

# EPSON

*Robot System  
Safety and Installation*

**Read this manual first**

Rev.6

EM135B2511F

Robot Controller RC90  
Programming Software EPSON RC+5.0

Manipulator LS series

Robot System Safety and Installation (RC90 / EPSON RC+5.0) Rev.6

# *Robot System Safety and Installation* (RC90 / EPSON RC+5.0)

Rev.6

Copyright © 2011-2013 SEIKO EPSON CORPORATION. All rights reserved.

## FOREWORD

Thank you for purchasing our robot products.

This manual contains the information necessary for the correct use of the Operator Panel.

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

Microsoft, Windows, and Windows logo are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries. Other brand and product names are trademarks or registered trademarks of the respective holders.

## TRADEMARK NOTATION IN THIS MANUAL

Microsoft® Windows® XP Operating system

Microsoft® Windows® Vista Operating system

Microsoft® Windows® 7 Operating system

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

## 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.

## INQUIRIES

Contact the following service center for robot repairs, inspections or adjustments.

If service center information is not indicated below, please contact the supplier office for your region.

Please prepare the following items before you contact us.

- Your controller model and its serial number
- Your manipulator model and its serial number
- Software and its version in your robot system
- A description of the problem

## SERVICE CENTER



## MANUFACTURER

### **SEIKO EPSON CORPORATION**

Toyoshina Plant

Industrial Solutions Division

6925 Toyoshina Tazawa,

Azumino-shi, Nagano, 399-8285

JAPAN

TEL : +81-(0)263-72-1530

FAX : +81-(0)263-72-1495

## SUPPLIERS

China

### **EPSON China Co., Ltd**

Factory Automation Division

7F, Jinbao Building No. 89 Jinbao Street

Dongcheng District, Beijing, China, 100005

TEL : +86-(0)-10-8522-1199

FAX : +86-(0)-10-8522-1120

Taiwan

### **EPSON Taiwan Technology & Trading Ltd.**

Factory Automation Division

14F, No.7, Song Ren Road, Taipei 110, Taiwan, ROC

TEL : +886-(0)-2-8786-6688

FAX : +886-(0)-2-8786-6677

Southeast Asia

### **Epson Singapore Pte Ltd.**

India

Factory Automation System

1 HarbourFrontPlace, #03-02

HarbourFront Tower one, Singapore

098633

TEL : +65-(0)-6586-5696

FAX : +65-(0)-6271-3182

Korea                   **EPSON Korea Co, Ltd.**  
Marketing Team (Robot Business)  
27F DaeSung D-Polis A, 606,  
Seobusaet-gil, Geumcheon-gu, Seoul, 153-803  
Korea  
TEL       : +82-(0)-2-3420-6692  
FAX       : +82-(0)-2-558-4271

North & South   **EPSON AMERICA, INC.**  
America           Factory Automation/Robotics  
18300 Central Avenue, Carson, CA 90746, USA  
TEL       : +1-562-290-5900  
FAX       : +1-562-290-5999  
E-MAIL   : info@robots.epson.com

Europe               **EPSON DEUTSCHLAND GmbH**  
Factory Automation Division  
Otto-Hahn-Str.4, D-40670 Meerbusch, Germany  
TEL       : +49-(0)-2159-538-1391  
FAX       : +49-(0)-2159-538-3170  
E-MAIL   : robot.infos@epson.de

Japan                **EPSON SALES JAPAN CORPORATION**  
Factory Automation Systems Department  
Nishi-Shinjuku Mitsui Bldg.6-24-1  
Nishishinjuku. Shinjuku-ku. Tokyo. 160-8324  
JAPAN  
TEL       : +81-(0)3-5321-4161

## For Customers in the European Union



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)



## Before Reading This Manual

NOTE



TP port of RC90 is for the Teach Pendant TP2. Do not connect the followings to TP port of RC90. Connecting to the followings may result in malfunction of the device since the pin assignments are different.

OPTIONAL DEVICE dummy plug

Operation Pendant OP500

Operator Pendant OP500RC

Jog Pad JP500

Teaching Pendant TP-3\*\* series

Teaching Pendant TP1

Operator Panel OP1

NOTE



For RC90, be sure to install the EPSON RC+5.0 to the development PC first, then connect the development PC and RC90 with the USB cable.

If RC90 and the development PC are connected without installing the EPSON RC+5.0 to the development PC, [Add New Hardware Wizard] appears. If this wizard appears, click the <Cancel> button.

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

This manual explains with the following combinations of Controllers and software.

Controller: RC90

Software: EPSON RC+5.0 ver. 5.4.1 or later

# TABLE OF CONTENTS

---

<b>1. Safety</b>	<b>1</b>
1.1 Conventions .....	1
1.2 Design and Installation Safety .....	2
1.3 Operation Safety .....	3
1.4 Maintenance Safety .....	6
1.5 Emergency Stop .....	9
1.6 Labels .....	11
1.7 Safety Features .....	14
1.8 Lockout / Tagout .....	17
<b>2. Installation</b>	<b>19</b>
System Example .....	20
2.1 Outline from Unpacking to Operation of Robot System ..	21
2.2 Unpacking .....	22
2.3 Transportation .....	23
2.4 Manipulator Installation .....	25
2.5 Controller Installation .....	29
2.6 Connection to EMERGENCY Connector (Controller) .....	31
2.7 Power Supply .....	38
2.8 Connecting Manipulator and Controller .....	40
2.9 Power-on .....	41
2.10 Saving Default Status .....	43
<b>3. First Step</b>	<b>44</b>
3.1 Installing EPSON RC+ 5.0 Software .....	44
3.2 Development PC and Controller Connection .....	47
3.3 Writing your first program .....	51
<b>4. Second Step</b>	<b>57</b>
4.1 Connection with External Equipment .....	57
4.2 Ethernet Connection of Development PC and Controller ..	58
4.3 Connection of Option TP2 .....	58

5. General Maintenance	59
5.1 Schedule for Maintenance Inspection.....	59
5.2 Inspection Point.....	60
6. Manuals	64
7. Directives and Norms	66



## 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.

### Relevant Manuals


Refer




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

### 1.3 Operation Safety

The following items are safety precautions for qualified Operator personnel:

 <p>WARNING</p>	<ul style="list-style-type: none"> <li>■ Please carefully read the <i>Safety-related Requirements</i> 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.</li> <li>■ 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.</li> <li>■ 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 speeds 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.</li> <li>■ Immediately press the Emergency Stop switch whenever the Manipulator moves abnormally while the robot system is operated. Continuing the operating 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.</li> </ul>
--	---

 <p>WARNING</p>	<ul style="list-style-type: none"> <li>■ 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, pull out 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.</li> </ul>
--	--

## 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 systems safety standards and other examples are given in this chapter. Therefore, to ensure that safety measures are complete, please refer to the other standards listed as well.

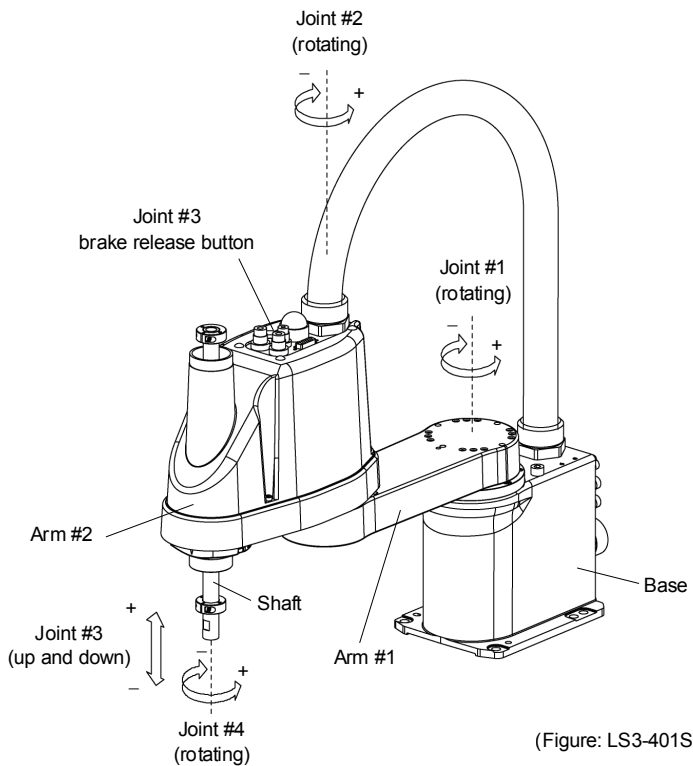
(Note: The following is only a partial list of the necessary safety standards.)

- ENISO12100-1 Safety of machinery - Basic concepts, general principles for design
- ENISO12100-2 Part 1. Basic terminology, methodology  
Part 2. Technical principles and specifications
- ENISO14121 Safety of machinery Principles for risk assessment
- EN13849-1 Safety of machinery-Safety related parts of control systems
- ENISO13850 Safety of machinery – Emergency stop – principles for design
- ENISO13855 Safety of machinery - Positioning of safeguards with respect to the approach speeds of parts of the human body.
- ENISO13857 Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs.
- ENISO 14120 (EN953) General requirements for design and construction of guards
- ISO10218 Robots for industrial environments -- Safety requirements
- ANSI /RIA R15.06 American National Standard; Industrial Robots and Robot Systems - Safety Requirements
- IEC204-1 (EN60204-1) Safety of machinery - Electrical equipment of machines  
Part 1. Specification for general requirements
- EN55011 Limits and methods of measurement of radio disturbance characteristic of industrial scientific and medical (ISM) radio frequency equipment.
- EN61000-6-2 Electromagnetic compatibility (EMC)  
Part 6-2: Generic standards - Immunity for industrial environments



**Part Names and Arm Motion**

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



## 1.4 Maintenance Safety

Please read this section, *Maintenance* of the Manipulator manual, *Maintenance* of the Contoroller 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.

 <p>WARNING</p>	<ul style="list-style-type: none"><li>■ 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, pull out 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.</li> <li>■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then pull out 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.</li> <li>■ 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.</li></ul>
--	---

 <p>CAUTION</p>	<ul style="list-style-type: none"><li>■ 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.<ul style="list-style-type: none"><li>- Never put alcohol, liquid gasket, or adhesive close to fire.</li><li>- Use alcohol, liquid gasket, or adhesive while ventilating the room.</li><li>- Wear protective gear including a mask, protective goggles, and oil-resistant gloves.</li><li>- If alcohol, liquid gasket, or adhesive gets on your skin, wash the area thoroughly with soap and water.</li><li>- 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.</li></ul></li></ul>
--	---



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.

## 1.5 Emergency Stop

If the Manipulator moves abnormally during operation, immediately press the Emergency Stop switch. The motor power will be turned OFF, and the arm motion by inertia will be stopped with the electromagnetic brake and dynamic brake.

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 while the robot system stops is different from that in normal operation.

To place the robot 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 press the Emergency Stop switch unnecessarily while the Manipulator is operating. Pressing the switch during the 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)

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

2.2.2 Inspection While the Power is ON (Manipulator is operating)  
Safety and Installation

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

### Free running distance in emergency

The operating Manipulator cannot stop immediately after the Emergency Stop switch is pressed.

However, remember that the values vary depending on conditions such as the weight of the end effector and work piece, Weight/Speed/Accel settings, operating pose, etc.




## 1.6 Labels

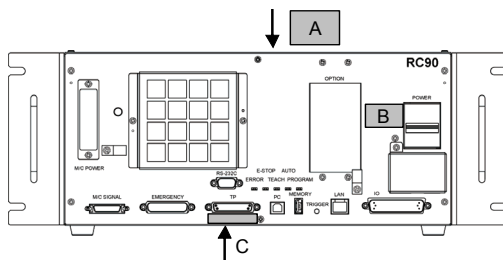
Labels are attached around the locations of the Controller and Manipulator where specific dangers exist.

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:





## 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.
B		Disconnect and lockout main power before performing maintenance and repair.
C		TP port of RC90 is for the Teach Pendant TP2. Do not connect the followings to TP port of RC90. Connecting to the followings may result in malfunction of the device. OPTIONAL DEVICE dummy plug, OP500, OP500RC, JP500, TP-3** series, TP1, and OP1 Refer to 4.3 <i>Connection of Option TP2</i> .



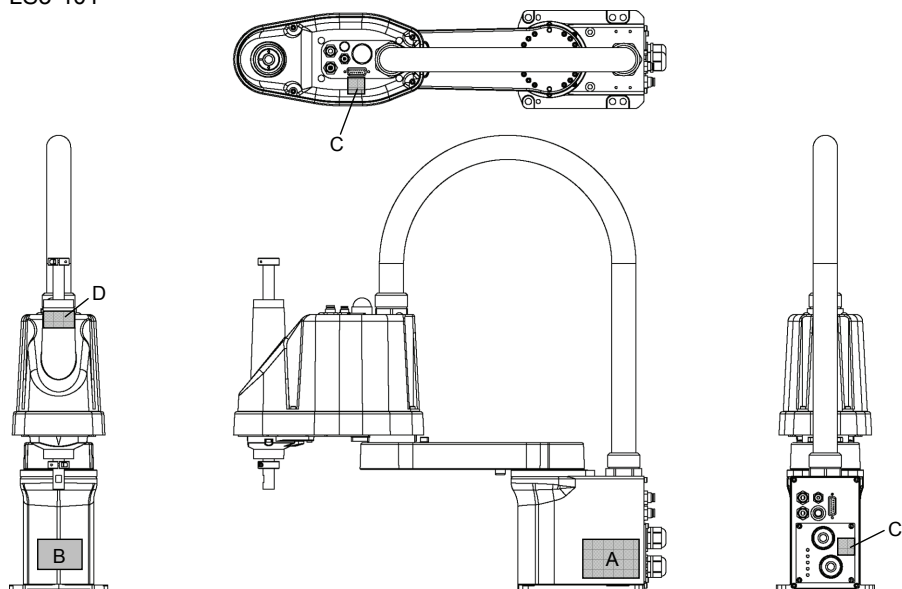
1. Safety

**Manipulator**

Location	Label	Note
A		<p>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.</p> <p>For installation and transportation of robots, follow the directions in this manual.</p>
B		<p>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.</p>
C		<p>Hazardous voltage exists while the Manipulator is ON. To avoid electric shock, do not touch any internal electric parts.</p>
D		<p>You can catch your hand or fingers between the shaft and cover when bringing your hand close to moving parts.</p> <p>Manipulators with bellows do not have this label for no danger of your hand or fingers being caught</p>

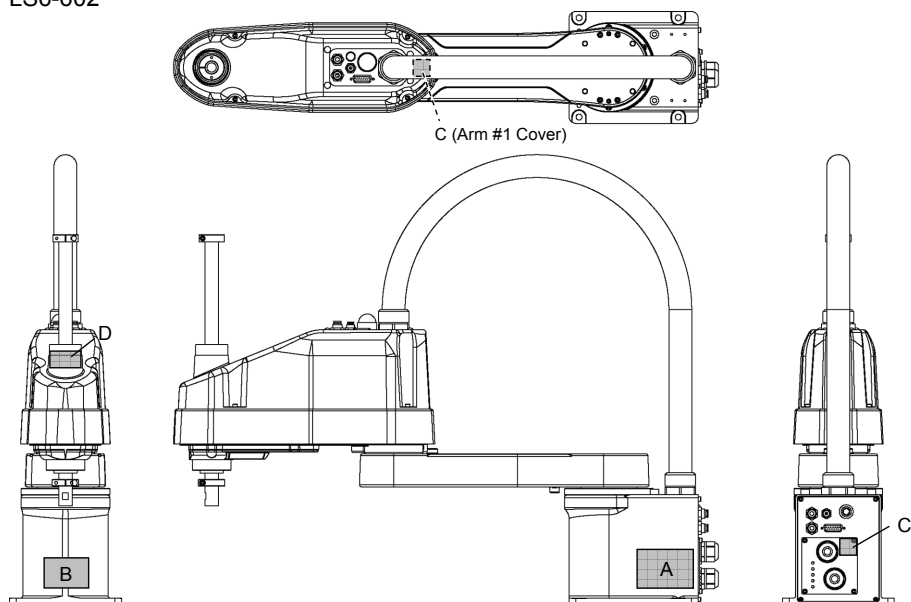


LS3-401\*



(Figure: LS3-401S)

LS6-602\*



(Figure: LS6-602S)

### 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.

#### 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.

## 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 Lockout / Tagout

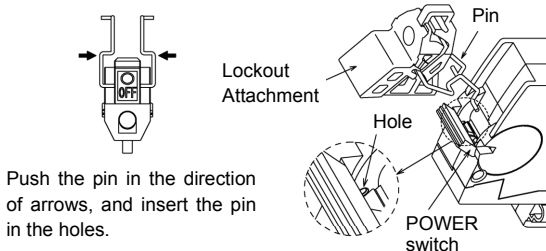
Lockout / tagout is a method to prevent any one from turning ON the robot system by mistake while someone else is within the safeguarded area for maintenance or repair.

When performing maintenance and repair, lockout and tagout using the following procedure. Use the lockout attachment for RC90.

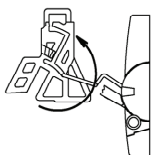
### Installing the Lockout Attachment

- (1) Turn OFF the POWER switch and place the lockout attachment on the POWER switch.

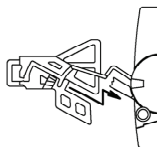
Insert the pin in the holes under the retractable actuator.



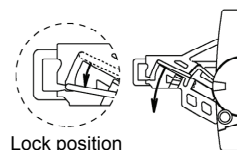
- (2) Turn the lockout attachment.



- (3) Install the lockout attachment on the switch.



- (4) Slide the pin to the lock position.



**Padlock Size and Weight**

The padlock is not supplied with the lockout attachment and must be supplied by the user.

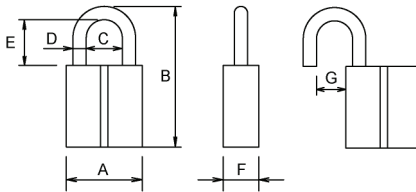
The total weight of the padlock can be a maximum of 45 g.

Make sure the padlock weight does not exceed 45 g, otherwise the POWER switch may be damaged.

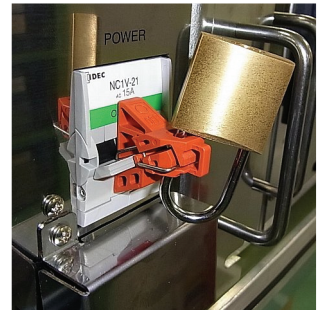
**Applicable Padlock**

(A)	(B)	C	D	E	(F)	G
19 to 25	35 to 42	9 to 11.5	4 to 4.5	11 to 15	8 to 10	7.5 to 9.0

(A) , (B) , (F) : Reference dimension



Recommended Padlock	
Manufacturer	Type No.
Alpha	1000-25
Master Lock	4120



**Safety Precautions**

When using the padlock, do not use the controller where it is subject to vibration or shock, otherwise failure or damage may result.

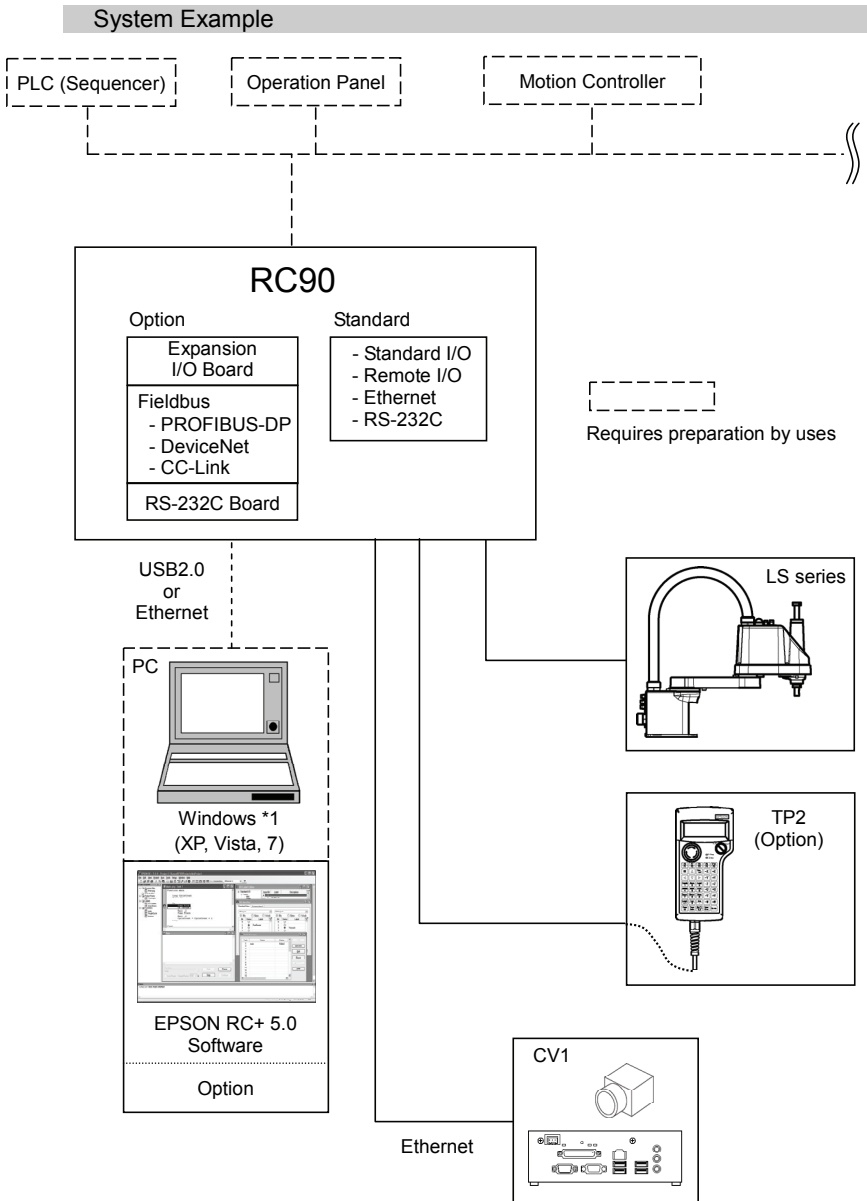
Do not apply a force of more than 50N on the lockout attachment, otherwise the lockout attachment will be damaged.

## 2. Installation

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

The outline to install the robot system is indicated on 2.1 Outline from Unpacking to Operation of Robot System. Refer to each section and/or the Manipulator manual and the Controller manual for unpacking, transportation, and installation.

## 2. Installation



\*1 EPSON RC+ 5.0 supports the following OS.

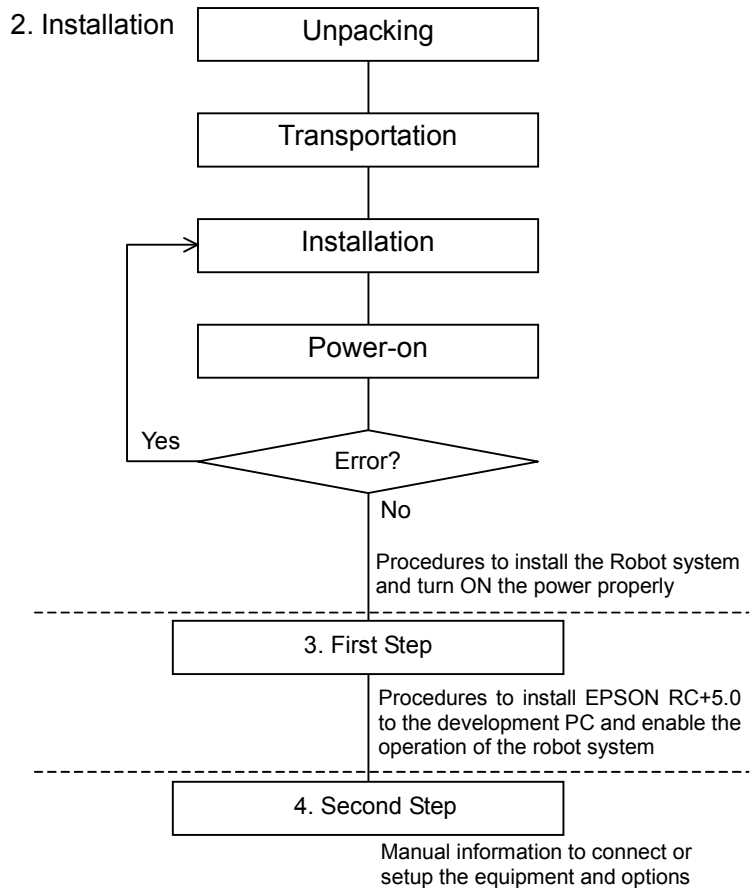
Windows XP Professional Service Pack 3 (EPSON RC+ 5.0 Ver.5.2.0 SP3 or after is required.)

Windows Vista Business Service Pack 2 (EPSON RC+ 5.0 Ver.5.3.1 or after is required.)

Windows 7 Professional (EPSON RC+ 5.0 Ver.5.3.4 or after is required.)



## 2.1 Outline from Unpacking to Operation of Robot System



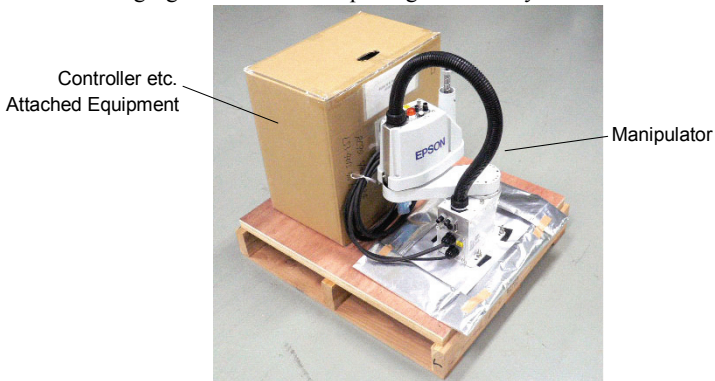
### 2.2 Unpacking

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.

#### Package Components Example

The following figure illustrates the package at delivery.



#### 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.

### Transportation Precautions

Transportation procedure

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

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.

Hoisting procedure

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

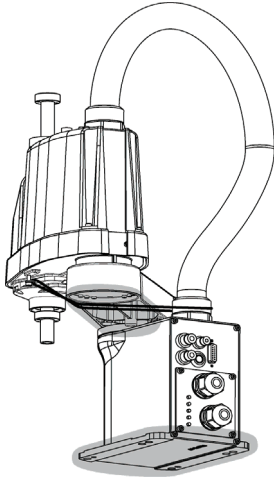
## 2. Installation

---

### Manipulator Transportation

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.



LS3-40 1\* : approx. 14 kg: 31 lb.

LS3-602\* : approx. 17 kg: 37.5 lb.

## 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.

### 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.

### Noise level

Noise level by movement of manipulator.

LS series: LAeq = 70 dB (A)

#### Operating conditions

Under rated load, 4-joints simultaneous motion, maximum speed, maximum acceleration, and duty 50%.

#### Measurement point

In front of the Manipulator, 1000 mm apart from the motion range, 50 mm above the base-installed surface.

## 2. Installation

---

### 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 torque and reaction force produced by the movement of the Manipulator are as follows:

	LS3-401*	LS6-602*
Max. Reaction torque on the horizontal plate	250 Nm	350 Nm
Max. Horizontal reaction force	1000 N	1500 N
Max. Vertical reaction force	1000 N	1500 N

The threaded holes required for mounting the Manipulator base are M8. Use mounting bolts with specifications conforming to ISO898-1 property class: 10.9 or 12.9.

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  $\mu\text{m}$  or less.

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

## Installation Procedure



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.



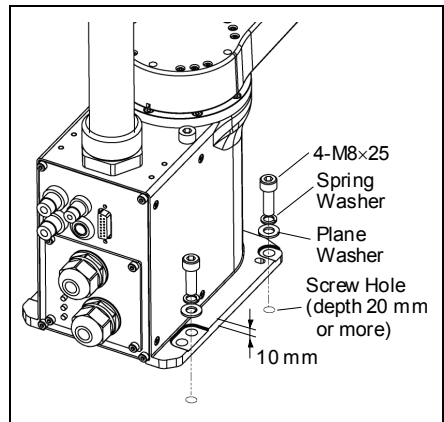
CAUTION

- Install the LS series 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.
  - LS3-401\* : approx. 14 kg: 31 lb.
  - LS6-602\* : approx. 17 kg: 37.5 lb.

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



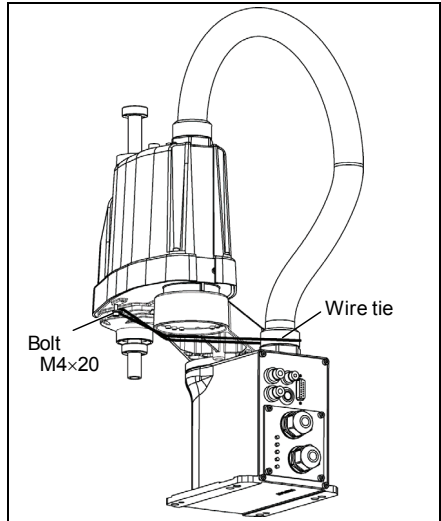
Use bolts with specifications conforming to ISO898-1 Property Class: 10.9 or 12.9.



## 2. Installation

---

- (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.





## 2.5 Controller Installation

### Installation Precautions

#### Environment conditions

- : The Controller 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 Controller 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 Controller and related equipment, and then pull out 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.

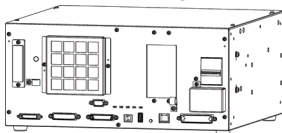
#### Cable

- : 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.

### Installation

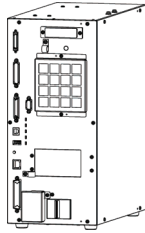
Install the controller on a flat surface such as wall, floor, and controller box in the direction shown from (A) to (C).

#### (A) Flat mounting



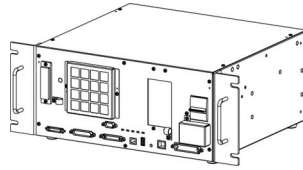
## 2. Installation

(B) Upright mounting



\* The rubber foot needs to be replaced.

(C) Rack mounting

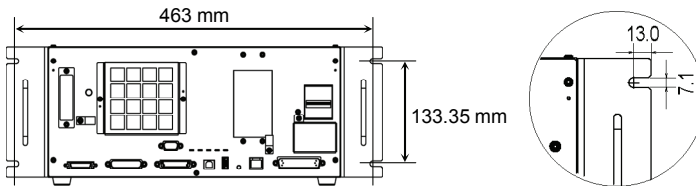


\* Rack-mount plate is required.

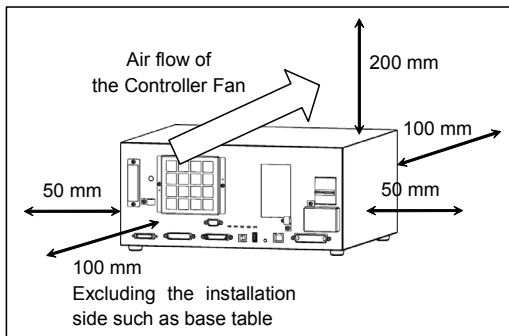
### NOTE



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



Ensure the draft around the in/out and also install the controller by keeping the distance as follows to prevent the nose influence from other equipments such as large contactor and relay.



Hot air with higher temperature than the ambient temperature (about 10 deg.C) comes out from the in/out of the Controller.


Make sure that heat sensitive devices are not placed near the outlet.

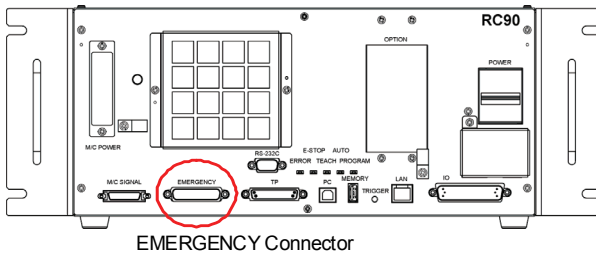
Arrange the cables in front of the Controller so that you can pull the Controller forward.

## 2.6 Connection to EMERGENCY Connector (Controller)

Connect a safeguard switch or Emergency Stop switch to the Controller EMERGENCY connector for safety.

When nothing is connected to the EMERGENCY connector, Controller does not operate normally.

 <b>WARNING</b>	<ul style="list-style-type: none"> <li>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.</li> </ul>
---	--




### 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

### Safety Door Switch

 <b>WARNING</b>	<ul style="list-style-type: none"> <li>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. The tape is put around the switch.). 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.</li> </ul>
---	---

In order to maintain a safe working zone, a safeguard must be erected around the Manipulator. The safeguard must have an interlock switch at the entrance to the working zone. 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 recognizes it to be 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.

### 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.

### 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+ 5.0 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.

### Emergency Stop Switch

If it is desired to create an external Emergency Stop switch(es) in addition to the Emergency Stop on the Teach Pendant and Operator Panel, make sure to connect such Emergency Stop switch(es) to the Emergency Stop input terminal on the EMERGENCY connector.

The Emergency Stop switch connected must comply with 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 Controller Manual *RC90 Setup & Operation: Circuit Diagrams*.

### 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.

- (1) Turn ON the Controller to boot the controller software while pressing the Emergency Stop switch.
- (2) Make sure that E-STOP LED of the controller is lighting.
- (3) Make sure that “E.Stop” is displayed on the EPSON RC+ 5.0 status bar.
- (4) Release the Emergency Stop Switch.
- (5) Select EPSON RC+ 5.0-[Tools]-[Robot Manager]-[Control Panel] and click the <Reset> button to execute the RESET command.
- (6) Make sure that E-STOP LED is turned OFF and that “E-Stop” is dimmed on the main window status bar.

### 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 (+)	16	ESTOP2+	Emergency Stop circuit 2 (+)
4	ESTOP1-	Emergency Stop circuit 1 (-)	17	ESTOP2-	Emergency Stop circuit 2 (-)
5	NC	*1	18	SDLATCH1	Safety Door Latch Release
6	NC	*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	NC				

\*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.

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 $\pm 10\%$ 37.5 mA $\pm 10\%$ / +24V input	3-4, 16-17 pin
Safety Door rated input voltage range Safety Door rated input current	+24 V $\pm 10\%$ 10 mA / +24 V input	7-8, 20-21 pin
Latch Release rated input voltage range Latch Release rated input current	+24 V $\pm 10\%$ 10 mA / +24 V input	18-19 pin

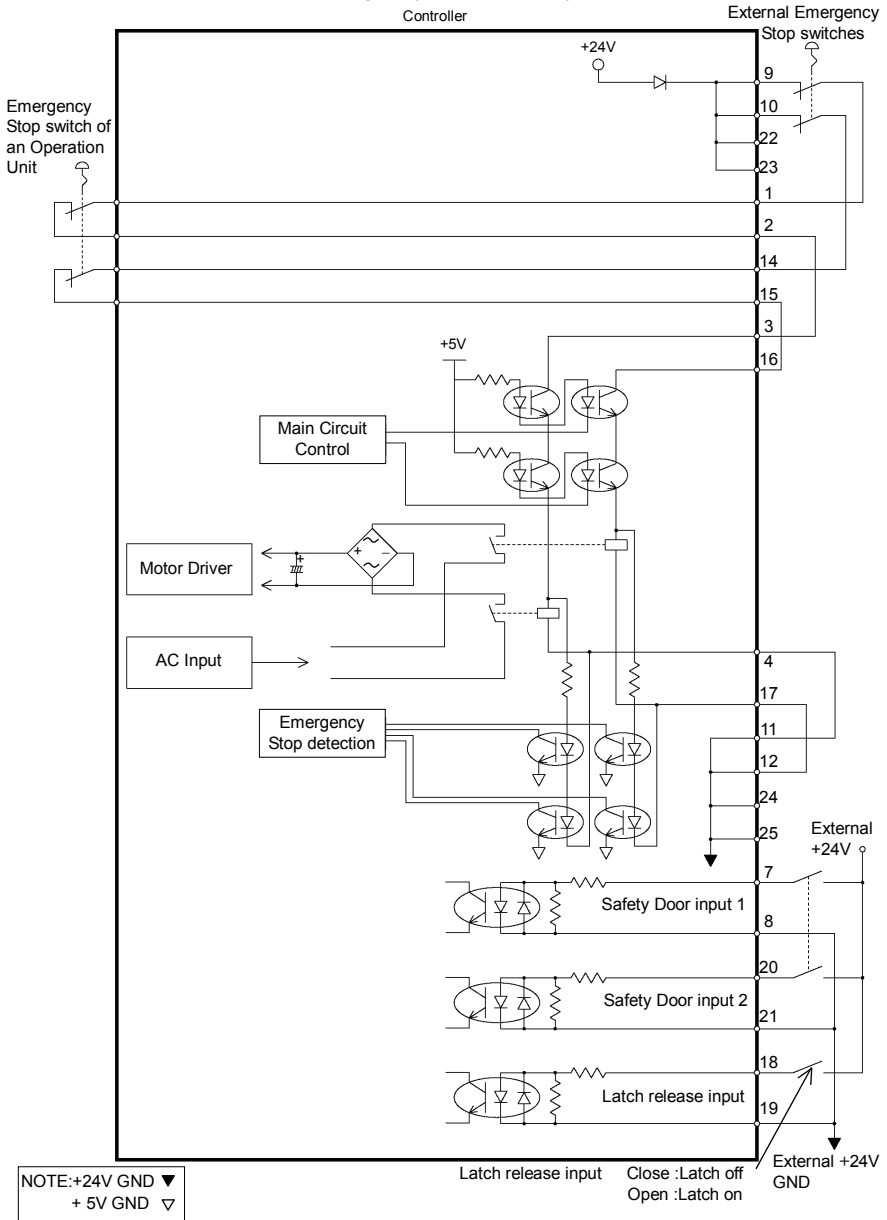
#### NOTE



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

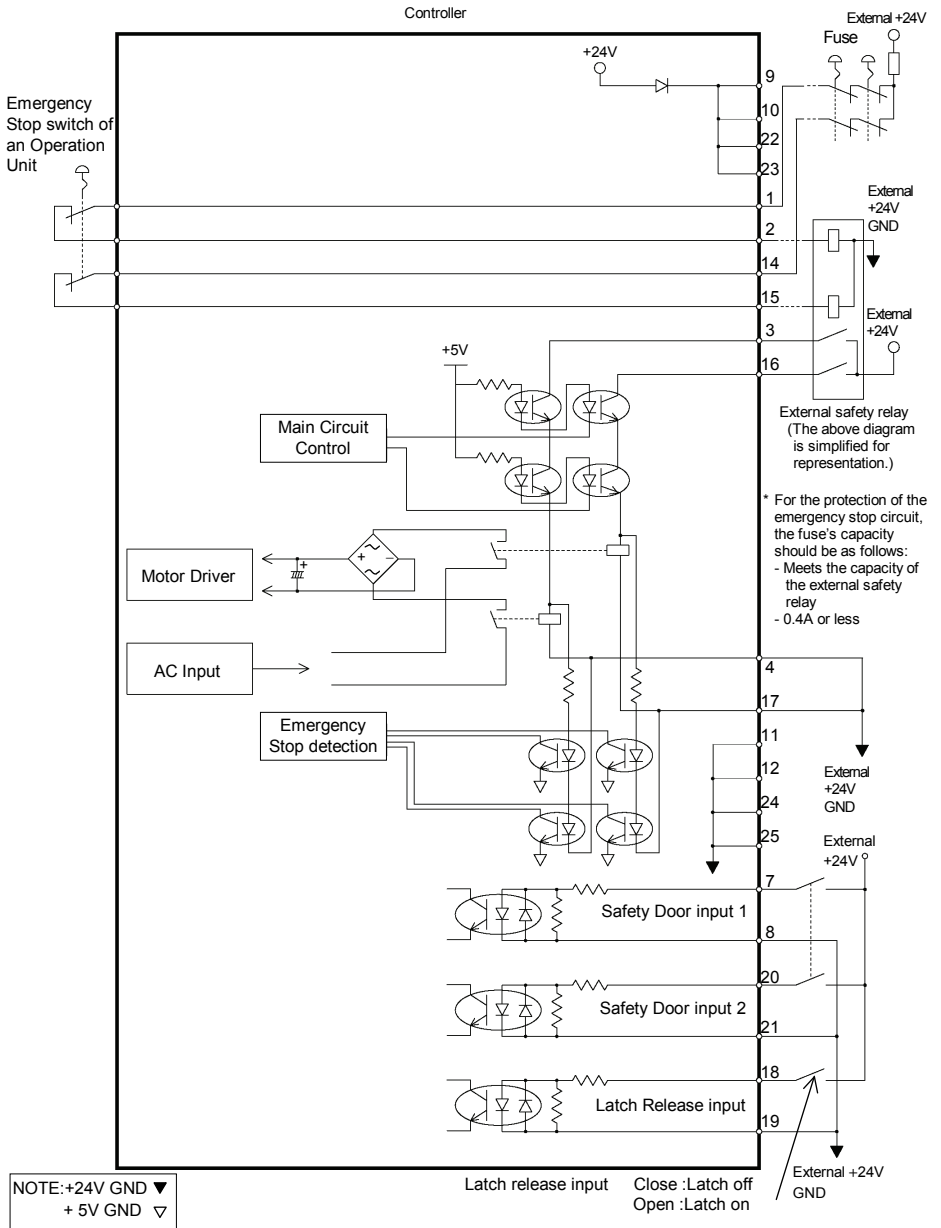
Circuit Diagrams

Example 1: External emergency stop switch typical application






Example 2: External safety relay typical application



## 2.7 Power Supply

 <b>WARNING</b>	<ul style="list-style-type: none"><li>■ 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, pull out 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</li><li>■ Make sure that cable manufacturing and connection are done by a qualified personal. When proceeding, be sure to connect the earth wire of the AC power cable colored green/yellow on the Controller 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 and receptacle for power connecting cable. Never connect the Controller directly to the factory power supply. (Field wiring)</li></ul>
---	---

The AC plug is the optional part.

Attach a proper plug to the cable that is suitable for the factory power supply.

### Connection Specification of Cable Wire

Purpose	Color
AC power wire (2 cables)	Black
Ground wire	Green / Yellow

### Specification of Power Plug (option)

Name	Model	Manufacturer
AC plug	4222R	AMERICAN DENKI

Cable length: 3 mm (Standard)

### AC Power Cable Connection

- (1) As shown in the right picture, connect the power cable to the AC IN terminal block.  
At this point, be careful of the ground wire position (Left). Secure the AC power cable to the chassis with the clamp.

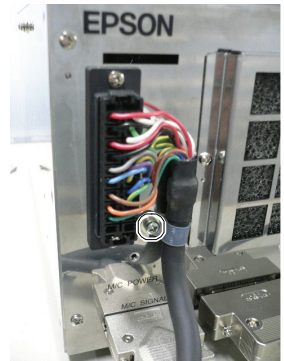


- (2) Mount the AC IN terminal block cover.  
(Secure the cover with one screw.)  
Keep the cables from being trapped.



### M/C Power Cable Connection

- (1) Mount the M/C Power Cable as shown in the picture and form the cables.
- (2) Set the M/C Power Cable in the clamp for the M/C Power Cable.
- (3) Mount the cover for the M/C Power Connector.
- (4) Secure the cover with the screw.



### 2.8 Connecting Manipulator and Controller

#### 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 pull out 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.

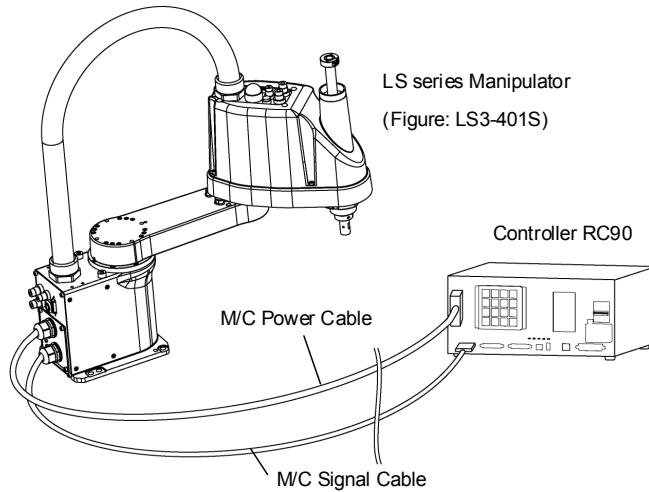
##### Wiring

- : 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.

## LS series and RC90 Connection



## 2.9 Power-on

## Power-on Precautions

## 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.

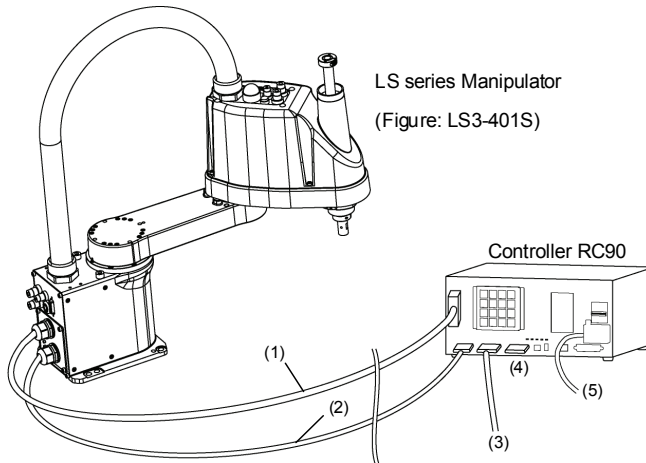
## Shipping bolts and jigs check before turning ON

- : Before first turning ON the power, 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

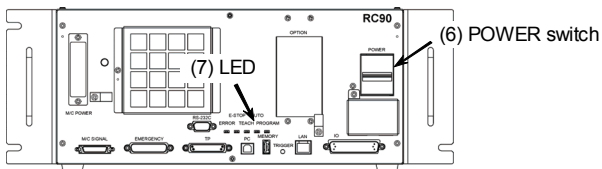
### Power ON Procedure



- (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 RC90 Controller.
- (5) Connect the AC power cable to the power supply socket.
- (6) Turn ON the POWER switch of the RC90 Controller.
- (7) The PROGRAM LED blinks approximately 30 seconds after Controller starts up normally.

If the ERROR LED is turned ON or blinking, check the connection in step (1) to (5) and turn ON the power again.

If the ERROR LED is still ON or blinking, contact the supplier.



## 2.10 Saving Default Status

The controller has been 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 *RC90 controller: 6.1 What is Controller Status Storage Function?*.

## 3. First Step

This section indicates the procedure to install the development PC EPSON RC+ 5.0, 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+ 5.0 Software

The EPSON RC+ 5.0 software needs to be installed on your development PC.

#### NOTE



We recommend using the EPSON RC+ 5.0 Ver.5.4.1 or later.

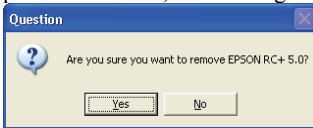
EPSON RC+ 5.0 Ver.5.4.1 supports the following OS.

Windows XP Professional Service Pack 3 or later

Windows Vista Business Service Pack 2 or later

Windows 7 Professional or later

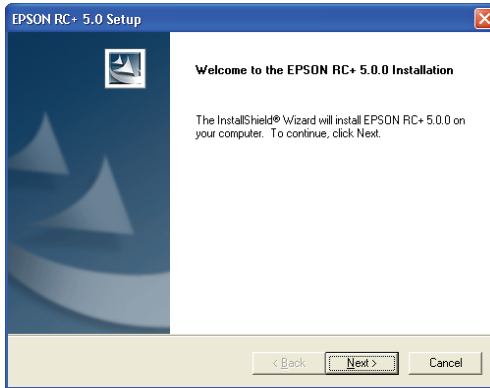
1. Insert the EPSON RC+ 5.0 Setup CD in the CD drive.
2. If EPSON RC+ 5.0 was previously installed, you will be asked to uninstall the previous version, otherwise go to step 3.



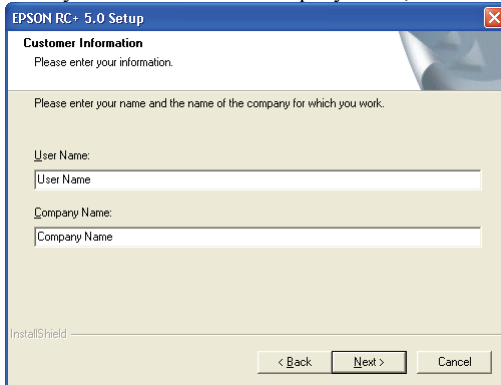
After uninstalling, you will be prompted to restart the computer. Start the setup program again by double-clicking the installer CD icon in My Computer, or by re-inserting the CD.



3. The welcome dialog will be displayed as shown below. Click the **Next** button to continue.



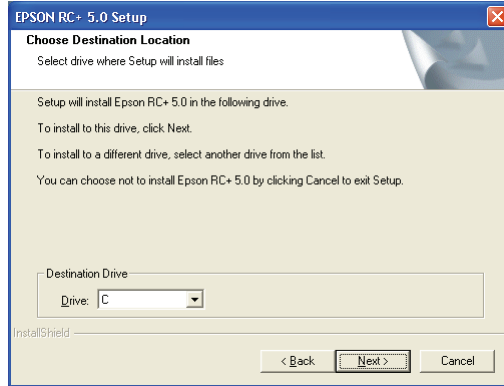
4. Enter your user name and company name, then click Next.



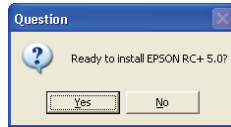
5. Select the drive where you want to install EPSON RC+ 5.0 and click **Next**.



The installation directory is called EpsonRC50 and cannot be changed.



6. You will be prompted to confirm installation. Click **Yes** to continue.



7. If required, Windows Installer and Microsoft .NET Framework 2.0 are installed on your system. This may take several minutes.



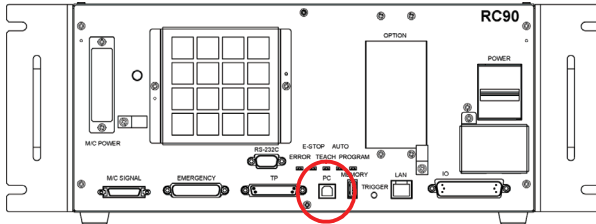
Adobe Reader needs to be installed on your PC in order to view the EPSON RC+ 5.0 manuals. If the installer cannot find Adobe Reader on your system, it will be installed at this time. Follow the instructions in the Adobe installer. Do not restart the system after the Adobe Reader installation has completed.

8. After the installation has completed, you may be prompted to restart your computer.

The EPSON RC+ 5.0 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

### NOTE



For other details of development PC and Controller connection, refer to *EPSON RC+ 5.0 User's Guide: PC to Controller Communications Command*.

For RC90, be sure to install the EPSON RC+5.0 to the development PC first, then connect the development PC and RC90 with the USB cable.

If RC90 and the development PC are connected without installing the EPSON RC+5.0 to the development PC, [Add New Hardware Wizard] appears. If this wizard appears, click the <Cancel> button.

### About Development PC Connection 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+ 5.0 software installed in the development PC.

Development PC connection port supports hot plug feature. Cables insert and remove from the development PC and the Controller is available when the power is ON. However, stop occurs when USB cable is removed from the Controller or the development PC during connection.

#### Precaution

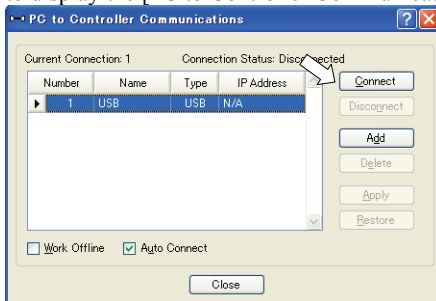
When connecting the development PC and the Controller, make sure of the followings.

- 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.

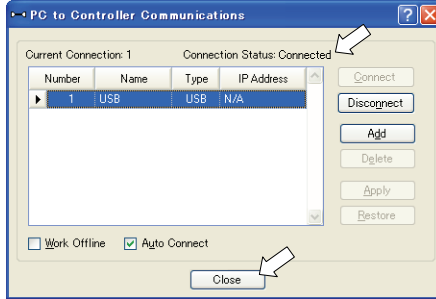
#### Software Setup and Connection Check

Connection of the development PC and the Controller is indicated.

- (1) Make sure that software EPSON RC+ 5.0 (Ver.5.4.1 or later is recommended) is installed to 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+ 5.0.
- (5) Select the EPSON RC+ 5.0 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+ 5.0.

### Backup the initial condition of the Controller

Backup the Controller data configured before shipment.

Follow these steps to backup the project and system configuration:

- (1) From the Project menu, select Copy.
- (2) Change the Destination Drive to a certain 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 certain drive.
- (7) Click OK. The system configuration will be backed up on the external media.

#### Disconnection of Development PC and Controller

Disconnection of the development PC and the Controller is indicated.

- (1) Select the EPSON RC+ 5.0 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 USB cable is removed when the Controller and the development PC is connected, stop occurs to the Robot. Make sure to click the <Disconnect> button in the [PC to Controller Communications] dialog before USB cable is removed.

### 3.3 Writing your first program

After installing the RC90 controller, robot, and EPSON RC+ 5.0 software on your PC, follow these instructions to create a simple application program so that you will become more familiar with the EPSON RC+ 5.0 development environment.

1. **Connect your PC to the RC90 Controller**

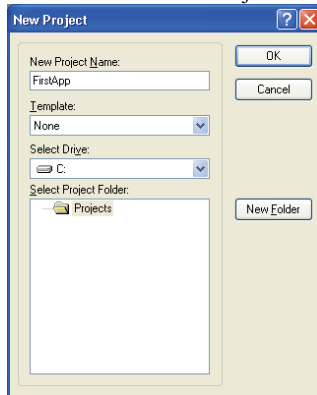
Install a USB cable between your PC and the RC90 Controller. Refer to the *3.2 Development PC and Controller Connection - Development PC Connection Port*.

2. **Start EPSON RC+ 5.0 Simple Mode**

Double-click the EPSON RC+ 5.0 Simple icon on the desktop.

3. **Create a new project**

(1) Select New from the Project menu.



(2) Type in a name for a project, for example, FirstApp.

(3) Click OK to create the new project.

When the new project is created, a program called Program.prg is created. You will see a window open with the title Program.prg with a cursor flashing in the upper left corner. Now you are ready to start entering your first program.

### 3. First Step

---

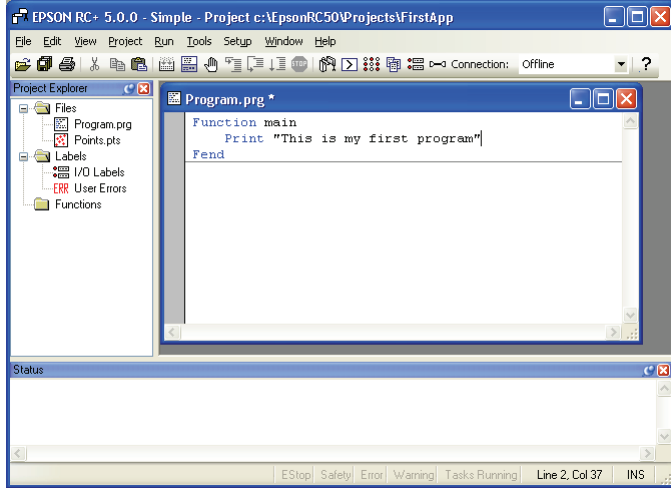
#### 4. Edit the program

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

```
Function main
```

```
    Print "This is my first program."
```

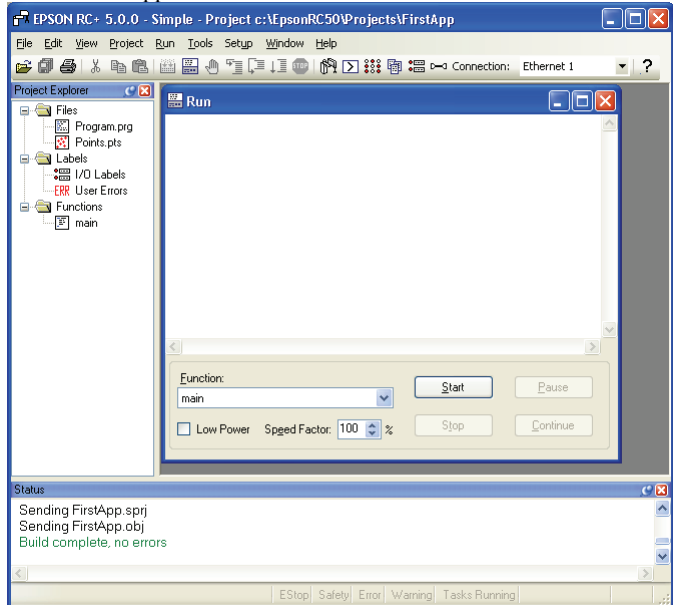
```
End
```





## 5. 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 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) You should see text similar to the following displayed in the [Status] window:

```


08:24:18 Task main started
08:24:18 All tasks stopped

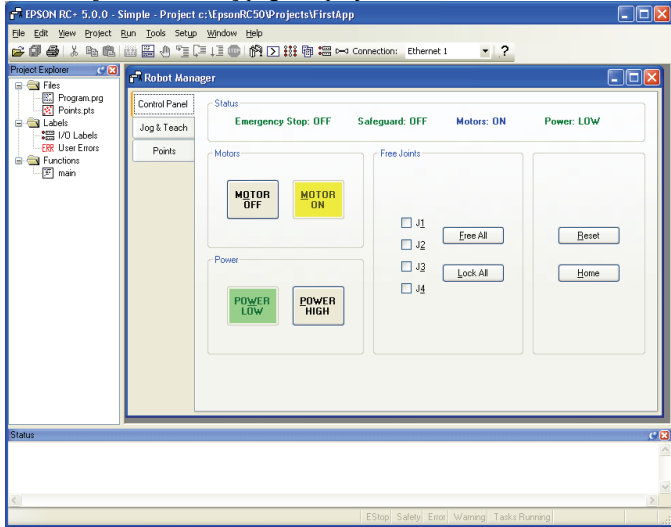
```

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

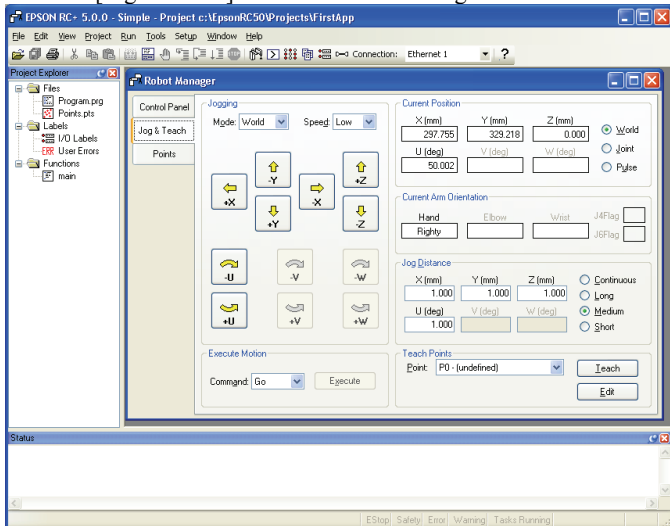
Now let's teach some robot points and modify the program to move the robot.


6. Teach robot points

- (1) Ensure that it is safe to operate the robot. Click the <Robot Manager> button  on the toolbar. You will see the [Robot Manager] window with the [Control Panel] page displayed.



- (2) Click on the <Motor On> button to turn on the robot motors. You will be prompted to confirm the operation.
- (3) Answer <Yes> to continue.
- (4) Click the [Jog & Teach] tab in the Robot Manager.



- (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) Jog the robot by clicking the <+Y> jog button. Hold the button down to continue jogging. Let go when the robot is about half way out in the work envelope.
- (7) Jog the robot down by clicking the <-Z> button.
- (8) Now change the current point to P1 by selecting P1 in the Point dropdown list next to the <Teach> button.
- (9) Click the <Teach> button. You will see a confirmation message to teach the point.
- (10) Answer <Yes>.
- (11) Click the <+X> button to jog the robot in the +X direction.
- (12) Change the current point to P2 by selecting P2 in the Point dropdown list.
- (13) Click the <Teach> button. You will see a confirmation message to teach the point.
- (14) Answer <Yes>.
- (15) Click the <Save> Project  toolbar button to save the changes.

## 7. Modify the program to include robot motion commands

- (1) Insert three new Go statements into the Program.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 on the <Start> button to run the program. The robot should move to each of the points you taught.

#### 8. 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 on the <Start> button to run the program.

The robot should go to each of the points you taught at 20% of speed, acceleration, and deceleration. The Power High statement enables your program to run the robot at high (normal) power, which in turn allows the robot speed and acceleration to be increased.

#### 9. Backup the project and system configuration

Even though this is only a sample project, we will backup the project and controller configuration. This is easy to do with EPSON RC+ 5.0. It is important that you keep regular backups of your applications on external media such as USB memory.

Follow these steps to backup the project and system configuration:

- (1) From the [Project] menu, select [Copy].
- (2) Change the [Destination Drive] to a certain 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 certain drive.
- (7) Click <OK>. The system configuration will be backed up on the external media.

Now that you have written your first program.

## 4. Second Step

Setup other necessary functions after operating the robot system as indicated in 3. *First Step*.

Manuals that indicate necessary setups and procedures are guided in this section. (For descriptions of each manual, refer to 6. *Manuals*.)

### 4.1 Connection with External Equipment

#### Remote Control

EPSON RC+ 5.0 User's Guide

*Remote Control*

ROBOT CONTROLLER RC90 (EPSON RC+5.0) manual

*Setup & Operation: I/O Remote Set Up*

I/O

EPSON RC+ 5.0 User's Guide

*I/O Setup*

ROBOT CONTROLLER RC90 (EPSON RC+5.0)

*Setup & Operation: I/O Connector*

*Setup & Operation: Expansion I/O Board (Option)*

Fieldbus I/O (Option)

ROBOT CONTROLLER RC90 (EPSON RC+5.0)

*Setup & Operation: Fieldbus I/O Board*

#### Ethernet

EPSON RC+ 5.0 User's Guide

*Ethernet Communication*

ROBOT CONTROLLER RC90 (EPSON RC+5.0)

*Setup & Operation: LAN Ethernet) Port*

#### RS-232C (Option)

EPSON RC+ 5.0 User's Guide

*RS-232C Communication*

ROBOT CONTROLLER RC90 (EPSON RC+5.0)

*Setup & Operation: RS-232C Board*

## 4.2 Ethernet Connection of Development PC and Controller

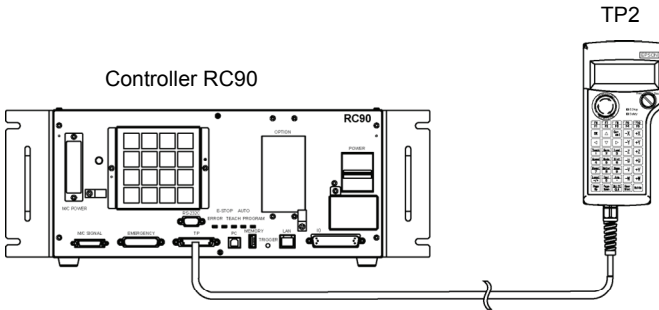
EPSON RC+ 5.0 User's Guide

*Ethernet Communication*

ROBOT CONTROLLER RC90 (EPSON RC+5.0)

*Setup & Operation: LAN (Ethernet) Port*

## 4.3 Connection of Option TP2



### TP2

#### Connection

Robot Controller RC90

*Setup & Operation: TP Port*

RC90/RC180 Option Teach Pendant TP2

*Function & 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 Schedule for Maintenance Inspection

Inspection points are divided into five stages: daily, monthly, quarterly, biannual, and annual. The inspection points are added every stage.

If the Manipulator is operated for 250 hours or longer per month, the inspection points must be added every 250 hours, 750 hours, 1500 hours, and 3000 hours operation.

	Inspection Point				
	Daily	Monthly	Quarterly	Biannual	Annual
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)		√			
⋮	⋮	⋮	⋮	⋮	⋮

h = hour

## 5. General Maintenance

### 5.2 Inspection Point

Inspection While the Power is OFF (Manipulator is not operating)

#### Manipulator

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 <i>Tightening Hexagon Socket Head Cap Bolts.</i> )	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.	Inside of Arm #2				√	√
Grease conditions	Refer to <i>Greasing.</i>					
Battery	-	Every 1.5 years				



## Controller

Inspection Point	Inspection Place	Daily	Monthly	Quarterly	Biannual	Annual
Visually check for external defects. Clean up if necessary.	External appearance of Controller	√	√	√	√	√
Clean the fan filter	-		√	√	√	√
Battery	-	Every 5 years				

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

## Manipulator

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					√
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	√	√	√	√	√

## 5. General Maintenance

### Controller

Inspection Point	Inspection Place	Daily	Monthly	Quarterly	Biannual	Annual
Check whether unusual sound or vibration is occurring.	Entire Controller	√	√	√	√	√
Make a backup of data.	Project and system data	Whenever data is changed.				

### Tightening Hexagon Socket Head Cap Bolts

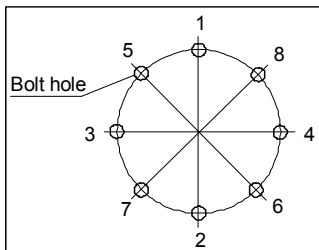
Hexagon socket head cap bolts are used in places where mechanical strength is required. (A hexagon socket head cap bolt will be called a “bolt” in this manual.) These bolts are fastened with the tightening torques shown in the following table. When it is necessary to refasten these bolts in some procedures 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	245 N·cm (25 kgf·cm)
M4	490 N·cm (50 kgf·cm)
M5	980 N·cm (100 kgf·cm)
M6	1,760 N·cm (180 kgf·cm)
M8	3,720 N·cm (380 kgf·cm)
M10	7,350 N·cm (750 kgf·cm)
M12	12,740 N·cm (1,300 kgf·cm)

Refer below for the set screw.

Set Screw	Tightening Torque
M4	245 N·cm (25 kgf·cm)
M5	392 N·cm (40 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.

### Greasing

The ball screw spline and reduction gear units need greasing regularly. Only use the grease specified.

Parts and Interval when the greasing is necessary have been described. Refer to the manipulator manual for details of the greasing procedure.

 <b>CAUTION</b>	<ul style="list-style-type: none"> <li>■ Keep enough grease in the Manipulator. Operating the Manipulator with insufficient grease will damage sliding parts and/or result in insufficient function of the Manipulator. Once the parts are damaged, a lot of time and money will be required for the repairs.</li> <li>■ If grease gets into your eyes, mouth, or on your skin, follow the instructions below.</li> </ul> <p>If grease gets into your eyes :</p> <p style="padding-left: 20px;">Flush them thoroughly with clean water, and then see a doctor immediately.</p> <p>If grease gets into your mouth :</p> <p style="padding-left: 20px;">If swallowed, do not induce vomiting. See a doctor immediately.</p> <p style="padding-left: 20px;">If grease just gets into your mouth, wash out your mouth with water thoroughly.</p> <p>If grease gets on your skin</p> <p style="padding-left: 20px;">Wash the area thoroughly with soap and water.</p>
---	--

	Greasing part	Greasing Interval
Joint #1	Reduction gear units	In the replacement of motor*
Joint #2	Reduction gear units	In the replacement of motor*
Joint #3	Ball screw spline shaft	Every 6 months

\* Under normal conditions, the reduction gear units shall be greased only when the motor is replaced. However, in case of severe working conditions (such as high duty, high speeds, large payloads, etc.), the reduction gear units must be greased every 10,000 hours.

## 6. Manuals

Descriptions of manual contents are indicated in this section.

Manuals are supplied by Acrobat PDF to use the Robot system.

Select EPSON RC+ 5.0-[Help]-[PDF Manual] to view the PDF manuals from a PC. (Click <Start>-[Program]-[EPSON RC+ 5.0] from the Windows desktop.)

### Software

#### EPSON RC+ 5.0 User's Guide

This manual indicates descriptions of 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        etc.

#### EPSON RC+ 5.0 SPEL+ Language Reference

This manual indicates descriptions of the SPEL+ language for robot program.

- Details of the commands
- Error Messages
- Precaution of EPSON RC+ 4.0 Compatibility        etc.

### Software Option

Following manuals contain information on the software options and commands.

- VB Guide 5.0
- Vision Guide 5.0
- Vision Guide 5.0 Properties and Results Reference
- GUI Builder 5.0
- Remote Control Reference

### Controller

#### ROBOT CONTROLLER RC90 (EPSON RC+ 5.0)

This manual indicates descriptions of the Robot Controller RC90 and Robot system.

- Safety
- Specification, Installation, Operation, and Setup
- Backup and Restore
- Maintenance
- Verifying Robot System Operation
- Error Codes        etc.

### Option

#### RC90/RC180 Option Teach Pendant TP2

This manual indicates descriptions of the option Teach Pendant.

- Safety
- Specification, Installation, Operation, and Setup
- Teaching Procedure
- TEACH/AUTO mode
- Troubleshooting        etc.

### Robot

#### EPSON SCARA ROBOT LS series

This manual indicates descriptions of the LS series manipulator.

- Safety
- Specification, Installation, Setting
- Maintenance
- Calibration        etc.

### 7. Directives and Norms

These products conform to the following directives and norms.

For more details of controller and manipulator, please refer to each manual.

Product Name	Model
Controller	RC90
Manipulator	LS 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
ENISO12100-1(2003)	Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology
ENISO12100-2(2003)	Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles
ENISO10218-1(2008)	Robots for industrial environments -Safety requirements-Part 1: Robot
EN60204-1(2006)	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
ENISO13849-1(2008) *	Safety of machinery - Safety - related parts of control systems - Part 1: General principles for design
ENISO13850(2008)	Safety of machinery - Emergency stop - principles for design
EN55011(2009)	Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement
EN61000-6-2(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

