EPSON
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Industrial Robot: 6-Axis Robots

VT series

Maintenance Manual

Rev.4

ENM231R5606F

Original instructions

Industrial Robot: 6-Axis Robots

VT series Maintenance Manual

Rev.4

FOREWORD

Thank you for purchasing our robot products.
This manual contains the information necessary for the correct use of the manipulator and the integrated Controller.
Please carefully read this manual and other related manuals before installing the robot system.
Keep this manual handy for easy access at all times.

The robot system and its optional parts are shipped to our customers only after being subjected to the strictest quality controls, tests, and inspections to certify its compliance with our high performance standards. Please note that the basic performance of the product will not be exhibited if our robot system is used outside of the usage conditions and product specifications described in the manuals.

This manual describes possible dangers and consequences that we can foresee. Be sure to comply with safety precautions on this manual to use our robot system safety and correctly.

TRADEMARKS

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TRADEMARK NOTATION IN THIS MANUAL

Microsoft® Windows® 8 operating system
Microsoft® Windows® 10 operating system
Microsoft® Windows® 11 operating system
Throughout this manual, Windows 8, Windows 10 and Windows 11 refer to above respective operating systems. In some cases, Windows refers generically to Windows 8, Windows 10 and Windows 11.

NOTICE

No part of this manual may be copied or reproduced without authorization.
The contents of this manual are subject to change without notice.
Please notify us if you should find any errors in this manual or if you have any comments regarding its contents.

MANUFACTURER

SEIKO EPSON CORPORATION

CONTACT INFORMATION

Contact information is described in “SUPPLIERS” in the first pages of the following manual:

Robot System Safety Manual Read this manual first

DISPOSAL

When disposing this product, dispose in accordance with the laws and regulations of each country.

Regarding battery disposal

The battery removal/replacement procedure is described in the following manuals:

Maintenance Manual

For European Union customers only

The crossed out wheeled bin label that can be found on your product indicates that this product and incorporated batteries should not be disposed of via the normal household waste stream. To prevent possible harm to the environment or human health please separate this product and its batteries from other waste streams to ensure that it can be recycled in an environmentally sound manner. For more details on available collection facilities please contact your local government office or the retailer where you purchased this product. Use of the chemical symbols Pb, Cd or Hg indicates if these metals are used in the battery.

This information only applies to customers in the European Union, according to DIRECTIVE 2006/66/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC and legislation transposing and implementing it into the various national legal systems.
For other countries, please contact your local government to investigate the possibility of recycling your product.

For Users in Taiwan region

Please separate used batteries from other waste streams to ensure that it can be recycled in an environmentally sound manner. For more details on available collection facilities please contact your local government office or the retailer where you purchased this product.

For California customers only

The lithium batteries in this product contain
Perchlorate Material - special handling may apply,
See www.dtsc.ca.gov/hazardouswaste/perchlorate

Before Reading This Manual

This section describes what you should know before reading this manual.

NOTE

"T" and "VT series" described in this manual are the following models.

VT6L series

NOTE

VT series Manipulators can use the Teach Pendant (TP2, TP3). Do not connect the other devices to TP port except TP2 and TP3. Connecting other devices may result in malfunction of the device since the pin assignments are different.

NOTE

Concerning the security support for the network connection:

The network connecting function (Ethernet) on our products assumes the use in the local network such as the factory LAN network. Do not connect to the external network such as Internet.

In addition, please take security measure such as for the virus from the network connection by installing the antivirus software.

NOTE

Security support for the USB memory:

Make sure the USB memory is not infected with virus when connecting to the Controller.

Features of VT series Manipulators

The VT series Manipulators are Controller integrated Manipulators.

Structure of Robot System

The VT series Manipulators can be used with the following combinations of software.

	Controller Firmware
VT6-A901S, VT6-A901C, VT6-A901P	Ver.7.4.56.2 or later
VT6-A901S-DC	Ver.7.4.57.1 or later

EPSON RC+ 7.0	Before Ver.7.4.6	!!!
	Ver.7.4.7 or later	OK

OK: Compatible All functions of the EPSON RC+ 7.0 and the robot system are available.

!!!: Compatible Connection is OK. It is recommended to use the following version or later. Display or control may not be operated properly.

EPSON RC+ 7.0 Ver.7.4.7

Shape of Motors

The shape of the motors used for the Manipulator that you are using may be different from the shape of the motors described in this manual because of the specifications.

Setting by Using Software

This manual contains setting procedures by using software. They are marked with the following icon.

The Manuals of This Product

The following are typical manual types for this product and an outline of the descriptions.

Safety Manual (book, PDF)

This manual contains safety information for all people who handle this product. The manual also describes the process from unpacking to operation and the manual you should look at next.

Read this manual first.

- Safety precautions regarding robot system and residual risk
- Declaration of conformity
- Training
- Flow from unpacking to operation

VT series Manual (PDF)

This manual describes the specifications and functions of the Manipulator. The manual is primarily intended for people who design robot systems.

- Technical information, functions, specifications, etc. required for the Manipulator installation and design
- Daily inspection of the Manipulator

Status Code/Error Code List (PDF)

This manual contains a list of code numbers displayed on the controller and messages displayed in the software message area. The manual is primarily intended for people who design robot systems or do programming.

VT series Maintenance Manual (PDF)

This manual describes the details of maintenance etc. The manual is intended for people who perform maintenance.

- Daily inspection
- Replacement and repair of maintenance parts
- The method of firmware update and controller setting backup etc.

EPSON RC+ 7.0 User's Guide (PDF)

This manual describes general information about program development software.

EPSON RC+ 7.0 SPEL+ Language Reference (PDF)

This manual describes the robot programming language "SPEL+".

Other Manual (PDF)

Manuals for each option are available.

VT6L Maintenance

VT6L Maintenance

This volume contains maintenance procedures with safety precautions for VT series Manipulators.

1. Safety Maintenance

Please read this chapter, this manual, and other relevant manuals carefully to understand safe maintenance procedures before performing any routine maintenance.

Only the personnel who have taken maintenance training held by us or suppliers should be allowed to maintain the robot system.

Important safety considerations are indicated throughout the manual by the following symbols. Be sure to read the descriptions shown with each symbol.

 WARNING	This symbol indicates that a danger of possible serious injury or death exists if the associated instructions are not followed properly.
 WARNING	This symbol indicates that a danger of possible harm to people caused by electric shock exists if the associated instructions are not followed properly.
 CAUTION	This symbol indicates that a danger of possible harm to people or physical damage to equipment and facilities exists if the associated instructions are not followed properly.

 WARNING	■ Do not remove any parts that are not covered in this manual. Follow the maintenance procedure strictly as described in this manual. Improper removal of parts or improper maintenance may not only cause improper function of the robot system but also serious safety problems. ■ Keep away from the Manipulator while the power is ON if you have not taken the training courses. Do not enter the operating area while the power is ON. Entering the operating area with the power ON is extremely hazardous and may cause serious safety problems as the Manipulator may move even it seems to be stopped. ■ When you check the operation of the Manipulator after replacing parts, be sure to check it while you are outside of the safeguarded area. Checking the operation of the Manipulator while you are inside of the safeguarded area may cause serious safety problems as the Manipulator may move unexpectedly. ■ Before operating the robot system, make sure that both the Emergency Stop switches and safeguard switch function properly. Operating the robot system when the switches do not function properly is extremely hazardous and may result in serious bodily injury and/or serious damage to the robot system as the switches cannot fulfill their intended functions in an emergency.

 WARNING	■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power plug. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) The unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.

 CAUTION	■ Manipulator may be warmed up due to motor heat or similar causes. Do not touch the Manipulator until temperature falls. Also, make sure the temperature of the Manipulator falls and is not hot when you touch it. Then perform teaching or maintenance. ■ When performing maintenance on the Manipulator, secure an empty space of about 50 cm around the Manipulator.

2. General Maintenance

This chapter describes maintenance inspections and procedures. Performing maintenance inspections and procedures properly is essential for preventing trouble and ensuring safety. Be sure to perform the maintenance inspections in accordance with the schedule.

2.1 Maintenance Inspection

2.1.1 Schedule for Maintenance Inspection

Inspection points are divided into five stages: daily, monthly, quarterly, biannual, and annual. The inspection points are added every stage.
If the Manipulator is operated for 250 hours or longer per month, the inspection points must be added every 250 hours, 750 hours, 1500 hours, and 3000 hours operation.

	Inspection Point					
	Daily inspection	Monthly inspection	Quarterly inspection	Biannual inspection	Annual inspection	Overhaul (replacement)
1 month (250 h)	Inspect every day	√				
2 months (500 h)		√				
3 months (750 h)		√	√			
4 months (1000 h)		√				
5 months (1250 h)		√				
6 months (1500 h)		√	√	√		
7 months (1750 h)		√				
8 months (2000 h)		√				
9 months (2250 h)		√	√			
10 months (2500 h)		√				
11 months (2750 h)		√				
12 months (3000 h)		√	√	√	√	
13 months (3250 h)		√				
⋮	⋮	⋮	⋮	⋮	⋮	⋮
20000 h						√

h = hour

2.1.2 Inspection Point

Inspection Item

Inspection Point	Inspection Place	Daily	Monthly	Quarterly	Biannual	Annual
Check looseness or backlash of bolts/screws.	End effector mounting bolts	√	√	√	√	√
	Manipulator mounting bolts	√	√	√	√	√
Check looseness of connectors.	External connectors on Manipulator (on the connector plates etc.)	√	√	√	√	√
Visually check for external defects. Clean up if necessary.	External appearance of Manipulator	√	√	√	√	√
	External cables		√	√	√	√
Check for bends or improper location. Repair or place it properly if necessary.	Safeguard etc.	√	√	√	√	√
Check the brake operation.	Brake for Arm #1 to #6	√	√	√	√	√
Check whether unusual sound or vibration occurs.	Whole	√	√	√	√	√
Check the power supply behavior.	Controller	-	-	-	-	√
Check behavior of the emergency stop button and safeguard.	Emergency stop button	-	-	-	-	√
	Safeguard	-	-	-	-	√

Inspection Method

Inspection Point	Inspection Method
Check looseness or backlash of bolts/screws.	Use a hexagonal wrench to check that the end effector mounting bolts and the Manipulator mounting bolts are not loose. When the bolts are loose, refer to "*VT Series Manual Regular Inspection 2.3 Tightening Hexagon Socket Head Cap Bolts*" and tighten them to the proper torque.
Check looseness of connectors.	Check that connectors are not loose. When the connectors are loose, reattach it not to come off.
Visually check for external defects. Clean up if necessary.	Check the appearance of the Manipulator and clean up if necessary. Check the appearance of the cable, and if it is scratched, check that there is no cable disconnection.
Check for bends or improper location. Repair or place it properly if necessary.	Check that the safeguard, etc. are located properly. If the location is improper, place it properly.
Check the brake operation.	Check that the arm does not fall when in MOTOR OFF. If the arm falls when in MOTOR OFF and the brake is not released, contact the supplier.
Check whether unusual sound or vibration occurs.	Check that there is no unusual sound or vibration when operating. If there is something wrong, contact the supplier.
Check the power supply behavior.	Turn OFF and ON the power supply, and check that it starts without any error.
Check behavior of the emergency stop button	Operate emergency stop switch with the motor energized, then check the LED lamp near the Joint #3 lights off and the ESTOP LED on the Controller lights up. If EPSON RC+ is connected, make sure to check "EStop" is displayed in red on the status bar.
Check behavior of the safeguard.	Operate safeguard with the motor energized, then check the LED lamp near the Joint #3 lights off. If EPSON RC+ is connected, make sure to check "Safety" is displayed in blue on the status bar.

2.2 Overhaul (Parts Replacement)

CAUTION	■ If you do not overhaul properly, it may have a serious impact on safety. ■ Overhaul timing is based on an assumption that all joints are operated for equal distance. If a particular joint has a high duty or high load, it is recommended to overhaul all joints (as many as possible) before exceeding 20,000 operation hours with the joint as a basis.

The parts for the Manipulator joints may cause accuracy decline or malfunction due to deterioration of the Manipulator resulting from long term use. In order to use the Manipulator for a long term, it is recommended to overhaul the parts (parts replacement).

The time between overhauls is 20,000 operation hours of the Manipulator as a rough indication.

However, it may vary depending on ambient temperature, usage condition and degree of the load (such as when operated with the maximum motion speed and maximum acceleration / deceleration in continuous operation) applied on the Manipulator.

NOTE

For EPSON RC+ 7.0, the recommended replacement time for the parts subject to maintenance (motors, reduction gear units, and timing belts) can be checked in the [Maintenance] dialog box.

Reference: *4. Alarm.*

Note:
The recommended replacement time for the maintenance parts is when it reaches the L10 life (time until 10% failure probability). In the [Maintenance] dialog box, the L10 life is displayed as 100%.

The Manipulator operation hours can be checked in [Controller Status Viewer] dialog box - [Motor On Hours].

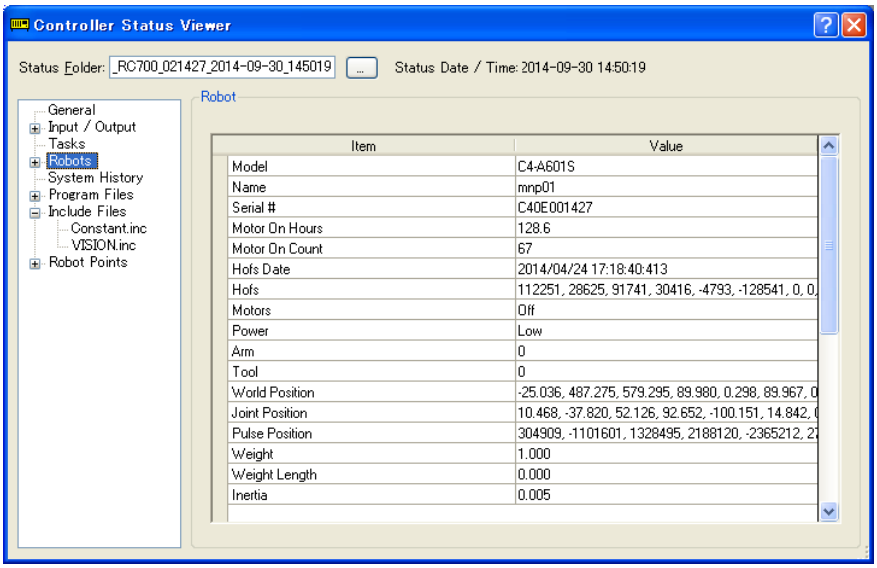
(1) Select EPSON RC+ menu-[Tools]-[Controller] to open the [Controller Tools] dialog box.

(2) Click the <View Controller Status> button to open the [Browse For Folder] dialog box.

(3) Select the folder where the information is stored.

(4) Click <OK> to view the [Controller Status Viewer] dialog box.

(5) Select [Robot] from the tree menu on the left side.



For the parts subject to overhaul, refer to "*21. Maintenance Parts List*".

For details of replacement of each part, refer to each chapter.

Please contact the supplier of your region for further information.

2.3 Greasing

Greasing is performed by serviceman who has taken maintenance training.
For greasing, please contact the supplier of your region.

Joint #1, 2, 3, 4, 5, 6 reduction gear units and bevel gear

As a rough indication, perform greasing at the same timing as overhaul.
However, it may vary depending on ambient temperature, usage condition and degree of the load (such as when operated with the maximum motion speed and maximum acceleration / deceleration in continuous operation) applied on the Manipulator.

2.3 Tightening Hexagon Socket Head Cap Bolts

Hexagon socket head cap bolts (herein after referred to as bolt) are used in places where mechanical strength is required. These bolts are fastened with the tightening torques shown in the following table.

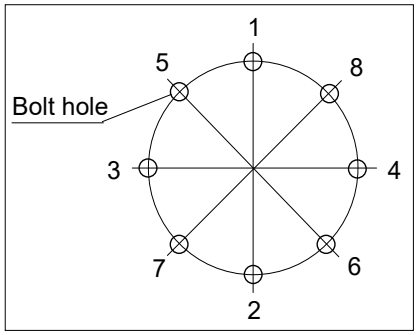
When it is necessary to refasten these bolts in some procedures in this manual (except special cases as noted), use a torque wrench so that the bolts are fastened with the appropriate tightening torques as shown below.

Bolt	Tightening Torque
M3	2.0 ± 0.1 N·m (21 ± 1 kgf·cm)
M4	4.0 ± 0.2 N·m (41 ± 2 kgf·cm)
M5	8.0 ± 0.4 N·m (82 ± 4 kgf·cm)
M6	13.0 ± 0.6 N·m (133 ± 6 kgf·cm)
M8	32.0 ± 1.6 N·m (326 ± 16 kgf·cm)
M10	58.0 ± 2.9 N·m (590 ± 30 kgf·cm)
M12	100.0 ± 5.0 N·m (1,020 ± 51 kgf·cm)

Refer below for the set screw.

Set Screw	Tightening Torque
M4	2.4 ± 0.1 N·m (26 ± 1 kgf·cm)
M5	4.0 ± 0.2 N·m (41 ± 2 kgf·cm)

The bolts aligned on a circumference should be fastened in a crisscross pattern as shown in the figure below.



Do not fasten all bolts securely at one time. Divide the number of times that the bolts are fastened into two or three and fasten the bolts securely with a hexagonal wrench. Then, use a torque wrench so that the bolts are fastened with tightening torques shown in the table above.

2.4 Matching Origins

After parts have been replaced (e.g. motor units, reduction gear units, timing belts), the Manipulator cannot operate properly because a mismatch exists between the origin stored in each motor and its corresponding origin stored in the Robot system.
Because of that, it is necessary to perform calibration (encoder rest and calibration) to match these origins.

For calibration, the pulse values for a specific position must be recorded in advance.
Before replacing parts, select easy point (pose) data from the registered point data to check the accuracy. Then, follow the steps below to display the pulse values and record them.

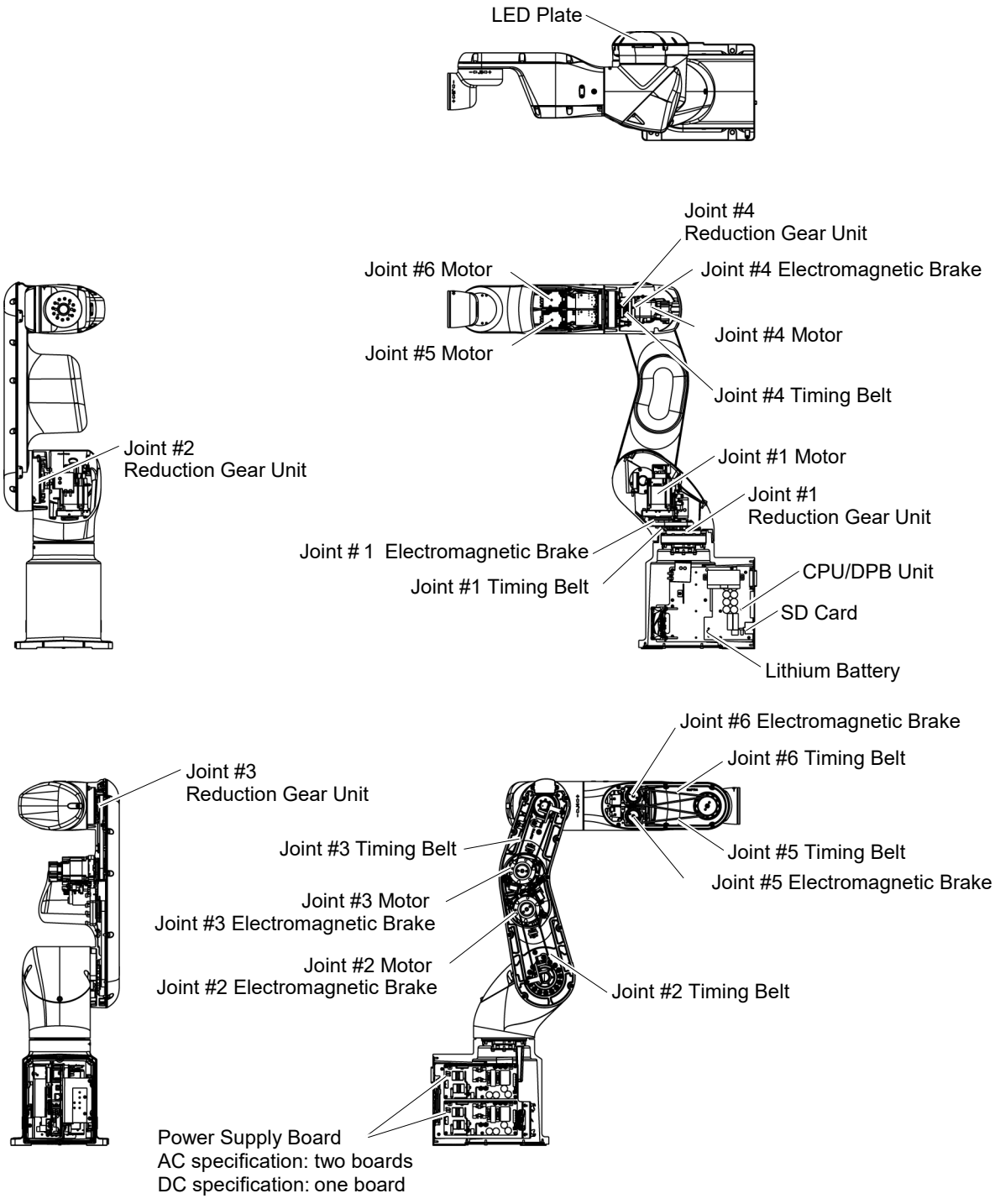
EPSON RC+

Execute the following command from the [Command Window].

```
>PULSE
```

`PULSE:` [Joint #1 Pulse value] `pls` [Joint #2 Pulse value] `pls` [Joint #3 Pulse value] `pls` [Joint #4 Pulse value] `pls`[Joint #5 Pulse value]`pls` [Joint #6 Pulse value]`pls`

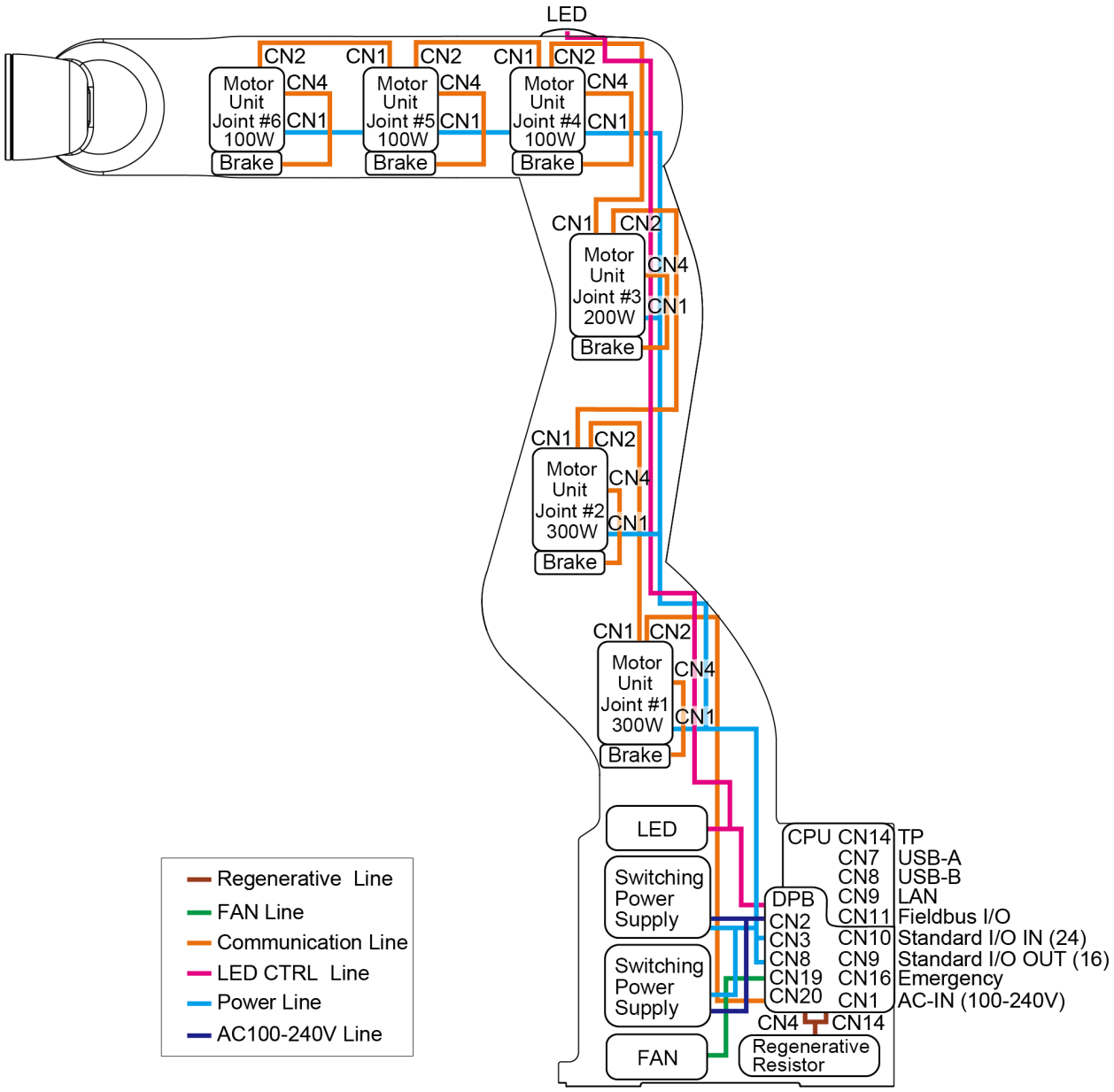
2.5 Layout of Maintenance Parts



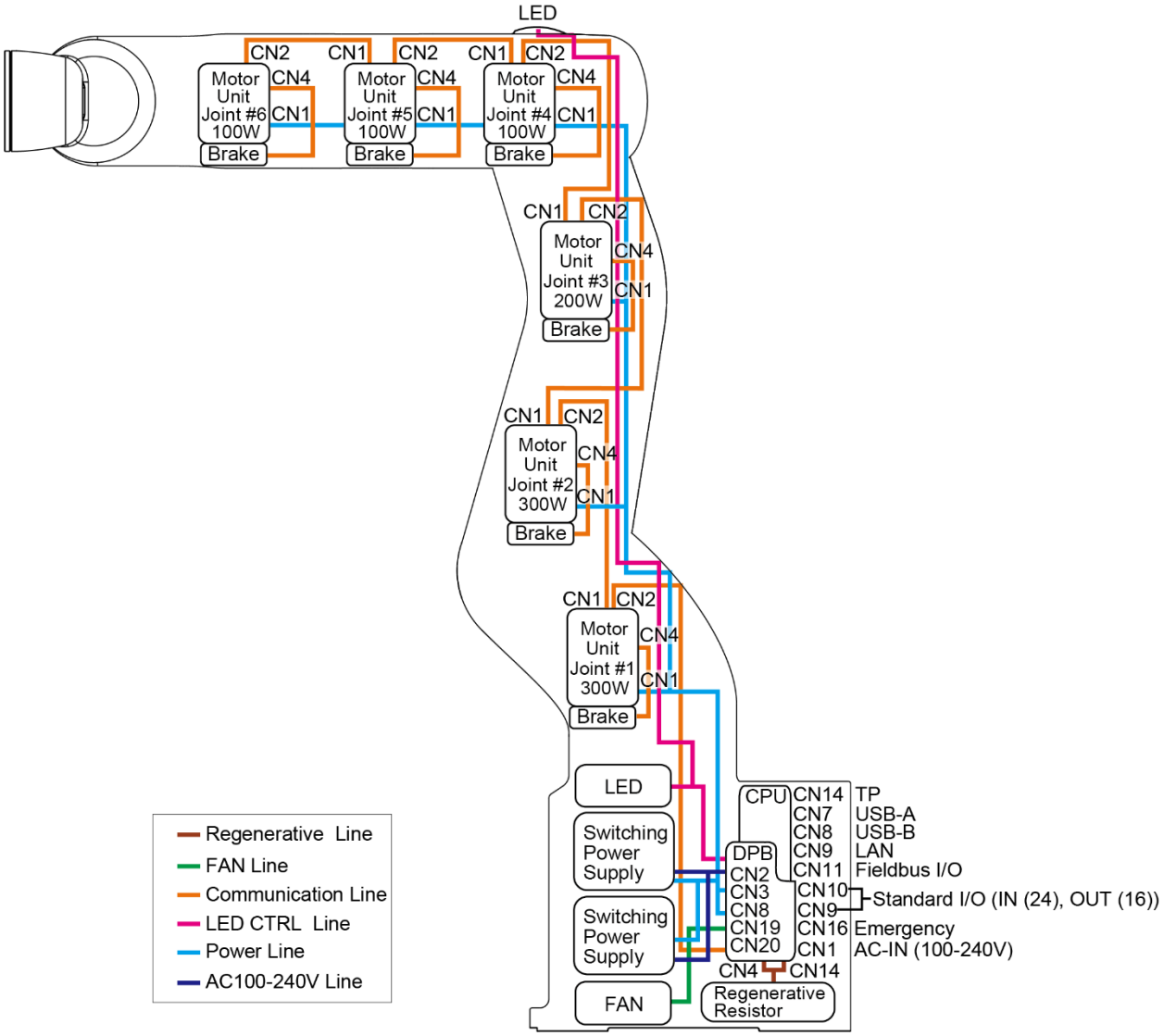
3. Manipulator Structure

3.1 AC Specification Manipulator

Standard, Cleanroom model

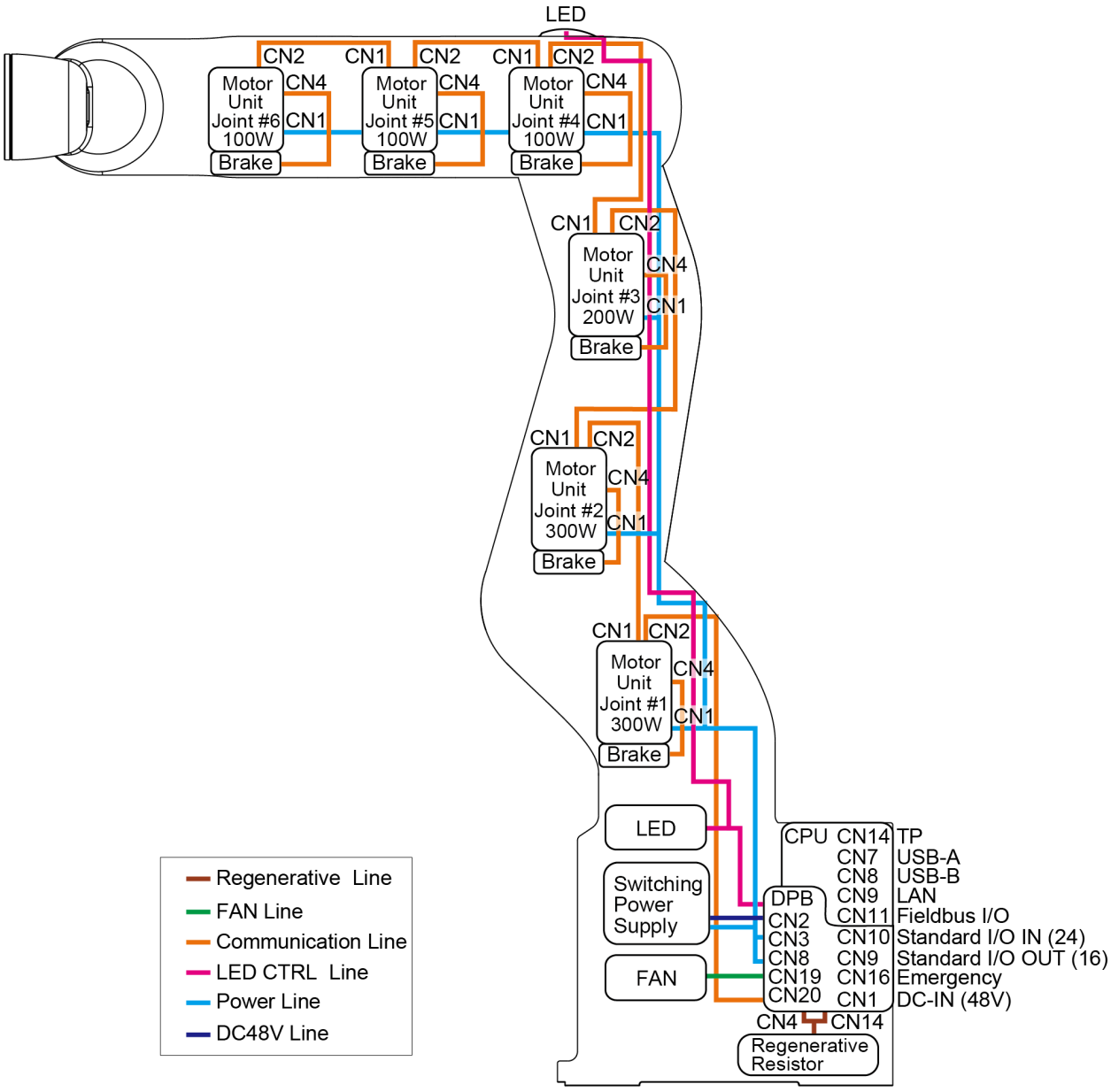


Protection model



3.2 DC Specification Manipulator

Standard model



4. Alarm

When the lithium batteries run out, a voltage reduction alarm warning occurs. However, the warning does not guarantee that the battery lasts until you replace it.

In addition, the parts of the Manipulator joints may cause accuracy decline or malfunction due to deterioration of the parts resulting from long term use. If the Manipulator breaks down due to deterioration of the parts, it will take significant time and cost for repair.

The following sections describe the alarm function which announces the following maintenance timings in order to perform maintenance well ahead of time before the warning error.

- Battery replacement
- Grease up
- Replacement of the timing belt
- Replacement of the motor
- Replacement of the reduction gear unit

4.1 Maintenance

The recommended replacement time can be configured for the batteries, timing belts, motors, and reduction gear units.

CAUTION	■ Make sure that the date and time on the Manipulator are set correctly. Maintenance cannot be performed properly with improper date and time setting. ■ If the CPU/DPB board or SD card is replaced, the Maintenance information may be lost. When you replaced these parts, confirm the date and time of the Manipulator and the Maintenance information.

NOTE

Settings of the Maintenance are different depending on installation methods of the firmware.

Initial installation : Maintenance is enabled.

Upgrade : Maintenance inherits the previous data.
(Disables as default)

For details for enabling or disabling the Maintenance, refer to the *EPSON RC+ 7.0 User's Guide 5.13.2 [System Configuration] Command (Setup Menu) - [Setup]-[System Configuration]-[Controller]-[Preferences] Page*.

NOTE

Maintenance is enabled at shipment.

If enabled, the Maintenance information for the timing belts, motors, and reduction gear units will be configured automatically when the robot is configured or changed.

When the Manipulator is deleted from the configuration, the Maintenance information will also be automatically deleted.

For details on the Manipulator configuration, refer to *the EPSON RC+ 7.0 User's Guide 10.1 Setting the Robot Model*.

CAUTION	■ Changing of the Manipulator should be done carefully. The alarm setting will be reset when the Manipulator is changed.

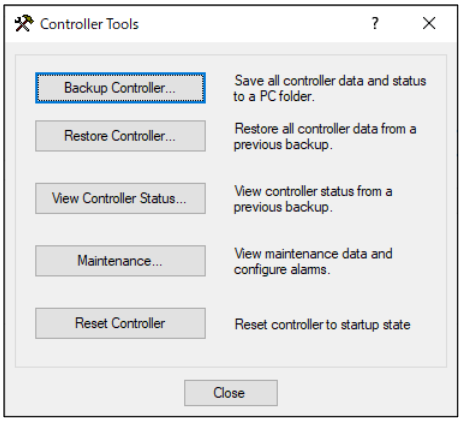
If the Maintenance is enabled, the battery is automatically configured at the first connection.

4.2 Maintenance Information

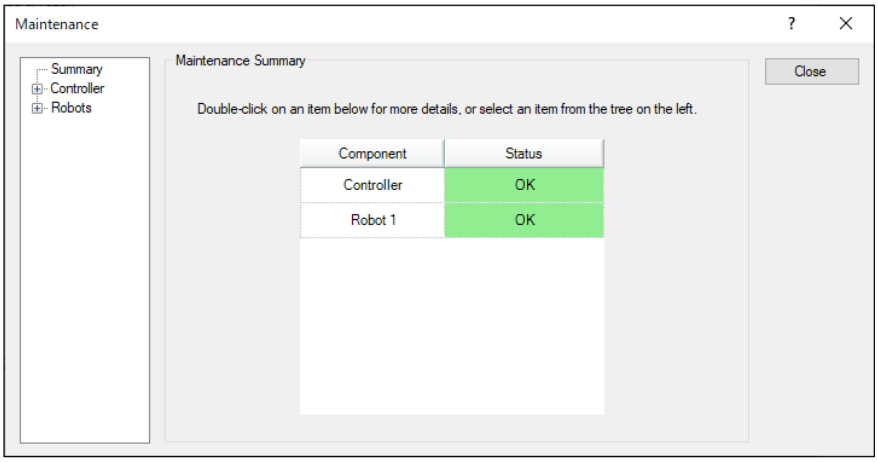
4.2.1 How to Check the Maintenance Information

The configured Maintenance information can be checked in the EPSON RC+.

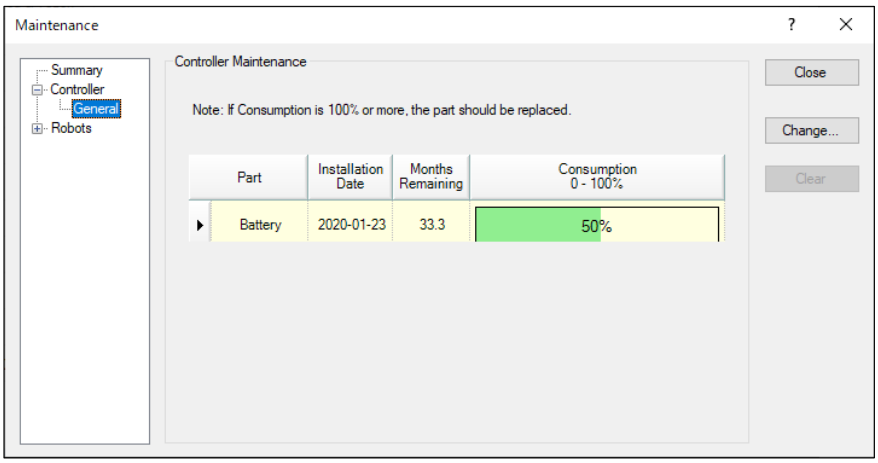
(1) Select EPSON RC+ 7.0 menu-[Tools]-[Maintenance] to display the [Controller Tools] dialog box.



(2) To check the Controller Maintenance information, click the <Maintenance> button and display the [Maintenance] dialog box.



(3) Select “General” or specify the axis from the tree to display information of the target parts.



NOTE The recommended replacement time for the battery is calculated based on the battery capacity and the Manipulator ON time. The battery may run out if it passes the recommended replacement time.

NOTE The recommended replacement time for the parts (e.g. timing belts, motors, reduction gear units) is when it reaches the L10 life (time until 10% failure probability). In the dialog box, the L10 life is displayed as 100%.

4.2.2 How to Edit the Maintenance Information

The configured Maintenance information can be edited in the EPSON RC+.

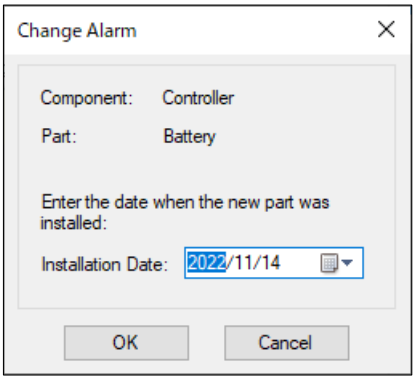
(1) Select the EPSON RC+ 7.0 menu-[Tools]-[Maintenance] to display the [Controller Tools] dialog box.

(2) To edit the Maintenance information, display the [Maintenance] dialog box.

(3) Select “General” or specify the axis from the tree to display information of the target parts.

(4) Select the alarm to be changed and click the <Change> button.

(5) Display the [Change Alarm] dialog box and enter any of the following.



Purchase or replacement date of the battery
Date of grease up
Purchase or replacement date of the timing belt
Purchase or replacement date of the motor
Purchase or replacement date of the reduction gear unit

(6) Click the <OK> button and change the specified alarm information.

NOTE The offset can be set for the consumption rate of already installed parts.
Follow the steps below to calculate a rough offset setting value.

1. Measure the usable months for the past operation by HealthRBAnalysis.
2. Confirm the past Motor ON time in the Controller status viewer.
3. Calculate a rough offset value with the following formula.

$$\text{Offset}=100\times\frac{\textit{Motor On time}}{24\times30.4375\times\textit{Usable months}}$$

For details, refer to the following manual.
EPSON RC+ 7.0 SPEL+ Language Reference.

4.2.3 Alarm Notifying Method

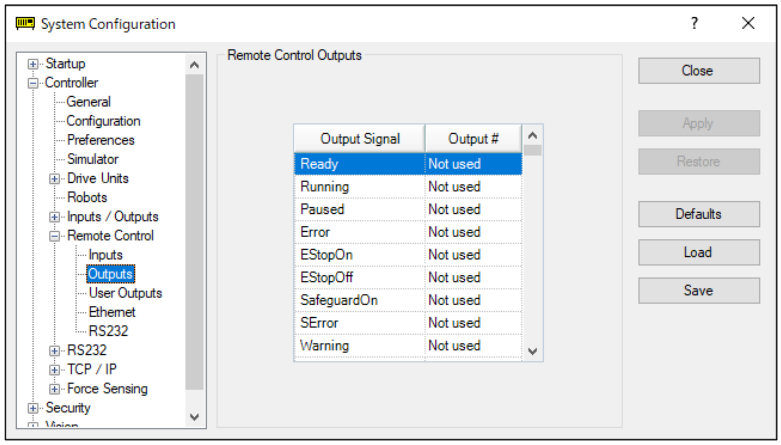
The Manipulator status becomes warning and displays warning message if any parts required to perform replacement or grease up.

For details, refer to the following manual.
Status Code / Error Code List

The alarm notifying method can be configured by the output bit of the Remote I/O.

The Remote I/O can be configured in the EPSON RC+ 7.0- [Setup] - [System Configuration] - [Controller] - [Remote Control].

For details, refer to the following manual.
EPSON RC+ 7.0 User's Guide 12.1 Remote I/O.



NOTE

The Controller enters the warning state if an alarm occurs.

Alarm1 to Alarm9 set in the output bit of the remote I/O monitor the occurrence of warnings every 5 minutes.

The alarm occurrence and output timing on the controller are different. It may be output to the remote I/O up to 5 minutes after the alarm is occurred on the controller.

4.2.4 How to Cancel the Alarm

An alarm occurs when the consumption rate of the parts reaches 100%.

NOTE

The alarm cannot be canceled by executing the Reset command or restarting the Controller.
The alarm can be canceled by the following method.

Operation from [Maintenance] dialog box of the EPSON RC+ 7.0
HealthCtrlReset Command
HealthRBReset Command

Refer to the following section to change the alarm information in the same steps.
"*4.2.2 How to Edit the Maintenance Information*"

5. Backup and Restore

5.1 What is the Backup Controller Function

The Manipulator configuration set by EPSON RC+ 7.0 can be stored with the “Backup Controller” function.

The Manipulator settings can be restored easily using the data previously stored with “Backup Controller” after a configuration mistake or Manipulator problem.

Be sure to execute “Backup Controller” before changing the Manipulator setup, before maintenance, or after teaching.

For some problems, backup may not be available before maintenance has to be performed. Be sure to backup the data after making changes before problems occur.

NOTE ☞ “Controller Status Storage” is one of the VT series Manipulator functions. It saves the Controller setup data same as “Backup Controller.”

There data can be used as the backup data at restoring.

The methods for “Controller Status Storage” are as follows:

A : “Controller status storage to USB memory”
For details, refer to “*VT series Manual VT6L Manipulator 8. Memory Port*”.

B : “Export Controller Status function” in EPSON RC+ 7.0.
For details, refer to the following manual.
EPSON RC+ 7.0 User’s Guide 5.10.10 [Import] Command (Project Menu).

5.2 Backup Data Types

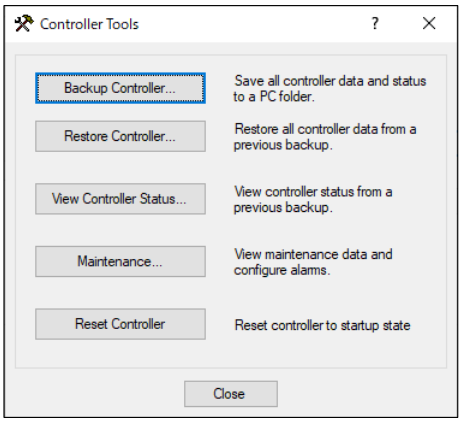
The table below shows the files created with “Backup Controller”.

File Name	Overview	
Backup.txt	Information file for restore	File including information for restoring the Manipulator.
CurrentMnp01.PRM	Manipulator parameters	Stores information such as ToolSet.
InitFileSrc.txt	Initial configuration	Stores various Manipulator parameters.
MCSys01.MCD	Manipulator configuration	Stores connected Manipulator information.
All the files related to Project	Project related	All the project files transferred to the Controller. Includes program files when EPSON RC+ 7.0 is configured to transfer source code to the Controller.
GlobalPreserves.dat	Global Preserve variables	Saves values of Global Preserve variables.
WorkQueues.dat	WorkQue information	Saves information of Queues information of the WorkQue.

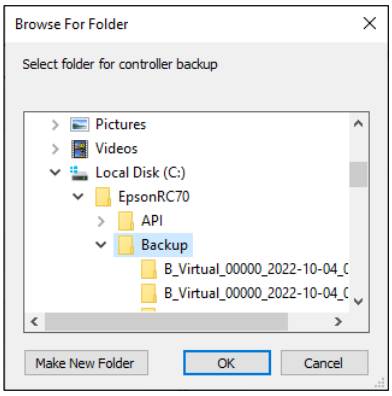
5.3 Backup

Backup the Manipulator status from EPSON RC+ 7.0.

(1) Select EPSON RC+ 7.0 menu-[Tools]-[Controller] to display the [Controller Tools] dialog box.



(2) Click the <Backup Controller…> button to display the [Browse For Folder] dialog box.



(3) Specify the folder to save the backup data. Create a new folder if desired.

(4) Click the <OK> button. A folder is created in the specified folder containing the backup data with a name in the following format.
B_VT_ serial number_ date status was saved
→ Example: B_VT_12345_2016-04-03_092941

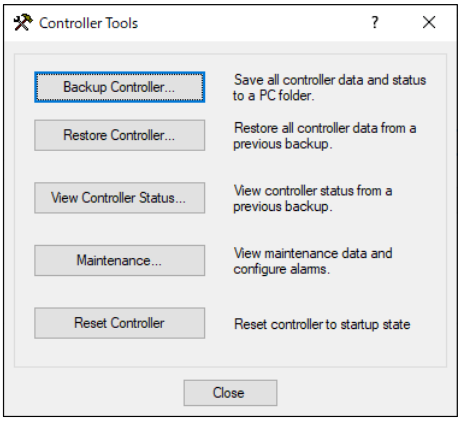
CAUTION	■ Do not edit the backup files. Otherwise, operation of the robot system after data restoration to the Manipulator is not assured.

5.4 Restore

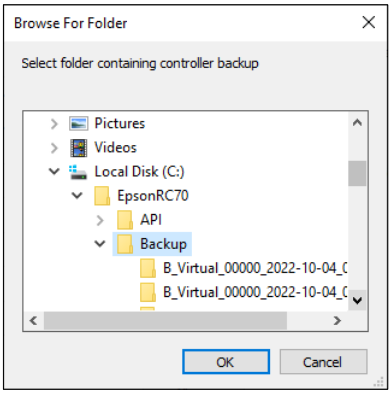
Restore the Manipulator status from EPSON RC+ 7.0.

CAUTION	■ Make sure that the data used for restoring was saved previously for same Manipulator. ■ Do not edit the backup files. Otherwise, operation of the robot system after data restoration to the Manipulator is not assured.

(1) Select the EPSON RC+ 7.0 menu-[Tools]-[Controller] to display the [Controller Tools] dialog box.



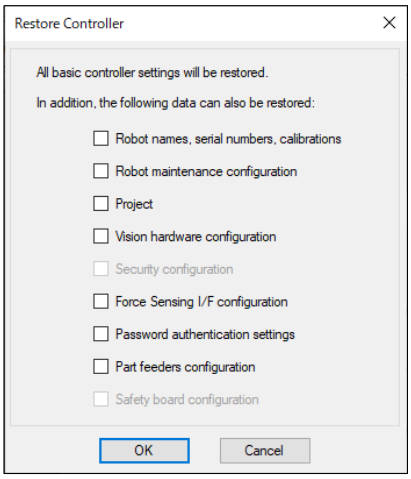
(2) Click the <Restore Controller…> button to display the [Browse For Folder] dialog box.



(3) Specify the folder that contains the backup data. Backup data folders are named using the following format:
B_VT_ serial number_ date status was saved
→ Example: B_VT_12345_2016-04-03_092941

NOTE ☞ Controller status backup to USB memory function can also be specified for restore. Specify the following folder.

(4) Click the <OK> button to display the [Restore Controller] dialog.



Robot name, serial #, calibration

This checkbox allows you to restore the robot (Manipulator) name, Manipulator serial number, Hofs data, and CalPls data. Make sure that the correct Hofs data is restored. If the wrong Hofs data is restored, the Manipulator may move to wrong positions.

This is not selected by the default setting.

Robot maintenance configuration

This checkbox allows you to restore the robot alarm related files.

For details, refer to *Maintenance 4. Alarm*.

This is not selected by the default setting.

Check this checkbox when restoring a backup data which is retrieved while the EPSON RC+ 7.0 menu-[Setup]-[System Configuration]-[Controller]-[Preferences]-[Enable robot maintenance data] checkbox is checked. If not checked, the maintenance data will not be reflected.

Project

This checkbox allows you to restore the files related to projects.

This is not selected by the default setting.

When a project is restored, the values of Global Preserve variables are loaded.

For details about Global Preserve variable backup, refer to the following manual.

EPSON RC+ 7.0 User's Guide 5.11.10 [Display Variables] Command (Run Menu).

Vision hardware configuration

This checkbox allows you to restore the vision hardware configuration.

For details, refer to refer to the following manual.

EPSON RC+ 7.0 option Vision Guide 7.0.

This is not selected by the default setting.

Security configuration

This checkbox allows you to restore the security configuration.

For details, refer to refer to the following manual.

EPSON RC+ 7.0 User's Guide 15. Security.

This is not selected by the default setting.

Force Sensing I/F configuration

This checkbox allows you to restore the Force Sensing I/F configuration.
This is not selected by the default setting.
This function is not supported for VT series Manipulator.

Password authentication setting

This checkbox allows you to restore the setting of authentication for PC connection.
The authentication password for PC connection and the setting to disable connection authentication are restored.
This is not selected by the default setting.

Part feeders configuration

This check box allows you to restore the communication settings, etc. of the part feeders.
For details, refer to the following manual.
EPSON RC+ 7.0 Option Part Feeding 7.0 Introduction & Software
This is not selected by the default setting.

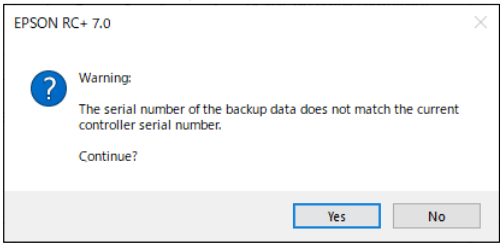
Safety board configuration

This checkbox allows you to restore the setting of the safety function.
For details, refer to the following manual.
Robot Controller Safety Function Manual
This function is not supported for VT series Manipulator.

(5) Click the <OK> button to restore the system information.

NOTE

Restore the system configuration saved using Backup Controller only for the same system.
When different system information is restored, the following warning message appears.



Click the <No> button (do not restore data) except for special situations such a Manipulator replacement.

NOTE

When restoring the backup including the robot information other than VT series, an error occurs.

NOTE

You cannot restore the backup including T series robot created in the virtual Controller of EPSON RC+ 7.0 to the VT series robot.

6. Firmware Update

This chapter describes the firmware upgrade procedure and data file initialization when firmware or Manipulator configuration errors cause Manipulator startup or operation failure.

6.1 Updating Firmware

Firmware (software stored in non-volatile memory) and data files necessary to control the Manipulator are preinstalled in the Manipulator. Controller configuration set from EPSON RC+ 7.0 is always saved in the Manipulator.

Firmware is supplied by CD-ROM as needed. Please contact the supplier of your region for information.

You must use a PC running EPSON RC+ 7.0 connected to a Manipulator with USB to update the Manipulator firmware. Firmware cannot be updated with an Ethernet connection.

NOTE

When installing the firmware Ver.7.5.0.x or later, be sure to use the PC which EPSON RC+ 7.0 Ver.7.5.0 or later is installed.

6.2 Firmware Upgrade Procedure

The firmware upgrade procedure is described as follows:

CAUTION	■ DO NOT unplug the USB cable, or turn OFF the Manipulator or the development PC during upgrade of the firmware. Doing so may result in malfunction of the robot system.

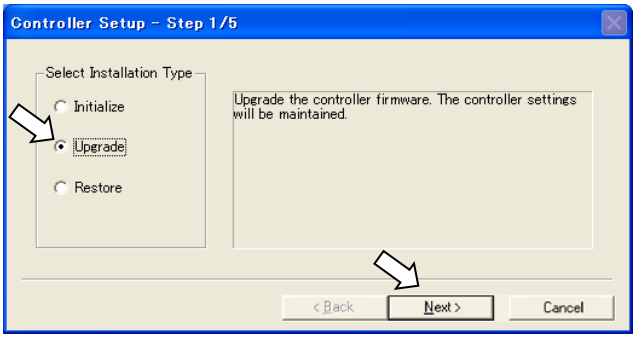
(1) Connect the development PC and the Manipulator with a USB cable (the firmware cannot be changed with an Ethernet connection).

(2) Turn ON the Manipulator. (Do not start the development software EPSON RC+ 7.0 until the firmware upgrade is completed.)

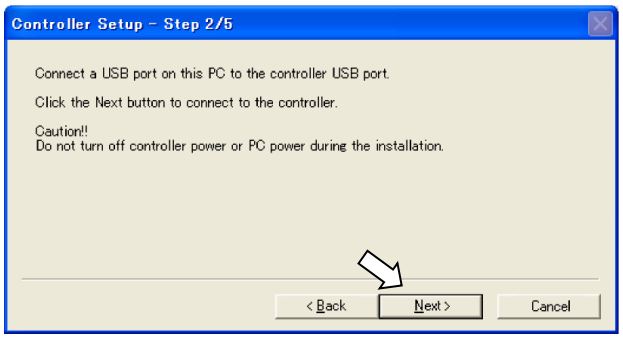
(3) Insert the “firmware CD-ROM” in the development PC CD-ROM drive

(4) Execute “CtrlsetupT.exe”. The following dialog box appears.

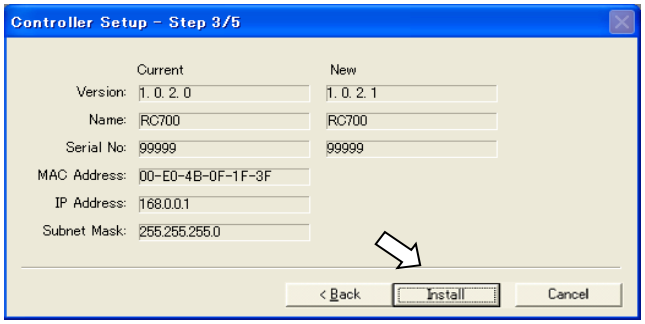
(5) Select the <Upgrade> option button and click the <Next> button.



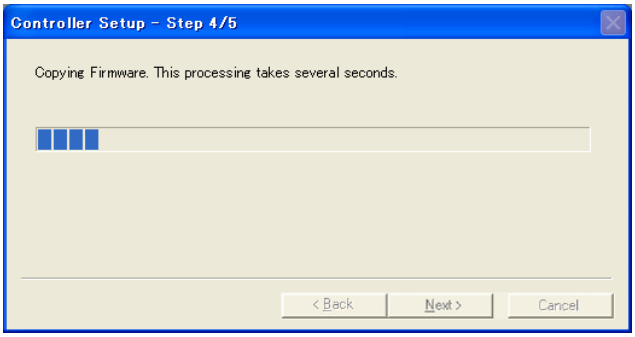
(6) Make sure that the development PC is connected to the Manipulator with a USB cable and Click the <Next> button.



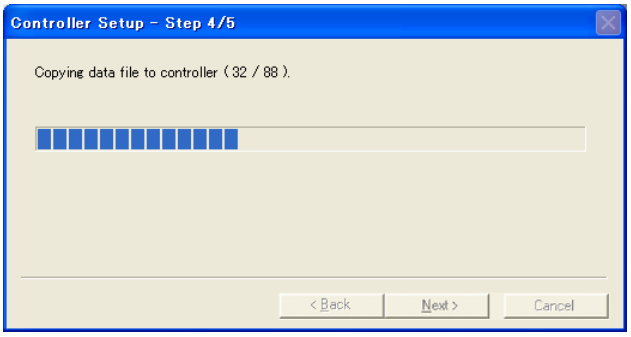
(7) Check the current firmware version and the new firmware version and click the <Install> button.



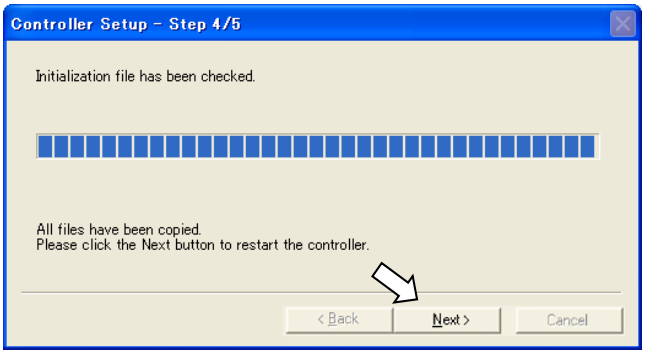
(8) The firmware upgrade starts. It takes several minutes to complete.



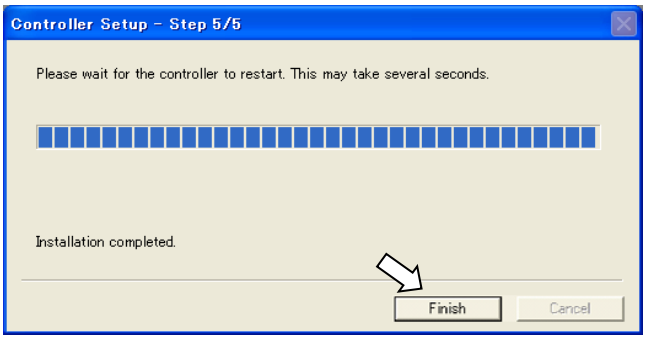
(9) Continuous data file transfer starts.



(10) The following dialog box appears when transfer has completed. Click the <Next> button to reboot the Manipulator.



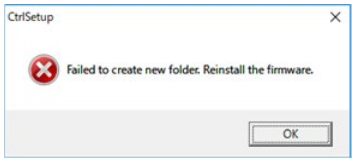
(11) The following dialog box appears after the Controller reboot. Click the <Finish> button.



The firmware upgrade is complete.

NOTE

When you install the firmware (Ver.7.4.0.2 or later) on the Controller which the firmware (before Ver.7.4.0.2) has been installed, the following message is displayed.



When the message is displayed, re-install the firmware.

6.3 Manipulator Recovery

If the Manipulator becomes inoperable, use the procedures described in this section to recover.

NOTE

Controller Backup is recommended for easy recovery of the Controller operation.
For details of Controller Backup, refer to refer to the following manual.
5. Backup and Restore.

6.4 Firmware Initialization Procedure

The firmware initialization procedures are described in this section.

CAUTION	■ DO NOT unplug the USB cable, or turn OFF the Manipulator or the development PC during upgrade of the firmware. Doing so may result in malfunction of the robot system.

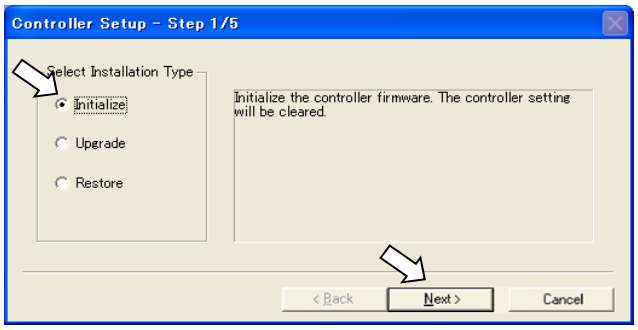
(1) Connect the development PC to the Manipulator with a USB cable (the firmware cannot be changed with an Ethernet connection).

(2) Turn ON the Manipulator. Do not start the development software EPSON RC+ 7.0 until firmware initialization is complete.

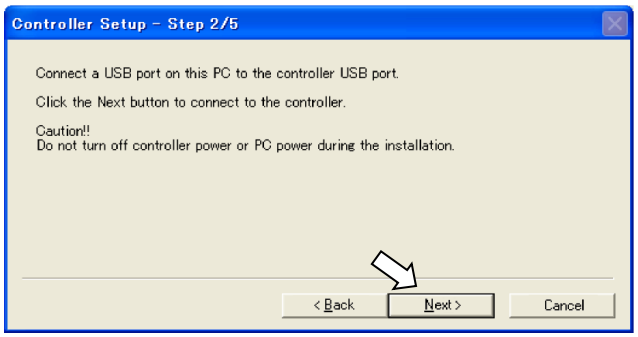
(3) Insert the “Firmware CD-ROM” in the development PC CD-ROM drive.

(4) Execute “Ctrlsetup.exe”.

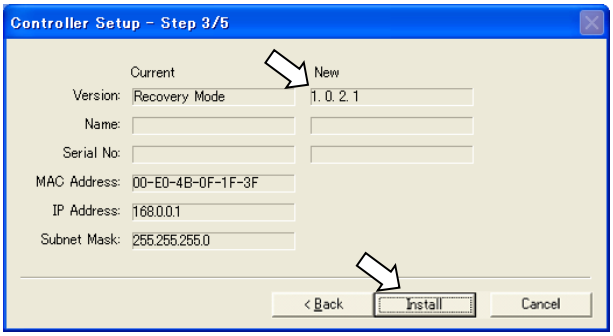
(5) Select the <Initialize> option button and click the <Next> button.



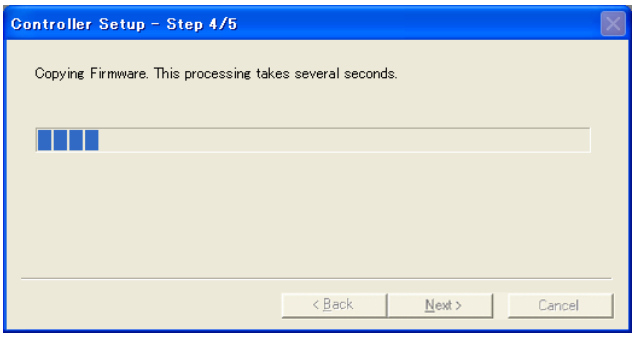
(6) Make sure that the development PC is connected to the Controller with a USB cable and Click the <Next> button.



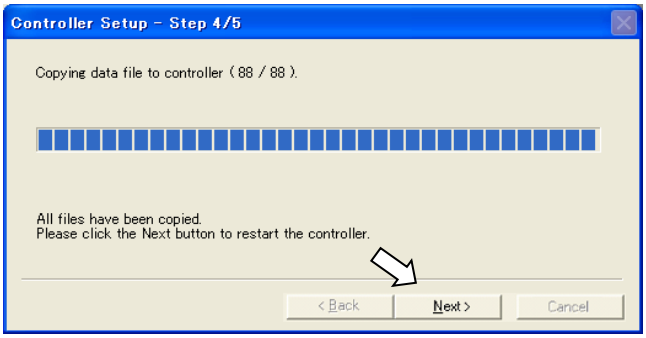
(7) Check the version information and click the <Install> button.



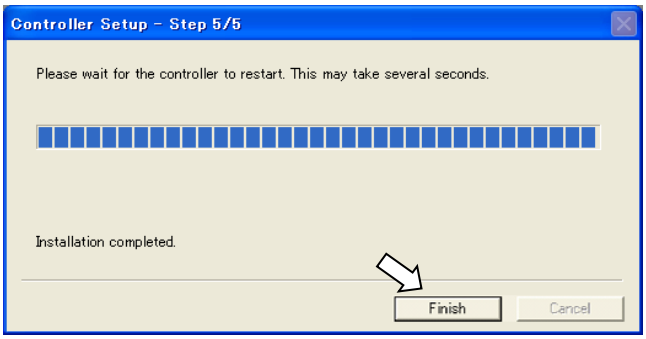
(8) Firmware and data file transfer starts. It takes several minutes to complete.



(9) The following dialog box appears when transfer is completed. Click the <Next> button to reboot the Manipulator.



(10) The following dialog box appears after the Manipulator reboot. Click the <Finish> button.

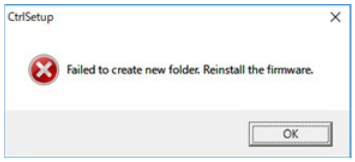


The firmware upgrade is completed.

Start EPSON RC+ 7.0 and restore the Controller settings.
For details of restoring the operating system, refer to "*5. Backup and Restore*".

NOTE

When you install the firmware (Ver.7.4.0.2 or later) on the Controller which the firmware (before Ver.7.4.0.2) has been installed, the following message is displayed.



When the message is displayed, re-install the firmware.

6.5 Adding Confirmation Steps by Strengthening Security of EtherNet Connection

From the following firmware version password authentication is required when connecting Controllers and PCs to a global accessible network.

F/W : Ver.7.4.58.x

In the following cases, connections of EtherNet (PC) connector and Remote Ethernet are not available.

Controller IP address is set to global IP address
Firmware version is Ver.7.4.58 or later
EPSON RC+7.0 is Ver.7.4.7 or before

When the Controller firmware is updated under the following conditions, additional steps to confirm whether to continue the firmware update may be execute depending on the configuration settings of the Controller. (step 3 or later shown below)

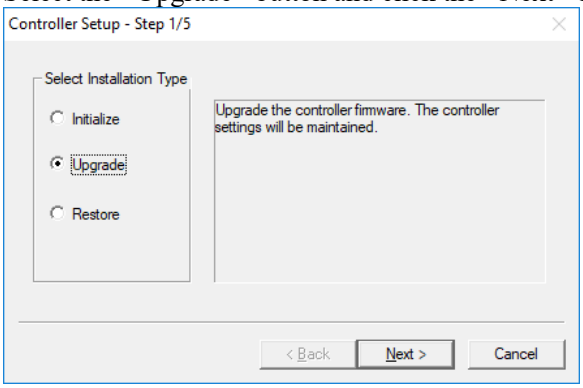
Controller IP address is set to global IP address
Firmware version to be installed is 7.4.8.x or later

The following describes the steps to confirm whether to continue the firmware update.

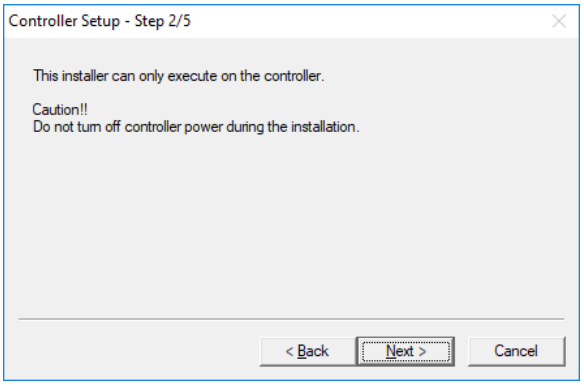
(1) Insert “Firmware CD-ROM” to be installed into the CD-ROM driver of the development PC.

(2) Execute “CtrlsetupT.exe”.

(3) Controller Setup window is displayed.
Select the <Upgrade> button and click the <Next> button.

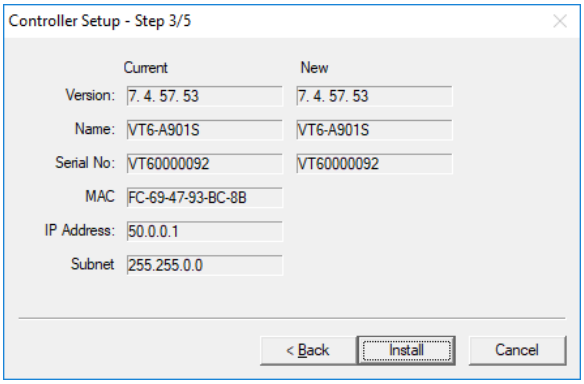


(4) Step 2 window is displayed.
Click the <Next> button.

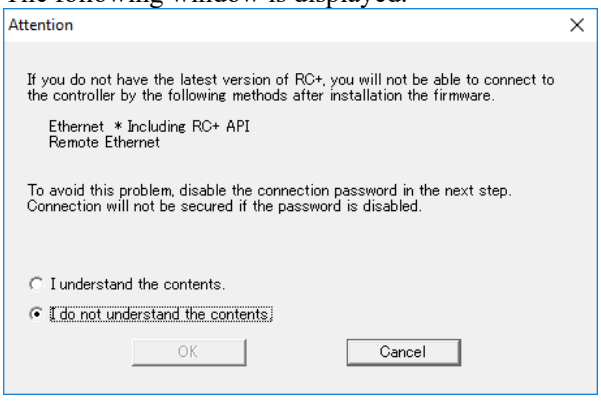


(5) Step 3 window is displayed.

(5)-1 When the steps to confirm whether to continue the firmware update is not executed:
Step 3 window is displayed.
Follow the instructions on the window and install the firmware.

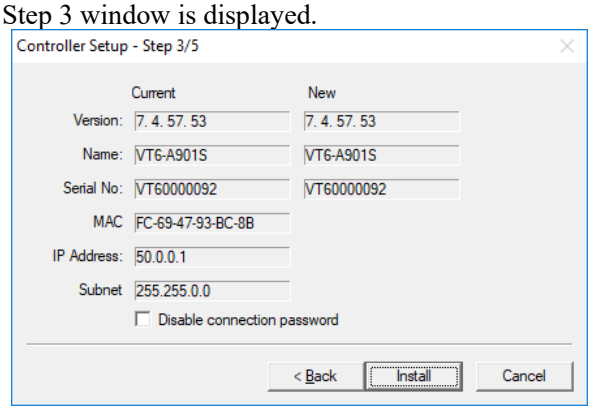


(5)-2 When the steps to confirm whether to continue the firmware update is executed:
The following window is displayed.



When the <I understand the contents> button is selected, the <OK> button will be enabled.
When the <OK> button is clicked, Step3 window is displayed. Go to the step (6).
When the <Cancel> button is clicked, Step3 window is displayed. The [Disable connection password] checkbox and the <Install> button will be grayed out and cannot be selected.

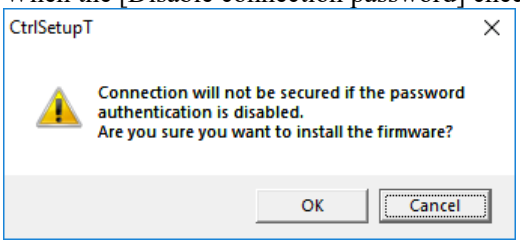
(6) Step 3 window is displayed.



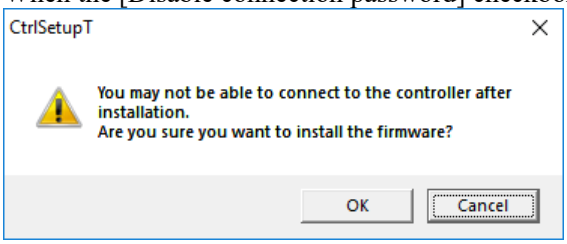
(6)-1 If the [Disable connection password] checkbox is selected, connection authentication after updating the firmware is disabled.

(6)-2 If the <Install> button is clicked, the confirmation window is displayed.

When the [Disable connection password] checkbox is selected:



When the [Disable connection password] checkbox is not selected:

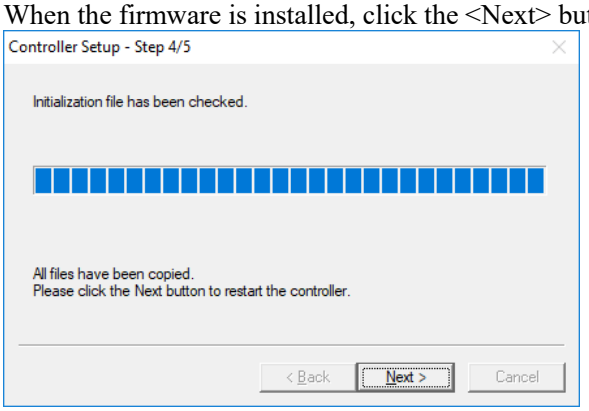


When the <OK> button is clicked, Step 4 window is displayed. Go to the step (7).

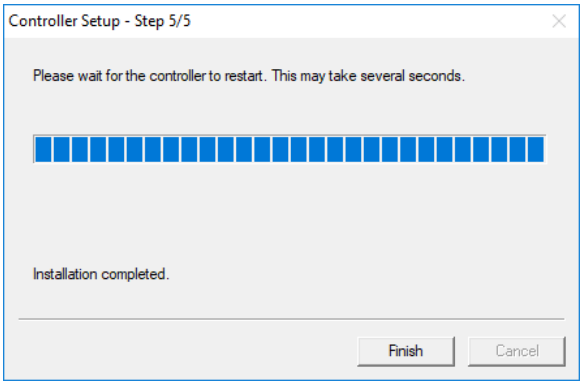
When the <Cancel> button is clicked, the window is closed.

(7) Firmware installation starts.

When the firmware is installed, click the <Next> button. Reboot the Controller.



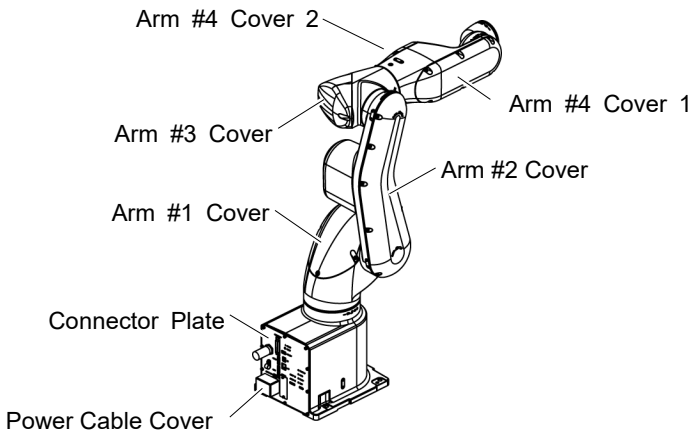
(8) When the Controller is rebooted, the following window is displayed.
Confirm that the firmware is installed.
Click the <Finish> button.



7. Covers

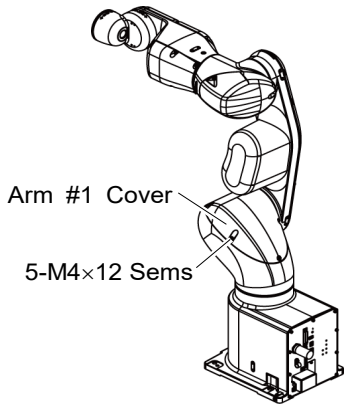
All procedures for removing and installing covers in maintenance are described in this chapter.

WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power plug. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system.



7.1 Arm #1 Cover

CAUTION	■ Do not remove the cover forcibly. Removing the cover forcibly may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.



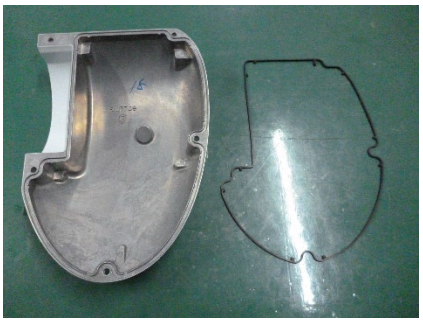
Arm #1 Cover Removal

Standard, Cleanroom model:

Unscrew the mounting bolts, and then lift the Arm #1 Cover.

Protection model:

Unscrew the mounting bolts, and then lift the Arm #1 Cover and Arm #1 gasket together.



NOTE
Be careful of wires and tubes when removing the cover.

NOTE
If the Arm #2 interferes with the tools when unscrewing the mounting bolts, move the Arm #2 to the position where it does not interfere with the tools before be performing operations.

Arm #1 Cover Installation

Standard, Cleanroom model:

Put the Arm #1 Cover to the Manipulator and secure with the mounting bolts.

Hexagon socket head cap bolts with captive washer: 5-M4×12 Sems

Tightening torque: 4 ± 0.2 Nm

Protection model:

Mount Arm #1 gasket in the groove of Arm #1 Cover. (Replace the gasket if there are flaws or deteriorations.)

Put the Arm #1 Cover to the Manipulator and secure with the mounting bolts.

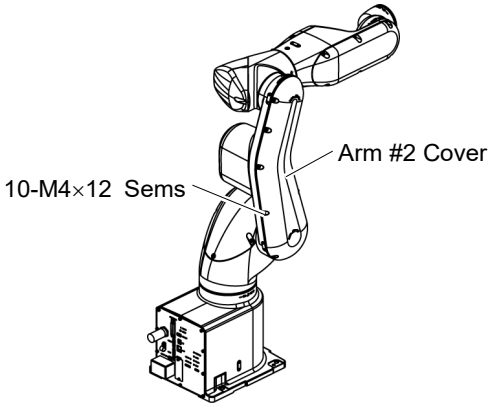
Hexagon socket head cap bolts with captive washer: 5-M4×12 Sems

Tightening torque: 4 ± 0.2 Nm

NOTE
When installing the cover, be careful not to get the gaskets and cables caught between the arm and cover.

7.2 Arm #2 Cover

CAUTION	■ Do not remove the cover forcibly. Removing the cover forcibly may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.



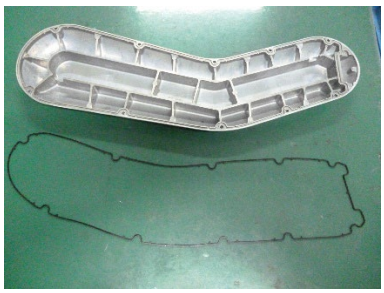
Arm #2 Cover Removal

Standard, Cleanroom model:

Unscrew the mounting bolts, and then lift the Arm #2 Cover.

Protection model:

Unscrew the mounting bolts, and then lift the Arm #2 Cover and Arm #2 gasket together.



NOTE

Be careful of wires and tubes when removing the cover.

Arm #2 Cover Installation

Standard, Cleanroom model:

Put the Arm #2 Cover to the Manipulator and secure with the mounting bolts.

Hexagon socket head cap bolts with captive washer: 10-M4×12 Sems
Tightening torque: 4 ± 0.2 Nm

Protection model:

Mount Arm #2 gasket in the groove of Arm #2 Cover. (Replace the gasket if there are flaws or deteriorations.)

Put the Arm #2 Cover to the Manipulator and secure with the mounting bolts.

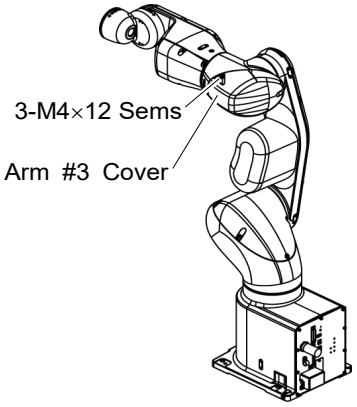
Hexagon socket head cap bolts with captive washer: 10-M4×12 Sems
Tightening torque: 4 ± 0.2 Nm

NOTE

When installing the cover, be careful not to get the gaskets and cables caught between the arm and cover.

7.3 Arm #3 Cover

CAUTION	■ Do not remove the cover forcibly. Removing the cover forcibly may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.



Arm #3 Cover Removal

Standard, Cleanroom model:

Unscrew the mounting bolts, and then lift the Arm #3 Cover.

Protection model:

Unscrew the mounting bolts, and then lift the Arm #3 Cover and Arm #3 gasket together.

NOTE Be careful of wires and tubes when removing the cover.

Arm #3 Cover Installation

Standard, Cleanroom model:

Put the Arm #3 Cover to the Manipulator and secure with the mounting bolts.

Hexagon socket head cap bolts with captive washer: 3-M4×12 Sems
Tightening torque: 4 ± 0.2 Nm

Protection model:

Mount Arm #3 gasket in the groove of Arm #3 Cover. (Replace the gasket if there are flaws or deteriorations.)

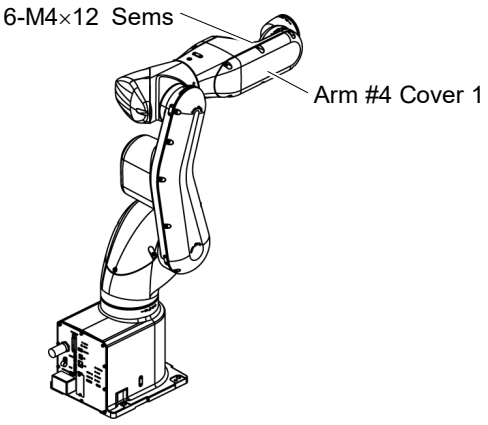
Put the Arm #3 Cover to the Manipulator and secure with the mounting bolts.

Hexagon socket head cap bolts with captive washer: 3-M4×12 Sems
Tightening torque: 4 ± 0.2 Nm

NOTE When installing the cover, be careful not to get the gaskets and cables caught between the arm and cover.

7.4 Arm #4 Cover 1

CAUTION	■ Do not remove the cover forcibly. Removing the cover forcibly may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.



Arm #4 Cover 1 Removal

Standard, Cleanroom model:

Unscrew the mounting bolts, and then lift the Arm #4 Cover 1.

Protection model:

Unscrew the mounting bolts, and then lift the Arm #4 Cover 1 and Arm #4 gasket 1 together.

NOTE

Be careful of wires and tubes when removing the cover.

Arm #4 Cover 1 Installation

Standard, Cleanroom model:

Put the Arm #4 Cover 1 to the Manipulator and secure with the mounting bolts.

Hexagon socket head cap bolts with captive washer: 6-M4×12 Sems
Tightening torque: 4 ± 0.2 Nm

Protection model:

Mount Arm #4 gasket 1 in the groove of Arm #4 Cover 1. (Replace the gasket if there are flaws or deteriorations.)

Put the Arm #4 Cover 1 to the Manipulator and secure with the mounting bolts.

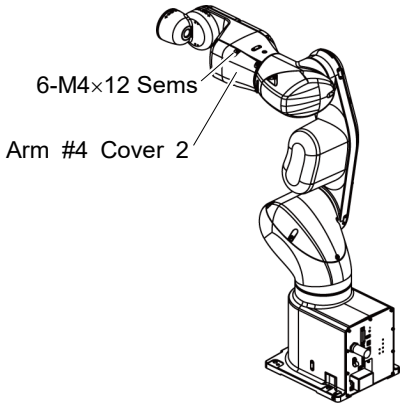
Hexagon socket head cap bolts with captive washer: 6-M4×12 Sems
Tightening torque: 4 ± 0.2 Nm

NOTE

When installing the cover, be careful not to get the gaskets and cables caught between the arm and cover.

7.5 Arm #4 Cover 2

CAUTION	■ Do not remove the cover forcibly. Removing the cover forcibly may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.



Arm #4 Cover 2 Removal

(1) Unscrew the mounting bolts, and then lift the Arm #4 Cover 2.

NOTE Do not remove the cover forcibly when removing it.

(2) Disconnect the connector from the board mounted on the rear side of the Arm #4 Cover 2.

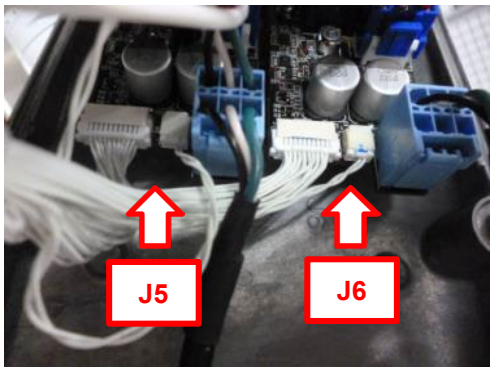
(3) Only for Protection model:
Remove Arm #4 gasket 2 from the Arm #4 Cover 2.

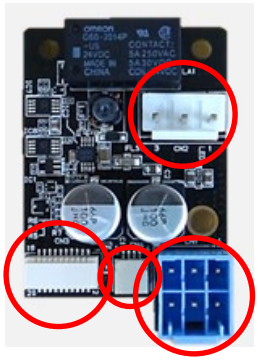
Arm #4 Cover 2 Installation

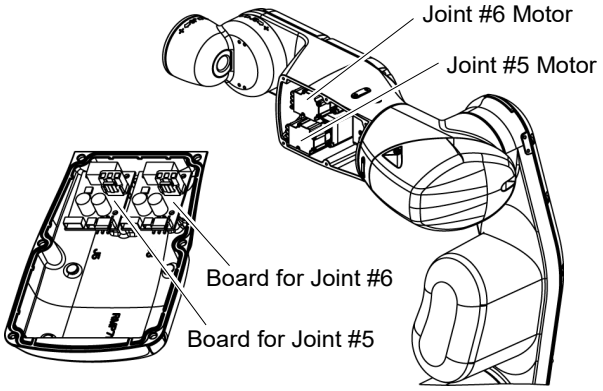
(1) Only for Protection model:
Mount Arm #4 gasket 2 in the groove of Arm #4 Cover 2. (Replace the gasket if there are flaws or deteriorations.)

(2) Connect the connector to the board on the rear side of the Arm #4 Cover 2.

NOTE Connect the connector to the board which supports each motor (J5, J6). Be careful not to connect it to wrong board or forget to connect.







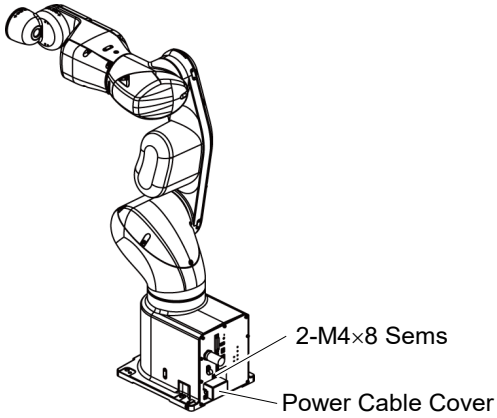
(3) Put the Arm #4 Cover 2 to the Manipulator and secure with the mounting bolts.

Hexagon socket head cap bolts with captive washer: 6-M4×12 Sems
Tightening torque: 4 ± 0.2 Nm

NOTE When installing the cover, be careful not to get the gaskets and cables caught between the arm and cover.

7.6 Power Cable Cover

Standard, Cleanroom model:



Power Cable Cover Removal

Unscrew the mounting bolts, and then lift the Power Cable Cover.

Power Cable Cover Installation

Put the Power Cable Cover to the connector plate and secure with the mounting bolts.

Hexagon socket head cap bolts with captive washer: 2-M4×8 Sems
Tightening torque: 0.9 ± 0.1 Nm

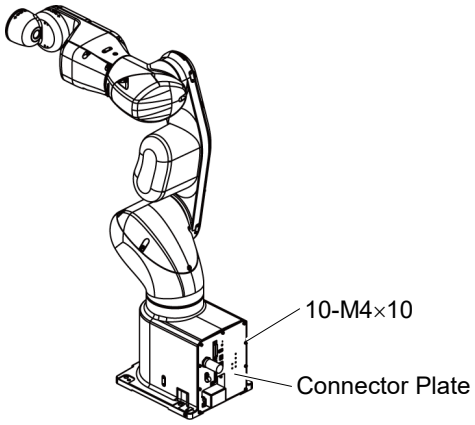
NOTE ☞ When installing the cover, be careful not to get the cables caught between the arm and cover

Protection model:

There is no Power Cable Cover.

7.7 Connector Plate

CAUTION	■ Do not remove the connector plate forcibly. Removing the connector plate forcibly may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the connector plate, be careful not to allow the cables to interfere with the plate mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the connector plate. Be sure to place the cables back to their original locations.



Connector Plate Removal

Standard, Cleanroom model:

(1) Remove the Power Cable Cover.

Reference: *7.6 Power Cable Cover.*

(2) Remove the power cable clamp and then remove Power Cable Connector.

NOTE When removing the Power cable connector, pull it out with pushing clips on both side of the connector.

(3) Unscrew the Connector Plate mounting bolts and then remove the Connector Plate.

Protection model:

(1) Unscrew the Connector Plate mounting bolts and then remove the Connector Plate.

(2) Remove the base gasket from the base.

Connector Plate Installation

Standard, Cleanroom model:

(1) Put the Connector Plate to the base and secure using the mounting bolts.
Hexagon socket head cap button bolt: 10-M4×10
Tightening torque: 4.0 ± 0.2 N·m

(2) Connect the Power Cable Connector and install the power cable clamp.

(3) Mount the Power Cable Cover.
Reference: *7.6 Power Cable Cover.*

Protection model:

(1) Mount the base gasket in the groove of the base.
(Replace the gasket if there are flaws or deteriorations.)

(2) Put the Connector Plate to the base and secure using the mounting bolts.
Hexagon socket head cap button bolt: 10-M4×10
Tightening torque: 4.0 ± 0.2 N·m

NOTE

When installing the connector plate, be careful not to get the gaskets and cables caught between the arm and cover.

8. Cable

 WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power plug. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

 CAUTION	■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) The unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.

8.1 Replacing Cable Unit

	Name		Quantity	Note
Maintenance part	Cable Unit		1	2191349
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Torque wrench		1	For tightening torque control
	Cross-point screwdriver (No. 2)		1	For cross-recessed screw
	Nippers		1	For cutting wire tie
Material	Wire tie		-	
Grease	GPL-224		-	For purchasing grease, please contact the supplier of your region.

CAUTION

- If the connectors have been disconnected during the replacement of the cable unit, be sure to reconnect the connectors to their proper positions. Refer to the wiring diagrams.
  Improper connection of the connectors may result in improper function of the robot system.
  For details on the connections, refer to the following manual.
  "*3. Manipulator Structure*"
- Be sure to connect the cables completely. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) The unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.
- Wear protective gear including a mask, protective goggles, and oil-resistant gloves during grease up. If grease gets into your eyes, mouth, or on your skin, follow the instructions below.
  If grease gets into your eyes
  : Flush them thoroughly with clean water, and then see a doctor immediately.
  If grease gets into your mouth
  : If swallowed, do not induce vomiting. See a doctor immediately.
  : If grease just gets into your mouth, wash out your mouth with water thoroughly.
  If grease gets on your skin
  : Wash the area thoroughly with soap and water.

When removing the Joint #2 motor unit, tilt the Arm #2 and press it against the Arm #1.
Reference: *10.1 Joint #2 - Replacing the Motor, Removal step (2)*

When removing the Joint #3 motor unit, tilt the Arm #3 and press it against the Arm #2.
Reference: *11.1 Joint #3 - Replacing the Motor, Removal step (2)*

Cable Unit Removal

(1) Move the Manipulator to the origin posture (0 pulse position).

(2) Turn OFF the Manipulator.

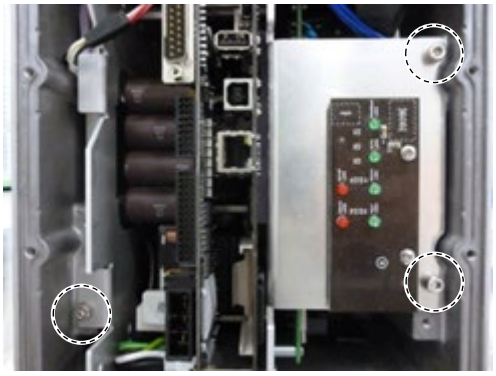
(3) Remove the following covers and plate.

Arm #1 Cover	Arm #2 Cover
Arm #3 Cover	Arm #4 Cover 1
Arm #4 Cover 2	Connector Plate

Reference: *7 Covers*

(4) Unscrew the mounting screws of the Controller Unit.

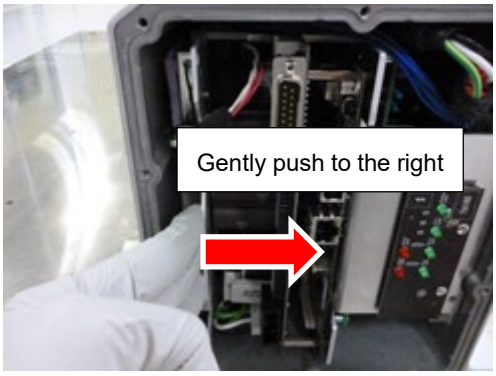
Hexagon socket head cap bolts:
3-M4×10 (with plain washer)

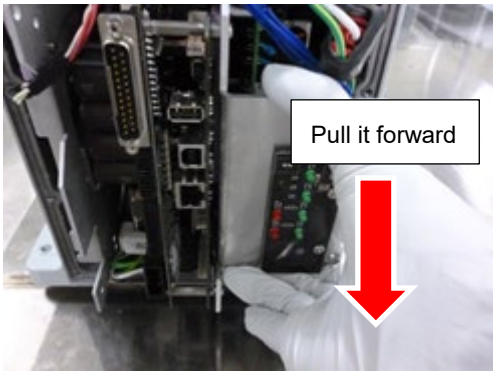


(5) Pull out the Controller Unit from the Manipulator base.

NOTE

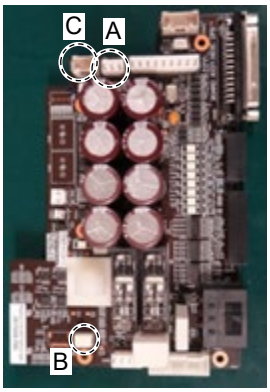
When pulling it out,
firstly push the plate of the Controller Unit to the right (see the picture) gently, then remove the thermal conductive sheet on the base and the Controller Unit. Next, pull the Controller Unit forward.

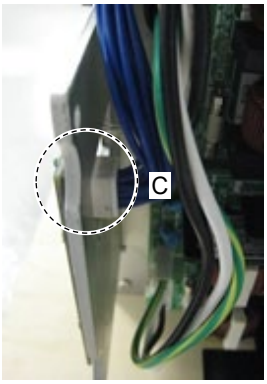




(6) Disconnect the following connectors of the Controller Unit.

A: Power cable connector
B: Signal cable connector
C: LED connectors × 2





(7) Remove the ground wire terminals inside the base.

Cross recessed head screws: M4×6

(8) Cut off the wire tie bound to the plate inside the base.

Wire tie: AB150

(9) Cut off the wire ties bound inside the Arm #1.

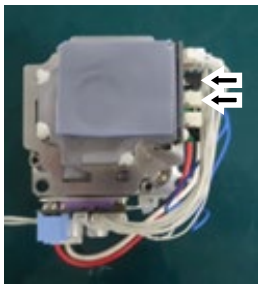
Wire ties : AB150 × 2
AB100 × 1

(10) Remove the ground wire terminals of Arm #1.

Cross recessed head screws: 2-M4× 6

(11) Disconnect the power cable connecter from the AMP board of Joint #1 motor.

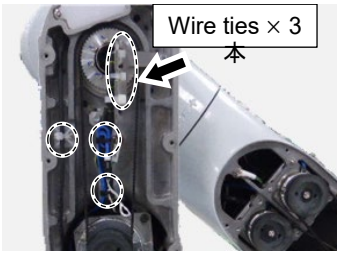
(12) Disconnect the signal cable connectors (for motor × 2) of Joint #1 motor.

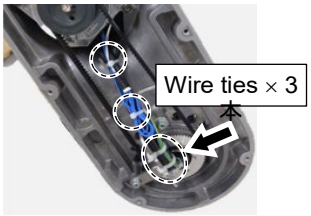


(13) Cut off the wire ties bound to inside the Arm #2.

Wire ties　: AB150 ×6
AB100 ×5

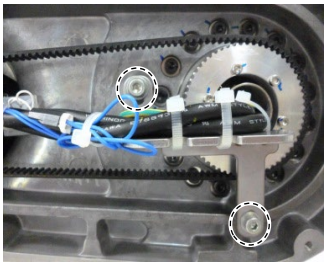
NOTE
Be careful not to cut the harness.

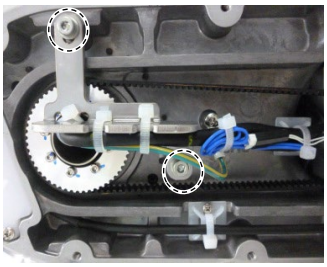




(14) Remove the cable fixing plate of Arm #2.

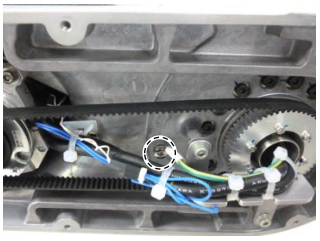
Hexagon socket head cap bolts with captive washer: 4-M4×12

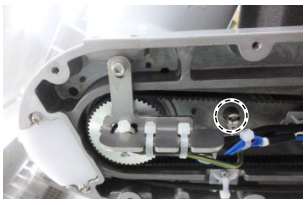




(15) Remove the ground wire terminals of Arm #2.

Cross recessed head screws: 2-M4×6





(16) Remove the Joint #2 motor.

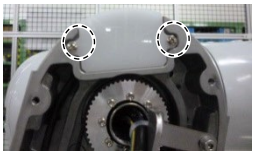
Reference: *10.1 Replacing Joint #2 Motor*

(17) Remove the Joint #3 motor.

Reference: *11.1 Replacing Joint #3 Motor*

(18) Remove the light guide plate.

Cross recessed head screws: 2-M3×10

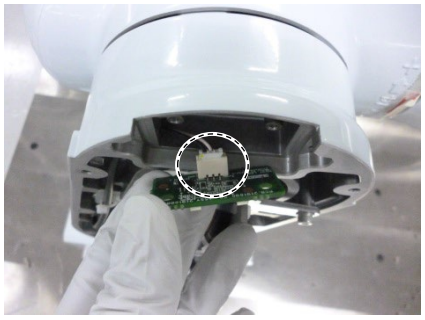


(19) Unscrew the cross recessed head screws fixing the LED board.

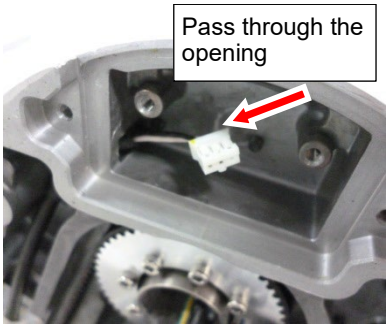
Cross recessed head screws: 2-M3×6

(20) Disconnect the connector which is connected to the LED board.

Connector: LED_CN1

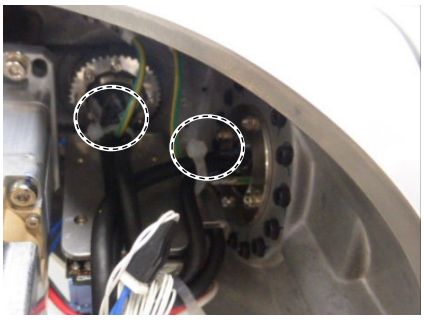


(21) Pass the LED cable through the opening of the Arm #2 and pull the LED cable out.



(22) Cut off the wire tie bound to the plate inside the Arm #3.

Wire ties: AB150 ×2

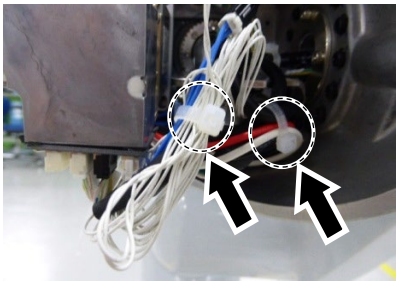


(23) Cut off the wire ties that bind the power cable and the signal cable of Joint #4 motor.

Wire ties: AB100 × 2

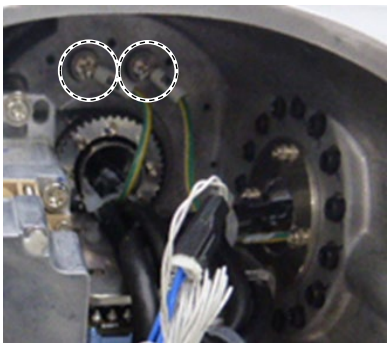
NOTE

Be careful not to cut the harness.

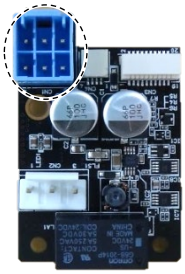


(24) Remove the ground wire terminals of Arm #3.

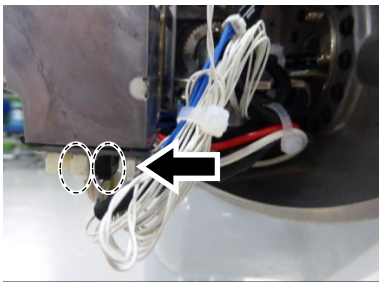
Cross recessed head screws: 2-M4×6



(25) Disconnect the power cable connecter from the AMP board of Joint #4 motor.

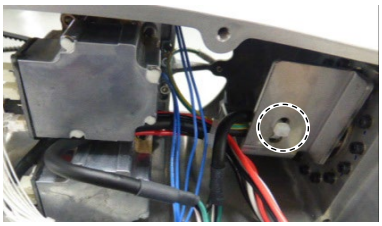


(26) Disconnect the signal cable connectors (for motor × 2) of Joint #4 motor.



(27) Cut off the wire ties bound to the plate inside the Arm #4.

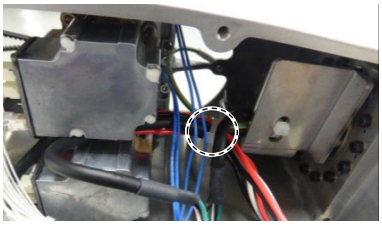
Wire tie: AB150



(28) Cut off the wire tie that binds the following cables and ground wire.

Wire tie: AB100

Joint #5 motor cable
Signal cable (for motor)
Joint #6 motor cable
Ground wire

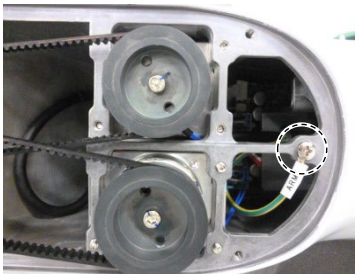


NOTE

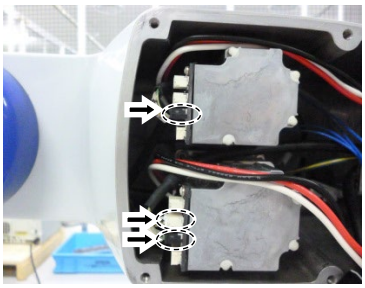
Be careful not to cut the harness.

(29) Remove the ground wire terminals of Arm #4.

Cross recessed head screws: M4×6



(30) Remove the signal cable connectors (for motor × 3) of the the Joint #5 motor and Joint #6 motor.



(31) Pass the ground wire and the following cables of each arm through the sleeve of each joint and pull them out.

Ground wires × 4
Signal cables (for motor × 5)
LED cable × 1

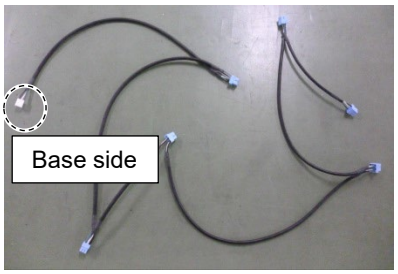
(32) Pass the power cable through the sleeve of each joint and pull it out in the following order.

Arm #4 → Arm #3 → Arm #2 → Arm #1 → Base

Cable Unit Installation

(1) Pass the new power cable in the following order.

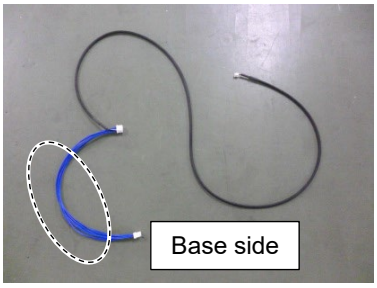
Base
→ Arm #1
→ Joint #1 Timing Belt
→ Arm #2
→ Arm #3
→ Joint #4 Timing Belt
→ Arm #4



NOTE When passing the cables between arms, be sure to pass them through the sleeve of each joint. The white connecter is the base side.

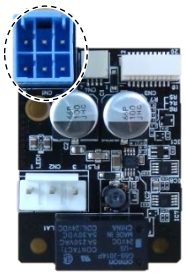
(2) Pass the new LED cables in the following order.

Base
→ Arm #1
→ Joint #1 Timing Belt
→ Arm #2



NOTE When passing the cables between arms, be sure to pass them through the sleeve of each joint. The blue cable is the base side.

(3) Connect the power cable connectors (× 6) of the Joint #1, 2, 3, 4, 5, 6 AMP board.

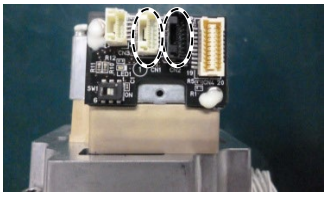


(4) Connect the signal cable connector (for motor) of the Joint #1, 2, 3, 4, 5, 6 motor unit.

NOTE When passing the cables between arms, be sure to pass them through the sleeve of each joint.

Confirm that the joint marked on the wire marker of the signal cable and the joint of the motor unit to be connected are the same.

Also, the same colored connecter is connected to each connector. (For the Joint #6 motor, only black colored connecter is connected.)



(5) Install the Joint #2 motor.

Reference: *10.1 Replacing Joint #2 Motor*

(6) Install the Joint #3 motor.

Reference: *11.1 Replacing Joint #3 Motor*

(7) Fix the ground wire between the base and the Arm #1.

Cross recessed head screws: 2-M4×6
Tightening torque: 2.0 ± 0.1 N·m

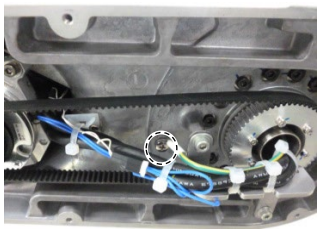
Base side:
Ground wire terminal marked “BASE” on the wire marker.

Arm #1 side:
Ground wire terminal marked “ARM1” on the wire marker.

(8) Fix the ground wire between the Arm #1 and the Arm #2.

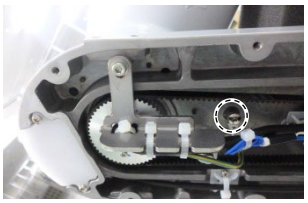
Cross recessed head screws: 2-M4×6
Tightening torque: 2.0 ± 0.1 N·m

Arm #1 side:
Ground wire terminal marked “ARM1” on the wire marker.



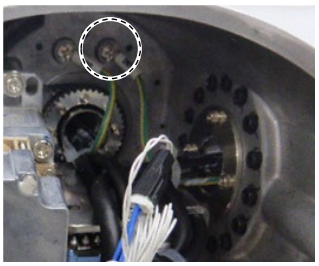
Arm #2 side:
Ground wire terminal marked “ARM2” on the wire marker.

(9) Fix the ground wire between the Arm #2 and the Arm #3



Cross recessed head screws: 2-M4×6
Tightening torque: 2.0 ± 0.1 N·m

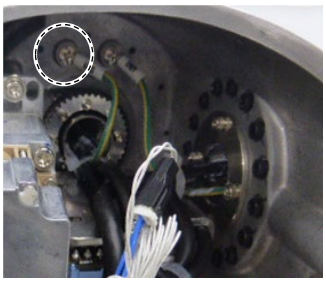
Arm #2 side:
Ground wire terminal marked “ARM2” on the wire marker.



Arm #3 side:
Ground wire terminal marked “ARM3” on the wire marker.

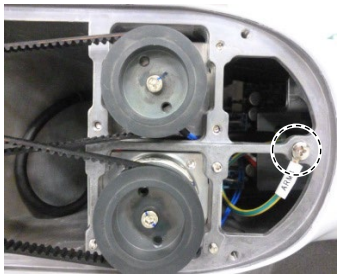
(10) Fix the ground wire between the Arm #3 and the Arm #4.

Cross recessed head screws: 2-M4×6
Tightening torque: 2.0 ± 0.1 N·m



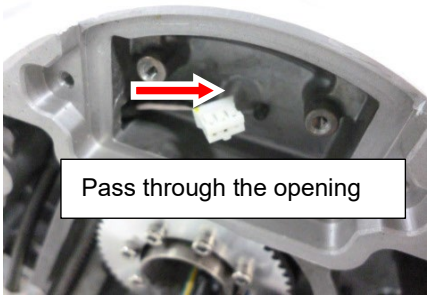
Arm #3 side:
Ground wire terminal marked “ARM3” on the wire marker.

Arm #4 side:
Ground wire terminal marked “ARM4” on the wire marker.



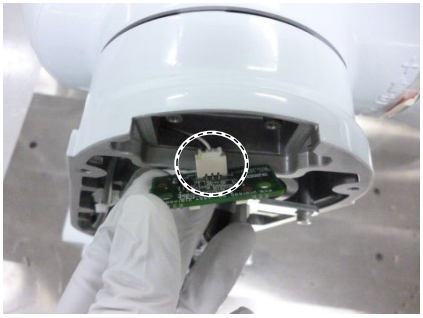
(11) Connect the LED cable connector to the opening of the end of Arm #2.

NOTE You can pass the connector through the opening easily by using the wire tie.



(12) Connect the LED cable connector to the LED board.

Connectors: LED_CN1

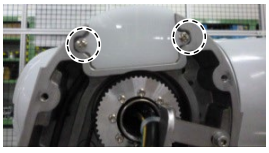


(13) Fix the LED board.

Cross recessed head screws: 2-M3×6
Tightening torque: 0.45 ± 0.1 N·m

(14) Fix the light guide plate.

Cross recessed head screws: 2-M3×10
Tightening torque: 0.45 ± 0.1 N·m



(15) Pass the wire tie through the hole inside the base.
Bind the following cables and the ground wire with the wire tie.

Wire tie: AB150

Power cable
LED cable
Signal cable (for motor)
Ground wire

(16) Pass the wire tie through the hole on the two plates of Arm #1. Bind the following cables and the ground wire with the wire tie.

Wire tie: AB150

Power cable
LED cable
Signal cable (for motor)
Ground wire

(17) Bind the following cables between the Joint #1 motor and the Controller Unit with the wire tie.

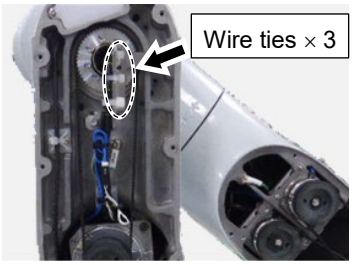
Wire tie: AB100

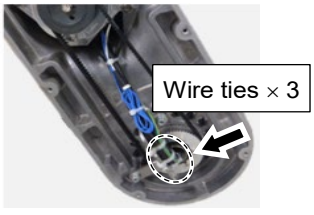
Signal cable (for motor)
Signal cable (for AMP board)

(18) Pass the wire tie through the plate inside the Arm #2.
Bind the following cables with the wire tie.

Wire tie : AB150 × 3
AB100 × 3

Power cable
LED cable (Joint #2 side only)
Signal cable (for motor)
Ground wire

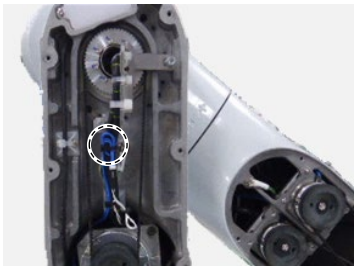




(19) Fold the each brake cable for Joint #2 and Joint #3 motors into the length of 40mm. Bind it with the following cables with the wire tie.

Wire tie : AB150 × 1
AB100 × 1

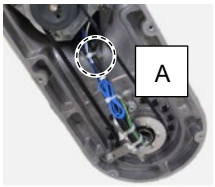
Power cable
Signal cable (for motor)
Brake cable

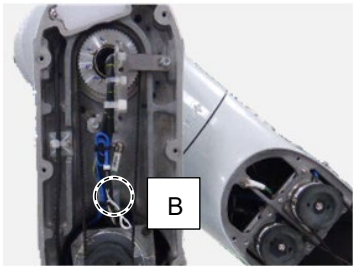


(20) Pass the wire tie through the mount base A and B inside Arm #2.
Bind the following cables with the wire tie.

Wire tie : AB150 × 1
AB100 × 1

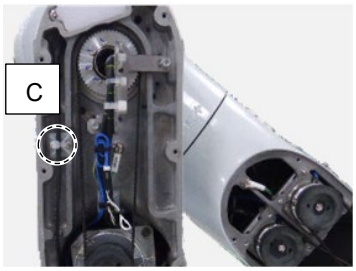
Power cable
Signal cable (for motor)
Brake cable
LED cable (mount base A only)

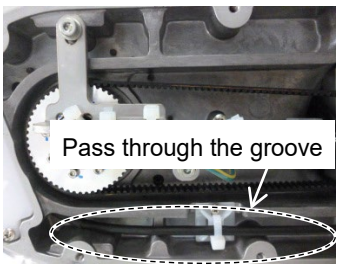




(21) Pass the LED cable through the groove for LED cable wiring of Arm #2.
Pass the wire tie through the mount base C and bind the LED cable with the wire tie.

Wire tie : AB150 × 1

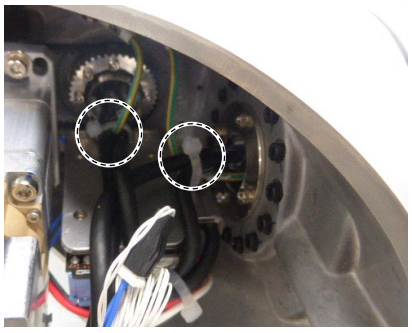




(22) Pass the wire tie through the hole inside the Arm #3.
Bind the following cables with the wire tie.

Wire tie: AB150

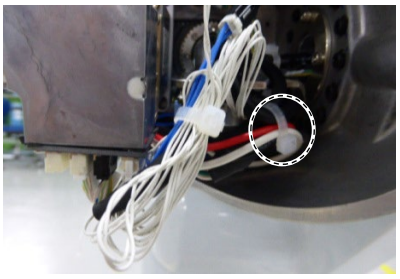
Power cable
Signal cable (for motor)
Ground wire



(23) Bind the following cables between the Joint #4 motor and the Joint #3 motor with the wire tie.

Wire tie: AB100

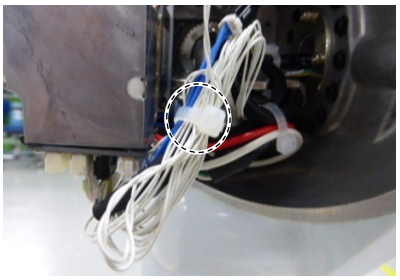
Power cable
Signal cable (for motor)
Motor cable



(24) Bind the following cables between the Joint #4 motor and the Joint #3 motor with the wire tie.

Wire tie: AB100

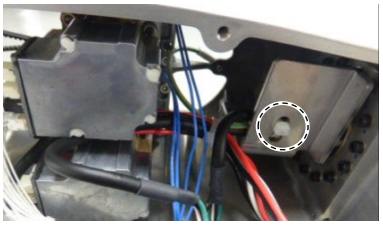
Signal cable(for AMP board)
Signal cable (for motor)
Brake cable



(25) Pass the wire tie through the hole inside the Arm #4. Bind the following cables and the ground wire with the wire tie.

Wire tie: AB150

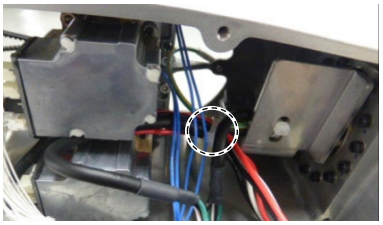
Power cable
Signal cable (for motor)
Ground wire



(26) Bind the following cables and the ground wire with the wire tie.

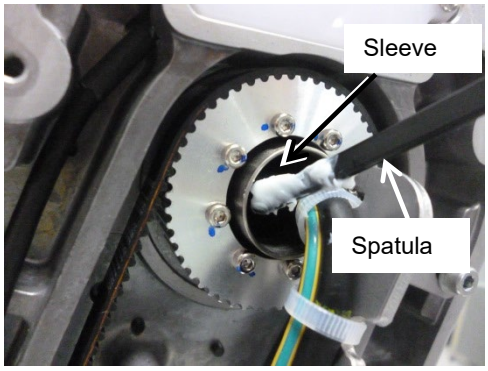
Wire tie: AB100

Motor cable (Joint #5)
Signal cable
Motor cable (Joint #6)
Ground wire



(27) Apply grease to the cables inside the each Joint sleeve.

Grease: GPL-224
Between Base-Arm #1 : 4.5±1g
Between Arm #1-Arm #2 : 4.5±1g
Between Arm #2-Arm #3 : 2.8±0.5g
Between Arm #3-Arm #4 : 2.8±0.5g

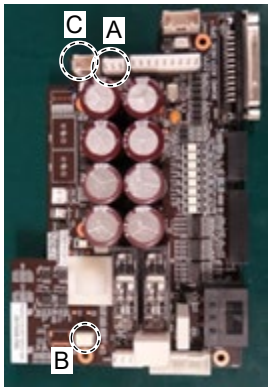


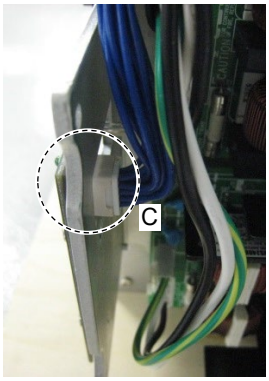
NOTE Apply grease evenly to the entire cable inside the sleeve and the end of the sleeve by using a slim spatula

When applying the grease, be careful not to attach the grease to the AMP board.

(28) Connect the following connectors to the Controller Unit.

A: Power cable connector
B: Signal cable connector
C: LED connectors × 2

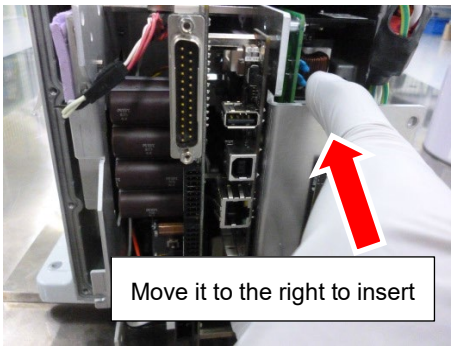


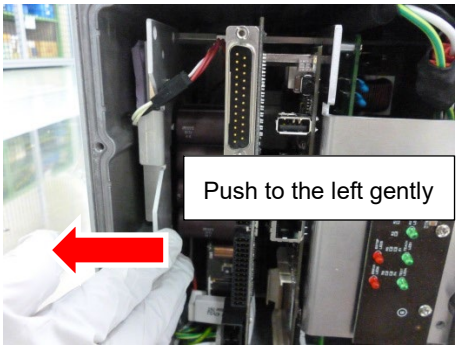


(29) Push the Controller Unit into the base.

NOTE Insert the Controller Unit while moving it to the right (see the picture).

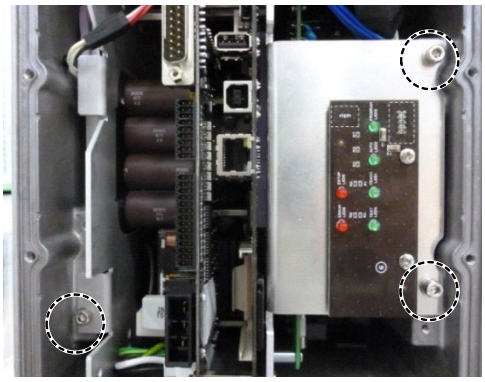
Then, gently move the plate of the Controller Unit to the left and let the thermal conductive sheet contacts with the wall inside the base.





(30) Tighten the mounting screws of the Controller Unit.

Hexagon socket head cap bolts: 3-M4×10 (with plain washer)
Tightening torque: 4.0 ± 0.2 N·m



(31) Install the following covers the plate.

Arm #1 Cover	Arm #2 Cover
Arm #3 Cover	Arm #4 Cover 1
Arm #4 Cover 2	Connector Plate

Reference: *7 Covers*

8.2 Insert or Pull out of Power Cable

NOTE
☞ Protection model Manipulator cannot insert or pull out power cable.

	Name	Quantity	Note
Tool	Cross-point screwdriver (No. 2)	1	For cross-recessed screw

Power Cable Pull out

Standard Cleanroom

(1) Turn OFF the Manipulator.

(2) Remove the power cable cover.

Reference: *7.6 Power Cable Cover*

(3) Remove the power cable clamp.

(4) Disconnect the power cable connector.

NOTE
☞ When removing the power cable connector, pull it out with pushing clips on both sides of the connector.

Power Cable Insertion

Standard Cleanroom

(1) Connect the power cable connector.

(2) Mount the power cable clamp.

(3) Mount the power cable cover.

Reference: *7.6 Power Cable Cover*

9. Joint #1

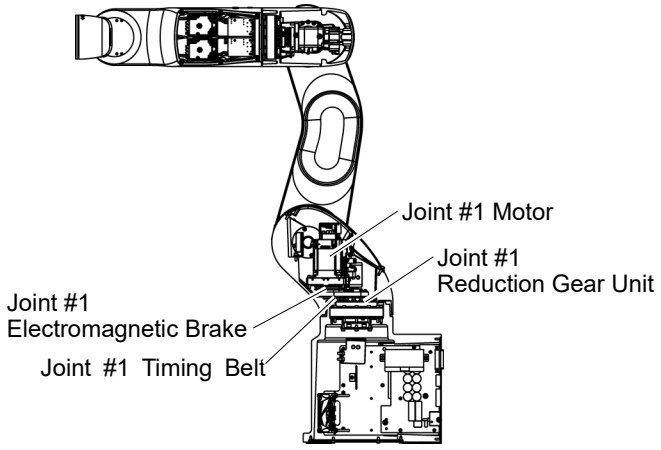
WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power plug. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

CAUTION	■ Be careful not to apply excessive shock to the motor shaft when replacing the motors. The shock may shorten the life cycle of the motors and encoder and/or damage them. ■ Never disassemble the motor and encoder. A disassembled motor and encoder will cause a positional gap and cannot be used again.

After parts have been replaced (motor units, reduction gear units, timing belts), the Manipulator cannot operate properly because a mismatch exists between the origin stored in each motor and its corresponding origin stored in the Robot system.
Because of that, it is necessary to perform calibration (encoder rest and calibration) to match these origins.

After replacing the parts, refer to the following section to perform calibration.

19. Calibration.



9.1 Replacing Joint #1 Motor

	Name		Quantity	Note
Maintenance parts	Joint #1 motor unit		1	2194596
	Thermal conductive sheet		1	1755573
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Torque wrench		1	For tightening torque control
	Nippers		1	For cutting wire tie
	Belt tension meter		1	Refer: Unitta U-505
Material	Wire tie		-	

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

Joint #1 Motor Removal

(1) Turn OFF the Manipulator.

(2) Remove the Arm #1 Cover.

Reference: *7.1 Arm #1 Cover.*

(3) Cut off the wire tie that binds the following cables.

Signal cable and the signal cable for AMP board between the Joint #1 motor and the Controller Unit

NOTE

Be careful not to cut the harness.

(4) Cut off the wire tie on the plate (Arm #1 sleeve side) and remove the plate.

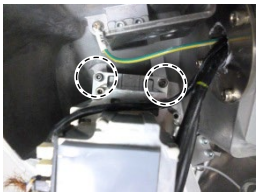
Hexagon socket head cap bolts: 2-M4×12 (with washer)

NOTE

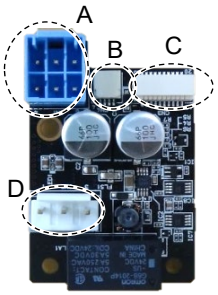
Be careful not to cut the harness.

(5) Remove the motor unit from the Arm #1.

Hexagon socket head cap bolts: 3-M4×22 (with slotted hole washer)

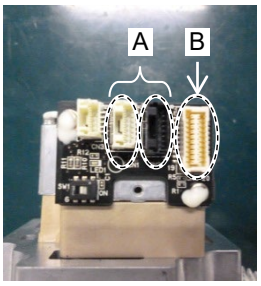


(6) Disconnect the following connectors from the AMP board.



A: Power cable connector
B: Brake connector
C: Signal cable connector (for AMP board)
D: Motor connector

(7) Disconnect the following connectors from the motor.



A: Signal cable connectors (for motor × 2)
B: Signal cable connector (for AMP board)

NOTE

The cables will be necessary again.
Be careful not to lose them.

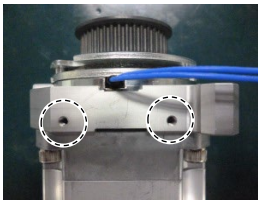
(8) Remove the AMP board fixing plate (with AMP board) from the motor unit.

Hexagon socket head cap bolts: 2-M3×6

Joint #1 Motor Installation

(1) Fix the AMP board fixing plate (with AMP board) to a new motor unit.

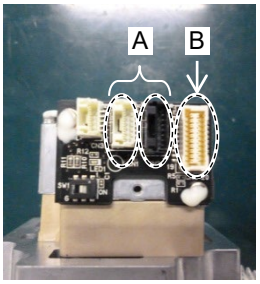
Hexagon socket head cap bolts: 2-M3×6
Tightening torque: 2.0 ± 0.1 N·m



(2) Connect the following connectors of the motor.

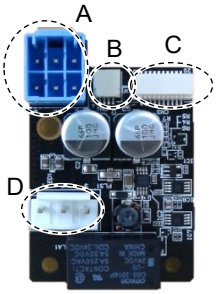
A: Signal cable connectors (for motor × 2)
B: Signal cable connector (for AMP board)

NOTE
Connector for the signal cable connector (for motor) is the same color.

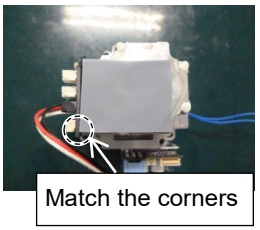


(3) Connect the following connectors of the AMP board.

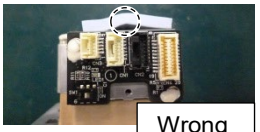
A: Power cable connector
B: Brake connector
C Signal cable connector (for AMP board)
D: Motor connector

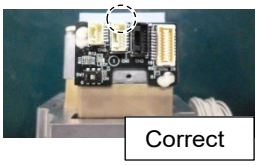


(4) Attach the thermal conductive sheet on the bottom of the motor unit. For the attaching position, refer to the picture on the right.



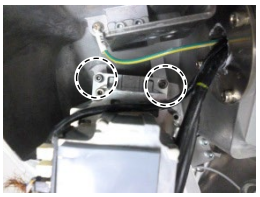
NOTE
Make sure that the entire surface of the thermal conductive sheet contacts with the rear side of the motor unit without lifting up the center of the sheet.





(5) Pass the timing belt through the motor pulley and loosely secure to the Arm #1.

Hexagon socket head cap bolts: 3-M4×22
(with slotted hole washer)



NOTE
Make sure that the gear grooves of the timing belt are fit into those of the pulley completely.
When securing the motor unit loosely, make sure that the motor unit can be moved by hand and it does not tilt when being pulled. If the unit is secured too loose or too tight, the belt will not have proper tension.

(6) Apply proper tension to the motor unit and fix it.

Joint #1 timing belt tension: 34~70 N
Belt tension meter setting values
Weight: 2.5g/mm width×m span
Width: 9.0mm
Span: 60mm

Hexagon socket head cap bolts: 3-M4×22 (with slotted hole washer)
Tightening torque: 4.0 ± 0.2 N·m

NOTE

Regarding belt tension:
Jumping (position gap) may occur if the value is below the lower limit.
Vibration (abnormal noise) or reduction in life of the parts may occur if the value exceeds the upper limit.
When you replace with a new belt, belt extends and the belt tension may decrease in the initial stage. Make sure to operate the robot two to three days and check the belt tension again.

(7) Mount the plate of the Arm #1 sleeve side.
Hexagon socket head cap bolts: 2-M4×12 (with a washer)
Tightening torque: 4.0 ± 0.2 N·m

Pass the wire tie through the hole on the plate.
Bind the following cables and the ground wire with the wire tie.
Motor cable
Signal cable (for motor)
LED cable
Ground wire

(8) Bind the following cables between the Joint #1 motor and the Controller Unit with the wire tie.

Wire tie: AB100

Signal cable (for motor)
Signal cable (for AMP board)

(9) Mount the Arm #1 cover.

Reference: *7.1 Arm #1 Cover*

(10) Turn ON the Manipulator.

Reference: *VT series Manual VT6L Manipulator 6.5 LED*

NOTE

When starting the manipulator for the first time after replacing the motor unit, the motor unit firmware is automatically updated. DO NOT turn OFF the Manipulator until it starts.

When you connect a motor unit connected to another axis, an error 5009 or 9709 will occur. To clear the error, enter the following command in [Command Window] and execute it.

Joint #1: > `MUIDReset 1`
Joint #2: > `MUIDReset 2`
Joint #3: > `MUIDReset 3`
Joint #4: > `MUIDReset 4`
Joint #5: > `MUIDReset 5`
Joint #6: > `MUIDReset 6`

Reboot the Controller.

(11) Calibrate the Joint #1.

Reference: *19. Calibration*

9.2 Replacing Joint #1 Reduction Gear Unit

Reduction gear unit is replaced by serviceman who has taken maintenance training.

For replacement of the reduction gear unit, please contact the supplier of your region.

9.3 Replacing Joint #1 Timing Belt

	Name	Quantity	Note
Maintenance parts	Timing Belt	1	1751536
Tools	Hexagonal wrench (width across flats: 3 mm)	1	For M4 hexagon socket head cap bolts
	Torque wrench	1	For tightening torque control
	Cross-point screwdriver (No. 2)	1	For cross-recessed screw
	Nippers	1	For cutting wire tie
	Belt tension meter	1	Refer: Unitta U-505
Material	Wire tie	-	

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement.
Be careful when performing maintenance work.

Joint #1 Timing Belt Removal

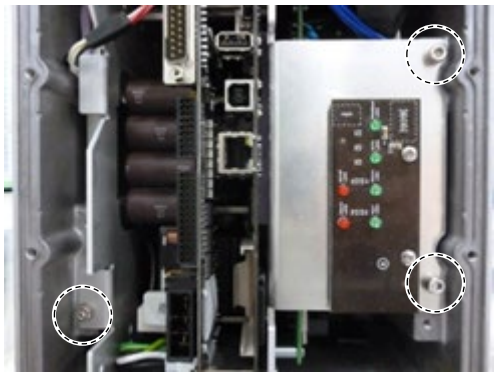
(1) Turn OFF the Manipulator.

(2) Remove the Arm #1 cover and the connector plate.

Reference: *7. Covers*

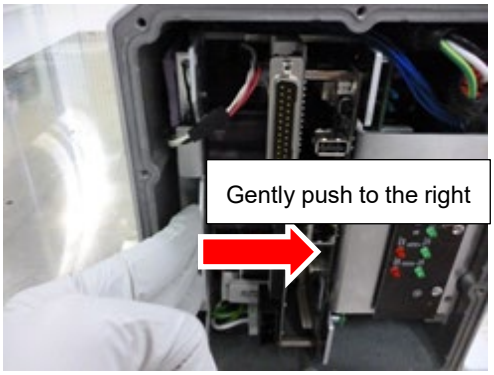
(3) Unscrew the mounting screws of the Controller Unit.

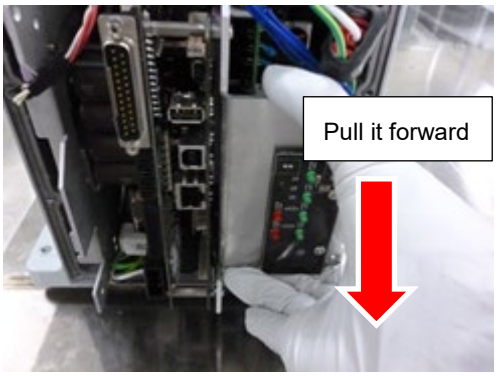
Hexagon socket head cap bolts:
3-M4×10 (with a plain washer)



(4) Pull out the Controller Unit from the Manipulator base.

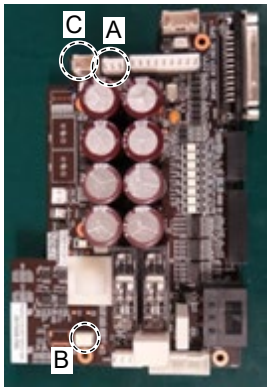
NOTE When pulling it out, firstly push the plate of the Controller Unit to the right (see the picture) gently, then remove the thermal conductive sheet on the base and the Controller Unit. Next, pull the Controller Unit forward.

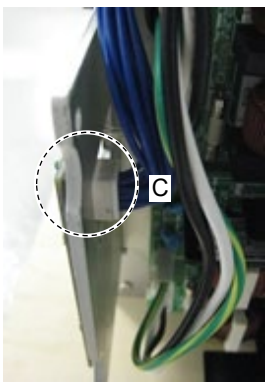




(5) Disconnect the following connectors of the Controller Unit.

A: Power cable connector
B: Signal cable connector
C: LED connectors × 2





(6) Remove the ground wire terminals inside the base.

Cross recessed head screws: M4×6

(7) Cut off the wire tie bound to the plate inside the base.

Wire tie: AB150

(8) Remove the Joint #1 motor unit.
Reference: *9.1 Replacing Joint #1 Motor*
Joint #1 Motor Removal (3) through (7)

(9) Pull out the following cables from the Arm #1 side and remove the Joint #1 timing belt.
Power cable
Signal cable (for motor)
LED cable
Ground wire

Joint #1 Timing Belt Installation

(1) Pass the following cables through a new Joint #1 timing belt.

Power cable
Signal cable (for motor)
LED cable
Ground wire

(2) Mount the Joint #1 motor unit.
Reference: *9.1 Replacing Joint #1 Motor*
Joint #1 Motor Installation (2) through (8)

(3) Connect the ground wire terminals inside the base.

Cross recessed head screws: M4×6
Tightening torque: 2.0 ± 0.1N m

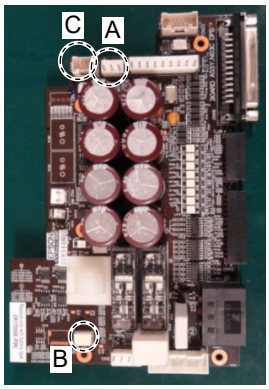
(4) Pass the wire tie through the hole on the plate inside the base.
Bind the following cables with the wire tie.

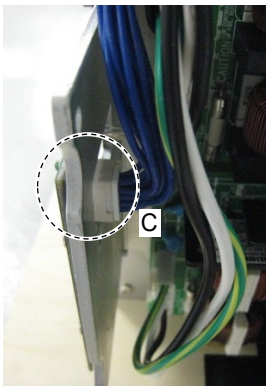
Wire tie: AB150

Power cable
LED cable
Signal cable (for motor)
Ground wire

(5) Connect the following connectors to the Controller Unit.

A: Power cable connector
B: Signal cable connector
C: LED connectors × 2

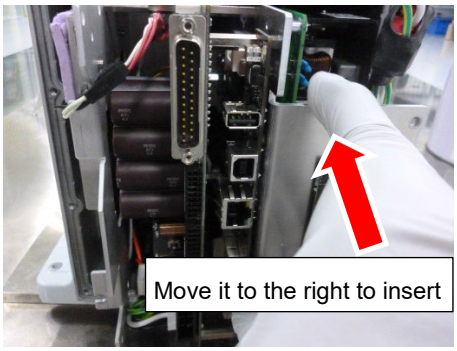


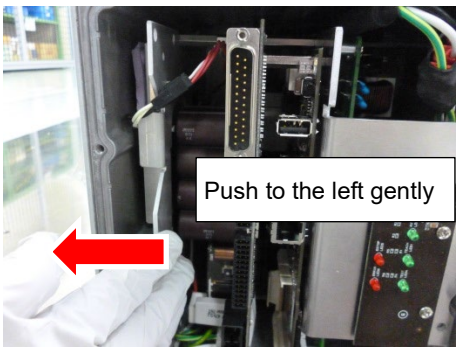


(6) Push the Controller Unit into the base.

NOTE Insert the Controller Unit while moving it to the right (see the picture).

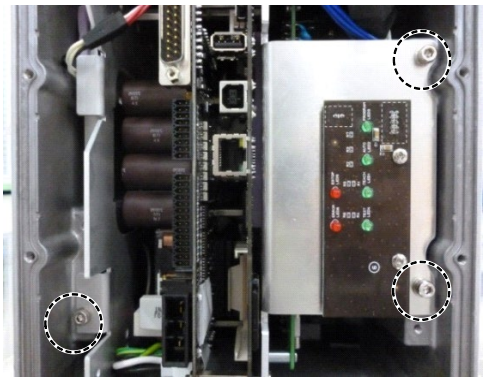
Then, gently move the plate of the Controller Unit to the left and let the thermal conductive sheet contacts with the wall inside the base.





(7) Tighten the mounting screws of the Controller Unit.

Hexagon socket head cap bolts: 3-M4×10 (with a plain washer)
Tightening torque: 4.0 ± 0.2 N·m



(8) Mount the Arm #1 cover and the connector plate.

Reference: *7. Covers*

(9) Turn ON the Manipulator.

Reference: *VT series Manual VT6L Manipulator 6.5 LED*

(10) Calibrate the Joint #1.

Reference: *19. Calibration*

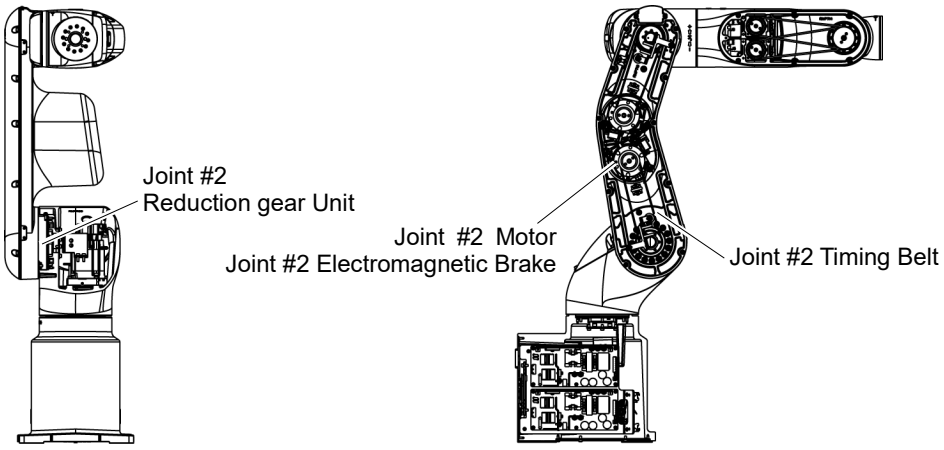
10. Joint #2

WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power plug. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

CAUTION	■ Be careful not to apply excessive shock to the motor shaft when replacing the motors. The shock may shorten the life cycle of the motors and encoder and/or damage them. ■ Never disassemble the motor and encoder. A disassembled motor and encoder will cause a positional gap and cannot be used again.

After parts have been replaced (motor units, reduction gear units, timing belts), the Manipulator cannot operate properly because a mismatch exists between the origin stored in each motor and its corresponding origin stored in the Robot system.
Because of that, it is necessary to perform calibration (encoder rest and calibration) to match these origins.

After replacing the parts, refer to the following section to perform calibration.
19. Calibration.



10.1 Replacing Joint #2 Motor

CAUTION	■ This procedure has possibility of damage or malfunction to the Manipulator. Be very careful when performing maintenance. ■ DO NOT loosen the bolts while the Arm #2 is not tilted. It may cause the belt come off and the Arm #2 falls down, and it is extremely hazardous. Be sure to do the Removal steps (1) and (2) before removing the motor.

	Name		Quantity	Note
Maintenance parts	Joint #2 motor unit		1	2194597
	Thermal conductive sheet		1	1755573
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Torque wrench		1	For tightening torque control
	Nippers		1	For cutting wire tie
	Belt tension meter		1	Refer: Unitta U-505
Material	Wire tie		-	

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

When removing the Joint #2 motor, tilt the Arm #2 and press it against the Arm #1.
Reference: *10.1 Joint #2 - Replacing the Motor,* Removal step (2)

Joint #2 Motor Removal

(1) Turn ON the Manipulator.

(2) Release the Joint #2 brake. Tilt the Arm #2 and push it against the Arm #1.

The Arm #2 falls by its weight when the Joint #2 motor unit is removed. Therefore, release the brake and tilt the Arm #2 in advance.

EPSON RC+

Command

```
>brake off, 2
```

NOTE

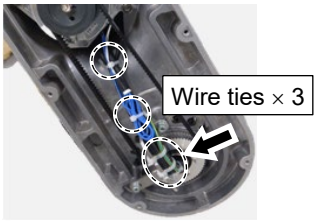
When pushing the arm, push the Arm #2 slowly to the Arm #1.
If a strong impact is applied to the joint, the Manipulator may get damage.

(3) Turn OFF the Manipulator.

(4) Remove the Arm #2 Cover.

Reference: *7.2 Arm #2 Cover.*

(5) Cut off the wire tie bound inside the Arm #2.
Wire tie : AB150 × 3
AB100 × 2

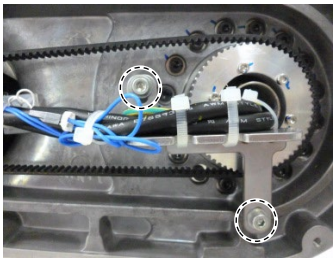


NOTE

Be careful not to cut the harness.

(6) Remove the cable fixing plate on the Arm #2. (Joint #2 side)

Hexagon socket head cap bolts with captive washer: 2-M4×12

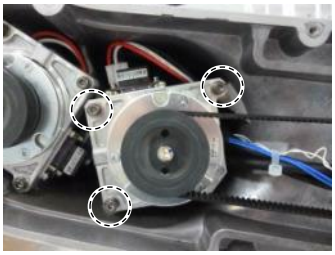


(7) Loosen the mounting screws of the Joint #2 motor unit and remove the Joint #2 timing belt.

Hexagon socket head cap bolts: 3-M4×22 (with slotted hole washer)

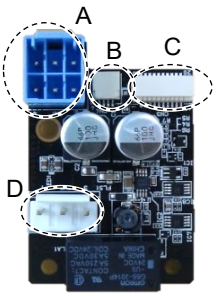
(8) Remove the motor unit from the Arm #2.

Hexagon socket head cap bolts: 3-M4×22 (with slotted hole washer)

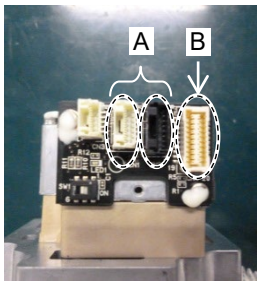


(9) Disconnect the following connectors from the AMP board.

A: Power cable connector
B: Brake connector
C: Signal connector (for AMP board)
D: Motor connector



(10) Disconnect the following connectors of the motor.



A: Signal cable connectors (for motor × 2)
B: Signal cable connector (for AMP board)

NOTE

The cables will be necessary again.
Be careful not to lose them.

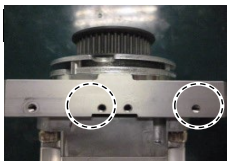
(11) Remove the AMP board fixing plate (with AMP board) from the motor unit.

Hexagon socket head cap bolts: 2-M3×6

Joint #2 Motor Installation

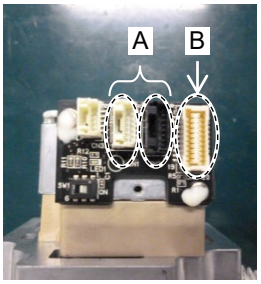
(1) Fix the AMP board fixing plate (with AMP board) to a new motor unit.

Hexagon socket head cap bolts: 2-M3×6
Tightening torque: 2.0 ± 0.1 N·m



(2) Connect the following connectors of the motor.

A: Signal cable connectors (for motor × 2)
B: Signal cable connector (for AMP board)

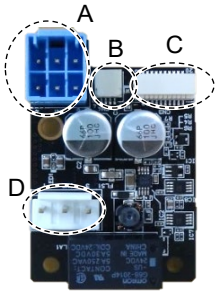


NOTE

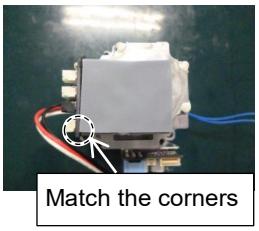
Connector for the signal cable connector (for motor) is the same color.

(3) Connect the connectors of the AMP board.

A: Power cable connector
B: Brake connector
C Signal cable connector (for AMP board)
D: Motor connector

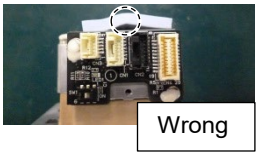


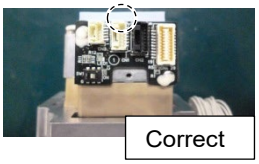
(4) Attach the thermal conductive sheet on the bottom of the motor unit. For the attaching position, refer to the picture on the right.



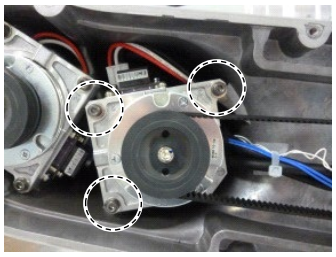
NOTE

Make sure that the entire surface of the thermal conductive sheet contacts with the rear side of the motor unit without lifting up the center of the sheet.





(5) Pass the timing belt through the motor pulley and loosely secure to the Arm #2.



Hexagon socket head cap bolts: 3-M4×22
(with slotted hole washer)

NOTE

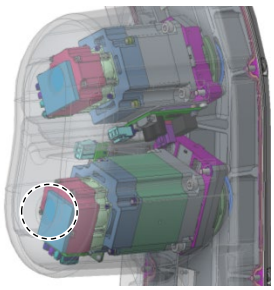
Make sure that the gear grooves of the timing belt are fit into those of the pulley completely.
When securing the motor unit loosely, make sure that the motor unit can be moved by hand and it does not tilt when being pulled. If the unit is secured too loose or too tight, the belt will not have proper tension.

NOTE

As shown on the picture, pass the cable through the rear side of the Arm #2 motor unit fixing part.
Before fixing the motor unit, make sure that the cables are not caught in the gap between the motor unit and Arm #2.

NOTE

Press the thermal conductive sheet on the rear side of the motor unit to the round convex part at the end of the Arm #2.



(6) Apply proper tension to the motor unit and fix it.

Joint #2 timing belt tension: 34 - 58 N
Belt tension meter setting values
Weight: 2.5g/mm width×m span
Width: 9.0mm
Span: 172mm

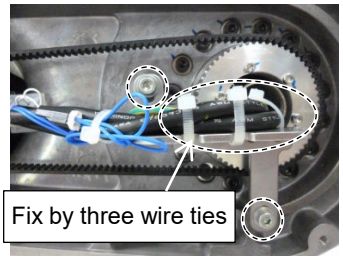
Hexagon socket head cap bolts: 3-M4×22 (with slotted hole washer)
Tightening torque: 4.0 ± 0.2 N·m

NOTE

Regarding belt tension:
Jumping (position gap) may occur if the value is below the lower limit.
Vibration (abnormal noise) or reduction in life of the parts may occur if the value exceeds the upper limit.
When you replace with a new belt, belt extends and the belt tension may decrease in the initial stage. Make sure to operate the robot two to three days and check the belt tension again

(7) Mount the cable fixing plate on the Arm #2.
(Joint #2 side)

Hexagon socket head cap bolts: 2-M4×12
(with a washer)
Tightening torque: 4.0 ± 0.2 N·m



Pass the wire ties (×3) to the plate.
Fix the following cables and the ground wire with the wire tie.

Wire tie: AB150

Motor cable
Signal cable (for motor)
LED cable
Ground wire

(8) Fold the brake cable of Joint #2 motor into the length of 40mm. Bind it with the following cables with the wire tie.

Wire tie: AB100

Power cable
Signal cable (for motor)
Brake cable

(9) Pass the wire tie to the mount base inside the Arm #2.

Bind the following cables with the wire tie.

Wire tie: AB100

Power cable
Signal cable (for motor)
Brake cable
LED cable (mount base A only)

(10) Mount the Arm #2 cover.

Reference: *7.2 Arm #2 Cover*

(11) Turn ON the Manipulator.

Reference: *VT series Manual VT6L Manipulator 6.5 LED*

NOTE

When starting the Manipulator for the first time after replacing the motor unit, the motor unit firmware is automatically updated. DO NOT turn OFF the Manipulator until it starts.

When you connect a motor unit connected to another axis, an error 5009 or 9709 will occur. To clear the error, enter the following command in [Command Window] and execute it.

Joint #1: > `MUIDReset 1`
Joint #2: > `MUIDReset 2`
Joint #3: > `MUIDReset 3`
Joint #4: > `MUIDReset 4`
Joint #5: > `MUIDReset 5`
Joint #6: > `MUIDReset 6`

Reboot the Controller.

(12) Calibrate the Joint #2.

Reference: *19. Calibration*

10.2 Replacing Joint #2 Reduction Gear Unit

Reduction gear unit is replaced by serviceman who has taken maintenance training.

For replacement of the reduction gear unit, please contact the supplier of your region.

10.3 Replacing Joint #2 Timing Belt

CAUTION	■ This procedure has possibility of damage or malfunction to the Manipulator. Be very careful when performing maintenance. ■ DO NOT loosen the bolts while the Arm #2 is not tilted. It may cause the belt come off and the Arm #2 falls down, and it is extremely hazardous. Be sure to do the Removal steps (1) and (2) before removing the motor.

	Name	Quantity	Note
Maintenance parts	Timing Belt	1	1753920
Tools	Hexagonal wrench (width across flats: 3 mm)	1	For M4 hexagon socket head cap bolts
	Torque wrench	1	For tightening torque control
	Cross-point screwdriver (No. 2)	1	For cross-recessed screw
	Nippers	1	For cutting wire tie
	Belt tension meter	1	Refer: Unitta U-505
Material	Wire tie	-	

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the controller power is OFF or the motor is OFF status. The brake does not work during replacement.
Be careful when performing maintenance work.

When removing the Joint #2 motor, tilt the Arm #2 and press it against the Arm #1.
Reference: *10.1 Joint #2 - Replacing the Motor*, Removal step (2)

Joint #2 Timing Belt Removal

(1) Remove the Joint #2 timing belt.

Reference: *10.1 Replacing Joint #2 Motor*
Joint #2 Motor Removal Step (1) through (7)

Joint #2 Timing Belt Installation

(1) Install the Joint #2 timing belt.

Reference: *10.1 Replacing Joint #2 Motor*
Joint #2 Motor Removal Step (5) through (11)

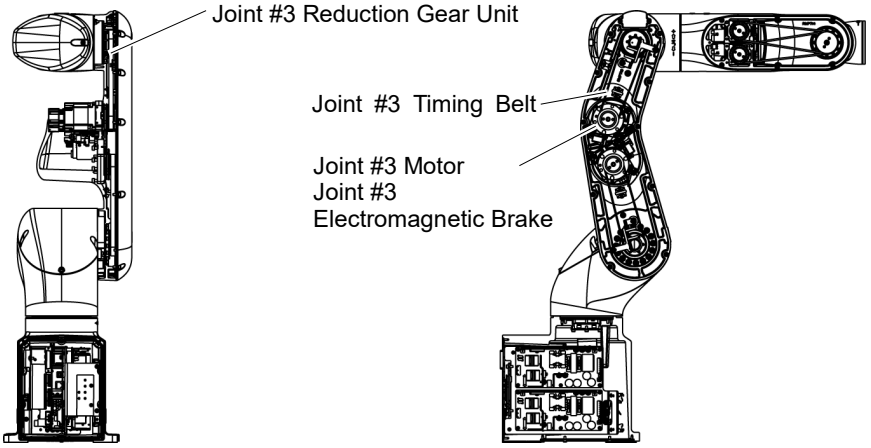
11. Joint #3

WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power plug. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

CAUTION	■ Be careful not to apply excessive shock to the motor shaft when replacing the motors. The shock may shorten the life cycle of the motors and encoder and/or damage them. ■ Never disassemble the motor and encoder. A disassembled motor and encoder will cause a positional gap and cannot be used again.

After parts have been replaced (motor units, reduction gear units, timing belts), the Manipulator cannot operate properly because a mismatch exists between the origin stored in each motor and its corresponding origin stored in the Robot system.
Because of that, it is necessary to perform calibration (encoder rest and calibration) to match these origins.

After replacing the parts, refer to the following section to perform calibration.
19. Calibration.



11.1 Replacing Joint #3 Motor

CAUTION	■ This procedure has possibility of damage or malfunction to the Manipulator. Be very careful when performing maintenance. ■ DO NOT loosen the bolts while the Arm #3 is not tilted. It may cause the belt come off and the Arm #3 falls down, and it is extremely hazardous. Be sure to do the Removal steps (1) and (2) before removing the motor.

	Name		Quantity	Note
Maintenance parts	Joint #3 motor unit		1	2194598
	Thermal conductive sheet		1	1755573
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Torque wrench		1	For tightening torque control
	Nippers		1	For cutting wire tie
	Belt tension meter		1	Refer: Unitta U-505
Material	Wire tie		-	

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

When removing the Joint #3 motor, tilt the Arm #3 and press it against the Arm #2.
Reference: *11.1 Joint #3 - Replacing the Motor,* Removal step (2)

Joint #3 Motor Removal

(1) Turn ON the Manipulator.

(2) Release the Joint #3 brake. Tilt the Arm #3 and push it against the Arm #2.

The Arm #3 falls by its weight when the Joint #3 motor unit is removed. Therefore, release the brake and tilt the Arm #3 in advance.

EPSON RC+

Command

```
>brake off, 3
```

NOTE

When pushing the arm, push the Arm #3 slowly to the Arm #2.

If a strong impact is applied to the joint, the Manipulator may get damage.

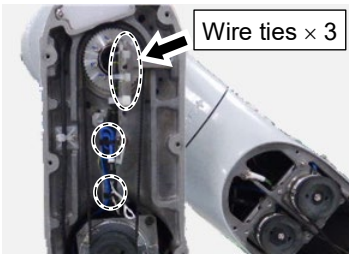
(3) Turn OFF the Manipulator.

(4) Remove the Arm #2 cover.

Reference: *7.2 Arm #2 Cover*

(5) Cut off the wire tie bound inside the Arm #2.

Wire tie : AB150 × 3
AB100 × 2

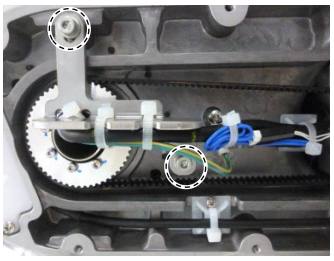


NOTE

Be careful not to cut the harness.

(6) Remove the cable fixing plate on the Arm #2. (Joint #3 side)

Hexagon socket head cap bolts with captive washer: 4-M4×12

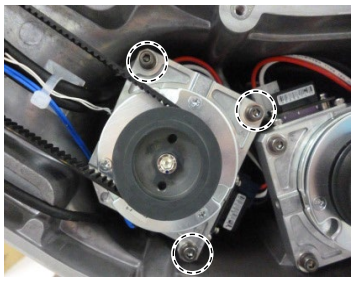


(7) Loosen the mounting screws of the Joint #3 motor unit and remove the Joint #3 timing belt.

Hexagon socket head cap bolts: 3-M4×22 (with slotted hole washer)

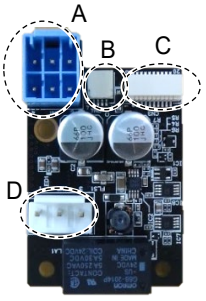
(8) Remove the Arm #2 from the motor unit.

Hexagon socket head cap bolts: 3-M4×22 (with slotted hole washer)

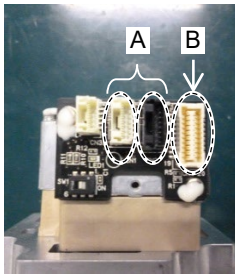


(9) Disconnect the following connectors from the AMP board.

A: Power cable connector
B: Brake connector
C: Signal cable connector (for AMP board)
D: Motor connector



(10) Disconnect the following connectors of the motor.



A: Signal cable connectors (for motor × 2)
B: Signal cable connector (for AMP board)

NOTE

The cables will be necessary again.
Be careful not to lose them.

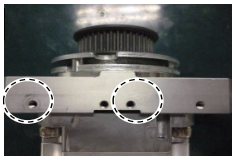
(11) Remove the AMP board fixing plate (with AMP board) from the motor unit.

Hexagon socket head cap bolts: 2-M3×6

Joint #3 Motor Installation

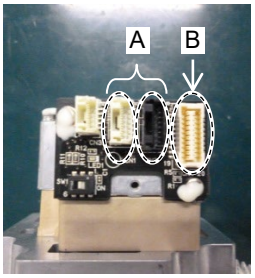
(1) Fix the AMP board fixing plate (with AMP board) to a new motor unit.

Hexagon socket head cap bolts: 2-M3×6
Tightening torque: 2.0 ± 0.1 N·m



(2) Connect the following connectors of the motor.

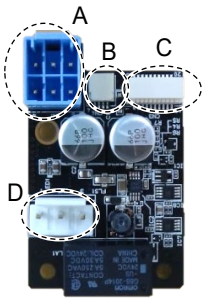
A: Signal cable connectors (for motor × 2)
B: Signal cable connector (for AMP board)



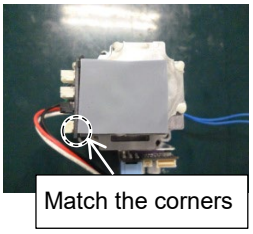
NOTE
Connector for the signal cable connector (for motor) is the same color.

(3) Connect the connectors of the AMP board.

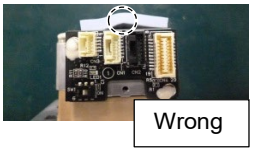
A: Power cable connector
B: Brake connector
C Signal cable connector (for AMP board)
D: Motor connector

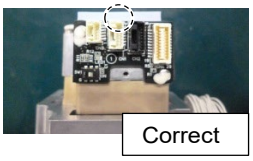


(4) Attach the thermal conductive sheet on the bottom of the motor unit. For the attaching position, refer to the picture on the right.

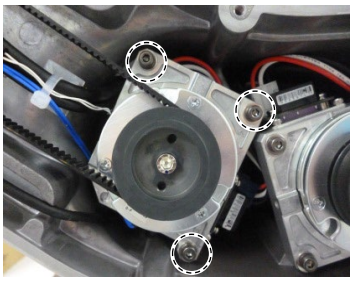


NOTE
Make sure that the entire surface of the thermal conductive sheet contacts with the rear side of the motor unit without lifting up the center of the sheet.





(5) Pass the timing belt through the motor pulley and loosely secure to the Arm #2.



Hexagon socket head cap bolts: 3-M4×22
(with slotted hole washer)

NOTE

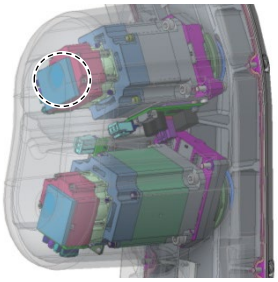
Make sure that the gear grooves of the timing belt are fit into those of the pulley completely.
When securing the motor unit loosely, make sure that the motor unit can be moved by hand and it does not tilt when being pulled. If the unit is secured too loose or too tight, the belt will not have proper tension.

NOTE

As shown on the picture, pass the cable through the rear side of the Arm #2 motor unit fixing part.
Before fixing the motor unit, make sure that the cables are not caught in the gap between the motor unit and Arm #2.

NOTE

Press the thermal conductive sheet on the rear side of the motor unit to the round convex part at the end of the Arm #2.



(6) Apply proper tension to the motor unit and fix it.

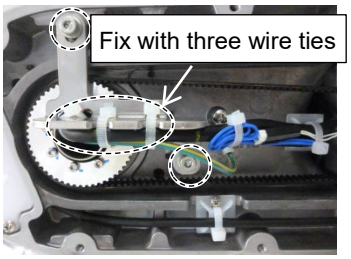
Joint #3 timing belt tension: 34 - 58 N
Belt tension meter setting values
Weight: 2.5g/mm width×m span
Width: 9.0mm
Span: 169mm

Hexagon socket head cap bolts: 3-M4×22 (with slotted hole washer)
Tightening torque: 4.0 ± 0.2 N·m

NOTE

Regarding belt tension:
Jumping (position gap) may occur if the value is below the lower limit.
Vibration (abnormal noise) or reduction in life of the parts may occur if the value exceeds the upper limit.
When you replace with a new belt, belt extends and the belt tension may decrease in the initial stage. Make sure to operate the robot two to three days and check the belt tension again

(7) Mount the cable fixing plate on the Arm #2. (Joint #3 side)



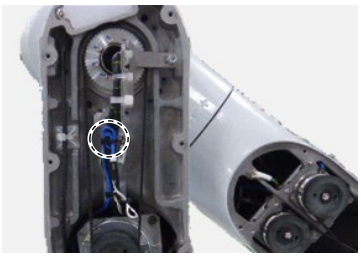
Hexagon socket head cap bolts: 2-M4×12 (with a washer)
Tightening torque: 4.0 ± 0.2 N·m

Pass the wire ties (×3) to the plate.
Bind the following cables and the ground wire with the wire tie.

Wire tie: AB150

Motor cable
Signal cable (for motor)
LED cable
Ground wire

(8) Fold the brake cable of Joint #3 motor into the length of 40mm. Bind it with the following cables with the wire tie.

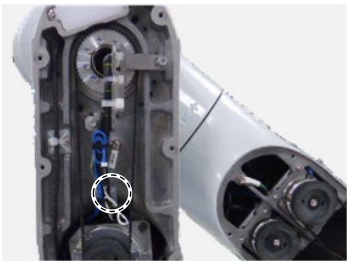


Wire tie: AB100

Power cable
Signal cable (for motor)
Brake cable

(9) Pass the wire tie to the mount base inside the Arm #2.

Bind the following cables with the wire tie.



Wire tie: AB100

Power cable
Signal cable (for motor)
Brake cable

(10) Mount the Arm #2 cover.

Reference: *7.2 Arm #2 Cover*

(11) Turn ON the Manipulator.

Reference: *VT series Manual VT6L Manipulator 6.5 LED*

NOTE ☞ When starting the Manipulator for the first time after replacing the motor unit, the motor unit firmware is automatically updated. DO NOT turn OFF the Manipulator until it starts.

When you connect a motor unit connected to another axis, an error 5009 or 9709 will occur. To clear the error, enter the following command in [Command Window] and execute it.

Joint #1: > `MUIDReset 1`
Joint #2: > `MUIDReset 2`
Joint #3: > `MUIDReset 3`
Joint #4: > `MUIDReset 4`
Joint #5: > `MUIDReset 5`
Joint #6: > `MUIDReset 6`

Reboot the Controller.

(12) Calibrate the Joint #3.

Reference: *19. Calibration*

11.2 Replacing Joint #3 Reduction Gear Unit

Reduction gear unit is replaced by serviceman who has taken maintenance training.

For replacement of the reduction gear unit, please contact the supplier of your region.

11.3 Replacing Joint #3 Timing Belt

CAUTION	■ This procedure has possibility of damage or malfunction to the Manipulator. Be very careful when performing maintenance. ■ DO NOT loosen the bolts while the Arm #3 is not tilted. It may cause the belt come off and the Arm #3 falls down, and it is extremely hazardous. Be sure to do the Removal steps (1) and (2) before removing the motor.

	Name	Quantity	Note
Maintenance parts	Timing Belt	1	1751537
Tools	Hexagonal wrench (width across flats: 3 mm)	1	For M4 hexagon socket head cap bolts
	Torque wrench	1	For tightening torque control
	Cross-point screwdriver (No. 2)	1	For cross-recessed screw
	Nippers	1	For cutting wire tie
	Belt tension meter	1	Refer: Unitta U-505
Material	Wire tie	-	

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

When removing the Joint #3 motor, tilt the Arm #3 and press it against the Arm #2.
Reference: *11.1 Joint #3- Replacing the Motor*, Removal step (2)

Joint #3 Timing Belt Removal

(1) Remove the Joint #3 timing belt.

Reference: *11.1 Replacing Joint #2 Motor*
Joint #3 Motor Removal Step (1) through (7)

Joint #3 Timing Belt Installation

(1) Install the Joint #3 timing belt.

Reference: *11.1 Replacing Joint #2 Motor*
Joint #3 Motor Removal Step (5) through (11)

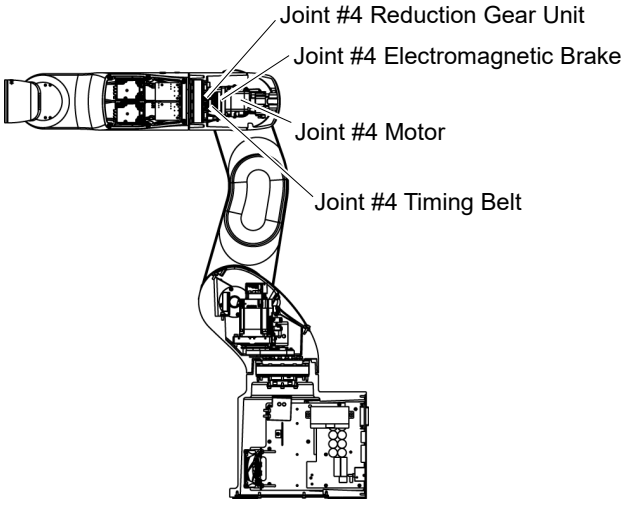
12. Joint #4

WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power plug. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

CAUTION	■ Be careful not to apply excessive shock to the motor shaft when replacing the motors. The shock may shorten the life cycle of the motors and encoder and/or damage them. ■ Never disassemble the motor and encoder. A disassembled motor and encoder will cause a positional gap and cannot be used again.

After parts have been replaced (motor units, reduction gear units, timing belts), the Manipulator cannot operate properly because a mismatch exists between the origin stored in each motor and its corresponding origin stored in the Robot system.
Because of that, it is necessary to perform calibration (encoder rest and calibration) to match these origins.

After replacing the parts, refer to the following section to perform calibration.
19. Calibration.



12.1 Replacing Joint #4 Motor

	Name	Quantity	Note
Maintenance parts	Joint #4 motor unit	1	2194599
Tools	Hexagonal wrench (width across flats: 3 mm)	1	For M4 hexagon socket head cap bolts
	Torque wrench	1	For tightening torque control
	Nippers	1	For cutting wire tie
	Belt tension meter	1	Refer: Unitta U-505
Material	Wire tie	-	

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

Joint #4 Motor Removal

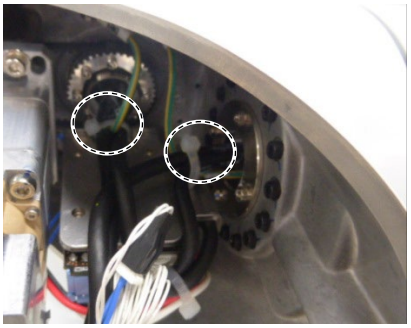
(1) Turn OFF the Manipulator.

(2) Remove the Arm #3 Cover.

Reference: *7.3 Arm #3 Cover.*

(3) Cut off the wire tie bound inside the Arm #3

Wire tie: AB150 × 2



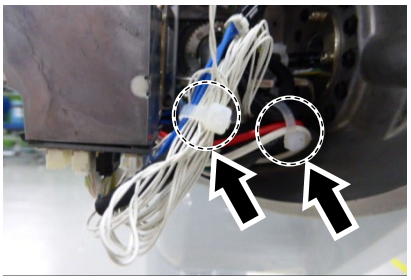
NOTE

Be careful not to cut the harness.

(4) Cut off the wire tie that binds the following cables of the Joint #4 motor.

Wire tie: AB100 × 2

Power cable
Signal cable

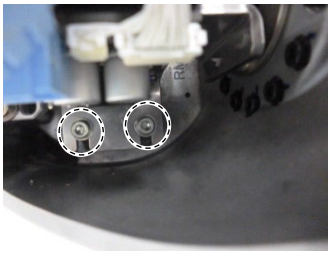


NOTE

Be careful not to cut the harness.

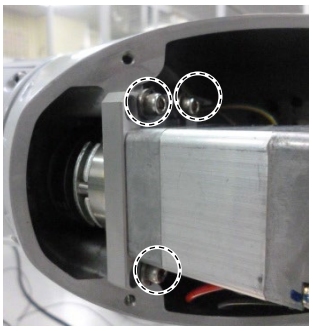
(5) Remove the plate (with AMP board) inside the Arm #3.

Hexagon socket head cap bolts with captive washer: 2-M4×12



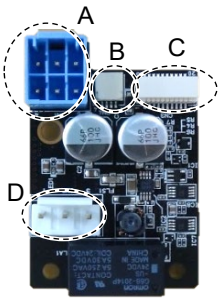
(6) Remove the Joint #4 motor unit.

Hexagon socket head cap bolts: 3-M4×18
(with slotted hole washer)



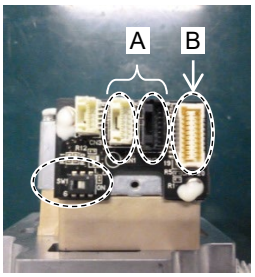
(7) Disconnect the following connectors from the AMP board.

A: Power cable connector
B: Brake connector
C: Signal cable connector (for AMP board)
D: Motor connector



(8) Disconnect the following connectors of the motor.

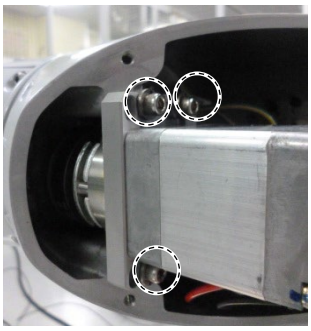
A: Signal cable connectors (for motor × 2)
B: Signal cable connector (for AMP board)



NOTE ☞ The cables will be necessary again.
Be careful not to lose them.

Joint #4 Motor Installation

(1) Pass the timing belt through the motor pulley and loosely secure to the Arm #3.



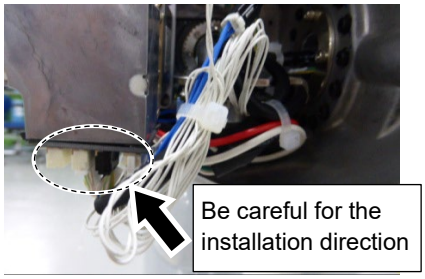
Hexagon socket head cap bolts: 3-M4×18
(with slotted hole washer)

NOTE

Make sure that the gear grooves of the timing belt are fit into those of the pulley completely.
When securing the motor unit loosely, make sure that the motor unit can be moved by hand and it does not tilt when being pulled. If the unit is secured too loose or too tight, the belt will not have proper tension.

NOTE

The direction to install the motor is the direction in which the connector of the motor faces downward.



(2) Apply proper tension to the motor unit and fix it.

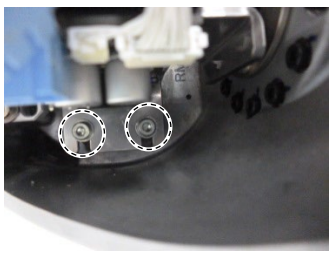
Joint #4 timing belt tension: 23 - 36 N
Belt tension meter setting values
Weight: 2.5g/mm width×m span
Width: 6.0mm
Span: 45mm

Hexagon socket head cap bolts: 3-M4×18 (with slotted hole washer)
Tightening torque: 4.0 ± 0.2 N·m

NOTE

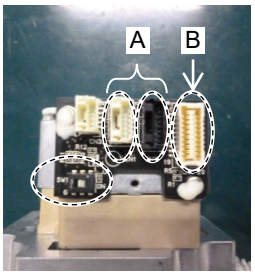
Regarding belt tension:
Jumping (position gap) may occur if the value is below the lower limit.
Vibration (abnormal noise) or reduction in life of the parts may occur if the value exceeds the upper limit.
When you replace with a new belt, belt extends and the belt tension may decrease in the initial stage. Make sure to operate the robot two to three days and check the belt tension again

(3) Mount the plate on the Arm #3.



Hexagon socket head cap bolts with captive washer: 2-M4×12
Tightening torque: 4.0 ± 0.2 N·m

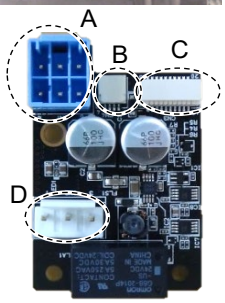
(4) Connect the following connectors of the motor.



A: Signal cable connectors (for motor × 2)
B: Signal cable connector (for AMP board)

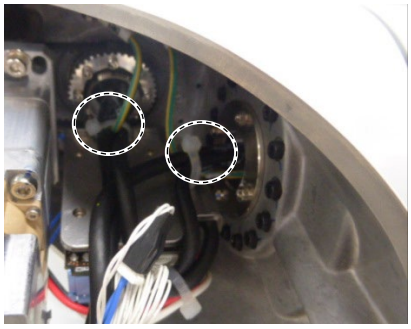
Connector for the signal cable connector (for motor) is the same color.

(5) Connect the connectors of the AMP board.



A: Power cable connector
B: Brake connector
C Signal cable connector (for AMP board)
D: Motor connector

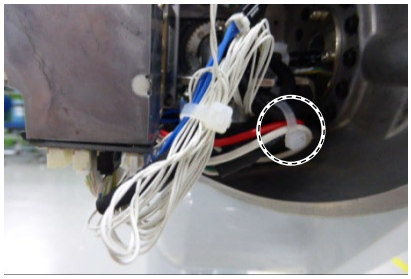
(6) Pass the wire tie through the hole on the plate inside the Arm #3.
Bind the following cables with the wire tie.



Wire tie: AB150

Power cable
Signal cable (for motor)
Ground wire

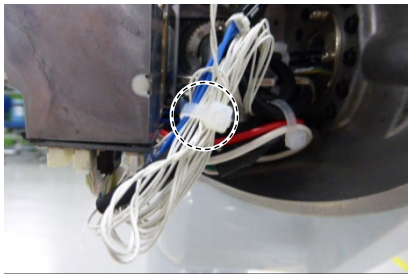
(7) Bind the following cables between the Joint #4 motor and the Joint #3 motor with the wire tie.



Wire tie: AB100

Power cable
Signal cable (for motor)
Motor cable

(8) Bind the following cables between the Joint #4 motor and the Joint #3 motor with the wire tie.



Wire tie: AB100

Signal cable (for AMP board)
Signal cable (for motor)
Brake cable

(9) Mount the Arm #3 cover.

Reference: *7.3 Arm #3 Cover*

(10) Turn ON the Manipulator.

Reference: *VT series Manual VT6L Manipulator 6.5 LED*

NOTE

When starting the Manipulator for the first time after replacing the motor unit, the motor unit firmware is automatically updated. DO NOT turn OFF the Manipulator until it starts.

When you connect a motor unit connected to another axis, an error 5009 or 9709 will occur. To clear the error, enter the following command in [Command Window] and execute it.

Joint #1: > `MUIDReset 1`
Joint #2: > `MUIDReset 2`
Joint #3: > `MUIDReset 3`
Joint #4: > `MUIDReset 4`
Joint #5: > `MUIDReset 5`
Joint #6: > `MUIDReset 6`

Reboot the Controller.

(11) Calibrate the Joint #4.

Reference: *19. Calibration*

12.2 Replacing Joint #4 Reduction Gear Unit

Reduction gear unit is replaced by serviceman who has taken maintenance training.

For replacement of the reduction gear unit, please contact the supplier of your region.

12.3 Replacing Joint #4 Timing Belt

	Name	Quantity	Note
Maintenance parts	Timing Belt	1	1751538
Tools	Hexagonal wrench (width across flats: 3 mm)	1	For M4 hexagon socket head cap bolts
	Torque wrench	1	For tightening torque control
	Cross-point screwdriver (No. 2)	1	For cross-recessed screw
	Nippers	1	For cutting wire tie
	Belt tension meter	1	Refer: Unitta U-505
Material	Wire tie	-	

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

Joint #4 Timing Belt Removal

(1) Turn OFF the Manipulator.

(2) Remove the following covers.

Arm #3 Cover
Arm #4 Cover 1
Arm #4 Cover 2

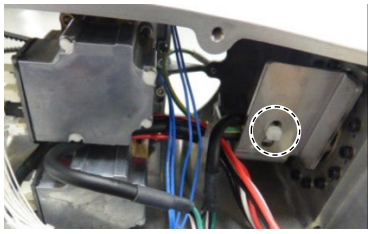
Reference: *7 Covers*

(3) Remove the Joint #4 motor.

Reference: *12.1 Replacing Joint #4 Motor*
Joint #4 Motor Removal step (3) through (7)

(4) Cut off the wire tie bound inside the Arm #4.

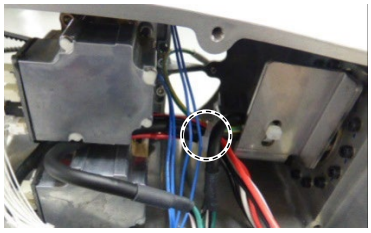
Wire tie: AB150



(5) Cut off the wire tie that binds the following cables and the ground wire.

Wire tie: AB100

Joint #5 motor cable
Signal cable (for motor)
Joint #6 motor cable
Ground wire

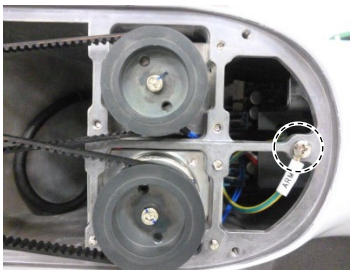


NOTE

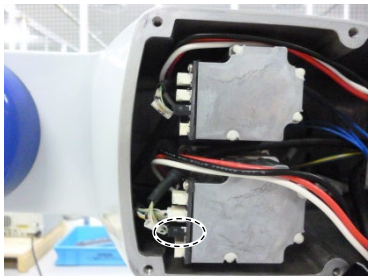
Be careful not to cut the harness.

(6) Remove the ground wire terminals of the Arm #4.

Cross-recessed screw: M4×6



(7) Disconnect the Joint #5 signal cable connector (for motor: black).



(8) Pass the Joint #4 sleeve and the Joint #4 timing belt so that the following cables and the ground wire will be Arm #3 side.

Cables disconnected connectors in the step (2) through (7)
- Power cable (Joint #5, 6 connector parts)
- Joint #5 signal cable (for motor)
- Ground wire

(9) Remove the Joint #4 timing belt.

Joint #4 Timing belt Installation

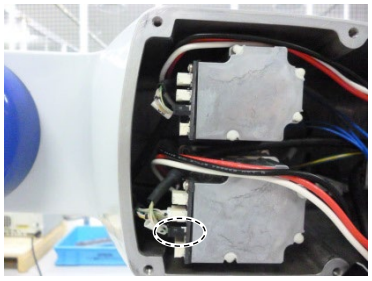
(1) Pass the following cables through a new Joint #4 timing belt.

Power cable (Joint #5, 6 connector part)
Joint #5 signal cable (for motor)
Ground wire

(2) Install the Joint #4 motor unit.

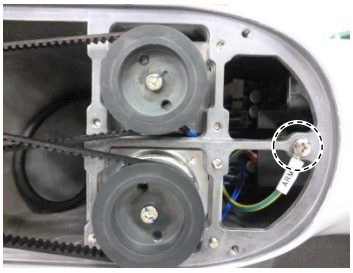
Reference: *12.1 Replacing Joint #4 Motor*
Joint #4 Motor Installation step (1) through (8)

(3) Connect the Joint #5 signal cable connector (for motor: black).



(4) Install the ground wire terminals of the Arm #4.

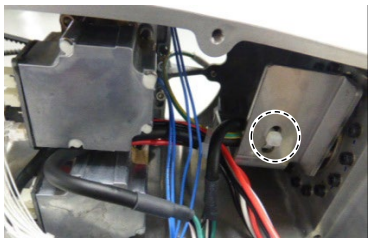
Cross-recessed screw: M4×6
Tightening torque: 2.0 ± 0.1 N·m



(5) Pass the wire tie through the hole on the plate inside the Arm #4.
Bind the following cables with the wire tie.

Wire tie: AB150

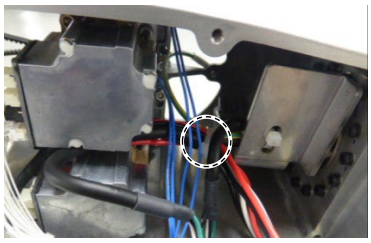
Power cable
Signal cable (for motor)
Ground wire



(6) Bind the following cables with the wire tie.

Wire tie: AB100

Motor cable(Joint #5)
Signal cable (Joint #5)
Motor cable (Joint #6)
Ground wire



(7) Mount the following covers.

Arm #3 Cover
Arm #4 Cover 1
Arm #4 Cover 2

Reference: *7 Covers*

(8) Turn ON the Manipulator.

Reference: *VT series Manual VT6L Manipulator 6.5 LED*

NOTE

When starting the Manipulator for the first time after replacing the motor unit, the motor unit firmware is automatically updated. DO NOT turn OFF the Manipulator until it starts.

(9) Calibrate the Joint #4.

Reference: *19. Calibration*

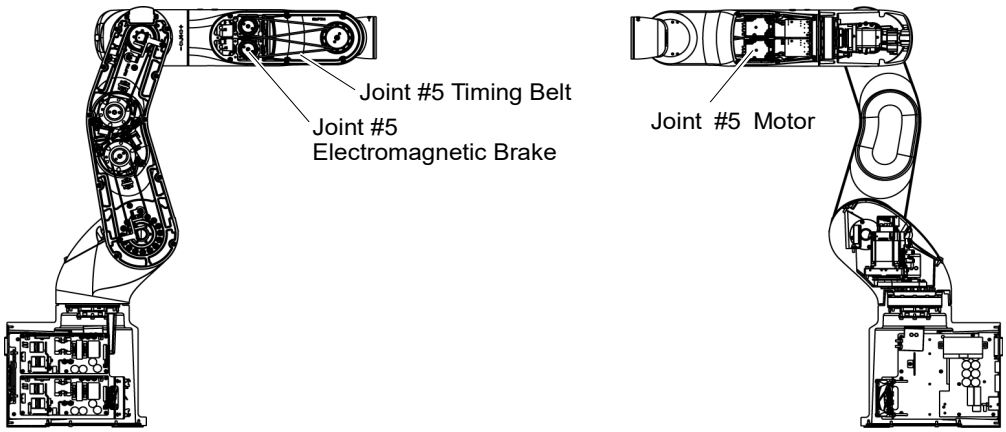
13. Joint #5

WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power plug. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

CAUTION	■ Be careful not to apply excessive shock to the motor shaft when replacing the motors. The shock may shorten the life cycle of the motors and encoder and/or damage them. ■ Never disassemble the motor and encoder. A disassembled motor and encoder will cause a positional gap and cannot be used again.

After parts have been replaced (motor units, reduction gear units, timing belts.), the Manipulator cannot operate properly because a mismatch exists between the origin stored in each motor and its corresponding origin stored in the Robot system.
Because of that, it is necessary to perform calibration (encoder rest and calibration) to match these origins.

After replacing the parts, refer to the following section to perform calibration.
19. Calibration.



13.1 Replacing Joint #5 Motor

	Name	Quantity	Note
Maintenance parts	Joint #5 motor unit	1	2194600
Tools	Hexagonal wrench (width across flats: 3 mm)	1	For M4 hexagon socket head cap bolts
	Torque wrench	1	For tightening torque control
	Nippers	1	For cutting wire tie
	Belt tension meter	1	Refer: Unitta U-505
Material	Wire tie	-	

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the controller power is OFF or the motor is OFF status. The brake does not work during replacement.
Be careful when performing maintenance work.

Joint #5 Motor Removal

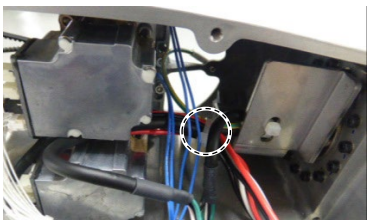
(1) Turn OFF the Manipulator.

(2) Remove the following covers.

Arm #4 Cover 1
Arm #4 Cover 2

Reference: *7. Covers*

(3) Cut off the wire tie that binds the following cables and the ground wire.



Wire tie: AB100

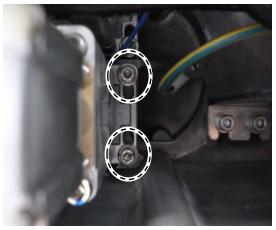
Joint #5 motor cable
Signal cable (for motor)
Joint #6 motor cable
Ground wire

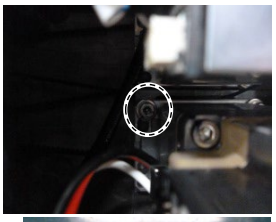
NOTE

Be careful not to cut the harness.

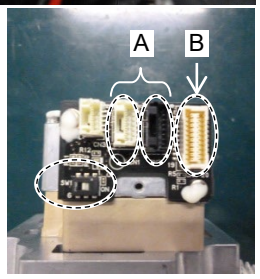
(4) Remove the Joint #5 motor unit.

Hexagon socket head cap bolts: 3-M4×20
(with slotted hole washer)





(5) Disconnect the following connectors of the motor.



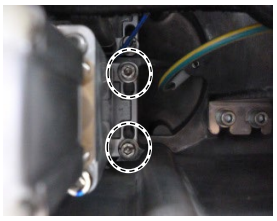
A: Signal cable connectors (for motor × 2)
B: Signal cable connector (for AMP board)

NOTE

The cables will be necessary again.
Be careful not to lose them.

Joint #5 Motor Installation

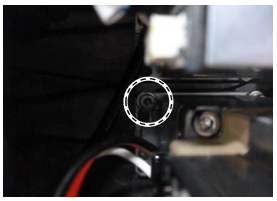
(1) Pass the timing belt through the motor pulley and loosely secure to the Arm #4.



Hexagon socket head cap bolts: 3-M4×20
(with slotted hole washer)

NOTE

Make sure that the gear grooves of the timing belt are fit into those of the pulley completely.
When securing the motor unit loosely, make sure that the motor unit can be moved by hand and it does not tilt when being pulled. If the unit is secured too loose or too tight, the belt will not have proper tension.



NOTE

The direction to install the motor is the direction in which the connector of the motor faces Joint #5 side.

(2) Apply proper tension to the motor unit and fix it.

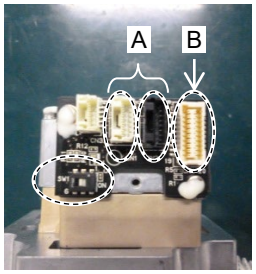
Joint #5 timing belt tension: 23 - 36 N
Belt tension meter setting values
Weight: 2.5g/mm width×m span
Width: 6.0mm
Span: 184mm

Hexagon socket head cap bolts: 3-M4×20 (with slotted hole washer)
Tightening torque: 4.0 ± 0.2 N·m

NOTE

Regarding belt tension:
Jumping (position gap) may occur if the value is below the lower limit.
Vibration (abnormal noise) or reduction in life of the parts may occur if the value exceeds the upper limit.
When you replace with a new belt, belt extends and the belt tension may decrease in the initial stage. Make sure to operate the robot two to three days and check the belt tension again

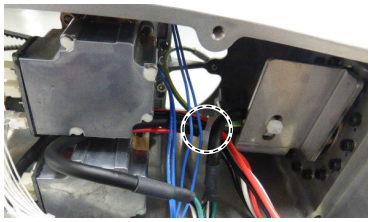
(3) Connect the following connectors of the motor.



A: Signal cable connectors (for motor × 2)
B: Signal cable connector (for AMP board)

Connector for the signal cable connector (for motor) is the same color.

(4) Bind the following cables and the ground wire with the wire tie.



Wire tie: AB100

Motor cable (Joint #5)
Signal cable (Joint #5)
Motor cable (Joint #6)
Ground wire

(5) Mount the following covers.

Arm #4 Cover 1
Arm #4 Cover 2

Reference: *7. Covers*

(6) Turn ON the Manipulator.

Reference: *VT series Manual VT6L Manipulator 6.5 LED*

NOTE

When starting the Manipulator for the first time after replacing the motor unit, the motor unit firmware is automatically updated. DO NOT turn OFF the Manipulator until it starts.

When you connect a motor unit connected to another axis, an error 5009 or 9709 will occur. To clear the error, enter the following command in [Command Window] and execute it.

Joint #1: > `MUIDReset 1`
Joint #2: > `MUIDReset 2`
Joint #3: > `MUIDReset 3`
Joint #4: > `MUIDReset 4`
Joint #5: > `MUIDReset 5`
Joint #6: > `MUIDReset 6`

Reboot the Controller.

(7) Calibrate the Joint #5 and the Joint #6.

Reference: 19. Calibration

13.2 Replacing Joint #5 Reduction Gear Unit

Reduction gear unit is replaced by serviceman who has taken maintenance training.

For replacement of the reduction gear unit, please contact the supplier of your region.

13.3 Replacing Joint #5 Timing Belt

	Name	Quantity	Note
Maintenance parts	Timing Belt	1	1762243
Tools	Hexagonal wrench (width across flats: 3 mm)	1	For M4 hexagon socket head cap bolts
	Torque wrench	1	For tightening torque control
	Cross-point screwdriver (No. 2)	1	For cross-recessed screw
	Nippers	1	For cutting wire tie
	Belt tension meter	1	Refer: Unitta U-505
Material	Wire tie	-	

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

Joint #5 Timing Belt Removal

(1) Remove the Joint #6 timing belt.

Reference: *14.3 Replacing Joint #6 Timing Belt*
Joint #6 Timing Belt Removal

(2) Remove the Joint #5 motor and the Joint #5 timing belt.

Reference: *13.1 Replacing Joint #5 Motor*
Joint #5 Motor Removal step (1) through (4)

Joint #5 Timing Belt Installation

(1) Remove the Joint #5 timing belt and the Joint #5 motor.

Reference: *13.1 Replacing Joint #5 Motor*
Joint #5 Motor Installation step (1) through (5)

(2) Install the Joint #6 timing belt.

Reference: *14.1 Replacing Joint #6 Motor*
Joint #6 Motor Installation step (1) through (5)

(3) Mount the following covers.
Arm #3 Cover
Arm #4 Cover 1
Arm #4 Cover 2

Reference: *7. Covers*

(4) Turn ON the Manipulator.

Reference: *VT series Manual VT6L Manipulator 6.5 LED*

NOTE ☞ When starting the Manipulator for the first time after replacing the motor unit, the motor unit firmware is automatically updated. DO NOT turn OFF the Manipulator until it starts.

(5) Calibrate the Joint #5 and the Joint #6.

Reference: *19. Calibration*

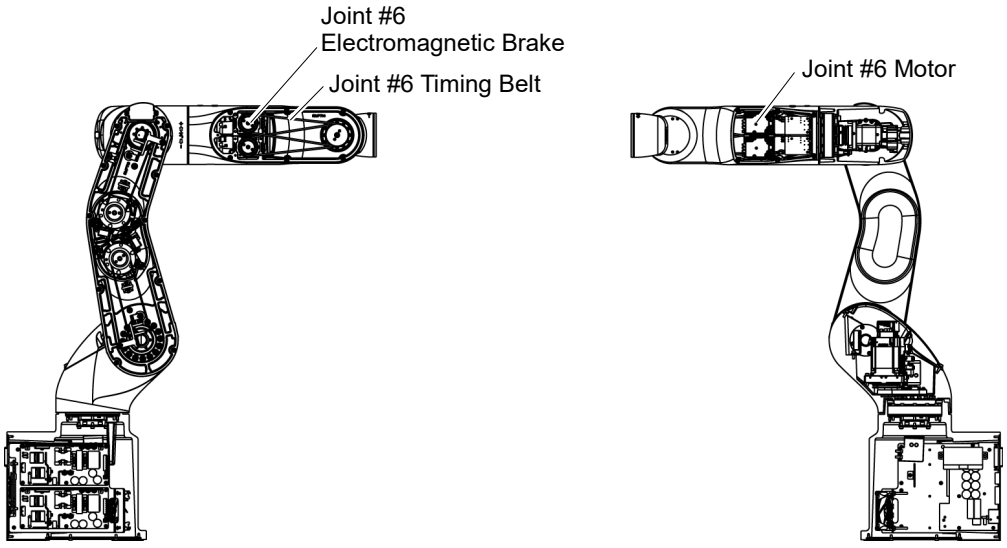
14. Joint #6

WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power plug. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

CAUTION	■ Be careful not to apply excessive shock to the motor shaft when replacing the motors. The shock may shorten the life cycle of the motors and encoder and/or damage them. ■ Never disassemble the motor and encoder. A disassembled motor and encoder will cause a positional gap and cannot be used again.

After parts have been replaced (motor units, reduction gear units, timing belts), the Manipulator cannot operate properly because a mismatch exists between the origin stored in each motor and its corresponding origin stored in the Robot system.
Because of that, it is necessary to perform calibration (encoder rest and calibration) to match these origins.

After replacing the parts, refer to the following section to perform calibration.
19. Calibration.



14.1 Replacing Joint #6 Motor

	Name		Quantity	Note
Maintenance parts	Joint #6 motor unit		1	2194601
Tools	Hexagonal wrench	width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Torque wrench		1	For tightening torque control
	Nippers		1	For cutting wire tie
	Belt tension meter		1	Refer: Unitta U-505
Material	Wire tie		-	

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the controller power is OFF or the motor is OFF status. The brake does not work during replacement.
Be careful when performing maintenance work.

Joint #6 Motor Removal

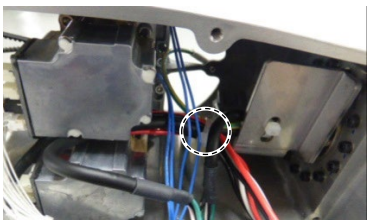
(1) Turn OFF the Manipulator.

(2) Remove the following covers.

Arm #4 Cover 1
Arm #4 Cover 2

Reference: *7. Covers*

(3) Cut off the wire tie that binds the following cables and the ground wire.



Wire tie: AB100

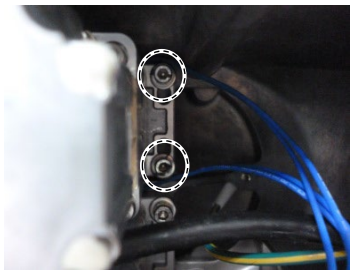
Joint #5 motor cable
Signal cable (for motor)
Joint #6 motor cable
Ground wire

NOTE

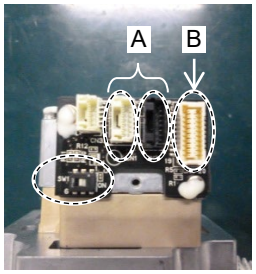
Be careful not to cut the harness.

(4) Remove the Joint #6 motor unit.

Hexagon socket head cap bolts: 3-M4×20
(with slotted hole washer)



(5) Disconnect the following connectors of the motor.



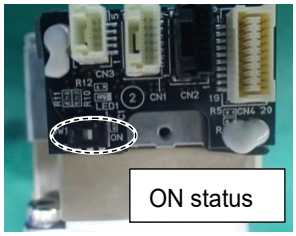
A: Signal cable connectors (for motor × 2)
B: Signal cable connector (for AMP board)

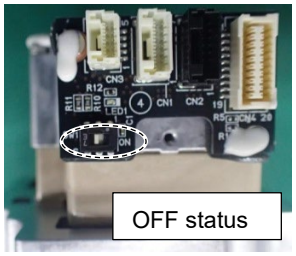
NOTE

The cables will be necessary again.
Be careful not to lose them.

Joint #6 Motor Installation

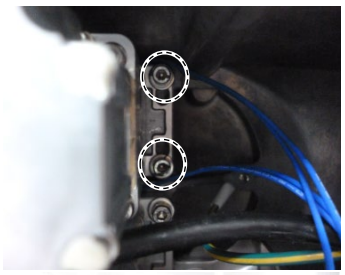
(1) Confirm that the terminating resistor switch of the Joint #6 motor is turned ON.
When the switch is OFF, push the tab to turn it ON.





(2) Pass the timing belt through the motor pulley and loosely secure to the Arm #4

Hexagon socket head cap bolts: 3-M4×20
(with slotted hole washer)

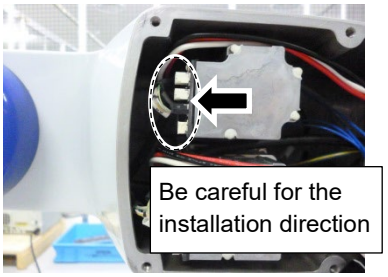


NOTE

Make sure that the gear grooves of the timing belt are fit into those of the pulley completely.
When securing the motor unit loosely, make sure that the motor unit can be moved by hand and it does not tilt when being pulled. If the unit is secured too loose or too tight, the belt will not have proper tension.

NOTE

The direction to install the motor is the direction in which the connector of the motor faces Joint #5 side



(3) Apply proper tension to the motor unit and fix it.

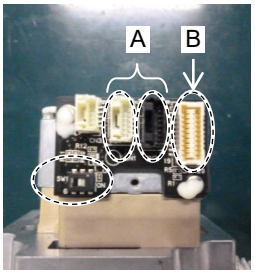
Joint #6 timing belt tension: 23 - 36N
Belt tension meter setting values
Weight: 2.5g/mm width×m span
Width: 6.0mm
Span: 184mm

Hexagon socket head cap bolts: 3-M4×20 (with slotted hole washer)
Tightening torque: 4.0 ± 0.2 N·m

NOTE

Regarding belt tension:
Jumping (position gap) may occur if the value is below the lower limit.
Vibration (abnormal noise) or reduction in life of the parts may occur if the value exceeds the upper limit.
When you replace with a new belt, belt extends and the belt tension may decrease in the initial stage. Make sure to operate the robot two to three days and check the belt tension again

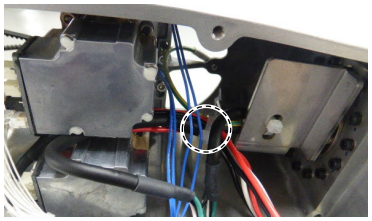
(4) Connect the following connectors of the motor.



A: Signal cable connectors (for motor × 2)
B: Signal cable connector (for AMP board)

Connector for the signal cable connector (for motor) is the same color.

(5) Bind the following cables and the ground wire with the wire tie.



Wire tie: AB100

Motor cable (Joint #5)
Signal cable (Joint #5)
Motor cable (Joint #6)
Ground wire

(6) Mount the following covers.

Arm #4 Cover 1
Arm #4 Cover 2

Reference: *7. Covers*

(7) Turn ON the Manipulator.

Reference: *VT series Manual VT6L Manipulator 6.5 LED*

NOTE

When starting the Manipulator for the first time after replacing the motor unit, the motor unit firmware is automatically updated. DO NOT turn OFF the Manipulator until it starts.

When you connect a motor unit connected to another axis, an error 5009 or 9709 will occur. To clear the error, enter the following command in [Command Window] and execute it.

Joint #1: > `MUIDReset 1`
Joint #2: > `MUIDReset 2`
Joint #3: > `MUIDReset 3`
Joint #4: > `MUIDReset 4`
Joint #5: > `MUIDReset 5`
Joint #6: > `MUIDReset 6`

Reboot the Controller.

(8) Calibrate the Joint #6.

Reference: *19. Calibration*

14.2 Replacing Joint #6 Reduction Gear Unit

Reduction gear unit is replaced by serviceman who has taken maintenance training.

For replacement of the reduction gear unit, please contact the supplier of your region.

14.3 Replacing Joint #6 Timing Belt

	Name	Quantity	Note
Maintenance parts	Timing Belt	1	1762243
Tools	Hexagonal wrench (width across flats: 3 mm)	1	For M4 hexagon socket head cap bolts
	Torque wrench	1	For tightening torque control
	Cross-point screwdriver (No. 2)	1	For cross-recessed screw
	Nippers	1	For cutting wire tie
	Belt tension meter	1	Refer: Unitta U-505
Material	Wire tie	-	

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

Joint #6 Timing Belt Removal

(1) Remove the Joint #6 motor and the Joint #6 timing belt.

Reference: *14.1 Replacing Joint #6 Motor*
Joint #6 Motor Removal step (1) through (4)

Joint #6 Timing Belt Installation

(1) Install the Joint #6 timing belt and the Joint # motor.

Reference: *14.1 Replacing Joint #6 Motor*
Joint #6 Motor Installation step (1) through (5)

(2) Mount the following covers.
Arm #3 Cover
Arm #4 Cover 1
Arm #4 Cover 2

Reference: *7. Covers*

(3) Turn ON the Manipulator.

Reference: *VT series Manual VT6L Manipulator 6.5 LED*

NOTE
When starting the Manipulator for the first time after replacing the motor unit, the motor unit firmware is automatically updated. DO NOT turn OFF the Manipulator until it starts.

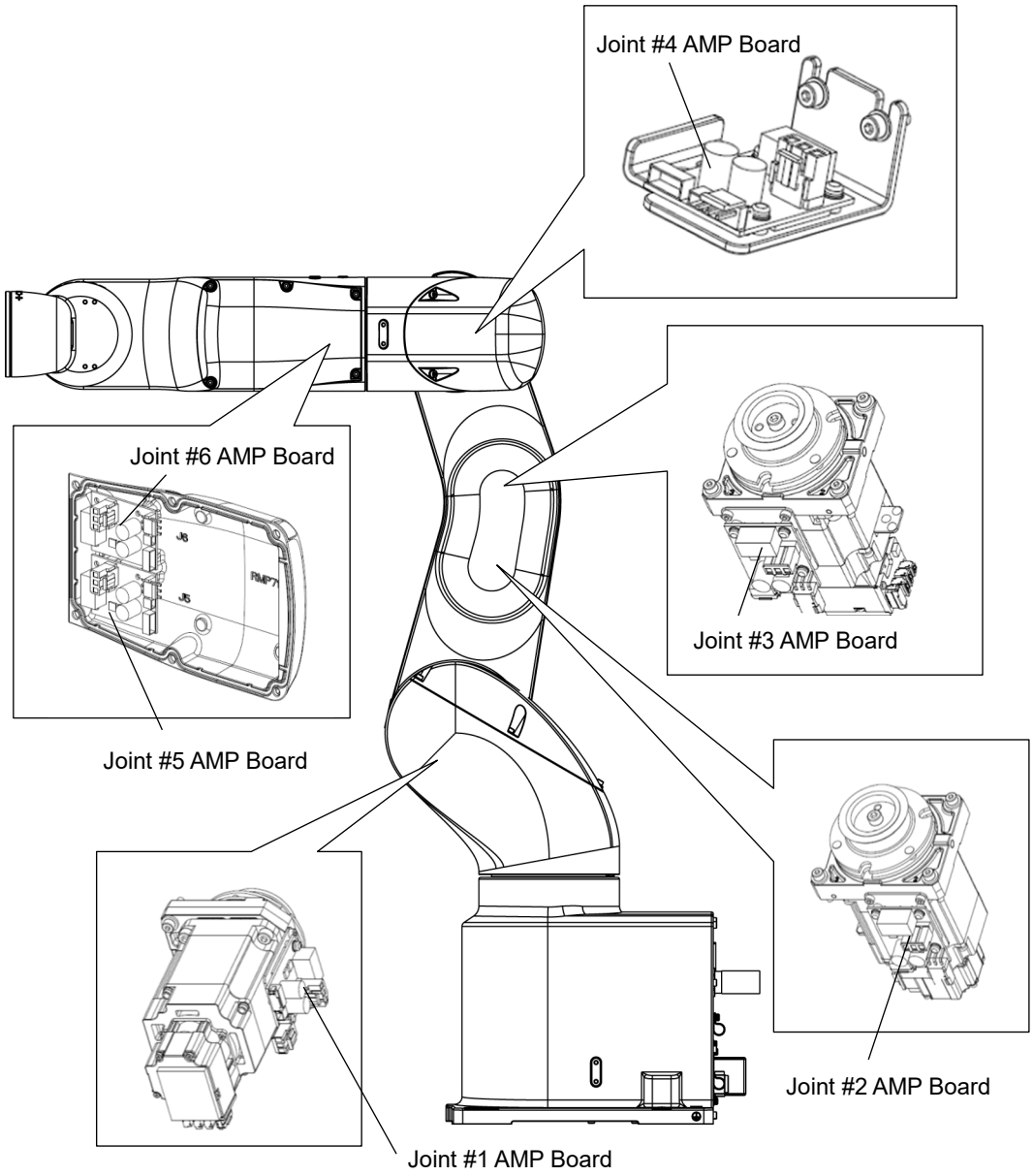
(4) Calibrate the Joint #5 and the Joint #6.

Reference: *19. Calibration*

15. AMP Board

 WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power plug. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

 CAUTION	■ Be careful not to apply excessive shock to the motor shaft when replacing the motors. The shock may shorten the life cycle of the motors and encoder and/or damage them. ■ Never disassemble the motor and encoder. A disassembled motor and encoder will cause a positional gap and cannot be used again.


Joint #4 AMP Board
Joint #6 AMP Board
Joint #5 AMP Board
Joint #3 AMP Board
Joint #2 AMP Board
Joint #1 AMP Board

15.1 Replacing AMP Board on Joint #1, #2, and #3

	Name		Quantity	Note
Maintenance parts	AMP Board		1	2189027
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Torque wrench		1	For tightening torque control
	Cross-point screwdriver (No. 2)		1	For cross-recessed screw
	Nippers		1	For cutting wire tie
	Belt tension meter		1	Refer: Unitta U-505
Material	Wire tie		-	

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement.
Be careful when performing maintenance work.

AMP Board Removal

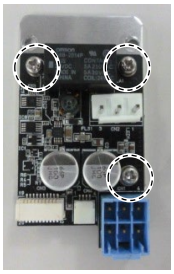
(1) Turn OFF the Manipulator.

(2) Remove the plate (with AMP board) from the motor unit.

Reference: *9.1 Joint #1 Motor Removal*
10.1 Joint #2 Motor Removal
11.1 Joint #3 Motor Removal

(3) Remove the AMP board from the plate.

Cross-recessed screws with a washer: 3-M3×6



NOTE

If the thermal conductive sheet is attached on the rear side of the AMP board, remove it. The thermal conductive sheet will be necessary again. Be careful not to lose it.

AMP Board Installation

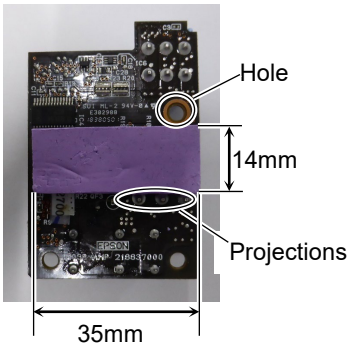
(1) If the thermal conductive sheet is removed in the Removal step (3), attach the sheet.

NOTE

The size of the thermal conductive sheet varies depending on the shipping time. According to the size of the thermal conductive sheet, follow the procedures below to attach the sheet.

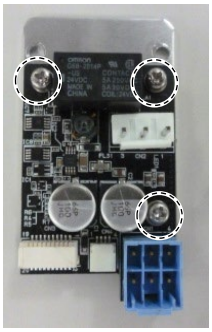
The size of the thermal conductive sheet is 35mm×24mm:
Attach the thermal conductive sheet on the plate. Attach the sheet in the direction that the longer sides of the thermal conductive sheet and the plate are parallel. As shown in the picture, the attachment position is inside the range surrounded by three spacers of the AMP board fixing part.

The size of the thermal conductive sheet is 35mm×14mm:
Attach the thermal conductive sheet on the AMP board.
For the attachment position of the thermal conductive sheet, refer to the picture on the right.
Be careful not to cover projections and hole.



(2) Mount the AMP board on the plate.

Cross-recessed screws with a washer: 3-M3×6
Tightening torque: 0.45 ± 0.1 N·m



(3) Fix the plate (with AMP board) to the motor unit and mount the motor unit.

Reference: *9.1 Joint #1 Motor Installation*
10.1 Joint #2 Motor Installation
11.1 Joint #3 Motor Installation

15.2 Replacing AMP Board on Joint #4

	Name		Quantity	Note
Maintenance parts	AMP Board		1	2189027
Tools	Hexagonal wrench	width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Torque wrench		1	For tightening torque control
	Cross-point screwdriver (No. 2)		1	For cross-recessed screw
	Nippers		1	For cutting wire tie
Material	Wire tie		-	

AMP Board Removal

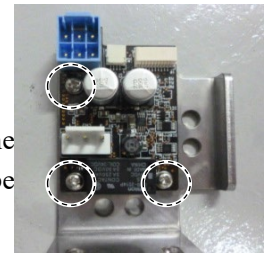
(1) Turn OFF the Manipulator.

(2) Remove the plate (with AMP board) from the Arm #3.

Reference: *12.1 Joint #4 Motor Removal*

(3) Remove the AMP board from the plate.

Cross-recessed screws with a washer: 3-M3×6



NOTE

If the thermal conductive sheet is attached on the rear side of the AMP board, remove it. The thermal conductive sheet will be necessary again. Be careful not to lose it.

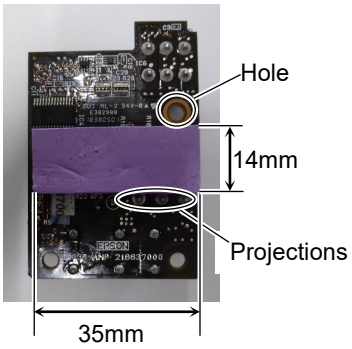
AMP Board Installation

(1) If the thermal conductive sheet is removed in the Removal step (3), attach the sheet.

NOTE The size of the thermal conductive sheet varies depending on the shipping time. According to the size of the thermal conductive sheet, follow the procedures below to attach the sheet.

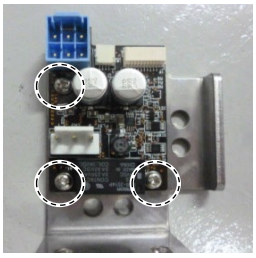
The size of the thermal conductive sheet is 35mm×24mm:
Attach the thermal conductive sheet on the plate. Attach the sheet in the direction that the longer sides of the thermal conductive sheet and the plate are parallel. As shown in the picture, the attachment position is inside the range surrounded by three spacers of the AMP board fixing part.

The size of the thermal conductive sheet is 35mm×14mm:
Attach the thermal conductive sheet on the AMP board.
For the attachment position of the thermal conductive sheet, refer to the picture on the right.
Be careful not to cover projections and hole.



(2) Mount the AMP board on the plate.

Cross-recessed screws with a washer: 3-M3×6
Tightening torque: 0.45 ± 0.1 N·m



(3) Mount the plate (with AMP board) on the Arm #3.

Reference: *12.1 Joint #4 Motor Installation*

15.3 Replacing AMP Board on Joint #5 and #6

	Name		Quantity	Note
Maintenance parts	AMP Board		1	2189027
Tools	Hexagonal wrench	width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Torque wrench		1	For tightening torque control
	Cross-point screwdriver (No. 2)		1	For cross-recessed screw

AMP Board Removal

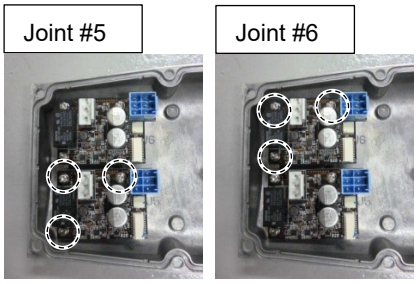
(1) Turn OFF the Manipulator.

(2) Remove the Arm #4 Cover 2.

Reference: *7.5 Arm #4 Cover 2*

(3) Remove the AMP board from the Arm #4 Cover 2.

Cross-recessed screws with a washer: 3-M3×6



AMP Board Installation

(1) Fix the AMP board on the Arm #4 Cover 2.

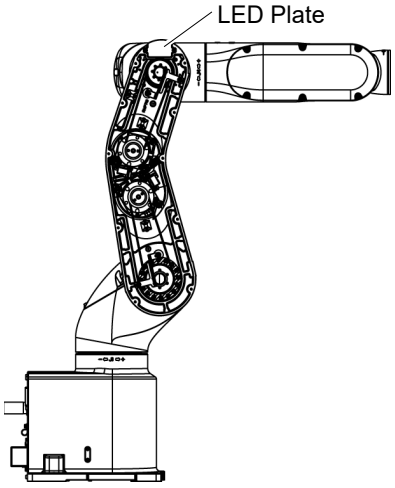
Cross-recessed screws with a washer: 3-M3×6
Tightening torque: 0.45 ± 0.1 N·m

(2) Mount the Arm #4 Cover 2.

Reference: *7.5 Arm #4 Cover 2*

16. LED Plate

WARNING	■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power plug. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.



16.1 Replacing LED Plate

	Name		Quantity	Note
Maintenance parts	LED Plate		1	1749496
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Torque wrench		1	For tightening torque control
	Cross-point screwdriver (No. 2)		1	For cross-recessed screw
	Nippers		1	For cutting wire tie
	Belt tension meter		1	Refer: Unitta U-505
Material	Wire tie		-	

LED Plate Removal

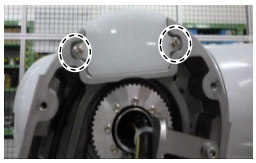
(1) Turn OFF the Manipulator.

(2) Remove the Arm #2 Cover.

Reference: *7.2 Arm #2 Cover*

(3) Remove the LED plate.

Cross-recessed screws: 2-M3×10



(4) Only for Protection model:

Remove the LED gasket.

LED Plate Installation

(1) Only for Protection model:

Mount the LED gasket in the groove of the Arm #2.

(2) Install the LED plate.

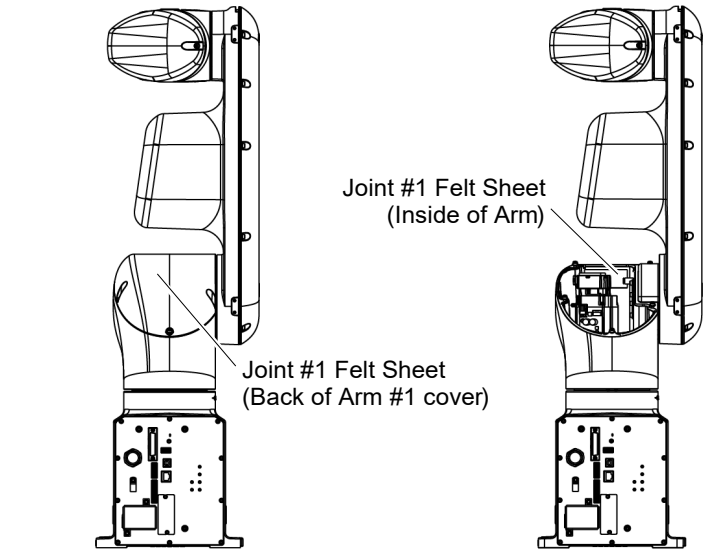
Cross-recessed screws: 2-M3×10
Tightening torque: 0.45 ± 0.1 N·m

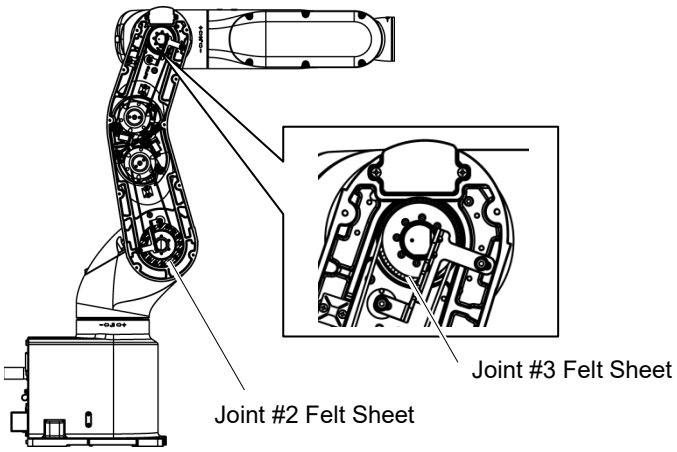
(3) Mount the Arm #2 Cover.

Reference: *7.2 Arm #2 Cover*

17. Felt Sheet

WARNING	■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power plug. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.





17.1 Replacing Joint #1 Felt Sheet

	Name	Quantity	Note
Maintenance part	Felt Sheet	2	1840429

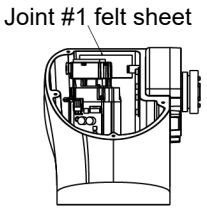
Joint #1 Felt Sheet Removal

(1) Turn OFF the Manipulator.

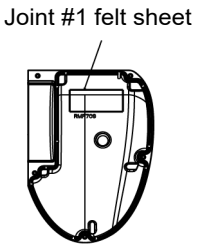
(2) Remove the Arm #1 Cover.

Reference: *7.1 Arm #1 Cover*

(3) Remove Joint #1 felt sheet from the Arm #1.



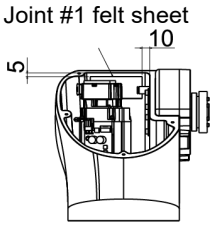
(4) Remove Joint #1 felt sheet from the Arm #1 Cover.



Joint #1 Felt Sheet Installation

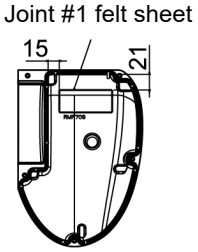
(1) Attach the felt sheet on the Arm #1.

One side of the felt sheet is a seal. See the position specified in the figure and attach the felt sheet on Arm #1.



(2) Attach the felt sheet on Arm #1 Cover.

One side of the felt sheet is a seal. See the position specified in the figure and attach the felt sheet on Arm #1 Cover.



(3) Mount the Arm #1 Cover.

Reference: *7.1 Arm #1 Cover*

17.2 Replacing Joint #2 Felt Sheet

	Name	Quantity	Note
Maintenance part	Felt Sheet	1	1755083

Joint #2 Felt Sheet Removal

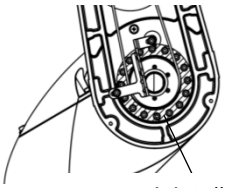
(1) Turn OFF the Manipulator.

(2) Remove the Arm #2 Cover.

Reference: *7.2 Arm #2 Cover*

(3) Remove Joint #2 felt sheet from the Arm #2.

Hold a slit on the one side of felt sheet to remove the sheet from the outside of the Joint #2.



Joint #2 Felt Sheet

Joint #2 Felt Sheet Installation

(1) Hold a slit on the one side of felt sheet to remove the sheet from the outside of the Joint #2.

One side of the felt sheet is a seal. Attach the felt sheet at the position where the Joint 2 screw holes and the holes of the Joint #2 felt sheet matches.

(2) Mount the Arm #2 Cover.

Reference: *7.2 Arm #2 Cover*

17.3 Replacing Joint #3 Felt Sheet

	Name	Quantity	Note
Maintenance parts	Felt Sheet	1	1755084

Joint #3 Felt Sheet Removal

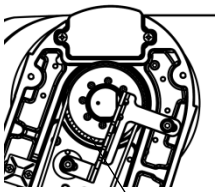
(1) Turn OFF the Manipulator.

(2) Remove the Arm #2 Cover.

Reference: *7.2 Arm #2 Cover*

(3) Remove Joint #3 felt sheet from the Arm #2.

Hold a slit on the one side of felt sheet to remove the sheet from the outside of the Joint #3.



Joint #3
Felt Sheet

Joint #3 Felt Sheet Installation

(1) Hold a slit on the one side of the Joint #3 felt sheet to remove the sheet from the outside of the Joint #3.

One side of the felt sheet is a seal. Attach the felt sheet so that it fits in the groove of the Joint #3 of Arm #2.

(2) Mount the Arm #2 Cover.

Reference: *7.2 Arm #2 Cover*

18. Controller Unit

WARNING	■ Do not connect or disconnect the connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power plug. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

WARNING	■ Take meticulous care when handling the lithium battery. Improper handling of the lithium battery as mentioned below is extremely hazardous and may result in heat generation, leakage, explosion, or inflammation. It also may cause serious safety problems. <Improper Handling> Attempting to charge Disassembling Connecting batteries improperly Exposing to fire Forcing discharge Deforming by pressure Short-circuit (Polarity; Positive/Negative) Heating (85 °C or more) Soldering the terminal of the lithium battery directly ■ When disposing the battery, consult with the professional disposal services or comply with the local regulation. Make sure that the battery terminal is insulated, even for a used buttery. If the terminal contacts with the other metals, it may short and result in heat generation, leakage, explosion, or inflammation.

The life span of the lithium battery varies depending on the energizing hours and installation environment of the Manipulator. It is about 7 years as a rough guide (when the Manipulator is connected to power for 8 hours a day). When the Manipulator is not connected to power, the battery consumption will significantly increase compared to when the Controller is energized. If warnings of voltage reduction occur, replace the lithium metal battery even if it has not reached the above product life.

NOTE

For EPSON RC+ 7.0, the recommended replacement time for the battery can be checked in the [Maintenance] dialog box.

Reference: *4. Alarm*

The battery may run out if it passes the recommended replacement time.
If no warnings of voltage reduction occur, the calibration for all joints is not necessary. You need to perform calibration if the position moves from the originals after replaced the battery.
Be sure to use the designated parts for the lithium battery.

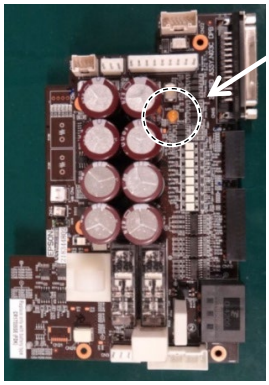
Reference: *21. Maintenance Parts List*

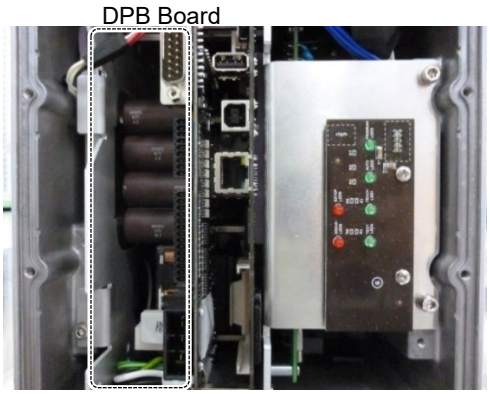
Be careful of the battery polarity to connect it correctly.

18.1 Replacing Controller Unit

WARNING

■ Make sure that orange colored charge confirmation LED on the DPB turns off when ejecting the Controller Unit. If operating without tuning off the LED, electric shock or other serious problems for safety may occur.





	Name		Quantity	Note
Maintenance parts	Controller Unit	AC specification	1	Standard, Cleanroom model: 2194603 Protection model: 2208039
		DC specification	1	2207771 (S/N: VT65T02*** only) 2216965 (all DC specification models)
Tools	Hexagonal wrench (width across flats: 3 mm)		1	For M4 hexagon socket head cap bolts
	Torque wrench		1	For tightening torque control
	Cross-point screwdriver (No. 2)		1	

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement.
Be careful when performing maintenance work.

18.1.1 Standard, Cleanroom Model

Controller Unit Removal

(1) Turn OFF the Manipulator.

(2) Remove the connector plate.

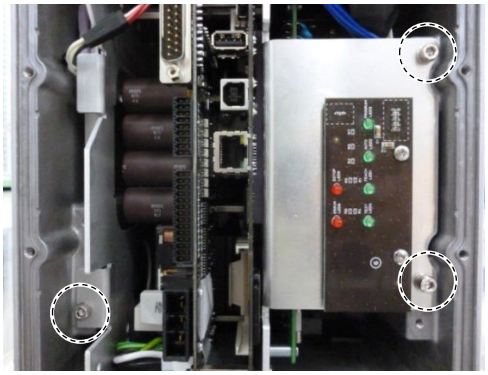
Reference: *Maintenance 7.7 Connector Plate*

Standard Cleanroom

(3) Disconnect the TP connector which is connected (inside) the connector plate.

(4) Unscrew the mounting screws of the Controller Unit.

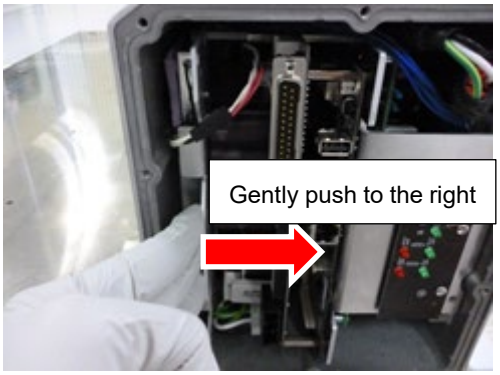
Hexagon socket head cap bolts:
3-M4×10 (with a plain washer)

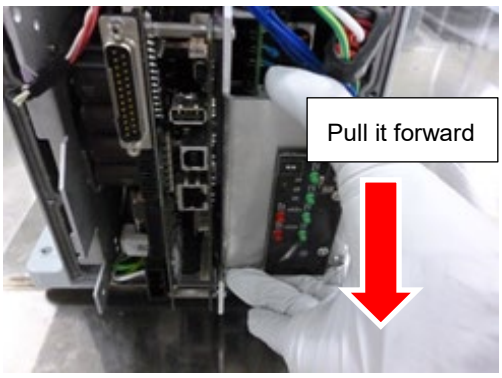


(5) Pull out the Controller Unit from the Manipulator base.

NOTE

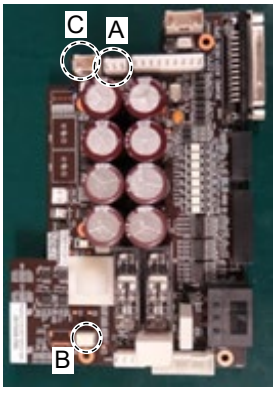
When pulling it out,
firstly push the plate of the Controller Unit to the right (see the picture) gently, then remove the thermal conductive sheet on the base and the Controller Unit.
Next, pull the Controller Unit forward.

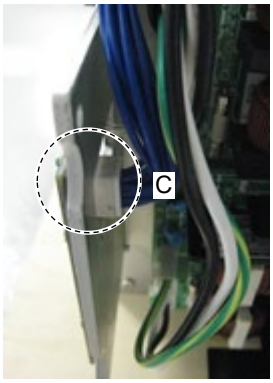




(6) Disconnect the following connectors of the Controller Unit.

A: Power cable connector
B: Signal cable connector
C: LED connectors × 2



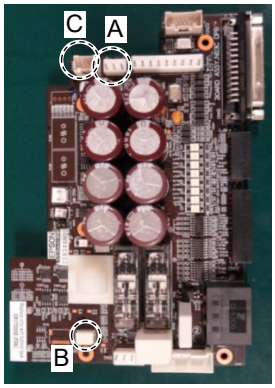


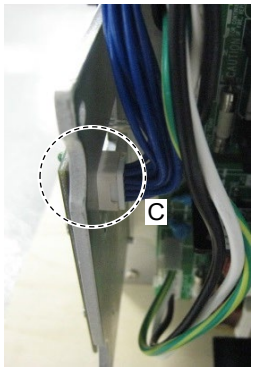
Controller Unit Installation

Standard Cleanroom

(1) Connect the following connectors to the Controller Unit.

A: Power cable connector
B: Signal cable connector
C: LED connectors × 2



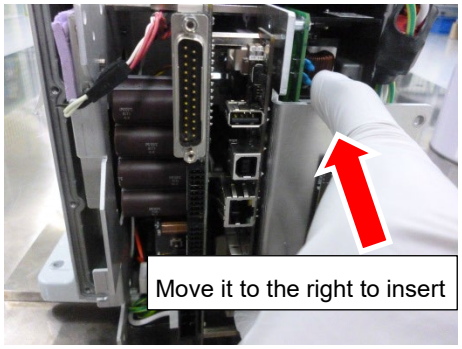


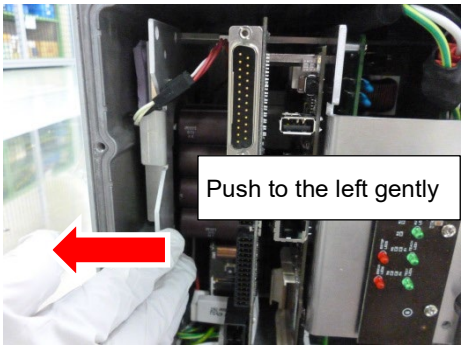
(2) Push the Controller Unit into the base.

NOTE

Insert the Controller Unit while moving it to the right (see the picture).

Then, gently move the plate of the Controller Unit to the left and let the thermal conductive sheet contacts with the wall inside the base.



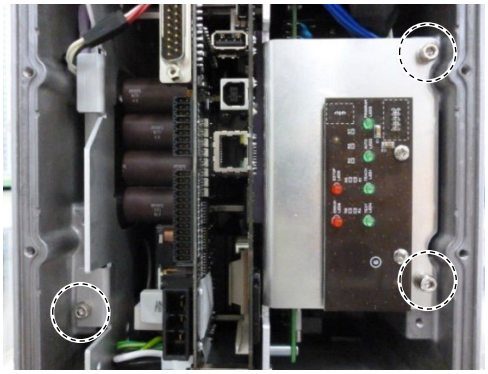


NOTE

Push the Controller Unit while fixing the cables from the Joint #1 motor at the base opening. Be careful not to push the cables to the back of the base.

(3) Fix the Controller Unit to the base.

Hexagon socket head cap bolts: 3-M4×10 (with a plain washer)
Tightening torque: 4.0 ± 0.2 N·m



(4) Connect the TP connector inside the connector plate.

(5) Mount the connector plate.

Reference: *7.7 Connector Plate*

18.1.2 Protection Model

Controller Unit Removal

Protection

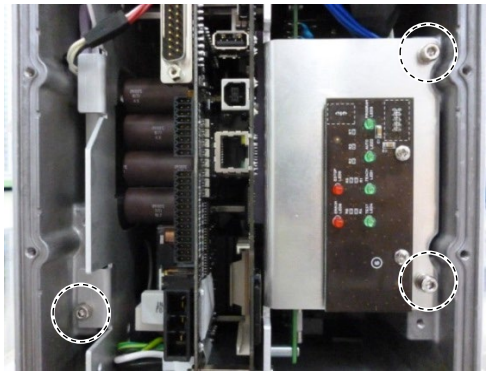
(1) Turn OFF the Manipulator.

(2) Remove the connector plate.

Reference: *7.7 Connector Plate*

(3) Unscrew the mounting screws of the Controller Unit.

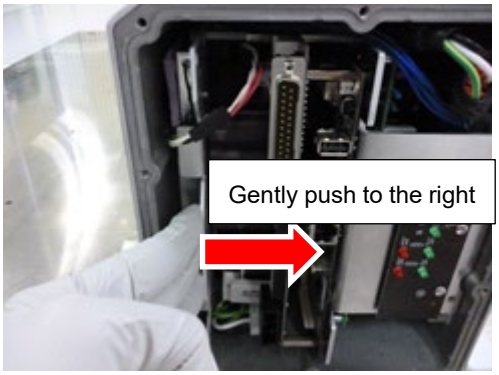
Hexagon socket head cap bolts:
3-M4×10 (with a plain washer)

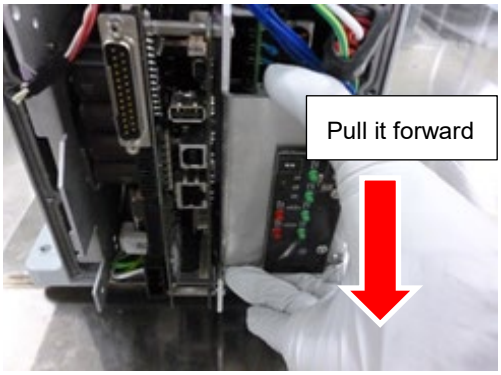


(4) Pull out the Controller Unit from the Manipulator base.

NOTE

When pulling it out,
firstly push the plate of the Controller Unit to the right (see the picture) gently, then remove the thermal conductive sheet on the base and the Controller Unit.
Next, pull the Controller Unit forward.

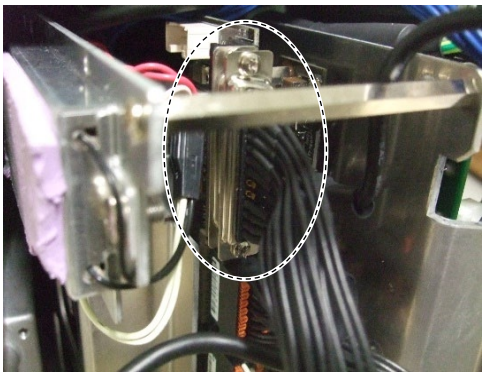




(5) Disconnect the TP connector which is connected (inside) the connector plate.

(6) Disconnect the following connectors.
USB type A connector
USB type B connector
LAN connector

(7) Disconnect the EMERGENCY connector.

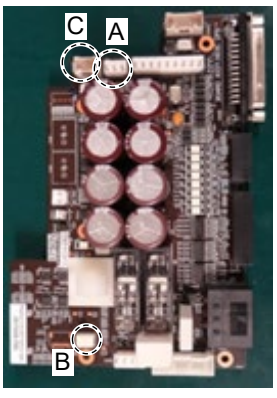


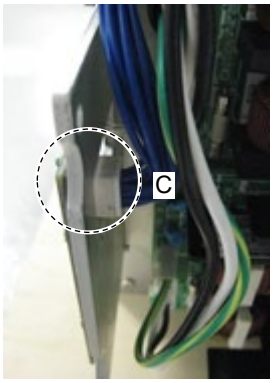
(8) Disconnect the two I/O connectors.

(9) Disconnect the power connector.

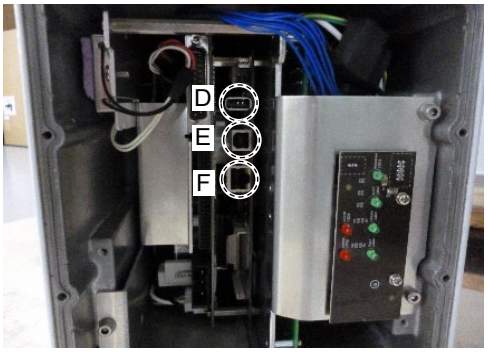
(10) Disconnect the following connectors of the Controller Unit.

A: Power cable connector
B: Signal cable connector
C: LED connectors × 2





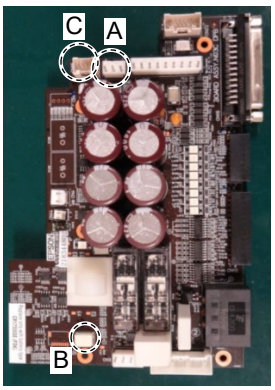
D: USB type A connector
E: USB type B connector
F: LAN connector



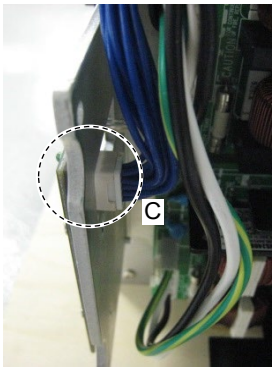
Controller Unit Installation

(1) Mount the base rear gasket in the groove on the back of the base.

(2) Connect the following connectors to the Controller Unit.



A: Power cable connector
B: Signal cable connector
C: LED connectors × 2
G: TP connector



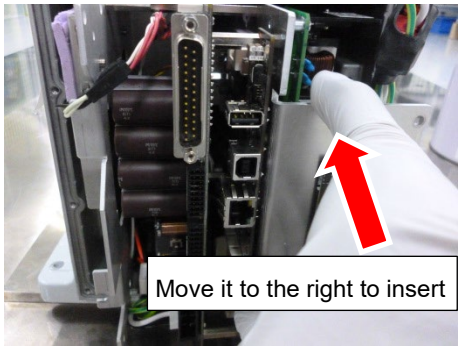
Protection

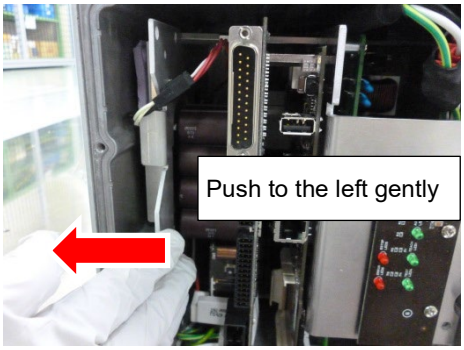
(3) Push the Controller Unit into the base.

NOTE

Insert the Controller Unit while moving it to the right (see the picture).

Then, gently move the plate of the Controller Unit to the left and let the thermal conductive sheet contacts with the wall inside the base.



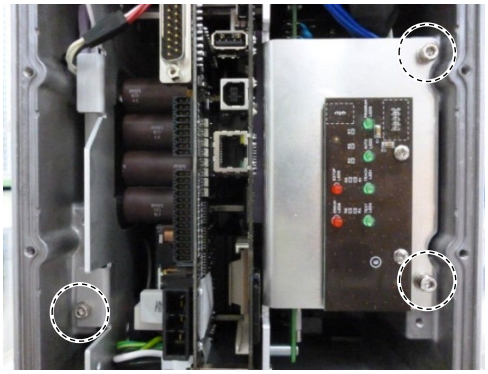


NOTE

Push the Controller Unit while fixing the cables from the Joint #1 motor at the base opening. Be careful not to push the cables to the back of the base.

(4) Fix the Controller Unit to the base.

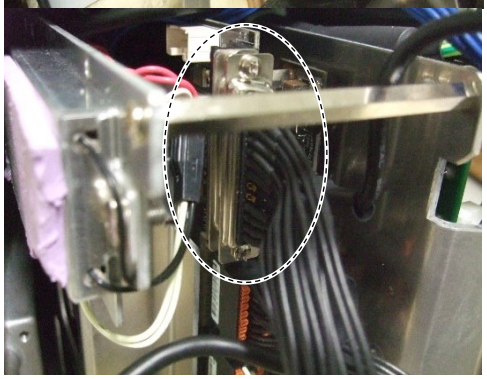
Hexagon socket head cap bolts: 3-M4×10 (with a plain washer)
Tightening torque: 4.0 ± 0.2 N·m



(5) Connect the power connector on the Controller Unit.

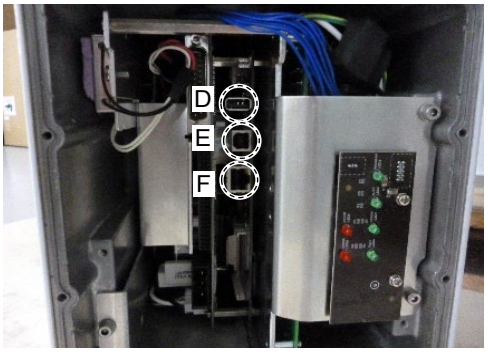
(6) Connect I/O connector on the Controller Unit.

(7) Connect EMERGENCY connector on the Controller Unit.



(8) Connect the following connectors on the Controller Unit.

D: USB (type A) connector
E: USB (type B) connector
F: LAN connector



(9) Mount the connector plate.

Reference: *7.7 Connector Plate*

18.2 Replacing Power Board

CAUTION	■ Heat sink has sharp part. Be sure to wear protective gloves when removing the power board or disconnecting cables.

	Name		Quantity	Note
Maintenance parts	Power Board	AC specification	2	2188638
		DC specifications	1	2207410 (S/N: VT65T02*** only) 2216953 (all DC specification models)
Tools	Cross-point screwdriver (No. 2)		1	

Power Board Removal

(1) Remove the Controller Unit.

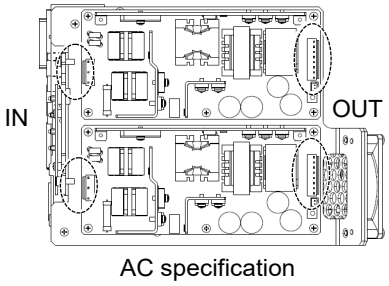
Reference: *18.1 Replacing Controller Unit*

(2) Disconnect the connectors of the power board.

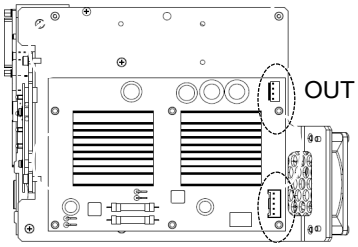
Power connectors
AC specification: (IN/OUT ×2 for each)
DC specification : (IN/OUT ×1)

(3) Remove the power board.

Pan head screws:
AC specification: 10-M3×8 Sems
DC specification: 6-M3×8 Sems



AC specification



DC specification

Power Board Installation

(1) Mount a new power board.

Pan head screws:
AC specification: 10-M3×8 Sems
DC specification: 6-M3×8 Sems

Tightening torque: 0.45 ± 0.1N·m

(2) Connect the connectors of the power board.

Power connectors:
AC specification: (IN/OUT ×2 for each)
DC specification: (IN/OUT ×1 for each)

(3) Mount the Controller Unit.

Reference: *18.1 Replacing Controller Unit*

18.3 Replacing CPU/DPB Board

	Name		Quantity	Note
Maintenance parts	CPU/DPB Board	AC specification	1	2193553
		DC specification	1	2207409
Tools	Cross-point screwdriver (No. 2)		1	

CPU/DPB Board Removal

(1) Remove the power board.

Reference: *18.2 Replacing Power Board*

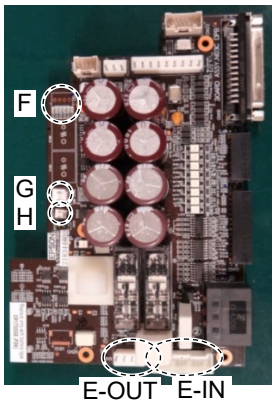
(2) Disconnect the CPU/DPB board connectors.

E: Power connector (IN/OUT ×1 for each)
F: Cooling fan connector
G: Regenerative resistor connector 1
H: Regenerative resistor connector 2

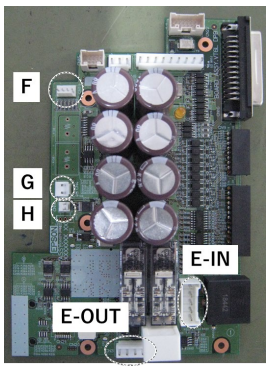
NOTE

Remember the cable layout for reconnecting after replacement.

AC specification



DC specification

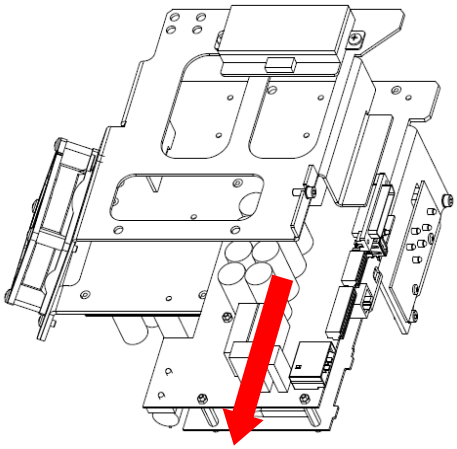


(3) Remove the CPU/DPB board.

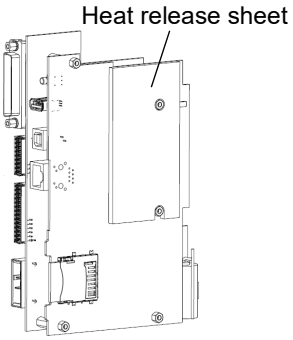
Binding head screws: 5-M3×6

NOTE

Firstly, unscrew the mounting screws. Next, pull the CPU/DPB board to the arrow direction.



(4) Remove the heat release sheet attached on the CPU board.



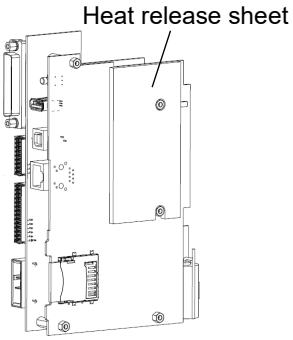
NOTE

The heat release sheet will be necessary again. Be careful not to lose them.

Be careful not to break the heat release sheet.

CPU/DPB Board Installation

(1) Attach the heat release sheet on the surface (the side with no connectors) of the new CPU/DPB board.



NOTE

Make sure not to attach the sheet on the wrong surface.

(2) Mount the CPU/DPB board and fix it by the mounting screws.

Binding head screws: 5-M3×6
Tightening torque: 0.45 ± 0.1N·m

NOTE

Mounting position of CPU/DPB board differs between Standard, Cleanroom model and Protection model.

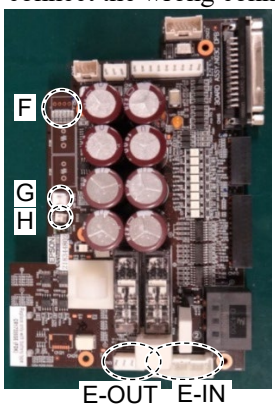
(3) Connect the CPU/DPB board connectors.

E: Power connector (IN/OUT ×1 for each)
F: Cooling fan connector
G: Regenerative resistor connector 1
H: Regenerative resistor connector 2

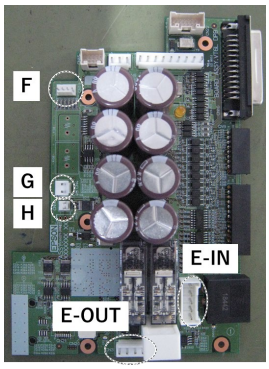
NOTE

Be careful not to connect the wrong connectors or forget to connect it.

AC specification



DC specification



(4) Mount the power board.

Reference: *18.2 Replacing Power Board*

18.4 Replacing Lithium Battery

	Name	Quantity	Note
Maintenance parts	Lithium Battery	1	2113554 (R13B060003)

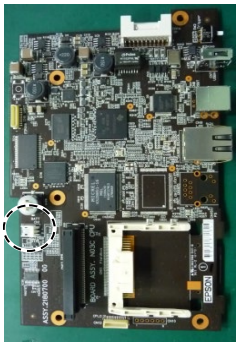
NOTE
Replace the battery within 30 minutes after turning OFF.
If more than 30 minutes pass after removing the battery, voltage of the capacitor lower and time may be reset.

Lithium Battery Removal

(1) Remove the CPU/DPB board from the base.

Reference: *18.3 Replacing CPU/DPB Board*

(2) Remove the battery from the battery connector.



Lithium Battery Installation

(1) Connect a new battery to the battery connector.

(2) Mount the CPU/DPB board to the base.

Reference: *18.3 Replacing CPU/DPB Board*

18.5 Replacing Cooling Fan

	Name	Quantity	Note
Maintenance parts	Cooling Fan	1	2191301
Tools	Cross-point screwdriver (No. 2)	1	

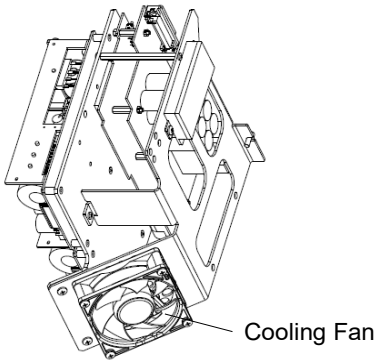
Cooling Fan Removal

(1) Remove the Controller Unit.

Reference: *18.1 Replacing Controller Unit*

(2) Remove the cooling fan.

Binding head screws: 4-M4×30



Cooling Fan Installation

(1) Mount a new cooling fan.

Binding head screws: 4-M4×30
Tightening torque: 0.45 ± 0.1N·m

(2) Mount the Controller Unit.

Reference: *18.1 Replacing Controller Unit*

18.6 Replacing SD Card

	Name	Quantity	Note
Maintenance parts	SD Card	1	2182748
Tools	Cross-point screwdriver (No. 2)	1	

NOTE

Remove the SD card after removing the fieldbus I/O module if fieldbus I/O module is inserted to the optional slot. Also, install fieldbus I/O module after installing the SD card.

For more details about fieldbus I/O module, refer to the following.

Reference: *18.7 Installing Fieldbus I/O.*

NOTE

The SD card insertion direction differs depending on the product shipment time.

18.6.1 Standard, Cleanroom Model

SD Card Removal

Standard, Cleanroom

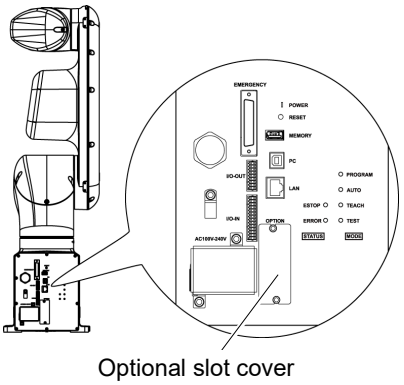
(1) Turn OFF the Manipulator.

(2) Remove the power plug.

(3) Remove the optional slot cover.

Pan head screws: 2-M3×6 Sems

(4) Push the SD card which is inserted near the optional slot to eject.



Optional slot cover

SD Card Installation

Standard, Cleanroom

(1) Push the SD card and inset to the SD card slot near the optional slot.

(2) Mount the optional slot cover.

Pan head screws: 2-M3×6 Sems
Tightening torque: 0.45 ± 0.1 N·m

18.6.2 Protection Model

SD Card Removal

Protection

(1) Turn OFF the Manipulator.

(2) Remove the power plug.

(3) Remove the connector plate.

Reference: *7.7 Connector Plate*

(4) Push the SD card which is inserted near the optional slot to eject.

SD Card Installation

Protection

(1) Push the SD card and inset to the SD card slot near the optional slot.

(2) Mount the connector plate.

Reference: *7.7 Connector Plates*

18.7 Fieldbus I/O

Fieldbus I/O of the VT series supports the following model.

DeviceNet™	CC-Link
PROFIBUS-DP	PROFINET
EtherNet/IP™	EtherCAT®
Modbus	

For details, refer to the following manuals.

Robot Controller Option Fieldbus I/O
EPSON RC+ 7.0 User's Guide 11.7 Fieldbus Slave I/O

 WARNING	■ Do not connect or disconnect the connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power plug. DO NOT connect it directly to a factory power source. ■ Be sure to perform installing procedure with turning OFF the robot system and related equipment and disconnect the power plug. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

 CAUTION	■ Check the clips of the fieldbus I/O module are securely hooked on the board when installing fieldbus I/O module. If the clips do not be hooked securely, connecter or fieldbus I/O module may get damages.

18.7.1 Standard, Cleanroom model

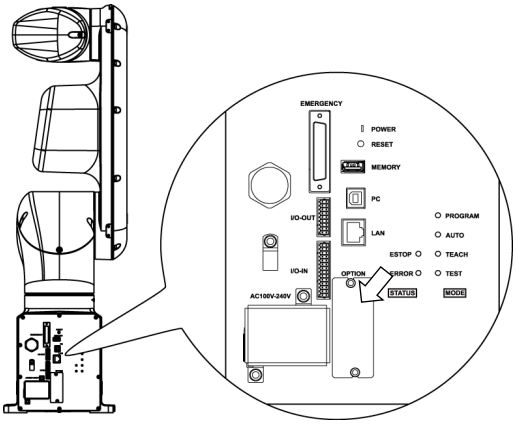
	Name	Quantity	Note
Tool	Cross-point screwdriver (No. 2) torque wrench (T8)	1 1	 Supplied with the module.

Fieldbus I/O Module Installation

Standard, Cleanroom model

(1) Turn OFF the Manipulator.

(2) Remove the optional slot cover on the back side of the Manipulator.



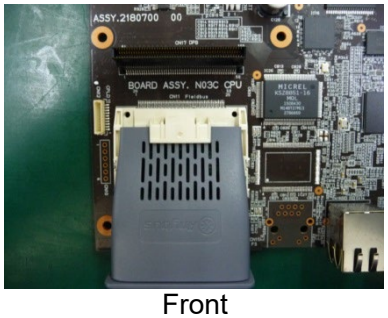
Sems bolt: 2-M3×6

(3) Inset the fieldbus I/O module to the optional slot.

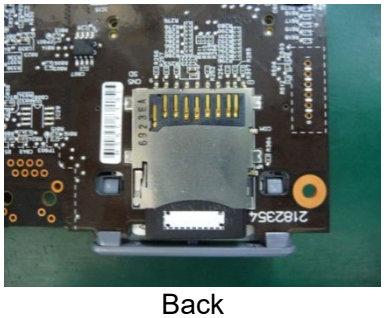
CAUTION	■ Check the tabs of the fieldbus I/O module are securely hooked on the board when installing fieldbus I/O module. If tabs do not be hooked securely, connecter or fieldbus I/O module may get damages.

(4) Tighten screws by using hex lobe wrench until fieldbus I/O module is fixed completely.

Image of installation



Front



Back

Fieldbus I/O Module Removal

Standard, Cleanroom model

(1) Unscrew the screws by using special tool until fieldbus I/O module is loosened.

(2) Remove the fieldbus I/O module.
You can remove the module by pulling loosened screws toward.

(3) Mount the optional slot cover.

18.7.2 Protection Model

EtherCAT, EtherNet IP, PROFINET

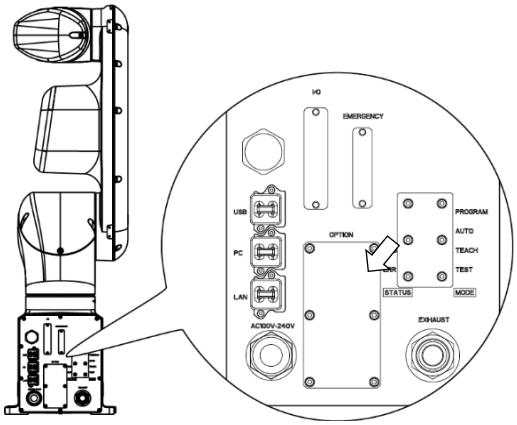
Fieldbus I/O Module Installation

Protection model EtherCAT, EtherNet IP, PROFINET

(1) Turn OFF the Manipulator.

(2) Remove the following parts on the rear side of the Manipulator.
Optional slot cover
Gaskets
Spacers

Hexagon socket head bolts
: 6-M3×8




Optional slot cover


Gasket + Spacers


Gasket, Spacers

NOTE

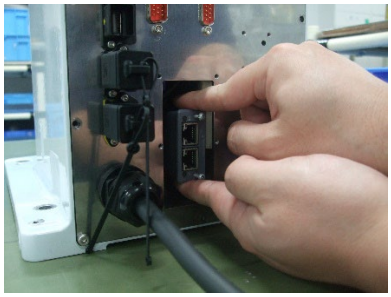
Note that the spacers may fall out when removing the gasket.

Be careful not to damage the mounting surface of the gasket. If the surface is damaged, water protection performance may not be ensured.

(3) Insert the fieldbus I/O module into the optional slot.

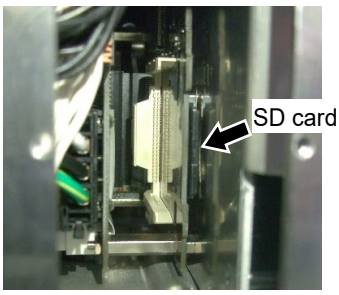
NOTE

Make sure that the fieldbus I/O module is completely inserted. Move the module up and down lightly and check whether the module is fixed in place.



NOTE

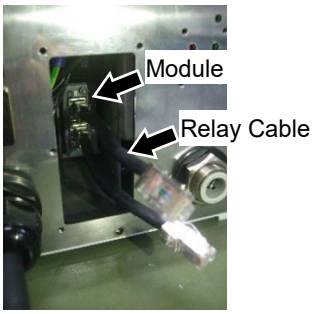
If you touch the SD card while installing the fieldbus I/O module, it may come out. Manipulator (Controller part) will not operate properly if the SD card is not inserted.



(4) Tighten the screws by using the supplied hex lobe wrench until the fieldbus module is fixed completely.

Tightening torque: 0.25 N·m

(5) Connect the relay cable to the fieldbus I/O module.
(The cable is supplied with the module.)

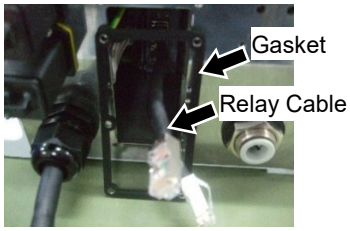


(6) Install the spacers to the gasket.
(6 spacers: the gasket is supplied with the module.)


Gasket + Spacers


Gasket, Spacers

(7) Pass the relay cable through the gasket.



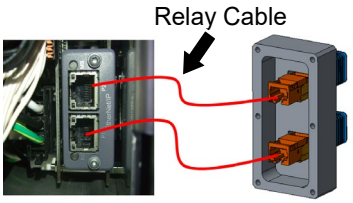
(8) Mount the optional block on the connector plate.

Hexagon socket head bolts:
6-M3×30 (with seal washer. The bolts are supplied with the module.)

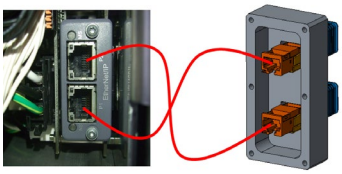
Tightening torque: 2.0 ± 0.1 N·m

Connect the relay cable as shown below. Be careful not to cross the cables.

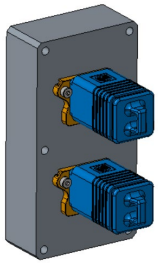
Correct



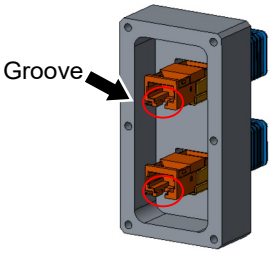
Wrong



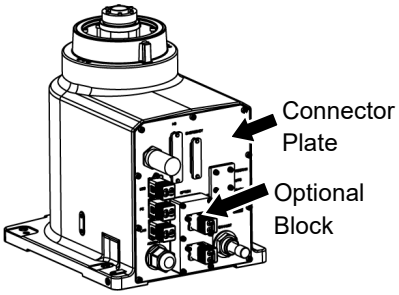
When mounting the optional block, make sure that a groove of the connector faces downward.



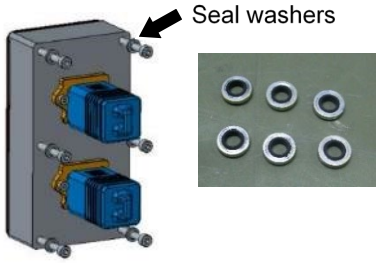
Optional Block (Outside)



Optional Block (Inside)

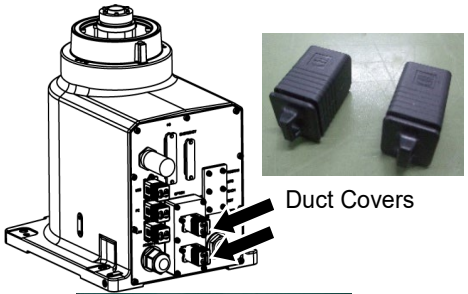


NOTE ☞ Be sure to embed the seal washers (supplied with the module) when tightening with hexagon socket head bolts. If the seal washers are not embedded, water protection performance may not be ensured.



NOTE ☞ Make sure that there is no scratches and/or dust on the gasket mounting surface. If the gasket is damaged or dusty, water protection performance may not be ensured.

NOTE ☞ Be sure to install the dust covers (supplied with the module) on the unused connectors. If the dust covers are not installed on connectors completely, water protection performance may not be ensured.



NOTE ☞ Be sure to use the dedicated cable (supplied with the module) for communication. If other cables are used, water protection performance may not be ensured.

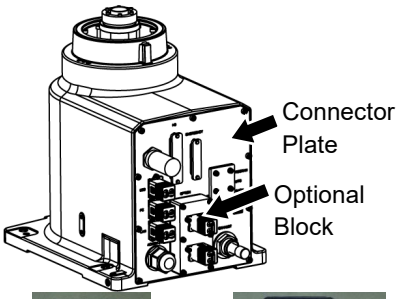
Fieldbus I/O Module Removal

Protection model
EtherCAT,
EtherNet IP,
PROFINET

(1) Turn OFF the Manipulator.

(2) Remove the bolts which secure the optional block to the connector plate.

Hexagon socket head bolts:
(supplied with the module.)
6-M3×30 (with seal washer)



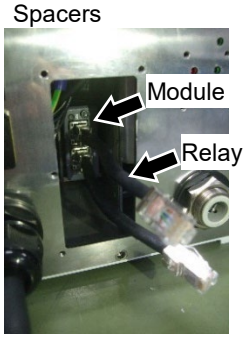
(3) Remove the two relay cables from the conector on the optional block side.

(4) Remove the gasket and spacers.

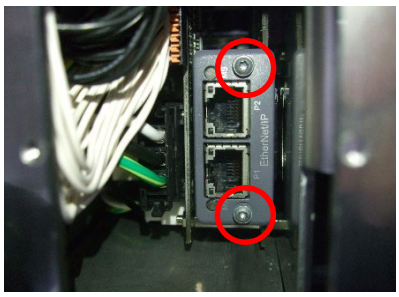

Gasket + Spacers


Gasket, Spacers

(5) Disconnect the relay cable from the fieldbus I/O module.



(6) Loosen the screws by using the supplied hex lobe wrench.



(7) Remove the fieldbus I/O module.

The module can be removed by pulling the screws forward with the screws loosened.

(8) Install the optional slot cover, gasket, and spacers.

Hexagon socket head bolts: 6-M3×8 (with seal washer.)

Tightenning torque: 2.0 ± 0.1N·m

NOTE

Be sure to embed the seal washers (supplied with the module) when tightening with hexagon socket head bolts.
If the seal washers are not embedded, water protection performance may not be ensured.
Make sure that there is no scratch and dust on the gasket mounting surface.
If the gasket is damaged or dusty, water protection performance may not be ensured.

CC-Link

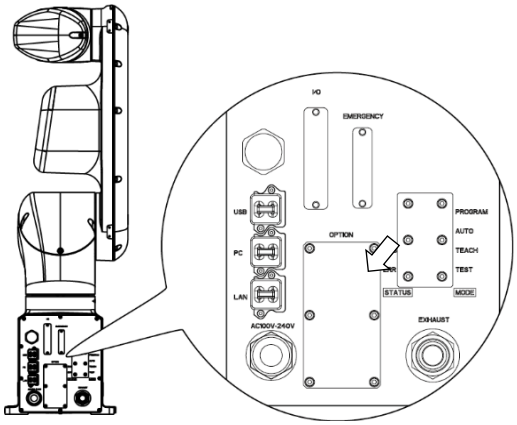
Fieldbus I/O Module Installation

Protection model
CC-Link

(1) Turn OFF the Manipulator.

(2) Remove the following parts on the rear side of the Manipulator.
Optional slot cover
Gaskets
Spacers

Hexagon socket head bolts
: 6-M3×8




Optional slot cover


Gasket + Spacers


Gasket, Spacers

NOTE

Note that the spacers may fall out when removing the gasket.

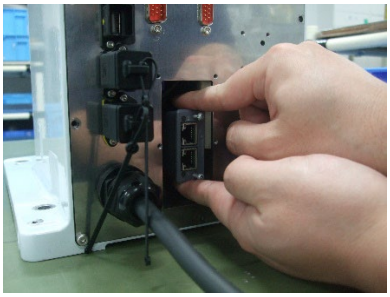
Be careful not to damage the mounting surface of the gasket. If the surface is damaged, water protection performance may not be ensured.

(3) Remove the connector which installed on the fieldbus I/O module.

(4) Insert the fieldbus I/O module into the optional slot.

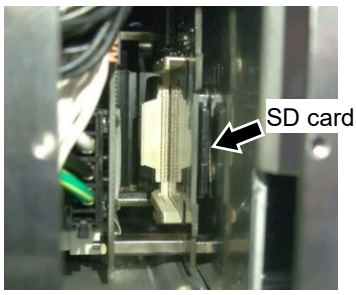
NOTE

Make sure that the fieldbus I/O module is completely inserted. Move the module up and down lightly and check whether the module is fixed in place.



NOTE

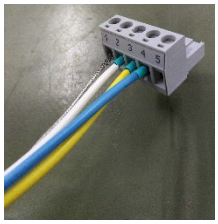
If you touch the SD card while installing the fieldbus I/O module, it may come out.
Manipulator (Controller part) will not operate properly if the SD card is not inserted.



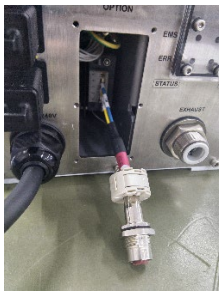
(5) Tighten the screws by using the supplied hex lobe wrench until the fieldbus module is fixed completely.

Tightening torque: 0.25 N·m

(6) Install the connector (supplied with the fieldbus I/O module) to the relay cable terminal which installed to the optional block.
1: Shield wire
2: White wire
3: Yellow wire
4: Blue wire



(7) Connect the supplied connector to the fieldbus I/O module.

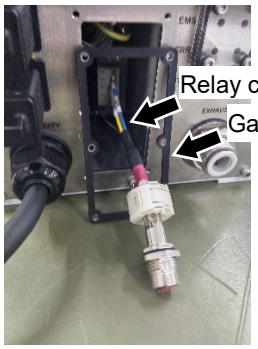


(8) Install the spacers to the gasket.
(6 spacers: the gasket is supplied with the module.)

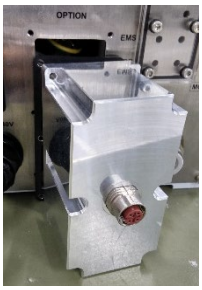

Gasket + Spacers

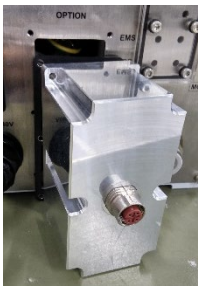

Gasket, Spacers

(9) Pass the relay cable through the gasket.



(10) Temporarily secure the relay cable connector to the optional block with a nut (M12).



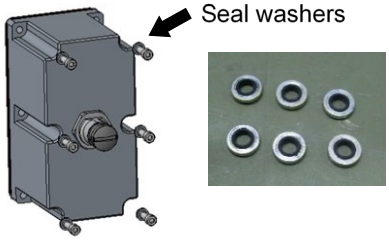


(11) Mount the optional block on the connector plate.

Hexagon socket head bolts:
6-M3×15 (with seal washer. The bolts are supplied with the module.)

Tightening torque: 2.0 ± 0.1·N·m

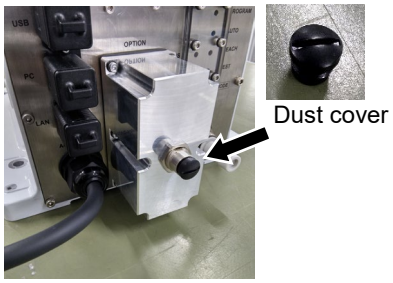
NOTE
Be sure to embed the seal washers (supplied with the module) when tightening with hexagon socket head bolts. If the seal washers are not embedded, water protection performance may not be ensured.



(12) Secure the relay cable connector to the optional block.
Secure the nut of the temporarily secured relay cable.
Nut: M12
Tightening torque: 3.0 N·m

NOTE
Make sure that there is no scratches and/or dust on the gasket mounting surface. If the gasket is damaged or dusty, water protection performance may not be ensured.

NOTE
Be sure to install the dust cover (supplied with the module) on the unused connector. If the dust cover is not installed on connector completely, water protection performance may not be ensured.

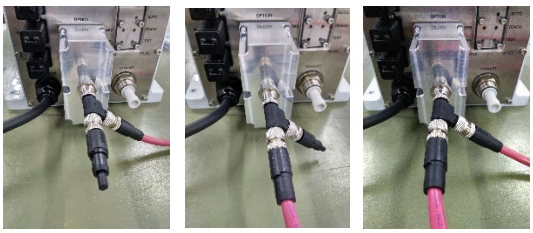


NOTE

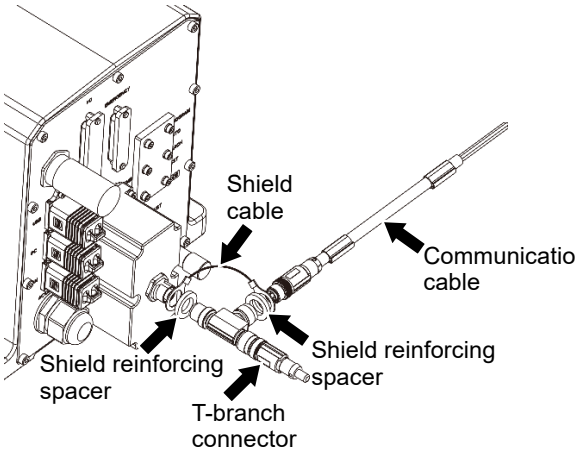
Be sure to use the dedicated cable (supplied with the module) for communication.
If other cables are used, water protection performance may not be ensured.

NOTE

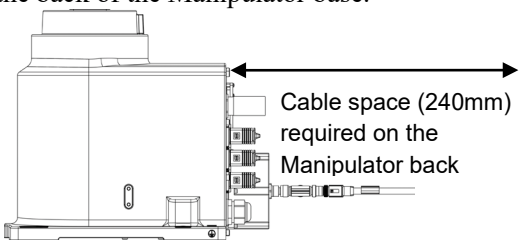
There are three methods to connect the communication cable.
Select the method according to your system.



When connecting the communication cable to the shorter port of the T-branch connector, mount the shield cable and the shield reinforcing spacer as shown in the figure.



Reserve 240mm of cable space on the back of the Manipulator base.



Fieldbus I/O Module Removal

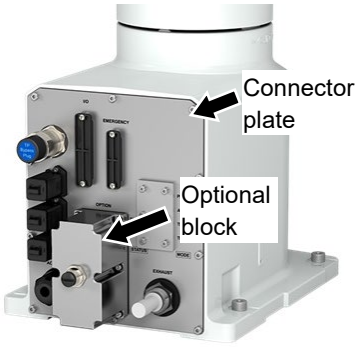
Protection model
CC-Link

(1) Turn OFF the Manipulator.

(2) Remove the bolts which secure the optional block to the connector plate.

Hexagon socket head bolts:
(supplied with the module.)
6-M3×15 (with seal washer)

If the cable is connected to the optional block, in advance, remove the cable from the optional block.



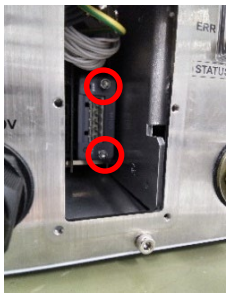
(3) Remove the supplied cable from the fieldbus I/O module.

(4) Remove the gasket and spacers.


Gasket + Spacers


Gasket, Spacers

(5) Loosen the screws by using the supplied hex lobe wrench.



(6) Remove the fieldbus I/O module.

The module can be removed by pulling the screws forward with the screws loosened.

(7) Install the optional slot cover, gasket, and spacers.

Hexagon socket head bolts: 6-M3×8 (with seal washer.)

Tightening torque: 2.0 ± 0.1N·m

Be sure to embed the seal washers (supplied with the module) when tightening with hexagon socket head bolts.
If the seal washers are not embedded, water protection performance may not be ensured.
Make sure that there is no scratch and dust on the gasket mounting surface.
If the gasket is damaged or dusty, water protection performance may not be ensured.

DeviceNet

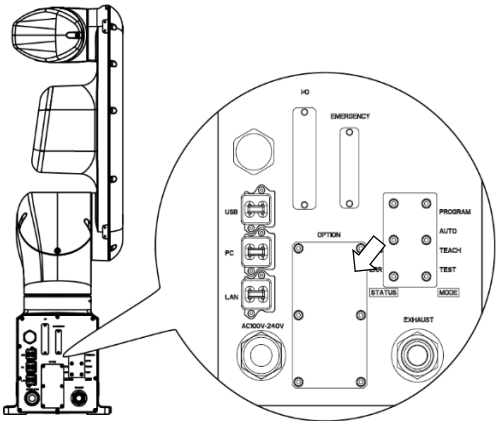
Fieldbus I/O Module Installation

Protection model DeviceNet

(1) Turn OFF the Manipulator.

(2) Remove the following parts on the rear side of the Manipulator.
Optional slot cover
Gaskets
Spacers

Hexagon socket head bolts
: 6-M3×8




Optional slot cover


Gasket + Spacers


Gasket, Spacers

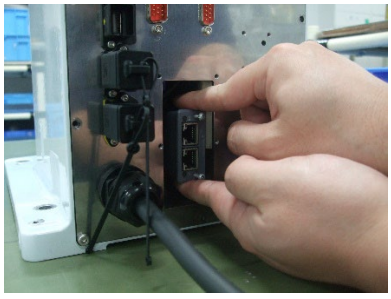
NOTE ☞ Note that the spacers may fall out when removing the gasket.

Be careful not to damage the mounting surface of the gasket. If the surface is damaged, water protection performance may not be ensured.

(3) Remove the connector which installed on the fieldbus I/O module.

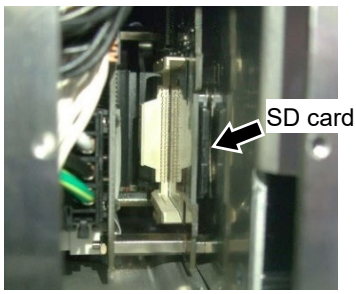
(4) Insert the fieldbus I/O module into the optional slot.

NOTE ☞ Make sure that the fieldbus I/O module is completely inserted. Move the module up and down lightly and check whether the module is fixed in place.



NOTE

If you touch the SD card while installing the fieldbus I/O module, it may come out. Manipulator (Controller part) will not operate properly if the SD card is not inserted.

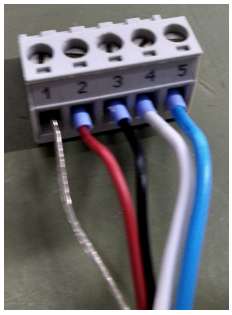


(5) Tighten the screws by using the supplied hex lobe wrench until the fieldbus module is fixed completely.

Tightening torque: 0.25 N·m

(6) Install the connector (supplied with the fieldbus I/O module) to the relay cable terminal which installed to the optional block.

1: Shield wire
2: Red wire
3: Black wire
4: White wire
5: Blue wire



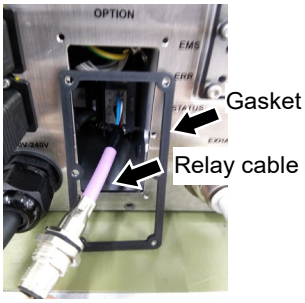
(7) Connect the supplied connector to the fieldbus I/O module.

(8) Install the spacers to the gasket.
(6 spacers: the gasket is supplied with the module.)

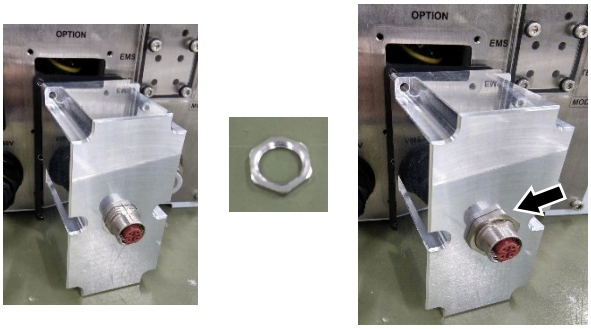
Gasket + Spacers

Gasket, Spacers

(9) Pass the relay cable through the gasket.



(10) Temporarily secure the relay cable connector to the optional block with a nut (M12).

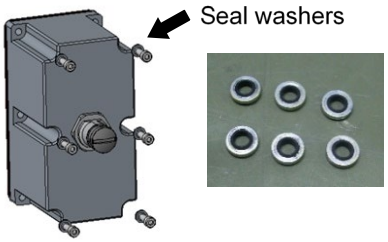


(11) Mount the optional block on the connector plate.

Hexagon socket head bolts:
6-M3×15 (with seal washer. The bolts are supplied with the module.)

Tightening torque: 2.0 ± 0.1·N·m

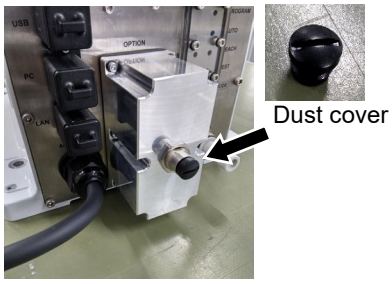
NOTE
Be sure to embed the seal washers (supplied with the module) when tightening with hexagon socket head bolts.
If the seal washers are not embedded, water protection performance may not be ensured.



(12) Secure the relay cable connector to the optional block.
Secure the nut of the temporarily secured relay cable.
Nut: M12
Tightening torque: 3.0 N·m

NOTE
Make sure that there is no scratches and/or dust on the gasket mounting surface.
If the gasket is damaged or dusty, water protection performance may not be ensured.

NOTE
Be sure to install the dust cover (supplied with the module) on the unused connector.
If the dust cover is not installed on connector completely, water protection performance may not be ensured.

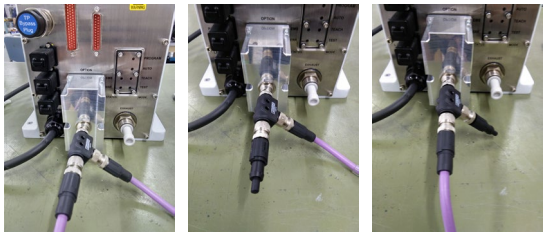


NOTE

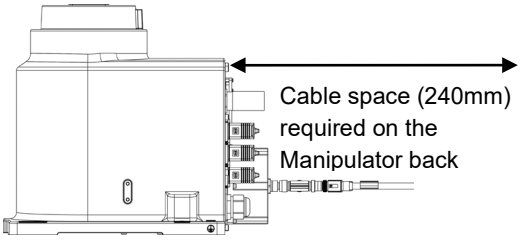
Be sure to use the dedicated cable (supplied with the module) for communication.
If other cables are used, water protection performance may not be ensured.

NOTE

There are three methods to connect the communication cable.
Select the method according to your system.



Reserve 240mm of cable space on the back of the Manipulator base.



Fieldbus I/O Module Removal

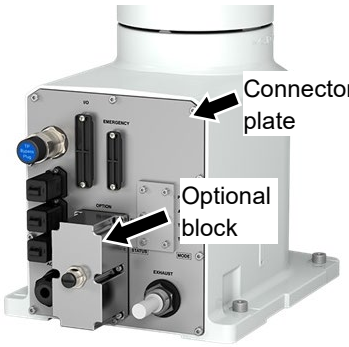
Protection model
DeviceNet

(1) Turn OFF the Manipulator.

(2) Remove the bolts which secure the optional block to the connector plate.

Hexagon socket head bolts:
(supplied with the module.)
6-M3×15 (with seal washer)

If the cable is connected to the optional block, in advance, remove the cable from the optional block.



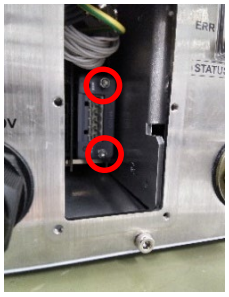
(3) Remove the supplied cable from the fieldbus I/O module.

(4) Remove the gasket and spacers.


Gasket + Spacers


Gasket, Spacers

(5) Loosen the screws by using the supplied hex lobe wrench.



(6) Remove the fieldbus I/O module.

The module can be removed by pulling the screws forward with the screws loosened.

(7) Install the optional slot cover, gasket, and spacers.

Hexagon socket head bolts: 6-M3×8 (with seal washer.)

Tightening torque: 2.0 ± 0.1N·m

Be sure to embed the seal washers (supplied with the module) when tightening with hexagon socket head bolts.
If the seal washers are not embedded, water protection performance may not be ensured.
Make sure that there is no scratch and dust on the gasket mounting surface.
If the gasket is damaged or dusty, water protection performance may not be ensured.

Profibus-DP

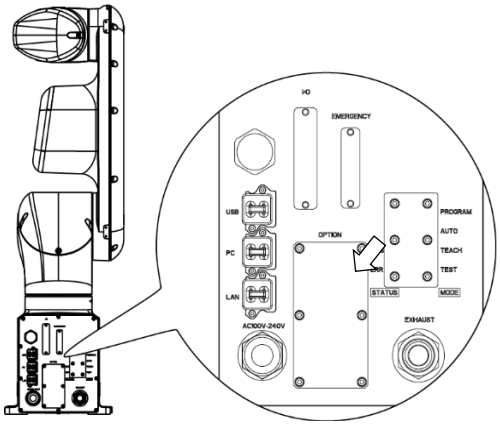
Fieldbus I/O Module Installation

Protection model Profibus-DP

(1) Turn OFF the Manipulator.

(2) Remove the following parts on the rear side of the Manipulator.
Optional slot cover
Gaskets
Spacers

Hexagon socket head bolts
: 6-M3×8




Optional slot cover

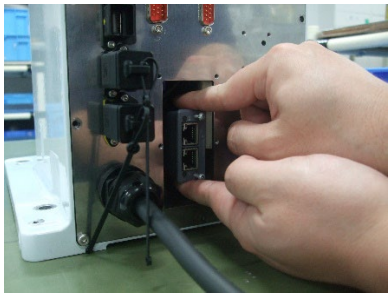

Gasket + Spacers


Gasket, Spacers

NOTE ☞ Note that the spacers may fall out when removing the gasket.

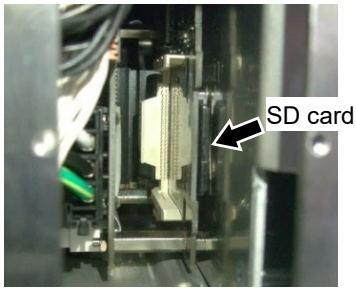
Be careful not to damage the mounting surface of the gasket. If the surface is damaged, water protection performance may not be ensured.

(3) Insert the fieldbus I/O module into the optional slot.



NOTE ☞ Make sure that the fieldbus I/O module is completely inserted. Move the module up and down lightly and check whether the module is fixed in place.

NOTE ☞ If you touch the SD card while installing the fieldbus I/O module, it may come out. Manipulator (Controller part) will not operate properly if the SD card is not inserted.



(4) Tighten the screws by using the supplied hex lobe wrench until the fieldbus module is fixed completely.

Tightening torque: 0.25 N·m

(5) Connect the D-sub connector to the fieldbus I/O module.
Tighten the two securing screws.

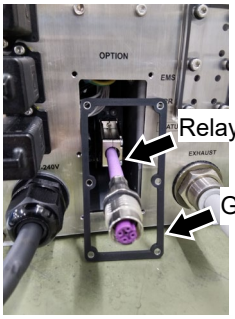
Tightening torque: 0.25 N·m

(6) Install the spacers to the gasket.
(6 spacers: the gasket is supplied with the module.)

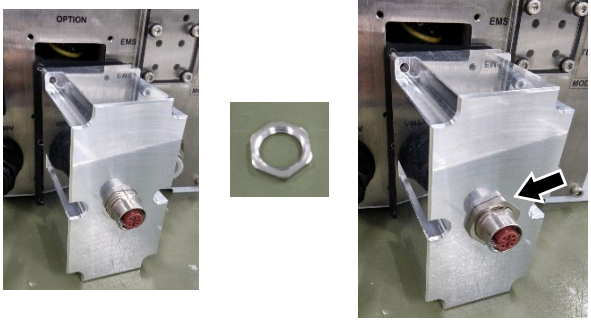

Gasket + Spacers


Gasket, Spacers

(7) Pass the relay cable through the gasket.



(8) Temporarily secure the relay cable connector to the optional block with a nut (M12).

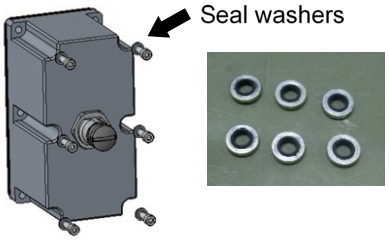


(9) Mount the optional block on the connector plate.

Hexagon socket head bolts:
6-M3×15 (with seal washer. The bolts are supplied with the module.)

Tightening torque: 2.0 ± 0.1·N·m

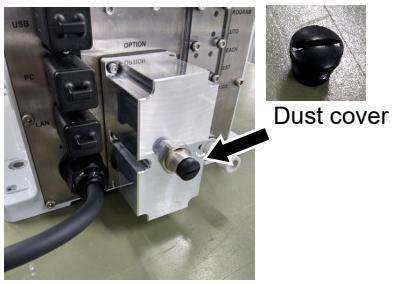
NOTE
Be sure to embed the seal washers (supplied with the module) when tightening with hexagon socket head bolts.
If the seal washers are not embedded, water protection performance may not be ensured.



(10) Secure the relay cable connector to the optional block.
Secure the nut of the temporarily secured relay cable.
Nut: M12
Tightening torque: 3.0 N·m

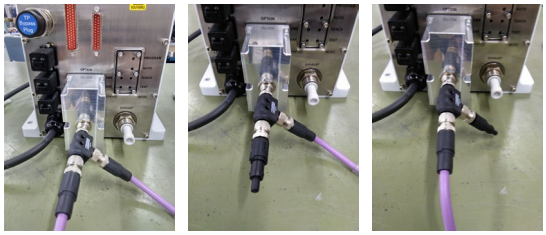
NOTE
Make sure that there is no scratches and/or dust on the gasket mounting surface.
If the gasket is damaged or dusty, water protection performance may not be ensured.

NOTE
Be sure to install the dust cover (supplied with the module) on the unused connector.
If the dust cover is not installed on connector completely, water protection performance may not be ensured.

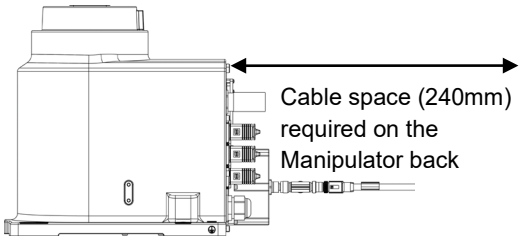


NOTE
Be sure to use the dedicated cable (supplied with the module) for communication.
If other cables are used, water protection performance may not be ensured.

NOTE
There are three methods to connect the communication cable.
Select the method according to your system.



Reserve 240mm of cable space on the back of the Manipulator base.



Fieldbus I/O Module Removal

Protection model
Profibus-DP

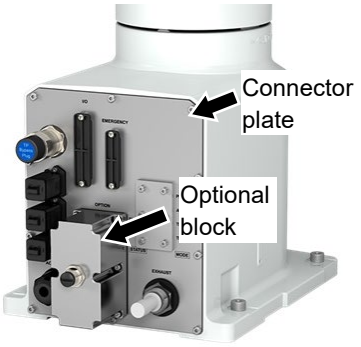
(1) Turn OFF the Manipulator.

(2) Remove the securing nut (M12) on the relay cable.

(3) Remove the bolts which secure the optional block to the connector plate.

Hexagon socket head bolts:
(supplied with the module.)
6-M3×15 (with seal washer)

If the cable is connected to the optional block, in advance, remove the cable from the optional block.



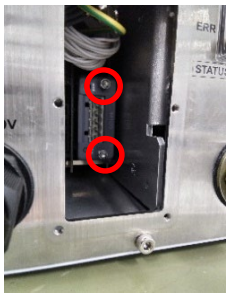
(4) Remove the gasket and spacers.


Gasket + Spacers


Gasket, Spacers

(5) Loosen and remove the two D-sub connector securing screws from the fieldbus I/O module.

(6) Loosen the screws on the fieldbus I/O module by using the supplied hex lobe wrench.



(7) Remove the fieldbus I/O module.

The module can be removed by pulling the screws forward with the screws loosened.

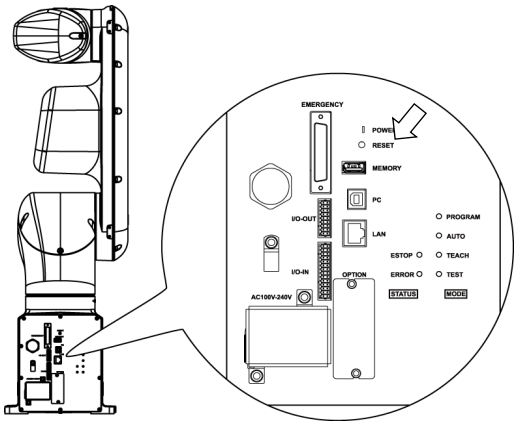
(8) Install the optional slot cover, gasket, and spacers.

Hexagon socket head bolts: 6-M3×8 (with seal washer.)

Tightening torque: 2.0 ± 0.1N·m

NOTE ☞ Be sure to embed the seal washers (supplied with the module) when tightening with hexagon socket head bolts.
If the seal washers are not embedded, water protection performance may not be ensured.
Make sure that there is no scratch and dust on the gasket mounting surface.
If the gasket is damaged or dusty, water protection performance may not be ensured.

18.8 RESET Switch



Standard, Cleanroom model

RESET switch has following function.

Manipulator reboot

Push the RESET switch for three seconds when booting the Manipulator.
Manipulator reboots.

Shape of RESET switch is difficult to push. Use a sharp edged object when pushing the RESET switch.

There is no RESET switch for Protection model.

19. Calibration

19.1 Overview

After parts have been replaced (motors, reduction gear units, timing belts, etc.), the Manipulator cannot perform positioning properly because a gap exists between the origin stored in each motor encoder and its corresponding origin stored in the Controller.
Therefore, it is necessary to match these origins after replacing the parts.
The process of aligning the two origins is called “Calibration”. Note that calibration is not the same as teaching*.

* “Teaching” means to teach the Controller coordinate points (including poses) anywhere in the operating area of the Manipulator.

 WARNING	■ To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to the *Installation and Design Precautions* in the *Safety* chapter of the *EPSON RC+ User’s Guide*. ■ Before operating the robot system, make sure that no one is inside the safeguarded area. The robot system can be operated in the mode for teaching even when someone is inside the safeguarded area. The motion of the Manipulator is always in restricted (low speeds and low power) status to secure the safety of an operator. However, operating the robot system while someone is inside the safeguarded area is extremely hazardous and may result in serious safety problems in case that the Manipulator moves unexpectedly.

In EPSON RC+, a coordinate point including the arm pose is defined as “point” and its data is called “point data”.

There are two methods to move the Manipulator during calibration.
- Releasing the electromagnetic brake and moving the arms manually.
  For details, refer to “*VT series Manual VT6L Manipulator 1.6 How to Move Arms with the Electromagnetic Brake*”.
- Moving the Manipulator using Jog & Teach.

Moving the Manipulator while releasing the electromagnetic brake involves risk as described below.
It is recommended to move the Manipulator using Jog & Teach.

CAUTION	■ Normally, release the brake of joints one by one. Take extra care if you need to release the brakes of two or more joints simultaneously. Releasing the brakes of two or more joints simultaneously may cause hands and fingers to be caught and/or equipment damage or malfunction of the Manipulator as the arms of the Manipulator may move in unexpected directions. ■ Be careful of the arm falling when releasing the brake. While the brake is being released, the Manipulator's arm falls by its own weight. The arm falling may cause hands and fingers to be caught and/or may cause equipment damage or malfunction of the Manipulator.

Also, pay attention to the following points at the encoder initialization.

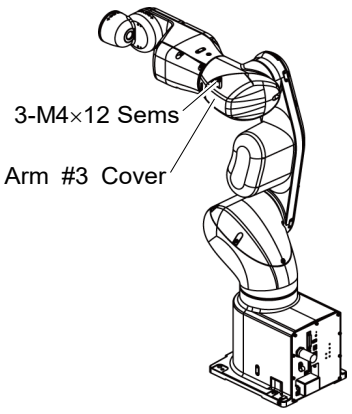
CAUTION	■ Joint #4 have no mechanical stops and they may be rotated more than 360 degrees. If the encoder initialization is performed with improper posture, the Manipulator moves outside the operation range. If the Manipulator was moved outside the operation range, the internal wiring may be damaged by being twisted or pinched and it may result in Manipulator malfunction.

When the origin position of the Joint #4 is uncertain, check torsion of the internal cables. The origin position is where the Manipulator has the internal cables not twisted at the basic orientation described in "*VT series Manual VT6L Manipulator 3.9 Checking the Basic orientation*".

NOTE

Torsion of the internal cables can be checked by removing the following cover.

Joint #4 : Arm #3 Cover



For details on Jog & Teach, refer to the following manual.

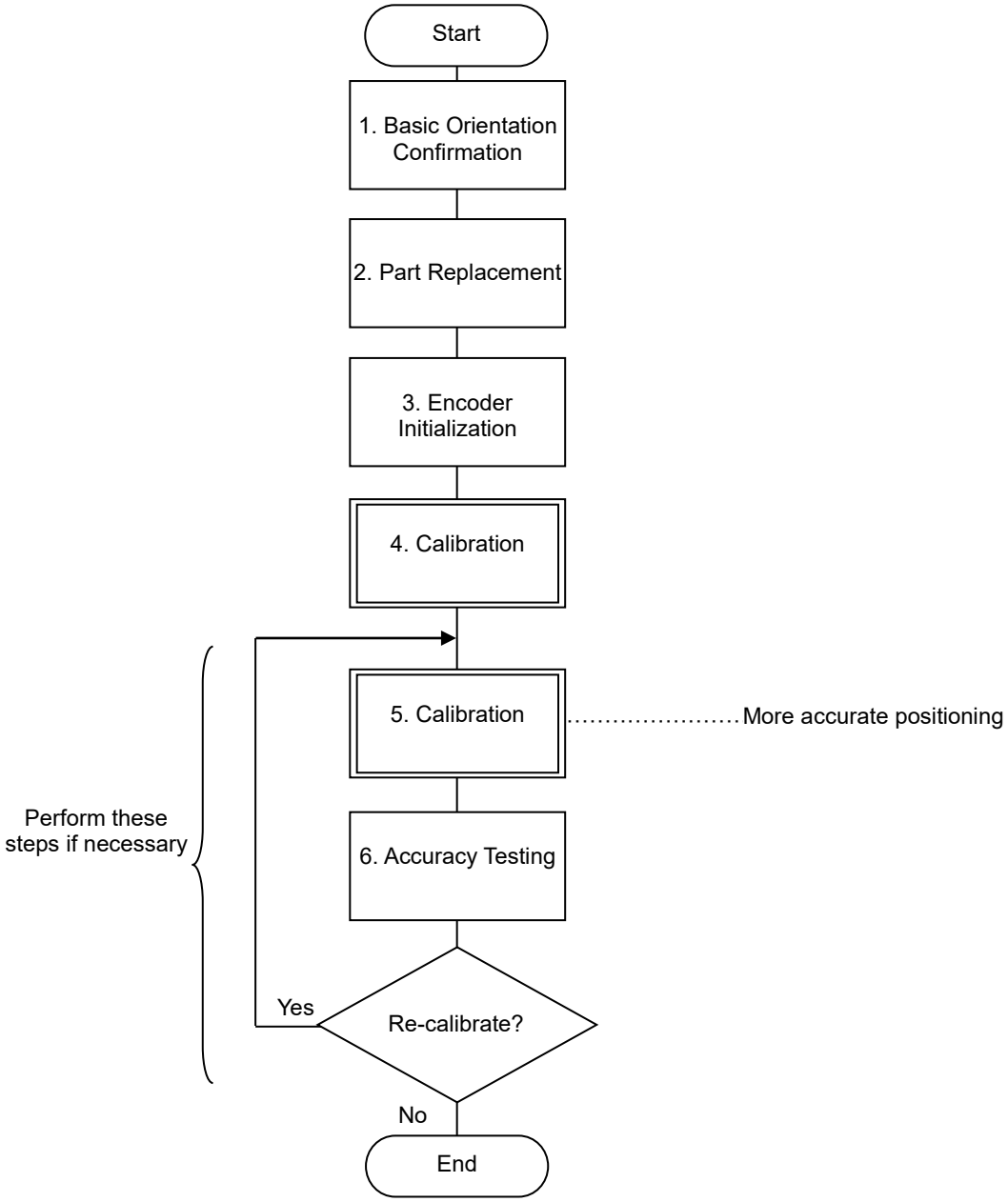
EPSON RC+ User's Guide

5.12.1 [Tools]-[Robot Manager]-[Jog and Teach] Page

NOTE

- For details about the basic orientation, refer to "*VT series Manual VT6L Manipulator 3.9 Checking the Basic orientation*".
- Calibrate one joint at a time. (Also, replace parts of one joint at a time.) If you calibrate the origins for multiple joints simultaneously, it will be more difficult to verify their origins and obtain the origin correct positions.

Calibration Flowchart



19.2 Calibration Procedures

Command Input

Command execution is required in some calibration procedures.
Select the EPSON RC+ menu-[Tools]-[Command Window].

This step is omitted in the calibration procedures.

Jog Motion

Setting of the jog motion is required in some calibration procedures.
Select EPSON RC+ menu-[Tools]-[Robot Manager] and select the [Jog & Teach] page.

The page above is indicated as [Jog & Teach] in the calibration procedures.

Follow steps 1 to 6 to calibrate the Manipulator.

1. Basic Orientation Confirmation

   Calibration is performed with the basic orientation of the Manipulator.
   For details about the basic orientation, refer to "*VT series Manual VT6L Manipulator 3.9 Checking the Basic Orientation*".

   When the Manipulator cannot have the basic orientation, define the reference orientation in advance, and record the point data. Also, put the "match marks" to indicate the orientation.

   The coordinate points including the Arm orientation are referred to as "points", and the data of the points are called "point data" in EPSON RC+.

2. Part Replacement

   Replace the parts as instructed in this manual.
   Be careful not to injure yourself or damage parts during part replacement

3. Encoder Initialization

   Follow the procedures below to initialize the encoder.

   Execute the following command in the [Command Window].

   EPSON RC+

   `>Encreset` [The joint number (1 to 6) of the encoder to be reset]

   Select EPSON RC+ menu-[Tools]-[Controller], then click <Reset Controller>.

4. Calibration

4-1 Visually move the calibrating Joint of the Manipulator to the basic orientation

EPSON RC+

Set the jog mode to “Joint” in the [Jog & Teach] panel from EPSON RC+ menu - [Tools] - [Robot Manager], and then move the Manipulator in Jog motion so that the target joint matches the basic orientation as much as possible.

When the Manipulator cannot have the basic orientation, move the Manipulator so that the “marks” depending on the predetermined reference orientation are aligned.

4-2 Initialize the Encoder

EPSON RC+

Execute the command in the [Command Window] from EPSON RC+ menu - [Tools] according to the joint to adjust as follows.

Joint #1 `>Encreset 1`
Joint #2 `>Encreset 2`
Joint #3 `>Encreset 3`
Joint #4 `>Encreset 4`
Joint #5 `>Encreset 5, 6`
Joint #6 `>Encreset 6`

4-3 Reboot the Controller

EPSON RC+

Click EPSON RC+ menu-[Tool]-[Controller]-<Reset Controller>.

4-4 Specify a pulse value set as an origin point

EPSON RC+

Execute the command in the [Command Window] from EPSON RC+ menu - [Tools] according to the joint to adjust as follows.

```
>calpls J1 pulse, J2 pulse, J3 pulse, J4 pulse, J5 pulse, J6 pulse
```

* Manipulator will not move.

Specify the pulse values “0” when the Manipulator is aligned to the basic orientation, or the values recorded at the predetermined reference orientation (where the match marks are aligned) to the command parameters (pulse values).

If the point data for the reference orientation is “P1”, the command parameters can be specified as follows

```
>calpls ppls(P1,1), ppls(P1,2), ppls(P1,3),
  ppls(P1,4), ppls(P1,5), ppls(P1,6)
```

4-5 Set the specified pulse value to the encoder

EPSON RC+

Execute the command in the [Command Window] from EPSON RC+ menu - [Tools] according to the joint to adjust as follows.

Joint #1 `>calib 1`
Joint #2 `>calib 2`
Joint #3 `>calib 3`
Joint #4 `>calib 4`
Joint #5 `>calib 5,6`
Joint #6 `>calib 6`

NOTE

When the origin of the Joint #5 is calibrated, the Joint #6 will be out of position. (Due to the structure of the Manipulator, any offset in the position of the Joint #5 affects the Joint #6.) Calibrate the origin of the Joint #6 together when calibrating the Joint #5.

Move the arm to several points to check if the arm moves to the original positions properly.
Teach points if fine adjustment is necessary.

5. Calibration (More accurate positioning)

EPSON RC+

Move the Manipulator to the selected point data by jogging in [Jog & Teach].

Move the joint* which is not calibrated to the specified point by motion command.

*When the Joint #5 is calibrated, adjust the Joints #1 - #4.

For example, when the selected point data is “P1”, execute “Motor On” in [Control Panel] and execute “Go P1” in [Jog & Teach].

Adjust the calibrated joints accurately by jog command so that the end effector is aligned to the selected point data position.

*When the Joint #5 is calibrated, adjust the Joint #5 and #6.

Select the “Joint” jog mode from [Jog & Teach] to change and adjust the angle of the calibrated joint.

Set the pulse values again at the adjusted point.

Execute the following command in the [Command Window] from EPSON RC+ menu - [Tools] to specify the pulse values to set.

```
>calpls J1 pulse, J2 pulse, J3 pulse, J4 pulse, J5 pulse, J6 pulse
```

* Manipulator will not move.

Specify the pulse values of the selected point data to the command parameters.
If the point data for the reference orientation is “P1”, the command parameters can be specified as follows

```
>calpls ppls(P1,1), ppls(P1,2), ppls(P1,3), ppls(P1,4),
ppls(P1,5), ppls(P1,6)
```

* Manipulator will not move.

Then, execute the following command in the [Command Window] to set the specified pulse values to the encoder according to the joint to set the origin point.

Joint #1 : `>Calib 1`
Joint #2 : `>Calib 2`
Joint #3 : `>Calib 3`
Joint #4 : `>Calib 4`
Joint #5 : `>Calib 5,6`
Joint #6 : `>Calib 6`

6. Accuracy Testing

Move the Manipulator to a different pose (point) to verify whether it moves back to the original position. If accuracy is inadequate, it is necessary to re-calibrate the origin using a different pose (point). You must set the pose (point) again if the Manipulator does not move back to the original position after re-calibration.

19.3 Calibration Procedures Using Mechanical Stoppers

	Name	Quantity	Note
Maintenance part	Calibration kit	1	1829118 Jig for calibration of Joint #4 and #6
Tools	Level	1	For calibration of Joint #4 and #6

The VT series uses the mechanical stoppers as the point of reference for calibration of the manipulator.
Joint #4 and #6 have no mechanical stoppers, so the calibration procedure differs.

Calibration J1, J2, J3 and J5

1. Release the brakes for each joint to be moved.

   EPSON RC+

   Execute the following command in the [Command Window].
   `>brake off,` [The joint (1 to 6) to release the brake]

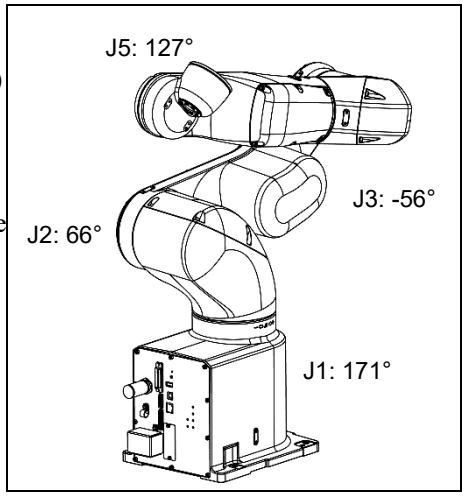
2. Move each joint manually to the mechanical stopper.

3. Brake on to each joint.

   EPSON RC+

   Execute the following command in the [Command Window].
   `>brake on,` [The joint (1 to 6) to apply the brake]

4. Check that each joint is in the mechanical stopper position. (See the image on the right)
   Reset the encoder.

   EPSON RC+

   Execute the following command in the [Command Window].
   `>Encreset` [The joint number (1 to 6) of the encoder to be reset]

5. Reboot the Controller

6. Specify the calibration position of each joint.

   EPSON RC+

   Execute the following command in the [Command Window].
   `>calpls 8538405, 4119406, -2598624, 0, 4672602, 0`

NOTE All models will use the following Mechanical Stopper positions.
The Wall Mounting manipulator has a software limited pulse range on J1. However the calibration position is the same.

	J1	J2	J3	J4	J5	J6
Mechanical Stopper Position [deg]	171	66	-56	-	127	-
Calibration Pulse Value	8538405	4119406	-2598624	-	4672602	-

7. Check that the motor is off, then calibrate each joint.

EPSON RC+

Execute the following command in the [Command Window].

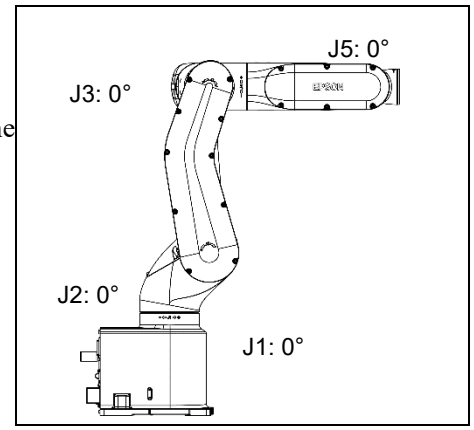
```
>calib 1,2,3,4,5,6
```

8. Move the manipulator to 0 Pulse position and calibrate Joint #4 and #J6.

EPSON RC+

Execute the following command in the [Command Window].

```
>pulse 0,0,0,0,0,0
```



Calibration (J4)

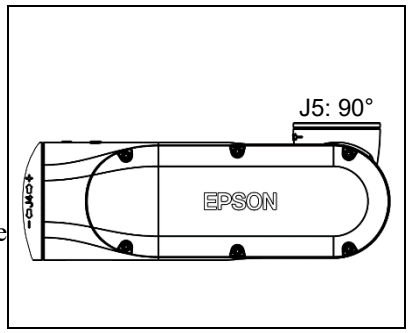
1. Turn the motor on.

   In one of the following ways, move the Joint #5 to 90° position.

   EPSON RC+

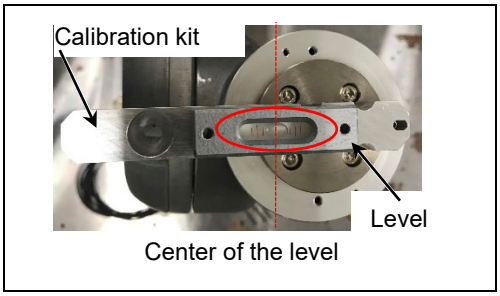
   - Use EPSON RC+ 7.0 [Tools]-[Robot Manager]-[Jog and Teach] Page.
   - Execute the following command in the [Command Window].

     ```
     >Go AglToPls (0,0,0,0,90,0)
     ```

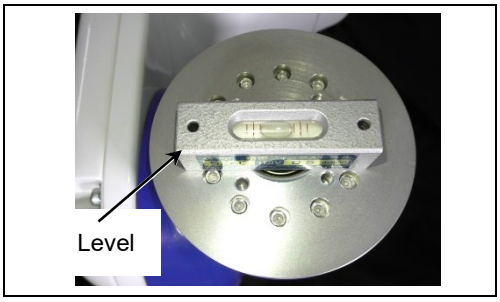


2. Turn the motor off.

3. Attach the calibration kit to the tool flange and place a level on the calibration kit.



NOTE In case of no calibration kit place the level on the Joint #5 flange.



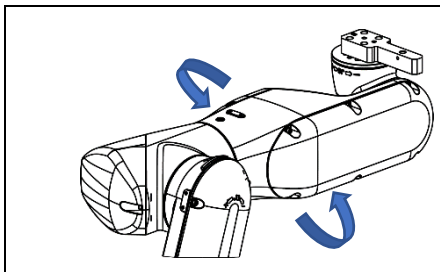
4. Release the Joint #4 brake.

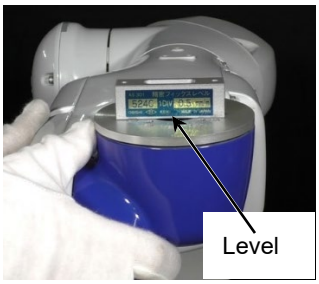
   EPSON RC+

   Execute the following command in the [Command Window].

   ```
   >brake off, 4
   ```

5. Manually adjust the Joint #4 angle until the level is centered.


Flange and calibration kit (J4)



6. Apply the brake to the Joint #4.

   EPSON RC+

   Execute the following command in the [Command Window].

   ```
   >brake on, 4
   ```

7. Reset the encoder.

   EPSON RC+

   Execute the following command in the [Command Window].

   ```
   >Encreset 4
   ```

8. Reboot the Controller.

9. Specify the calibration position of Joint #4.

EPSON RC+

Execute the following command in the [Command Window].

```
>calpls 8538405, 4119406, -2598624, 0, 4672602, 0
```

NOTE

After “Calibration J1, J2, J3 and J5 – Step 6”, Calpls of Joint #4 should be still 0.

10. Calibrate Joint #4.

EPSON RC+

Execute the following command in the [Command Window].

```
>calib 4
```

11. Move the Manipulator to 0 Pulse position and check the result.

EPSON RC+

Execute the following command in the [Command Window].

```
>Motor On
>Pulse 0,0,0,0,0,0
```

NOTE

For details about calibration, refer to “19.2 Calibration Procedures”.

Calibration (J4)

1. Turn the motor on.
   Move the manipulator to 0 pulse position.

EPSON RC+

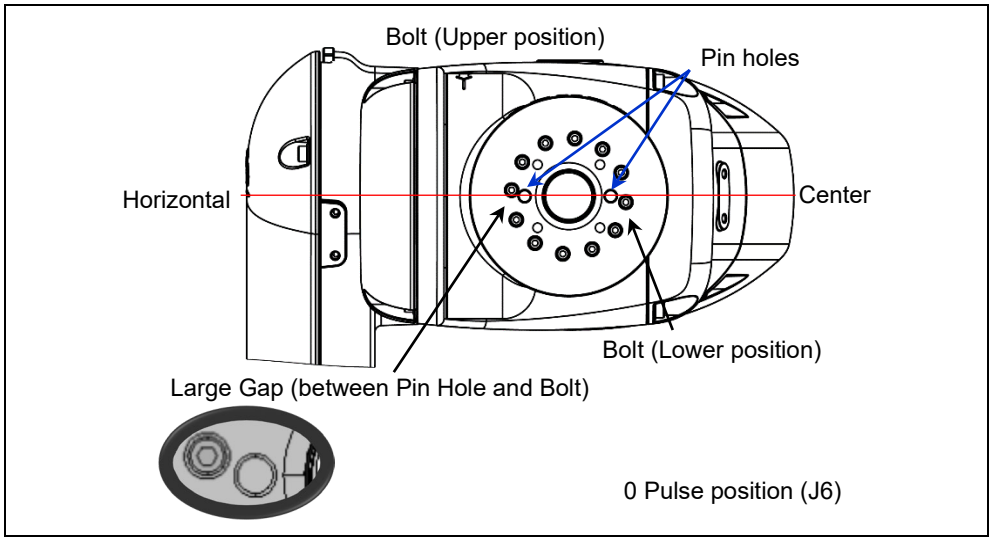
Execute the following command in the [Command Window].

```
> Go AglToPls (0,0,0,0,0,0)
```

2. Attach the calibration kit to the tool flange and place a level on the calibration kit.

NOTE

In case of no calibration kit use the Pin Holes as guide for horizontal positioning.

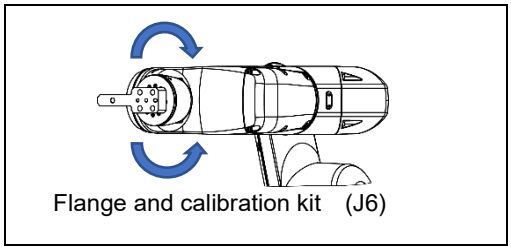


EPSON RC+

3. Release the Joint #6 brake.
   Execute the following command in the [Command Window].

```
>brake off, 6
```

4. Manually adjust the Joint #6 angle until the level is centered.



EPSON RC+

5. Apply the brake to the Joint #6.
   Execute the following command in the [Command Window].

```
>brake on, 6
```

6. Reset the encoder.

EPSON RC+

Execute the following command in the [Command Window].

```
>encreset 6
```

7. Reboot the Controller.

8. Specify the calibration position of Joint #6.

EPSON RC+

Execute the following command in the [Command Window].

```
>calpls 8538405, 4119406, -2598624, 0, 4672602, 0
```

NOTE

After “Calibration J1, J2, J3 and J5 – Step 6”, Calpls of Joint #6 should be still 0.

9. Calibrate Joint #6.

EPSON RC+

Execute the following command in the [Command Window].

```
>calib 6
```

10. Move the Manipulator to 0 Pulse position and check the result.

Execute the following command in the [Command Window].

EPSON RC+

```
>Motor On
>Pulse 0,0,0,0,0,0,0
```

NOTE

For details about calibration, refer to “19.2 Calibration Procedures”.

20. Error Code Table

For error code, refer to the following manual.

Status Code / Error Code List

21. Maintenance Parts List

Part Name			Code	Note		Reference	Overhaul *1
Cover	Arm #1		1774549			7.1	
	Arm #2		1774548			7.2	
	Arm #3		1774547			7.3	
	Arm #4	1	1774546			7.4	
		2	1774550			7.5	
Cable unit			2191349			8.1, 8.2	
AC servo motor	Joint #1		2194596	300 W unit		9.1	✓
	Joint #2		2194597			10.1	✓
	Joint #3		2194598	200 W unit		11.1	✓
	Joint #4		2194599	100W unit		12.1	✓
	Joint #5		2194600			13.1	✓
	Joint #6		2194601			14.1	✓
Timing belt	Joint #1		1751536	Width 9 mm	255mm	9.1, 9.3	✓
	Joint #2		1753920		501mm	10.1, 10.3	✓
	Joint #3		1751537		480 mm	11.1, 11.3	✓
	Joint #4		1751538	Width 6 mm	210 mm	12.1, 12.3	✓
	Joint #5, #6		1762243		495 mm	13.1, 13.3 14.1, 14.3	✓
Thermal conductive sheet			1755573	For motor		9.1, 10.1, 11.1	
AMP board			2189027	For motor		15.1, 15.2, 15.3	
LED plate			1749496	Arm #2		16	
Felt sheet	Joint #1		1840429	Arm #1		17.1	
	Joint #2		1755083	Arm #2		17.2	
	Joint #3		1755084			17.3	
Controller Unit	Standard Cleanroom		2194603	CPU board, DPB board, Cooling fan unit		18.1	
	Protection		2208039				
Controller Unit	AC specification		2194603	Standard Cleanroom	CPU board, DPB board, Cooling fan unit	18.1	
			2208039	Protection			
	DC specification		2207771	S/N: VT65T02*** only			
			2216965	All DC specification model			
Power board	AC specification		2188638			18.2	
	DC specification		2207410	S/N: VT65T02*** only			
			2216953	All DC specification model			
CPU/DPB board	AC specification		2193553	With: battery Without: SD, Heat release sheet		18.3	
	DC specification		2207409				

Part Name			Code	Note	Reference	Overhaul *1
Lithium battery			2113554	(Code 2: R13B060003)	18.4	
Cooling fan			2191301		18.5	
SD card			2182748		18.6	
TP Plug			2171258	Standard Cleanroom	- -	
			2205248	Protection	-	
Gasket	Base	Rear gasket	1804004 1825359	Protection model		
		Subplate gasket	1822684			
		LED gasket	1804010			
	Arm #1	Cover gasket	1804011 1825378			
	Arm #2	Cover gasket	1804013			
		LED gasket	1804014			
	Arm #3	Cover gasket	1804016			
	Arm #4	Cover gasket (Left)	1804018			
		Cover gasket (Right)	1804019			
Seal washer		M3	1803975			
		M4	1665882			
		M22	1666016			
Calibration kit			1829118		19.3	

Part Name			Code	Note	Reference
Grease *2	SK-1A	Joint #1, #2, #3, #4	-	For purchasing grease, and adhesive, please the supplier of your region	9.2, 10.2, 11.2, 12.2
	SK-2	Joint #5, #6, Bevel gear	-		13.2, 14.2
	GPL-224	Cable	-		8.1, 8.2
Adhesive *2	LOCTITE641		-		9.2, 10.2, 11.2, 12.2, 13.2 14.2
Wire tie	AB100		1675753	1 bag (100 pcs: white)	8.1, 8.2
	AB150		1675754	1 bag (100 pcs: white)	

*1 Overhaul:
As a rough indication, perform the overhaul (parts replacement) before reaching 20,000 operation hours of the Manipulator. The operation hours can be checked in [Controller Status Viewer] dialog box - [Motor On Hours]. For details, refer to *Maintenance 2.2 Overhaul*.

*2 Regarding purchase of grease and adhesive:
Due to the chemicals regulations of individual countries (the UN GHS), we are requesting our customers to purchase grease and other materials required for maintenance from the manufacturers listed in the table below as of April 2015.

Regarding purchase of grease and other materials, please contact the following manufacturers. If there is anything unclear, please contact the suppliers of your region.

Product name	Manufacturer	URL
Harmonic Grease SK-1A Harmonic Grease SK-2	Harmonic Drive Systems Inc.	https://www.harmonicdrive.net/
Krytox®GPL-224	Chemours	https://www.chemours.com/en/brands-and-products
LOCTITE641 LOCTITE243	LOCTITE	http://loctite.com/

22. Option Parts List

Part Name		Code	Note	Reference*
Camera plate unit		R12NZ900ZZ		11.1
Tool Adapter (ISO flange)		R12NZ900ZX		11.2
Adjustable Mechanical Stops	J1	R12NZ90101		11.3
	J2	R12NZ90102		
	J3	R12NZ90103		
External Wiring Kit		R12NZ900ZW		11.4

* Refer to *VT series Manual VT6L Manipulator*