EPSON



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Revision History

If, even after the establishment and issue of the first edition of this manual, changes are made in the mechanism or parts of the product with the purpose of improving the performance and reliability, revised editions shall be issued as necessary. Always use this manual after ensuring that it is the latest version.

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Maintenance Information

1.1 Safety Maintenance

Maintenance of robot system shall always be performed by personnel who has taken safety training.

Personnel who has taken safety training refers to a person who has taken safety training for workers engaged in activities related to industrial robots as stipulated by the laws and regulations of each country (such as the knowledge on industrial robots, knowledge on operations and teaching, knowledge on activities concerning inspection, etc., and training on related laws). Personnel who has taken training held by the manufacturer refers to a person who has completed the introduction training and maintenance training.

 Do not remove any parts that are not covered in this manual. Follow the maintenance procedure strictly as described in this manual. Do not proceed using any methods other than described in this manual when you do replace a part or maintain the equipment. 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 when 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.
• To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. 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.
• When maintaining the manipulator, wear at least the following protective gear. Working without protective gear may cause serious safety problems.
Work clothes suitable for work
· Helmet
Safety shoes



 Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects cables. Do not bend or pull the cables forcibly.) The unnecessary strain on the cables may result in damage to the disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardo may result in electric shock and/or improper function of the robot system. 				
 When operating maintenance of Manipulator, secure about 500 mm of empty space around the Manipulator. 				
• Carefully use alcohol, liquid gasket, and adhesive following respective instructions and instructions below. Careless use of alcohol, liquid gasket, or adhesive may cause a fire and/or safety problem.				
 Never put alcohol, liquid gasket, or adhesive close to fire. 				
 Use alcohol, liquid gasket, or adhesive while ventilating the room. 				
 Wear protective gear including a mask, protective goggles, and oil-resistant gloves. 				
 If alcohol, liquid gasket, or adhesive gets on your skin, wash the area thoroughly with soap and water. 				
 If alcohol, liquid gasket, or adhesive gets into your eyes or mouth, flush your eyes or wash out your mouth with clean water thoroughly, and then see a doctor immediately. 				
• 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. 				

1.2 General Maintenance

Performing maintenance inspections properly is essential for preventing trouble and maintaining safety. This chapter describes the schedules for maintenance inspection and procedures.

Be sure to perform the maintenance inspections in accordance with the schedule.

1.2.1 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, 1,500 hours, and 3,000 hours operation.

	Inspection Point					
	Daily inspection	Monthly inspection	Quarterly inspection	Biannual inspection	Annual inspection	Overhaul (replacement)
1 month (250 h)		\checkmark	-	-	-	-
2 months (500 h)			-	-	-	-
3 months (750 h)			\checkmark	-	-	-
4 months (1,000 h)	1		-	-	-	-
5 months (1,250 h)	Ins		-	-	-	-
6 months (1,500 h)	pec		\checkmark		-	-
7 months (1,750 h)	t ev		-	-	-	-
8 months (2,000 h)	ery		-	-	-	-
9 months (2,250 h)	day		\checkmark	-	-	-
10 months (2,500 h)			-	-	-	-
11 months (2,750 h)			-	-	-	-
12 months (3,000 h)		\checkmark	\checkmark	\checkmark	\checkmark	-
13 months (3,250 h)			-	-	-	-
:	:	:	:	:	:	:
20,000 h	-	-	-	-	-	

1.2.2 Inspection Point

Inspection Item

Inspection Point	Inspection Place	Daily	Monthly	Quarterly	Biannual	Annual
Check looseness or backlash of	End effector mounting bolts	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark
bolts/screws.	Manipulator mounting bolts	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark
Check looseness of connectors.	External connectors on Manipulator (on the Connector Plates etc.)	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark
Visually check for external defects.	External appearance of Manipulator	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark
Clean up if necessary.	External cables	-		\checkmark	\checkmark	\checkmark
Check for bends or improper location. Repair or place it properly if necessary.	Safeguard, etc.	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark
Check either the external short connector or the brake release unit connector is connected.	The external short connector on the back side of the Manipulator, or the brake release unit connector.	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark
Check the Brake operation	Joint #1 to 6 break	\checkmark		\checkmark	\checkmark	\checkmark
Check whether unusual sound or vibration occurs.	Whole		\checkmark			
Check if the fan is running (C8XL/C12XL only)	Fan	\checkmark		\checkmark	\checkmark	\checkmark

Inspection Method

Inspection Point	Inspection Method
Check looseness or	Use a hexagonal wrench to check that the end effector mounting bolts and the Manipulator mounting bolts are not loose.
Dacklash of Dolls/Screws.	When the bolts are loose, refer to 1.2.6 Tightening Bolts/Screws and tighten them to the proper torque.
Check looseness of	Check that connectors are not loose.
connectors.	When the connectors are loose, reattach it not to come off. Check that connectors are not loose.
Visually check for external	Check the appearance of the Manipulator and clean up if necessary.
defects.	Check the appearance of the cable, and if it is scratched, check that there is no visible internal cable.
Clean up if necessary.	

Inspection Point	Inspection Method
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 whether external short connector or break release connector is connected. When neither is connected, connect either one.
Check either the external short connector or the brake release unit connector is connected.	M/C Cable backward M/C Cable downward
Check the Brake	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 that there is no unusual sound or vibration during operation, no stiffness or looseness in the sliding
sound or vibration occurs.	parts or moving parts, and that the operation is performed smoothly. If an abnormality is suspected, replace the part in which the abnormality has occurred.
Check if the fan is running (C8XL/C12XL only)	Check that the fan is running when in MOTOR ON. If the fan is not running when in MOTOR ON, contact the supplier.

1.2.3 Overhaul (Parts Replacement)



• 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 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 the EPSON RC+ 7.0 Ver. 7.2.x or later (firmware Ver.7.2.x.x or later), the recommended replacement time for the parts subject to maintenance (Motors, Reduction Gears, and Timing Belts) can be checked in the [Maintenance] dialog box of the EPSON RC+ 7.0.

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%.

For the parts subject to overhaul, refer to Chapter 5 Exploded View/Maintenance Parts List.

For details of replacement of each part, refer to Chapter 2 Maintenance.

Please contact the supplier of your region for further information.

How to View the Maintenance Information

The configured maintenance information can be checked in the EPSON RC+ 7.0 Ver.7.2.x or later.

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

🛠 Controller Tools	? 🗙
Backup Controller	Save all controller data and status to a PC folder.
<u>R</u> estore Controller	Restore all controller data from a previous backup.
View Controller Status	View controller status from a previous backup.
Maintenance	View maintenance data and configure alarms.
Re <u>s</u> et Controller	Reset controller to startup state
	Nose

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

Maintenance					? 🛛
Summary ⊕ Controller ⊕ Robots	-Maintenance Summa Double-click on a	ry an item below for more	details, or select an item	from the tree on the lef	Close
		Component	Status		
		Controller	ок		
		Robot 1	WARNING		

3. Select "General" or specify the axis from the tree to display information of the target parts.

laintenance				? 🛛
Summary Controller	Controller Maintenance			Close
⊡-General ⊡-Robots	Note: If Consumption is 10	0% or more, the pa	rt should be replaced.	Change
	Part Instal Da	ation Months Remaining	Consumption 0 - 100%	Clear
	Battery 2016-	02-19 9999.0	0%	
	Damaini			h a a a d a a
NOTE	Remain	ng mor	iths is calculated	based of

How to Edit the Maintenance Information

The configured maintenance information can be edited in the EPSON RC+ 7.0 Ver.7.2.x or later.

When replaced the parts subject to maintenance (Motors, Reduction Gears, and Timing Belts), please edit the Maintenance Information.

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

🛠 Controller Tools	? 🗙
Backup Controller	Save all controller data and status to a PC folder.
<u>R</u> estore Controller	Restore all controller data from a previous backup.
View Controller Status	View controller status from a previous backup.
Maintenance	View maintenance data and configure alarms.
Reset Controller	Reset controller to startup state
	Close

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 followings.



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

How to check the Manipulator operation hours

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

- 1. Select EPSON RC+ menu- [Tools] [Controller] to open the [Controller Tools] dialog.
- 2. Click the <View Controller Status> button to open the [Browse For Folder] dialog.
- 3. Select the folder where the information is stored.
- 4. Click <OK> to view the [Controller Status Viewer] dialog.
- 5. Select [Robots] from the tree menu on the left side (Dialog image: EPSON RC+ 7.0)

Controller Status Viewer				
Status <u>F</u> older: _RC700_02142	7_2014-09-30_145019 Status Date Robot	/ Time: 2014-09-30 14:50:19		
Tasks	Item	Value	1	
Robots	Model	C4-A601S		
System History	Name	mnp01		
include Files	Serial #	C40E001427		
- Constant.inc	Motor On Hours	128.6		
VISION.inc	Motor On Count	67		
. Robot Points	Hofs Date	2014/04/24 17:18:40:413		
	Hofs	112251, 28625, 91741, 30416, -4793, -128541, 0, 0,		
	Motors	Off		
	Power	Low		
	Arm	0		
	Tool	0		
	World Position	-25.036, 487.275, 579.295, 89.980, 0.298, 89.967, 0		
	Joint Position	10.468, -37.820, 52.126, 92.652, -100.151, 14.842, 0		
	Pulse Position	304909, -1101601, 1328495, 2188120, -2365212, 2		
	Weight	1.000		
	Weight Length	0.000		
	Inertia	0.005		
			J.	

1.2.4 Greasing

The reduction gear units and the bevel gear need greasing regularly. Only use the grease specified in the following table.



• Before greasing, 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.

• Keep enough grease in the Manipulator. Operating the Manipulator with insufficient grease will damage sliding parts and/or result in insufficient function of the Manipulator. Once the parts are damaged, a lot of time and money will be required for the repairs.
 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.

	Greasing part	Greasing Interval	Grease
Joints #1, 2, 3, 4, 5	Reduction gear units	Overhaul timing	SK-1A
Joint # 6	Reduction gear units	Overnaul uming	SK-2
Joint # 6	Bevel gear	Overhaul timing	SK-2

Joint #1, 2, 3, 4, 5, 6 Reduction Gears

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.

NOTE	•	Before greasing, move the Manipulator so that the grease inlet is not directed down. Do not remove the grease plug while the grease inlet is directed down. Otherwise the oil content separated from the grease may leak out.
	•	Do not use any tool to install and remove the grease nipple and grease line extension jig. Always handle them directly by your hand. If the grease nipple or grease line extension jig is installed or removed with a tool such as wrench, they may be damaged.

Joint #1 Reduction Gear Unit (Table Top Mounting)

1	Remove the <u>Arm #1 side cover</u> .
2	Remove the grease plug from the Joint #1 grease inlet located inside the Arm #1.
3	Attach the grease nipple to the Joint #1 grease inlet.



Joint #1 Reduction Gear Unit (Ceiling Mounting, Wall mounting)



5	Inject grease from the grease nipple using a grease gun.					
	SK-1A: 11 g					
	Grease Gun					
6	Remove the grease nipple and grease line extension jig from the Joint #1 grease inlet.					
7)	Attach the grease plug to the Joint #1 grease inlet.					
	POINT					
	If the grease plug is damaged of deteriorated, replace it with a new one. Grease plug					
8	Apply a thin coat of grease (SK-1A) to the O-ring.					
-	POINT					
	Fit the O-ring into the base groove.					
	 Do not allow the O-ring to come out of the groove. 					
	• If the O-ring is swollen, damaged, or deteriorated, replace it with a new one.					



Joint #2 Reduction Gear Unit





Joint #3 Reduction Gear Unit

(1)	Remove the grease plug from the Joint #3 grease inlet of the Arm #2.				
2	Attach the grease nipple to the Joint #3 grease inlet.				
()) Inject grease from the grease nipple using a grease gun.				
	SK-1A: 3 g				
	Grease Gun				
4	Remove the grease nipple from the Joint #3 grease inlet.				



Joint #4 Reduction Gear Unit







Joint #5 Reduction Gear Unit







Joint #6 Reduction Gear Unit





Joint #6 Bevel Gear





1.2.5 Tools/Materials

Tools used

Name		Quantity	Note	
	width across flats: 1.5 mm	1	For M3 hexagon socket head set screws	
	width across flats: 2 mm	1	For M2.5 silver and black hexagon socket head cap screws, and for M hexagon socket head set screws	
Hexagonal wrench	width across flats: 2.5 mm	1	For M3 silver and black hexagon socket head cap screws, and for M5 hexagon socket head set screws	
5	width across flats: 3 mm	1	For M4 silver and black hexagon socket head cap screws	
	width across flats: 4 mm	1	For M5 silver and black hexagon socket head cap screws	
	width across flats: 5 mm	1	For M6 silver and black hexagon socket head cap screws	
	width across flats: 6 mm	1	For M8 silver and black hexagon socket head cap screws	
Torque wrench0.7 N·m to 44.0 N·m1For details, refer to 1.2.6 Tightening Bolts/Screws .		For details, refer to 1.2.6 Tightening Bolts/Screws.		
Phillips screwdriver Ph2		1	For covers, and for securing the Ground Wires	
Flat head screwdriver		1	For grease plug	
Needle-nose pliers		1	For removing the Air Tubes	
Feeler gauge (0.5 mm)		2	For adjusting the fixing position of the pulleys and Brake Hubs	
Wronch	width across flats: 5 mm	1	2.9.1 Removing the Cable Unit (For removing the D-sub Connectors)	
WIENCI	width across flats: 8 mm	1	For removing and installing the air tube fittings	
Box wrench width across flats: 5 mm		1	2.9.1 Removing the Cable Unit (For removing the D-sub Connectors)	
Nipper		1	For cutting wire tie	
Spatula		1	For applying grease on the Reduction Gear	
Wiping cloth		1	For wiping grease from the Reduction Gear	
Sonic Belt Tension M	eter	1	3.1 Adjusting the Timing Belt Tension	
Force gauge		1	3.1 Adjusting the Timing Belt Tension	
Suitable cord (Length about 800 mm)		1	3.1 Adjusting the Timing Belt Tension	
Cushioning or rags		1	To prevent the arms from being damaged	
Grease up kit (A set of grease gun, nipple, and extension jig)		1	Maintenance Parts Code: 1674592	

Materials used

Name		Quantity	Note	
Grease		Proper quantity	For details, refer to 1.2.4 Greasing.	
Liquid gasket		Proper quantity	For preventing oil leaks and securing parts	
Adhesive		Proper quantity	For securing parts	
Alcohol		Proper quantity	For wiping grease from the J1/J2 Reduction Gear and the Ball Screw Spline	
	AB100	Proper quantity	Fixing the cables	
	AB150			
Wire tie	AB200			
	AB250			
	AB350			

Grease, Liquid gasket, Adhesive

Please contact the following manufacturers for the purchase. If there is anything unclear, please contact the supplier of your region.

Product name	Manufacturer	URL	
Harmonic Grease SK-1A	Hormonia Drivo Svotomo Inc	https://www.harmonicdrive.net/	
Harmonic Grease SK-2	namonic Drive Systems Inc.		
Krytox®GPL-224	Chemours	https://www.chemours.com/en/brands-and-products	
1207B	ThreeBond Co.,Ltd	https://www.threebond.com	
LOCTITE641	LOCTITE	https://loctite.com/	

1.2.6 Tightening Bolts/Screws

In the manual, bolts and screws that are removed or installed for maintenance are shown below.

Unless otherwise specified, when re-tightening these bolts for maintenance tasks described in the manual, use a torque wrench and tighten them to the tightening torques noted in the table below.

Example) S01: 6-M4x15

S01 indicates the "Type" in the table below. Be sure to tighten with the correct tightening torque after confirming the "Type" and "Size".

Туре	Type Description		Tightening torque (N⋅m)
		M2.5	1.0 +/- 0.1
	Hexagon socket head cap screw (silver)	M3	2.0 +/- 0.1
801		M4	4.0 +/- 0.2
301		M5	8.0 +/- 0.4
		M6	13.0 +/- 0.6
		M8	32.0 +/- 1.6
		M3	2.5 +/- 0.15
	Hexagon socket head cap screw	M4	5.0 +/- 0.25
S02	(black)	M5	10.0 +/- 0.5
	(Reduction Gear, etc.)	M6	18.0 +/- 0.9
		M8	44.0 +/- 2.2
	Cross recessed pan head screw	M2	0.2 +/- 0.03
S03		M3	0.45 +/- 0.1
	(Circuit boards, etc.)	M4	0.45 +/- 0.1
804	Cross recessed pan head screw	M3	0.45 +/- 0.05
304	(Ground Wires, etc.)	M4	0.9 +/- 0.1
		M3	0.9 +/- 0.1
S05	Hexagon socket head set screw	M4	2.4 +/- 0.1
		M5	4.0 +/- 0.2
S06	Cross recessed truss screw	M4	09+/-01
000	(Covers, etc.)	דועו	0.0 17- 0.1
Туре	Description	Size	Tightening torque (N·m)
------	-----------------------------------	------	-------------------------
\$07	Cross recessed binding head screw	M3	0.45 +/- 0.1
507	(DC/DC Board)		

We recommend that 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.

1.3 Parts Layout





1.4 Difference between M/C Cable Backward model and M/C Cable Downward model

1.4.1 Connector Plate



1.4.2 Base Cover





M/C Cable Downward model



Maintenance

2.1 Overview

2.1.1 Precautions for Maintenance

- Perform disassembly and assembly according to the procedures described in the manual.
- The parts for the Reduction Gear Unit are managed with serial numbers. Before installing parts, make sure the serial numbers of each match. Combining parts with different serial numbers may result in vibrations, abnormal noise, or other issues that may affect the accuracy of the robot.
- Remove connectors by releasing the latch. When connecting connector, make sure the latch is closed.
- Do not pull the connector or cable with force. Doing so may cause damage.
- When fixing the covers and plates, be careful not to pinch the cables.
- When cutting a wire tie, be careful not to damage the cables.
- Installation of a Silicone Sheet or securing with a wire tie are measures to prevent pulling or grazing of the cable when the robot moves, and also to prevent friction between connectors. Use the Silicone Sheet and wire tie according to the instructions in the manual to fix the cables.
- Make sure that the wire tie is not over-tightened with force.
- When tightening screws, use the correct tightening torque. For details, refer to 1.2.6 Tightening Bolts/Screws.
- Fasten the bolts aligned on a circumference in a crisscross pattern. For details, refer to <u>1.2.6 Tightening Bolts/Screws</u>.
- When loosening Motor Plate securing screws, or attaching or removing parts that affect belt tension, make sure to adjust the timing belt tension.

For details, refer to <u>3.1 Adjusting the Timing Belt Tension</u>.

- Before applying grease, wipe off the old grease and anti-rust oil. If any old grease is left behind, the lubrication may deteriorate, the anti-rust oil may harden, and the robot accuracy may be affected.
- Apply the specified amount of grease to the parts specified in the manual.
- When applying grease, take care that the grease does not adhere on to the surrounding parts. Oil separation of the surrounding grease may result in oil leakage. Therefore, be sure to wipe off any adhering grease.

Maintenance

2.1.2 Viewing the Maintenance Page

Each page is configured as shown below.

Top page of each section

The exploded view shows all parts and units that need to be removed and reinstalled in the section.



Notation of product names in the manual In this manual, the model name is used to describe where the bolt/screw type or work procedure differs depending on the model number or model name.

Model Number	Model Name	
C8-B901***	C8L	
C8-B1401***	C8XL	
C12-B1401**	C12XL	

About the bolt and screw type

S01: 3-M4x20

S01 indicates the bolt or screw type.

For details on the type, the size, torque value, etc., refer to <u>1.2.6 Tightening Bolts/Screws</u>.

Body page for instructions

Work sequence

The white circle numbers (e.g. 1) are the step numbers for

removing or disassembling the unit or component.

Black circle numbers (e.g. **1**) are step numbers for assembling

or installing the unit or component.



The configuration of parts to be removed/attached is shown by illustrations. The details of the work, precautions for work, and points, etc., are described.

CAUTION

Indicates information about risks which may cause injury to persons and risks which the Manipulator functions cannot be implemented.

POINT

Indicates a method of proceeding with work in an efficient manner.

NOTE

Indicates information not concerning the work procedures.

SK-1A: 102g

Indicates that lubrication is required.

Refer to <u>1.2.5 Tools/Materials</u> for grease manufacturer and other details.

Clicking the underlined blue characters will open the corresponding page.

You can return to the original page by simultaneously pressing the [Alt] key and the [\leftarrow] key.

* The operation method may differ depending on the viewer. For details, refer to Help of each viewer.

2.2 Joint #1 (M/C Cable Backward)

2.2.1 Joint #1 Replacing the Timing Belt



(

Removing the Timing Belt



1)	Turn OFF the Controller.
2)	 Remove the following parts. <u>Base Maintenance Cover</u> Connector Plate (<u>M/C Cable Backward: C8L</u>), (<u>M/C Cable Backward: C8XL, C12XL</u>) <u>J1 Motor unit</u>
3)	Perform steps ④ and ⑤ of Removing the Cable Unit, and remove the J1 Timing Belt.



Installing the Timing Belt



1	Assemble the J1 Timing Belt and Cable Unit.
-	Perform step 🕏 of Installing the Cable Unit.
2	Install the following parts.
	• <u>J1 Motor unit</u>
	Connector Plate
	(M/C Cable Backward: C8L), (M/C Cable Backward: C8XL, C12XL)
	Base Maintenance Cover
3	After assembly, perform calibration of Joint #1.
	3.2 Calibration





Removing the Motor Unit



1	Remove the Base Maintenance Cover.
2	Remove the Connector Plate.
	M/C Cable Backward: C8L, M/C Cable Backward: C8XL, C12XL
	POINT
	Disconnect the required connectors according to the following procedure. Here, only remove the Connector Plate.
(0)	Disconnect the Motor Connectors (CN111, CN311, CN410).
	The second se

<C8XL/C12XL only> (4)Removing the Motor Unit Remove the Heat Radiation Block and the Radiation Sheet. 1. Cut the wire tie (AB350), and remove the Heat Radiation Block. (2)2. Remove the Radiation Sheet. (3)CAUTION • The Heat Radiation Block, bolts, and Radiation Sheet will be used again during installation. Store it so that you do not lose it. • The Radiation Sheet is easy to break, so be careful when removing it. S01: 1-M5x15 Heat Radiation Block Radiation Sheet 6 Wire tie (AB350) 7 (5)Îq (4)(5)Cut the wire tie binding the brake cable to the J1 Motor Plate shaft. Brake cable Wire tie (8) (4)



Removing the Motor Unit



Remove the loosened screws, then remove the J1 Motor unit. **POINT**

The J1 Motor unit can be removed from the Connector Plate side.

CAUTION

8

The Radiation Sheet may be left inside the base. It will be used again during installation of the Motor Unit, so remove it from inside the base.





Install the J1 Motor unit.

1. Check that the Radiation Sheet is installed in the position shown in the figure. If a protective film is applied to the Radiation Sheet, remove the film.

POINT

The Radiation Sheet may be left inside the base when replacing the motor. Remove from inside the base, and affix it on the Motor Unit.

CAUTION

Operating the Manipulator without the Radiation Sheet in place may result in heating of the motor thus generating an error.







POINT

• Make sure that the teeth of the Timing Belt and the pulley are properly engaged.



• The standard for temporary fastening is where the Motor Unit can be moved by hand and will not tilt when pulled. If this is either too loose or too tight, it will not provide the proper tension to the belt.

CAUTION

If the Timing Belt is placed on the flange, correct tension will not be obtained during belt tension adjustment.



Set the belt so that it is level with respect to the pulley without it being placed on the flange.



<C8XL/C12XL only>

If the Heat Radiation Block has been removed, install using the following procedure.

- 1. Check that the Radiation Sheet is applied to the Heat Radiation Block.
 - If a protective film is applied to the Radiation Sheet, remove the film.

CAUTION

2

Operating the Manipulator without the Radiation Sheet in place may result in heating of the motor thus generating an error.







6. Wrap the wire tie around the motor, and tighten so that the Heat Radiation Block presses on the Motor Unit. Heat Radiation Block Wire tie POINT Tighten the wire tie to the extent that the Radiation Sheet pressed between the Heat Radiation Block and the Motor Unit is pressed out and protrudes. CAUTION Tightening the wire tie with too much force may cause the motor cable to break. Take care to not tighten the wire tie with too much force. Adjust the belt tension. 3 3.1 Adjusting the Timing Belt Tension 4 Temporarily secure the J1 brake plate. Secure the brake plate to the extent that it can still be moved sideways by hand. S01: 3-M4x20 J1 brake plate



5 Check that the motor and the brake center are aligned.

CAUTION

Use dedicated tools to check that the motor and the brake center are aligned.

Misalignment of the brake center may cause abnormal sounds or apply abnormal torque on the brake, which may result in malfunction of the brake.

1. Insert the J1 brake positioning jig into the brake plate hole.

Check that the jig can be inserted until the line marked on the curved surface of the jig is aligned with the surface of the brake plate.

If the line is not aligned with the surface of the brake plate but is above it, the motor and brake are misaligned, and the brake friction plate must be adjusted. Follow the procedure below to make the adjustment.

- 2. Use the brake release unit (optional part) to release the brake.
- 3. Adjust the position of the brake friction plate. Insert the jig into the hole in the brake plate, and when the line marked on the curved surface of the jig is aligned with the brake plate surface, the friction plate positioning is complete.
- 4. Remove the brake release unit.







2

2.2.3 Joint #1 Replacing the Brake



Removing the Brake





2.2.4 Joint #1 Replacing the Reduction Gear Unit



Removing the Reduction Gear Unit



)	Remove the Base Maintenance Cover.
)	Remove the Connector Plate.
	M/C Cable Backward: C8L, M/C Cable Backward: C8XL, C12XL
)	Remove the <u>J1 Motor unit</u> .
)	Remove the <u>J2 Motor unit.</u>
)	Perform steps ④ to ⑥ of <u>Removing the Cable Unit</u> .
)	Remove Arm1.
	1. Remove the grease tube on the Arm1 side.
	Grease tube



2. Remove Arm1. A S02: 15-M6x30 and washer CAUTION Have at least two workers perform this work. At least one worker must support the Manipulator to prevent its arm from falling. Pay special attention to damage resulting from the Manipulator falling or hands or feet being caught in the Manipulator. Remove the J1 Reduction Gear Unit. S02: 12-M6x50 J1 Reduction Gear Unit

1

Installing the Reduction Gear Unit







Install Arm1.

A

S02: 15-M6x30 and washer (18.0 +/- 0.9 N · m)



WARNING

Have at least two workers perform this work. At least one worker must support the Manipulator to prevent its arm from falling.

Pay special attention to damage resulting from the Manipulator falling or hands or feet being caught in the Manipulator.

Connect the grease tube to the Arm1-side fitting.



Perform steps **6** to **7** of Installing the <u>Cable Unit</u>.

Install the <u>J2 Motor unit</u>.

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Installing the Reduction Gear Unit



6	Install the <u>J1 Motor unit</u> .
7	Install the Connector Plate
	M/C Cable Backward: C8L_M/C Cable Backward: C8XL_C12XL
8	Install the Base Maintenance Cover.
9	After assembly, perform calibration of Joint #1.
	3.2 Calibration



2.3 Joint #1 (M/C Cable Downward)

2.3.1 Joint #1 Replacing the Timing Belt


Removing the Timing Belt



1	Turn OFF the Controller.		
2	Turn the Manipulator laterally.		
_	CAUTION		
	When turning the Manipulator laterally, there must be two or more people to work on it so that at least one of them can support the arm while the others are removing the bolts. Removing the bolts without supporting the arm may result in the arm falling, bodily injury, and/or malfunction of the robot system.		
3	Remove the following parts.		
	 Base Cover (M/C Cable Downward: C8L), (M/C Cable Downward: C8XL, C12XL) 		
	<u>Connector Plate (M/C Cable Downward)</u>		
	<u>J1 Motor Unit</u>		
4	Remove the J1 Timing Belt.		
	Perform steps ④ and ⑤ of <u>Removing the Cable unit</u> .		

1

2

3

Installing the Timing Belt



Assemble the J1 Timing Belt and Cable Unit.	
Perform step 🕏 of Installing the Cable Unit.	
Install the following parts.	
• <u>J1 Motor Unit</u>	
<u>Connector Plate</u> (M/C Cable Downward)	
Base Cover (M/C Cable Downward: C8L), (M/C Cable Downward: C8XL, C12XL)	
Base Maintenance Cover	
After assembly, perform calibration of Joint #1.	
3.2 Calibration	



2.3.2 Joint #1 Replacing the Motor Unit



Removing the Motor Unit



- 1 Remove the following covers.
 - Base Maintenance Cover
 - Base Cover (M/C Cable Downward: C8L), (M/C Cable Downward: C8XL, C12XL)
 - Connector plate (M/C cable downward)

Disconnect the cables from the base and disconnect the following connectors.
 Connector: CN111, CN311, CN410

(3) Remove the J1 Motor unit.

Perform steps ④ to ⑧ for <u>Removing the J1 Motor Unit</u> of the "Joint #1 (M/C Cable Backward)".

Installing the Motor Unit



 Install the J1 Motor unit. Perform steps • to • for <u>Installing the J1 Motor Unit</u> of the "Joint #1 (M/C Cable Backward)".
 Connect the following connectors. Connector: CN111, CN311, CN410
 Install the following covers.
 Install the following covers.
 <u>Connector plate</u> (M/C cable downward)
 Base Cover (M/C Cable Downward: C8L), (M/C Cable Downward: C8XL, C12XL)
 Base Maintenance Cover
 After assembly, perform calibration of Joint #1. 3.2 Calibration

2.3.3 Joint #1 Replacing the Brake



Removing the Brake



1	Perform steps ① and ② for <u>Removing the J1 Motor Unit</u> of the "Joint #1 (M/C Cable Downward)".	
2	Perform steps (5) and (6) for <u>Removing the J1 Motor Unit</u> of the "Joint #1 (M/C Cable Backward)".	
3	Remove the J1 brake from J1 brake plate.	
	A S01: 3-M4x25 J1 brake plate	
	Image: state stat	

Installing the Brake





2.3.4 Joint #1 Replacing the Reduction Gear Unit



Removing the Reduction Gear Unit



1	Remove the <u>J1 Motor unit</u> .
2	Remove the J1 Reduction Gear Unit.

Perform steps 1 to 2 for <u>Removing the J1 Reduction Gear Unit</u> of the "Joint #1 (M/C Cable Backward)".

Installing the Reduction Gear Unit



	Install the J1 Reduction Gear Unit.		
_	Perform steps 1 to 5 for <u>Installing the J1 Reduction Gear Unit</u> of the "Joint #1 (M/C Cable Backward)".		
2	Install the <u>J1 Motor unit</u> .		
-			

3 After assembly, perform calibration of Joint #1.

3.2 Calibration

2.4 Joint #2

2.4.1 Joint #2 Replacing the Timing Belt



Removing the Timing Belt



Turn ON the controller.

2 Release the J2 brake, and manually push and move Arm2 until it comes in contact with the mechanical stopper, and push it against Arm1.

CAUTION

Arm2 falls by its weight when the J2 Motor unit is removed. Release the brake and tilt Arm2 in advance.



- ③ Turn OFF the Controller.
- (4) Remove the <u>Arm1 center cover</u>.
- (5) Remove the <u>Arm1 side cover</u>.



Removing the Timing Belt



(6) Loosen the screws securing the J2 Motor unit.



WARNING

Loosening the screws while Arm2 is not tilted will result in the belt coming off and Arm2 falling, which is very dangerous. Prior to loosening the J2 Motor unit screws, ensure that work in step ⁽²⁾ is performed and that Arm2 is tilted.

Remove the J2 Timing Belt.

POINT

7

First remove the belt from pulley 1.



Installing the Timing Belt





Installing the Timing Belt



CAUTION

2

3

If the Timing Belt is placed on the flange, correct tension will not be obtained during belt tension adjustment.



Temporarily secure the J2 Motor unit.



POINT

The standard for temporary fastening is where the Motor Unit can be moved by hand and will not tilt when pulled. If this is either too loose or too tight, it will not provide the proper tension to the belt.

- Adjust the belt tension.
- 3.1 Adjusting the Timing Belt Tension
- 4 Install the <u>Arm1 center cover</u>.

5 Install the <u>Arm1 side cover</u>.

- 6 After assembly, perform calibration of Joint #2.
 - 3.2 Calibration



Removing the Motor Unit



Turn ON the controller.

Release the J2 brake, and manually push and move Arm2 until it comes in contact with the mechanical stopper, and push it against Arm1.

CAUTION

Arm2 falls by its weight when the J2 Motor unit is removed. Release the brake and tilt Arm2 in advance.



Turn OFF the Controller.

Remove the <u>J2 Timing Belt</u>.



Motor Unit Disassembly







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Motor Unit Assembly







Joint #2

J

J







y

J

J









1	Insert the J2 Motor unit inside Arm2.
0	Install the <u>J2 Timing Belt</u> .
	Perform steps 1 to 6.
3	Connect the J2 Motor Connectors (CN121, CN321, CN420). CN420 CN420 CN420 CN420 CN420 CN420 CN420
4	Bind CN420 (J2 brake cable), CN3 (gyro cable), and other cables. Binding position CN3: Approx. 65 mm from the connector end CN420-1: Approx. 125 mm from the connector end Wire tie (AB150)

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Installing the Motor Unit



	multiventitiee	Disclosure Scope. maintenance Trainea Personner Only
5	Install the <u>Arm1 center cover</u> .	
6	Install the <u>Arm1 side cover</u> .	
7	After assembly, perform calibration of Joint #. <u>3.2 Calibration</u>	2.

2.4.3 Joint #2 Replacing the Brake



Removing the Brake



(1) Refer to <u>J2 Motor Unit Disassembly</u> and remove the J2 brake.

Installing the Brake





Refer to <u>J2 Motor Unit Assembly</u> and install the J2 brake.

2.4.4 Joint #2 Replacing the Reduction Gear



Removing the Reduction Gear



<Preparation>
Prepare a work stand upon which to place the arm removed from the Manipulator.
Guidelines for work stand
Width x Depth: 1.0 x 0.5 m
Height: 300 mm to 500 mm from bottom of the Manipulator
Load capacity: 10 kg
Turn ON the controller.
Release the J2 brake, and manually push and move Arm2 until it comes in contact with the
mechanical stopper, and push it against Arm1.
CAUTION
Arm2 falls by its weight when the J2 Motor unit is removed. Release the brake and tilt
Arm2 in advance.



(3) Turn OFF the Controller.



Pulley 2




Removing the Reduction Gear



Remove Arm2. C8L: A S02: 16-M5x30 and washer C8XL: A S02: 16-M6x35 and washer

CAUTION

(8)

• Remove the bolts to remove the Arm1 side arm and Arms 2, 3, 4, 5, and 6 (end effector).

There is a possibility of hands and fingers being caught, and/or damage to or malfunction in the Manipulator. Be very careful when removing the arms. Have at least two workers support the Manipulator while another worker removes the bolts.

• The arms are connected by internal cables. Place the removed arms on the work stand in order to not apply load on the cables. Applying load on the cables may result in cable disconnection.





Removing the Reduction Gear



Remove the Wave Generator unit. Wave Generator unit

POINT

(11)

Turn the Reduction Gear Unit with the Wave Generator unit built in upside down. Remove the Wave Generator unit by tapping it lightly near the center axis with a plastic hammer.



Removing the Reduction Gear



Remove the Arm2 O-ring. POINT

(12)

The part has grease applied. Perform the work while wiping off the grease.







Install the O-ring in the O-ring groove.

1

- Applying a small amount of grease (SK-1A) to the O-ring will make it stick to the arm, facilitating subsequent work.
- Insert the O-ring firmly into the groove.
- If the O-ring is stretched, damaged, or has deteriorated, replace with a new one.



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Secure the J2 Reduction Gear Unit to Arm2. C8L: S02: 12-M5x40

C8XL/C12XL: S02: 12-M6x45





Tighten the screws using the following procedure. Refer to the figure above. **CAUTION**

- Ensure that diagonally opposite screws are tightened alternately.
- Do not tighten the screws all the way at once. Instead, divide this into four times and tighten to the following torques.

C8L

5

50E							
Percentage of the specified torque	Torque value	Unit		Percentage of the specified torque	Torque value	Unit	
20%	2.0 +/- 0.1	N ∙ m		20%	3.6 +/- 0.18	- N∙m	
40%	4.0 +/- 0.2			40%	7.2 +/- 0.36		
80%	8.0 +/- 0.4			80%	14.4 +/- 0.72		
100%	10.0 +/- 0.5			100%	18.0 +/- 0.9		
ptate the Wave Generator so that its longside aligns with the positions of screws (1)							

C8XI /C12XI

1. Rotate the Wave Generator so that its longside aligns with the positions of screws (1) and (2).

2. Tighten screws (1) and (2) to 20% of the torque value.

3. Tighten screws (1) and (2) to 40% of the torque value.







Manipulator to prevent its arm from falling. Pay special attention to damage resulting from the Manipulator falling or hands or feet being caught in the Manipulator.





Secure Arm2. 9

1. Lift up the Arm1 side arm and Arms 2, 3, 4, 5, and 6 (ends) to install and temporarily secure the Arm2.

Have at least two workers perform this work. At least one worker must support the Manipulator to prevent its arm from falling.

Pay special attention to damage resulting from the Manipulator falling or hands or feet being caught in the Manipulator.

C8L:



POINT

After this, the reduction gear will be centered, so temporarily secure the Arm2 to the extent that J2 reduction gear rattles.

2. Install the J2 pulley 2. A S05: 2-M5x10 (4.0 +/- 0.2 N·m) Pulley 2 POINT <For C8XL/C12XL> Set the key in the shaft and insert the J2 pulley 2 while aligning with the key groove. If the screw positions are incorrect or the bushing is not set, this may cause damage on

CAUTION

the side, and may result in the part being unable to be removed.





3. Manually move Arm2 back and forth 30°.



POINT

Adjust so that the fixing screws are centered in the clearance as shown in the figure.





4. Rotate pulley 2 left and right by 180°. Pulley 2 5. Perform the following procedure to secure Arm2. CAUTION • Ensure that diagonally opposite screws are tightened alternately. • Do not tighten the screws all the way at once. Instead, divide this into four (or two) times and tighten to the following torques. C8L C8XL/C12XL S02: 16-M5x30 and washer S02: 16-M6x35 and washer (10.0 +/- 0.5 N·m) (18.0 +/- 0.9 N·m) Percentage of Percentage of Torque Torque the specified Unit the specified Unit value value torque torque 20% 2.0 +/- 0.1 20% 3.6 +/- 0.18 40% 4.0 +/- 0.2 40% 7.2 +/- 0.36 N۰m N·m 80% 8.0 +/- 0.4 80% 14.4 +/- 0.72 100% 10.0 +/- 0.5 100% 18.0 +/- 0.9





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2.5 Joint #3

2.5.1 Joint #3 Replacing the Timing Belt





Removing the Timing Belt



1 Turn ON the controller.

(2) Release the J3 brake, and manually push and move Arm3 until it comes in contact with the mechanical stopper, and push it against Arm2.

CAUTION

- Arm3 falls by its weight when the J3 Motor unit is removed. Release the brake and tilt Arm3 in advance.
- There is a possibility of hands and fingers being caught, and/or damage to or malfunction in the Manipulator. Take care during operation.



③ Turn OFF the Controller.

 $\overline{(4)}$

Remove the <u>Arm2 side cover</u>.



Installing the Timing Belt







2.5.2 Joint #3 Replacing the Motor Unit



Removing the Motor Unit





Motor Unit Disassembly



1

Motor Unit Disassembly



	A					
1)	Remove the J3 Motor unit.					
2)	Remove the Motor Pulley unit. POINT					
	Remove the Motor Pulley and the Brake Hub together.					
	 Loosen the two screws on the D-cut surface of the motor shaft when viewing the J2 Motor unit from above. 					
	Brake Hub					
	A S05: 2-M5x12					
	Motor Pulley					
	2. Remove the Motor Pulley unit from the motor shaft.					
	Brake Hub					
	Motor Pulley					



J

J

J

j

Motor Unit Assembly





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Motor Unit Assembly



Install the J3 brake.

CAUTION

A

2

If the screw positions are incorrect or the bushing is not set, this may cause damage on the side, and may result in the part being unable to be removed.

S05: 2-M5x10 (4.0 +/- 0.2 N ⋅ m)



POINT

- Install the J3 brake according to the orientation shown in the figure.
- Install the bushing on the side without the D-cut.
- Tighten the screws while pressing the J3 brake against the Motor Plate.





J


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J





Removing the Brake



(1) Refer to <u>J3 Motor Unit Disassembly</u> and remove the J3 brake.

Installing the Brake



1 Refer to <u>J3 Motor Unit Assembly</u> and install the J3 brake.

2.5.4 Joint #3 Replacing the Reduction Gear



Removing the Reduction Gear



	<preparation></preparation>
	Prepare a work stand upon which to place the arm removed from the Manipulator.
	Guidelines for work stand
	Width x Depth: 1.0 x 0.5 m
	Height: 600 mm to 1200 mm from bottom of the Manipulator
	Load capacity: 10 kg
(1)	Turn ON the controller.
2	Release the J3 brake, and manually push and move Arm3 until it comes in contact with the mechanical stopper, and push it against Arm2.
	CAUTION
	 Arm3 falls by its weight when the J3 Motor unit is removed. Release the brake and tilt Arm3 in advance.
	 There is a possibility of hands and fingers being caught, and/or damage to or malfunction in the Manipulator. Take care during operation.
3	Turn OFF the Controller.
4	Remove the <u>J3 Timing Belt</u> .







Removing the Reduction Gear



(1) Remove the Wave Generator unit.



POINT

Turn the Reduction Gear Unit with the Wave Generator unit built in upside down. Remove the Wave Generator unit by tapping it lightly near the center axis with a plastic hammer.







Installing the Reduction Gear



1 Install the O-ring.

POINT

- Applying a small amount of grease (SK-1A) to the O-ring will make it stick to the arm, facilitating subsequent work.
- Insert the O-ring firmly into the groove.
- If the O-ring is stretched, damaged, or has deteriorated, replace with a new one.



Maintenance



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Apply grease at the location shown in the figure.
 SK-1A: 26 g



CAUTION

If grease is on the areas shown in the figure, wipe off the grease.





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5





Secure the J3 Reduction Gear Unit to Arm3.





Tighten the screws using the following procedure. Refer to the figure above. **CAUTION**

- Ensure that diagonally opposite screws are tightened alternately.
- Do not tighten the screws all the way at once. Instead, divide this into four times and tighten to the following torques.

Percentage of the specified torque	Torque value	Unit
20%	1.1 +/- 0.05	
40%	2.2 +/- 0.11	Niem
80%	4.4 +/- 0.22	• • • • • •
100%	5.5 +/- 0.5	

- 1. Rotate the Wave Generator so that its longside aligns with the positions of screws (1) and (2).
- 2. Tighten screws (1) and (2) to 20% of the torque value.
- 3. Tighten screws (1) and (2) to 40% of the torque value.



Wave washer

Arm2 side arm



Arm3

Installing the Reduction Gear



- 9 Temporarily secure the Arm3.
 - 1. Lift up the Arm2 side arm and Arms 3, 4, 5, and 6 (ends) to install and temporarily secure the Arm3.

CAUTION

- Have at least two workers perform this work. At least one worker must support the Manipulator to prevent its arm from falling.
- Pay special attention to damage resulting from the Manipulator falling or hands or feet being caught in the Manipulator.
 - A S02: 16-M4x25 and washer



POINT

After securing the arm, manually move the arm to check that there is no rattling or misalignment of the Reduction Gear.





3. Manually lift Arm3 60° upward from this position.



POINT

Adjust so that the fixing screws are centered in the clearance as shown in the figure.





mannee



5. Perform the following procedure to secure Arm3.

CAUTION

- Ensure that diagonally opposite screws are tightened alternately.
- Do not tighten the screws all the way at once. Instead, divide this into four (or two) times and tighten to the following torques.

S02: 16-M4x25 and washer (5.5 +/- 0.5 N·m)

Percentage of the specified torque	Torque value	Unit
20%	1.1 +/- 0.05	
40%	2.2 +/- 0.11	Nom
80%	4.4 +/- 0.22	N · m
100%	5.5 +/- 0.5	







- 2. Tighten screws (1) and (2) to 20% of the torque value.
- 3. Tighten screws (1) and (2) to 40% of the torque value.
- 4. Rotate pulley 2 so that the shaft D-cut is in the position shown in the figure.



5. Tighten screws (3) and (4) to 20% of the torque value.6. Tighten screws (3) and (4) to 40% of the torque value.

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- 8. Tighten screws (1) and (2) to 80% of the torque value.
- 9. Tighten screws (1) and (2) to 100% of the torque value.
- 10. Rotate pulley 2 so that the shaft D-cut is in the position shown in the figure.



11. Tighten screws (3) and (4) to 80% of the torque value.12. Tighten screws (3) and (4) to 100% of the torque value.







21. Rotate pulley 2 so that the shaft D-cut is in the position shown in the figure.



22. Tighten screws (13) and (14) to 40% and then 100% torque values.23. Rotate pulley 2 so that the shaft D-cut is in the position shown in the figure.



24. Tighten screws (15) and (16) to 40% and then 100% torque values.

POINT

After securing the arm, manually move the arm to check that there is no rattling or misalignment of the Reduction Gear.



2.6 Joint #4

2.6.1 Joint #4 Replacing the Timing Belt



Removing the Timing Belt



1 Turn ON the controller.

Release the J3 brake, and manually push and move Arm3 until it comes in contact with the mechanical stopper, and push it against Arm2.

CAUTION

- Arm3 falls by its weight when the J3 Motor unit is removed. Release the brake and tilt Arm3 in advance.
- There is a possibility of hands and fingers being caught, and/or damage to or malfunction in the Manipulator. Take care during operation.



(3) Turn OFF the Controller.



Ð	Remove the <u>Arm4 side cover</u> (both sides).
5	Remove the <u>J4 Motor unit</u> .
9	Removing the <u>Cable unit</u> . Perform step [®] through 11 of step [®] .
\mathcal{D}	Protect pulled-out connectors with masking tape or similar. POINT This protects connector clips from breaking and adherence of grease during subsequent work.
Ð	Remove the J4 Timing Belt from Arm3. J4 Timing Belt



C8-B/C12-B Service Manual Disclosure Scope: Maintenance Trained Personnel Only Maintenance 5 Install the Arm3 maintenance cover. Installing the Timing Belt 6 Install the Arm4 side cover (both sides). 7 Install the Arm4 maintenance cover. 3 After assembly, perform calibration of Joint #4. 8

3.2 Calibration

6

7

9³ 3

Joint #4

3

5

6

2.6.2 Joint #4 Replacing the Motor Unit





Removing the Motor Unit



1	Turn OFF the Controller.
2	Remove the <u>Arm3 cover</u> .
3	Remove the Arm2 side cover (both sides).
(4)	Disconnect the J4 Motor Connectors (CN141, CN341, CN440).
	 Using a marker pen or tape, mark all of the cables bound with the wire tie as shown in the figure. Tape Wire tie
	2. Cut the wire tie.
	Wire tie
	3. Remove the connectors (CN440, CN141, CN341).




Remove the screws securing the J4 Motor Plate, and remove the J4 Motor unit from Arm3.
 POINT

- The J4 Motor Plate screws are at a position approximately 120 mm in.
- Remove the screws securing the Motor Plate to the arm as shown in the figure. Take care not to remove the screws securing the motor itself to the Motor Plate.
 - S01: 2-M4x15 and washer



Motor Unit Disassembly



Maintenance

Motor Unit Disassembly





(1)Remove the <u>J4 Motor unit</u>.

2 Cut the wire tie (AB100) securing the brake and motor cable to the motor.









J

Motor Unit Disassembly









J







J

Maintenance





1

2

Installing the Motor Unit



Remove the Arm3 maintenance cover. Loosen the screws on the Arm3 cable fixing plate 1, and remove the plate. A S01: 2-M4x10 Arm3 cable fixing plate 1 POINT Slide the cutout section on the Arm3 cable fixing plate 1. Arm3 cable fixing plate 1

3



Install the J4 Motor unit. Refer to the figure below for each part name. Pulley 2 0 Timing Belt Pulley 1 1. With the Timing Belt correctly engaged with pulley 2, insert the J4 Motor into the arm while lifting the Arm3 cable fixing plate 1. J4 Motor unit

Installing the Motor Unit



POINT

The Timing Belt may not be engaged with pulley 2, as shown in the figure. Check that it is correctly engaged with pulley 2.



2. Set the Timing Belt on pulley 1.

POINT

Adjustment of the position of the J4 Motor up or down when setting the Timing Belt on pulley 1 can be easily performed from the Arm3 maintenance cover side.



Installing the Motor Unit



POINT

• Make sure that the teeth of the Timing Belt and the pulley are properly engaged. Check from the three locations of the Arm2 side cover, Arm3 maintenance cover, and Arm3 cover.



• The standard for temporary fastening is where the Motor Unit can be moved by hand and will not tilt when pulled. If this is either too loose or too tight, it will not provide the proper tension to the belt.

CAUTION

If the Timing Belt is placed on the flange, correct tension will not be obtained during belt tension adjustment.



6 7

Installing the Motor Unit

5





Installing the Motor Unit



8	Install the <u>Arm3 cover</u> .
0	Install the <u>Arm3 maintenance cover</u> .
10	Install the <u>Arm2 side cover</u> .
1	After assembly, perform calibration of Joint #4.
	3.2 Calibration

2.6.3 Joint #4 Replacing the Brake



Removing the Brake



1 Refer to <u>J4 Motor Unit Disassembly</u> and remove the J4 brake.

Installing the Brake



1 Refer to <u>J4 Motor Unit Assembly</u> and install the J4 brake.

2.6.4 Joint #4 Replacing the Reduction Gear Unit





Removing the Reduction Gear Unit



(1) Refer to <u>Removing the Arm4 Unit</u> and remove the Arm4 Unit.

Remove the Arm4 extension part.

S02: 8-M5x30

- 1. Rotate the Arm4 extension part and shift its position to make the bolt head visible.
- 2. Remove the bolt with the exposed head.



Arm4 extension part

- 3. Similarly, rotate the Arm4 extension part and shift its position to make the other bolt head visible. Use this same method to remove all the bolts.
- 4. Pull out the Arm4 extension part from Arm3.

POINT

A

(2)

Arm3 and the Arm4 extension part have a mating surface configuration. Pull out the Arm4 extension part while moving it slightly up and down, and back and forth.

Removing the Reduction Gear Unit



(3) Remove the J4 Reduction Gear Unit.

1. Remove the J4 flange and Wave Generator.

POINT

If it is difficult to remove them, insert a tool between the J4 flange and the arm, and widen the gap between them little by little.

CAUTION

Be careful not to damage the parts.

A S02: 16-M3x20





(4)

Removing the Reduction Gear Unit



1. Remove the J4 sleeve holder.
Sol: 4-M3x6
2. Remove the J4 sleeve.

J4 sleeve
J4 sleeve holder
J4 sleeve holder
CAUTION
Handle the sleeve with care since it is thin and easy to deform.
POINT

The parts are attached together with the liquid gasket, and may be difficult to remove. If difficult to remove, pull out while rotating the sleeve.





Installing the Reduction Gear Unit







6. Install the Wave Generator. Wave Generator 7. Install the O-ring attached to the Reduction Gear on the O-ring groove on the J4 Reduction Gear. O-ring 8. Install the J4 flange. S02: 16-M3x20 (2.4 +/- 0.1 N · m) J4 flange

Pulley spacer

Screw





2.7 Joint #5

2.7.1 Joint #5 Replacing the Timing Belt





Installing the Timing Belt



Install the J5 Timing Belt. 1 Timing Belt Pulley 2 Pulley 1 POINT • First place the belt on pulley 1. Wrong Correct • Make sure that the teeth of the Timing Belt and the pulley are properly engaged. CAUTION If the Timing Belt is placed on the Pulley flange, correct tension will not be \bigcirc obtained during belt tension adjustment. **Timing Belt** Set the belt so that it is level with respect to the pulley Flange without it being placed on the **Timing Belt** flange.






Removing the Motor Unit











Motor Unit Disassembly







Maintenance





J



Joint #5

3





1. Align the motor shaft D-cut surface with the screw holes, and set the Brake Hub.



2. Place 0.5-mm feeler gauges or scales on the brake to ensure a 0.5-mm gap between the Brake Hub and the brake.



CAUTION

Failure to create a proper gap between the Brake Hub and the brake may cause the parts to rub during motor operation, causing a malfunction.



J

Installing the Motor Unit







POINT

• Make sure that the teeth of the Timing Belt and the pulley are properly engaged.



• The standard for temporary fastening is where the Motor Unit can be moved by hand and will not tilt when pulled. If this is either too loose or too tight, it will not provide the proper tension to the belt.

CAUTION

If the Timing Belt is placed on the flange, correct tension will not be obtained during belt tension adjustment.



Installing the Motor Unit



Install the Air Tube.

3

1. Use an 8-mm wrench to rotate the part shown in the figure, and install the metal fitting.



POINT

- Install in front of the Motor Unit.
- After tightening by hand, further tighten one sixth to quarter of a turn.

CAUTION

- Excessive tightening may result in air leakage due to connector breakage or gasket deformation.
- Insufficient tightening may result in air leakage due to connector breakage or gasket deformation.

2. Install the Air Tube.







C8-B/C12-B Service Manual

Installing the Motor Unit



6	Install the Arm4 side cover (both sides).	

After assembly, perform calibration of Joint #5.
<u>3.2 Calibration</u>

Joint #5

Maintenance

2.7.3 Joint #5 Replacing the Brake



Removing the Brake



Refer to <u>J5 Motor Unit Disassembly</u> and remove the J5 brake.

Installing the Brake



Refer to <u>J5 Motor Unit Assembly</u> and install the J5 brake.

2.7.4 Joint #5 Replacing the Arm4 Unit



Removing the Arm4 Unit



1 Turn ON the controller.

2 Release the J3 brake, and manually push and move Arm3 until it comes in contact with the mechanical stopper, and push it against Arm2.

CAUTION

- Arm3 falls by its weight when the J3 Motor unit is removed. Release the brake and tilt Arm3 in advance.
- There is a possibility of hands and fingers being caught, and/or damage to or malfunction in the Manipulator. Take care during operation.



3	Turn OFF the Controller.
4	Remove the <u>Arm4 maintenance cover</u> .
5	Remove the <u>Arm4 side cover</u> (both sides).
6	Remove the <u>Arm3 cover</u> .
7	Remove the Arm3 maintenance cover.



Maintenance	Disclosure Scope: Maintenance Trained Personnel Onl
emove the <u>Arm2 side cover</u> (both sides).	
emoving the Cable unit.	
erform step \circledast through 12 of step \circledast .	
emoving the <u>J4 Timing Belt</u> .	
erform steps ${ar {\Bbb O}}$ and ${\centstar {\Bbb S}}$.	
emove the Arm4 unit.	
Arm4 unit	
Pull out all cables passing through the Arr	m4 extension part from the Arm4 unit side.



2. Remove the screws shown in the figure, then remove the Arm4 unit. Arm4 unit Arm4 extension part



2.8 Joint #6

2.8.1 Joint #6 Replacing the Timing Belt



Removing the Timing Belt





Installing the Timing Belt







2.8.2 Joint #6 Replacing the Motor Unit



Removing the Motor Unit





POINT

Slide the cutout section on the cable fixing plate.



2. Cut the wire tie.



3. Disconnect the connectors (CN361, CN461, CN161).



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Motor Unit Disassembly


Motor Unit Disassembly





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Motor Unit Assembly



Ē





Joint #6

l







Joint #6

J

Installing the Motor Unit



Install the J6 Motor unit.

1. Insert the J6 Motor unit inside Arm4.



POINT

1

First pass the CN161 cable, and insert into the arm from the bottom of the motor.

2. Set the Timing Belt around pulley 1 and pulley 2, and temporarily secure the J6 Motor unit.

POINT

First place the belt on pulley 2.





POINT

• Make sure that the teeth of the Timing Belt and the pulley are properly engaged.



• The standard for temporary fastening is where the Motor Unit can be moved by hand and will not tilt when pulled. If this is either too loose or too tight, it will not provide the proper tension to the belt.

CAUTION

If the Timing Belt is placed on the flange, correct tension will not be obtained during belt tension adjustment.







4. Install the cable protection plate.

CAUTION

Be careful not to let the cables get pinched.



POINT

Slide the cutout section on the cable protection plate, and secure with screws.





Joint #6





(1)

Refer to <u>J6 Motor Unit Disassembly</u> and remove the J6 brake.

Removing the Brake



Installing the Brake



Refer to <u>J6 Motor Unit Assembly</u> and install the J6 brake.

2.9 Replacing the Cable Unit

2.9.1 Removing the Cable Unit







2. Disconnect the RJ45 connector. POINT Press the connector clip, and pull out. RJ45 connector 3. Disconnect the F-sensor connector. POINT Open the clips on both ends of the connector and pull it out. Clip F-sensor connector Clip



4. Disconnect the B-Release plug and D-sub connector.



5. Disconnect the DC/DC Board connectors (CN1, CN2, CN3), and remove the DC/DC Board.



CN411

CN411-2







7. Remove the ground wire plate.

CAUTION

When removing the plate, take care not to damage the DC/DC Board, such as by contacting the base.



POINT

The Ground Wires may be attached in positions different to what is shown in the figure. Record the attachment positions before disconnecting, so that they can be returned to their positions during installation.





9. Pull the following cables and connectors down through the hole in the base.

- D-sub cable
- Ground Wire
- RJ45 connector
- F-sensor connector



10. Disconnect the connectors (CN111, CN311, CN410, CN411 (motor/brake), CN3L, CN202, CN312, CN200, CN300, CN201, CN301, CN3G0).

POINT

Press the connector clip, and pull out.





11. Disconnect the Air Tubes (blue/white).



POINT

These procedures remove the Connector Plate from the Manipulator.





Loosen the screws securing the plate for preventing cable interference, and remove the plate.
Sol: 2-M3x6
Plate for preventing cable interference

Slide the cutout section on the plate for preventing cable interference.





2. Remove the cable bracket and Silicone Sheet. Silicone Sheet Cable bracket

In preparation for reassembly, mark the cable bundle positions so that you can see the positional relationship, or attach wire ties for markers as shown in the photo.

3. Remove the J1 Timing Belt.





Maintenance



3. Remove the J1 cable fixing plate.A S01: 2-M4x10

J1 cable fixing plate

- t the connectors disconnected from parts such as the Connector F
- 4. Protect the connectors disconnected from parts such as the Connector Plate with masking tape or similar.

POINT

This protects connector clips from breaking and adherence of grease during work.



5. Pull out the internal cables from the base side toward the Arm1 side.

CAUTION

Attempting to pull out all the cables at once may break the cables, so disconnect the cables one by one in order from the one with the smallest connector to the largest one.



Wire ties

CN121









Arm2 cable fixing plate

Arm2 cable bracket (C2) and silicone tube

Wire tie

Protective











CN3



Maintenance 6. Disconnect the Air Tubes (blue/white) inside Arm3. POINT • Remove the air tube fittings from the air tubes. • The air tube fittings will be used again during installation. Store them and do not dispose of them. Air tube fittings Air Tube (white) Air Tube (blue) 7. Disconnect the connector (CN3) from gyro board 2. Gyro board 2





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8. Cut the wire tie (AB300) from the Arm4 cable fixing plate, and remove the Silicone Sheet.

POINT

The Silicone Sheet will be used again during installation. Store it and do not dispose of it.



9. Pull out the following cables in order from the Arm4 side to the Arm3 side.

- 1. Air Tubes (blue/white)
- 2. LAN cable (CN581-3)
- 3. CN351/CN361/FB14 cable





10. Cut the wire tie, and disconnect the cables from Arm3 cable fixing plate 2. 11. Remove the Silicone Sheet from the cables. Arm3 cable fixing plate 2 Wire tie Silicone Sheet POINT The Silicone Sheet will be used again during installation. Store it and do not dispose of it. 12. Pull out the cables from the Arm3 side to the Arm2 side. Arm3 Cables Arm2





2.9.2 Installing the Cable Unit



<Preparation>

 Check that the Cable Unit contains the following parts. Silicone Sheet: 3 (25 mm x 120 mm) F-sensor connector housing: 2



2. Disconnect the connectors (CN203, CN152, CN162, CN521, CN522, CN592), and separate the Cable Unit.







Installing the Cable Unit



POINT

Leave out the other connector cables for a certain length, as shown in the figure, in order to store them in Arm3.



3. Pass the following cables from the Arm3 side to the Arm4 side.

CAUTION

Forcibly pulling on the cables may cause the connectors to disconnect, damage the connectors, or break the cables.

- CN351/CN361/FB14 cable
- LAN cable (CN581-3)
- Air Tubes (blue/white)

POINT

1. Pass the braid tube from the Arm4 side to the Arm3 side. Insert the connectors through the braid tube, as shown in the figure, and secure the tube with the wire tie so that connectors are not pulled out. Use a braid tube.





2. While feeding cables from the Arm3 side, pull the braid tube from the Arm4 side
to pass the cables through the tube.
If it is difficult to pass the cables through the tube, pass the cables one by one in
the order below. When doing so, securing the connector to the tip of a long wire
makes the work easier to perform.
CN351-1 cable, CN361-1 cable, LAN cable, Ground Wire, Air Tubes (blue/white)

4. Pass the Cable Unit (Arm4 side) separated in <Preparation> Step 2 through Arm4 to Arm3.



POINT

<C8XL only>

Pass the following cables passed from the Arm3 side through the silicone tube.

- CN351/CN361/FB14 cable
- LAN cable (CN581-3)
- Air Tubes (blue/white)



Installing the Cable Unit



POINT

Bring the Ethernet cable and Air Tube out of the Arm4 J5 Reduction Gear side, as shown in the figure, and bring the remaining cables out of the J6 Reduction Gear side.





S01: 2-M4x10

(4.0 +/- 0.2 N·m)

Arm4 D-sub attachment

A



3. Install the Arm4 D-sub attachment.CAUTIONBe careful not to let the cables get pinched in the attachment.



4. Connect the J5 Motor Connectors (CN151, CN351, CN451, CN460).



5. Attach the Ground Wires (FB14, FB15, FB17) inside Arm4 to the cable protection plate.















8. Connect the connectors (CN203, CN152, CN162, CN521, CN441, CN522, CN592, LED) inside Arm3.

9. Connect the Arm4-side and base-side Air Tubes with air tube fittings.

POINT

- Connect Air Tubes of the same color.
- The air tube fittings removed from the Cable Unit before replacement will be used again.













2. Temporarily secure the cables to Arm2 using the cable bracket (C3A). **POINT**

- Secure so that the cables can still be pushed up.
- Align the silicone tube and cable bracket (C3A) positions.



Α



3. Push up the whole of the cables by 10 mm in the direction indicated with the arrow to allow for some space.



Cable



Installing the Cable Unit



7. Bind the cable protective spring to the Arm2 cable fixing plate. Wire tie: AB100

Number of turns of spring to fix: 4 turns

Cable protective spring



POINT

Install the Arm2 cable fixing plate on the Cable Unit with the orientation as shown in the figure.









POINT

Secure the Arm2 cable fixing plate by hooking the cutouts onto the fixing bolts.











2. Temporarily secure the cables to Arm1 using the cable bracket (C2). POINT • Secure so that the cables can still be pushed up. • Align the silicone tube and cable bracket (C2) positions. S01: 2-M3x6 A Silicone tube Cable bracket (C2) Cable 3. Push up the whole of the cables by 10 mm in the direction indicated with the arrow to allow for some space. Cable







9. Pass four wire ties through the Arm1 cable fixing plate as shown in the figure. At this point, temporarily fasten the wire ties just tight enough that the cables can move. Wire tie (AB150) Wire tie (AB300) Wire tie (AB150) Wire tie (AB300) Arm1 cable fixing plate 10. Pull out the internal cables from the Arm1 side toward the base side.



11. Temporarily secure the Arm1 cable fixing plate to Arm1. **POINT**

Secure it enough that the plate does not move.

A S01: 2-M4x10



12. Adjust the cable length with attention paid to the following.

- No excess looseness or tension on the cables.
- The cables should not be pressed strongly against the arm edge.
- The CN421, CN121, and CN321 connectors should reach the end face of Arm1 when they are pulled out. The cables should not be too long.



Arm1 end face



13. Place a mark on the cables at the sleeve outlet on the base side.



14. Bind the cables using the wire ties passed through the Arm1 cable fixing plate. (4 locations)

POINT

Branch and secure the cables.

CAUTION

Bind the cables so that the cable positions do not change.










4. Install the plate for preventing cable interference.

S01: 2-M3x6 (2.0 +/- 0.1 N ⋅ m)

Plate for preventing cable interference



POINT

Α

Slide the cutout section on the plate for preventing cable interference, and secure with screws.







5. Connect the Air Tubes (blue/white) in accordance with the indications on the Connector Plate.

CAUTION

Check the Air Tube colors before connecting.

- White: Air1
- Blue: Air2



6. Connect the M/C cable connectors (CN111, CN311, CN410, CN411 (motor/brake), CN3L, CN202, CN312, CN200, CN300, CN201, CN301, CN3G0).





7. Pass the following cables and connectors through the hole in the base.

- D-sub cable
- Ground Wires
- RJ45 connector
- F-sensor connector



8. Install the ground wire terminals (PE3, FB4, FB3, FB16, FB8, FB7, FB6, FB5) to the ground wire plate.











2.10 Replacing the Board

2.10.1 Replacing Gyro Board 1



Removing Gyro Board 1







POINT

Installing Gyro Board 1



1 Install the gyro board 1 protective plate on gyro board 1.

Install the gyro board 1 protective plate to the board with the orientation as shown in the figure. Any orientation is acceptable for installation of the gyro board 1 fixing plate.





2.10.2 Replacing Gyro Board 2



Removing Gyro Board 2





Installing Gyro Board 2









2.10.3 Replacing the DC/DC Board





2.11 Replacing the LED Lamp





- Cê

 Turn OFF the Controller.
Remove the Arm3 cover.
Disconnect the connector (LED) for the LED lamp. **POINT** The connector (LED) for the LED lamp is under the Arm3 cover when it is open.
Remove the LED lamp. **POINT** Turn the plastic nut securing the LED lamp in Arm3 counterclockwise.

Disclosure Scope: Maintenance Trained Personnel Only

Maintenance

2.12 Replacing the M/C Cable

2.12.1 Removing the M/C Cable



Removing the M/C Cable	1	Turn OFF the Controller power.
	2	Disconnect the following connectors from the Controller. Power cable connector, Signal cable connector
	3	Remove the Connector plate. <u>M/C Cable Backward: C8L, M/C Cable Backward: C8XL,C12XL,</u> <u>M/C Cable Downward</u>
	4	Remove the connectors. Connectors: CN111, CN200, CN201, CN202, CN300, CN301, CN3G0, CN312, CN3L1
5	5	Remove the Connector sub plate.

2.12.2 Installing the M/C Cable



1 Install the <u>Connector sub plate</u>.

2

5

Connect the connectors of the new M/C cable to these of the cable unit. Connectors: CN111, CN200, CN201, CN202, CN300, CN301, CN3G0, CN312, CN3L1



3	Install the Connector plate.
	M/C Cable Backward: C8L, M/C Cable Backward: C8XL,C12XL,
	M/C Cable Downward
1	Connect the following connectors to the Controllor

Connect the following connectors to the Controller.

Power cable connector, Signal cable connector

Turn ON the Controller power.

2.13 Replacing the Fan (C8XL/C12XL only)

2.13.1 Removing the Fan





2.13.2 Installing the Fan



Install the fan, and connect the connector (FAN).



POINT

1

Ensure that the fan cables are at the top, and install so that the cables are toward the heat sink.





2.14 Cover

Here, this explains the names of the covers using the typical "M/C Cable Backward Model (Standard Model/Cleanroom Model)".





2.14.1 Base Cover (M/C Cable Backward)

Standard Model/Cleanroom Model





Protection Model

A. Removal





B. Installation



1 Install the base bottom gasket in the groove on the base bottom.

POINT If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.



2 Install the base cover. CAUTION

- If bolts other than the hexagon socket head cap screws are used, the bolt heads may protrude from the end face of the base and the cover may not be fixed stably.
- When installing the cover, be careful not to pinch the Rubber Gasket and cables. Also, do not bend or push the cables in using excessive force.



2.14.2 Base Cover (M/C Cable Downward) (C8L)

Standard Model/Cleanroom Model





Protection Model

A. Removal





B. Installation






2

3

2.14.3 Base Cover (M/C Cable Downward) (C8XL, C12XL)





A. Removal











2.14.4 Base Maintenance Cover





A. Removal



1 Remove the Base Maintenance Cover.

POINT

When removing the Base Maintenance Cover, also remove the base maintenance gasket.







2.14.5 Arm1 Center Cover





A. Removal



 Remove the Arm1 center cover.
 POINT
 When removing the Arm1 center cover, also remove the Arm1 center gasket.
 S01: 5-M4x12 with washer



Install the Arm1 center gasket in the groove on the Arm1 center cover.
POINT

If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.



Install the Arm1 center cover.

CAUTION

2

When installing the cover, be careful not to pinch the Rubber Gasket and cables. Also, do not bend or push the cables in using excessive force.



2.14.6 Arm1 Side Cover



A. Removal



(1) Remove the Arm1 side cover.

 POINT

 When removing the Arm1 side cover, also remove the Arm1 side gasket.

 A

 S01: 8-M4x12 with washer

 Image: Arm1 side cover

 Arm1 side cover



Install the Arm1 side gasket in the groove on the Arm1 side cover.

POINT

If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.



2 Install the Arm1 side cover on the Manipulator.

CAUTION

When installing the cover, be careful not to pinch the Rubber Gasket and cables. Also, do not bend or push the cables in using excessive force.



2.14.7 Arm2 Side Cover





A. Removal







Install the Arm2 side gasket in the groove on the Arm2 side cover.

If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.



2 Install the Arm2 side cover on the Manipulator.

CAUTION

POINT

When installing the cover, be careful not to pinch the Rubber Gasket and cables. Also, do not bend or push the cables in using excessive force.



2.14.8 Arm3 Cover







A. Removal







Install the Arm3 gasket in the groove on the Arm3 Cover.

POINT If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.



2 Install the Arm3 Cover on the Manipulator.

CAUTION

When installing the cover, be careful not to pinch the Rubber Gasket and cables. Also, do not bend or push the cables in using excessive force.



2.14.9 Arm3 Maintenance Cover





A. Removal



(1)Move the arm to a position where the cover can be easily removed.

Remove the Arm3 maintenance cover.

POINT

When removing the Arm3 maintenance cover, also remove the Arm3 maintenance gasket.







-	lestell the energy on the holes in the Diskhan Orabet (Andress)		
U	Install the spacers on the holes in the Rubber Gasket. (4 places)		
2	Apply t mainte POINT • Afte Ru • If ar Ga	the liquid gasket to mance gasket to the er applying the liqui ubber Gasket is fixe ny damage or deten asket. Gasket applying Spacer	the Arm3 maintenance gasket, and secure the Arm3 e Arm3 maintenance cover. d gasket, leave it until the liquid gasket becomes solid and the ed. rioration is observed in the Rubber Gasket, replace the Rubber $\underbrace{\operatorname{Orrel}_{Arm3} \operatorname{maintenance} \operatorname{cover}_{Arm3} \operatorname{maintenance} \operatorname{gasket}}_{Arm3}$

Installation



3 Install the Base Maintenance Cover.

CAUTION

When installing the cover, be careful not to pinch the Rubber Gasket and cables. Also, do not bend or push the cables in using excessive force.

A S01: 4-M4x10 (4.0 +/- 0.2 N·m)



2.14.10 Arm4 Side Cover





A. Removal



Remove the Arm4 side cover. POINT When removing the Arm4 side cover, also remove the Arm4 side gasket. A S01: 7-M4x12 with washer Arm4 side cover **EPSON** CAUTION The Rubber Gasket has spacers. Be careful not to lose these spacers. Spacer Disconnect the connector. • Cover (left): RJ45 connector RJ45 connector



Maintenance

Cover (right): F-sensor connector
Open the two plastic clips of the connector on the cover and pull out the metallic
connector.

 F-sensor connector



Install the Arm4 side gasket in the groove on the Arm4 side cover.

If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.



Insert the connectors (RJ45 connector/F-sensor connector).

3 Install the Arm4 side cover on the Manipulator.

CAUTION

1

POINT

When installing the cover, be careful not to pinch the Rubber Gasket and cables. Also, do not bend or push the cables in using excessive force.



Arm4 side cover **EPSON**

2.14.11 Arm4 Maintenance Cover





A. Removal



(1)Move the arm to a position where the cover can be easily removed.

2 Remove the Arm4 maintenance cover.

POINT

When removing the Arm4 maintenance cover, also remove the Arm4 maintenance gasket.

A



1

B. Installation





2.14.12 Arm4 D-sub Attachment

Standard Model/Cleanroom Model



Remove the Arm4 D-sub attachment. (1)

CAUTION

- Cables are connected internally, so do not pull with force when removing.
- When installing the attachment, be careful not to pinch the cables. Also, do not bend or push the cables in using excessive force.





A. Removal



1 Remove the Arm4 D-sub attachment.

CAUTION

Cables are connected internally, so do not pull with force when removing.

POINT

A

When removing the D-sub attachment, also remove the D-sub attachment gasket.





1 Install the D-sub attachment gasket in the groove on the D-sub attachment. POINT

If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.



2.14.13 Connector Plate (M/C Cable Backward) (C8L)

Standard Model/Cleanroom Model



CAUTION

- Do not pull the Connector Plate with force. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.
- At reassembly, check the cable arrangement when removing the Connector Plate in order to return to a reasonable wiring arrangement.
- When installing the Connector Plate, do not nip the Rubber Gasket or cables, or bend and push them in using excessive force. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.

(1) Remove the Connector Plate.



(1)

Protection Model

A. Removal



CAUTION • Do not pull the Connector Plate with force. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. • At reassembly, check the cable arrangement when removing the Connector Plate in order to return to a reasonable wiring arrangement. Remove the Connector Plate. POINT When removing the Connector Plate, also remove the base rear gasket. S01: 11-M4x10 **Connector Plate** CAUTION The Rubber Gasket has spacers. Be careful not to lose these spacers. Spacer
B. Installation



CAUTION

1

When installing the Connector Plate, do not nip the Rubber Gasket or cables, or bend and push them in using excessive force. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.

Install the spacers on the holes in the Rubber Gasket. (11 places)



2 Apply the liquid gasket to the base rear gasket, and secure the base rear gasket to the Connector Plate.

POINT

- After applying the liquid gasket, leave it until the liquid gasket becomes solid and the Rubber Gasket is fixed.
- If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.





3

2

2.14.14 Connector Plate (M/C Cable Backward) (C8XL, C12XL)

Standard Model/Cleanroom Model



CAUTION

- Do not pull the Connector Plate with force. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.
- At reassembly, check the cable arrangement when removing the Connector Plate in order to return to a reasonable wiring arrangement.
- When installing the Connector Plate, do not nip the Rubber Gasket or cables, or bend and push them in using excessive force. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.

(1) Remove the fan.





(3)

Protection Model

A. Removal



CAUTION

- Do not pull the Connector Plate with force. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.
- At reassembly, check the cable arrangement when removing the Connector Plate in order to return to a reasonable wiring arrangement.

Remove the fan.

(2) Remove the heat sink.

POINT

(1)

- When removing the heat sink, remove the Rubber Gasket on the heat sink and Connector Plate.
- When removing the Connector Plate, also remove the base rear gasket.

A S01: 4-M4x15

CAUTION

The Rubber Gasket has spacers. Be careful not to lose these spacers.



Heat sink

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B. Installation



CAUTION

When installing the Connector Plate, do not nip the Rubber Gasket or cables, or bend and push them in using excessive force. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.

1 Install the spacers on the holes in the Rubber Gasket. (11 places)



Apply the liquid gasket to the base rear gasket, and secure the base rear gasket to the Connector Plate.

POINT

- After applying the liquid gasket, leave it until the liquid gasket becomes solid and the Rubber Gasket is fixed.
- If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.





2.14.15 Connector Plate (M/C Cable Downward)

Standard Model/Cleanroom Model



CAUTION

- Cables are connected internally, so do not pull with force when removing.
- At reassembly, check the cable arrangement when removing the Connector Plate in order to return to a reasonable wiring arrangement.
- When installing the Connector Plate, do not nip the Rubber Gasket or cables, or bend and push them in using excessive force. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.

(1) Remove the Connector Plate.



Protection Model

A. Removal



CAUTION

- Cables are connected internally, so do not pull with force when removing.
- At reassembly, check the cable arrangement when removing the Connector Plate in order to return to a reasonable wiring arrangement.
- (1) Remove the Connector Plate.

POINT

When removing the Connector Plate, also remove the base bottom gasket together.



B. Installation



CAUTION

When installing the Connector Plate, do not nip the Rubber Gasket or cables, or bend and push them in using excessive force. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.

Install the base bottom gasket in the groove on the base bottom.

POINT

A

1

2

If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.

Install the Connector Plate.



2.14.16 Connector Sub Plate

Standard Model/Cleanroom Model



Remove the Connector Plate. (1)M/C Cable Backward: C8L, M/C Cable Backward: C8XL, C12XL, M/C Cable Downward CAUTION Attempting to remove the connector sub plate alone while the connectors are still connected may damage the cables. (2)Disconnect the Ground Wires (PE2). A S04: 1-M4x6 Connector Plate Connector sub plate

3

Standard Model/Cleanroom Model



Remove the connector sub plate. CAUTION Cables are connected internally, so do not pull with force when removing. A S01: 4-M4x10 with seal washer



Protection Model

A. Removal



(1)Remove the Connector Plate. M/C Cable Backward: C8L, M/C Cable Backward: C8XL, C12XL, M/C Cable Downward CAUTION Attempting to remove the connector sub plate alone while the connectors are still connected may damage the cables. 2 Disconnect the Ground Wires (PE2). A S04: 1-M4x6 **Connector Plate** Connector sub plate



Maintenance

Remove the connector sub plate.

CAUTION

Cables are connected internally, so do not pull with force when removing.

POINT

(3)

When removing the connector sub plate, also remove the base sub plate gasket together.





• Be careful not to lose the seal washers.

B. Installation



1	Install the spacers on the holes in the Rubber Gasket. (4 places)					
			Spacer			
2	Apply the liquid gasket to the base sub plate gasket, and secure the base sub plate gasket					
	POINT					
	 After applying the liquid gasket, leave it until the liquid gasket becomes solid and the Rubber Gasket is fixed. 					
	 If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket. 					
	0	Gasket applying				
	0	Spacer	Connector sub plate			
			Sub plate gasket			





Adjustment

3.1 Adjusting the Timing Belt Tension

The Manipulator uses six types of Timing Belts.

When removing or replacing parts related to the belt, be sure to adjust the tension of the Timing Belt.

• If the belt tension falls below the lower limit, the belt may jump off the teeth and cause positioning failure.

If the belt tension exceeds the upper limit, it may cause oscillation (abnormal noise) and reduce the service life of parts.

CAUTION • When the belt is replaced with a new one, the belt may stretch and lose tension at first.

Be sure to check the belt tension again after operating the robot for a few days.

3.1.1 Items to be prepared

- Force gauge
- Sonic Belt Tension Meter Recommended: U-508 (Gates Unitta)
- Suitable cord (Length about 800 mm)
- Belt Tensioner JIG (Maintenance Parts Code: 1674582)

3.1.2 Belt Tension Values

Tension Meter setting values

	J1	J2	J3	J4	J5	J6
Unit mass (g/mm width x m span)	4.0	4.0	2.5	2.5	2.5	2.5
Belt width (mm)	20	14	10	6	6	6
Belt span (mm)	160	146	168	61	117	122

Tension standard values

	J1	J2	J3	J4	J5	J6
Belt tension (Minimum to maximum) (N)	89 to 149	58 to 95	25 to 85	15 to 30	15 to 30	15 to 30

C8-B/C12-B Service Man	ual	Adjustment	Disclosure Scope: Maintenance Trained Personnel Only	
3.1.3 Adjustment I	<u>lethod</u>			
	 Make sure that the belt is set Temporarily tighten the parts tightening torque. 	to be level with respect to the pulle used to adjust the belt tension. After	ey without it being placed on the flange. er adjusting the tension, tighten the bolts with the correct	
	• Take care not to apply exces	sive tension to the belt.		
	Measure the tension near the	ecenter of the belt.		

Joint #1 Timing Belt

- 1. Apply the proper tension to the Joint #1 timing belt and secure the Joint #1 motor unit.
- When securing the motor unit, attach the heat dissipation sheet to the right side of the base (when seeing from the rear side of the Manipulator).

Joint #1 timing belt tension: 89 to 149 N

Belt tension meter setting values

Weight: 4.0 g/mm width x m span, Width: 20 mm, Span: 160 mm



NOTE

<When using the belt tensile jig (maintenance part)>

Use the specified screws to temporarily secure the belt tensile jig (for J1, J2, J3) to the Joint #1 motor plate. As the screw is tightened, the Joint #1 motor unit will be pulled and tension will be applied.



<For C8XL/C12XL>

The belt tensile jig can be used even when the heat radiation block is assembled together with the motor.

Remove the screws (S01: 1-Mx15) securing the heat radiation block to the motor plate, and use the specified screws (S01: 1-M5x45).

When belt adjustment is complete, secure the heat radiation block to the motor plate using the screws (S01: 1-M5x15 (8.0 +/- $0.4 \text{ N} \cdot \text{m}$)).



Joint #2 Timing Belt

1. Apply the proper tension to the Joint #2 timing belt and secure the Joint #2 motor unit.

Joint #2 timing belt tension: 58 to 95 N

Belt tension meter setting values

Weight: 4.0 g/mm width x m span, Width: 14 mm, Span: 146 mm



NOTE

When using the belt tensile jig (maintenance part):

Fix the belt tensile jig (for J1, J2, and J3) with the screws (2-M4x35) and push the rubber against the pulley. Tension can be applied by pushing the rubber with the set screw (M6x25).



Joint #3 Timing Belt

1. Apply the proper tension to the Joint #3 timing belt and secure the Joint #3 motor unit.

Joint #3 timing belt tension: 25 to 85 N

Belt tension meter setting values

Weight: 2.5 g/mm width x m span, Width: 10 mm, Span: 168 mm



NOTE

When using the belt tensile jig (maintenance part):

Fix the belt tensile jig (for J1, J2, J3) with the screws (2-M4x35) and push the rubber against the pulley. Tension can be applied by pushing the rubber with the set screw (M6x25).



S01: 2-M4x15 and washer (4.0 +/- 0.2 № m)

Joint #4 timing belt tension: 15 to 30 N Belt tension meter setting values



Adjustment

When using the belt tensile jig (maintenance part): Fix the belt tensile jig (for J4, J5, J6) to the Joint #4 motor plate.

Weight: 2.5 g/mm width x m span, Width: 6 mm, Span: 61 mm

Belt tensile jig (for J4, J5, J6)

1. Apply the proper tension to the Joint #4 timing belt and secure the Joint #4 motor unit.

Joint #4 Timing Belt

Push the belt tensile jig (for J4, J5, and J6) against the Arm #3 as shown in the photo. Insert the screw to the through hole at the center and fix it lightly to the hole for the belt tensile jig.

As the screw is tightened, the Joint #4 motor unit will be pulled and tension will be applied.



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Joint #5 Timing Belt

S01: 2-M4x15 and washer (4.0 +/- 0.2 N· m)

Weight: 2.5 g/mm width x m span, Width: 6 mm, Span: 117 mm

Joint #5 timing belt tension: 15 to 30 N Belt tension meter setting values





NOTE

When using the belt tensile jig (maintenance part):

Fix the belt tensile jig (for J4, J5, and J6) with the screws (2-M4x15) and push the rubber against the pulley. Tension can be applied by pushing the rubber with the set screw (M6x15).



1. Apply the proper tension to the Joint #5 timing belt and secure the Joint #5 motor unit.

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Joint #6 Timing Belt

Belt tension meter setting values

Weight: 2.5 g/mm width x m span, Width: 6 mm, Span: 122 mm

1. Apply the proper tension to the Joint #6 timing belt and secure the Joint #6 motor unit.

and washer (4.0 +/- 0.2 N[.] m)



Adjustment



NOTE

When using the belt tensile jig (maintenance part):

S01: 2-M4x15

Fix the belt tensile jig (for J4, J5, and J6) with the screws (2-M4x15) and push the rubber against the pulley.

Tension can be applied by pushing the rubber with the set screw (M6x15).



3.2 Calibration

3.2.1 What is Calibration?

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.



• 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 the *C-B* series Manual C8 Manipulator 3.1.6 How to Move Arms with the Electromagnetic Brake, C-B series Manual C12 Manipulator 4.1.6 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.

 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 to 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 to or malfunction of the Manipulator.

Also, pay attention to the following points at the encoder initialization.

• The Joint #1 and 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 home positions of the Joints #1 and #4 are uncertain, check torsion of the internal cables. The home positions NOTE are where the Manipulator has the internal cables not twisted at the basic orientation described in C-B series Manual C8 Manipulator 3.3.6 Checking the Basic orientation, C-B series Manual C12 Manipulator 4.3.6 Checking the Basic orientation. Torsion of the internal cables can be checked by removing the following covers. Joint #1 : Base cover (Cable backward model), Connecter plate (Cable downward model) Joint #4 : Arm #3 cover (common between cable downward and cable backward models) Arm #3 cover (common between cable downward and cable backward models) Connecter plate Base cover (Cable downward model) (Cable backward model)

For details on Jog & Teach, refer to the following manual.

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NOTE	• For details about the basic orientation, refer to C-B series Manual C8 Manipulator 3.3.6 Checking the Basic orientation, C-B series Manual C12 Manipulator 4.3.6 Checking the Basic orientation.
	 Whenever possible, calibrate one joint at a time. (Also, replace parts of one joint at a time whenever possible.) If you calibrate the origins for multiple joints simultaneously, it will be more difficult to verify their origins and obtain the origin correct positions. However, joint #5 cannot be calibrated alone due to the structure of the Manipulator. Make sure you calibrate joint #5 and #6 at the same time.

3.2.2 Calibration Flowchart



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3.2.3 Calibration Procedure

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 panel, window, and page above are indicated as [Jog & Teach] in the calibration procedures.

Calibration Procedure

Follow steps 1 to 7 to calibrate the Manipulator.

1. Basic Pose Confirmation

Pose data (Point data) prior to the part replacement (motors, reduction gear unit, or belt) is necessary for the calibration.

Verify the recorded pulse values of the basic pose obtained in the C-B series Manual C8 Manipulator 3.3.6 Checking the Basic orientation, C-B series Manual C12 Manipulator 4.3.6 Checking the Basic orientation.

2. Part Replacement

Replace parts as instructed in this manual.

Be careful not to injure yourself or damage parts during part replacement.

3. Encoder Initialization

Turn ON the Controller while all joints are in the motion range.

The error message "Encoder alarm has occurred. Check robot battery. EPSON RC+ must be restarted." will be displayed.

Initialize the encoder at the current position and reset the error.

Initialize the encoder using one of the following procedures.

Execute the following command at the [Monitor Window].



>Encreset [The joint number (1 to 6) of the encoder to be reset]

Select EPSON RC+ menu-[Tools]-[Controller], then click <Reset Controller>.

After resetting the error, the motor encoder of the joint whose parts have been replaced will be initialized.

Set the jog mode to "Joint" in [Jog & Teach] and operate the Manipulator in jog motion to match the home position marks (0 pulse position) of the joint accurately.

When the joint cannot move to the home position, operate the Manipulator to match the tram mark placed in *C-B series Manual C8* Manipulator 3.3.6 Checking the Basic orientation, *C-B series Manual C12 Manipulator 4.3.6 Checking the Basic orientation* as accurate as possible.

Initialize the encoder when the joint matches the home position or the tram mark.

For the encoder initialization, refer to the procedure indicated above.

NOTEWhen 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.

4. Calibration

Calibration marks of each joint



4-1. Move the arm you want to calibrate to the position of the calibration mark.



Select menu-[Tool]-[Robot Manager]-[Jog & Teach] panel to move the Manipulator.

If an error occurs after replacing the motor and you cannot use the [Jog & Teach] panel or "Brake OFF, *" does not work (* is an axis number to calibrate.), go through the steps 4 and 5 now.

Then, [Jog & Teach] panel and "Brake OFF, *" will be available. Move the arm you want to calibrate to the position of the calibration mark.

4-2.Reset the encoder.



Execute one of the following commands to reset the encoder of the joint you want to calibrate from the menu-[Tool]-[Command Window].

- 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.



Click EPSON RC+ menu-[Tool]-[Controller]-<Reset Controller>.

4-4.Input the command in the Command window and execute it.



Execute one of the following commands to reset the encoder of the joint you want to calibrate from the menu-[Tool]-[Command Window].

>calpls 0,0,0,0,0,0

* Manipulator does not move.

4-5.Perform the calibration.



Execute one of the following commands to reset the encoder of the joint you want to calibrate from the menu-[Tool]-[Command Window].

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

- Warning 590 (Detect the different of the calibration settings in the controller and Safety Board) occurs when the Calib command are executed.
 - Warning 590 is cleared by updating the Hofs value in the safety board.
5. Calibration (More accurate positioning)



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 being calibrated, move the Joints #1 - #4 to the home positions.

For example, when the selected point data is "P1", execute "Motor On" in [Control Panel] and execute "Go P1" in [Jog & Teach].

Position the calibrating joint* to the selected point data position accurately by jog command.

* When the Joint #5 is being calibrated, move the Joint #5 and #6 to the home positions.

Select the "Joint" jog mode from [Jog & Teach] to operate in the jog motion.

Enter the command below in the command window and execute it.

Execute the command below in the menu -[Tools]-[Command Window].

>calpls ppls(P1,1), ppls(P1,2), ppls(P1,3), ppls(P1,4), ppls(P1,5), ppls(P1,6)

* The Manipulator will not move.

Perform the calibration. Input one of the following commands according to the joint being calibrated.

- 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
- Warning 590 (Detect the different of the calibration settings in the controller and Safety Board) occurs when the Calib command are executed.
 - Warning 590 is cleared by updating the Hofs value in the safety board.

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.

7. Verification

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RC700E is required to verifying the safety function after completing calibration.

For details on the verification procedure, refer to the RC700-E Series Service Manual 3.4 Setup Procedure After Parts Replacement (Safety Board).



Block Diagram/Wiring Diagram

4.1 Block Diagram

4.1.1 C8-B



<u>4.1.2 C12-B</u>



4.2 Wiring Diagram

4.2.1 Ground Wire (PE, FB)



No.	Connection	
(1)	FB15 - FB8	
(2)	FB14 - FB6	
(3)	FB17 - FB16	
(4)	FB12 - FB4	
(5)	FB13 - FB5	
(6)	FB11 - FB3	
(7)	FB2 - M/C Signal	
(8)	FB1 - M/C Power	
(9)	FB9 - F-sensor	
(10)	FB10 - RJ45	
(11)	Gyro board 1- CN6 - Gyro board 2- CN3G0 - M/C Signal	
(12)	PE1 - M/C Power	
(13)	PE2 - PE4	
(14)	PE6 - PE3	
(15)	PE7 - PE10	
(16)	PE11 - PE9	
(17)	PE8 - PE5	

4.2.2 Motor Cable



No.	Connection			
(1)	Joint #1 Motor - CN311 - CN312 - M/C Signal			
(2)	Joint #2 Motor - CN321	ON1000 M/O O'meet		
(3)	Joint #3 Motor - CN331	- CN300 - M/C Signal		
(4)	Joint #4 Motor - CN341	_		
(5)	Joint #5 Motor - CN351	- CN301 - M/C Signal		
(6)	Joint #6 Motor - CN361	-		

4.2.3 Brake Wire, LED Wire



No.	Connection			
(1)	A Broke CN410 Broke Dower Supply CN411	- B-release		
(1)	JI BIAKE - CIN410 - BIAKE Power Supply - CIN411	- CN202 - M/C Power		
()	In Dealer ON1400, Dealer Devery Oversity, ON1404	- B-release		
(2)	J2 Brake - CIN420 - Brake Power Supply - CIN421	- CN202 - M/C Power		
(2)	J3 Brake - CN430 - Brake Power Supply - CN431	- B-release		
(3)		- CN202 - M/C Power		
(4)	J4 Brake - CN440 - Brake Power Supply - CN441	- B-release		
		- CN202 - M/C Power		
		- B-release		
(5)	JS Brake - CIN450 - Brake Power Supply - CIN451	- CN202 - M/C Power		
	J6 Brake - CN460 - Brake Power Supply - CN461	- B-release		
(6)		- CN202 - M/C Power		
(7)		- B-release		
(7)	LED - CINSLU -	- CN3L1 - M/C Signal		

4.2.4 User Plate

	D- sub 15pin		
F-sensor	RJ45	(3)	
			RJ45 F-sensor D-sub 15pin
	(1)	(2)	

No.	Connection		
(1)	F-sensor - CN592 - F-sensor		
(2)	D-sub 15pin - CN521 - D-sub 15pin		
(3)	RJ45 - RJ45		



Exploded View/Maintenance Parts List

5.1 Exploded View

<u>5.1.1 C8-B</u>





C8L/C8XL No.2







C8L/C8XL No.5

<u>5.1.2 C12-B</u>





C12-B No.2







5.2 Maintenance Parts List

<u>5.2.1 C8-B</u>

Ref. No.	Parts Name	Parts Code	Note	Overhaul
001	Timing Belt	1655929	Joint #1 (C8L-B)	
002	Timing Belt	1655930	Joint #1 (C8XL-B)	
003	Motor	2232752	Joint #1	
004	Brake	2172926	Joint #1, Joint #2	
005	Reduction Gear Unit	1674603	Joint #1 (C8L-B)	
006	Reduction Gear Unit	1674604	Joint #1 (C8XL-B)	
007	Timing Belt	1655924	Joint #2 (C8L-B)	
008	Timing Belt	1655927	Joint #2 (C8XL-B)	
009	Motor	2230547	Joint #2	
010	Reduction Gear Unit	1674605	Joint #2 (C8L-B)	
011	Reduction Gear Unit	1674606	Joint #2 (C8XL-B)	
012	Timing Belt	1655918	Joint #3 (C8L-B)	
013	Timing Belt	1655919	Joint #3 (C8XL-B)	
014	Motor	2230549	Joint #3	
015	Brake	2172927	Joint #3	
016	Reduction Gear Unit	1933056	Joint #3 (C8L-B)	
017	Reduction Gear Unit	1674608	Joint #3 (C8XL-B)	
018	Timing Belt	1655931	Joint #4	
019	Motor	2232753	Joint #4, Joint #5, Joint #6	
020	Brake	2172928	Joint #4, Joint #5, Joint #6	
021	Reduction Gear Unit	1674609	Joint #4 (C8L-B)	
022	Reduction Gear Unit	1675434	Joint #4 (C8XL-B)	

C8-B/C12-B Service Manual		Exploded View/Maintena	Exploded View/Maintenance Parts List		Disclosure Scope: Maintenance Trained Personnel Only	
Ref. No.	Parts Name	Parts Code		Note	Overhaul	
023	Timing Belt	1655932	Joint #5		\checkmark	
024	Timing Belt	1655933	Joint #6		\checkmark	
025	Gyro Board 1	2228302				
026	Gyro Board 2	2228303				
027	DC/DC Board	2172386				

<u>5.2.2 C12-B</u>

Ref. No.	Parts Name	Parts Code	Note	Overhaul
001	Timing Belt	1655930	Joint #1	\checkmark
002	Motor	2232752	Joint #1	\checkmark
003	Brake	2172926	Joint #1, Joint #2	\checkmark
004	Reduction Gear Unit	1674604	Joint #1	\checkmark
005	Timing Belt	1655927	Joint #2	\checkmark
006	Motor	2230547	Joint #2	\checkmark
007	Reduction Gear Unit	1674606	Joint #2	\checkmark
008	Timing Belt	1655919	Joint #3	\checkmark
009	Motor	2230549	Joint #3	\checkmark
010	Brake	2172927	Joint #3	\checkmark
011	Reduction Gear Unit	1654199	Joint #3	\checkmark
012	Timing Belt	1655931	Joint #4	\checkmark
013	Motor	2230550	Joint #4, Joint #5, Joint #6	\checkmark
014	Brake	2172928	Joint #4, Joint #5, Joint #6	\checkmark
015	Reduction Gear Unit	1821978	Joint #4	\checkmark
016	Timing Belt	1655932	Joint #5	\checkmark
017	Timing Belt	1655933	Joint #6	\checkmark
020	Gyro Board 1	2228302		
021	Gyro Board 2	2228303		
022	DC/DC Board	2224571		