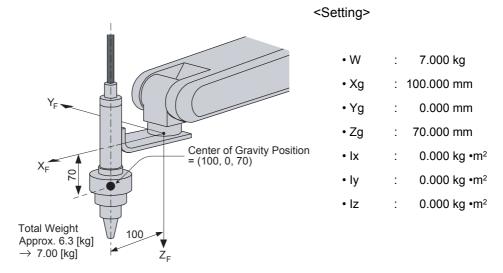
- Method to approximate the entire tool in hexahedron or cylinder.
- Method to calculate from each weight and center of gravity position of plural mass.

Refer to the following setting examples for details.

<Example 1>

For the example shown below, the center of gravity is set on the flange coordinates assuming that the center of gravity is positioned slightly inclined to the head from the center.

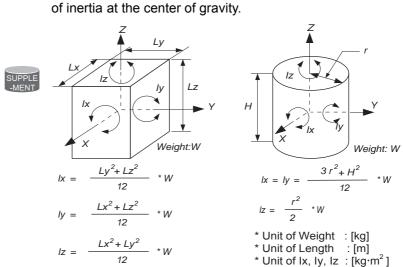
There is no need to set the moment of inertia at the center of gravity since the size of the tool is not so large.



The own moment of inertia calculation for hexahedron and cylinder

The own moment of inertia of hexahedron and cylinder can be calculated by the next expression when the center of gravity is at the center.

Refer to the expression when the calculation of the moment

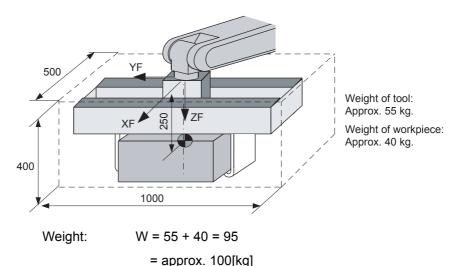


<Example 2>

It is necessary to set the moment of inertia at the center of gravity when the entire size of the tool and workpiece is large compared to the distance from the flange to the center of gravity position.

Calculate the moment of inertia at the center of gravity roughly from the expression (refer to the forementioned supplement: "The own moment of inertia calculation for hexahedron and cylinder"), by approximating the entire tool in the shape of the hexahedron or the cylinder.

If the weight of held workpiece is greatly different, it is more effective to set tool load information on each workpiece and to switch the tool on each step according to the held workpiece. Set the tool load information in the state to hold the heaviest workpiece when using the tools without switching them.



Center of gravity: Position at flange right under 250mm almost

$$(Xg, Yg, Zg) = (0,0,250)$$

Moment of inertia at the center of gravity:

The hexahedron of $0.500 \times 0.400 \times 1.000$ [m] which encloses the entire tool + workpiece is assumed.

By the expression to calculate the own moment of inertia of hexahedron,

Ix =
$$(Ly^2 + Lz^2 / 12) * W$$

= $((0.400^2 + 1.000^2) / 12) * 100 = 9.667 = approx. 10.000$
Iy = $(Lx^2 + Lz^2 / 12) * W = ((0.500^2 + 0.400^2) / 12) * 100 = 3.417$
= approx. 3.500
Iz = $(Lx^2 + Ly^2 / 12) * W = ((0.500^2 + 1.000^2) / 12) * 100 = 10.417$
= approx. 10.500

<Setting>

W : 100.000 kg
Xg : 0.000 mm
Yg : 0.000 mm
Zg : 250.000 mm
Ix : 10.000 kg.m²
Iy : 3.500 kg.m²
Iz : 10.500 kg.m²

How to calculate "Center of gravity position" and "moment of inertia at center of gravity" for plural mass

The center of gravity position and the moment of inertia at the center of gravity of the entire tool can be calculated by the weight and the center of gravity position of each mass when the tool can be thought that the tool consists of two or more big mass.

- 1. Divide the tool into some parts as the weight and the center of gravity position can be roughly presumed. It is not necessary to divide in detail. The tool is approximated in construction of rough parts.
- 2. Calculate the weight and the center of gravity position of the each parts on flange coordinates. It does not care by a rough value. Calculate the own moments of inertia of the big parts. (If parts are small, it is not necessary to calculate the own moments of inertia. Refer to above-mentioned supplement: "The own moment of inertia calculation for hexahedron and cylinder" for how to calculate the own moment of inertia.)

wi : Weight of the i-th parts [kg]

(xi, yi, zi) : Center of gravity position of the i- th parts (On flange coordinates) [mm]

Icxi, Icyi, Iczi: Own moments of inertia of the i-th parts [kg*m²]



3. The center of gravity position of the entire tool is calculated by the next expression.

$$xg = \{w1 * x1 + w2 * x2 + + wi * xi\} / (w1 + w2 + + wi)$$

 $yg = \{w1 * y1 + w2 * y2 + + wi * yi\} / (w1 + w2 + + wi)$
 $zg = \{w1 * z1 + w2 * z2 + + wi * zi\} / (w1 + w2 + + wi)$

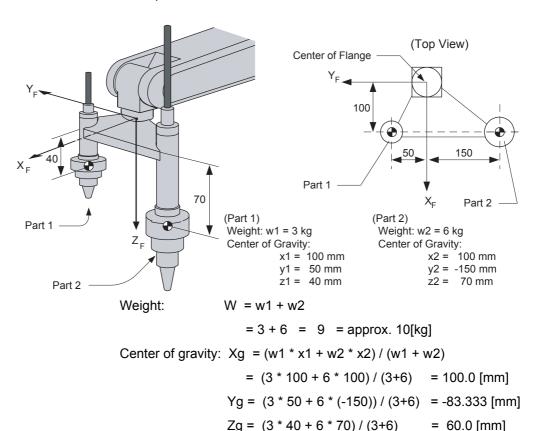
4. The moment of inertia at the center of gravity position of the entire tool is calculated by the next expression.

<Example 3>

When there are two or more big mass as shown in the figure below, perform:

- Set the center of gravity position when the center of gravity position of the entire tool is roughly understood, and set the moment of inertia at the center of gravity calculated by approximating the entire tool in the shape of hexahedron or cylinder. (It is enough in this setting usually.); or
- 2. When weight in each mass and the center of gravity position are understood, the center of gravity position and the moment of inertia at the center of gravity of the entire tool can be calculated. (Refer to forementioned supplement column: "How to calculate "Center of gravity position" and "moment of inertia at the center of gravity" for plural mass".)

This example shows the calculation with the method 2.



The moment of inertia at the center of gravity position:

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$$Iz = 3 * ((100 - 100)^{2} + (50 - (-83))^{2}) * 10^{-6}$$

$$+ 6 * ((100 - 100)^{2} + ((-150) - (-83))^{2}) * 10^{-6}$$

$$= 0.080 = approx. 0.100$$

* The own moment of inertia (Icxi, Icyi, Iczi) of the part is disregarded in this example, since each part is smaller than the entire tool.

<Setting>

W : 10.000 kg
 Xg : 100.000 mm
 Yg : -83.333 mm
 Zg : 60.000 mm
 lx : 0.100 kg.m²
 ly : 0.010 kg.m²
 lz : 0.100 kg.m²

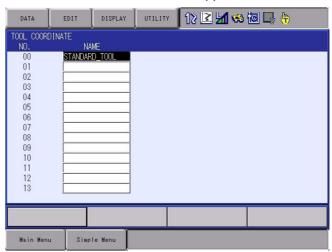
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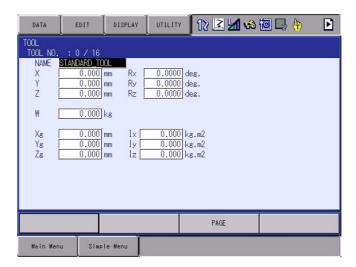
8.4 ARM Control

8.4.3.3 Registering Tool Load Information

Tool load information is registered in the tool file.

- 1. Select {ROBOT} under the main menu.
- 2. Select {TOOL}.
 - The tool coordinate list window appears.
 - The tool coordinate list window appears only when TOOL NO.
 SWITCH in the TEACHING CONDITION window is set to PERMIT.
 - When TOOL NO. SWITCH in the TEACHING CONDITION window is set to PROHIBIT, the tool window appears.



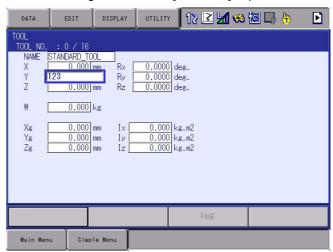


- 3. Select the desired tool number.
 - (1) Move the cursor to the number of the desired tool, and press [SELECT] in the tool list window.
 - (2) The tool coordinate window of the selected number appears.
 - (3) Select the desired number in the tool coordinate window by pressing the page key or clicking on the {PAGE} button.
 - (4) To switch the tool list window and the tool coordinate window, press {DISPLAY} → {LIST} or {DISPLAY} → {COORDINATE DATA}.

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8.4 ARM Control

- 4. Select the desired item to register and input the value.
 - The window can be scrolled with the cursor.
 - The menu enters the state of a numeric input if the cursor is on the desired item to register and the [SELECT] is pressed.



5. Press [ENTER].

- The input value is registered.
- The servo power is automatically turned OFF when editing the value while the servo power is ON, followed by a message "Servo off by changing data" displayed for three seconds.

· When the data setting is not done

It is considered that data is not set correctly in tool load information in the following cases.

- When the weight (W) is "0".
- When the center of gravity position (Xg, Yg, Zg) are all "0".

In these cases, the manipulator is controlled by the initial setting values (vary according to each robot model) which were set to the parameter before shipping.

Initial Setting Value:

Weight: W = Payload

Center of gravity position: (Xg, Yg, Zg) = (0, 0, Allowed value of B-axis for payload)

In this case, when an actual tool load is not large enough, the manipulator cannot sufficiently exert its function (speed and acceleration or deceleration).

Especially, when operating the manipulator with the initial setting value, a large difference in the load between the actual tool load and the initial setting value may cause vibrations in the manipulator motion. Thus, it is essential to correctly set the tool load information for the proper operation of the manipulator.



Moreover, when the tool which an actual tool center of gravity position greatly offsets in X-direction or Y-direction is installed the generated moment by the tool cannot be compensated.

To set the tool load information correctly, following message appears when the playback operation is executed by using the initial setting value.

"Using robot without setting tool info. may result in premature failure of the robot. Set W, Xg, Yg, and Zg in the tool file."

· Switch of the tool file

In case that two or more tool files are used, information on an effective tool file is referred for tool load information used by the ARM control at that time in according to switch tool file.

Set the same value of tool load information in each tool file when the tool file is switched to change only TCP (when neither the weight nor the center of gravity position of the entire tool installed in the flange is changed).

Moreover, set tool load information to the corresponding tool file respectively when total weight and the center of gravity position etc. of the tool is changed (when the system which exchange the tool by automatic tool changer). 8.5 Work Home Position

8.5 Work Home Position

8.5.1 Description of Work Home Position

The work home position is a reference point for manipulator operations. It prevents interference with peripheral device by ensuring that the manipulator is always within a set range as a precondition for operations such as starting the line. The manipulator can be moved to the set work home position by operation from the programming pendant, or by signal input from an external device. When the manipulator is in the vicinity of the work home position, the work home position signal turns ON.

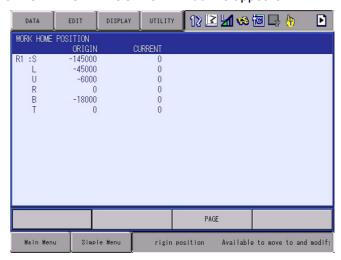
8.5.2 Setting Work Home Position

8.5.2.1 Work Home Position Window

1. Select {ROBOT} under the main menu.

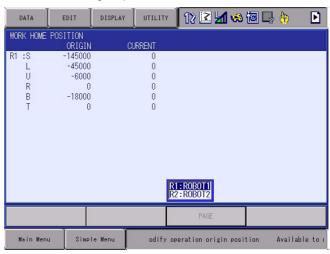


- 2. Select {WORK HOME POS}.
 - The WORK HOME POSITION window is appears.



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- 8.5 Work Home Position
- 3. Press the page key .
 - When two or more manipulators exist in the system, use the page key to change the control group, or click on {PAGE} to select the desired control group.



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8.5.2.2 Registering or Changing Work Home Position

- 1. Press the axis keys in the work home position display.
 - Move the manipulator to the new work home position.
- 2. Press [MODIFY], [ENTER].
 - New work home position is set.

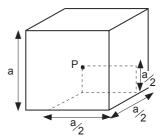
When the work home position is changed, the cubic interference area is automatically set as cube 64 and 63 in the base coordinate system.

- The cube 64 is for ROBOT1
- The cube 63 is for ROBOT2

The work home position cube is a cube like the one shown in the figure below; the length of its sides is determined by a parameter setting made by the user (units: μ m). By changing this parameter setting, the size of the cube can be changed.



Fig. 8-3: <u>S3C1097</u>: Length of Each Side of Work Home Position Cube (μm)



Specify whether "COMMAND POSITION" or "FEEDBACK POSITION" is to be set to the work home position cube signal's CHECK MEASURE in the interference area settings. "COMMAND POSITION" is the default setting.

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8.5.2.3 Returning to Work Home Position

In the teach mode

- 1. Press [FWD] in the work home position display.
 - The manipulator moves to the new work home position. The moving speed is the selected manual speed.

In the play mode

When the work home position return signal is input (detected at leading edge), the TCP of the manipulator is moved to the work home position. When the manipulator moves, a message "Manipulator is moving to work home position" is displayed. In this case, the move interpolation is MOVJ, and the speed applied is the one set in the parameters. (S1CxG56; units: 0.01%.)

8.5.2.4 Outputting Work Home Position Signal

This signal is output any time the current position of the TCP of the manipulator is checked and found to be within the work home position cube.

Interference Area

8.6 Interference Area

8.6.1 Description of Interference Area

The interference area is a function that prevents interference between multiple manipulators or the manipulator and peripheral device.

The areas can be set up to 64 areas. There are two types of interference areas, as follows:

- · Cubic Interference Area
- · Axis Interference Area

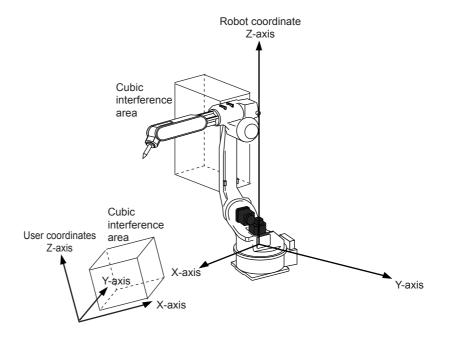
The FS100 judges whether the TCP of the manipulator is inside or outside this area, and outputs this status as a signal.

8.6.2 Cubic Interference Area

8.6.2.1 Description of Cubic Interference Area

This area is a rectangular parallelepiped which is parallel to the base coordinate, robot coordinate, or user coordinate.

The FS100 judges whether the current position of the manipulator's TCP is inside or outside this area, and outputs this status as a signal.



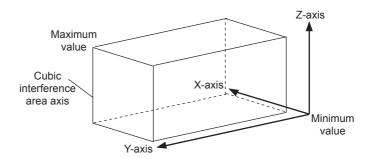
FS100

8.6 Interference Area

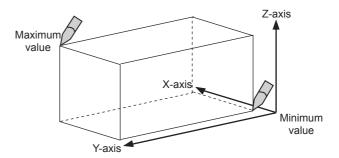
8.6.2.2 Cube Setting Method

There are three ways to set cubic a interference area as described in the following sections:

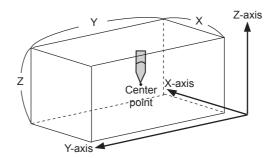
1. Enter the maximum and minimum values for the cube coordinates.



2. Move the manipulator at the maximum and minimum value positions of the cube corner using the axis keys.



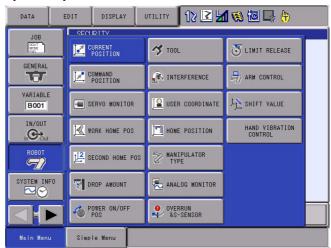
3. After entering the lengths of the three faces of the cube (axial length) using the Numeric keys, move the manipulator to the center point of the cube using the axis keys.



8.6 Interference Area

8.6.2.3 Setting Operation

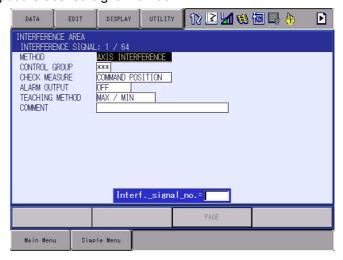
1. Select {ROBOT} under the main menu.



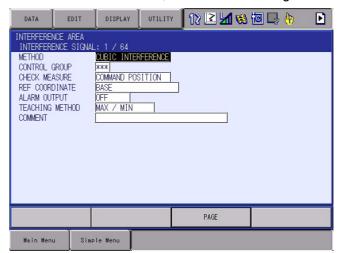
- 2. Select {INTERFERENCE}.
 - The INTERFERENCE AREA window is shown.



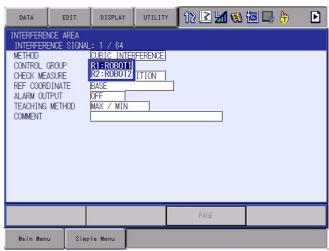
- 8.6 Interference Area
- 3. Select the desired cube number.
 - Select the desired cube number with the page key number input.
 - When selecting the cube number by number input, select {PAGE} to input the desired signal number.



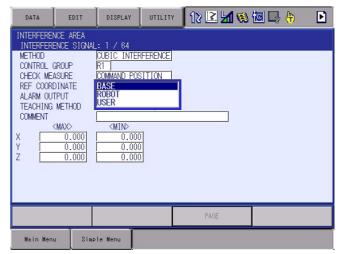
- 4. Select "METHOD".
 - "AXIS INTERFERENCE" and "CUBIC INTERFERENCE" are displayed alternately every time [SELECT] is pressed. If "CUBIC INTERFERENCE" is selected, the window is changed.



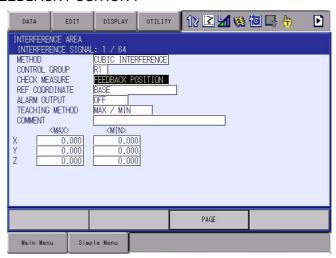
- 8.6 Interference Area
- 5. Select "CONTROL GROUP".
 - A selection dialog box appears.
 - (1) Select the desired control group.



- 6. Select "REF COORDINATES".
 - A selection dialog box appears.
 - (1) Select the desired coordinate.
 - (2) If the user coordinates are selected, the number input line is displayed. Input the user coordinate number and press [ENTER].



- 8.6 Interference Area
- 7. Select "CHECK MEASURE".
 - Press [SELECT] to alternate between "COMMAND POSITION" and "FEEDBACK POSITION".



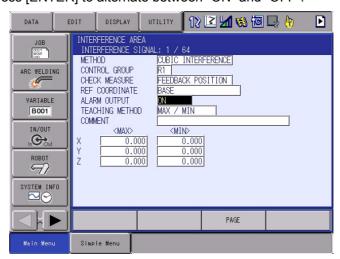
To stop the manipulator movement using the interference signal (use the cube interference signal for mutual interference between robots), set CHECK MEASURE to "COMMAND POSITION".



When set to the "FEEDBACK POSITION", the manipulator decelerates to a stop after entering the interference area.

When using the interference signal to inform an external unit of the actual manipulator position, use the "FEEDBACK POSITION" setting to enable the signal output in more accurate timing.

- 8. Select "ALARM OUTPUT".
 - Press [ENTER] to alternate between "ON" and "OFF".



 When "ALARM OUTPUT" is "ON", the alarm below occurs if the manipulator's TCP enters the set interference area, and the manipulator stops its motion immediately.

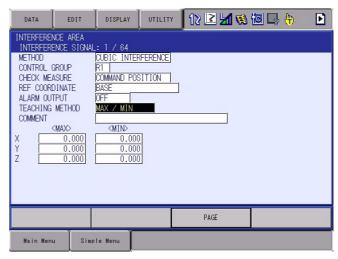
AL4902: CUBE INTERFERENCE (TCP)

FS100

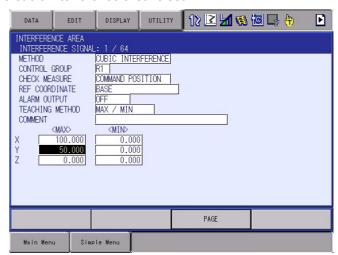
8.6 Interference Area

Number input of cube coordinates

- 1. Select "METHOD".
 - (1) Press [SELECT] to alternate between "MAX/MIN" and "CENTER POS".
 - (2) Select "MAX/MIN".



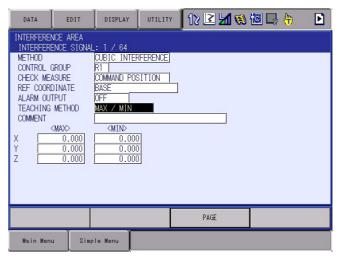
- 2. Input number for "MAX" and "MIN" data and press [ENTER].
 - The cubic interference area is set.



8.6 Interference Area

Teaching corners

- 1. Select "METHOD".
 - (1) Press [SELECT] to alternate between "MAX/MIN" and "CENTER POS".
 - (2) Select "MAX/MIN".



2. Press [MODIFY].

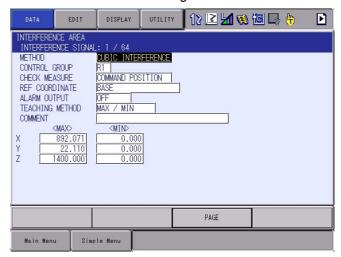
- The message "Teach max./min. position" appears.



- 3. Move the cursor to "<MAX>" or "<MIN>".
 - Move the cursor to "<MAX>" when changing the maximum value, and move cursor to "<MIN>" when changing the minimum value.
 The cursor only moves to either "<MIN>" or "<MAX>" at this time.
- 4. Move the manipulator using the axis keys.
 - Move the manipulator to the maximum or minimum position of the cube using the axis keys.

Interference Area 8.6

- 5. Press [ENTER].
 - The cubic interference area is registered.

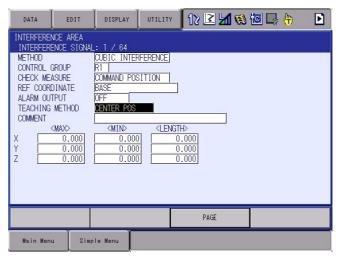


FS100

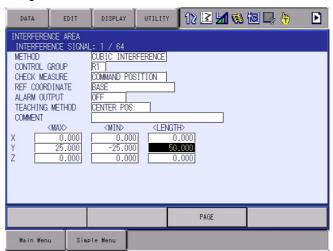
8.6 Interference Area

Number input of cube side length and teaching center

- 1. Select "METHOD".
 - (1) Press [SELECT] to alternate between "MAX/MIN" and "CENTER POS".
 - (2) Select "CENTER POS".



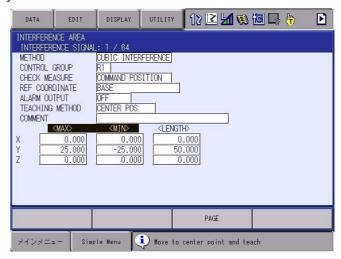
- 2. Input data for length of the cube, then press [ENTER].
 - The length is set.



8.6 Interference Area

3. Press [MODIFY].

 The message "Move to center point and teach" appears. The cursor only moves to either "<MIN>" or "<MAX>" at this time.



- 4. Move the manipulator using the axis keys.
 - Move the manipulator to the center point of the cube using the axis keys.
- 5. Press [ENTER].
 - The current position is registered as the center point of the cube.



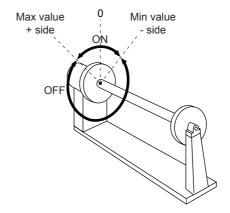
	8	System Setup
FS100	8.6	Interference Area

8.6.3 Axis Interference Area

8.6.3.1 Description of Axis Interference Area

The axis interference area is a function that judges the current position of the each axis and outputs a signal. Once the maximum and minimum values have been set at the plus and minus sides of the axis to define the working range, a signal indicating whether the current position of the axis is inside or outside this range is output. (ON: inside, OFF: outside)

Fig. 8-4: Axis Interference Signal for Station Axis

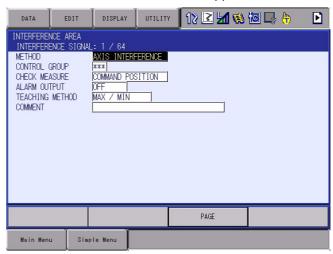


FS100

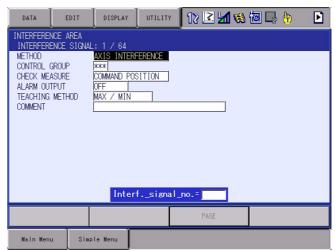
8.6 Interference Area

8.6.3.2 Setting Operation

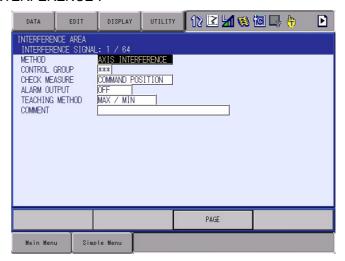
- 1. Select {ROBOT} under the main menu.
- 2. Select {INTERFERENCE}.
 - The INTERFERENCE AREA window appears.



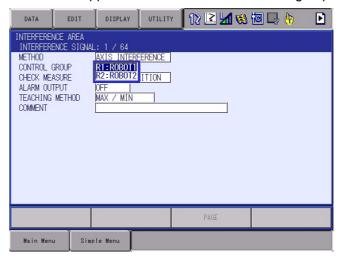
- 3. Select the desired interference signal number.
 - Select the desired interference signal number using the page key
 or by number input.
 - When selecting the desired interference signal number by number input, select {PAGE} to input the desired signal number.



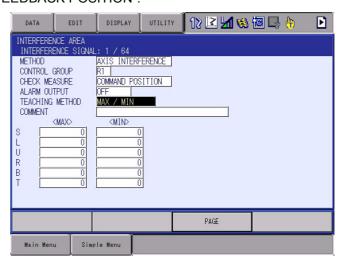
- 8.6 Interference Area
- 4. Select "METHOD".
 - Press [SELECT] to alternate between "AXIS INTERFERENCE" and "CUBIC INTERFERENCE". In this case, select "AXIS INTERFERENCE".



- 5. Select "CONTROL GROUP".
 - A selection box appears. Select the desired control group.

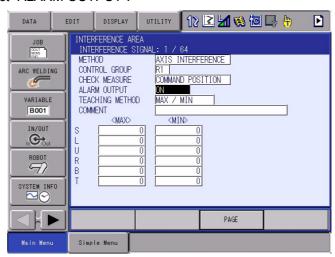


- 6. Select "CHECK MEASURE".
 - Press [SELECT] to alternate between "COMMAND POSITION" and "FEEDBACK POSITION".



8.6 Interference Area

7. Select "ALARM OUTPUT".



- Press [SELECT] to alternate between "ON" and "OFF".
- When "ALARM OUTPUT" is "ON", the alarm below occurs if the manipulator's TCP enters the set interference area, and the manipulator stops its motion immediately.

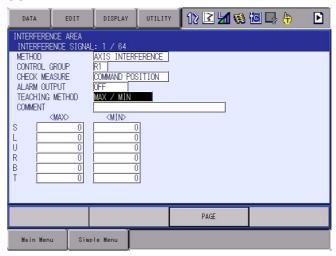
AL4901: AXIS INTERFERENCE

FS100

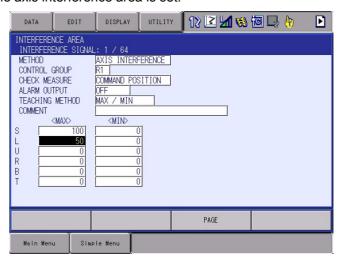
8.6 Interference Area

Number input of axis data coordinates

- 1. Select "METHOD".
 - (1) Press [SELECT] to alternate between "MAX/MIN" and "CENTER POS".



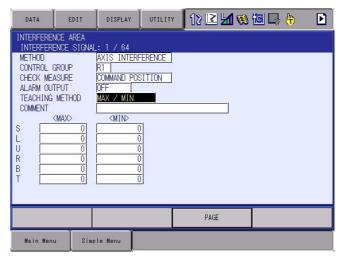
- (2) Select "MAX/MIN".
- 2. Input number for "MAX" and "MIN" data and press [ENTER].
 - The axis interference area is set.



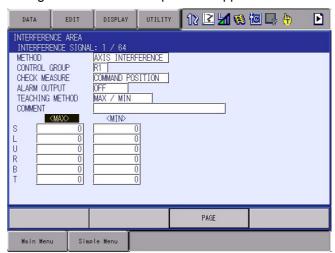
8.6 Interference Area

Teaching corners

- 1. Select "METHOD".
 - (1) Each time [SELECT] is pressed, "MAX/MIN" and "CENTER POS" switch alternately.
 - (2) Select "MAX/MIN".



- 2. Press [MODIFY].
 - A message "Teach max./min. position" appears.

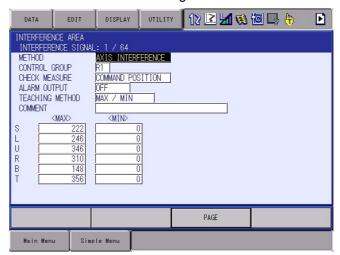


- 3. Move the cursor to "<MAX>" or "<MIN>".
 - Move the cursor to "<MAX>" when changing the maximum value, and move cursor to "<MIN>" when changing the minimum value. The cursor only moves to either "<MIN>" or "<MAX>" at this time.
- 4. Move the manipulator using the axis keys.
 - Move the manipulator to the maximum or minimum position of the cube using the axis keys.

FS100

- 8.6 Interference Area
- 5. Press [ENTER].

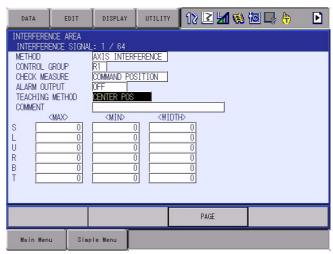
- The cubic interference area is registered.



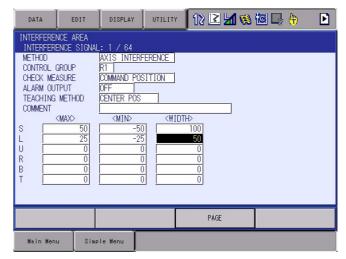
8.6 Interference Area

■ Number input of center position (WIDTH) and teaching center

- 1. Select "METHOD".
 - (1) Press [SELECT] to alternate "MAX/MIN" and "CENTER POS".
 - (2) Select "CENTER POS".



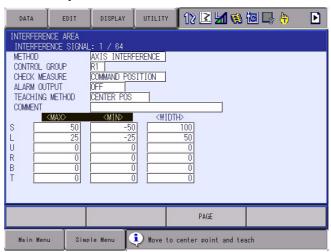
- 2. Input number for "WIDTH" data and press [ENTER].
 - "WIDTH" is set.



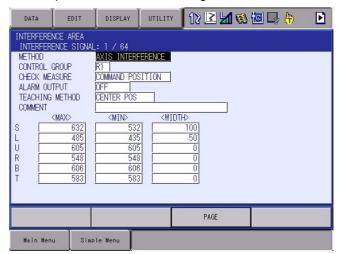
8.6 Interference Area

3. Press [MODIFY].

A message "Move to the center point and teach" appears.
 The cursor only moves to either "<MIN>" or "<MAX>" at this time.



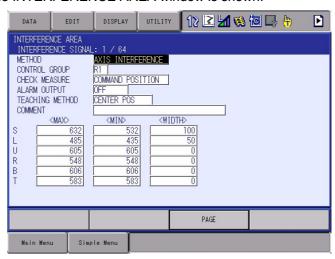
- 4. Move the manipulator using the axis keys.
 - Move the manipulator to the center position of the cube using the axis keys.
- 5. Press [ENTER].
 - The center position of the cube is registered.



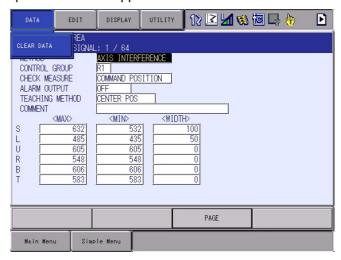
8.6 Interference Area

8.6.4 Clearing Interference Area Data

- 1. Select {ROBOT} under the main menu.
- 2. Select {INTERFERENCE}.
 - The INTERFERENCE AREA window is shown.

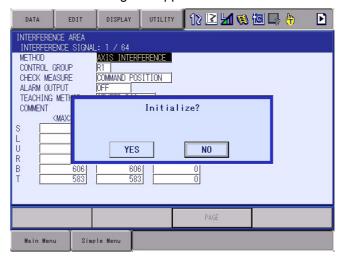


- 3. Select interference signal to be cleared.
 - (1) Select the desired interference signal number to be cleared using the page key or by number input.
 - (2) When selecting the desired interference signal number by number input, select {PAGE} to input the desired signal number.
- 4. Select {DATA} under the menu.
 - The pull-down menu appears.

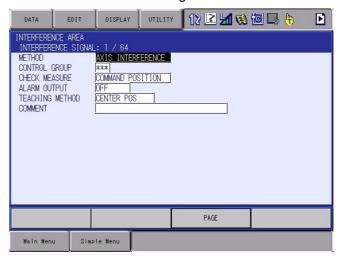


FS100

- 8.6 Interference Area
- 5. Select {CLEAR DATA}.
 - The confirmation dialog box appears.



- 6. Select {YES}.
 - All the data of the interference signal number are cleared.



8.7 Shock Detection Function

8.7.1 Shock Detection Function

The shock detection function is a function to decrease damage due to the collision by stopping the manipulator without any external sensor when the tool or the manipulator collide with peripheral device.

When the shock is detected either in teach mode or in play mode, the manipulator is stopped immediately.



WARNING

- This function does not completely avoid damage to the peripheral devices; moreover, it does not guarantee the user's safety.
- Make sure to supply the safety measures such as the safeguarding etc. Refer to chapter 1 "Safety" to chapter 6 "Test of Program Operation" for the safety measures in details.

Failure to observe this warning may result in Injury or damage to machinery caused by contact with the manipulator.

8.7.2 Shock Detection Function Setting

At the factory default setting, the threshold value is set to detect a collision without a miss even when the manipulator is operating at the maximum speed, on the assumption that the tool file is correctly set. To detect a collision during normal operation, check the following points:

- The tool's load and moment do not exceed the rated values.
- The actual tool load and the tool file setting value are the same.
- The U-arm payload information and the set weight of U-arm payload in the ARM CONTROL window are the same.

In addition, detection sensitivity can be decreased for only a specific section where a contact task is performed.

The detection sensitivity is set by setting the detection level.

8.7.2.1 Shock Detection Level Setting

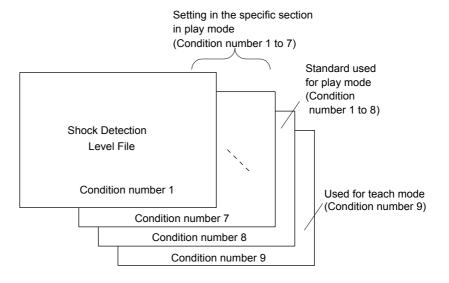
The shock detection level is set in the shock detection level set file.

The shock detection level set file are nine condition files as following figure.

- Condition numbers 1 to 7 are used when the detection level is changed in a specific section in play mode.
- Condition number 8 is used as standard in play mode: this function is operated by the detection level set in this file during playback operation.
- Condition number 9 is for teach mode: the shock detection function applies the detection level set here when the manipulator is operated in teach mode.
- Condition numbers 1 to 8 are set for each axis and condition 9 is set for each group.

The detection level is changed by a job instruction SHCKSET.

- After the instruction is executed, the shock will be detected by the specified detection level when the condition number is specified with the SHCKSET instruction.
- The detection level is returned to standard level when the SHCKRST instruction is executed.





The detection level of condition number 8 (a standard in play mode) is adopted in play mode excluding the range between SHCKSET and SHCKRST in the job.

Teach Mode Each Axis Setting Function

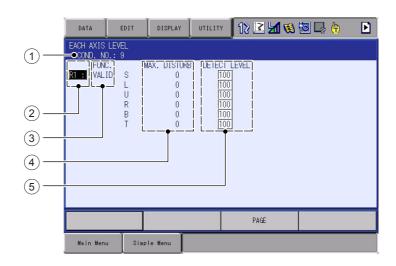
Usually, the detection level setting of teach mode is set for each group.



By using this function, the detection level can be set for each

S2C869: Teach Mode Each Axis Setting Function

(1: VALID, 0: INVALID)



1 Condition Number (1 to 9)

- 1 to 7: for changing detection level in play mode.
 - 8: for standard detection level in play mode.
 - 9: for detection level in teach mode.

(2) Robot Select

Select the manipulator whose detection level is to be changed.

(3) Function Select

Specifies VALID/INVALID of the shock detection function. The shock detection function is specified for each manipulator.

- 1. Select the manipulator whose function is to be enabled or disabled.
- 2. Move the cursor to "VALID" or "INVALID" and press [SELECT]. Each time [SELECT] is pressed, "INVALID" and "VALID" are displayed alternately. The change is available for all the condition numbers.

(4) Max. Disturbance Force

Indicates the maximum disturbance force to the manipulator when the manipulator is moved in play back operation or axis operation.

Refer to this value when inputting the detection level value in (5). The maximum disturbance force can be cleared by selecting {DATA} \rightarrow {CLEAR MAX VALUE} in the menu.

(5) Detection Level (Level range: 1 to 500)

Specifies the shock detection level. Set a value larger than the maximum disturbance force.

The value set by default (the level 100) enables the function without false detection even if the manipulator is operated at the maximum speed.

To change DETECT LEVEL, move the cursor to the subject manipulator, and press [SELECT] to display the numeric input status; input the value with a numeric key and press [ENTER]. To increase the detection sensitivity, set the level to small value, and to decrease the sensitivity, set the level to large value.

Method of shock detection level file setting

- 1. Select {ROBOT} under the main menu.
- 2. Select {SHOCK SENS LEVEL}.
 - The EACH AXIS LEVEL window appears.
 - Perform either of the following operations to display the page of desired condition number:
 - (1) Press {PAGE} in the window. Enter the desired condition number using numeric keys and press [ENTER]. Then the page of the condition number appears.
 - (2) Press the page key to change the condition number.
- Level setting for the condition numbers 1 to 8.
 Level setting values can be set for each axis on the EACH AXIS LEVEL window.

Perform the following "Disturbance force measurement", then perform "Setting all levels at once".

■ Disturbance force measurement

- 1 Mount the tool, workpiece, external equipment, and equipment on the arm to the manipulator.
- 2 Set the tool file correctly. Set the load information (weight and center of gravity) of the tool.
- (3) Set the detection level values of all the axes to 100.
 - (1) Open the SHOCK DETECT LEVEL window.
 - (2) Select {DATA}, then {CLEAR MAX VALUE}.
- (4) Perform the JOB.

Setting all levels at once

- 1) Open the SHOCK DETECT LEVEL window.
- (2) Select {DATA}, then {CHANGE EVERY LEVEL}.
- (3) Enter 120 in the coefficient (%) by which the max. disturbance force is multiplied.

The following calculated value A or B, whichever is larger, is set to the DETECT LEVEL.

A: (Max. disturbance force) x (coefficient = 120%)

B: (Max. disturbance force) + 15

<Example>

When the max. disturbance force is 80, the DETECT LEVEL is 96. When the max. disturbance force is 10, the DETECT LEVEL is 25.

4. Level setting for the condition number 9.

The level setting for the condition number 9 is for the teach mode.

This setting is made for each group.

Refer to the max. disturbance force to set the DETECT LEVEL.



- Perform all the jobs to use for 5 to 6 hours.
- If a work job is performed both with holding a workpiece and without holding a workpiece, measure both patterns.
- In the event of a collision while measuring the max. disturbance force, clear the max. disturbance force by selecting {DATA}, then {CLEAR MAX VALUE}. Then try again.



- The max. disturbance force is cleared when the power is turned ON/OFF. Therefore, DO NOT set the level based on the max. disturbance force immediately after turning ON/OFF the power.
- When the teaching point, operation speed, operation position, etc. of a job are greatly changed due to teaching modification, etc., measure the max. disturbance force and set the DETECT LEVEL again.
- When the load of tool or workpiece is greatly modified, measure the max. disturbance force and set the DETECT LEVEL again.

To avoid false detection during manipulator operation, set the following calculated value A or B, whichever is larger, to the DETECT LEVEL. An emergency stop of the manipulator due to the false detection may become a factor to damage the speed reducers and tools.



- A: (Max. disturbance force) x (coefficient = 120%)
- B: (Max. disturbance force) + 15

<Example>

When the max. disturbance force is 80, set the DETECT LEVEL to 96 or more.

When the max. disturbance force is 10, set the DETECT LEVEL to 25 or more.

To adjust to the change in the grease viscosity at a cold start, the offset value is automatically added to DETECT LEVEL until the robot has operated for a certain period of time.



Thus, at a cold start, the shock detection will be performed only when the value is more than or equal to the sum of DETECT LEVEL and the offset value.

The offset value varies depending on the manipulator type.



DETECT LEVEL can be modified only when the security mode is set to the management mode.

8.7.2.2 Tool Load Information Setting

To increase the accuracy of shock detection, set the tool load information in the tool file. Refer to *chapter 8.4.3 "Setting Tool Load Information" at page 8-48* for details of the tool load information setting.

8.7.2.3 U-Arm Payload Setting

To perform shock detection more accurately, set the U-arm payload.

See *chapter 8.4.2 "ARM CONTROL Window" at page 8-43* for details of the U-arm payload setting.

8.7.2.4 Instruction of Shock Detection Function

SHCKSET instruction

The SHCKSET instruction changes the shock detection level to the value set in the shock detection level file during play back operation.

The additional items of the SHCKSET instruction are as follows.



1 Robot Setting

Specifies the manipulator (R1, R2) or the station (ST1, ST2, ST3) of which shock detection level is to be modified.

If nothing is specified, the modification is applied to the shock detection level of the job control group in this instruction.

However, in the case of coordinated job, the modification is applied to the shock detection level of the slave axis group.

(2) Shock Detection Level Condition Number (1 to 7)

Specifies the shock detection level condition number in which the detection level in playback mode is set.

■ SHCKRST instruction

The shock detection level changed by the SHCKSET instruction is reset and returned to the detection level of the standard (value set in condition number 8) by the SHCKRST instruction.

The additional item of the SHCKRST instruction is as follows.



1 Robot Setting

Specifies the manipulator (R1, R2) or the station (ST1, ST2, ST3) of which shock detection level is to be reset.

If nothing is specified, the modification will be applied to the shock detection level of the job control group of this instruction.

However, in the case of coordinated job, the modification is applied to the shock detection level of the slave axis group.

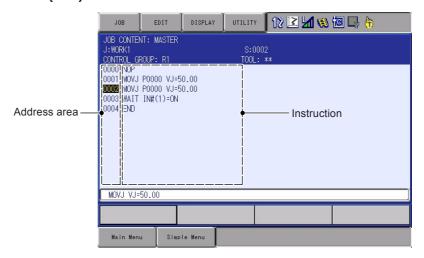
FS100

8.7 Shock Detection Function

Instruction registration

The instruction is registered when the cursor is in the address area in the JOB CONTENT window in teach mode.

1. Select {JOB} under the main menu.



- 2. Select {JOB}.
- 3. Move the cursor in the address area.

■ SHCKSET

- 1. Move the cursor to the immediately preceding line where the SHCKSET instruction is to be registered.
- 2. Press [INFORM LIST].
 - The inform list dialog box is shown.



- 3. Select SHCKSET instruction.
 - (1) SHCKSET instruction is shown in the input buffer line.

SHOKSET SSL#(1)

- 8.7 Shock Detection Function
- 4. Change the value of additional item and numerical data.
 - < When registering the instruction as it is >
 Operate the step 5 when registering the instruction in the input buffer line as it is.
 - < When adding or changing the additional item >

• When changing the shock detection level

(1) When changing the shock detection level, move the cursor to the shock detection level condition number; hold down [SHIFT] and press the up/down cursor key to change the condition number.



• When the value is input with the numeric key

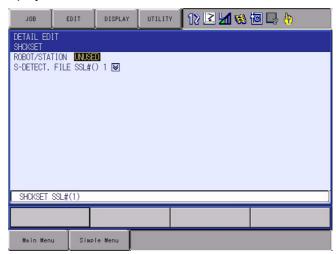
I) When the value is input with the numeric key, press [SELECT] to display the input buffer line.



II) Press [ENTER] to change the number in the input buffer line.

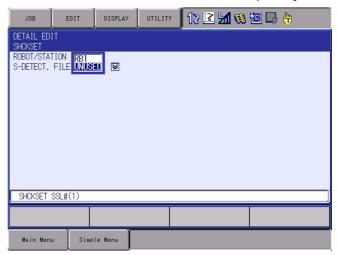
• When robot specification is added

 When robot specification is added, move the cursor to the instruction in the input buffer line and press [SELECT] to display the DETAIL window.



- II) Move the cursor to "UNUSED" of "ROBOT/STATION", and press [SELECT].
- III) The selection box appears.

IV) Point the cursor to the robot to be added and press [SELECT].



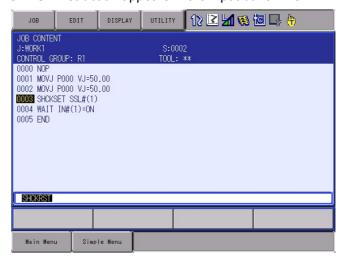
- V) When the addition of robot is completed, press [ENTER].
- VI) The DETAIL window closes and the JOB CONTENT window appears.
- 5. Press [INSERT] then [ENTER].
 - The instruction displayed in the input buffer line is registered.

■ SHCKRST

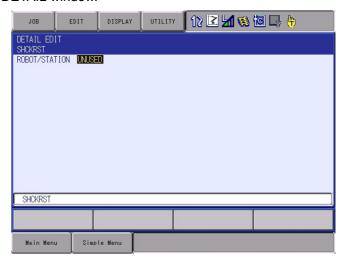
- 1. Move the cursor to the immediately preceding line where the SHCKRST instruction is to be registered.
- 2. Press [INFORM LIST].
 - The inform list appears.



- 3. Select SHCKRST instruction.
 - SHCKRST instruction appears in the input buffer line.



- 8.7 Shock Detection Function
- 4. Change the value of the additional item.
 - < When registering the instruction as it is >
 Operate the step 5 when registering the instruction in the input buffer line as it is.
 - < When adding or changing the additional item >
 - (1) When adding the robot specification, move the cursor to instruction in the input buffer line and press [SELECT] to display the DETAIL window.



- (2) Move the cursor to "UNUSED" of "ROBOT/STATION", and press [SELECT].
- (3) The selection box appears.
- (4) Point the cursor to the robot to be added and press [SELECT].



- (5) When the addition of robot is completed, press [ENTER].
- (6) The DETAIL window closes and the JOB CONTENT window appears.
- 5. Press [INSERT] then [ENTER].
 - The instruction displayed in the input buffer line is registered.

8.7.2.5 Resetting Shock Detection Alarm

When the collision of tool/manipulator and peripheral device is detected with the shock detection function, the manipulator stops instantaneously with alarm output. In this case, the shock detection alarm is displayed.



The shock detection alarm in teach mode and play mode can be reset by the following operation.

- 1. Press [SELECT].
 - The alarm is reset when "RESET" is selected on the alarm display, and the shock detection status is released.
- 2. Operation after resetting the detection status.
 - In teach mode, the JOG operation of the manipulator is enabled by resetting the status.
 - In the play mode, move the manipulator once to the safety position in the teach mode to check the damage though the playback operation is possible after resetting the status.



When manipulator is stopped instantaneously while having contact with the object and the detection alarm is tried to reset on the alarm window, the situation in which the alarm cannot be reset may occur since the collision may be detected again after resetting.

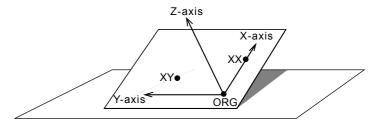
In this case, set the shock detection function "INVALID", or increase the detection level in teach mode and retreat the manipulator to a safety position.

8.8 User Coordinate Setting

8.8.1 User Coordinates

8.8.1.1 Definition of User Coordinates

User coordinates are defined by three points that have been taught to the manipulator through axis operations. These three defining points are ORG, XX, and XY, as shown in the diagram below. These three points of positional data are registered in a user coordinate file.



User coordinate definition point

ORG: Home position

XX: Point on the X-axis

XY: Point on the Y-axis

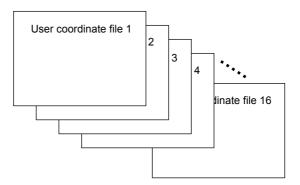
ORG is the home position, and XX is a point on the X-axis. XY is a point on the Y-axis side of the user coordinates that has been taught, and the directions of Y- and Z-axes are determined by point XY.



It is important that the two points ORG and XX be taught accurately.

8.8.1.2 Number of User Coordinate Files

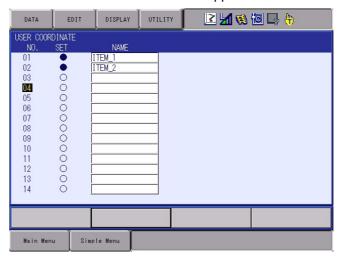
Up to 16 kinds of user coordinates can be registered. Each coordinate has a user coordinate No. and is called a user coordinate file.



8.8.2 User Coordinate Setting

8.8.2.1 Selecting User Coordinate File

- 1. Select {ROBOT} under the main menu.
- 2. Select {USER COORDINATE}.
 - (1) The USER COORDINATE window appears.



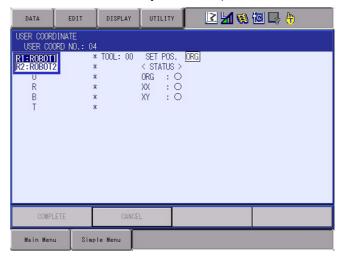
- (2) The "●" denotes that the user coordinates is completed to set and the "O" denotes that it is not completed.
- (3) To check the position of the user coordinates select {DISPLAY} → {COORDINATE DATA}.
- (4) The following window appears.



3. Select the user coordinate number.

8.8.2.2 Teaching User Coordinates

- 1. Select the robot.
 - Select "**" on the upper left of the window to select the subject robot.
 (This operation can be omitted if the robot selection has already been made or if there is only one robot.)

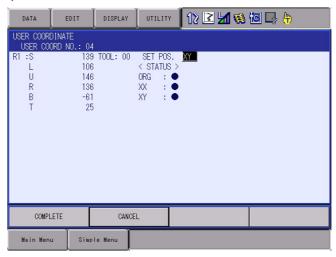


- 2. Select "SET POS".
 - Select the teaching point.

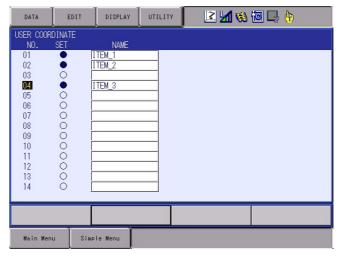


3. Move the manipulator to the desired position with the axis keys.

- 8.8 User Coordinate Setting
- 4. Press [MODIFY] then [ENTER].
 - Taught position is registered.
 - Repeat the steps 2 to 4 to teach ORG, XX and XY.
 - "●" denotes that teaching is completed and "O" denotes that it is not completed.



- To check the taught positions, call up the required window among ORG to XY and press [FWD]. The manipulator moves to the set position.
- If there is a difference between the current position of the manipulator and the displayed position data, "ORG", "XX", or "XY" flashes.
- 5. Select "COMPLETE".
 - User coordinates are registered in the file.
 - Once the user coordinate setting is completed, the following window appears.



8.8.2.3 Clearing User Coordinates

- 1. Select {DATA} under the pull-down menu.
- 2. Select (CLEAR DATA).
 - The confirmation dialog box appears.



- 3. Select {YES}.
 - All data is cleared.



8.9 Releasing Overrun or Tool Shock Sensor

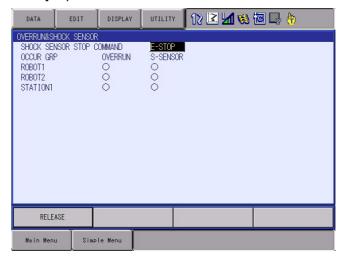
8.9 Releasing Overrun or Tool Shock Sensor



To operate the manipulator with the overrun or shock sensor released, pay extra attention to the safety of the surrounding operation environment.

If the manipulator stops by overrun detection or tool shock sensor detection, release the overrun or tool shock sensor by the following procedure and reset the alarm and move the manipulator with the axis keys.

- 1. Select {ROBOT} under the main menu.
- 2. Select {OVERRUN & S-SENSOR}.
 - The OVERRUN & SHOCK SENSOR window appears.
 - Select either "EMERGENCY STOP" or "HOLD" to set the item "SHOCK SENSOR STOP COMMAND" which specifies the stop condition in the current shock sensor detection.
 - "E-STOP" and "HOLD" are displayed alternately every time [SELECT] is pressed.



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8.9 Releasing Overrun or Tool Shock Sensor

3. Select "RELEASE".

- The control group in which overrun or shock sensor is detected is indicated with "●".
- If "RELEASE" is selected, overrun or tool shock sensor is released and "CANCEL" indication will be displayed.



4. Select "ALM RST".

 The alarm is reset and manipulator can be moved with the axis keys.



After releasing the overrun or tool shock sensor, if "CAN-CEL" is selected or the window is changed to the other one, the release of the overrun or tool shock sensor will be canceled.

8.10 Soft Limit Release Function

8.10 Soft Limit Release Function

The switches that are set to detect the motion range of the manipulator are called limit switches. The operating range is monitored by the software in order to stop motion before these limit switches are reached. These software limits are called "soft limits". The operating range of the manipulator is controlled by the following two soft limits.

- · Maximum motion range for each axis
- Cubic operation area set parallel to the robot coordinate system

These soft limits are continually monitored by the system, and the manipulator automatically stops when the its TCP reaches a soft limit.

When the manipulator is stopped at a soft limit, temporarily release the soft limit by the following procedure, then move the manipulator away from the soft limit in a direction opposite to the earlier operation direction.

- 1. Select {ROBOT} under the main menu.
- 2. Select {LIMIT RELEASE}.
 - The LIMIT RELEASE window appears.



- 3. Select "SOFT LIMIT RELEASE".
 - Press [SELECT] to alternate between "VALID" and "INVALID".
 - When "SOFT LIMIT RELEASE" is set to "VALID", the message "Soft limits have been released" appears.



 When "SOFT LIMIT RELEASE" is set to "INVALID", the message "Softlimits off released" is displayed for a few seconds.



- The taught data cannot be registered when the soft limit is being released.
- The setting of "SOFT LIMIT RELEASE" becomes "INVALID" when the mode is changed to the play mode.

8.11 All Limit Release Function

8.11 All Limit Release Function



CAUTION

To operate the manipulator with all limits released, pay extra attention to ensure the safety of the surrounding operation environment.

Failure to observe this caution may result in injury or damage to equipment due to the unexpected manipulator motion exceeding its range of motion.

The following limits can be released with the all limit release function:

Limit Type	Contents
Mechanical Limit	Limit to check manipulator's range of motion.
L-U Interference	Limit to check L- and U-axis interference area.
Soft Limit on Each Axis	Soft limit to check manipulator's range of motion.
Cube Interference	Limit to check cube interference area set by user.

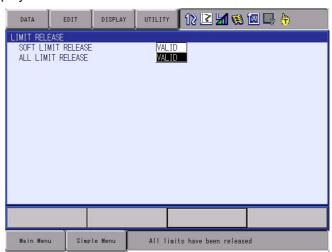


The all limit release function is available only when the security mode is set to the management mode. Refer to *chapter 7 "Security System" at page 7-1* for details on the security modes.

- 1. Select {ROBOT} under the main menu.
- 2. Select {LIMIT RELEASE}.
 - The LIMIT RELEASE window appears.



- 8.11 All Limit Release Function
- 3. Select "ALL LIMITS RELEASE".
 - Press [SELECT] to alternate between "VALID" and "INVALID".
 - When ALL LIMIT RELEASE is changed to "VALID", the message "All limits have been released" is displayed. When the setting changes to "INVALID", the message "All limits off released" is displayed for a few seconds.



8.12 Instruction Level Setting

8.12 Instruction Level Setting

8.12.1 Setting Contents

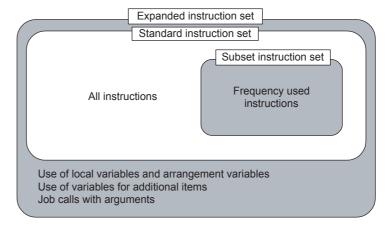
8.12.1.1 Instruction Set

There are three instruction sets that can be used when registering the instructions for the robot programming language (INFORM III): the subset instruction set, the standard instruction set, and the expanded instruction set.

- Subset Instruction Set:
 The instructions displayed in the instruction list are limited to just those that are most frequently used, reducing the number of instructions that can be registered. Since few instructions are shown, selection and input are simple.
- Standard Instruction Set/Expanded Instruction Set:
 All the INFORM III instructions can be used. The number of additional items to be used in each instruction differ in the standard instruction set and expansion instruction set.
 In the standard instruction set, the following functions cannot be used. However, operation becomes easier because the number of data items decreases when registering an instruction.
 - Use of local variables and arrangement variable
 - Use of variables for additional items (Example: MOVJ VJ = I000)

When instructions are executed, for example during playback, all the instructions can be executed regardless of the instruction set used.

Fig. 8-5: Instruction Set



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8.12 Instruction Level Setting

8.12.1.2 Learning Function

When an instruction is entered from the instruction list, the additional items that were entered last time are also shown. This function can simplify instruction input.

To register the same additional items as those in the former operation, register them without changing.

1. Register an instruction.



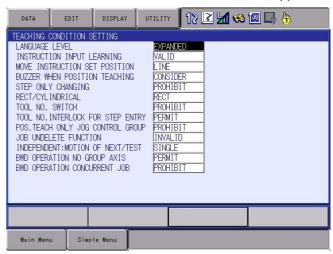
2. The next time an attempt is made to register the same instruction as in 1, the same additional items as were registered last time are also shown in the input buffer line.



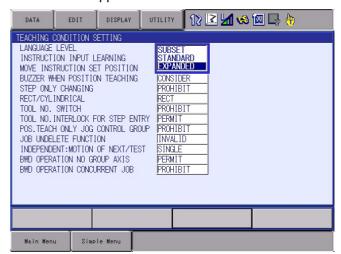
8.12 Instruction Level Setting

8.12.2 Setting Instruction Set Level

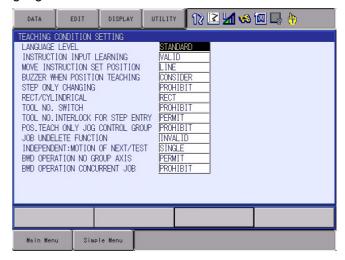
- 1. Select {SETUP} under the main menu.
- 2. Select {TEACHING CONDITION SETTING}.
 - The TEACHING CONDITION SETTING window appears.



- 3. Select "LANGUAGE LEVEL".
 - The selection list appears.



- 4. Select desired language level.
 - Language level is set.

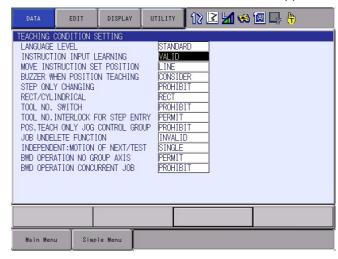


8.12 Instruction Level Setting

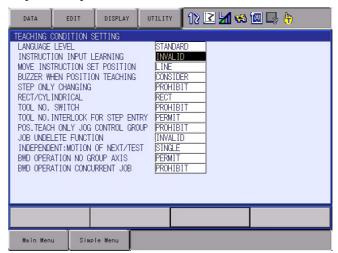
8.12.3 Setting Learning Function

The learning function is set at "VALID" by default.

- 1. Select {SETUP} under the main menu.
- 2. Select {TEACHING CONDITION SETTING}.
 - The TEACHING CONDITION SETTING window appears.



- 3. Select "INSTRUCTION INPUT LEARNING".
 - Press [SELECT] to alternate between "VALID" and "INVALID".

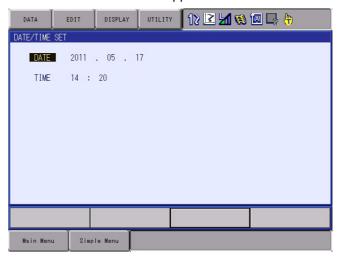


8.13 Setting Controller Clock

8.13 Setting Controller Clock

To check the current date and time, follow the procedure below.

- 1. Select {SETUP} under the main menu.
- 2. Select {DATE/TIME}.
 - The DATE/TIME SET window appears.



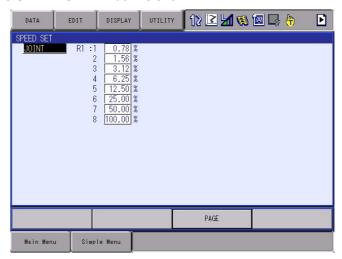
To set the current date and time, follow the procedure below.

- 1. While pressing the main menu key , turn the power OFF then back
- 2. Select {SYSTEM}, then {SETUP}. Then, select "DATE" or "TIME".
 - The DATE/TIME SET window appears.
- 3. Select "DATE" or "TIME".
 - The input buffer line appears.
- 4. Input the new date/time.
 - For instance, to set the date to September 1, 2010, input "2010.9.1".
 To set the time at twelve o'clock, enter "12.00".
- 5. Press [ENTER].
 - The date or time is changed.

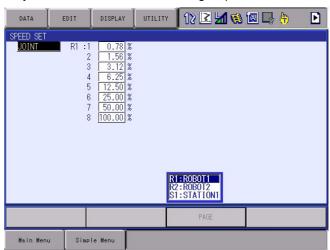
8.14 Setting Play Speed

8.14 Setting Play Speed

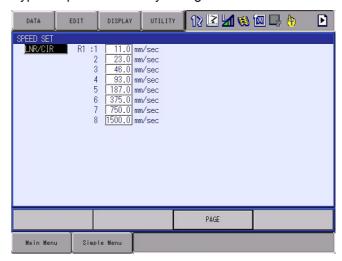
- 1. Select {SETUP} under the main menu.
- 2. Select (SET SPEED).
 - The SPEED SET window is shown.



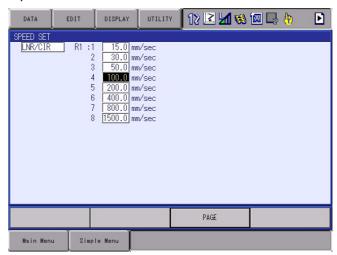
- 3. Press the page key .
 - When two or more manipulators and stations exist in the system,
 use the page key to change the control group, or click on
 {PAGE} to select the desired control group.



- 8.14 Setting Play Speed
- 4. Select "JOINT" or "LNR/CIR".
 - The type of speed alternately changes from "JOINT" to "LNR/CIR".



- 5. Select the speed to modify.
 - The input buffer line appears.
- 6. Input the speed value.
- 7. Press [ENTER].
 - The speed is modified.



8.15 Numeric Key Customize Function

8.15 Numeric Key Customize Function

8.15.1 Description of Numeric Key Customize Function

With this function, the user can set the function of an application that has been allocated to the numeric keys of the programming pendant to the other function.

Since any frequently used operation can be allocated to the numeric keys on the programming pendant, decreased key operations reduce the teaching time.



The Numeric Key Customize Function is allowed to set only when the security mode is set to the management mode.

8.15.2 Allocatable Functions

There are two allocation methods as follows:

- Key Allocation (EACH)
- Key Allocation (SIM)

8.15.2.1 Key Allocation (EACH)

With key allocation (EACH), the manipulator operates according to the allocated function when the numeric key is pressed. The allocatable functions are listed below.

Function	Description
Manufacturer allocation	Allocated by Yaskawa. Allocating another function invalidates the function allocated by the manufacturer.
Instruction allocation	Allocates any instructions assigned by the user.
Job call allocation	Allocates job call instructions (CALL instructions). The jobs to be called are only those registered in the reserved job names. (Specified by the registration No.)
Display allocation	Allocates any displays assigned by the user.

8.15.2.2 Key Allocation (SIM)

With key allocation (SIM), the manipulator operates according to the allocated function when the interlock key and the numeric key are pressed at the same time. The allocatable functions are listed below.

Function	Description
Alternate output allocation	Turns ON/OFF the specified user output signal when the
	interlock key and the allocated Numeric key are
	pressed at the same time.
Momentary output allocation Pulse output allocation	Turns ON the specified user output signal user when the
	interlock key and the allocated user key are pressed at the same time.
	Turns ON the specified user output signal only for the
	specified period when the interlock key 📅 and the
	allocated Numeric key are pressed at the same time.
Group output	Sends the specified output to the specified general group
allocation (4-bit/8-bit)	output signals when the interlock key
	allocated Numeric key are pressed at the same time.
Analog output	Sends the specified voltage to the specified output port
allocation	when the interlock key and the allocated Numeric key
	are pressed at the same time.
Analog incremental	Sends the voltage increased by the specified value to the
output allocation	specified output port when the interlock key and the allocated Numeric key are pressed at the same time.

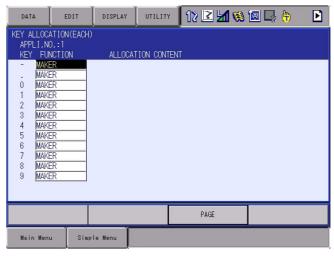


In a system for multiple applications, a numeric key can be allocated for each application.

8.15.3 Allocating Operation

8.15.3.1 Allocation Window

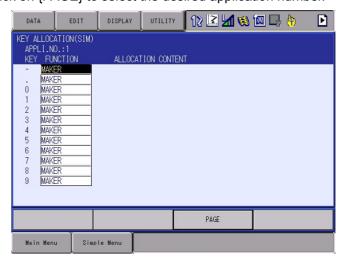
- 1. Select {SETUP} under the main menu.
- 2. Select {KEY ALLOCATION}.
 - The KEY ALLOCATION (EACH) window appears.



- 3. Select (DISPLAY).
 - Pull-down menu appears.
 - To call up the KEY ALLOCATION (SIM) window, select {ALLOCATE SIM. KEY}.



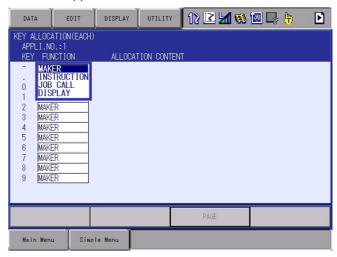
- 4. Select {ALLOCATE SIM. KEY}.
 - The KEY ALLOCATION (SIM) window appears.
 - In a system with multiple applications, press the page key to change the window to the allocation window for each application, or click on {PAGE} to select the desired application number.



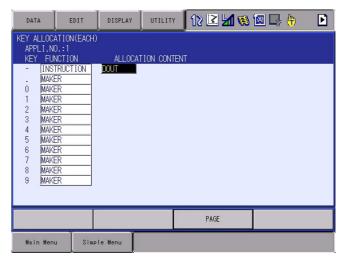
8.15.3.2 Instruction Allocation

Set this function in the KEY ALLOCATION (EACH) window.

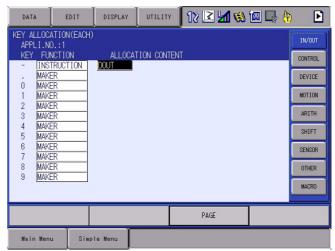
- 1. Move the cursor to "FUNCTION" of the key to be allocated and press [SELECT].
 - Selection list appears.



- 2. Select "INSTRUCTION".
 - The instruction is shown in the "ALLOCATION CONTENT".



(1) To change the instruction, move the cursor to the instruction and press [SELECT]. Then the instruction group list appears.

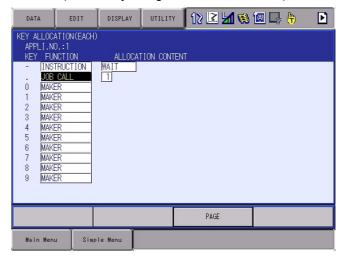


- 8.15 Numeric Key Customize Function
 - (2) Select the group which contains the instruction to modify.
 - (3) When the instruction list dialog box is shown, select the instruction to be changed.



8.15.3.3 Job Call Allocation

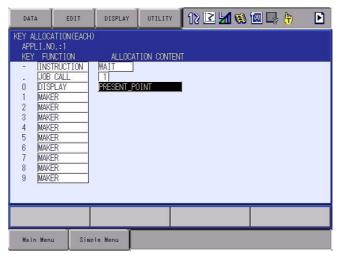
- 1. Move the cursor to the "FUNCTION" of the key to be allocated and press [SELECT].
 - A selection list appears.
- 2. Select "JOB CALL".
 - The reserved job registration No. is shown in the "ALLOCATION CONTENT" (reserved job registration No.: 1 to 10).



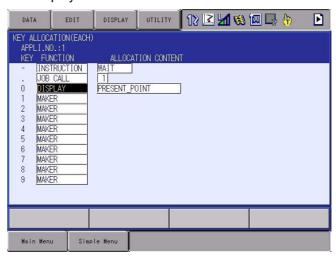
- (1) To change the reserved job registration No. move the cursor to the No. and press [SELECT]. Then input buffer line appears.
- (2) Input the number to be changed, and press [ENTER].

8.15.3.4 Display Allocation

- 1. Move the cursor to the "FUNCTION" of the key to be allocated and press [SELECT].
 - Selection list appears.
- 2. Select [DISPLAY].
- 3. Move the cursor to "ALLOCATION CONTENT" and press [SELECT].
 - Character input is available.
- 4. Input the name of the reserved window and press [ENTER].
 - The reserved name input to the "ALLOCATION CONTENT" is shown.

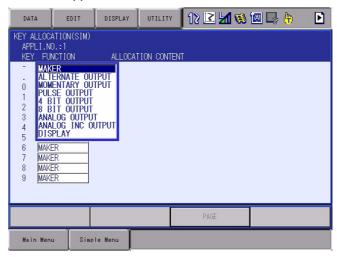


- 5. Open the window for allocation.
- 6. Press the interlock key and the allocated key at the same time.
 - A message "Reserved display registered" appears, and the window is registered.
 - In this case, the CURRENT POSITION window is registered by pressing the interlock key + [0] with the CURRENT POSITION window displayed on the screen.

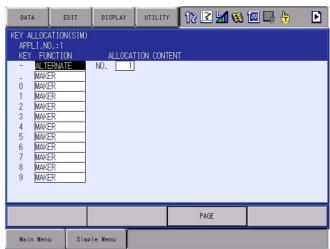


8.15.3.5 Alternate Output Allocation

- 1. Move the cursor to the "FUNCTION" of the key to be allocated and press [SELECT].
 - Selection list appears.



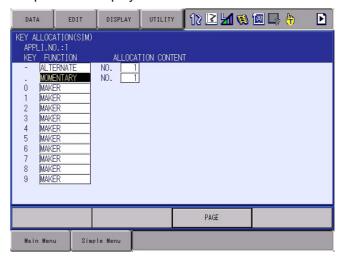
- 2. Select "ALTERNATE OUTPUT".
 - The output No. is displayed in the "ALLOCATION CONTENT".



- (1) To change the output No., move the cursor to the No. and press [SELECT]. Then numeric value can be entered.
- (2) Input the number to be changed, and press [ENTER].

8.15.3.6 Momentary Output Allocation

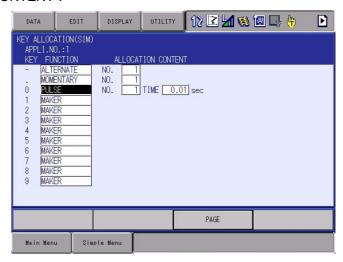
- 1. Move the cursor to the "FUNCTION" of the key to be allocated and press [SELECT].
 - A selection list appears.
- 2. Select "MOMENTARY OUTPUT".
 - The output No. is displayed in the "ALLOCATION CONTENT".



- (1) To change the output No., move the cursor to the No. and press [SELECT]. Then numeric value can be entered.
- (2) Input the number to be changed, and press [ENTER].

8.15.3.7 Pulse Output Allocation

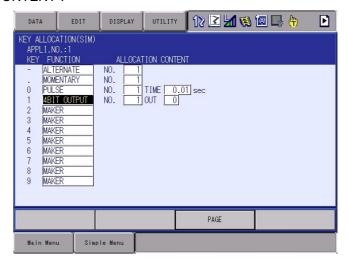
- 1. Move the cursor to the "FUNCTION" of the key to be allocated and press [SELECT].
 - A selection list appears.
- 2. Select "PULSE OUTPUT".
 - The output No. and output time are displayed in the "ALLOCATION CONTENT".



- To change the output No. or output time, move the cursor to the No. or time and press [SELECT]. Then numeric value can be entered.
- (2) Input the number or time to be changed, and press [ENTER].

8.15.3.8 Group (4-bit/8-bit) Output Allocation

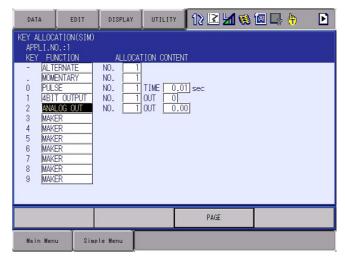
- 1. Move the cursor to the "FUNCTION" of the key to be allocated and press [SELECT].
 - A selection list appears.
- 2. Select "4 BIT OUTPUT" or "8 BIT OUTPUT".
 - The output No. and output value are displayed in the "ALLOCATION CONTENT".



- (1) To change the output No. or output value, move the cursor to the No. or value and press [SELECT]. Then numeric value can be entered.
- (2) Input the number or value to be changed, and press [ENTER].

8.15.3.9 Analog Output Allocation

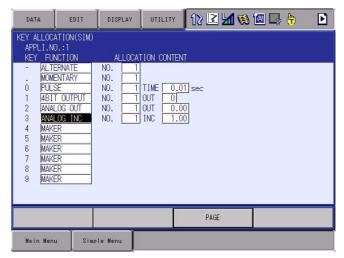
- 1. Move the cursor to the "FUNCTION" of the key to be allocated and press [SELECT].
 - A selection list appears.
- 2. Select "ANALOG OUTPUT".
 - The output port number and the output voltage value are displayed in the "ALLOCATION CONTENT".



- (1) To change the output port No. or output voltage value, move the cursor to the No. or voltage value and press [SELECT]. Then numeric value can be entered.
- (2) Input the number or voltage value to be changed, and press [ENTER].

8.15.3.10 Analog Incremental Output Allocation

- 1. Move the cursor to the "FUNCTION" of the key to be allocated and press [SELECT].
 - A selection list appears.
- 2. Select "ANALOG INC OUTPUT".
 - The output port No. and incremental value are displayed in the "ALLOCATION CONTENT".



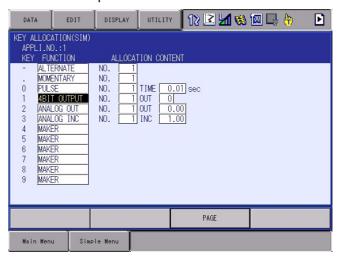
- (1) To change the output port No. or incremental value, move the cursor to the No. or incremental value and press [SELECT]. Then numeric values can be entered.
- (2) Input the number or incremental value to be changed, and press [ENTER].

8.15.4 Allocation of I/O Control Instructions

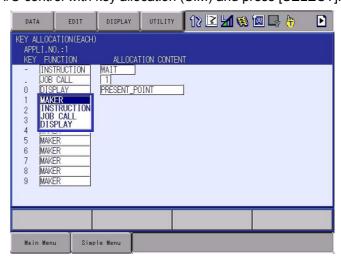
In key allocation (SIM), output control instructions can be allocated to the numeric keys that have been allocated one of the following I/O controls with key allocation (EACH).

Function	Output Control Instruction allowed to be Allocated
Alternate output allocation	DOUT OT# (No.) ON
Momentary output allocation	
Pulse output allocation	PULSE OT# (No.) T = output time
Group output allocation (4-bit)	DOUT OGH (No.) output value
Group output allocation (8-bit)	DOUT OG# (No.) output value
Analog output allocation	AOUT AO# (No.) output voltage value

- 1. Allocation of I/O control instruction.
 - Allocate the I/O control instruction with key allocation (SIM) following the forementioned procedure.



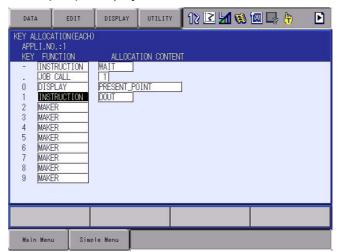
2. Move the cursor to the "FUNCTION" of the key that has been allocated with I/O control with key allocation (SIM) and press [SELECT].



- Selection list appears.

3. Select "OUTPUT CONTROL INST".

 The instruction corresponding to the I/O control allocated by key allocation (SIM) is displayed in the "ALLOCATION CONTENT".



 The allocated instruction changes automatically when "ALLOCATION CONTENT" is changed by key allocation (SIM).
 Even if the I/O control allocation is changed to the default setting allocated by the manufacturer with key allocation (SIM), the settings for key allocation (EACH) remain the same.

FS100

8.15 Numeric Key Customize Function

8.15.5 Execution of Allocation

8.15.5.1 Executing Instruction/Output Control Allocation

- 1. Press the key allocated for instruction allocation or output control allocation.
 - The allocated instruction is displayed in the input buffer line.



- 2. Press [INSERT] and [ENTER].
 - The instruction displayed in the input buffer line is registered.



8.15.5.2 Executing Job Call Allocation

- 1. Press the key allocated for the job call allocation.
 - The CALL instruction is displayed in the input buffer line.
- 2. Press [INSERT] then [ENTER].
 - The CALL instruction shown in the input buffer line is registered.

8.15.5.3 Executing Display Allocation

- 1. Press the key allocated for the display allocation.
 - The allocated display appears.

8.15.5.4 Executing I/O Control Allocation

Alternate output allocation, momentary output allocation, pulse output allocation, group output allocation (4-bit/8-bit), analog output allocation, analog incremental output allocation are executed by the following operation.

- 1. Press the interlock key and the key allocated for I/O control allocation at the same time.
 - Allocated functions are executed.

8.16 Changing Output Status

8.16 Changing Output Status

The status of external output signals can be changed from the programming pendant by using either of the following two methods.

- On the user output status window
- On the RELAY ON window

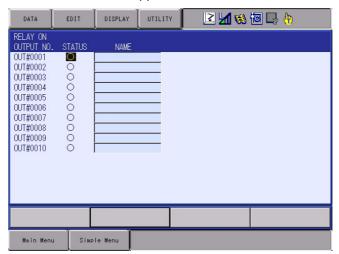
The method that uses the RELAY ON window, which is described here, simplifies the operation for changing the status of signals that are used frequently.



A maximum of 64 output signals can be shown on the RELAY ON window and they must be set in advance to parameters \$4C327 to \$4C390.

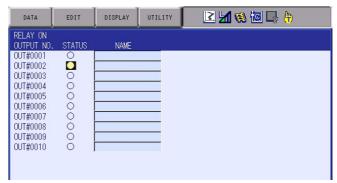
If they are not set, the sub menu in the RELAY ON window will not be displayed.

- 1. Select {IN/OUT} under the main menu.
- 2. Select {RELAY ON}.
 - The RELAY ON window appears.



- 3. Select the desired signal to change the output status.
 - Select the status (● or O) of the desired signal.

- 8.16 Changing Output Status
- 4. Press the interlock key +[SELECT].
 - The output status is changed. (●: status ON; O: status OFF.)



It is also possible to turn the relevant external output signal



on only for the duration that the interlock key + [SELECT] are pressed.

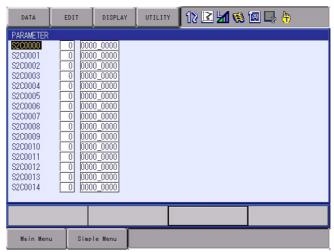
This selection is made in advance by setting the parameters (S4C391 to 454) to "1".

8.17 Changing Parameter Setting

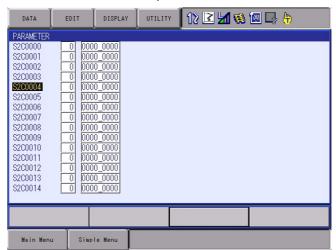
8.17 Changing Parameter Setting

The parameter settings can be changed only by the operator who has the correct user ID number for the management mode.

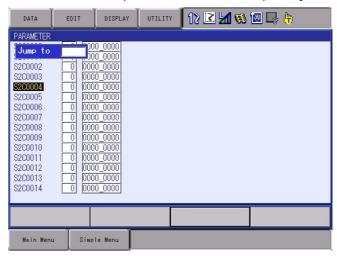
- 1. Select {PARAMETER} under the main menu.
- 2. Select the parameter type.
 - The PARAMETER window appears. Select the desired parameter.



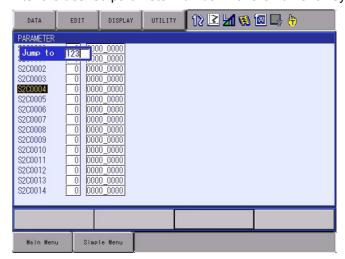
3. Move the cursor to the desired parameter number.



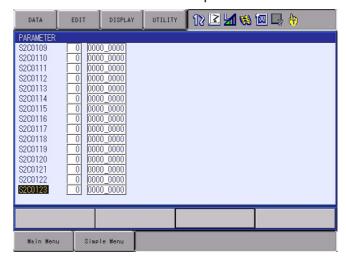
- 8.17 Changing Parameter Setting
 - When the desired parameter number is not in the current window, move the cursor in the following way:
 - (1) Move the cursor to a parameter number and press [SELECT].



(2) Enter the desired parameter number with the numeric keys.



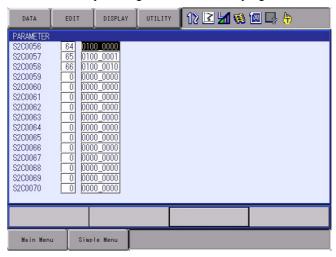
- (3) Press [ENTER].
- (4) The cursor moves to the selected parameter number.



8.17 Changing Parameter Setting

Set the parameters in the following manner.

- 1. Select the parameter data to be set.
 - (1) Move the cursor to the parameter number data (decimal or binary) in the PARAMETER window, and press [SELECT].
 - (2) To enter a decimal setting, select the decimal figure.
 - (3) To enter a binary setting, select the binary figure.



2. Enter the value.

 If a decimal figure is selected, enter a decimal value with the numeric keys.

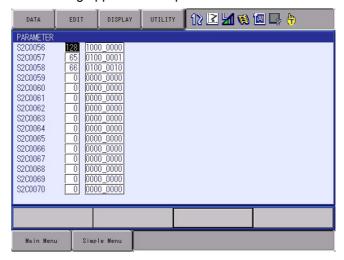


- If a binary figure is selected, move the cursor to the binary figure data in the input buffer line, and press [SELECT].
- Each time [SELECT] is pressed, "0" and "1" alternate in the window.
- "0" or "1" can also be entered with the numeric keys.



3. Press [ENTER].

- The new setting appears in the position where the cursor is located.



8.18 File Initialization

8.18 File Initialization

8.18.1 Initializing Job File

- 1. While pressing the main menu key , turn the power OFF then back ON.
- 2. Change the security mode to the management mode.
- 3. Select {FILE} under the main menu.
- 4. Select {INITIALIZE}.
 - The INITIALIZE window appears.



5. Select {JOB}.

A confirmation dialog box appears.



6. Select {YES}.

- The job data is initialized.

When JOB is initialized, the following files are reset at the same time.

Be careful when initializing JOB.



- · User coordinates
- Variable data
- System definition parameter (S4D)
- · Robot calibration data
- · Conveyor calibration data

FS100

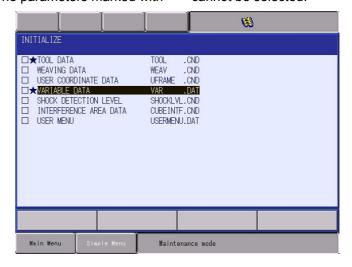
8.18 File Initialization

8.18.2 Initializing Data File

- 1. While pressing the main menu key , turn the power OFF then back ON.
- 2. Change the security mode to the management mode.
- 3. Select (FILE) under the main menu.
- 4. Select {INITIALIZE}.
- 5. Select {FILE/GENERAL DATA}.
 - The INITIALIZE window appears.



- 6. Select the data file to be initialized.
 - The selected data file/general data are marked with "★".
 - The parameters marked with "■" cannot be selected.

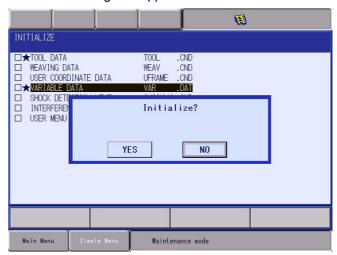


FS100

8.18 File Initialization

7. Press [ENTER].

A confirmation dialog box appears.



8. Select {YES}.

- The selected data file/general data are initialized.

8.18 File Initialization

8.18.3 Initializing Parameter File

- 1. While pressing the main menu key , turn the power OFF then back ON.
- 2. Change the security mode to the management mode.
- 3. Select (FILE) under the main menu.
- 4. Select {INITIALIZE}.
- 5. Select {PARAMETER}.
 - The parameter selection window appears.



- 6. Select the parameter to be initialized.
 - The selected parameter is marked with "★".
 - The parameters marked with "■" cannot be selected.

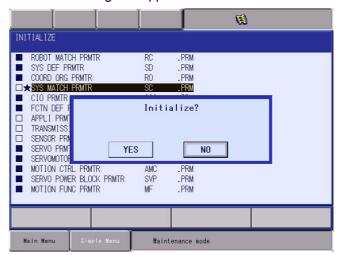


FS100

8.18 File Initialization

7. Press [ENTER].

- A confirmation dialog box appears.



8. Select {YES}.

- The selected parameter is initialized.

FS100

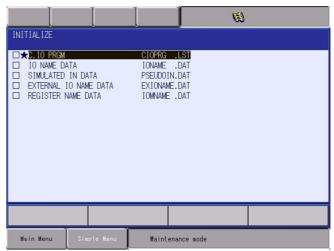
8.18 File Initialization

8.18.4 Initializing I/O Data

- 1. While pressing the main menu key , turn the power OFF then back ON.
- 2. Change the security mode to the management mode.
- 3. Select (FILE) under the main menu.
- 4. Select (INITIALIZE).
- 5. Select {I/O DATA}.
 - The I/O data selection window appears.



- 6. Select data to be initialized.
 - The selected data is marked with "★".
 - The I/O data marked with "■" cannot be selected.

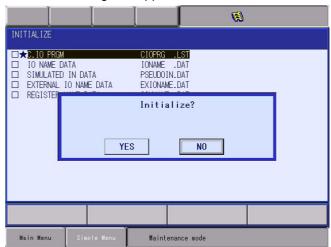


FS100

8.18 File Initialization

7. Press [ENTER].

- A confirmation dialog box appears.



8. Select {YES}.

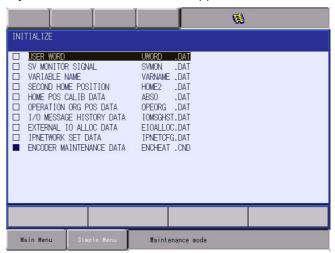
- The selected data is initialized.

FS100

8.18 File Initialization

8.18.5 Initializing System Data

- 1. While pressing the main menu key , turn the power OFF then back ON.
- 2. Change the security mode to the management mode.
- 3. Select (FILE) under the main menu.
- 4. Select {INITIALIZE}.
- 5. Select {SYSTEM DATA}.
 - The system data selection window appears.



- 6. Select the parameter to be initialized.
 - The selected data is marked with "★".
 - The system data marked with "■" cannot be selected.



FS100

8.18 File Initialization

7. Press [ENTER].

A confirmation dialog box appears.



8. Select {YES}.

- The selected data is initialized.

8.19 Display Setting Function

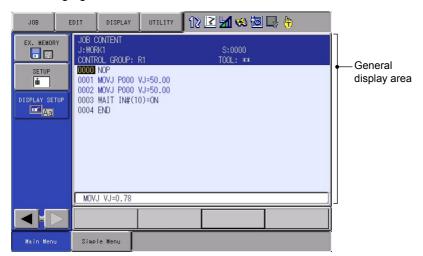
8.19.1 Font Size Setting

FS100 enables changing the font size displayed on the screen.

The fonts displayed on the screen can be selected from eight patterns of fonts in the font size setting dialog box.

8.19.1.1 Applicable Range for Font Size Change

Changing the font size is allowed in the general display area indicated in the following figure:



8.19.1.2 Settable Font Size

The following eight patterns of fonts are available in setting the size of fonts displayed on the screen.

	Font Size	Font Style
1	Small	Regular
2	Small	Bold
3	Regular	Regular
4	Regular	Bold
5	Large	Regular
6	Large	Bold
7	Extra large	Regular
8	Extra large	Bold

FS100

8.19 Display Setting Function

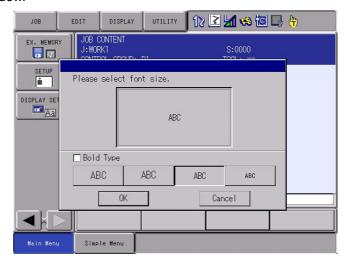
8.19.1.3 Setting Font Size

To set the font size, first off display the font size setting dialog box as follows.

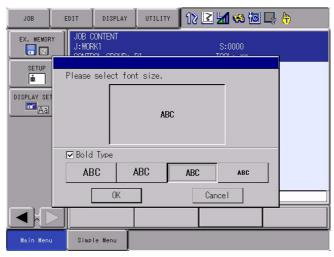
1. Select {DISPLAY SETUP} then {CHANGE FONT} under the main menu.



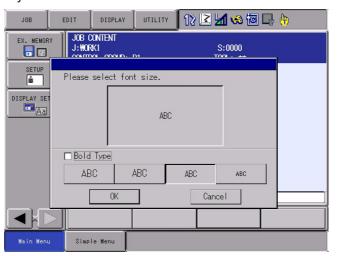
2. The font size setting dialog box appears on the center of the current window.



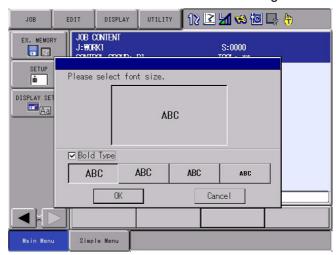
- 8.19 Display Setting Function
- To set the font size in the font size setting dialog box, follow the procedure below.
 - 1. Specify the font style.
 - The {Bold Type} check box can be checked or unchecked alternately each time the check box is selected.
 - Check the {Bold Type} check box as follows to set the font to the bold style.



• Clear the {Bold Type} check box as follows to set the font to the regular style.



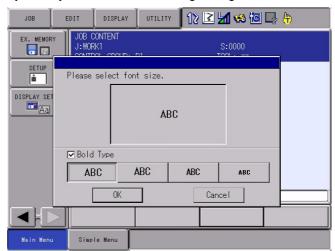
- 8.19 Display Setting Function
- 2. Specify the font size.
 - Select a button from the four buttons in the dialog box.



3. The font size setting dialog box is closed, and the screen displays the font specified in the dialog box.

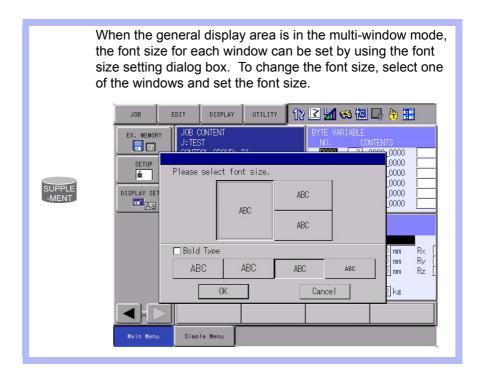


- To cancel the setting of the font size, follow the procedure below.
 - 1. Select {Cancel} in the font size setting dialog box.



2. The dialog box closes without changing the font size.







Do not turn OFF the FS100 power supply when the font size is being changed (when the font size setting dialog box is on the screen).

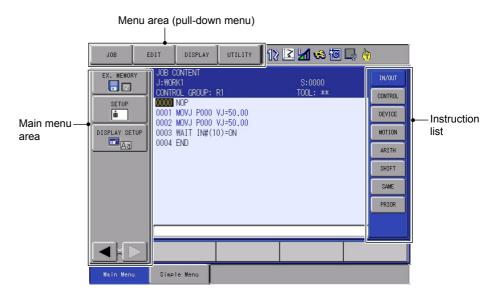
8.19.2 Operation Button Size Setting

FS100 enables changing the size of operation buttons.

The button size in the main menu area, menu area, and instruction list can be respectively selected from three sizes.

8.19.2.1 Applicable Range for Button Size Change

Changing the button size is allowed in the main menu, menu (pull-down menu), and instruction list indicated in the following figure:



8.19.2.2 Settable Button Size

The following three sizes of buttons are available in setting the size of each operation button; the font style of the character string on buttons can also be specified.

	Button Size	Font Style
1	Small	Regular
		Bold
2	Regular	Regular
		Bold
3	Large	Regular
		Bold

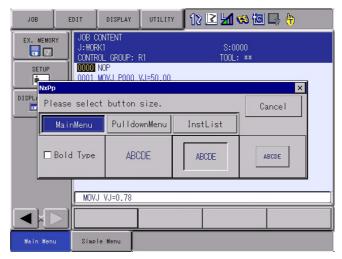
8.19.2.3 Setting Button Size

To set the button size, first off display the button size setting dialog box as follows.

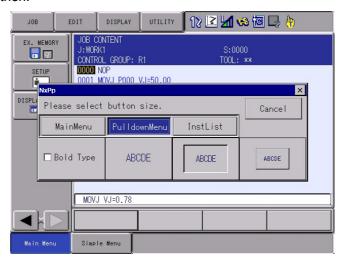
 Select {DISPLAY SETUP} then {CHANGE BUTTON} under the main menu.



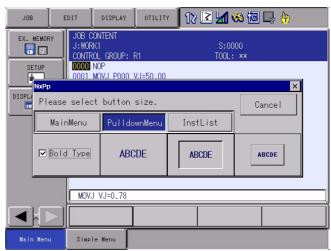
 The font size setting dialog box appears on the center of the current window.



- 8.19 Display Setting Function
- To set the button size in the button size setting dialog box, follow the procedure below.
 - 1. Specify the area to set the button size.
 - (1) Select the desired area from the area setting buttons.
 - (2) The buttons in the selected area is subject to size setting.
 - (3) Note that only the last-selected button determines the area subject to size setting, even if settings are performed several times before then.

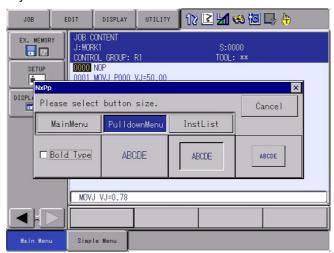


- 2. Specify the font style.
 - The {Bold Type} check box can be checked or unchecked alternately each time the check box is selected.
 - Check the {Bold Type} check box as follows to set the font to the bold style.

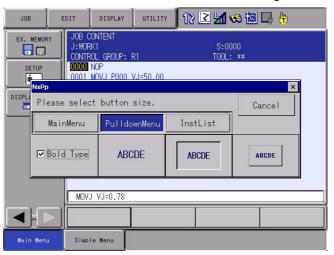


8.19 Display Setting Function

• Clear the {Bold Type} check box as follows to set the font to the regular style.



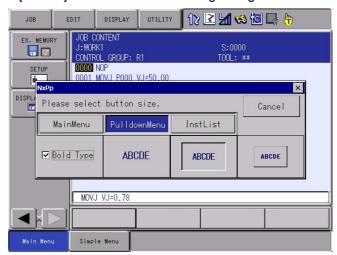
- 3. Specify the button size.
 - Select a button from the three buttons in the dialog box.



- 4. The font size setting dialog box is closed, and the screen displays the buttons specified in the dialog box.
 - The modification is applied only to the buttons in the area selected with the area setting button. (In this example, the change is applied only to the pull-down menu buttons in the menu area.)



- 8.19 Display Setting Function
- To cancel the setting of the button size, follow the procedure below.
 - 1. Select {Cancel} in the button size setting dialog box.



- The dialog box closes without changing the button size.





Do not turn OFF the FS100 power supply when the button size is being changed (when the button size setting dialog box is on the screen, or when an hourglass is indicated in the middle of the screen).

8.19 Display Setting Function

8.19.3 Initialization of Screen Layout

The font/button size changed with the font/button size setting function can be collectively changed back to the regular size.

8.19.3.1 Initializing Screen Layout

To initialize the screen layout, follow the procedure below.

1. Select {DISPLAY SETUP} then {INITIALIZE LAYOUT} under the main menu.



 A confirmation dialog box appears on the center of the current window.



- 8.19 Display Setting Function
- To initialize the screen layout, follow the procedure below.
 - 1. select {OK}.



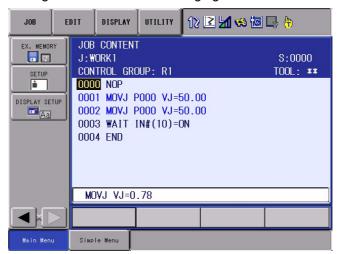
 The dialog box is closed, and the font/button sizes are collectively changed to the regular size.



- 8.19 Display Setting Function
- To cancel the initialized screen layout, follow the procedure below.
 - 1. Select {CANCEL}.



- The dialog box closes without changing the current screen layout.





Do not turn OFF the FS100 power supply when the screen layout is being initialized (when the confirmation dialog box is on the screen, or when an hourglass is indicated in the middle of the screen).

8.19.4 Saving Layout

The settings of the font size and button size are saved. The screen is displayed with the font size and button size specified last time by the current controller.



In the maintenance mode, the screen is displayed with the standard font size and button size regardless of the settings of them. The font size and button size can be changed in the maintenance mode, but the settings are not saved.

8.20 Hand Vibration Control Function

8.20 Hand Vibration Control Function

8.20.1 Description of Hand Vibration Control Function

With this function, vibration caused by the hand or workpiece can be reduced.

The reduction of vibration eliminates the need to improve the accuracy of and to reduce the speed of picking-up or placing motion for handling application, which reduces cycle time.



Make correct settings to make the best of the hand vibration control function.

For settings, refer to chapter 8.20.3 "Setting Hand Vibration Control Function" at page 8-157.



 The path and cycle time of the robot changes depending on the settings of the hand vibration control function. Make sure to check operation after changing the settings.

8.20.2 Supported Models

The following high-speed handling models support the hand vibration control function:

- MPK2
- MPP3



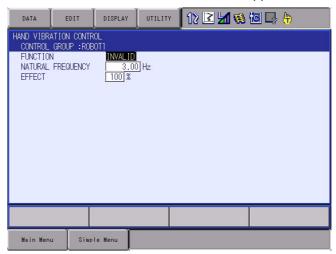
The hand vibration control function can be supported by the system with one manipulator.

It cannot be supported by the system with an external axis and/or station.

8.20 Hand Vibration Control Function

8.20.3 Setting Hand Vibration Control Function

- 1. Select {ROBOT} under the main menu.
- 2. Select {HAND VIBRATION CONTROL}.
 - The HAND VIBRATION CONTROL window appears.



1) FUNCTION

Specifies VALID or INVALID of the hand vibration control function

Move the cursor to "VALID/INVALID", then press [SELECT]. Press [SELECT] to alternate between VALID and INVALID.

(2) NATURAL FREQUENCY [Hz]

Specifies the natural frequency of the hand or workpiece. Move the cursor to "NATURAL FREQUENCY" and press [SELECT] to enter a numeric value. Enter a setting value by using the numeric keys, then press [ENTER].

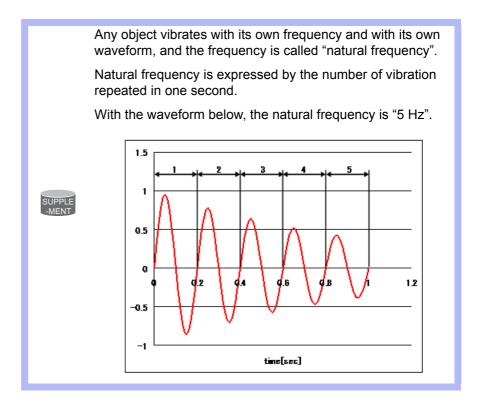
(3) EFFICIENCY [%] (Range: 1 to 100)

Specifies the efficiency of the hand vibration control function. Move the cursor to "EFFICIENCY" and press [SELECT] to enter a numeric value. Enter a setting value by using the numeric keys, then press [ENTER].

- 3. Enable the function by setting "FUNCTION" to "VALID".
- 4. Set the natural frequency.
 - If the natural frequency of the hand or workpiece is known, set the value.

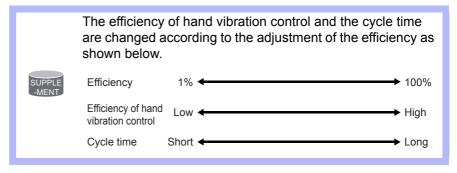
If the natural frequency of the hand or workpiece is not known, set the value with which vibration is minimized when the manipulator operates. It is acceptable to set this value even if the natural frequency of the hand or workpiece is known.

8.20 Hand Vibration Control Function



5. Set the efficiency.

Set the efficiency of the hand vibration control function.
 Normally, there is no need to change it from 100%.
 However, by changing the value, the efficiency of hand vibration control and the cycle time can be adjusted.





The settings of the hand vibration control function can be changed only when the security mode is set to the management mode.

8.21 Manual Brake Release Function

8.21.1 Outline

With this function, the brake of each motor of the manipulator and the external axis can be forcibly released by using the programming pendant.

Note that the following operating conditions must be met:

· Operating conditions

(1)FS100 condition

The FS100 must be started up normally.

(2)Mode

All modes (REMOTE, PLAY, TEACH)

(3)Security

All security modes (Operation, Edit, Management)

(4)Others

- The servo is not turned ON.
- The emergency stop is not incoming. (programming pendant, external signal, controller (optional))
- The interlock connector is connected.

Also, observe the following restrictions on the axis whose brake is to be released:

Restrictions

Due to the hardware configuration, the brake release can be performed only by the following units:

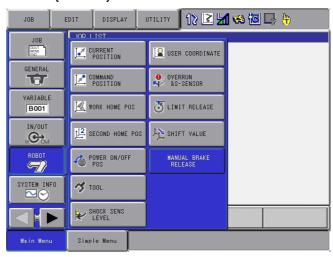
- Group of the S-, L-, and U-axes (the first, second, and third axes)
- Group of the R-, B-, and T-axes (the fourth, fifth, and sixth axes)
- The E-axis or the first external axis, etc. (the seventh axis)
- The first or the second external axis, etc. (the eighth axis)



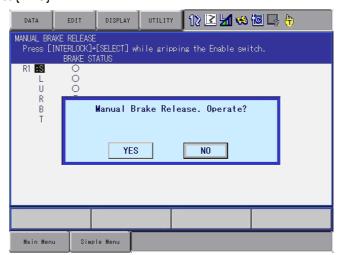
• Use great caution when manually releasing the brake because the brakes of up to 3 axes are released.

8.21.2 Manual Brake Release Procedure

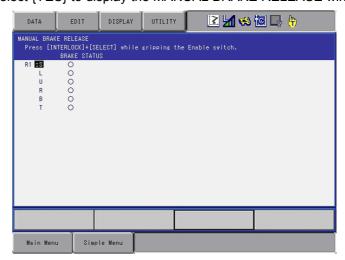
- 1. Select {ROBOT} under the main menu, then select the submenu {MANUAL BRAKE RELEASE}.
 - The submenu {MANUAL BRAKE RELEASE} is displayed under the main menu {ROBOT}.



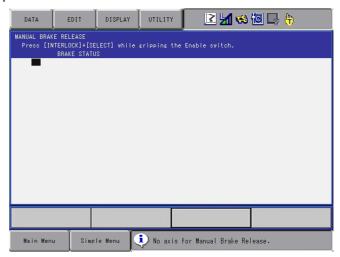
2. Select {YES}.



- When the manual brake release menu is selected, a warning message appears to prevent improper operation.
- Select {YES} to display the MANUAL BRAKE RELEASE window.



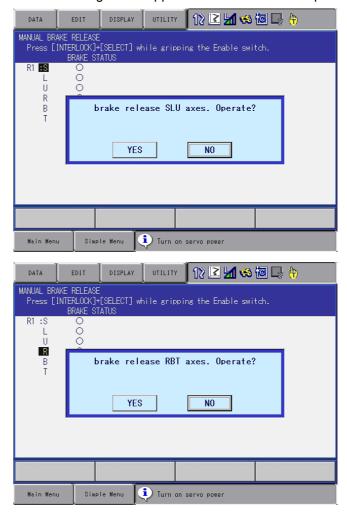
 If there is no axis whose brake can be released in such a case when the interlock connector is not connected, the following window appears.



 Select {NO} to display the following window. The same window is displayed if the interlock connector is removed while the MANUAL BRAKE RELEASE window is being displayed.



- 8.21 Manual Brake Release Function
- 3. Move the cursor to the axis whose brake is to be released. Then press the interlock key + [SELECT] while gripping the enable switch.
 - Since the brakes of multiple axes will be released if the S-, L-, or U-axis (the first, second, or third axis) or the R-, B-, or T-axis (the fourth, fifth, or sixth axes) is selected, one of the following confirmation dialog boxes appears. Proceed to the step 4.



 If the E-axis, the first external axis, or the second external axis (the seventh or eighth axis) is selected, the brake is released and the BRAKE STATUS is displayed.



BRAKE STATUS O: Brake locked ●:Brake released

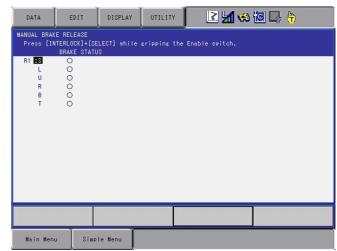
- The brake is locked with one of the following conditions:
- [SELECT] is released. (See the CAUTION box below.)
- The emergency stop button on the programming pendant, the FS100 (optional), or the external device is pressed.
- The enable switch is released, or gripped more tightly to press it further.
- The window is switched from the MANUAL BRAKE RELEASE window to another.
- The interlock connector is removed.



- The brake is released by pressing the interlock key + [SELECT] while gripping the enable switch. At this time, note that the brake remains released when only the interlock key is released.
- 4. Select {YES} in the selection dialog box.
 - Select {NO} or press [CANCEL] to close the confirmation dialog box without releasing the brake.

After that, press the interlock key + [SELECT] while gripping the enable switch to display the confirmation dialog box again. Proceed to the step 4.

When {YES} is selected, the brake is not released immediately. Do not move the cursor, and press the interlock key + [SELECT] while gripping the enable switch again to release the brakes of the 3 axes including the axis at which the cursor points.



BRAKE STATUS O: Brake locked ●:Brake released

- When the axis whose brake is to be released is changed by moving the cursor, proceed to the step 3.
- The brake is locked with one of the following conditions:
- [SELECT] is released. (See the CAUTION box below.)
- The emergency stop button on the programming pendant, the FS100 (optional), or the external device is pressed.
- The enable switch is released, or gripped more tightly to press it further.
- The window is switched from the MANUAL BRAKE RELEASE window to another.
- The interlock connector is removed.



The brake is released by pressing the interlock key + [SELECT] while gripping the enable switch. At this time, note that the brake remains released when only the interlock key is released.

8.21.3 Warning Message

If the manual brake release is performed under one of the following conditions, a warning message appears in the message area on the screen.

In this case, note that the brake cannot be released.

- The servo is turned ON.
- The emergency stop button on the programming pendant is pressed.
- The emergency stop button on the FS100 (optional) is pressed.
- The external emergency stop signal is incoming.
- The interlock connector is not connected.

9.1 System Backup with FS100

9 System Backup

For the FS100, the system data can be collectively backed up in advance so that the data can be immediately loaded and restored in case of an unexpected trouble such as data loss.

9.1 System Backup with FS100

For the FS100, four types of collective backup are available: CMOS.BIN, CMOSBK.BIN, ALCMSxx.HEX, and CMOSxx.HEX.

9.1.1 Function Types of Data

9.1.1.1 CMOS.BIN

For the normal backup, use this data.

Save: Perform in the maintenance mode (the editing mode or higher.)

Load: Perform in the maintenance mode (the management mode.)

As for the load/save procedures, refer to *chapter 9.2 "Backup by CMOS.BIN"* at page 9-3.

Target Area: All areas of the internally stored data.

9.1.1.2 CMOSBK.BIN

This data is used in the automatic backup function.

Save: Saves with the preset conditions in the normal mode.

Load: Perform for the system restoration in the maintenance mode (the management mode.)

For details, refer to chapter 9.3 "Automatic Backup Function" at page 9-9.

Target Area: All areas of the internally stored data.

9.1.1.3 CMOSxx.HEX

This data is loaded/saved in the FD/CF menu in the normal mode.

Save: Perform in the normal mode (the editing mode or higher.)

Load: Perform in the normal mode (the management mode.)

For details, refer to "FS100 OPERATOR'S MANUAL".

Target Area: The collected data including "Job File", "Data File", "Parameter File", "System Data", and "I/O Data" which can be individually loaded/saved in the FD/CF menu. Because the setting information of robot etc. are not included in this collected data, the system cannot be completely restored.

9.1.1.4 ALCMSxx.HEX

This data is for the manufacturer only. Users can save but cannot load this data.

9.1 System Backup with FS100

9.1.2 Device

For the backup of the FS100 system, a CompactFlash card or a USB memory stick can be used.

(For the automatic backup function, USB memory cannot be used.)

The following tables show the recommended CompactFlash and USB memory.

<Recommended CompactFlash>

No.	Manufacturer	Model	Remarks
1	Hagiwara Solutions Co., Ltd.	MCF10P-256MS	256MB
2	Hagiwara Solutions Co., Ltd.	MCF10P-512MS	512MB
3	Hagiwara Solutions Co., Ltd.	MCF10P-A01GS	1GB
4	Hagiwara Solutions Co., Ltd.	MCF10P-A02GS	2GB

< Recommended USB Memory>

No.	Manufacturer	Model	Remarks
1	Hagiwara Solutions Co., Ltd.	UDG4-*GDRJ	* denotes the capacity: 1GB, 2GB, 4GB

In order to save the batch data, 8 MBytes per file is needed in the medium.

Note that the free space for one working file is needed in addition to the free space for the stored files when using the automatic backup function.

Also, it is recommended to store the backup data in two or more media to minimize problems if the medium is damaged.

The water-proof function of the programming pendant is not effective while a USB memory stick is connected to the programming pendant.



Also, if a USB memory stick is connected constantly, it may drop off.

Use a CompactFlash card instead if there is no means to maintain the water-proof function or to prevent a USB memory stick from dropping off.

To use a USB memory stick, connect it to the USB device of the main CPU board. 9 System BackupFS100 9.2 Backup by CMOS.BIN

9.2 Backup by CMOS.BIN

Perform the backup by CMOS.BIN in the maintenance mode.

The chart below shows the availability of CMOS save and CMOS load in each security mode in the maintenance mode.

Security	CMOS Save	CMOS Load	
Operation Mode	Not available	Not available	
Editing Mode	Available	Not available	
Management Mode	Available	Available	
Yaskawa Mode	Available	Available	

FS100

9.2 Backup by CMOS.BIN

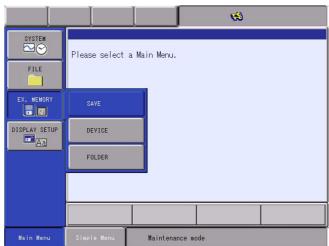
9.2.1 CMOS.BIN Save

Follow the procedures below to save CMOS.BIN.

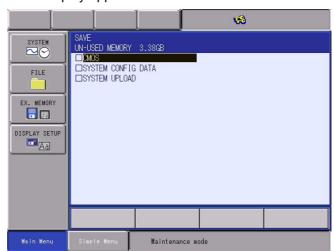
- 1. While pressing the main menu key , turn ON the FS100 power supply.
- 2. Insert a CompactFlash card into the CompactFlash slot on the programming pendant.
 - When using USB memory instead of CompactFlash, mount a USB memory stick to the programming pendant, select {DEVICE}, then select "USB: PENDANT".

To connect a USB memory stick to the USB device of the main CPU board, mount a USB memory stick to the USB device, select {DEVICE}, then select "USB: CONTROLLER".

- 3. Select {EX. MEMORY} under the main menu.
 - The sub menu appears.



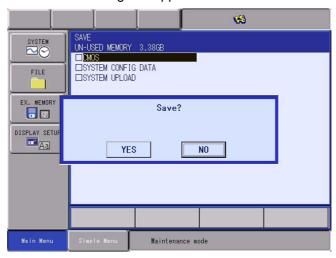
- 4. Select {SAVE}.
 - The save display appears.



The items marked with "■" cannot be selected.

FS100

- 9.2 Backup by CMOS.BIN
- 5. Select (CMOS).
 - The confirmation dialog box appears.



- 6. Select {YES}.
 - Select {YES} to save the CMOS data into a CompactFlash card.
 - When saving the file, if the CMOS.BIN file already exists in the CompactFlash card, the following confirmation dialog box appears.



7. Select {YES}.

- The CMOS.BIN file is overwritten in the CompactFlash card.

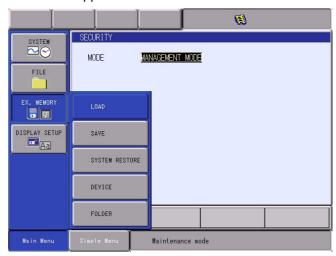
FS100

9.2 Backup by CMOS.BIN

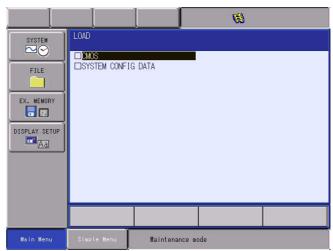
9.2.2 CMOS.BIN Load

Follow the procedures below to load CMOS.BIN.

- 1. While pressing the main menu key , turn ON the FS100 power supply.
- 2. Change the security mode to the maintenance mode.
- 3. Insert a CompactFlash card into the CompactFlash slot on the programming pendant.
 - When using USB memory instead of CompactFlash, mount a USB memory stick to the programming pendant, select {DEVICE}, then select "USB: PENDANT".
 - To connect a USB memory stick to the USB device of the main CPU board, mount a USB memory stick to the USB device, select {DEVICE}, then select "USB: CONTROLLER".
- 4. Select {EX. MEMORY} under the main menu.
 - The sub menu appears.



- 5. Select {LOAD}.
 - The load display appears.



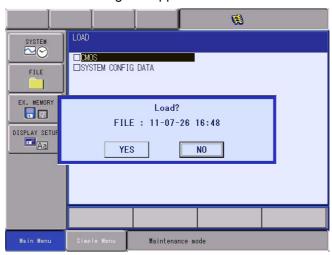
The items marked with "■" cannot be selected.

FS100

9.2 Backup by CMOS.BIN

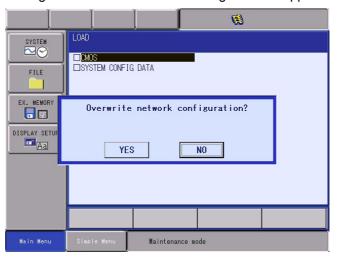
6. Select (CMOS).

- The confirmation dialog box appears.



7. Select {YES}.

- The dialog box "Overwrite network configuration?" appears.



8. Select {YES} or {NO}.

- If {YES} is selected, the network configuration in the controller is overwritten and the contents of the loaded "CMOS.BIN" file are reflected to the CMOS in the controller.
- If {NO} is selected, the network configuration in the controller is not updated and the other data are reflected to the CMOS in the controller.

9.2 Backup by CMOS.BIN



CAUTION

When the "CMOS load" is performed, the current CMOS data is replaced with the CMOS data (the contents of "CMOS.BIN") in the selected device. Therefore, before performing the load, make sure to perform the "CMOS Save" of the CMOS data to be loaded.

After the "CMOS load", check if the contents written in the FS100 are the same as before, and check to be sure that safety is confirmed with the current manipulator position. After that, start the manipulator's operation.



CAUTION

When the network configuration is updated, the IP address in the controller is also updated. After the update, the settings of IP address and subnet mask are changed, which may make it impossible to communicate with the programming pendant or computer. Make sure to record the network configuration of the programming pendant, computer, etc. in advance.

9.3 Automatic Backup Function

9.3.1 Automatic Backup Function

9.3.1.1 Objective

With the automatic backup function, the data saved in the FS100 such as system setting or operational condition are collectively backed up in the specified device.

In case of an unexpected trouble such as data loss, the backup data saved in the CompactFlash card by the automatic backup function can be loaded to the FS100 memory to restore the file data.



The automatic backup function is enabled only while the FS100 power supply is ON whereas it isn't while in the maintenance mode or the power supply is OFF.

9.3.1.2 Outline

The automatic backup function saves the internally stored data in a single file in advance for the smooth restoration from unexpected troubles of the FS100.

The teaching operation is one of the factors that changes the internally stored data. Thus, a mode which backs up the latest data after the teaching operation is prepared. To confirm the termination of the teaching operation, check the mode key whether it is changed from teach mode to play mode.

Other than the teaching operation, the present position of the robot or the value of a variable can be pointed out as the factors to change the internally stored data. These data, however, are changed after each operation and have very little need to be retained permanently. Accordingly, backing up these data at regular interval should be well enough to operate and the mode to back up the data at regular interval is also prepared.

Furthermore, the mode to back up the data when starting up the FS100 and when inputting signals are also available for some specific versions.

With the automatic backup function, all the part where the internal data is stored in the physical memory area is collectively saved. If there is any data which is in the middle of changing while executing the automatic backup function, the data might not be usable for restoration because of its inconsistency. Therefore, the function is terminated with an error during the play back operation or while the manipulator is in motion so that the automatic backup cannot be operated. Set the automatic backup function to be executed while the manipulator is not in the playback status and while the manipulator is stopped.

System Backup Automatic Backup Function 9.3

The automatic backup function has the following functions and features.

No.	Function/Feature	Explanation
1	Cyclic backup In the teach mode, the data in memory is backed up in a specified cycle from a specified starting time.	This function backs up as much of the latest data as possible during editing. The backup data saved in the CompactFlash card can be loaded to the FS100 in case of data loss so that the damage can be minimized.
2	Backup when switching modes When switching the mode from the teach mode to the play mode, the data in memory is backed up.	The editing data is backed up when editing is completed. The latest data is automatically backed up with this mode.
3	Backup when start-up When the FS100 starts up, the data in memory is backed up.	When the FS100 starts up, the data in memory is backed up. Since the editing/playback operation is usually completed when the FS100 power is turned OFF, the latest data is automatically backed up with this mode.
4	Backup when inputting specified signals The data in memory is backed up when a specified signal (#40560) is input.	The data in memory is backed up by the signal from the host at the intended timing. Although the above mentioned items 1 to 3 are designed to back up the data automatically, this function backs up the data in accordance with the instruction from the host.
5	Backup while robot program is stopped The backup during playback is disabled. However, in the play mode, the backup is enabled if the robot is stopped. ("Cyclic backup" and "Backup when inputting specified signals")	Backs up the variables for essential data.
6	Backup and retry at low priority The data in memory is backed up at low priority so that this operation does not affect the other operations. When other operations affect the backup operation, the backup is suspended and retried later.	The backup operation hardly affects the other operations so that the programming pendant can be used even during the backup operation.
7	Backup in binary The data is saved as binary data. The range is same as that of the "ALL CMOS AREA" in {FD/CF}, but the data type is different.	Backup in binary allows the system to be easily and speedily restored.
8	Setting of items Parameters can limit the settings of the backup condition.	Unnecessary settings can be avoided with this setting.

9.3.2 Settings for Automatic Backup

To set the automatic backup function, insert a CompactFlash card into the CompactFlash slot on the programming pendant or connect a USB memory stick to the USB device of the main CPU board, then set each item on the AUTO BACKUP SET display.



Four ways to perform the automatic backup are available: "Cyclic backup", "Backup when switching modes", "Backup when start-up", and "Backup when inputting specified signals".

The automatic backup can be performed only when the robot is not during playback and the robot is stopped.

To use the automatic backup function, insert a CompactFlash card into the CompactFlash slot on the programming pendant or insert a USB memory stick into *chapter 9.3.2.2 "USB Device of Main CPU Board*".

9.3.2.1 CompactFlash

When the data could not be saved in a CompactFlash card during an automatic backup due to the absence or insufficient capacity of the CompactFlash card, an error message "Cannot backup the media" appears.

(At the same time, the signal "occurrence of error" is output, but the robot program will not stop.)

Check if the CompactFlash card is inserted and if it has enough capacity, and take the necessary measures.

Yaskawa recommends that the data be saved in two or more CompactFlash cards to minimize problems if the CompactFlash card is damaged.

Regarding CompactFlash card, refer to <Recommended CompactFlash> in *chapter 9.1.2 "Device" at page 9-2.*

Storage capacity needed for the CompactFlash card is as follows: (The number of stored files + 1) X 8 MByte

The number of storable files is automatically calculated and the MAX value is shown when AUTO BACKUP SET display appears.

9.3.2.2 USB Device of Main CPU Board

When the data could not be saved in a USB memory stick during an automatic backup due to the absence or insufficient capacity of the USB memory stick, an error message "Cannot backup the media" appears. (At the same time, the signal "occurrence of error" is output, but the robot program will not stop.)

Check if the USB memory stick is inserted and if it has enough capacity, and take the necessary measures.

Yaskawa recommends that the data be saved in two or more USB memory sticks to minimize problems if the USB memory stick is damaged. Regarding USB memory stick, refer to < Recommended USB Memory> in chapter 9.1.2 "Device" at page 9-2.

Storage capacity needed for the USB memory stick is as follows: (The number of stored files + 1) X 8 MByte

The number of storable files is automatically calculated and the maximum number is shown when AUTO BACKUP SET display appears.

9.3.2.3 AUTO BACKUP SET Display

Settings

Select the following items on the AUTO BACKUP SET display and set values for the automatic backup.

- RESERVE TIME BACKUP (VALID/INVALID of the cyclic backup)
- BASE TIME
- BACKUP CYCLE
- RETRY CYCLE
- MODE CHANGE BACKUP (VALID/INVALID of the backup when switching the mode from teach mode to play mode)
- STARTUP AUTO BACKUP (VALID/INVALID of the backup when the FS100 starts up)
- SPECIFIC INPUT BACKUP (VALID/INVALID of the backup when inputting specified signals)
- UNIV.OUT NO. ON ERROR
- DISPLAY AT EMERGENCY
- DURING ALARM OCCURENCE
- STORED FILE SETTING
- DEVICE

 With the version in which "STORED FILE SETTING" is settable, the capacity of a CompactFlash card inserted into the programming pendant is checked when the setting window appears. Therefore, a few seconds may be needed to open the setting window and an error may occur if no CompactFlash card is inserted.

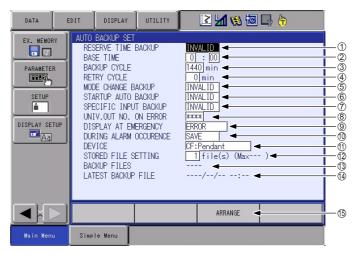


 When changing the settings of "STORED FILE SETTING" or executing "ARRANGE", the files "CMOSBK.BIN" and "CMOSBK??.BIN" (? is a number) in the CompactFlash card are changed in name or deleted. If a certain file of this type is needed to be saved before changed in name or deleted, evacuate it into a PC, etc. beforehand.



Each item's setting cannot be changed in the AUTO BACKUP SET display during alarm occurrence.

- 9.3 Automatic Backup Function
- 1. Turn ON the FS100.
 - If the auto backup function is already set valid, insert a CompactFlash card.
- 2. Insert a CompactFlash card into the CompactFlash slot on the programming pendant.
- 3. Change the security mode to the management mode.
- 4. Select {SETUP} under the main menu.
- 5. Select (AUTO BACKUP SET).
 - The AUTO BACKUP SET display appears.



(1) RESERVE TIME BACKUP

Sets the backup function to valid or invalid in a specified cycle from a specified starting time.

Press [SELECT] to alternate between "INVALID" and "VALID".

The reserve time can be set by inputting values in (2), (3), and (4) in the display.

Every time values are set to these three items, reset the RESERVE TIME BACKUP to VALID.

If these settings are incorrect, the RESERVE TIME BACKUP cannot be reset to VALID.

If so, check and then change the values to the correct settings.

(2) BASE TIME

Specifies the reference time to start reserve time backup.

The time elapsed from the reference time for a BACKUP CYCLE period is recognized as the BACKUP TIME.

The first automatic backup is performed at the first BACKUP TIME after the power of the FS100 is turned ON.

The automatic backup after the first time, is performed at the interval of BACKUP CYCLES.

The reference time ranges from 0:00 to 23:59.

(3) BACKUP CYCLE

Specifies the length of time for a cycle to back up.

After the first backup, the next backup is performed automatically in the time specified in the BACKUP CYCLE.

Set the backup cycle in minutes. The cycle setting ranges from 10 to 9999 minutes, and is longer than the RETRY CYCLE.

(4) RETRY CYCLE

Specifies the length of time for a cycle to retry backing up when the backup operation is suspended.

After being suspended, the backup is retried in the time specified in the RETRY CYCLE.

Set the retry cycle in minutes. The cycle setting ranges from 0 to 255, and is shorter than the BACKUP CYCLE.

When it is set to 0, retry will not be performed.

(5) MODE CHANGE BACKUP

Sets the automatic backup function to be valid or invalid when the mode is switched from teach mode to play mode.

Press [SELECT] to alternate between "INVALID" and "VALID".

(6) STARTUP AUTO BACKUP

Sets the backup function to be valid or invalid when the power of the FS100 is turned ON.

Press [SELECT] to alternate between "INVALID" and "VALID".

(7) SPECIFIC INPUT BACKUP

Sets the backup function to be valid or invalid when specific input signal (# 40560) is input (rising edge from 0 to 1).

Press [SELECT] to alternate between "INVALID" and "VALID".

8 UNIV.OUT NO. ON ERROR

Outputs "1" to the specified user output signal which was specified in this chapter when the automatic backup error occurs.

The term "automatic backup error" here means that the backup is not performed successfully before the next backup (including retry operation) starts.

(9) DISPLAY AT EMERGENCY

Sets the method of notification of the automatic backup error to "ERROR" or "MESSAGE".

Press [SELECT] to alternate between "ERROR" and "MESSAGE".

10 DURING ALARM OCCURENCE

Sets the backup function to be valid or invalid when an alarm occurs. Press [SELECT] to alternate between "INVALID" and "VALID".

(11) DEVICE

Specifies the device to store data.

Press [SELECT] to specify the device.

When the device is set to "CF: PENDANT", the automatic backup is performed only if communication is established between the programming pendant and the FS100, and one of the four settings (RESERVE TIME BACKUP, MODE CHANGE BACKUP, STARTUP AUTO BACKUP, and SPECIFIC INPUT BACKUP) in the AUTO BACKUP SET display is set to "VALID".

(12) STORED FILE SETTING

Sets the number of files to be stored by the automatic backup function. The number mentioned on the right side of this item with "(Max)" indication is the maximum number of files (up to 100) that can be stored in the CompactFlash card inserted when this window is displayed.

The settings range from 1 to (Max). When this setting value is changed, the backup file arrangement starts.

13 BACKUP FILES

Indicates the existence of the files or the number of backup files stored in the CompactFlash card inserted when this window is displayed.

(14) LATEST BACKUP FILE

Indicates the date of the latest file in the CompactFlash card inserted when this window is displayed.

(15) ARRANGE

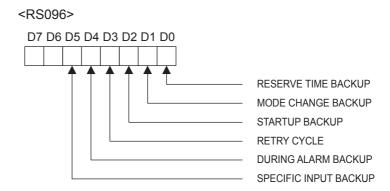
When the setting of maximum number of stored files is changed, the file arrangement of the backup files in the CompactFlash card is executed. With this operation, the file arrangement can be performed without changing the maximum number of stored files.

6. Set the desired item, and press [ENTER].

Window setting restrictions

RS parameter can restrict the settings of some items in the automatic backup window.

When setting the bit of RS096 parameter shown below to "1", the corresponding items are restricted. The restricted items are indicated with "INVALID" in the display and input and modification to the item become impossible. Also, the automatic backup does not function with the restricted items.



9.3.2.4 FS100 Status and Automatic Backup

Backup Timing	Backup Timing FS100 Status		Automatic Backup	
			Compact Flash ready to save the data	Absence or insufficient capacity of the CompactFlash
From a specified starting time	Teach mode	Editing (Accessing to the memory)	Retry	Retry
		When editing is interrupted	Backup	Error
	Play mode Remote mode	Executing jobs	Disabled	Disabled
		When stopped	Backup	Error
When a specified signal (#40560) is	Teach mode	Editing (Accessing to the memory)	Error	Error
input		When editing is interrupted	Backup	Error
	Play mode Remote mode	Executing jobs	Disabled	Disabled
		When stopped	Backup	Error
When switching the mode from the teach mode to the play mode	-		Backup	Error
When the FS100 starts up	-		Backup	Error

^{*} Retry is not performed when an error occurs.

Reserve time backup

While the data in the FS100 memory is being edited or overwritten, the automatic backup is not performed at the specified backup starting time and is suspended and retried later. To start the backup at the reserved time, set to the time when the robot program is stopped and no job or file is edited.

■ Backup when switching from teach mode to play mode

When the mode is repeatedly switched from the teach mode to the play mode or vice versa within 1 to 2 seconds, backup starts after the last time the mode is switched.

■ Backup when FS100 starts up

Since the automatic backup process is added to the FS100 start-up process, a few extra seconds are needed to start up the FS100.

^{*} An error can be indicated by a message depending on setting.

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9 System Backup

9.3 Automatic Backup Function

Backup when specific signal is input

While the FS100 memory is edited such as overwriting, the backup operation becomes an error even if there is an input to a specific signal (#40560). To start the specific input backup, perform it while the robot program is stopped and a job or file is not being modified.

Also, since the signal input is executed at rising detection, turn the signal to "0" if it is already "1", then return to "1" again.

Overwriting limit in CompactFlash

The number of times to overwrite the CompactFlash card is limited. Because frequent backup operations may shorten the life of CompactFlash card, minimize the number of backup times.

■ Overwriting limit in USB memory

The number of times to overwrite the USB memory stick is limited. Because frequent backup operations may shorten the life of USB memory stick, minimize the number of backup times.

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9.3 Automatic Backup Function

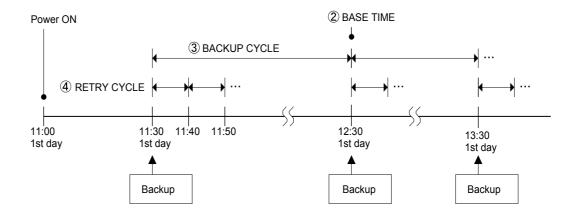
9.3.2.5 Setting Examples

■ Setting Example 1

The following diagram shows a setting example with the following conditions:

BASE TIME: 12:30

BACKUP CYCLE: 60 (minutes)
RETRY CYCLE: 10 (minutes)



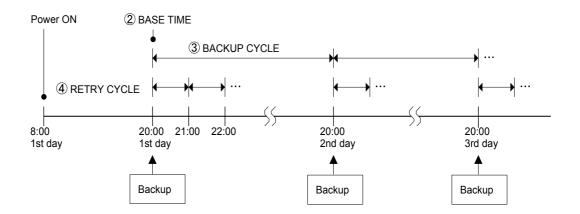
Setting Example 2

The following diagram shows a setting example with the following conditions:

BASE TIME: 20:00

BACKUP CYCLE: 1440 (minutes) (24 hours)

RETRY CYCLE: 60 (minutes)





While a job is being executed, the automatic backup or retry is not performed. Also, after an error occurs in writing into the selected device, the retry is not performed until the next backup starting time.

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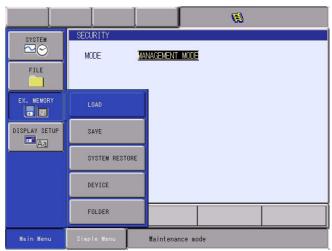
9.4 Restoring Backup Data

9.4 Restoring Backup Data

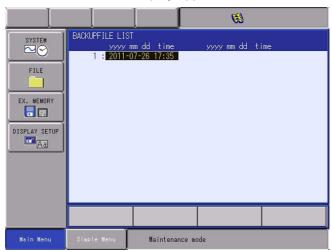
Restore the backup data saved in the CompactFlash card to the FS100 in the maintenance mode.

9.4.1 Restoring Procedure

- 1. Insert the CompactFlash card with the backup data into the CompactFlash slot on the programming pendant.
 - The backup data is stored under the file name "CMOSBK.BIN" or "CMOSBK??.BIN" (? is a number).
- 2. While pressing the main menu key , turn ON the FS100 power supply.
- 3. Change the security mode to the management mode.
- 4. Select {EX. MEMORY} under the main menu.
 - The sub menu appears.



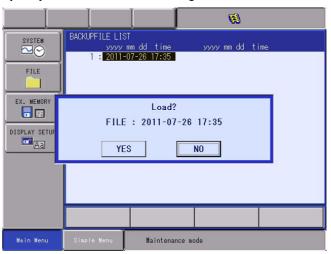
- 5. Select {SYSTEM RESORE}.
 - The SYSTEM RESTORE display appears.
- 6. Select {SYSTEM RESTORE}.
 - The BACKUP FILE LIST display appears.



- 9.4 Restoring Backup Data
- 7. Select the file to be loaded.
 - The confirmation dialog box "Initialize monitoring time?" appears.



- Select {YES} to initialize the system monitoring time.
 Select {NO} to continue counting the current system's monitoring time.
- 8. Select {YES} in the confirmation dialog box.



 The confirmation dialog box "Overwrite network configuration?" appears.



9.4 Restoring Backup Data

9. Select {YES}.

- The network configuration set in the FS100 is overwritten, and the loaded contents of "CMOS.BIN" or "CMOSBK??.BIN" (? is a number) are loaded.
- When the load of "CMOSBK.BIN" or "CMOSBK??.BIN" (? is a number) starts, the message "Loading system data. Don't turn the power off." appears.





When "SYSTEM RESTORE" is performed, the internally stored data in the FS100 is replaced with the contents of "CMOSBK.BIN" or "CMOSBK??.BIN" (? is a number).

Give due consideration to it before performing "SYSTEM RESTORE".

After "SYSTEM RESTORE", check if the contents written in the FS100 are the same as before, and check to be sure that safety is confirmed with the current manipulator position. After that, start the manipulator's operation.

9.5 Error List

9.5.1 Error Contents

Error No.	Data	Message	Cause
0770	*	The robot or the station is in motion.	The automatic backup would not work when the robot or a manipulator is in motion.
3390		File not found	The file to be loaded no longer exists.
3460	*	Check storage medium	
	1		Insufficient capacity of the storage medium. Check the medium.
	2		Cannot access to the storage medium. Check the medium.
3501	*	Cannot backup to medium	Cannot access to the storage medium. Check the medium.
3550	*	The automatic backup is executed. Try it later.	The automatic backup window cannot be called to display while the automatic backup is being processed.
3551	*	The automatic backup is executed. Arrange the file after it is finished.	The file arrangement cannot be operated during the automatic backup operation.
3560	*	Failed to re-arrange the backup file.	Failed to re-arrange the backup file in the storage medium for a reason other than access.
3580	*	Accessing to backup file. Try it later.	To display another window and then display the automatic backup window again after "ARRANGE" operation, "ARRANGE" process must be completely finished.
3581	*	Accessing to backup file. Try "ARRANGE" operation later.	The previous "ARRANGE" process must be completely finished to perform the next "ARRANGE" operation.

9.6 Restoring FS100 Controller

Acquire the FS100 system program and the FS100 batch data (file name: CMOS.BIN) in advance by following the procedures below.

This enables rapid and easy restoration of the system in case of system failure.

9.6.1 Data Backup and Program Upload

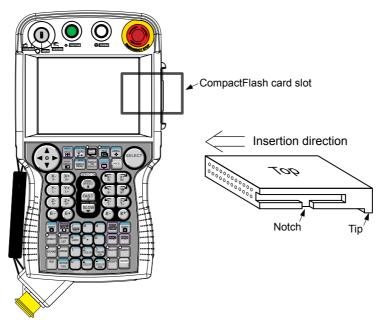
By the program upload function of the FS100, the FS100 system program can be saved in the CompactFlash card or USB memory stick inserted into the programming pendant, or the USB memory stick inserted into the main CPU board.

9.6.1.1 Backup Medium Preparation

For saving the FS100 system program, supply a CompactFlash card or a USB memory stick with free space of 50 MB or more, and follow the procedure below.

- 1. Connect the prepared device (CompactFlash card or USB memory stick) to the PC.
- 2. Delete all data in the device by using Windows Explorer, etc.
- 3. Remove the device from the PC, then insert it into the programming pendant or the main CPU board.

Fig. 9-1: Inserting CompactFlash Card into Programming Pendant

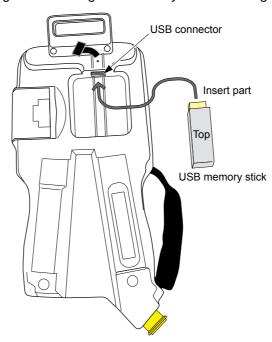


Make sure to insert a CompactFlash card to the correct direction. Make the programming pendant face up, and make the center notches of both sides and the tip of the CompactFlash card face down, then insert it slowly.

If the CompactFlash card is inserted forcibly, the card or the CF card slot may be damaged.

After inserting the card into the slot, make sure to close the cover of the slot before use.

Fig. 9-2: Inserting USB Memory Stick into Programming Pendant

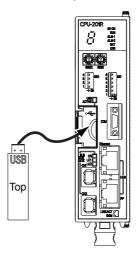


Make sure to insert a USB memory stick to the correct direction. Make the programming pendant face down, and make the top of the USB memory stick face up and make the connector point upward, then insert it slowly.

If the USB memory stick is inserted forcibly, the stick or the USB connector may be damaged.

After removing the stick from the connector, make sure to close the cover of the connector before use.

Fig. 9-3: Inserting USB Memory Stick into Main CPU Board



Make sure to insert a USB memory stick to the correct direction.

Make the top of the USB memory stick face to the left, then insert it slowly.

If the USB memory stick is inserted forcibly, the stick or the USB connector may be damaged.

After removing the stick from the connector, make sure to close the cover of the connector before use.

9 System Backup FS100

Restoring FS100 Controller 9.6

File system of device

Use an FAT 16 or FAT 32 formatted USB memory stick.

Precautions for handling device

- Do not subject the device to excessive force or shock by dropping it, bending it, etc.
- Do not subject it to water, oil, organic solvent, dust, or soot.
- Do not use or store it in a location where excessive static electricity or electrical noise is present.
- During data writing or reading, do not remove or insert the device and do not turn the power OFF.
- Backup the data regularly to another medium for data protection. This can minimize the impact of data damage or loss in case of improper operation or accident.

Recommended device

It is recommenced to use the CompactFlash cards or USB memory sticks listed in chapter 9.1.2 "Device" at page 9-2.

9 System Backup

FS100

9.6 Restoring FS100 Controller

9.6.1.2 Data Backup

Backup the FS100 batch data (file name: CMOS.BIN) by following the procedure below.

When using the programming pendant, perform the steps 1 to 6, and when not using the programming pendant, perform the steps 7 to 9.

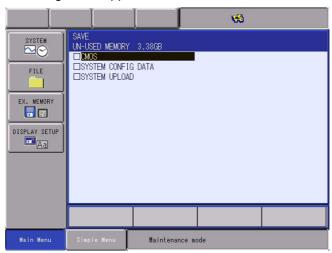
- 1. While pressing the main menu key , turn ON the FS100 power supply.
 - The maintenance mode starts.
- 2. Select {DEVICE}.
 - Select the device to save data.



- 3. Select {EX. MEMORY} under the main menu.
 - The sub menu appears.



- 4. Select {SAVE}.
 - The following menu appears.



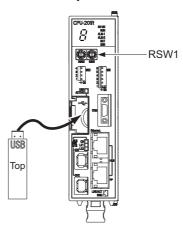
- 5. Select (CMOS).
 - A confirmation dialog box appears.



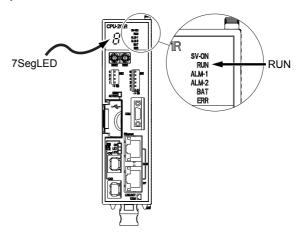
- 6. Select {YES}.
 - CMOS save starts.
 - The process is completed when the message "Saving system data.
 Don't turn the power off." at the human interface display area disappears.



- 9.6 Restoring FS100 Controller
- 7. Open the door of the FS100 controller. Turn the RSW1 of the main CPU board from "0" to "E" by using a precision screwdriver (flathead, 2 mm), and insert a USB memory stick into the main CPU board.



- 8. Turn ON the FS100 power supply.
 - CMOS save starts.
 - While saving data, "J" lights up on the 7SegLED of the main CPU board, and the LED of RUN blinks.
 - When data save is finished, the LED of RUN of the main CPU board lights up.





- If CMOS data exists in the root directory of the USB memory stick, it will be forcibly overwritten.
- Do not remove the USB memory stick while saving data.
 Failure of the stick may result if it is removed while saving data.
- 9. After data save is finished, turn OFF the FS100 power supply.
 - Turn the RSW1 of the main CPU board from "E" to "0".
 - Remove the USB memory stick.

9 System Backup

FS100

9.6 Restoring FS100 Controller

9.6.1.3 Program Upload

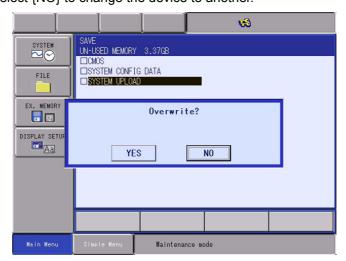
After finishing data backup, subsequently upload the program.

When using the programming pendant, perform the steps 1 to 8, and when not using the programming pendant, perform the steps 9 to 11.

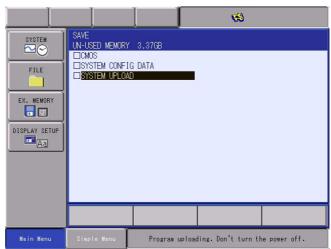
- 1. While pressing the main menu key , turn ON the FS100 power supply.
 - The maintenance mode starts.
- 2. Select {DEVICE}.
 - Select the device to save the system program.
- 3. Select {EX. MEMORY} under the main menu.
 - The sub menu appears.
- 4. Select {SAVE}.
- 5. Select {SYSTEM UPLOAD}.
 - A confirmation dialog box appears.



- 6. Select {YES}.
 - The confirmation dialog box "Overwrite?" appears.
 Select {YES} to overwrite.
 Select {NO} to change the device to another.



- 7. Select {YES}.
 - Program upload starts.
 - The process is completed when the message "Program uploading. Don't turn the power off." at the human interface display area disappears.



- 8. Turn OFF the FS100 power supply, and remove the device.
 - For restoration, make sure to store the device to which the FS100 batch data (file name: CMOS.BIN) is backed up and the program is uploaded by following the procedures above.
 When a job is created, added, or modified, or a parameter, etc. is changed, perform chapter 9.6.1.2 "Data Backup" at page 9-26.
 When the system software is upgraded, perform chapter 9.6.1.3 "Program Upload" at page 9-29.

<Procedure without using the programming pendant>

- 9. Open the door of the FS100 controller. Turn the RSW1 of the main CPU board from "0" to "F" by using a precision screwdriver (flathead, 2 mm), and insert a USB memory stick into the main CPU board.
- 10. Turn ON the FS100 power supply.
 - Program upload starts.
 - While uploading the program, "u (lowercase)" lights up on the 7SegLED of the main CPU board, and the LED of RUN blinks.
 - When program upload is finished, the LED of RUN of the main CPU board lights up.
- 11. After program upload is finished, turn OFF the FS100 power supply.
 - Turn the RSW1 of the main CPU board from "F" to "0".
 - Remove the USB memory stick from the main CPU board.



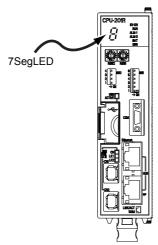
- The root folder of the USB memory stick is forcibly overwritten.
- Do not remove the USB memory stick while uploading the program.
 Failure of the stick may result if it is removed while uploading the program.

9.6.2 Restoration Procedure

Check whether the replacement of the main CPU board is necessary. If the replacement is necessary, follow the procedure below to restore the FS100.

Failure of the FS100 is suspected when

- The 7SegLED of the main CPU board does not light up after turning ON the FS100 power supply.
- The 7SegLED of the main CPU board fully lights up after turning ON the FS100 power supply, but it does not count up after that.
- After turning ON the FS100 power supply, the programming pendant keeps showing the startup window (showing the robot) for more than one minute, and the 7SegLED of the main CPU board stays turned off or fully lit up.



 After turning ON the FS100 power supply, an error described in chapter 9.7 "Error Indication" at page 9-35 occurs, and the error occurs again even after a retry.



 After the main CPU board is replaced, it is impossible to operate the manipulator normally before writing the system program, and loading the batch file or performing initialization in the maintenance mode.

Give due consideration to it before replacing the main CPU board.



The restoration cannot be performed by using the optional software pendant (PC version).

Make sure to use the programming pendant.

9.6.2.1 Preparation of Programming Pendant

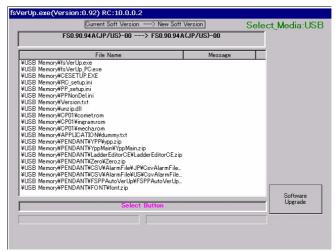
For the FS100 in which a dummy connector inserted, prepare the programming pendant.

9.6.2.2 Preparation of Device for Writing System Program

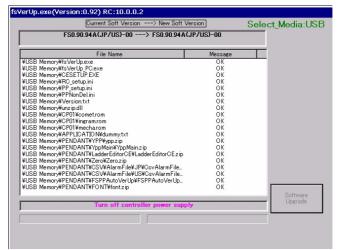
Insert the device used in *chapter 9.6.1 "Data Backup and Program Upload" at page 9-23* into the programming pendant.

9.6.2.3 Writing System Program

- 1. While pressing the interlock key + [8] + [SELECT], turn ON the FS100 power supply.
 - The upgrading tool starts.



- 2. Select {Software Upgrade}.
 - Upgrade starts.
 - The upgrade is completed when the message "Turn off controller power supply" appears at the bottom of the screen.



9 System Backup

FS100

9.6 Restoring FS100 Controller

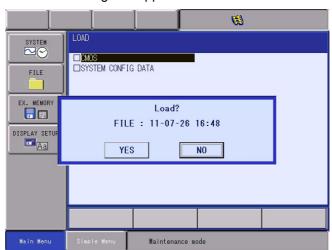
9.6.2.4 Writing Backup Data

Write the data by following the procedure below.

- 1. While pressing the main menu key , turn ON the FS100 power supply.
 - The maintenance mode starts.
- 2. Change the security mode to the management mode.
- 3. Select {EX. MEMORY} under the main menu.
 - The sub menu appears.
- 4. Select {LOAD}.
 - The LOAD window appears.

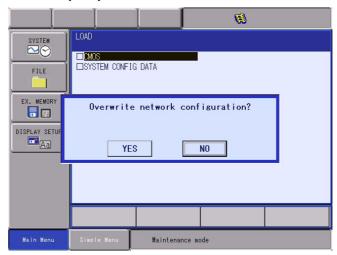


- 5. Select (CMOS).
 - A confirmation dialog box appears.



6. Select {YES}.

 The confirmation dialog box "Overwrite network configuration?" appears. If this step is performed after replacing the main CPU board, select {YES}.



7. Select {YES}.

- Load starts, and the data inside FS100 is updated.
- The loading process is completed when the message "Loading system data. Don't turn the power off." at the human interface display area disappears.

Turn the FS100 power supply OFF then back ON to start it normally.

9.7 Error Indication

9.7 Error Indication

If an error number is indicated on the 7SegLED of the main CPU board, check the error content and correct the error. The error number is repeatedly indicated.

<Example of repeated indication>

The indication repeats every second in the order of $[\Box] \rightarrow [0] \rightarrow [0] \rightarrow [0] \rightarrow [0]$

- □: The alphabet ("J", "L", "u", or "b") of the selected function is indicated.
 - J: System batch data save process
 - L: Language file load/save process
 - u: Program upload process
 - b: Boot program executing process

7SegLED indication	Error content and countermeasure
□ 0001.	No USB memory stick. Insert a USB memory stick, and retry.
□ 0010.	The RC_SETUP.INI file needed for upgrading does not exist. Retry according to <i>chapter 9.6 "Restoring FS100 Controller"</i> at page 9-23. If the error occurs again, replace the USB memory stick, then retry according to <i>chapter 9.6 "Restoring FS100 Controller"</i> at page 9-23.
□ 0011.	The file needed for upgrading does not exist. Retry according to chapter 9.6 "Restoring FS100 Controller" at page 9-23. If the error occurs again, replace the USB memory stick, then retry according to chapter 9.6 "Restoring FS100 Controller" at page 9-23.
□ 0012.	The system file does not exist. Retry according to chapter 9.6 "Restoring FS100 Controller" at page 9-23. If the error occurs again, replace the USB memory stick, then retry according to chapter 9.6 "Restoring FS100 Controller" at page 9-23.
□ 0013.	The language file does not exist. Copy the language file to the USB memory stick, then retry.
□ 0020.	CRC error occurred. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.
□ 0021.	Expanded in memory, but verification error occurred. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.
□ 0022.	Writing failed because the maximum writing size was exceeded. Replace the USB memory stick to a new one, or delete files in it.
□ 0024.	The USB memory stick does not have enough free space. Replace the USB memory stick to a new one, or delete files in it.
□ 0030.	Failed to ERASE or format the Flash Rom. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.

9.7

7SegLED indication	Error content and countermeasure
□ 0041.	File open error occurred in a file stored in the USB memory stick. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the USB memory stick, then retry according to <i>chapter 9.6 "Restoring FS100 Controller"</i> at page 9-23.
□ 0042.	File read error occurred in a file stored in the USB memory stick. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the USB memory stick, then retry according to <i>chapter 9.6 "Restoring FS100 Controller"</i> at page 9-23.
□ 0043.	File write error occurred in a file stored in the USB memory stick. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the USB memory stick, then retry according to <i>chapter 9.6 "Restoring FS100 Controller"</i> at page 9-23.
□ 0044.	File close error occurred in a file stored in the USB memory stick. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the USB memory stick, then retry according to chapter 9.6 "Restoring FS100 Controller" at page 9-23.
□ 0045.	File creation failed in a file stored in the USB memory stick. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the USB memory stick, then retry according to <i>chapter 9.6 "Restoring FS100 Controller"</i> at page 9-23.
□ 0046.	File directory creation failed in a file stored in the USB memory stick. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the USB memory stick, then retry according to <i>chapter 9.6 "Restoring FS100 Controller"</i> at page 9-23.
□ 0047.	File directory deletion failed in a file stored in the USB memory stick. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the USB memory stick, then retry according to <i>chapter 9.6 "Restoring FS100 Controller" at page 9-23.</i>
□ 0048.	File deletion failed in a file stored in the USB memory stick. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the USB memory stick, then retry according to <i>chapter 9.6 "Restoring FS100 Controller"</i> at page 9-23.
□ 0049.	File rename failed in a file stored in the USB memory stick. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the USB memory stick, then retry according to <i>chapter 9.6 "Restoring FS100 Controller" at page 9-23.</i>
□ 004F.	File open error occurred in a file stored in the USB memory stick. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the USB memory stick, then retry according to chapter 9.6 "Restoring FS100 Controller" at page 9-23.

9.7

7SegLED indication	Error content and countermeasure
□ 0051.	Access error occurred in a file stored in the Flash Rom. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.
□ 0052.	File read error occurred in a file stored in the Flash Rom. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.
□ 0053.	File write error occurred in a file stored in the Flash Rom. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.
□ 0054.	File close error occurred in a file stored in the Flash Rom. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.
□ 0055.	File creation error occurred in a file stored in the Flash Rom. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.
□ 0056.	File directory creation error occurred in a file stored in the Flash Rom. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.
□ 0057.	File directory deletion error occurred in a file stored in the Flash Rom. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.
□ 0058.	File deletion error occurred in a file stored in the Flash Rom. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.
□ 0059.	File rename error occurred in a file stored in the Flash Rom. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.
□ 005F.	Access error occurred in a file stored in the Flash Rom. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.
□ 0090.	Error code only for the manufacturer. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.
□ 0091.	Error code only for the manufacturer. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.
□ 0092.	Error code only for the manufacturer. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.
□ 0999.	An error other than the above occurred. Turn the FS100 power supply OFF then back ON. If the error occurs again, replace the main CPU board.

10.1 Functional Overview

10 Upgrade Function

10.1 Functional Overview

For the CPU configuration, the FS100 has two pieces of software: the software for the main CPU board and the software for the programming pendant. Due to the compatibility of each software's version, the system runs only with the specified combination of the software versions.

Thus, the FS100 can upgrade the software for the programming pendant if the combination of the software for the main CPU and the programming pendant is invalid.

10.2 Upgrade Procedure

10.2.1 Confirmation of Software Version of Main CPU and Programming Pendant

The combination of the software versions for the main CPU and the programming pendant is automatically checked in 25 seconds after the FS100 power supply is turned on.

Only if the combination is invalid, automatic upgrade will be performed. If the combination is compatible, automatic upgrade will not be performed.

- If the software versions of the main CPU and the programming pendant are compatible:
- The initial window appears.



10 Upgrade Function

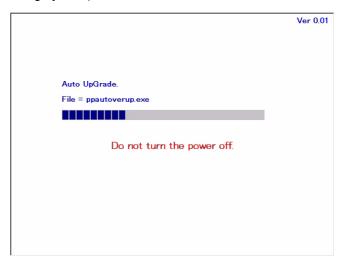
FS100

10.2 Upgrade Procedure

10.2.2 Automatic Upgrade

If the programming pendant software is older than the one stored in the main CPU memory, or if the software version is incompatible, automatic upgrade will be performed.

Note that the OS of the programming pendant will not be upgraded. (OS: operating system)



- 1. After the automatic upgrade process is completed, the programming pendant reboots and the main CPU stops communication processing.
- 2. After the programming pendant reboots, the main CPU restarts the communication processing and the initial window appears on the programming pendant screen.



To avoid the automatic upgrade, turn ON the FS100 power supply while pressing the interlock key + [5] + [SELECT].

DO NOT turn off the main power supply during automatic upgrade process.

In case the main power supply is turned off, exercise the following process.

- Turn on the main power supply of FS100.
 - Automatic upgrade might be exercised again.



- In case error occurs during automatic upgrade process.
 - (1) Supply CF for upgrading or USB memory.
 - (2) Press [2] + [8] + [HIGH SPEED].
 -Upgrade of the OS of Programming Pendant
 - (3) Press the interlock key F + [8] + [SELECT].
 - (4) Exercise manual upgrading.Refer to "FS100 Upgrade Procedure"
- If no recovery is made with all the procedure above, replace the pendant.

11.1 Addition of I/O Modules

11 Modification of System Configuration

11.1 Addition of I/O Modules

To add I/O modules, turn OFF the power supply.



Addition operation must be performed in the management mode.

In the operation mode or editing mode, only reference of status setting is possible.

- 1. While pressing the main menu key , turn the FS100 power supply OFF then back ON.
- 2. Change the security mode to the management mode.
- 3. Select {SYSTEM} under the main menu.
 - The system window appears.



- 4. Select (SETUP).
 - The SETUP window appears.
 - The items marked with "■" cannot be selected.



11.1 Addition of I/O Modules

- 5. Select (IO MODULE).
 - The current status of the mounted I/O module is shown.



- 6. Confirm the status of mounted I/O module.
 - Confirm that each station (ST#) window is the same as the I/O module's actual mounting status.
 - The following information is shown for each station.

ST#	Station address of I/O module
DI	Number of contact input points ¹⁾
DO	Number of contact output points ¹⁾
BOARD	Circuit board type ²⁾

- 1) A hyphen, -, indicates that the corresponding I/O section is not mounted.
- 2) If the system cannot recognize the circuit board type, a row of stars (*****) are shown. No problem will occur as long as the values displayed in DI and DO are correct.
- 7. Press [ENTER].
 - Confirm the statuses of the mounted I/O modules for the other stations.



11 Modification of System Configuration

FS100

11.1 Addition of I/O Modules

8. Press [ENTER].

- The confirmation dialog box appears.



9. Select {YES}.

 The system parameters are then set automatically according to the current mounted hardware status. The procedure for the addition of the I/O module is complete.



If there is a difference between the displayed contents and the actual mounted status, confirm the status again. If the status is correct, the I/O module may be defective: in such a case, contact your Yaskawa representative.

11.2 Addition of Base and Station Axes

To add the base and station axes, mount all hardware correctly and then execute maintenance mode.



Addition operation must be performed in the management mode.

In the operation mode or editing mode, only reference of status setting is possible.

When adding a base and a station axis, set the following items:

TYPE

Select one in the type list.

- In case of base axis (B1, B2)
 Select one of RECT-X, -Y, -Z, -XY, -XZ, -YZ or -XYZ.
- In case of station axis (S1, S2, S3)
 Select UNIV-* ("*" represents the number of axes) when using a mechanism other than the registered type as a station axis.
- CONNECTION

In the CONNECTION window, specify the SERVOPACK which is connected with each axis group, the contactor which is used for the SERVOPACK, and the overrun signal (OT).

AXIS TYPE

Select from the axis type list.

- In case of TURN-* type
 No need to select (The axis type is set as TURN type.)
- In case of RECT-* type
 Select BALL-SCREW type or RACK & PINION type.
- In case of UNIV-* type
 Select BALL-SCREW type, RACK & PINION type or TURN type.
- MECHANICAL SPECIFICATION
 - If axis type is ball-screw type, set the following items:

• MOTION RANGE (+) [mm]
• MOTION RANGE (-) [mm]

- REDUCTION RATIO (numerator)
- REDUCTION RATIO (denominator)

• BALL-SCREW PITCH [mm/r]

• If axis type is rack & pinion type, set the following items.

• MOTION RANGE (+) [mm]
• MOTION RANGE (-) [mm]

- REDUCTION RATIO (numerator)
- REDUCTION RATIO (denominator)
- PINION DIAMETER [mm]

	11	Modification of System Configuration
FS100	11.2	Addition of Base and Station Axes

• If axis type is turn type, set the following items.

• MOTION RANGE (+) [deg] • MOTION RANGE (-) [deg]

• REDUCTION RATIO (numerator)

• REDUCTION RATIO (denominator)

• OFFSET (1st and 2nd axis) [mm]

- MOTOR SPECIFICATION Set the following items.
 - MOTOR
 - SERVO AMP
 - CONVERTER
 - ROTATION DIRECTION [normal/reverse]
 - MAX. RPM [rpm]
 - ACCELERATION SPEED [sec]
 - INERTIA RATIO

^{*} Select MOTOR, AMPLIFIER and CONVERTER from each type list on the display.

11 Modification of System Configuration

FS100

11.2 Addition of Base and Station Axes

11.2.1 Base Axis Setting

11.2.1.1 Selection of Base Axis Type

Select the type of base axis to be added or modified.

- 1. While pressing the main menu key , turn the FS100 power supply OFF then back ON.
- 2. Change the security mode to the management mode.
- 3. Select {SYSTEM} under the main menu.
 - The system window appears.



- 4. Select (SETUP).
 - The SETUP window appears.
 - Note that the items marked with "■" cannot be set.



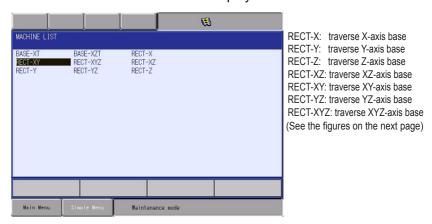
11 Modification of System Configuration

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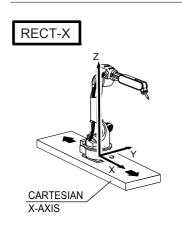
- 11.2 Addition of Base and Station Axes
- 5. Select (CONTROL GROUP).
 - The current control group type is displayed.



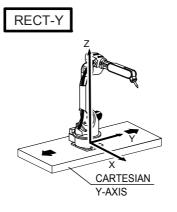
- 6. Move the cursor to the type of control group to be modified, and press [SELECT].
 - The MACHINE LIST window is displayed.



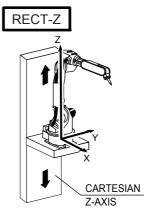
- 7. Select one in the type list.
 - After the type selection, the window changes to the CONNECTION window.



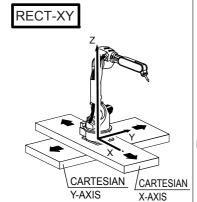
Base axis direction of travel coincides with robot coordinate X-Axis.



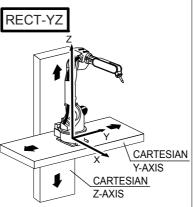
Base axis direction of travel coincides with robot coordinate Y-Axis.



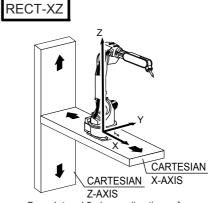
Base axis direction of travel coincides with robot coordinate Z-Axis.



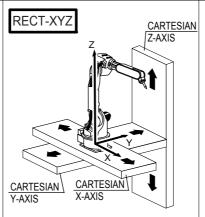
Base 1st and 2nd axes directions of travel coincide with robot coordinate X-Axis and Y-Axis, respecitively.



Base 1st and 2nd axes directions of travel coincide with robot coordinate Y-Axis and Z-Axis, respectively.



Base 1st and 2nd axes directions of travel coincide with robot coordinate X-Axis and Z-Axis,respectively.

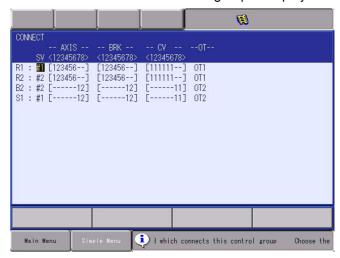


Base 1st, 2nd, and 3rd axes directions of travel coincide with robot coordinate X-Axis, Y-Axis, and Z-Axis, respectively.

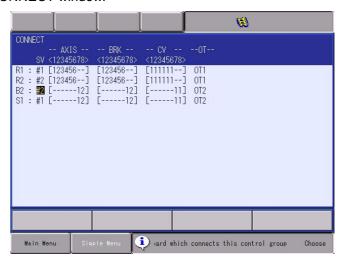
11.2.1.2 Connection Setting

In the CONNECT window, it is specified that each axis of each control group is connected to which connector of the SERVO board, which brake of the contactor unit, which converter, and which overrun signal.

- 1. Confirm the type of each control group in the CONNECT window.
 - The connection status of each control group is displayed.



- 2. Select the connection item of a desired control group.
 - The settable items are displayed.
 - Select an item to change the setting. Select {Cancel} to return to the CONNECT window.



- Specify which connector (CN) of the SERVO board each axis of each control group is connected to.
 - The numbers in [] represent axis numbers, and indicate which axis is connected to which connector.
- Specify which brake (BRK) each axis of each control group is connected to.
 - The numbers in [] represent the axis numbers, and indicate which axis is connected to which brake.
- Specify which converter (CV) each axis of each control group is connected to.
 - The numbers in [] represent the converter numbers, and indicate which axis is connected to which converter.

- Specify which overrun signal (OT) each control group is connected to.
- In this example, B2 (Base) is connected in the following manner:

1st axis → SERVO Board (SV #2), Connector (7CN),

Brake Connector (BRK7), Converter (CV #1)

2nd axis → SERVO Board (SV #2), Connector (8CN)

Brake Connector (BRK8) Converter (CV #2)

Overrun → (OT2)

3. An overrun signal is allocated to a control group. Thus, when an overrun alarm occurs, the subcode is indicated by the control group. (With software of a version before DS1.20.00(A)-00, the subcode is indicated in binary.)

However, select "NOT CONNECT" if an overrun switch is not installed to the control group or the allocation of the external axis overrun signal is not needed.

Regarding the connection of the external axis overrun signal, refer to chapter 13.2.3 "Connection for External Axis Overrun" at page 13-13.

- 4. Select a desired item.
- 5. Press [ENTER] in the CONNECT window.
 - The setting in the CONNECT window is completed, the window changes to the CONTROL GROUP window, and a confirmation dialog box appears.



 Select {YES} to set the system parameters automatically according to the selected items in the windows so far. Modification of System ConfigurationAddition of Base and Station Axes

6. Initialize related files.

FS100



11.2.1.3 Axis Configuration Setting

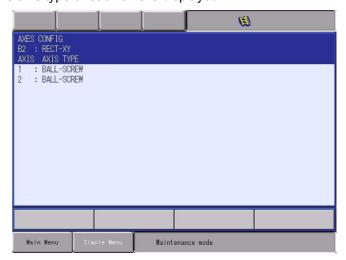
Select "DETAIL" in the CONTROL GROUP window to select "INIT (initialization)", "MODIFY", "DELETE", or "DETAIL".



- Select "INIT" to initialize parameters according to the current settings.
- Select "MODIFY" to see the MACHINE LIST window.
- Select "DELETE" to delete the selected axis's type.
- Select "DETAIL" to move to the AXIS CONFIG window.

The axis type is specified in the AXES CONFIG window.

- 1. Confirm axis type of each axis in the AXES CONFIG window.
 - The axis type of each axis is displayed.



11 Modification of System Configuration

FS100

- 11.2 Addition of Base and Station Axes
- 2. Select the axis type to be modified.
 - (1) The settable axis type is displayed.



- (2) Select "BALL-SCREW" when the servo track is ball-screw type, and "RACK&PINION" when the servo track is rack-and-pinion type. After the selection, the window returns to the AXES CON-FIG window.
- (3) Select the axis type.
- 3. Press [ENTER] in the AXES CONFIG window.
- 4. The setting in the AXES CONFIG window is completed and the window moves to the MECHANICAL SPEC window.

11.2.1.4 Mechanical Specification Setting

The mechanical data is specified in the MECHANICAL SPEC window.

- 1. Confirm specification of each axis in the MECHANICAL SPEC window.
 - The mechanical specification of axis is shown.

MECHANICAL SPEC window (BALL-SCREW type)



- MOTION RANGE
- : Input maximum moving position (positive (+) direction and negative (-) direction) from home position when setting the home position to 0. (Unit: mm)
- REDUCTION RATIO: Input the numerator and the denominator.
 <e.g.> If the reduction ratio is 1/2, the numerator should be set as 1.0 and the denominator should be set as 2.0.
- BALL-SCREW PITCH: Input the traveling length when the ballscrew rotates once. (Unit: mm/r)

MECHANICAL SPEC window (RACK & PINION type)



- MOTION RANGE

: Input maximum moving position (positive (+) direction and negative (-) direction) from home position when setting the home position to 0. (Unit: mm)

	11	Modification of System Configuration
FS100	11.2	Addition of Base and Station Axes

- 11.2 Addition of Base and Station Axes
 - REDUCTION RATIO: Input the numerator and the denominator. <e.g.>If the reduction ratio is 1/120, the numerator should be set as 1.0 and the denominator should be set as 120.0.
 - PINION DIAMETER: Input the diameter of a pinion. (Unit: mm)
- 2. Select the item to be modified.
 - Point the cursor to the item subject for setting value modification, and press [SELECT].
- 3. Modify the settings.
 - The selected item is in the input status. Input the setting value, and press [ENTER].
- 4. Press [ENTER] in the MECHANICAL SPEC window.
 - After the setting, the current window moves to the window for the next axis setting. Complete the settings for all axes in the same manner.
 - When [ENTER] is pressed in the MECHANICAL SPEC window for the last axis, the setting in the MECHANICAL SPEC window is completed and the window moves to the MOTOR SPEC window.

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11.2.1.5 Motor Specification Setting

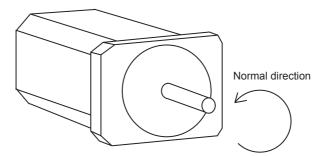
The motor data is specified in the MOTOR SPEC window.

- 1. Confirm specification of each axis in the MOTOR SPEC window.
 - The motor specification of each axis is displayed.



- 2. Select the desired item.
 - When a numerical value is selected, the number input buffer line appears.
 - When MOTOR (or SERVO AMP or CONVERTER) is selected, the list window of MOTOR (SERVO AMP, or CONVERTER) appears.
 - ROTATION DIRECTION: Set the rotation direction to which the current position is increased. (The counterclockwise view from the loaded side is the normal rotation.)

Fig. 11-1: AC Servo Motor



- MAX. RPM: Input maximum rotation speed of a motor. (Unit: rpm)
- ACCELARATION TIME: Input time between 0.01 and 1.00 to reach maximum speed from stopping status at 100% JOINT speed. (Unit: sec)
- INERTIA RATIO: The initial value is set at 300 in case of servo track;
 0 in case of rotation axis.
 However, if the following phenomenon occurs in motion, deal with
 - However, if the following phenomenon occurs in motion, deal with the followed procedure.
- <Phenomenon 1>
 - During motion, the axis moves unsteadily to the direction of travel.
 - → Check the motion by increasing this ratio in increments of 100.
- <Phenomenon 2>
 - During pause, the motor makes a strange noise.
 - → Check the motion by decreasing this ratio in increments of 100.

11 Modification of System Configuration

FS100

- 11.2 Addition of Base and Station Axes
- 3. Modify the settings.
- 4. Press [ENTER] in the MOTOR SPEC window.
 - After the setting, the current window moves to the window for the next axis setting. Complete the settings for all axes in the same manner.
 - When [ENTER] is pressed in the MOTOR SPEC window for the last axis, the setting in the MOTOR SPEC window is completed and the confirmation dialog box appears.



- Select {YES} to set the system parameters automatically according to the selected items in the windows so far.
- 5. Initialize related files.
 - Addition or modification of the base axis is completed.

11.2.2 Station Axis Setting

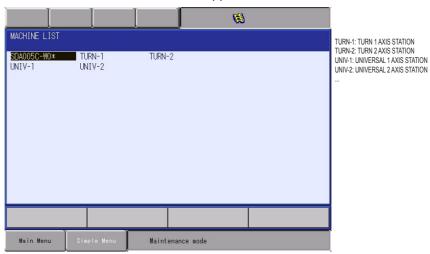
11.2.2.1 Selection of Station Axis Type

Select the type of station axis to be added or modified.

- 1. Confirm the type of control group in CONTROL GROUP window.
 - The CONTROL GROUP window appears.

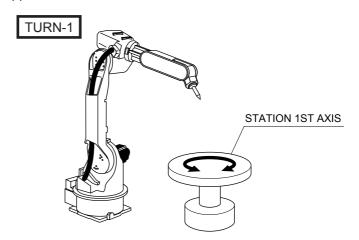


- 2. Select the type of control group to be modified.
 - The MACHINE LIST window appears.



11 Modification of System Configuration FS100

- 11.2 Addition of Base and Station Axes
- 3. Select desired type in the type list.
 - After the type selection, the window changes to the CONNECT window.
 - Select "UNIV" (universal) when using a mechanism other than the registered type (such as a servo track) as a station axis. When "UNIV" is selected, interpolation motion (linear, circular, etc.) is not supported.



11.2.2.2 Connection Setting

In the CONNECT window, it is specified that each axis of each control group is connected to which connector of the SERVO board, which brake, which converter, and which overrun signal.

Note that the software version should be DS1.20.00(A)-00 or higher to set the overrun signal.

- 1. Confirm the type of each control group in the CONNECT window.
 - Connection status of each control group is displayed.



- 2. Select the connection item of desired control group.
 - The settable items are displayed.
 - Select an item to change the setting. Select {Cancel} to return to the CONNECT window.
 - Specify which connector (CN) of the SERVO board each axis of each control group is connected to.
 - The numbers in [] represent axis numbers, and indicate which axis is connected to which connector.
 - Specify which brake (BRK) each axis of each control group is connected to.
 - The numbers in [] represent the axis numbers, and indicate which axis is connected to which brake.
 - Specify which converter (CV) each axis of each control group is connected to.
 - The numbers in [] represent the converter numbers, and indicate which axis is connected to which converter.
 - Specify which overrun signal (OT) each control group is connected to.
 - In this example, S1 (Station) is connected in the following manner:

1st axis	\rightarrow	SERVO Board (SV #1),	Connector (7CN),
		Brake Connector (BRK7),	Converter (CV #1)
2nd axis	\rightarrow	SERVO Board (SV #1),	Connector (8CN),
		Brake Connector (BRK8),	Converter (CV #3)
Overrun	\rightarrow	(OT2)	

	11	Modification of System Configuration
FS100	11.2	Addition of Base and Station Axes

- 3. In software of the version DS1.20.00(A)-00 or higher, an overrun signal is allocated to a control group. Therefore, when an overrun alarm occurs, the subcode is indicated by the control group. (With software of a version before DS1.20.00(A)-00, the subcode is indicated in binary.)
 - However, select "NOT CONNECT" if an overrun switch is not installed to the control group or the allocation of the external axis overrun signal is not needed.
 - Regarding the connection of the external axis overrun signal, refer to chapter 13.2.3 "Connection for External Axis Overrun" at page 13-13.
- 4. Select a desired item.
- 5. Press [ENTER] in the CONNECT window.
 - The setting in the CONNECT window is completed, the window changes to the CONTROL GROUP window, and the confirmation dialog box appears.
 - Select {YES} to set the system parameters automatically according to the selected items in the windows so far.
- 6. Initialize related files.

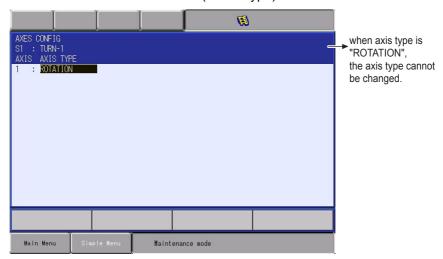
11.2.2.3 Axis Configuration Setting

Select "DETAIL" in the CONTROL GROUP window to select "INIT (initialization)", "MODIFY", "DELETE", or "DETAIL".

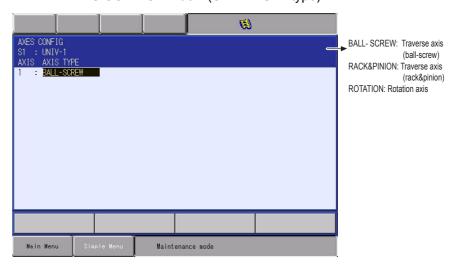
- Select "INIT" to initialize parameters according to the current settings.
- Select "MODIFY" to see the MACHINE LIST window.
- Select "DELETE" to delete the selected axis's type.
- Select "DETAIL" to move to the AXIS CONFIG window.

The axis type and motor type are specified in the AXES CONFIG window.

- 1. Confirm axis type of each axis in the AXES CONFIG window.
 - The axis type of each axis is displayed.
 - AXES CONFIG window (TURN type)



AXES CONFIG window (UNIVERSAL type)



11 Modification of System Configuration

FS100

11.2 Addition of Base and Station Axes

- 2. Select the axis type to be modified.
 - The settable axis type is displayed.



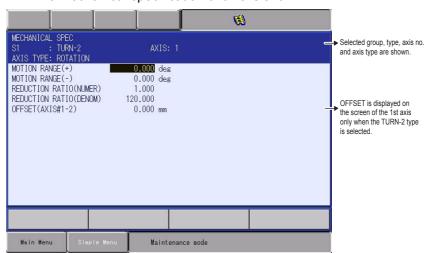
- 3. Select the desired axis type.
- 4. Press [ENTER] in the AXES CONFIG window.
 - The setting in the AXES CONFIG window is completed and the window moves to the MECHANICAL SPEC window.

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11.2.2.4 Mechanical Specification Setting

The mechanical data is specified in the MECHANICAL SPEC window.

- 1. Confirm specification of each axis in the MECHANICAL SPEC window.
 - The mechanical specification of axis is shown.



- MOTION RANGE : Input maximum moving position (positive (+)

direction and negative (-) direction) from home position when setting the home position to 0.

(Unit: deg)

- REDUCTION RATIO: Input the numerator and the denominator.

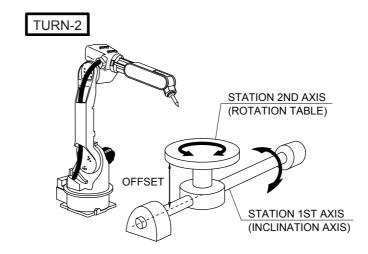
<e.g.> If the reduction ratio is 1/120, the numerator should be set as 1.0 and the denominator should be set as 120.0.

OFFSET : Offset should be specified at "TURN-2" type

only.

Input length between the center of bending axis (1st axis) and the turning table (2nd axis).

(Unit: mm)



• MECHANICAL SPEC window (BALL-SCREW type)



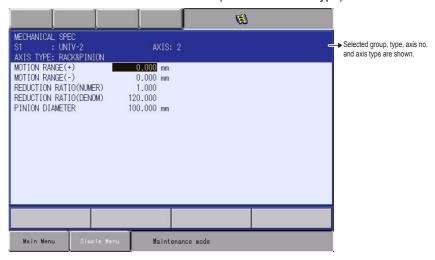
MOTION RANGE

: Input maximum moving position (positive (+) direction and negative (-) direction) from home position when setting the home position to 0. (Unit: mm)

- REDUCTION RATIO: Input the numerator and the denominator. <e.g.> If the reduction ratio is 1/2, the numerator should be set as 1.0 and the denominator should be set as 2.0.

- BALL-SCREW PITCH: Input the traveling length when the ballscrew rotates once. (Unit: mm/r)

• MECHANICAL SPEC window (RACK & PINION type)



MOTION RANGE

: Input maximum moving position (positive (+) direction and negative (-) direction) from home position when setting the home position to 0. (Unit: mm)

REDUCTION RATIO: Input the numerator and the denominator.

<e.g.>If the reduction ratio is 1/120, the numerator should be set as 1.0 and the denominator should be set as 120.0.

- PINION DIAMETER: Input the diameter of a pinion. (Unit: mm)

- 11.2 Addition of Base and Station Axes
 - MECHANICAL SPEC window (ROTATION type)



- MOTION RANGE: Input maximum moving position (positive (+) direction and negative (-) direction) from home position when setting the home position to 0. (Unit: deg)
- REDUCTION RATIO: Input the numerator and the denominator.
 <e.g.> If the reduction ratio is 1/120, the numerator should be set as 1.0 and the denominator should be set as 120.0.
- 2. Modify the settings.
- 3. Press [ENTER] in the MECHANICAL SPEC window.
 - After the setting, the current window moves to the window for the next axis setting. Complete the settings for all axes in the same manner.When [ENTER] is pressed in the MECHANICAL SPEC window for the last axis, the setting in the MECHANICAL SPEC window is completed and the window moves to the MOTOR SPEC window.

11.2.2.5 Motor Specification Setting

The motor data is specified in the MOTOR SPEC window.

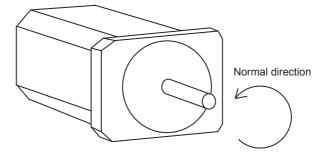
- 1. Confirm specification of each axis in the MOTOR SPEC window.
 - The motor specification of each axis is displayed.



2. Select a desired item.

- When a numerical value is selected, the number input buffer line appears.
 - When MOTOR (or SERVO AMP or CONVERTER) is selected, the list window of MOTOR (SERVO AMP or CONVERTER) appears.
- When the type is selected, the window returns to the AXES CONFIG window.
- ROTATION DIRECTION: Set the rotation direction to which the current position is increased. (The counterclockwise view from the loaded side is the normal rotation.)

Fig. 11-2: AC Servo Motor



- MAX. RPM: Input maximum rotation speed of a motor. (Unit: rpm)
- ACCELARATION SPEED: Input time between 0.01 and 1.00 to reach maximum speed from stopping status at 100% JOINT speed. (Unit: sec)
- INERTIA RATIO: The initial value is set at 300 in case of servo track;
 0 in case of rotation axis.
 However, if the following phenomenon occurs in motion, deal with

the followed procedure.

- 11.2 Addition of Base and Station Axes
 - <Phenomenon 1>

During motion, the axis moves unsteadily to the direction of travel.

- → Check the motion by increasing this ratio in increments of 100.
- <Phenomenon 2>
 - During pause, the motor makes a strange noise.
 - → Check the motion by decreasing this ratio in increments of 100.
- 3. Modify the settings.



CAUTION

- If the control axis configuration is changed by addition of a base axis or station axis, the internal data of the job file are also changed so that the job file data should be initialized.
 Initialize the job file data with procedure "File Initialize" in this manual after changing the construction.
- When the data, motion range for example, should be changed after the addition of a base axis or station axis, the change can be done in the same procedure as shown above. In this case, the control axis configuration is not changed so the job file data should not be initialized.

12 FS100 Specification



WARNING

 Make sure that there is no one within the manipulator's operating range and that you are in a safe place before turning ON the FS100 power.

Injury may result from collision with the manipulator to anyone entering the manipulator's operating range.

- Always set the teach lock before starting teaching.
- 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.
 - Always have an escape plan in mind in case the manipulator comes toward you unexpectedly.
 - Ensure that you have a place to retreat to in case of emergency.

Improper or unintentional manipulator operation can result in injury.

 Before operating the manipulator, check that the SERVO ON lamp goes out when the emergency stop button on the programming pendant is pressed.

Injury or damage to machinery may result if the manipulator cannot be stopped in case of an emergency.

The emergency stop button is located on the right of the programming pendant.

12



CAUTION

- Perform the following inspection procedures prior to performing teaching operations. If problems are found, correct them immediately, and be sure that all other necessary processing has been performed.
 - Check for problems in manipulator movement.
 - Check for damage to the insulation and sheathing of external wires.
- Always return the programming pendant to its specified position after use.

If the programming pendant is inadvertently left on the manipulator, fixture, or on the floor, the manipulator or a tool could collide with it during manipulator movement, possibly causing injuries or equipment damage.

 Make sure that a system manager stores the key of the mode select switch on the programming pendant.

After operation, the key should be removed and stored by the system manager.

Improper or unintended manipulator operation may result in injury.

Also, the key or the mode select switch may be damaged if the programming pendant is dropped with the key inserted.

12 FS100 Specification

FS100

12.1 Specifications of FS100

12.1 Specifications of FS100

Item	For Japan and North America For Europe				
Structure	Free-standing, open type				
Dimensions	470 (W) × 200 (H) × 420 (D) mm				
Approximate mass	20 kg (except options such as an additional external axis)				
	45 kg (SDA5F, SDA10F, SDA20F) (except options such as an additional external axis)				
Cooling system	Direct cooling				
Grounding	Grounding resistance: 100 Ω or less, excl	usive grounding ¹⁾			
Digital I/O	NPN	PNP			
	Specific signals (hardware): 10 inputs and 1 outputs				
	General signals (standard, maximum): 28 inputs, 28 output (transistor: 28 outputs)				
Positioning system	By serial communication (absolute encoder)				
Drive unit	SERVOPACK for AC servomotors				
Acceleration/ deceleration	Software servo control				
Memory capacity	10000 steps, 1000 instructions				
CIO ladder	Max. 1500 step				
Built-in transformer	None				
Brake release	The brake of each system can be release programming pendant.	d individually by the			

¹ Perform grounding in accordance with all relevant local and national electrical codes.

The size of the ground wire must be equal to or larger than the size listed in table 4-2 "FS100 Power Capacity, Cable Size, and Circuit Protector" at page 4-6.

12.2 Functions of FS100

Programming Pendant	Coordinate System	Joint, Rectangular/Cylindrical, Tool, User Coordinates				
Operation	Modification of Teaching Points	Adding, Deleting, Correcting (Robot axes and external axes respectively can be corrected.)				
	Inching Operation	Possible				
	Path	Forward/Reverse step, Continuous				
	Confirmation	feeding				
	Speed Adjustment	Fine adjustment possible during operating or pausing				
	Timer Setting	Possible every 0.01 s				
	Short-cut Function	Direct-open function, Multi-window				
	Interface	CF (CompactFlash) card slot, USB port (USB1.1) (on programming pendant), USB port (2.0) (on control circuit board), RS232C (on control circuit board), LAN (100 BASE-TX/10BASE-T) (on control circuit board) (optional)				
Safety	Essential	JIS (Japanese Industrial Standard)				
Feature	Running Speed Limit	User definable				
	Enable Switch	3 position type. Servo power can be turned on at the middle position only. (Located on programming pendant)				
	Collision proof Frames	Cubic frame, Axis frame				
	Self-Diagnosis	Classifies error and two types of alarms (major and minor) and displays the data				
	User Alarm Display	Possible to display alarm messages for peripheral device				
	Machine Lock	Test-run of peripheral devices without robot motion				
	Door Interlock	A door can be opened only when a circuit breaker is OFF.				
Maintenance Function	Operation Time Display	Control power-on time, Servo power-on time, Playback time, Operation time, Work time				
	Alarm Display	Alarm message, troubleshooting, previous alarm records				
	I/O Diagnosis	Simulated enabled/disabled output possible				
	T.C.P. Calibration	Automatically calibrates parameters for end effectors using a master positioner				

FS100

12 FS100 Specification 12.2 Functions of FS100

Programming	Programming Type	Interactive programming
	Language	Robot language: INFORM II
	Robot Motion Control	Joint coordinates, Linear/Circular interpolations, Tool coordinates
	Speed Setting	Percentage for joint coordinates, 0.1mm/s units for interpolations, Angular velocity for T.C.P. fixed motion
	Program Control Instructions	Jumps, Calls, Timer, Robot stop, Execution of some instructions during manipulator motion
	Variable	Global variable, Local variable
	Variable Type	Byte type, Integer-type, Double precision-type, Real type, Position type, String type
	I/O Instructions	Discrete I/O, Pattern I/O processing

12.3 Specifications of Programming Pendant

12.3 Specifications of Programming Pendant

Item	Specifications	
Туре	JZRCR-YPP03-1 or JZRCR-YPP13-1	-
Dimensions	169 (W) \times 314.5 (H) \times 50 (D) mm (excluding protrusions)	
Approximate mass	990 g	4.0000
Material	Reinforced plastic	
Control device	(1) Select key (2) Axis keys (3) Numeric/application keys (4) Mode switch with a key (mode: teach, play, remote) Key type: AS6-SK-132 (manufactured by IDEC) 1) (5) Emergency stop button (6) Enable switch (7) CompactFlash card slot (CompactFlash is optional.) (8) USB port (1 port)	6
Display	640 × 480 pixel color LCD, touch panel (Alphanumeric characters, Chinese characters, Japanese letters, etc.)	3
IEC protection class	IP65	-
Cable length	Standard: 8 m, Max.: 20 m (optional)	-
Key sheet	General (1 sheet only)	-

¹ Two keys are supplied with the programming pendant.

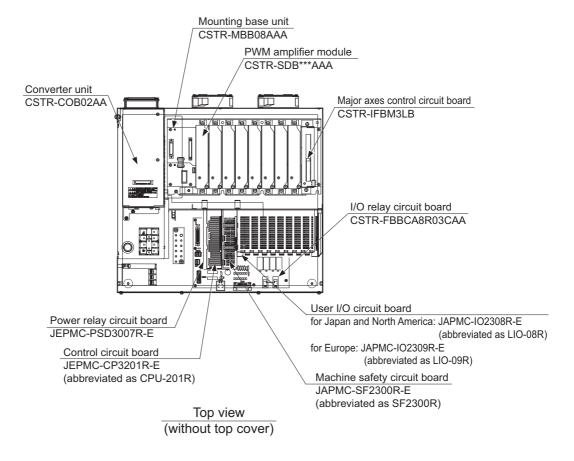
12.4 Equipment Configuration of FS100

12.4 Equipment Configuration of FS100

The equipment configuration of the FS100 is described below.

12.4.1 Arrangement of Units and Circuit Boards

Fig. 12-1: Equipment Configuration of FS100



13 Description of Units and Circuit Boards



WARNING

 When turning ON the power to FS100, be sure that there is no one within the manipulator's operating range, and that you are in a safe place.

Injury may result from collision with the manipulator to anyone entering the manipulator's operating range. Always press the emergency stop button immediately if there are problems.

- Always set the teach lock before starting teaching.
- 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 unintended manipulator operation may result in injury.

 Before operating the manipulator, check that the SERVO ON lamp goes out when the emergency stop button on the programming pendant is pressed.

Injury or damage to machinery may result if the manipulator cannot be stopped in case of an emergency. The emergency stop button is located on the right of the programming pendant.

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CAUTION

Perform the following inspection procedures prior to performing teaching operations. If problems are found, correct them immediately, and be sure that all other necessary processing has been performed.

- Check for problems in manipulator movement.
- Check for damage to insulation and sheathing of external wires.
- Always return the programming pendant to its specified position after use.

If the programming pendant is inadvertently left on the manipulator or fixture, or on the floor, the manipulator or a tool could collide with it during manipulator movement, possibly causing injuries or equipment damage.

 Make sure that a system manager stores the key of the mode select switch on the programming pendant.

After operation, the key should be removed and stored by the system manager.

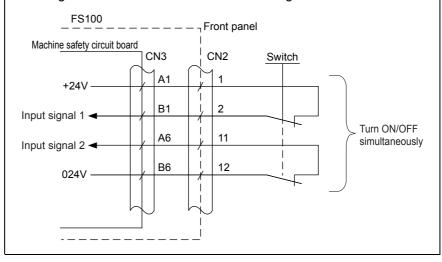
Improper or unintended manipulator operation may result in injury.

Also, the key or the mode select switch may be damaged if the programming pendant is dropped with the key inserted.

Cautions on Connection for Dual Input Signals

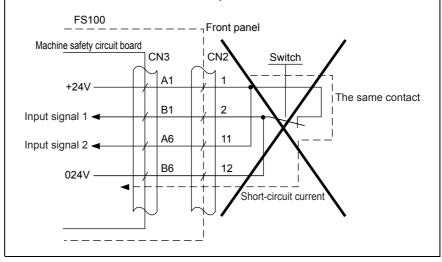


- Connect the switch (contact) that turns the dual signals ON and OFF simultaneously.
- If the timing that turns the two signals ON and OFF is not right, a disagreement alarm occurs. Refer to the figure below.





- Do not connect two signals to the same contact point.
 (Prepare two individual contact points)
- Since the power supply for each signal is reversed, it will shortcircuit and may cause breakdown of FS100 Unit if the signals are connected to the same contact point.



13.1 CPU Unit

13.1 CPU Unit

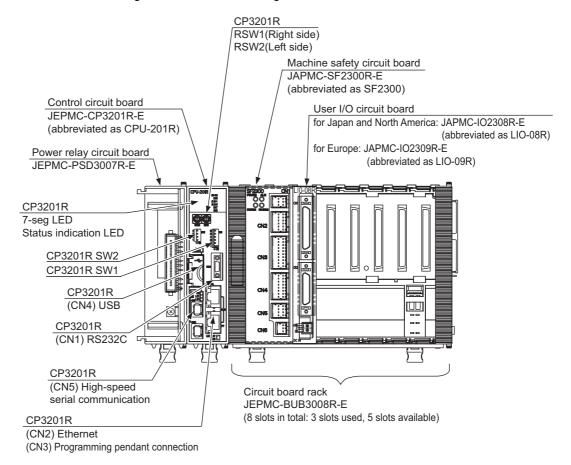
13.1.1 CPU Unit Configuration

CPU unit consists of a power relay circuit board, control circuit board, circuit board rack, machine safety circuit board, and user I/O circuit board.

The machine safety circuit board and user I/O circuit board are mounted on the circuit board rack.

The power relay circuit board, control circuit board, and circuit board rack are connected by using the connectors on the back.

Fig. 13-1: CPU Unit Configuration



13.1 CPU Unit

13.1.2 Circuit Board in CPU Unit

13.1.2.1 Control Circuit Board (JEPMC-CP3201R-E, Abbreviated as CPU-201R)

This board performs to control the entire system, display to the programming pendant, control the operating keys, control operation, and calculate interpolation.

The operation status of the FS100 is indicated by the 7-seg LED and status indication LED.

(For details of the 7-seg LED and status indication LED, refer to *chapter* 11 "LED Indicator on Each Circuit Board" of "FS100 MAINTENANCE MANUAL".)

This board is connected with the major axes control circuit board (CSTR-IFBM3LB) via high-speed serial communication, and has a USB port (2.0) and Ethernet (100BASE-TX/10-BASE-TX).



Please do not change the factory setting of RSW1 except operations which are described at chapter 9. (Factory setting is [0])



Please do not change the factory setting of RSW2. (Factory setting is [0])



Please do not change the DIP switch settings of SW1 and SW2.

(Factory settings are all "OFF")

13.1.2.2 Power Relay Circuit Board (JEPMC-PSD3007R-E)

This is the relay board to receive the control power supply for the entire CPU rack from the converter unit (CSTR-COB02AA).

13.1.2.3 Circuit Board Rack (JEPMC-BUB3008R-E)

This is the rack to mount the circuit boards including optional circuit boards.

This rack is connected with the control circuit board (JEPMC-CP3201R-E) by using the connectors on the back.

The total number of slots is 8, but the circuit boards (machine safety circuit board and user I/O circuit board) are mounted as standard. Thus, the number of available slots is 5, i.e., 5 optional circuit boards can be mounted.

13.2 Machine Safety Circuit Board (JAPMC-SF2300R-E, Abbreviated as SF2300)

13.2.1 Machine Safety Circuit Board (JAPMC-SF2300R-E)

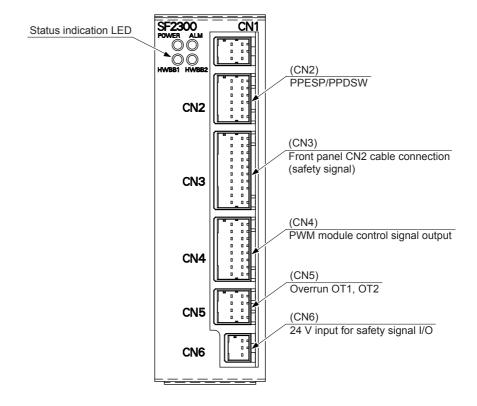
This unit contains dual processing circuits for safety signal.

It processes external safety signals with the dual processing circuits and control ON/OFF of the output of the PWM amplifier module according to conditions.

The functions of the machine safety circuit board include the following:

- Robot system input circuit (safety signal dual circuits)
- Servo-ON enable (ONEN) input circuit (dual circuits)
- Protection stop (PSTOP) input circuit (dual circuits)
- Programming pendant signal PPESP, PPDSW input circuit (dual circuits)

For details of the status indication LED, refer to *chapter 10 "LED Indicator* on Each Circuit Board" of "FS100 MAINTENANCE MANUAL".



13.2.2 Connection for Robot System Input Signal

A connector to input the robot system signal is prepared on the lower right of the front panel of the FS100. (Connector number: CN2)

For connection, refer to the connection diagram of each item.

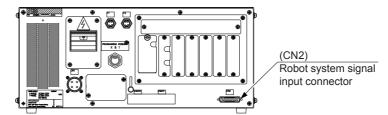


Table 13-1: Pin Assignment of Robot System Signal Input Connector (CN2)

Controller-side connector: 17JE-13250-02(D4A)A, manufacturer: DDK Note: fitting stud M2.6

Mating connector: 17JE-43250-02(D8A1)-CG (connector with hood), manufacturer: DDK * Upon shipment of the FS100, a dummy connector which short-circuits each system signal is attached.

Pin No. Signal Name 1 SAFF_1+ Safeguarding (safety plug) (first system) 2 SAFF_1- * Upon shipment of the FS100, with a jumper cable in the dunt of the FS100,	this is short-circuited mmy connector. this is short-circuited mmy connector. system) this is short-circuited
* Upon shipment of the FS100, with a jumper cable in the dunt a jumper cable in the dunt a jumper cable in the dunt to the FS100, with a jumper cable in the dunt a jumper cable in the dunt to the FS100, with a jumper cable in the dunt to the fS100, wit	this is short-circuited mmy connector. this is short-circuited mmy connector. system) this is short-circuited
with a jumper cable in the duntage of the protection stop (first system) PSTOP_1- PSTOP_1- Upon shipment of the FS100, with a jumper cable in the duntage of the FS100, with a jumper	this is short-circuited mmy connector. system) this is short-circuited
* Upon shipment of the FS100, with a jumper cable in the dun 5	nmy connector. system) this is short-circuited
with a jumper cable in the dun EXESP_1+ External emergency stop (first statement) Upon shipment of the FS100, with a jumper cable in the dun ESPOUT_1+ Do not short-circuit.	nmy connector. system) this is short-circuited
6 EXESP_1- * Upon shipment of the FS100, with a jumper cable in the dun 7 ESPOUT_1+ Do not short-circuit.	this is short-circuited
with a jumper cable in the dun 7 ESPOUT_1+ Do not short-circuit.	
8 ESPOUT_1-	
9 PPESP3+ Programming pendant emerger	ncy stop output
10 PPESP3- (first system)	
11 SAFF_2+ Safeguarding (safety plug) (sec	
* Upon shipment of the FS100, with a jumper cable in the dun	
13 Not used	
14 PSTOP_2+ Protection stop (second system	
* Upon shipment of the FS100, with a jumper cable in the dun	
16 EXESP_2+ External emergency stop (seco	
* Upon shipment of the FS100, with a jumper cable in the dun	
18 ESPOUT_2+ Do not short-circuit.	
19 ESPOUT_2-	
20 PPESP4+ Programming pendant emerger	ncy stop
21 PPESP4- output(second system)	
22 Not used	
23 Not used	
24 Not used	
25 Not used	

^{*} To input a system signal, supply a new connector for the signal. To a signal not used, connect a jumper cable similarly to when the FS100 is shipped.

13 Description of Units and Circuit Boards	13	Description of	of Units and	Circuit Boards
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FS100 Machine Safety Circuit Board (JAPMC-SF2300R-E, Abbreviated as

SF2300)

13.2.2.1 Connection for Protection Stop (PSTOP) Signal

Connect this signal line when using the function to immediately turn OFF the servo power for safety protection when the servo power of the FS100 robot system is turned ON.

This signal is not used as standard, and a jumper cable is connected in the dummy connector.

To use this signal, supply a new connector and perform wiring.

To a robot system signal which is not used, connect a jumper cable similarly to when the FS100 is shipped.

The dual inputs of the protection stop signal are used for safety. Thus, connect the switch (contact) that turns the dual signals ON and OFF simultaneously.

If only one of the signals is turned ON, an alarm occurs.

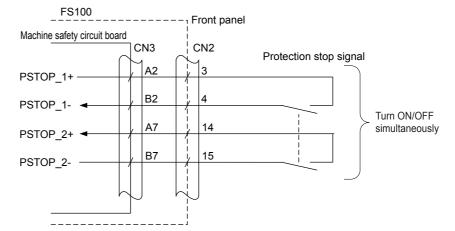


Fig. 13-2: Connection for Protection Stop Signal

13.2.2.2 Connection for Safeguarding (Safety Plug) (SAFF) Signal

This is the signal to turn OFF the servo power when the safeguarding opens.

Connect the interlock signal of the safety plug, etc. mounted on the door of safeguarding.

When the interlock signal is input, the servo power turns OFF, and the servo power cannot be turned ON after that.

This is disabled in the teach mode.

Upon shipment of the FS100, a jumper cable is connected in the dummy connector.

To use the robot, supply a new connector and perform wiring of the safeguarding signal.

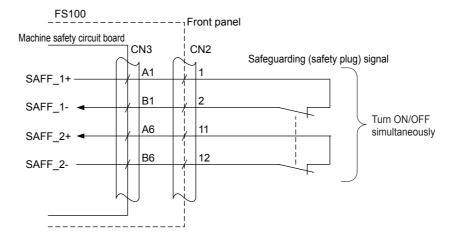
To a robot system signal which is not used, connect a jumper cable similarly to when the FS100 is shipped.



 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.

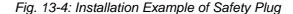
Fig. 13-3: Connection for Safeguarding (Safety Plug) Signal

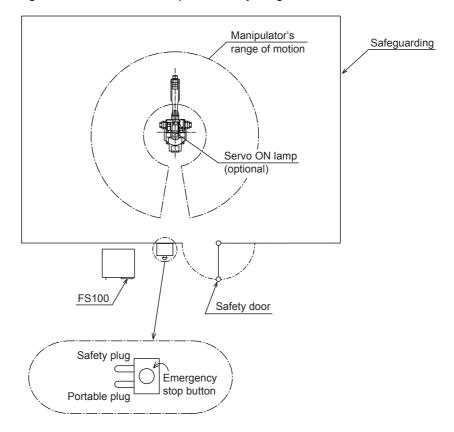


■ Installation example of safety plug

Install a safeguarding and a door with the interlock function around the manipulator so that an operator must open the door to enter and the interlock function stops the robot operation when the door opens.

The safety plug input signal is the signal to connect this interlock signal.





When the servo power is ON, input the interlock signal to turn OFF the servo power.

(The servo power cannot be turned ON while the interlock signal is input.)

Note that the servo power does not turn OFF in the teach mode. (The servo power can be turned ON even while the interlock signal is input.)

13.2.2.3 Connection for External Emergency Stop (EXESP) Signal

This signal is used to connect the emergency stop switch of an external device, etc.

If the signal is input, the servo power is turned OFF and the job is stopped. While the signal is input, the servo power cannot be turned ON.

Upon shipment of the FS100, a jumper cable is connected in the dummy connector.

To use the this signal, supply a new connector and perform wiring of the external emergency stop signal.

To a robot system signal which is not used, connect a jumper cable similarly to when the FS100 is shipped.



 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.

FS100 Front panel Machine safety circuit board CN3 CN2 External emergency stop signal 15 EXESP_1+ В3 6 EXESP_1-Turn ON/OFF 16 Α8 simultaneously EXESP_2+ 17 B8 EXESP_2-

Fig. 13-5: Connection for External Emergency Stop Signal

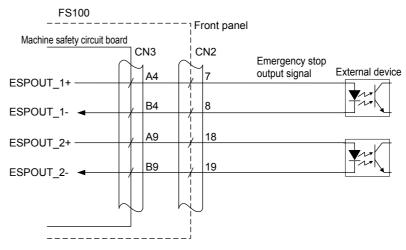
13.2.2.4 Connection for Emergency Stop Output (ESPOUT) Signal

This signal outputs, as dual signals, the signal status of the emergency stop of the programming pendant, the external emergency stop, and the safeguarding (safety plug) in the automatic operation mode.

This signal can be used to check the signal status of the emergency stop of the programming pendant, the external emergency stop, and the safeguarding (safety plug) in the automatic operation mode by using an external safety device, etc. (for monitor use only)

To use this signal, supply a new connector and perform wiring.

Fig. 13-6: Connection for Emergency Stop Output Signal



^{*} Output capacity: 24 VDC, 50 mA max.

13	Des	scrip	tion	of	Units	and	Circuit Boards
			_				

13.2.3 Connection for External Axis Overrun

FS100

If the overrun input of an external axis, etc. other than the manipulator is needed, perform connection as shown in *fig. 13-7 "Connection for External Axis Overrun Signal"*.

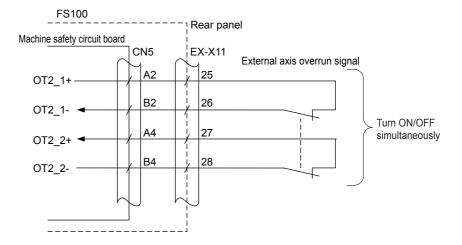
If the signal is input, the servo power is turned OFF and the job is stopped. While the signal is input, the servo power cannot be turned ON.

The dual inputs of the external axis overrun signal are used for safety. Thus, connect the switch (contact) that turns the dual signals ON and OFF simultaneously.

If only one of the signals is turned ON, an alarm occurs.

For the standard specification (without external axis), this signal cannot be used because the connectors for input (EX-X11, EX-X12) are not mounted.

Fig. 13-7: Connection for External Axis Overrun Signal



13.3 Converter Unit

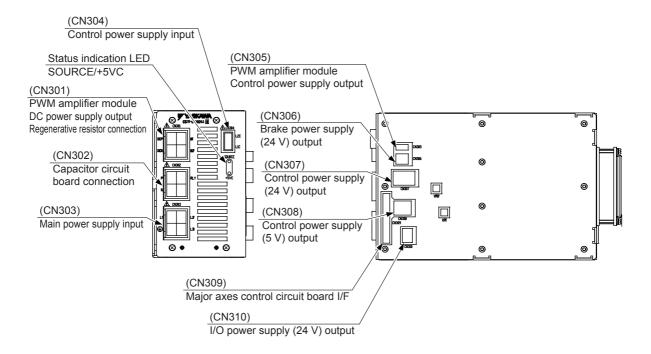
13.3 Converter Unit

13.3.1 Converter Unit (CSTR-COB02AA)

The converter unit (CSTR-COB02AA) has the following functions:

- 1. Supplies the DC power (5 V, 24 V) for control (system, I/O, brake)
- Converts the main power supply (three-phase 200/220 VAC at 50/60 Hz for all manipulator models, single-phase 200/230 VAC at 50/60 Hz for MHJ, MH5F, MH5LF, SIA5F, SIA10F, SIA20F, SDA10F, SDA20F) to DC power, and supplies it to the PWM amplifier module for each axis.

Use the converter unit (CSTR-COB02AA) with the capacitor circuit board (CSTR-CRBCC22AAA).



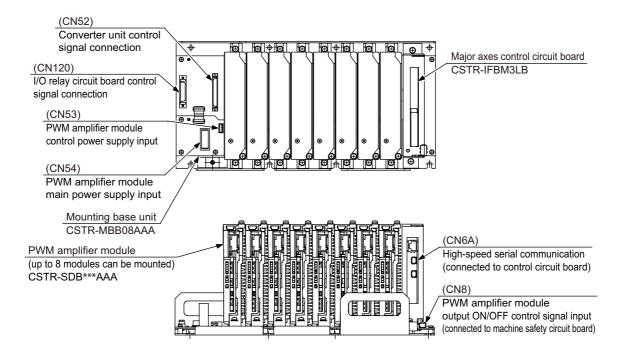
Item	Specifications			
Input power supply	Main power supply: three-phase 200/220 VAC at 50/60 Hz for all manipulator models single-phase 200/230 VAC at 50/60 Hz for MHJ, MH5F, MH5LF, SIA5F, SIA10F, SIA20F, SDA10F, SDA20F Control power supply: single-phase 200 to 230 VAC at 50/60 Hz Range of voltage regulation: +10% to -15%			
Output voltage	DC power supply for PWM amplifier module: Input voltage ×√2 Control power supply: 16.5 V (for PWM amplifier module) : 5 V (for CPU rack control power supply) : 24 V (24V1: for system, 24V3: for I/O, 24V4: for brake)			
Monitor and				
alarm function	Indication	Color	Status	
	SOURCE	Green	Lights up with the input of control power supply.	
	+5VC	Green	Lights up with the output of +5VC.	

13.4 SERVOPACK

13.4 SERVOPACK

A SERVOPACK consists of a mounting base unit, PWM amplifier module, and major axes control circuit board. The configuration of PWM amplifier module differs depending on the manipulator model.

13.4.1 Description of Each Unit



13.4.1.1 Mounting Base Unit (CSTR-MBB08AAA)

A mounting base unit consists of a base circuit board (CSTR-MBBCA08AAA) and a motherboard (CSTR-MBBCB08AAA). The major axes control circuit board (CSTR-IFBM3LB) and up to 8 PWM amplifier modules (CSTR-SDB***AAA) can be mounted to the mounting base unit.

The main power supply (280 VDC) and the control power supply (16.5 V, 5 V, 24 V) of the PWM amplifier module are received from the converter unit (CSTR-COB02AA).

Also, the mounting base unit receives the output ON/OFF signal of the PWM amplifier module from the machine safety circuit board (JAPMC-SF2300R-E), and distributes it to each PWM amplifier module.

13.4 SERVOPACK

13.4.1.2 PWM Amplifier Module (CSTR-SDB***AAA)

This module converts the main power supply (DC, input voltage \times $\sqrt{2}$) supplied from the converter to three-phase motor current, and outputs to each servomotor.

13.4.1.3 Major Axes Control Circuit Board (CSTR-IFBM3LB)

This is the circuit board to control the servomotor for the manipulator.

It controls the converter unit and the PWM amplifier modules.

Also, it connects to the I/O relay circuit board (CSTR-FBBCA8R03CAA), and controls the brake of each servomotor.

In addition to the control of the manipulator's major axes, this circuit board has the following functions:

- Can be used by connecting the brake power supply control circuit to the I/O relay circuit board (CSTR-FBBCA8R03CAA)
- Can be used by connecting the direct-in circuit to the I/O relay circuit board (CSTR-FBBCA8R03CAA)

13.4.1.4 Configuration of PWM Amplifier Module

The configurations of the PWM amplifier module for each manipulator are shown below.

Table 13-2: Configurations of PWM Amplifier Module

	S-axis(AMP1)	L-axis(AMP2)	U-axis(AMP3)	R-axis(AMP4)	B-axis(AMP5)	T-axis(AMP6)	E-axis(AMP7)	Rotation-axis(AMP8)
MHJ	CSTR-SDBR90	CSTR-SDBR90	CSTR-SDBR90	CSTR-SDBR90	CSTR-SDBR90	CSTR-SDBR90	_	_
мнзғ	CSTR-SDBR90	CSTR-SDBR90	CSTR-SDBR90	CSTR-SDBR90	CSTR-SDBR90	CSTR-SDBR90	_	_
MH5F	CSTR-SDB3R8	CSTR-SDB3R8	CSTR-SDB1R6	CSTR-SDBR90	CSTR-SDBR90	CSTR-SDBR90	_	_
MH6F	CSTR-SDB5R5	CSTR-SDB5R5	CSTR-SDB3R8	CSTR-SDBR90	CSTR-SDBR90	CSTR-SDBR90	_	_
MH12	CSTR-SDB5R5	CSTR-SDB5R5	CSTR-SDB3R8	CSTR-SDBR90	CSTR-SDBR90	CSTR-SDBR90	_	-
HP20F	CSTR-SDB5R5	CSTR-SDB120	CSTR-SDB5R5	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB1R6	_	_
MPP3	CSTR-SDB120	CSTR-SDB120	CSTR-SDB120	_	_	CSTR-SDBR90	_	_
MPK2F	CSTR-SDB120	CSTR-SDB120	CSTR-SDB5R5	1	CSTR-SDB1R6	CSTR-SDB1R6	-	-
SIA5F	CSTR-SDB1R6	_						
SDA5F	CSTR-SDB1R6	CSTR-SDB3R8						
SDASF	CSTR-SDB1R6	_						
SIA10F	CSTR-SDB3R8	CSTR-SDB3R8	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB1R6	_
SDA10F	CSTR-SDB3R8	CSTR-SDB3R8	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB5R5
SDATOF	CSTR-SDB3R8	CSTR-SDB3R8	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB1R6	_
SIA20F	CSTR-SDB5R5	CSTR-SDB5R5	CSTR-SDB3R8	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB3R8	-
SDA20F	CSTR-SDB5R5	CSTR-SDB5R5	CSTR-SDB3R8	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB3R8	CSTR-SDB5R5
SDAZUF	CSTR-SDB5R5	CSTR-SDB5R5	CSTR-SDB3R8	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB1R6	CSTR-SDB3R8	_

Note: AMP7 and AMP8 are also used for external axes.

Used amplifier types:

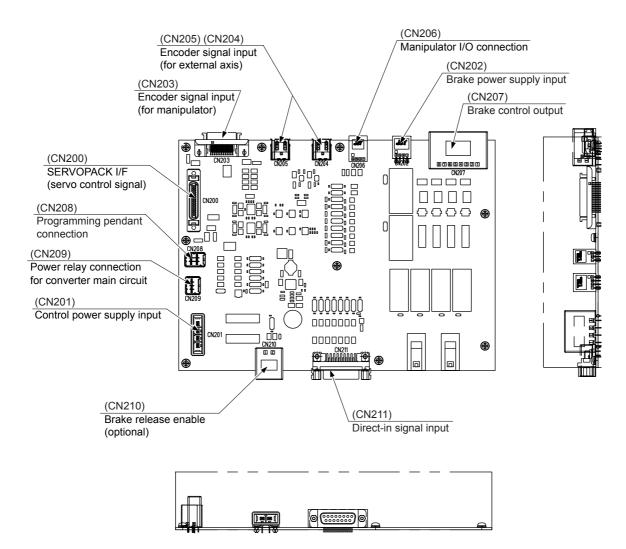
R90, 1R6, 3R8, 5R5, 120 (5 types in total)

13.5 I/O Relay Circuit Board (CSTR-FBBCA8R03CAA)

13.5 I/O Relay Circuit Board (CSTR-FBBCA8R03CAA)

This circuit board transmits and receives the encoder signals and the control I/O signals to and from the SERVOPACK.

Also, it controls the ON/OFF of brake relay by the control signal from the major axes control circuit board (CSTR-IFBM3LB).



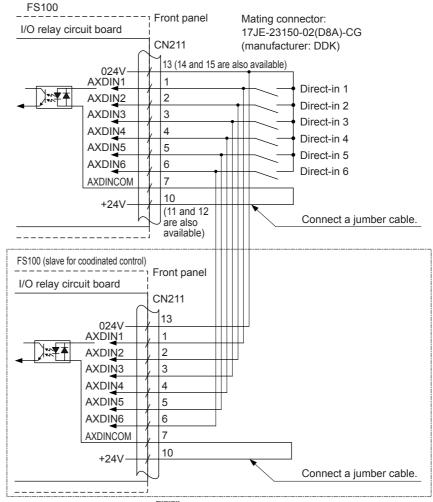
FS100 Front View

13.5 I/O Relay Circuit Board (CSTR-FBBCA8R03CAA)

13.5.1 Connection for Direct-in Signal

This signal is used to input responsive signals when using the search function, etc. An example connection is shown in *fig. 13-8 "Example Connection for Direct-in Signal (AXDIN1 to AXDIN6)"*.

Fig. 13-8: Example Connection for Direct-in Signal (AXDIN1 to AXDIN6)



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

- 13 Description of Units and Circuit Boards
- 13.6 User I/O Circuit Board for Japan and North America: (JAPMC-IO2308R-E, Abbreviated as LIO-08R)

13.6 User I/O Circuit Board for Japan and North America: (JAPMC-IO2308R-E, Abbreviated as LIO-08R)



Regarding the user I/O circuit board for the FS100 for Europe (JAPMC-IO2309R-E, abbreviated as LIO-09R), refer to chapter 13.7 "User I/O Circuit Board for Europe: (JAPMC-IO2309R-E, Abbreviated as LIO-09R)" at page 13-32.

The FS100 has one user I/O circuit board (JAPMC-IO2308R-E) in its CPU unit as standard.

The user I/O circuit board (JAPMC-IO2308R-E) has 2 connectors for digital input/output (robot user input/output).

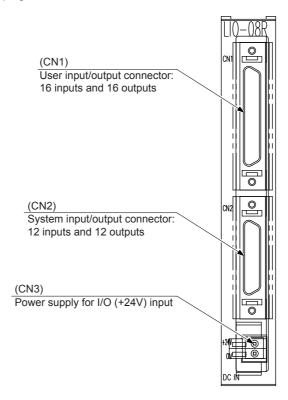
28 inputs and 28 outputs are available.

System input/output and user input/output can be used when allocating these inputs and outputs.

The system input/output is the signal with a function specified in advance. It is mainly used to control the manipulator and related devices as a system from the external control device such as a fixturing controller or a integrated controller, etc.

The user input/output is mainly used in the job of manipulator motion as the timing signal between the manipulator and peripheral devices.

For the details of allocation, refer to fig. 13-11(a) "Connection Diagram of User Input/Output Connector (CN1) of User I/O Circuit Board (JAPMC-IO2308R-E) for Japan and North America" at page 13-26 and fig. 13-11(b) "Connection Diagram of System Input/Output Connector (CN2) of User I/O Circuit Board (JAPMC-IO2308R-E) for Japan and North America" at page 13-27.



	13	Description of Units and Circuit Boards
FS100	13.6	User I/O Circuit Board for Japan and North America: (JAPMC-IO2308R-E, Abbreviated as LIO-08R)

In addition to user input/output, status of LIO-08R can be entered to the external input signal.

Logical number	Signal name	Description		
		Bit content	'1'	'0'
20050	24V_CHK ¹⁾	DC24V Low voltage ditection	Normal	Abnormal (Voltage drop or disconnection of external fuse)
20051	1 (FIXED)		1 (FIXED)	
20052	1 (FIXED)		1 (FIXED)	
20053	1 (FIXED)		1 (FIXED)	
20054	1 (FIXED)		1 (FIXED)	
20055	1 (FIXED)		1 (FIXED)	
20056	MOST1	Module status1	Normal	Abnormal
20057	OSC_CHK	Oscillator stop detection	Abnormal	Normal
20060	MOST	Module status	Abnormal	Normal
20061	1 (FIXED)		1 (FIXED)	
20062	1 (FIXED)		1 (FIXED)	
20063	1 (FIXED)		1 (FIXED)	
20064	1 (FIXED)		1 (FIXED)	
20065	1 (FIXED)		1 (FIXED)	
20066	1 (FIXED)		1 (FIXED)	
20067	1 (FIXED)		1 (FIXED)	

¹ DC24There is an lower voltage detection for the blown detection of DC24V power supply external fuse. When the input voltage is lower than 15V, DC24V lower voltage detection of the status input signal would be an error.

Internal Power Supply

(factory-set)

13.6 User I/O Circuit Board for Japan and North America: (JAPMC-IO2308R-E, Abbreviated as LIO-08R)

13.6.1 Connection for External Power Supply for Input/Output

As standard, the input/output power supply is the internal power supply.

The FS100 can use the internal power supply of approx. 0.5 A, 24 VDC for input/output.

This internal power supply is protected by the fuse (F1: 0.6 A) on the front panel.

To use the FS100 with an external power supply, perform connection as follows:

- Remove the cable connected to the power supply connector (CN3) of the user I/O circuit board from the connector.
 Make sure to insulate the removed cable.
- Connect the external power supply to the power supply connectors of the user I/O circuit board by connecting +24V to CN3-2 and 0V to CN3-1.

To prevent burnout at short circuit of the 24V power supply or short circuit of the output, use an external fuse in the 24V line.

For the details of external fuse, refer to chapter 13.6.2 "Protection by External Fuse" at page 13-22.

FS100 FS100 Front panel Front panel Converter unit Converter unit (CSTR-COB02AA) (CSTR-COB02AA) CN307 +24V CN307 Not used F1: 0.6 A 0.5 A max Remove the pre-connected cable from CN3 of the user I/O circuit board, and insulate it. 024V User I/O circuit board User I/O circuit board (JAPMC-IO2308R-E) (JAPMC-IO2308R-E) CN3 CN3 External power supply 024V +24V

Fig. 13-9: Connection for Power Supply for Input/Output

External Power Supply

+24V/1 A

(User supplied)

13.6 User I/O Circuit Board for Japan and North America: (JAPMC-IO2308R-E, Abbreviated as LIO-08R)

The FS100 can use the internal power supply of approx.
 0.5 A, 24 VDC for input/output.

To use current exceeding the above, or to insulate between the inside and the outside, use the external 24 V power supply.



 Install the external power supply outside the controller to prevent external noise from entering the inside of the controller.

Do not connect the power lines from the external power supply to the terminals CN3-1 and CN3-2 if the connection is set for using the internal power supply (with the pre-connected cable connected).

The internal power supply and the external power supply interfere with each other, which may result in equipment failure.

13.6.2 Protection by External Fuse

The user I/O circuit board (JAPMC-IO2308R-E) does not have a built-in protection device (fuse) for short circuit of the 24 VDC power supply or short circuit of the output, etc.

To prevent burnout, use an external fuse (rated current: 1 A, fast-acting fuse) in the +24V line of external power supply.

The user I/O circuit board has a built-in circuit to detect if the external fuse for the 24 VDC power supply is blown.

Voltage drop of the 24 VDC power supply or a blown external fuse, etc. is detected as an error.

13.6.2.1 Protection by External Fuse in Common Line of Output Signal

If the output current is too large for the rated current (1 A) of the external fuse for the 24 VDC power supply, perform either or both of the following:

- Increase the capacity of the external fuse for the 24 VDC power supply up to the maximum of 2 A. (Use a fast-acting fuse.)
- Add an external fuse in the common line of the output signal.

For CN1, connect an external fuse (fast-acting fuse) with the rated current of 1 A for every 8 outputs.

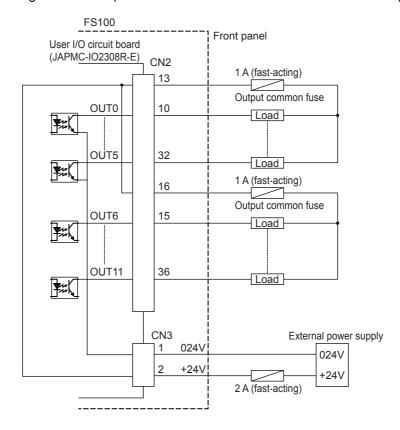
For CN2, connect an external fuse (fast-acting fuse) with the rated current of 1 A for every 6 outputs.

13 Description of Units and Circuit Boards

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13.6 User I/O Circuit Board for Japan and North America: (JAPMC-IO2308R-E, Abbreviated as LIO-08R)

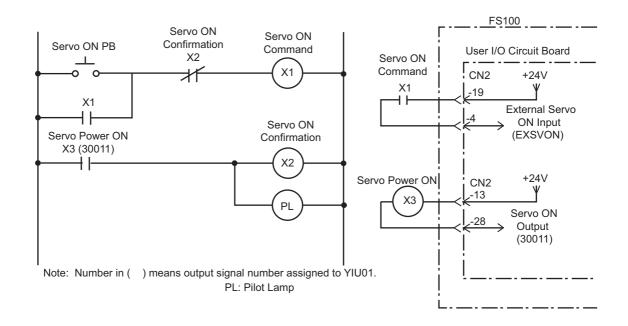
Fig. 13-10: Example Connection for External Fuse in Common Line of Output Signal



13.6 User I/O Circuit Board for Japan and North America: (JAPMC-IO2308R-E, Abbreviated as LIO-08R)

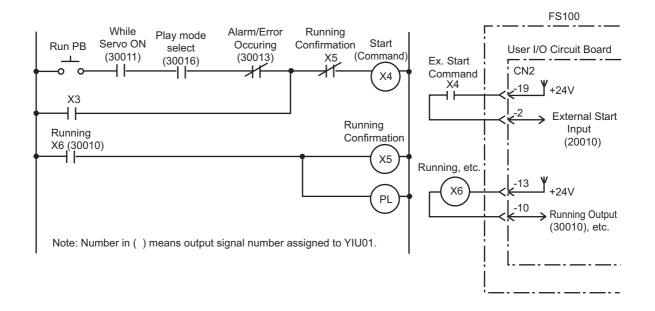
13.6.3 Example of Servo ON Sequence Circuit from External Device

Only the rising edge of the servo ON signal is valid. This signal turns ON the manipulator servo power supply. The set and reset timings are shown in the following.



13.6.4 Example of Start Sequence Circuit from External Device

Only the rising edge of the external start signal is valid. This signal starts the manipulator. Reset this signal with the interlock configuration that determines if operation can start and with the playback (RUNNING) signal confirming that the manipulator has actually started moving.



	13	Description of Units and Circuit Boards
FS100	13.6	User I/O Circuit Board for Japan and North America: (JAPMC-IO2308R-E, Abbreviated as LIO-08R)

13.6.5 Input/Output Connector (CN1, CN2)

When wiring, refer to the types of the input/output connectors (CN1, CN2) of the user I/O circuit board (JAPMC-IO2308R-E) shown below.

13.6.5.1 User Input/Output Connector (CN1)

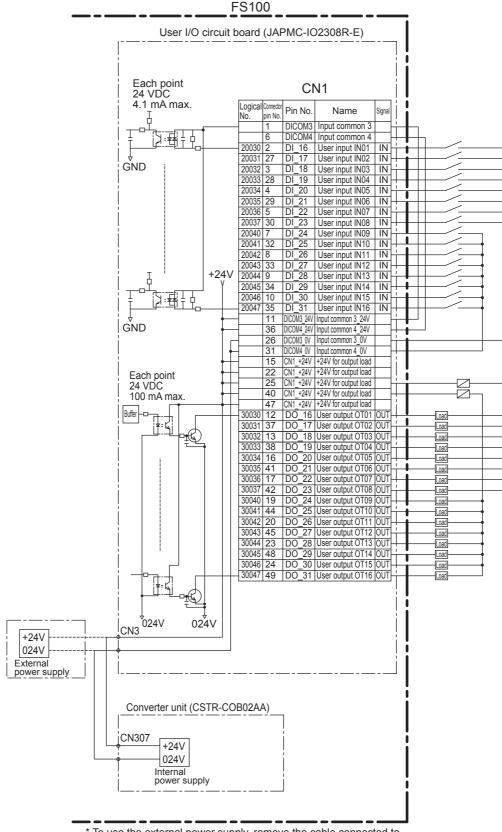
Item	Description	
Used connector	10250-52A3PL (manufacturer: Sumitomo 3M Limited)	
Mating connector	10150-3000PE (manufacturer: Sumitomo 3M Limited) 10350-52A0-008 (manufacturer: Sumitomo 3M Limited) 10350-52F0-008 (manufacturer: Sumitomo 3M Limited)	Connector body Shell, thumbscrew lock type Shell, quick-release latching type

13.6.5.2 System Input/Output Connector (CN2)

Item	Description	
Used connector	10236-52A3PL (manufacturer: Sumitomo 3M Limited)	
Mating connector	10136-3000PE (manufacturer: Sumitomo 3M Limited) 10336-52A0-008 (manufacturer: Sumitomo 3M Limited) 10336-52F0-008 (manufacturer: Sumitomo 3M Limited)	Connector body Shell, thumbscrew lock type Shell, quick-release latching type

- 13 Description of Units and Circuit Boards
- 13.6 User I/O Circuit Board for Japan and North America: (JAPMC-IO2308R-E, Abbreviated as LIO-08R)

Fig. 13-11(a): Connection Diagram of User Input/Output Connector (CN1) of User I/O Circuit Board (JAPMC-IO2308R-E) for Japan and North America

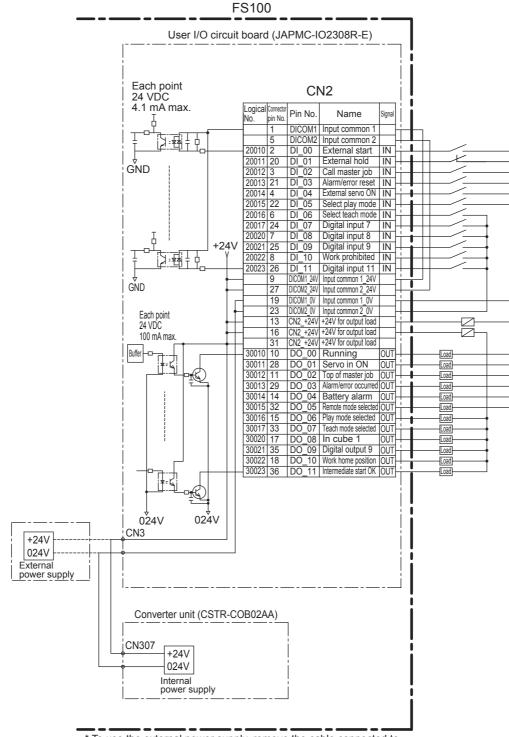


^{*} To use the external power supply, remove the cable connected to the power supply connector (CN3) of the user I/O circuit board from the connector.

Make sure to insulate the removed cable.

13.6 User I/O Circuit Board for Japan and North America: (JAPMC-IO2308R-E, Abbreviated as LIO-08R)

Fig. 13-11(b): Connection Diagram of System Input/Output Connector (CN2) of User I/O Circuit Board (JAPMC-IO2308R-E) for Japan and North America



^{*} To use the external power supply, remove the cable connected to the power supply connector (CN3) of the user I/O circuit board from the connector.

Make sure to insulate the removed cable.

FS100	Description of Units and Circuit Boards User I/O Circuit Board for Japan and North America: (JAPMC-
	 IO2308R-E, Abbreviated as LIO-08R)

Table 13-3: System Input

Logical Number	Input Name/Function
20010	EXTERNAL START Functions the same as the [START] button on the programming pendant. Only the rising edge of the signal is valid. It starts robot operation (playback). This signal is invalid if external start is prohibited from the playback condition display.
20011	EXTERNAL HOLD Functions the same as the [HOLD] button on the programming pendant, and is used when connecting a temporary stop switch of an external control device, etc. Connect a break-contact switch to this signal. When this signal is input (OFF), the JOB is stopped. During the input, the operation cannot be started and the axes cannot be operated. Also, while this signal is OFF, the [HOLD] button on the programming pendant lights up.
	Note that this signal is disabled as the default setting. To enable this signal, enable "EXTERNAL HOLD" in the {OPERATE ENABLE} under the main menu {SETUP} of the programming pendant in the management mode. For details, refer to chapter 13.6.6 "Enabling External Hold" at page 13-29.
20012	CALL MASTER JOB Only the rising edge of the signal is valid. It calls up the top of the robot program, that is the top of the master job ¹⁾ . This signal is invalid during playback, during teach-lock and when play master or call is prohibited (set from the playback operation condition display).
20013	ALARM/ERROR RESET After an alarm or error has occurred and the cause been corrected, this signal resets the alarm or error.
20014	EXTERNAL SERVO ON Turns ON the servo power supply. Only the rising edge of the signal is valid.
20015	SELECT PLAY MODE The play mode is selected when the mode key on the programming pendant is set at "REMOTE". Only the rising edge of the signal is valid. When this selection signal assigned concurrently with other mode selection signal, the teach mode is selected on a priority basis. The signal is invalid while EXTERNAL MODE SWITCH is prohibited.
20016	SELECT TEACH MODE The teach mode is selected when the mode key of the programming pendant is set at "REMOTE". The other mode selection is unavailable when this signal is ON; the signal is selected by priority even when the other selection signal is ON, enabling the teach mode selection.

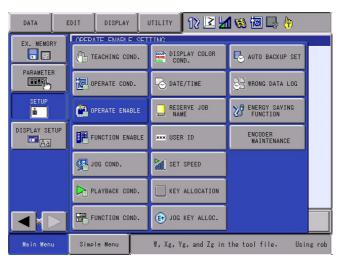
¹ A master job is a job (program) which can be called by CALL MASTER JOB.
Other functions are the same as for normal jobs. Normally, the parent job, which manages the child jobs called up immediately after the power is turned ON, is set as the master job.

13.6 User I/O Circuit Board for Japan and North America: (JAPMC-IO2308R-E, Abbreviated as LIO-08R)

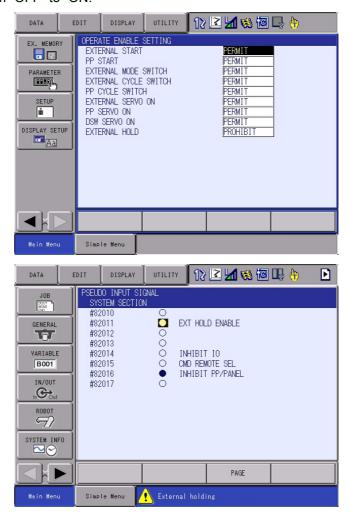
13.6.6 Enabling External Hold

The external hold signal is disabled as the default setting so that the manipulator can be operated without the I/O cable connected. To enable the external hold signal, follow the procedure below.

1. In the management mode, select {OPERATE ENABLE} under the main menu {SETUP}.



2. Switch "EXTERNAL HOLD" from "PROHIBIT" to "PERMIT". By doing so, the pseudo input signal #82011 "EXT HOLD ENABLE" changes from "OFF" to "ON.



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- 13 Description of Units and Circuit Boards
- 13.6 User I/O Circuit Board for Japan and North America: (JAPMC-IO2308R-E, Abbreviated as LIO-08R)

The initial value of the concurrent I/O is as shown below, so the system input #40067 can be controlled by the break-contact switch connected to #20011.



• Be sure to use the break-contact switch for the external hold switch.

 After the setting of the external hold, check to be sure that the external hold functions properly. While the external hold switch is in operation, the [HOLD] button on the programming pendant lights up.

	13	Description of Units and Circuit Boards
FS100	13.6	User I/O Circuit Board for Japan and North America: (JAPMC-IO2308R-E, Abbreviated as LIO-08R)

Table 13-4: System Output

Logical Number	Output Name/Function
30010	RUNNING This signal signifies that the job is running. (Signifies that the job is running, system status is waiting reserved start, or test run is running.) This signal status is the same status as [START] in the programming pendant.
30011	SERVO IS ON This signal signifies that the servo power is turned ON, internal processing such as current position creation is complete, and the system is able to receive the START command. This signal turns OFF when the servo power supply turns OFF. It can be used for FS100 status diagnosis for an external start.
30012	TOP OF MASTER JOB This signal signifies that the execution position is the top of the master job. This signal can be used to confirm that the master job has been called.1)*1
30013	ALARM/ERROR OCCURRED This signal signifies that an alarm or an error occurred. If a major error occurs, this signal remains ON until the main power is turned OFF.
30014	BATTERY ALARM This signal turns ON to notify that the battery requires replacing when the voltage drops from the battery for backup memory of the encoder. Major problems may result if memory data is lost because of an expired battery. It is recommended to avoid these problems by using this signal as a warning signal.
30015 to 30017	REMOTE/PLAY/TEACH MODE SELECTED This signal notifies the current mode setting. These signals are synchronized with the mode select switch in the programming pendant. The signal corresponding to the selected mode turns ON.
30020	WORK COMMAND This signal provides the command for the general tool to operate. TOOL ON instruction execution or the [TOOL ON] key in the programming pendant turns this signal ON and TOOL OFF instruction execution or the [TOOL OFF] key in the programming pendant turns it OFF. However, it remains OFF while the WORK PROHIBITED signal (2022) is input or while the robot is stopped.
30022	WORK HOME POSITION (IN CUBE 64) ²⁾ This signal turns ON when the current TCP lies inside the work home position area. Use this signal to evaluate whether the robot is in the start position.
30023	INTERMEDIATE START OK This signal turns ON when the manipulator operates. It turns OFF when the currently executed line is moved with the cursor or when editing operation is carried out after HOLD is applied during operation. Therefore, this signal can be used as a restart interlock after a HOLD is applied. However, it also turns ON in the teach mode and TEACH MODE SELECTED signal must be referred together.

This signal is not output during operation.
 The work home position cube and Cube 64 are the same.

13.7 User I/O Circuit Board for Europe: (JAPMC-IO2309R-E, Abbreviated as LIO-09R)



Regarding the user I/O circuit board for the FS100 for Japan and North America (JAPMC-IO2308R-E, abbreviated as LIO-08R), refer to chapter 13.6 "User I/O Circuit Board for Japan and North America: (JAPMC-IO2308R-E, Abbreviated as LIO-08R)" at page 13-19.

The FS100 has one user I/O circuit board (JAPMC-IO2309R-E) in its CPU unit as standard.

The user I/O circuit board (JAPMC-IO2309R-E) has 2 connectors for digital input/output (robot user input/output).

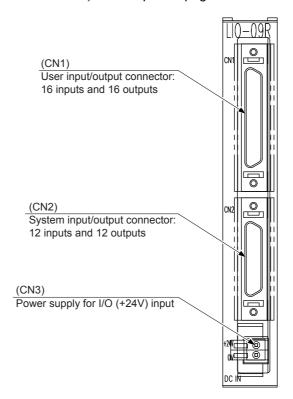
28 inputs and 28 outputs are available.

System input/output and user input/output can be used when allocating these inputs and outputs.

The system input/output is the signal with a function specified in advance. It is mainly used to control the manipulator and related devices as a system from the external control device such as a fixturing controller or a integrated controller, etc.

The user input/output is mainly used in the job of manipulator motion as the timing signal between the manipulator and peripheral devices.

For the details of allocation, refer to fig. 13-14(a) "Connection Diagram of User Input/Output Connector (CN1) of User I/O Circuit Board (JAPMC-IO2309R-E) for Europe" at page 13-39 and fig. 13-14(b) "Connection Diagram of System Input/Output Connector (CN2) of User I/O Circuit Board (JAPMC-IO2309R-E) for Europe" at page 13-40.



	13	Description of Units and Circuit Boards
FS100	13.7	User I/O Circuit Board for Europe: (JAPMC-IO2309R-E, Abbreviated as LIO-09R)

In addition to user input/output, status of LIO-09R can be entered to the external input signal.

Logical number	Signal name	Description		
		Bit content	'1'	'0'
20050	24V_CHK ¹⁾	DC24V Low voltage ditection	Normal	Abnormal (Voltage drop or disconnection of external fuse)
20051	1 (FIXED)		1 (FIXED)	
20052	1 (FIXED)		1 (FIXED)	
20053	1 (FIXED)		1 (FIXED)	
20054	1 (FIXED)		1 (FIXED)	
20055	1 (FIXED)		1 (FIXED)	
20056	MOST1	Module status1	Normal	Abnormal
20057	OSC_CHK	Oscillator stop detection	Abnormal	Normal
20060	MOST	Module status	Abnormal	Normal
20061	1 (FIXED)		1 (FIXED)	
20062	1 (FIXED)		1 (FIXED)	
20063	1 (FIXED)		1 (FIXED)	
20064	1 (FIXED)		1 (FIXED)	
20065	1 (FIXED)		1 (FIXED)	
20066	1 (FIXED)		1 (FIXED)	
20067	1 (FIXED)		1 (FIXED)	

¹ DC24There is an lower voltage detection for the blown detection of DC24V power supply external fuse. When the input voltage is lower than 15V, DC24V lower voltage detection of the status input signal would be an error.

(factory-set)

13.7 User I/O Circuit Board for Europe: (JAPMC-IO2309R-E, Abbreviated as LIO-09R)

13.7.1 Connection for External Power Supply for Input/Output

As standard, the input/output power supply is the internal power supply.

The FS100 can use the internal power supply of approx. 0.5 A, 24 VDC for input/output.

This internal power supply is protected by the fuse (F1: 0.6 A) on the front panel.

To use the FS100 with an external power supply, perform connection as follows:

- Remove the cable connected to the power supply connector (CN3) of the user I/O circuit board from the connector.
 Make sure to insulate the removed cable.
- Connect the external power supply to the power supply connectors of the user I/O circuit board by connecting +24V to CN3-2 and 0V to CN3-1.

To prevent burnout at short circuit of the 24V power supply or short circuit of the output, use an external fuse in the 24V line.

For the details of external fuse, refer to *chapter 13.6.2* "Protection by External Fuse" at page 13-22.

FS100 FS100 Front panel Front panel Converter unit Converter unit (CSTR-COB02AA) (CSTR-COB02AA) CN307 +24V CN307 Not used 0.5 A max. F1: 0.6 A Remove the pre-connected cable from CN3 of the user I/O circuit board, and insulate it. 024V User I/O circuit board User I/O circuit board (JAPMC-IO2309R-E) (JAPMC-IO2309R-E) CN3 CN3 External power supply 024V +24V +24V/1 A (User supplied) Internal Power Supply External Power Supply

Fig. 13-12: Connection for Power Supply for Input/Output

The FS100 can use the internal power supply of approx.
 0.5 A, 24 VDC for input/output.

To use current exceeding the above, or to insulate between the inside and the outside, use the external 24 V power supply.



 Install the external power supply outside the controller to prevent external noise from entering the inside of the controller.

Do not connect the power lines from the external power supply to the terminals CN3-1 and CN3-2 if the connection is set for using the internal power supply (with the pre-connected cable connected).

The internal power supply and the external power supply interfere with each other, which may result in equipment failure.

13.7.2 Protection by External Fuse

The user I/O circuit board (JAPMC-IO2309R-E) does not have a built-in protection device (fuse) for short circuit of the 24 VDC power supply or short circuit of the output, etc.

To prevent burnout, use an external fuse (rated current: 1 A, fast-acting fuse) in the +24V line of external power supply.

The user I/O circuit board has a built-in circuit to detect if the external fuse for the 24 VDC power supply is blown.

Voltage drop of the 24 VDC power supply or a blown external fuse, etc. is detected as an error.

13.7.2.1 Protection by External Fuse in Common Line of Output Signal

If the output current is too large for the rated current (1 A) of the external fuse for the 24 VDC power supply, perform either or both of the following:

- Increase the capacity of the external fuse for the 24 VDC power supply up to the maximum of 2 A. (Use a fast-acting fuse.)
- Add an external fuse in the common line of the output signal.

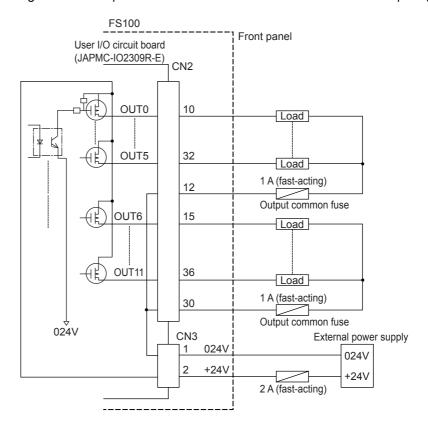
For CN1, connect an external fuse (fast-acting fuse) with the rated current of 1 A for every 8 outputs.

For CN2, connect an external fuse (fast-acting fuse) with the rated current of 1 A for every 6 outputs.

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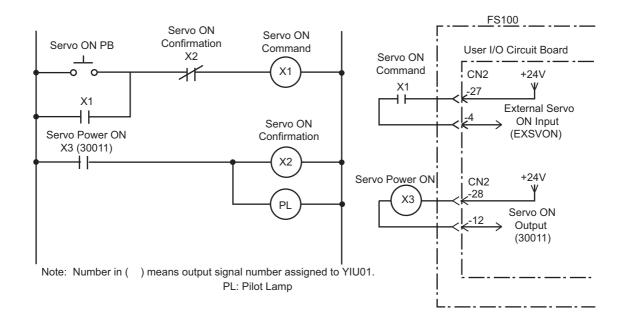
- 13 Description of Units and Circuit Boards
- 13.7 User I/O Circuit Board for Europe: (JAPMC-IO2309R-E, Abbreviated as LIO-09R)

Fig. 13-13: Example Connection for External Fuse in Common Line of Output Signal



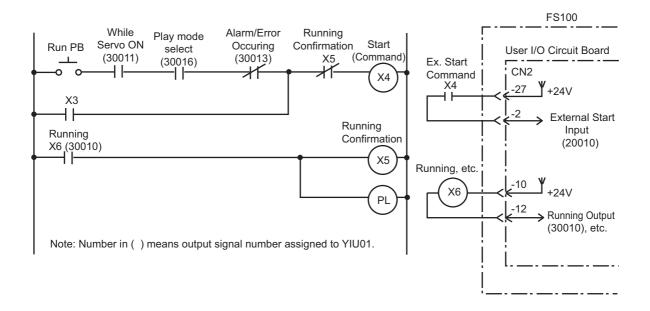
13.7.3 Example of Servo ON Sequence Circuit from External Device

Only the rising edge of the servo ON signal is valid. This signal turns ON the manipulator servo power supply. The set and reset timings are shown in the following.



13.7.4 Example of Start Sequence Circuit from External Device

Only the rising edge of the external start signal is valid. This signal starts the manipulator. Reset this signal with the interlock configuration that determines if operation can start and with the playback (RUNNING) signal confirming that the manipulator has actually started moving.



as LIO-09R)	FS100	13 13.7	Description of Units and Circuit Boards User I/O Circuit Board for Europe: (JAPMC-IO2309R-E, Abbreviated as LIO-09R)
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13.7.5 Input/Output Connector (CN1, CN2)

When wiring, refer to the types of the input/output connectors (CN1, CN2) of the user I/O circuit board (JAPMC-IO2309R-E) shown below.

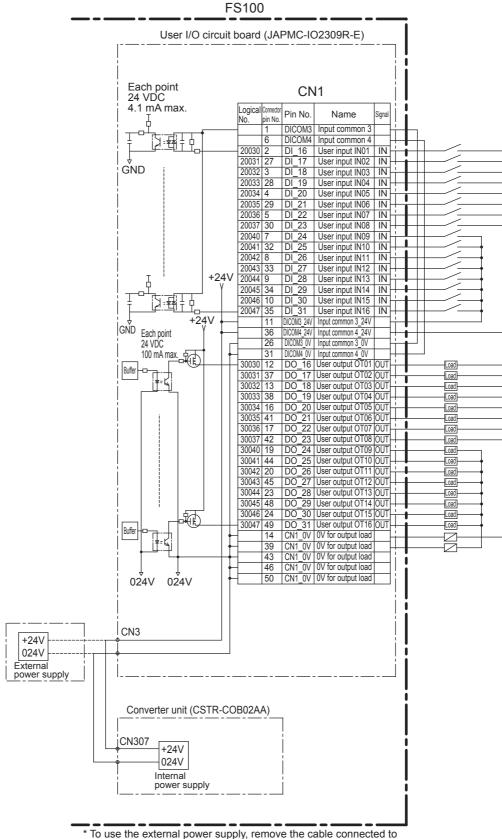
13.7.5.1 User Input/Output Connector (CN1)

Item	Description	
Used connector	10250-52A3PL (manufacturer: Sumitomo 3M Limited)	
Mating connector	10150-3000PE (manufacturer: Sumitomo 3M Limited) 10350-52A0-008 (manufacturer: Sumitomo 3M Limited) 10350-52F0-008 (manufacturer: Sumitomo 3M Limited)	Connector body Shell, thumbscrew lock type Shell, quick-release latching type

13.7.5.2 System Input/Output Connector (CN2)

Item	Description	
Used connector	10236-52A3PL (manufacturer: Sumitomo 3M Limited)	
Mating connector	10136-3000PE (manufacturer: Sumitomo 3M Limited) 10336-52A0-008 (manufacturer: Sumitomo 3M Limited) 10336-52F0-008 (manufacturer: Sumitomo 3M Limited)	Connector body Shell, thumbscrew lock type Shell, quick-release latching type

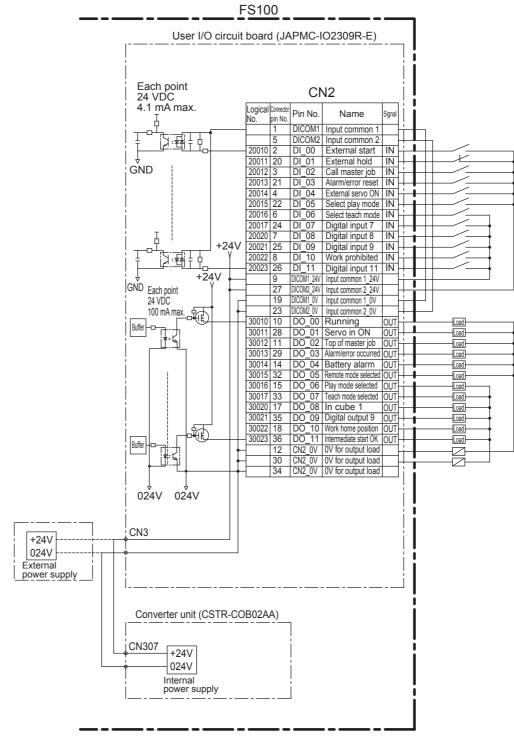
Fig. 13-14(a): Connection Diagram of User Input/Output Connector (CN1) of User I/O Circuit Board (JAPMC-IO2309R-E) for Europe



the power supply connected (CN3) of the user I/O circuit board from the connector.

Make sure to insulate the removed cable.

Fig. 13-14(b): Connection Diagram of System Input/Output Connector (CN2) of User I/O Circuit Board (JAPMC-IO2309R-E) for Europe



^{*} To use the external power supply, remove the cable connected to the power supply connector (CN3) of the user I/O circuit board from the connector.

Make sure to insulate the removed cable.

	13	Description of Units and Circuit Boards
FS100	13.7	User I/O Circuit Board for Europe: (JAPMC-IO2309R-E, Abbreviated as LIO-09R)

Table 13-5: System Input

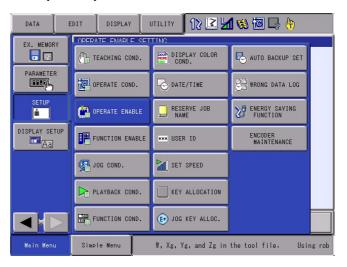
Logical Number	Input Name/Function
20010	EXTERNAL START Functions the same as the [START] button in the programming pendant. Only the rising edge of the signal is valid. It starts robot operation (playback). This signal is invalid if external start is prohibited from the playback condition display.
20011	EXTERNAL HOLD Functions the same as the [HOLD] button on the programming pendant, and is used when connecting a temporary stop switch of an external control device, etc. Connect a break-contact switch to this signal. When this signal is input (OFF), the JOB is stopped. During the input, the operation cannot be started and the axes cannot be operated. Also, while this signal is OFF, the [HOLD] button on the programming pendant lights up.
	Note that this signal is disabled as the default setting. To enable this signal, enable "EXTERNAL HOLD" in the {OPERATE ENABLE} under the main menu {SETUP} of the programming pendant in the management mode. For details, refer to chapter 13.7.6 "Enabling External Hold" at page 13-42.
20012	CALL MASTER JOB Only the rising edge of the signal is valid. It calls up the top of the robot program, that is the top of the master job ¹⁾ . This signal is invalid during playback, during teach-lock and when play master or call is prohibited (set from the playback operation condition display).
20013	ALARM/ERROR RESET After an alarm or error has occurred and the cause been corrected, this signal resets the alarm or error.
20014	EXTERNAL SERVO ON Turns ON the servo power supply. Only the rising edge of the signal is valid.
20015	SELECT PLAY MODE The play mode is selected when the mode key on the programming pendant is set at "REMOTE". Only the rising edge of the signal is valid. When this selection signal assigned concurrently with other mode selection signal, the teach mode is selected on a priority basis. The signal is invalid while EXTERNAL MODE SWITCH is prohibited.
20016	SELECT TEACH MODE The teach mode is selected when the mode key of the programming pendant is set at "REMOTE". The other mode selection is unavailable when this signal is ON; the signal is selected by priority even when the other selection signal is ON, enabling the teach mode selection.

A master job is a job (program) which can be called by CALL MASTER JOB.
 Other functions are the same as for normal jobs. Normally, the parent job, which manages the child jobs called up immediately after the power is turned ON, is set as the master job.

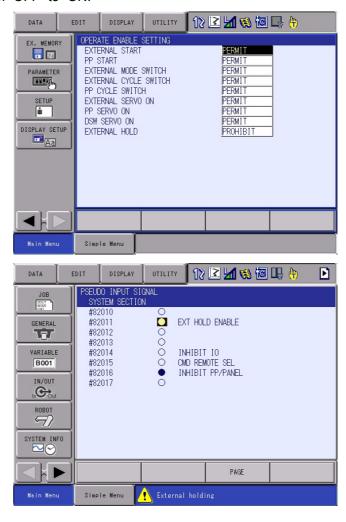
13.7.6 Enabling External Hold

The external hold signal is disabled as the default setting so that the manipulator can be operated without the I/O cable connected. To enable the external hold signal, follow the procedure below.

1. In the management mode, select {OPERATE ENABLE} under the main menu {SETUP}.



2. Switch "EXTERNAL HOLD" from "PROHIBIT" to "PERMIT". By doing so, the pseudo input signal #82011 "EXT HOLD ENABLE" changes from "OFF" to "ON.



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- 13.7 User I/O Circuit Board for Europe: (JAPMC-IO2309R-E, Abbreviated as LIO-09R)

The initial value of the concurrent I/O is as shown below, so the system input #40067 can be controlled by the break-contact switch connected to #20011.



• Be sure to use the break-contact switch for the external hold switch.

 After the setting of the external hold, check to be sure that the external hold functions properly. While the external hold switch is in operation, the [HOLD] button on the programming pendant lights up.

FS100	13 13.7	Description of Units and Circuit Boards User I/O Circuit Board for Europe: (JAPMC-IO2309R-E, Abbreviated as LIO-09R)

Table 13-6: System Output

Logical Number	Output Name/Function
30010	RUNNING This signal signifies that the job is running. (Signifies that the job is running, system status is waiting reserved start, or test run is running.) This signal status is the same status as [START] in the programming pendant.
30011	SERVO IS ON This signal signifies that the servo power is turned ON, internal processing such as current position creation is complete, and the system is able to receive the START command. This signal turns OFF when the servo power supply turns OFF. It can be used for FS100 status diagnosis for an external start.
30012	TOP OF MASTER JOB This signal signifies that the execution position is the top of the master job. This signal can be used to confirm that the master job has been called. ^{1)*1}
30013	ALARM/ERROR OCCURRED This signal signifies that an alarm or an error occurred. If a major error occurs, this signal remains ON until the main power is turned OFF.
30014	BATTERY ALARM This signal turns ON to notify that the battery requires replacing when the voltage drops from the battery for backup memory of the encoder. Major problems may result if memory data is lost because of an expired battery. It is recommended to avoid these problems by using this signal as a warning signal.
30015 to 30017	REMOTE/PLAY/TEACH MODE SELECTED This signal notifies the current mode setting. These signals are synchronized with the mode select switch in the programming pendant. The signal corresponding to the selected mode turns ON.
30020	WORK COMMAND This signal provides the command for the general tool to operate. TOOL ON instruction execution or the [TOOL ON] key in the programming pendant turns this signal ON and TOOL OFF instruction execution or the [TOOL OFF] key in the programming pendant turns it OFF. However, it remains OFF while the WORK PROHIBITED signal (2022) is input or while the robot is stopped.
30022	WORK HOME POSITION (IN CUBE 64) ²⁾ This signal turns ON when the current TCP lies inside the work home position area. Use this signal to evaluate whether the robot is in the start position.
30023	INTERMEDIATE START OK This signal turns ON when the manipulator operates. It turns OFF when the currently executed line is moved with the cursor or when editing operation is carried out after HOLD is applied during operation. Therefore, this signal can be used as a restart interlock after a HOLD is applied. However, it also turns ON in the teach mode and TEACH MODE SELECTED signal must be referred together.

This signal is not output during operation.
 The work home position cube and Cube 64 are the same.

A

	absolute data	8-
	absolute encoder	
	ACCELARATION SPEED	. 11-2
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