EPSON

Robot System

Safety and Installation

Read this manual first

Rev.15 EM183B3598F

Robot Controller Control Unit RC700
RC700-A
Drive Unit RC700DU
RC700DU-A

Programming Software EPSON RC+7.0

Manipulator G1 G3 G6 G10 G20 series
RS series
C4 C8 series
N2 N6 series
X5 series

Robot System　Safety and Installation (RC700 / EPSON RC+7.0)　Rev.15

Robot System　Safety and Installation
(RC700 / EPSON RC+7.0)

Rev.15

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FOREWORD

Thank you for purchasing our robot products.

This manual contains the information necessary for the correct use of the robot system.

Please carefully read this manual and other related manuals before installing the robot system.

Keep this manual handy for easy access at all times.

WARRANTY

The robot system and its optional parts are shipped to our customers only after being subjected to the strictest quality controls, tests, and inspections to certify its compliance with our high performance standards.

Product malfunctions resulting from normal handling or operation will be repaired free of charge during the normal warranty period. (Please ask your Regional Sales Office for warranty period information.)

However, customers will be charged for repairs in the following cases (even if they occur during the warranty period):

1. Damage or malfunction caused by improper use which is not described in the manual, or careless use.
2. Malfunctions caused by customers' unauthorized disassembly.
3. Damage due to improper adjustments or unauthorized repair attempts.
4. Damage caused by natural disasters such as earthquake, flood, etc.

Warnings, Cautions, Usage:

1. If the robot system associated equipment is used outside of the usage conditions and product specifications described in the manuals, this warranty is void.
2. If you do not follow the WARNINGS and CAUTIONS in this manual, we cannot be responsible for any malfunction or accident, even if the result is injury or death.
3. We cannot foresee all possible dangers and consequences. Therefore, this manual cannot warn the user of all possible hazards.

TRADEMARKS

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TRADEMARK NOTATION IN THIS MANUAL

Microsoft® Windows® XP Operating system

Microsoft® Windows® Vista Operating system

Microsoft® Windows® 7 Operating system

Microsoft® Windows® 8 Operating system

Microsoft® Windows® 10 Operating system

Throughout this manual, Windows XP, Windows Vista, Windows 7, Windows 8, and Windows 10 refer to above respective operating systems. In some cases, Windows refers generically to Windows XP, Windows Vista, Windows 7, Windows 8, and Windows 10.

NOTICE

No part of this manual may be copied or reproduced without authorization.

The contents of this manual are subject to change without notice.

Please notify us if you should find any errors in this manual or if you have any comments regarding its contents.

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Regarding battery disposal

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

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

The battery removal/replacement procedure is described in the following manuals:
Controller manual / Manipulator manual (Maintenance section)

For California customers only

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

Before Reading This Manual

NOTE

Concerning the security support for the network connection:
The network connecting function (Ethernet) on our products assumes the use in the local network such as the factory LAN network. Do not connect to the external network such as Internet.
In addition, please take security measure such as for the virus from the network connection by installing the antivirus software.

NOTE

Security support for the USB memory:
Make sure the USB memory is not infected with virus when connecting to the Controller.

Control System Configuration

Robot Controller Drive Unit RC700DU is available for the following version.

EPSON RC+ 7.0 Ver.7.1.0 or later

Robot Controller RC700-A
Robot Controller Drive Unit RC700DU-A is available for the following version.

EPSON RC+ 7.0 Ver.7.1.2 or later

Manipulators can be connected with the following versions.

C4 series	: EPSON RC+ 7.0 Ver.7.0.0
C8 series (C8XL)	: EPSON RC+ 7.0 Ver.7.1.3
C8 series (C8, C8L)	: EPSON RC+ 7.0 Ver.7.1.4
C8 series (wall mounting)	: EPSON RC+ 7.0 Ver.7.2.0
N2 series	: EPSON RC+ 7.0 Ver.7.2.0
N6 series	: EPSON RC+ 7.0 Ver.7.3.4
G1, G3, G6, G10, G20, RS series	: EPSON RC+ 7.0 Ver.7.1.2
X5 series	: EPSON RC+ 7.0 Ver.7.3.0

China RoHS

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产品中有害物质的名称及含量

机器人型号名称	C4 C8 G1 G3 G6 G10 G20 RS3 RS4 N2 N6 X5系列						适用的系列								
部件名称	有害物质						C4	C8	G1	G3	G6	G10 G20	RS3 RS4	N2 N6	X5
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)									
机器人	×	○	○	○	○	○									
电机（执行器单元、电机单元）	×	○	○	○	○	○	レ	レ	レ	レ	レ	レ	レ	レ	レ
减速机单元	×	○	○	○	○	○	レ	レ	レ	レ	レ	レ	レ	レ	－
电磁制动器	×	○	○	○	○	○	レ	レ	レ	レ	レ	レ	レ	レ	－
同步皮带	○	○	○	○	○	○	レ	レ	レ	レ	レ	レ	レ	レ	－
电池单元（电池、电池固定架、电池基板）	×	○	○	○	○	○	レ	レ	レ	レ	レ	レ	レ	レ	－
密封（密封填料、油封、密封脂、垫片、O型环）	×	○	○	○	○	○	レ	レ	レ	レ	レ	レ	レ	レ	－
润滑脂	○	○	○	○	○	○	レ	レ	レ	レ	レ	レ	レ	レ	－
电缆（M/C电缆、连接电缆）	×	○	○	○	○	○	レ	レ	レ	レ	レ	レ	レ	レ	レ
散热片	○	○	○	○	○	○	レ	レ	－	レ	－	レ	－	－	－
LED指示灯	○	○	○	○	○	○	レ	レ	レ	レ	レ	レ	レ	レ	－
电路板	×	○	○	○	○	○	レ	レ	レ	レ	レ	レ	レ	レ	－
外罩	○	○	○	○	○	○	レ	レ	レ	レ	レ	レ	レ	レ	－
滚珠丝杠花键	○	○	○	○	○	○	－	－	レ	レ	レ	レ	レ	－	－
制动解除开关	×	○	○	○	○	○	－	－	レ	レ	レ	レ	レ	－	－
伸缩罩	○	○	○	○	○	○	－	－	レ	レ	レ	レ	レ	－	－
FPC单元	×	○	○	○	○	○	－	－	－	－	－	－	－	レ	－
扎带	○	○	○	○	○	○	レ	レ	レ	レ	レ	レ	レ	レ	－
原点标记	○	○	○	○	○	○	－	－	－	－	－	－	－	レ	－
气管接头	×	○	○	○	○	○	レ	レ	レ	レ	レ	レ	レ	レ	－
EZ模块	×	○	○	○	○	○	－	－	－	－	－	－	－	－	レ

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产品环保使用期限的使用条件

关于适用于在中华人民共和国境内销售的电器电子产品的环保使用期限，在遵守该产品的安全及使用注意事项的条件下，从生产日期开始计算，在标志的年限内，本产品中含有的有害物质不会对环境造成严重污染或对人身、财产造成严重损害。

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产品中有害物质的名称及含量

机器人型号名称		C4 C8 G1 G3 G6 G10 G20 RS3 RS4 N2 N6 X5系列						适用的系列									
部件名称		有害物质						C4	C8	G1	G3	G6	G10 G20	RS3 RS4	N2	N6	X5
		铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)										
选件	制动解除单元	×	○	○	○	○	○	レ	レ	－	－	－	－	－	レ	レ	－
	相机安装板	○	○	○	○	○	○	レ	レ	－	レ	レ	レ	レ	レ	レ	レ
	PS兼容板（工具适配器）	×	○	○	○	○	○	レ	レ	－	－	－	－	－	レ	レ	－
	底座侧固定金属件	×	○	○	○	○	○	レ	レ	－	－	－	－	－	－	－	－
	可调机械挡块	×	○	○	○	○	○	レ	レ	－	－	－	－	－	－	－	－
	MC短接连接器	×	○	○	○	○	○	－	レ	－	－	－	－	－	レ	レ	－
	用户接头套件	×	○	○	○	○	○	レ	レ	－	－	－	－	－	レ	－	－
	用户连接器套件	×	○	○	○	○	○	レ	レ	－	－	－	－	－	レ	レ	－
	原点调整板	×	○	○	○	○	○	－	－	－	－	－	－	－	レ	－	－
	地面支架	×	○	○	○	○	○	－	－	－	－	－	－	－	レ	－	－
	配线引导装置	×	○	○	○	○	○	－	－	－	－	－	－	－	レ	－	－
	力传感器	×	○	○	○	○	○	レ	レ	－	レ	レ	レ	レ	レ	レ	－

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产品中有害物质的名称及含量

控制器型号名称	RC700 RC700-A RC700DU RC700DU-A系列						适用的系列			
部件名称	有害物质						RC700	RC700-A	RC700DU	RC700DU-A
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)				
控制器	×	○	○	○	○	○				
机壳	○	○	○	○	○	○	レ	レ	レ	レ
电路板	×	○	○	○	○	○	レ	レ	レ	レ
开关电源	×	○	○	○	○	○	レ	レ	レ	レ
风扇	×	○	○	○	○	○	レ	レ	レ	レ
线束	×	○	○	○	○	○	レ	レ	レ	レ
电源保护装置	×	○	○	○	○	○	レ	レ	レ	レ
存储卡	×	○	○	○	○	○	レ	レ	レ	レ
电池	○	○	○	○	○	○	レ	レ	レ	レ
连接器附件	×	○	○	○	○	○	レ	レ	レ	レ

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控制器型号名称		RC700 RC700-A RC700DU RC700DU-A系列						适用的系列			
部件名称		有害物质						RC700	RC700-A	RC700DU	RC700DU-A
		铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)				
选件	电路板	×	○	○	○	○	○	レ	レ	–	–
	接线	×	○	○	○	○	○	レ	レ	レ	レ
	接线端子	×	○	○	○	○	○	レ	レ	レ	レ
	紧急停止开关	×	○	○	○	○	○	レ	レ	レ	レ
	TP1	×	○	○	○	○	○	レ	レ	–	–
	TP2	×	○	○	○	○	○	レ	レ	–	–
	TP3	×	○	○	○	○	○	–	レ	–	–
	墙面安装金属件	×	○	○	○	○	○	レ	レ	–	–
	Hot Plug Kit	×	○	○	○	○	○	–	レ	–	–
	CK1	×	○	○	○	○	○	レ	レ	–	–
	CV1	×	○	○	○	○	○	レ	レ	–	–
	CV2	×	○	○	○	○	○	レ	レ	–	–
	相机	×	○	○	○	○	○	レ	レ	–	–
	延长管	×	○	○	○	○	○	レ	レ	–	–
	GigE相机PoE 转换器	×	○	○	○	○	○	レ	レ	–	–
	GigE相机PoE 交换集线器	×	○	○	○	○	○	レ	レ	–	–
	GigE相机三脚 架适配器	×	○	○	○	○	○	レ	レ	–	–
	以太网交换机	×	○	○	○	○	○	レ	レ	–	–
	力传感器I/F (FC1, FC2)	×	○	○	○	○	○	レ	レ	–	–
	USB选件密钥	×	○	○	○	○	○	レ	レ	–	–
	VRT	×	○	○	○	○	○	レ	レ	レ	レ

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附注： 本表格及环保使用期限标志依据中国的有关规定而制定，中国以外的国家/地区则无需关注。

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1. Safety

Installation and transportation of robots and robotic equipment shall be performed by qualified personnel and should conform to all national and local codes.

Please read this manual and other related manuals before installing the robot system or before connecting cables.
Keep this manual handy for easy access at all times.

1.1 Conventions

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

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

1.2 Design and Installation Safety

Only trained personnel should design and install the robot system. Trained personnel are defined as those who have taken robot system training held by the manufacturer, dealer, or local representative company, or those who understand the manuals thoroughly and have the same knowledge and skill level as those who have completed the training courses.

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*.

The following items are safety precautions for design personnel:

WARNING

- Personnel who design and/or construct the robot system with this product must read the *Safety* chapter in the *EPSON RC+ User's Guide* to understand the safety requirements before designing and/or constructing the robot system. Designing and/or constructing the robot system without understanding the safety requirements is extremely hazardous, and may result in serious bodily injury and/or severe equipment damage to the robot system.
- The Manipulator and the Controller must be used within the environmental conditions described in their respective manuals. This product has been designed and manufactured strictly for use in a normal indoor environment. Using the product in an environment that exceeds the specified environmental conditions may not only shorten the life cycle of the product but may also cause serious safety problems.
- The robot system must be used within the installation requirements described in the manuals. Using the robot system outside of the installation requirements may not only shorten the life cycle of the product but also cause serious safety problems.

Further precautions for installation are mentioned in the following manuals. Please read this chapter carefully to understand safe installation procedures before installing the robots and robotic equipment.

1.2.1 Relevant Manuals

Refer

This manual : 2. Installation
Manipulator manual : Setup & Operation 3. Environment and Installation
Controller manual : Setup & Operation 3. Installation

1.2.2 Designing a Safe Robot System

It is important to operate robots safely. It is also important for robot users to give careful consideration to the safety of the overall robot system design.

This section summarizes the minimum conditions that should be observed when using EPSON robots in your robot systems.

Please design and manufacture robot systems in accordance with the principles described in this and the following sections.

Environmental Conditions

Carefully observe the conditions for installing robots and robot systems that are listed in the “Environmental Conditions” tables included in the manuals for all equipment used in the system.

System Layout

When designing the layout for a robot system, carefully consider the possibility of error between robots and peripheral equipment. Emergency stops require particular attention, since a robot will stop after following a path that is different from its normal movement path. The layout design should provide enough margins for safety. Refer to the manuals for each robot, and ensure that the layout secures ample space for maintenance and inspection work.

When designing a robot system to restrict the area of motion of the robots, do so in accordance with the methods described in each manipulator manual. Utilize both software and mechanical stops as measures to restrict motion.
Install the emergency stop switch at a location near the operation unit for the robot system where the operator can easily press and hold it in an emergency.

Do not install the controller at a location where water or other liquids can leak inside the controller. In addition, never use liquids to clean the controller.

Disabling Power to the System using lock out / tag out

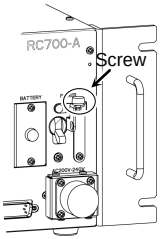
The power connection for the robot controller should be such that it can be locked and tagged in the off position to prevent anyone from turning on power while someone else is in the safeguarded area.

UL-compliant Controller (RC700-A-UL):

Perform lockout using the following procedure.

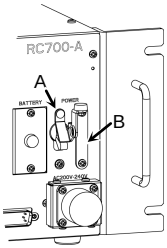
A padlock for lockout should be prepared by users.
Applicable shackle diameter: 4.0 to 6.5 mm

(1) Remove a fixing screw of the lockout bracket A by hand.

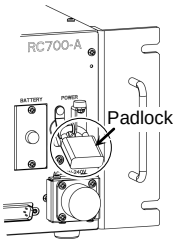


(2) Rotate the lockout bracket A.

(3) Set the screw removed in the step (1) to the lockout bracket B so as not to lose it.



(4) Put a padlock through the holes of the lockout brackets A and B to lock.



End Effector Design

Provide wiring and piping that will prevent the robot end effector from releasing the object held (the work piece) when the robot system power is shut off.

Design the robot end effector such that its weight and moment of inertia do not exceed the allowable limits. Use of values that exceed the allowable limits can subject the robot to excessive loads. This will not only shorten the service life of the robot but can lead to unexpectedly dangerous situations due to additional external forces applied to the end effector and the work piece.

Design the size of the end effector with care, since the robot body and robot end effector can interfere with each other.

Peripheral Equipment Design

When designing equipment that removes and supplies parts and materials to the robot system, ensure that the design provides the operator with sufficient safety. If there is a need to remove and supply materials without stopping the robot, install a shuttle device or take other measures to ensure that the operator does not need to enter a potentially dangerous zone.

Ensure that an interruption to the power supply (power shutoff) of peripheral equipment does not lead to a dangerous situation. Take measures that not only prevent a work piece held from being released as mentioned in “End effector Design” but that also ensure peripheral equipment other than the robots can stop safely. Verify equipment safety to ensure that, when the power shuts off, the area is safe.

Remote Control

To prevent operation by remote control from being dangerous, start signals from the remote controller are allowed only when the control device is set to REMOTE, TEACH mode is OFF, and the system is configured to accept remote signals. Also when remote is valid, motion command execution and I/O output are available only from remote. For the safety of the overall system, however, safety measures are needed to eliminate the risks associated with the start-up and shutdown of peripheral equipment by remote control.

Emergency Stop

Each robot system needs equipment that will allow the operator to immediately stop the system’s operation. Install an emergency stop device that utilizes emergency stop input from the controller and all other equipment.

During the emergency stop, the power supplied to the motor for driving the robot is shut off, and the robot is stopped due to the dynamic brake.

Make sure that all external components that shut off the power in case of emergency are turned OFF by the emergency stop circuit. Do not design to turn OFF the robot controller by using outputs of all I/O boards. For example, if the I/O board is faulty, the controller cannot turn OFF the power of external components. The emergency stop on the controller is hardwired to disconnect the motor power from the robot, but not the external power supplies.

For details of the Safeguard system, refer to the following section.
1.5 Emergency Stop

Safeguard System

To ensure safety, a safeguard system should be installed for the robot system.

When installing the safeguard system, strictly observe the following points:

Refer to each manipulator manual, and install the safeguard system outside the maximum space. Carefully consider the size of the end effector and the work pieces to be held so that there will be no error between the moving parts and the safeguard system.

Manufacture the safeguard system to withstand calculated external forces (forces that will be added during operation and forces from the surrounding environment).

When designing the safeguard system, make sure that it is free from sharp corners and projections, and that the safeguard system itself is not dangerous.

Make sure that the safeguard system can only be removed by using a tool.

There are several types of safeguard devices, including safety doors, safety barriers, light curtains, safety gates, and safety floor mats. Install the interlocking function in the safeguard device. The safeguard interlock must be installed so that the safeguard interlock is forced to work in case of a device failure or other unexpected accident. For example, when using a door with a switch as the interlock, do not rely on the switch's own spring force to open the contact. The contact mechanism must open immediately in case of an accident.

Connect the interlock switch to the safeguard input of the drive unit's EMERGENCY connector. The safeguard input informs the robot controller that an operator may be inside the safeguard area. When the safeguard input is activated, the robot stops immediately and enters pause status, as well as either operation-prohibited status or restricted status (low power status).

Make sure not to enter the safeguarded area except through the point where the safeguard interlock is installed.

The safeguard interlock must be installed so that it can maintain a safe condition until the interlock is released on purpose once it initiates. The latch-release input is provided for the EMERGENCY connector on the Controller to release the latch condition of the safeguard interlock. The latch release switch of the safeguard interlock must be installed outside of the safeguarded area and wired to the latch-release input.

It is dangerous to allow someone else to release the safeguard interlock by mistake while the operator is working inside the safeguarded area. To protect the operator working inside the safeguarded area, take measures to lock out and tag out the latch-release switch.

Presence Sensing Device

The above mentioned safeguard interlock is a type of presence sensing device, since it indicates the possibility of somebody being inside the safeguard system. When separately installing a presence sensing device, however, perform a satisfactory risk assessment and pay thorough attention to its dependability.

Here are precautions that should be noted:

- Design the system so that when the presence sensing device is not activated or a dangerous situation still exists that no personnel can go inside the safeguard area or place their hands inside it.
- Design the presence sensing device so that regardless of the situation the system operates safely.
- If the robot stops operating when the presence sensing device is activated, it is necessary to ensure that it does not start again until the detected object has been removed. Make sure that the robot cannot automatically restart.

Resetting the Safeguard

Ensure that the robot system can only be restarted through careful operation from outside the safeguarded system. The robot will never restart simply by resetting the safeguard interlock switch. Apply this concept to the interlock gates and presence sensing devices for the entire system.

Robot Operation Panel

The robot operation panel must not be located inside of the robot work envelope / workcell. Ensure that the robot system can be operated from outside of the safeguard.

1.3 Operation Safety

The following items are safety precautions for qualified Operator personnel:

 WARNING	■ Please carefully read the *Safety-related Requirements* before operating the robot system. Operating the robot system without understanding the safety requirements is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system. ■ Do not enter the operating area of the Manipulator while the power to the robot system is turned ON. Entering the operating area with the power ON is extremely hazardous and may cause serious safety problems as the Manipulator may move even if it seems to be stopped. ■ 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 status (low speed and low power) 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. ■ Immediately press the Emergency Stop switch whenever the Manipulator moves abnormally while the robot system is operated. Continuing operation of the robot system while the Manipulator moves abnormally is extremely hazardous and may result in serious bodily injury and/or severe equipment change to the robot system.

 WARNING	■ 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.

 WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system.

 CAUTION	■ Whenever possible, only one person should operate the robot system. If it is necessary to operate the robot system with more than one person, ensure that all people involved communicate with each other as to what they are doing and take all necessary safety precautions. ■ SCARA Robot: Joint #1, #2, and #4: If the joints are operated repeatedly with the operating angle less than 5 degrees, they may get damaged early because the bearings are likely to cause oil film shortage in such situation. To prevent early breakdown, move the joints larger than 50 degrees for about five to ten times a day. Joint #3: If the up-and-down motion of the hand is less than 10 mm, move the joint a half of the maximum stroke for five to ten times a day. ■ Vertical 6-axis Robot: If the joints are operated repeatedly with the operating angle less than 5 degrees, they may get damaged early because the bearings are likely to cause oil film shortage in such situation. To prevent early breakdown, move the joints larger than 30 degrees for about five to ten times a day. ■ Oscillation (resonance) may occur continuously depending on the robot motion speed, combination of Arm orientation, and end effector load. Oscillation arises from natural oscillation frequency of the Arm and can be controlled by following measures. Changing Manipulator speed Changing the teach points Changing the end effector load

 CAUTION	■ Manipulator may be warmed up due to motor heat or similar causes. Do not touch the Manipulator until temperature falls. Also, make sure the temperature of the Manipulator falls and is not feel hot when you touch it. Then perform teaching or maintenance.

1.3.1 Safety-related Requirements

Specific tolerances and operating conditions for safety are contained in the manuals for the robot, controller and other devices. Be sure to read those manuals as well.

For the installation and operation of the robot system, be sure to comply with the applicable local and national regulations.

Robot system safety standards and other examples are given in this chapter.
To ensure that safety measures are satisfied, also refer to these standards.

(Note: The following is a partial list of the necessary safety standards.)

EN ISO 10218-1	Robots and robotic devices -- Safety requirements for industrial robots -- Part 1: Robots
EN ISO 10218-2	Robots and robotic devices -- Safety requirements for industrial robots -- Part 2: Robot systems and integration
ANSI/RIA R15.06	American National Standard for Industrial Robots and Robot Systems -- Safety Requirements
EN ISO 12100	Safety of machinery -- General principles for design -- Risk assessment and risk reduction
EN ISO 13849-1	Safety of machinery -- Safety-related parts of control systems -- Part 1: General principles for design
EN ISO 13850	Safety of machinery -- Emergency stop -- Principles for design
EN ISO 13855	Safety of machinery -- Positioning of safeguards with respect to the approach speeds of parts of the human body.
EN ISO 13857	Safety of machinery -- Safety distances to prevent hazard zones being reached by upper and lower limbs.
ISO 14120 EN 953	Safety of machinery -- Guards -- General requirements for the design and construction of fixed and movable guards
IEC 60204-1 EN 60204-1	Safety of machinery -- Electrical equipment of machines -- Part 1: General requirements
CISPR11 EN55011	Industrial, scientific and medical (ISM) radio-frequency equipment -- Electromagnetic disturbance characteristics -- Limits and methods of measurement
IEC 61000-6-2 EN 61000-6-2	Electromagnetic compatibility (EMC) -- Part 6-2: Generic standards -- Immunity for industrial environments

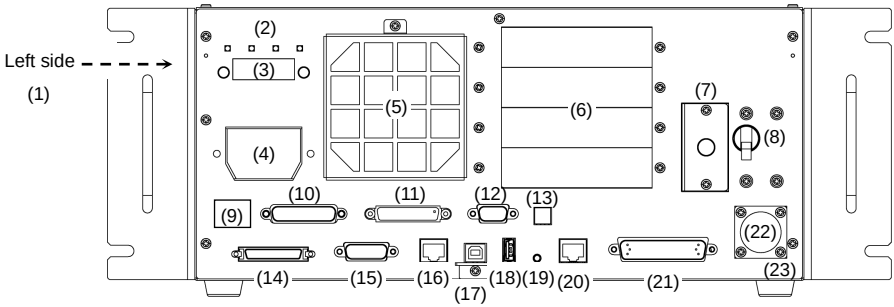
RC700-A / RC700DU-A UL specification

Compatibility assessment of the UL-compliant model is performed according to the following standards.

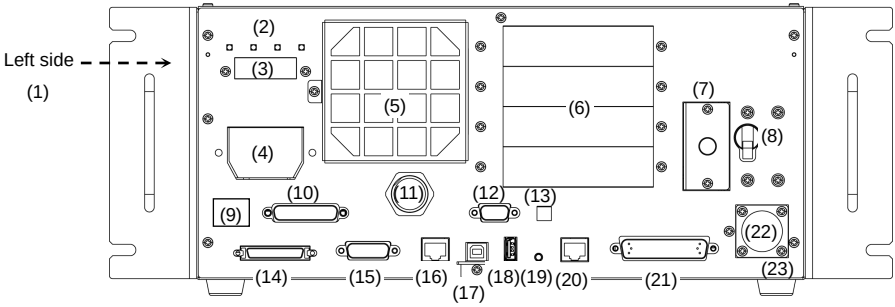
UL1740 (2007 Edition)
ANSI/RIA R15.06-2012
NFPA 79 (2015 Edition)
CSA/CAN Z434-14
ISO 138491-1:2015
IEC62061:2005

1.3.2 Part Names / Arm Motion

RC700

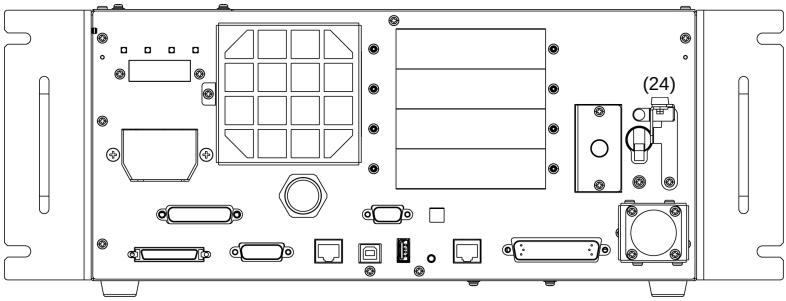


RC700-A



(1) Control unit Number label
(2) LED
(3) Seven-segment Display
(4) M/C POWER connector
(5) Fan Filter
(6) Option slot
(7) Battery
(8) POWER switch
(9) Connection Check label
(10) EMERGENCY connector
(11) TP port
(12) Standard RS-232C port
(13) Encoder Voltage Adjustment Switch
(14) M/C SIGNAL connector
(15) R-I/O connector
(16) RC700: DU OUT connector
RC700-A: OUT connector
(17) Development PC connection USB port
(18) Memory port
(19) Trigger Switch
(20) LAN (Ethernet communication) port
(21) I/O connector
(22) AC IN
(23) Control unit signature label

RC700-A-UL



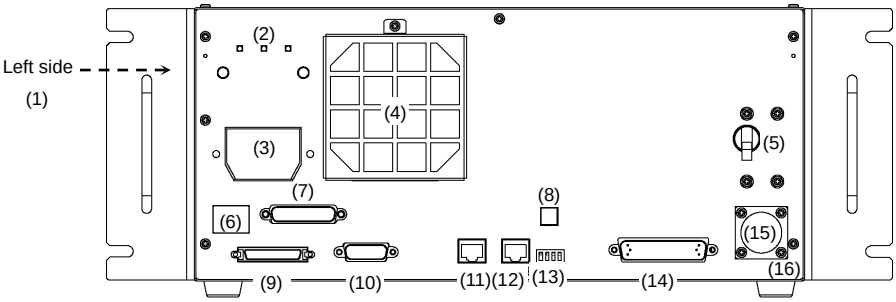
UL-compliant Controller (RC700-A-UL):

This model has (24) lockout mechanism.

For the lockout procedure, refer to the following section.

1.2.2 Designing a Safe Robot System
- Disabling Power to the System using lockout / tagout

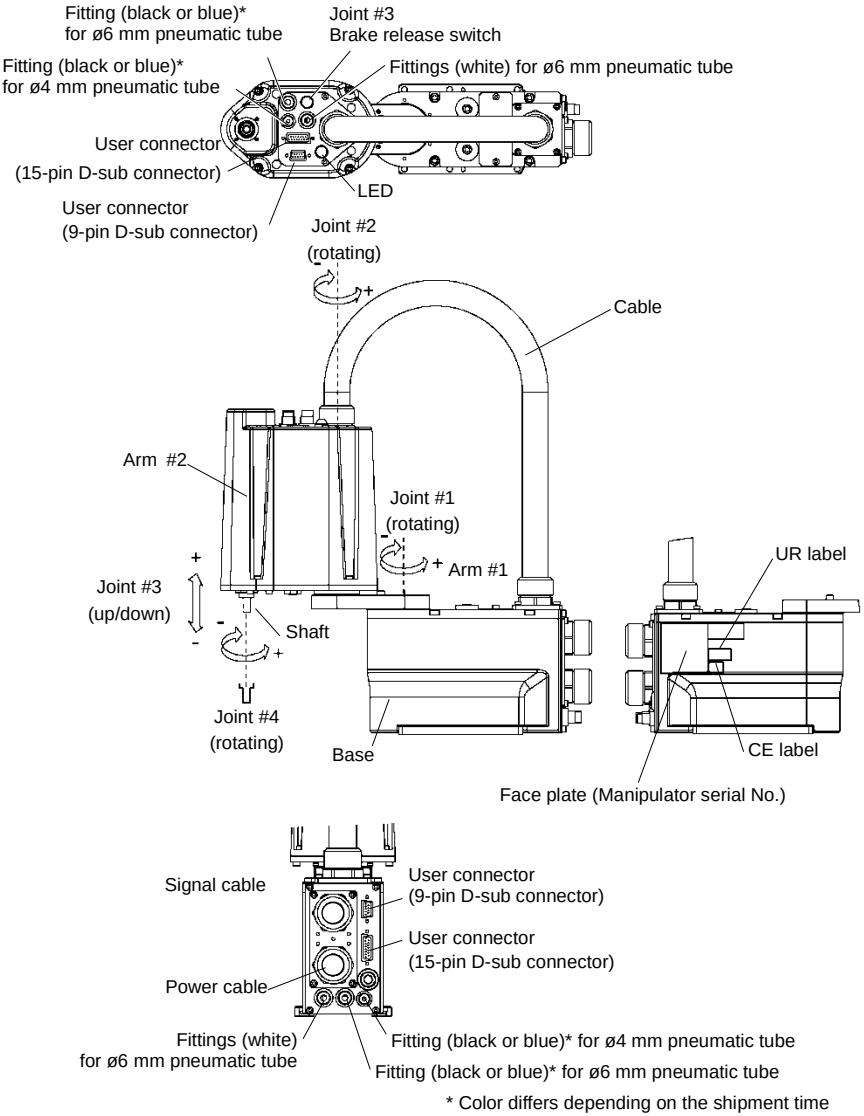
RC700DU / RC700DU-A



(1) Drive Unit Number label
(2) LED
(3) M/C POWER connector
(4) Fan Filter
(5) POWER switch
(6) Connection Check label
(7) EMERGENCY connector
(8) Encoder Voltage Adjustment Switch
(9) M/C SIGNAL connector
(10) R-I/O connector
(11) RC700: DU OUT connector
RC700-A: OUT connector
(12) RC700: DU IN connector
RC700-A: IN connector
(13) RC700DU No. setup switch
(14) I/O connector
(15) AC IN
(16) Drive unit signature label

G1

The motion range of each arm is shown in the figure below. Take all necessary safety precautions.



When the system is placed in emergency mode, push the arm or joint of the Manipulator by hand as shown below:

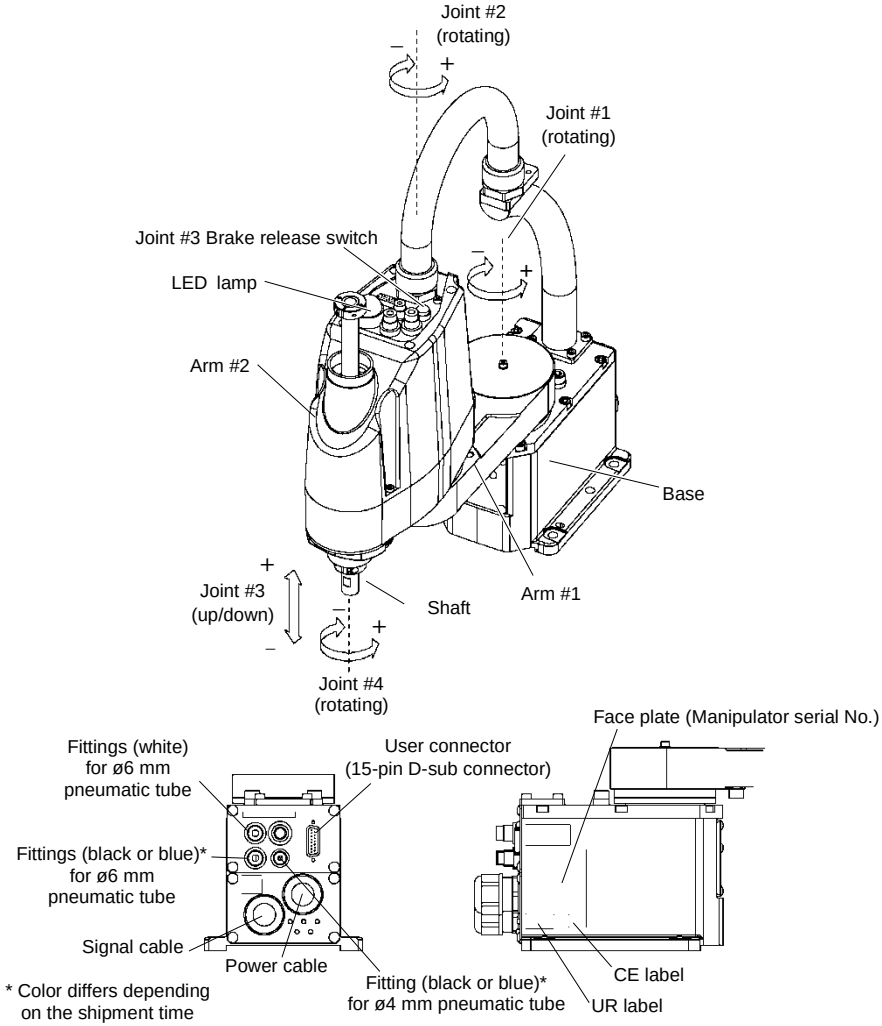
Arm #1	Push the arm by hand.
Arm #2	Push the arm by hand.
Joint #3	The joint cannot be moved up/down by hand until the electromagnetic brake applied to the joint has been released. Move the joint up/down while pressing the brake release switch.
Joint #4	Rotate the shaft by hand.

NOTE

When the brake release switch is pressed in emergency mode, the brake for Joint #3 is released. Be careful of the shaft while the brake release switch is pressed because the shaft may be lowered by the weight of an end effector.

G3

The motion range of each arm is shown in the figure below. Take all necessary safety precautions.



When the system is placed in emergency mode, push the arm or joint of the Manipulator by hand as shown below:

Arm #1	Push the arm by hand.
Arm #2	Push the arm by hand.
Joint #3	The joint cannot be moved up/down by hand until the electromagnetic brake applied to the joint has been released. Move the joint up/down while pressing the brake release switch.
Joint #4	Rotate the shaft by hand.

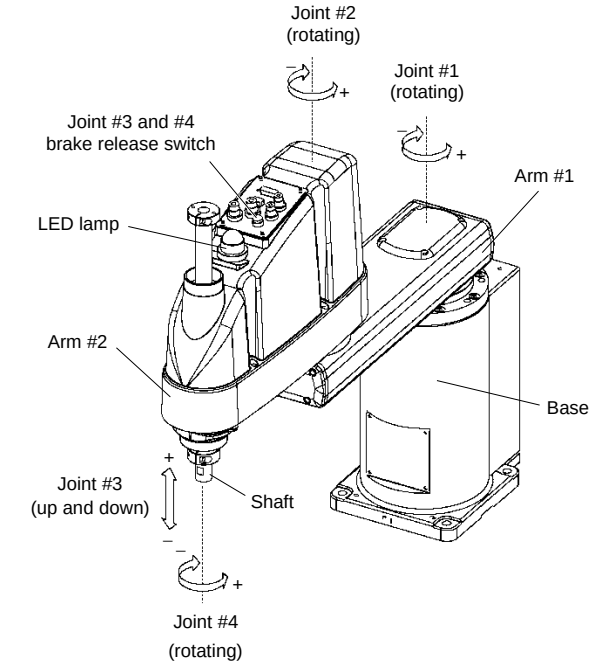
NOTE

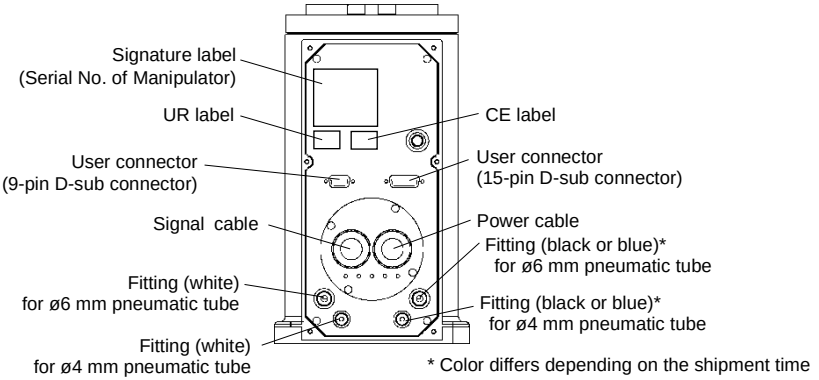
When the brake release switch is pressed in emergency mode, the brake for Joint #3 is released.

Be careful of the shaft while the brake release switch is pressed because the shaft may be lowered by the weight of an end effector.

G6

The motion range of each arm is shown in the figure below. Take all necessary safety precautions.





* Color differs depending on the shipment time

When the system is placed in emergency mode, push the arm or joint of the Manipulator by hand as shown below:

Arm #1	Push the arm by hand.
Arm #2	Push the arm by hand.
Joint #3	The joint cannot be moved up/down by hand until the electromagnetic brake applied to the joint has been released. Move the joint up/down while pressing the brake release switch.
Joint #4	For G6-**1**, Rotate the shaft by hand. For G6-**3**, The shaft cannot be rotated by hand until the electromagnetic brake applied to the shaft has been released. Move the shaft while pressing the brake release switch.

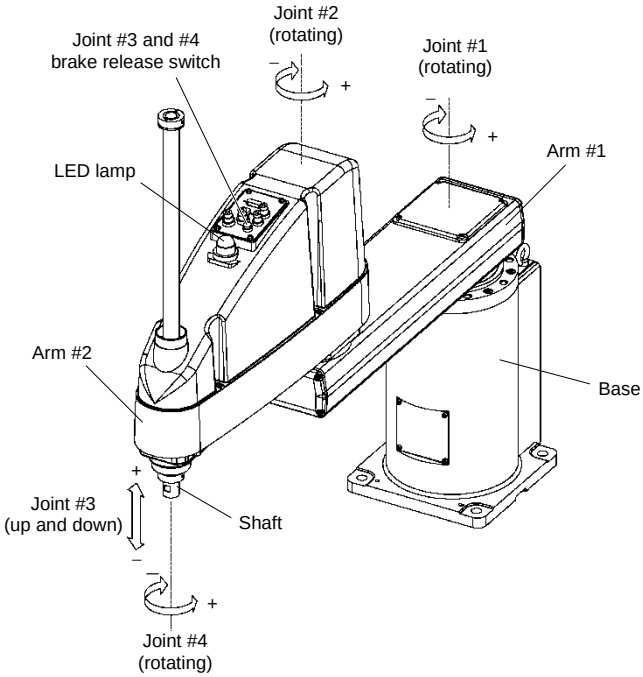
NOTE

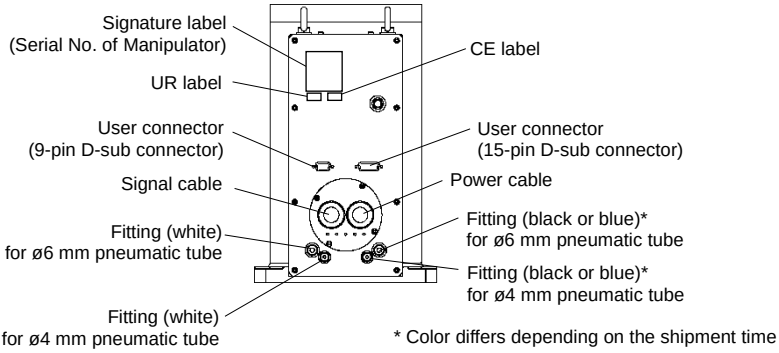
The brake release switch affects both Joints #3 and #4. When the brake release switch is pressed in emergency mode, the brakes for both Joints #3 and #4 are released simultaneously.
(For G6-**1**, Joint #4 has no brake on it.)

Be careful of the shaft falling and rotating while the brake release switch is pressed because the shaft may be lowered by the weight of an end effector.

G10/G20

The motion range of each arm is shown in the figure below. Take all necessary safety precautions.





* Color differs depending on the shipment time

When the system is placed in emergency mode, push the arm or joint of the Manipulator by hand as shown below:

Arm #1	Push the arm by hand.
Arm #2	Push the arm by hand.
Joint #3	The joint cannot be moved up/down by hand until the electromagnetic brake applied to the joint has been released. Move the joint up/down while pressing the brake release switch.
Joint #4	The shaft cannot be rotated by hand until the electromagnetic brake applied to the shaft has been released. Move the shaft while pressing the brake release switch.

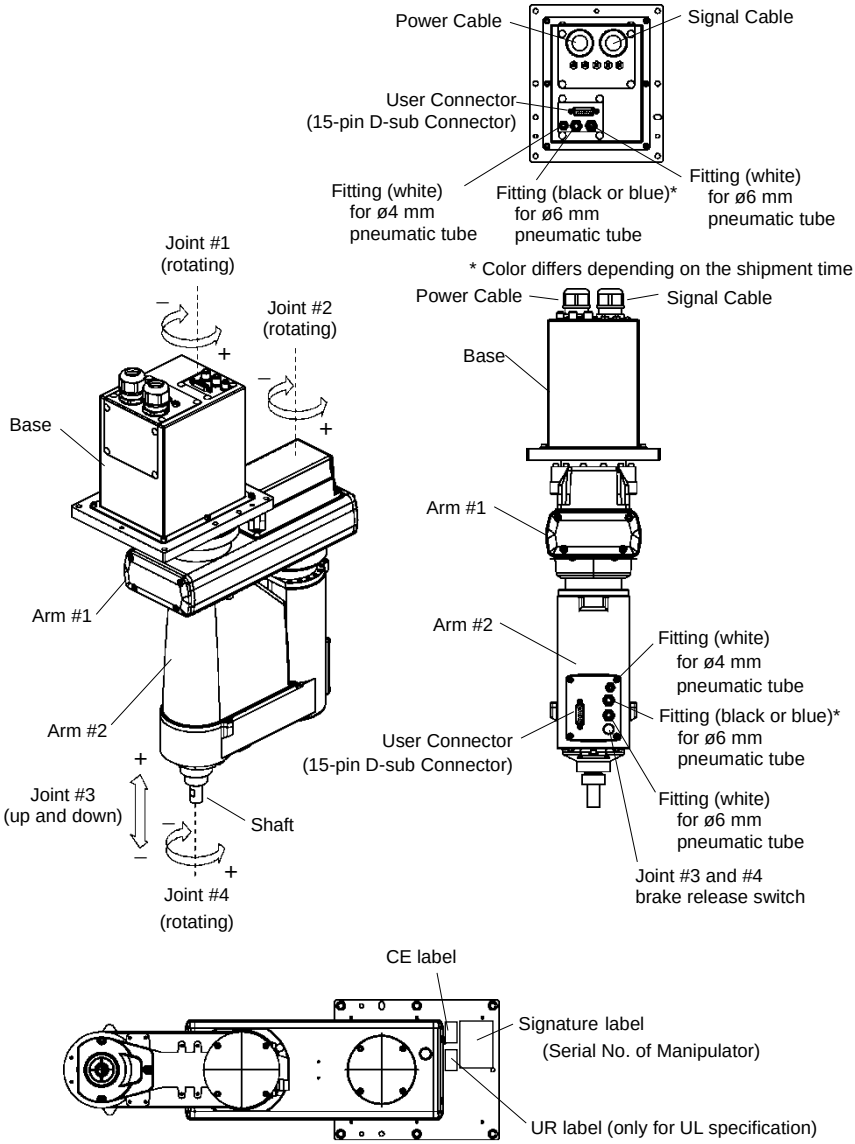
NOTE

The brake release switch affects both Joints #3 and #4. When the brake release switch is pressed in emergency mode, the brakes for both Joints #3 and #4 are released simultaneously.

Be careful of the shaft falling and rotating while the brake release switch is pressed because the shaft may be lowered by the weight of an end effector.

RS3

The motion range of each arm is shown in the figure below. Take all necessary safety precautions.



When the system is placed in emergency mode, push the arm or joint of the Manipulator by hand as shown below:

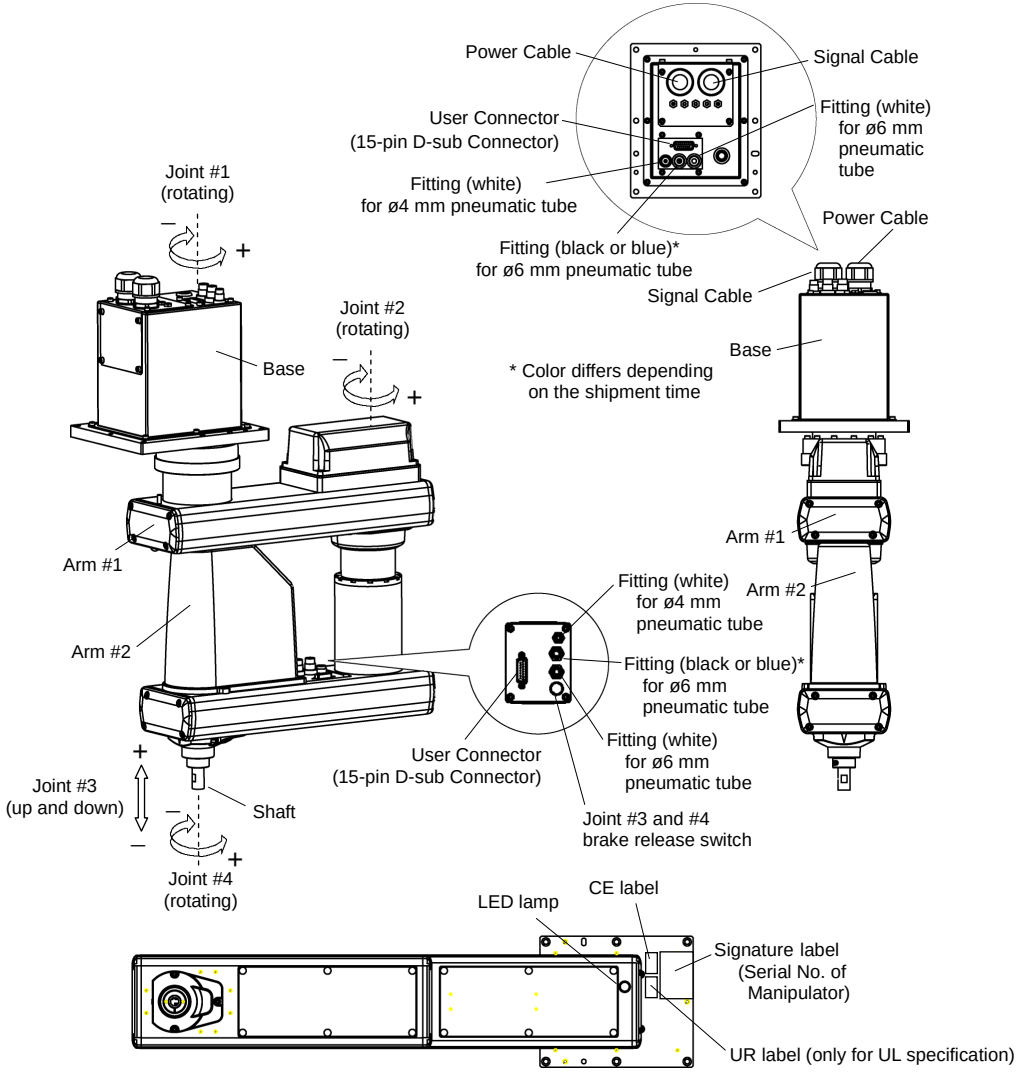
Arm #1	Push the arm by hand.
Arm #2	Push the arm by hand.
Joint #3	The joint cannot be moved up/down by hand until the electromagnetic brake applied to the joint has been released. Move the joint up/down while pressing the brake release switch.
Joint #4	Rotate the shaft by hand.

NOTE

Be careful of the shaft while the brake release switch is pressed because the shaft may be lowered by the weight of an end effector.

RS4

The motion range of each arm is shown in the figure below. Take all necessary safety precautions.



When the system is placed in emergency mode, push the arm or joint of the Manipulator by hand as shown below:

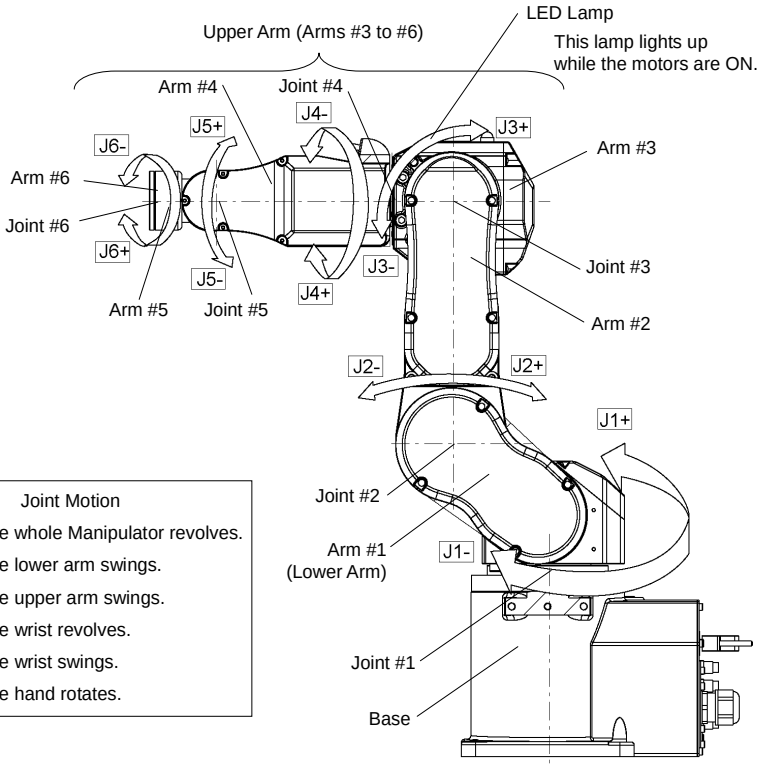
Arm #1	Push the arm by hand.
Arm #2	Push the arm by hand.
Joint #3	The joint cannot be moved up/down by hand until the electromagnetic brake applied to the joint has been released. Move the joint up/down while pressing the brake release switch.
Joint #4	Rotate the shaft by hand.

NOTE

Be careful of the shaft while the brake release switch is pressed because the shaft may be lowered by the weight of an end effector.

C4

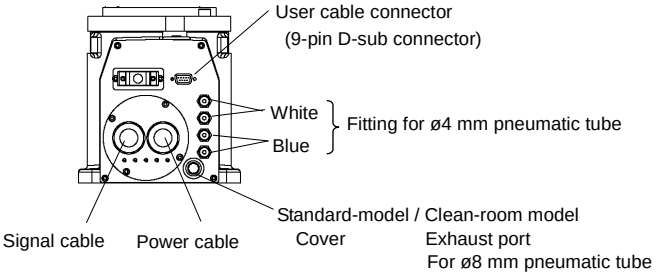
The motion range of each arm is shown in the figure below. Take all necessary safety precautions.

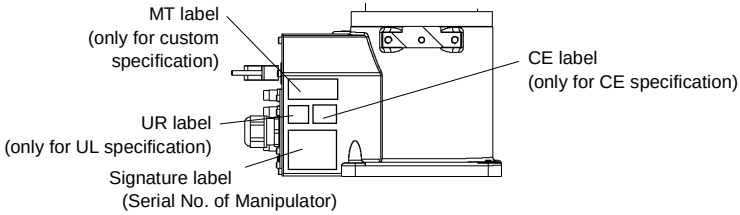


Joint Motion
Joint #1 : The whole Manipulator revolves.
Joint #2 : The lower arm swings.
Joint #3 : The upper arm swings.
Joint #4 : The wrist revolves.
Joint #5 : The wrist swings.
Joint #6 : The hand rotates.

NOTE

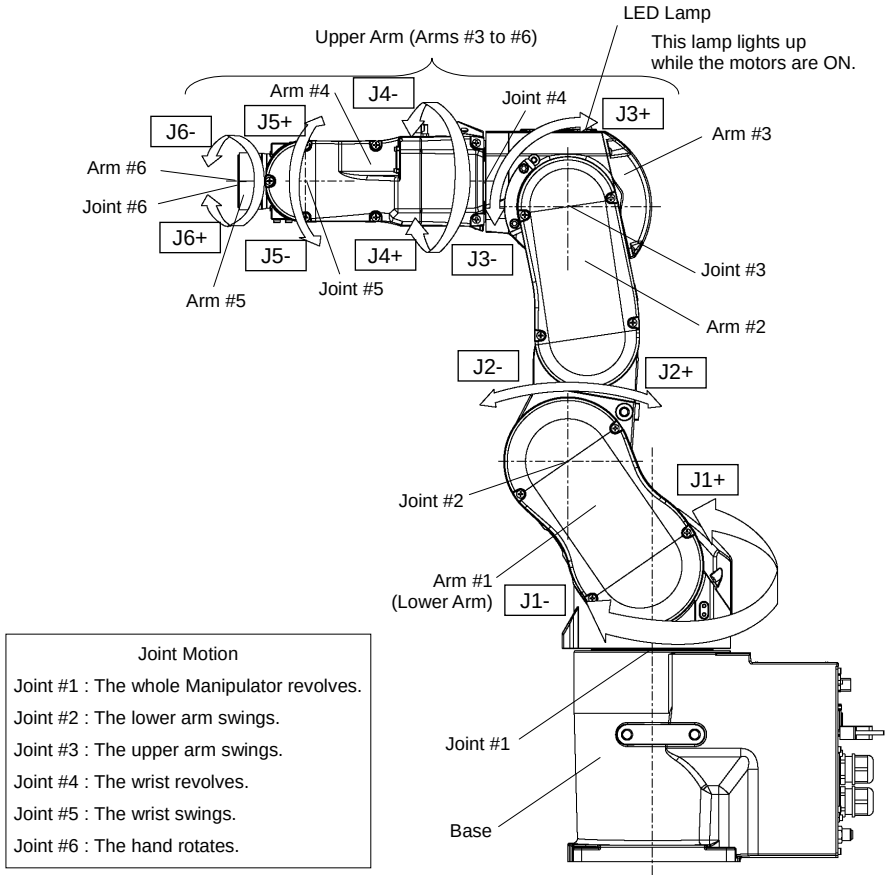
When the LED lamp is lighting or the controller power is on, the current is being applied to the manipulator. (The LED lamp may not be seen depending on the Manipulator's posture. Be very careful.) Performing any work with the power ON is extremely hazardous and it may result in electric shock and/or improper function of the robot system. Make sure to turn OFF the controller power before the maintenance work.


User cable connector
(9-pin D-sub connector)
White
Blue
Fitting for ø4 mm pneumatic tube
Standard-model / Clean-room model
Signal cable
Power cable
Cover
Exhaust port
For ø8 mm pneumatic tube


MT label
(only for custom
specification)
CE label
(only for CE specification)
UR label
(only for UL specification)
Signature label
(Serial No. of Manipulator)

C8

The motion range of each arm is shown in the figure below. Take all necessary safety precautions.



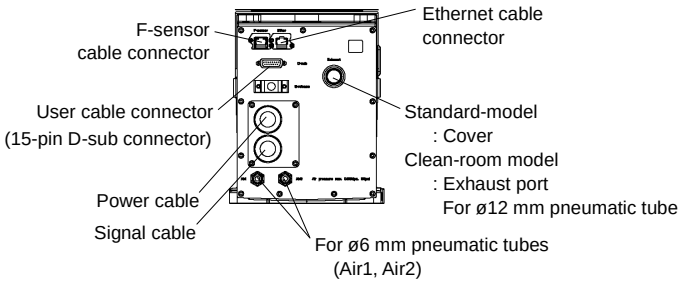
Joint Motion
Joint #1 : The whole Manipulator revolves.
Joint #2 : The lower arm swings.
Joint #3 : The upper arm swings.
Joint #4 : The wrist revolves.
Joint #5 : The wrist swings.
Joint #6 : The hand rotates.

(Figure: C8-A701* (C8))

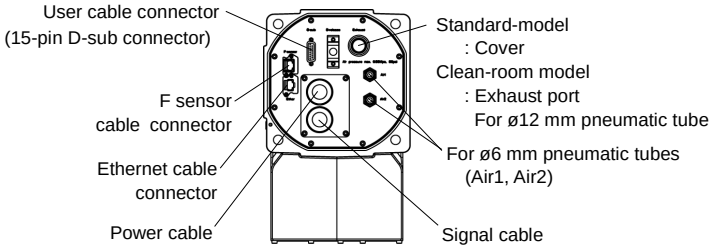
NOTE

When the LED lamp is lighting or the controller power is on, the current is being applied to the manipulator. (The LED lamp may not be seen depending on the Manipulator's posture. Be very careful.) Performing any work with the power ON is extremely hazardous and it may result in electric shock and/or improper function of the robot system. Make sure to turn OFF the controller power before the maintenance work.

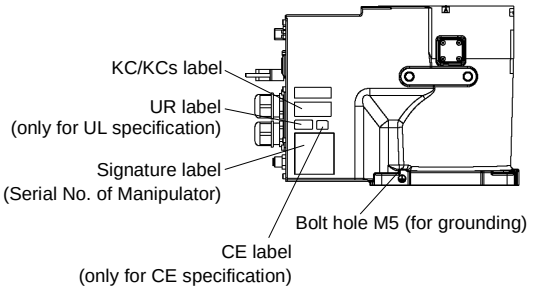
Cable backward model



Cable downward model

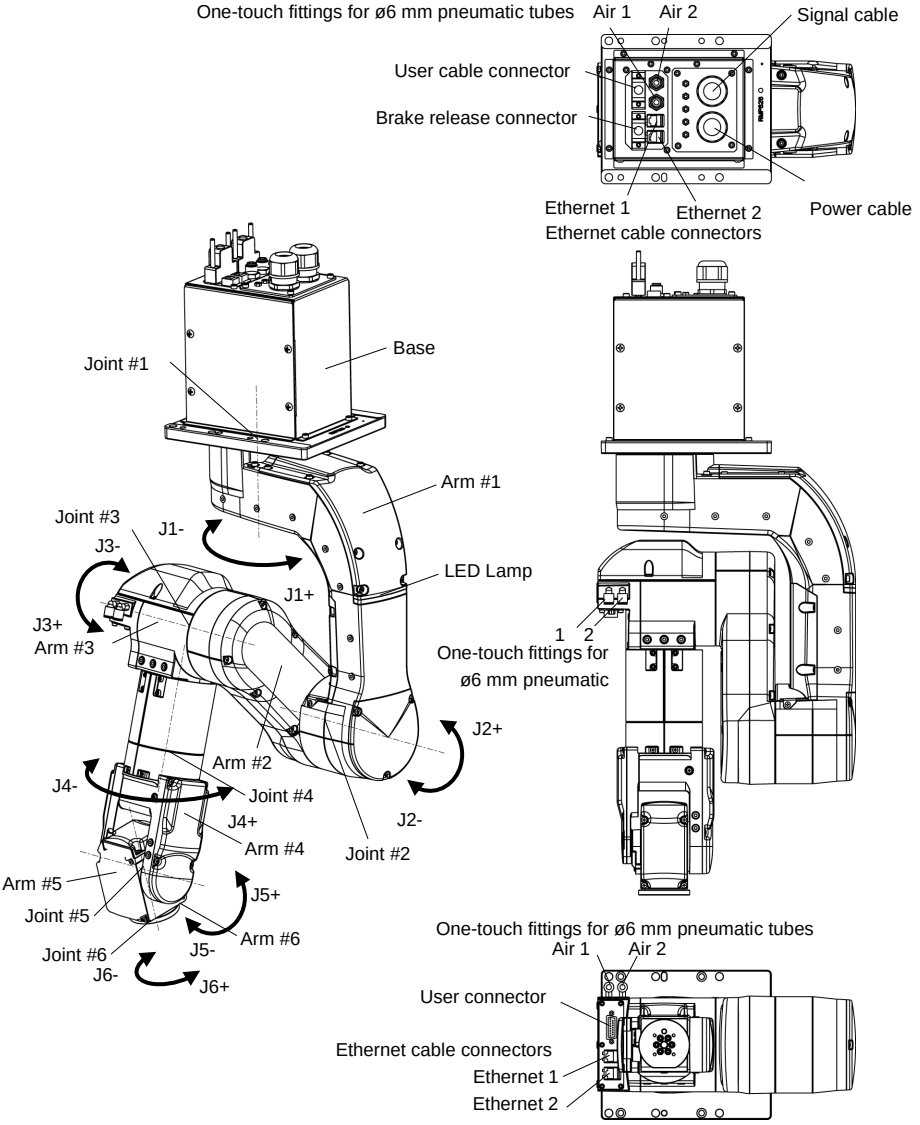


Cable backward model / Cable downward model



(Figure: Cable backward model)

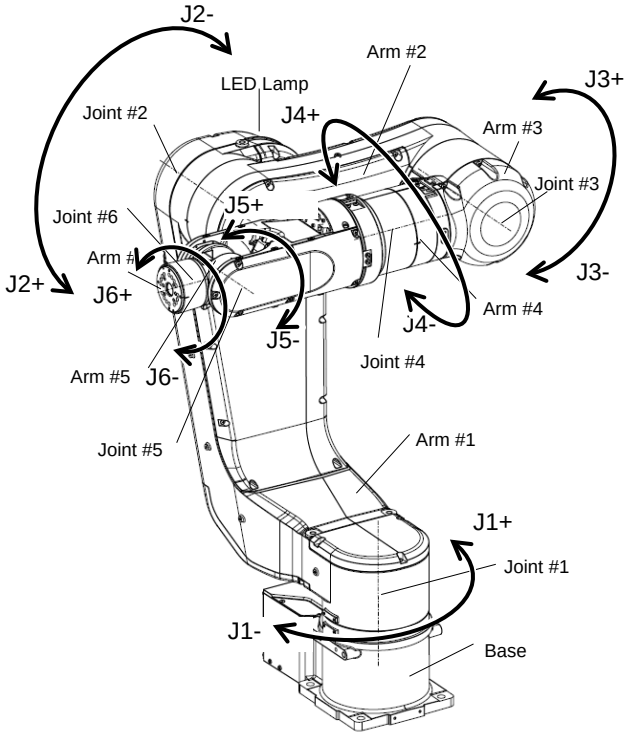
N2

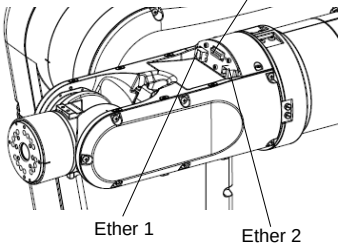


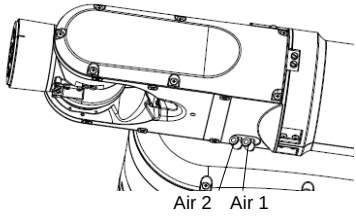
NOTE

When the LED lamp is lighting or the controller power is on, the current is being applied to the manipulator. (The LED lamp may not be seen depending on the Manipulator's posture. Be very careful.) Performing any work with the power ON is extremely hazardous and it may result in electric shock and/or improper function of the robot system. Make sure to turn OFF the controller power before the maintenance work.

N6





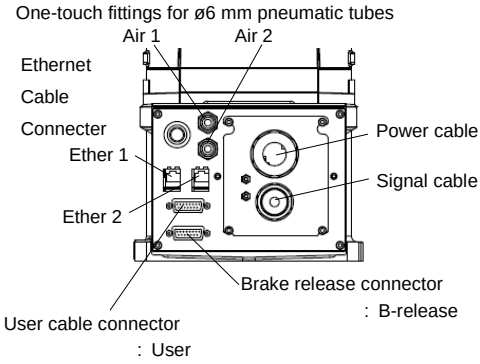


One-touch fittings for ø6 mm pneumatic tubes

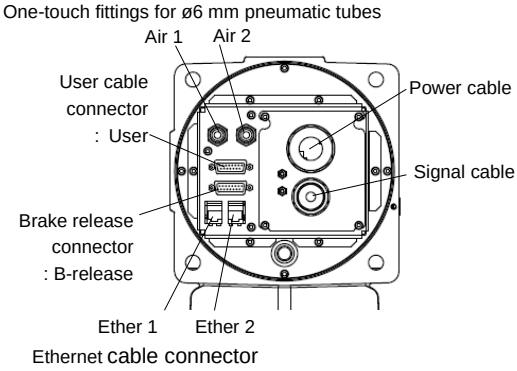
NOTE

When the LED lamp is lighting or the controller power is on, the current is being applied to the manipulator. (The LED lamp may not be seen depending on the Manipulator's posture. Be very careful.) Performing any work with the power ON is extremely hazardous and it may result in electric shock and/or improper function of the robot system. Make sure to turn OFF the controller power before the maintenance work.

Cable installation direction: Standard (backward)



Cable installation direction: Downward



X5

The operation varies with different module combination. For details, refer to the EZ Module X5 Series manual.

1.3.3 Operation Modes

The robot system has three operation modes: TEACH, AUTO, and TEST modes.

TEACH mode
This mode enables point data teaching and checking close from the Robot using the Teach Pendant.
Robot operates in Low power status.

AUTO mode
This mode enables automatic operation (program execution) of the Robot system at the factory.
In this mode, robot operation and program execution are not allowed when the safety door is open.

TEST mode

(T1)
This mode enables program verification while the Enable Switch is held down and the safeguard (including the safety door) is open.
This is a low speed program verification function (T1: manual deceleration mode) which is defined in Safety Standards.
In this mode, the specified Function can be executed with multi-task / single-task, multi-manipulator / single-manipulator at low speed.

(T2)
RC700-A option
TP3 only
This mode enables program verification while the Enable Switch is held down and the safeguard (including the safety door) is open.
Unlike the TEST/T1, the program verification in a high speed is available in this mode.
In this mode, the specified Function can be executed with multi-task / single-task, multi-manipulator / single-manipulator at high speed.

NOTE

T2 mode cannot be used on RC700-A Controllers complying with the UL standards.

1.4 Maintenance Safety

Please read this section, *Maintenance* of the Manipulator manual, *Maintenance* of the Controller manual, and other related manuals carefully to understand safe maintenance procedures before performing any maintenance.

Only authorized personnel who have taken the safety training should be allowed to maintain the robot system. The safety training is the program for the industrial robot operator that follows the laws and regulations of each nation.
The personnel who have taken the safety training acquire knowledge of industrial robots (operations, teaching, etc.), knowledge of inspections, and knowledge of related rules/regulations. Only personnel who have completed the robot system-training and maintenance-training classes held by the manufacturer, dealer, or locally-incorporated company should be allowed to maintain the robot system.

 WARNING	■ Do not remove any parts that are not covered in this manual. Follow the maintenance procedure strictly as described in this manual, *Maintenance* of the Manipulator manual, and *Maintenance* of the Controller manual. Improper removal of parts or improper maintenance may not only cause improper function of the robot system but also serious safety problems. ■ Keep away from the Manipulator while the power is ON if you have not taken the training courses. Do not enter the operating area while the power is ON. Entering the operating area with the power ON is extremely hazardous and may cause serious safety problems as the Manipulator may move even though 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 switches function properly. Operating the robot system when the switches do not function properly is extremely hazardous and may result in serious bodily injury and/or serious damage to the robot system as the switches cannot fulfill their intended functions in an emergency.


WARNING

■ Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. To shut off power to the robot system, disconnect the power plug from the power source. Performing any work while connecting the AC power cable to a factory power source is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source.
Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

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


CAUTION

■ Carefully use alcohol, liquid gasket, and adhesive following respective instructions and also instructions below. Careless use of alcohol, liquid gasket, or adhesive may cause a fire and/or safety problems.

- 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.


CAUTION

- 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.

- Manipulator may be warmed up due to motor heat or similar causes. Do not touch the Manipulator until temperature falls. Also, make sure the temperature of the Manipulator falls and you do not feel hot when you touch it. Then perform teaching or maintenance.

1.5 Emergency Stop

G1, G3, G6, G10, G20, RS, C4, C8, N2 , N6 series

If the Manipulator moves abnormally during operation, immediately press the Emergency Stop switch. Pressing the Emergency Stop switch immediately changes the manipulator to deceleration motion and stops it at the maximum deceleration speed.

However, avoid pressing the Emergency Stop switch unnecessarily while the Manipulator is running normally. Pressing the Emergency Stop switch locks the brake and it may cause wear on the friction plate of the brake, resulting in the short life of the brake.

Normal brake life cycle: About 2 years (when the brakes are used 100 times/day)

To place the system in emergency mode during normal operation, press the Emergency Stop switch when the Manipulator is not moving.

Refer to the Controller manual for instructions on how to wire the Emergency Stop switch circuit.

Do not turn OFF the Controller while the Manipulator is operating.

If you attempt to stop the Manipulator in emergency situations, make sure to stop the Manipulator using the E-STOP of the Controller.

If the Manipulator is stopped by turning OFF the Controller while it is operating, following problems may occur.

- Reduction of the life and damage of the reduction gear unit
- Position gap at the joints

In addition, if the Controller was forced to be turned OFF by blackouts and the like while the Manipulator is operating, make sure to check the following points after power restoration.

- Whether or not the reduction gear is damaged
- Whether or not the joints are in their proper positions

If there is a position gap, perform calibration by referring to the Maintenance: Calibration in the Manipulator manual.

Manipulator manuals contain information on the Emergency Stop. Please also read the descriptions in the manual and use the robot system properly.

Before using the Emergency Stop switch, be aware of the followings.

- The Emergency Stop (E-STOP) switch should be used to stop the Manipulator only in case of emergencies.
- To stop the Manipulator operating the program except in emergency, use Pause (halt) or STOP (program stop) commands
  Pause and STOP commands do not turn OFF the motors. Therefore, the brake does not function.
- For the Safeguard system, do not use the circuit for E-STOP.

For details of the Safeguard system, refer to the following manuals.

EPSON RC+ User's Guide

2. Safety - Installation and Design Precautions - Safeguard System

Safety and Installation

2.6 Connection to EMERGENCY Connector

To check brake problems, refer to the following manuals.

Manipulator Manual Maintenance

2.1.2 Inspection Point

- Inspection While the Power is ON (Manipulator is operating)

Safety and Installation

5.1.1 Manipulator

- Inspection While the Power is ON (Manipulator is operating)

X5 series

If the Manipulator moves abnormally during operation, immediately press the Emergency Stop switch. Pressing the Emergency Stop switch immediately changes the manipulator to deceleration motion and stops it at the maximum deceleration speed.
However, avoid pressing the Emergency Stop switch unnecessarily while the Manipulator is running normally. Otherwise, the Manipulator may hit the peripheral equipment since the operating trajectory until the robot system stops is different from that in normal operation.
Do not press the Emergency Stop switch unnecessarily while the Manipulator is operating. Pressing the switch during operation makes the brakes work. This will shorten the life of the brakes due to the worn friction plates.

Normal brake life cycle: About 2 years (when the brakes are used 100 times/day)

Also, the Emergency Stop during operation applies impact on the reduction gear unit, and it may result in the short life of the reduction gear unit.
To place the robot system in emergency mode during normal operation, press the Emergency Stop switch while the Manipulator is not moving.
Refer to the Robot Controller manual for instructions on how to wire the Emergency Stop switch circuit.

NOTE

When the Manipulator is stopped by the emergency stop function (the electric current for the motor is cut off), the J1 and J2 axes may overrun a maximum of 150 mm from their servo motion target points. Therefore, design the layout of the robot system so that the end effector does not collide with peripheral equipment.

When the Manipulator is stopped by the emergency stop while it is moving with large load being applied, an error may occur. If the error occurs, reset it by the Reset command.
Example: If the Emergency Stop switch is pressed while the RH module is carrying an 80 kg workpiece.
The following error occurs:
5040: Motor torque output failure in high power state.

Do not turn OFF the Controller while the Manipulator is operating.
If you attempt to stop the Manipulator in emergency situations such as “Safeguard Open”, make sure to stop the Manipulator using the Emergency Stop switch of the Controller.
If the Manipulator is stopped by turning OFF the Controller while it is operating, the following problems may occur.
Reduction of the life and damage of the reduction gear unit
Position gap at the joints

In addition, if the Controller was forced to be turned OFF by blackouts and the like while the Manipulator is operating, make sure to check the following points after power restoration.

Whether or not the reduction gear is damaged
Whether or not the joints are in their proper positions

If there is a position gap, perform calibration by referring to the *4.13 Calibration* in this manual.
Before using the Emergency Stop switch, be aware of the followings.
The Emergency Stop (E-STOP) switch should be used to stop the Manipulator only in case of emergencies.

Before using the Emergency Stop switch, be aware of the followings.

- The Emergency Stop (E-STOP) switch should be used to stop the Manipulator only in case of emergencies.
- To stop the Manipulator operating the program except in emergency, use Pause (halt) or STOP (program stop) commands
  Pause and STOP commands do not turn OFF the motors. Therefore, the brake does not function.
- For the Safeguard system, do not use the circuit for E-STOP.

For details of the Safeguard system, refer to the following manuals.
EPSON RC+ User's Guide
2. Safety - Installation and Design Precautions - Safeguard System
Safety and Installation
2.6 Connection to EMERGENCY Connector

To check brake problems, refer to the following manuals.
Safety and Installation
5.1.1 Manipulator
- Inspection While the Power is ON (Manipulator is operating)

1.5.1 Free running distance in emergency

The Manipulator in operation cannot stop immediately after the Emergency Stop switch is pressed.
However, remember that the values vary depending on following conditions:

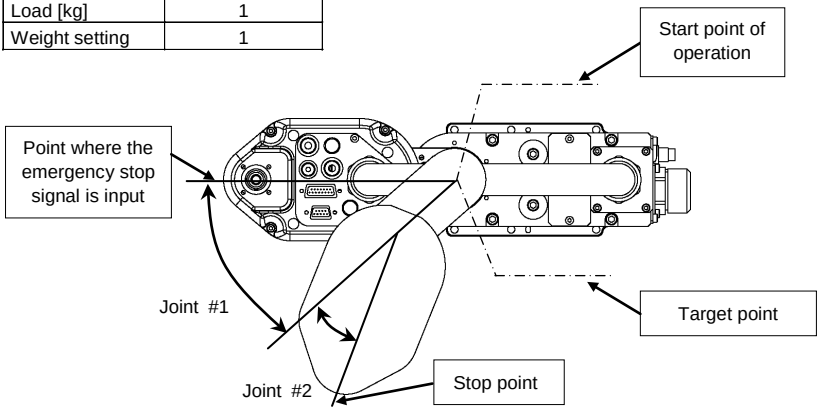
Hand weight	WEIGHT Setting	ACCEL Setting
Workpiece weight	SPEED Setting	Posture etc.

Approximate time and distance of the free running are as follow:

G1

Conditions for measurement

Accel setting	100
Speed setting	100
Load [kg]	1
Weight setting	1

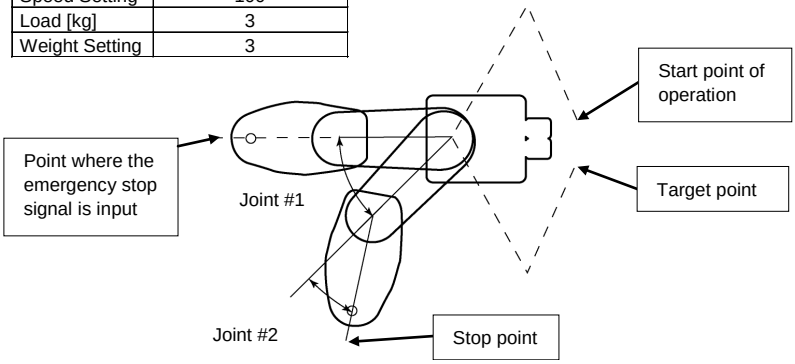


			Controller	RC700-A	
			Manipulator	G1-171*, G1-171*Z	G1-221*, G1-221*Z
Free running time	Joint #1 + Joint #2	[s]		0.17	0.18
	Joint #3	[s]		0.13	
Free running angle	Joint #1	[deg]		22	28
	Joint #2	[deg]		19	20
	Joint #1 + Joint #2	[deg]		41	48
Free running distance	Joint #3	[mm]		48	

G3

Conditions for Measurement

Accel Setting	100
Speed Setting	100
Load [kg]	3
Weight Setting	3

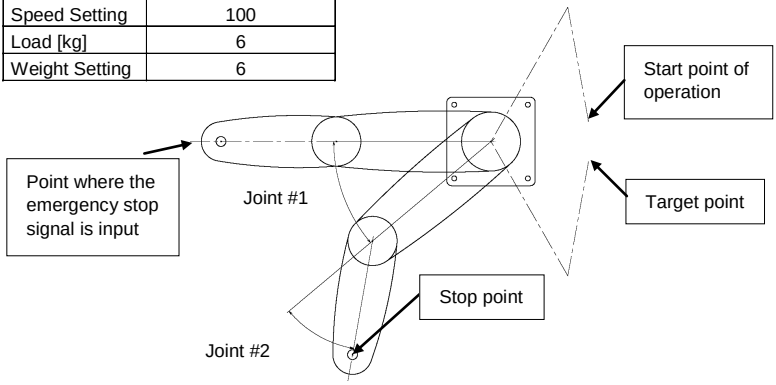


			Controller	RC700-A		
			Manipulator	G3-25***	G3-30***	G3-35***
Free running time	Joint #1 + Joint #2	[s]		0.3	0.2	0.3
	Joint #3	[s]		0.2	0.2	0.2
Free running angle	Joint #1	[deg]		20	20	35
	Joint #2	[deg]		20	20	25
	Joint #1 + Joint #2	[deg]		40	40	60
Free running distance	Joint #3	[mm]		60	60	60

G6

Conditions for Measurement

Accel Setting	100
Speed Setting	100
Load [kg]	6
Weight Setting	6

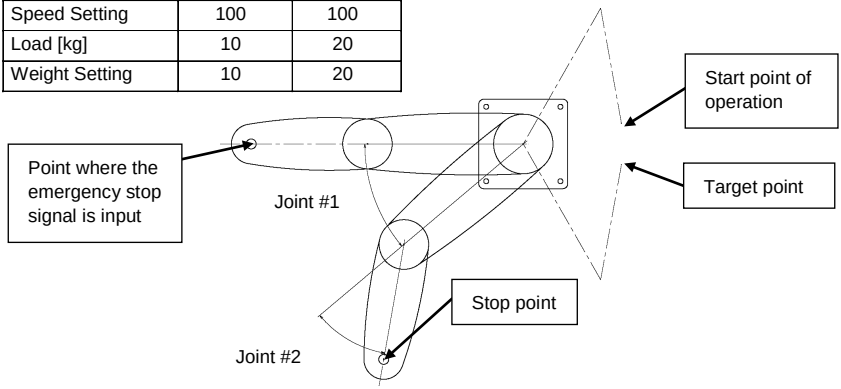


			Controller	RC700-A		
			Manipulator	G6-45***	G6-55***	G6-65***
Free running time	Joint #1 + Joint #2	[s]		0.5	0.5	0.5
	Joint #3	[s]		0.4	0.4	0.4
Free running angle	Joint #1	[deg]		35	30	35
	Joint #2	[deg]		70	55	70
	Joint #1 + Joint #2	[deg]		105	85	105
Free running distance	Joint #3 G6-**1** G6-**3**	[mm]		95	95	95

G10/G20

Conditions for Measurement

	G10	G20
Accel Setting	100	100
Speed Setting	100	100
Load [kg]	10	20
Weight Setting	10	20

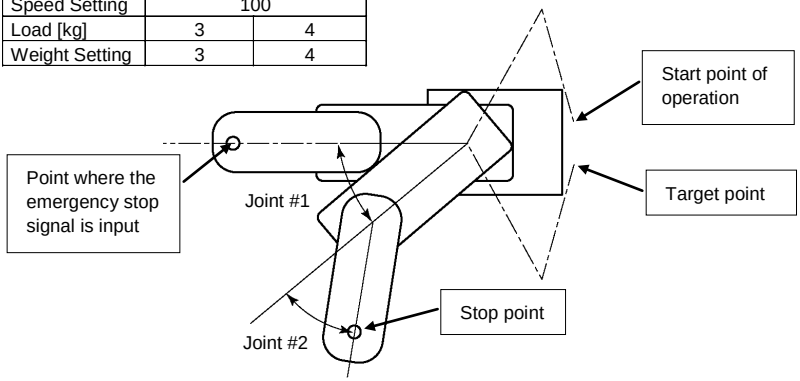


		Controller	RC700-A			
		Manipulator	G10-65***	G10-85***	G20-85***	G20-A0***
Free running time	Joint #1 + Joint #2	[s]	0.5	0.8	0.9	0.7
	Joint #3	[s]	0.3	0.3	0.3	0.3
Free running angle	Joint #1	[deg]	40	85	90	75
	Joint #2	[deg]	65	75	70	65
	Joint #1 + Joint #2	[deg]	105	160	160	140
Free running distance	Joint #3 G10/G20-**1**[mm] G10/G20-**4**		80	80	140	140

RS

Conditions for Measurement

	RS3-351*	RS4-551*
Accel Setting	100	
Speed Setting	100	
Load [kg]	3	4
Weight Setting	3	4



			Controller	RC700-A	
			Manipulator	RS3-351*	RS4-551*
Free running time	Joint #1 + Joint #2	[s]		0.3	0.7
	Joint #3	[s]		0.2	0.3
Free running angle	Joint #1	[deg]		50	30
	Joint #2	[deg]		30	70
	Joint #1 + Joint #2	[deg]		80	100
Free running distance	Joint #3	[mm]		55	65

C4

Conditions of Measurement

	C4 series
ACCEL Setting	100
SPEED Setting	100
Load [kg]	4
WEIGHT Setting	4

Robot controller		RC700 / RC700-A	
Manipulator		C4-A601**	C4-A901**
Free running time [s]	Arm #1	0.4	0.3
	Arm #2	0.4	0.4
	Arm #3	0.4	0.5
	Arm #4	0.3	
	Arm #5	0.4	
	Arm #6	0.3	
Free running angle [deg]	Arm #1	85	60
	Arm #2	60	65
	Arm #3	55	55
	Arm #4	40	
	Arm #5	40	
	Arm #6	25	

C8

Conditions of Measurement

	C8 series
ACCEL Setting	100
SPEED Setting	100
Load [kg]	8
WEIGHT Setting	8

Robot controller			RC700-A		
Manipulator			C8-A701** (C8)	C8-A901** (C8L)	C8-A1401** (C8XL)
Free running time [s]	Arm #1	Table Top, Ceiling	0.5	0.5	0.9
		Wall	0.9	0.9	1.7
	Arm #2		0.5	0.6	0.7
	Arm #3		0.5	0.5	0.4
	Arm #4		0.5	0.4	0.5
	Arm #5		0.2	0.2	0.3
	Arm #6		0.2	0.2	0.3
Free running angle [deg]	Arm #1	Table Top, Ceiling	60	50	70
		Wall	110	100	130
	Arm #2		60	60	40
	Arm #3		70	50	30
	Arm #4		70	60	90
	Arm #5		30	30	50
	Arm #6		40	30	30

N2

Conditions of Measurement

	N2 series
ACCEL Setting	100
SPEED Setting	100
Load [kg]	2.5
WEIGHT Setting	2.5

Robot controller		RC700-A
Manipulator		N2-A450S*
Free running time [s]	Arm #1	0.75
	Arm #2	0.7
	Arm #3	0.5
	Arm #4	0.35
	Arm #5	0.35
	Arm #6	0.3
Free running angle [deg]	Arm #1	55
	Arm #2	65
	Arm #3	70
	Arm #4	20
	Arm #5	20
	Arm #6	40

N6

Conditions of Measurement

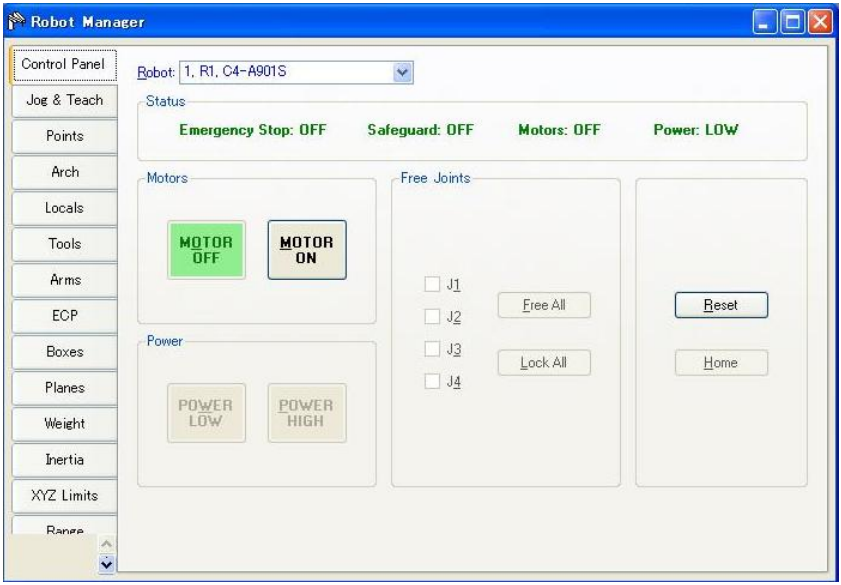
	N6 series
ACCEL Setting	100
SPEED Setting	100
Load [kg]	6
WEIGHT Setting	6

Robot controller		RC700-A
Manipulator		N6-A1000**
Free running time [s]	Arm #1	0.75
	Arm #2	0.65
	Arm #3	0.65
	Arm #4	0.3
	Arm #5	0.2
	Arm #6	0.1
Free running angle [deg]	Arm #1	70
	Arm #2	65
	Arm #3	70
	Arm #4	100
	Arm #5	30
	Arm #6	5

1.5.2 How to reset the emergency mode

Select EPSON RC+ [Tools] – [Robot Manager] – [Control Panel] tab, and then click <Reset>.

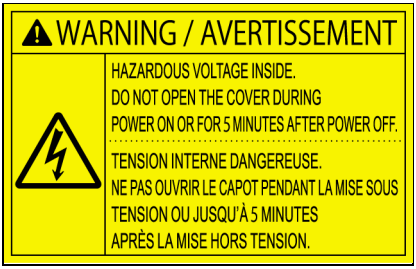
The Control Panel page contains buttons for basic robot operations, such as turning motors on/off and homing the robot. It also shows status for Emergency Stop, Safeguard, Motors, and Power.

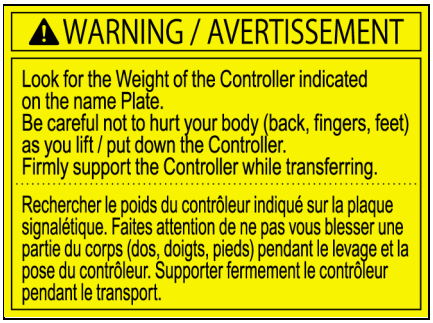
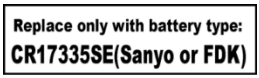


1.6 Labels

Labels are attached around the locations of the Controller and Manipulator where specific dangers exist.
Be sure to comply with descriptions and warnings on the labels to operate and maintain the Robot System safely.
Do not tear, damage, or remove the labels. Use meticulous care when handling those parts or units to which the following labels are attached as well as the nearby areas:

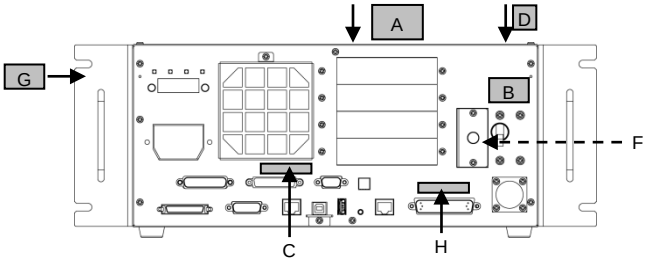
1.6.1 Controller

Location	Label	Note
A		Residual voltage exists. To avoid electric shock, do not open the cover while the Power is ON, or for 300 seconds after the Power is OFF.
		Residual voltage exists. To avoid electric shock, do not open the cover while the Power is ON, or for 5 minutes after the Power is OFF.
B	 	Disconnect and lockout main power before performing maintenance and repair.

Location	Label	Note
C		Do not connect the followings to TP port. Connecting to the followings may result in malfunction of the device. OPTIONAL DEVICE dummy plug, OP500, OP500RC, JP500, TP-3** series, and OP1
D		Hazardous voltage exists while the Manipulator is ON. To avoid electric shock, do not touch any internal electric parts.
E		Weight of the unit is indicated on the Signature label Make sure to check the weight before units transfer or relocation and prevent throwing out your back at holding the unit. Also, make sure to keep your hands, fingers, and feet safe from being caught or serious injury.
F		Make sure to use the designated lithium battery. Refer to Controller Manual *Maintenance* *10. Maintenance parts list*

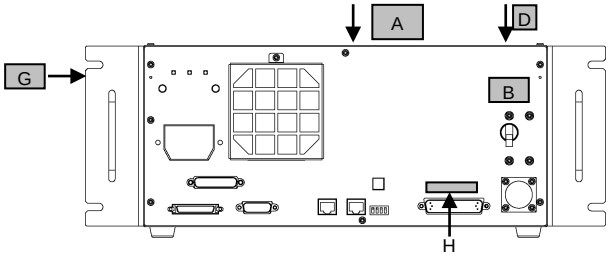
Location	Label
G	ROBOT CONTROLLER MODEL : RC700 SERIAL NO. : 0000000001 MANUFACTURED : 06/2017 AC200-240V 50/60Hz SINGLE PHASE 2500VA max WEIGHT 12kg MANUFACTURER: SEIKO EPSON CORPORATION 3-5,OWA 3-CHOME,SUWA-SHI NAGANO-KEN,392-8502 JAPAN http://global.epson.com/company/ ENTITY PLACING ON EU MARKET: EPSON DEUTSCHLAND GmbH OTTO-HAHN-STR.4,D-40670 MEERBUSCH,GERMANY https://neon.epson-europe.com/de/en/robots/ 0000000001
H	CONTROLLER S/N R7C x x x x x x x

RC700 / RC700-A Control Unit

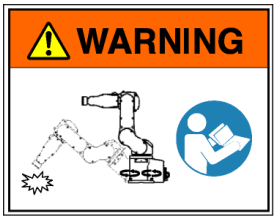
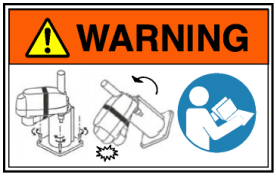
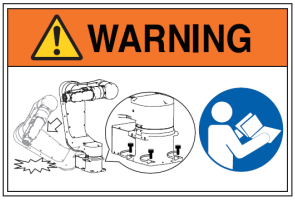
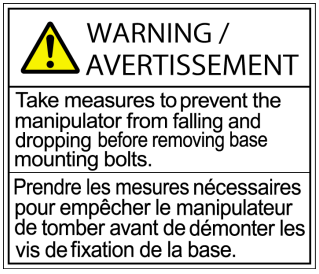
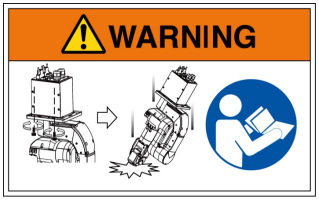


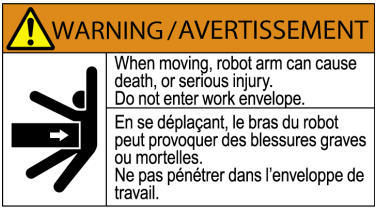
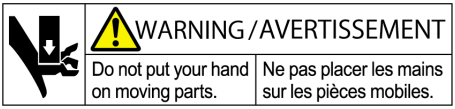
(Figure: RC700)

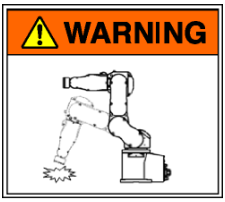
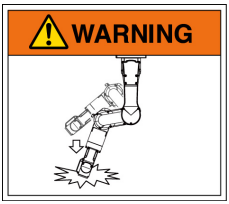
RC700DU / RC700DU-A Drive Unit

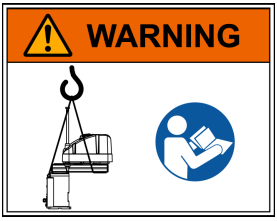
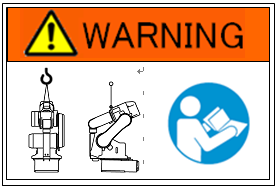
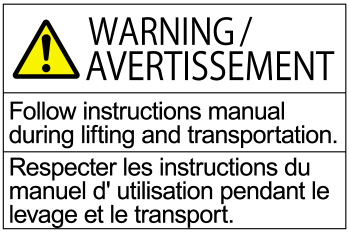


1.6.2 Manipulator

Location	Label	Note
A	   	Before loosening the base mounting screws, hold the arm and secure it tightly with a band to prevent hands or fingers from being caught in the Manipulator. For installation and transportation of robots, follow the directions in this manual.
		To avoid the Manipulator from falling, support the Manipulator before removing the base mounting screws. Follow the instructions in this manual for transportation and installation.

Location	Label	Note
B	 	Do not enter the operation area while the Manipulator is moving. The robot arm may collide against the operator. This is extremely hazardous and may result in serious safety problems.
C	 	Hazardous voltage exists while the Manipulator is ON. To avoid electric shock, do not touch any internal electric parts.
D		You may get your hand or fingers caught between the shaft and cover when bringing your hand close to moving parts. * Manipulators with bellows do not have this label for no danger of your hand or fingers being caught.
	 	You may get your hand or fingers caught when bringing your hand close to moving parts.

Location	Label	Note
E		C4: Be careful of the arm falling due to its own weight when pressing the brake release switch. This label is attached on the optional brake release box. C8: When releasing the brakes, be careful of the arm falling due to its own weight. This label is attached on the Manipulator and optional brake release box.
		When releasing the brakes, be careful of the arm falling due to its own weight. This warning label is attached on the Manipulator and optional brake release unit.
		When the brake release box is used: Details of procedures for releasing the brakes using the brake release box are described in the Manipulator manuals.

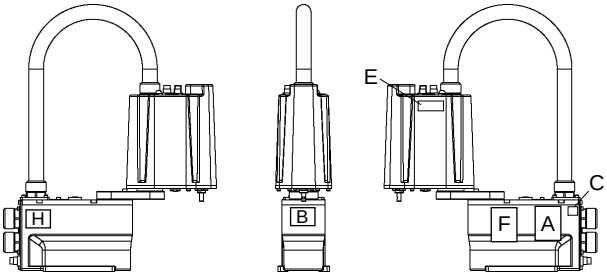
Location	Label	Note
E	 	When releasing the brakes, be careful of the arm falling / rotation due to its own weight.
F	   	Only authorized personnel should perform sling work and operate a crane and a forklift. When these operations are performed by unauthorized personnel, it is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system.

Location	Label	Note
G		HOT Be careful not to burn yourself.

Location	Label
H	

Location of Labels

G1



G3

Common

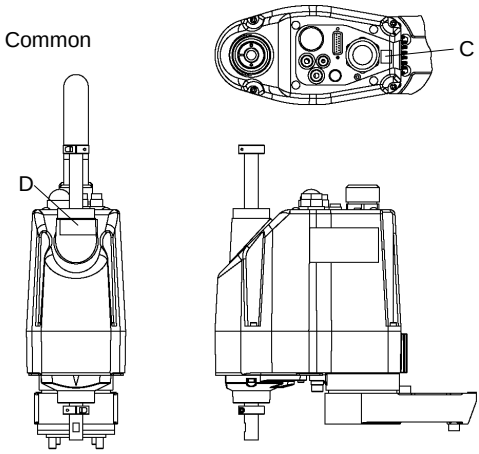
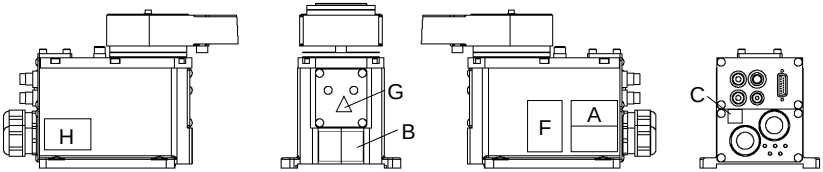
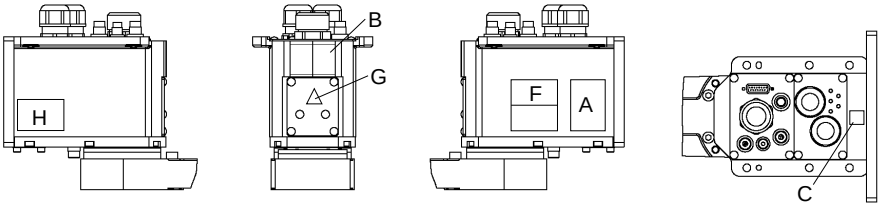


Table Top Mounting

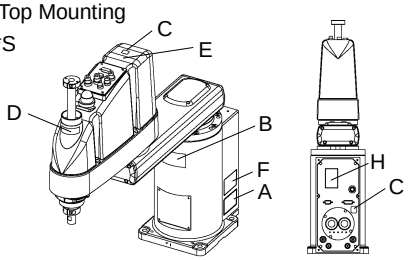


Multiple Mounting

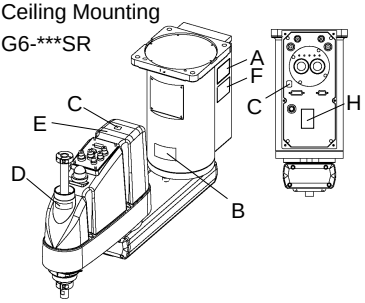


G6

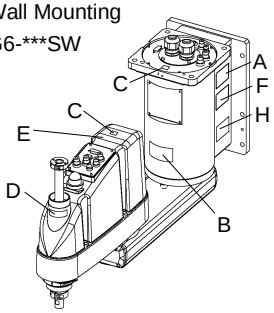
Table Top Mounting
G6-***S



Ceiling Mounting
G6-***SR

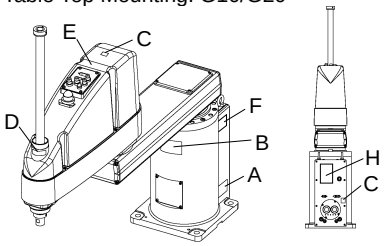


Wall Mounting
G6-***SW

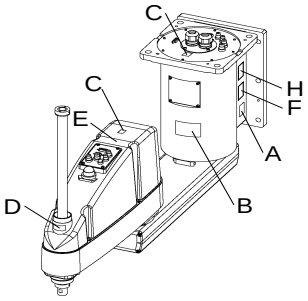


G10/G20

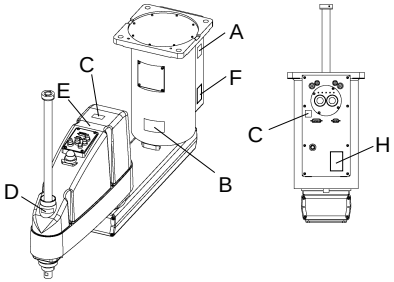
Table Top Mounting: G10/G20-****



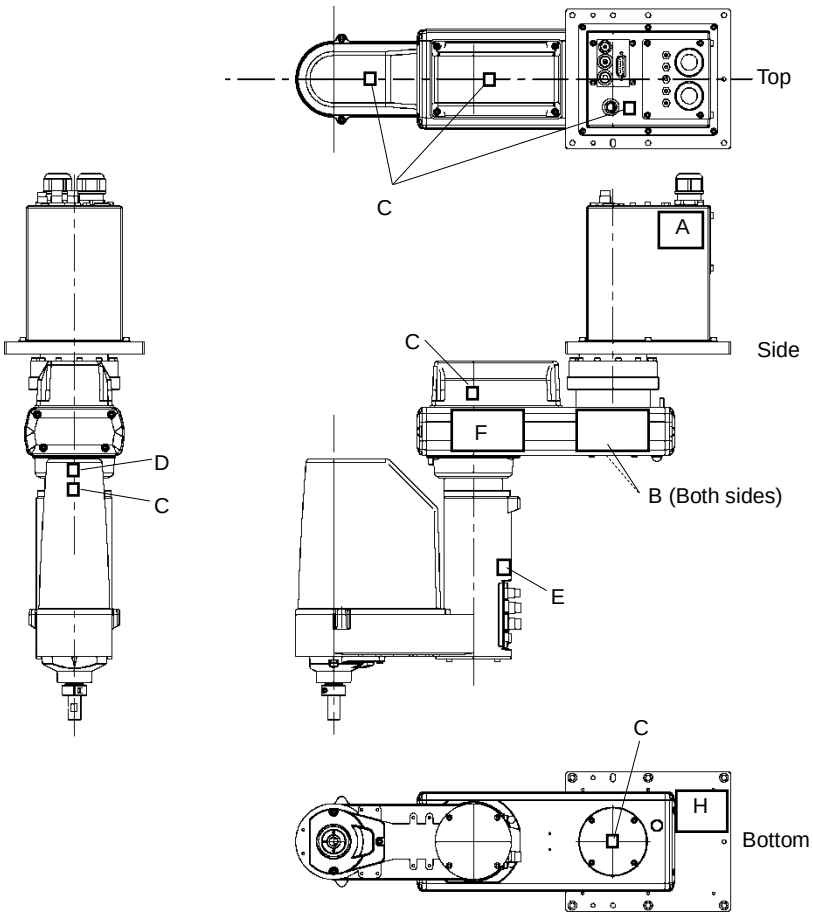
Wall Mounting: G10/G20-****W



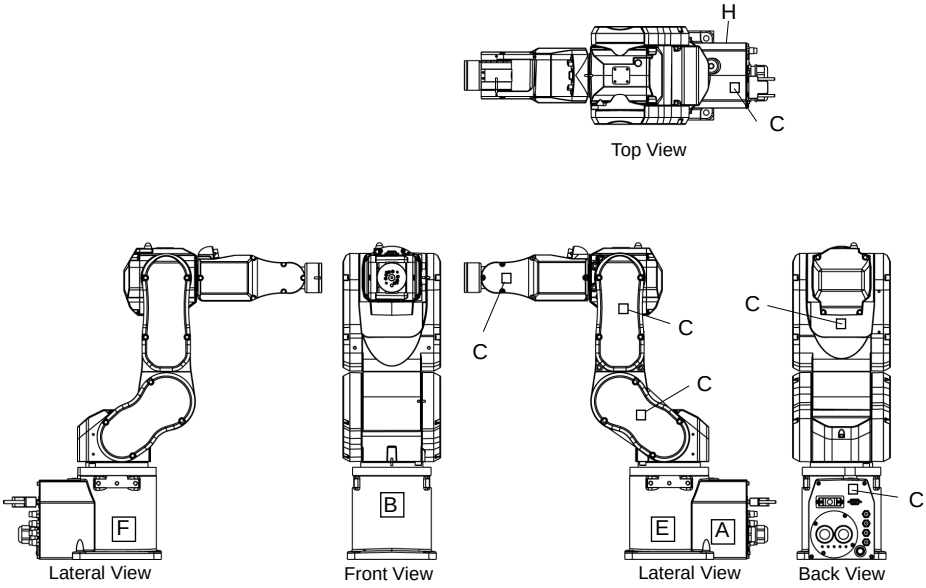
Ceiling Mounting: G10/G20-****R



RS

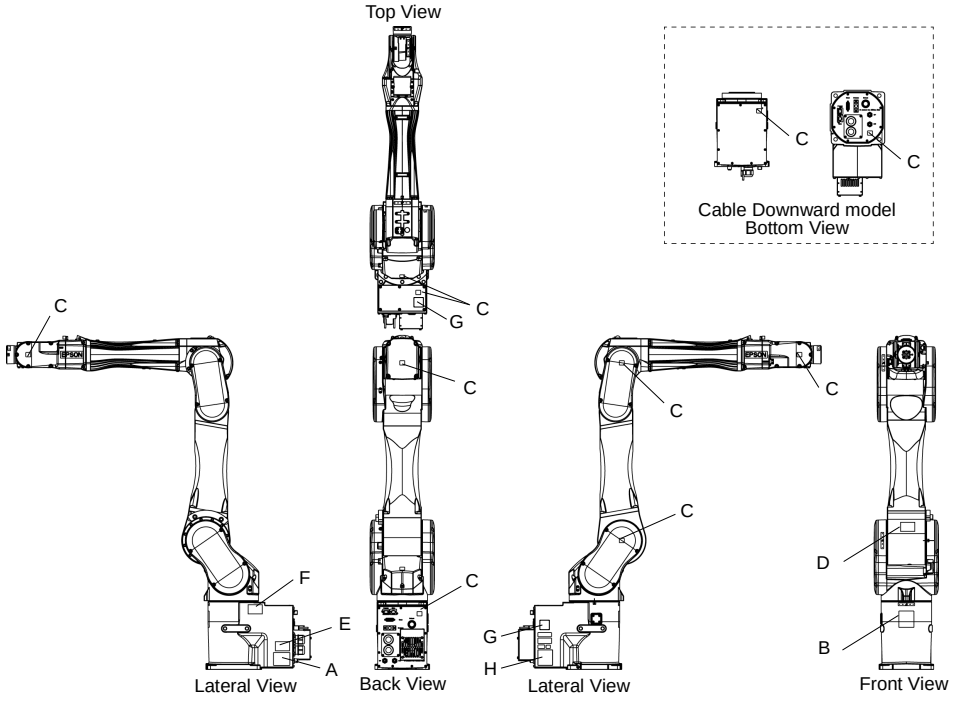


C4



E: This label is attached on the UL-approved Manipulators and the optional brake release box

C8

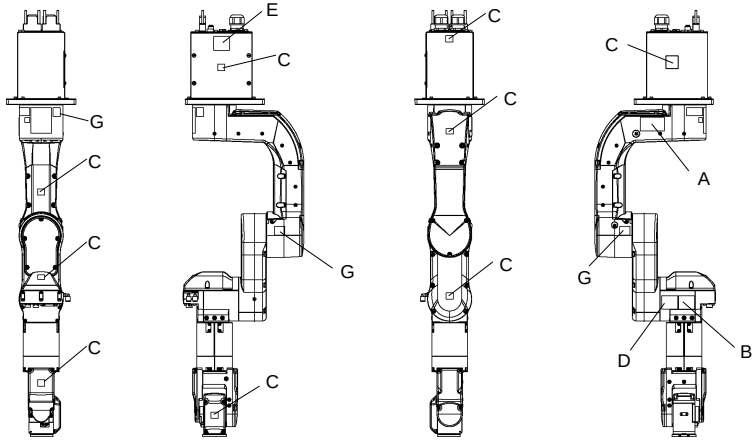


(Illust: C8-A1401* (C8XL))

E: This label is attached on the UL-approved Manipulators and the optional brake release box

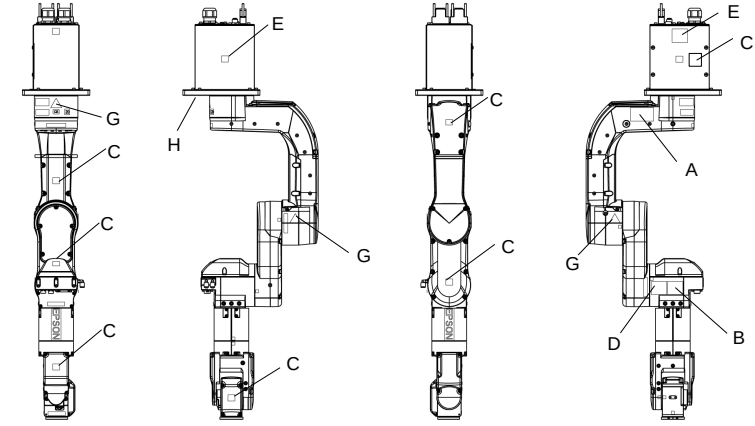
N2

S/N: N201000001~N201010000



Lateral View　Front View　Lateral View　Back View

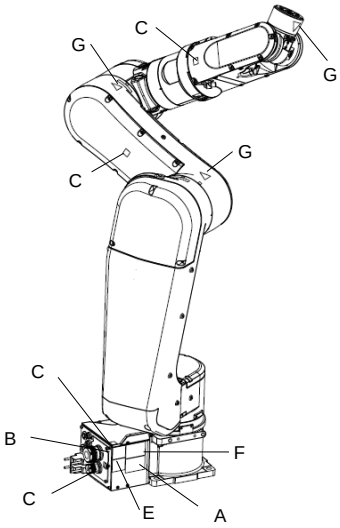
S/N: N201010001 or more

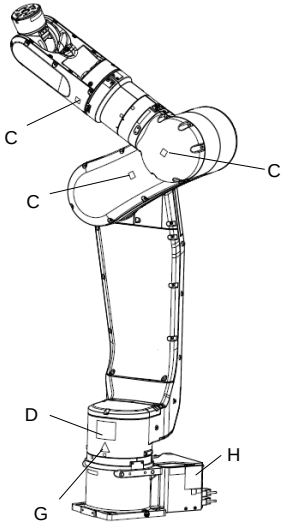


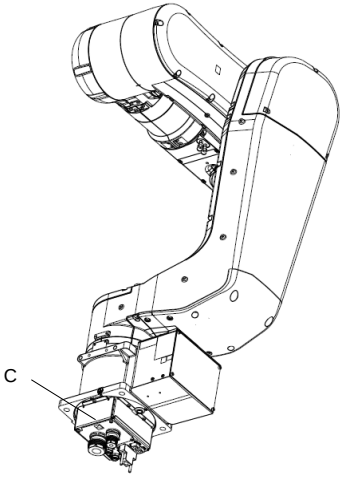
Lateral　Front　Lateral　Back

E: This label is attached on the UL-approved Manipulators and the optional brake release box

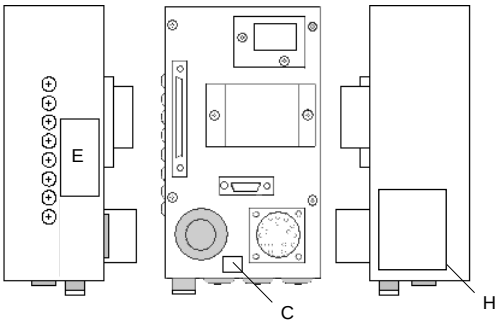
N6







X5



NOTE

Label E is for the manipulator of up/down axis.

1.7 Safety Features

The robot control system supports safety features described below. However, the user is recommended to strictly follow the proper usage of the robot system by thoroughly reading the attached manuals before using the system. Failure to read and understand the proper usage of the safety functions is highly dangerous.

Among the following safety features, the Emergency Stop Switch and Safety Door Input are particularly important. Make sure that these and other features function properly before operating the robot system.

For details, refer to the *2.5 Controller Installation - Safety Door Switch and Latch Release Switch.*

Emergency Stop Switch

The EMERGENCY connector on the Controller has expansion Emergency Stop input terminals used for connecting the Emergency Stop switches.
Pressing any Emergency Stop switch can shut off the motor power immediately and the robot system will enter the Emergency Stop condition.
Stop category of Emergency Stop input: Category 0 (refer to Safety Standard IEC60204-1)

Safety Door Input

In order to activate this feature, make sure that the Safety Door Input switch is connected to the EMERGENCY connector at the Controller.
When the safety door is opened, normally the Manipulator immediately stops the current operation, and the status of Manipulator power is operation-prohibited until the safety door is closed and the latched condition is released. In order to execute the Manipulator operation while the safety door is open, you must change the mode selector key switch on the Teach Pendant to the “Teach” mode. Manipulator operation is available only when the enable switch is on. In this case, the Manipulator is operated in low power status.
Stop category of Safety door input: Category 1 (refer to Safety Standard IEC60204-1)

Low Power Mode

The motor power is reduced in this mode.
Executing a power status change instruction will change to the restricted (low power) status regardless of conditions of the safety door or operation mode. The restricted (low power) status ensures the safety of the operator and reduces the possibility of peripheral equipment destruction or damage caused by careless operation.

Dynamic Brake

The dynamic brake circuit includes relays that short the motor armatures. The dynamic brake circuit is activated when there is an Emergency Stop input or when any of the following errors is detected: encoder cable disconnection, motor overload, irregular motor torque, motor speed error, servo error (positioning or speed overflow), irregular CPU, memory check-sum error and overheat condition inside the Motor Driver Module.

Motor Overload Detection

The dynamic brake circuit is activated when the system detects that the load on the motor has exceeded its capacity.

Irregular Motor Torque (out-of-control manipulator) Detection

The dynamic brake circuit is activated when irregularity with motor torque (motor output) is detected (in which case the Manipulator is out of control).

Motor Speed Error Detection

The dynamic brake circuit is activated when the system detects that the motor is running at incorrect speed.

Positioning Overflow -Servo Error- Detection

The dynamic brake circuit is activated when the system detects that the difference between the Manipulator's actual position and commanded position exceeds the margin of error allowed.

Speed Overflow -Servo Error- Detection

The dynamic brake circuit is activated when the Manipulator's actual speed is detected to mark an overflow (the actual speed is outside the nominal range) error.

CPU Irregularity Detection

Irregularity of CPU that controls the motor is detected by the watchdog timer. The system CPU and the motor controlling CPU inside the Controller are also designed to constantly check each other for any discrepancies. If a discrepancy is detected, the dynamic brake circuit is activated.

Memory Check-sum Error Detection

The dynamic brake circuit is activated when a memory check-sum error is detected.

Overheat Detection at the Motor Driver Module

The dynamic brake circuit is activated when the temperature of the power device inside the Motor Driver module is above the nominal limit.

Relay Deposition Detection

The dynamic brake circuit is activated when relay deposition is detected.

Over-Voltage Detection

The dynamic brake circuit is activated when the voltage of the Controller is above the normal limit.

AC Power Supply Voltage Drop Detection

The dynamic brake circuit is activated when the drop of the power supply voltage is detected.

Temperature Anomaly Detection

The temperature anomaly is detected.

Fan Malfunction Detection

Malfunction of the fan rotation speed is detected.

1.8 Manipulator Specifications

G1

Item		4-axis spec	
		G1-171*	G1-221*
Mounting type		Table Top	
Arm length	Arm #1, #2	175 mm	225 mm
	Arm #1	75 mm	125 mm
	Arm #2	100 mm	
Weight (cables not included)		8 kg	
Driving method	All joints	AC servo motor	
Max. operating speed *1	Joint #1, #2	2630 mm/s	3000 mm/s
	Joint #3 (Z)	1200 mm/s	
	Joint #4 (U)	3000 deg/s	
Repeatability	Joint #1, #2	± 0.005 mm	± 0.008 mm
	Joint #3 (Z)	± 0.01 mm	
	Joint #4 (U)	± 0.01 deg	
Max. motion range	Joint #1	± 125 deg	
	Joint #2 (Cleanroom model)	± 140 deg (± 140 deg)	± 152 deg (±149 deg)
	Z stroke (Cleanroom model)	± 100 (80) mm	
	Joint #4	± 360 deg	
Max. pulse range (pulse)	Joint #1	– 1019449 ~ 6262329 pulse	
	Joint #2 (Cleanroom model)	± 2548623 (± 2548623)	± 2767076 (± 2712463)
	Joint #3 (Cleanroom model)	– 1092267 to 0 (– 873813 to 0)	
	Joint #4	– 393216 to 393216	
Resolution	Joint #1	3.43322E-05 deg/pulse	
	Joint #2	5.49316E-05 deg/pulse	
	Joint #3	9.15527E-05 mm/pulse	
	Joint #4	9.15527E-04 deg/pulse	
Motor power consumption		All joints: 50 W	
Payload	Rated	0.5 kg	
	Maximum	1 kg	
Joint #4 allowable moment of inertia *2	Rated	0.0003 kg·m^2	
	Maximum	0.004 kg·m^2	
Shaft diameter		ø 8 mm	
Mounting hole		125 × 88 (4-M6)	

Item		4-axis spec	
		G1-171*	G1-221*
Joint #3 down force		50 N	
Installed wire for customer use		24 pin (9+15)	
Installed pneumatic tube for customer use		1 pneumatic tube (ø 4 mm) : 0.59 MPa (6 kgf/cm^2 : 86 psi) 2 pneumatic tubes (ø 6 mm) : 0.59 MPa (6 kgf/cm^2 : 86 psi)	
Environmental requirements	Ambient temperature	5 to 40 deg C (with minimum temperature variation)	
	Ambient relative humidity	10 to 80 % RH (no condensation)	
	Vibration level	4.9 m/s^2 (0.5G) or less	
Noise level *3		65dB	
Installation environment		Cleanroom + ESD (ISO Class 3) *4	
Assignable Value ( ) Default values	Speed	1 to (5) to 100	
	Accel *5	1 to (10) to 120	
	SpeedS	1 to (50) to 2000	
	AccelS	1 to (200) to 25000	
	Fine	0 to (10000) to 65000	
	Weight	0,100 to (0.5,100) to 1,100	
Safety standard		CE Marking : EMC Directive Machinery Directive RoHS Directive KC Marking / KCs Marking UL standards (In case of UL specification): UL1740, ANSI/RIA R15.06, NFPA 79	

Item		3-axis spec	
		G1-171*Z	G1-221*Z
Mounting type		Table Top	
Arm length	Arm #1, #2	175 mm	225 mm
	Arm #1	75 mm	125 mm
	Arm #2	100 mm	
Weight (cables not included)		8 kg	
Driving method	All joints	AC servo motor	
Max. operating speed *1	Joint #1, #2	2630 mm/s	3000 mm/s
	Joint #3 (Z)	1200 mm/s	
	Joint #4 (U)	3000 deg/s	
Repeatability	Joint #1, #2	± 0.005 mm	± 0.008 mm
	Joint #3 (Z)	± 0.01 mm	
	Joint #4 (U)	-	
Max. motion range	Joint #1	± 125 deg	
	Joint #2 (Cleanroom model)	± 135 deg. (± 123 deg.)	± 135 deg. (± 132 deg.)
	Z stroke (Cleanroom model)	± 100 (80) mm	
	Joint #4	-	
Max. pulse range (pulse)	Joint #1	– 1019449 to 6262329 pulse	
	Joint #2 (Cleanroom model)	± 2457600 (± 2239147)	± 2457600 (± 2402987)
	Joint #3 (Cleanroom model)	– 1092267 to 0 (– 873813 to 0)	
	Joint #4	– 393216 to 393216	
Resolution	Joint #1	3.43322E-05 deg/pulse	
	Joint #2	5.49316E-05 deg/pulse	
	Joint #3	9.15527E-05 mm/pulse	
	Joint #4	9.15527E-04 deg/pulse	
Motor power consumption		All joints: 50 W	
Payload	Rated	0.5 kg	
	Maximum	1.5 kg	
Joint #4 allowable moment of inertia *2	Rated	-	
	Maximum	-	
Shaft diameter		ø 8 mm	
Mounting hole		125 × 88 (4-M6)	
Joint #3 down force		50 N	
Installed wire for customer use		24 pin (9 + 15)	

Item		3-axis spec	
		G1-171*Z	G1-221*Z
Installed pneumatic tube for customer use		1 pneumatic tube (ø 4 mm): : 0.59 MPa (6 kgf/cm^2 : 86 psi) 2 pneumatic tubes (ø 6 mm): : 0.59 MPa (6 kgf/cm^2 : 86 psi)	
Environmental requirements	Ambient temperature	5 to 40 deg.C (with minimum temperature variation)	
	Ambient relative humidity	10 to 80 % RH (no condensation)	
	Vibration level	4.9 m/s^2 (0.5 G) or less	
Noise level *3		65 dB	
Installation environment		Cleanroom + ESD (ISO Class 3) *4	
Assignable Value ( ) Default values	Speed	1 to (5) to 100	
	Accel *5	1 to (10) to 120	
	SpeedS	1 to (50) to 2000	
	AccelS	1 to (200) to 25000	
	Fine	0 to (10000) to 65000	
	Weight	0, 100 to (0.5, 100) to 1.5, 100	
Safety standard		CE Marking : EMC Directive Machinery Directive RoHS Directive KC Marking / KCs Marking UL standards (In case of UL specification): UL1740, ANSI/RIA R15.06, NFPA 79	

*1: In the case of PTP command.
Maximum operating speed for CP command is 2000 mm/s on horizontal plane.

*2: In the case where the center of gravity is at the center of Joint #4.
If the center of gravity is not at the center of Joint #4, set the parameter using Inertia command.

*3: Conditions of Manipulator during measurement as follows:
Operating conditions : Under rated load, 4-joints simultaneous motion, maximum speed, maximum acceleration, and duty 50%.
Measurement point : Rear of the Manipulator, 1000 mm apart from the motion range, 50 mm above the base-installed surface.

*4: The exhaust system in the Cleanroom-model Manipulator draws air from the base interior and arm cover interior.
A crack or other opening in the base unit can cause loss of negative air pressure in the outer part of the arm, which can cause increased dust emission. Seal firmly the exhaust port and the exhaust tube with vinyl tape.
If the exhaust flow is not sufficient, dust particle emission may exceed the specified maximum level.
Cleanliness level : Class ISO 3 (ISO14644-1)
Amount of Dust (0.1 µm diameter or larger) in 28317 cm^3 (1cft) sample-air around the center of the motion rang: 10 particles or less.)
Exhaust System : Exhaust port : Inner diameter: ø8 mm
Exhaust tube : Polyurethane tube
Outer diameter ø8 mm
or Inner diameter ø16mm or larger
Recommended exhaust flow rate: approx. 1000 cm^3/s (Normal)
ESD specification uses resin materials with antistatic treatment. This model controls adhesion of dust due to electrification.

*5: In general use, Accel setting 100 is the optimum setting that maintains the balance of acceleration and vibration when positioning. Although values larger than 100 can be set to Accel, it is recommended to minimize the use of large values to necessary motions since operating the manipulator continuously with the large Accel setting may shorten the product life remarkably.

G3

Item		G3 series Manipulator		
Arm length	Arm #1, #2	250 mm	300 mm	350 mm
	Arm #1	120 mm	170 mm	220 mm
	Arm #2	130 mm	130 mm	130 mm
Max. operating speed *1	Joint #1, #2	3550 mm/s	3950 mm/s	4350 mm/s
	Joints #3	1100 mm/s		
	Joint #4	3000 deg/s		
Repeatability	Joint #1, #2	± 0.008 mm	± 0.01 mm	± 0.01 mm
	Joint #3	± 0.01 mm		
	Joint #4	± 0.005 deg		
Payload	Rated	1 kg		
	Maximum	3 kg		
Joints #4 allowable moment of inertia *2	Rated	0.005 kg·m^2		
	Maximum	0.05 kg·m^2		
Resolution	Joint #1	0.0000343323 deg/pulse		
	Joint #2	0.0000549316 deg/pulse		
	Joint #3	0.0000878906 mm/pulse		
	Joint #4	0.000240928 deg/pulse		
Hand	Shaft diameter	ø 16 mm		
	Through hole	ø 11 mm		
Mounting hole	Table top mounting	120 × 120 mm (4-M8)		
	Multiple mounting	Wall mounting : 174 × 70 mm (4-M8)		
		Ceiling mounting : 120 × 120 mm (4-M8) / custom specification		
Weight (cables not included)		14 kg : 31 lb		
Driving method	All joints	AC servo motor		
Motor power consumption	Joint #1	200 W		
	Joint #2	150 W		
	Joint #3	150 W		
	Joint #4	150 W		
Option	Mounting type	-	Multiple mounting	
	Installation environment	Cleanroom & ESD *3		
Joint #3 down force		150 N		
Installed wire for customer use		15 (15 pin: D-sub) 15 cores		
Installed pneumatic tube for customer use		2 pneumatic tubes (ø6 mm) : 0.59 MPa (6 kgf/cm^2 : 86 psi)		
		1 pneumatic tubes (ø4 mm) : 0.59 MPa (6 kgf/cm^2 : 86 psi)		
Environmental requirements	Ambient temperature	5 to 40 deg C (with minimum temperature variation)		
	Ambient relative humidity	10 to 80% (no condensation)		
Noise level *4		L_{Aeq} = 70 dB (A)		

Item		G3 series Manipulator
Assignable Value ( ) Default values	Speed	1 to (5) to 100
	Accel *5	1 to (10) to 120
	SpeedS	1 to (50) to 2000
	AccelS	1 to (200) to 25000
	Fine	0 to (10000) to 65000
	Weight	0, 130 to (1, 130) to 3, 130
Safety standard		CE Marking : EMC Directive Machinery Directive RoHS Directive KC Marking / KCs Marking UL standards (In case of UL specification): UL1740, ANSI/RIA R15.06, NFPA 79

Max. motion range (deg) (mm) / Max. pulse range (pulse)

Standard-model / Table Top Mounting

Item				G3-251S	G3-301S-*	G3-351S-*
Max. motion range (deg), (mm)	Straight	Joint #1		± 140		
		Joint #2		± 141	± 142	
	Curved	Joint #1	Right hand	-	– 125 to 150	– 110 to 165
			Left hand	-	– 150 to 125	– 165 to 110
		Joint #2	Right hand	-	– 135 to 150	– 120 to 165
			Left hand	-	– 150 to 135	– 165 to 120
	Common	Joint #3		150 mm		
		Joint #4		± 360		
Max. pulse range (pulse)	Straight	Joint #1		– 1456356 to 6699236		
		Joint #2		± 2566827	± 2585032	
	Curved	Joint #1	Right hand	-	– 1019449 to 6990507	– 582543 to 7427414
			Left hand	-	– 1747627 to 6262329	– 2184534 to 5825423
		Joint #2	Right hand	-	– 2457600 to 2730667	– 2184534 to 3003734
			Left hand	-	– 2730667 to 2457600	– 3003734 to 2184534
	Common	Joint #3		–1706667 to 0		
		Joint #4		± 1494221		

Standard-model / Multiple Mounting

Item				G3-301SM	G3-351SM-*
Max. motion range (deg), (mm)	Straight	Joint #1		± 115	± 120
		Joint #2		± 135	± 142
	Curved	Joint #1	Right hand	-	– 105 to 130
			Left hand	-	– 130 to 105
		Joint #2	Right hand	-	– 120 to 160
			Left hand	-	– 160 to 120
	Common	Joint #3		150 mm	
		Joint #4		± 360	
Max. pulse range (pulse)	Straight	Joint #1		– 728178 to 5971058	– 873814 to 6116694
		Joint #2		± 2457600	± 2585032
	Curved	Joint #1	Right hand	-	– 436907 to 6407965
			Left hand	-	– 1165085 to 5679787
		Joint #2	Right hand	-	– 2184534 to 2912712
			Left hand	-	– 2912712 to 2184534
	Common	Joint #3		–1706667 to 0	
		Joint #4		± 1494221	

Cleanroom & ESD model / Table Top Mounting

Item				G3-251C	G3-301C-*	G3-351C-*
Max. motion range (deg), (mm)	Straight	Joint #1		± 140		
		Joint #2		± 137	± 141	± 142
	Curved	Joint #1	Right hand	-	– 125 to 150	– 110 to 165
			Left hand	-	– 150 to 125	– 165 to 110
		Joint #2	Right hand	-	– 135 to 145	– 120 to 160
			Left hand	-	– 145 to 135	– 160 to 120
	Common	Joint #3		120 mm		
		Joint #4		± 360		
Max. pulse range (pulse)	Straight	Joint #1		– 1456356 to 6699236		
		Joint #2		± 2494009	± 2566827	± 2585032
	Curved	Joint #1	Right hand	-	– 1019449 to 6990507	– 582543 to 7427414
			Left hand	-	– 1747627 to 6262329	– 2184534 to 5825423
		Joint #2	Right hand	-	– 2457600 to 2639645	– 2184534 to 2912712
			Left hand	-	– 2639645 to 2457600	– 2912712 to 2184534
	Common	Joint #3		– 1365334 to 0		
		Joint #4		± 1494221		

Cleanroom & ESD model / Multiple Mounting

Item				G3-301CM	G3-351CM-*
Max. motion range (deg), (mm)	Straight	Joint #1		± 115	± 120
		Joint #2		± 135	± 142
	Curved	Joint #1	Right hand	-	– 105 to 130
			Left hand	-	– 130 to 105
		Joint #2	Right hand	-	– 120 to 150
			Left hand	-	– 150 to 120
	Common	Joint #3		120 mm	
		Joint #4		± 360	
Max. pulse range (pulse)	Straight	Joint #1		– 728178 to 5971058	– 873814 to 6116694
		Joint #2		± 2457600	± 2585032
	Curved	Joint #1	Right hand	-	– 436907 to 6407965
			Left hand	-	– 1165085 to 5679787
		Joint #2	Right hand	-	– 2184534 to 2730667
			Left hand	-	– 2730667 to 2187534
	Common	Joint #3		– 1365334 to 0	
		Joint #4		± 1494221	

*1: In the case of PTP command.
Maximum operating speed for CP command is 2000 mm/s on horizontal plane.

*2: In the case where the center of gravity is at the center of Joint #4.
If the center of gravity is not at the center of Joint #4, set the parameter using Inertia command.

*3: The exhaust system in the Cleanroom-model Manipulator draws air from the base interior and arm cover interior.
A crack or other opening in the base unit can cause loss of negative air pressure in the outer part of the arm, which can cause increased dust emission.
Do not remove the maintenance cover on the front of the base.
Seal the exhaust port and the exhaust tube with vinyl tape so that the joint is airtight.
If the exhaust flow is not sufficient, dust particle emission may exceed the specified maximum level.
Cleanliness level : Class ISO 3 (ISO14644-1)
Amount of dust (0.1 µm diameter or larger) in 28317 cm^3 (1cft) sample-air around the center of the motion rang: 10 particles or less.
Exhaust System : Exhaust port diameter:
Inner diameter: ø12 mm / Outer diameter: ø16 mm
Exhaust tube: Polyurethane tube
Outer diameter: ø12 mm (Inner diameter:ø8 mm) or
Inner diameter ø16mm or larger
Recommended exhaust flow rate : approx. 1000 cm^3/s (Normal)
ESD specification uses resin materials with antistatic treatment. This model controls adhesion of dust due to electrification.

*4: Conditions of Manipulator during measurement as follows:
Operating conditions : Under rated load, 4-joints simultaneous motion, maximum speed, maximum acceleration, and duty 50%.
Measurement point : Rear of the Manipulator, 1000 mm apart from the motion range, 50 mm above the base-installed surface.

*5: In general use, Accel setting 100 is the optimum setting that maintains the balance of acceleration and vibration when positioning. Although values larger than 100 can be set to Accel, it is recommended to minimize the use of large values to necessary motions since operating the manipulator continuously with the large Accel setting may shorten the product life remarkably.

G6

Item			G6-****
Mounting type			Table Top
Environment			Cleanroom-model + ESD *1, Protected-model *2
Arm length	Arm #1, #2	45	450 mm
		55	550 mm
		65	650 mm
	Arm #3	1	180 mm : G6-**1S*, D* 150 mm : G6-**1C*, P*, D* with bellows option
		3	330 mm : G6-**3S*, D* 300 mm : G6-**3C*, P*, D* with bellows option
Weight (not include the weight of cables)		45/55	27 kg : 60 lb
		65	28 kg : 62 lb
Driving method	All joints		AC servo motor
Max. operating speed *3	Joint #1, #2	45	6440 mm/s
		55	7170 mm/s
		65	7900 mm/s
	Joint #3	1	1100 mm/s
		3	2350 mm/s
	Joint #4		2400 deg/s
Repeatability	Joint #1, #2		± 0.015 mm
	Joint #3		± 0.01 mm
	Joint #4		± 0.005 deg
Max. motion range	Joint #1	45	± 152 deg
		55	
		65	
	Joint #2	45	± 142 to 147.5 deg *a
		55	± 147.5 deg
		65	±147.5 deg
	Joint #3	1	180 mm : G6-**1S*, D* 150 mm : G6-**1C*, P*, D* with bellows option
		3	330 mm : G6-**3S*, D* 300 mm : G6-**3C*, P*, D* with bellows option
	Joint #4		± 360 deg

Item			G6-****
Maximum pulse range (pulse)	Joint #1	45	-1805881 to +7048761
		55	
		65	
	Joint #2	45	± 2585031 to 2685156 *a
		55	± 2685156
		65	± 2685156
	Joint #3	1	-1976708 : G6-**1S*, D* -1647257 : G6-**1C*, P*, D* with bellows option
		3	-1811982 : G6-**3S*, D* -1647257 : G6-**3C*, P*, D* with bellows option
	Joint #4		± 1961226

*a : G6-45*** Joint #2

		Max. motion range	Max. pulse range
G6-45*S*, D*	Z 0 to –270	147.5 deg	±2685156 pulse
	Z –270 to –330	145 deg	±2639645 pulse
G6-45*C*/ P* / D* with bellows option	Z 0 to –240	147.5 deg	±2685156 pulse
	Z –240 to –300	142 deg	±2585031 pulse

Item			G6-****R	G6-****W
Mounting type			Ceiling	Wall
Environment			Cleanroom-model + ESD [*1], Protected-model [*2]	
Arm length	Arm #1, #2	45	450 mm	
		55	550 mm	
		65	650 mm	
	Arm #3	1	180 mm : G6-**1S*, D* 150 mm : G6-**1C*, P*, D* with bellows option	
		3	330 mm : G6-**3S*, D* 300 mm : G6-**3C*, P*, D* with bellows option	
Weight (not include the weight of cables)		45/55	27 kg : 60 lb	29 kg : 64 lb
		65	28 kg : 62 lb	29.5 kg : 65 lb
Driving method	All joints		AC servo motor	
Max. operating speed [*3]	Joint #1, #2	45	6440 mm/s	
		55	7170 mm/s	
		65	7900 mm/s	
	Joint #3	1	1100 mm/s	
		3	2350 mm/s	
	Joint #4		2400 deg/s	
Repeatability	Joint #1, #2		± 0.015 mm	
	Joint #3		± 0.01 mm	
	Joint #4		± 0.005 deg	
Max. motion range	Joint #1	45	± 120 deg	± 105 deg
		55	± 152 deg	± 135 deg
		65		± 148 deg
	Joint #2	45	± 130 deg	
		55	± 147.5 deg : S ± 145 deg : C*, P*, D* with bellows option	
		65	± 147.5 deg	
	Joint #3	1	180 mm : G6-**1S*, D* 150 mm : G6-**1C*, P*, D* with bellows option	
		3	330 mm : G6-**3S*, D* 300 mm : G6-**3C*, P*, D* with bellows option	
	Joint #4		± 360 deg	

Item			G6-****R	G6-****W
Mounting type			Ceiling	Wall
Maximum pulse range (pulse)	Joint #1	45	-873814 to +6116694	-436907 to +5679787
		55	-1805881 to +7048761	-1310720 to +6553600
		65		-1689373 to +6932253
	Joint #2	45	± 2366578	
		55	± 2685156 : S	
			± 2639645 : C*, P*, D* with bellows option	
		65	± 2685156	
	Joint #3	1	-1976708 : G6-**1S*, D* -1647257 : G6-**1C*, P*, D* with bellows option	
		3	-1811982 : G6-**3S*, D* -1647257 : G6-**3C*, P*, D* with bellows option	
	Joint #4		± 1961226	

Item			G6-*****
Resolution	Joint #1		0.0000343 deg/pulse
	Joint #2		0.0000549 deg/pulse
	Joint #3	1	0.0000911 mm/pulse
		3	0.0001821 mm/pulse
	Joint #4		0.0001836 deg/pulse
Motor power consumption	Joint #1		400 W
	Joint #2		400 W
	Joint #3		200 W
	Joint #4		100 W
Payload	Rated		3 kg
	Maximum		6 kg
Joint #4 allowable moment of inertia *4	Rated		0.01 kg·m^2
	Maximum		0.12 kg·m^2
Hand	Shaft diameter		ø20 mm
	Through hole		ø14 mm
Joint #3 down force			150 N
Installed wire for customer use			24 (15 pin + 9 pin : D-sub)
Installed pneumatic tube for customer use			2 pneumatic tubes (ø6 mm) : 0.59 MPa (6 kgf/cm^2 : 86 psi)
			2 pneumatic tubes (ø4 mm) : 0.59 MPa (6 kgf/cm^2 : 86 psi)
Environmental requirements	Ambient temperature		5 to 40deg C (with minimum temperature variation)
	Ambient relative humidity		10 to 80% (no condensation)
Noise level *5			L_{Aeq} = 70 dB(A)
Assignable Value ( ) Default values	Speed		1 to (5) to 100
	Accel *6		1 to (10) to 120
	SpeedS		1 to (50) to 2000
	AccelS		1 to (200) to 25000
	Fine		0 to (10000) to 65000
	Weight		0, 250 to (3, 250) to 6, 250
Safety standard			CE Marking : EMC Directive Machinery Directive RoHS Directive KC Marking / KCs Marking UL standards (In case of UL specification): UL1740, ANSI/RIA R15.06, NFPA 79

*1: The exhaust system in the Cleanroom-model Manipulator (G6-***C*) draws air from the base interior and arm cover interior.
A crack or other opening in the base unit can cause loss of negative air pressure in the outer part of the arm, which can cause increased dust emission.
Do not remove the maintenance cover on the front of the base.
Seal the exhaust port and the exhaust tube with vinyl tape so that the joint is airtight.
If the exhaust flow is not sufficient, dust particle emission may exceed the specified maximum level.

Cleanliness level : Class ISO 3 (ISO14644-1)
Amount of Dust (0.1 μm diameter or larger) in 28317 cm^3 (1cft) sample-air around the center of the motion rang: 10 particles or less.)
Exhaust System : Exhaust port diameter: Inner diameter: ø12 mm/Outer diameter: ø16 mm
Exhaust tube : Polyurethane tube
Outer diameter: ø12 mm (Inner diameter: ø8 mm)
or Inner diameter ø16 mm or larger
Recommended exhaust flow rate: Approx. 1000 cm^3/s (Normal)

ESD specification uses resin materials with antistatic treatment. This model controls adhesion of dust due to electrification.

*2: IP (International Protection) for the Protected-model Manipulator indicates International Standard of the protection level against dust and water.

Normal G6-***D* Manipulators do not have bellows. The normal G6-***D* Manipulator (without bellows option) operates under adverse conditions with oily mist.

If necessary, select the bellows option at shipment.

The Manipulators with bellows (option) comply with grade of protection IP54 (IEC 60529, JIS C0920).

Model	Degree of protection		
G6-***D* with bellows option	IP54	Dust: 5	Dust shall not ingress in a quantity to interfere with satisfactory operation of the equipment.
		Water: 4	Water splashing against the enclosure from any direction shall have no harmful effect.
G6-***P*	IP65	Dust: 6	No ingress of dust.
		Water: 5	Water projected by a nozzle against enclosure from any direction shall have no harmful effects.

*3: In the case of PTP command. Maximum operating speed for CP command is 2000 mm/s on horizontal plane.

*4: In the case where the center of gravity is at the center of Joint #4. If the center of gravity is not at the center of Joint #4, set the parameter using Inertia command.

*5: Conditions of Manipulator during measurement as follows:

Operating conditions	:	Under rated load, 4-joints simultaneous motion, maximum speed, maximum acceleration, and duty 50%.
Measurement point	:	Rear of the Manipulator, 1000 mm apart from the motion range, 50 mm above the base-installed surface.

*6: In general use, Accel setting 100 is the optimum setting that maintains the balance of acceleration and vibration when positioning. Although values larger than 100 can be set to Accel, it is recommended to minimize the use of large values to necessary motions since operating the manipulator continuously with the large Accel setting may shorten the product life remarkably.

G10/G20

Item			G10/G20-****
Mounting type			Table Top
Environment			Cleanroom-model + ESD [*1] , Protected-model [*2]
Arm length	Arm #1, #2	65	650 mm (G10 only)
		85	850 mm (G10, G20)
		A0	1000 mm (G20 only)
	Arm #3	1	180 mm : G10/G20-**1S*, D* 150 mm : G10/G20-**1C*, P*, D* with bellows option
		4	420 mm : G10/G20-**4S*, D* 390 mm : G10/G20-**4C*, P*, D* with bellows option
Weight (not include the weight of cables)	G10	65	46 kg: 102 lb
	G10/G20	85	48 kg: 106 lb
	G20	A0	50 kg: 111 lb
Driving method	All joints		AC servo motor
Max. operating speed [*3]	Joint #1, #2	65	8800 mm/s
		85	11000 mm/s
		A0	11500 mm/s
	Joint #3	1	1100 mm/s
		4	2350 mm/s
	Joint #4	G10	2400 deg/s
		G20	1700 deg/s
Repeatability	Joint #1, #2		± 0.025 mm
	Joint #3		± 0.01 mm
	Joint #4		± 0.005 deg
Max. motion range	Joint #1	65	± 152 deg
		85	
		A0	
	Joint #2	65	± 152.5 deg *a
		85	
		A0	
	Joint #3	1	180 mm : G10/G20-**1S*, D* 150 mm : G10/G20-**1C*, P*, D* with bellows option
		4	420 mm : G10/G20-**4S*, D* 390 mm : G10/G20-**4C*, P*, D* with bellows option
	Joint #4		± 360 deg

Item			G10/G20-****
Max. pulse range (pulse)	Joint #1	65	–1805881 to +7048761
		85	
		A0	
	Joint #2	65	± 2776178 *a
		85	
		A0	
	Joint #3	1	–1946420 : G10/G20-**1S*, D* –1622016 : G10/G20-**1C*, P*, D* with bellows option
		4	–2270823 : G10/G20-**4S*, D* –2108621 : G10/G20-**4C*, P*, D* with bellows option
	Joint #4	G10	± 1951517
		G20	± 2752512

NOTE The length of Arm #1 + #2 varies in different Manipulator models.
65 : 650 mm G10 only
85 : 850 mm G10 / G20
A0 : 1000 mm G20 only

Item			G10/G20-****R	G10/G20-*****W
Mounting type			Ceiling	Wall
Environment			Cleanroom-model + ESD *1 Protected-model *2	
Arm length	Arm #1, #2	65	650 mm (G10 only)	
		85	850 mm (G10, G20)	
		A0	1000 mm (G20 only)	
	Arm #3	1	180 mm : G10/G20-**1S*, D* 150 mm : G10/G20-**1C*, P*, D* with bellows option	
		4	420 mm : G10/G20-**4S*, D* 390 mm : G10/G20-**4C*, P*, D* with bellows option	
Weight (not include the weight of cables)	G10	65	46 kg: 102 lb	51 kg: 113 lb
	G10/G20	85	48 kg: 106 lb	53 kg: 117 lb
	G20	A0	50 kg: 111 lb	55 kg: 122 lb
Driving method	All joints		AC servo motor	
Max. operating speed *3	Joints #1, #2	65	8800 mm/s	
		85	11000 mm/s	
		A0	11500mm/s	
	Joint #3	1	1100 mm/s	
		4	2350 mm/s	
	Joint #4	G10	2400 deg/s	
		G20	1700 deg/s	
Repeatability	Joint #1, #2		± 0.025 mm	
	Joint #3		± 0.01 mm	
	Joint #4		± 0.005 deg	
Max. motion range	Joint #1	65	± 107 deg	± 107 deg
		85	± 152 deg	
		A0		
	Joint #2	65	± 130 deg	
		85	± 152.5 deg *a	
		A0		
	Joint #3	1	180 mm : G10/G20-**1S*, D* 150 mm : G10/G20-**1C*, P*, D* with bellows option	
		4	420 mm : G10/G20-**4S*, D* 390 mm : G10/G20-**4C*, P*, D* with bellows option	
	Joint #4		± 360 deg	

<table>
<tr><th colspan="3">Item</th><th>G10/G20-****R</th><th>G10/G20-*****W</th></tr>
<tr><td rowspan="8">Max.
pulse range
(pulse)</td><td rowspan="3">Joint #1</td><td>65</td><td>–495161
to +5738041</td><td rowspan="3">–495161
to +5738041</td></tr>
<tr><td>85</td><td rowspan="2">–1805881
to +7048761</td></tr>
<tr><td>A0</td></tr>
<tr><td rowspan="3">Joint #2</td><td>65</td><td colspan="2">± 2366578</td></tr>
<tr><td>85</td><td colspan="2" rowspan="2">± 2776178 *a</td></tr>
<tr><td>A0</td></tr>
<tr><td rowspan="2">Joint #3</td><td>1</td><td colspan="2">–1946420 : G10/G20-**1S*, D*
–1622016 : G10/G20-**1C*, P*,
D* with bellows option</td></tr>
<tr><td>4</td><td colspan="2">–2270823 : G10/G20-**4S*, D*
–2108621 : G10/G20-**4C*, P*,
D* with bellows option</td></tr>
<tr><td rowspan="2">Joint #4</td><td>G10</td><td colspan="2">± 1951517</td></tr>
<tr><td>G20</td><td colspan="2">± 2752512</td></tr>
</table>

*a : The Joint #2 values for the following manipulators

	Max. motion range	Max. pulse range
G10/G20-85C, P, D with bellows option (Z: –360 to –390 only) G10/G20-85CW, PW, DW with bellows option G10/G20-85CR, PR, DR with bellows option	± 151 deg	± 2748871

Item			G10-*****	G20-*****
Resolution	Joint #1		0.0000343 deg/pulse	
	Joint #2		0.0000549 deg/pulse	
	Joint #3	1	0.0000925 mm/pulse	
		4	0.000185 mm/pulse	
	Joint #4		0.0001845 deg/pulse	0.0001308 deg/pulse
Motor power consumption	Joint #1		750 W	
	Joint #2		600 W	
	Joint #3		400 W	
	Joint #4		150 W	
Payload	Rated		5 kg	10 kg
	Maximum		10 kg	20 kg
Joint #4 allowable moment of inertia *4	Rated		0.02 kg·m^2	0.05 kg·m^2
	Maximum		0.25 kg·m^2	0.45 kg·m^2
Hand	Shaft diameter		ø25 mm	
	Through hole		ø18 mm	
Joint #3 down force			250 N	
Installed wire for customer use			24 (15 pin + 9 pin : D-sub)	
Installed pneumatic tube for customer use			2 pneumatic tubes (ø6 mm) : 0.59 MPa (6 kgf/cm^2 : 86 psi)	
			2 pneumatic tubes (ø4 mm) : 0.59 MPa (6 kgf/cm^2 : 86 psi)	
Environmental requirements	Ambient temperature		5 to 40 degC (with minimum temperature variation)	
	Ambient relative humidity		10 to 80% (no condensation)	
Noise level *5			L_{Aeq} = 70 dB(A)	
Assignable Value ( ) Default values	Speed		1 to (5) to 100	
	Accel *6		1 to (10) to 120	
	SpeedS		1 to (50) to 2000	
	AccelS		1 to (200) to 25000	
	Fine		0 to (10000) to 65000	
	Weight		0, 400 to (10, 400) to 20, 400	
Safety standard			CE Marking : EMC Directive Machinery Directive RoHS Directive KC Marking / KCs Marking UL standards (In case of UL specification): UL1740, ANSI/RIA R15.06, NFPA 79	

*1: The exhaust system in the Cleanroom-model Manipulator (G10/G20-***C*) draws air from the base interior and arm cover interior.
A crack or other opening in the base unit can cause loss of negative air pressure in the outer part of the arm, which can cause increased dust emission.
Do not remove the maintenance cover on the front of the base.
Seal the exhaust port and the exhaust tube with vinyl tape so that the joint is airtight.
If the exhaust flow is not sufficient, dust particle emission may exceed the specified maximum level.
Cleanliness level: Class ISO 3 (ISO14644-1)
Amount of dust (0.1 µm diameter or larger) in 28317 cm^3 (1cft) sample-air around the center of the motion rang: 10 particles or less.)
Exhaust System: Exhaust port diameter: Inner diameter: ø12 mm/Outer diameter: ø16 mm
Exhaust tube : Polyurethane tube
Outer diameter: ø12 mm (Inner diameter: ø8 mm)
or Inner diameter ø16mm or larger
Recommended exhaust flow rate: Approx. 1000 cm^3/s (Normal)

ESD specification uses resin materials with antistatic treatment. This model controls adhesion of dust due to electrification.

*2: IP (International Protection) for the Protected-model Manipulator indicates International Standard of the protection level against dust and water.

Normal G10/G20-***D* Manipulators do not have bellows. The normal G10/G20-***D* Manipulator (without bellows option) operates under adverse conditions with oily mist.

If necessary, select the bellows option at shipment.

The Manipulators with bellows (option) comply with grade of protection IP54 (IEC 60529, JIS C0920).

Model	Degree of protection		
G10/G20-***D* with bellows option	IP54	Dust: 5	Dust shall not ingress in a quantity to interfere with satisfactory operation of the equipment.
		Water: 4	Water splashing against the enclosure from any direction shall have no harmful effect.
G10/G20-***P*	IP65	Dust: 6	No ingress of dust.
		Water: 5	Water projected by a nozzle against enclosure from any direction shall have no harmful effects.

*3: In the case of PTP command.
Maximum operating speed for CP command is 2000 mm/s on horizontal plane.

*4: In the case where the center of gravity is at the center of Joint #4.
If the center of gravity is not at the center of Joint #4, set the parameter using Inertia command.

*5: Conditions of Manipulator during measurement as follows:
Operating conditions : Under rated load, 4-joint simultaneous motion, maximum speed, maximum acceleration, and duty 50%.
Measurement point : Rear of the Manipulator, 1000 mm apart from the motion range, 50 mm above the base-installed surface.

*6: In general use, Accel setting 100 is the optimum setting that maintains the balance of acceleration and vibration when positioning. Although values larger than 100 can be set to Accel, it is recommended to minimize the use of large values to necessary motions since operating the manipulator continuously with the large Accel setting may shorten the product life remarkably.

RS3

Item			RS3-351*
Arm length	Arm #1, #2		350 mm
	Arm #1		175 mm
	Arm #2		175 mm
Max. operating speed *1	Joint #1, #2		6237 mm/s
	Joint #3		1100 mm/s
	Joint #4		2600 deg/s
Repeatability	Joint #1, #2		± 0.01 mm
	Joint #3		± 0.01 mm
	Joint #4		± 0.01 deg
Payload	Rated		1 kg
	Maximum		3 kg
Joint #4 allowable moment of inertia *2	Rated		0.005 kg·m^2
	Maximum		0.05 kg·m^2
Max. motion range	Joint #1		± 225 deg
	Joint #2		± 225 deg
	Joint #3	RS*-**1S	130 mm
		RS*-**1C	100 mm
	Joint #4		± 720 deg
Max. pulse range (pulse)	Joint #1		– 2560000 to + 5973334 pulse
	Joint #2		± 4177920 pulse
	Joint #3	RS*-**1S	– 1479112 pulse to 0 pulse
		RS*-**1C	– 1137778 pulse to 0 pulse
	Joint #4		± 3145728 pulse
Resolution	Joint #1		0.0000527 deg/pulse
	Joint #2		0.0000538 deg/pulse
	Joint #3		0.0000879 mm/pulse
	Joint #4		0.000229 deg/pulse
Hand	Shaft diameter		ø 16 mm
	Through hole		ø 11 mm
Mounting hole			6-M6
Weight (cables not included)			17 kg: 38 lb
Driving method	All joints		AC servo motor
Motor power consumption	Joint #1		400 W
	Joint #2		200 W
	Joint #3		150 W
	Joint #4		100 W
Option	Installation environment		Cleanroom & ESD *3
Joint #3 down force			150 N
Installed wire for customer use			15 wires: D-sub / 15 pin connectors

Item		RS3-351*
Installed pneumatic tube for customer use		2 pneumatic tubes (ø 6 mm) : 0.59 MPa (6 kgf/cm^2 : 86 psi)
		1 pneumatic tube (ø 4 mm) : 0.59 MPa (6 kgf/cm^2 : 86 psi)
Environmental requirements	Ambient temperature	5 to 40 degC (with minimum temperature variation)
	Ambient relative humidity	10 to 80% RH (no condensation)
Noise level *4		LAeq = 65 dB(A) or under
Assignable Value ( ) Default values	Speed	1 to (5) to 100
	Accel *5	1 to (10) to 120
	SpeedS	1 to (50) to 2000
	AccelS	1 to (200) to 25000
	Fine	0 to (10000) to 65000
	Weight	0, 175 to (1, 175) to 3, 175
Safety standard		CE Marking : EMC Directive Machinery Directive RoHS Directive KC Marking / KCs Marking UL standards (In case of UL specification): UL1740, ANSI/RIA R15.06, NFPA 79

*1: In the case of PTP command.
Maximum operating speed for CP command is 2000 mm/s on horizontal plane.

*2: In the case where the center of gravity is at the center of Joint #4.
If the center of gravity is not at the center of Joint #4, set the parameter using Inertia command.

*3: The exhaust system in the Cleanroom-model Manipulator draws air from the base interior and arm cover interior.
A crack or other opening in the base unit can cause loss of negative air pressure in the outer part of the arm, which can cause increased dust emission.
Do not remove the maintenance cover on the front of the base.
Seal the exhaust port and the exhaust tube with vinyl tape so that the joint is airtight.
If the exhaust flow is not sufficient, dust particle emission may exceed the specified maximum level.
Cleanliness level: Class ISO 3 (ISO14644-1)
Amount of Dust (0.1 µm diameter or larger) in 28317 cm^3 (1cft) sample-air around the center of the motion rang: 10 particles or less.)
Exhaust System: Exhaust port diameter: Inner diameter: ø12 mm / Outer diameter: ø16 mm
Exhaust tube : Polyurethane tube
Outer diameter: ø12 mm (Inner diameter: ø8 mm)
or Inner diameter ø16mm or larger
Recommended exhaust flow rate: approx. 1000 cm^3/s (Normal)
ESD specification uses resin materials with antistatic treatment. This model controls adhesion of dust due to electrification.

*4: Conditions of Manipulator during measurement as follows:

Operating conditions	: Under rated load, 4-joints simultaneous motion, maximum speed, maximum acceleration, and duty 50%.
Measurement point	: Rear of the Manipulator, 1000 mm apart from the motion range, 50 mm above the base-installed surface.

*5: In general use, Accel setting 100 is the optimum setting that maintains the balance of acceleration and vibration when positioning. Although values larger than 100 can be set to Accel, it is recommended to minimize the use of large values to necessary motions since operating the manipulator continuously with the large Accel setting may shorten the product life remarkably.

RS4

Item			RS4-551*
Arm length	Arm #1, #2		550 mm
	Arm #1		275 mm
	Arm #2		275 mm
Max. operating speed *1	Joint #1, #2		7400 mm/s
	Joint #3		1100 mm/s
	Joint #4		2600 deg/s
Repeatability	Joint #1, #2		± 0.015 mm
	Joint #3		± 0.01 mm
	Joint #4		± 0.01 deg
Payload	Rated		1 kg
	Maximum		4 kg
Joint #4 allowable moment of inertia *2	Rated		0.005 kg·m^2
	Maximum		0.05 kg·m^2
Max. motion range	Joint #1		± 225 deg
	Joint #2		± 225 deg
	Joint #3	RS*-**1S	130 mm
		RS*-**1C	100 mm
	Joint #4		± 720 deg
Max. pulse range (pulse)	Joint #1		– 4096000 to + 9557334 pulse
	Joint #2		± 4177920 pulse
	Joint #3	RS*-**1S	– 1479112 pulse to 0 pulse
		RS*-**1C	– 1137778 pulse to 0 pulse
	Joint #4		± 3145728 pulse
Resolution	Joint #1		0.0000330 deg/pulse
	Joint #2		0.0000538 deg/pulse
	Joint #3		0.0000879 mm/pulse
	Joint #4		0.000229 deg/pulse
Hand diameter	Shaft diameter		ø 16 mm
	Through hole		ø 11 mm
Mounting hole			6-M6
Weight (cables not included)			19 kg: 42 lb
Driving method	All joints		AC servo motor
Motor power consumption	Joint #1		400 W
	Joint #2		400 W
	Joint #3		150 W
	Joint #4		100 W
Option	Environment		Cleanroom & ESD *3
Joint #3 down force			150 N
Installed wire for customer use			15 wires: D-sub / 15 pin connectors

Item		RS4-551*
Installed pneumatic tube for customer use		2 pneumatic tubes (ø 6 mm) : 0.59 MPa (6 kgf/cm^2 : 86 psi)
		1 pneumatic tube (ø 4 mm) : 0.59 MPa (6 kgf/cm^2 : 86 psi)
Environmental requirements	Ambient temperature	5 to 40 degC (with minimum temperature variation)
	Ambient relative humidity	10 to 80% RH (no condensation)
Noise level *4		LAeq = 65 dB(A) or less
Assignable Value ( ) Default values	Speed	1 to (5) to 100
	Accel *5	1 to (10) to 120
	SpeedS	1 to (50) to 2000
	AccelS	1 to (200) to 25000
	Fine	0 to (10000) to 65000
	Weight	0, 275 to (1, 275) to 4, 275
Safety standard		CE Marking : EMC Directive Machinery Directive RoHS Directive KC Marking / KCs Marking UL standards (In case of UL specification): UL1740, ANSI/RIA R15.06, NFPA 79

*1: In the case of PTP command.
Maximum operating speed for CP command is 2000 mm/s on horizontal plane.

*2: In the case where the center of gravity is at the center of Joint #4.
If the center of gravity is not at the center of Joint #4, set the parameter using Inertia command.

*3: The exhaust system in the Cleanroom-model Manipulator draws air from the base interior and arm cover interior together.
A crack or other opening in the base unit can cause loss of negative air pressure in the outer part of the arm, which can cause increased dust emission.
Do not remove the maintenance cover on the front of the base.
Seal the exhaust port and the exhaust tube with vinyl tape so that the joint is airtight.
If the exhaust flow is not sufficient, dust particle emission may exceed the specified maximum level.

Cleanliness level: Class ISO 3 (ISO14644-1)

Amount of Dust (0.1 µm diameter or larger) in 28317 cm^3 (1cft) sample-air around the center of the motion rang: 10 particles or less.)

Exhaust System: Exhaust port diameter: Inner diameter: ø12 mm/Outer diameter: ø16 mm

Exhaust tube : Polyurethane tube
Outer diameter: ø12 mm (Inner diameter: ø8 mm)
or Inner diameter ø16mm or larger
Recommended exhaust flow rate: approx. 1000 cm^3/s (Normal)

ESD specification uses resin materials with antistatic treatment. This model controls adhesion of dust due to electrification.

*4: Conditions of Manipulator during measurement as follows:

Operating conditions	: Under rated load, 4-joints simultaneous motion, maximum speed, maximum acceleration, and duty 50%.
Measurement point	: Rear of the Manipulator, 1000 mm apart from the motion range, 50 mm above the base-installed surface.

*5: In general use, Accel setting 100 is the optimum setting that maintains the balance of acceleration and vibration when positioning. Although values larger than 100 can be set to Accel, it is recommended to minimize the use of large values to necessary motions since operating the manipulator continuously with the large Accel setting may shorten the product life remarkably.

C4

Item		Specification	
Model Number		C4-A601**	C4-A901**
Model Name		C4	C4L
Mounting type		Table Top mounting (Ceiling mounting) *1	
Weight (not include the weight of cables or shipping jigs)		27 kg (59.5 lb.)	29 kg (63.9 lb.)
Driving method	All joints	AC servo motor	
Max. operating speed *2	Joint #1	450 deg/s	275 deg/s
	Joint #2	450 deg/s	275 deg/s
	Joint #3	514 deg/s	289 deg/s
	Joint #4	555 deg/s	
	Joint #5	555 deg/s	
	Joint #6	720 deg/s	
Maximum synthetic speed		9459 mm/s	8495 mm/s
Repeatability	Joint #1 to #6	± 0.02 mm	± 0.03 mm
Max. motion range	Joint #1	± 170 deg	±170° deg (UL specification ± 160 deg)
		± 180 deg without the mechanical stop	
		-	UL specification:± 160 deg
	Joint #2	– 160 deg to + 65 deg	
	Joint #3	– 51 deg to + 225 deg	
	Joint #4	± 200 deg	
	Joint #5	± 135 deg	
	Joint #6	± 360 deg	
Max. pulse range	Joint #1	± 4951609	± 8102633 (UL specification 7626008)
		± 5242880 without the mechanical stop	± 8579259 without the mechanical stop
		-	UL specification: ± 7626008
	Joint #2	– 4660338 to + 1893263	– 7626008 to + 3098066
	Joint #3	– 1299798 to + 5734400	– 2310751 to + 10194489
	Joint #4	± 4723316	
	Joint #5	± 3188238	
	Joint #6	± 6553600	
Resolution	Joint #1	0.0000343 deg/pulse	0.0000210 deg/pulse
	Joint #2	0.0000343 deg/pulse	0.0000210 deg/pulse
	Joint #3	0.0000392 deg/pulse	0.0000221 deg/pulse
	Joint #4	0.0000423 deg/pulse	
	Joint #5	0.0000423 deg/pulse	

Item		Specification	
	Joint #6	0.0000549 deg/pulse	
Motor power consumption	Joint #1	400 W	
	Joint #2	400 W	
	Joint #3	150 W	
	Joint #4	50 W	
	Joint #5	50 W	
	Joint #6	50 W	
Payload *3	Rated	1 kg	
	Max.	4 kg (5 kg with arm downward positioning)	
Allowable moment	Joint #4	4.41 N·m (0.45 kgf·m)	
	Joint #5	4.41 N·m (0.45 kgf·m)	
	Joint #6	2.94 N·m (0.3 kgf·m)	
Allowable moment of inertia (GD2/4) *4	Joint #4	$0.15\ kg{\cdot}m^2$	
	Joint #5	$0.15\ kg{\cdot}m^2$	
	Joint #6	$0.10\ kg{\cdot}m^2$	
Installed wire for customer use		9 wires (D-sub)	
Installed pneumatic tube for customer use *5		4 pneumatic tubes, Allowable pressure: 0.59MPa (6 kgf/cm^2) (89 psi)	
Environmental requirements *6	Ambient Temperature	5 to 40 deg C	
	Ambient relative humidity	20 to 80 % (no condensation)	
	Vibration	$4.9\ m{\cdot}s^2$ (0.5 G) or less	
Noise level *7		LAeq = 80 dB (A) or under	
Environment		Standard / Cleanroom model & ESD *8	
Default values (Max. setting values)	SPEED	5 (100)	
	ACCEL *9	5, 5 (120, 120)	
	SPEEDS	50 (2000)	
	ACCELS	200 (25000)	200 (15000) *10
	FINE	10000, 10000, 10000, 10000, 10000, 10000 (65535, 65535, 65535, 65535, 65535, 65535)	
	WEIGHT	1 (5)	
Safety standard		CE Marking : EMC Directive Machinery Directive RoHS Directive KC Marking / KCs Marking UL standards (In case of UL specification): UL1740, ANSI/RIA R15.06, NFPA 79	

*1: Manipulators are set to “Table Top mounting” at shipment. To use the manipulators as “Ceiling mounting”, you need to change the model settings.
For details on how to change the model settings, refer to *5.5 Changing the Robot*, and *EPSON RC+ User's Guide Robot Configuration*.

*2: In case of PTP control

*3: If the payload exceeds the maximum payload, refer to the section “*Restrictions on payload exceeding the maximum payload*” in *Setup & Operation 4.3.1 WEIGHT Setting*.

*4: If the center of gravity is at the center of each arm. If the center of gravity is not at the center of each arm, set the eccentric quantity using INERTIA command.

*5: For details of the installed pneumatic tube for customer use, refer to the *Setup & Operation 3.6 User Wires and Pneumatic Tubes*.

*6: For details of the environmental requirements, refer to the *Setup & Operation 3.1 Environmental Conditions*.

*7: Conditions of Manipulator at measurement are as follows:

Operating conditions:	Under rated load, 6 arms simultaneous motion, maximum speed, maximum acceleration, and duty 50%.
Measurement point:	1000 mm apart from the rear of Manipulator

*8: The exhaust system in the Cleanroom-model Manipulator draws air from the base interior and arm cover interior.
A crack or other opening in the base unit can cause loss of negative air pressure in the outer part of the arm, which can cause increased dust emission.
Do not remove the covers.
Seal the exhaust port and the exhaust tube with vinyl tape so that the joint is airtight.
If the exhaust flow is not sufficient, dust particle emission may exceed the specified maximum level.

Cleanliness level	: Class ISO 3 (ISO14644-1)
Exhaust System	: Fitting for ø8 mm pneumatic tube Refer to *Setup & Operation: 3.6 User Wires and Pneumatic Tubes*. 60 L/min vacuum
Exhaust tube	: Polyurethane tube Outer diameter: ø8 mm (Inner diameter: ø5 to 6 mm)

ESD specification uses resin materials with antistatic treatment. This model controls adhesion of dust due to electrification.

*9: In general use, Accel setting 100 is the optimum setting that maintains the balance of acceleration and vibration when positioning. Although values larger than 100 can be set to Accel, it is recommended to minimize the use of large values to necessary motions since operating the manipulator continuously with the large Accel setting may shorten the product life remarkably.

*10: Maximum AccelS setting value for payload of 4 kg or more is 12000.
Although setting the value exceeding 12000 does not cause an error, do not set the value in order to prevent manipulator malfunction.

C8

Item		Specification		
Model Number		C8-A701***	C8-A901***	C8-A1401***
Model Name		C8	C8L	C8XL
Mounting type *1		Table Top mounting, Ceiling mounting, Wall mounting		
Weight (not include the weight of cables or shipping jigs)	Standard model, Cleanroom & ESD model	49 kg (108 lb.)	52 kg (115 lb.)	62 kg (137 lb.)
	Protection model	53 kg (117 lb.)	56 kg (123 lb.)	66 kg (146 lb.)
Driving method	All joints	AC servo motor		
Max. operating speed *2	Joint #1	331 deg/s	294 deg/s	200 deg/s
	Joint #2	332 deg/s	300 deg/s	167 deg/s
	Joint #3	450 deg/s	360 deg/s	200 deg/s
	Joint #4	450 deg/s		
	Joint #5	450 deg/s		
	Joint #6	720 deg/s		
Maximum synthetic speed		8958 mm/s	9679 mm/s	8858 mm/s
Repeatability	Joint #1 ~ #6	± 0.02 mm	± 0.03 mm	± 0.05 mm
Max. motion range	Joint #1	± 240 deg		
	Joint #2	– 158 deg ~ + 65 deg	– 158 deg ~ + 65 deg	– 135 deg ~ + 55 deg
	Joint #3	– 61 deg ~ + 202 deg		
	Joint #4	± 200 deg		
	Joint #5	± 135 deg		
	Joint #6	± 360 deg		
Max. pulse range (pulse)	Joint #1	± 9507090	± 10695600	± 15736800
	Joint #2	– 6245685 ~ + 2569428	– 6903178 ~ + 2839915	– 10616940 ~ + 4325420
	Joint #3	– 1776754 ~ + 5883677	– 2220949 ~ + 7354618	– 3997696 ~ + 13238272
	Joint #4	± 5461400		
	Joint #5	± 3932280		
	Joint #6	± 6553800		
Resolution (deg/pulse)	Joint #1	0.0000252	0.0000224	0.0000153
	Joint #2	0.0000253	0.0000229	0.0000127
	Joint #3	0.0000343	0.0000275	0.0000153
	Joint #4	0.0000366		
	Joint #5	0.0000343		
	Joint #6	0.0000549		
Motor power consumption	Joint #1	1000 W		
	Joint #2	750 W		
	Joint #3	400 W		
	Joint #4	100 W		
	Joint #5	100 W		
	Joint #6	100 W		

Item		Specification		
Model Number		C8-A701**	C8-A901**	C8-A1401**
Model Name		C8	C8L	C8XL
Payload *3	Rated	3 kg		
	Max.	8 kg		
Allowable moment of inertia ($GD^2/4$) *4	Joint #4	0.47 kg·m^2		
	Joint #5	0.47 kg·m^2		
	Joint #6	0.15 kg·m^2		
Allowable moment	Joint #4	16.6 N·m (1.69 kgf·m)		
	Joint #5	16.6 N·m (1.69 kgf·m)		
	Joint #6	9.4 N·m (0.96 kgf·m)		
Allowable moment of inertia ($GD^2/4$) *4	Joint #4	0.47 kg·m^2		
	Joint #5	0.47 kg·m^2		
	Joint #6	0.15 kg·m^2		
Installed wire for customer use		15 wires (D-sub) 8 pin (RJ45) Cat 5e or equivalent 6 pin (for F-sensor)		
Installed pneumatic tube for customer use *5		ø6 mm pneumatic tubes (2 tubes), Allowable pressure: 0.59 MPa (6 kgf/cm^2)(89 psi)		
Environmental requirements *6	Ambient Temperature	5 to 40 deg C		
	Ambient relative humidity	10 to 80 % (no condensation)		
	Vibration	4.9 m·s^2 (0.5 G) or less		
Noise level *7		LAeq = 80 dB (A) or under		
Environment		Standard / Cleanroom model & ESD *8, Protection model (IP67) *9		
Applicable Controller		RC700-A, RC700DU-A		
Default values (Max. setting values)	SPEED	5 (100)		
	ACCEL *10	5, 5 (120, 120)		
	SPEEDS	50 (2000)		
	ACCELS *11	200 (35000)	200 (25000)	
	FINE	10000, 10000, 10000, 10000, 10000, 10000 (130000, 130000, 130000, 130000, 130000, 130000)		
	WEIGHT	3 (8)		
	INERTIA	0.03 (0.15)		
Safety standard		CE Marking : EMC Directive Machinery Directive RoHS Directive KC Marking / KCs Marking UL standards (In case of UL specification): UL1740, ANSI/RIA R15.06, NFPA 79		

*1: Mounting types other than “Table Top mounting”, “Ceiling mounting”, and “Wall mounting” are out of specification. If you prefer other mounting types, please contact us.

*2: In case of PTP control.

*3: Do not apply the load exceeding the maximum payload.

*4: If the center of gravity is at the center of each arm. If the center of gravity is not at the center of each arm, set the eccentric quantity using INERTIA command.

*5: For details of the installed pneumatic tube for customer use, refer to the C8 series Manipulator Manual *Setup & Operation 3.6 User Wires and Pneumatic Tubes*.

*6: For details of the environmental requirements, refer to the C8 series Manipulator Manual *Setup & Operation 3.1 Environmental Conditions*.

*7: Conditions of Manipulator at measurement are as follows:

Operating conditions : Under rated load, 6 arms simultaneous motion, maximum speed, maximum acceleration, and C8, C8L:duty 50%., C8XL:duty 30%.

Measurement point : 1000 mm apart from the rear of Manipulator

*8: The exhaust system in the Cleanroom-model Manipulator draws air from the base interior and arm cover interior. A crack or other opening in the base unit can cause loss of negative air pressure in the outer part of the arm, which can cause increased dust emission. Do not remove the covers. Seal the exhaust port and the exhaust tube with vinyl tape so that the joint is airtight. If the exhaust flow is not sufficient, dust particle emission may exceed the specified maximum level.

Cleanliness level : C8, C8L ISO Class 3 (ISO14644-1)
(Number of particles of 0.1 μm or larger in a sample air ($28317\ cm^3$: 1 cft) around the center of the motion area = less than 28 particles)

: C8XL ISO Class 4 (ISO14644-1)
(Number of particles of 0.1 μm or larger in a sample air ($28317\ cm^3$: 1 cft) around the center of the motion area = less than 283 particles)

Exhaust System	:	Fitting for ø8 mm pneumatic tube Refer to C8 series Manipulator Manual *Setup & Operation: 3.6 User Wires and Pneumatic Tubes*. 60 L/min vacuum
Exhaust tube	:	Polyurethane tube Outer diameter: ø8 mm (Inner diameter: ø5 to 6 mm)

ESD specification uses resin materials with antistatic treatment. This model controls adhesion of dust due to electrification.

*9: Protection level for the protection-model Manipulators is IP67 (IEC standard). The Manipulators can be used in environments where the possibility of dust, water, and water-soluble cutting oil falling of the Manipulator exists.
However, please be careful of the following:

- The Manipulator is not rust-proofed. Do not use the Manipulator in environment where corrosive liquids exist.
- Fluids that deteriorate the sealing materials, such as organic solvents, acids, alkalis, and chlorine cutting fluids, cannot be used
- The Manipulator cannot be used for underwater operations.
- The Controller does not have protection features against the environment (Controller's protection level: IP20)
  Make sure to install the system where environmental requirements for the Controller are satisfied.

<Reference>

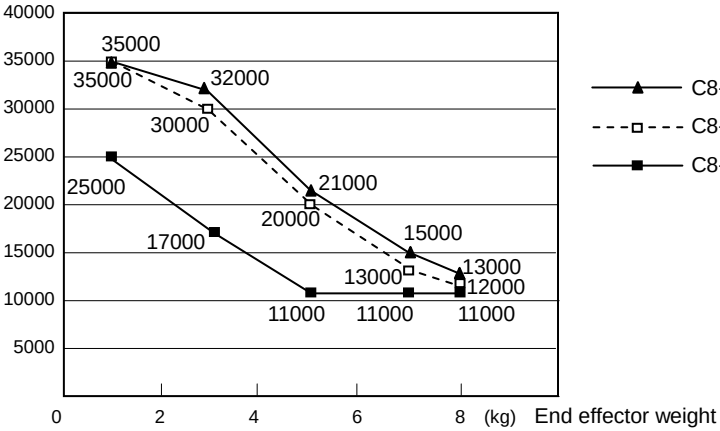
- IP40 of IEC standard
  [Protection level against ingress of solid objects]
  Protection from entry by solid objects with a diameter or thickness greater than 1.0 mm.
  [Protection level against ingress of liquids]
  No protection
- IP67 of IEC standard
  [Protection level against ingress of solid objects]
  Totally protected against dust.
  [Protection level against liquids]
  Protection from ingress of water in harmful quantity when the Manipulator is immersed in water for 30 minutes under the condition that the highest point of the Manipulator is located 0.15 m below the surface of the water and the lowest point is located 1 m below the surface of the water.
  (Tested while the manipulator is stopped.)

*10: In general use, Accel setting 100 is the optimum setting that maintains the balance of acceleration and vibration when positioning. Although values larger than 100 can be set to Accel, it is recommended to minimize the use of large values to necessary motions since operating the manipulator continuously with the large Accel setting may shorten the product life remarkably.

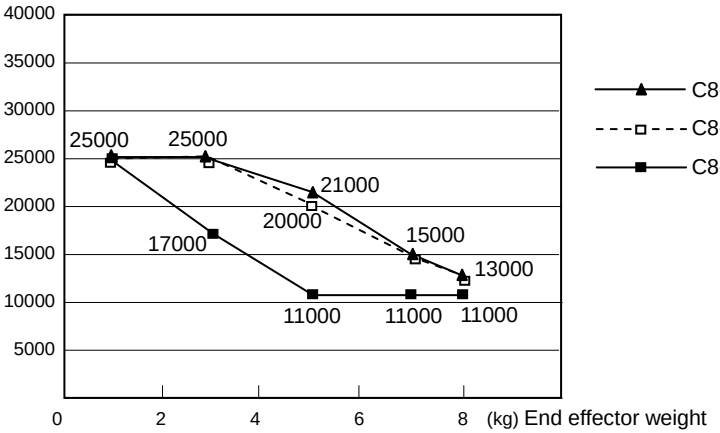
*11: Maximum AccelS setting value varies depending on the load. Refer to the table below for details.
Setting the value which exceeds the maximum AccelS causes an error. In such a case, check the setting value.

Maximum AccelS setting value

Table Top mounting, Ceiling mounting



Wall mounting



N2

Item		Specification	
Model Number		N2-A450SR	N2-A450S
Model Name		N2	
Mounting type		Ceiling mounting	Table Top mounting *1
Weight (excluding cables)		19 kg (42 lb.)	
Driving method	All joints	AC servo motor	
Max. operating speed *2	Joint #1	297°/s	
	Joint #2	297°/s	
	Joint #3	356°/s	
	Joint #4	356°/s	
	Joint #5	360°/s	
	Joint #6	360°/s	
Maximum synthetic speed		5772 mm/s	
Repeatability	Joint #1 ~ #6	± 0.02 mm	
Max. motion range	Joint #1	± 180°	
	Joint #2	± 180°	
	Joint #3	± 180°	
	Joint #4	± 195°	
	Joint #5	± 130°	
	Joint #6	± 360°	
Max. pulse range	Joint #1	± 7929856	
	Joint #2	± 7929856	
	Joint #3	± 6619136	
	Joint #4	± 7170731	
	Joint #5	± 4915200	
	Joint #6	± 13107200	
Resolution	Joint #1	0.0000227°/pulse	
	Joint #2	0.0000227°/pulse	
	Joint #3	0.0000272°/pulse	
	Joint #4	0.0000272°/pulse	
	Joint #5	0.0000275°/pulse	
	Joint #6	0.0000275°/pulse	
Motor power consumption	Joint #1	100 W	
	Joint #2	100 W	
	Joint #3	100 W	
	Joint #4	30 W	
	Joint #5	30 W	
	Joint #6	15 W	

Item		Specification	
Model Number		N2-A450SR	N2-A450S
Model Name		N2	
Payload [*3]	Rated	1 kg	
	Max.	2.5 kg	
Allowable moment	Joint #4	5.4 N·m (0.55 kgf·m)	
	Joint #5	5.4 N·m (0.55 kgf·m)	
	Joint #6	2.4 N·m (0.24 kgf·m)	
Allowable moment of inertia (GD2/4) [*4]	Joint #4	0.2 kg·m^2	
	Joint #5	0.2 kg·m^2	
	Joint #6	0.08 kg·m^2	
Installed wire for customer use		15 wires (D-sub) 8 pin (RJ45) Cat 5e or equivalent (2 cables) (also used for Force Sensor)	
Installed pneumatic tube for customer use [*5]		ø6 mm pneumatic tubes (2 tubes), Allowable pressure: 0.59 MPa (6 kgf/cm^2) (89 psi)	
Environmental requirements [*6]	Ambient Temperature	5 to 40 deg C	
	Ambient relative humidity	10 to 80% (no condensation)	
	Vibration	4.9 m·s^2 (0.5 G) or less	
Noise level [*7]		LAeq = 80 dB (A) or under	
Environment		Standard	
Applicable Controller		RC700-A	
Default values (Max. setting values)	SPEED	5 (100)	
	ACCEL [*8]	5, 5 (120, 120)	
	SPEEDS	50 (1120)	
	ACCELS	200 (5000)	
	FINE	10000, 10000, 10000, 10000, 10000, 10000 (65000, 65000, 65000, 65000, 65000, 65000)	
	WEIGHT	1 (2.5)	
	INERTIA	0.005 (0.08)	
Safety standard		CE Marking : EMC Directive, Machinery Directive, RoHS Directive KC Marking / KCs Marking	

*1: Manipulators are set to “Ceiling mounting” at shipment.
To use the manipulators as “Table Top mounting”, you need to change the model settings.
Mounting types other than “Ceiling mounting” and “Table Top mounting” are out of specification.
If you prefer other mounting types, please contact us.
For details on how to change the model settings, refer to *5.4 Changing the Robot*, and *EPSON RC+ User’s Guide Robot Configuration*.

*2: In case of PTP control

*3: Do not apply the load exceeding the maximum payload.

*4: If the center of gravity is at the center of each arm. If the center of gravity is not at the center of each arm, set the eccentric quantity using INERTIA command.

*5: For details of the installed pneumatic tube for customer use, refer to the *Setup & Operation 3.7 User Wires and Pneumatic Tubes*.

*6: For details of the environmental requirements, refer to the *Setup & Operation 3.1 Environmental Conditions*.

*7: Conditions of Manipulator at measurement are as follows:

Operating conditions:	Under rated load, 6 arms simultaneous motion, maximum speed, maximum acceleration, and duty 50%.
Measurement point:	1000 mm apart from the rear of Manipulator

*8: In general use, Accel setting 100 is the optimum setting that maintains the balance of acceleration and vibration when positioning. Although values larger than 100 can be set to Accel, it is recommended to minimize the use of large values to necessary motions since operating the manipulator continuously with the large Accel setting may shorten the product life remarkably.

N6

Item		Specification
Model Number		N6-A1000**
Model Name		N6
Mounting type		Ceiling mounting, Table Top mounting [*1]
Weight (excluding cables)		69 kg (152 lb.)
Driving method	All joints	AC servo motor
Max. operating speed [*2]	Joint #1	326°/s
	Joint #2	326°/s
	Joint #3	444°/s
	Joint #4	444°/s
	Joint #5	450°/s
	Joint #6	537°/s
Repeatability		± 0.04 mm
Max. motion range	Joint #1	± 180°
	Joint #2	± 180°
	Joint #3	± 180°
	Joint #4	± 200°
	Joint #5	± 125°
	Joint #6	± 360°
Max. pulse range	Joint #1	± 6619136 pulse
	Joint #2	±6619136 pulse
	Joint #3	± 5308416 pulse
	Joint #4	± 5898240 pulse
	Joint #5	± 3640889 pulse
	Joint #6	± 8773632 pulse
Resolution	Joint #1	0.0000272°/pulse
	Joint #2	0.0000272°/pulse
	Joint #3	0.0000339°/pulse
	Joint #4	0.0000339°/pulse
	Joint #5	0.0000343°/pulse
	Joint #6	0.0000410°/pulse
Motor power consumption	Joint #1	600 W
	Joint #2	600 W
	Joint #3	400 W
	Joint #4	100 W
	Joint #5	100W
	Joint #6	100W
Payload [*3]	Rated	3 kg
	Max.	6 kg

Item		Specification
Model Number		N6-A1000**
Model Name		N6
Allowable moment	Joint #4	15.2 N·m (1.55kgf·m)
	Joint #5	15.2 N·m (1.55kgf·m)
	Joint #6	9.4 N·m (0.96 kgf·m)
Allowable moment of inertia (GD2/4) *4	Joint #4	0.42 kg·m2
	Joint #5	0.42 kg·m2
	Joint #6	0.14 kg·m2
Installed wire for customer use		15 wires (D-sub) 8 pin (RJ45) Cat 5e or equivalent (2 cables) (also used for Force Sensor)
Installed pneumatic tube for customer use *5		ø6 mm pneumatic tubes (2 tubes), Allowable pressure: 0.59 MPa (6 kgf/cm^2) (89 psi)
Environmental requirements *6	Ambient Temperature	5 to 40 deg C
	Ambient relative humidity	10 to 80% (no condensation)
	Vibration	4.9 m·s^2 (0.5 G) or less
Noise level *7		LAeq = 80 dB (A) or under
Environment		Standard
Applicable Controller		RC700-A, RC700DU-A
Default values (Max. setting values)	SPEED	3~5 (100)
	ACCEL *8	5, 5 (120, 120)
	SPEEDS	50 (2000)
	ACCELS	200 (15000~25000)
	FINE	10000, 10000, 10000, 10000, 10000, 10000 (65000, 65000, 65000, 65000, 65000, 65000)
	WEIGHT	3 (6)
	INERTIA	0.03 (0.14)
Safety standard		CE Marking : EMC Directive, Machinery Directive, RoHS Directive

*1: Manipulators are set to “Table Top mounting” at shipment.
To use the manipulators as “Ceiling mounting”, you need to change the model settings.
Mounting types other than “Table Top mounting” and “Ceiling mounting” are out of specification.
If you prefer other mounting types, please contact us.
For details on how to change the model settings, refer to *5.4 Changing the Robot*, and *EPSON RC+ User's Guide Robot Configuration*.

*2: In case of PTP control

*3: Do not apply the load exceeding the maximum payload.

*4: If the center of gravity is at the center of each arm. If the center of gravity is not at the center of each arm, set the eccentric quantity using INERTIA command.

*5: For details of the installed pneumatic tube for customer use, refer to the *Setup & Operation 3.7 User Wires and Pneumatic Tubes*.

*6: For details of the environmental requirements, refer to the *Setup & Operation 3.1 Environmental Conditions*.

*7: Conditions of Manipulator at measurement are as follows:

Operating conditions:	Under rated load, 6 arms simultaneous motion, maximum speed, maximum acceleration, and duty 50%.
Measurement point:	1000 mm apart from the rear of Manipulator

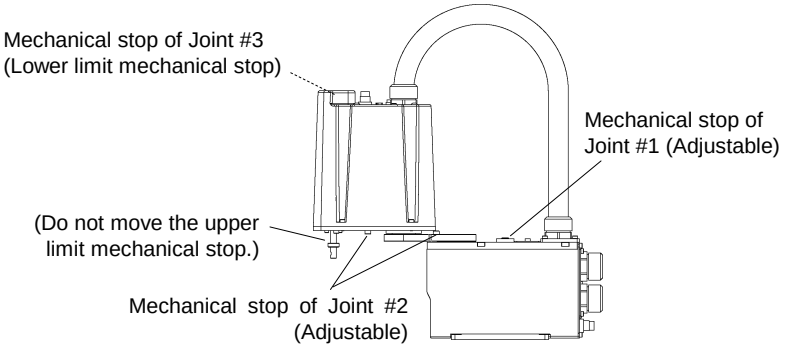
*8: In general use, Accel setting 100 is the optimum setting that maintains the balance of acceleration and vibration when positioning. Although values larger than 100 can be set to Accel, it is recommended to minimize the use of large values to necessary motions since operating the manipulator continuously with the large Accel setting may shorten the product life remarkably.

X5

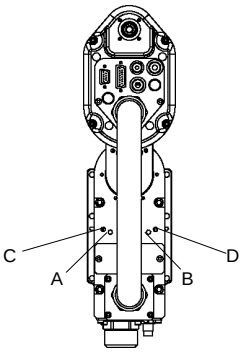
For details, refer to *EZ MODULES X5 series* manual.

1.9 Motion Range Setting by Mechanical Stops

G1



Joint #1

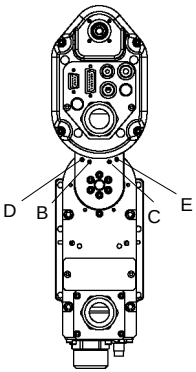


(° = degree)

Model	A	B	C	D
All	+125°	−125°	+120°	−120°

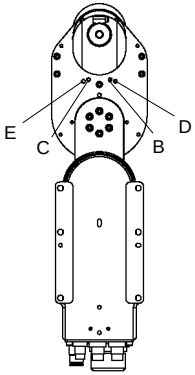
Joint #2

G1-171*



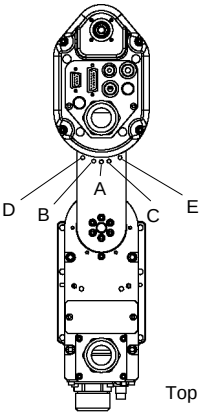
Top

G1-171CZ



Bottom

G1-221*



Top

(° = degree)

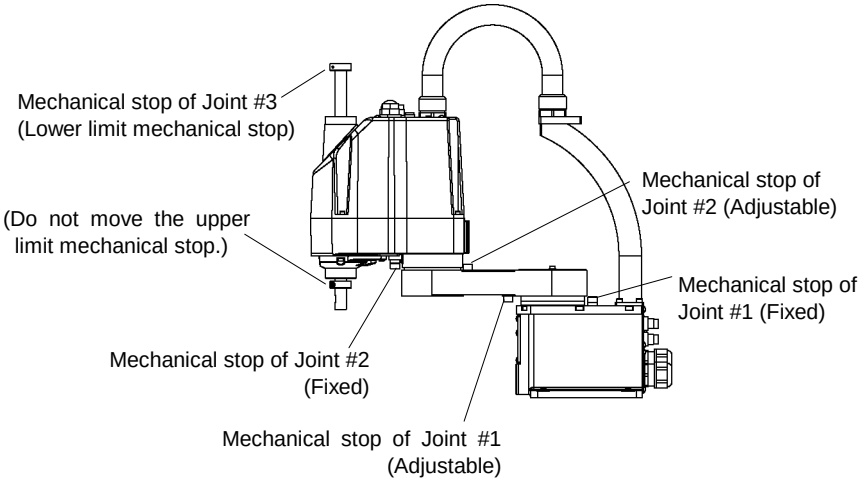
Model		A	B *1	C *1	D	E
4-axis spec	G1-171S	-	+140°	–140°	+130°	–130°
	G1-171C	-	+140°	–140°	+130°	–130°
	G1-221S	±152°	+140°	–140°	+125°	–125°
	G1-221C	±149°	+140°	–140°	+125°	–125°
3-axis spec	G1-171SZ	-	+135°	–135°	+125°	–125°
	G1-171CZ *2	-	+123°	–123°	+115°	–115°
	G1-221SZ	-	+135°	–135°	+120°	–120°
	G1-221CZ	-	+132°	–132°	+120°	–120°

*1 Standard position of the mechanical stop

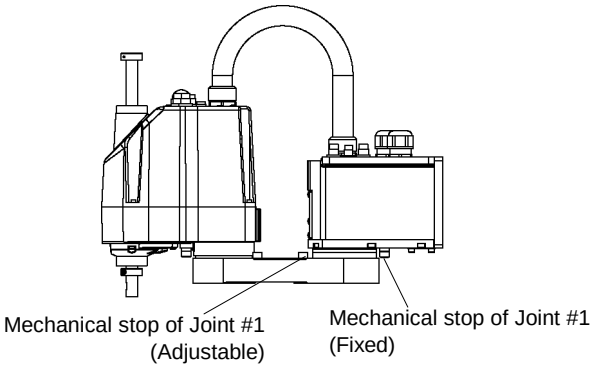
*2 Limits the motion range using the bolts in the Arm #2 bottom to prevent the bellows from contacting the manipulator body.

G3

Table Top Mounting



Multiple Mounting

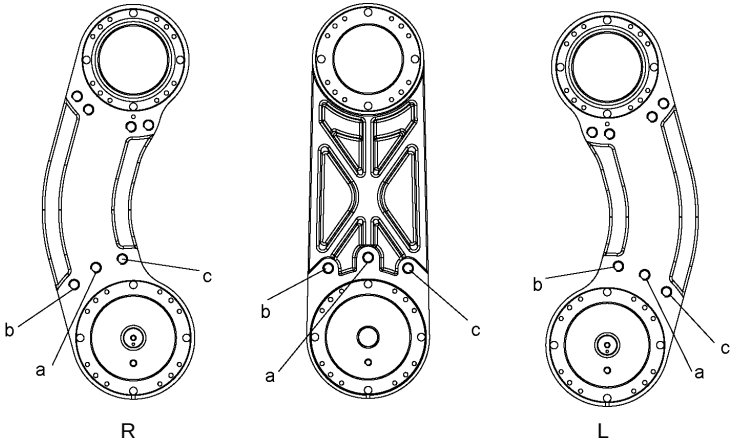


* The different mechanical stop positions from Table Top mounting are indicated for Multiple mounting.

Install the bolts for the mechanical stop of Joint #1 (adjustable) to the following position.

Table Top mounting	:	Arm bottom side
Multiple mounting	:	Arm top side

Joint #1 Mechanical Stops



R L

Views from the bottom of Arm #1

Model	Arm	a	b	c
G3-**1S, C	250	±140°	-110°	+110°
	300	±140°	-110°	+110°
	350	±140°	-110°	+110°
G3-**1S, C-R	300	-125° ~ +150°	-105°	+130°
	350	-110° ~ +165°	-90°	+145°
G3-**1S, C-L	300	-150° ~ +125°	-130°	+105°
	350	-165° ~ +110°	-145°	+90°
G3-**1SM, CM	300	±115°	-100°	+100°
	350	±120°	-105°	+105°
G3-351SM, CM-R	350	-105° ~ +130°	-95°	+120°
G3-351SM, CM-L	350	-130° ~ +105°	-120°	+95°

Setting Angle	+90°	+95°	+100°	+105°	+110°	+115°	+120°
Pulse Value	5242880	5388516	5534151	5679787	5825423	5971058	6116694

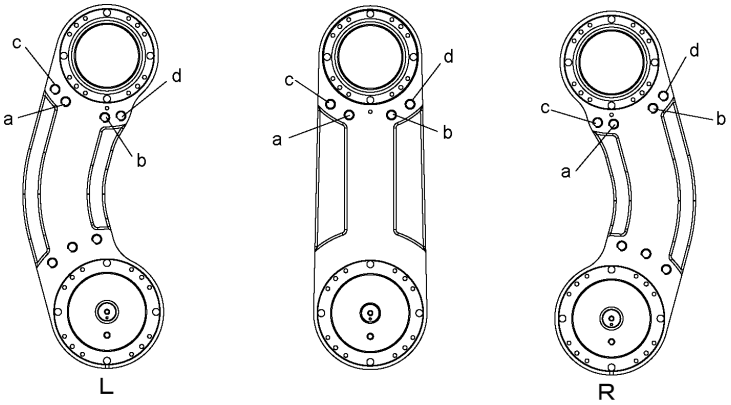
Setting Angle	+125°	+130°	+140°	+145°	+150°	+165°
Pulse Value	6262329	6407965	6699236	6844872	6990507	7427414

Setting Angle	-90°	-95°	-100°	-105°	-110°	-115	-120°
Pulse Value	0	-145636	-291271	-436907	-582542	-728178	-873813

Setting Angle	-125°	-130°	-140°	-145°	-150°	+165°
Pulse Value	-1019449	-1165085	-1456356	-1601991	-1747627	-2184533

(°: degree)

Joint #2 Mechanical Stops



Views from the top of Arm #1

Model	Arm	a	b	c	d
G3-**1S, C	250	+141°	-141°	+120°	-120°
	300	+142°	-142°	+120°	-120°
	350	+142°	-142°	+120°	-120°
G3-**1S, C-R	300	+150°	-135°	+130°	-115°
	350	+165°	-120°	+145°	-100°
G3-**1S, C-L	300	+135°	-150°	+115°	-130°
	350	+120°	-165°	+100°	-145°
G3-**1SM, CM	300	+135°	-135°	+115°	-115°
	350	+142°	-142°	+120°	-120°
G3-351SM, CM-R	350	+160°	-120°	+150°	-110°
G3-351SM, CM-L	350	+120°	-160°	+110°	-150°

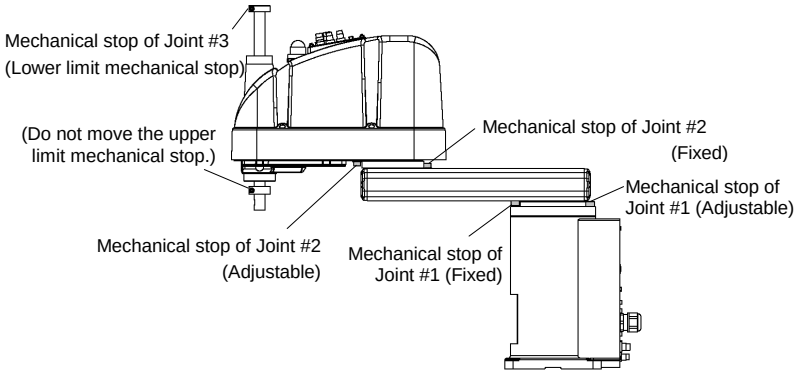
Setting Angle	+100°	+110°	+115°	+120°	+130°	+135°
Pulse Value	1820444	2002488	2093511	2184533	2366577	2457600
Setting Angle	+141°	+142°	+145°	+150°	+160°	+165°
Pulse Value	2566826	2585031	2639644	2730666	2912711	3003733
Setting Angle	-100°	-100°	-115°	-120°	-130°	-135°
Pulse Value	-1820444	-2002488	-2093511	-2184533	-2366577	-2457600
Setting Angle	-141°	-142°	-145°	-150°	-160°	-165°
Pulse Value	-2566826	-2585031	-2639644	-2730666	-2912711	-3003733

(°: degree)

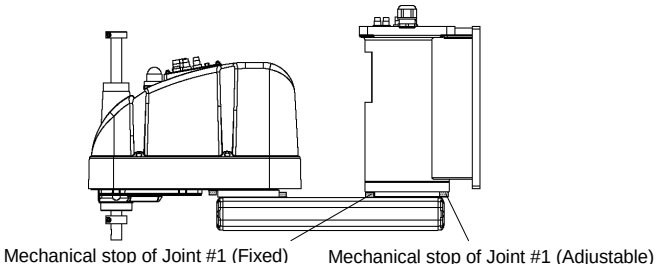
NOTE In case of Multiple Mounting, it is impossible to limit the operating range completely because it may hit the wall within the setting range of mechanical stops.

G6

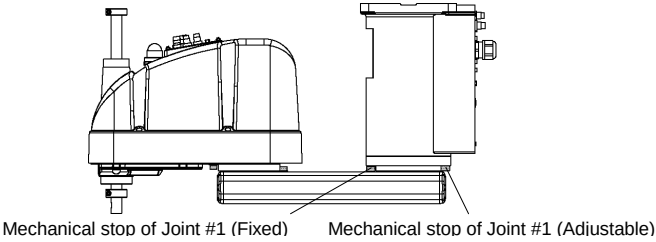
Table Top Mounting



Wall Mounting

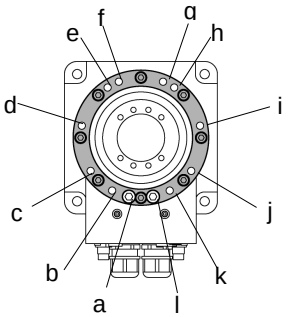


Ceiling Mounting



* The different mechanical stop positions from Table Top mounting are indicated for Wall mounting and Ceiling mounting.

Joint #1 Mechanical Stops



Joint #1

Mounting	Arm Length	a	b	c	d	e	f
Table Top	45, 55, 65	+152°	+135°	+105°	+60°	+20°	+5°
Ceiling	55, 65						
Wall	65		+148°				
	55		+135°				
Ceiling	45		+120°		+75°	+30°	
Wall	45						

Mounting	Arm Length	g	h	i	j	k	l
Table Top	45, 55, 65	-5°	-20°	-60°	-105°	-135°	-152°
Ceiling	55, 65						
Wall	65					-148°	
	55					-135°	
Ceiling	45		-30°	-75°		-120°	
Wall	45						

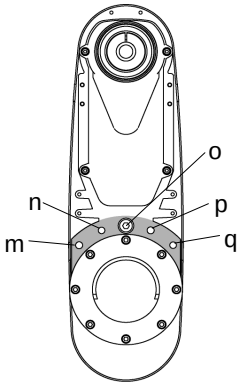
Setting Angle	+152°	+148°	+135°	+120°	+105°	+75°	+60°
Pulse Value	7048761	6932253	6553600	6116694	5679787	4805974	4369067

Setting Angle	+30°	+20°	+5°	-5°	-20°	-30°	-60°
Pulse Value	3495254	3203983	2767076	2475805	2038898	1747627	873814

Setting Angle	-75°	-105°	-120°	-135°	-148°	-152°
Pulse Value	436907	-436907	-873814	-1310720	-1689373	-1805881

(°: degree)

Joint #2 Mechanical Stops



Joint #2

Model		Arm Length	m	n	o	p	q
Table Top, Ceiling, Wall		55, 65	+100°	+125°	+147.5°	-125°	-100°
Table Top	G6-45*S, D	45 (Z : 0 to –270)					
		45 (Z :–270 to –330)			+145°		
	G6-45*C, P, D bellows	45 (Z : 0 to –240)			+147.5°		
		45 (Z :–240 to –300)			+142°		
Ceiling, Wall		45			+130°		

The bellows for G6-***D* are options at shipment.

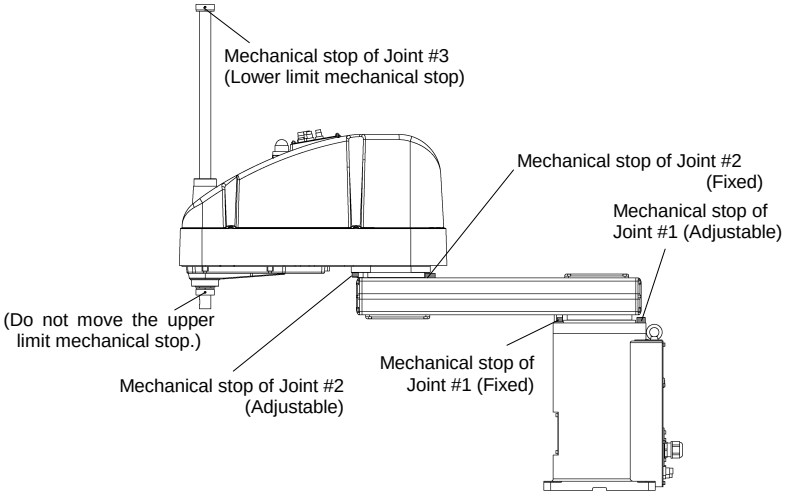
Setting Angle	+147.5°	+145°	+142°	+130°	+125°	+100°
Pulse Value	2685156	2639645	2585031	2366578	2275556	1820445

Setting Angle	-100°	-125°	-130°	-142°	-145°	-147.5°
Pulse Value	-1820445	-2275556	-2366578	-2585031	-2639644	-2685156

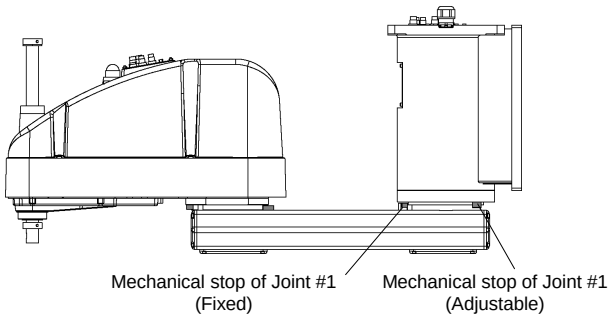
(°: degree)

G10/G20

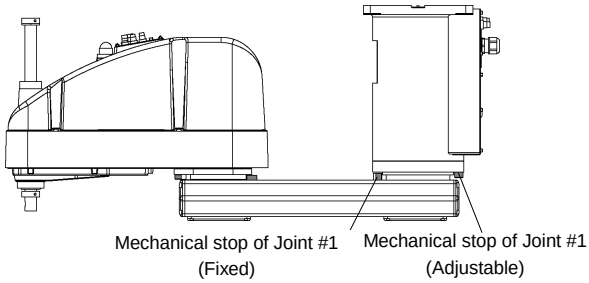
Table Top Mounting



Wall Mounting

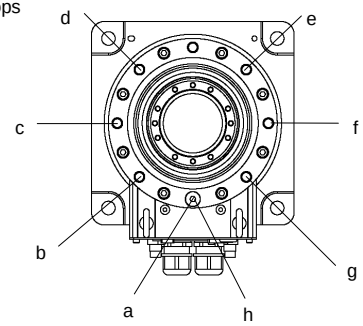


Ceiling Mounting



* The different mechanical stop positions from Table Top Mounting are indicated for Wall Mounting and Ceiling Mounting.

Joint #1 Mechanical Stops



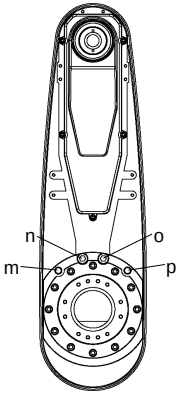
Joint #1

Mounting	Arm Length	a	b	c	d	e	f	g	h
Table Top	65, 85, A0	+152°	+107°	+60°	+15°	-15°	-60°	-107°	-152°
Ceiling	85, A0								
Ceiling	65								
Wall	65, 85, A0								

	a	b	c	d	e	f	g	h
Setting Angle	+152°	+107°	+60°	+15°	-15°	-60°	-107°	-152°
Pulse Value	+7048761	+5738041	+4369067	+3058347	+2184534	+873814	-495161	-1805881

(°: degree)

Joint #2 Mechanical Stops



Joint #2

Model		Arm Length		m	n	o	q
Table Top, Ceiling, Wall		A0		+122.5°	+152.5°	-152.5°	-122.5°
Table Top	G10/G20 -85*S, D	85					
	G10/G20 -85*C, P, D bellows	85	Z: 0 to –360				
			Z: –360 to –390	+121°	+151°	-151°	-121°
Ceiling, Wall	G10/G20 -85*SR, SW, DR, DW	85		+122.5°	+152.5°	-152.5°	-122.5°
	G10/G20 -85*CR, CW, PR, PW, DR bellows, DW bellows	85		+100°	+130°	-130°	-100°
Table Top		65		+122.5°	+152.5°	-152.5°	-122.5°
Ceiling, Wall		65		+100°	+130°	-130°	-100°

The bellows for G10/G20-***D* are options at shipment.

Setting Angle	+100°	+121°	+122.5°	+151°	+152.5°
Pulse Value	+1820445	+2202738	+2230045	+2748871	+2776178

Setting Angle	-152.5°	-151°	-122.5°	-121°	-100°
Pulse Value	-2776178	-2748871	-2230045	-2202738	-1820445

(°: degree)

NOTE

In the range Z: –360 to –390 mm, the area is limited by interference of the Manipulator body and the arm.

C4

Mechanical stops physically limit the absolute area that the Manipulator can move.

Be sure to turn OFF the Controller in advance.

Bolts are not provided, arrange for them by yourself.

Use bolts conforming to the strength specified by ISO-898-1, property class: 12.9.

Specify the pulse range again after changing the position of the mechanical stop.

For details on the pulse range setting, refer to the *C4 series Manipulator manual Setup & Operation 5.1 Motion Range Setting by Pulse Range (for All Arms)*.

Be sure to set the pulse range not to exceed the setting angles of the mechanical stop.

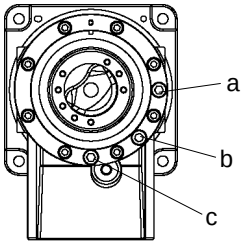
Motion Range Setting of Arm #1

Install the bolt to the threaded hole corresponding to the angle you want to set.

Normally a mechanical stop is equipped at [b].

[a] and [c] limit the one side of motion range.

Remove the bolts when the motion range of the Arm #1 is set to ±180 deg.



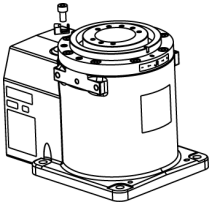
M8×15 hexagon socket head cap bolt
Tightening torque: 37.2 N·m (380 kgf·cm)

		a	b		c
Angle (deg)		−125	±170	±180	+125
Pulse (pulse)	C4-A601**	−3640889	±4951609	±5242880	+3640889
	C4-A901**	−5957819	±8102633	±8579259	+5957819
	C4-A901**-UL		±7626008		
Bolt		Applied	Applied (Normal)	Not applied	Applied

Mechanical stop for UL specification

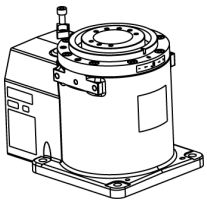
There is a specified mechanical stop for UL specification.
Mount the mechanical stop as shown in the figure below.

C4



C4L

The setting angle differs from the non-UL compliant model.
(refer to the above table)



Motion Range Setting of Arm #2

There are threaded holes corresponding to each angle on the Manipulator.

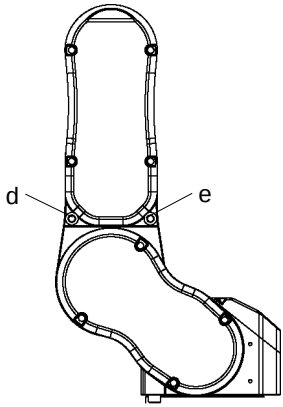
Normally there is no mechanical stop equipped. (–160 deg - +65 deg)

[d] and [e] limit the one side of motion range.

C4-A601**

M10×15 hexagon socket head cap bolt

Tightening torque: 73.5 N·m (750 kgf·cm)



	d	e	-	-
Angle (deg)	–143	+48	–160	+65
Pulse (pulse)	–4165177	+1398102	–4660338	+1893263
Bolt	Applied	Applied	Not applied (Normal)	Not applied (Normal)

Contact us about C4-A901**.

Motion Range Setting of Arm #3

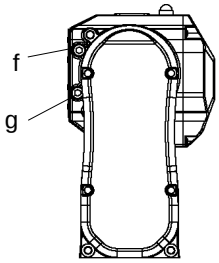
There are threaded holes corresponding to each angle on the Manipulator.

Normally mechanical stops are equipped to [f] and [g]. (+225 deg - –51 deg)

C4-A601**, C4-A901**

M8×12 hexagon socket head cap bolt

Tightening torque: 37.2 N·m (380 kgf·cm)



		f	g
Angle (deg)		+225	–51
Pulse (pulse)	C4-A601**	+5734400	–1299798
	C4-A901**	+10194489	–2310751
Bolt		Applied (Normal)	Applied (Normal)

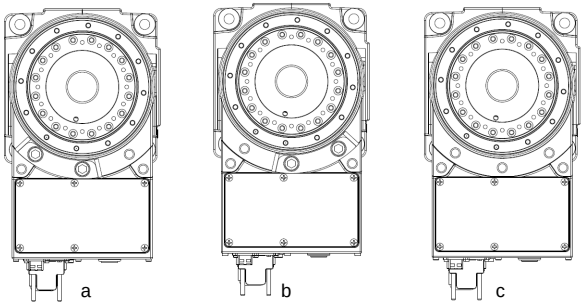
C8

Mechanical stops physically limit the absolute area that the Manipulator can move.
Be sure to turn OFF the Controller in advance.
Bolts are not provided, arrange for them by yourself.
Use bolts included with shipment.
Specify the pulse range again after changing the position of the mechanical stop.
For details on the pulse range setting, refer to the C8 series Manipulator manual *Setup & Operation 5.1 Motion Range Setting by Pulse Range (for All Arms*).
Be sure to set the pulse range not to exceed the setting angles of the mechanical stop.

Motion Range Setting of Arm #1

Install the adjustable mechanical stop (J1) to the threaded hole corresponding to the angle you want to set. Normally the mechanical stop is not installed.

Hexagon socket head cap bolt M12×30×2 bolts
Tightening torque 42.0 ± 2.1N·m (428 ± 21 kgf·cm)



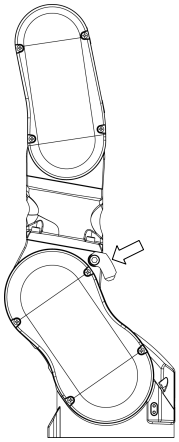
		a	b	c
Angle (deg)		–145, +110	–110, +145	±240
Pulse (pulse)	C8-A701*** (C8)	–5743867 +4357416	–4357416 +5743867	±9507090
	C8-A901*** (C8L)	–6461925 +4902150	–4902150 +6461925	±10695600
	C8-A1401*** (C8XL)	–9507650 +7212700	–7212700 +9507650	±15736800
Adjustable mechanical stop (J1)		Applied	Applied	Not applied (Normal)

Motion Range Setting of Arm #2

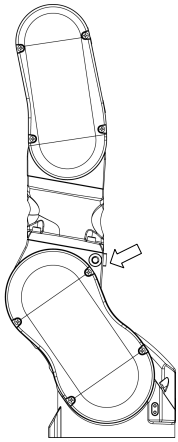
C8-A701*** (C8), C8-A901*** (C8L)

Remove the mechanical stop installed as standard and install the adjustable mechanical stop (C8/C8L_J2).
(Arm #2 standard motion range -158 deg ~ +65 deg)

Hexagon socket head cap bolt	M10×35×1 bolt
Tightening torque	32.0 ± 1.6 N·m (326 ± 16 kgf·cm)



d



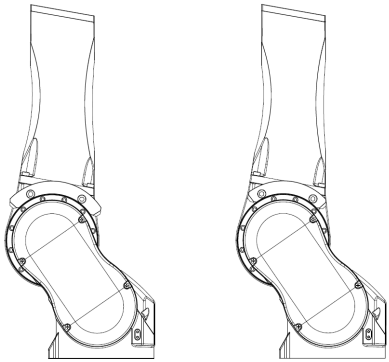
e

		d	e
Angle (deg)		–158, +30	–158, +65
Pulse(pulse)	C8-A701*** (C8)	–6245685 +1185890	–6245685 + 2569428
	C8-A901*** (C8L)	–6903178 +1310730	–6903178 +2839915
Adjustable mechanical stop (C8/C8L_J2)		Applied	Applied (Normal)

C8-A1401*** (C8XL)

Remove the mechanical stop installed as standard and install the adjustable mechanical stop (C8XL_J2).
(Arm #2 standard motion range –135 deg ~ +55 deg)

Hexagon socket head cap bolt	M10×35×2 bolts
Tightening torque	32.0 ± 1.6 N·m (326 ± 16 kgf·cm)

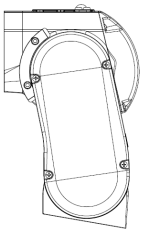


		d	e
Angle (deg)		–125, +45	–135, +55
Pulse(pulse)	C8-A1401** (C8XL)	–9830500 +3538980	–10616940 +4325420
Adjustable mechanical stop (C8XL_J2)		Applied	Applied (Normal)

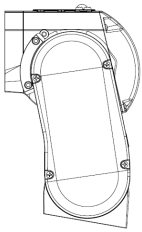
Motion Range Setting of Arm #3

Remove the mechanical stop installed as standard and install the adjustable mechanical stop (J3).
(Arm #3 standard motion range -61 deg ~ +202 deg)

Hexagon socket head cap bolt	M6×15×2 bolts
Tightening torque	13.0 ± 0.6 N·m (133 ± 6 kgf·cm)



f



g

		f	g
Angle (deg)		–51, +192	–61, +202
Pulse(pulse)	C8-A701*** (C8)	–1485483 +5592406	–1776754 +5883677
	C8-A901*** (C8L)	–1856859 +6990528	–2220949 +7354618
	C8-A1401*** (C8XL)	–3342336 +12582912	–3997696 +13238272
Adjustable mechanical stop (J3)		Applied	Applied (Normal)

1.10 End User Training

Persons in charge of safety management should confirm that the operators who program, operate, and maintain the robot and robot system take proper training and have expertise to conduct the work safely.
Training should include at least the following:

- Study of regulation safety procedures, and safety-related recommendations by robot manufacturers and system designers.
- Clear explanation of the work involved.
- Description of all control equipment required for the work and their functions.
- Explanation of potential hazards involved in the work.
- Work safety procedures and specific methods of avoiding potential hazards.
- Safety device and interlock function testing and confirmation methods are working properly.

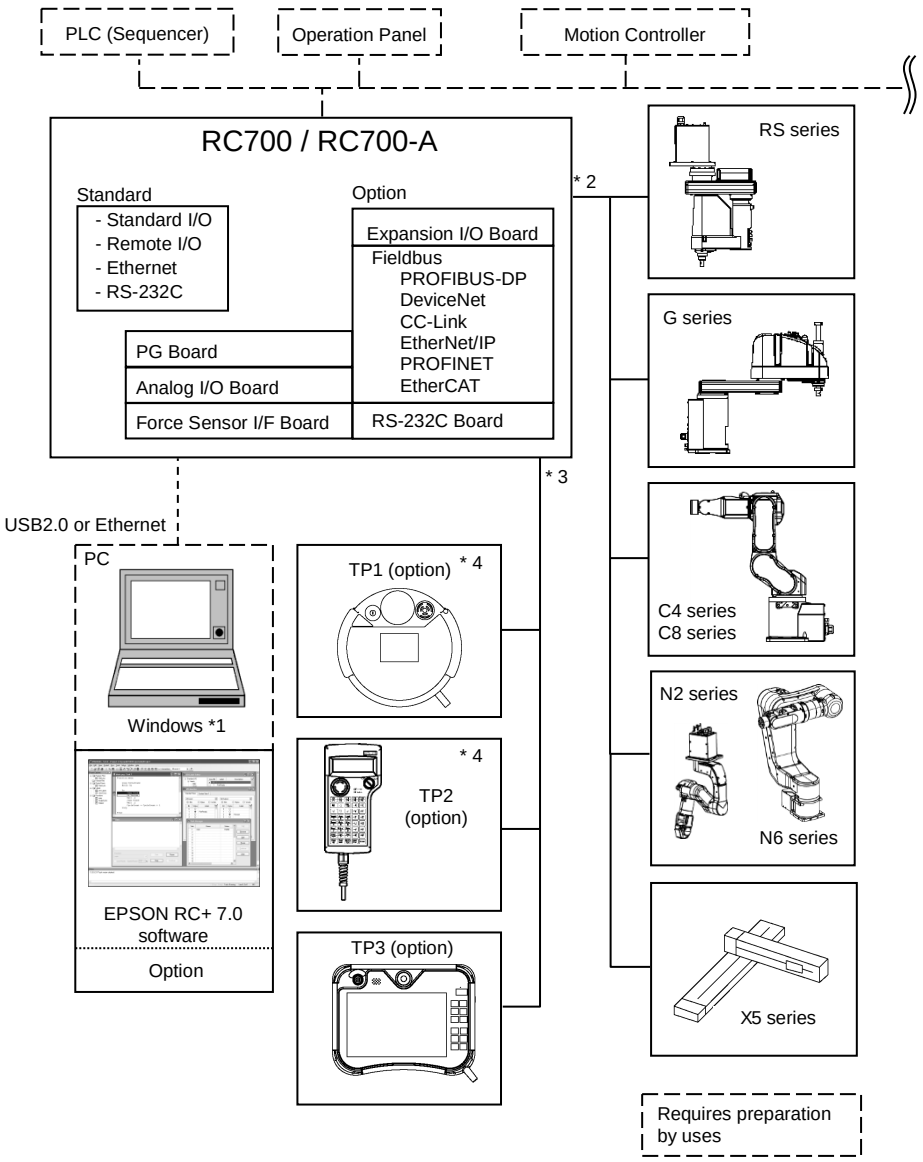
2. Installation

This chapter contains precautions for safe and accurate installation of the robot system.

The workflow for installing the robot system is described in *2.1 Outline from Unpacking to Operation of Robot System.* For unpacking, transportation, and installation, refer to the respective section and the Manipulator and Controller manuals.

System Example

Control Unit only



*1 EPSON RC+ 7.0 supports the following OS.
Windows XP Professional Service Pack 3
(EPSON RC+ 7.0 Ver. 7.2.0 or earlier)
Windows Vista Business Service Pack 2
Windows 7 Professional Service Pack 1
Windows 8.1 Pro (EPSON RC+ 7.0 Ver.7.1.0 or later)
Windows 10 Pro (EPSON RC+ 7.0 Ver.7.2.0 or later)

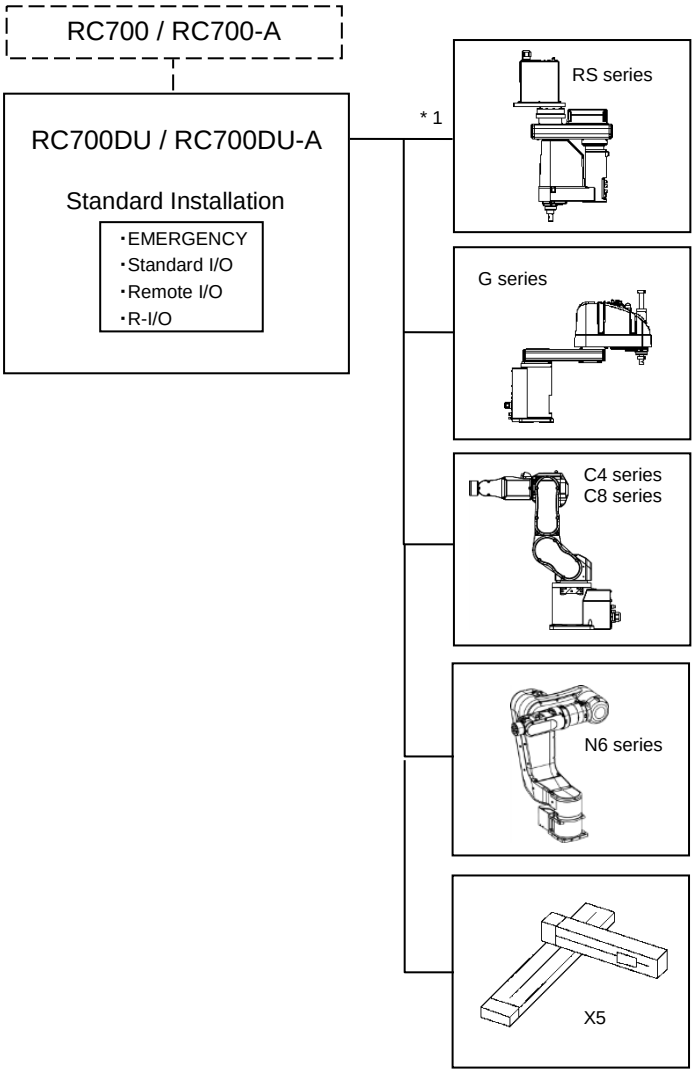
*2 Any one of the manipulators can be controlled.
Available combinations are as follows. (✓: connectable)

	C4	C8	G	RS	N2	N6	X5
RC700	✓	-	-	-	-	-	-
RC700-A	✓	✓	✓	✓	✓	✓	✓

*3 Any one of the Teach pendant can be controlled.
TP3 cannot be connected to RC700.

*4 When connecting to RC700-A, a dedicated conversion cable is required.

Control Unit and Drive Unit



*1 Any one of the manipulators can be controlled.
Available combinations are as follows. (✓: connectable)

	C4	C8	G	RS	N2	N6	X5
RC700DU	✓	-	-	-	-	-	-
RC700DU-A	✓	✓	✓	✓	-	✓	✓

NOTE

Drive Unit is the auxiliary unit connected with the control unit using the special cable.

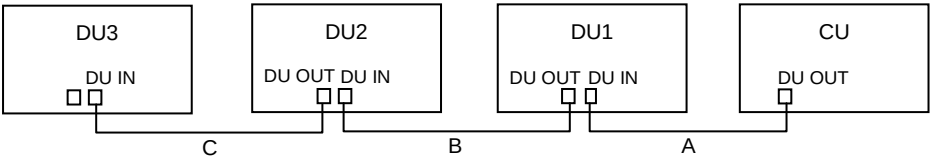
Drive Unit cannot operate alone.

Up to three Drive Units can be used per robot system.

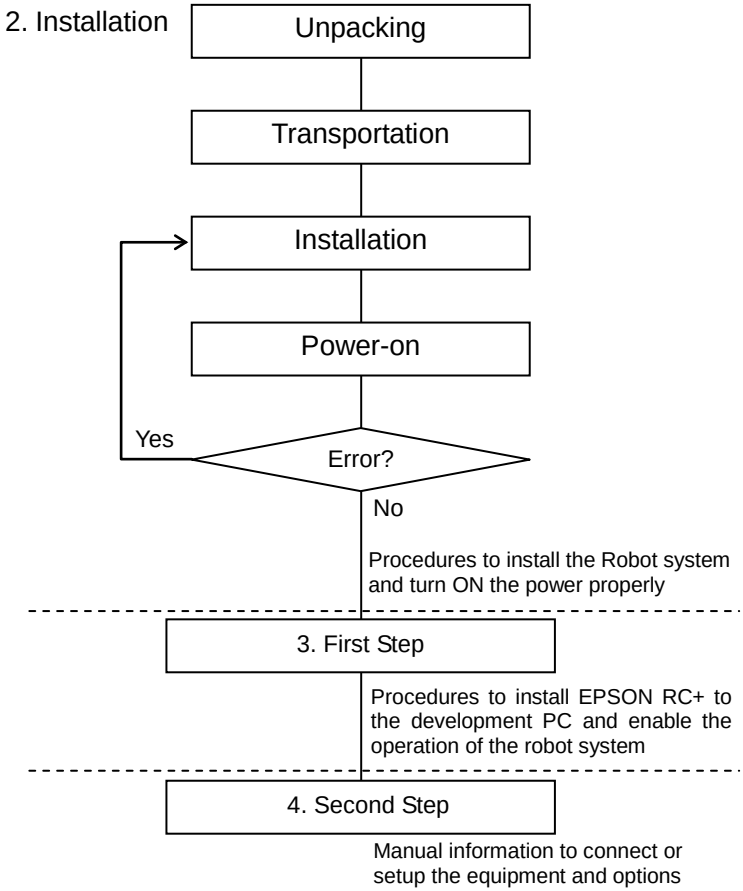
A: Control Unit and 1st Drive Unit (CU-DU1)

B: 1st Drive Unit and 2nd Drive Unit (DU1-DU2)

C: 2nd Drive Unit and 3rd Drive Unit (DU2-DU3)



2.1 Outline from Unpacking to Operation of Robot System



2.2 Unpacking

Installation and transportation of robots and robotic equipment shall be performed by qualified personnel and should conform to all national and local codes.

Using a cart or similar equipment, transport the Manipulator in the same conditions as it was delivered. Observe the following when unpacking the Manipulator.

2.2.1 Unpacking Precautions

Transportation procedure

: Only authorized personnel should perform sling work and operate a crane or forklift. When these operations are performed by unauthorized personnel, it is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system.

Vibration at transportation

: Avoid excessive vibration or shock during Manipulator transporting. Excessive vibration or shock may cause equipment damage to and/or malfunction of the Manipulator.

Anchor bolt

: When removing the anchor bolts, support the Manipulator to prevent falling. Removing the anchor bolts without supporting the Manipulator may get hands, fingers, or feet caught as the Manipulator will fall.

Wire tie

: Do not remove the wire tie securing the arm until you finish the installation. You may get your hands caught in the Manipulator when the wire tie is removed before completing the installation.

2.3 Transportation

Installation and transportation of robots and robotic equipment shall be performed by qualified personnel and should conform to all national and local codes.

2.3.1 Transportation Precautions

Transportation procedure

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Only authorized personnel should perform sling work and operate a crane or forklift. When these operations are performed by unauthorized personnel, it is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system.

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Anchor bolt

: When removing the anchor bolts, support the Manipulator to prevent falling.
Removing the anchor bolts without supporting the Manipulator may get hands, fingers, or feet caught as the Manipulator will fall.

Wire tie

: Do not remove the wire tie securing the arm until you finish the installation.
You may get your hands caught in the Manipulator when the wire tie is removed before completing the installation.

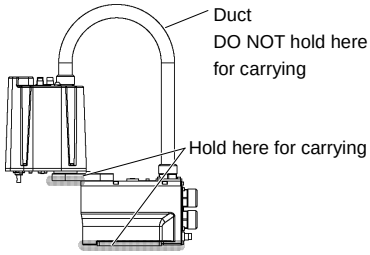
Hoisting procedure

: Stabilize the Manipulator with your hands when hoisting it. Unstable hoisting is extremely hazardous and may results in serious bodily injury and/or severe equipment damage to the robot system as the fall of the Manipulator.

2.3.2 Manipulator Transportation

G1

To carry the Manipulator, secure the Manipulator to the delivery equipment or hold the areas indicated in gray in the figure (bottom of Arm #1 and bottom of the base) by hand. Never hold the duct to carry the Manipulator.



G1-171*
approx. 8 kg :18 lb.
G1-221*
approx. 8 kg :18 lb.

G3

To carry the Manipulator, have two or more people to work on it and secure the Manipulator to the delivery equipment or hold the areas indicated in gray in the figure (bottom of Arm #1 and bottom of the base) by hand.
When holding the bottom of the base by hand, be very careful not to get your hands or fingers caught.

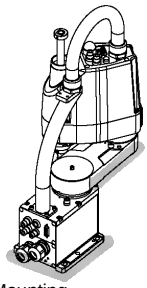
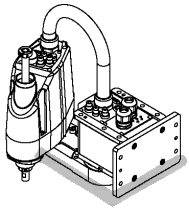


Table Top Mounting
G3-251* : approx. 14 kg: 31 lb.
G3-301* : approx. 14 kg: 31 lb.
G3-351* : approx. 14 kg: 31 lb.



Multiple Mounting
G3-301*M : approx. 14 kg: 31 lb.
G3-351*M : approx. 14 kg: 31 lb

G6

To carry the Manipulator, have two or more people to work on it and secure the Manipulator to the delivery equipment or hold the areas indicated in gray in the figure (bottom of Arm #1 / bottom of the base) by hand. When holding the bottom of the base by hand, be very careful not to get hands or fingers caught.

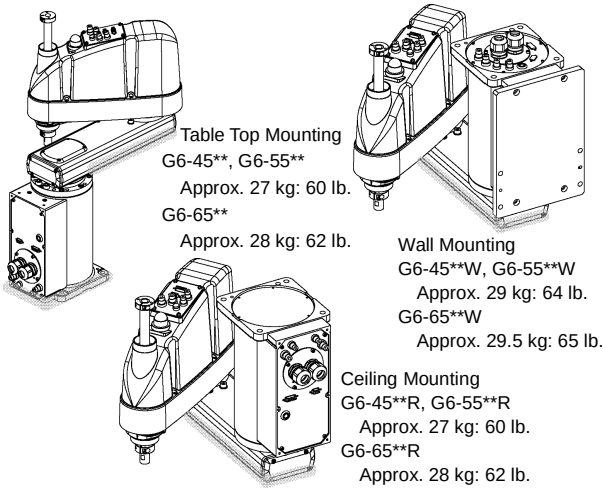


Table Top Mounting
G6-45**, G6-55**
Approx. 27 kg: 60 lb.
G6-65**
Approx. 28 kg: 62 lb.

Wall Mounting
G6-45**W, G6-55**W
Approx. 29 kg: 64 lb.
G6-65**W
Approx. 29.5 kg: 65 lb.

Ceiling Mounting
G6-45**R, G6-55**R
Approx. 27 kg: 60 lb.
G6-65**R
Approx. 28 kg: 62 lb.

G10 / G20

To carry the Manipulator, secure the Manipulator to the delivery equipment, or pass belts through the eyebolts and hoist it with your hands. Make sure to hold the areas indicated in gray in the figure (bottom of Arm #1 and bottom of the base) by hand.

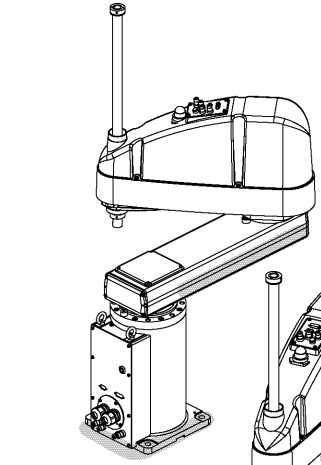
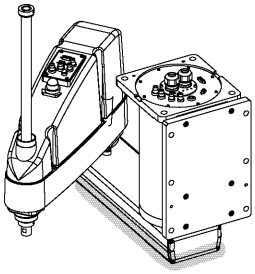
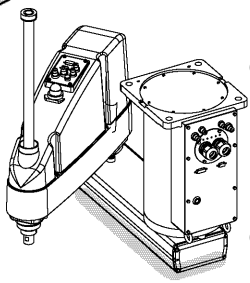


Table Top Mounting: *



Wall Mounting: W



Ceiling Mounting: R

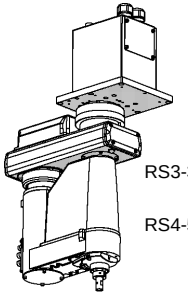
G10
65**, **R : Approx. 46 kg : 102 lb
65**W : Approx. 51 kg : 113 lb

G10/G20
85**, **R : Approx. 48 kg : 106 lb
85**W : Approx. 53 kg : 117 lb

G20
A0**, **R : Approx. 50 kg : 111 lb
A0**W : Approx. 55 kg : 122 lb

RS

To carry the Manipulator, have two or more people to work on it and secure the Manipulator to the delivery equipment or hold the areas indicated in gray in the figure (bottom of Arm #1 and bottom of the base) by hand.
When holding the bottom of the base by hand, be very careful not to get your hands or fingers caught.

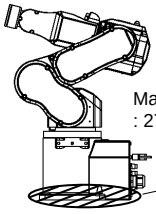


RS3-351* : approx. 17 kg : 38 lb.
(except cables)
RS4-551* : approx. 19 kg : 42 lb.
(except cables)

C4

To carry the Manipulator, have two or more people to work on it and secure the Manipulator to the delivery equipment or hold the areas indicated in gray in the figure (bottom of Arm #1 and bottom of the base) by hand.
When holding the bottom of the base by hand, be very careful not to get your hands or fingers caught.

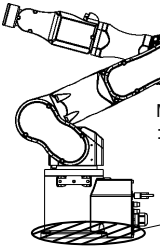
C4-A601**



Manipulator weight
: 27 kg (59.5 lb.)

DO NOT hold
the bottom of the
base by hand.

C4-A901**



Manipulator weight
: 29 kg (63.9 lb.)

DO NOT hold
the bottom of the
base by hand.

C8

To carry the Manipulator, secure it to the delivery equipment or have at least 2 people to hold it by hand. Also, do not hold the bottom of the base (the screened parts in the figure). Holding these parts by hand is extremely hazardous and may cause your hands and fingers caught.

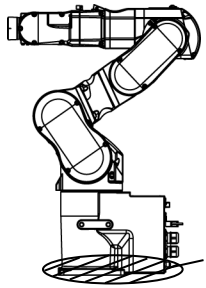


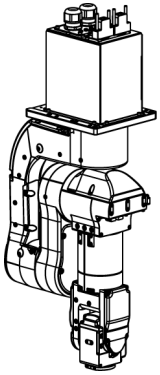
Figure: C8-A901* (C8L)
DO NOT hold the bottom of the base by hand

Manipulator weight

	C8-A701**: C8	C8-A901**: C8L	C8-A1401** (C8XL)
Standard, Clean-room model	49 kg : 108 lb.	52 kg : 115 lb.	62 kg :137 lb.
Protection model	53 kg : 117 lb.	56 kg : 123 lb.	66 kg : 146 lb.

N2

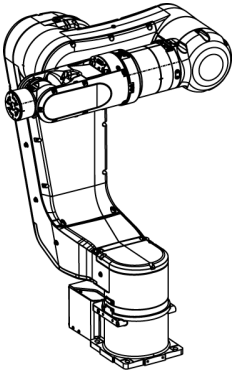
To carry the Manipulator, be sure to have at least 2 people to hold the bottom of the base or the Arm by hand. When holding the base installation face by hand, be careful not to cause your hands and fingers caught.



Manipulator weight: 19 kg: 42 lb

N6

To carry the Manipulator, be sure to have at least 2 people to hold the bottom of the base or the Arm by hand. When holding the base installation face by hand, be careful not to cause your hands and fingers caught.



Manipulator weight: 69 kg: 152 lb

X5

Transport separately

Make sure not to apply ropes to the motor unit, secure the other part of body instead when roping or transporting the manipulator.

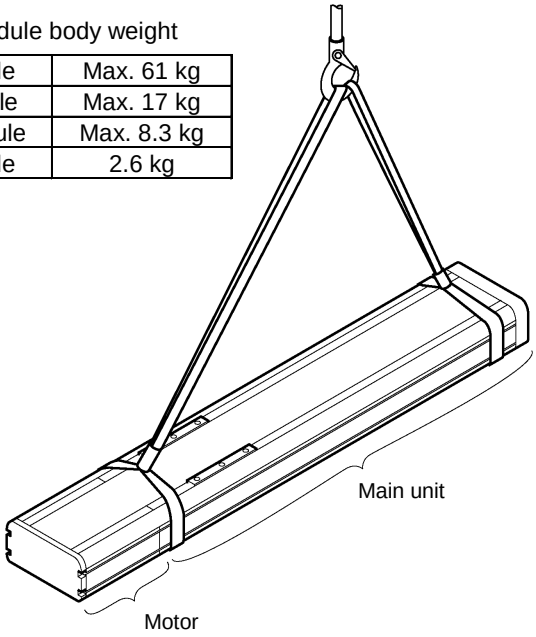
Transport with multi-axis installed

To avoid colliding while transporting, use ropes or fittings to secure parts.

- Basically, transport the manipulator on module basis.

Module body weight

RH module	Max. 61 kg
RM module	Max. 17 kg
RSz module	Max. 8.3 kg
RU module	2.6 kg



2.4 Manipulator Installation

Installation and transportation of robots and robotic equipment shall be performed by qualified personnel and should conform to all national and local codes.

2.4.1 Installation Precautions

Safeguard installation

: 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*.

Space between safeguard and Manipulator

: Install the Manipulator at a location with sufficient space so that a tool or a work piece on the end effector does not reach a wall or a safeguard when the Manipulator extends its arm fully while holding a work piece. Installing the Manipulator at a location with insufficient space is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system as a tool or a work piece may collide with a wall and a safeguard.

Manipulator check before installation

: Before installing and operating the Manipulator, make sure that all parts of the Manipulator are in place and have no external defects. Missing or defective parts may cause improper operation of the Manipulator. Improper operation of the Manipulator is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system.

Wall mounting and ceiling mounting

: When mounting the Manipulator on a wall or ceiling, secure the Manipulator to the wall or ceiling that has enough strength and rigidity. Mounting the Manipulator on a wall or ceiling that has insufficient strength and rigidity is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system as the Manipulator may fall or vibrate.

Side mounting and ceiling mounting

: When mounting the Manipulator on a wall or ceiling, for safety purposes, attach the support to the Manipulator base to prevent the Manipulator from falling. If the Manipulator falls, it is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system.

For Protected-model

: Connect the power cable connection and the signal cable connector to the Manipulator immediately after the Manipulator installation. The Manipulator without connecting them may result in electric shock and/or malfunction of the robot system as it cannot ensure IP65.

2.4.2 Environment

A suitable environment is necessary for the robot system to function properly and safely. Be sure to install the robot system in an environment that meets the following conditions:

Item	Conditions
Ambient temperature *	5 to 40°C (with minimum temperature variation)
Ambient relative humidity	10 to 80% (no condensation)
First transient burst noise	2 kV or less
Electrostatic noise	4 kV or less
Environment	- Install indoors. - Keep away from direct sunlight. - Keep away from dust, oily smoke, salinity, metal powder or other contaminants. - Keep away from flammable or corrosive solvents and gases. - Keep away from water. - Keep away from shocks or vibrations. - Keep away from sources of electric noise.

Manipulators are not suitable for operation in harsh environments such as painting areas, etc. When using Manipulators in inadequate environments that do not meet the above conditions, please contact us.

Special Environmental Conditions

The surface of the Manipulator has general oil resistance. However, if your requirements specify that the Manipulator must withstand certain kinds of oil, please consult your distributor.

Rapid change in temperature and humidity can cause condensation inside the Manipulator.
If your requirements specify that the Manipulator handles food, please consult your distributor to check whether the Manipulator will damage the food or not.

The Manipulator cannot be used in corrosive environments where acid or alkaline is used. In a salty environment where the rust is likely to gather, the Manipulator is susceptible to rust.

 WARNING	■ Use an earth leakage breaker on the AC power cable of the Controller to avoid electric shock and circuit breakdown caused by short circuit. Prepare the earth leakage breaker that pertains the Controller you are using. For details, refer to the Controller manual.

 CAUTION	■ When cleaning the Manipulator, do not rub it strongly with alcohol or benzene. It may lose luster on the coated face.

2.4.3 Noise level

Noise level by movement of manipulator.

<table>
<tr><th colspan="2">Manipulator</th><th>Level dB(A)</th><th>Operating conditions</th><th>Measurement point</th></tr>
<tr><td colspan="2">G1
RS3 RS4</td><td>65 or less</td><td rowspan="2">Under rated load,
4-joints, simultaneous motion,
maximum speed,
maximum acceleration,
and duty 50%</td><td rowspan="8">Rear of the Manipulator,
1,000 mm apart from the motion range,
50 mm above the base-installed surface</td></tr>
<tr><td colspan="2">G3 G6
G10 G20</td><td>70 or less</td></tr>
<tr><td rowspan="6">X5</td><td>RH</td><td>75.3 or less</td><td rowspan="6">Under rated load,
maximum speed,
maximum acceleration,
and duty 50%</td></tr>
<tr><td>RM</td><td>76.5 or less</td></tr>
<tr><td>RG-HM</td><td>75.1 or less</td></tr>
<tr><td>YZ-MS</td><td>76.8 or less</td></tr>
<tr><td>RP-HMSz</td><td>76.2 or less</td></tr>
<tr><td>RU-HMSz</td><td>76.2 or less</td></tr>
<tr><td colspan="2">C4</td><td>80 or less</td><td>Under rated load,
All arm simultaneous operation,
maximum speed,
maximum acceleration,
and duty 50%</td><td>1,000 mm apart from the back of the Manipulator,
50 mm above the base-installed surface.</td></tr>
<tr><td colspan="2">C8
N2 N6</td><td>80 or less</td><td>Under rated load,
All arm simultaneous operation,
maximum speed,
maximum acceleration,
and duty
C8, C8L, N2: 50%
C8XL: 30%
N2, N6: 50%</td><td>1,000 mm apart from the back of the Manipulator.</td></tr>
</table>

2.4.4 Base Table

A base table for anchoring the Manipulator is not supplied. Please make or obtain the base table for your Manipulator. The shape and size of the base table differs depending on the use of the robot system. For your reference, we list some Manipulator table requirements here.

The base table must not only be able to bear the weight of the Manipulator but also be able to withstand the dynamic movement of the Manipulator when it operates at maximum acceleration. Ensure that there is enough strength on the base table by attaching reinforcing materials such as crossbeams.

Use the mounting bolts conforming to the strength of ISO898-1 property class 12.9.

The table must be secured on the floor or wall to prevent it from moving.

The Manipulator must be installed horizontally.

When using a leveler to adjust the height of the base table, use a screw with M16 diameter.

The torque and reaction force produced by Manipulator motion are as follows:

G, RS series

	G					RS	
	G1	G3	G6	G10	G20	RS3	RS4
Max. Reaction torque on the horizontal plate (Nm)	100	300	500	1,000	1,000	500	500
Max. Horizontal reaction force (N)	200	2,000	2,500	4,500	7500	1,200	1,400
Max. Vertical reaction force (N)	300	1,000	1,500	2,000	2,000	1,100	1,100
Threaded holes for Mounting screw	M6	M8	M8	M12	M12	M6	M6

The plate for the Manipulator mounting face should be 20 mm thick or more and made of steel to reduce vibration. The surface roughness of the steel plate should be 25 μm or less.

C4 series

	C4-A601**	C4-A901**
Max. Reaction torque on the horizontal plate (Nm)	500	700
Max. Horizontal reaction force (N)	800	800
Max. Vertical reaction force (N)	600	1000
Max. Reaction torque on the horizontal plate (Nm)	2,500	2,500
Threaded holes for Mounting screw	M8	M8

C8 series

	C8-A701**	C8-A901**	C8-A1401**
Max. Reaction torque on the horizontal plate (Nm)	1,600	1,800	2,600
Max. Horizontal reaction force (N)	1,200	1,300	1,300
Max. Vertical reaction force (N)	1,900	2,200	3,400
Max. Reaction torque on the horizontal plate (Nm)	1,600	1,800	2,600
Threaded holes for Mounting screw	M12	M12	M12

The plate for the Manipulator mounting face should be 30 mm thick or more and made of steel to reduce vibration. The surface roughness of the steel plate should be 25 μm or less.

N2 series

	N2-A450S*
Max. Reaction torque on the horizontal plate (Nm)	200
Max. Horizontal reaction force (N)	300
Max. Vertical reaction force (N)	300
Max. Reaction torque on the horizontal plate (Nm)	1,600
Threaded holes for Mounting screw	M6

The plate for the Manipulator mounting face should be 20 mm thick or more and made of steel to reduce vibration. The surface roughness of the steel plate should be 25 μm or less.

N6 series

	N6-A1000**
Max. Reaction torque on the horizontal plate (Nm)	800
Max. Horizontal reaction force (N)	1,800
Max. Vertical reaction force (N)	1,100
Max. Reaction torque on the horizontal plate (Nm)	3,200
Threaded holes for Mounting screw	M12

The plate for the Manipulator mounting face should be 30 mm thick or more and made of steel to reduce vibration. The surface roughness of the steel plate should be 25 μm or less.

X5

	Single axis	2-axis		3-axis	4-axis
	RH, RM	RG-HM	YZ-MS	RP-HMSz	RU-HMSz
Max. Horizontal reaction force (N)	1,400N	2,000N	1,400N	2,000N	2,000N
Max. Vertical reaction force (N)	—	—	1,050N	1,050N	1,050N
Max. Reaction torque on the horizontal plate (Nm)	—	—	—	—	40Nm

The flatness of the mounting base shall be 0.1 mm or less and the surface shall be free of interfering protrusions.

Adjust the flatness of mounting base using shims when clearance exists between the module surface and the mounting base around the mounting holes

Use mounting bolts with specifications conforming to ISO898-1 property class: 10.9 or 12.9.

The table must be secured on the floor or wall to prevent it from moving.

The Manipulator must be installed horizontally.

When using a leveler to adjust the height of the base table, use a screw with M16 diameter.

2.4.5 Installation Procedure

NOTE

When the Manipulator is Clean-model, unpack it outside of the clean room. Secure the Manipulator not to fall, and then wipe off the dust on the Manipulator with a little alcohol or distilled water on a lint-free cloth. After that, carry the Manipulator in the clean room. Connect an exhaust tube to the exhaust port after installation.

G1

There are 4 threaded holes for the Manipulator base. Use M6 mounting bolts conforming to the strength, ISO898-1 property class: 6.9.

Tightening torque: 13 N·m (133 kgf·cm)

G1-177* 8kg: 18lb.

G1-221* 8kg: 18lb.

G3 : Table Top Mounting

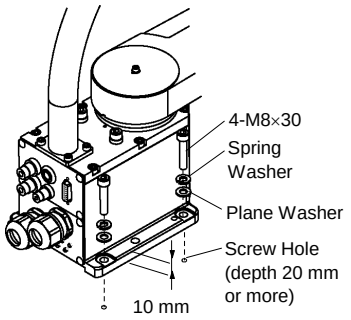
CAUTION	■ Install the Table Top Mounting Manipulator with two or more people. The Manipulator weights are as follows. Be careful not to get hands, fingers, or feet caught and/or have equipment damaged by a fall of the Manipulator. G3-251* : approx. 14 kg: 31 lb. G3-301* : approx. 14 kg: 31 lb. G3-351* : approx. 14 kg: 31 lb.

(1) Secure the base to the base table with four bolts.

NOTE

Use bolts with specifications conforming to ISO898-1 Property Class: 10.9 or 12.9.

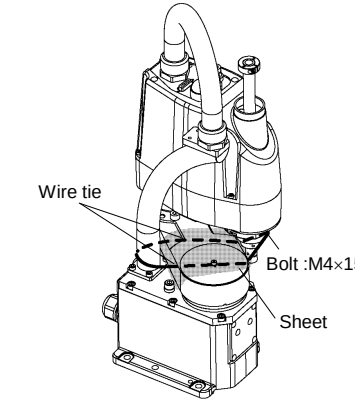
Tightening torque
: 32.0 N·m (326 kgf·cm)



(2) Using nippers, cut off the wire tie binding the shaft and arm retaining bracket on the base.

(3) Remove the bolts securing the wire ties removed in step (2).

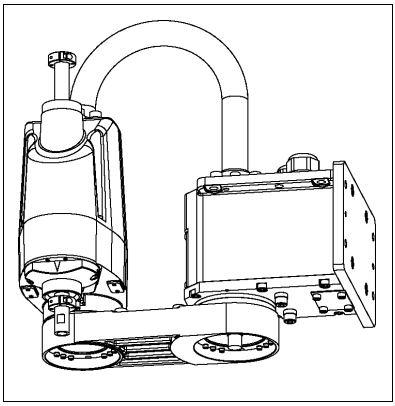
(4) Remove the shipping bolt and jigs.



G3 : Multiple Mounting

WARNING	■ Install the Multiple Mounting Manipulator with two or more people. The Manipulator weights are as follows. Be careful not to get hands, fingers, or feet caught and/or have equipment damaged by a fall of the Manipulator. G3-301*M : approx. 14 kg: 31 lb. G3-351*M : approx. 14 kg: 31 lb. ■ When installing the Manipulator to the wall, support the Manipulator, and then secure the anchor bolts. Removing the support without securing the anchor bolts properly is extremely hazardous and may result in fall of the Manipulator.

(1) Unpack the manipulator with retaining the arm posture.

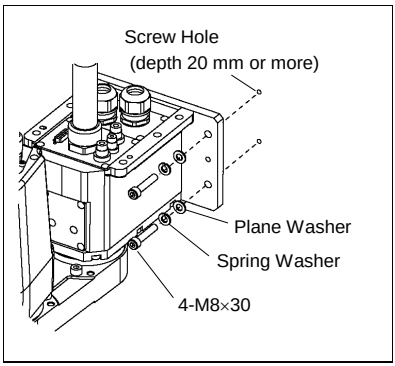


(2) Secure the base to the wall with four bolts.

NOTE

Use bolts with specifications conforming to ISO898-1 Property Class: 10.9 or 12.9.

Tightening torque
: 32.0 N·m (326 kgf·cm)



(3) Remove the shipping bolt and jigs.

G6 : Table Top Mounting

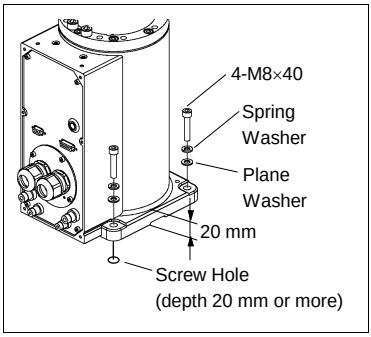
WARNING	■ Install the Table Top Mounting Manipulator with two or more people. The Manipulator weights are as follows. Be careful not to get hands, fingers, or feet caught and/or have equipment damaged by a fall of the Manipulator. G6-45** : Approximately 27 kg: 60 lb. G6-55** : Approximately 27 kg: 60 lb. G6-65** : Approximately 28 kg: 62 lb.

(1) Secure the base to the base table with four bolts.

NOTE

Use bolts with specifications conforming to ISO898-1 Property Class: 10.9 or 12.9.

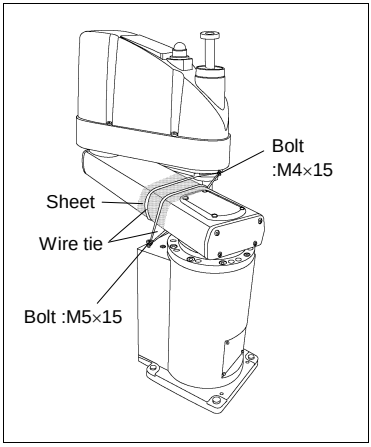
Tightening torque
: 32.0 N·m (326 kgf·cm)



(2) Using nippers, cut off the wire tie binding the shaft and arm retaining bracket on the base.

(3) Remove the bolts securing the wire ties removed in step (2).

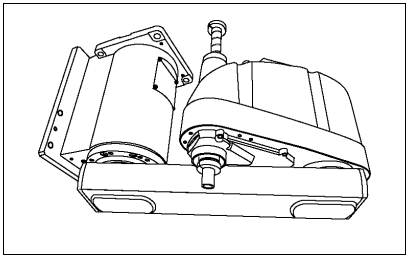
(4) Remove the shipping bolt and jigs.



G6 : Wall Mounting

WARNING	■ Install the Wall Mounting Manipulator with two or more people. The Manipulator weights are as follows. Be careful not to get hands, fingers, or feet caught and/or have equipment damaged by a fall of the Manipulator. G6-45**W : Approximately 29 kg: 64 lb. G6-55**W : Approximately 29 kg: 64 lb. G6-65**W : Approximately 29.5 kg: 65 lb. ■ When installing the Manipulator to the wall, support the Manipulator, and then secure the anchor bolts. Removing the support without securing the anchor bolts properly is extremely hazardous and may result in fall of the Manipulator.

(1) Unpack the manipulator with retaining the arm posture.

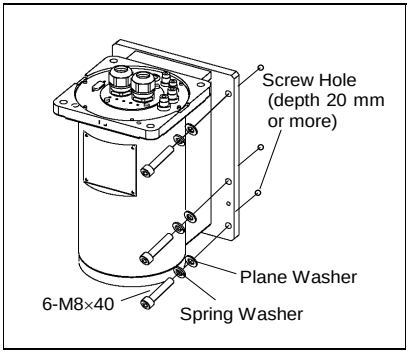


(2) Secure the base to the wall with six bolts.

NOTE

Use bolts with specifications conforming to ISO898-1 Property Class: 10.9 or 12.9.

Tightening torque
: 32.0 N·m (326 kgf·cm)

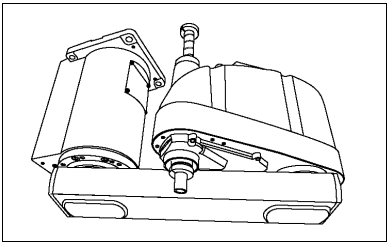


(3) Remove the shipping bolt and jigs.

G6 : Ceiling Mounting

WARNING	■ Install the Ceiling Mounting Manipulator with two or more people. The Manipulator weights are as follows. Be careful not to get hands, fingers, or feet caught and/or have equipment damaged by a fall of the Manipulator. G6-45**R : Approximately 27 kg: 60 lb. G6-55**R : Approximately 27 kg: 60 lb. G6-65**R : Approximately 28 kg: 62 lb. ■ When installing the Manipulator to the ceiling, support the Manipulator, and then secure the anchor bolts. Removing the support without securing the anchor bolts properly is extremely hazardous and may result in fall of the Manipulator.

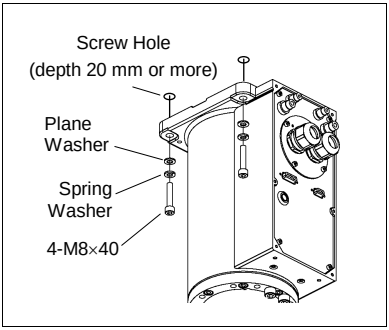
(1) Unpack the manipulator with retaining the arm posture.



(2) Secure the base to the ceiling with four bolts.

NOTE Use bolts with specifications conforming to ISO898-1 Property Class: 10.9 or 12.9.

Tightening torque
: 32.0 N·m (326 kgf·cm)



(3) Remove the shipping bolt and jigs.

G10/G20 : Table Top Mounting

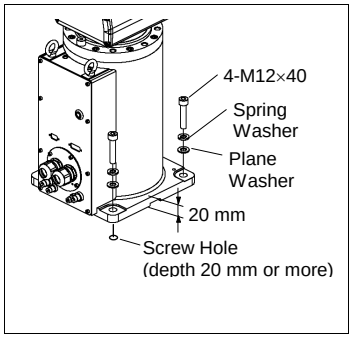
WARNING	■ Install the Table Top Mounting Manipulator with four or more people. The Manipulator weights are as follows. Be careful not to get hands, fingers, or feet caught and/or have equipment damaged by a fall of the Manipulator. G10-65** : Approximately 46 kg :102 lb. G10/G20-85** : Approximately 48 kg :106 lb. G20-A0** : Approximately 50 kg :111 lb.

(1) Secure the base to the base table with four bolts.

NOTE

Use bolts with specifications conforming to ISO898-1 Property Class: 10.9 or 12.9.

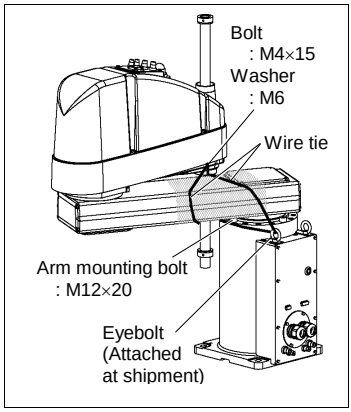
Tightening torque
: 73.5 N·m (750 kgf·cm)



(2) Using nippers, cut off the wire tie binding the shaft and arm retaining bracket on the base.

(3) Remove the bolts securing the wire ties removed in step (2).

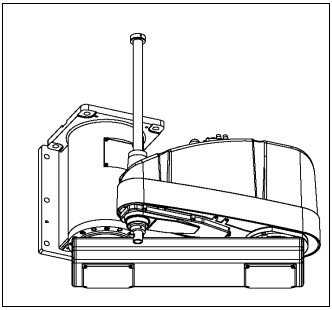
(4) Remove the shipping bolt and jigs.



G10/G20 : Wall Mounting

WARNING	■ Install the Wall Mounting Manipulator with four or more people. The Manipulator weights are as follows. Be careful not to get hands, fingers, or feet caught and/or have equipment damaged by a fall of the Manipulator. G10-65**W : Approximately 51 kg :113 lb. G10/G20-85**W : Approximately 53 kg :117 lb. G20-A0**W : Approximately 55 kg :122 lb. ■ When installing the Manipulator to the wall, support the Manipulator, and then secure the anchor bolts. Removing the support without securing the anchor bolts properly is extremely hazardous and may result in fall of the Manipulator.

(1) Unpack the manipulator with retaining the arm posture.

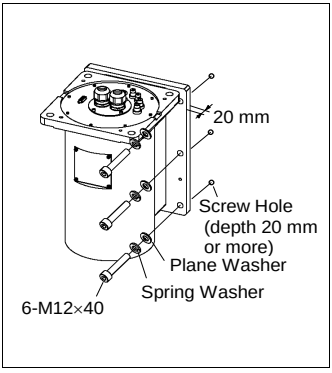


(2) Secure the base to the wall with six bolts.

NOTE Use bolts with specifications conforming to ISO898-1 Property Class: 10.9 or 12.9.

Tightening torque
: 32.0 N·m (326 kgf·cm)

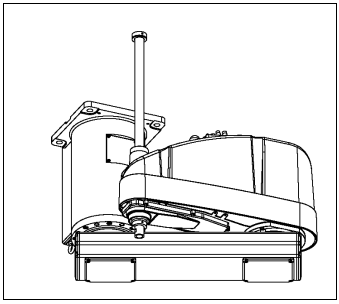
(3) Remove the shipping bolt and jigs.



G10/G20 : Ceiling Mounting

WARNING	■ Install the Ceiling Mounting Manipulator with four or more people. The Manipulator weights are as follows. Be careful not to get hands, fingers, or feet caught and/or have equipment damaged by a fall of the Manipulator. G10-65**R : Approximately 46 kg :102 lb. G10/G20-85**R : Approximately 48 kg :106 lb. G20-A0**R : Approximately 50 kg :111 lb. ■ When installing the Manipulator to the ceiling, support the Manipulator, and then secure the anchor bolts. Removing the support without securing the anchor bolts properly is extremely hazardous and may result in fall of the Manipulator.

(1) Unpack the manipulator with retaining the arm posture.

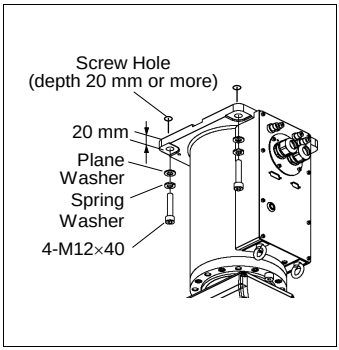


(2) Secure the base to the ceiling with four bolts.

NOTE

Use bolts with specifications conforming to ISO898-1 Property Class: 10.9 or 12.9.

Tightening torque
: 32.0 N·m (326 kgf·cm)

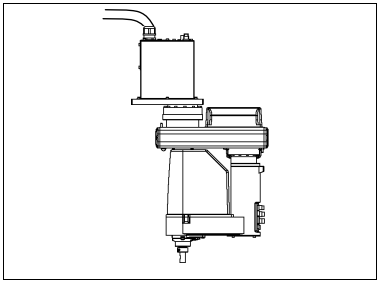


(3) Remove the shipping bolt and jigs.

RS

CAUTION	■ Install the Manipulator with two or more people. The Manipulator weights are as follows. Be careful not to get hands, fingers, or feet caught and/or have equipment damaged by a fall of the Manipulator. RS3-351*: approx. 17 kg : 38 lb. (except cables) RS4-551*: approx. 19 kg : 42 lb. (except cables) ■ When installing the Manipulator to the ceiling, support the Manipulator, and then secure the anchor bolts. Removing the support without securing the anchor bolts properly is extremely hazardous and may result in fall of the Manipulator.

(1) Unpack the Manipulator with retaining the arm posture.

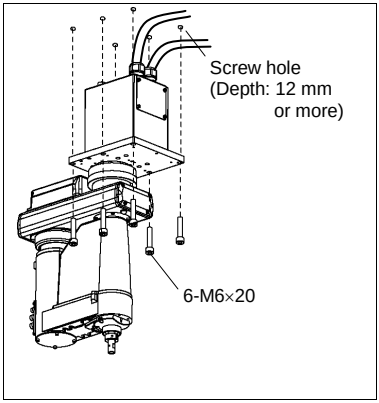


(2) Secure the base to the wall with 6 bolts.

NOTE

Intensity of the bolts should be equivalent to ISO898-1 Property Class 10.9 or 12.9.

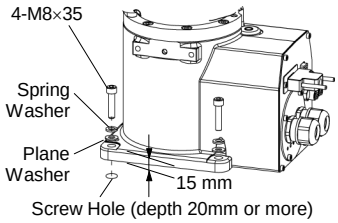
Tightening torque
: 13.0 N·m (133 kgf·cm)



(3) Remove the shipping bolt and jigs.

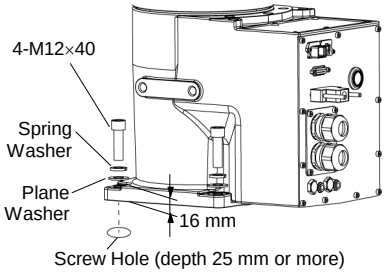
C4

There are four threaded holes for the Manipulator base. Use M8 mounting bolts conforming to the strength of ISO898-1 property class 12.9.



C8

There are four threaded holes for the Manipulator base.
Use M12 mounting bolts conforming to the strength of ISO898-1 property class 10.9 or 12.9.
Tightening torque:
100.0 ± 5.0 N·m (1,020 ± 51 kgf·cm)

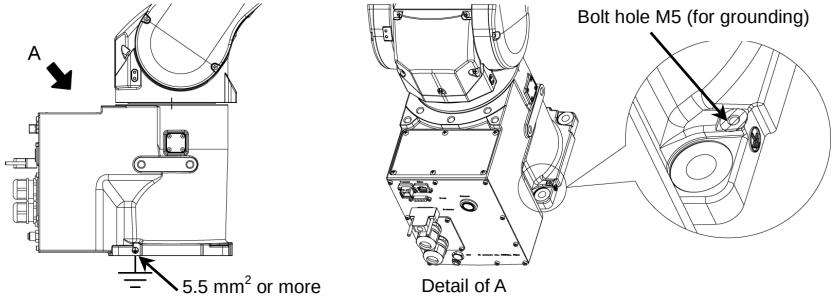


Grounding

WARNING	■ Ground resistance must be 100 Ω or less. Improper ground resistance may result in fire and/or electric shock. ■ Do not use the ground line for the Manipulator in common with other ground lines or grounding electrodes for other electric power, motor power, welding devices, etc. Using the ground line for the Manipulator in common with other ground lines or grounding electrodes may result in electric shock and/or malfunction of the robot system. ■ When using metal ducts, metallic conduits, or distributing racks for cable, ground in accordance with national and local electric equipment technical standards. Grounding that does not meet the standards may result in electric shock and/or malfunction of the robot system.

Follow local regulations for grounding. It is recommended that the core size of the grounding wire be 5.5 mm^2 or more.

Directly connect the ground line to the Manipulator as shown in the figure below.

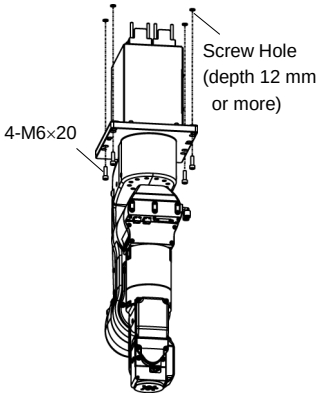


N2

There are four threaded holes for the Manipulator base.

Use M6 mounting bolts conforming to the strength of ISO898-1 property class 10.9 or 12.9.

Tightening torque: 13 N·m (133 kgf·cm)



NOTE

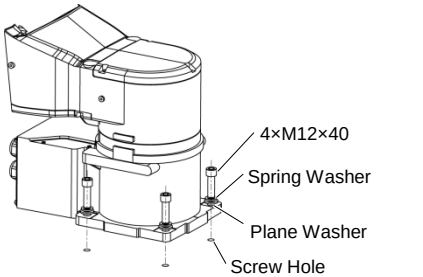
The Joint #1 is not equipped with the brake. When installing the Manipulator, be careful not to rotate the Joint #1.
The cable may break when exceeding Max. motion range. Be careful to operate.

N6

There are four threaded holes for the Manipulator base.

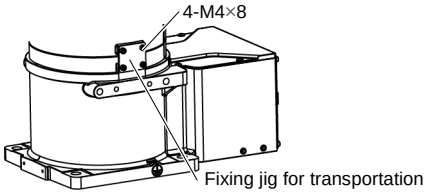
Use M12 mounting bolts conforming to the strength of ISO898-1 property class 10.9 or 12.9.

Tightening torque: 100 N·m (1020 kgf·cm)



After installing the robot, make sure to remove the fixing jig that fix the base and the Arm #1.

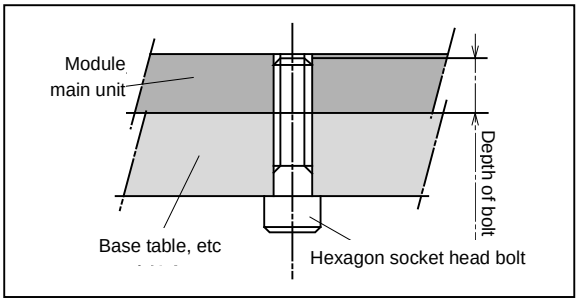
Hexagon socket head screws: 4-M4×8



X5

If using the tap hole on the back side of the module unit and directly securing the main body:

- Process the through hole on the base table and secure from the back side.
- In addition, using ø8H7 hole on the back side of the body, you can decide where to secure. In this case, see the figure below for the pin on the base table.



	RH module	RM module
Bolt diameter	M8	M6
Depth of bolt	12-16 mm	9–12 mm
Tightening torque	33.3N·m	14.7N·m

If using the mounting braket (option) and secure the module unit from the upper side:

- Mount the mounting braket on the module main unit with the attached bolt.
- Process a screw on te mounting base table and secure the module unit from the upper side.

	RH module mounting bracket	RM module mounting bracket	YZ-MS mounting bracket
Code	R114X4E001	R114X4E002	R114X4E005
Attached bolt diameter × Length (units)	M8 × 20 (4)	M6 × 20 (4)	M8 × 20 (4) M6 × 20 (4)
Tightening torque	33.3N·m	14.7N·m	33.3N·m (M8) 14.7N·m (M6)
(Recommended) Units to use	RH600 : 2 RH800 : 3 RH1000 : 3	RM350 : 2 RM550 : 2	RM350 : 1 RM750 : 2
Weight	approx. 2.4 kg	approx.1.8 kg	approx.3.6 kg
Applicable module	RH RG-HM RD-HM RP-HMSz RU-HMSz	RM RG-MS RD-MS RP-MSSz	YZ-MS

2.5 Control unit and Drive unit Installation

2.5.1 Environment

Environment conditions

: The Control unit and Drive unit must be used within the environmental conditions described in their manuals. This product has been designed and manufactured strictly for use in a normal indoor environment. Using the product in the environment that exceeds the conditions may not only shorten the life cycle of the product but also cause serious safety problems.

For Clean-room installation

: The Control unit and Drive unit is not designed for clean-room specification. If it must be installed in a clean room, make sure to install it in the proper enclosure with adequate ventilation and cooling.

Installation procedure

: Before performing any installation procedure, turn OFF the Control unit and Drive unit 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.

Cable

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

In order to optimize the robot system's performance for safety, the Controller must be placed in an environment that satisfies the following conditions:

NOTE

- The Controller is not designed for clean-room specification. If it must be installed in a clean room, be sure to install it in a proper enclosure with adequate ventilation and cooling.
- Install Controller in a location that allows easy connection / disconnection of cables.

Item	Condition
Ambient temperature	5 to 40 deg.C (with minimal variation)
Ambient relative humidity	20% to 80% (with no condensation)
First transient burst noise	2 kV or less (Power supply wire) 1 kV or les (Signal wire)
Electrostatic noise	4 kV or less
Base table	Use a base table that is at least 100 mm off the floor. Placing the Controller directly on the floor could allow dust penetration leading to malfunction.

If the Controller must be used in an environment that does not fulfill the conditions mentioned above, take adequate countermeasures. For example, the Controller may be enclosed in a cabinet with adequate ventilation and cooling.

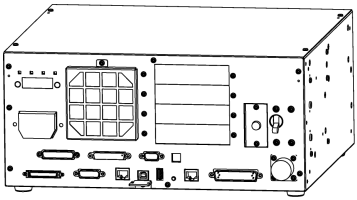
- Install indoors only.
- Place in a well-ventilated area.
- Keep away from direct sunlight and radiation heat.
- Keep away from dust, oily mist, oil, salinity, metal powder or other contaminants.
- Keep away from water.
- Keep away from shocks or vibrations.
- Keep away from sources of electronic noise
- Keep away from strong electric or magnetic fields.

2.5.2 Installation

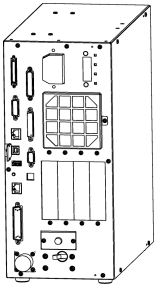
Install the Control unit and Drive unit on a flat surface such as wall, floor, and controller box in the direction shown in (A) to (C).

(Figure: Control unit: RC700.)

(A) Flat mounting

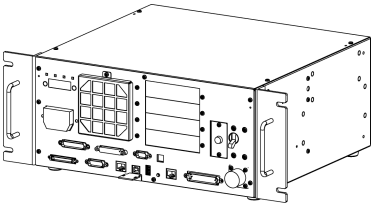


(B) Upright mounting



* The rubber foot needs to be replaced.

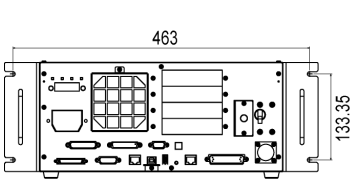
(C) Rack mounting

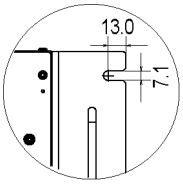


* A plate for rack mounting is required.

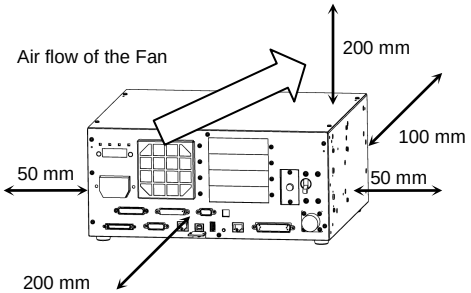
NOTE

For Control unit and Drive unit installation to the Controller box or the base table, process screw hole drilling as follows.





Ensure the air flow around the supply and exhaust ports, and install the Controller while leaving space from other equipment or walls as below.



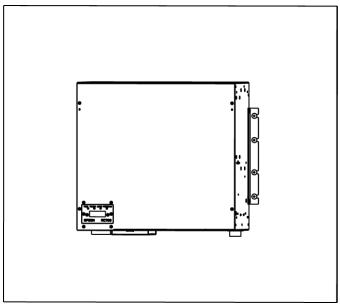
Air with higher temperature than the ambient air (about 10 deg C) is blown out from the exhaust port of the Controller.
Do not place the heat sensitive devices near the exhaust port.

Route the cables so that they can be pulled out to the front side of the Controller.

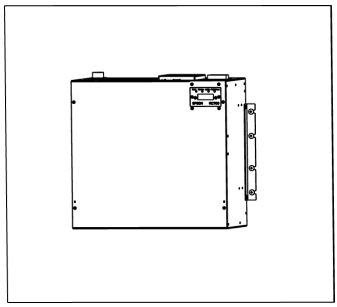
2.5.3 Wall Mounting Option

The Control unit and Drive unit have a wall mounting option.

Wall mounting with the front side down



Wall mounting with the front side up



Refer to one of the following for the Installation Procedure.

Installation Procedure sheet attached to the wall mounting option.

Manual: ROBOT CONTROLLER RC700 / RC700-A
Setup & Operation 3.2.3 Wall Mounting Option

2.6 Connection to EMERGENCY Connector

NOTE

The details of safety requirements for this section are described in the *User's Guide 2. Safety*. Please refer to them to keep the robot system safe.

WARNING

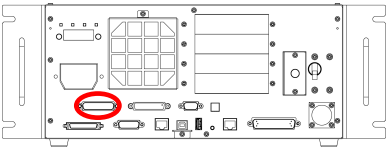
- Not only when turning on the device, but also changing use environment such as add options or replace parts for maintenance, make sure that the emergency stop or safety door work properly.

Connect a safeguard switch or Emergency Stop switch to the Control unit and Drive unit EMERGENCY connector for safety.
When nothing is connected to the EMERGENCY connector, Control unit and Drive unit does not operate normally.

WARNING

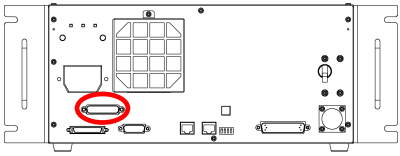
- Before connecting the connector, make sure that the pins are not bent. Connecting with the pins bent may damage the connector and result in malfunction of the robot system.

Control unit



EMERGENCY connecter (Figure: RC700)

Drive unit



EMERGENCY connecter

2.6.1 Safety Door Switch and Latch Release Switch

The EMERGENCY connector has input terminals for the Safety Door switch and the Emergency Stop switch. Be sure to use these input terminals to keep the system safe.

Connector	Standard
EMERGENCY connector (Controller side)	D-sub25 Pin (male) Mounting style #4-40

2.6.2 Safety Door Switch

 WARNING	■ The interlock of the Safety Door must be functioning when the robot system is operated. Do not operate the system under the condition that the switch cannot be turned ON/OFF (e.g. covering the switch with tape). Operating the robot system when the switch is not functioning properly is extremely hazardous and may cause serious safety problems as the Safety Door input cannot fulfill its intended function.

In order to maintain a safe working zone, a safeguard must be set up around the Manipulator. The safeguard must have an interlock switch at the entrance to the working zoon. The Safety Door that is described in this manual is one of the safeguards and an interlock of the Safety Door is called a Safety Door switch. Connect the Safety Door switch to the Safety Door input terminal on the EMERGENCY connector.

The Safety Door switch has safety features such as temporary hold-up of the program or the operation-prohibited status that are activated whenever the Safety Door is opened.

Observe the following in designing the Safety Door switch and the Safety Door.

- For the Safety Door switch, select a switch that opens as the Safety Door opens, and not by the spring of the switch itself.
- The signal from the Safety Door (Safety Door input) is designed to input to two redundant signals. If the signals at the two inputs differ by two seconds or more, the system regards it as a critical error. Therefore, make sure that the Safety Door switch has two separate redundant circuits and that each connects to the specified pins at the EMERGENCY connector on the Controller.
- The Safety Door must be designed and installed so that it does not close accidentally.

2.6.3 Latch Release Switch

The controller software latches the following conditions:

- The safety door is open.
- The operation mode is “TEACH”.

The EMERGENCY connector has an input terminal for a latch release switch that cancels the latched conditions.

Open : The latch release switch latches conditions that the safety door is open or the operation mode is “TEACH”.

Closed : The latch release switch releases the latched conditions.

NOTE

When the latched TEACH mode is released while the safety door is open, the status of Manipulator power is operation-prohibited because the safety door is open at that time.
To execute a Manipulator operation, close the safety door again, and then close the latch release input.

2.6.4 Checking Latch Release Switch Operation

NOTE

Refer to *3.2 Development PC and Controller Connection* and connect the development PC and Controller before checking the function.

After connecting the safety door switch and latch release switch to the EMERGENCY connector, be sure to check the switch operation for safety by following the procedures described below before operating the Manipulator.

(1) Turn ON the Controller while the safety door is open in order to boot the controller software.
(2) Make sure that “Safety” is displayed on the EPSON RC+ 7.0 status bar.
(3) Close the safety door, and turn ON the switch connecting to the latch release input.
Make sure that the “Safety” is dimmed on the status bar.

The information that the safety door is open can be latched by software based on the latch release input condition.

Open : The latch release switch latches condition that the safety door is open. To cancel the condition, close the safety door, and then close the safety door latch release input.

Closed : The latch release switch does not latch the condition that the safety door is open.

NOTE

The latch release input also functions to acknowledge the change of TEACH mode.

In order to change the latched condition of the TEACH mode, turn the mode selector key switch on the Teach Pendant to “Auto”. Then, close the latch release input.

2.6.5 Emergency Stop Switch

If it is desired to create an external Emergency Stop switch in addition to the Emergency Stop on the Teach Pendant and Operator Panel, make sure to connect the Emergency Stop switch to the Emergency Stop input terminal on the EMERGENCY connector.
The Emergency Stop switch connected must comply with the related safety standards (such as IEC60947-5-5) and the following:

- It must be a push button switch that is “normally closed”.
- A button that does not automatically return or resume.
- The button must be mushroom-shaped and red.
- The button must have a double contact that is “normally closed”.

NOTE

The signal from the Emergency Stop switch is designed to use two redundant circuits.
If the signals at the two circuits differ by two seconds or more, the system recognizes it as a critical error. Therefore, make sure that the Emergency Stop switch has double contacts and that each circuit connects to the specified pins on the EMERGENCY connector at the Controller. Refer to the following:
2.6.8 Circuit Diagrams – Control Unit.
2.6.9 Circuit Diagrams – Drive Unit.

2.6.6 Checking Emergency Stop Switch Operation

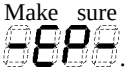
NOTE

Refer to *3.2 Development PC and Controller Connection* and connect the development PC and Controller before checking the function.

Once the Emergency Stop switch is connected to the EMERGENCY connector, continue the following procedure to make sure that the switch functions properly. For the safety of the operator, the Manipulator must not be powered ON until the following test is completed.

Control Unit RC700

(1) Turn ON the Controller to boot the controller software while pressing the Emergency Stop switch.

(2) Make sure that the seven-segment LED on the Controller displays  .

(3) Make sure that “E.Stop” is displayed on the EPSON RC+ 7.0 status bar.

(4) Release the Emergency Stop Switch.

(5) Select EPSON RC+ 7.0-[Tools]-[Robot Manager]-[Control Panel] and click the <Reset> button to execute the RESET command.

(6) Make sure that  LED is turned OFF and that “E-Stop” is dimmed on the main window status bar.

Drive Unit RC700DU

(1) Turn ON the controller to boot the software while pressing the Emergency Stop switch.

(2) Make sure that “ERROR/E-STOP” LED on Drive Unit has been turned ON.

(3) Make sure that “E.Stop” is displayed on the status bar on the EPSON RC+ main window.

(4) Release the Emergency Stop Switch.

(5) Execute the RESET command.

(6) Make sure that “ERROR/E-STOP” LED turns OFF and “E-Stop” display fades on the main window status bar.

2.6.7 Pin Assignments

The EMERGENCY connector pin assignments are as follows:

Pin No.	Signal	Function	Pin No.	Signal	Function
1	ESW11	Emergency Stop switch contact (1) *3	14	ESW21	Emergency Stop switch contact (2) *3
2	ESW12	Emergency Stop switch contact (1) *3	15	ESW22	Emergency Stop switch contact (2) *3
3	ESTOP1+	Emergency Stop circuit 1 (+)*4	16	ESTOP2+	Emergency Stop circuit 2 (+)*4
4	ESTOP1–	Emergency Stop circuit 1 (-)*4	17	ESTOP2–	Emergency Stop circuit 2 (-)*4
5	Not used	*1	18	SDLATCH1	Safety Door Latch Release
6	Not used	*1	19	SDLATCH2	Safety Door Latch Release
7	SD11	Safety Door input (1) *2	20	SD21	Safety Door input (2) *2
8	SD12	Safety Door input (1) *2	21	SD22	Safety Door input (2) *2
9	24V	+24V output	22	24V	+24V output
10	24V	+24V output	23	24V	+24V output
11	24VGND	+24V GND output	24	24VGND	+24V GND output
12	24VGND	+24V GND output	25	24VGND	+24V GND output
13	Not used				

*1 Do not connect anything to these pins.

*2 A critical error occurs if the input values from the Safety Door 1 and Safety Door 2 are different for two or more seconds. They must be connected to the same switch with two sets of contacts.

*3 A critical error occurs if the input values from the Emergency Stop switch contact 1 and Emergency Stop switch contact 2 are different for two or more seconds. They must be connected the same switch with two sets of contacts.

*4 Do not apply reverse voltage to the Emergency Stop circuit.

Emergency Stop switch output rated load	+30 V 0.3 A or under	1-2, 14-15 pin
Emergency Stop rated input voltage range Emergency Stop rated input current	+24 V ±10% 37.5 mA ±10% / +24V input	3-4, 16-17 pin
Safety Door rated input voltage range Safety Door rated input current	+24 V ±10% 10 mA / +24 V input	7-8, 20-21 pin
Latch Release rated input voltage range Latch Release rated input current	+24 V ±10% 10 mA / +24 V input	18-19 pin

NOTE

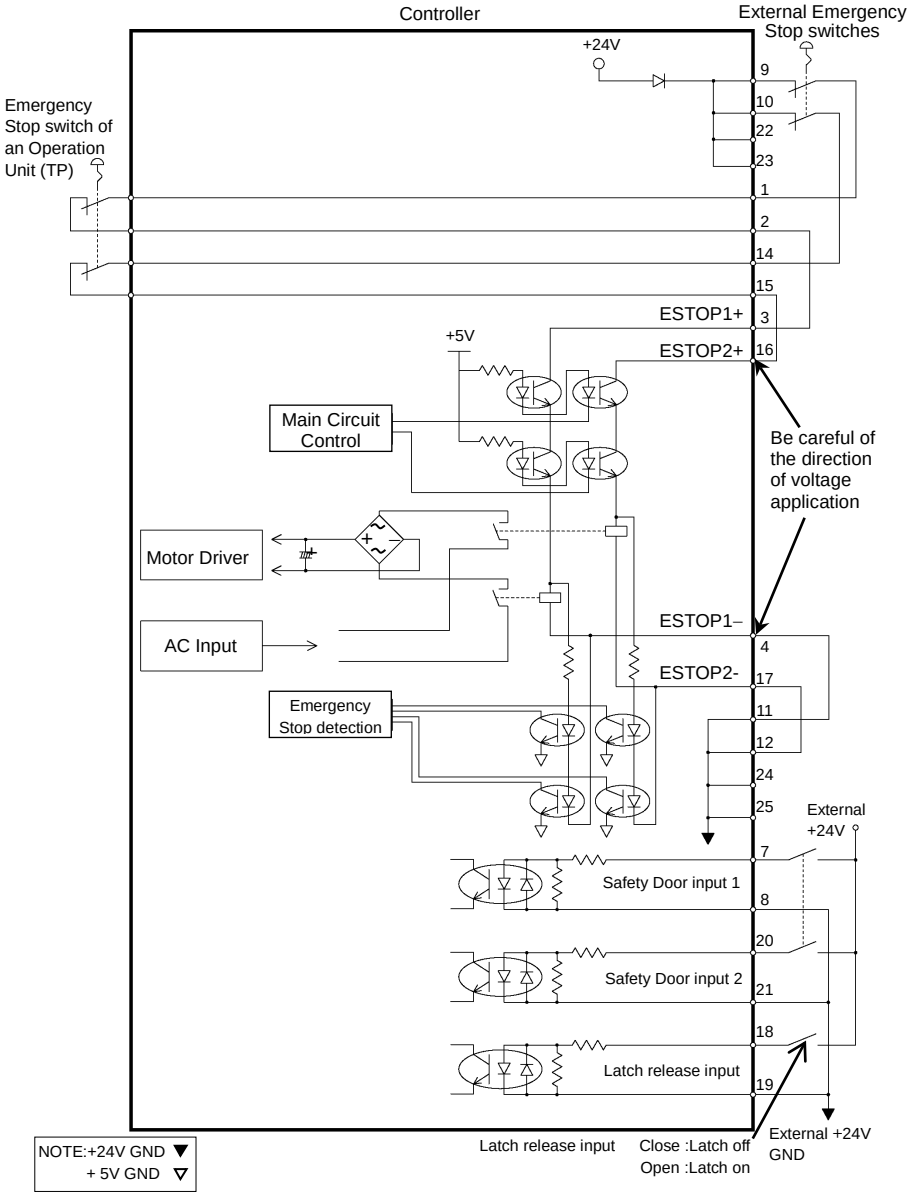
The total electrical resistance of the Emergency Stop switches and their circuit should be 1 Ω or less.

CAUTION

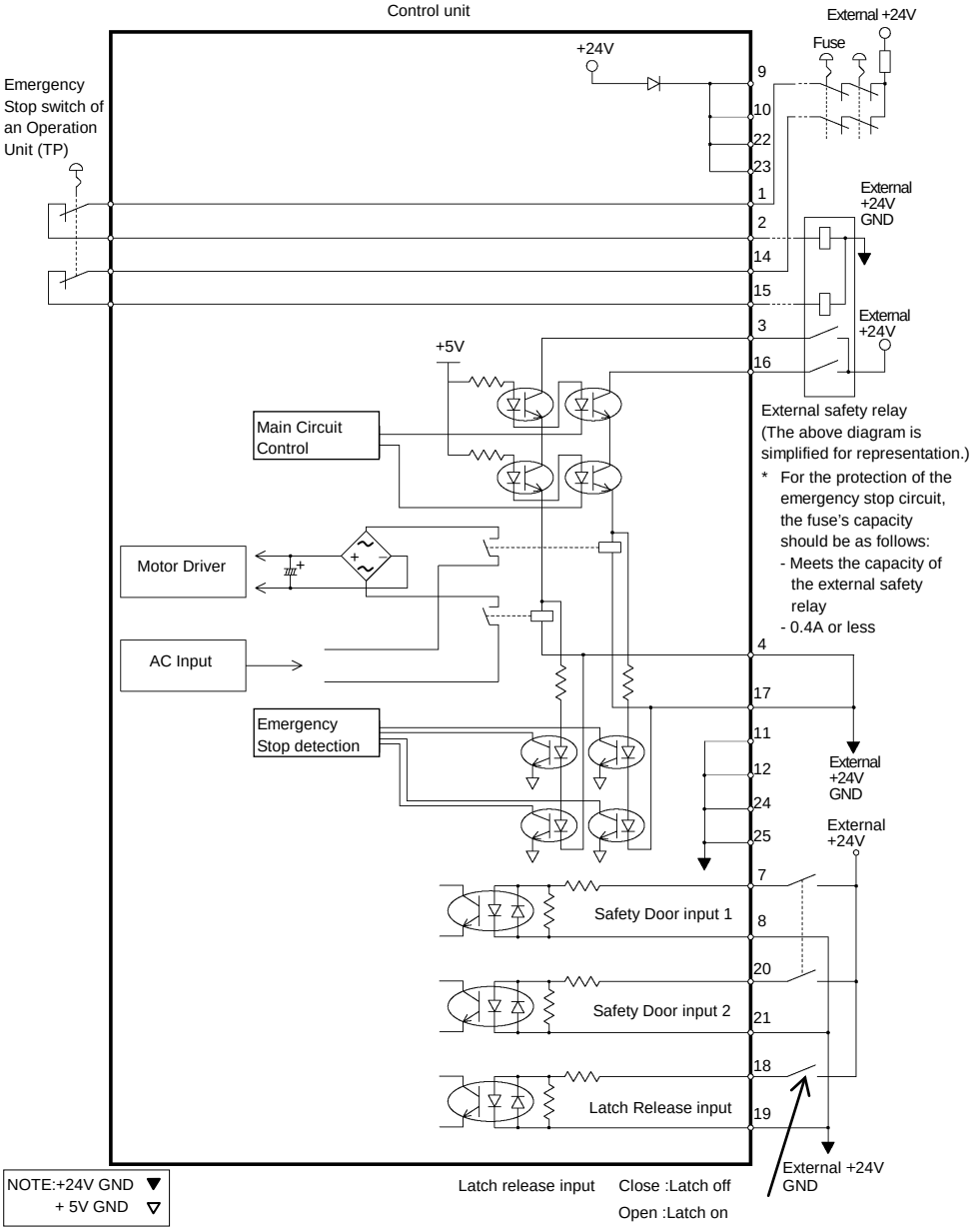
- The 24 V output is for emergency stop. Do not use it for other purposes. Doing so may result in system malfunction.
- Do not apply reverse voltage to the Emergency Stop circuit. Doing so may result in system malfunction.

2.6.8 Circuit Diagrams – Control unit

Example 1: External emergency stop switch typical application

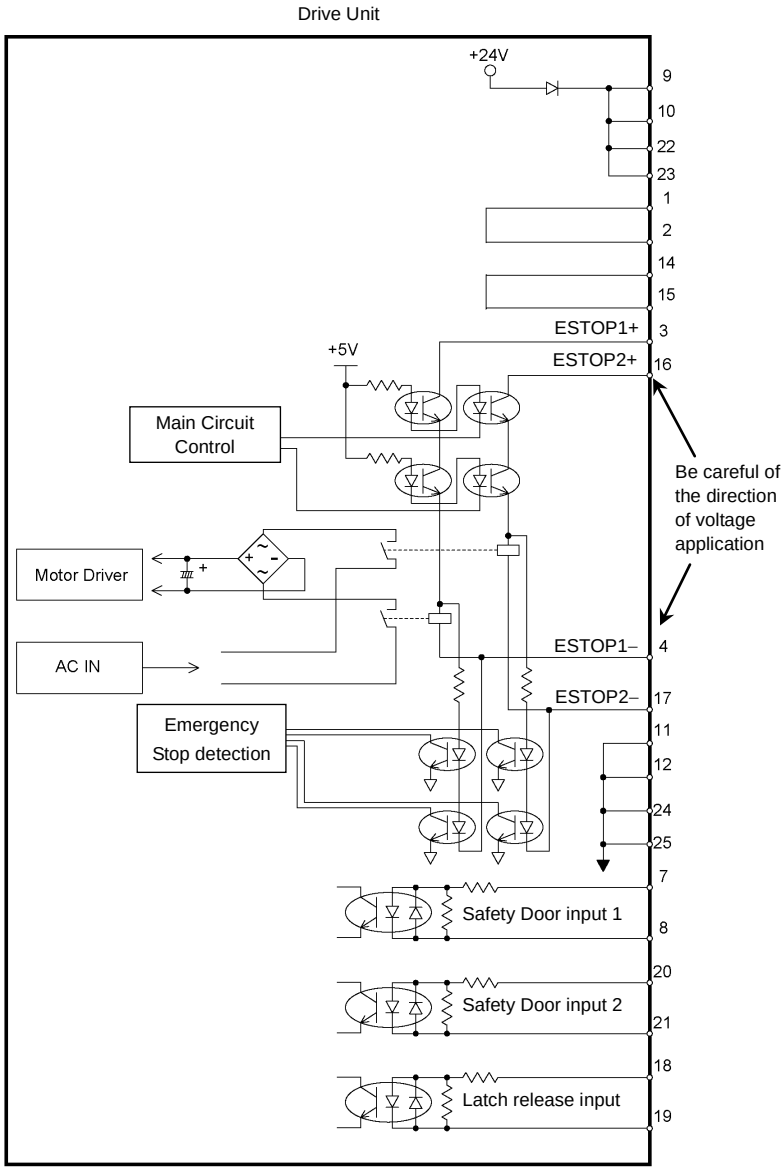


Example 2: External safety relay typical application



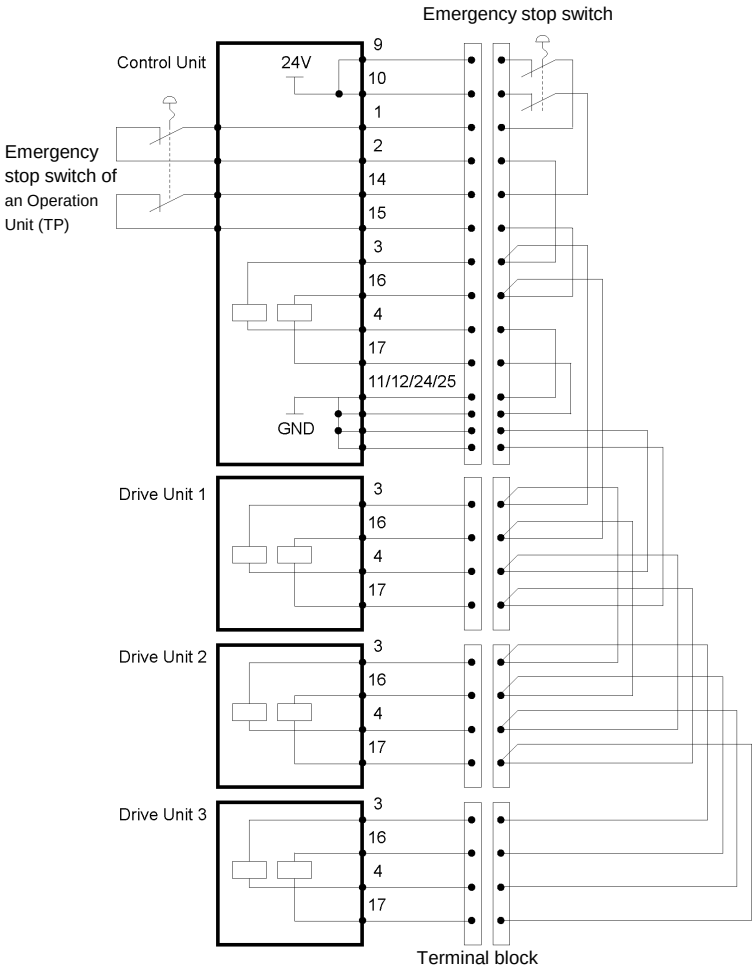
2.6.9 Circuit Diagrams – Drive unit

Circuit Diagram



Wiring Example for Emergency Stop

Example 1: External emergency stop switch typical application

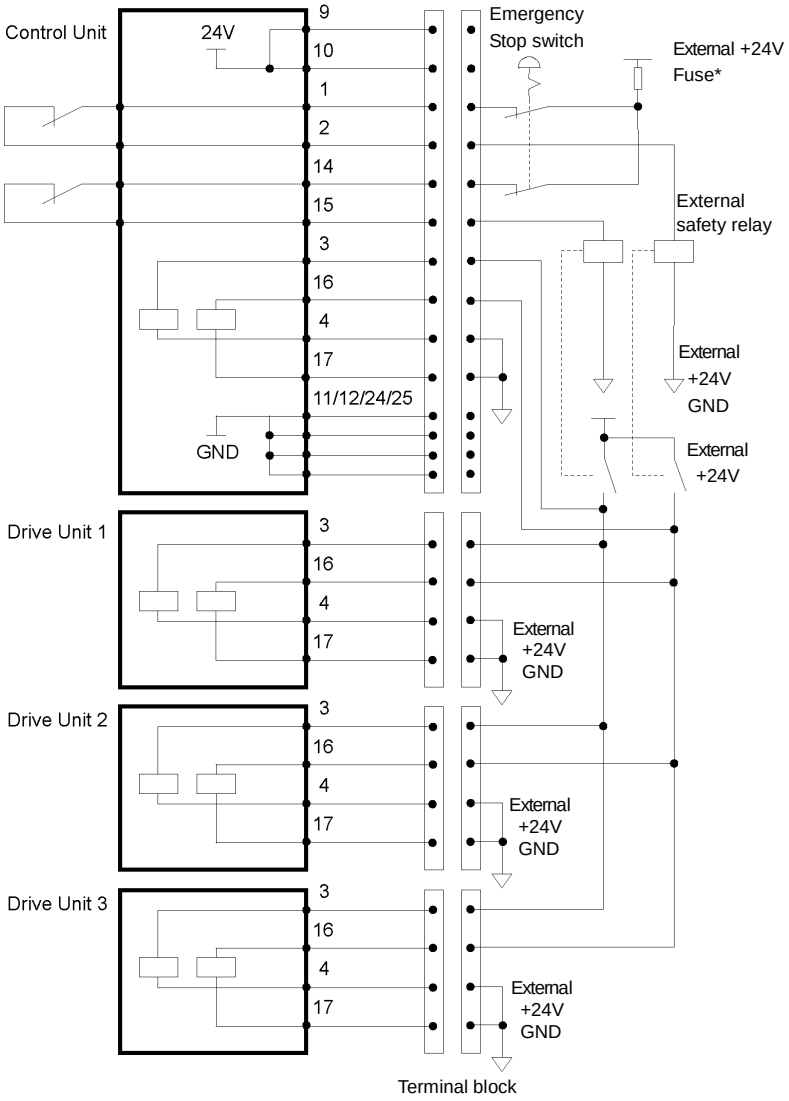


NOTE

The Emergency cable, Emergency cable kit, and Terminal block are offered as options.

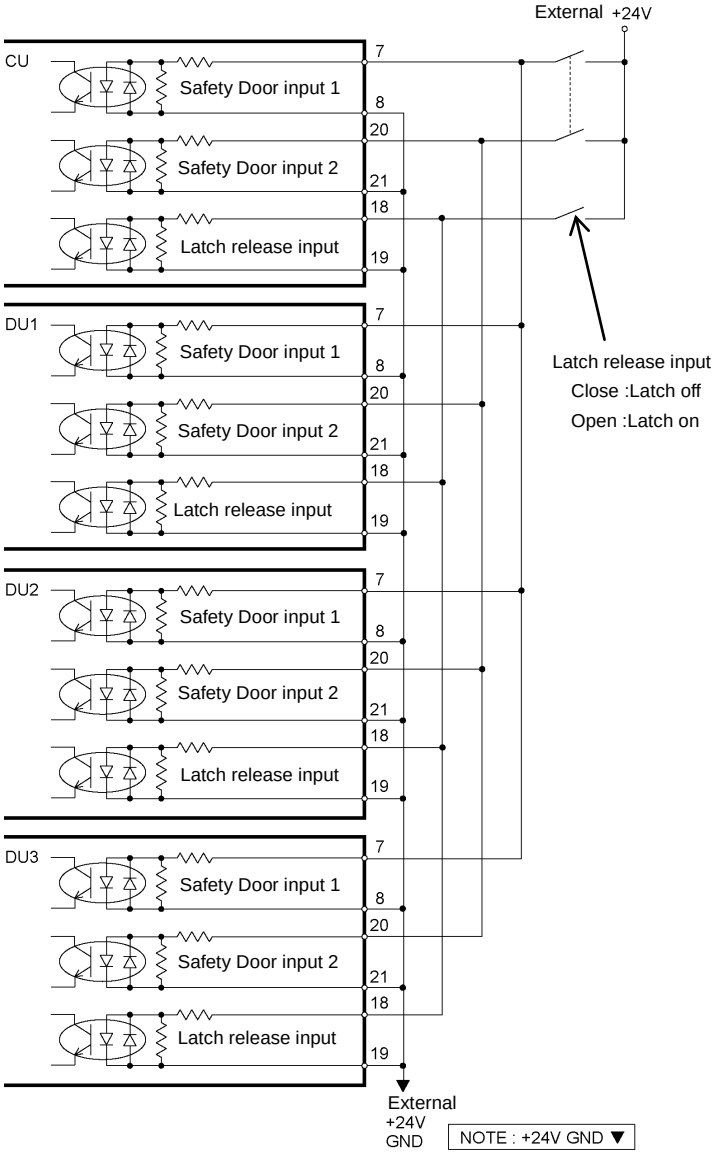
Design the cables connecting the units within 20 m long.

Example 2: External safety relay typical application



* Fuse
For the protection of the emergency stop circuit, the fuse's capacity should be as follows:
- Meets the capacity of the external
- 0.4A or less

Wiring Example for Safety Door Input / Latch Release Input



NOTE

Design the cables connecting the units within 20 m long.

2.7 Power supply, AC power cable

2.7.1 Power Supply

Ensure that the power meets the following specifications.

Item	Specification
Voltage	200 to 240 VAC (Input voltage should be with in ±10 % of the rated voltage.)
Phase	Single phase
Frequency	50/60 Hz
Momentary Power Interrupt	10 ms or less
Power Consumption	Maximum : 2.5 kVA Actual consumption depends on the model, motion, and load of the Manipulator. For approximate power consumption of each model, refer to the followings. C4 : 1.2 kVA C8 : 2.5 kVA N2 : 0.6 kVA N6 : 1.0 kVA RS3 : 1.2 kVA RS4 : 1.4 kVA G1 : 0.5 kVA G3 : 1.1 kVA G6 : 1.5 kVA G10 : 2.4 kVA G20 : 2.4 kVA Refer to the Manipulator manual for rated consumption of the Manipulator motor. Rated power consumption of X5 varies depending on the manipulator model. For details, please contact us.
Peak Current	When power is turned ON : Approximately 85 A (2 ms) When motor is ON: Approximately 75 A (2 ms)
Leakage Current	Max.10 mA
Ground Resistance	100 Ω or less

Install an earth leakage circuit breaker or a circuit breaker in the AC power cable line at 15 A or less rated electric current. Both should be a two-pole disconnect type. If you install an earth leakage circuit breaker, make sure to use an inverter type that does not operate by induction of a 10 kHz or more leakage current. If you install a circuit breaker, please select one that will handle the above mentioned “peak current”.

The power receptacle should be installed near the equipment and should be easily accessible.

2.7.2 AC Power Cable

 WARNING	■ Make sure that operations are done by a qualified personal. ■ Be sure to connect the earth wire (green/yellow) of the AC power cable to the earth terminal of the factory power supply. The equipment must be grounded properly at all times to avoid the risk of electric shock. ■ Always use a power plug or a disconnecting device for power connecting cable. Never connect the Controller directly to the factory power supply. ■ Select the plug or a disconnecting device which conform safety standards for nations.

Make sure to insert the plug of the AC power cable firmly when connecting to the Controller.

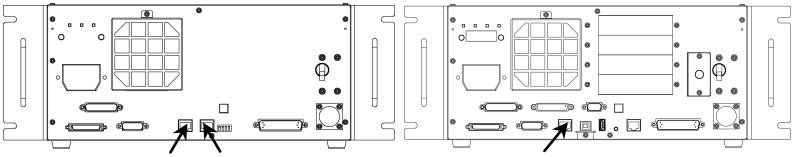
Item	Specification
AC power wire (2 cables)	Black, Black or Black, White
Ground wire	Green / Yellow
Cable length	3 m
Terminal	M4 round solderless terminal

2.8 Drive Unit Connection

Drive Unit is connected to the Control Unit using the attached connection cable.

Up to three Drive Units can be connected to the Control Unit.

(Figure: RC700, RC700DU)



Drive Unit (DU): RC700DU / RC700DU-A

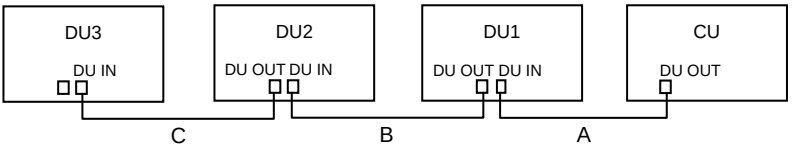
Control Unit (CU): RC700 / RC700-A

* Name: RC700-A, RC700DU-A: OUT, IN

A: Control Unit and 1st Drive Unit (CU-DU1)

B: 1st Drive Unit and 2nd Drive Unit (DU1-DU2)

C: 2nd Drive Unit and 3rd Drive Unit (DU2-DU3)



When you use one Drive Unit:
Connect nothing to DU OUT of the 1st Drive Unit (DU1). Otherwise, it results in the robot controller malfunction.

When you use two Drive Units:
Connect nothing to DU OUT of the 2nd Drive Unit (DU2). Otherwise, it results in the robot controller malfunction.

When you use three Drive Units:
Connect nothing to DU OUT of the 3rd Drive Unit (DU3). Otherwise, it results in the robot controller malfunction.

NOTE When connecting the connection cable, make sure to connect to DU IN and DU OUT properly. Improper connection may cause malfunction.

NOTE Do not use any LAN cables on the market. Otherwise, it results in the robot controller malfunction.

How to turn on the power switch:

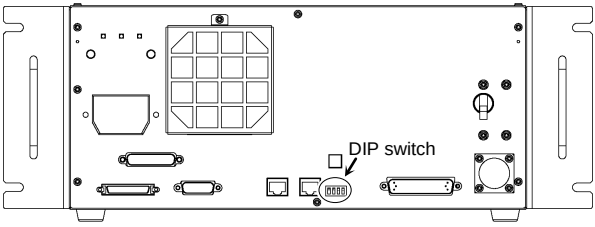
Check the connection first. Then, make sure to turn on the power switch of Drive Unit before turning on the power switch of Control Unit.

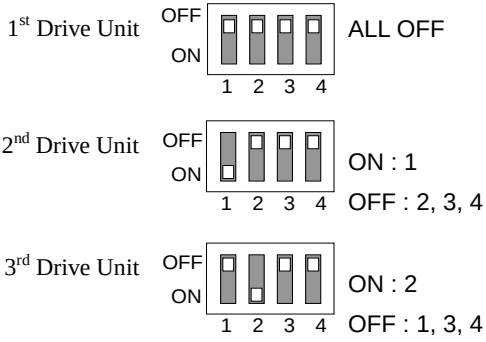
2.9 Drive Unit Setup

The DIP switch is equipped on the front side to configure 1st, 2nd, and 3rd Drive Unit. Follow the steps below to set up the Drive Unit.

(1) Turn OFF the Drive Unit.

(2) Change the DIP switch.





(3) Attach the DU number label on Drive Unit.

DU1 : 1st Drive Unit

DU2 : 2nd Drive Unit

DU3 : 3rd Drive Unit

(4) Plug in the power connector. Turn ON the Drive Unit.

2.10 Connecting Manipulator and Controller

2.10.1 Connecting Precautions

Before Connection

: Before connecting the connector, make sure that the pins are not bent. Connecting with the pins bent may damage the connector and result in malfunction of the robot system.

Connecting procedure

: Before performing any connecting 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.

Cable

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

Connection

: When connecting the Manipulator and the Controller, make sure that the serial numbers on each equipment match. Improper connection between the Manipulator and Controller may not only cause improper function of the robot system but also safety problems.
The serial number of supported Manipulator is labeled on the controller.

Wiring

: Only authorized or certified personnel should be allowed to perform wiring. Wiring by unauthorized or uncertified personnel may result in bodily injury and/or malfunction of the robot system.

For Clean-model

: When the Manipulator is a Clean-model, use it with an exhaust system.
For details, refer to the Manipulator manual.

For Protected-model

: Connect the power cable connector and the signal cable connector to the Manipulator immediately after the Manipulator installation. The Manipulator without connecting them may result in electric shock and/or malfunction of the robot system as it cannot ensure IP65.

Connect the power connector and the signal connector of the M/C cables to the Controller.

2.11 Power-on

2.11.1 Power-on Precautions

Manipulator check

: Before operating the Manipulator, make sure that all parts of the Manipulator are in place and have no external defects. Missing or defective parts may cause improper operation of the Manipulator. Improper operation of the Manipulator is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system.

Shipping bolts and jigs check before turning ON

: Before turning ON the power after installation, be sure to remove the shipping bolts and jigs from the Manipulator. Turning ON the power while the shipping bolts and jigs are attached may result in equipment damage to the Manipulator.

Power activation

: Anchor the Manipulator before turning ON the power to or operating the Manipulator. Turning ON the power to or operating the Manipulator that is not anchored is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system as the Manipulator may fall down

When supplying the power again

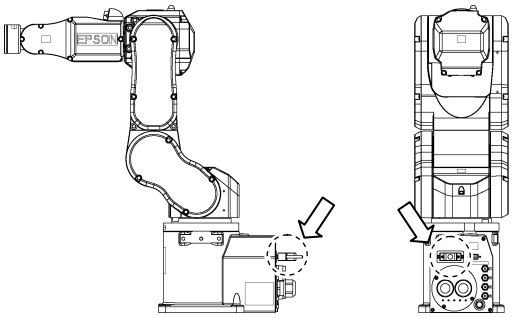
: When supplying the power to the controller again, turn OFF the controller and wait for 5 seconds or more. Then, turn ON the controller again.

C4, C8 series manipulator has following parts for releasing brakes.

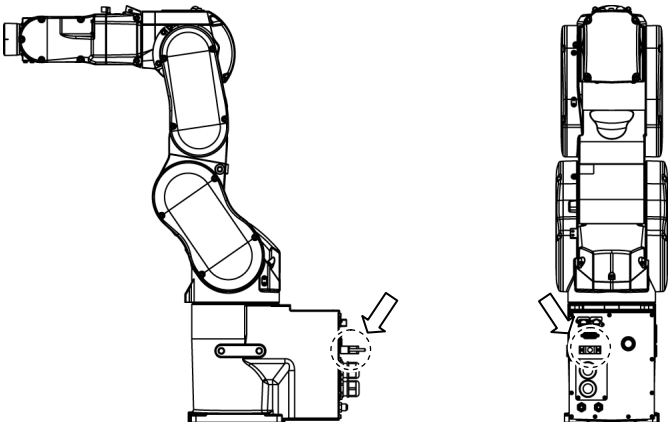
1. Brake release unit (option)
2. External short connector

When operating the manipulator, be sure to connect either of the parts to the position indicated below. (Figure: The external short connector is connected)

C4



C8



For details on the brake release unit and the manipulators, refer to the following manuals:

EPSON ProSix C4 series Manipulator Manual

EPSON ProSix C8 series Manipulator Manual

WARNING	■ If the manipulator is operated without connecting the above parts, the brakes cannot be released and it may cause damage on them. After using the brake release unit, be sure to connect the external short connector to the Manipulator, or check connection of the connector for the brake release unit.

WARNING	■ When connecting or replacing the parts, turn OFF the power to the Controller and the brake release unit. Inserting and removing the connector while the power is ON may result in electrical shock.

2.11.2 Power ON Procedure

(1) Check the M/C power cable connection.

(2) Check the M/C signal cable connection.

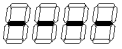
(3) Check the EMERGENCY connector connection.

(4) Connect the TP bypass plug to the TP port of the Robot Controller.

(5) Connect the AC power cable to the power supply socket.

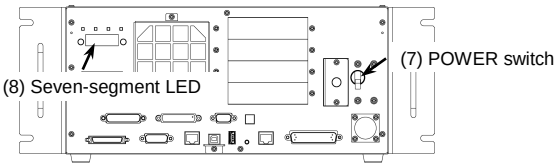
(6) When you use Drive Unit:
Check the Control Unit and Drive Unit connection.
Turn ON the Drive Unit POWER switch.

(7) Turn ON the POWER switch of the Control unit.

(8) The seven-segment LED blinks as  approximately 30 seconds after Control unit starts up normally.

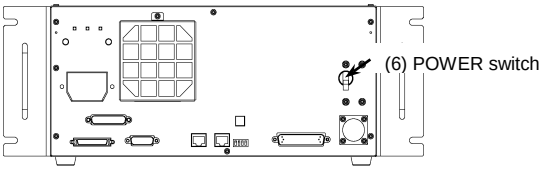
If an error is displayed, check connection in step (1) to (5) and turn ON the power again.
If an error is displayed after checking the connection, contact the supplier in your region.

Control unit RC700/RC700-A



(Figure: RC700)

Drive unit RC700DU/RC700DU-A



2.12 Saving Default Status

The Controller is already setup with the purchased robot(s) at shipment. However, just in case, we recommend saving the default controller status. A USB memory is necessary to save the controller status.

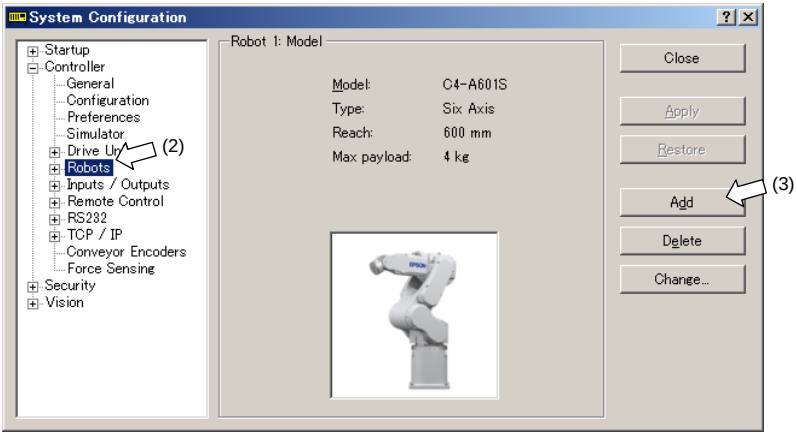
For the procedure of controller status storage, refer to *Robot controller: 6. Memory Port*.

2.13 Adding Information of the Additional System

Adding of information of the new system is required only for customers who purchased the Drive Unit singly.

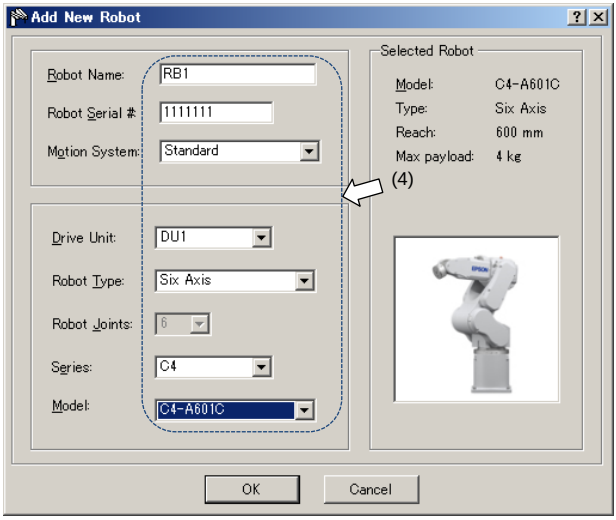
Install the Control Unit and Drive Unit, and then turn on the robot system. After turning on the system, add information of the additional system.

(1) Select the EPSON RC+ 7.0-[Setup]-[System Configuration].
[System Configuration] dialog box will appear.



(2) Click [Controller]-[Robots] in the tree on the left.

(3) Click <Add> button.
[Add New Robot] dialog box will appear.

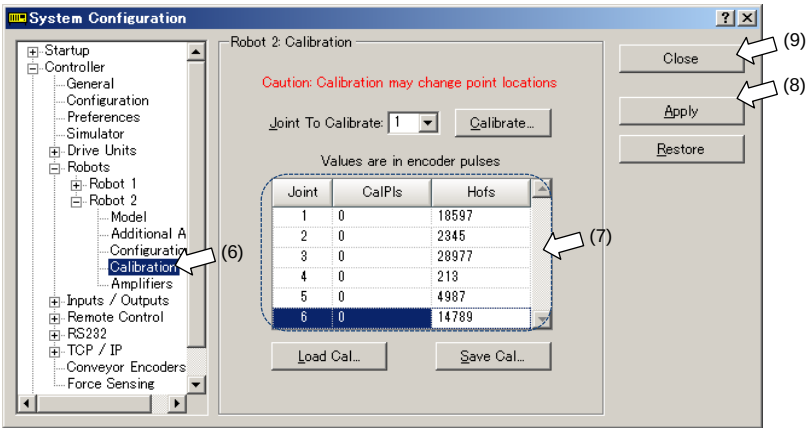


(4) Enter the following items by referring to the RC700DU Robot System Hofs Data Sheet (hereinafter referred to as Hofs sheet) which is included with shipment.

Item	Description
Robot Name :	Type a name for the new manipulator. (Example: RB1 Robot1)
Robot Serial # :	Type “Serial No.” on the Hofs sheet. (or the serial number on the manipulator’s nameplate) Any serial number can be used, but it is recommended to use the number described above.
Motion System :	Select “Standard”. If there is no other motion systems installed, “Standard” should be already selected.
Drive Unit :	Select a Drive Unit for your manipulator. (DU1, DU2, DU3) DU numbers are configured by the dip switch on the front side and indicated by the indication labels.
Robot Type :	Select a manipulator type.
Robot Joints :	This item cannot be changed.
Series :	Select a manipulator series.
Model :	Select a manipulator model. All manipulators available for the motor driver currently installed in the controller will be displayed.

(5) Click the <OK> button. The EPSON RC+ will restart.

(6) Click [Controller]-[Robots]-[Robot **]-[Calibration] in the tree on the left. Following dialog box will appear.



(7) Type the values on the Hofs sheet to [CalPls] and [Hofs].

(8) Click the <Apply> button.

(9) Click the <Close> button.

3. First Step

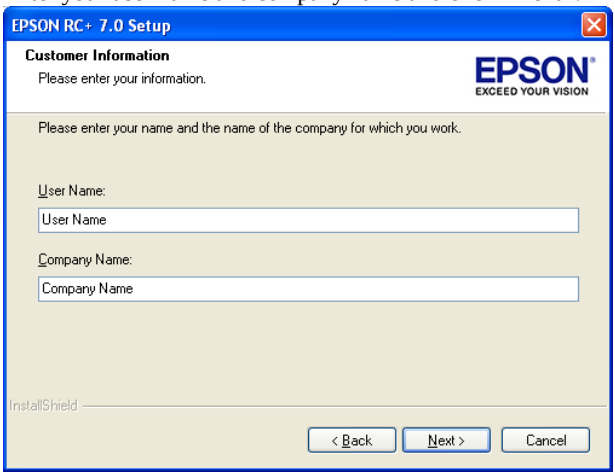
This section indicates the procedure to install the development PC EPSON RC+, and execute simple program after connecting the development PC and Controller with a USB.
Make sure that the Robot system is installed safely by following the description in *1. Safety* and *2. Installation*. Then, operate the Robot system in the following procedures.

3.1 Installing EPSON RC+ 7.0 Software

The EPSON RC+ 7.0 software needs to be installed on your development PC.

(1) Insert the EPSON RC+ 7.0 Setup DVD in the DVD drive.
(2) The following dialog will be displayed. Click <Next>.

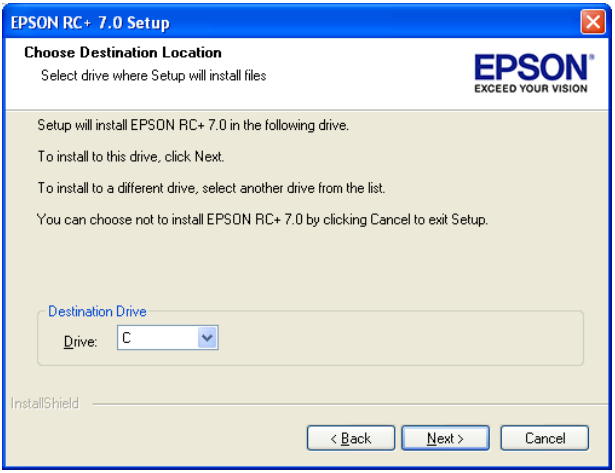
(3) Enter your user name and company name and click <Next>.



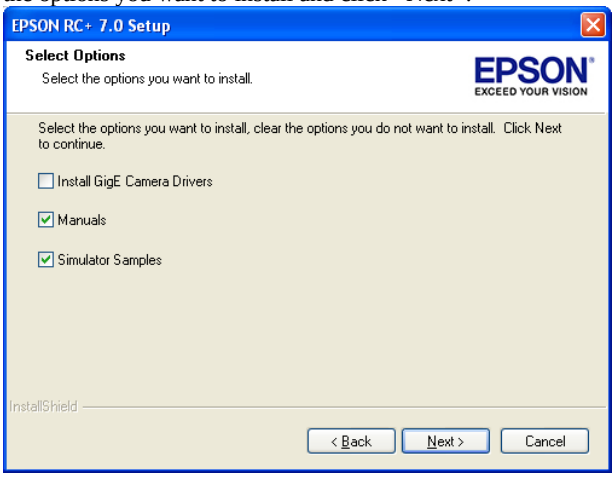
(4) Select the drive where you want to install EPSON RC+ 7.0 and click <Next>.

NOTE

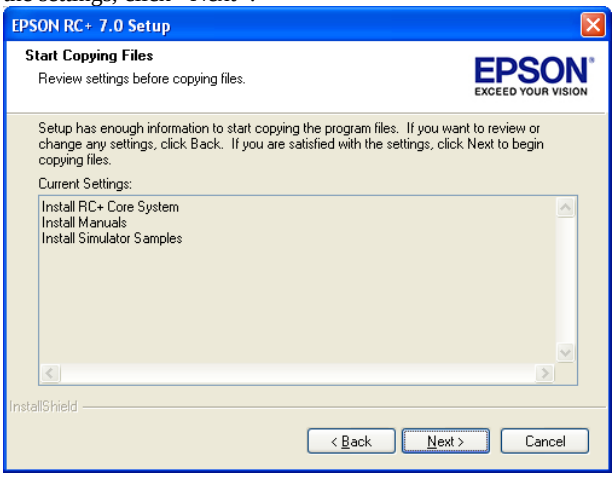
The installation directory is called EpsonRC70. This cannot be changed.



(5) The dialog for selecting the options to be installed will be displayed. Check the options you want to install and click <Next>.



(6) The dialog to review the settings will be displayed. If you are satisfied with the settings, click <Next>.



(7) If required, install “Windows Installer” and “Microsoft .NET Framework 3.5” on your system. This may take several minutes.

NOTE

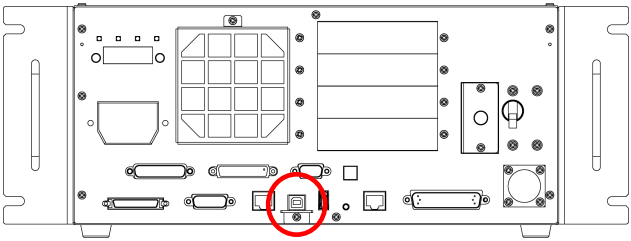
Adobe Reader needs to be installed on your PC in order to view the EPSON RC+ 7.0 manuals. If the installer cannot find Adobe Reader on your system, it will be installed at this time. Follow the instructions in the Adobe installer. Do not restart the system after the Adobe Reader installation has completed.

(8) After the installation has completed, restart your computer.

The EPSON RC+ 7.0 software installation is now completed.

3.2 Development PC and Controller Connection

Connect the development PC and the USB port for connection (USB B series connector).



Development PC connection Port

(Figure: RC700)

NOTE

- For other details of development PC and Controller connection, refer to *EPSON RC+7.0 User's Guide: PC to Controller Communications Command*.
- For RC700 / RC700-A, be sure to install the EPSON RC+7.0 to the development PC first, then connect the development PC and RC700 / RC700-A with the USB cable.
  If RC700 / RC700-A and the development PC are connected without installing the EPSON RC+7.0 to the development PC, [Add New Hardware Wizard] appears. If this wizard appears, click the <Cancel> button.

3.2.1 About Development PC Connection USB Port

Development PC connection port supports following USB.

- USB2.0 HighSpeed/FullSpeed (Speed auto selection, or FullSpeed mode)
- USB1.1 FullSpeed

Interface Standard : USB specification Ver.2.0 compliant
(USB Ver.1.1 upward compatible)

Connect the Controller and development PC by a USB cable to develop the robot system or set the Controller configuration with the EPSON RC+ 7.0 software installed in the development PC.

Development PC connection port supports hot plugging. Insertion and removal of the cables while the power of the development PC and the Controller are ON is available. However, the manipulator stops when the USB cable is removed while the Controller and the development PC are connected.

3.2.2 Precaution

When connecting the development PC and the Controller, make sure of the following.

- Connect the development PC and the Controller with 5 m or shorter USB cable. Do not use the USB hub or extension cable.
- Make sure that no other devices except development PC is used for development PC connection port.
- Use PC or USB cable that supports USB2.0 HighSpeed mode to operate in USB2.0 HighSpeed mode.
- Do not pull or bend the cable strongly.
- Do not allow unnecessary strain on the cable.
- When development PC and the Controller is connected, do not insert or remove other USB devices from the development PC. Connection with the Controller may disconnect.

3.2.3 Software Setup and Connection Check

The following is the steps of connecting the development PC and the Controller.

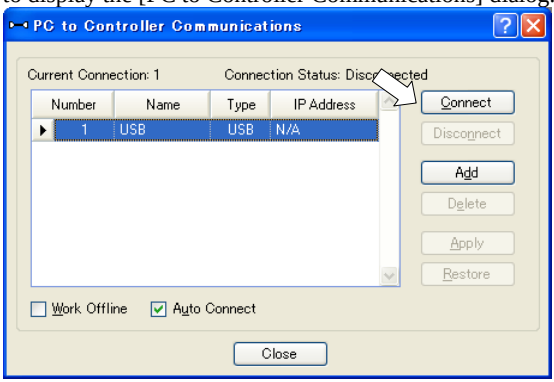
(1) Make sure that EPSON RC+ 7.0 is installed on the Controller connected to the development PC.
(Install the software when it is not installed.)

(2) Connect the development PC and the Controller by the USB cable.

(3) Turn ON the Controller.

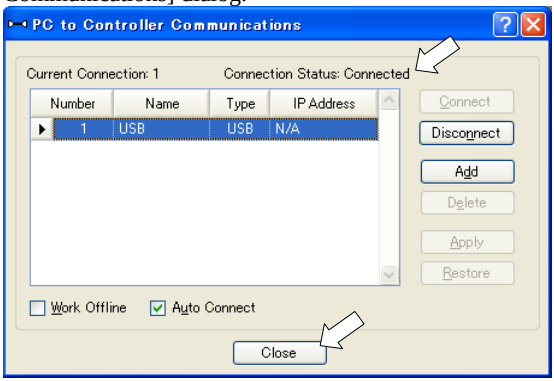
(4) Start the software EPSON RC+ 7.0.

(5) Select the EPSON RC+ 7.0 menu-[Setup]-[PC to Controller Communications] to display the [PC to Controller Communications] dialog.



(6) Select the “No.1 USB” and click the <Connect> button.

(7) After development PC and the Controller connection is completed, “Connected” is displayed in the [Connection status:]. Make sure that “Connected” is displayed and click the <Close> button to close the [PC to Controller Communications] dialog.



Connection of the development PC and the Controller is completed. Now robot system can be used from EPSON RC+ 7.0.

3.2.4 Backup the initial condition of the Controller

Backup the Controller data configured before shipment.

Project and system configuration backup procedure:

(1) From the [Project] menu, select [Copy].
(2) Change the [Destination Drive] to an arbitrary drive.
(3) Click <OK>. The project will be copied to the external media.
(4) From the [Tools] menu, select [Controller].
(5) Click on the <Backup Controller> button.
(6) Select the arbitrary drive.
(7) Click <OK>. The system configuration will be backed up on the external media.

3.2.5 Disconnection of Development PC and Controller

Disconnection of the development PC and the Controller is indicated.

(1) Select the EPSON RC+ 7.0 menu-[Setup]-[PC to Controller Communications] to display the [PC to Controller Communications] dialog.

(2) Click the <Disconnect> button.
Controller and the development PC is disconnected and USB cable can be removed.

NOTE

If the USB cable is removed while the Controller and the development PC are connected, the Manipulator stops. Be sure to click the <Disconnect> button in the [PC to Controller Communications] dialog before removing the USB cable.

3.2.6 Moving the Robot to Initial Position

Robot can be operated by the following methods other than creating and executing the program.

Manual operation

Jog motion by the Teach Pendant

Command execution from the EPSON RC+

Jog motion from the EPSON RC+

This section explains about following methods.

A: Manual operation

B: Command execution from the EPSON RC+

C: Jog motion from the EPSON RC+

A: Manual operation

Move the non-excited robot manually.

For SCARA robot:

Joints with no electromagnetic brake can be moved manually.
Joints with the brakes (Joint #3 only, or Joints #3 and #4) can be moved manually while the break release switch on the manipulator is being pressed with the controller ON.

For 6-axis robot:

Manipulators can be moved manually by pressing the brake release switch when the brake release unit is connected.
For details, refer to *Brake Release Unit* in each manipulator manual.

Also, manipulators can be moved manually by releasing the electromagnetic brake from the command window of the EPSON RC+.

 CAUTION	■ Normally, release the brake of joints one by one. Take extra care if you need to release the brakes of two or more joints simultaneously. Releasing the brakes of two or more joints simultaneously may result in hands or fingers being 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 result in hands or fingers being caught and/or equipment damage to or malfunction of the Manipulator. ■ Before releasing the brake, be sure to keep the Emergency Stop switch handy so that you can immediately press the Emergency Stop switch. Otherwise, you cannot immediately stop the arm falling due to an erroneous operation. The arm falling may cause equipment damage to and/or malfunction of the Manipulator.

(1) Start the EPSON RC+ 7.0.
Double click the <EPSON RC+ 7.0> icon on the desktop.

(2) Open the command window.
EPSON RC+ 7.0 menu-[Tool]-[Command Window]

(3) Execute the following command in [Command Window].

```
>Reset
```

```
>Brake Off,[Arm # (1 to 6) whose brake will be released]
```

Execute the following command to turn on the brake again.

```
>Brake On,[Arm # (1 to 6) whose brake will be turned on]
```

B: Command execution from the EPSON RC+

Move the robot by exciting the robot motors and executing the command.

Following explains the example of moving all joints to the 0 pulse positions by specifying the pulse for each joint.

(1) Start the EPSON RC+ 7.0.
Double click the <EPSON RC+ 7.0> icon on the desktop.

(2) Open the command window.
EPSON RC+ 7.0 menu-[Tools]-[Command Window]

(3) Execute the following command in [Command Window].

For SCARA robot:

```
>Motor On
>Go Pulse (0,0,0,0)
```

For 6-axis robot:

```
>Motor On
>Go Pulse (0,0,0,0,0,0)
```

For position and posture of Manipulator at 0 pulse position, refer to *Motion Range* in the Manipulator manuals.

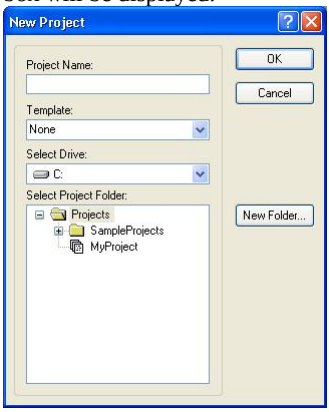
C: Jog motion from the EPSON RC+

Move the robot by exciting the motors and operating from the Jog & Teach window of the EPSON RC+.

(1) Start the EPSON RC+ 7.0.
Double click the <EPSON RC+ 7.0> icon on the desktop.

(2) Create a new project.

1. EPSON RC+ 7.0 menu-[Project]-[New Project]. [New Project] dialog box will be displayed.

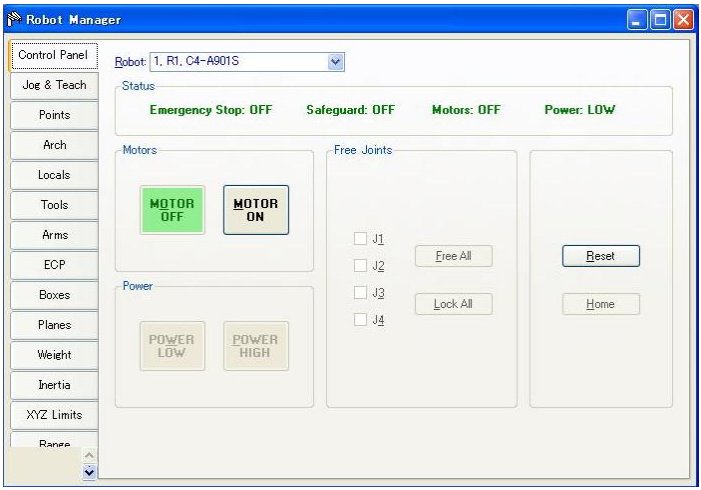


2. Enter the project name in [Project Name] box. (Ex: FirstApp)

3. Click the <OK> button and create the new project.

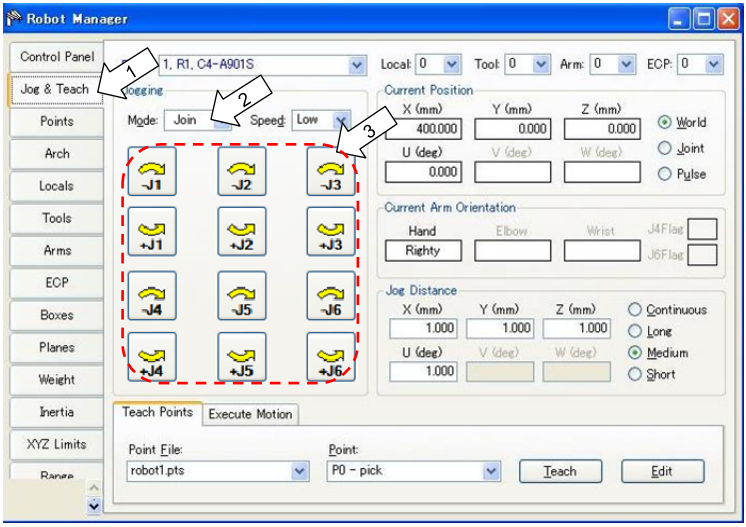
(3) Open the robot manager.
EPSON RC+ 7.0 menu-[Tools]-[Robot Manager].

(4) Turn ON the motors.
Check that the [Control Panel] tab is open. Click the <MOTOR ON> button.



(5) Move the manipulator with Jog motion.

1. Select [Jog & Teach] tab.



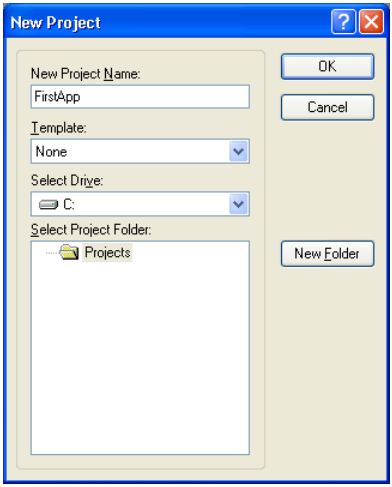
2. Select “Joint” in [Jogging]-<Mode>.
3. Move the manipulator by joint by clicking J1-J6 jog keys.
Manipulator can be moved by setting to other modes or setting the jog distance.

3.3 Writing your first program

After installing the Controller, Manipulator, and EPSON RC+ 7.0 software on your PC, follow the instructions below to create a simple application program so that you will become more familiar with the EPSON RC+ 7.0 development environment.

1. Start EPSON RC+ 7.0
   Double-click the EPSON RC+ 7.0 icon on the desktop.

2. Create a new project
   (1) Select [New] from the [Project] Menu. The [New Project] dialog box will be displayed.



   (2) Type a project name in the [New Project Name] box.
   (e.g. FirstApp)

   (3) Click <OK> to create the new project.

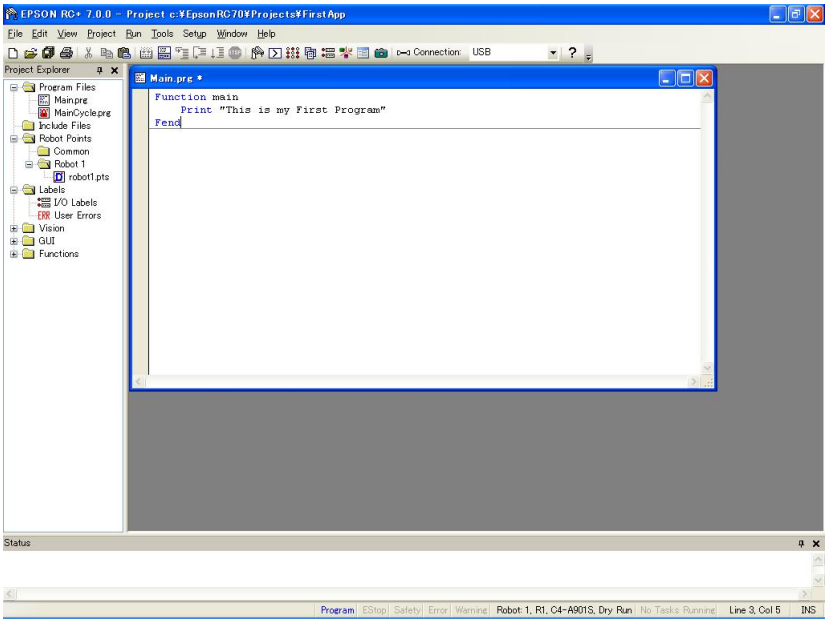
   When the new project is created, a program called Main.prg is created.
   The window titled Main.prg will be displayed with a cursor flashing in the upper left corner.

   Now you are ready to start entering your first program.

3. Edit the program

Type the following program lines in the Main.prg edit window.

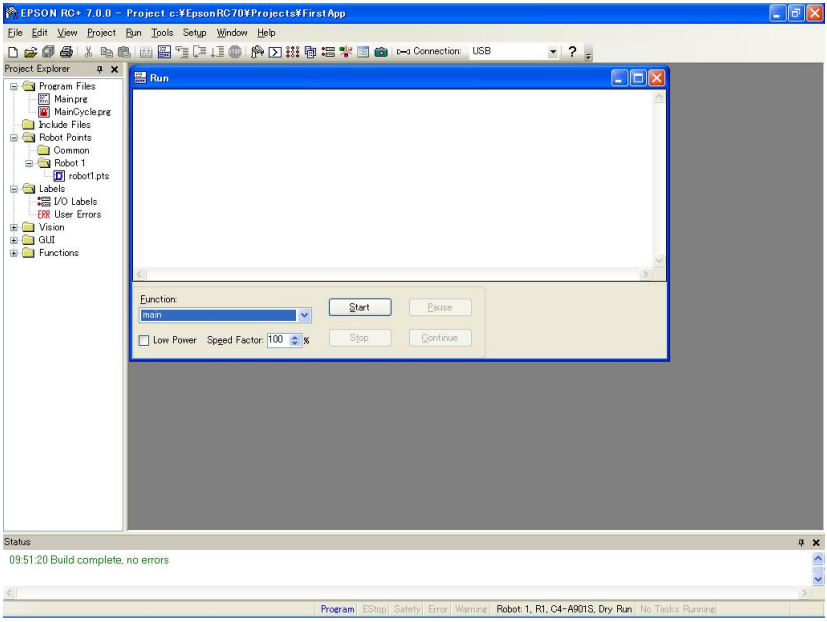
```
Function main
   Print "This is my first program."
Fend
```



4. Run the program

(1) Press F5 to run the program. (F5 is the hot key for the [Run Window] selection of the [Run] Menu). You will see the Status window located at the bottom of the main window showing the build operation status.

(2) During project build, your program is compiled and linked. Then communications is established with the controller and project files are sent to the controller. If there are no errors during build, the Run window will appear.



(3) Click the Start button on the Run window to run the program.

(4) The texts like the following will be displayed in the status window.

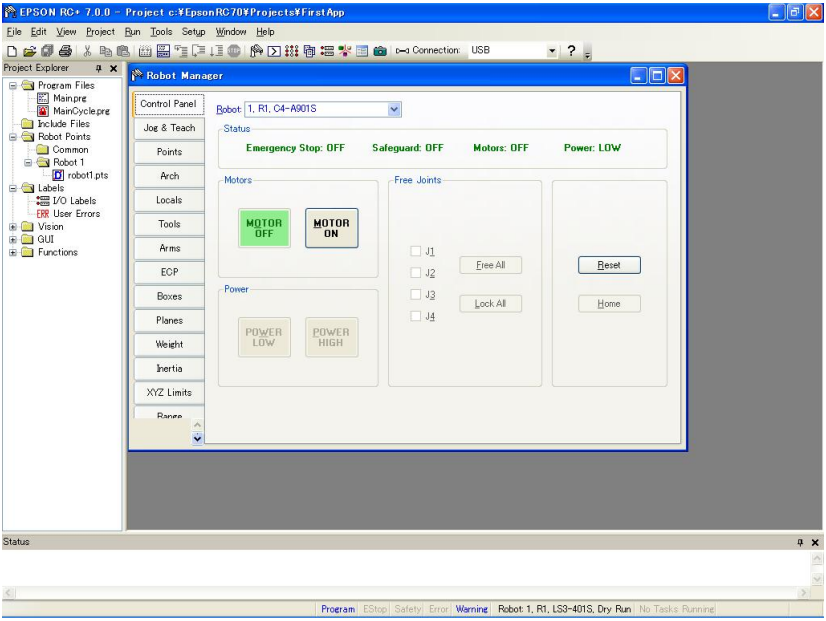
```
19:32:45 Task main started

19:32:45 All tasks stopped
```

On the Run window, you will see the output of the print statement.

Now let's teach some robot points and modify the program to move the robot.

5. Teach robot points

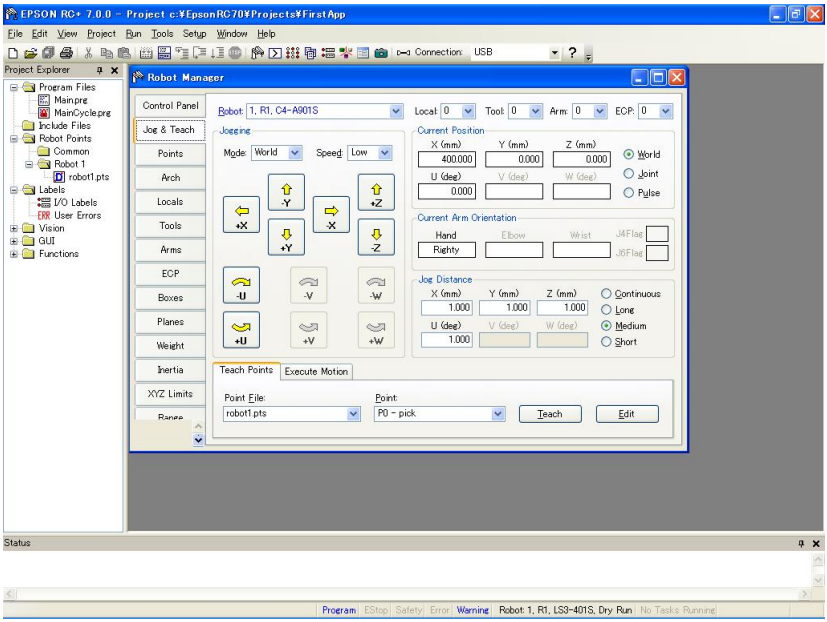
(1) Make sure that it is safe to operate the robot. Click the <Robot Manager> button on the toolbar to display the [Robot Manager] window.



(2) Click the [Control Panel] tab.
Then, click the <Motor On> button to turn on the robot motors. You will be prompted to confirm the operation.

(3) Click <Yes> to continue.

(4) Click the [Jog & Teach] tab.



(5) Click the <Teach> button in the lower right corner to teach point P0. You will be prompted for a point label and description.

(6) Click the <+Y> jog button to jog the robot in +Y direction. Hold the button down to keep jogging. Move the robot until it reaches the middle of the work envelope.

(7) Click the <-Z> button to lower the Z axis of the robot.

(8) Select “P1” in the [Point (P)] dropdown list which is next to the <Teach> button. The current point is set to P1.

(9) Click the <Teach> button. You will see a confirmation message to teach the point.

(10) Click the <Yes> button.

(11) Click the <+X> button to jog the robot in the +X direction.

(12) Select “P2” in the [Point (P)] dropdown list which is next to the <Teach> button. The current point is set to P2.

(13) Click the <Teach> button. You will see a confirmation message to teach the point.

(14) Click the <Yes> button.

(15) Click the <Save Project> toolbar button to save the changes.

6. Modify the program to include robot motion commands
   (1) Insert three new Go statements into the Main.prg program as shown below:

```
Function main
    Print "This is my first program."
    Go P1
    Go P2
    Go P0
Fend
```

   (2) Press F5 to display the Run window.
   (3) Click the <Start> button to execute the program.
   The robot will move to the points you taught.

7. Modify the program to change speed of robot motion commands
   (1) Insert the Power, Speed, and Accel commands as shown in the program below:

```
Function main
    Print "This is my first program."
    Power High
    Speed 20
    Accel 20, 20
    Go P1
    Go P2
    Go P0
Fend
```

   (2) Press F5 to display the Run window.
   (3) Click the <Start> button to execute the program.

   The robot will move to each of the points you taught at 20% speed, acceleration, and deceleration. The Power High statement executes the program to operate the robot with increased speed and acceleration.

8. Backup the project and system configuration

Even though this is only a sample project, we will backup the project and controller configuration. Backup can be done easily with EPSON RC+ 7.0. It is important that you keep regular backups of your applications on an external media such as a USB memory key.

Follow the steps below to back up the project and system configuration:

(1) Select the EPSON RC+ 7.0 menu - [Project] - [Copy].

(2) Change the [Destination Drive] to an arbitrary drive.

(3) Click <OK>. The project will be copied to the external media.

(4) Select the EPSON RC+ 7.0 menu - [Tools] - [Controller].

(5) Click on the <Backup Controller> button.

(6) Select the arbitrary drive.

(7) Click <OK>. The system configuration will be backed up on the external media.

4. Second Step

After operating the robot system as instructed in *3. First Step*, setup other functions as necessary.
This section shows the manuals which contains information of necessary settings and setting procedure.
(For details of the manuals, refer to *6. Manuals*.)

4.1 Connection with External Equipment

4.1.1 Remote Control

EPSON RC+ 7.0 User's Guide
Remote Control
ROBOT CONTROLLER RC700/RC700-A manual
Setup & Operation: I/O Remote Set Up

I/O
EPSON RC+ 7.0 User's Guide
I/O Setup
ROBOT CONTROLLER RC700/RC700-A manual
Setup & Operation: 11. I/O Connector
Setup & Operation: 14.2 Expansion I/O Board

Fieldbus I/O (Option)
ROBOT CONTROLLER RC700/RC90 Option Fieldbus I/O Board

4.1.2 Ethernet

EPSON RC+ 7.0 User's Guide
Ethernet Communication
ROBOT CONTROLLER RC700/RC700-A manual
Setup & Operation: 7. LAN (Ethernet Communication) Port

4.1.3 RS-232C (Option)

EPSON RC+ 7.0 User's Guide
RS-232C Communication
ROBOT CONTROLLER RC700/RC700-A manual
Setup & Operation: 14.4 RS-232C Board

4.1.4 Analog I/O board (Option)

ROBOT CONTROLLER RC700/RC700-A manual
Setup & Operation: 14.6 Analog I/O board

4.1.5 Force Sensor I/F board (Option)

ROBOT CONTROLLER RC700/RC700-A manual
Setup & Operation: 14.7 Force Sensor I/F board

4.2 Ethernet Connection of Development PC and Controller

EPSON RC+ 7.0 User's Guide
Ethernet Communication
ROBOT CONTROLLER RC700/RC700-A manual
Setup & Operation: 7. LAN (Ethernet Communication) Port

4.3 Connection of Teach Pendant (Option)

Robot Controller RC700/RC700-A manual
Setup & Operation: TP Port
RC700/RC90 Option Teach Pendant TP1 manual
Functions & Installation: Installation
RC700/RC90 Option Teach Pendant TP2 manual
Functions & Installation: Installation
RC700-A Option Teach Pendant TP3 manual
Functions & Installation: Installation

5. General Maintenance

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

5.1 Maintenance

5.1.1 Manipulator

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

	Inspection Point					
	Daily	Monthly	Quarterly	Biannual	Annual	Overhaul (replacement)
1 month (250 h)	Inspect every day	√				
2 months (500 h)		√				
3 months (750 h)		√	√			
4 months (1000 h)		√				
5 months (1250 h)		√				
6 months (1500 h)		√	√	√		
7 months (1750 h)		√				
8 months (2000 h)		√				
9 months (2250 h)		√	√			
10 months (2500 h)		√				
11 months (2750 h)		√				
12 months (3000 h)		√	√	√	√	
13 months (3250 h)		√				
⋮	⋮	⋮	⋮	⋮	⋮	
20,000 h						√

h = hour

Inspection While the Power is ON (Manipulator is operating)

Inspection Point	Inspection Place	Daily	Monthly	Quarterly	Biannual	Annual
Check motion range	Each joint					√
Move the cables back and forth lightly to check whether the cables are disconnected.	External cables (including cable unit of the Manipulator)				√	√
Push each arm in MOTOR ON status to check whether backlash exists.	Each arm					√
Check whether unusual sound or vibration occurs.	Whole	√	√	√	√	√
Measure the accuracy repeatedly by a gauge.	Whole					√
RS, G1, G3, G6, G10, G20 Turn ON and OFF the Brake Release switch and check the sound of the electromagnetic brake. If there is no sound, replace the brake.	Brake	√	√	√	√	√
C4, C8, N2, N6 When brake release unit is installed: Connect the brake release unit and check the sound of the electromagnetic brake with the brake released. If there is no sound, replace the brake. When brake release unit is not installed: Execute Brake off command (brake off, joint #) from the command window of the EPSON RC+ while the motors are OFF, and then check the sound of the electromagnetic brake. If there is no sound, replace the brake.	Brake	√	√	√	√	√

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Inspection items	Recommended Intervals
Loose bolts, connectors and cables	Once a week
Inspect timing belt for damage and looseness.	Every half year
Replace cables.	Every two years
Replace timing belt.	Every two years

Inspection While the Power is OFF (Manipulator is not operating)

Inspection Point	Inspection Place	Daily	Monthly	Quarterly	Biannual	Annual
Check looseness or backlash of bolts/screws. Tighten them if necessary. (For the tightening torque, refer to *Tightening Hexagon Socket Head Cap Bolts*.)	End effector mounting bolts	√	√	√	√	√
	Manipulator mounting bolts	√	√	√	√	√
	Each arm locking bolts	√	√	√	√	√
	Bolts/screws around shaft					√
	Bolts/screws securing motors, reduction gear units, etc.					√
Check looseness of connectors. If the connectors are loosen, push it securely or tighten.	External connectors on Manipulator (on the connector plates etc.)	√	√	√	√	√
	Manipulator cable unit		√	√	√	√
Visually check for external defects. Clean up if necessary.	External appearance of Manipulator	√	√	√	√	√
	External cables		√	√	√	√
Check for bends or improper location. Repair or place it properly if necessary.	Safeguard etc.	√	√	√	√	√
Check tension of timing belts. Tighten it if necessary.	Base, Inside of Arm				√	√
Grease conditions	Refer to *5.4 Greasing*.					
Battery	Refer to *5.5 Handling and Disposal of Batteries*					
C4, C8, N2, N6: 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.	√	√	√	√	√

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Inspection Point	Inspection Place	Daily	Monthly	Quarterly	Biannual	Annual
Replace a cable or flexible tube if it has serious crack or breakage. Check for loose bolts by tightening them.	Cables	√	√	√	√	√
Check for a loose bolts by tightening them.	Bolts for securing the module	√	√	√	√	√
	Bolts for securing the end effector	√	√	√	√	√

5.1.2 Control Unit (RC700, RC700-A)

Part	Fan filter		Fan (Front)	Fan (Rear)	Battery
Content	Cleaning	Replacement	Replacement	Replacement	Replacement
Code	-	R13N865021	R13B060510	R13B060510	R13B060003
Quantity	-	1	1	1	1
Maintenance interval	More than once a month is recommended	When the filter gets deteriorated	When the error 515 occurs, or when the abnormal noise occurs	When the error 516 occurs, or when the abnormal noise occurs	Every 5 years, or when the error 511 occurs
Possible malfunction if maintenance is not performed	The temperature inside the Controller may get too high and the robot system may not operate properly. The error may occur due to reduction of the fun rotation.	The robot system may not operate properly due to dust or the like.	The error 9015 occurs and the robot system may stop.	The error 9016 occurs and the robot system may stop.	The error 9011 occurs and the robot system may stop.
Duration (reference)	5 minutes	5 minutes	20 minutes	15 minutes	5 minutes
Reference: *Maintenance*	*7.1 Fan Filter*	*7.1 Fan Filter*	*7.2.1 Front Fan*	*7.2.2 Regenerative Fan (RC700-A only)*	*7.3 Battery*
Expected product life	-	-	30,000 hours	30,000 hours	-

* Refer to the *Maintenance* chapters in the *Robot Controller RC700/RC700-A* manual.

5.1.3 Drive Unit (RC700DU, RC700DU-A)

Part	Fan filter		Fan (Front)	Fan (Rear)
Content	Cleaning	Replacement	Replacement	Replacement
Code	-	R13N865021	R13B060510	R13B060510
Quantity	-	1	1	1
Maintenance interval	More than once a month is recommended	When the filter gets deteriorated	When the error * 525, 535, 545 occurs, or when the abnormal noise occurs	When the error * 526, 536, 546 occurs, or when the abnormal noise occurs
Possible malfunction if maintenance is not performed	The temperature inside the Controller may get too high and the robot system may not operate properly. The error may occur due to reduction of the fun rotation.	The robot system may not operate properly due to dust or the like.	One of the errors * 9025, 9035, or 9045 occurs and the robot system may stop.	One of the errors * 9026, 9036, or 9046 occurs and the robot system may stop.
Duration (reference)	5 minutes	5 minutes	20 minutes	15 minutes
Reference: *Maintenance*	*4.1 Fan Filter*	*4.1 Fan Filter*	*4.2.1 Front Fan*	*4.2.2 Regenerative Fan (RC700DU-A only)*
Expected product life	-	-	30,000 hours	30,000 hours

* The error number depends on the number of Drive Units.

* Refer to the *Maintenance* chapters in the *Robot Controller RC700DU/RC700DU-A* manual.

5.2 Overhaul (Parts Replacement)

CAUTION	■ 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 gear units, and timing belts) can be checked in the [Maintenance] dialog box of the EPSON RC+ 7.0.
For details, refer to the following manual.
Robot Controller RC700 / RC700-A Maintenance 6. Alarm

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

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

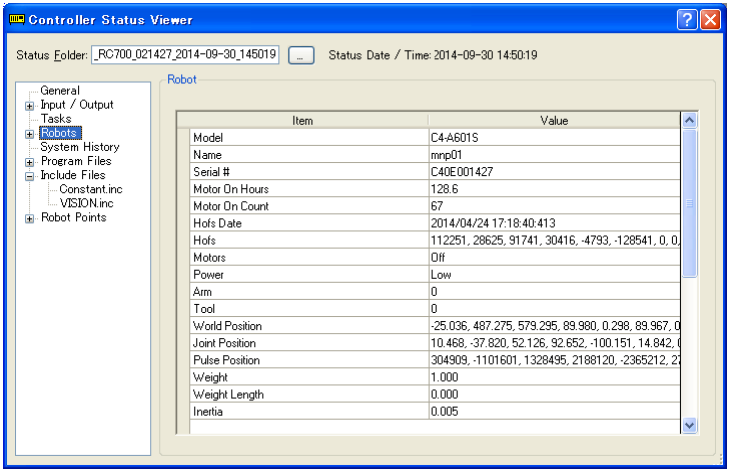
(1) Select EPSON RC+ menu-[Tools]-[Controller] to open the [Controller Tools] dialog.

(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 [Robot] from the tree menu on the left side (Dialog image: EPSON RC+ 7.0)



For the parts subject to overhaul, refer to Manipulator manual: Maintenance section: *Maintenance Parts List*.

For details of replacement of each part, refer to the Manipulator manual: Maintenance section.

Please contact the distributor of your region for further information.

5.3 Tightening Hexagon Socket Head Cap Bolts

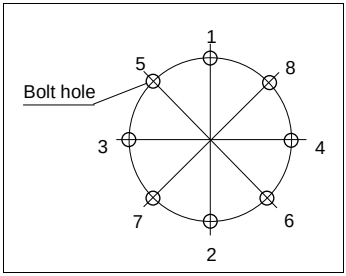
Hexagon socket head cap bolts are used in places where mechanical strength is required. (A hexagon socket head cap bolt will be called a “bolt” in this manual.) These bolts are fastened with the tightening torques shown in the following table.
When it is necessary to refasten these bolts in some procedures in this manual (except special cases as noted), use a torque wrench so that the bolts are fastened with the appropriate tightening torques as shown below.

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

Refer below for the set screw.

Set Screw	Tightening Torque
M3	1.5 ± 0.1 N·m (16 ± 1 kgf·cm)
M4	2.4 ± 0.1 N·m (26 ± 1 kgf·cm)
M5	3.9 ± 0.2 N·m (40 ± 2 kgf·cm)
M6	8.0 ± 0.4 N·m (82 ± 4 kgf·cm)

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



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

5.4 Greasing

The ball screw spline and reduction gear units need greasing regularly. Only use the grease specified.

This section contains information of the parts requiring lubrication and greasing intervals. For details of the lubrication procedure, refer to the Manipulator manual.

 CAUTION	■ Keep enough grease in the Manipulator. Operating the Manipulator with insufficient grease damages the sliding parts resulting in insufficient Manipulator performance. It may also require a lot of time and money for repair. ■ 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.

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 grease can be checked in the [Maintenance] dialog box of the EPSON RC+ 7.0.

For details, refer to the following manual.
Robot Controller RC700 / RC700-A Maintenance 6. Alarm

G, RS series

	Greasing part	Greasing Interval
Joint #1, #2	Reduction gear units	Overhaul timing
Joint #3	Ball screw spline shaft	At 100 km of operation (50 km for first greasing)

Joint #1, 2 reduction gear units

As a rough indication, perform greasing at the same timing as overhaul.
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.

Joint #3 Ball screw spline shaft

The recommended greasing interval is at 100 km of operation. However, perform greasing at 50 km of operation for the first time of greasing.

C4, C8 series

	Greasing part	Greasing Interval
All Joints	Reduction gear units	Overhaul timing
Joint #6	Bevel gear	Once a year (every 8000 hours)

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

As a rough indication, perform greasing at the same timing as overhaul.
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.

N2

	Greasing part	Greasing Interval
All Joints	Actuator unit, Reduction gear unit	Overhaul timing

Joint #1, 2, 3, 4, 5, 6 actuator units, Joint #5 reduction gear unit

As a rough indication, perform greasing at the same timing as overhaul.
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.

N6

	Greasing part	Greasing Interval
Joint #1, #2, 3, #4, and #5	Reduction gear unit	10,000 hours or 2 years, whichever comes first
Joint #6		
Joint #6	Bevel gear	Once a year (every 8000 hours)

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

As a rough indication, perform greasing in 10,000 hours or 2 years, whichever comes first.

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.

X5

Ball screws and linear guides used for the modules are equipped with a unique lubrication system, which consists of the K1 lubrication unit* and high load grease. Because of this lubrication system, you do not need replenish the grease if the robot system is going to be operated in the conditions described hereunder.

(1) Clean environment and no contamination.
(2) Ambient temperature is 0°C to 40°C and no condensation.
(3) Load conditions, transportable mass and moment are in the criteria as specified.

* K1 lubrication unit: Made of a porous synthetic resin that contains a large amount of lubricating oil and supplies the lubrication oil for a long time.

5.5 Handling and Disposal of Batteries

CAUTION

- Use meticulous care when handling the lithium battery. Improper handling of the lithium battery as mentioned below is extremely hazardous, and may result in heat generation, leakage, explosion, or inflammation, and may cause serious safety problems.
  - ・Battery Charge
  - ・Deformation by Pressure
  - ・Disassembly
  - ・Short-circuit (Polarity; Positive/Negative)
  - ・Incorrect Installation
  - ・Heating (85°C or more)
  - ・Exposing to Fire
  - ・Soldering the terminal of the lithium battery directly
  - ・Forced Discharge
- Be sure to use the battery supplied as maintenance part from EPSON.
- When disposing the battery, consult with the professional disposal services or comply with the local regulation.
  Spent battery or not, make sure the battery terminals are insulated. If the terminal contacts with the other metals, it may short and result in heat generation, leakage, explosion, or inflammation.

WARNING

- Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system.
- To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the 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.

Robot Controller

Before starting battery replacement, turn on the controller for approximately one minute. Perform the replacement within 10 minutes to prevent data loss.
Make sure to use the designated lithium battery.

Manipulator

When the lithium battery power is low, an error will occur to warn the user about the low battery status when the Controller is turned ON (when software is started up).
When the error occurs, the position data in motors will be lost and all joints need to be completely calibrated again.

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

Manipulator	Battery life
C4 series	1.5 years
RS, G1, G3, G6, G10, G20, C8, N2, N6, X5 series	3 years

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 battery can be checked in the [Maintenance] dialog box of the EPSON RC+ 7.0.
For details, refer to the following manual.
Robot Controller RC700 / RC700-A Maintenance 6. Alarm

The battery may run out if it passes the recommended replacement time.

If the error of the Power-low warning is not occurred, the calibration of the all joints is not necessary. However, when the position is out of place after the battery replacement, perform the calibration.
Be sure to use the designated lithium battery and the battery board.
Be sure to set the correct polar when installing the battery.

6. Manuals

This section describes contents of each manual.
The manuals below are provided in PDF format for using the robot system.
To read the PDF manuals on a PC, select EPSON RC+ 7.0-[Help]-[PDF Manual].
(Click <Start>-[Program]-[EPSON RC+ 7.0] from the Windows desktop.)

Software

EPSON RC+ 7.0 User's Guide

This manual contains information on the Robot system and program development software.

- Safety
- Robot System Operation and Configuration
- Operation of Program Development Software EPSON RC + GUI
- SPEL+ Language and Application
- Configuration of Robot, I/O, Communication

EPSON RC+ 7.0 SPEL+ Language Reference

This manual contains information on the SPEL+ programming language.

- Details of the commands
- Error Messages
- Precaution of EPSON RC+ 4.0, 5.0, and 6.0 Compatibility

Software Options

Followings manuals contain information on the software options and commands.

- RC+ API 7.0
- Vision Guide 7.0 Hardware & Setup
- Vision Guide 7.0 Software
- Vision Guide 7.0 Properties & Results Reference
- GUI Builder 7.0
- Remote Control Reference
- Force Control 7.0
- Force Control 7.0 Properties & Status Reference

Controller

ROBOT CONTROLLER RC700/RC700-A

DRIVE UNIT RC700DU/RC700DU-A

This manual indicates descriptions of the Robot Controller RC700, RC700-A, Drive unit RC700DU, RC700DU-A and Robot system.

- Safety
- Specification, Installation, Operation, and Setup
- Backup and Restore
- Maintenance
- Verifying Robot System Operation
- Error Codes

Controller Options

Followings manuals contain information on the controller options.

- PG Motion System
- Fieldbus I/O
- Teach Pendant TP1
- Teach Pendant TP2
- Teach Pendant TP3

Manipulator

The manipulator manuals contain information on the manipulator(s).

Each manipulator model has a different manual.

EPSON SCARA ROBOT : G1, G3, G6, G10, G20, RS (RS3, RS4)

EPSON ProSix : C4, C8, N2, N6

EZ module : X5 series

- Safety
- Specification, Installation, Setting
- Maintenance
- Calibration

7. Directives and Norms

These products conform to the following directives and norms.
For more details of the controller and the manipulator, please refer to each manual.

Product Name	Model
Controller	RC700 RC700-A
Manipulator	C4 series C8 series G series RS series N series X5 series

Name	Definition
Directive 2006/42/EC	Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC
Directive 2004/108/EC	Directive 2004/108/EC relating to electromagnetic compatibility and repealing Directive 89/336/EEC
EN ISO 12100 (2010)	Safety of machinery -- General principles for design -- Risk assessment and risk reduction
EN ISO 10218-1 (2011)	Robots and robotic devices -- Safety requirements for industrial robots -- Part 1: Robots
EN 60204-1 (/A1:2009)	Safety of machinery -- Electrical equipment of machines -- Part 1: General requirements
EN ISO 13849-1 (2008) *	Safety of machinery -- Safety - related parts of control systems -- Part 1: General principles for design
EN ISO 13850 (2008)	Safety of machinery -- Emergency stop - principles for design
EN 55011 (2009)	Industrial, scientific and medical (ISM) radio-frequency equipment -- Electromagnetic disturbance characteristics -- Limits and methods of measurement
EN 61000-6-2 (2005)	Electromagnetic compatibility (EMC) -- Part 6-2: Generic standards -- Immunity for industrial environments

*Emergency stop circuit category3, PL d

Safety Door circuit category3, PL d