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

MOTOMAN INSTRUCTIONS

MOTOMAN-BMDA5 INSTRUCTIONS
FS100 INSTRUCTIONS
FS100 OPERATOR’S MANUAL
FS100 MAINTENANCE MANUAL

The FS100 OPERATOR’S MANUAL above is applicable to both FS100 and FS100L controllers.
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Phone: 937-847-6200

www.motoman.com
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1 Introduction

MANDATORY

• This maintenance manual is intended to explain operating instructions and maintenance procedures primarily for the MOTOMAN-BMDA5.

• General items related to safety are listed in chapter 1: Safety of the FS100 Instructions. To ensure correct and safe operation, carefully read the FS100 instructions before reading this manual.

CAUTION

• Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating and maintenance 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.
We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems (ANSI/RIA R15.06-2012). You can obtain this document from the Robotic Industries Association (RIA) at the following address:

Robotic Industries Association  
900 Victors Way  
P.O. Box 3724  
Ann Arbor, Michigan 48106  
TEL: (734) 994-6088  
FAX: (734) 994-3338  
www.roboticsonline.com

Ultimately, well-trained personnel are the best safeguard against accidents and damage that can result from improper operation of the equipment. The customer is responsible for providing adequately trained personnel to operate, program, and maintain the equipment. NEVER ALLOW UNTRAINED PERSONNEL TO OPERATE, PROGRAM, OR REPAIR THE EQUIPMENT!

We recommend approved Yaskawa training courses for all personnel involved with the operation, programming, or repair of the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
1.1 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.

- **MANDATORY**: Always be sure to follow explicitly the items listed under this heading.

- **PROHIBITED**: Must never be performed.

Even items described as "CAUTION" may result in a serious accident in some situations. At any rate, be sure to follow these important items.

**NOTE**

To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “DANGER”, “WARNING” and “CAUTION”.

---

**DANGER**

- Maintenance and inspection must be performed by specified personnel.

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

- For disassembly or repair, contact your Yaskawa representative.
- Do not remove the motor, and do not release the brake.

  Failure to observe these safety precautions may result in death or serious injury from unexpected turning of the manipulator’s arm.
• Before maintenance, inspection and wiring, make sure to turn OFF the primary power supply, and put up a warning sign. (ex. DO NOT TURN ON THE POWER)

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

• After completing the maintenance inspection, make sure where is the home position before operating the manipulator.

Failure to observe this warning may cause unexpected manipulator motion, resulting in collision or 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.

• In the case of not using the programming pendant, be sure to supply the emergency stop button on the equipment. Then before operating the manipulator, check to be sure that the servo power is turned OFF by pressing the emergency stop button.

Connect the external emergency stop button to the 5-6 pin and 16-17 pin of the robot system signal connector (CN2).

• Upon shipment of the FS100, this signal is connected by a jumper cable in the dummy connector. To use the signal, make sure to supply a new connector, and then input it.

If the signal is input with the jumper cable connected, it does not function, which may result in personal injury or equipment damage.

• Once the emergency stop button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn the servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

• 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.
- Operating the manipulator with the programming pendant.
- Running the system in the check mode.
- Performing automatic operations.

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation.

Always press an emergency stop button immediately if there is a problem. The emergency stop button is located on the right of the programming pendant.
1 Introduction

1.2 Definition of Terms Used Often in This Manual

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

In this manual, the equipment is designated as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS100 Controller</td>
<td>FS100</td>
</tr>
<tr>
<td>FS100 Programming Pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator cable</td>
</tr>
<tr>
<td>FS100 programming pendant dummy connector</td>
<td>Programming pendant dummy connector</td>
</tr>
</tbody>
</table>
1.3 Registered Trademark

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

1.4 Explanation of Nameplate

The following nameplate is attached to the manipulator. Important information for the manipulator such as its type, serial number, and weight is engraved on the nameplate. Prior to operating the manipulator, confirm the contents.
1.5 Customer Support Information

If you need assistance with any aspect of your BMDA5 system, please contact Motoman Customer Support at the following 24-hour telephone number:

(937) 847-3200

For routine technical inquiries, you can also contact Motoman Customer Support at the following e-mail address:

techsupport@motoman.com

When using e-mail to contact Motoman Customer Support, please provide a detailed description of your issue, along with complete contact information. Please allow approximately 24 to 36 hours for a response to your inquiry.

Please use e-mail for routine inquiries only. If you have an urgent or emergency need for service, replacement parts, or information, you must contact Motoman Customer Support at the telephone number shown above.

Please have the following information ready before you call:

- System: BMDA5
- Primary Application: Bio Medical
- Controller: FS100
- Software Version: Access this information on the Programming Pendant's LCD display screen by selecting {MAIN MENU} - {SYSTEM INFO} - {VERSION}
- Robot Serial Number: Located on the robot data plate
- Robot Sales Order Number: Located on the FS100 controller data plate
2 Absolute Data Recovery Procedures

2.1 Outline

When a wire harness in a manipulator is disconnected, an encoder that this manipulator type uses for detecting its position loses rotation data (multiturn data). The purpose of the battery backup alarm recovery function is to recover a home position when multiturn data is cleared. For this recovery, the home position calibration should be performed using "home position calibration key slot" set to each axis of a manipulator.

2.2 Function

The following section explains the principle of the battery backup alarm recovery function. The motor position PMH at the home position calibration is represented by home position calibration data (following equation).

\[ PMH = (N_1 \text{ rotation } \times \text{PPR}) + P_1 \text{ pulse} \]

- \( N_1 \): Multiturn data at the home position calibration
- \( \text{PPR} \): The number of pulse per 1 rotation of an encoder
- \( P_1 \): Data in 1 rotation at the home position calibration

When a signal line of wire harness in a manipulator is disconnected, multiturn data of a serial encoder is cleared at a random point. Move the manipulator near the home position. "Near the home position" indicates the point where each "home position calibration key slot" set to each axis matches. At this point, perform the battery backup alarm recovery function operation. The home position calibration data \( P_{\text{NEW}} \) at this time is represented by the following equation.

\[ P_{\text{NEW}} = (N_2 \text{ rotation } \times \text{PPR}) + P_2 \text{ pulse} \]

- \( N_2 \): Multiturn data at the new home position calibration
- \( P_2 \): Data in 1 rotation at the new home position calibration

Even though multiturn data is cleared, the point in 1 rotation should be the same as \( P_1 \) (the point in 1 rotation at the first home position calibration). Therefore, the true home position (\( P_{\text{TRUE}} \)) is found in the following equation.

\[ P_{\text{TRUE}} = (N_2 \text{ rotation } \times \text{PPR}) + P_1 \text{ pulse} \]
2.3 Recovery Procedures

Fig. 2-1 Recovery Procedures

1. Alarm 4311 "ENCODER BACK-UP ERROR" occurs.
2. Reset the alarm.
Move the axis which causes alarm occurrence to the home position of the manipulator to align "home position calibration key slots". (Refer to Fig. 2-2 "Aligning Key Slots").

![Fig. 2-2 Aligning Key Slots](image)

3. Display the top menu to select {ROBOT}, and then select {HOME POSITION} in the sub menu to display the HOME POSITION CALIBRATION window.
4. Move the cursor to the menu area using the area key, and then select {UTILITY} to display the pull-down menu.
5. Select {BACKUP ALARM RECOVERY} to display the BACKUP ALARM RECOVERY mode window.
6. Point the cursor to the axis which is to be changed, and then select it to display the confirmation dialog box. However, selecting the axis which has no absolute data does not display any dialog boxes.
7. When {YES} is selected, the selected axis is set to the home position, and "●" changes to "○", and then the absolute data becomes "---". Repeat the step 7 and 8 to all the displayed axes.
8. When all settings have finished, the BACKUP ALARM RECOVERY mode window returns to the HOME POSITION CALIBRATION window.
9. Move the axis which causes alarm occurrence to the home position of the manipulator (0 pulse position) again, and then confirm that "home position calibration key slots" are aligned. Depending on the home position, the slots may be misaligned. In this case, enter the value which is increased by 4096 or the value which is decreased by 4096 to absolute data of the misaligned axis using numeric keys, so that "home position calibration key slots" are aligned.
L-axis absolute data: 10000 pulse

-4096 pulse
10000 - 4096 = 5904
Set the 5904 pulse again to the L-axis absolute data.

+4096 pulse
10000 + 4096 = 14096
Set the 14096 pulse again to the L-axis absolute data.

Fig. 2-3 Correction of the Result
3 Manipulator Replacement Procedures

WARNING

• Do not start the manipulator or even turn ON the power before it is firmly anchored. The manipulator may overturn and cause injury or damage.

CAUTION

• Sling applications and crane or forklift operations must be performed by authorized personnel only.

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

• Avoid excessive vibration or shock during transport.

Failure to observe this caution may adversely affect the performance as the system consists of precision components.

• Do not install or operate the manipulator which is damaged or lacks parts.

Failure to observe this caution may cause injury or damage.

NOTE

When replacing a manipulator, refer to "Transport" and "Installation" in each section of the instructions.
3.1 Manipulator Replacement Procedures

The following section explains the manipulator replacement procedures.

1. Turn OFF the power supply, and then disconnect the manipulator cable from the manipulator.
2. Remove tools from the manipulator.
3. Remove the manipulator from the installation base.
4. Install a new manipulator.
   - To enhance the repeatability of the position, install the manipulator using positioning pins.
5. Attach the tools.
   - To enhance the repeatability of the position, install the manipulator using positioning pins.
6. Connect the manipulator with the controller, and then turn ON the power supply.
7. Change the absolute data of the controller.
   - Enter the value indicated on the absolute data label delivered with the new manipulator.
   - For how to change the absolute data, refer to section 8.1 “Changing the Absolute Data Home Position Calibration” described in FS100 INSTRUCTIONS.
   - Absolute data label is also attached to the inner part of the manipulator cover.

8. Replace the absolute data label on the controller side.
   - Since the absolute data label is attached to the upper part of the controller cover rear side, attach the absolute data label of the new manipulator on the old one.
9. Change the posture of the manipulator to the home position posture.
   - Confirm that absolute data is rewritten correctly.
10. Perform teaching correction.
    - Since each manipulator has a difference to another, teaching points may vary. Move the manipulator in the teach mode to the points where accuracy of positioning is necessary or where interference is severe, and then perform teaching correction when teaching points are different from the correct point.
    - When teaching points tend to slide to the same direction, correct the gap using the parallel shifting function. (Refer to chapter 6 “Convenient Functions” in the FS100 OPERATOR’S MANUAL.)
11. When teaching correction finishes, perform test operation, and then confirm that the manipulator operates normally.

Fig. 3-4 Location of the Absolute Data Label

Absolute data label (Example)
4 Removal and Installation Procedures of Actuator

When removing and installing an actuator, prepare the following items.

**NOTE**
- When applying sealing bond in the actuator connection process, remove remaining sealing bond on the applying surface in advance and degrease the surface, and then apply sealing bond. For removing the Loctite 518, use the Loctite gasket remover 79040. For removing the Loctite 242, use the Loctite Gasket Remover 7200.
- When fixing cables using a cable tie in the installation process of an actuator, fix the central part of the vinyl tape which bundles cables.

When removing and installing an actuator, prepare the following items.

<table>
<thead>
<tr>
<th>BMDA5</th>
<th>Name</th>
<th>Type</th>
<th>Qty</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation-axis</td>
<td>Name</td>
<td>Type</td>
<td>Qty</td>
<td>Manufacturer</td>
</tr>
<tr>
<td>o</td>
<td>Jig</td>
<td>HW1400322-2</td>
<td>1</td>
<td>Yaskawa</td>
</tr>
<tr>
<td>o</td>
<td>Battery</td>
<td>HW0472612-A</td>
<td>2</td>
<td>Yaskawa</td>
</tr>
<tr>
<td>o</td>
<td>Sealing bond (liquid gasket)</td>
<td>ThreeBond 1206C</td>
<td>-</td>
<td>ThreeBond Co., Ltd.</td>
</tr>
<tr>
<td>o</td>
<td>Sealing bond</td>
<td>Loctite 518</td>
<td>-</td>
<td>Henkel Japan Ltd.</td>
</tr>
<tr>
<td>o</td>
<td>Adhesive for preventing screw looseness</td>
<td>Loctite 242</td>
<td>-</td>
<td>Henkel Japan Ltd.</td>
</tr>
<tr>
<td>o</td>
<td>Grease</td>
<td>(1) MP1 grease or (2) Harmonic Grease SK-1A</td>
<td>-</td>
<td>(1) Nippon Grease Co., Ltd. (2) Harmonic Drive Systems Inc.</td>
</tr>
</tbody>
</table>
4.1 Removal and Installation Procedures of T-Axis Actuator

- Refer to Fig. 4-5 "Removal and Installation of T-Axis Actuator" and Table 4-1 "Parts Checklist (Removal and Installation of T-Axis Actuator).

- [Preparation]
  - Loctite 518 (sealing bond)

**Removal of T-Axis Actuator**

1. Change the posture of the arm on the side where the actuator is to be removed to the home position posture.
2. Turn OFF the power supply of the FS100.
3. Remove the hexagon head screws M3 (5), and then remove the cover (6) and the gasket (7).
4. Remove all the connectors of the cable (4) inside the cover (6).
   - Remove the vinyl which protects the connector, and then remove the connector.
5. Remove the hexagon socket head cap screws M4 (3) (8 screws), and then remove the flange (8).
   - [View A] For removing, use the tapped holes M4 (2 places) of the flange (8).
6. Remove the hexagon socket head cap screws M4 (9) (2 screws), and then remove the holder (10) and the spacer (11).
   - [View B] For removing, use the tapped holes M4 (2 places) of the spacer (11).
7. Remove the hexagon socket head cap screws M3 (12) (12 screws), and then remove the T-axis actuator (1) from the arm (2).
8. Remove the hexagon socket head cap screws M2 (13) (5 screws), and then remove the pipe (14).
Installation of T-Axis Actuator

1. Attach the washers M2 to the hexagon socket head cap screws M2 (13) (5 screws), and then attach the pipe (14) to the T-axis actuator (1).
   [Tightening torque: 0.34 N·m (0.035 kgf·m)]

2. Apply sealing bond (Loctite 518) to the T-axis actuator (1) as shown in the View C. Attach the T-axis actuator (1) to the arm (2) in the direction shown in the View C.
   • For attaching, pass the cable (4) through the T-axis actuator (1).
   [Caution] When inserting the T-axis actuator (1) in the arm (2), do not give a shock to the actuator by hitting it.

3. Attach the conical spring washers 2H-3 to the hexagon socket head cap screws M3 (12) (12 screws), and then fix the T-axis actuator (1) to the arm (2).
   [Tightening torque: 1.4 N·m (0.14 kgf·m)]

4. Apply sealing bond (Loctite 518) to the T-axis actuator (1) as shown in the View B.

5. Attach the conical spring washers 2H-4 to the hexagon socket head cap screws M4 (9) (2 screws), and then attach the spacer (11) and the holder (10) to the T-axis actuator (1) in the direction shown in the View D.
   [Tightening torque: 4.0 N·m (0.41 kgf·m)]

6. Apply sealing bond (Loctite 518) to the holder (10) as shown in the View D.

7. Attach the conical spring washers 2H-4 to the hexagon head screws M4 (3) (8 screws), and then attach the flange (8) to the holder (10).
   [Tightening torque: 4.0 N·m (0.41 kgf·m)]

8. Attach all the connectors of the cable (4) inside the cover (6).
   • Attach the vinyl (17) which protects the connectors, and then fix them with the cable tie (16).

9. Attach the washers M3 to the hexagon head screws M3 (5) (5 screws), and then attach the cover (6) and the gasket (7).
   [Tightening torque: 0.5 N·m (0.052 kgf·m)]

Apply LOCTITE 518 to the shaded area.

Fig. 4-5 Removal and Installation of T-Axis Actuator
Table 4-1  Parts Checklist (Removal and Installation of T-Axis Actuator)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>T-axis actuator SGAGS-370PA26-YR1</td>
<td>1</td>
</tr>
<tr>
<td>(2)</td>
<td>Arm (wrist) HW0201331-2</td>
<td>1</td>
</tr>
<tr>
<td>(3)</td>
<td>Hexagon socket head cap screw M4 (length: 25 mm)</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2H-4 (TRIVALENT CHROMATE)</td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>Cable (Wire harness in arm part)</td>
<td>1 each</td>
</tr>
<tr>
<td></td>
<td>R1 side (Left-arm): HW1171402-A, R2 side (Right-arm): HW1171402-B</td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>Hexagon head screw M3 (length: 8 mm) (STAINLESS)</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Washer M3 (STAINLESS)</td>
<td></td>
</tr>
<tr>
<td>(6)</td>
<td>Cover (wrist cover) HW0201358-1</td>
<td>1</td>
</tr>
<tr>
<td>(7)</td>
<td>Gasket HW1400063-2</td>
<td>1</td>
</tr>
<tr>
<td>(8)</td>
<td>Flange HW1300045-2</td>
<td>1</td>
</tr>
<tr>
<td>(9)</td>
<td>Hexagon socket head cap screw M4 (length: 18 mm)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2H-4</td>
<td></td>
</tr>
<tr>
<td>(10)</td>
<td>Holder HW1400053-2</td>
<td>1</td>
</tr>
<tr>
<td>(11)</td>
<td>Spacer HW1300047-2</td>
<td>1</td>
</tr>
<tr>
<td>(12)</td>
<td>Hexagon socket head cap screw M3 (length: 50 mm)</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2H-3 (TRIVALENT CHROMATE)</td>
<td></td>
</tr>
<tr>
<td>(13)</td>
<td>Hexagon socket head cap screw M2 (length: 5 mm)</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Washer M2</td>
<td></td>
</tr>
<tr>
<td>(14)</td>
<td>Pipe HW0415358-1</td>
<td>1</td>
</tr>
<tr>
<td>(15)</td>
<td>Bearing 6702LLF</td>
<td>1</td>
</tr>
<tr>
<td>(16)</td>
<td>Cable tie T50R</td>
<td>2</td>
</tr>
<tr>
<td>(17)</td>
<td>Vinyl HW9405566-1</td>
<td>1</td>
</tr>
</tbody>
</table>
4.2 Removal and Installation Procedures of B-Axis Actuator

- Refer to Fig. 4-6 "Removal and Installation of B-Axis Actuator" and Table 4-2 "Parts Checklist (Removal and Installation of B-Axis Actuator)".
- [Preparation]
  - Loctite 518 (sealing bond)

### Removal of B-Axis Actuator

1. Change the posture of the arm on the side where the actuator is to be removed to the home position posture.
2. Turn OFF the power supply of the FS100.
3. Remove the hexagon head screws M3 (5) (12 screws), and then remove the covers (6) (a and b) and the gaskets (7) (a and b).
4. Remove all the connectors of the cable (4) inside the covers (6) (a and b).
   - Remove the vinyl (14) which protects the connector, and then remove the connector.
5. Cut the cable ties (8) (3 screws) fixing the cable (4) using a nipper.
6. Disconnect the cable (4) from the B-axis actuator (1).
   (Disconnect it in the direction of the arrow D.)
7. Remove the hexagon socket head cap screws M4 (9) (9 screws), and then remove the arm (2).
   - [View A] For removing, use the tapped holes M4 (2 places) of the arm (2).
8. Remove the hexagon socket head cap screws M3 (10) (12 screws), and then remove the B-axis actuator (1) from the arm (3).
   - [View B] For removing, use the tapped holes M3 (2 places) of the B-axis actuator (1).
9. Remove the hexagon socket head cap screws M2 (11) (5 screws), and then remove the pipe (12).
Installation of B-Axis Actuator

1. Apply sealing bond (Loctite 518) to the B-axis actuator (1) as shown in the View C. Attach the B-axis actuator (1) to the arm (3) in the direction shown in the View C. [Caution] When inserting the B-axis actuator (1) in the arm (3), do not give a shock to the actuator by hitting it.

2. Attach the conical spring washers 2H-3 to the hexagon socket head cap screws M3 (12 screws), and then fix the B-axis actuator (1) to the arm (3). [Tightening torque: 1.4 N·m (0.14 kgf·m)]

3. Apply sealing bond (Loctite 518) to the B-axis actuator (1) as shown in the View B.

4. Attach the conical spring washers 2H-4 to the hexagon socket head cap screws M4 (9) (9 screws), and then attach the arm (2) to the B-axis actuator (1). [Tightening torque: 4.0 N·m (0.41 kgf·m)]

5. Attach the washers M2 to the hexagon socket head cap screws M2 (11) (5 screws), and then attach the pipe (12) to the B-axis actuator (1). [Tightening torque: 0.34 N·m (0.035 kgf·m)]

6. Pass the cable (4) through the B- and T-axis actuators. (Pass it through in the opposite direction of the arrow D.)

7. Fix the cable (4) using the cable ties (8) (3 screws). [Caution] Fix the central part of the vinyl tape which bundles cables.

8. Attach all the connectors of the cable (4) inside the covers (6) (a and b). • Attach the vinyl (14) which protects the connectors, and then fix them with the cable tie (13).

9. Attach the washers M3 to the hexagon head screws M3 (5) (12 screws), and then attach the covers (6) (a and b) and the gaskets (7) (a and b). [Tightening torque: 0.5 N·m (0.052 kgf·m)]

Fig. 4-6  Removal and Installation of B-Axis Actuator

Apply LOCTITE 518 to the shaded area.

(1) B-axis actuator

View B

(2) Arm
Tapped holes M4 (diagonal) (2 places)
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>B-axis actuator SGAGS-920PA29-YR1*</td>
<td>1</td>
</tr>
<tr>
<td>(2)</td>
<td>Arm (wrist) HW0201331-2</td>
<td>1</td>
</tr>
<tr>
<td>(3)</td>
<td>Arm (wrist base) HW0102777-2</td>
<td>1</td>
</tr>
<tr>
<td>(4)</td>
<td>Cable (Wire harness in arm part)</td>
<td>1 each</td>
</tr>
<tr>
<td></td>
<td>R1 side (Left-arm): HW1171402-A, R2 side (Right-arm): HW1171402-B</td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>Hexagon head screw M3 (length: 8 mm) (STAINLESS)</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Washer M3 (STAINLESS)</td>
<td></td>
</tr>
<tr>
<td>(6)a</td>
<td>Cover (wrist cover) HW0201358-1</td>
<td>1</td>
</tr>
<tr>
<td>(6)b</td>
<td>Cover (wrist base cover) HW0201349-1</td>
<td>1</td>
</tr>
<tr>
<td>(7)a</td>
<td>Gasket HW1400063-2</td>
<td>1</td>
</tr>
<tr>
<td>(7)b</td>
<td>Gasket HW1400062-2</td>
<td>1</td>
</tr>
<tr>
<td>(8)</td>
<td>Cable tie T50R</td>
<td>3</td>
</tr>
<tr>
<td>(9)</td>
<td>Hexagon socket head cap screw M4 (length: 12 mm),</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2H-4</td>
<td></td>
</tr>
<tr>
<td>(10)</td>
<td>Hexagon socket head cap screw M3 (length: 50 mm) (TRIVALENT CHROMATE)</td>
<td>12</td>
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<td></td>
<td>Conical spring washer 2H-3 (TRIVALENT CHROMATE)</td>
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</tr>
<tr>
<td>(11)</td>
<td>Hexagon socket head cap screw M2 (length: 5 mm),</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Washer M2</td>
<td></td>
</tr>
<tr>
<td>(12)</td>
<td>Pipe HW0415358-1</td>
<td>1</td>
</tr>
<tr>
<td>(13)</td>
<td>Cable tie T50R</td>
<td>4</td>
</tr>
<tr>
<td>(14)</td>
<td>Vinyl HW9405566-1</td>
<td>2</td>
</tr>
</tbody>
</table>
4.3 Removal and Installation Procedures of R-Axis Actuator

- Refer to Fig. 4-7 "Removal and Installation of R-Axis Actuator" and Table 4-3 "Parts Checklist (Removal and Installation of R-Axis Actuator)".

- [Preparation]
  ThreeBond 1206C (sealing bond)
  Loctite 518 (sealing bond)
  Loctite 242 (Adhesive for preventing screw looseness)
  MP1 grease (or Harmonic Grease SK-1A)

### Removal of R-Axis Actuator

1. Change the posture of the arm on the side where the actuator is to be removed to the home position posture.
2. Turn OFF the power supply of the FS100.
3. Remove the hexagon head screws M3 (5)a (12 screws) and the hexagon head screws M4 (5)b (5 screws), and then remove the covers (6) (a to c) and the gaskets (7) (a to c).
4. Remove all the connectors of the cable (4) inside the covers (6) (a to c).
   - Remove the vinyl (15) which protects the connector, and then remove the connector.
5. Cut the cable ties (20) (5 screws) fixing the cable (4) using a nipper.
6. Disconnect the cable (4) from the R-, B-, and T-axis actuator.
   (Disconnect it in the direction of the arrow E.)
7. Remove the hexagon head screws M4 (8) (6 screws) and the hexagon socket head cap screws M4 (9) (2 screws), and then remove the arm (2) and the plate (10).
   - [View A] For removing, use the tapped holes M4 (2 places) of the arm (2).
8. Remove the hexagon socket head cap screws M3 (11) (12 screws), and then remove the spacer (12).
   - [View B] For removing, use the tapped holes M3 (2 places) of the spacer (12).
9. Remove the hexagon socket head cap screws M3 (13) (12 screws), and then remove the R-axis actuator (1) from the arm (3).
   - [View C] For removing, use the tapped holes M3 (2 places) of the R-axis actuator (1).
10. Remove the hexagon socket head cap screws M2.5 (16) (6 screws), and then remove the pipe (17).
11. Remove the hexagon socket head cap screws M2 (18) (4 screws), and then remove the plate (19).
**Installation of R-Axis Actuator**

1. Apply sealing bond (ThreeBond 1206C) to the plate (19) as shown in the View F.
2. Apply LOCTITE 242 (adhesive for preventing screw looseness) to the hexagon socket head cap screws M2 (18) (4 screws), and then attach the plate (19) to the R-axis actuator (1).
   [Tightening torque: 0.44 N·m (0.045 kgf·m)]
3. Attach the washers M2.6 to the hexagon socket head cap screws M2.5 (16) (6 screws), and then attach the pipe (17) to the R-axis actuator (1).
   [Tightening torque: 1.1 N·m (0.11 kgf·m)]
4. Apply sealing bond (Loctite 518) to the R-axis actuator (1) as shown in the View D. Attach the R-axis actuator (1) to the arm (3) in the direction shown in the View D.
   [Caution] When inserting the R-axis actuator (1) in the arm (3), do not give a shock to the actuator by hitting it.
5. Attach the conical spring washers 2H-3 to the hexagon socket head cap screws M3 (13) (12 screws), and then fix the R-axis actuator (1) to the arm (3).
   [Tightening torque: 1.9 N·m (0.19 kgf·m)]
6. Apply sealing bond (Loctite 518) to the R-axis actuator (1) as shown in the View C.
   [Caution] Be careful that sealing bond does not adhere to the tooth surface of the speed reducer.
7. Apply MP1 grease (or Harmonic Grease SK-1A) to the lip part of the V-ring (14).
8. Attach the conical spring washers 2H-3 to the hexagon socket head cap screws M3 (11) (12 screws), and then attach the spacer (12) to the R-axis actuator (1) in the direction shown in the View B.
   [Tightening torque: 2.25 N·m (0.23 kgf·m)]
9. Apply sealing bond (Loctite 518) to the spacer (12) as shown in the View B.
10. Attach the conical spring washers 2H-4 to the hexagon head screws M4 (8) (6 screws), and then attach the plate (10) and the arm (2) to the R-axis actuator (1).
    [Tightening torque: 2.8 N·m (0.29 kgf·m)]
11. Attach the GT-LH washers M4 to the hexagon socket head cap screws M4 (9) (2 screws), and then fix the arm (2).
    [Tightening torque: 4.8 N·m (0.49 kgf·m)]
12. Pass the cable (4) through the R-, B-, and T-axis actuators.
    (Pass it through in the opposite direction of the arrow E.)
13. Fix the cable (4) using the cable ties (20) (5 screws).
    [Caution] Fix the central part of the vinyl tape which bundles cables.
14. Attach all the connectors of the cable (4) inside the covers (6) (a to c).
    • Attach the vinyl (15) which protects the connectors, and then fix them with the cable tie (21).
15. Attach the washers M3 to the hexagon head screws M3 (5)a (12 screws), and the washers M4 to the hexagon head screws M4 (5)b (5 screws), and then use them to attach the covers (6) (a to c) and the gaskets (7) (a to c).
    [(5)a Tightening torque: 0.5 N·m (0.052 kgf·m)]
    [(5)b Tightening torque: 1.2 N·m (0.12 kgf·m)]
Fig. 4-7  Removal and Installation of R-Axis Actuator
### Table 4-3  Parts Checklist (Removal and Installation of R-Axis Actuator)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>R-axis actuator SGAGS-411JA2A-YR1*</td>
<td>1</td>
</tr>
<tr>
<td>(2)</td>
<td>Arm (wrist base) HW0102777-2</td>
<td>1</td>
</tr>
<tr>
<td>(3)</td>
<td>Arm (casing) HW0102709-1</td>
<td>1</td>
</tr>
<tr>
<td>(4)</td>
<td>Cable (Wire harness in arm part)</td>
<td>1 each</td>
</tr>
<tr>
<td></td>
<td>R1 side (Left-arm): HW1171402-A, R2 side (Right-arm): HW1171402-B</td>
<td></td>
</tr>
<tr>
<td>(5)a</td>
<td>Hexagon head screw M3 (length: 8 mm) (STAINLESS)</td>
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</tr>
<tr>
<td></td>
<td>Washer M3 (STAINLESS)</td>
<td></td>
</tr>
<tr>
<td>(5)b</td>
<td>Hexagon head screw M4 (length: 16 mm) (STAINLESS)</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Washer M4 (STAINLESS)</td>
<td></td>
</tr>
<tr>
<td>(6)a</td>
<td>Cover (wrist cover) HW0201358-1</td>
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</tr>
<tr>
<td>(6)b</td>
<td>Cover (wrist base cover) HW0201349-1</td>
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</tr>
<tr>
<td>(6)c</td>
<td>Cover (casing cover) HW0315050-1</td>
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</tr>
<tr>
<td>(7)a</td>
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</tr>
<tr>
<td>(7)b</td>
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<td>(7)c</td>
<td>Gasket HW1400065-2</td>
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</tr>
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<td>Hexagon head screw M4 (length: 20 mm) (HIGH-TENSILE STEEL)</td>
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<td>Conical spring washer 2H-4 (STAINLESS)</td>
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<tr>
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<td>Hexagon socket head cap screw M4 (length: 20 mm) GT-LH washer M4</td>
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<td>Plate HW1403326-2</td>
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<tr>
<td>(11)</td>
<td>Hexagon socket head cap screw M3 (length: 20 mm) Conical spring washer 2H-3</td>
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<td>(12)</td>
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<td>Hexagon socket head cap screw M3 (length: 20 mm) TRIVALENT CHROMATE),</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2H-3 TRIVALENT CHROMATE)</td>
<td></td>
</tr>
<tr>
<td>(14)</td>
<td>V-ring BM-1217-A3</td>
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</tr>
<tr>
<td>(15)</td>
<td>Vinyl HW9405566-1</td>
<td>3</td>
</tr>
<tr>
<td>(16)</td>
<td>Hexagon socket head cap screw M2.5 (length: 6 mm) Washer M2.6</td>
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</tr>
<tr>
<td>(17)</td>
<td>Pipe HW0411562-1</td>
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</tr>
<tr>
<td>(18)</td>
<td>Hexagon socket head cap screw M2 (length: 8 mm)</td>
<td>4</td>
</tr>
<tr>
<td>(19)</td>
<td>Plate HW0411595-1</td>
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</tr>
<tr>
<td>(20)</td>
<td>Cable tie T50R</td>
<td>5</td>
</tr>
<tr>
<td>(21)</td>
<td>Cable tie T50R</td>
<td>6</td>
</tr>
</tbody>
</table>
4.4 Removal and Installation Procedures of U-Axis Actuator

- Refer to Fig. 4-8 "Removal and Installation of U-Axis Actuator" and Table 4-4 "Parts Checklist (Removal and Installation of U-Axis Actuator)".

- [Preparation]
  ThreeBond 1206C (sealing bond)
  Loctite 518 (sealing bond)
  Loctite 242 (Adhesive for preventing screw looseness)
  MP1 grease (or Harmonic Grease SK-1A)

### Removal of U-Axis Actuator

1. Change the posture of the arm on the side where the actuator is to be removed to the home position posture.
2. Turn OFF the power supply of the FS100.
3. Remove the hexagon head screws M3 (5)a (12 screws) and the hexagon head screws M4 (5)b (11 screws), and then remove the covers (6) (a to d) and the gaskets (7) (a to d).
4. Remove all the connectors of the cable (4) inside the covers (6) (a to d).
   - Remove the vinyl (17) which protects the connector, and then remove the connector.
5. Cut the cable ties (15) (7 screws) fixing the cable (4) using a nipper.
6. Disconnect the cable (4) from the U-, R-, B-, and T-axis actuator.
   (Disconnect it in the direction of the arrow D.)
7. Remove the hexagon socket head cap screws M3 (8) (12 screws), and then remove the arm (2).
   - [View A] For removing, use the tapped holes M3 (2 places) of the arm (2).
8. Remove the hexagon socket head cap screws M3 (9) (12 screws), and then remove the U-axis actuator (1) from the arm (3).
   - [View B] For removing, use the tapped holes M3 (2 places) of the U-axis actuator (1).
9. Remove the hexagon socket head cap screws M2.5 (10) (6 screws), and then remove the pipe (11).
10. Remove the hexagon socket head cap screws M2 (12) (4 screws), and then remove the plate (13).
Installation of U-Axis Actuator

1. Apply sealing bond (ThreeBond 1206C) to the plate (13) as shown in the View E.
2. Apply LOCTITE 242 (adhesive for preventing screw looseness) to the hexagon socket head cap screws M2 (12) (4 screws), and then attach the plate (13) to the U-axis actuator (1).
   [Tightening torque: 0.44 N·m (0.045 kgf·m)]
3. Attach the washers M2.5 to the hexagon socket head cap screws M2.5 (10) (6 screws), and then attach the pipe (11) to the U-axis actuator (1).
   [Tightening torque: 1.1 N·m (0.11 kgf·m)]
4. Apply sealing bond (Loctite 518) to the U-axis actuator (1) as shown in the View C.
   Attach the U-axis actuator (1) to the arm (3) in the direction shown in the View C.
   [Caution] When inserting the U-axis actuator (1) in the arm (3), do not give a shock to the actuator by hitting it.
5. Attach the conical spring washers 2H-3 to the hexagon socket head cap screws M3 (9) (12 screws), and then fix the U-axis actuator (1) to the arm (3).
   [Tightening torque: 1.85 N·m (0.19 kgf·m)]
6. Apply sealing bond (Loctite 518) to the U-axis actuator (1) as shown in the View B.
   [Caution] Be careful that sealing bond does not adhere to the tooth surface of the speed reducer.
7. Apply MP1 grease (or Harmonic Grease SK-1A) to the lip part of the V-ring (15).
8. Attach the GT-LH washers M3 to the hexagon socket head cap screws M3 (8) (12 screws), and then attach the arm (2) to the U-axis actuator (1).
   [Tightening torque: 2.25 N·m (0.23 kgf·m)]
   (Pass it through in the opposite direction of the arrow D.)
10. Fix the cable (4) using the cable ties (16) (7 screws).
    [Caution] Fix the central part of the vinyl tape which bundles cables.
11. Attach all the connectors of the cable (4) inside the covers (6) (a to d).
    • Attach the vinyl (17) which protects the connectors, and then fix them with the cable tie (16).
12. Attach the washers M3 to the hexagon head screws M3 (5)a (12 screws), and the washers M4 to the hexagon head screws M4 (5)b (11 screws), and then use them to attach the covers (6) (a to d) and the gaskets (7) (a to d).
    [(5)a Tightening torque: 0.5 N·m (0.052 kgf·m)]
    [(5)b Tightening torque: 1.2 N·m (0.12 kgf·m)]
13. Perform home position calibration of the U-axis.
Apply LOCTITE 518 to the shaded area.

Apply LOCTITE 518 to the shaded area.

Apply ThreeBond 1206C to the shaded area.

Apply MP1 grease to the lip part of the V-ring.

Tapped holes M3 (diagonal) (2 places)

Fig. 4-8 Removal and Installation of U-Axis Actuator
### Table 4-4  Parts Checklist (Removal and Installation of U-Axis Actuator)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>U-axis actuator SGAGS-411KA2A-YR1*</td>
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</tr>
<tr>
<td>(2)</td>
<td>Arm (casing) HW0102709-1</td>
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</tr>
<tr>
<td>(3)</td>
<td>Arm (L-arm B) HW0102708-1</td>
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</tr>
<tr>
<td>(4)</td>
<td>Cable (Wire harness in arm part)</td>
<td>1 each</td>
</tr>
<tr>
<td></td>
<td>R1 side (Left-arm): HW1171402-A, R2 side (Right-arm): HW1171402-B</td>
<td></td>
</tr>
<tr>
<td>(5a)</td>
<td>Hexagon head screw M3 (length: 8 mm) (STAINLESS)</td>
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</tr>
<tr>
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<td>Washer M3 (STAINLESS)</td>
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<tr>
<td>(5b)</td>
<td>Hexagon head screw M4 (length: 16 mm) (STAINLESS)</td>
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<td>Washer M4 (STAINLESS)</td>
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</tr>
<tr>
<td>(6b)</td>
<td>Cover (wrist base cover) HW0201349-1</td>
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</tr>
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<td>(6c)</td>
<td>Cover (casing cover) HW0315050-1</td>
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<tr>
<td>(6d)</td>
<td>Cover (L-arm B cover) HW0315049-1</td>
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<td>(7c)</td>
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<td>(7d)</td>
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<tr>
<td>(8)</td>
<td>Hexagon socket head cap screw M3 (length: 20 mm) GT-LH washer M3</td>
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<tr>
<td>(9)</td>
<td>Hexagon socket head cap screw M3 (length: 20 mm) (TRIVALENT CHROMATE)</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2H-3 (TRIVALENT CHROMATE)</td>
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<tr>
<td>(10)</td>
<td>Hexagon socket head cap screw M2.5 (length: 6 mm) Washer M2.6</td>
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<td>Pipe HW0411562-1</td>
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<td>(12)</td>
<td>Hexagon socket head cap screw M2 (length: 8 mm)</td>
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<td>Plate HW0411595-1</td>
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<td>V-ring BM-1217-A3</td>
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<tr>
<td>(16)</td>
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</tr>
<tr>
<td>(17)</td>
<td>Vinyl HW9405566-1</td>
<td>4</td>
</tr>
</tbody>
</table>
4.5 Removal and Installation Procedures of E-Axis Actuator

- Refer to Fig. 4-9 "Removal and Installation of E-Axis Actuator" and Table 4-5 "Parts Checklist (Removal and Installation of E-Axis Actuator)."

- [Preparation]
  - ThreeBond 1206C (sealing bond)
  - Loctite 518 (sealing bond)
  - Loctite 242 (Adhesive for preventing screw looseness)
  - MP1 grease (or Harmonic Grease SK-1A)

**Removal of E-Axis Actuator**

1. Change the posture of the arm on the side where the actuator is to be removed to the home position posture.
2. Turn OFF the power supply of the FS100.
3. Remove the hexagon head screws M3 (5)\textsuperscript{a} (12 screws) and the hexagon head screws M4 (5)\textsuperscript{b} (18 screws), and then remove the covers (6) (a to e) and the gaskets (7) (a to e).
4. Remove all the connectors of the cable (4) inside the covers (6) (a to e).
   - Remove the vinyl (19) which protects the connector, and then remove the connector.
5. Cut the cable ties (20) (10 screws) fixing the cable (4) using a nipper.
6. Disconnect the cable (4) from the E-, U-, R-, B-, and T-axis actuator.
   (Disconnect it in the direction of the arrow D.)
7. Remove the hexagon head screws M5 (8) (5 screws) and the hexagon socket head cap screws M5 (9) (3 screws), and then remove the arm (2) and the plate (10).
   - [View C] For removing, use the tapped holes M5 (2 places) of the arm (2).
8. Remove the hexagon socket head cap screws M4 (11) (12 screws), and then remove the spacer (12).
   - [View E] For removing, use the tapped holes M4 (2 places) of the spacer (12).
9. Remove the hexagon socket head cap screws M4 (13) (12 screws), and then remove the E-axis actuator (1) from the arm (3).
   - [View B] For removing, use the tapped holes M4 (2 places) of the E-axis actuator (1).
10. Remove the hexagon socket head cap screws M2.5 (14) (6 screws), and then remove the pipe (15).
11. Remove the hexagon socket head cap screws M2 (16) (4 screws), and then remove the plate (17).
### Installation of E-Axis Actuator

1. Apply sealing bond (ThreeBond 1206C) to the plate (17) as shown in the View A.

2. Apply LOCTITE 242 (adhesive for preventing screw looseness) to the hexagon socket head cap screws M2 (16) (4 screws), and then attach the plate (17) to the E-axis actuator (1).
   
   [Tightening torque: 0.44 N·m (0.045 kgf·m)]

3. Attach the washers M2.5 to the hexagon socket head cap screws M2.5 (14) (6 screws), and then attach the pipe (15) to the E-axis actuator (1).
   
   [Tightening torque: 1.1 N·m (0.11 kgf·m)]

4. Apply sealing bond (Loctite 518) to the E-axis actuator (1) as shown in the View F.
   
   Attach the E-axis actuator (1) to the arm (3) in the direction shown in the View F.
   
   [Caution] When inserting the E-axis actuator (1) in the arm (3), do not give a shock to the actuator by hitting it.

5. Attach the conical spring washers 2H-4 to the hexagon socket head cap screws M4 (13) (12 screws), and then fix the E-axis actuator (1) to the arm (3).
   
   [Tightening torque: 4.0 N·m (0.41 kgf·m)]

6. Apply sealing bond (Loctite 518) to the E-axis actuator (1) as shown in the View B.
   
   [Caution] Be careful that sealing bond does not adhere to the tooth surface of the speed reducer.

7. Apply MP1 grease (or Harmonic Grease SK-1A) to the lip part of the V-ring (18).

8. Attach the conical spring washers 2H-4 to the hexagon socket head cap screws M4 (11) (12 screws), and then attach the spacer (12) to the E-axis actuator (1) in the direction shown in the View E.
   
   [Tightening torque: 4.8 N·m (0.49 kgf·m)]

9. Apply sealing bond (Loctite 518) to the spacer (12) as shown in the View E.

10. Attach the conical spring washers 2H-5 to the hexagon head screws M5 (8) (5 screws), and then attach the plate (10) and the arm (2) to the E-axis actuator (1).
    
    [Tightening torque: 5.89 N·m (0.6 kgf·m)]

11. Attach the GT-LH washers M5 to the hexagon socket head cap screws M5 (9) (3 screws), and then fix the arm (2).
    
    [Tightening torque: 10 N·m (1.0 kgf·m)]

    
    (Pass it through in the opposite direction of the arrow D.)

13. Fix the cable (4) using the cable ties (20) (10 screws).
    
    [Caution] Fix the central part of the vinyl tape which bundles cables.

14. Attach all the connectors of the cable (4) inside the covers (6) (a to e).
    
    • Attach the vinyl (19) which protects the connectors, and then fix them with the cable tie (21).

15. Attach the washers M3 to the hexagon head screws M3 (5)a (12 screws), and the washers M4 to the hexagon head screws M4 (5)b (18 screws), and then use them to attach the covers (6) (a to e) and the gaskets (7) (a to e).

    [(5)a Tightening torque: 0.5 N·m (0.052 kgf·m)]
    
    [(5)b Tightening torque: 1.2 N·m (0.12 kgf·m)]

Apply MP1 grease to the lip part of the V-ring.

Apply LOCTITE 518 to the shaded area.

Apply ThreeBond 1206C to the shaded area.

Apply LOCTITE 518 to the shaded area.

Fig. 4-9 Removal and Installation of E-Axis Actuator
Table 4-5 Parts Checklist (Removal and Installation of E-Axis Actuator)

<table>
<thead>
<tr>
<th>No.</th>
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</tr>
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<td>E-axis actuator SGAGS-761KA2A-YR1*</td>
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</tr>
<tr>
<td>(2)</td>
<td>Arm (L-arm B) HW0102708-1</td>
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</tr>
<tr>
<td>(3)</td>
<td>Arm (L-arm A) HW0102707-1</td>
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</tr>
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<td>(4)</td>
<td>Cable (Wire harness in arm part)</td>
<td>1 each</td>
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<tr>
<td></td>
<td>R1 side (Left-arm): HW1171402-A, R2 side (Right-arm): HW1171402-B</td>
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<tr>
<td>(5)a</td>
<td>Hexagon head screw M3 (length: 8 mm) (STAINLESS)</td>
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<td>Washer M3 (STAINLESS)</td>
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<td>(5)b</td>
<td>Hexagon head screw M4 (length: 16 mm) (STAINLESS)</td>
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<td>Washer M4 (STAINLESS)</td>
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<tr>
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<td>Cover (wrist base cover) HW0201349-1</td>
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<td>(6)c</td>
<td>Cover (casing cover) HW0315050-1</td>
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<tr>
<td>(6)d</td>
<td>Cover (L-arm B cover) HW0315049-1</td>
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<td>(7)d</td>
<td>Gasket HW1400067-2</td>
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<tr>
<td>(7)e</td>
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<td>(8)</td>
<td>Hexagon head screw M5 (length: 25 mm) (HIGH CHROME STAINLESS),</td>
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<td>Conical spring washer 2H-5 (STAINLESS)</td>
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<td>(14)</td>
<td>Hexagon socket head cap screw M2.5 (length: 6 mm) Washer M2.6</td>
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<td>(18)</td>
<td>V-ring BM-1221-A3</td>
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<tr>
<td>(19)</td>
<td>Vinyl HW9405566-1</td>
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</tr>
<tr>
<td>(20)</td>
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</tr>
<tr>
<td>(21)</td>
<td>Cable tie T50R</td>
<td>10</td>
</tr>
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4.6 Removal and Installation Procedures of L-Axis Actuator

- Refer to Fig. 4-10 "Removal and Installation of L-Axis Actuator" and Table 4-6 "Parts Checklist (Removal and Installation of L-Axis Actuator).

- [Preparation]
  - ThreeBond 1206C (sealing bond)
  - Loctite 518 (sealing bond)
  - Loctite 242 (Adhesive for preventing screw looseness)
  - MP1 grease (or Harmonic Grease SK-1A)

### Removal of L-Axis Actuator

1. Change the posture of the arm on the side where the actuator is to be removed to the home position posture.
2. Turn OFF the power supply of the FS100.
3. Remove the hexagon head screws M3 (5)a (12 screws) and the hexagon head screws M4 (5)b (26 screws), and then remove the covers (6) (a to f) and the gaskets (7) (a to f).
4. Remove all the connectors of the cable (4) inside the covers (6) (a to f).
   - Remove the vinyl (15) which protects the connector, and then remove the connector.
5. Cut the cable ties (16) (11 screws) fixing the cable (4) using a nipper.
6. Disconnect the cable (4) from the L-, E-, U-, R-, B-, and T-axis actuator. (Disconnect it in the direction of the arrow D.)
7. Remove the hexagon socket head cap screws M4 (8) (12 screws), and then remove the arm (2).
   - [View A] For removing, use the tapped holes M4 (2 places) of the arm (2).
8. Remove the hexagon socket head cap screws M4 (9) (12 screws), and then remove the L-axis actuator (1) from the arm (3).
   - [View B] For removing, use the tapped holes M4 (2 places) of the L-axis actuator (1).
9. Remove the hexagon socket head cap screws M2.5 (10) (6 screws), and then remove the pipe (11).
10. Remove the hexagon socket head cap screws M2 (12) (4 screws), and then remove the plate (13).
Installation of L-Axis Actuator

1. Apply sealing bond (ThreeBond 1206C) to the plate (13) as shown in the View C.
2. Apply LOCTITE 242 (adhesive for preventing screw looseness) to the hexagon socket head cap screws M2 (12) (4 screws), and then attach the plate (13) to the L-axis actuator (1).
   [Tightening torque: 0.44 N·m (0.045 kgf·m)]
3. Attach the washers M2.5 to the hexagon socket head cap screws M2.5 (10) (6 screws), and then attach the pipe (11) to the U-axis actuator (1).
   [Tightening torque: 1.1 N·m (0.11 kgf·m)]
4. Apply sealing bond (Loctite 518) to the L-axis actuator (1) as shown in the View E. Attach the L-axis actuator (1) to the arm (3) in the direction shown in the View E.  
   [Caution] When inserting the L-axis actuator (1) in the arm (3), do not give a shock to the actuator by hitting it.
5. Attach the conical spring washers 2H-4 to the hexagon socket head cap screws M4 (9) (12 screws), and then fix the L-axis actuator (1) to the arm (3).
   [Tightening torque: 4.0 N·m (0.41 kgf·m)]
6. Apply sealing bond (Loctite 518) to the L-axis actuator (1) as shown in the View B.  
   [Caution] Be careful that sealing bond does not adhere to the tooth surface of the speed reducer.
7. Apply MP1 grease (or Harmonic Grease SK-1A) to the lip part of the V-ring (15).
8. Attach the GT-LH washers M4 to the hexagon socket head cap screws M4 (8) (12 screws), and then attach the arm (2) to the L-axis actuator (1).
   [Tightening torque: 4.8 N·m (0.49 kgf·m)]
9. Pass the cable (4) through the L-, E-, U-, R-, B-, and T-axis actuators. (Pass it through in the opposite direction of the arrow D.)
10. Fix the cable (4) using the cable ties (16) (11 screws).
    [Caution] Fix the central part of the vinyl tape which bundles cables.
11. Attach all the connectors of the cable (4) inside the covers (6) (a to f).
    • Attach the vinyl (15) which protects the connectors, and then fix them with the cable tie (17).
12. Attach the washers M3 to the hexagon head screws M3 (5)a (12 screws), and the washers M4 to the hexagon head screws M4 (5)b (26 screws), and then use them to attach the covers (6) (a to f) and the gaskets (7) (a to f).
    [(5)a Tightening torque: 0.5 N·m (0.052 kgf·m)]
    [(5)b Tightening torque: 1.2 N·m (0.12 kgf·m)]
13. Perform home position calibration of the L-axis.
Apply ThreeBond 1206C to the shaded area.

Apply LOCTITE 518 to the shaded area.

Apply MP1 grease to the lip part of the V-ring.

Apply LOCTITE 518 to the shaded area.

Fig. 4-10 Removal and Installation of L-Axis Actuator
### Table 4-6  Parts Checklist (Removal and Installation of L-Axis Actuator)

<table>
<thead>
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<th>No.</th>
<th>Name</th>
<th>Qty</th>
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<td>(1)</td>
<td>L-axis actuator SGAGS-761KA2A-YR1*</td>
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</tr>
<tr>
<td>(2)</td>
<td>Arm (L-arm B) HW0102708-1</td>
<td>1</td>
</tr>
<tr>
<td>(3)</td>
<td>Arm (L-arm A) HW0102707-1</td>
<td>1</td>
</tr>
<tr>
<td>(4)</td>
<td>Cable (Wire harness in arm part) R1 side (Left-arm):HW1171402-A, R2 side (Right-arm): HW1171402-B</td>
<td>1 each</td>
</tr>
<tr>
<td>(5)a</td>
<td>Hexagon head screw M3 (length: 8 mm) (STAINLESS) Washer M3 (STAINLESS)</td>
<td>12</td>
</tr>
<tr>
<td>(5)b</td>
<td>Hexagon head screw M4 (length: 16 mm) (STAINLESS) Washer M4 (STAINLESS)</td>
<td>26</td>
</tr>
<tr>
<td>(6)a</td>
<td>Cover (wrist cover) HW0201358-1</td>
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</tr>
<tr>
<td>(6)b</td>
<td>Cover (wrist base cover) HW0201349-1</td>
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<tr>
<td>(6)c</td>
<td>Cover (casing cover) HW0315050-1</td>
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</tr>
<tr>
<td>(6)d</td>
<td>Cover (L-arm B cover) HW0315049-1</td>
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</tr>
<tr>
<td>(6)e</td>
<td>Cover (L-arm A cover) HW0315048-1</td>
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<td>(6)f</td>
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<td>(8)</td>
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<tr>
<td>(9)</td>
<td>Hexagon socket head cap screw M4 (length: 25 mm) (TRIVALENT CHROMATE) Conical spring washer 2H-4 (TRIVALENT CHROMATE)</td>
<td>12</td>
</tr>
<tr>
<td>(10)</td>
<td>Hexagon socket head cap screw M2.5 (length: 6 mm) Washer M2.6</td>
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<tr>
<td>(11)</td>
<td>Pipe HW0411562-1</td>
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<tr>
<td>(12)</td>
<td>Hexagon socket head cap screw M2 (length: 8 mm)</td>
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<td>V-ring BM-1221-A3</td>
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<td>(16)</td>
<td>Cable tie T50R</td>
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<td>(17)</td>
<td>Cable tie T50R</td>
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</table>
4.7 Removal and Installation Procedures of S-Axis Actuator

• Refer to Fig. 4-11 "Removal and Installation of S-Axis Actuator" and Table 4-7 "Parts Checklist (Removal and Installation of S-Axis Actuator)."

• [Preparation]
  ThreeBond 1206C (sealing bond)
  Loctite 518 (sealing bond)
  Loctite 242 (Adhesive for preventing screw looseness)
  MP1 grease (or Harmonic Grease SK-1A)

■ Removal of S-Axis Actuator

1. Change the posture of the arm on the side where the actuator is to be removed to the home position posture.
2. Turn OFF the power supply of the FS100.
3. Remove the hexagon head screws M3 (5)a (12 screws) and the hexagon head screws M4 (5)b (26 screws), and then remove the covers (6) (a to f) and the gaskets (7) screws(a to f).
4. Remove all the connectors of the cable (4) inside the covers (6) (a to f).
   • Remove the vinyl (25) which protects the connector, and then remove the connector.
5. Remove the hexagon head screws M8 (8) (2 screws) and the hexagon head screws M4 (9) (4 screws), and then remove the cover (10) and the gasket (11).
6. Remove the GT-SA bolts M4 (12) (2 screws), and then remove the support (13).
7. Remove the connector S-PG, S-PW, and S-BR inside the cover (10).
   • Remove the vinyl (25) which protects the connector, and then remove the connector.
8. Cut the cable ties (26) (13 screws) fixing the cable (4) using a nipper.
   (Disconnect it in the direction of the arrow D.)
10. Remove the hexagon head screws M5 (14) (5 screws) and the hexagon socket head cap screws M5 (15) (3 screws), and then remove the arm (2) and the plate (16).
   • [View A] For removing, use the tapped holes M5 (2 places) of the arm (2).
11. Remove the hexagon socket head cap screws M4 (17) (12 screws), and then remove the spacer (18).
   • [View B] For removing, use the tapped holes M4 (2 places) of the spacer (18).
12. Remove the hexagon socket head cap screws M4 (19) (12 screws), and then remove the S-axis actuator (1) from the S-base (3).
   • [View C] For removing, use the tapped holes M4 (2 places) of the S-axis actuator (1).
13. Remove the hexagon socket head cap screws M2.5 (20) (6 screws), and then remove the pipe (21).
14. Remove the hexagon socket head cap screws M2 (22) (4 screws), and then remove the plate (23).
Installation of S-Axis Actuator

1. Apply sealing bond (ThreeBond 1206C) to the plate (23) as shown in the View E.
2. Apply LOCTITE 242 (adhesive for preventing screw looseness) to the hexagon socket head cap screws M2 (22) (4 screws), and then attach the plate (23) to the S-axis actuator (1).
   [Tightening torque: 0.44 N·m (0.045 kgf·m)]
3. Attach the washers M2.5 to the hexagon socket head cap screws M2.5 (20) (6 screws), and then attach the pipe (21) to the S-axis actuator (1).
   [Tightening torque: 1.1 N·m (0.11 kgf·m)]
4. Apply sealing bond (Loctite 518) to the S-axis actuator (1) as shown in the View C. Attach the S-axis actuator (1) to the S-base (3) in the direction shown in the View C.
   [Caution] When inserting the S-axis actuator (1) in the S-base (3), do not give a shock to the actuator by hitting it.
5. Attach the conical spring washers 2H-4 to the hexagon socket head cap screws M4 (19) (12 screws), and then fix the S-axis actuator (1) to the S-base (3).
   [Tightening torque: 4.0 N·m (0.41 kgf·m)]
6. Apply sealing bond (Loctite 518) to the S-axis actuator (1) as shown in the View G.
   [Caution] Be careful that sealing bond does not adhere to the tooth surface of the speed reducer.
7. Apply MP1 grease (or Harmonic Grease SK-1A) to the lip part of the V-ring (24).
8. Attach the conical spring washers 2H-4 to the hexagon socket head cap screws M4 (17) (12 screws), and then attach the spacer (18) to the S-axis actuator (1) in the direction shown in the View B.
   [Tightening torque: 4.8 N·m (0.49 kgf·m)]
9. Apply sealing bond (Loctite 518) to the spacer (18) as shown in the View B.
10. Attach the conical spring washers 2H-5 to the hexagon head screws M5 (14) (5 screws), and then attach the plate (6) and the arm (2) to the S-axis actuator (1).
    [Tightening torque: 5.89 N·m (0.6 kgf·m)]
11. Attach the GT-LH washers M5 to the hexagon socket head cap screws M5 (15) (3 screws), and then fix the arm (2).
    [Tightening torque: 10 N·m (1.0 kgf·m)]
    (Pass it through in the opposite direction of the arrow D.)
13. Fix the cable (4) using the cable ties (26) (13 screws).
    [Caution] Fix the central part of the vinyl tape which bundles cables.
14. Attach all the connectors of the cable (4) inside the covers (6) (a to f) and (10).
    • Attach the vinyl (25) which protects the connectors, and then fix them with the cable tie (27).
15. Attach the support (13) to the S-base (3) using the GT-SA bolts M4 (12) (2 screws).
    [Tightening torque: 2.8 N·m (0.29 kgf·m)]
16. Attach the washers M4 to the hexagon head screws M4 (9) (4 screws), and then attach the cover (10) and the gasket (11).
    [Tightening torque: 1.2 N·m (0.12 kgf·m)]
17. Attach the spring washers M8 to the hexagon head screws M8 (8) (2 screws), and attach them to the S-base (3).
18. Attach the washers M3 to the hexagon head screws M3 (5)a (12 screws), and the washers M4 to the hexagon head screws M4 (5)b (26 screws), and then use them to attach the covers (6) (a to f) and the gaskets (7) (a to f).
   [(5)a Tightening torque: 0.5 N·m (0.052 kgf·m)]
   [(5)b Tightening torque: 1.2 N·m (0.12 kgf·m)]
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<td>Arm (L-arm A) HW0102707-1</td>
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</tr>
<tr>
<td>(3)</td>
<td>Arm (S-head) HW0102706-1</td>
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</tr>
<tr>
<td>(4)</td>
<td>Cable (Wire harness in arm part)</td>
<td>1 each</td>
</tr>
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<td></td>
<td>R1 side (Left-arm): HW1171402-A, R2 side (Right-arm): HW1171402-B</td>
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<td>Washer M3 (STAINLESS)</td>
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<td>(5)b</td>
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<td>Washer M4 (STAINLESS)</td>
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<td>Cover (wrist cover) HW0201358-1</td>
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<tr>
<td>(6)b</td>
<td>Cover (wrist base cover) HW0201349-1</td>
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</tr>
<tr>
<td>(6)c</td>
<td>Cover (casing cover) HW0315050-1</td>
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<tr>
<td>(6)d</td>
<td>Cover (L-arm B cover) HW0315049-1</td>
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</tr>
<tr>
<td>(6)e</td>
<td>Cover (L-arm A cover) HW0315048-1</td>
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</tr>
<tr>
<td>(6)f</td>
<td>Cover (S-head cover) HW0315047-1</td>
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<td>(7)a</td>
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<tr>
<td>(7)b</td>
<td>Gasket HW1400062-2</td>
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</tr>
<tr>
<td>(7)c</td>
<td>Gasket HW1400065-2</td>
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<td>(7)d</td>
<td>Gasket HW1400067-2</td>
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<td>Washer M4 (STAINLESS)</td>
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</tr>
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<td>(10)</td>
<td>Cover HW1403844-1</td>
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<tr>
<td>(11)</td>
<td>Gasket HW1403845-1</td>
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<td>(12)</td>
<td>GT-SA bolt M4 (length: 12 mm)</td>
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<td>Conical spring washer 2H-5</td>
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<td>Conical spring washer 2H-4 (TRIVALENT CHROMATE)</td>
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<td>Washer M2.6</td>
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<td>(26)</td>
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<tr>
<td>(27)</td>
<td>Cable tie T50R</td>
<td>14</td>
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4.8 Removal and Installation Procedures of Rotation-Axis Actuator

- Refer to Fig. 4-12 "Removal and Installation of Rotation-Axis Actuator" and Table 4-8 "Parts Checklist (Removal and Installation of Rotation-Axis Actuator)".

- [Preparation]
  - Battery HW0472612-A (2 sets)
  - Loctite 518 (sealing bond)
  - Jig HW1400322-2

■ Removal of Rotation-Axis Actuator

1. Attach jig HW1400322-2 to the manipulator while it is in the shipping posture described in Fig. A of Fig. 4-12 "Removal and Installation of Rotation-Axis Actuator".
2. Turn OFF the power supply of the FS100.
3. Remove the hexagon head screws M4 (2) (6 screws), and then remove the cover (3) and the gasket (5).
4. Attach the battery HW0472612-A to the BAT1 and BAT2 connectors (2 screws each) inside the cover (3).
   (The batteries are for saving home position data of the arm part actuator.)
5. Remove all the connectors inside the cover (3) except the BAT1 and the BAT2.
   - Remove the vinyl which protects the connector, and then remove the connector.
6. Cut the cable ties (6) (2 screws) fixing the rotation-axis cable (4) using a nipper.
7. Remove the hexagon head screws M5 (7) (8 screws), and then remove the cover (8) and the gasket (9).
8. Disconnect the rotation-axis cable (4) from the rotation-axis actuator (1).
   (Disconnect it in the direction of the arrow B.)
9. Remove the hexagon socket head cap screws M5 (20) (10 screws) and the hexagon socket head cap screws M5 (10) (4 screws), use jig HW1400322-2 to suspend the manipulator by a crane, and then remove the S-base.
   - [View C] For removing, use the tapped holes M5 (2 places) of the S-base.
10. Remove the hexagon socket head cap screws M5 (11) (10 screws) and the hexagon socket head cap screws M5 (12) (2 screws).
    (The hexagon socket head cap screws (12) hold together the actuator and stopper (17).)
11. Remove the rotation-axis actuator (1) from the base.
    - [View E] For removing, use the tapped holes M5 (2 places) of the rotation-axis actuator (1).
12. Remove the hexagon socket head cap screws M3 (13) (4 screws), and then remove the guide (14).
13. Remove the GT-SA bolts M3 (18) (6 screws), and then remove the cover (19).
    - [View F] For removing, use the tapped holes M3 (2 places) of the cover (19).
14. Remove the hexagon socket head cap screws M3 (15) (6 screws), and then remove the pipe (16).
Installation of Rotation-Axis Actuator

1. Attach the cover (19) to the rotation-axis actuator using the GT-SA bolts M3 (18) (6 screws) in the direction shown in the View F.
   [Tightening torque: 1.4 N·m (0.14 kgf·m)]
2. Attach the conical spring washers 2H-3 to the hexagon socket head cap screws M3 (15) (6 screws), and then attach the pipe (16) to the rotation-axis actuator.
   [Tightening torque: 1.4 N·m (0.14 kgf·m)]
3. Attach the conical spring washers 2H-3 to the hexagon socket head cap screws M3 (13) (4 screws), and then attach the guide (14) to the cover (19).
   [Tightening torque: 1.4 N·m (0.14 kgf·m)]
4. Apply sealing bond (Loctite 518) to the rotation-axis actuator (1) as shown in the View E.
5. Attach the rotation-axis actuator (1) to the base.
   [Caution] When inserting the rotation-axis actuator (1) in the S-base, do not give a shock to the actuator by hitting it.
6. Attach the conical spring washers 2H-5 to the hexagon socket head cap screws M5 (12) (2 screws), and then attach the stopper as shown in the View D.
   [Tightening torque: 8.3 N·m (0.85 kgf·m)]
7. Attach the conical spring washers 2H-5 to the hexagon socket head cap screws M5 (11) (10 screws), and then fix the rotation-axis actuator (1).
   [Tightening torque: 8.3 N·m (0.85 kgf·m)]
8. Remove the plug LP-M5 of the grease inlets (2 places) of the rotation-axis actuator (1).
9. Apply sealing bond (Loctite 518) to the rotation-axis actuator (1) as shown in the View D.
10. Attach the flat washers M5 to the hexagon socket head cap screws M5 (20) (10 screws), and the GT-LH washers M5 to the hexagon socket head cap screws M5 (10) (4 screws), and then use them to install the S-base to the rotation-axis actuator (1).
11. Pass the rotation-axis cable (4) through the rotation-axis actuator (1).
    (Pass it through in the opposite direction of the arrow B.)
12. Attach the washers M5 to the hexagon head screws M5 (7) (8 screws), and then attach the cover (8) and the gasket (9).
13. Fix the rotation-axis cable (4) using the cable ties (6) (2 screws).
    [Caution] Fix the central part of the vinyl tape which bundles cables.
14. Attach all the connectors in the cover (3).
    (Refer to Fig. 5-16 "Cable Connector in S-Base Connection Diagram")
   • Attach the vinyl (21) which protects the connectors, and then fix them with the cable tie (22).
15. Remove the batteries HW0472612-A (2 sets) attached to the BAT1 and BAT2 connectors (2 screws each) in the cover (3).
    [Caution] Before removing the battery, connect all connectors.
16. Put the cable connector in the cover (3), attach the washers M4 to the bolts M4 (2) (6 screws), and then use them to attach the cover (3) and gasket (5).
   • Be careful that the air line does not bend when putting the cable connectors in.
   • Be careful that the cables and the air line are not caught in the cover in installing.
17. Perform home position calibration of the rotation-axis.
Fig. 4-12 Removal and Installation of Rotation-Axis Actuator

Apply LOCTITE 518 to the shaded area.

Grease inlet plugs (diagonal) (2 places)

(1) Rotation-axis actuator

(2) Tapped holes M5 (diagonal) (2 places)

Connection point for cable connector

Apply LOCTITE 518 to the shaded area.

(15) Cover
(16) Tapped holes M3 (diagonal) (2 places)

Fig. 4-12 Removal and Installation of Rotation-Axis Actuator
## 4-33 Table 4-8 Parts Checklist (Removal and Installation of Rotation-Axis Actuator)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
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<td>Rotation-axis actuator SGAGS-172LA29-YR3*</td>
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</tr>
<tr>
<td>(2)</td>
<td>Hexagon head screw M4 (length: 12 mm) (STAINLESS) Washer M4 (STAINLESS)</td>
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</tr>
<tr>
<td>(3)</td>
<td>Cover HW0415495-2</td>
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</tr>
<tr>
<td>(4)</td>
<td>Rotation-axis cable HW1171126-A</td>
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</tr>
<tr>
<td>(5)</td>
<td>Gasket HW1403836-1</td>
<td>1</td>
</tr>
<tr>
<td>(6)</td>
<td>Cable tie T50R</td>
<td>2</td>
</tr>
<tr>
<td>(7)</td>
<td>Hexagon head screw M5 (length: 12 mm) (STAINLESS) Washer M5 (STAINLESS)</td>
<td>8</td>
</tr>
<tr>
<td>(8)</td>
<td>Cover HW1405302-1</td>
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<tr>
<td>(9)</td>
<td>Gasket HW1403843-1</td>
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<tr>
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<tr>
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<td>Hexagon socket head cap screw M3 (length: 8 mm) Conical spring washer 2H-3</td>
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</tr>
<tr>
<td>(14)</td>
<td>Guide HW1400036-1</td>
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</tr>
<tr>
<td>(15)</td>
<td>Hexagon socket head cap screw M3 (length: 6 mm) Conical spring washer 2H-3</td>
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<tr>
<td>(17)</td>
<td>Stopper HW0415544-2</td>
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<tr>
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<td>GT-SA bolt M3 (length: 12 mm)</td>
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<td>(19)</td>
<td>Cover HW0414186-1</td>
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<td>(21)</td>
<td>Vinyl HW9405566-1</td>
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<tr>
<td>(22)</td>
<td>Cable tie T50R</td>
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</table>
5 Disconnection and Connection Procedures of Cables

5.1 Disconnection and Connection of Arm Part Cable

- Refer to Fig. 5-13 "Disconnection and Connection of Arm Part Cable" and "Table 5-9 "Parts Checklist (Disconnection and Connection of Arm Part Cable)".

### Disconnection of Arm Part Cable

1. Change the posture of the arm on the side where the actuator is to be removed to the home position posture.
2. Turn OFF the power supply of the FS100.
3. Remove the bolts M4 (5) (6 screws), and then remove the cover (6) and the gasket (7).
4. Inside the cover (6), remove the cable connector on the arm's side which is to be removed (R1 or R2).
   - Remove the vinyl (14) which protects the connector, and then remove the connector.
5. Remove the hexagon head screws M8 (8) (2 screws) and the hexagon head screws M4 (9) (4 screws), and then remove the cover (10) and the gasket (11).
6. Remove the GT-SA bolts M4 (12) (2 screws), and then remove the support (13). Remove the connector S-PG, S-PW, and S-BR inside the cover (10).
   - Remove the vinyl (14) which protects the connector, and then remove the connector.
7. Remove the hexagon head screws M3 (2)a (12 screws) and the hexagon head screws M4 (2)b (26 screws), and then remove the covers (3) (a to f) and the gaskets (4) (a to f).
8. Remove all the connectors of the cable (1) inside the covers (3) (a to f).
   - Remove the vinyl (14) which protects the connector, and then remove the connector.
9. Cut the cable ties (15) (13 screws) fixing the cable (1) using a nipper.
10. Disconnect the cable (1) from the arm.
    (Disconnect it in the direction of the arrow A.)

### Connection of Arm Part Cable

1. Pass the cable (1) through the arm.
   (Pass it through in the opposite direction of the arrow A.)
2. Fix the cable (1) using the cable ties (15) (13 screws).
3. Attach all the connectors of the cable (4) inside the covers (6) (a to f) and (10).
   - Attach the vinyl (14) which protects the connectors, and then fix them with the cable tie (16).
4. Attach the support (13) to the S-base (3) using GT-SA bolts M4 (12) (2 screws).
   [Tightening torque: 2.8 N-m (0.29 kgf-m)]
5. Attach the washers M4 to the hexagon head screws M4 (9) (4 screws), and then attach the cover (10) and the gasket (11).
   [Tightening torque: 1.2 N-m (0.12 kgf-m)]
6. Attach the spring washers M8 to the hexagon head screws M8 (8) (2 screws), and attach them to the S-base (17).
7. Attach the washers M3 to the hexagon head screws M3 (2)a (12 screws), and the washers M4 to the hexagon head screws M4 (2)b (26 screws), and then use them to attach the covers (3) (a to f) and the gaskets (4) (a to f).
- [(2)a] Tightening torque: 0.5 N·m (0.052 kgf·m)]
- [(2)b] Tightening torque: 1.2 N·m (0.12 kgf·m)]

Fig. 5-13  Disconnection and Connection of Arm Part Cable
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<th>No.</th>
<th>Name</th>
<th>Qty</th>
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<td>(1)</td>
<td>Cable (Wire harness in arm part) R1 side (Left-arm): HW1171402-A, R2 side (Right-arm): HW1171402-B</td>
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<td>(2)a</td>
<td>Hexagon head screw M3 (length: 8 mm) (STAINLESS) Washer M3 (STAINLESS)</td>
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<tr>
<td>(2)b</td>
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<td>Cover (wrist cover) HW0201358-1</td>
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5.2 Disconnection and Connection of Rotation-Axis Cable

- Refer to Fig. 5-14 "Disconnection and Connection of Rotation-Axis Cable", Fig. 5-15 "Rotation-Axis Cable C-Base Connection Diagram" and "Table 5-10 "Parts Checklist (Disconnection and Connection of Rotation-Axis Cable)".
- [Preparation]
  Battery HW0472612-A (2 sets)

### Disconnection of Rotation-Axis Cable

1. Change the posture of the manipulator to the home position posture.
2. Turn OFF the power supply of the FS100.
3. Remove the bolts M4 (2) (6 screws), and then remove the cover (3) and the gasket (4).
4. Attach the battery HW0472612-A to the BAT1 and BAT2 connectors (2 screws each) inside the cover (3).
   (The batteries are for saving home position data of the arm part actuator.)
5. Remove all the connectors inside the cover (3) except the BAT1 and the BAT2.
   (Refer to Fig. 5-16 "Cable Connector in S-Base Connection Diagram")
   - Remove the vinyl which protects the connector, and then remove the connector.
6. Remove the hexagon head screws M5 (5) (8 screws), and then remove the C-base (6) and the gasket (7).
7. Remove the connector and the air line of the cable (1) attached to the C-base (6).
   (Refer to Fig. 5-15 "Rotation-Axis Cable C-Base Connection Diagram")
8. Remove the hexagon head screws M5 (8) (8 screws), and then remove the cover (9) and the gasket (10).
9. Remove the connector of the cable (1) to the battery of the cover (9).
10. Cut the cable ties (11) (4 screws) using a nipper.
11. Disconnect the cable (1) from the rotation-axis.
   (Disconnect it in a downward direction.)

### Connection of Rotation-Axis Cable

1. Pass the rotation-axis cable (1) through the rotation-axis.
   (Pass it through from bottom to top.)
2. Fix the cable (1) using the cable ties (11) (4 screws).
   [Caution] Fix the central part of the vinyl tape which bundles cables.
3. Attach the connector and the air line of the cable (1) to the C-base (6).
   (Refer to Fig. 5-15 "Rotation-Axis Cable C-Base Connection Diagram")
4. Attach the washers M5 to the hexagon head screws (5), and then attach the C-base (6) and the gasket (7).
5. Attach the connector of the cable (1) to the battery of the cover (9).
6. Attach the cover (9) and the gasket (10) using the hexagon head screws M5 (8) (8 screws).
   Attach the connector in the cover (3).
   (Refer to Fig. 5-16 "Cable Connector in S-Base Connection Diagram")
   • Attach the vinyl (13) which protects the connectors, and then fix them with the cable tie (12).
7. Remove the batteries HW0472612-A (2 sets) attached to the BAT1 and BAT2 connectors (2 screws each) in the cover (3).
   [Caution] Before removing the battery, connect all connectors.
8. Put the cable connector in the cover (3), attach the washers M4 to the hexagon head screws M4 (2) (6 screws), and then use them to attach the cover (3) and gasket (4).
   • Be careful that the air line does not bend when putting the cable connectors in.
   • Be careful that the cables and the air line are not caught in the cover (3) in installing.

Fig. 5-14 Disconnection and Connection of Rotation-Axis Cable
Fig. 5-15 Rotation-Axis Cable C-Base Connection Diagram

Table. 5-10 Parts Checklist (Disconnection and Connection of Rotation-Axis Cable)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Rotation-axis cable HW1171126-A</td>
<td>1</td>
</tr>
<tr>
<td>(2)</td>
<td>Hexagon head screw M4 (length: 12 mm) (STAINLESS)</td>
<td>6</td>
</tr>
<tr>
<td>(3)</td>
<td>Cover HW0415495-2</td>
<td>1</td>
</tr>
<tr>
<td>(4)</td>
<td>Gasket HW1403836-1</td>
<td>1</td>
</tr>
<tr>
<td>(5)</td>
<td>Hexagon head screw M5 (length: 10 mm) (STAINLESS)</td>
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</tr>
<tr>
<td></td>
<td>Washer M5 (STAINLESS)</td>
<td></td>
</tr>
<tr>
<td>(6)</td>
<td>C-base unit HW1371717-B</td>
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</tr>
<tr>
<td>(7)</td>
<td>Gasket HW1405304-1</td>
<td>1</td>
</tr>
<tr>
<td>(8)</td>
<td>Hexagon head screw M5 (length: 12 mm) (STAINLESS)</td>
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</tr>
<tr>
<td></td>
<td>Washer M5 (STAINLESS)</td>
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<tr>
<td>(9)</td>
<td>Cover HW1405302-1</td>
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<td>(10)</td>
<td>Gasket HW1403843-1</td>
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<td>(11)</td>
<td>Cable tie T50R</td>
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<td>(12)</td>
<td>Cable tie T50R</td>
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<tr>
<td>(13)</td>
<td>Vinyl HW9405566-1</td>
<td>1</td>
</tr>
</tbody>
</table>
Connect the battery before removing the arm from the R1 side.

Connect the battery before removing the arm from the R2 side.

* Not used.

Connect them to the rotation-axis actuator.

Fig. 5-16 Cable Connector in S-Base Connection Diagram