

EPSON

Robot Controller RC800L Manual

Original instructions
Control Unit RC800L

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1. Introduction

1.1 Introduction

Thank you for purchasing this Epson robot system. This manual provides the information necessary for correctly using the robot system.

Before using the system, please read this manual and related manuals to ensure correct use.

After reading this manual, store it in an easily accessible location for future reference.

Epson conducts rigorous testing and inspection to ensure that the performance of our robot systems meets our standards. Please note that if the Epson robot system is used outside the operating conditions described in the manual, the product will not perform up to its basic performance.

This manual describes potential hazards and problems that are foreseen. To use the Epson robot system safely and correctly, be sure to follow the safety information contained in this manual.

1.2 Trademarks

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

This product uses eT-Kernel provided by eSOL Co., Ltd.

1.3 Notation

Microsoft® Windows® 10 operating system

Microsoft® Windows® 11 operating system

In this manual, the above operating systems are referred to as Windows 10 and Windows 11, respectively. Windows 10 and Windows 11 are sometimes collectively referred to as Windows.

1.4 Terms of Use

No part of this instruction manual may be reproduced or reprinted in any form without express written permission.

The information in this document is subject to change without notice.

Please contact us if you find any errors in this document or if you have any questions about the information in this document.

1.5 Manufacturer

SEIKO EPSON CORPORATION

1.6 Contact Information

Contact information details are listed in the "Supplier" section in the following manual.

Note that the contact information may vary depending on your region.

"Safety Manual - Contact Information"

The Safety Manual is also available at the following site.

URL: <https://download.epson.biz/robots/>



1.7 Disposal

When disposing of this product, please do so in accordance with the laws and regulations of your country.

1.8 Disposal of Coin Cell Batteries

Refer to the following manual for the removal and replacement procedures for coin cell batteries.

"Service Manual"

1.8.1 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 adverse effects on the environment and human health, the product and its batteries should be separated from other waste and recycled in an environmentally responsible manner. Contact your local government or product distributor for information on collection facilities.

The Pb, Cd, or Hg symbol means that these metals are used in the battery.

KEY POINTS

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, and to customers in countries in Europe, Middle East and Africa (EMEA) where they have implemented equivalent regulations.

For information on recycling products in other countries, please contact your local government.

1.8.2 For Customers in the Taiwan Region



Used batteries should be separated from other waste and recycled in an environmentally responsible manner. Contact your local government or product distributor for information on collection facilities.

1.8.3 For California Customers

The coin cell manganese dioxide lithium battery used in this product contains perchlorate material that requires special handling.

Refer to the following document.

<https://dtsc.ca.gov/perchlorate/>

1.9 Before Use

CAUTION

- Regarding the necessity for organizational measures for cyber security

Organizational measures like those described below should be taken to address cybersecurity risks:

- Perform risk analysis based on security threats and vulnerabilities related to your organization's assets.
- Establish a security policy to address risks and educate and train appropriate personnel.
- Establish guidelines for how to respond when security issues arise and make them known throughout your organization.

- Security measures for network connections

Epson robot systems are designed to be used within a closed local area network. Please refrain from connecting to networks with Internet access. If a connection to the Internet is required, please implement the necessary technical measures* to protect from malicious attacks and vulnerabilities over the Internet.

*These measures include, but are not limited to, access controls, firewalls, data diodes, and so on.

KEY POINTS

- Do not connect the following devices to the TP port of RC800L. The different signal arrangement could cause a breakdown in the device.
 - Dummy plug (optional device)
 - Operation Pendant OP500
 - Operator Pendant OP500RC
 - Jog Pad JP500
 - Operator Panel OP1
 - Teach Pendant TP1/ TP3/ TP4
 - Hot Plug Kit
- For RC800L, be sure to install Epson RC+ to the development PC first, and then connect the development PC and RC800L with the USB cable.

If RC800L and the development PC are connected without installing Epson RC+ to the development PC, the [Add New Hardware Wizard] appears. If this wizard appears, click the [Cancel] button.

- Security measures for USB memory devices

Make sure that any USB memory device that will be connected to the Controller is not infected with a virus.

1.10 Setting by Using Software

This manual contains setup procedures using the software.

Those sections are indicated by the following symbols.

Epson
RC+ 8.0

1.11 Manual Types for This Product

This describes the typical types of manuals for this product and presents an overview of their content.

■ **Safety Manual**

This manual contains safety-related information intended for all people who use this product. It also guides the user through the process from unpacking to usage and the manuals that should be referred to next.

Please read this manual first.

- Safety information and residual risks of robot systems
- Declaration of Conformity
- Training
- Process from unpacking to usage

■ **Robot Controller Safety Function Manual**

This describes the procedures for configuring the safety functions of this product and the configuration software. It is primarily intended for those who design robot systems.

■ **RC800L Manual**

This manual describes the installation of the entire robot system and explains the specifications and functions of the Controller. It is primarily intended for those who design robot systems.

- Robot system installation procedure (specific details on the process from unpacking to usage)
- Controller daily inspection points
- Controller specifications and basic functions

■ **xx Series Manual** (xx: Manipulator series name)

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

- Manipulator installation, technical information needed for design, function and specification tables, etc.
- Manipulator daily inspection points

■ **Status Code/Error Code List**

This provides the code numbers displayed on the Controller and messages displayed in the message area of the software. It is primarily intended for those who design and program robot systems.

■ **Epson RC+ User's Guide**

This manual presents an overview of the program development software.

■ **SPEL+ Language Reference**

This manual explains the robot programming language SPEL+.

Other manuals

Manuals are available for each option.

Maintenance and servicing manuals

Manuals for maintenance and servicing are not included with the product.

Maintenance should be performed by people who have received maintenance training provided by Epson and the suppliers. For more information, please contact the supplier.

2. Safety

2.1 Safety

Before using the robot system, be sure to check the basic safety information by referring to the following manual.
"Safety Manual"

After reading this manual, store it in an easily accessible location for future reference.

This product is a dedicated device for Epson robots to be used in an industrial environment for the transport and assembly of components in a safe, isolated area.

Conventions used in this manual

The following symbols are used in this manual to indicate important safety information. Be sure to read the descriptions shown with each symbol.

WARNING

This symbol indicates an imminently hazardous situation which, if operation is not performed properly, will result in death or serious injury.

WARNING

This symbol indicates a potentially hazardous situation which, if operation is not performed properly, could result in an injury due to electric shock.

CAUTION

This symbol indicates a potentially hazardous situation which, if operation is not performed properly, may result in an injury or in property damage only.

2.2 Safety Compliance

Specific tolerances and conditions of use for ensuring safety are described in the manuals for the Manipulators and Controllers. Be sure to also read these manuals.

Observe the safety standards of the respective country and region when installing and operating the robot system. The following are examples of safety standards related to robot systems and other safety standards.

Please refer not only to this chapter but also to these standards and take adequate safety measures.

Note: These standards are not intended to include all of the required safety standards.

- **ISO 10218-1**
Robots and robotic devices -- Safety requirements for industrial robots -- Part 1: Robots
- **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

- **ISO 12100**
Safety of machinery -- General principles for design -- Risk assessment and risk reduction
- **ISO 13849-1**
Safety of machinery -- Safety-related parts of control systems -- Part 1: General principles for design
- **ISO 13850**
Safety of machinery -- Emergency stop function-- Principles for design
- **ISO 13855**
Safety of machinery -- Positioning of safeguards with respect to the approach speeds of parts of the human body.
- **ISO 13857**
Safety of machinery -- Safety distances to prevent hazard zones being reached by upper and lower limbs.
- **ISO14120**
Safety of machinery -- Guards -- General requirements for the design and construction of fixed and movable guards
- **IEC 60204-1**
Safety of machinery -- Electrical equipment of machines -- Part 1: General requirements
- **CISPR11**
Industrial, scientific and medical (ISM) radio-frequency equipment -- Electromagnetic disturbance characteristics -- Limits and methods of measurement
- **IEC 61000-6-2**
Electromagnetic compatibility (EMC) -- Part 6-2: Generic standards -- Immunity for industrial environments

2.3 Role for Safety Managers

Safety managers should perform the following:

- Password management
- Training implementation

2.3.1 Password Management

Safety managers should manage the following passwords:

- Epson RC+ security user password
- Safety board password
- Controller Ethernet connection password

2.3.2 Training Implementation

Safety managers should ensure that personnel responsible for programming, operating, and maintaining the Manipulator and robot system undergo proper training. Also, they should make sure that personnel have the ability to safely perform that work.

Training should include at least the following items:

- Description of standard safety procedures and safety recommendations by robot manufacturers and robot system designers
- Description of the response to an emergency or abnormal situation (e.g., means of escape if caught in a Manipulator)
- Clear description of the work
- Description of all control devices required for the work and their functions
- Description of hazards associated with the work
- Specific methods to avoid foreseeable hazards, including safe work procedures
- Description of the method for testing the functions of safety devices and interlocks or description of the method to check that they are functioning properly
- Description of the method for checking safety function parameters and of the method for setting safety function parameters correctly

2.4 Knowledge and Training Required to Work with Robot Systems

■ Work with robot systems

People who work with robot systems must receive safety training for workers engaged in work related to industrial robots* as required by the laws and regulations of the respective country.

* The safety training for workers engaged in work related to industrial robots must include the following content.

- Knowledge of industrial robots
 - Knowledge of industrial robot operation, teaching, etc.
 - Knowledge of inspection and other work
 - Education on relevant laws and regulations
-
- **Transportation work (slinging, crane operation, forklift operation, etc.)**
Workers must be qualified in slinging, crane operation, forklift operation, etc.
 - **Power plug installation (e.g., when installing a power plug to match a factory power socket)**
Workers must have expertise and skill in installing factory power plugs.

- **Power cable installation work**

Workers must have expertise and skill in installing power cables.

- **Design, unpacking, and installation of robot systems**

Workers must have received the installation training provided by Epson and the supplier.

- **Installation of optional circuit boards on Controllers/Installation of wall-mounted options**

Workers must have received the maintenance training provided by Epson and the supplier.

- **Maintenance work on robot systems**

Workers must have received the maintenance training provided by Epson and the supplier.

3. Installation of Robot System

This section describes the process from unpacking to operation of the robot system and the design of the robot system. It is primarily intended for those who carry in and install the robot system and for those who connect to the development PC and perform setup.

3.1 System Configuration Example

Refer to the following section for details.

[System Configuration Example](#)

3.2 Unpacking and Transportation

The robot and robotic equipment must be unpacked and transported by staff who has received installation training conducted by Epson or its suppliers. Also, the laws and regulations of the installation country must be followed.

Before using the robot system, be sure to check the basic safety information by referring to the following manual.
"Safety Manual"

During unpacking and relocation of the Manipulator, avoid applying an external force to its arms and motors.

When transporting the Manipulator over long distances, secure it directly to transporting equipment so that it will not fall. If necessary, pack the Manipulator using the same packaging as delivery.

For the transportation procedure for the Manipulator, refer to the following manual.
"Manipulator Manual"

3.3 Manipulator Installation

The robot and robotic equipment must be installed by staff who has received installation training conducted by Epson or its suppliers. Also, the laws and regulations of the installation country must be followed.

Before using the robot system, be sure to check the basic safety information by referring to the following manual.
"Safety Manual"

For the installation environment and installation procedure for the Manipulator, refer to the following manual.
"Manipulator Manual"

3.4 Controller Installation

Refer to the following section for details.

[Installation](#)

3.5 Designing a Safe Robot System

In addition to ensuring safe operation of the robot, it is also important that robot users give careful consideration to safety for the entire robot system that is designed.

This section explains the minimum requirements that must be observed when using Epson robots in your robot systems.

Please design and manufacture robot systems by following the principles described in this manual.

3.5.1 Environmental Requirements

Be sure that the environment where the robot and robot system are installed meets the requirements contained in the manuals for all equipment used in the system.

3.5.2 System Layout

When designing the layout for a robot system, be sure to fully take into account the possibility of interference between robots and peripheral equipment. Particular attention must be paid to emergency stops because a robot will stop after following a path that is different from its normal movement path. The layout design should provide adequate margins for safety. The layout should also ensure adequate space for maintenance and inspection.

When designing a robot system to restrict the area of motion of the robots, do so by following the methods described in the Manipulator manual. Limiting is done either by Soft Axis Limiting or by mechanical stops. For Soft Axis Limiting, refer to the following manual.

"Robot Controller Safety Function Manual"

For limiting by mechanical stops, refer to the following manual.

"Manipulator Manual"

Ensure to install the emergency stop switch at a location near the operation unit for the robot system where the operator can easily access the switch to immediately press it in an emergency.

Do not install the Controller at a location where water or other liquids could enter the Controller. Never use water or other liquids to clean the Controller.

To ensure that lockouts are implemented safely during servicing and maintenance, disconnectors should be located outside the safety barriers wherever possible.

3.5.3 Disabling Power to the System Using Lockout/Tagout

RC800L Controller does not have a lock out mechanism. When you perform maintenance or the like with the AC power input sections turned off, lock out or tag out the disconnecting device used with the power cable.

3.5.4 Hand Design

Perform the wiring and piping work so that the robot hand will not release the workpiece (object being grasped) even when the robot system power is shut off.

Design the robot hand such that its weight and moment of inertia do not exceed the allowable limits. Use of a robot hand that exceeds 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 the additional external forces applied to the hand and the workpiece.

Be sure to select the size of the hand with care because the robot body and robot hand could interfere with each other.

3.5.5 Peripheral Equipment Design

When designing equipment that removes and supplies parts and materials to the robot system, ensure that the design enables adequate safety for the operator.

If it is necessary to remove or 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 hazardous zone.

Ensure that an interruption to the power supply (power shutoff) of peripheral equipment will not lead to a hazardous situation. In addition to taking measures to prevent release of held workpieces as mentioned in "Hand Design," measures must also be taken to ensure peripheral equipment other than the robots can stop safely. Verify equipment safety to ensure that no hazardous situations will occur if the power is cut off.

3.5.6 Remote Control

For the safety of the overall robot system, safety measures must be implemented to eliminate the risks associated with the starting and stopping of peripheral equipment by remote control.

With this product, the robot system can be operated remotely by assigning a remote function to the Controller I/O. Refer to the following section.

I/O Remote Settings

When the remote function is enabled, motion command execution and I/O output are available only from a remote source.

3.5.7 Power Off During Manipulator Operation

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

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

- Reduced life and damage to reduction gear
- Position shift at the joints

Also, if the Controller power was cut off due to a power outage or similar situation while the Manipulator is operating, be sure to check for any of the following points after power is restored.

- Damage in reduction gear
- Shifting of the joints from their proper positions
If there is any position shift, perform zero position adjustment.

3.5.8 Emergency Stop

Each robot system needs equipment that will allow the operator to immediately stop the system's operation. Install an emergency stop device by using emergency stop input from the Controller or other equipment.

Refer to the following section.

Emergency Stop Input Connector

Safety I/O Connector

Before using the emergency stop switch, be aware of the following points.

- The emergency stop switch should be used to stop the Manipulator only in case of emergencies.
- Besides pressing the emergency stop switch when an emergency occurs, to stop the Manipulator during program operation, use the Pause or STOP (program stop) statements assigned to a standard I/O.
The Pause and STOP statements do not turn off motor energization, and so the brake is not locked.

To place the robot system in emergency stop mode in a non-emergency (normal) situation, press the emergency stop switch while the Manipulator is not operating.

Do not press the emergency stop switch unnecessarily while the Manipulator is operating normally. It could shorten the lifespan of the following components.

- Brakes

The brakes will be locked, which will shorten the lifespan of the brakes due to worn brake friction plates.

- Normal brake lifespan:
About 2 years (when the brakes are used 100 times/day)
or about 20,000 times

- Reduction gears

An emergency stop applies an impact to the reduction gear, which can shorten its life.

Stopping distance of emergency stop

The Manipulator during operation cannot stop immediately after the emergency stop switch is pressed. Also, the stopping time and movement distance vary depending on the following factors.

- Hand weight, WEIGHT setting, ACCEL setting, workpiece weight, SPEED setting, movement posture, etc.

For the stopping time and movement distance of the Manipulator, refer to the following manual.

"Manipulator Manual - Appendix B. Stopping Time and Stopping Distance at Emergency Stop"

3.5.9 Safeguard (SG)

To maintain a safe working zone, safety barriers must be set up around the Manipulator, and safeguards must be installed at the entrance and exit of the safety barriers.

The term "safeguard" as used in this manual refers to a safety device with an interlock that allows entry into the safety barriers. Specifically, this includes safety door switches, safety barriers, light curtains, safety gates, safety floor mats, and so on. The safeguard is an input that informs the Robot Controller that an operator may be inside the safety barriers. You must assign at least one Safeguard (SG) in Safety Function Manager. Refer to the following section.

Safety I/O Connector

When the safeguard is opened, Protective Stop operates to change to the safeguard open state (display: SO).

- Safeguard open

Operations are prohibited. Further robot operation is not possible until either the safeguard is closed, the latched state is released, and a command is executed, or the TEACH or TEST operation mode is turned on and the enable circuit is activated.

- Safeguard closed

The robot can operate automatically in an unrestricted (high power) state.

WARNING

- If a third party accidentally releases the safeguard while an operator is working inside the safety barriers, this may result in a hazardous situation. To protect the operator working inside the safety barriers, implement measures to lock out or tag out the latch release switch.
- To protect operators working near the robot, be sure to connect the safeguard and make sure that it works properly.

Installing safety barriers

Set the safety barrier outside of the Manipulator's maximum range. Carefully take into account the size of the end effector and the workpieces to be held so that no interference occurs between the operating parts and the safety barriers.

For details on the Manipulator's maximum range, refer to the Manipulator manual.

Installing safeguards

Design the safeguards so that they satisfy the following requirements:

- When using a key switch type safety device, use a switch that forcibly opens the interlock contacts. Do not use switches that open their contacts using the spring force of the interlock.
- When using an interlock mechanism, do not disable the interlock mechanism.
- When using light curtains, keep the safeguard open until the latch condition is released.

Considering the stopping distance

During operation, the Manipulator cannot stop immediately even if the safeguard is opened. Also, the stopping time and movement distance vary depending on the following factors.

Hand weight, WEIGHT setting, ACCEL setting, workpiece weight, SPEED setting, movement posture, etc.

For the stopping time and movement distance of the Manipulator, refer to the following manual.

"Manipulator Manual - Appendix C. Stopping Time and Stopping Distance When the Safeguard is Open"

Please refer to the above values and ISO13855 when performing calculations.

Precautions for safeguard operation

Do not open the safeguard unnecessarily while the motor is energized. Frequent safeguard inputs will reduce the life of the relay.

- Normal relay lifespan: About 20,000 times

3.5.10 Presence Sensing Device

The above-mentioned safeguard interlock is a type of presence sensing device because it indicates the possibility of somebody being inside the safety barriers. When installing a separate presence sensing device, perform a full risk assessment, and pay careful attention to its reliability.

Take note of the following points.

- Design the system so that an operator cannot enter inside the safety barriers or cannot reach it unless the presence sensing device is activated or the hazard situation has ended.
- Design the presence sensing device so that it ensures fail-safe operation regardless of the system state.
- If the robot stops operating when the presence sensing device is activated, ensure that the robot will not restart operation until the detected object has been removed. Make sure that the robot cannot automatically restart by any operation.

3.5.11 Resetting Safeguards

Ensure that the robot system can only be restarted by operation from outside the safety barriers. The robot must never restart by simply resetting the safeguard. Apply this concept to the interlocks and presence sensing devices for the entire system.

3.5.12 Robot Operation Panel

If a robot operation panel is installed, be sure to install at a position where it can be operated from outside of the safety barriers.

3.6 Connections

3.6.1 Connection of Interlocked Guard Switch (Safety Device) and Emergency Stop Switch

To ensure safety, connect a safeguard switch, emergency stop switch, or similar safety device to the safety I/O connector or emergency stop input connector of the Controller. Refer to the following sections for details.

Emergency Stop Input Connector

Safety I/O Connector

If nothing is connected to the safety I/O connector, the Controller does not operate normally.

The default assignments are as follows:

- EMERGENCY connector: Short plug
- Safety I/O 1ch: Emergency stop (Estop)
- Safety I/O 2ch: Safeguard (SG)

3.6.2 Controller Power Supply

Connect the Controller power supply. For details on the power supply specifications and how to connect the AC power cable, refer to the following section.

Power Supply

3.6.3 Connection of Manipulator and Controller

3.6.3.1 Connection Notes

▪ Before connection

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

▪ Connection procedure

Before performing any connection procedure, be sure that the AC power input sections are shut off from electricity. This includes turning off the Controller and related equipment, unplugging the power cable from the outlet, and so on.

Performing any work procedure with the power turned on is extremely dangerous and may result in electric shock and/or malfunction of the robot system.

▪ Cables

Be sure to connect the cables properly.

The cables should be connected at all times. Use a guard cover to protect the cables. Do not put heavy objects on the cables, bend or pull on the cables forcibly, or allow the cables to be pinched. Damaged cables, broken wires, or contact failure is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

▪ Connection-related information

When connecting the Manipulator and the Controller, check that the serial numbers match for each device. Improper connection between the Manipulator and the Controller may not only lead to malfunction of the robot system but also safety problems.

The serial number of the supported Manipulator is labeled on the Controller.

- **Wiring**

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

3.7 Saving the Default Settings

The Controller has already been configured with the purchased robot(s) at shipment. However, in case of data loss, we recommend saving the default Controller settings. A USB memory device is required to save the Controller settings. Refer to the following section.

Memory Port

3.8 Power On

3.8.1 Power On Notes

- **Check of Manipulator**

Before operating the Manipulator, be sure that no parts of the Manipulator are missing and that it has no damage or other external defects. Missing parts or damage may cause malfunction of the Manipulator, is extremely hazardous, and may result in serious injury and/or severe equipment damage to the robot system.

- **Check of transportation fixtures before power on**

Before turning on the power after installation is completed, be sure to remove the transportation fixtures from the Manipulator. Turning on the power while the transportation fixtures are attached may result in damage to the main drive unit of the Manipulator.

- **Anchoring of Manipulator**

Anchor the Manipulator before turning on the power or operating it. Turning on the power to or operating the Manipulator while it is not anchored may cause the Manipulator to fall over, which is extremely hazardous and may result in serious injury and/or severe damage to the robot system.

- **Initial operation**

Be sure to always check at low speed when operating the Manipulator for the first time and when executing an operation program for the first time. Suddenly performing operation at high speed is extremely hazardous because the Manipulator may be unable to respond to unexpected movements, resulting in collision with the Manipulator or other situations where serious injury or severe damage occurs.

- **When turning on the power again**

When turning the Controller off and on again, turn off the Controller and wait for at least five seconds before turning it on again.

3.8.2 Power On Procedure

For connector names and their locations, refer to the following.

Part Names and Their Functions

1. Check the connection with the Manipulator.
Check the connection between the M/C POWER connector and the M/C SIGNAL connector.
2. Check the connection between the safety I/O connector and the emergency stop input connector.
3. Connect the TP bypass plug to the TP port.
4. Connect the AC power cable to the power socket.
5. Turn on the POWER switch of the Controller.
6. When the Controller starts up normally, about 30 seconds after turning on the power, the 7-segment LED will blink



If an error is displayed, check the connections in steps (1) to (5), and turn the power off and on again. If an error is displayed even after checking the connections and turning the power off and on again, please contact the supplier.

CAUTION

Turning the power off before the 7-segment LED flashes ---- may lead to a malfunction of the Controller.

KEY POINTS

After a Controller which has an internal cooling fan is turned on, the fan will rotate for about 10 seconds. After that, the Controller's internal cooling fan stops rotating. The fan starts rotating again when robot operation (motor ON) starts.

7. Once the Controller successfully starts, perform the following checks.

Check	Procedure	Results
Emergency stop operation	Press the emergency stop switch with the motor energized.	EP is displayed on the Controller's 7-segment LED. Emergency stop is displayed on the Epson RC+.
Safeguard operation	Operate the safeguard with the motor energized.	SO is displayed on the Controller's 7-segment LED. Safeguard is displayed on the Epson RC+.

KEY POINTS

If the results are different, perform the following checks. If there is still no improvement, please contact the supplier.

- Check wiring.
- Check functions assigned to safety I/O.

8. If various safety functions are set, check the assigned safety functions.

Check	Procedure	Results
SLS_T	Use TP to switch to TEACH mode.	On I/O monitor, SLS enable and disable will switch in conjunction with input
Soft axis limiting	Intentionally enter the area by using jog or other means *1	Changes to STO state
STO output	Operate emergency stop button or safeguard to change to STO state	Input of connected safety device changes
Emergency stop output	Press the emergency stop button	Input of connected safety device changes
Enable output	Grip the enable switch	Input of connected safety device changes
SLS_T output	Use TP to switch to TEACH mode.	Input of connected safety device changes

*1 To escape from the restricted area, switch to TEACH mode by using TP.

3.9 First Step

This section presents the procedure for installing Epson RC+ to the development PC, connecting the development PC and the Controller by USB, and executing a simple program.

First, make sure that the robot system is installed safely by following the information provided in "Safety" and "Installation." Then, operate the robot system by following the procedures in this chapter.

3.9.1 Installing Epson RC+ Software

Install Epson RC+ software on your development PC.

For installing the software, refer to the following manual.

"Epson RC+ User's Guide"

3.9.2 Connecting the Development PC and the Controller

Connect the development PC to the connection USB port for the development PC.

For the connector position, refer to the following section.

Part Names and Their Functions

KEY POINTS

- For other details on the connection between the development PC and the Controller, refer to the following manual.
"Epson RC+ User's Guide - [PC and Controller Communications] (Setup Menu)"
- For RC800L, be sure to install Epson RC+ to the development PC first, and then connect the development PC and RC800L with the USB cable.

If RC800L and the development PC are connected without installing Epson RC+ to the development PC, the [Add New Hardware Wizard] appears. If this wizard appears, click the [Cancel] button.

3.9.2.1 What is Development PC Connection USB Port?

Connect the Controller and development PC by a USB cable to enable development of the robot system and setting of the Controller configuration with the Epson RC+ software installed in the development PC.

The development PC connection port supports hot plugging, and so cables can be inserted and removed while the development PC and the Controller are turned on. However, the robot stops when the USB cable is removed while the Controller and the development PC are connected.

3.9.2.2 Notes

Pay attention to the following points when connecting the development PC and the Controller.

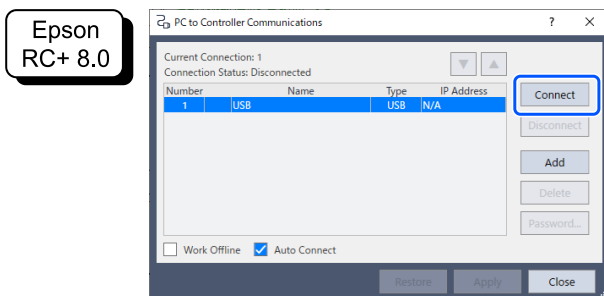
- Connect the development PC and the Controller using a USB cable that meet the standards, and do not use a USB hub or extension cable.
- Connect one Controller per development PC.
Connecting multiple Controllers to one development PC may cause unintended Controller operation.
- Do not connect any device other than the development PC to the development PC connection port.
- Do not pull on or bend the cable excessively.

- Do not apply excessive force to the connector.
- While the development PC and the Controller are connected, do not connect or disconnect other USB devices from the development PC. This could cause the Controller to disconnect.

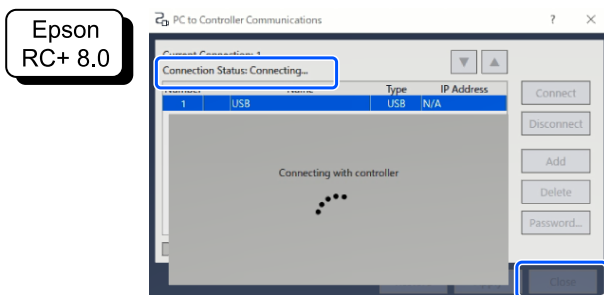
3.9.2.3 Connecting the PC and the Controller Using the Development PC Connection USB Port

This explains the procedure for connecting the development PC and the Controller.

1. Make sure that the Epson RC+ software is installed on the development PC connected to the Controller.
(Install the software if it is not installed.)
2. Connect the development PC and the Controller by a USB cable.
3. Turn on the Controller.
4. Start the Epson RC+ software.
5. From the Epson RC+ menu, select [Setup] - [PC to Controller Communications] to display the [PC to Controller Communications] dialog box.



6. Select No.1, and click the [Connect] button.
7. After connection of the development PC and the Controller is completed, "Connected" is displayed in the [Connection Status:] field. Check that "Connected" is displayed, and click the [Close] button to close the [PC to Controller Communications] dialog box.



This completes the connection of the development PC and the Controller. The robot system can now be used from Epson RC+.

3.9.2.4 Backing Up the Controller Initial Status

Back up the Controller setting data that was configured at shipment.

Backup procedure for project and system settings:

1. From the Epson RC+ menu, select [Project] - [Copy].
2. In the [Copy Project] dialog box, change the [Destination Drive] box to the desired drive.

3. Click the [OK] button. The project is copied to the external media.
4. From the Epson RC+ menu, select [Tools] - [Controller].
5. Click the [Backup Controller] button.
6. In the [Drive] box, select the desired drive.
7. Click the [OK] button. The system settings are backed up to the external media.

3.9.2.5 Disconnecting the Development PC and the Controller

This explains the procedure for disconnecting the development PC and the Controller.

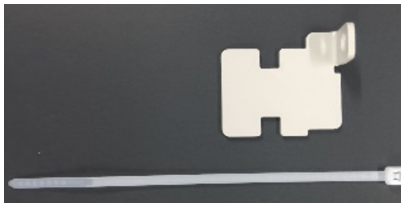
1. From the Epson RC+ menu, select [Setup] - [PC to Controller Communications] to display the [PC to Controller Communications] dialog box.
2. Click the [Disconnect] button.
After the [Disconnect] button is clicked, the Controller and the development PC are disconnected, and the USB cable can be removed.

KEY POINTS

If the USB cable is removed while the Controller and the development PC are connected, the robot will be stopped. Be sure to click the [Disconnect] button in the [PC to Controller Communications] dialog box before removing the USB cable.

3.9.2.6 USB Cable Locking Method

This section describes how to lock the USB cable into place.



1. Remove the screw on the left side of the USB port.



2. Attach the fixture using the screw in step 1.
3. Connect the USB cable to the USB port.

*the USB cable is not attached.



4. Pass the wire tie through the groove of the fixture and secure the USB cable.
5. Cut off any excess length of the cable tie.

3.9.3 Checking Safety Function Parameters

This section describes the procedure for checking safety function parameters on a development PC.

1. Connect the development PC and the Controller.

Connecting the Development PC and the Controller

2. In Epson RC+, select [Setup] - [System Configuration] to display the [System Configuration] dialog box.
3. Under [Controller] - [Safety Functions], click [Safety Function Manager].
Safety Function Manager starts.
4. Check the safety function parameters set for the Controller in the Safety Function Manager.
For details, refer to the following manual.
"Robot Controller Safety Function Manual"

3.9.4 Initial Settings for Safety Function Parameters

This procedure is only for customers who wish to change the safety function settings.

This section describes the procedure for making initial settings for safety function parameters on a development PC.

1. Start Safety Function Manager.

For the startup procedure, see steps 1 to 3 of "Checking Safety Function Parameters."

2. Change the safety function parameters in the Safety Function Manager.

For details on how to operate the Safety Function Manager, refer to the following manual.

"Robot Controller Safety Function Manual"

3. Confirm that the safety functions operate properly.

To check safety function operation, refer to the following manual.

"Robot Controller Safety Function Manual"

3.9.5 Checking Operation of Safety Functions (Emergency Stop Switch and Safeguard)

1. Refer to the following to check the operation of the emergency stop switch.

Connecting an Emergency Stop Switch

Connecting as Emergency Stop

2. Refer to the following to check the operation of the safeguard.

Connecting as Safeguard

3.9.6 Moving the Robot to Initial Posture

In addition to creating and executing programs, the robot can also be operated by the following methods.

- Manual operation
- Jog operation by the Teach Pendant
- Command execution from Epson RC+
- Jog operation from Epson RC+

This section explains the following operation methods.

A: Manual operation

B: Command execution from Epson RC+

C: Jog operation from Epson RC+

A: Manual operation

Move the robot by hand while it is in a non-energized state.

Joints without electromagnetic brakes can be moved directly by hand.

CAUTION

- Normally, release the brakes of joints one at a time. If the brakes of two or more joints must be released simultaneously due to unavoidable reasons, use extreme care. Releasing the brakes of two or more joints simultaneously may cause the arm to fall in an unexpected direction, resulting in hands or fingers getting caught or Manipulator damage or breakdown.
- Be careful of the arm falling when releasing the brake.
While the brake release switch is being pressed, the robot arm will fall by its own weight.
The arm falling may result in hands or fingers getting caught or robot damage or breakdown.
- When releasing the brake in the software, always do so with the emergency stop switch within reach. Otherwise, if the emergency stop switch is not easily accessible, you will be unable to immediately stop the arm falling due to an erroneous operation, which could lead to robot damage or breakdown.
- The brake signal is not IEC 61800-5-2 Safe brake Control (SBC) certified. As such, be aware of the potential for the robot arm to fall due to a malfunctioning brake signal when approaching the robot.

1. Start Epson RC+.

Double click the <Epson RC+> icon on the Desktop. You can also select from the Windows menu.

2. Open the command window.

From the Epson RC+ menu, select [Tools] - [Command Window].

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

```
>Reset  
>SFree, [Arm # (1 to 4) whose brake is released]
```

Execute the following command to activate the brake again.

```
>SLock, [Arm # (1 to 4) whose brake is activated]
```

B: Command execution from Epson RC+

Once the robot motors are energized, execute the command to move the robot.

This presents an example of moving all joints to the 0 pulse positions by specifying the pulse for each joint.

1. Start Epson RC+.

Double click the <Epson RC+> icon on the Desktop. You can also select from the Windows menu.

2. Open the command window.

From the Epson RC+ menu, select [Tools] - [Command Window].

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

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

For the position and posture of the Manipulator at the 0 pulse position, refer to the following manual.

"Manipulator Manual - Motion Range"

C: Jog operation from Epson RC+

Energize the robot motors, operate the robot from the Jog & Teach window of Epson RC+.

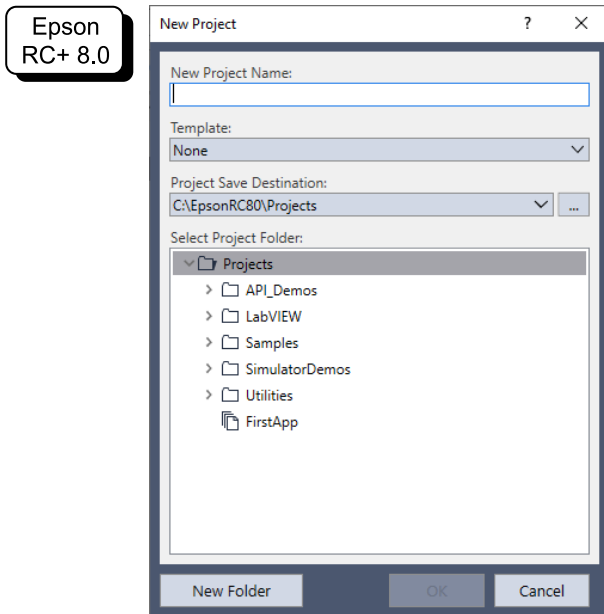
1. Start Epson RC+.

Double click the <Epson RC+> icon on the Desktop. You can also select from the Windows menu.

2. Create a new project.

i. From the Epson RC+ menu, select [Project] - [New].

The [New Project] dialog box is displayed.



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

iii. Click the [OK] button to create the new project.

2. Open the robot manager.

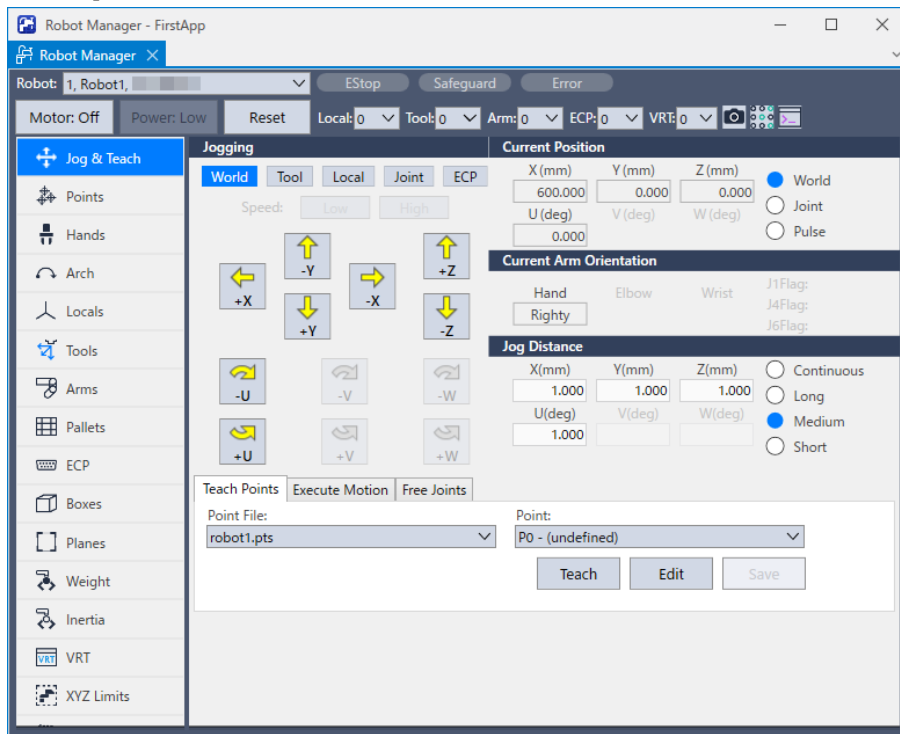
From the Epson RC+ menu, select [Tools] - [Robot Manager].

3. Turn on the motors.

Check that the [Control Panel] tab is open.

Click the [Motor: Off] button.

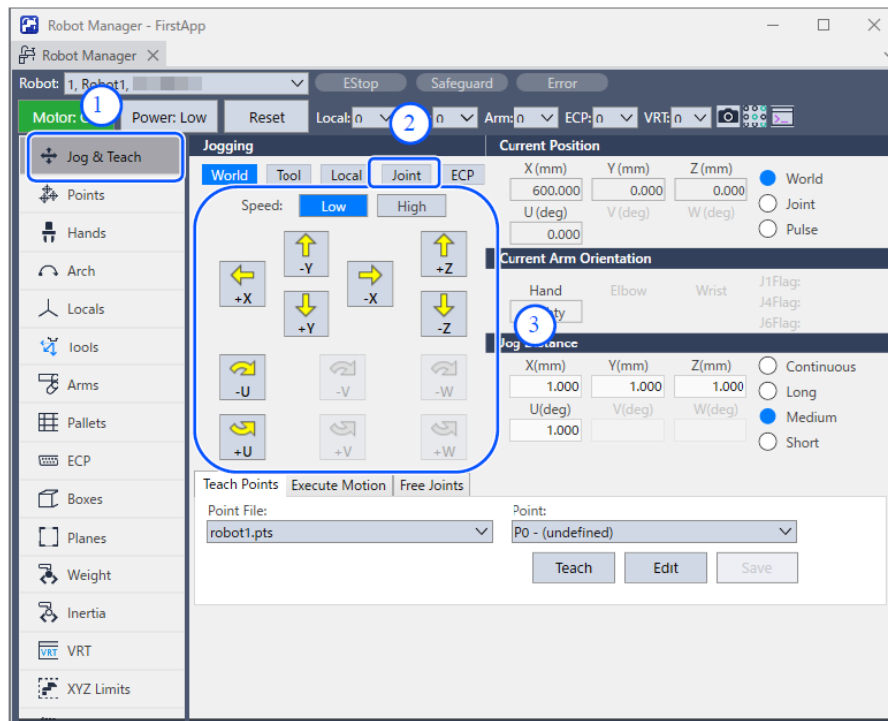
Epson
RC+ 8.0



4. Perform jog operation.

i. Select the [Jog & Teach] tab.

Epson
RC+ 8.0



ii. From [Jogging], select "Joint."

iii. Click jog keys J1-J4 to operate the selected joint.

Movement is possible by setting to other modes or setting the movement distance.

3.9.7 Writing Your First Program

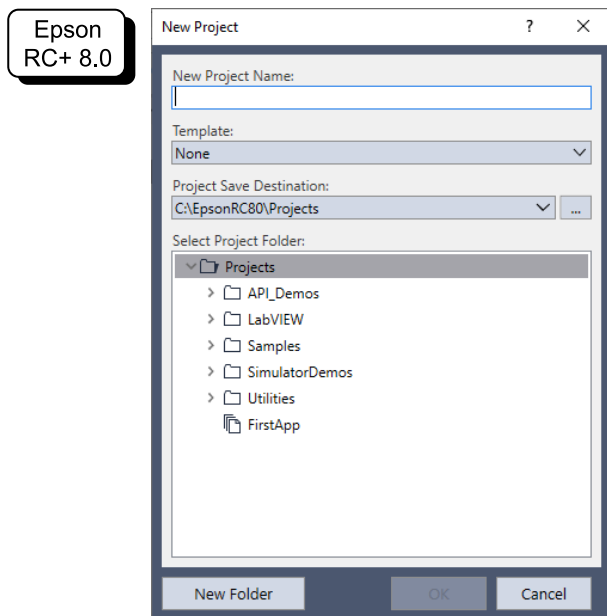
After installing the Controller and robot, and installing the Epson RC+ software on the PC, follow the procedure below to create a simple application program so that you will become more familiar with the Epson RC+ development environment.

1. Start Epson RC+.

Double click the <Epson RC+> icon on the Desktop. You can also select from the Windows menu.

2. Create a new project.

- i. From the Epson RC+ menu, select [Project] - [New]. The [New Project] dialog box is displayed.



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

- iii. Click the [OK] button to create the new project.

When the new project is created, a program called Main.prg is also created.

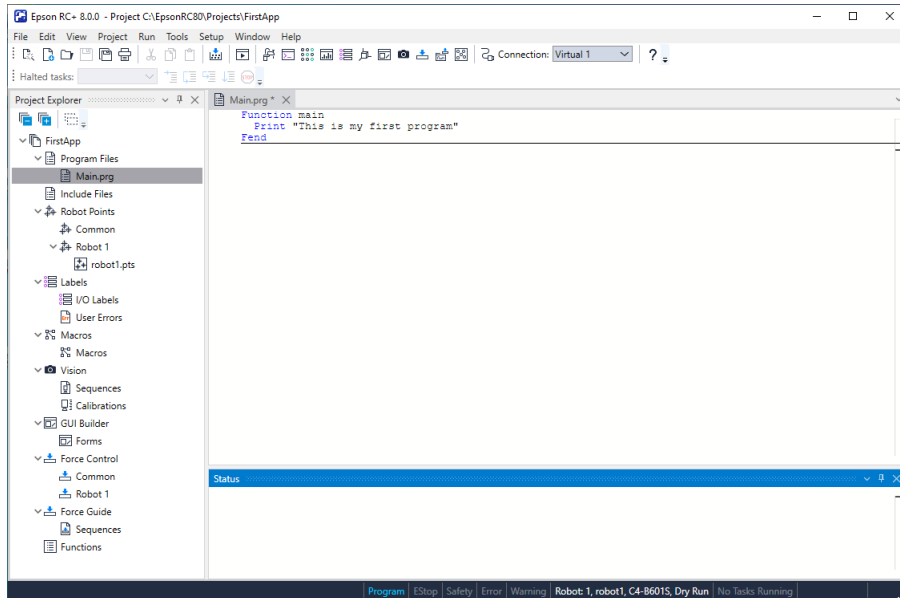
A window titled Main.prg is displayed with a cursor flashing in the upper left corner. Now you are ready to start entering your first program.

3. Edit the program.

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

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

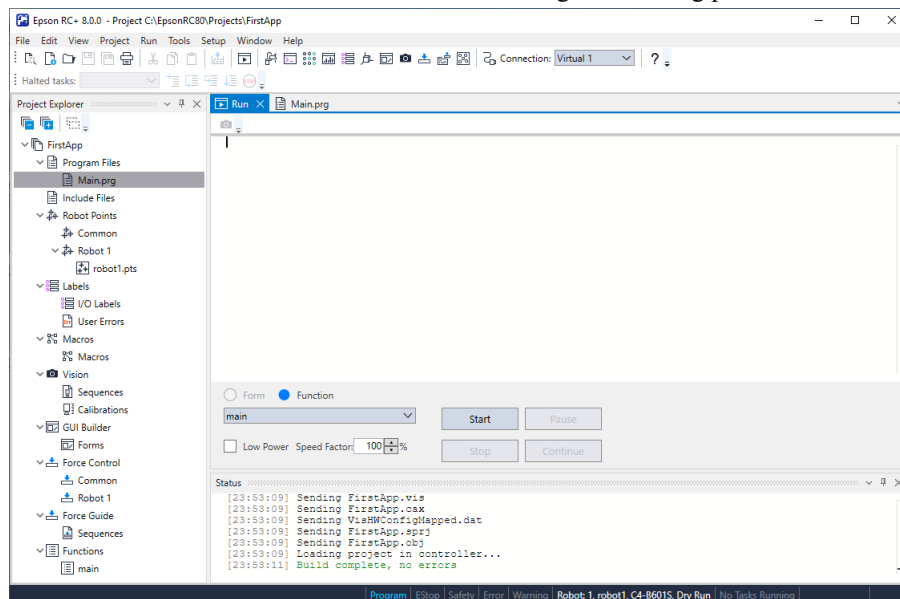
Epson
RC+ 8.0



4. Run the program.

- i. Press F5 to display the Run window. (F5 is the shortcut key for selecting [Run] - [Run Window] in the Epson RC+ menu.) At the bottom of the main window, the Status window appears indicating the build operation status.
- ii. During the project building process, your program is loaded into the memory and compiled. Then, the program and project files are sent to the Controller. If there are no errors during the building process, the Run window appears.

Epson
RC+ 8.0



- iii. Click the [Start] button in the Run window to run the program.
- iv. Messages like the following are displayed in the Status window.
Task main started
All tasks stopped

The Run window shows the statement output.

Now let's teach some robot points to create a program that moves the robot.

KEY POINTS

Teaching of this procedure should be done outside the safeguard.

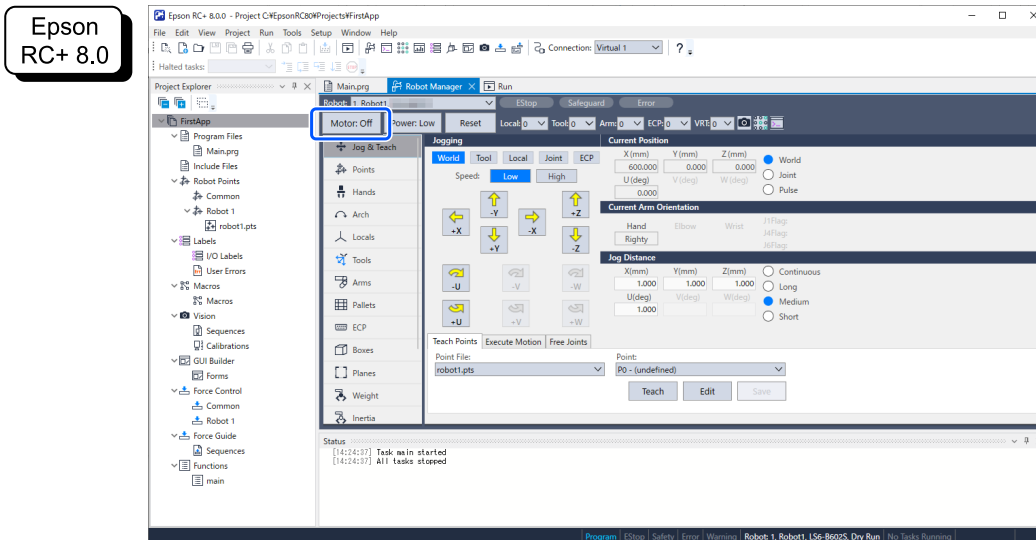
5. Teach robot points.

i. Confirm whether safe robot operation is possible. Click the [Robot Manager] button on the toolbar.

ii. Turn on the motors.

2. Make sure that [Robot Manager] is displayed.

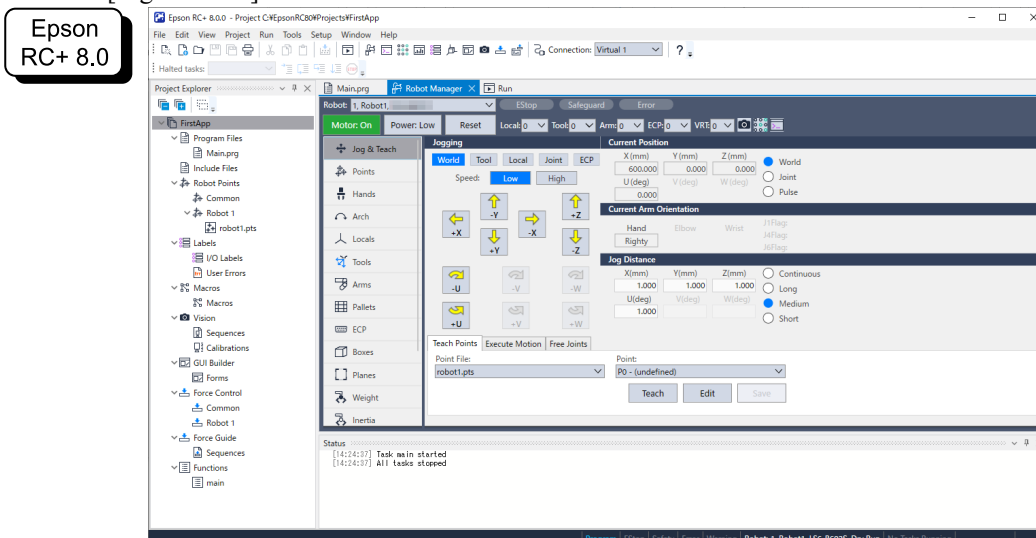
Click the [Motor: Off] button.



You are prompted to confirm the operation.

iii. Click the [Yes] button.

iv. Click the [Jog & Teach] tab.



v. Teach point P0. Click the [Teach] button in the lower right corner of the screen. You are prompted for a point label and description.

vi. Click the [+Y] jog button to jog the robot in the +Y direction. Hold the button down to keep jogging. Move the robot until it reaches around the middle of the work envelope.

- vii. Click the [-Z] button to lower the Z-axis of the robot.
 - viii. Select "P1" in the [Point:] dropdown list, which is next to the [Teach] button. The current point is set to P1.
 - ix. Click the [Teach] button. A confirmation message for teaching the point appears.
 - x. Click the [Yes] button.
 - xi. Click the [+X] button to jog the robot in the +X direction.
 - xii. Select "P2" in the [Point:] dropdown list, which is next to the [Teach] button. The current point is set to P2.
 - xiii. Click the [Teach] button. A confirmation message for teaching the point appears.
 - xiv. Click the [Yes] button.
 - xv. Click the [Save Project] button on the toolbar to save the changes.
6. Modify the program to include robot motion commands.

- i. Insert Go statements into the Main.prg program.

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

- ii. Press F5 to display the Run window.
 - iii. Click the [Start] button to execute the program.
The robot will move to the points that were taught.
7. Modify the program to change the speed of the robot motion commands.

- i. 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
```

- ii. Press F5 to display the Run window.
 - iii. Click the [Start] button to execute the program.
 - iv. The robot will move to each of the points that were taught at 20% acceleration, and deceleration. The Power High statement executes the program to operate the robot with increased speed and acceleration/deceleration.
8. Back up the project and system settings.
- Back up the project and the Controller settings of the created program. Backups can be made easily using Epson RC+. It is

important to make and store regular backups of your applications onto external media such as a USB memory device.

Backup procedure for project and system settings:

- i. From the Epson RC+ menu, select [Project] - [Copy].
- ii. In the [Copy Project] dialog box, change the [Destination Drive] box to the desired drive.
- iii. Click the [OK] button. The project is copied to the external media.
- iv. From the Epson RC+ menu, select [Tools] - [Controller].
- v. Click the [Backup Controller] button.
- vi. In the [Drive] box, select the desired drive.
- vii. Click the [OK] button. The system settings are backed up to the external media.

3.10 Second Step

After actually operating the robot system, make any required settings.

This chapter shows the manuals containing information on the necessary settings and setting procedures.

3.10.1 Connecting with External Equipment

3.10.1.1 Remote Control

Refer to the following section.

I/O Remote Settings

"Epson RC+ User's Guide - Remote Control"

I/O

Refer to the following section.

I/O Connector

"Epson RC+ User's Guide - I/O Setup"

Fieldbus I/O (Option)

Refer to the following section.

"Robot Controller Option Fieldbus I/O"

3.10.1.2 Ethernet

Refer to the following section.

LAN (Ethernet Communication) Port

"Epson RC+ User's Guide"

- "Security for Controller Ethernet Connection"
- "Security for Compact Vision CV2-A Ethernet Connection"
- "Security for Feeder Ethernet Connection"
- "Ethernet Communication"

3.10.2 Connecting the Teach Pendant (Option)

Refer to the following section.

TP Port

"Robot Controller Option Teach Pendant TP2 manual, Functions & Installation: Installation"

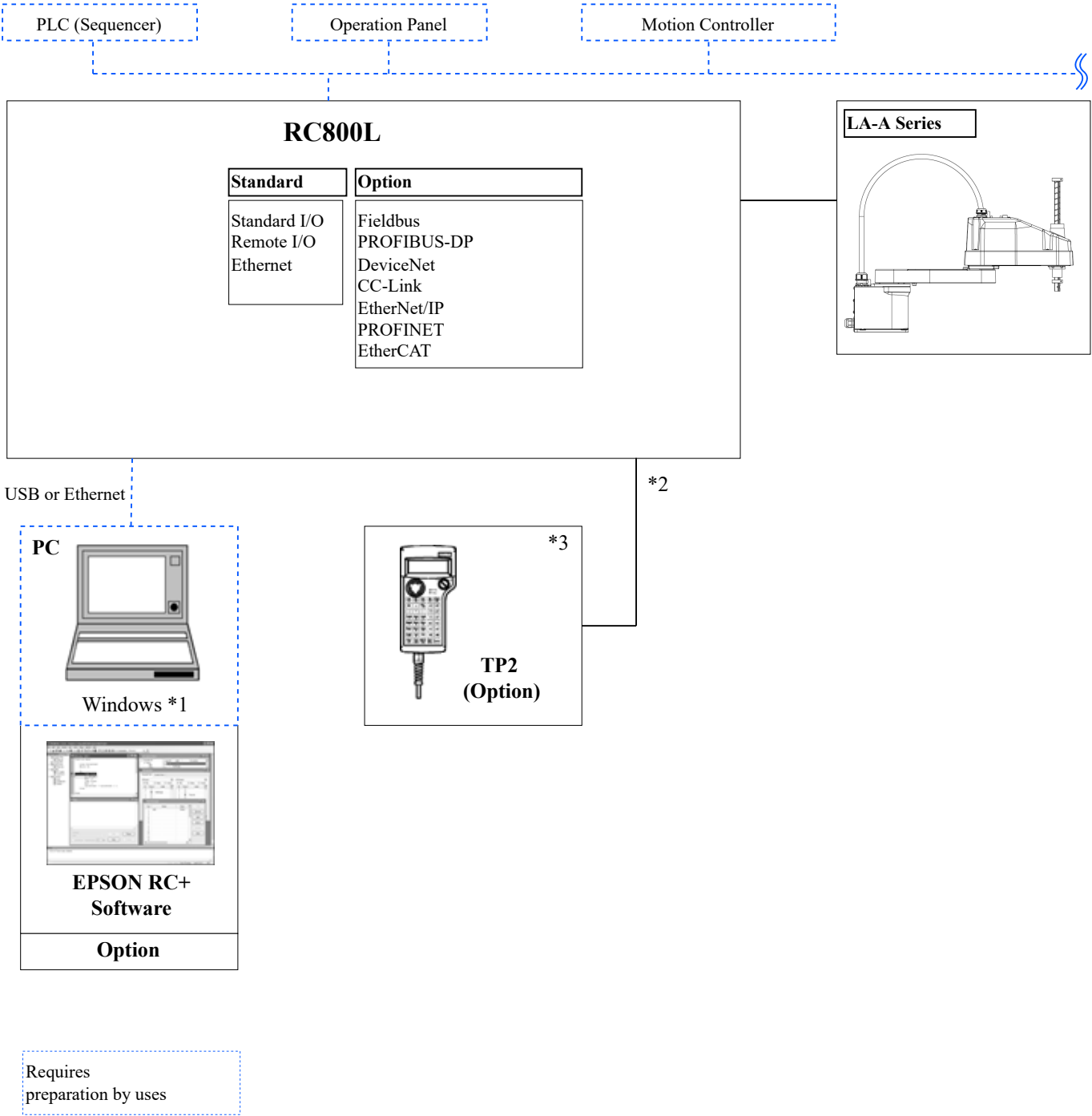
4. Function Information

This section describes each function of the Robot Controller.

This is primarily intended for those who want to learn more about Robot Controllers.

4.1 Specifications

4.1.1 System Configuration Example



*1 For the system requirements, refer to the following manual.
"Epson RC+ User's Guide"

4.1.2 Safety Functions

4.1.2.1 Safety Functions

The robot system has the following safety functions. Because of their particular importance for safety, always make sure that they are working before using the robot system.

Controller Safety Function standard functions:

■ Safe Torque OFF (STO)

A signal input from the Robot Controller opens a relay to cut off the power supply to the motors and stop the robot. This is a safe state for the Robot Controller.

STO is operated indirectly from an emergency stop or protective stop. It will also operate when the Safety board detects abnormalities. It cannot operate directly.

■ Emergency Stop

This function allows the robot to perform an emergency stop by a signal input from a safety relay or from an emergency stop switch attached to the emergency stop input connector or safety I/O connector. After the signal is input, an SS1 is executed, and after the motor stops, the robot is in an emergency stop status. During the emergency stop status, EP is displayed on the 7-segment LED of the Robot Controller.

There are three emergency stop circuits for the Robot Controller:

- Emergency stop input connector (E-Stop)
- Port of the safety I/O connector configured for the emergency stop (Safety Input)
- Emergency stop switch attached to Teach Pendant (E-Stop, TP)

■ Safeguard (SG) (protective stop)

This function allows the robot to perform a protective stop by a signal input from a safety peripheral device attached to the safety I/O connector. After the signal is input, the SS1 is executed, and after the motor stops, the robot is in a protective stop status. SO is displayed on the 7-segment LED of the Robot Controller.

The Robot Controller safeguard (SG) circuit is as follows.

- Port of the safety I/O connector configured for the safeguard (SG)

■ Enable

Enable is the path connected to the enable switch when the Teach Pendant is connected. Only Epson Teach Pendants can be connected, and customer enable switches cannot be connected.

When the system detects that the enable switch of the Teach Pendant is not in the middle position, the SS1 is executed, and the robot is in an STO state.

■ Soft Axis Limiting

This monitors that each axis of the robot is within its operating range. If the system detects that an axis of the robot exceeded the limiting range, the robot emergency stop and STO are immediately executed, putting the Robot Controller in the error status.

The restricted range for each axis of the robot is set in the dedicated software (Safety Function Manager).

■ Safety outputs

External safety devices can be connected to the safety outputs of the Robot Controller to perform notifications of the ON/OFF status of the safety functions.

By assigning settings in the dedicated software (Safety Function Manager), the following safety signals can be output:

- STO state
- Status of the emergency stop switch
- Status of the enable switch
- Enabled/disabled status of the Safety Limited Speed (SLS_T)

- **Safety Limited Speed (SLS_T)**

Monitor the robot's motion speed while it is being taught. If the system detects that the robot exceeded the Maximum Speed, the robot emergency stop and STO are immediately executed, putting the Robot Controller in the error status. The safety speed limit of the robot is set in the dedicated software (Safety Function Manager).

4.1.2.2 Safety Parameters

The equipment manufacturer should select peripherals that can meet Cat. 3 PLd using the following values.

Common parameters

Safety Status	Type of Element	Proof Test Interval	DC	PL and Category	SIL and HFT
STO	B	20 years	Medium	PLd, Cat.3	SIL2, HFT1

Parameters for each safety function

Controller Safety Function Name			Enable Mode	Stop Category	SFF	PFHd 10 ⁻⁷	Response Time (ms)
Emergency Stop	E-Stop, TP		ALL	1	98%	2.1	690
	Safety Input		ALL	1	98%	2.1	690
Safeguard (SG)/Safeguard (Protective Stop)			AUTO	1	98%	2.1	700
Enable			TEACH TEST	1	98%	2.1	690
Soft Axis Limiting			AUTO TEST	1	98%	2.1	80
Safety Outputs	STO		ALL	-	99%	1.5	680
	Emergency Stop	E-Stop, TP	ALL	-	99%	1.1	20
		Safety Input	ALL	-	99%	1.1	20
	Enable		ALL	-	99%	1.1	20
	SLS_T		TEACH	-	99%	1.1	50
SLS_T			TEACH	1	98%	2.1	80

The B10D values for switches provided by Epson are as follows:

- Emergency Stop switch (Option and TP): 250,000
- Enable switch: 1,000,000

4.1.3 Specifications Table

Item	Specifications			
Machine name	Robot Controller			
Product series	RC800L			
Model	R137AN: For LA-A Series			
Robot Manipulator control	Programming language and robot control software	Epson RC+ (multitasking robot language)		
	Speed control	During PTP control	Programmable from 1 to 100%	
		During CP control	Can be programmed by specifying actual speed	
	Acceleration/deceleration control	During PTP control	Programmable from 1 to 100% and auto acceleration	
		During CP control	Can be programmed by specifying actual acceleration	
Operation method	PTP (Point-To-Point) method CP (Continuous Path) method			
Storage capacity	Maximum object size	4 MB		
	Point data area	1,000 points/file		
	Backup variable area	Max. 768 kB (including management table area) 400 variables are available in String type (assuming 1,024 bytes). For other types (Boolean, Byte, Double, Int32, Int64, Integer, Long, Real, Short, Ubyte, UInt32, UInt64, and Ushort), 4,000 variables are available.		
External I/O signals (standard)	Safety I/O	Inputs	5, redundant path	Assigned functions can be changed by the "Safety Function Manager"
		Outputs	3, redundant path	
	Standard I/O	Inputs	24	8 inputs/8 outputs have remote function assignments Assignments can be changed
		Outputs	16	
Communication interface (standard)	Ethernet	1 port 10BASE-T, 100BASE-TX, 1000BASE-T		
	Development PC Connection USB Port	1 port, TypeB		

Item	Specifications			
	Memory Port	1 port, TypeA Use a USB memory device that meets the following conditions: - USB 2.0/3.0 compatible - FAT32 format - No security features (USB memory devices that require password entry cannot be used) - MBR format * By using Microsoft's "Media Creation Tool", the USB memory will be in GPT format. Therefore, you will need to convert it to MBR format.		
Options	Communication interface	Fieldbus I/O	PROFIBUS-DP	One of those at left can be added
			DeviceNet	
			CC-Link	
			EtherNet/IP	
			PROFINET	
			EtherCAT	
Protective functions *1	Low power mode, dynamic braking, overload detection, torque error detection, speed error detection, position deviation, speed deviation overflow detection, overheat detection, fan trouble detection (excluding Controllers that do not have a fan), relay melting detection, overvoltage detection, low AC power voltage detection, temperature abnormality detection, CPU error detection, Memory error detection			
Power supply	200 to 240 VAC Single phase, 50 or 60 Hz			
Maximum rated capacity	2.5 kVA (varies depending on the Manipulator model.)			
Full load current	15.0 A			
Short-circuit current rating	5 kA			
Maximum allowable fault loop impedance	TN: 0.32Ω TT: 200Ω			
Insulation resistance	100 MΩ min.			
Ambient temperature	Installation	5 to 40°C		
	Transportation, storage	- 20 to 60°C		
Ambient relative humidity	Installation	20 to 80% (with no condensation)		
	Transportation, storage	10 to 90% (with no condensation)		
Weight *2	10 kg			
Protection class	IP20			

Item	Specifications
Vibration resistance	Frequency: 10 to 57 Hz Amplitude: 0.075 mm Frequency: 57Hz to 150 Hz Acceleration: 9.8 m/s ² 10 times each in X, Y, and Z directions
Shock resistance	Acceleration: 50 m/s ² Applied time: 30 ms 3 times each in X, Y, and Z directions
Overvoltage category	2
Pollution level	2

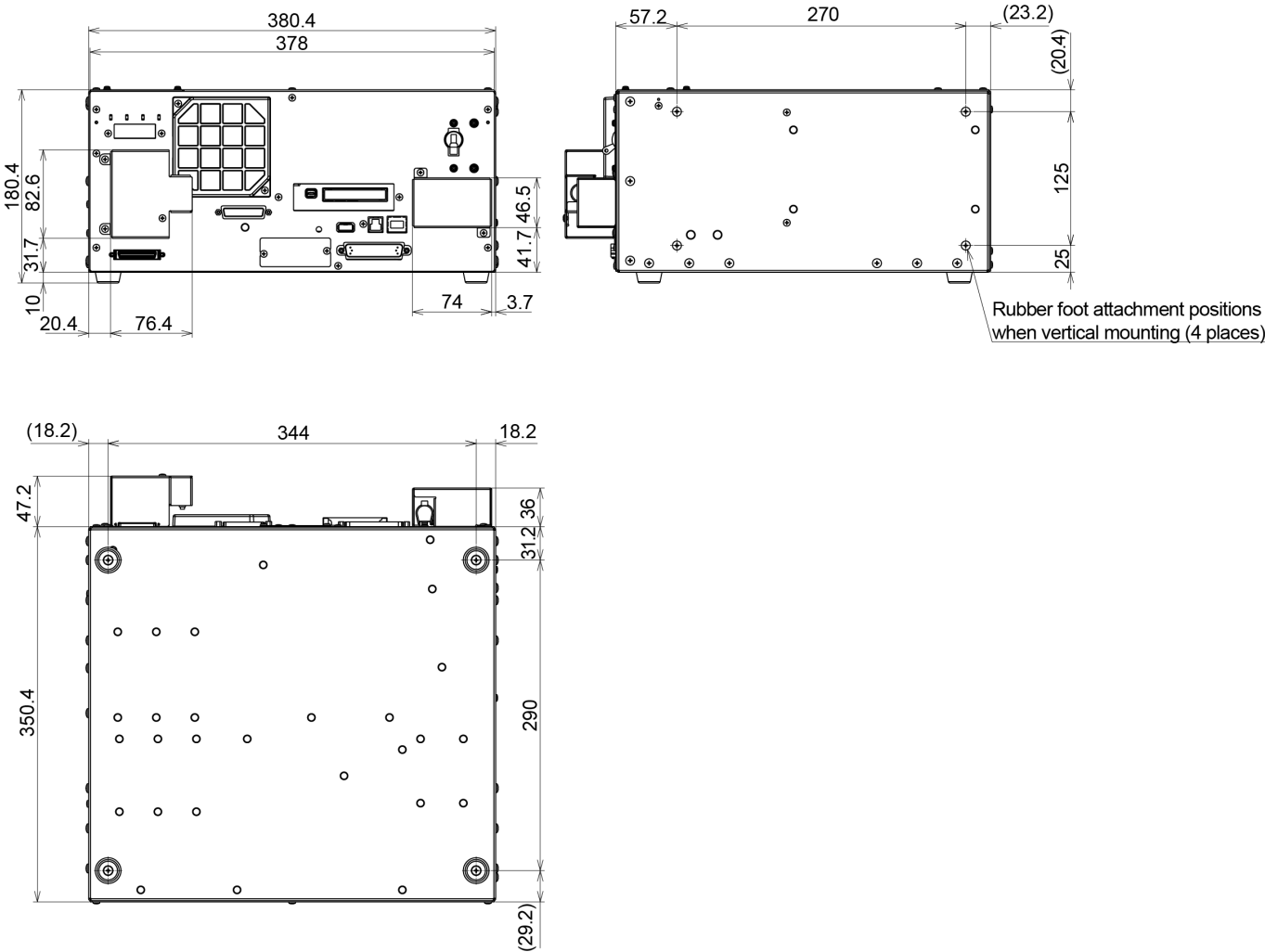
*1 Thermal memory function is not provided.

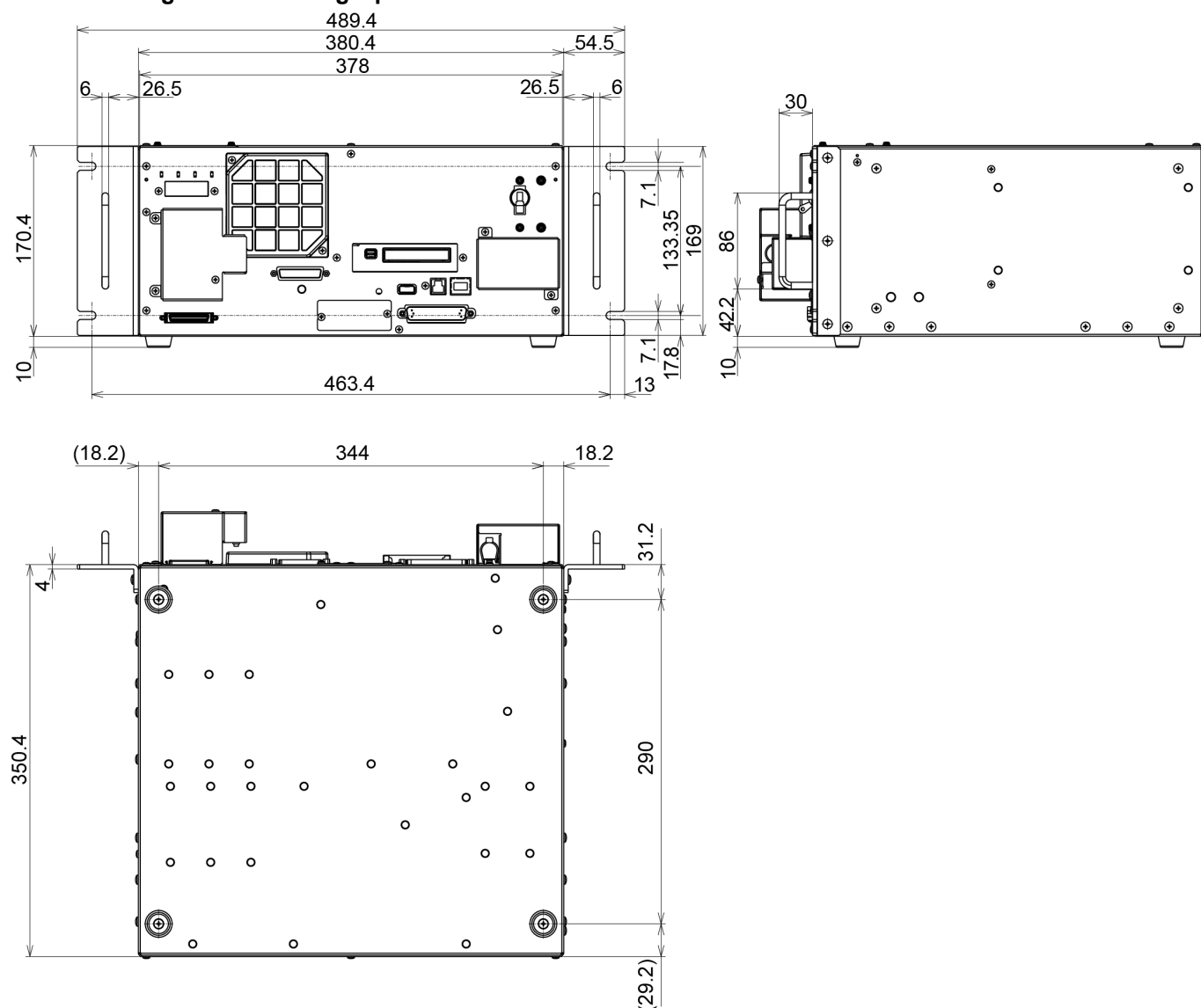
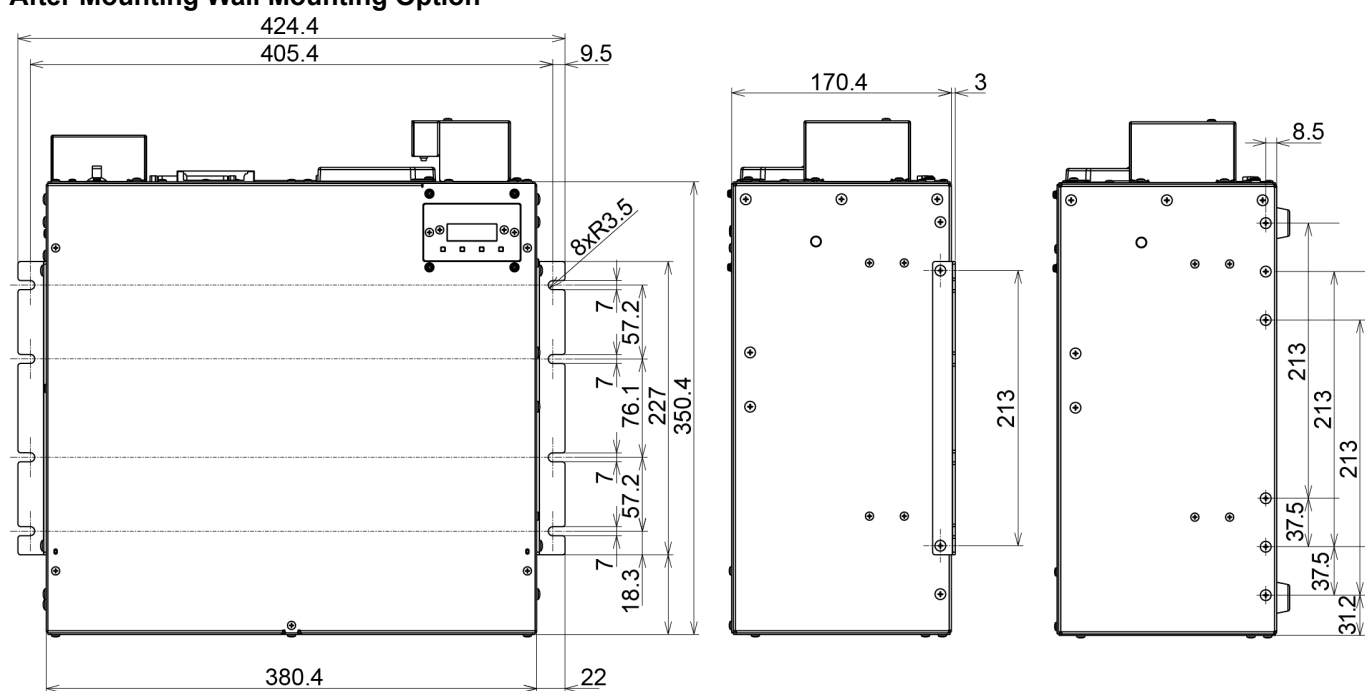
*2 The Controller body is labeled with the weight.

When transporting or relocating the Controller, check the weight and be careful not to hurt your back when lifting it. Also, be careful not to pinch or injure your hands, feet, or other body part due to dropping it.

4.1.4 Dimensions

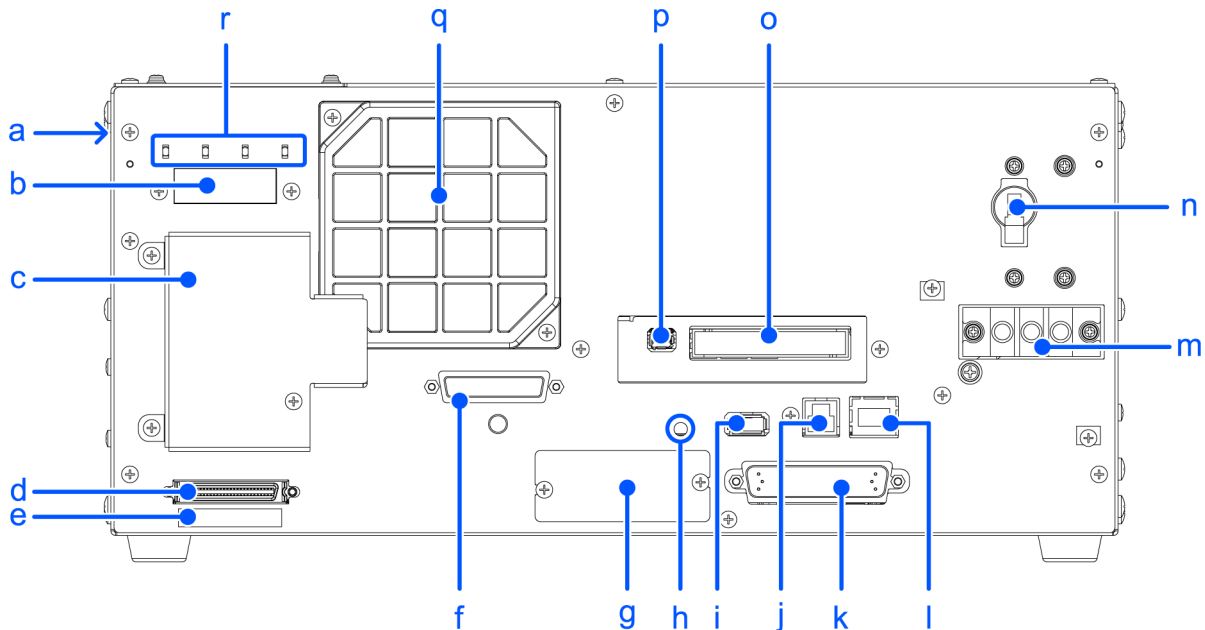
Standard
(Units: mm)



After Mounting Rack Mounting Option**After Mounting Wall Mounting Option**

4.2 Part Names and Their Functions

RC800L



[a] Face plate label

This label contains the Controller's serial number and other information.

[b] 7-segment display

This is a 4-digit, 7-segment LED that is used to indicate the line number, and the Controller status (error number, warning number, emergency stop, or safeguard status).

Refer to the following section.

LED and 7-segment LED

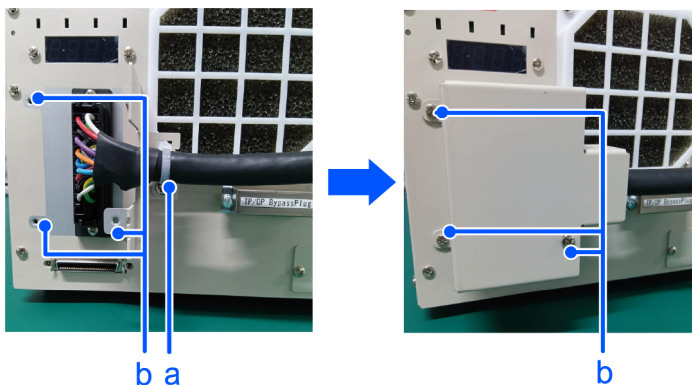
[c] M/C POWER connector (the connector has a cover)

This is the power supply connector for the Manipulator.

Connect the power cable supplied with the Manipulator to this connector.

Turn off the power before inserting or removing the connector.

1. Screw the clamp into place (in one place) and secure the cable routing.
2. Screw the cover to the connector (in three places).



Symbol	Description
a	Clamp screw position (in one place)
b	Connector screw position (in three place)

[d] M/C SIGNAL connector

This connector is for signals such as a motor position detector for Manipulators.

Connect the signal cable supplied with the Manipulator.

Turn off the power before inserting or removing the connector.

Insert the connector until it clicks into place.

[e] Serial number label for connected Manipulator

This label indicates the Manipulator to be connected.

It contains the Manipulator model and serial number.

MANIPULATOR
LVxxxx0000

[f] TP port

This port is for connecting the optional Teach Pendant (TP2) or the Teach Pendant (TP) bypass plug.

Refer to the following section.

TP Port**KEY POINTS**

Do not connect the following devices to the TP port of RC800L. The different signal arrangement could cause a breakdown in the device.

- Dummy plug (optional device)
- Operation Pendant OP500
- Operator Pendant OP500RC
- Jog Pad JP500
- Operator Panel OP1
- Teach Pendant TP1/ TP3/ TP4
- Hot Plug Kit

[g] Fieldbus I/O

This connector is for connecting optional Fieldbus I/O.

[h] Trigger switch

This switch is for the "Controller Backup" function to a USB memory device.

Refer to the following section.

Memory Port**[i] Memory port**

This port is for connecting a USB memory device (commercially available) and using the Controller Backup function. Do not connect any USB devices other than USB memory devices.

Refer to the following section.

Memory Port

[j] Development PC connection USB port

This port is for connecting the Controller and development PC with a USB cable.

Do not connect any device other than the development PC.

Refer to the following section.

[Connecting the Development PC and the Controller](#)

[k] I/O connector

This connector is used for connecting external input/output devices. Up to 24 inputs and 16 outputs can be connected.

Refer to the following section.

[I/O Connector](#)

[l] LAN (Ethernet communication) port

This port is for connecting the Controller and development PC with an Ethernet cable.

Refer to the following section.

[LAN \(Ethernet Communication\) Port](#)

[m] AC power supply

This connector is used to input a 200 VAC power supply.

Refer to the following section.

[Power Supply - AC Power Cable](#)

[n] POWER switch

This is the power switch for the Controller.

[o] Safety I/O connector

These connectors are for safety-related input signals such as emergency stop and safeguard and for output signals that can be connected to safety PLCs and similar devices.

Refer to the following section.

[Safety I/O Connector](#)

[p] Emergency stop input connector

This port is a dedicated connector for emergency stop signal input.

Refer to the following section.

[Emergency Stop Input Connector](#)

[q] Cooling fan filter

This is the dust filter. It is mounted in front of the cooling fan.

Even Controllers that do not have a cooling fan have a mounted filter.

Filters should be inspected periodically for dirtiness and cleaned as necessary.

Leaving the filter dirty may cause the inside of the Controller to overheat or may cause a malfunction of the robot system.

[r] LED

The LED corresponding to the current operation mode is turned on.

(TEST, TEACH, AUTO, PROGRAM)

Refer to the following section.

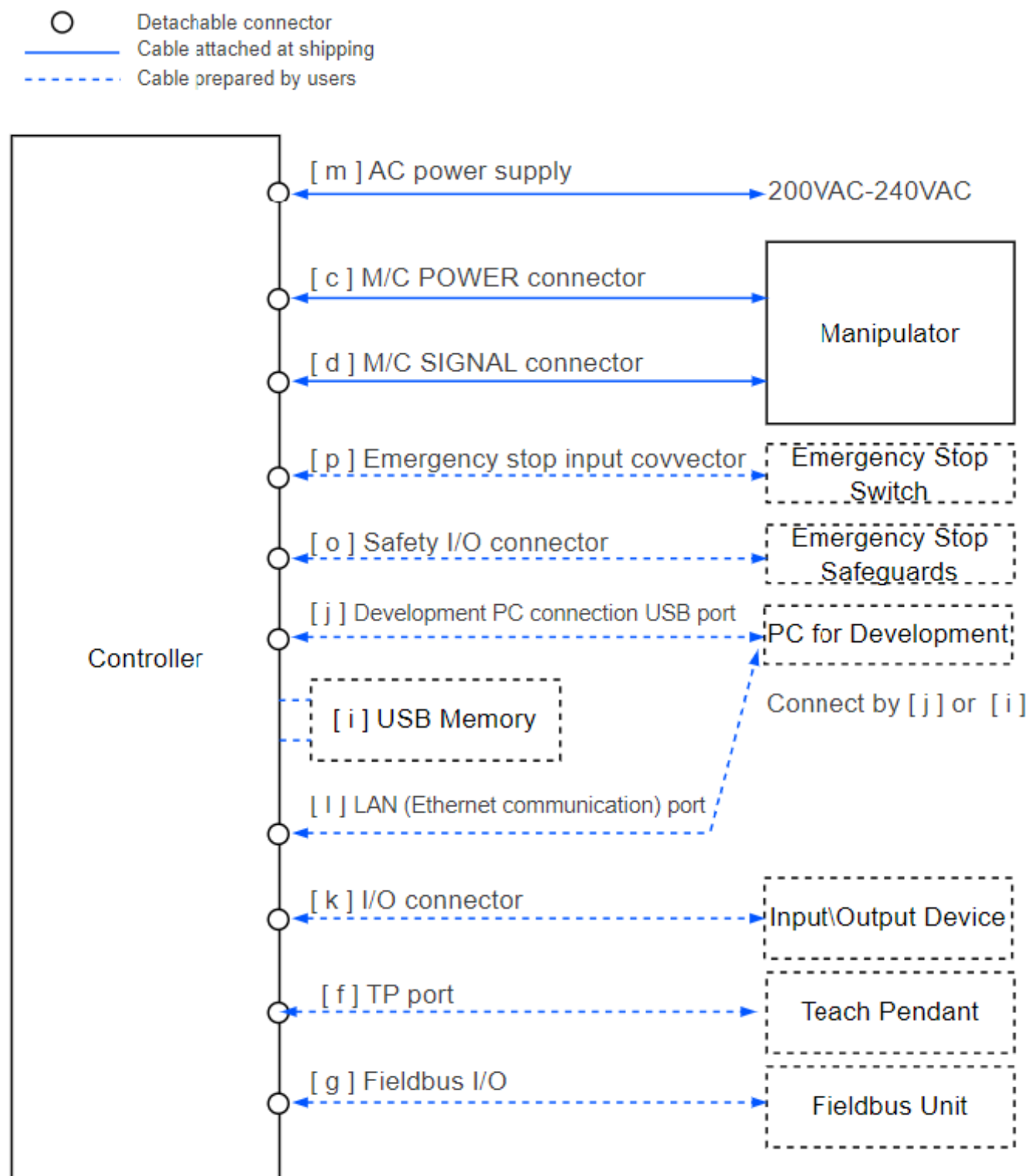
[LED and 7-segment LED](#)

Lockout mechanism

RC800L Controller does not have a lockout mechanism. When you perform maintenance or the like with the AC power input sections turned off, lock out or tag out the disconnecting device used with the power cable.

4.3 Connecting the Cables

4.3.1 Connection Example



4.3.2 Connecting Controllers and Manipulators

A power cable and signal cable are used to connect the Controller to the Manipulator.

WARNING

- Before connecting or disconnecting cables, be sure to shut off the AC power input sections. This includes turning off the Controller and related equipment, unplugging the power cable from the outlet, and so on. Connecting or disconnecting cables while the power is on may result in an electric shock or malfunction.
- Be sure to connect the cables properly. Also, protect cables by using strong cable covers, and do not place heavy objects on the cables, bend them to extreme angles, pull them forcibly, or allow them to get pinched. Damaged cables, broken wires, or contact failure is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

CAUTION

- The serial number of the supported Manipulator is labeled on the Controller. Check that the serial number matches for each device. Improper connection between the Manipulator and the Controller may not only lead to malfunction of the robot system but also safety problems.
- When connecting the Manipulator and the Controller, check that the serial numbers match for each device. Improper connection between the Manipulator and the Controller may not only lead to malfunction of the robot system but also serious safety problems. The connection method between the Manipulator and the Controller varies depending on the Controller.

The Manipulator model and various setting values are stored in the Controller. For this reason, connection must be performed to the Manipulator with the serial number indicated on the serial number label on the front face of the Controller.

KEY POINTS

The serial number of the Manipulator is shown on the Manipulator's face plate. For details, refer to the following manual.

"Manipulator Manual"

4.3.3 LED and 7-segment LED

4.3.3.1 LED and 7-segment LED Display

The Controller has 4 LEDs and a 4-digit, 7-segment LED

- LED
The LED (TEST, TEACH, AUTO, PROGRAM) corresponding to the current operation mode (TEST, TEACH, AUTO, PROGRAM) lights up.
- 7-segment LED
This displays line numbers and the Controller status (error number, warning number, emergency stop, and safeguard status).

From immediately after power-on until Controller startup

- LED
All four LEDs blink.

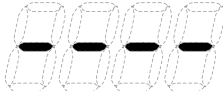


- 7-segment LED
All 4-digit 7 segments are turned off.

After Controller startup

- LED
The LEDs (TEST, TEACH, AUTO, PROGRAM) corresponding to the current operation mode (TEST, TEACH, AUTO, PROGRAM) turn on.
- 7-segment LED
The displayed information changes depending on the Controller status.
If several Controller conditions occur at the same time, the displayed information on the top row takes precedence. For example, if an "emergency stop state" and a "safeguard open state" occur at the same time, the following display will appear.



Controller State	7-segment LED Display	
Preparing to save the Controller state to the USB memory device	Repetition of the following display 	
Saving the Controller state to the USB memory device	The elapsed time while saving the Controller state is displayed as a percentage	
Successfully saved Controller state to the USB memory device	(00) display (2 sec.)	
Failed to save Controller state to the USB memory device	(EE) display (2 sec.)	
Emergency stop state		Blinking display
Safeguard open state	(SO)	Blinking display
Error state	Repetition of 4-digit error number (0.5 sec.) and (EEEE) display (0.5 sec.)	*1
Warning state	Repetition of 4-digit warning number (0.5 sec.) and (HELP) display (0.5 sec.)	*1

Controller State	7-segment LED Display		
READY state		Blinking display	
START state	 (L) Line number	Blinking display	*2
PAUSE state	 (P) Line number	Blinking display	*2

*1 For error numbers, please refer to the following manual or online help.

"Status Code/Error Code List"

*2 In the initial state, the execution line of task number 1 is displayed in 3 digits.





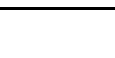

The task number that is displayed can be changed with a Ton statement.



For details, refer to the following manual or online help.

"Epson RC+ SPEL+ Language Reference"

4.3.3.2 Displays of Special States

When the 7-segment display shows the following details, it indicates a special state.

7-segment LED Display	State	Remedy
	Controller startup process failed	When Initialize Error occurs, restart the Controller. If the Initialize Error is still displayed even after restarting the Controller, please contact the supplier.
	Controller startup process failed	When Initialize Error occurs, restart the Controller. If the Initialize Error is still displayed even after restarting the Controller, please contact the supplier.
	Display: 9999 Controller is in recovery mode	Refer to the following section and carry out recovery work. Appendix C: Troubleshooting-Controller Recovery
	Display: 9998 Low AC power detected and Controller software terminated	Confirm the AC power supply voltage. If this occurs after maintenance, confirm that each harness is properly connected to the board.
	Display: 9997 Epson RC+ (software) or the Teach Pendant (optional) issued a command to exit the software.	This is the normal display when the system is shut down. No action is required.
	Hardware information is updating	If hardware information is updated while updating the firmware, it will be displayed. The data is updating. Do not turn off the power until the indicator disappears.

7-segment LED Display	State	Remedy
	System storage initialization The numeric value represents the initialization status. 00 % to 99 %	The data is updating. Do not turn off the power until the indicator disappears.
	System error S-00 % to S-99 %	Restart the Controller. If it is still displayed even after restarting the Controller, please contact the supplier.

4.3.4 Protective Functions

The robot system is equipped with protective functions operated by the software to protect peripheral devices and the robot system itself. However, these functions are only intended for unexpected events.

- **Low power mode**

This mode keeps a low motor output.

Execution of a power mode change command allows changing to a restricted state (low power mode) regardless of whether the safeguard is opened or closed and regardless of the operation mode. Low power mode ensures operator safety and reduces the risk of destruction and damage to peripheral equipment due to careless operation.

- **Dynamic braking**

The dynamic brake circuit consists of a relay that short-circuits the motor power wire at the motor side (brake action).

When an emergency stop is input, or when the following abnormalities are detected, the dynamic brake is activated to stop motor rotation. (Encoder disconnection detection, overload detection, torque error detection, speed error detection, position deviation overflow detection, speed deviation overflow detection, CPU error detection, memory error detection, overheat detection)

- **Overload detection**

This detects a motor overload state.

- **Torque error detection**

This detects abnormalities in the motor torque.

- **Speed error detection**

This detects abnormalities in the motor speed.

- **Position deviation overflow detection**

This detects abnormalities in the difference between the motion command and the current position.

- **Speed deviation overflow detection**

This detects abnormalities in the difference between the speed command and actual speed.

- **SCPU error detection** A watchdog timer is used to detect abnormalities in the CPU that controls the motor. Also, the CPU that manages the system in the Controller and the CPU that controls the motor constantly monitor each other's status.

- **SMemory error detection** This detects checksum errors in memory.

- **Overheat detection**

This detects temperature abnormalities in the motor driver module.

- **Relay melting detection**

This detects melting or open failure of relay contacts.

- **Overvoltage detection**

This detects overvoltage errors in the Controller.

- **AC power voltage drop detection**

This detects a drop in the power supply voltage.

- **Temperature error detection**

This detects abnormalities in the Controller temperature.

- **Fan trouble detection**

This detects abnormalities in the fan speed.

4.4 Installation

4.4.1 Bundled Accessories

For details about bundled accessories, refer to the following section.

[Appendix B: Bundled Accessories](#)

4.4.2 Installation Requirements

WARNING

- Do not disassemble the product in areas not described in the manual or perform maintenance in a manner different from these procedures. Improper disassembly or maintenance may not only lead to a malfunction in the robot system, but can also cause serious safety issues.

CAUTION

- Manipulators and Controllers should be used under the environmental conditions described in the respective manual. This product is designed and manufactured for use in a normal indoor environment. Use of the product in an environment that does not meet the operating environmental conditions will not only shorten the product life, but may also cause serious safety issues.

4.4.2.1 Installation Environment

A suitable environment is necessary to maintain the functionality of the robot system and ensure its safe use. The Controller should be installed in a location that meets the following conditions.

CAUTION

- The Controller is not designed with cleanroom specifications. If it must be installed in a cleanroom, adequate measures must be taken for the environment, such as by enclosing the Controller in a cabinet with adequate ventilation and cooling.
- Install the Controller in a location near an outlet that allows easy connection and disconnection of power cables.
- Install the Controller outside the safety barriers.
- If there are conductive objects such as fences or ladders within 2.5 meters of the Controller, these objects must be grounded.
- This product should be used in an overvoltage category 2, pollution degree 2 environment.

- Ambient temperature**

5 to 40°C

- Ambient relative humidity**

20 to 80% (with no condensation)

- Fast transient burst noise**

2 kV or less (power supply wire)

1 kV or less (signal wire)

- **Electrostatic noise**

4 kV or less

- **Base table**

- The Controller should be installed 0.4 to 2 meters above the floor for ease of maintenance.
- The power shut-off switch should be installed at a height of 0.6 to 1.9 meters from the floor.

- **Installation surface**

Inclination 0.5° or less

(If installed vertically, the Controller may fall over when touched.)

- **Altitude**

2,000 m or less

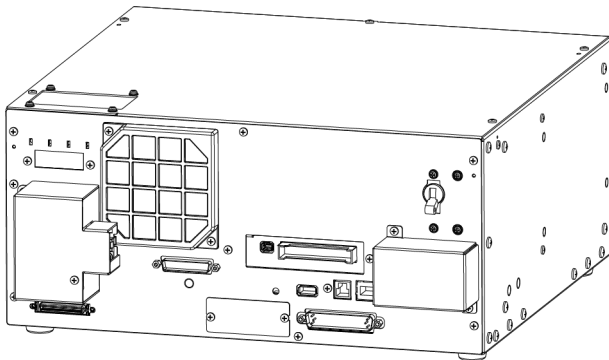
If the Controller must be installed in an environment that does not satisfy the conditions below, adequate countermeasures must be taken for the environment, such as by enclosing the entire Controller in a cabinet with adequate ventilation and cooling.

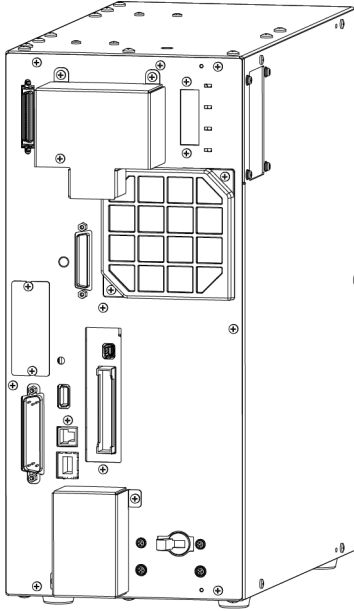
- Indoor, well-ventilated area
- Not exposed to direct sunlight
- Not exposed to radiant heat
- Not exposed to air that contains dust, oily mist, oil smoke, salt, metal powder, corrosive gas, or other contaminants
- Not exposed to splashing of water
- Not exposed to impacts or vibrations
- Not exposed to relays, contactors, or other sources of electronic noise
- Not exposed to strong electric or magnetic fields

4.4.2.2 Installation Method and Space

Install the Controller on a flat surface (such as a wall, base table, and Controller box) in the orientation shown in (A) to (C).

(A) Flat mounting

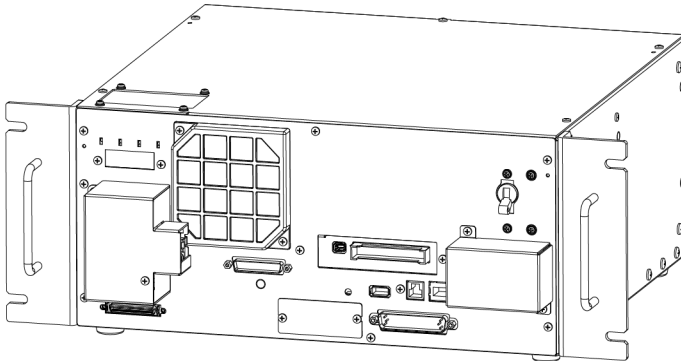


(B) Vertical mounting

* The rubber feet on the bottom need to be replaced. Attach the rubber feet with the flat side facing the Controller. Remove the screws that contact the rubber feet.

The size of the screws securing the rubber feet is $M4 \times 8$.

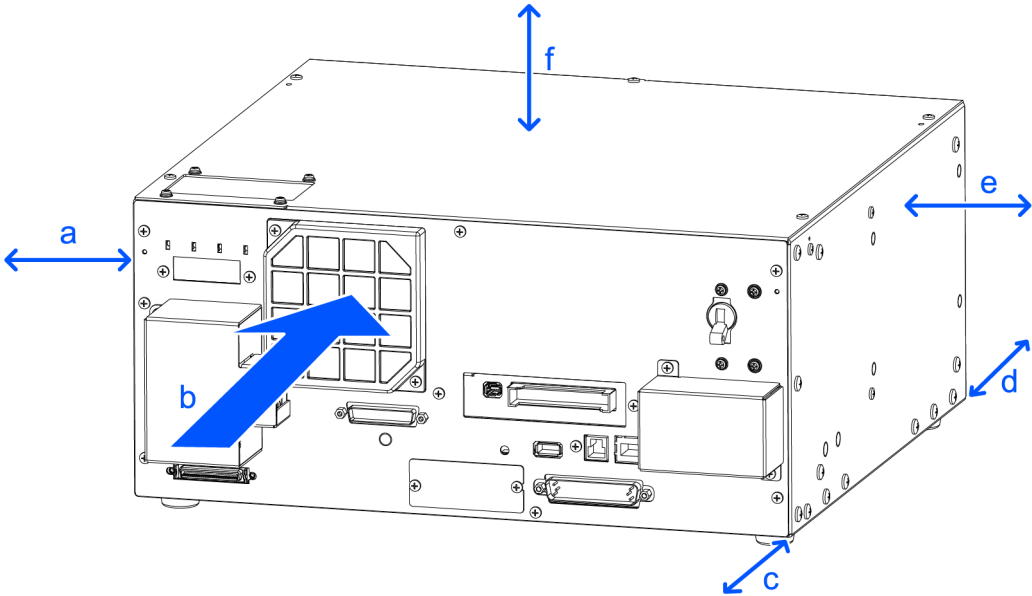
Be careful to not lose the screws when replacing the rubber feet. Do not use screws with a different size.

(C) Rack mounting (option)

* A plate for rack mounting is required. The rack mounting is an option. For more information, please contact the supplier.

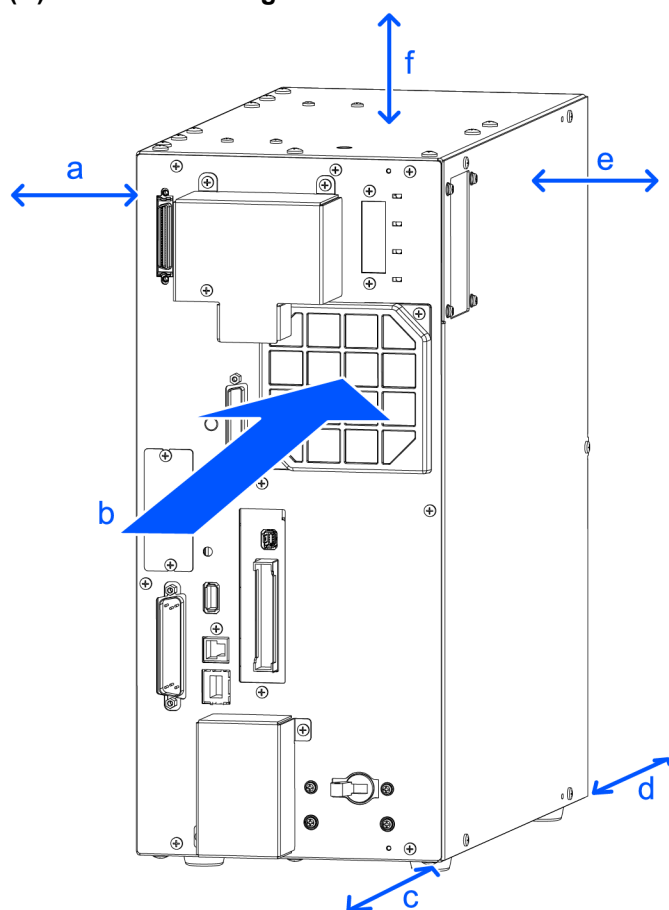
To ensure proper ventilation around the supply and exhaust ports, install the Controller at a position that is the following distance away from other equipment and walls.

(A) Flat mounting, (C) Rack mounting
(Illustration shows flat mounting.)



Symbol	Description
a	50 mm
b	Controller fan air direction
c	200 mm (excluding mounting surfaces such as the base table)
d	100 mm
e	50 mm
f	50 mm *

* Leave a space of at least 200 mm to ensure easy access for maintenance.

(B) Vertical mounting

Symbol	Description
a	50 mm
b	Controller fan air direction
c	200 mm (excluding mounting surfaces such as the base table)
d	100 mm
e	50 mm *
f	50 mm

* Leave a space of at least 200 mm to ensure easy access for maintenance.

- The Controller's exhaust port blows out air at a temperature about 10°C higher than the ambient temperature. Make sure that heat-sensitive devices are not placed near the exhaust port.
- Route the cables so that the Controller can be pulled out in the forward direction.

4.4.2.3 Wall Mounting Option

The Controller has a wall mounting option. For more information, please contact the supplier.

4.4.3 Power Supply

4.4.3.1 Power Supply Specifications

Prepare an AC power supply that meets the following specifications.

Item	Specifications
Rated voltage	200 to 240 VAC ($\pm 10\%$)
Number of phases	Single phase
Frequency	50 / 60 Hz
Guaranteed time for momentary power interrupt	10 ms or less
Rated capacity *1	Max: 2.5 kVA The rated capacity in actual use depends on the type of Manipulator and its operation and load. For the approximate rated capacity of each model, refer to the following values. LA3-A: 0.8 kVA LA6-A: 0.9 kVA For the rated capacity of the Manipulator motor, refer to the following manual. " Manipulator Manual"
Rated current	R137AN: 2.2 A
Full load current	15 A
Short-circuit current rating	5 kA
Inrush current	At power-on: Approx. 85 A (2 ms.) With motor on: Approx. 75 A (2 ms.)
Leakage current	Less than 3.5 mA
Overvoltage category	2

*1 This is calculated based on the peak current during cycle operation.

Install a circuit breaker (double-pole interruption type) with a rated current of 15 A or less in the AC power line.

If installing a circuit breaker, be sure to use an inverter type that is insensitive to leakage currents at frequencies above 10 kHz.

If installing a circuit breaker, select one that can withstand the above inrush current.

The power receptacle should be installed as close as possible to the equipment and where the plug can be easily connected and disconnected.

This product should be used in overvoltage category 2 or pollution degree 2 environments.

When installing a transformer, select one that meets the following specifications Refer to the following for connections.

AC Power Cable

Item	Specifications
Capacity	3.5 kVA
% Impedance	2.1% or more

If installed in North America, the transformer overload protection should be in accordance with NFPA 70.

The requirements of EN 60364-4-41 must be satisfied under the following conditions.

TN

Product name	CB, CP, NFB Rated current	System voltage	Maximum allowable fault loop impedance
RC800L	15 A	200V	0.32Ω

TT *1, *2

Product name	Circuit breaker *3		System voltage	Maximum allowable fault loop impedance *4
	Rated current	Rated sensitivity current (I Δ n)		
RC800L	15 A	30 mA	200V	200Ω

*1 The rated sensitivity current and maximum allowable fault loop impedance may be specified by the regulatory authorities. Follow their instructions if any.

*2 Type B circuit breakers may be required.

*3 A circuit breaker is required outside of the Controller. Evaluated using the NV50-SVFU. An equivalent product can also be used.

*4 Including ground resistance.

4.4.3.2 AC Power Cable

WARNING

- All work operations should be performed by people with specialized knowledge and skills in the field.
- The ground wire (green/yellow) of the AC power cable must be connected to the ground terminal of the power distribution system. If the ground wire is improperly connected to ground, it may result in the electric shock.
- Always use a power plug or a disconnecting device for the power connection cable. Never connect the Controller directly to the factory power supply.
- Select a plug or disconnecting device which complies with the safety standards of the respective country.
- When connecting to a transformer, connect the N and PE terminals of the AC power cable to the neutral terminal of the transformer.

Connect the power supply as shown in the table below.

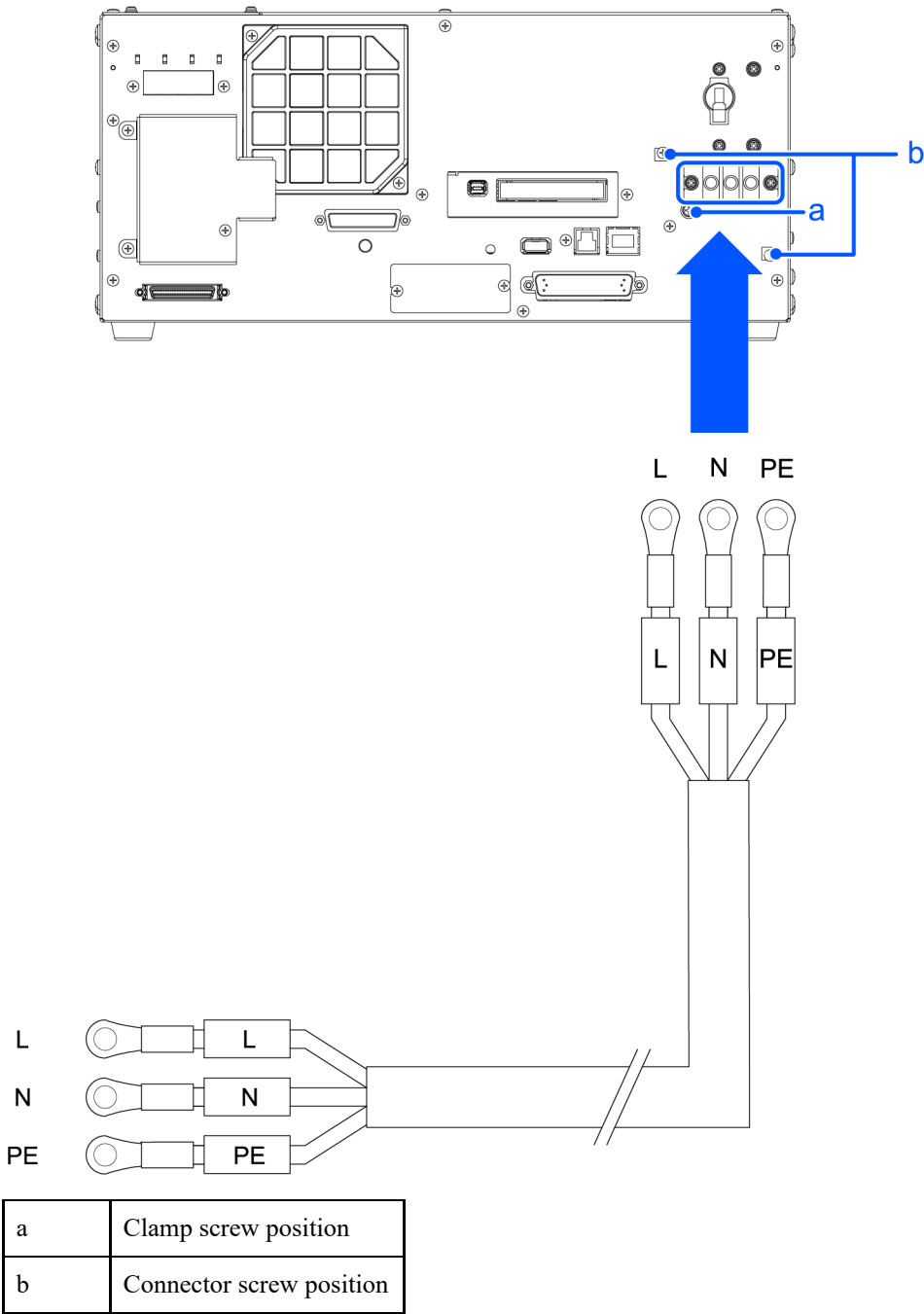
Identification Label	Connection Point
N	Neutral
L	Live
PE	Protective earth

Specifications

Item	Specifications
Cable length	3 m
Wire diameter	AWG14 / 2.5 mm ²
Terminal	M4 round terminal
Recommended tightening torque	1.8 N·m *

*: The tightening torque should be determined after checking the specifications of the plug to be used.

1. Screw the AC power cable to the terminal block (in three places). When connecting the wires to the Controller, match the characters of the Controller display and the wires' identification labels. The order is L, N, and PE from the left.
2. Attach the clear resin cover (included) to the terminal block.
3. Screw the clamp into place (in one place) and secure the cable routing.
4. Screw the cover to the connector (in two places).



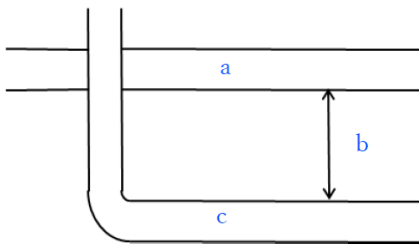
4.4.4 Key Points for Noise Reduction

Pay attention to the following points when wiring to minimize the effect of noise.

- The power supply must be grounded to a class D ground (grounding resistance of 100 Ω or less).
Grounding of the Controller frame is important not only for the purpose of preventing electric shock, but also to reduce the effects of electrical disturbances from the surrounding area. The ground wire (green/yellow) of the Controller power cable must be connected to the ground terminal of the power distribution system.
For details on the plug and the AC power cable of the Controller, refer to the following section.

Power Supply

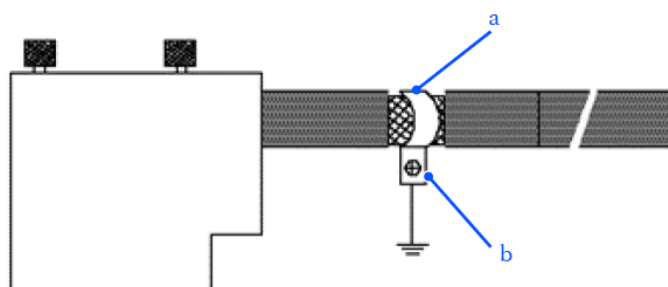
- Power should be supplied as far as possible away from power lines connected to equipment which may be a source of noise.
- If the Controller and single-phase AC motor are powered from the same power line, change the phase.
- Power lines should be twisted pair.
- AC and DC lines should be housed in different ducts and as far apart as possible.
For example, AC motor power lines and Controller power lines should be as far away as possible from I/O lines for devices such as sensors and valves, and both should not be bundled together with cable ties.
If the lines are crossed, they should be crossed perpendicularly.



Symbol	Description
a	Dedicated AC line duct
b	Keep as far apart as possible
c	Dedicated DC line duct

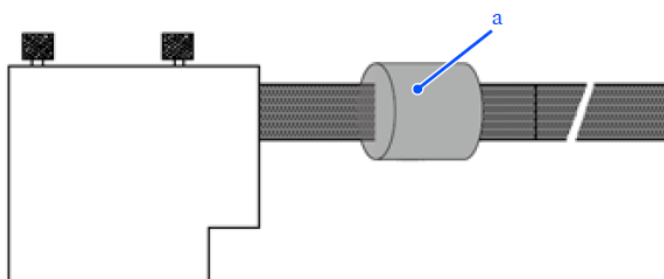
- Keep wiring to I/O connectors and safety I/O connectors as short as possible. Be sure to use shielded wires, and clamp the shield inside the connector. Also, keep as far away as possible from noise sources in the surrounding area.
- When using inductive load components such as relays and solenoid valves for Controller I/O, use components that have noise protection.
If the component is not protected from noise, be sure to attach a diode or other noise-protection component immediately before the inductive load. Select noise protection components that match the withstand voltage and current according to the inductive load.
- For AC motors such as conveyors (induction motors, 3-phase induction motors, etc.), be sure to insert a spark suppressor between the wires when starting, switching forward/reverse rotation, and so on.
Putting it between the lines and as close as possible to the motor will also increase its effectiveness.
- Communication cables such as USB, Ethernet, and fieldbus are susceptible to noise, and so keep them as far away as possible from noise sources in the surrounding area.
- The following EMC measures should be implemented for the Fieldbus I/O cables as needed.

- Ground the cable shield section.



Symbol	Description
a	Remove outer sheath and affix with an FG clamp
b	Screw into the Controller and ground it

- Attach ferrite core to cable.



Symbol	Description
a	Ferrite core

- The following EMC measures should be implemented for the AC power cable, MC cable, and each communication cable if necessary.
 - Attach ferrite core to one or both sides of the cable.
 - Remove outer sheath of the cable and ground with FG clamp.
 - Attach a shield tube to the cable and ground the shield tube.
- The following EMC measure should be implemented for the Manipulator base table if necessary.
 - When you use a conductive base table, install it with a ground wire, etc.

4.5 Operation Modes (TEACH, AUTO)

4.5.1 Overview of Operation Modes

The robot system has three modes.

WARNING

- When teaching, a supervisor should be positioned outside the safety barriers so that the robot can be stopped immediately if an anomaly occurs.

Before teaching, visually confirm that there are no hazards, such as the presence of a third party inside the safety barriers.

▪ **TEACH mode**

This mode is used to approach the robot and teach or check point data using a Teach Pendant.

In this mode, the robot always operates in a low-power state.

In addition, speed at 250 mm/s or less is monitored.

▪ **AUTO mode**

This mode is for automatic operation (program execution) of the robot system during factory operation.

In this mode, robot operation and program execution are prohibited when the safeguard is open.

For more information on Teach Pendants, refer to the following manuals.

"Robot Controller Option Teach Pendant TP2"

4.5.2 Switching Operation Modes

WARNING

- Operation is switched between TEACH mode and AUTO mode by the mode selector keyswitch on the Teach Pendant. When switching modes, be sure to switch when outside the safety barriers to avoid hazards.
- Before selecting AUTO mode, restore any paused safeguard functions.

▪ **TEACH mode**

When the mode selector keyswitch is switched to "TEACH," operation is set to TEACH mode.

Switching to TEACH mode during program execution aborts program execution.

Also, if the robot is operating, it will come to an immediate stop. (Quick Pause)

▪ **AUTO mode**

After closing the safeguard, switch the mode selector keyswitch to "AUTO," and turn on the latch release input signal to set to AUTO mode.

▪ **TEST mode**

• **T1**

Set the mode selector keyswitch to "TEACH/T1" to enter TEACH mode. Tap the [Test] tab to enter T1 mode.

• **T2**

Set the mode selector keyswitch to "TEACH/T2" to enter TEACH mode. Tap the [Test (T2)] tab to enter T2 mode. If a password has been set, enter the password.

WARNING

- When the mode is switched from TEACH to AUTO, the message "Workers must leave the safeguard area" appears on the Teach Pendant display. Please ensure safety when performing work operations.

KEY POINTS

- The TEACH mode status is latched by software.
To switch mode from TEACH to AUTO, a latch release input is required.
Refer to the following section.

Connecting as Safeguard

- When the mode is switched using the mode selector keyswitch, the motor is turned off.
- When switching from TEACH mode to AUTO mode, the latch must be released.
- To switch modes using the mode selector keyswitch, set the enable switch to OFF.

An error occurs when the mode is switched using the mode change keyswitch and the motor is turned on while the enable switch is turned on. If this happens, turn off the enable switch once, turn on the enable switch again, and then turn on the motor.

4.5.3 Program Mode (AUTO)

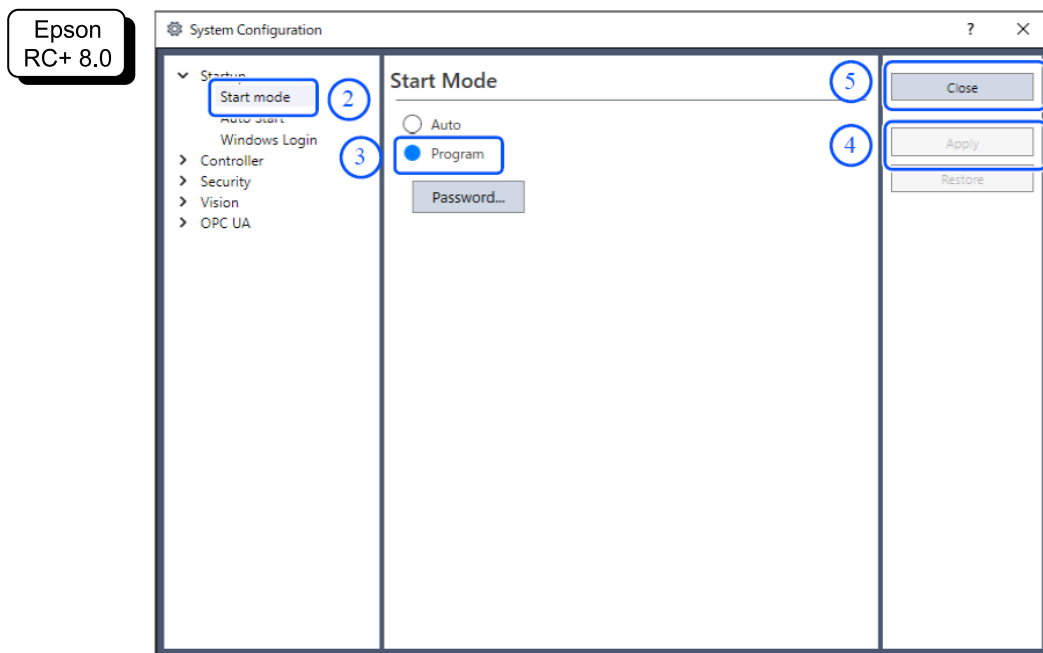
4.5.3.1 What is Program Mode (AUTO)?

Program mode is for programming, debugging, adjusting, and conducting maintenance on the robot system. The following procedure is used to enter program mode.

4.5.3.2 Settings from Epson RC+

This section describes the procedure for entering program mode from Epson RC+.

1. In the Epson RC+ menu, select [Setup] - [System Configuration] to display the [System Configuration] dialog box.



2. Select [Startup] - [Start Mode].
3. Select the [Program] button.
4. Click the [Apply] button.
5. Click the [Close] button.

4.5.4 Automatic Operation Mode (AUTO)

4.5.4.1 What is Automatic Operation Mode (AUTO)?

Automatic operation mode is for automatic operation of the robot system. There are two ways to enter automatic operation mode.

- A
Set the start mode of Epson RC+ to "Operator mode," and start Epson RC+. (Settings from Epson RC+)
- B
Set Epson RC+ to offline.

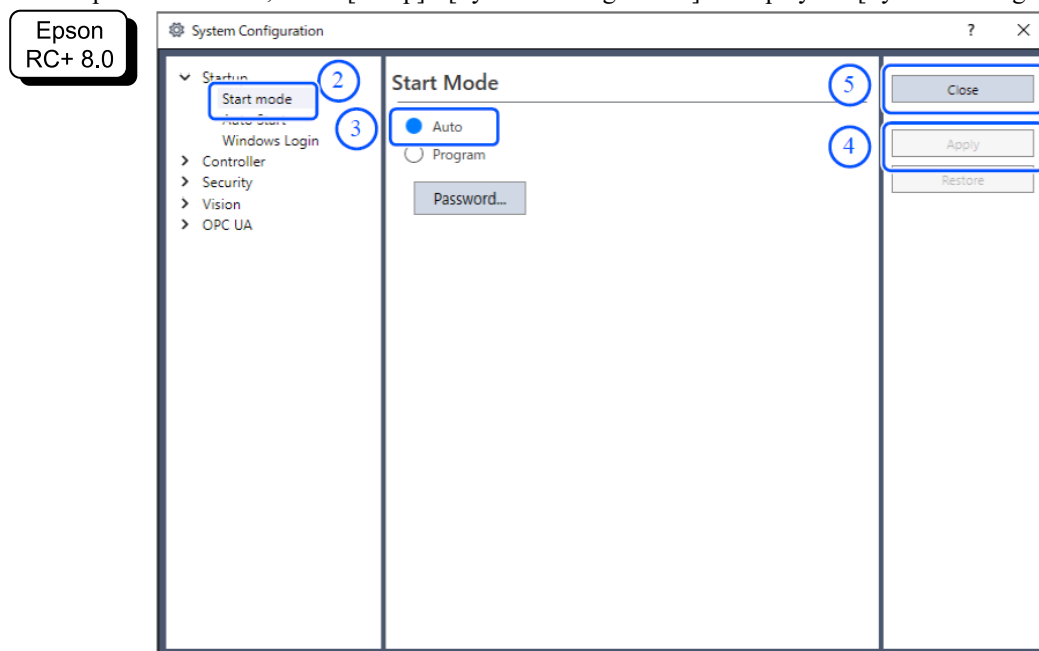
KEY POINTS

Programs can be executed and stopped by the control device specified from Epson RC+. (Control device settings)

4.5.4.2 Settings from Epson RC+

This section describes the procedure for entering automatic operation mode from Epson RC+.

1. In the Epson RC+ menu, select [Setup] - [System Configuration] to display the [System Configuration] dialog box.

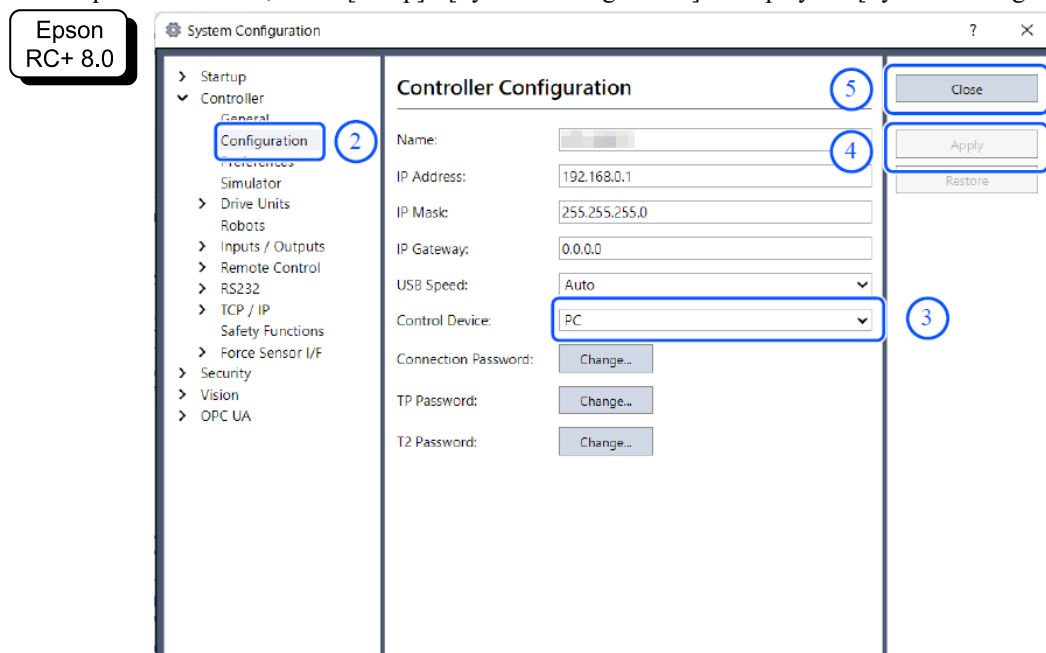


2. Select [Startup] - [Start Mode].
3. Select the [Auto] button.
4. Click the [Apply] button.
5. Click the [Close] button.

4.5.4.2.1 Control Device Settings

This section describes the procedure for setting up a control device from Epson RC+.

1. In the Epson RC+ menu, select [Setup] - [System Configuration] to display the [System Configuration] dialog box.



2. Select [Controller] - [Configuration].

3. From [Controller Configuration] - [Control Device], select one of the following two types.

- PC
- Remote I/O

4. Click the [Apply] button.

5. Click the [Close] button.

4.6 Memory Port

The "Controller Backup" function to a USB memory device can be used by inserting a USB memory device (commercially available) into the Controller's memory port.

4.6.1 What is Controller Backup?

This function allows various information (data) of the Controller to be saved to a USB memory device at the push of a button. Data saved on a USB memory device can be loaded by Epson RC+ to accurately and easily determine the status of the Controller and program.

The saved data can also be used when restoring data to the Controller.

4.6.2 Before Using the Controller Backup Function

4.6.2.1 Notes

CAUTION

- Regardless of the Controller status, the Controller Backup function can be executed at any time after the Controller is started.

However, no operations from the console, including aborting or pausing, are accepted while this function is running.

This function also affects the cycle time of the robot and communication with Epson RC+. In particular, if it is not necessary, do not execute the Controller Backup function while the robot is operating.
- Although the memory port is physically a general-purpose USB port, never connect any USB devices other than USB memory devices.
- The USB memory device should be inserted directly into the memory port of the Controller. Operation is not guaranteed when there is a cable or hub between the Controller and the USB memory device.
- Insert and remove the USB memory device slowly and securely.
- Do not modify the saved files with editors or other software. Operation of the robot system is not guaranteed when data is restored to the Controller.

4.6.2.2 Supported USB Memory Devices

For the supported USB memory devices, refer to the following section.

[Specifications Table](#)

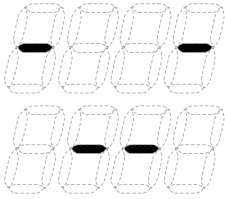
4.6.3 Using the Controller Backup Function

4.6.3.1 Controller Backup by Trigger Button

This section describes the procedure for backing up the Controller settings to a USB memory device.

1. Insert the USB memory device into the memory port.
2. Wait approximately 10 seconds for the Controller to recognize the USB memory device.

3. Press the trigger button on the Controller.
4. Once data transfer is started, the following display is repeated. Wait until this display ends and the returns to its original state. (The transfer time varies depending on the size of the project and other factors.)



5. If the save is successful, the following will be displayed for 2 seconds.



If the save fails, the following will be displayed for 2 seconds.



6. Remove the USB memory device from the Controller.

KEY POINTS

- It is recommended that the USB memory device include an LED that enables the user to check the status change in step 2.
- If saving is executed with the motor turned on, saving may fail in rare cases. Either use another USB memory device, or perform the save with the motor turned off.

4.6.3.2 Data Loading by Epson RC+

For details on the procedure for using Epson RC+ to load data saved on a USB memory device and to display the Controller status, refer to the following manual.

"Epson RC+ User's Guide - [Controller] Command (Tools Menu)"

4.6.3.3 Forwarding by E-mail

This section describes the procedure for transferring data saved on a USB memory device by e-mail.

1. Insert the USB memory device into a PC capable of sending e-mail.
2. Make sure the following folder is on the USB memory device.
"BU_Controller type name_Serial number_Date and time"
3. Compress the folder identified in step 2, attach it to an email, and send it.

KEY POINTS

- If you do not want to transfer files related to your project, such as program files, delete them before transferring.
- This function can be used by end-users to send data to Epson or to a system integrator for analysis of a problem.

4.6.4 Details of Saved Data

The following files are created by the Controller Backup.

File Name	Description
Backup.txt	Information file for restoration: This file contains the information required when restoring the Controller.
CurrentMnp01.PRM	Robot parameters: Information such as ToolSet is saved here.
CurrentStatus.txt	Status saving data: The program status and I/O status are saved here.
ErrorHist.csv	Error history
InitFileSrc.txt	Initial settings: Various settings of the Controller are saved here.
MCSys01.MCD	Robot settings: Information on connected robots is saved here.
SrcmcStat.txt	Hardware information: Hardware installation information is saved here
Project_name.obj	OBJ file: This is the result of the project build. Prg files are not included.
GlobalPreserves.dat	Backup variables: The values of the backup variables (Global Preserve variables) are saved here.
MCSRAM.bin MCSYSTEMIO.bin MCTABLE.bin MDATA.bin SERVOSRAM.bin VXDWORK.bin	Internal information on robot operation
WorkQueues.dat	Work queue information: Queue information from the work queue is saved here.
SFConfig.txt	Safety Board related items: Information of the Safety Board is saved here.
All files related to the project except project name.obj *1	Project related files: In the Epson RC+ menu, select [Setup] - [System Configuration] to display the [System Configuration] dialog box. The project is saved when the [Include project files when status exported] box is selected in the menu - [Controller] - [Preferences] dialog box. Program files are included.
X_Y.dat X=1-6 Y=1-10 *2	Data for error analysis: Data for analyzing errors that occurred is saved here.

*1 You can choose not to save "All files related to the project except project name.obj" by deselecting the setting option.

*2 You can select to include the data for error analysis in "X_Y.dat" in the data to be saved according to the Preferences or the settings at the time of backup.

4.7 LAN (Ethernet Communication) Port

KEY POINTS

- For other details on the connection between the development PC and the Controller, refer to the following manual.
"Epson RC+ User's Guide - [PC and Controller Communications] (Setup Menu)"
- For information on how to use the Ethernet (TCP/IP) communication function from the robot application software, refer to the following manual or online help.
"Epson RC+ User's Guide - TCP/IP Communications"

4.7.1 What is a LAN (Ethernet Communication) Port?

For the supported Ethernet communication port, refer to the following section.

[Specifications Table](#)

The port serves two purposes.

- **Connecting to the development PC**

This port can be used to connect the Controller to the development PC.

This enables the same operations as when connecting the Controller and development PC by the dedicated development PC connection port.

Refer to the following section.

[Connecting the Development PC and the Controller](#)

- **Connecting to other Controllers and PCs**

By creating robot application software, Ethernet (TCP/IP) communication between multiple Controllers is possible.

4.7.2 IP Addresses

Starting from the following firmware version, password authentication was added for greater security when connecting Controllers and PCs.

- F/W: Ver.7.4.8.x

KEY POINTS

For details on the password settings, refer to the following manual.

"Epson RC+ User's Guide - Setting Password for PC Ethernet Controller Connection"

Epson robot systems are designed to be used within a closed local area network. To ensure security, the setting of a global IP address is now considered as access to the Internet, and so a password is required to authenticate the connection.

Note that password authentication is not performed for a USB connection.

Use the private IP addresses in the following ranges:

- 10.0.0.1 to 10.255.255.254
- 172.16.0.1 to 172.31.255.254

- 192.168.0.1 to 192.168.255.254

The Controller is factory set to the default values.

- IP address: 192.168.0.1
- Subnet mask: 255.255.255.0
- Default gateway: 0.0.0.0

The PC and the Controller should be configured with separate IP addresses within the same subnet.

- PC: 192.168.0.10
- Controller: 192.168.0.1

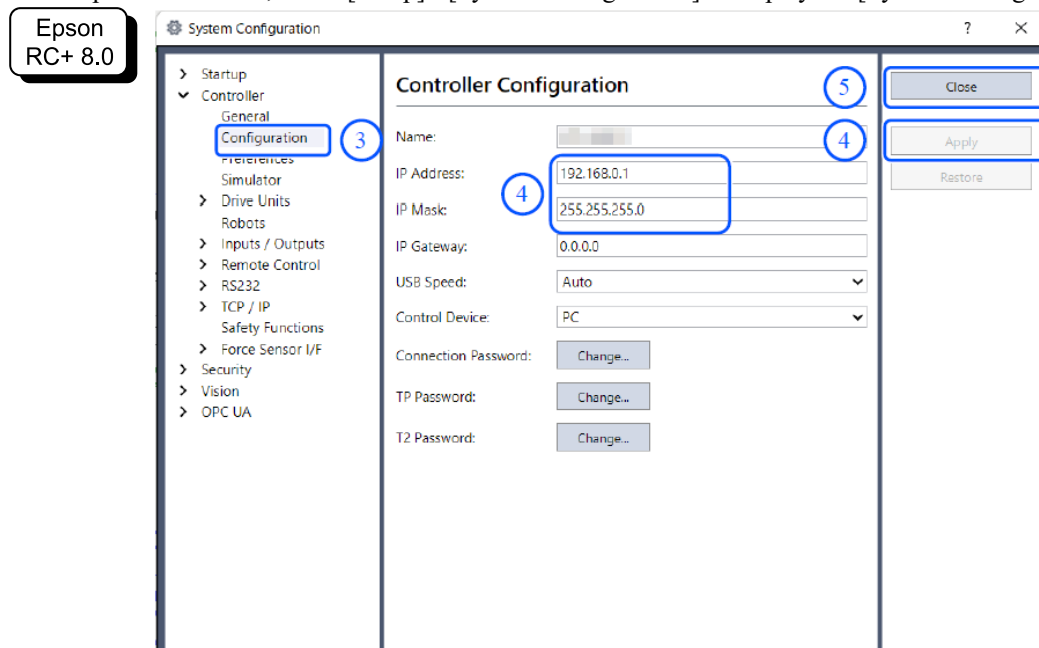
4.7.3 Controller IP Address Change Procedure

This section describes the procedure for changing the IP address of the Controller.

1. Connect the development PC and the Controller by a USB cable.
Refer to the following section.

Connecting the Development PC and the Controller

2. In the Epson RC+ menu, select [Setup] - [System Configuration] to display the [System Configuration] dialog box.



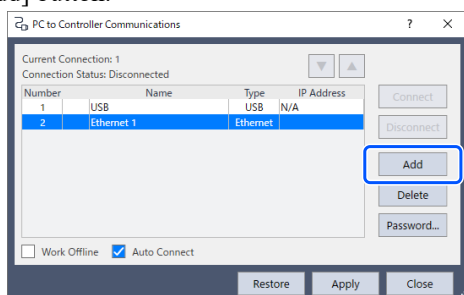
3. Select [Controller] - [Configuration].
4. Set appropriate values for the IP address and subnet mask, and click the [Apply] button.
5. Click the [Close] button. The Controller is automatically restarted.
When the Controller restart dialog box no longer appears, setting of the IP address is complete.

4.7.4 Connecting the Development PC and Controller via Ethernet

This explains the procedure for connecting the development PC and Controller over an Ethernet connection.

1. Connect an Ethernet cable to the development PC and Controller.
2. Turn on the Controller.

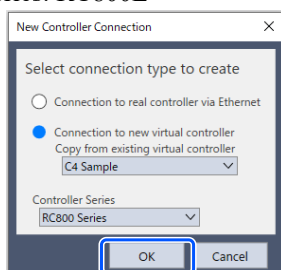
3. Start the Epson RC+ software.
4. From the Epson RC+ menu, select [Setup] - [PC to Controller Communications] to display the [PC to Controller Communications] dialog box.
5. Click the [Add] button.

Epson
RC+ 8.0

6. Perform the following settings and then click the [OK] button.

Connection method: Connection to Controller via Ethernet

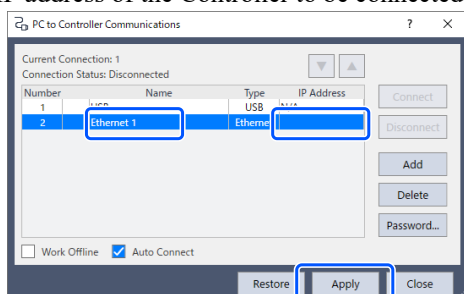
Controller series: RC800L

Epson
RC+ 8.0

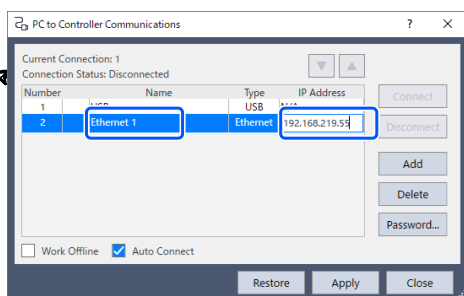
7. No. 2 is added. Make the following settings, and click the [Apply] button.

Name: Valid value for identifying the Controller to be connected

IP Address: IP address of the Controller to be connected

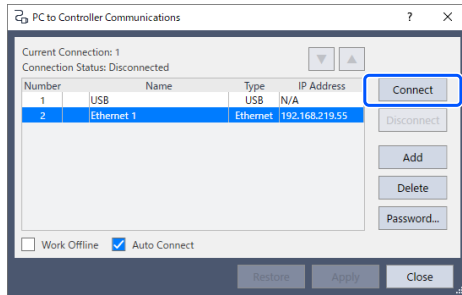
Epson
RC+ 8.0

8. The [Name] and [IP Address] set in Step 7 are displayed.

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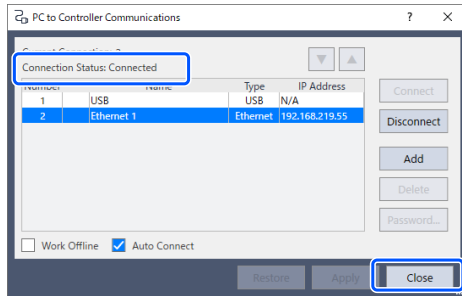
9. Confirm that "No.2" is selected and then click the [Connect] button.

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RC+ 8.0



10. After connection of the development PC and the Controller is completed, "Connected" is displayed in the [Connection Status:] field. Check that "Connected" is displayed, and click the [Close] button to close the [PC to Controller Communications] dialog box.

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RC+ 8.0



This completes the connection of the development PC and the Controller. The robot system can now be used from Epson RC+ over an Ethernet connection.

4.7.5 Disconnecting the Development PC and Controller via Ethernet

This explains the procedure for disconnecting the development PC and the Controller.

1. From the Epson RC+ menu, select [Setup] - [PC to Controller Communications] to display the [PC to Controller Communications] dialog box.
2. Click the [Disconnect] button.
After the [Disconnect] button is clicked, the Controller and development PC are disconnected and the Ethernet cable can be removed.

KEY POINTS

If the Ethernet cable is removed while the Controller and development PC are still connected, the robot will stop. Click the [Disconnect] button in the [PC to Controller Communications] dialog box before removing the Ethernet cable.

4.8 TP Port

4.8.1 What is a TP Port?

This port is used to connect a Teach Pendant. Teach Pendants TP2 can be used.

For the connector position, refer to the following section.

Part Names and Their Functions

KEY POINTS

If nothing is connected to the TP port, the Controller enters an emergency stop state. When not connecting a Teach Pendant, connect the TP bypass plug.

An external enable switch cannot be connected to the TP port. Use the enable switch provided with the Teach Pendant.

4.8.2 Connecting a Teach Pendant

The communication settings are configured automatically. The Teach Pendant can be used by either of the following methods.

- A: Plug the Teach Pendant connector into the Controller, and turn on the Controller.
- B: With the Controller turned on, plug in the Teach Pendant connector.

WARNING

- The Teach Pendant can be connected and disconnected while the Controller power is turned on.
- When the Teach Pendant connector is disconnected from the Controller while the Teach Pendant mode selector keyswitch is set to "Teach," the Teach Pendant remains in TEACH mode. The Teach Pendant cannot be switched to AUTO mode. Before disconnecting the Teach Pendant connector, switch the operation mode to "Auto."
- When switching from TEACH mode to AUTO mode, the latch must be released.
- The disconnection and storage of the Teach Pendant should be supervised by a manager. Only people authorized by the manager are allowed to touch the Teach Pendant.
- To prevent confusion between enabled and disabled emergency stop devices, keep the Teach Pendant connected to the Controller and the disconnected Teach Pendant in separate locations.
- When entering inside the safety barriers for teaching or other operations, set the Teach Pendant mode to TEACH mode, remove the mode selector key, and enter inside the safety barriers while holding that key. If the key is left in the Teach Pendant without removing it, a third party could accidentally switch to automatic operation, which is extremely dangerous and could lead to serious safety issues.
- Teach Pendants should be installed in such a way as to reduce the risk of tripping and falling due to cables.

For more information on Teach Pendants, refer to the following manuals.

"Robot Controller Option Teach Pendant TP2"

4.9 Emergency Stop Input Connector

KEY POINTS

Details about the safety requirements in this section are provided in the following manual. Read together with this manual to ensure safety.

"Epson RC+ User's Guide - Safety"

CAUTION

- Before use, confirm that the emergency stop and safeguard functions work properly not only when starting up but also when any changes are made from the previous usage state, such as after the safety function settings are changed, options are added, or parts are replaced for maintenance.

To ensure safety, connect the emergency stop switch and other safety devices to the Controller.

Two types of connectors can connect emergency stop switches: the emergency stop input connector and safety I/O connector.

This section describes the emergency stop input connector.

CAUTION

- Before connecting a connector, check that the connector is not damaged. Connecting with a damaged connector may lead to a breakdown or malfunction of the robot system.

Emergency stop input connector

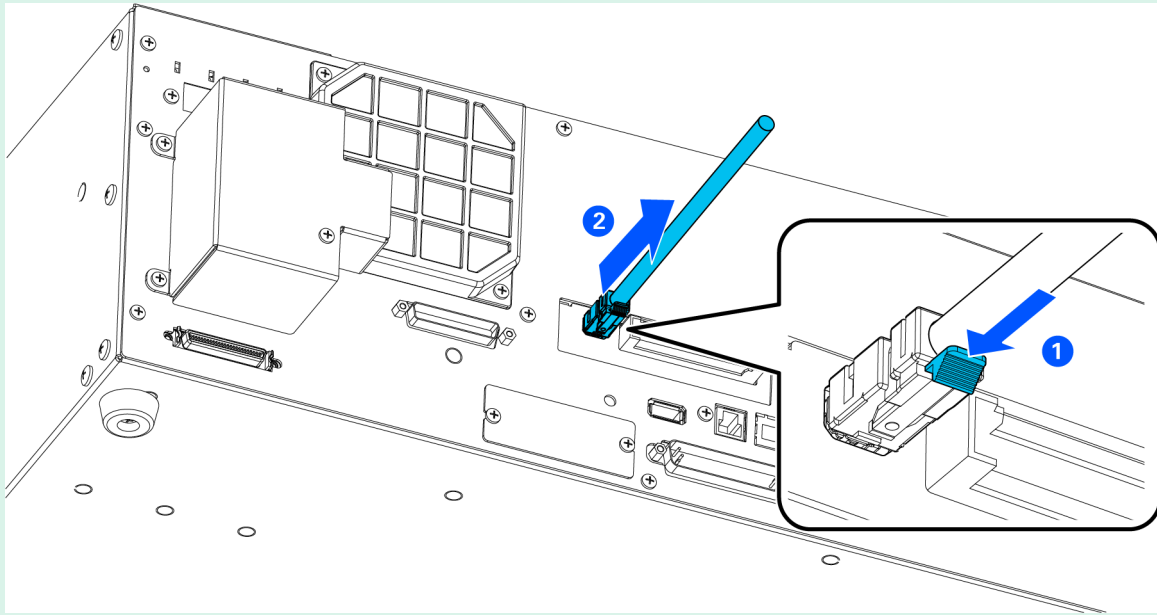
For the connector position, refer to the following section.

Part Names and Their Functions

KEY POINTS

- If nothing is connected to the emergency stop input connector, the Controller enters an emergency stop state. When this connector is not used, connect the EMERGENCY connector short plug.

- When unplugging the cable, pull it out while pressing down the lever on the cable-side connector.



4.9.1 Connecting an Emergency Stop Switch

4.9.1.1 Connection Locations for Emergency Stop Switch

An emergency stop switch can be connected to the following locations:

- Emergency stop switch attached to Teach Pendant
- Emergency stop input connector
- Port configured for emergency stop for safety I/O connector (default: configured)
Refer to the following section.

Connections: [Safety I/O Connector](#)

Configurations: "Robot Controller Safety Function Manual"

4.9.1.2 Emergency Stop Switch

Use an emergency stop switch that satisfies the following conditions and complies with the relevant safety standards (such as IEC 60947-5-5).

- Normally closed pushbutton switch
- Switch that cannot reset automatically
- Red mushroom type switch
- Switch with two form B contacts

KEY POINTS

The emergency stop input has a redundant circuit design. If the status of these redundant circuits differs by two seconds or longer, the system recognizes it as an error in the emergency stop circuit. For this reason, be sure that the emergency stop switch has two form B contacts, and connect by referring to the following section.

[Wiring Examples](#)

All locations with startup capabilities should have an emergency stop function.

4.9.1.3 Emergency Stop Switch Function Check

After the emergency stop switch is connected to the emergency stop input connector, be sure to use the following procedure to check the function of the switch to ensure safety before operating the Manipulator.

1. With the emergency stop switch pressed down, turn on the power to start the Controller.
2. Check that the 7-segment LED on the Controller displays the following.



3. Check that [EStop] is displayed on the Epson RC+ status bar.
4. Release the emergency stop switch.
5. Execute the RESET statement.
Select [Tools] - [Robot Manager], click the [Reset] button, and execute the RESET statement.
6. Check that the LED shown below is turns off and the [EStop] display disappears from the status bar.



4.9.1.4 Recovering from an Emergency Stop State

Before recovering from an emergency stop state, follow the safety check procedure specified for the system. After the safety check is completed, perform the following operations to reset the emergency stop state.

- Resetting the emergency stop switch
- Executing the RESET statement

4.9.2 Signal Arrangement and Electrical Specifications

The signal arrangement of the emergency stop input connector is shown in the following table.

Pin Number	Signal Name	Function
1	24 V for emergency stop	Internal 24 V output
2	Emergency stop input M *1	Emergency input 1
3	N.C. *2	Not used
4	24 V for emergency stop	Internal 24 V output
5	Emergency stop input S *1	Emergency input 2
6	N.C. *2	Not used
7	N.C. *2	Not used
8	N.C. *2	Not used

*1 An error occurs if the input times of emergency stop input M and emergency stop input S differ by two seconds or more. Connect a switch having two identical contacts.

*2 Do not connect anything to these pins.

Electrical characteristics of EMERGENCY connector

- 24V rated load for emergency stop: +24 V 0.4 A or less
- Emergency stop input voltage range: +24 V $\pm 10\%$
- Emergency stop input current: 37.5 mA $\pm 10\%$ at +24 V input

CAUTION

- The 24 V output for emergency stop is for connecting to emergency stop switches, relays, MOS-FETs, and other switches. Do not use it for other purposes. Doing so may result in system breakdown.

KEY POINTS

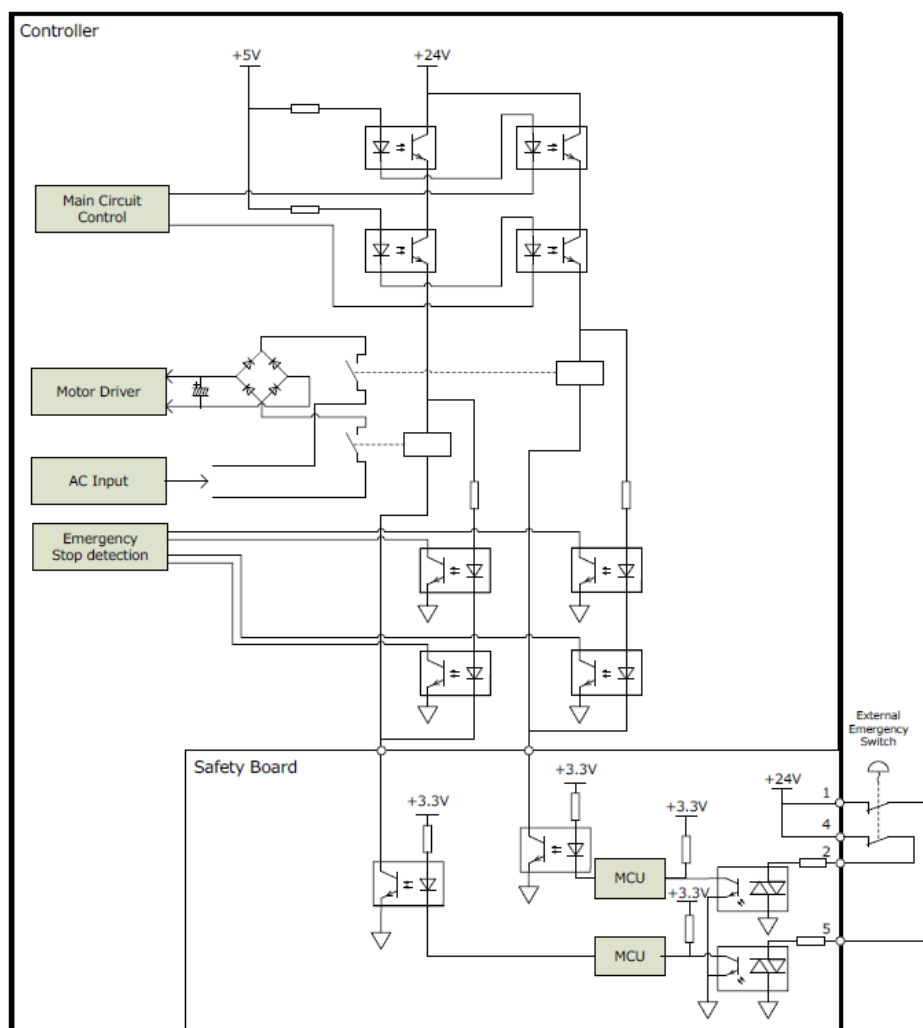
The total electrical resistance of the emergency stop switches and their circuit should not exceed 1 Ω .

WARNING

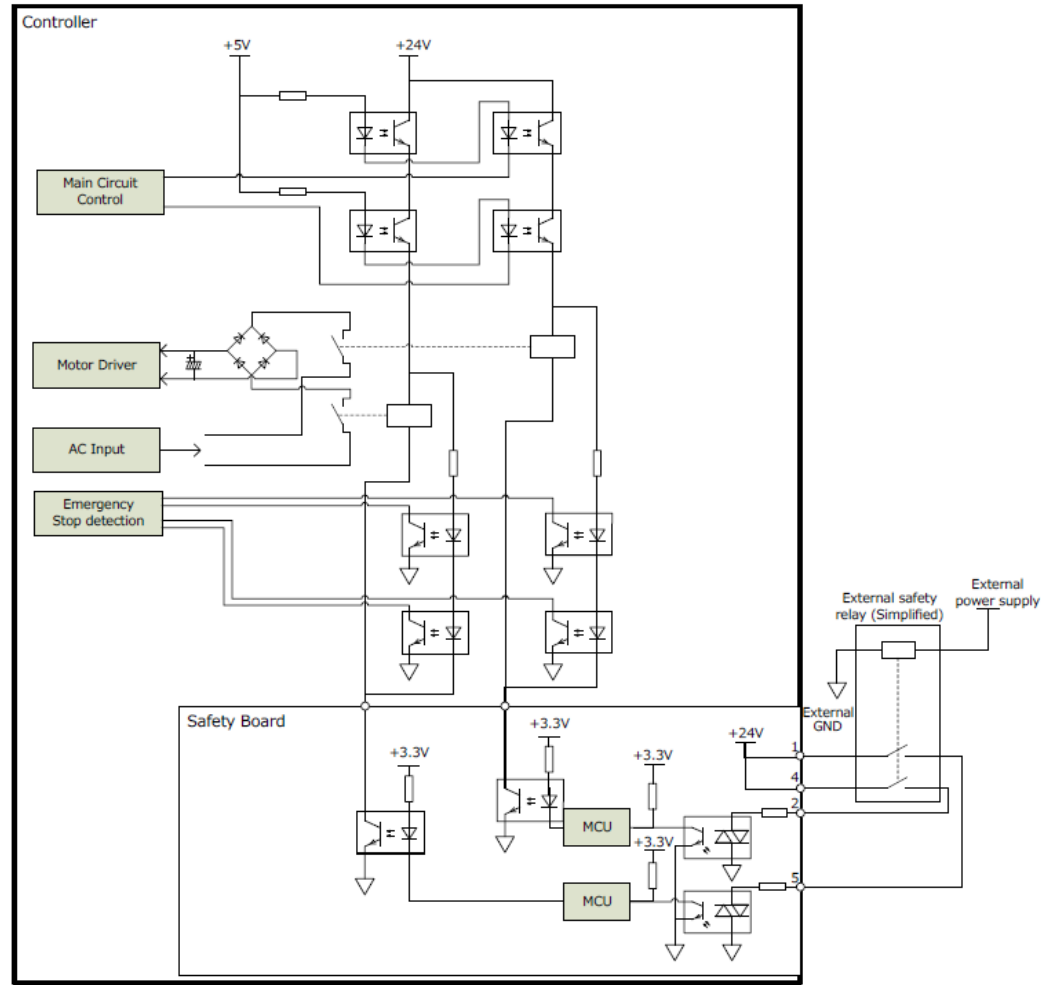
Cables should be connected at all times. Use a guard cover to protect the cables. Do not put heavy objects on the cables, bend or pull on the cables forcibly, or allow the cables to be pinched. Damaged cables, broken wires, or contact failure is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

4.9.3 Wiring Examples

4.9.3.1 Example 1: When External Emergency Stop Switch is Connected



4.9.3.2 Example 2: When External Safety Relay is Connected



4.10 Safety I/O Connector

4.10.1 Safety I/O

This Controller has safety-compliant safety inputs (5ch) and safety outputs (3ch).

- Safety inputs (category 3 PLd)
- Safety outputs (category 3 PLd)

Emergency stop switches, safeguards, laser curtains, and similar devices can be connected to the safety inputs.

Safety PLCs and similar devices can be connected to the safety outputs.

The safety inputs and outputs have a redundant design, and an error occurs if the redundant circuits are mismatched for two seconds. If an error occurs, the Controller must be restarted.

An external power supply is required to use the safety I/O. Also, various settings must be configured using the "Safety Function Manager" to use the safety I/O. For details on the setting procedure, refer to the following manual.

"Robot Controller Safety Function Manual"

Turn off the power before connecting to the safety I/O connectors.

WARNING

Cables should be connected at all times. Use a guard cover to protect the cables. Do not put heavy objects on the cables, bend or pull on the cables forcibly, or allow the cables to be pinched. Damaged cables, broken wires, or contact failure is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

4.10.2 Signal Arrangement



Check the orientation of the connectors before connecting them.

Signal Arrangement of Safety I/O Connector (XW4N-28D2 Male)

Pin Number	Signal Name	Function	Pin Number	Signal Name	Function
A1	Ex-GND	External GND connection	B1	SAFETY_IN_COM-M	Safety input common 1
A2	Ex-24V	External 24 V connection	B2	SAFETY_IN5-M	Safety input 5-1
A3	SAFETY_OUT3-M	Safety input 3-1	B3	SAFETY_IN4-M	Safety input 4-1
A4	SAFETY_OUT2-M	Safety input 2-1	B4	SAFETY_IN3-M	Safety input 3-1
A5	SAFETY_OUT1-M	Safety input 1-1	B5	SAFETY_IN2-M	Safety input 2-1
A6	Not used	*1	B6	SAFETY_IN1-M	Safety input 1-1
A7	Not used	*1	B7	Not used	*1
A8	Latch signal1	Latch release signal *2	B8	Not used	*1
A9	Not used	*1	B9	SAFETY_IN1-S	Safety input 1-2
A10	Latch signal2	Latch release signal *2	B10	SAFETY_IN2-S	Safety input 2-2
A11	Not used	*1	B11	SAFETY_IN3-S	Safety input 3-2
A12	SAFETY_OUT1-S	Safety input 1-2	B12	SAFETY_IN4-S	Safety input 4-2
A13	SAFETY_OUT2-S	Safety input 2-2	B13	SAFETY_IN5-S	Safety input 5-2
A14	SAFETY_OUT3-S	Safety input 3-2	B14	SAFETY_IN_COM-S	Safety input common 2

*1: Do not connect anything to these pins.

*2: The latch signal is not a safety signal. Connect 24V and GND. Since it is bipolar, it does not matter which way it is connected.

4.10.3 Safety Inputs

The safety inputs have a redundant circuit design, and an error occurs if the inputs are mismatched for two or more seconds. The safety inputs have five channels, with independent input terminals and one 24 V/GND terminal (COM) common to all five channels.

When connecting the wires, check the safety I/O connector pin assignments in the signal arrangement.

4.10.3.1 Safety Input Specifications

Interface specifications

To use the safety inputs, a SELV-certified external power supply is required.

The wire to be connected should be AWG24 to 16 or processed with ferrule terminals, and the length should be 20 m or less.

Check the XW4M/XW4N specifications for details on connectors and wire connections.

Available functions

The following functions are available when configured in "Safety Function Manager." For details on the settings, refer to the following manual.

"Robot Controller Safety Function Manual"

- Emergency stop
- Safeguard (SG)

Safety input electrical specifications

Input voltage range: +12 to 24 V $\pm 10\%$

ON voltage: +11 V (Min.)

OFF voltage: +5 V (Max.)

Input current: Typ. 11 mA at +24 V

The input circuit uses a bidirectional photocoupler, so two types of connections are possible. Refer to the connection examples.

Connected peripherals

Safety devices that can be connected to safety inputs are shown in the following table.

Safety devices with diagnostic pulses should have a maximum pulse width of 500 μ s and a minimum diagnostic pulse interval of 20 ms.

Device Name	Certification
Laser curtain	IEC61496-1 Type4
Laser scanner	IEC61496-1 Type3
Safety PLC	IEC61131-2
Safety switch	IEC60947-5-1

4.10.3.2 Connecting as Emergency Stop

In addition to the emergency stop input connector, an emergency stop switch can also be used with the safety I/O connector. An external power supply is required when using an emergency stop switch with the safety I/O connector.

Checking operation of the emergency stop switch that is set to the safety input

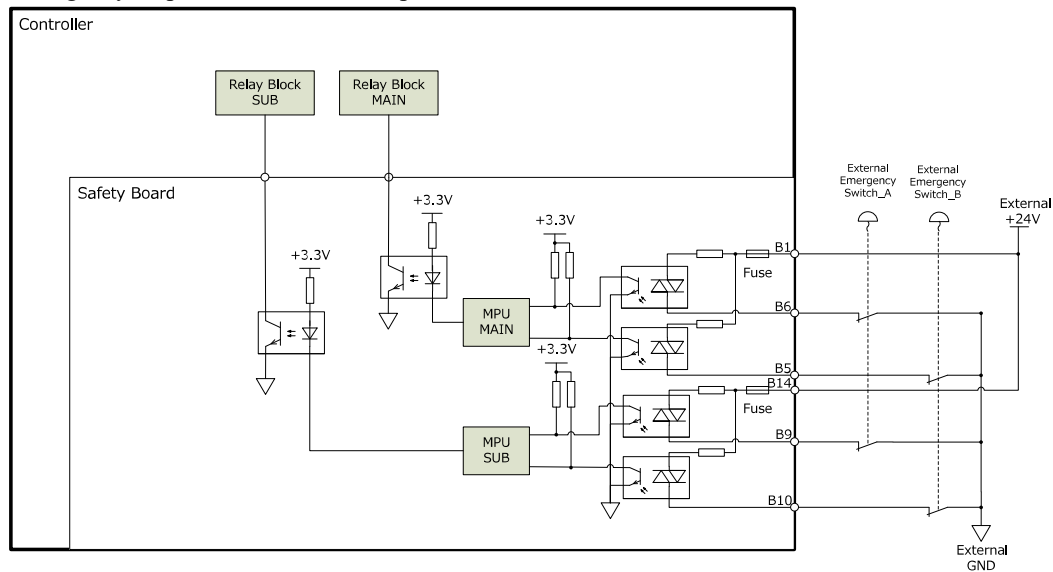
Check using the same procedure as the emergency stop input connector.

Recovering from an emergency stop state

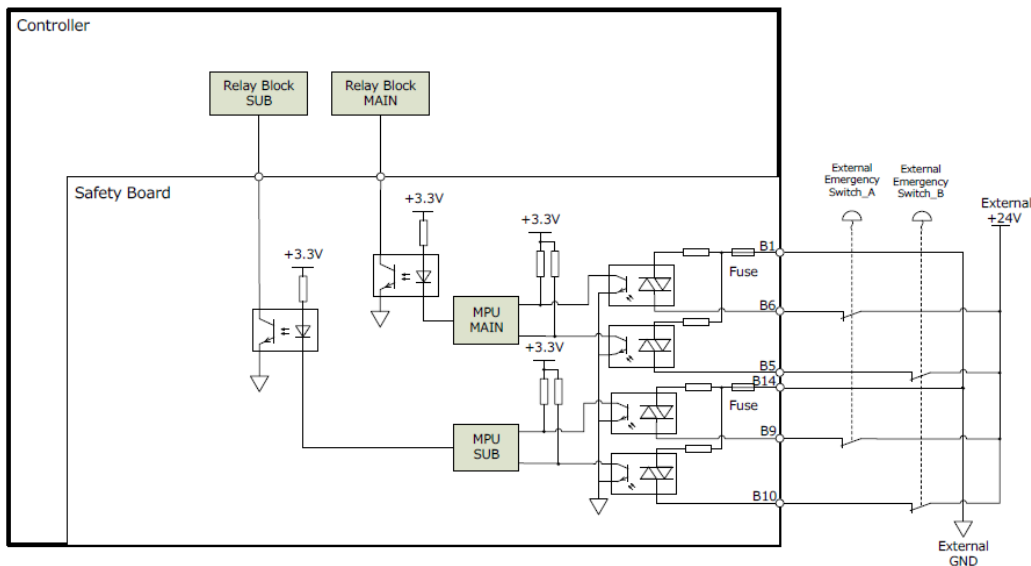
Recover using the same procedure as the emergency stop input connector.

Connection examples

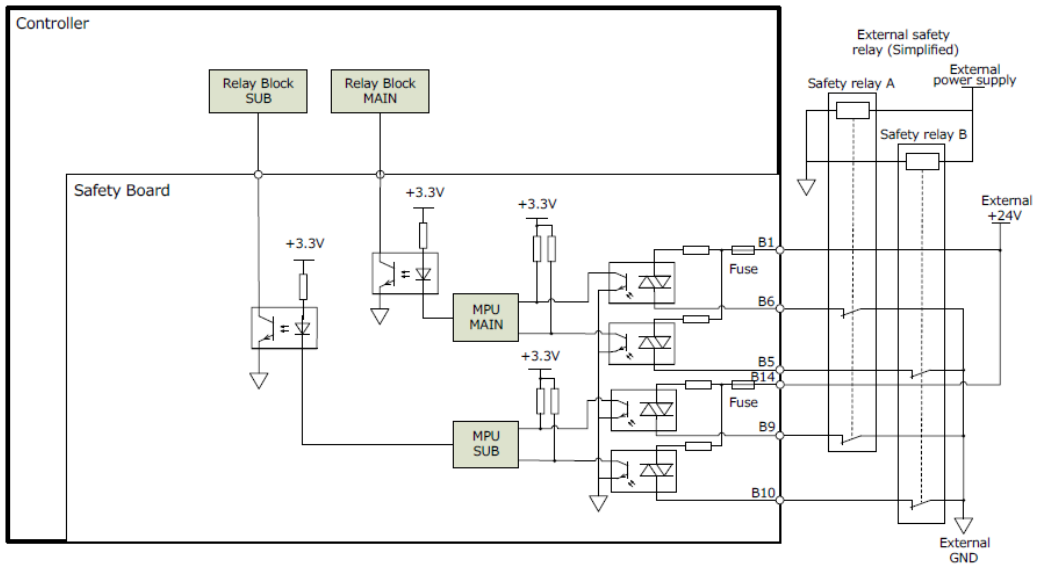
Emergency stop switch: Connection pattern 1



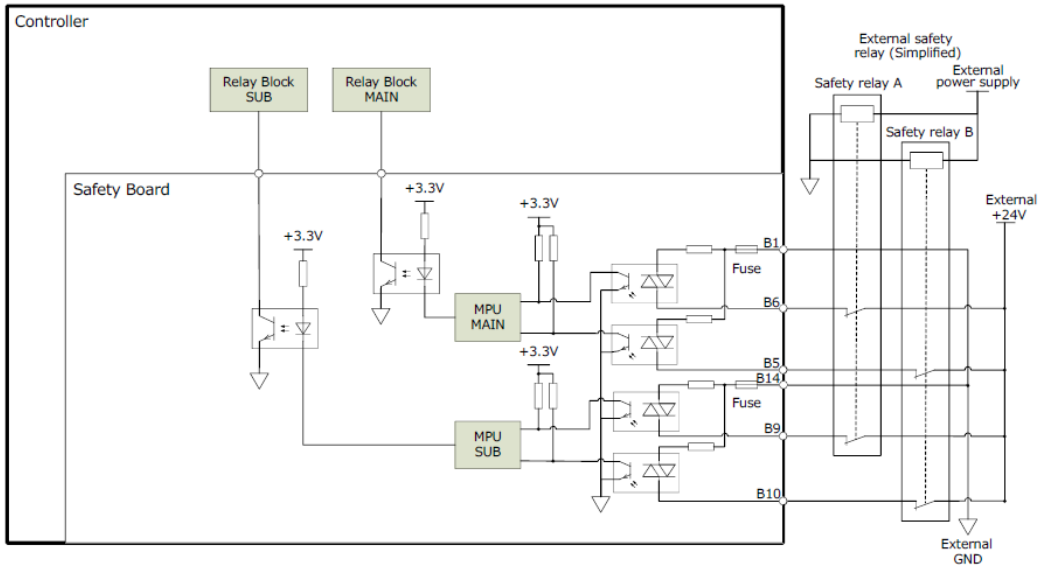
Emergency stop switch: Connection pattern 2



Safety relay: Connection pattern 1



Safety relay: Connection pattern 2



4.10.3.3 Connecting as Safeguard

To maintain a safe working zone, safety barriers must be set up around the Manipulator. The safety barriers must have an safety devices at the entrance and exit to the working zone. The term "safeguard" as used in this manual refers to a safety device with an interlock that allows entry into the safety barriers. Specifically, this includes safety door switches, safety barriers, light curtains, safety gates, safety floor mats, and so on. You must assign at least one Safeguard (SG) in Safety Function Manager.

Connection conditions

Design the safeguards so that they satisfy the following conditions:

- When using a key switch type safety device, use a switch that forcibly opens the interlock contacts. Do not use switches that open their contacts using the spring force of the interlock.
- When using an interlock mechanism, do not disable the interlock mechanism.
- The safety I/Os have redundant circuits. Safeguard switches with two contacts should be used, and each contact should be connected to a redundant circuit.

KEY POINTS

The safeguard input has a redundant circuit design. If the status of these redundant circuits differs by two seconds or longer, the system recognizes it as an error in the safeguard circuit. Ensure that the safeguard input has redundant circuits.

Latch release input

The safeguard state and TEACH mode state are latched by software. The safety I/O connector has a latch release input for releasing these latched states. (The term "latch" means "hold.")

This signal is a single signal type because it is a non-safety signal.

When connecting switches, use normally open switches.

- Latch release input open (switch OFF)
The safeguard open state and TEACH mode state are latched.
- Latch release input close (switch ON)
The latched state is released.

KEY POINTS

When the latched state of TEACH mode is released while the safeguard is open, operation is prohibited because the safeguard is open. To start the Manipulator, close the safeguard and then close the latch release input.

When connecting, maintain the following electrical characteristics for latch release input.

The latch release input uses bipolar components, so it does not matter whether the power supply is connected to Pin A8 or A10.

Voltage: +24 V $\pm 10\%$

Current: 10 mA/+24 V input

CAUTION

Because the latch release input terminal has only one channel, if it is assigned to multiple safeguards, they will operate together. Therefore, if you wish to place a latch release switch on each safeguard, connect the switches in series.

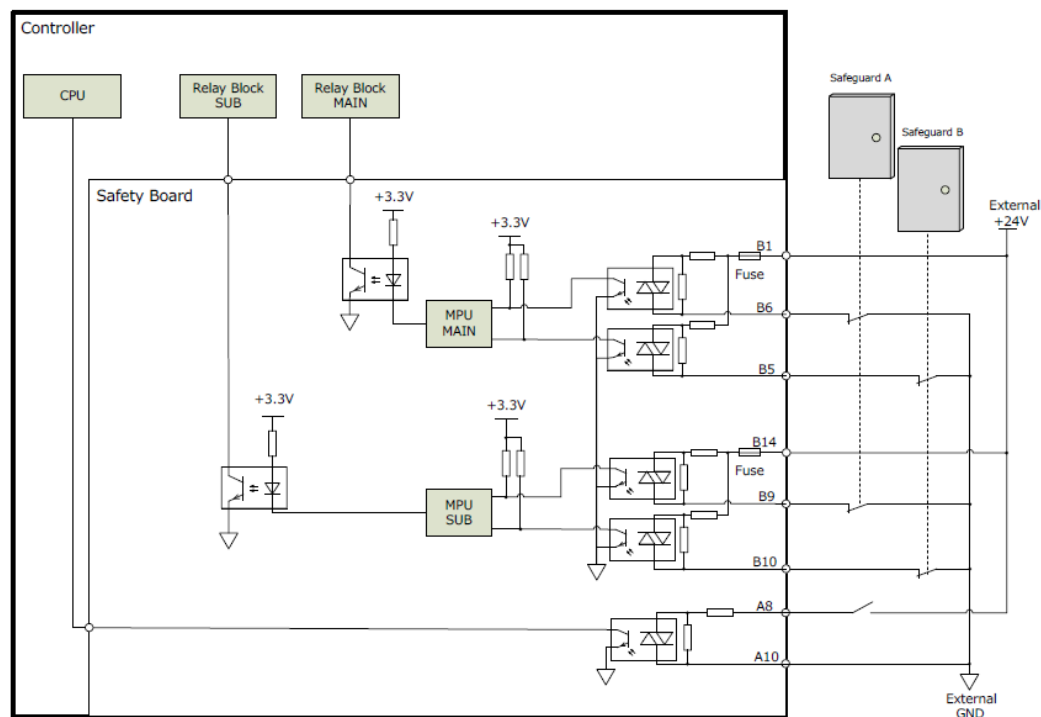
Checking the switch function

After connecting the safeguard switch and latch release switch to the safety I/O connector, a safety check must be performed. Use the following procedure to check the function of the switch before operating the Manipulator.

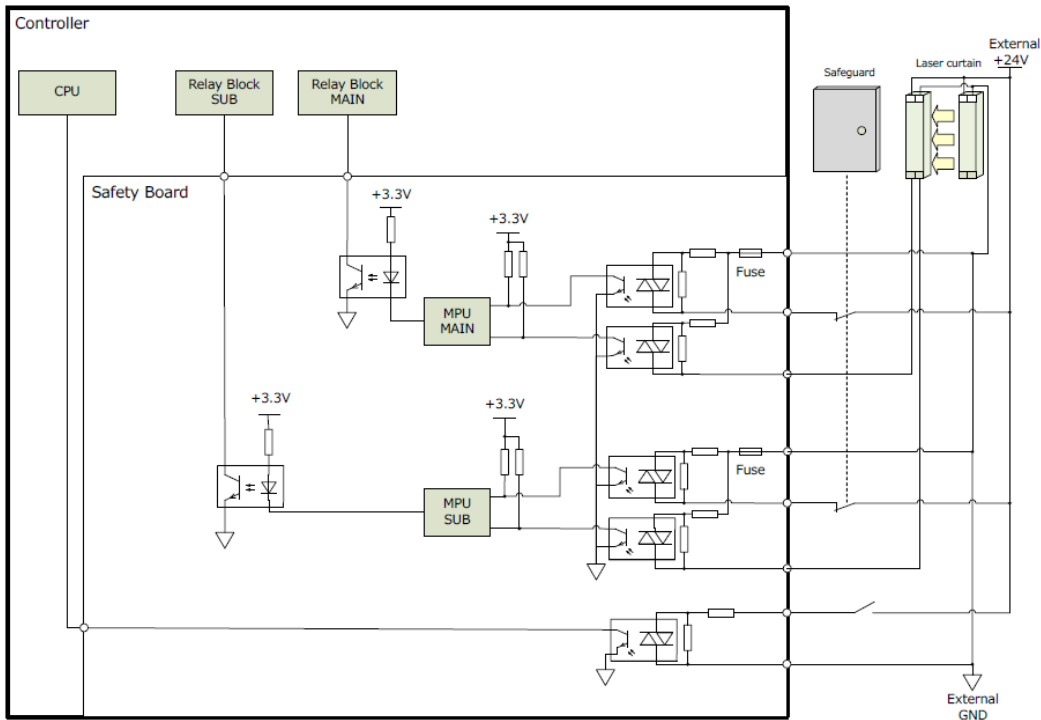
1. While the safeguard is open, turn on the power to start up the Controller.
2. Make sure that "Safety" is displayed on the status bar on the screen. Or confirm that "SO" is displayed on the Controller's 7-segment LED.
3. Close the safeguard and turn on the switch connected to the latch release input.
4. Make sure that "Safety" no longer appears on the status bar. Or confirm that "SO" is no longer displayed on the Controller's 7-segment LED.

Connection examples

When two safeguards are connected



When a safeguard and laser curtain are connected



4.10.4 Safety Outputs

The safety outputs have a redundant circuit design, and an error occurs if the inputs are mismatched for two or more seconds. There are three channels for safety outputs, each with independent output terminals. To use the output terminals, external 24 V and GND power must be supplied.

When connecting the wires, check the safety I/O connector pin assignments in the signal arrangement.

4.10.4.1 Safety Output Specifications

Interface specifications

To use the safety outputs, a SELV-certified external power supply is required.

The wire to be connected should be AWG24 to 16 or processed with ferrule terminals, and the length should be 20 m or less.

Check the XW4M/XW4N specifications for details on connectors and wire connections.

Available functions

The following functions are available when configured in "Safety Function Manager." For details on the settings, refer to the following manual.

"Robot Controller Safety Function Manual"

- Enable ON/OFF
- Emergency ON/OFF
- STO State ON/OFF
- SLS_T State ON/OFF

Safety output electrical specifications

Rated output voltage: +24 V \pm 10%

Maximum output current: Max. 100 mA per output

On-resistance: Typ. 5.5 Ω

The output circuit can only output Source. Do not connect in reverse.

Connect the power supply to 24 V (A2) and GND (A1), and use the output of each terminal as Source output. Refer to the connection examples.

Connected peripherals

This device can be connected to a safety output.

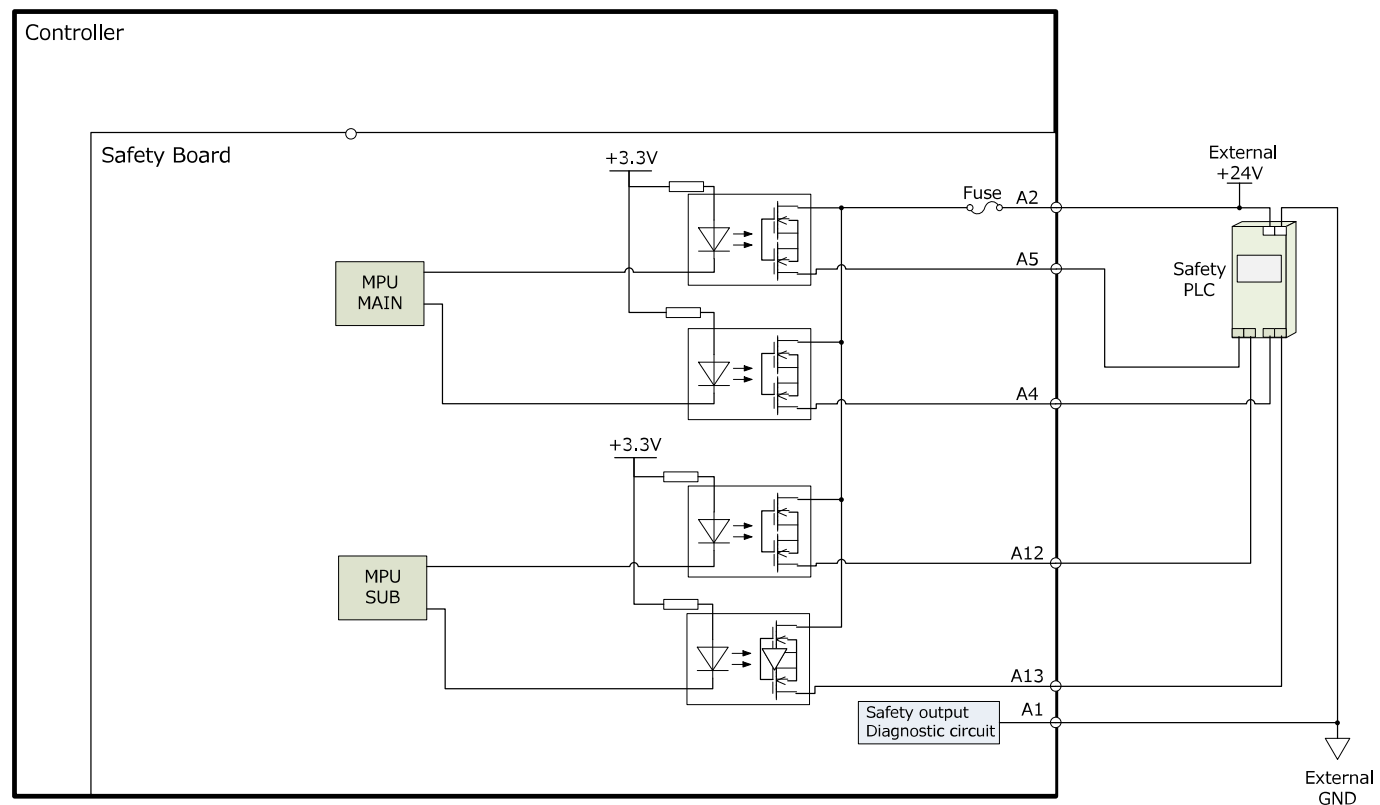
Device Name	Certification
Safety PLC	IEC 61131-2
Safety Relay	IEC 61801-3

4.10.4.2 Connecting Safety Outputs

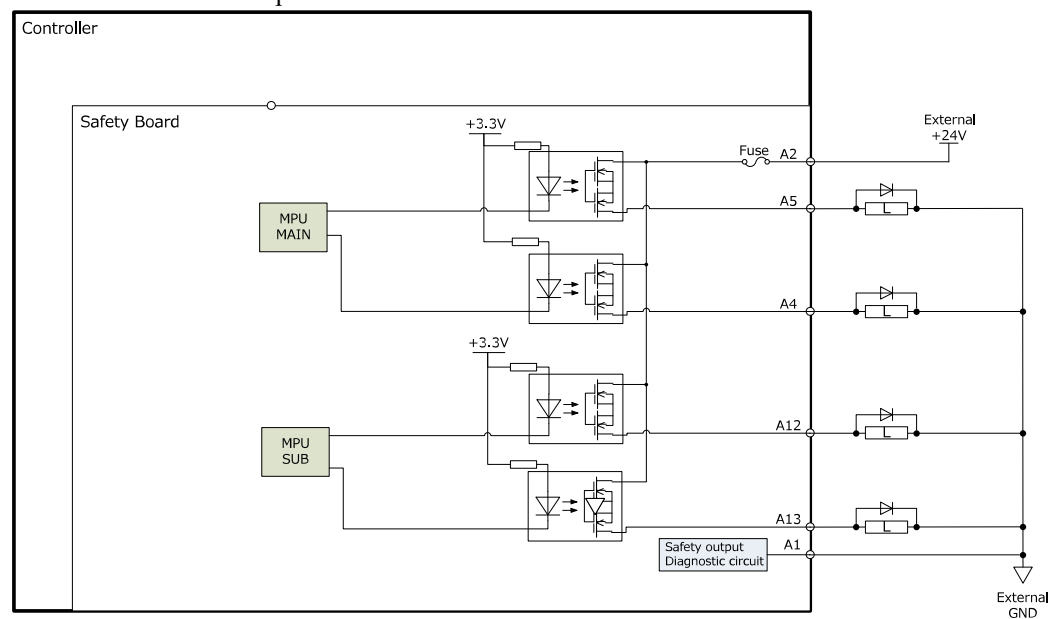
The safety outputs support Source outputs only.

Connection examples

When Safety PLC is connected



When Safety Relay is connected
Insert a diode for circuit protection.



4.11 I/O Connector

I/Os are connectors for user input/output devices.

I/O	POINTS	Pin Number
Inputs	24	0-23
Outputs	16	0-15

- When wiring, refer to the following section to prevent noise generation.

[Key Points for Noise Reduction](#)

- By default, remote functions are assigned to the I/O of input bit numbers 0 to 7 and output bit numbers 0 to 8. For details, refer to the following section.

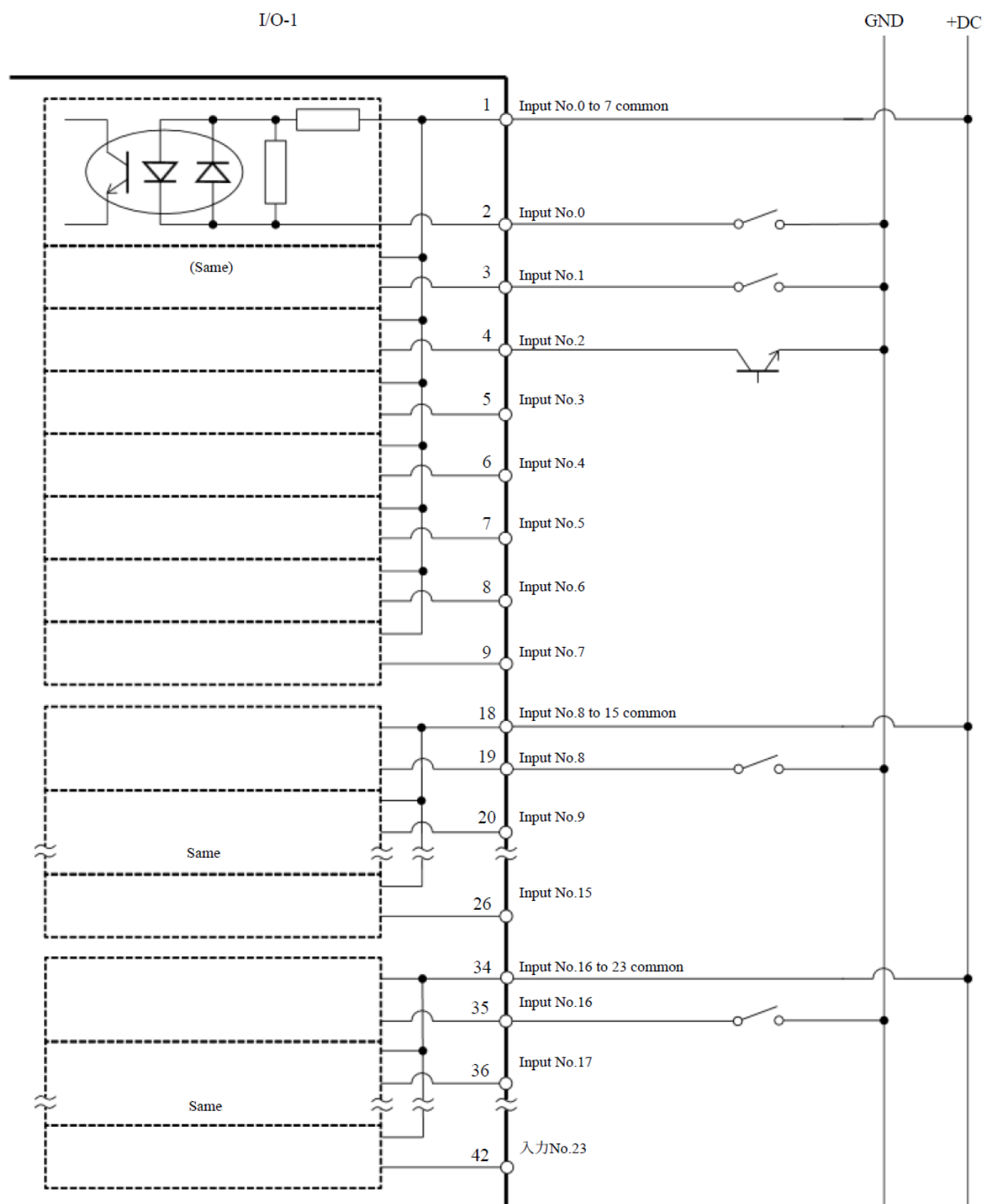
[I/O Remote Settings](#)

4.11.1 Input Circuit

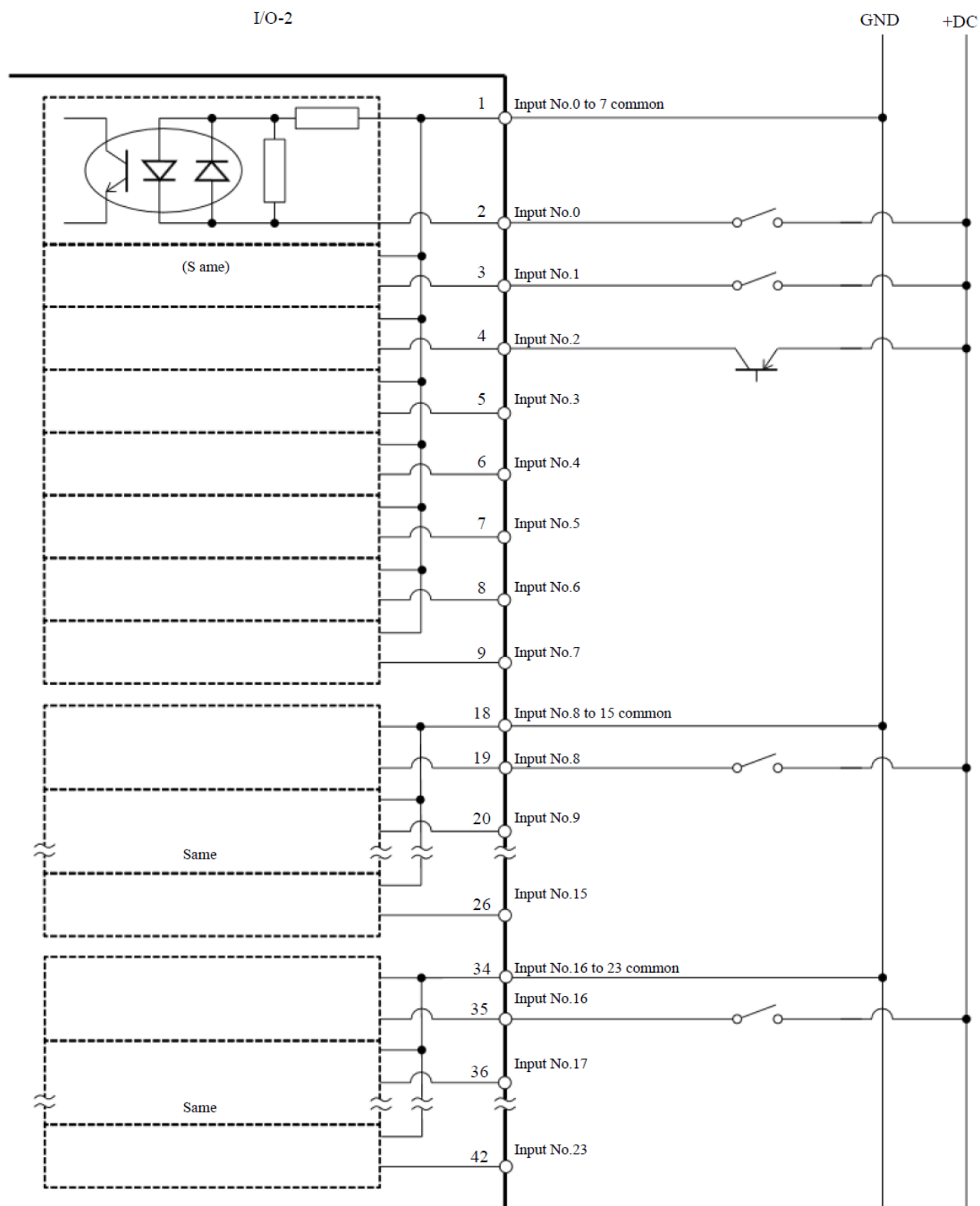
- Input voltage range: +12 to 24 V $\pm 10\%$
- ON voltage: ≥ 10.0 V (Min.)
- OFF voltage: ≤ 1 V (Max.)
- Input current: 10 mA Typ. at +24 V input

The input circuit uses a bidirectional photocoupler, which allows the following two types of wiring.

4.11.1.1 Input Circuit Diagram and Wiring Example 1



4.11.1.2 Input Circuit Diagram and Wiring Example 2



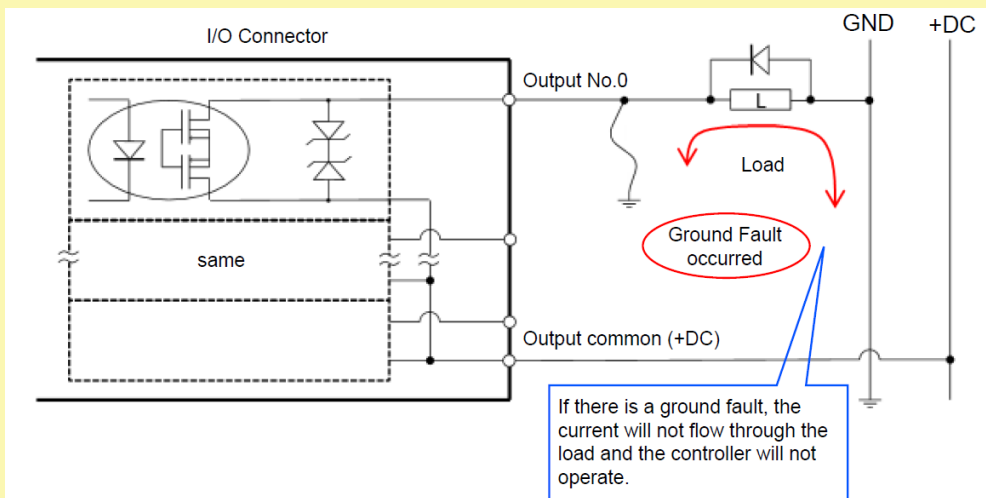
4.11.2 Output Circuit

- Rated output voltage: +12 V to 24 V $\pm 10\%$.
- Maximum output current: 100 mA per output
- Output driver: PhotoMOS relay
- On-resistance (average): 23.5 Ω or less

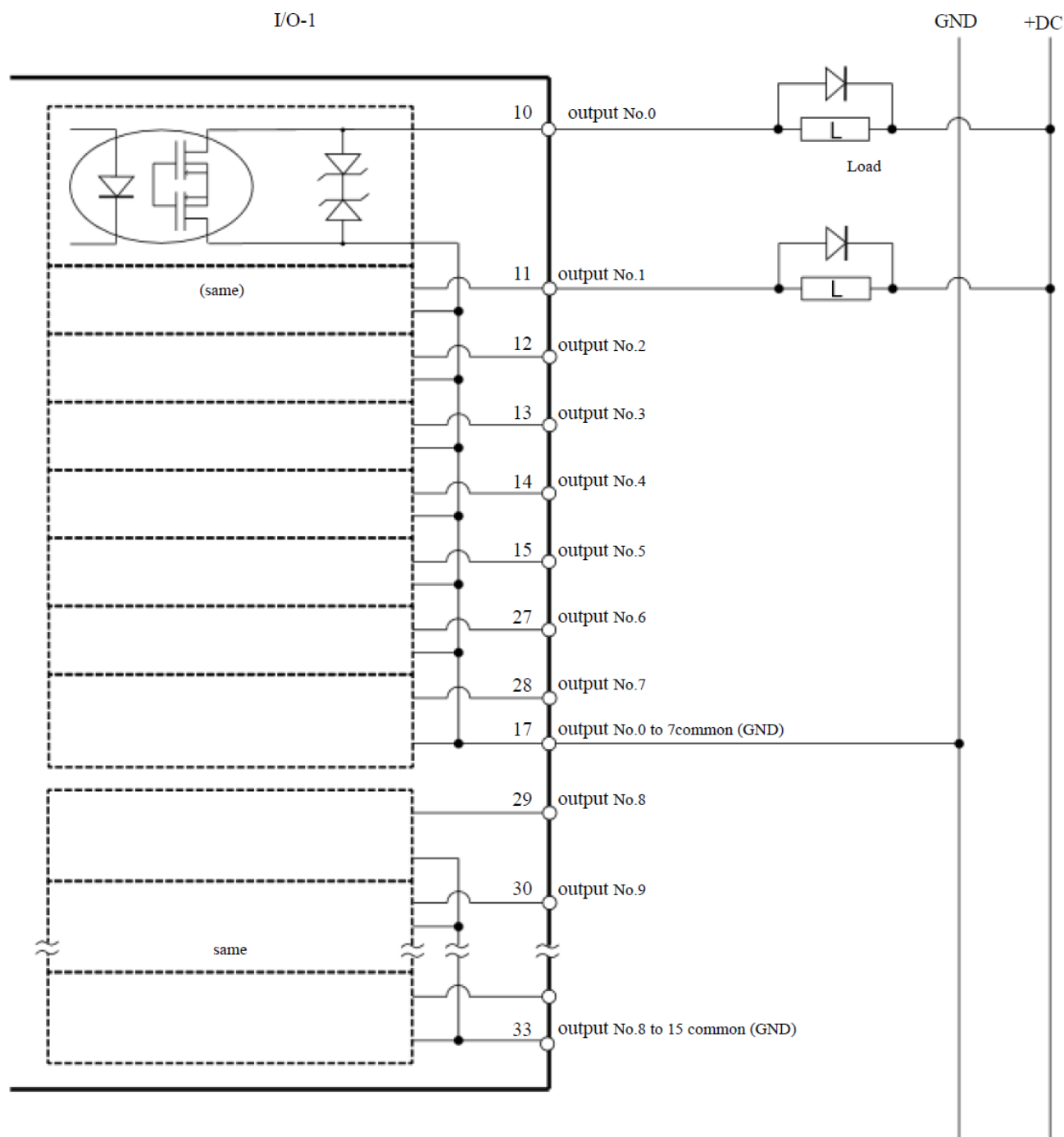
The output circuit uses a non-polarized PhotoMOS relay, which allows the following two types of wiring.

CAUTION

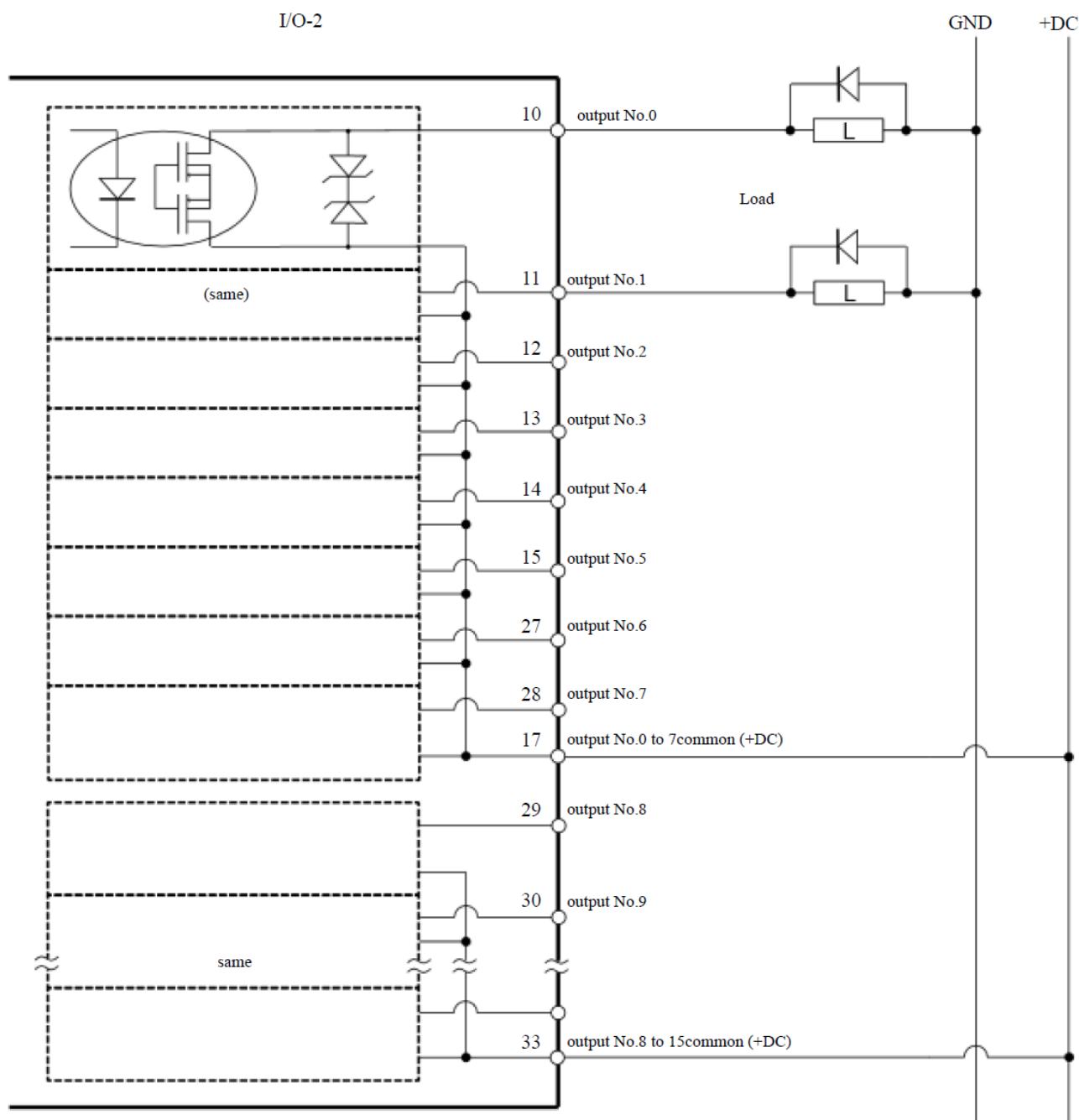
- To comply with the EU Machinery Directive, use positive common (PNP) to prevent unintended operation of the load if a ground fault occurs in the wiring between the Controller and the load.



4.11.2.1 Output circuit diagram and wiring example 1: Sink type (NPN)



4.11.2.2 Output circuit diagram and wiring example 2: Source type (PNP)



4.11.3 Signal Arrangement

Pin Number	Signal Name	Pin Number	Signal Name
1	Input common No. 0 to 7	26	Input No. 15
2	Input No. 0 (Start)	27	Output No. 6 (SError)
3	Input No. 1 (SelProg1)	28	Output No. 7 (Warning)
4	Input No. 2 (SelProg2)	29	Output No. 8 (EstopOff)
5	Input No. 3 (SelProg4)	30	Output No. 9

Pin Number	Signal Name	Pin Number	Signal Name
6	Input No. 4 (Stop)	31	Output No. 10
7	Input No. 5 (Pause)	32	Not used
8	Input No. 6 (Continue)	33	Output common No. 8 to 15
9	Input No. 7 (Reset)	34	Input common No. 16 to 23
10	Output No. 0 (Ready)	35	Input No. 16
11	Output No. 1 (Running)	36	Input No. 17
12	Output No. 2 (Paused)	37	Input No. 18
13	Output No. 3 (Error)	38	Input No. 19
14	Output No. 4	39	Input No. 20
15	Output No. 5 (SafeguardOn)	40	Input No. 21
16	Not used	41	Input No. 22
17	Output common No. 0 to 7	42	Input No. 23
18	Input common No. 8 to 15	43	Output No. 11
19	Input No. 8	44	Output No. 12
20	Input No. 9	45	Output No. 13
21	Input No. 10	46	Output No. 14
22	Input No. 11	47	Output No. 15
23	Input No. 12	48	Not used
24	Input No. 13	49	Not used
25	Input No. 14	50	Not used

By default, the remote functions shown in parentheses () are assigned to the I/O of inputs 0 to 7 and outputs 0 to 8. To assign remote functions, refer to the following section.

I/O Remote Settings

Connector Name	Standard
I/O Connector (Controller side)	D-sub 50-pin male Mating screw lock part #4 - 40

* I/O connectors, I/O cables, and terminal blocks are available as options.

4.12 I/O Remote Settings

This section describes the functions and timing of the input/output signals.

By assigning remote functions to Standard I/O, the robot system can be controlled from user-provided operating devices or sequencers.

By default, remote functions are assigned to the I/O of input numbers 0 to 7 and output numbers 0 to 8.

To be able to accept remote input from an external source, the control device must be set to remote in addition to assigning the remote function.

The I/O numbers where remote functions are assigned can be changed by the user.

For the setting procedure, refer to the following manual or online help.

"Epson RC+ User's Guide - Remote Control"

CAUTION

- When using I/O with remote settings, pay attention to the following points. Using I/O with remote settings without satisfying the requirements may lead to system failure or safety issues.
 - This signal is not a safety signal. Do not use it for safety-related functions.
 - When making settings, do not make a mistake in the relationship between function assignments and wiring.
 - Be sure to check the correspondence between the functions and wiring before supplying power.
 - When checking operation, try to anticipate configuration or wiring errors. If the Manipulator performs an abnormal operation due to a setting or wiring error, do not hesitate to immediately stop Manipulator operation by pressing the emergency stop switch or by other means.

KEY POINTS

- The remote function is enabled even when virtual I/O mode is enabled.
- When making the remote settings for the I/O, make a record of the settings or save them as file data.
- When remote functions are assigned to Fieldbus I/O, their responsiveness varies depending on the communication speed of the fieldbus. For details on the responsiveness of fieldbus, refer to the following manual.

"Robot Controller Option Fieldbus I/O"

4.12.1 I/O Signal Functions

By default, remote functions are assigned to the I/O of input numbers 0 to 7 and output numbers 0 to 8.

To change the function assignments from the default settings, the settings must be made using Epson RC+.

4.12.1.1 Inputs

Remote input enables external operation of Manipulators and Controllers by inputting signals when valid conditions specified for each function are met.

To be able to accept remote input from an external source, the control device must be set to remote in addition to assigning the remote function. "AutoMode output" is turned on when the remote input can be accepted from an external source.

Signals other than "SelProg" execute their respective functions when the input acceptance condition is satisfied at the rising edge of the signal. Functions are performed automatically, and so there is no need to create special programs.

KEY POINTS

- If an error occurs, execute "Reset" to clear the error state before executing a remote input command. Use "Error output" and "Reset input" to allow the remote device to monitor and clear error states.
- When the remote input command does not meet the input acceptance conditions, the CmdError signal is output. The CmdError signal is not set to default for remote I/O output signals. When using the remote function, set the CmdError signal to the remote I/O output signal.

Function Name	Default	Description	Input Acceptance Condition (*1)
Start	0	Execute the function selected in SelProg (*2) (*3)	Ready output ON Error output OFF EStopOn output OFF SafeguardOn output OFF EStopOff output ON Pause input OFF Stop input OFF
SelProg1	1	Specify Main function number to be executed (*2)	-
SelProg2	2		
SelProg4	3		
SelProg8	Not set		
SelProg16	Not set		
SelProg32	Not set		
Stop	4	Abort all tasks and commands	-
Pause	5	Pause all tasks (*4)	Running output ON
Continue	6	Resume paused task	Paused output ON Pause input OFF Stop input OFF
Reset	7	Emergency stop reset and error reset (*5)	Ready output ON
Shutdown	Not set	Shut down system	-
Continue	6	Continue paused task (*5)	Paused output ON Pause input OFF Stop input OFF
ContinueManualRecover	Not set	Continue paused task (manual recovery) (*6)	-
Reset	7	Emergency stop release and error release (*7)	Ready output ON

Function Name	Default	Description	Input Acceptance Condition (*1)
ForcePowerLow	Not set	Operate under a forced low power function Robot operates at low power Does not accept Power High control by commands, etc. Performs the following operations depending on Controller environment settings Stop or pause all tasks and commands (*8)	Always This input is accepted even when AutoMode output is OFF.
SelRobot	Not set	Change output conditions for MotorsOn, AtHome, PowerHigh, and MCalReqd (*9)	-
SelRobot1 SelRobot2 SelRobot4 SelRobot8 SelRobot16	Not set	Specify robot number to execute command (*10)	-
SetMotorOn	Not set	Turn on robot motors (*10) (*11)	Ready output ON EStopOn output OFF SafeguardOn output OFF EStopOff output ON SetMotorOff input OFF
SetMotorOff	Not set	Turn off robot motors (*10)	Ready output ON
SetPowerHigh	Not set	Set robot power mode to High (*10)	Ready output ON EStopOn output OFF SafeguardOn output OFF EStopOff output ON SetPowerLow input OFF
SetPowerLow	Not set	Set robot power mode to Low (*10)	Ready output ON

Function Name	Default	Description	Input Acceptance Condition (*1)
Home	Not set	Move robot arm to user-defined home position	Ready output ON Error output OFF EStopOn output OFF SafeguardOn output OFF EStopOff output ON MotorsOn output ON Pause input OFF Stop input OFF
ALIVE	Not set	Input signal for alive monitoring of the Controller The same signal as the input is output to the output-side ALIVE. The master device can perform alive monitoring of the Controller by periodically switching inputs and checking output signals.	-
MCal	Not set	Execute MCal (*10) (*12)	Ready output ON Error output OFF EStopOn output OFF SafeguardOn output OFF EStopOff output ON MotorsOn output ON Pause input OFF Stop input OFF
Recover	Not set	Execute a recovery operation to the position when the safeguard was open after the safeguard was closed (*13) (*14)	Paused output ON Error output OFF EStopOn output OFF SafeguardOn output OFF EStopOff output ON RecoverReqd output ON Pause input OFF Stop input OFF
ExtCmdSet	Not set	This is an expansion remote I/O command. For details, refer to the following manual. "Remote Control Reference - Remote I/O to Be Used"	-
ExtRespGet	Not set		-
ExtCmdReset	Not set		-

Function Name	Default	Description	Input Acceptance Condition (*1)
ALIVE	Not set	Input the input signal for performing alive monitoring of the Controller The same signal as the input is output to the output-side ALIVE. The master device can perform alive monitoring of the Controller by periodically switching inputs and checking output signals.	-
ExtCmd_0-15	Not set	This is an expansion remote I/O command. For details, refer to the following manual. "Remote Control Reference - Remote I/O to Be Used"	-
ExtCmd_16-31	Not set		
ExtCmd_32-47	Not set		
ExtCmd_48-63	Not set		
ExtCmd_64-79	Not set		
ExtCmd_80-95	Not set		
ExtCmd_96-111	Not set		
ExtCmd_112-127	Not set		
SelAxis	Not set	Specify the applicable robot	-
SelAxis1-4	Not set	Specify the applicable axis (*15)	-
ResetCtrlParts	Not set	Clear Maintenance information (for the Controller) (*16)	-
SelCtrlParts1-8	Not set	Select Maintenance information (for the Controller) (*16)	-
ResetRbParts	Not set	Clear Maintenance information (for robots) (*17)	-
SelRbParts1-8	Not set	Select Maintenance information (for robots) (*17)	-

(*1) "AutoMode output" ON is omitted because it is a common input acceptance condition for all.

(*2) "Start input" executes the function specified by the 6 bits "SelProg1, 2, 4, 8, 16, 32."

Function Name	SelProg1	SelProg2	SelProg4	SelProg8	SelProg16	SelProg32
Main	0	0	0	0	0	0
Main1	1	0	0	0	0	0
Main2	0	1	0	0	0	0
Main3	1	1	0	0	0	0
:						
Main60	0	0	1	1	1	1
Main61	1	0	1	1	1	1
Main62	0	1	1	1	1	1
Main63	1	1	1	1	1	1

0=OFF, 1=ON

(*3) Do not run the Restart command of the SPEL+ program and the remote input Start signal at the same time. Running programs in duplicate may cause a 2503 error to occur.

(*4) "NoPause task" and "NoEmgAbort task" do not pause.

For details, refer to the following manual or online help.

"Epson RC+ Language Reference - Pause"

(*5) This resumes the execution of a paused task.

The setting for "Auto safeguard position recovery" setting in the Controller preferences is for control from Epson RC+ 8.0. This is not a setting to enable or disable the recovery operation of this command.

If you want to control the enabled/disabled status of automatic recovery by remote command, execute the Continue command and ContinueManualRecover command separately as necessary.

(*6) This resumes the execution of a paused task. With the Continue command, processing equivalent to the Recover command is also performed. Since this command does not include processing equivalent to the Recover command, the operation to recover to the position when the safeguard is opened is not performed.

You must execute the Recover command before executing this command.

[Use case]

Use this command to return to the original position (position with the safeguard open) with the Recover command and resume the program while confirming that no collision will occur during the recovery operation.

[Recovery method]

- Safeguard closed->Recover->ContinueManualRecover
- Safeguard closed->Continue
- Safeguard closed->ContinueManualRecover->Continue

[Supplemental explanation]

Before executing this command, be sure to perform a recovery operation with the Recover command. Use the Continue command to perform the recovery operation and resume execution of the task at once. An error occurs if you execute the ContinueManualRecover command without executing the Recover command.

(*7) This turns off I/O outputs and initializes robot parameters.

For details, refer to the online help or the following manual.

"SPEL+ Language Reference - Reset"

(*8) This performs all tasks and commands, robot power modes, and PowerHigh command operations according to the set values in the Controller preferences.

Environment settings (1): "Low power at ForcePowerLow signal OFF"

Environment settings (2): "Pause tasks at ForcePowerLow signal change"

For details on Controller environment settings, refer to the following manual.

"Epson RC+ User's Guide - [Setup] - [System Configuration] - [Controller] - [Preferences]"

Environment settings (1)	Environment settings (2)	ForcePowerLow Signal Change	All tasks and commands	Robot power mode	PowerHigh command
0	0	1->0	Stop	Low only	Accept
0	0	0->1	Stop	Low only	Not accepted
0	1	1->0	Operation continues	High/Low	Accept
0	1	0->1	Pause	Low only	Not accepted
1	0	1->0	Stop	Low only	Not accepted

Environment settings (1)	Environment settings (2)	ForcePowerLow Signal Change	All tasks and commands	Robot power mode	PowerHigh command
1	0	0->1	Stop	Low only	Accept
1	1	1->0	Pause	Low only	Not accepted
1	1	0->1	Operation continues	High/Low	Accept

(*9) This switches output conditions for MotorsOn, AtHome, PowerHigh, and MCalReqd.

The conditions are selected using SelRobot-SelRobot16, and this signal can be set to switch the output conditions.

Once a selection is made, the condition is retained until it is switched again or until the Controller is turned off and restarted.

The default value is Selects All Robots.

(*10) If multiple robots are connected to the Controller, the value specified by the 5 bits of "SelRobot1, 2, 4, 8, 16" corresponds to the robot number.

Robot No.	SelRobot1	SelRobot2	SelRobot4	SelRobot8	SelRobot16
0(All)	0	0	0	0	0
1	1	0	0	0	0
2	0	1	0	0	0
3	1	1	0	0	0
4	0	0	1	0	0

0=OFF, 1=ON

In the RC800 series, 0 to 4 can be specified. If 5 or higher is specified, an error will occur because the robot cannot be registered.

(*11) This also initializes robot parameters.

For details, refer to the following manual or online help.

"Epson RC+ Language Reference - Motor"

(*12) For details, refer to the following manual or online help.

"Epson RC+ Language Reference - MCal"

(*13) This input is intended for advanced users. Ensure that you fully understand the input specifications before use.

The CmdRunning output and CmdError output do not change relative to this input.

The "NoEmgAbort task" is not aborted. All tasks and commands are also aborted when the input changes from ON to OFF.

(*14) After the safeguard is closed, perform the recovery operation to the position when the safeguard is open.

The setting for "Auto safeguard position recovery" setting in the Controller preferences is for control from Epson RC+ 8.0.

This is not a setting to enable or disable the recovery operation of this command.

If you want to control the enabled/disabled status of automatic recovery by remote command, execute the Continue command and ContinueManualRecover command separately as necessary.

(*15) The conditions are selected using SelAxis1-SelAxis4 and the axis is switched using SelAxis.

Function Name	Initial Value	Description	Input Acceptance Condition
SelAxis	Not set	Change the conditions for reflecting the Maintenance command (*a)	AutoMode output ON

Function Name	Initial Value	Description	Input Acceptance Condition
SelAxis1 SelAxis2 SelAxis4	Not set	Specify axis number for executing command (*b)	AutoMode output ON

(*a) This switches the conditions for reflecting Maintenance.

The conditions are selected using SelAxis1-SelAxis4, and this signal can be set to switch the reflection conditions.

Once selected, the conditions are retained until they are switched again or the Controller is turned off or restarted. All axes are unselected by default.

The selectable axis numbers vary depending on SelAxis.

If an axis that is not applicable is selected, the command execution is ignored.

(*b) The value specified by the 3 bits of "SelAxis1, 2, 4" corresponds to the axis number of the robot.

Axis 1 to Axis 6 can be specified.

Axis number	SelAxis1	SelAxis2	SelAxis4
0 (Reserved)	0	0	0
1	1	0	0
2	0	1	0
:			
6	0	1	1
7 (Reserved)	1	1	1

0=OFF, 1=ON

(*16) The conditions are selected using SelCtrlParts1-SelCtrlParts8 select conditions and ResetCtrlParts clears the Controller's Maintenance information.

Function Name	Initial Value	Description	Input Acceptance Condition
ResetCtrlParts	Not set	Clear Controller Maintenance information (*a)	AutoMode output ON
SelCtrlParts1 SelCtrlParts2 SelCtrlParts4 SelCtrlParts8	Not set	Specify Maintenance data number to be cleared (*b)	AutoMode output ON

(*a) The conditions are selected using SelCtrlParts1-SelCtrlParts8, and this clears the specified Maintenance information. Information is cleared regardless of whether errors and warnings have occurred.

(*b) The information to be cleared is specified by SelCtrlParts1-8 and executed by ResetCtrlParts.

The value specified by the 4 bits of "SelCtrlParts1, 2, 4, 8" is the part designation number for resetting information.

SelCtrlParts 1	SelCtrlParts 2	SelCtrlParts 4	SelCtrlParts 8	Parts (Controller)
0	0	0	0	(Reserved)
1	0	0	0	Battery
0	1	0	0	(Reserved)

SelCtrlParts 1	SelCtrlParts 2	SelCtrlParts 4	SelCtrlParts 8	Parts (Controller)
:				
0	1	1	1	(Reserved)
1	1	1	1	(Reserved)

0=OFF, 1=ON

(*17) The conditions are selected using SelRbParts1-SelRbParts8, and ResetRbParts clears the robot's Maintenance information.

Function Name	Initial Value	Description	Input Acceptance Condition
ResetRbParts	Not set	Clear Controller Maintenance information (*a)	AutoMode output ON
SelRbParts1 SelRbParts2 SelRbParts4 SelRbParts8	Not set	Specify Maintenance data number to be cleared (*b)	AutoMode output ON

(*a) This selects the conditions in SelRbParts1-SelRbParts8 to clear the specified Maintenance information. Information is cleared regardless of whether errors and warnings have occurred.

(*b) The information to be cleared is specified by SelRbParts1-8 and executed by ResetRbParts. The value specified by the 4 bits of "SelRbParts1, 2, 4, 8" is the part designation number for resetting information.

SelRbParts 1	SelRbParts 2	SelRbParts 4	SelRbParts 8	Parts (Robot)
0	0	0	0	(Reserved)
1	0	0	0	Battery
0	1	0	0	Timing belt
1	1	0	0	Grease
0	0	1	0	Motor
1	0	1	0	Reduction gear
0	1	1	0	Ball screw spline
1	1	1	0	(Reserved)
:				
0	1	1	1	Reserved
1	1	1	1	Reserved

0=OFF, 1=ON

4.12.1.2 Outputs

Remote output is a function that outputs the current Manipulator status, Controller status, and operation mode to an external device from the Controller.

Remote output always outputs the status of the assigned function externally, regardless of the control device settings. Output is performed automatically, and so there is no need to create a special program.

Function Name	Default	Description
Ready	0	ON when Controller startup is complete and no tasks are running
Running	1	ON when task is running However, OFF when "Paused output" is ON
Paused	2	ON when paused task is present
Error	3	ON when error has occurred "Reset input" is required to recover from an error state. (*1)
EStopOn	Not set	OFF except in emergency stop state ON in emergency stop state OFF in Controller power off state (*2)(*3)
SafeguardOn	5	ON when safeguard is open
SError	6	ON when a critical error has occurred If a critical error has occurred, it cannot be recovered using "Reset input." The Controller must be restarted. (*1)
Warning	7	ON when warning has occurred Even if a warning has occurred, the task can be executed as usual. However, take corrective action to address the cause of the warning as soon as possible. (*1)
EStopOff	8	ON except in an emergency stop state OFF in emergency stop state OFF in Controller power off state (*3)
MotorsOn	Not set	ON when robot motor is on (*4)
AtHome	Not set	ON when robot is in the home position (*4)
PowerHigh	Not set	ON when robot is in the High power mode (*4)
MCalReqd	Not set	ON when robot has not performed MCal (*4)
RecoverReqd	Not set	ON when even one robot is waiting for the execution of the recovery operation after the safeguard is closed
RecoverInCycle	Not set	ON when even one robot is executing the recovery operation
WaitingRC	Not set	ON when Controller is waiting for connection to RC+
CmdRunning	Not set	ON during input command execution
CmdError	Not set	ON when input command could not be accepted
CurrProg1 CurrProg2 CurrProg4 CurrProg8 CurrProg16 CurrProg32	Not set	Outputs the main function number running or last executed (*5)
AutoMode	Not set	ON when remote input can be accepted (*6)

Function Name	Default	Description
TeachMode	Not set	ON when in TEACH mode (*3)
TestMode	Not set	ON when in TEST mode
EnableOn	Not set	ON when enable switch is on (*3)
ErrorCode1 to ErrorCode8192	Not set	Output the error number
InsideBox1 to InsideBox15	Not set	ON when robot is inside the entry detection area (*7)
InsidePlane1 to InsidePlane15	Not set	ON when robot is on the entry detection plane (*8)
PositionX	Not set	Outputs the current X coordinate in the world coordinate system. (*9) (*10)
PositionY	Not set	Outputs the current Y coordinate in the world coordinate system. (*9) (*10)
PositionZ	Not set	Outputs the current Z coordinate in the world coordinate system. (*9) (*10)
PositionU	Not set	Outputs the current U coordinate in the world coordinate system. (*9) (*10)
PositionV	Not set	Outputs the current V coordinate in the world coordinate system. (*9) (*10)
PositionW	Not set	Outputs the current W coordinate in the world coordinate system. (*9) (*10)
Torque1	Not set	Outputs the current torque value of Joint #1. (*9) (*10)
Torque2	Not set	Outputs the current torque value of Joint #2. (*9) (*10)
Torque3	Not set	Outputs the current torque value of Joint #3. (*9) (*10)
Torque4	Not set	Outputs the current torque value of Joint #4. (*9) (*10)
CPU	Not set	Outputs the CPU load ratio of the user program. (*11)
ESTOP	Not set	Outputs the number of times an emergency stop has been performed.
ALIVE	Not set	Output signal for alive monitoring of the Controller Outputs the signal that was input by the input-side ALIVE. The master device can perform alive monitoring of the Controller by periodically switching inputs and checking output signals.
ForceControlOn	Not set	ON when the robot is performing a force control function (*4)
ExtCmdGet	Not set	This is an expansion remote I/O command. For details, refer to the following manual. "Remote Control Reference - Remote I/O to Be Used"
ExtRespSet	Not set	
ExtCmdResult	Not set	
ExtError	Not set	
ExtResp_0-15	Not set	
ExtResp_16-31	Not set	
ExtResp_32-47	Not set	
ExtResp_48-63	Not set	

ExtResp_64-79	Not set	
ExtResp_80-95	Not set	
ExtResp_96-111	Not set	
ExtResp_112-127	Not set	
GetPartsStsCtrl0-15	Not set	Maintenance status (Controller) (*12)
GetPartsStsRb0-15	Not set	Maintenance status (Robot) (*13)

(*1) The correspondence between Error, SError, and Warning outputs and the corresponding status/error numbers are shown below.

Output Function Name	Error Numbers
Error	1000~8999
SError	9000~9999
Warning	410~999

For details on status numbers/error numbers, refer to the following manual.

"Status Code/Error Code List"

(*2) EStopOn is not recommended because the outputs for the emergency stop and Controller power off states do not match. To output the emergency stop state, assign EStopOff.

The default settings have also been changed to specifications in which EStopOff is assigned.

(*3) Do not the following signals for safety-related functions. The signals do not meet Cat 3&PLd.

EStopOn, EStopOff, TeachMode, EnableOn

(*4) The following output is produced under the conditions selected by SelRobot. After switching the conditions by SelRobot, wait 40 ms before inputting the data.

Function Name	State of SelRobot1-SelRobot16 at SelRobot Input	
	0: Selects All Robots	1 to 16: Selects Robot Number
MotorsOn	ON when even one robot motor is on	ON when the selected robot motor is on
AtHome	ON when all robots are in the home position	ON when the selected robot is in the home position
PowerHigh	ON when even one robot is in the High power mode	ON when the selected robot is in the High power mode
MCalReqd	ON when even one robot has not performed MCal	ON when the selected robot has not performed MCal
ForceControlOn	ON when even one robot is performing a force control function	ON when the selected robot is performing a force control function

(*5) Outputs the function number that is being executed or was last executed using the 6 bits of "CurrProg1, 2, 4, 8, 16, 32."

Function Name	CurrProg1	CurrProg2	CurrProg4	CurrProg8	CurrProg16	CurrProg32
Main	0	0	0	0	0	0

Function Name	CurrProg1	CurrProg2	CurrProg4	CurrProg8	CurrProg16	CurrProg32
Main1	1	0	0	0	0	0
Main2	0	1	0	0	0	0
Main3	1	1	0	0	0	0
:						
Main60	0	0	1	1	1	1
Main61	1	0	1	1	1	1
Main62	0	1	1	1	1	1
Main63	1	1	1	1	1	1

0=OFF, 1=ON

(*6) Remote input can be accepted in the following two cases:

- When in automatic operation mode and the control device is remote
- When in program mode and remote I/O is enabled

(*7) For details, refer to the following manual or online help.

"Epson RC+ Language Reference - Box"

(*8) For details, refer to the following manual or online help.

"Epson RC+ Language Reference - Plane"

(*9) If SelRobot1, SelRobot2, SelRobot4, SelRobot8, and SelRobot16 are set, information for the selected robot is output. If nothing is set, information on robot 1 is output.

(*10) This is output in the Real format.

(*11) The total load ratio of user-created tasks is output. For the CPU load ratio, see the Task Manager.

(*12) The warning status of each part is indicated by the bits.

Bit	Parts (Controller)
0	(Reserved)
1	Battery
2	(Reserved)
:	
14	(Reserved)
15	(Reserved)

(*13) The warning status of each part is indicated by the bits.

Bit	Parts (Robot)
0	(Reserved)
1	Battery

Bit	Parts (Robot)
2	Timing belt
3	Grease
4	Motor
5	Reduction gear
6	Ball screw spline
7	(Reserved)
:	
14	(Reserved)
15	(Reserved)

4.12.2 Timing Charts

4.12.2.1 Input Signal Notes

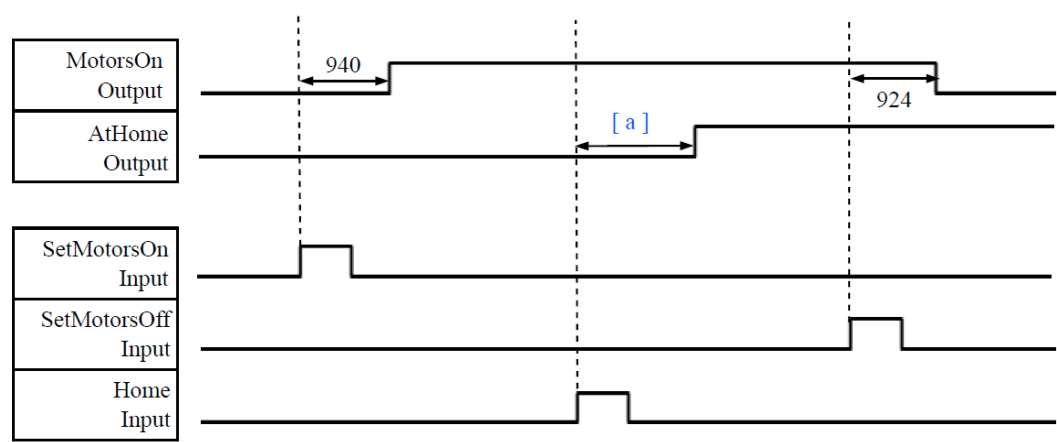
The timing charts show the timing for the Controller's key operations. Be sure to follow the timing chart when inputting signals.

However, note that the times in the charts are approximate. The time varies depending on the number of Manipulators, the number of tasks running, the Controller's CPU speed, and other factors.

Remote signals should be generated by pulse input, and each input should be designed to avoid overlapping as much as possible.

The pulse width of an input signal should be at least 25 msec, and input with chattering should be avoided.

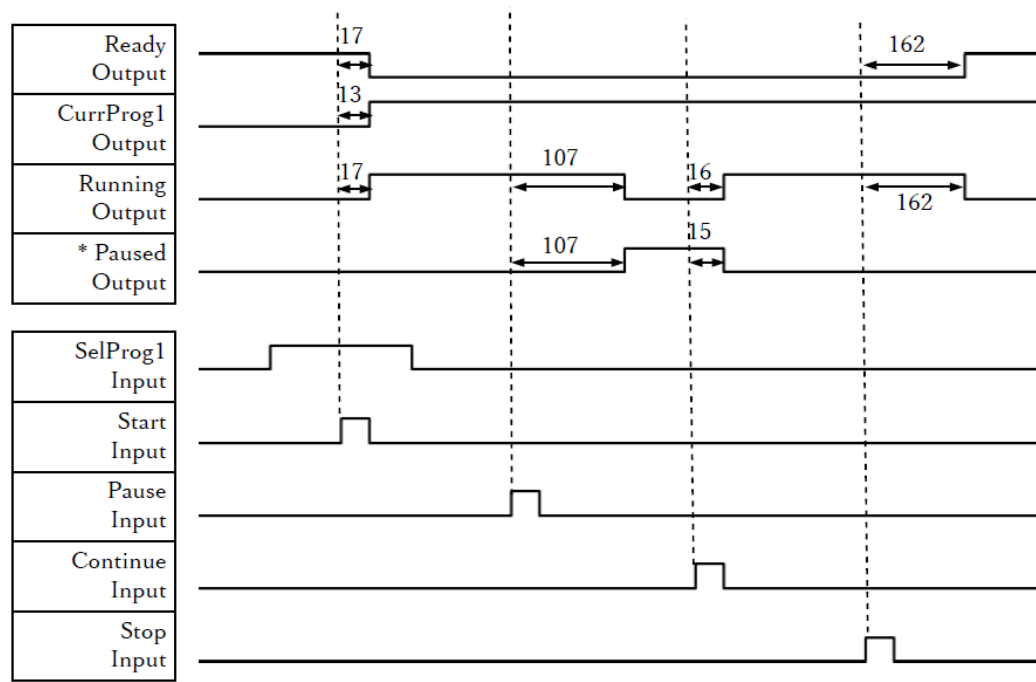
4.12.2.2 Timing for Operation Execution Sequence



(Units: msec)

Symbol	Description
a	This depends on the Home motion command.

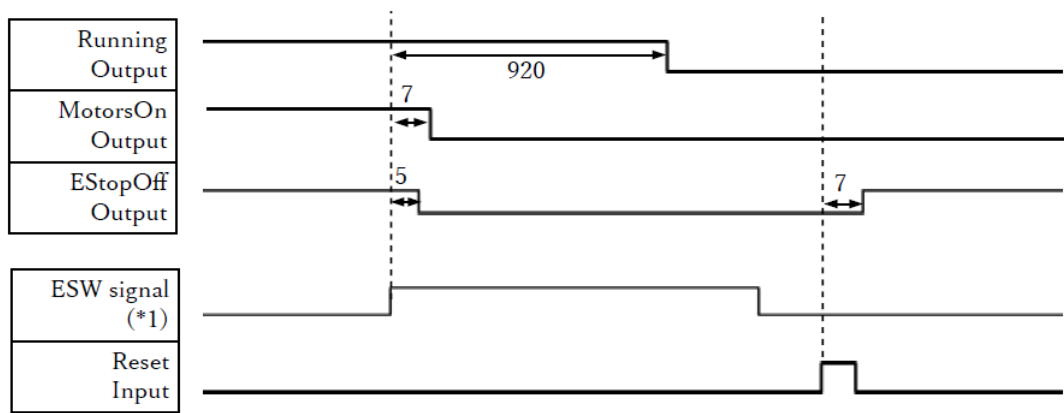
4.12.2.3 Timing for Program Execution Sequence



(Units: msec)

* This varies depending on the Quick Pause (QP) setting and the program operation state at PAUSE input.

4.12.2.4 Timing for Emergency Stop Sequence



(Units: msec)

(*1) This is the logical signal that indicates the timing of Controller internal processing.
For more information on the input signal names and operation conditions, refer to the following section.

[Signal Arrangement and Electrical Specifications](#)

4.13 Fieldbus I/O

Fieldbus I/O supports the following modules.

- DeviceNet™
- PROFIBUS-DP
- PROFINET
- CC-LINK
- EtherNet/IP™
- EtherCAT®
- Modbus

For details, refer to the following manuals.

Robot Controller Option Fieldbus I/O

"Epson RC+ User's Guide - Fieldbus Slave I/O"

For details on installing the Fieldbus I/O module, refer to the following manual.

"RC800L Service Manual - Fieldbus I/O Module"

5. Periodic Inspection



Accurate inspection work is necessary to prevent breakdowns and ensure safety.
This section explains when inspections should be performed and what should be inspected.
Perform inspections according to the predetermined schedule.

5.1 RC800L Periodic Inspection

5.1.1 Inspection Items and Their Inspection Frequency

For part names and their locations, refer to the following.

Part Names and Their Functions

Inspection Item	Frequency	Inspection Method	Check Method
Controller	12 months	Power down and restart	Starts up without errors
Emergency Stop Switch	12 months	Press the emergency stop switch with the motor energized	The 7-segment LED on the Controller displays the following: 
Safeguard	12 months	Operate the safeguard with the motor energized	The 7-segment LED on the Controller displays the following: 
Fan filter	1 month	Perform a visual check and clean	No dirtiness
Fan (front)	1 month	Check for operating noise, visual check of the 7-segment LED	No unusual noise, no warning 515 appears on the 7-segment LED
Enable switch	12 months	When motor is turned on in teach mode, grip or release the enable switch to check if motor excitation is turned off	The indicating lamp on the Manipulator turns off For details, refer to the following manual. "Manipulator Manual"
Encoder	12 months	Confirm zero position *If you turned off the Controller, make sure to always check the zero position as a startup inspection.	Manipulator is at set zero position

5.2 Backup and Restore

5.2.1 What is Controller Backup?

Various settings configured with Epson RC+ can be easily saved with the "Controller Backup."

If the settings were made incorrectly or the Controller has failed, the Controller settings can be easily recovered using the data saved with the "Controller Backup."

Be sure to always perform the "Controller Backup" after the Controller settings were changed, before maintenance, or after teaching.

Depending on the problem, it may not be possible to make a backup before maintenance work. Be sure to always back up your latest data.

KEY POINTS

RC800L has a function called "Export Controller Status." This function can store the same data as the "Controller Backup."

The stored data can also be used as backup data for data restoration.

There are several ways to save the "Export Controller Status."

- A: Controller Backup function to a USB memory device
Refer to the following section.
[Memory Port](#)
- B: Controller settings import function
For details, refer to the following manual.
"Epson RC+ User's Guide - [Import] Command (Project Menu)"

5.2.2 Backed-up Data

For more information on backed-up files, refer to the following section.

[Details of Saved Data](#)

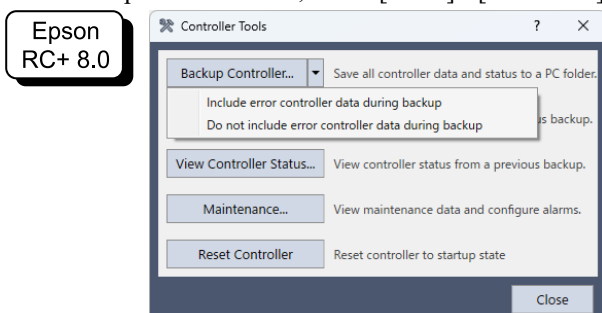
When backup is performed from Epson RC+, the following files will be backed up.

- SimObjects.dat • SimObjects.jpg • CAD.zip
Simulator data: This includes layout information, screenshot images of the entire layout, and CAD files that are being used.

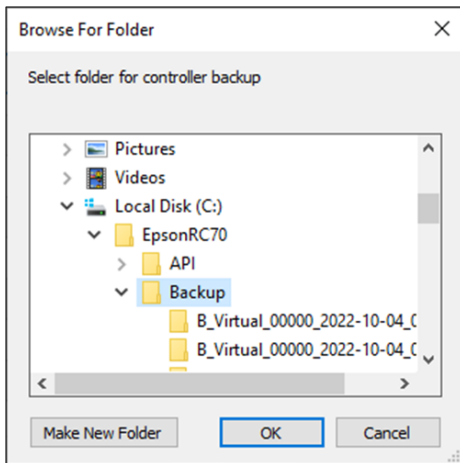
5.2.3 Backup

Controller settings can be backed up from Epson RC+.

1. From the Epson RC+ menu, select [Tools] - [Controller] to display the [Controller Tools] dialog box.



- Click the button for the target to backup from [Backup Controller...] and display the [Browse For Folder] dialog.



- Specify the folder where the backup data will be stored. Create a new folder if needed.
- After clicking the [OK] button, a folder for storing the backup data will be created under the specified folder.
"B_ Controller Type Name_Serial Number_Date and Time"

⚠ CAUTION

Do not modify the saved files with editors or other software. Operation of the robot system is not guaranteed when data is restored to the Controller.

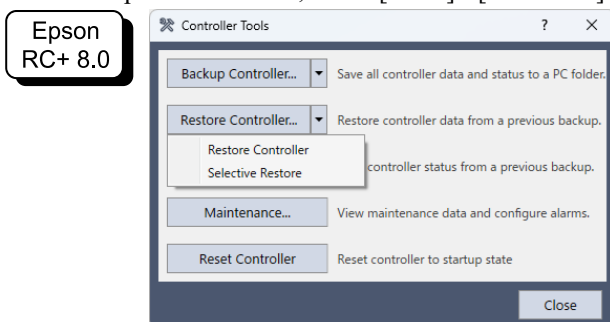
5.2.4 Restore

Controller settings can be restored from Epson RC+.

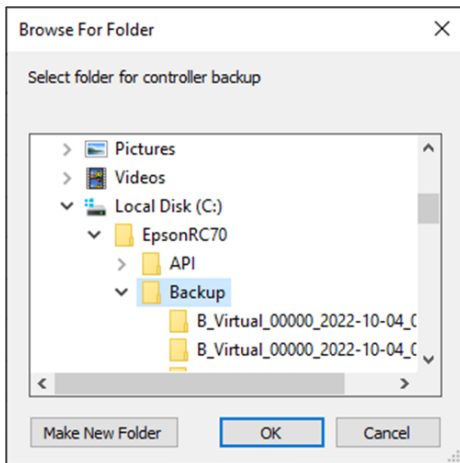
⚠ CAUTION

- When restoring, be sure to use the data for the same Controller that was used when making the backup.
- Do not modify the saved files with editors or other software. Operation of the robot system is not guaranteed when data is restored to the Controller.

- From the Epson RC+ menu, select [Tools] - [Controller] to display the [Controller Tools] dialog box.



2. Click the button for the target to restore from [Restore Controller...] and display the [Browse For Folder] dialog.

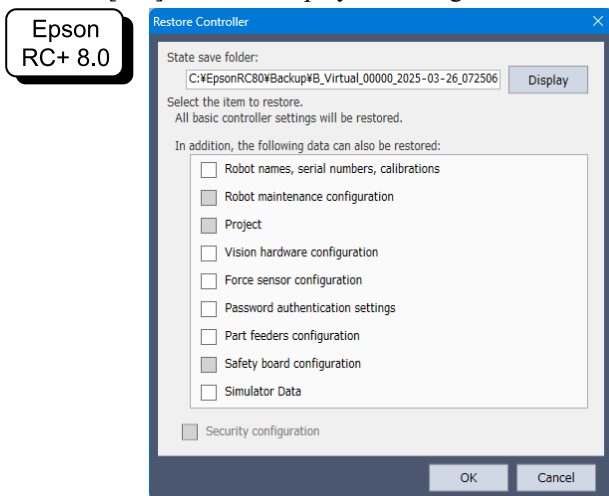


3. Specify the folder where the backup data is stored.
"B_ Controller Type Name_Serial Number_Date and Time"

KEY POINTS

The "Controller Backup" function to the USB memory device also allows selection of the saved data.

4. Click the [OK] button to display the dialog box for selecting data to be restored.



■ Robot names, serial numbers, calibrations

This function also restores the robot name, robot serial number, Hofs data, and CalPIs data. Note that restoring incorrect Hofs data will prevent the robot from operating at the correct position.

By default, this is not selected (check mark removed).

■ Robot maintenance configuration

The Maintenance information files are also restored.

Refer to the following section.

[Alarm Function](#)

By default, this is not selected (check mark removed).

To include the Maintenance information files, from the Epson RC+ menu, go to [Setup] - [System Configuration] - [Controller] - [Preferences], and select the [Enable robot maintenance data] checkbox. Note that if the acquired backup data is restored without selecting this checkbox, the Maintenance information will not be applied.

■ Project

Project-related files are also restored.

By default, this is not selected (check mark removed).

When a project is restored, all backup variable (Global Preserve variable) values are initialized.

For details on how to restore backup variable values, refer to the following manual.

"Epson RC+ User's Guide - [Display Variables] Command (Run Menu)"

■ Vision hardware configuration

The vision hardware configuration is also restored.

For details, refer to the following manual.

"Epson RC+ Option Vision Guide"

By default, this is not selected (check mark removed).

■ Security configuration

The security configuration is also restored.

For details, refer to the following manual.

"Epson RC+ User's Guide - Security"

By default, this is not selected (check mark removed).

■ Password authentication settings

The PC connection authentication settings are also restored.

The PC connection authentication password and connection authentication disable settings are restored.

By default, this is not selected (check mark removed).

■ Safety board configuration

Safety Function Manager starts and restores the safety board. For details, refer to the following manual.

"Robot Controller Safety Function Manual"

This data can be checked only if you are using the Controller with safety board installed. By default, this is not selected (check mark removed).

■ Simulator data

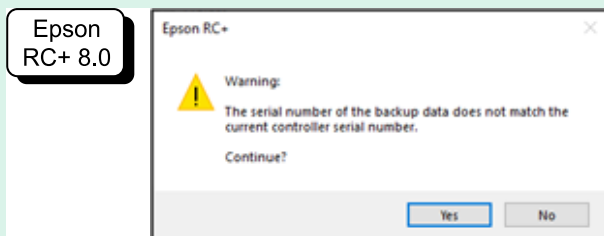
The simulator data settings will be restored. It is not checked off by default. This can be selected when the simulator data is included in the backup data. It is available in the standard and premium edition.

5. Click the [OK] button to restore the system information.

KEY POINTS

- The system configuration that was saved by the Controller settings backup should be restored only on the same system (Controller settings restore).

If the user tries to restore information from a different system, the following warning dialog box appears.



Except in special cases such as replacing a Controller, you should click the [No] button to not restore the data.

- Restoring a backup that contains unsupported robot information to the target Controller will result in an error.

- Restoring "Robot names, serial numbers, calibrations" and "Safety board configuration" separately may cause an error when the Controller is started.

When an error occurs, refer to the following manual to correct it.

"Status Code/Error Code List"

- When restoring, the IP address is not restored to prevent unexpected communication interruptions due to the IP address being overwritten. The most recent IP address set to the Controller is retained.
- When you select "Robot names, serial numbers, calibrations" or "Safety board configuration", you need to enter the safety board password. For details, refer to the following manual.

"Robot Controller Safety Function Manual"

5.3 Alarm Function

The parts used in each joint part of the robot may deteriorate due to usage over time, resulting in loss of accuracy and possible breakdowns. When a robot breaks down due to deterioration of parts or other reasons, significant time and expense are incurred in repairing the robot.

To enable maintenance well in advance of warning errors, this section describes the following methods (alarms) that alert the user when it is time to perform maintenance.

KEY POINTS

When using Epson RC+ 8.0, the Controller firmware version requires 7.5.4.x or later.

5.3.1 Maintenance

The recommended replacement intervals can be set for robot grease, timing belts, motors, reduction gears, ball screw splines and Batteries for robots.

CAUTION

Verify that the Controller's date and time are set correctly. If an incorrect date and time are set, the alarm function will not operate properly.

KEY POINTS

Maintenance is enabled at factory shipping.

If enabled, the Maintenance information for grease, timing belts, motors, reduction gears, Batteries for robots, and ball screw splines is automatically set when the robot is set up or changed.

Grease is applied to the following target location.

- Ball screw spline unit of Joint #3

When a robot is deleted, the Maintenance information is automatically deleted.

For details on how to set up the robot, refer to the following manual.

"Epson RC+ User's Guide - Setting the Robot Model"

CAUTION

Be careful when making changes to the robot. Changing the robot resets the alarm.

KEY POINTS

The Maintenance information varies depending on the Controller that has configured the robot. If the robot is replaced with a robot with a different serial number, the Maintenance information will not work properly. After replacing a robot, edit the Maintenance information.

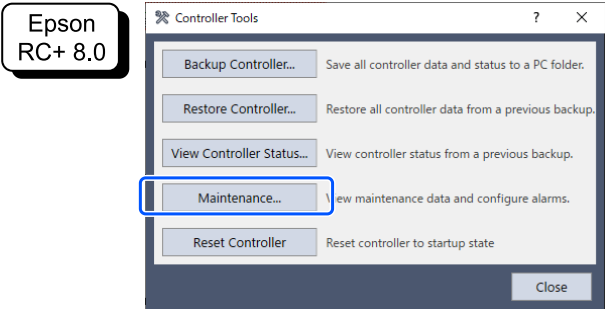
Refer to the following section.

Editing the Maintenance Information

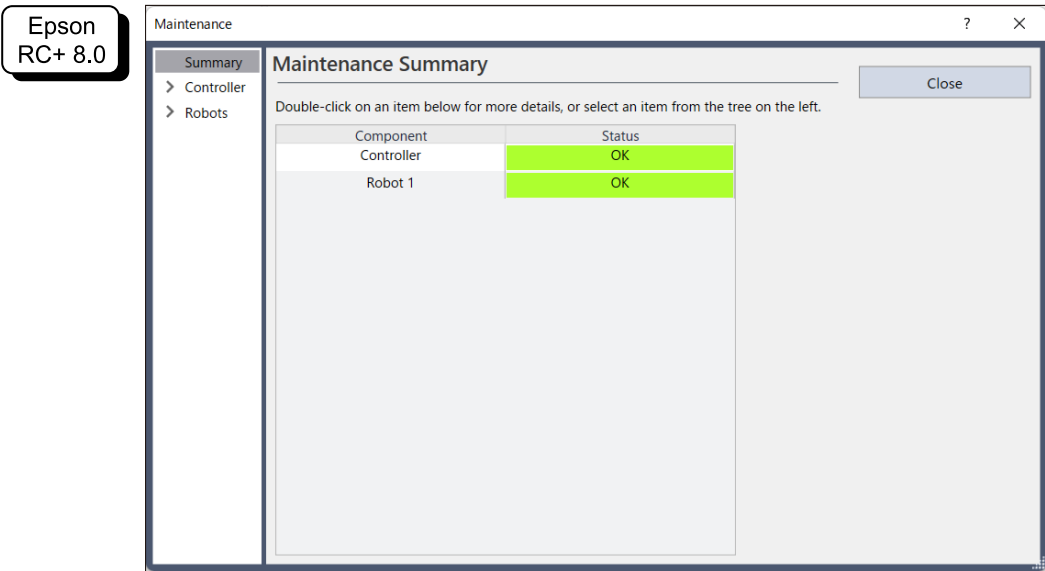
5.3.2 Viewing the Maintenance Information

This section describes the procedure for viewing the Maintenance information that was set.

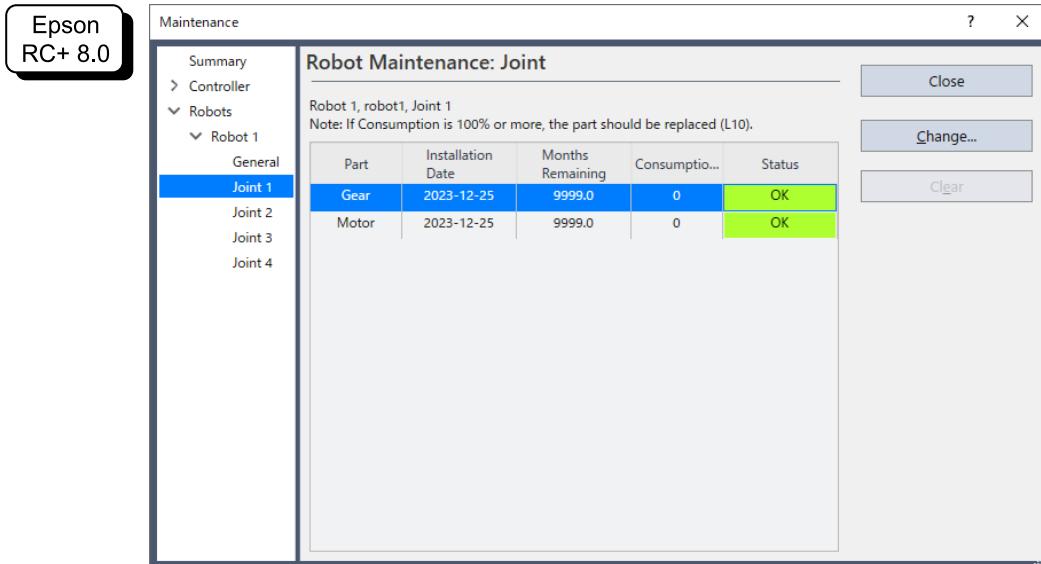
- 1. From the Epson RC+ menu, select [Tools] - [Controller] to display the [Controller Tools] dialog box.



- 2. To view the Maintenance information, click the [Maintenance] button to display the [Maintenance] dialog box.



3. Select a common or specified axis from the tree to display information on the target part.



KEY POINTS

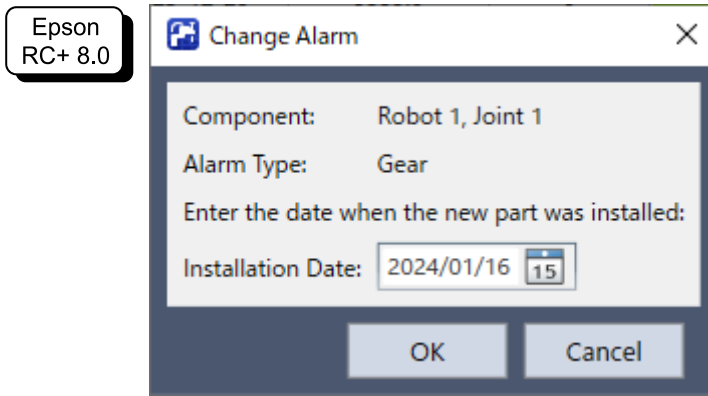
- The recommended grease replacement interval is based on the number of days that have elapsed from the last grease application date. The replacement interval may vary depending on the customer's load and other usage methods.
- The recommended replacement interval for maintenance items (timing belt, motor, reduction gear, ball screw spline) is L10 life (period up to 10% breakage probability). In the [Maintenance] dialog box, the L10 life is shown as 100%.
- The number of months remaining is calculated based on the past operation conditions.
The period used for the calculation can be set using the "HealthCalcPeriod" command. (Default: Controller power-on 7 days)
The number of remaining months may not be calculated properly until the period used for calculation has elapsed once.
- The recommended robot battery replacement interval is estimated based on the battery storage and the time the Controller is energized. If the recommended replacement interval is exceeded, the battery may run out.

5.3.3 Editing the Maintenance Information

This section describes the procedure for editing the Maintenance information that was set.

1. From the Epson RC+ menu, select [Tools] - [Controller] to display the [Controller Tools] dialog box.
2. To edit the Maintenance information, open the [Maintenance] dialog box.
3. Select a common or specified axis from the tree to display information on the target part.
4. Select the alarm to be changed, and click the [Change] button.

5. Open the [Change Alarm] dialog box, and enter one of the following dates.



- Date grease was applied
- Date timing belt purchased or replaced
- Date motor purchased or replaced
- Date reduction gear purchased or replaced
- Date ball screw spline purchased or replaced
- Date battery purchased or replaced

6. Click the [OK] button to change the specified alarm information.

KEY POINTS

An offset can be set for the wear rate of an existing part.

The following calculations should be used as a guideline for setting the offset.

1. Measures the number of available months for past operations using the "HealthRBAAnalysis" command.
2. Check the past motor power-on time in the status save viewer.
3. The following formula is used to calculate the approximate offset.

$$\text{Offset} = 100 \times \frac{\text{Motor On time}}{24 \times 30.4375 \times \text{Usable months}}$$

For details, refer to the following manual.

"Epson RC+ SPEL+ Language Reference"

5.3.4 Alarm Notification Procedure

When the recommended replacement interval or recommended greasing interval is reached for any part, the Controller enters a warning state and displays a warning message.

For details, refer to the following manual.

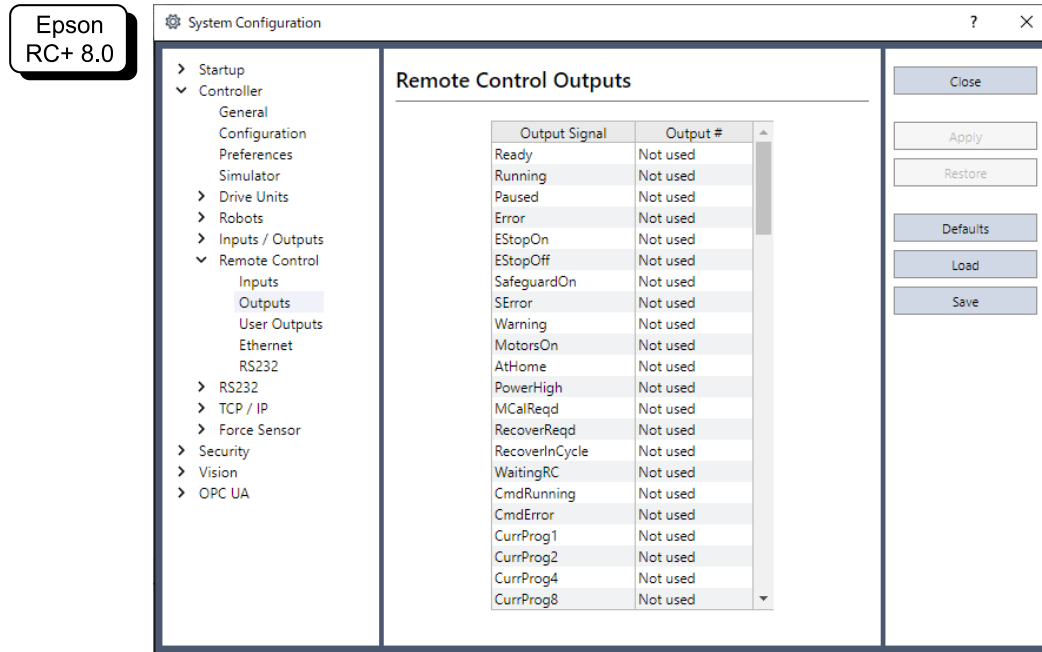
"Status Code/Error Code List"

One method of alarm notification is to set the alarm to an output bit of the remote I/O.

Remote I/O can be set from [Setup] - [System Configuration] - [Controller] - [Remote Control] in Epson RC+.

For details, refer to the following manual.

"Epson RC+ User's Guide - Remote I/O"



KEY POINTS

- If an alarm occurs, the Controller enters a warning state.
- Alarm1 to Alarm9, which are set to the output bits of the remote I/O, monitor the occurrence of warnings in five-minute cycles.
- The timing of alarm occurrence and their output at the Controller is different. The alarm may be output to the remote I/O up to 5 minutes after the alarm has occurred at the Controller.

5.3.5 Resetting an Alarm

Alarms can be reset in the one of the following ways.

- Reset operation from the [Maintenance] dialog box in Epson RC+
- HealthCtrlReset command
- HealthRBReset command

The [Clear] button executes the above commands.

To reset the alarm display, you must restart the Controller. An alarm occurs when the wear rate of the component that was set reaches 100%. Replace the components as soon as possible. Note that if the alarm is reset without replacing the components, the alarm will not occur until the wear rate reaches the specified value (500%) or an error occurs.

6. Appendix

6.1 Appendix A: Option Parts List

Part Name	Code	Notes
CC-Link module	R12NZ901LC	-
DeviceNet module	R12NZ901L7	-
PROFIBUS-DP module	R12NZ901L8	-
PROFINET module	R12NZ901LB	-
EtherNet/IP module	R12NZ901LA	-
EtherCAT module	R12NZ901L9	-
Controller wall mounting option	R12NZ901L5	-
Rack mounting plate	R12NZ901HR	-
D-SUB 50-pin connector for standard I/O	R12NZ901HT	-

6.2 Appendix B: Bundled Accessories

- TP2 bypass plug: 1 pc.
- EMERGENCY connector short plug: 1 pc.
- Safety I/O connector: 1 pc.
- Power cable: 1 pc.
- USB cable bracket: 1 pc.

6.3 Appendix C: Troubleshooting

This chapter describes the firmware upgrade procedure and the firmware and data file initialization procedure needed when errors in firmware or robot setting information cause the Controller to fail to start properly or to fail to connect to the development PC.

6.3.1 Upgrading Firmware

Software (firmware) and data files necessary to control the Controller and the robot are preinstalled in the Controller. Controller setting information that was set by the user from the development software is also saved in the Controller as needed.

If necessary, the firmware is available on CD-ROM and other sources. For details on how to get the firmware, please contact the supplier.

To upgrade the firmware, a development PC where the development software Epson RC+ is installed must be connected to a Controller by a USB cable or an Ethernet cable. (Firmware cannot be initialized over an Ethernet connection.)

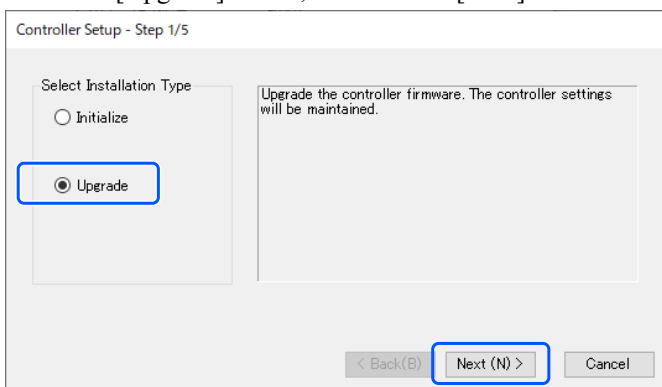
KEY POINTS

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

6.3.2 Firmware Upgrade Procedure

This section explains the firmware upgrade procedure.

1. Connect the development PC and the Controller by a USB cable or an Ethernet cable.
(Firmware cannot be initialized over an Ethernet connection.)
2. Turn on the Controller.
(Do not start the development software Epson RC+ until the firmware upgrade process is completed.)
3. Get the Epson RC+ installer from the DVD or the Epson Robot Software Installer.
4. Execute "Ctrlsetup80.exe" in the installer folder.
The following dialog box appears.
5. Select the [Upgrade] button, and click the [Next] button.



6. Make sure that the development PC is connected to the Controller by a USB cable or an Ethernet cable, and select [Connection] matches your connection environment. When you select Ethernet, specify the IP address set for the

Controller.

Click the [Connect] button.

Controller Setup - Step 2/5

This installer can only execute on the controller.

Caution!!
Do not turn off controller power during the installation.

Connection

☒ USB

☐ Ethernet 192.168.0.1

< Back(B) Connect Cancel

7. Check the current firmware version and the new firmware version, and click the [Install] button.

Controller Setup - Step 3/5

	Current	New
Version :		
Name :	RC800	RC800
Serial No. :	99999	99999
MAC Address :		
IP Address :	192.168.0.1	
Subnet Mask :	255.255.255.0	

< Back(B) Install Cancel

8. Firmware transfer and installation are started. The process takes several minutes to complete.

Controller Setup - Step 4/5

Copying data file to the controller.

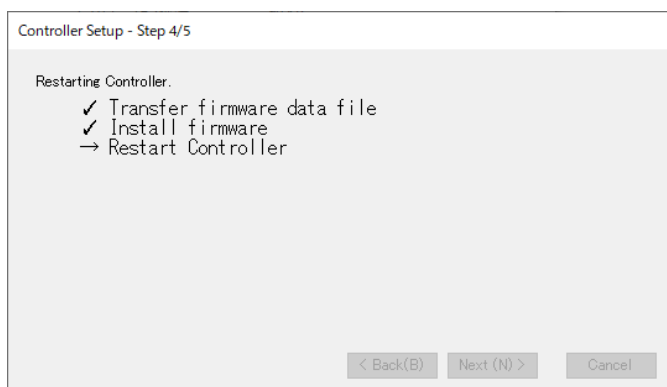
→ Transfer firmware data file
Install firmware
Restart Controller

< Back(B) Next (N) > Cancel

KEY POINTS

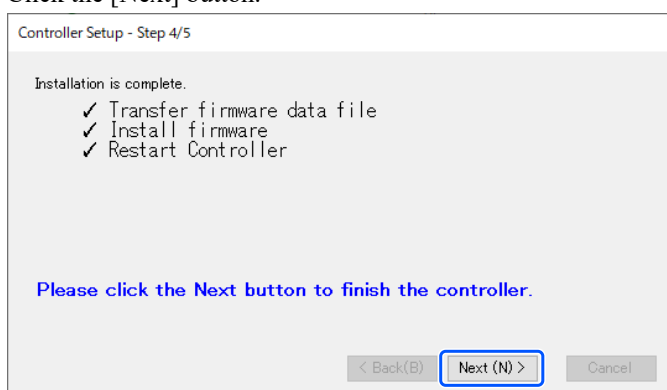
During transfer, do not disconnect connection cables or turn off the Controller or development PC.

9. The Controller is rebooted when the data file transfer and installation have been completed.



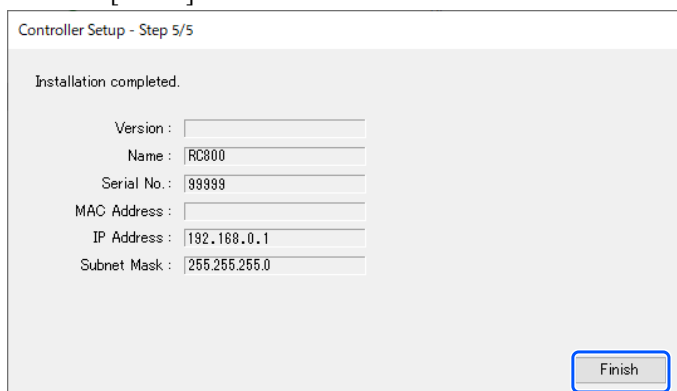
10. The following dialog box appears after the Controller is rebooted.

Click the [Next] button.



11. The following dialog box appears.

Click the [Finish] button.



This completes the firmware upgrade.

6.3.3 Controller Initialization

If the Controller becomes inoperable for any reason, perform initialization.

KEY POINTS

Backup of the system being run is recommended beforehand to ensure that the system can be easily restored to its operational state.

Refer to the following section.

Backup and Restore

If you cannot initialize, please contact the supplier.

6.3.4 Firmware Initialization Procedure

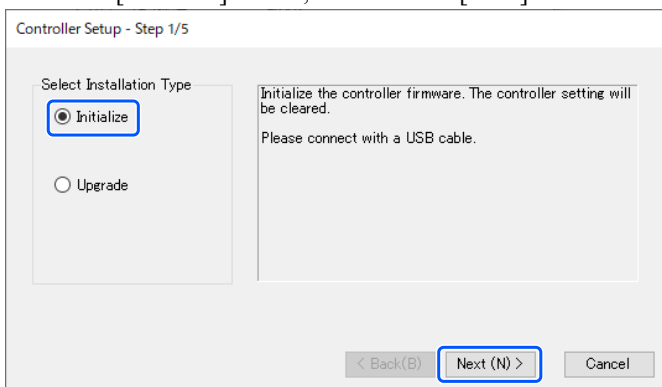
This section explains the firmware initialization procedure.

KEY POINTS

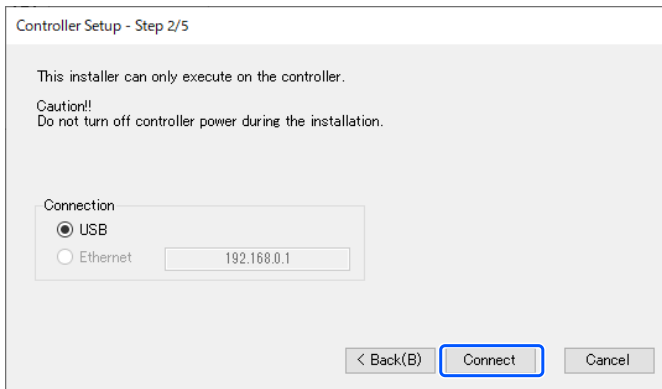
In the following cases, connections cannot be established with an Ethernet (PC) connector or by remote Ethernet.

- The Controller IP address is set to a global IP address

1. Connect the development PC and the Controller by a USB cable.
(Firmware cannot be initialized over an Ethernet connection.)
2. Turn on the Controller.
(Do not start the development software Epson RC+ until the firmware upgrade process is completed.)
3. Get the Epson RC+ installer from the DVD or the Epson Robot Software Installer.
4. Execute "Ctrlsetup80.exe" in the installer folder.
5. Select the [Initialize] button, and click the [Next] button.



6. Make sure that the development PC is connected to the Controller by a USB cable, and click the [Connect] button.



Controller Setup - Step 2/5

This installer can only execute on the controller.

Caution!!
Do not turn off controller power during the installation.

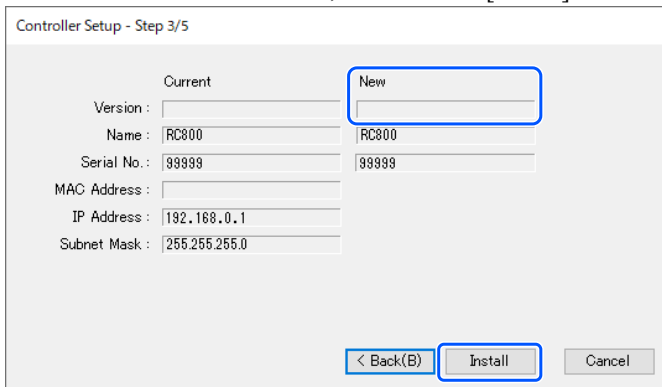
Connection

☒ USB

☐ Ethernet 192.168.0.1

< Back(B) Connect Cancel

7. Check the version information, and click the [Install] button.

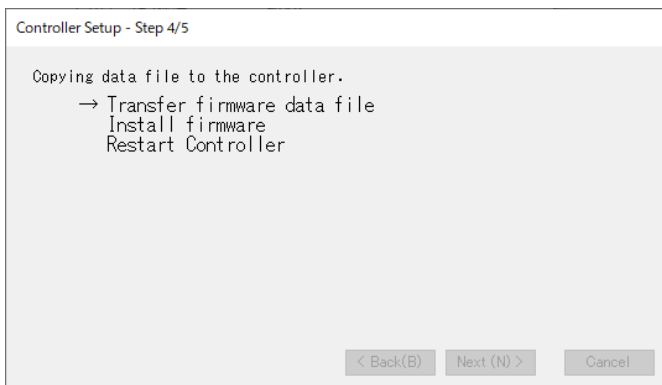


Controller Setup - Step 3/5

Current	New
Version :	
Name :	RC800
Serial No. :	99999
MAC Address :	
IP Address :	192.168.0.1
Subnet Mask :	255.255.255.0

< Back(B) Install Cancel

8. Firmware transfer and installation are started. The process takes several minutes to complete.



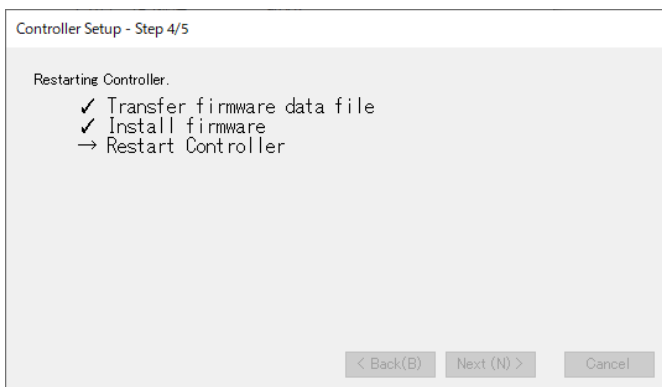
Controller Setup - Step 4/5

Copying data file to the controller.

- Transfer firmware data file
- Install firmware
- Restart Controller

< Back(B) Next (N) > Cancel

9. The Controller is rebooted when the data transfer and installation have been completed.



Controller Setup - Step 4/5

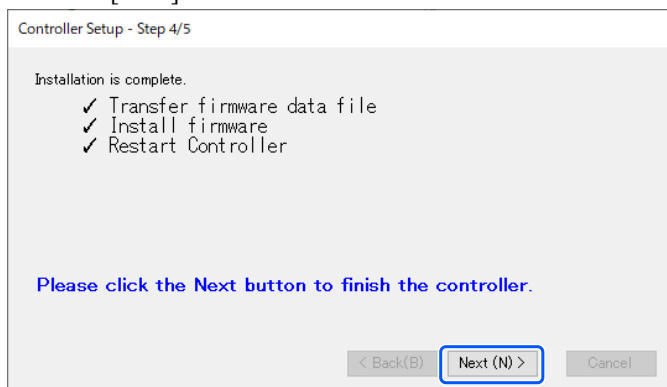
Restarting Controller.

- ✓ Transfer firmware data file
- ✓ Install firmware
- Restart Controller

< Back(B) Next (N) > Cancel

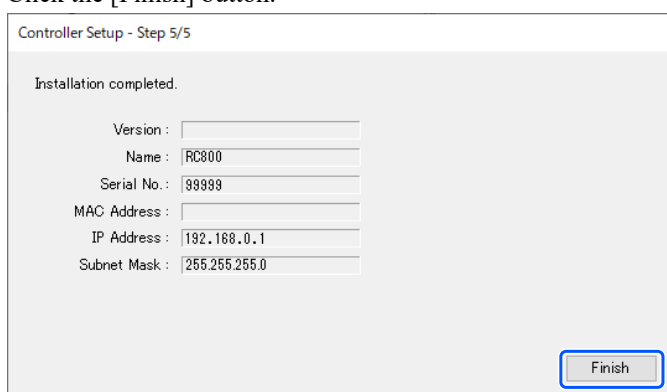
10. The following dialog box appears after the Controller is rebooted.

Click the [Next] button.



11. The following dialog box appears.

Click the [Finish] button.



This completes the firmware initialization process.

Start Epson RC+, and restore the running system.

Refer to the following section.

Backup and Restore