EPSON

Industrial Robot: 6-Axis Robots
VT-B series Manual

Original instructions

Rev.1
ENM263R8503F

Table of Contents

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.

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

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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 Regarding battery disposal

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

“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 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

Before using this manual, be sure that you understand the following information.

⚠ 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

- “VT-B” and “VT-B series” described in this manual are the following models.
  VT6-B series
- VT-B series Manipulators can use the Teach Pendant (TP2, TP4). Do not connect the other devices to TP port except TP bypass plug, TP2 and TP4. The different signal arrangement could cause a breakdown in the device.
- Security measures regarding network connection

  The network connection function (Ethernet) equipped in our product is assumed to be used in a local network such as a factory LAN. Do not connect to the external network such as Internet. In addition, take security measures such as for the virus from the network connection by installing the anti virus software.

- 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.

1.9.1 Features of VT-B series Manipulator

The VT series Manipulators are Controller integrated Manipulators.

1.9.2 Structure of Robot System

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

- Controller Firmware: Ver.7.5.58.x or later
- Software: Epson RC+ 8.0 or later

1.9.3 Shape of Motors

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

1.9.4 Setting by Using Software

This manual contains setup procedures using the software. Those sections are indicated by these symbols.

Epson RC+

1.9.5 Images used in this manual

The photos and illustrations of the Manipulators shown in this manual may differ in shape and appearance from your Manipulator due to the time it was shipped, specifications, and other factors.

1.10 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

VT-B series Manual

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. Installation

2.1 Safety

The Manipulator and its related equipment should be unpacked and transported by people who have received installation training provided by Epson and the suppliers. Also, the laws and regulations of the installation country must be followed.

Before use, please read this manual and other related manuals to ensure correct use. After reading this manual, store it in an easily accessible location for future reference.

This product is intended for transporting and assembling parts in a safely isolated area.

2.1.1 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

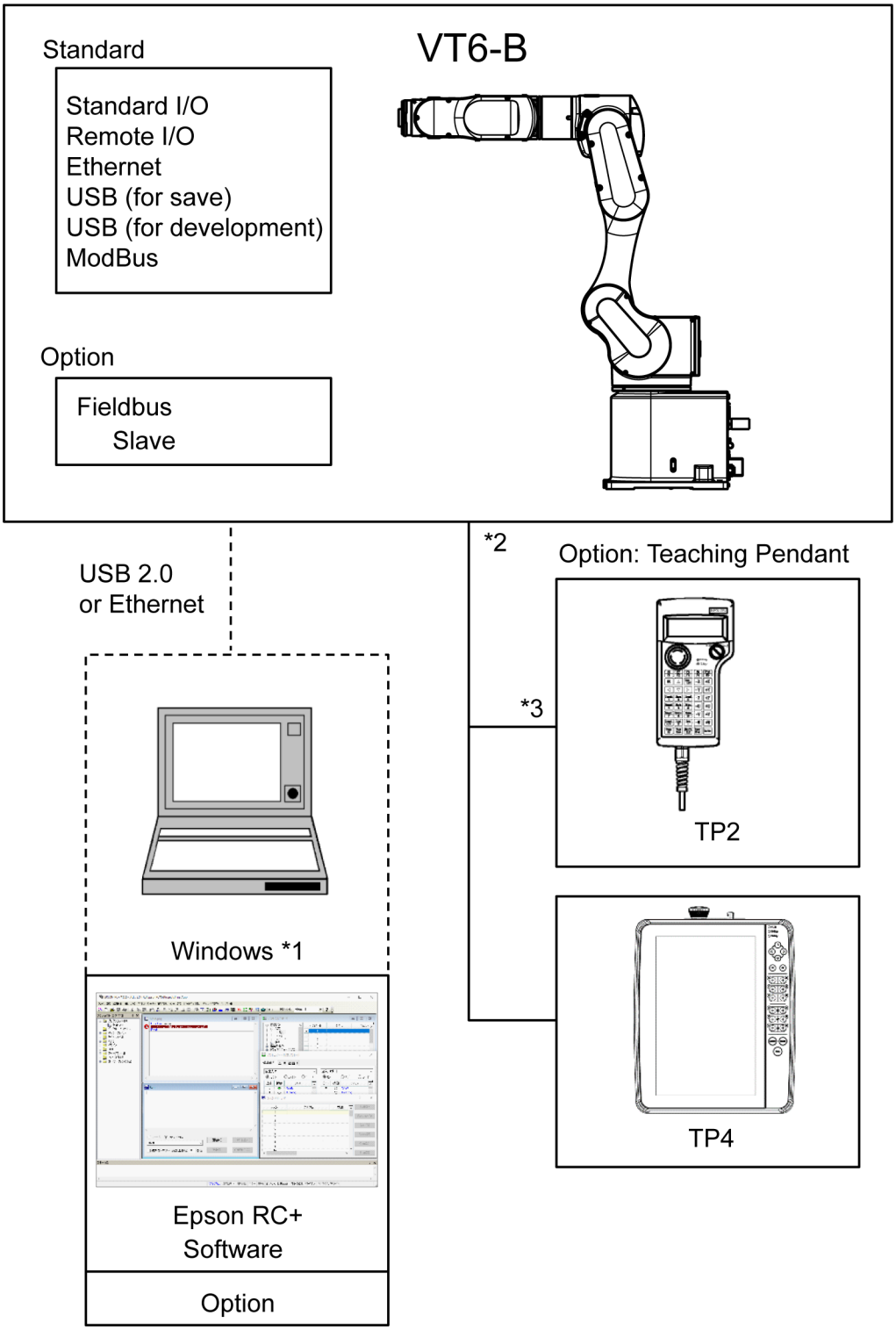
This symbol indicates a potentially hazardous situation which, if operation is not performed properly, could result in an injury due to electric shock.

⚠ CAUTION

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

2.2 Installation

2.2.1 System Configuration Example



*1 For the system requirements, refer to the following manual:
"Epson RC+ User's Guide"
*2 Either one of the teaching pendant is available.
*3 When connecting to VT-B series, a dedicated conversion cable is required.

2.2.2 Unpacking

Unpacking of the Manipulator and related equipment should be performed by people who have received installation training provided by Epson and the 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"

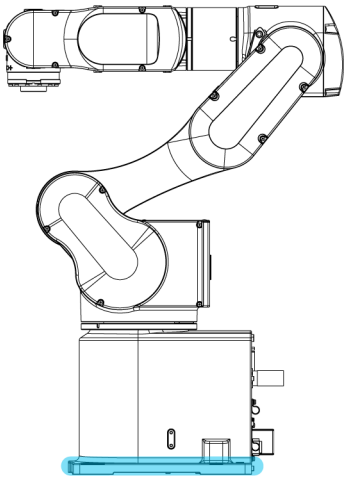
2.2.3 Transportation

2.2.3.1 Transportation Precautions

Transportation and of the Manipulator and related equipment should be performed by personnel who has received installation training provided by Epson and the 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"

2.2.3.2 Holding Position and Number of People to Transport Manipulator

- Holding position when transporting: Except for prohibited part to hold
- Number of people needed in transportation: at least two
- Prohibited part to hold: Back of the base (shaded area)



2.2.4 Environment and Installation

Installation of the Manipulator and related equipment should be performed by personnel who has received installation training provided by Epson and the 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 details, refer to the following section.

Environment and Installation

2.2.5 Connection to EMERGENCY Connector

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

When nothing is connected to the EMERGENCY connector, the Controller does not operate normally. For details, refer to the following section.

EMERGENCY connector

2.3 Power On

2.3.1 Power supply, Power cable, Breaker

> ⚠ WARNING
>
> There is no power switch on the Manipulator. Right after inserting a power plug to power, the robot system turns ON. Be ware of electric shock when inserting a power plug.

For power supply, power cable, and circuit breaker, refer to the following:

Power supply

2.3.2 Power-On Precautions

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 to operators and/or severe equipment damage.

Check the 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 to operators and/or severe equipment damage.

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

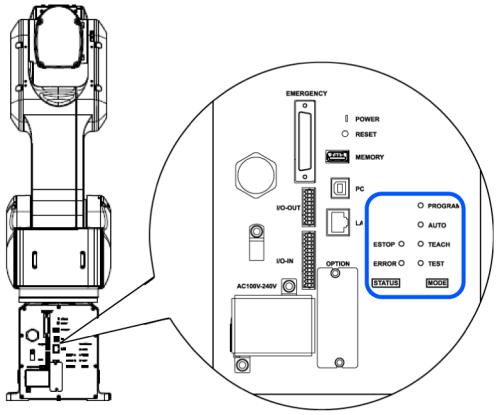
When turning the Controller off and on again, turn off the Controller and wait for at least five seconds before turning it on again.
If the robot has not been turned on for more than six months, do not turn the motor on immediately after powering it on.
After turning on the power, leave the robot for about 15 minutes before turning on the motor.

2.3.3 Power On Procedure

1. Check the EMERGENCY connector connection.
2. Connect the TP bypass plug to the TP port.
3. Connect the power cable to the Manipulator.
4. Connect the power cable to the power supply socket.
5. The AUTO LED blinks approximately 30 seconds after the Controller starts up normally.

If the ERROR LED is turned ON or blinking, check connection in step (1) to (4) and turn ON the power again.
If the ERROR LED is still ON or blinking, contact the supplier.

> ⚠ CAUTION
>
> Turning off the Manipulator before the AUTO LED starts blinking may cause the Controller to malfunction.



2.4 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.
Make sure that the Robot system is installed safely by the description in “1. Safety” and “2. Installation”. Then, operate the Robot system in the following procedures.

2.4.1 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"

2.4.2 Development PC and Manipulator Connection

Connect the development PC and the development PC connection port.

For the connector position, refer to the following section.

Part Names

KEY POINTS

- For other details on connecting the development PC and Manipulator, refer to the following manual: Epson RC+ User's Guide "[PC to Controller Communications] (Setup Menu)".
- Be sure to install the Epson RC+ to the development PC first, then connect the development PC and Manipulator with the USB cable. If the Manipulator and the development PC are connected without installing the Epson RC+ to the development PC, [Add New Hardware Wizard] appears. If this wizard appears, click the [Cancel] button.

2.4.2.1 What is Development PC Connection USB Port?

Connect the Manipulator and development PC by a USB cable to enable development of the robot system and setting of the Manipulator 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.

2.4.2.2 Notes

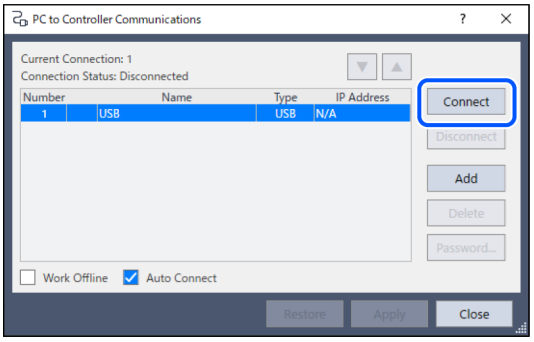
Pay attention to the following points when connecting the development PC and the Manipulator.

- Connect the development PC and the Manipulator with a USB cable that meets the standard. Do not use the 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 Manipulator are connected, do not connect or disconnect other USB devices from the development PC. This could cause a disconnection with the Manipulator.

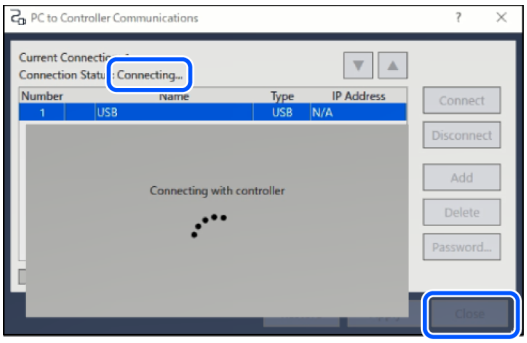
2.4.2.3 Software Setup and Connection Check

The following are steps for connecting the development PC and the Manipulator.

1. Make sure that the Epson RC+ software is installed on the development PC connected to the Manipulator. (Install the software if it is not installed.)
2. Connect the development PC and the Manipulator by a USB cable.
3. Turn ON the Manipulator.
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.



6. Select the “No.1 USB” and click the [Connect] button.
7. After connection of the development PC and the Manipulator is completed, "Connected" is displayed in [Connection Status:]. Make sure that “Connected” is displayed and click the [Close] button to close the [PC to Controller Communications] dialog.



Connection of the development PC and the Manipulator is completed. The robot system can now be used from Epson RC+.

2.4.2.4 Backup the Initial Status of the Manipulator

Backup the Manipulator data configured before shipment.

Backup procedure for project and system settings:

1. From the Epson RC+ menu, select [Project] - [Copy].
2. In the [Copy Project] dialog, 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.

2.4.2.5 Disconnecting the Development PC and Manipulator

This section explains the procedure for disconnecting the development PC and the Manipulator.

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

KEY POINTS

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

2.4.2.6 Moving the Manipulator to Initial Posture

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

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

This section explains the following operation methods.

- A: Execute command from the Epson RC+
- B: Jog operation from the Epson RC+
- C: Manual operation

A: Execute command from the Epson RC+

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

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.
2. Open the command window.
   Epson RC+ menu-[Tools]-[Command Window]
3. Execute the following command in [Command Window].

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

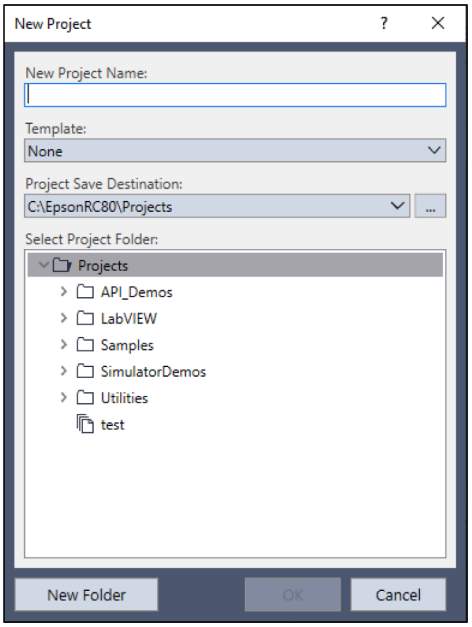
For the position and posture of the Manipulator at the 0 pulse position, refer to “Motion Range” in the Manipulator manuals.

B: Jog operation from the Epson RC+

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

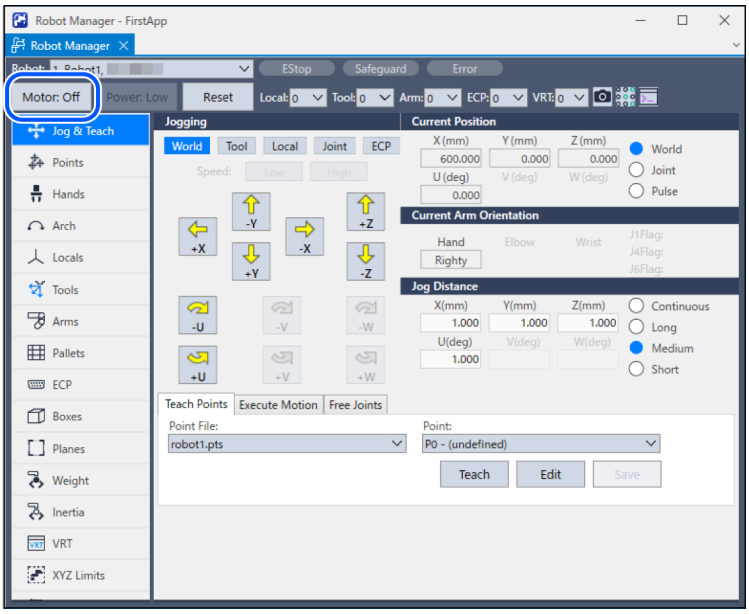
1. Start Epson RC+.
   Double click the [Epson RC+] icon on the desktop.
2. Create a new project.

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

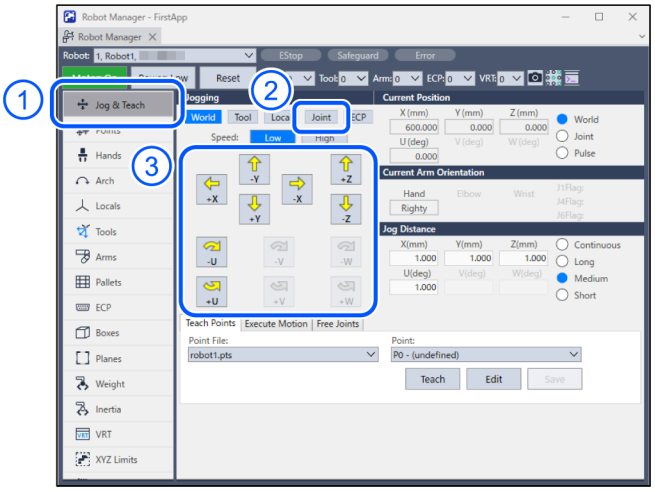


- Type a project name in the [New Project Name] box. (e.g. FirstApp)
- Click the [OK] button to create the new project.

3. Open the Robot Manager.
   From the Epson RC+ menu, select [Tools] - [Robot Manager].
4. Turn ON the motors.
   Click the [Motor: Off] button.



Perform jog operation. 5. Select the [Jog & Teach] tab.



- Epson RC+ 8.0: From [Jogging], select "Joint."
- Click jog keys J1-J4 to operate the selected joint. Movement is possible by setting to other modes or setting the movement distance.

C: Manual operation

Manually move the Manipulator that is in a non-energized state.

You can move the Manipulator manually by releasing the solenoid brake from the command window of Epson RC+.
For details, refer to the following section.

Release the Brake by the Software

> ⚠ 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.
> - When the brake is released, the arm may fall due to its own weight and operate in an unexpected direction. Makes sure to always take measures to prevent the arm from falling, and check the safety of your surrounding when starting work.
> - When releasing the brake using 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.

1. Start Epson RC+.
   Double click the [Epson RC+] icon on the desktop.
2. Open the command window.
   Epson RC+ menu-[Tools]-[Command Window]
3. Execute the following command in [Command Window].

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

Execute the following command to activate the brake again.

```
>Brake On,[Arm # (1 to 6) whose brake is activated]
```

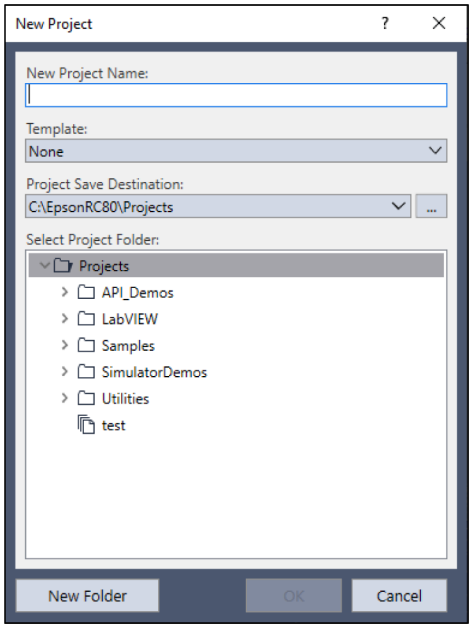
2.4.3 Writing Your First Program

After installing the Manipulator, 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.

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

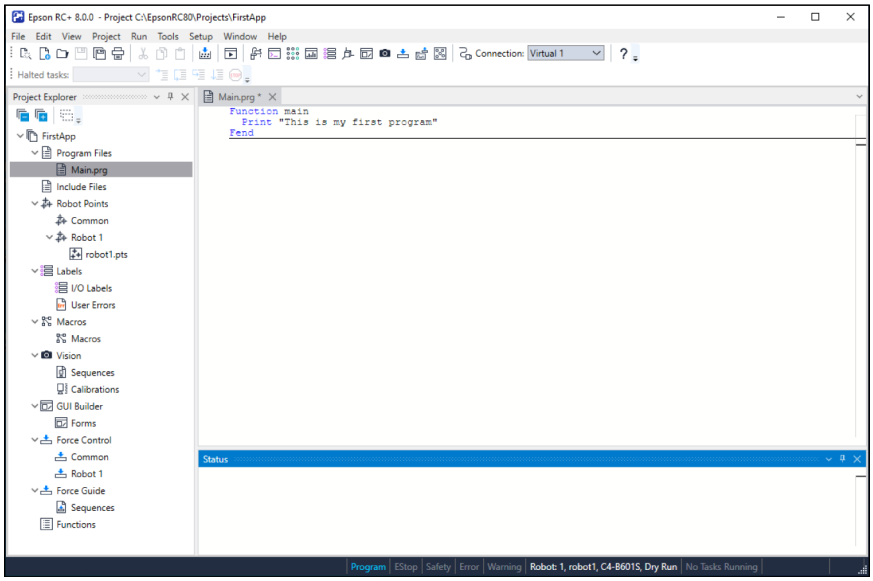


   - Type a project name in the [New Project Name] box. (e.g. FirstApp)

   - 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.

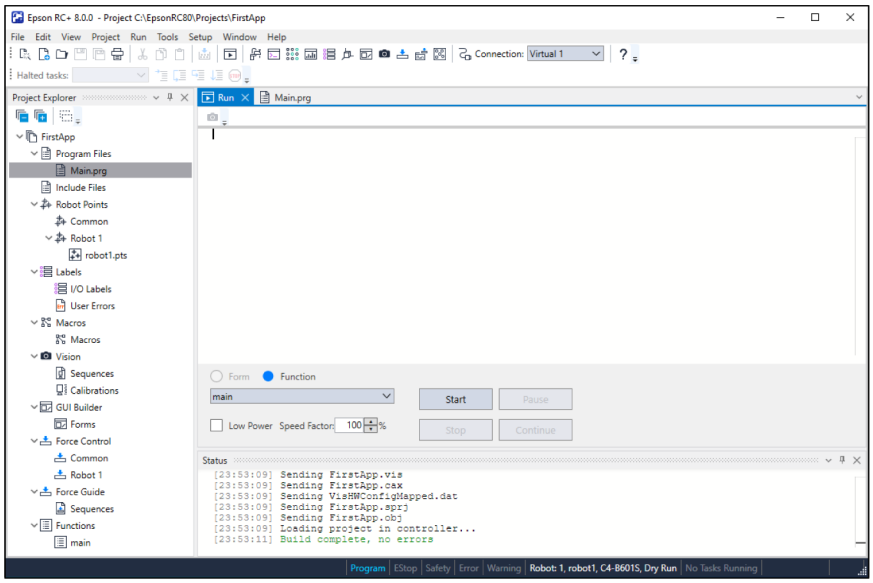
3. Edit the program.
   Type the following program lines in the Main.prg edit window.

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



4. Run the program.

- 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.
- During the project building process, your program is loaded into the memory and compiled. Then, the program and project files are sent to the Manipulator. If there are no errors during the building process, the Run window appears.



- Click the [Start] button in the Run window to run the program.
- The tasks like the following will be displayed in the status window.

```
Task main started
All tasks stopped
```

The Run window shows the statement output.

Next, teach some points to create a program that moves the Manipulator.

KEY POINTS

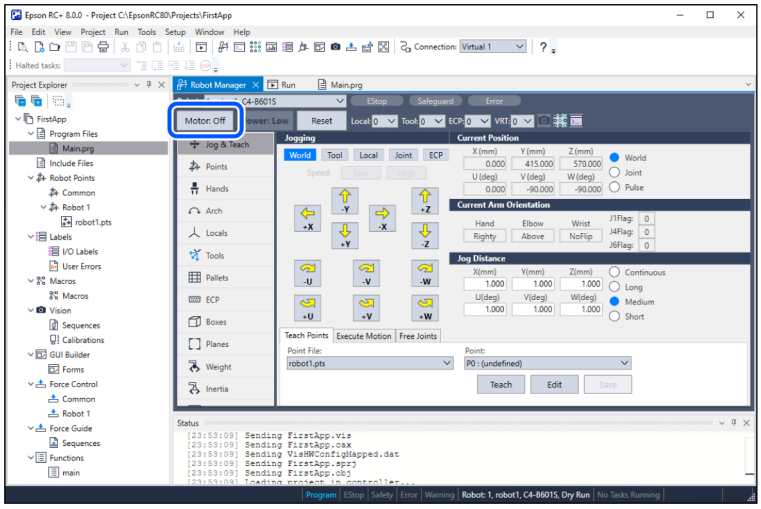
Teaching of this procedure should be done outside the safeguard.

5. Teach points.

   i. Make sure that it is safe to operate the robot. Click the [Robot Manager] button on the toolbar. 2. Make sure that [Robot Manager] is displayed.

   ii. Turn ON the motors.

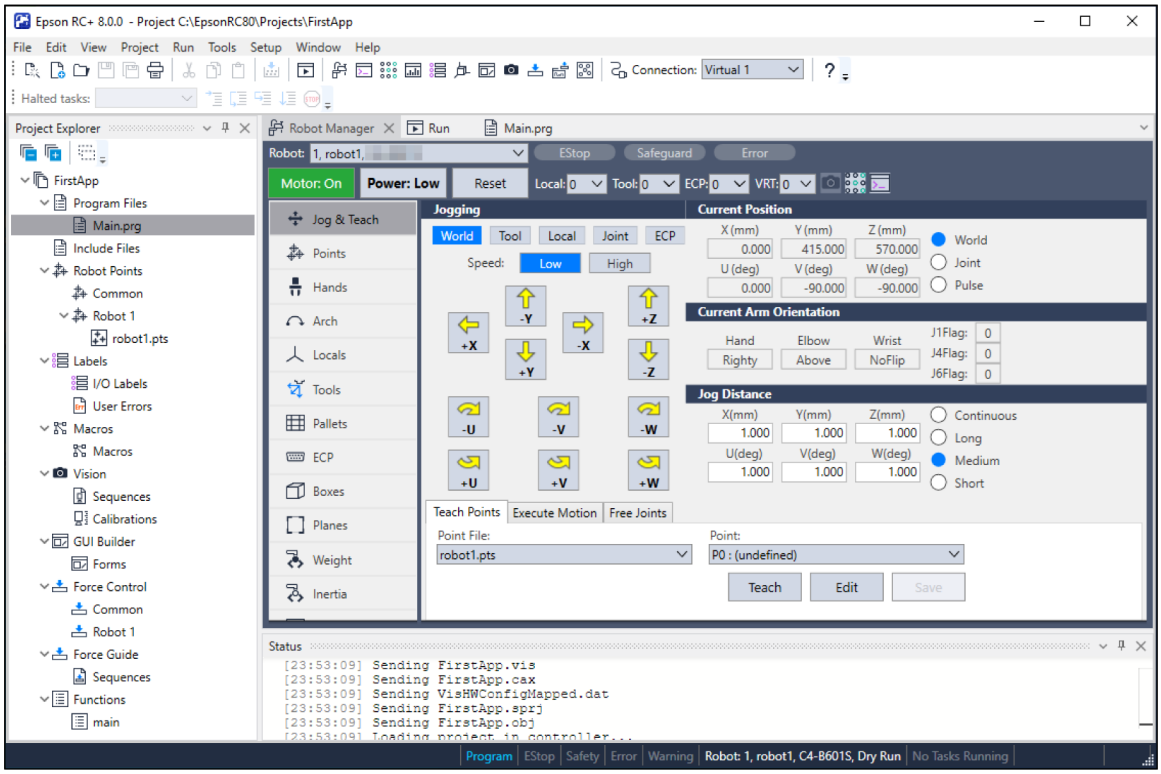
   Click the [Motor: Off] button.



   You are prompted to confirm the operation.

   iii. Click the [Yes] button.

   iv. Select 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 Manipulator until it reaches around the middle of the work envelope.

vii. Click the [-Z] button to lower the Z-axis of the Manipulator.

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

ix. Click the [Teach (T)] button. A confirmation message for teaching the point appears.

x. Click the [Yes] button.

xi. Click the [+X] button to jog the Manipulator in the +X direction.

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

xiii. Click the [Teach (T)] 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 Manipulator motion commands.

- Insert Go statements into the Main.prg program.

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

- Press F5 to display the Run window.
- Click the [Start] button to execute the program. The Manipulator will move to the points that were taught.

7. Modify the program to change the speed of the Manipulator motion commands.
   - 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
```

   - Press F5 to display the Run window.
   - Click the [Start] button to execute the program.
     The Manipulator 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 Manipulator settings of the created program. Backup can be done easily with 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.

2.5 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.

2.5.1 Connecting with External Equipment

2.5.1.1 Remote Control

Refer to the following section.
"Epson RC+ User's Guide - Remote Control"
I/O Remote Settings

I/O

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

Fieldbus I/O (Option)

"Robot Controller Option Fieldbus I/O"

2.5.1.2 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"

2.5.2 Ethernet Connection of Development PC and Manipulator

Refer to the following section for procedures on connecting the development PC and the Controller via Ethernet.

Ethernet Connection of Development PC and Manipulator

"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"

2.5.3 Connecting the Teach Pendant (Option)

TP Port

"Robot Controller Option Teach Pendant TP2 - Functions & Installation: Installation"
"Robot Controller Option Teach Pendant TP4 - Functions & Installation: Installation"

3. VT6-B Manipulator

3.1 Safety

Unpacking and transportation of the Manipulators and related equipment shall be performed by personnel who has taken robot system training held by Epson and suppliers. Also, the laws and regulations of the installation country must be followed.
Make sure to read this manual and other related manuals before installing the robot system.
Keep this manual handy for easy access at all times and reread it when you find anything unclear.

3.1.1 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 a minor or moderate injury or in property damage only.

3.1.2 Design and Installation Safety

This product is intended for transporting and assembling parts in a safely isolated area.

The robot system should be designed and installed by people who have received installation training provided by Epson and the suppliers.

To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to the following:

Safeguard (Safeguard Interlock)

The following items are safety precautions for design personnel:

⚠ WARNING

- Personnel who design and/or construct the robot system with this product must read the “Safety Manual” and check the safety requirements. Designing and/or constructing the robot system without understanding the safety requirements is extremely hazardous, and may result in serious bodily injury and/or severe equipment damage. It may cause serious safety related problems.

- The robot system must be used within the environmental conditions described in their respective manuals. 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.
- The robot system must be used within the installation requirements described in the manuals. Using the robot system outside of the installation requirements may not only shorten the life cycle of the product but also cause serious safety problems.
- When designing or installing a robot system, wear at least the following protective gear. Working without protective gear may cause serious safety problems.
  - Work clothes suitable for work
  - Helmet
  - Safety shoes

Refer to the following for the installation safety information.

Environment and Installation

Be sure to read this section and follow the safety information before installation to ensure that the installation work is performed safely.

3.1.3 Operation Safety

The following items are safety precautions for operator personnel:

⚠ WARNING

- Make sure to read the “Safety Manual” before operating. Operating the robot system without understanding the safety precautions is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system.
- Do not enter the work envelope of the Manipulator while the power to the robot system is turned ON. Entering the work envelope with the power ON is extremely hazardous and may cause serious safety problems as the Manipulator may move even if it seems to be stopped.
- Before operating the robot system, make sure that no one is inside the safeguarded area. The robot system can be operated in the mode for teaching even when someone is inside the safeguarded area. The motion of the Manipulator is always in restricted (low speed and low power) status to secure the safety of an operator. However, operating the robot system while someone is inside the safeguarded area is extremely hazardous and may result in serious safety problems in case that the Manipulator moves unexpectedly.
- Immediately press the emergency stop switch whenever the Manipulator moves abnormally while the robot system is operated. Continuing the operation while the Manipulator moves abnormally is extremely hazardous and may result in serious bodily injury and/or severe equipment damage.
- If you are to mount the Manipulator on the mobile platform and press the Emergency Stop switch to stop the Manipulator, be sure to design the system so that the mobile platform also stops. If the mobile platform does not stop and it keeps moving, it is extremely hazardous and may result in serious bodily injury and/or severe equipment damage.

- Do not operate the Manipulator when the mobile platform is moving. When using the Manipulator, it must be surrounded by the safeguards. Operating the Manipulator while the mobile platform is moving may result in serious bodily injury and/or severe equipment damage.

⚠ WARNING

- To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power receptacle. DO NOT connect it directly to a factory power source.

⚠ CAUTION

- Whenever possible, only one person should operate the robot system. If it is necessary to operate the robot system with more than one person, ensure that all people involved communicate with each other as to what they are doing and take all necessary safety precautions.
- If the joints are operated repeatedly with the operating angle less than 5 degrees, they may get damaged early because the bearings are likely to cause oil film shortage in such situation. If it is operated repeatedly, it may lead to an early breakdown. To prevent early breakdown, move each joint larger than 30 degrees for about once an hour.
- Vibration (resonance) may occur continuously depending on the combination of robot motion speed, Arm orientation, and hand load. Vibration arises from natural vibration frequency of the Arm and can be controlled by following measures.
  - Changing the Manipulator speed
  - Changing the teach points
  - Changing the hand load
- The Manipulator may be heated due to motor heat etc. Do not touch the Manipulator until the temperature falls. After confirming that the temperature of the Manipulator has fallen and is not hot when you touch it, perform teaching or maintenance.
- When mounting the Manipulator on the mobile platform, be sure to stop the Manipulator while the mobile platform is in operation. The Manipulator stops when motors on all axes are turned OFF (servo free status). If you cannot turn OFF the motor, set power mode to “Low” and perform exclusive control of the mobile platform and Manipulator so that they do not move simultaneously.

3.1.4 Emergency Stop

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

Avoid pressing the emergency stop switch unnecessarily while the Manipulator is running normally.

- The Manipulator may hit peripheral equipments.
  When you press the Emergency Stop switch, the operating trajectory until the robot system stops is different from that in normal operation.
- The life of the brakes will be shortened.
  The brakes are locked and the brake friction plate is worn.
  Normal brake lifespan: About 2 years (when the brakes are used 100 times/day)
  However, the normal relay life is approximately 20,000 times. If you press the emergency stop switch unnecessarily, the life of the relay will be shortened.
- Impact is applied on the reduction gear unit which may result in shortening the life of the reduction gear unit.

To place the system in emergency mode during normal operation, press the emergency stop switch when the Manipulator is not moving.
Instructions on how to wire the emergency stop switch circuit is described in the following manual.

EMERGENCY connector

Do not turn OFF the Controller while the Manipulator is operating. If you attempt to stop the Manipulator in emergency situations, make sure to stop the Manipulator using the E-STOP of the Controller.
If the Manipulator is stopped by turning OFF the power while it is operating, the following problems may occur.

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

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

- Damage in reduction gear
- Shifting of the joints from their proper positions

If there was any shifting, maintenance is required. For more information, contact the supplier.
Also, the same kind of problems may occur if there is an error and the the Manipulator stops during the operation. Check the condition of the Manipulator and perform calibration if necessary.

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

- The emergency stop switch (E-STOP) should be used to stop the Manipulator only in case of emergencies
- Besides pressing the emergency stop switch (E-STOP) when an emergency occurs, to stop the Manipulator during program operation, use the Pause (halt) or STOP (program stop) command. The Pause and STOP statements do not turn off motor energization, and so the brake is not locked.
- When the emergency stop switch is pressed, a great force is applied to the base table. When mounting the Manipulator on the mobile platform, be sure to design the system so that the system does not turnover and the Manipulator does not fall over.

To check for problems regrading brakes, refer to the following.

VT6-B Manipulator Periodic Inspection

KEY POINTS

Test pulse cannot be used with the emergency stop input of this model.

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 section.

Appendix B: Stopping Time and Stopping Distance at Emergency Stop

3.1.5 Safeguard (Safeguard Interlock)

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. There are several types of safeguards such as safety door switches, safety barriers, light curtains, safety gates, safety floor mats, and so on. The term “safeguard” described in this manual is a type of safeguard.

When a closed safeguard is opened during robot motion, the safeguard interlock function operates. In such case, the robot stops immediately and starts to decelerate. When the robot stops operating, it enters into pose status, and all robot motors turn OFF. The safeguard input works in the following way

Safeguard open
The robot stops immediately, motors are turned OFF, and further operation is impossible. The robot will not operate until either the safeguard is closed or TEACH or TEST mode is turned ON and the enable circuit is engaged.

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

Do not open the safeguard unnecessarily while the motor is energized. Frequent safeguard inputs will reduce the life of the relay.
Normal relay lifespan: Approximately 20,000 times

For details on wiring methods, refer to the following.

EMERGENCY connector

When using light curtains, keep the safeguard open until the latch condition is released.

> **KEY POINTS**
>
> Test pulse cannot be used with the safeguard input of this model.

> **⚠ WARNING**
>
> - The EMERGENCY connector on the Controller has a safeguard input circuit to connect the safeguard interlock switch. To protect operators working near the robot, be sure to connect the safeguard interlock switch and make sure that it works properly.
> - The time to stop the robot and the stopping distance by the safeguard interlock function will change depending on the conditions of use. Be sure to confirm that safety is ensured according to the installation environment of the robot.

Stopping distance when the safeguard is opened

During operation, the Manipulator cannot stop immediately even if the safeguard is opened. Also, the stopping time and displacement 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 section.

Appendix C: Stopping Time and Stopping Distance when the Safeguard is Open

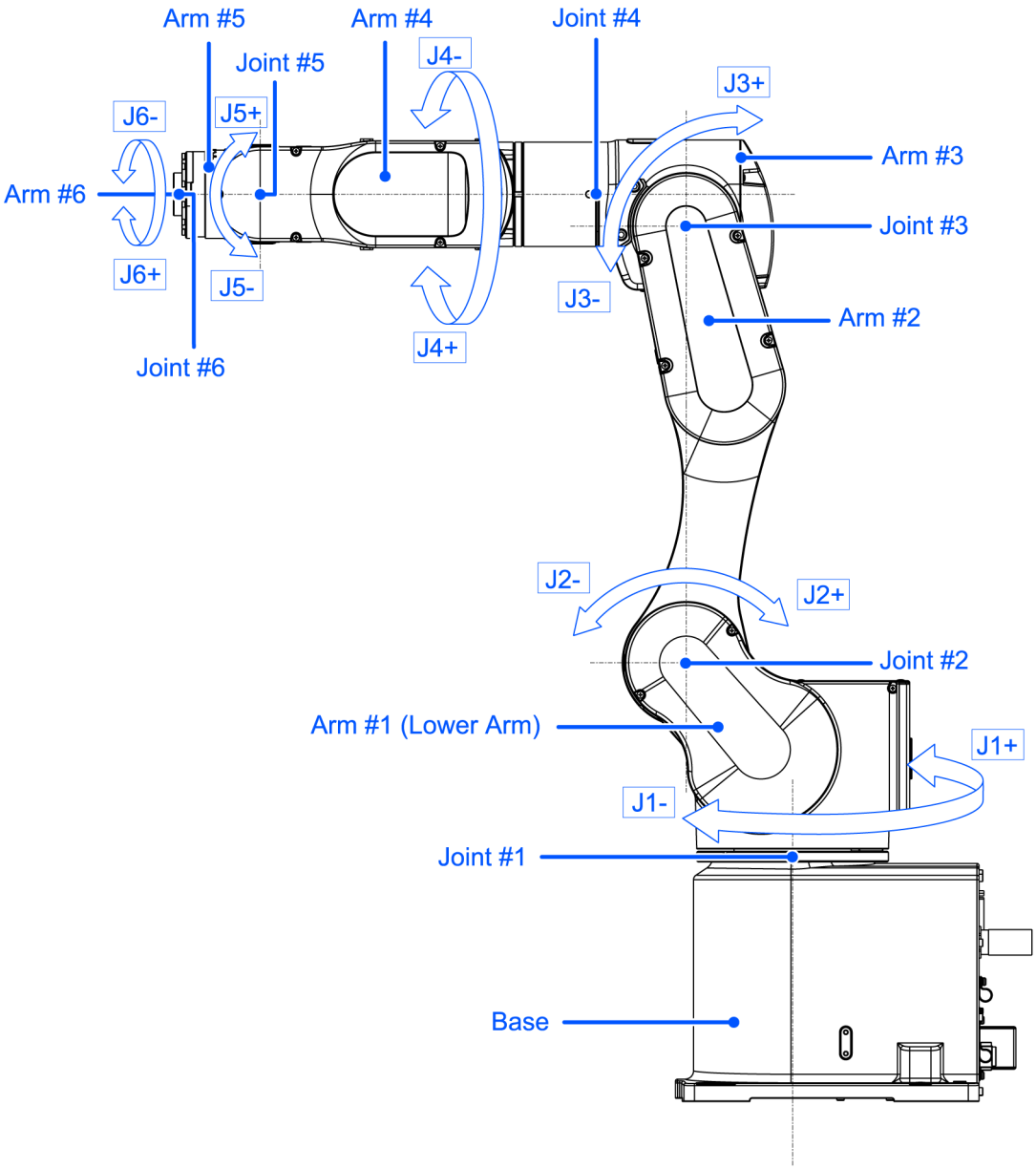
3.1.6 How to Move Arms with the Electromagnetic Brake

While the electromagnetic brake is on (such as in emergency mode), you cannot move any arm by pushing manually.

For procedures to release the electromagnetic brake, refer to the following section.
When the electromagnetic brake is released, the arms can be moved manually.

Release the Brake by the Software
(When the software is available)

3.1.6.1 Arm Motion



3.1.6.2 Release the Brake by the Software

⚠ 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.

- When releasing the brakes using the software, the arm may fall by its own weight and operate in an unexpected direction. Be sure to always take measures to prevent the arm from falling and check the safety of your surrounding before working.
- 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 from falling due to an erroneous operation, which could cause the Manipulator to be damaged and breakdown.

Epson RC+

After releasing the Emergency Stop switch, execute the following command in the [Command Window].

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

Execute the following command to activate the brake again.

```
>Brake On,[Arm # (1 to 6) whose brake is activated]
```

3.1.7 Precaution for Operation in Low Power Status

In the low power status, the operating speed and torque are limited compared to the regular status.
However, a high torque may be generated in order to support the weight of the Manipulator as shown in the graph below.
Your hands or fingers may get caught during operation. The Manipulator may also collide with peripheral equipment and cause equipment damage or malfunction of the Manipulator. Be careful when operating the Manipulator.

Maximum Joint Output Torque in Lower Power Mode [Unit: N m]

VT6-B901* (Table top mounting), VT6-A901SR (Ceiling mounting)

Joint	#1	#2	#3	#4	#5	#6
Joint Torque	39.72	332.50	141.85	37.79	30.92	17.23

VT6-B901SW (Wall mounting)

Joint	#1	#2	#3	#4	#5	#6
Joint Torque	195.74	332.50	141.85	37.79	30.92	17.23

⚠ CAUTION

- Carefully operate the Manipulator in the low power status. A comparatively high joint torque may be generated. It may cause your hands and fingers caught and/or cause equipment damage or malfunction of the Manipulator as it may collide with peripheral equipment.

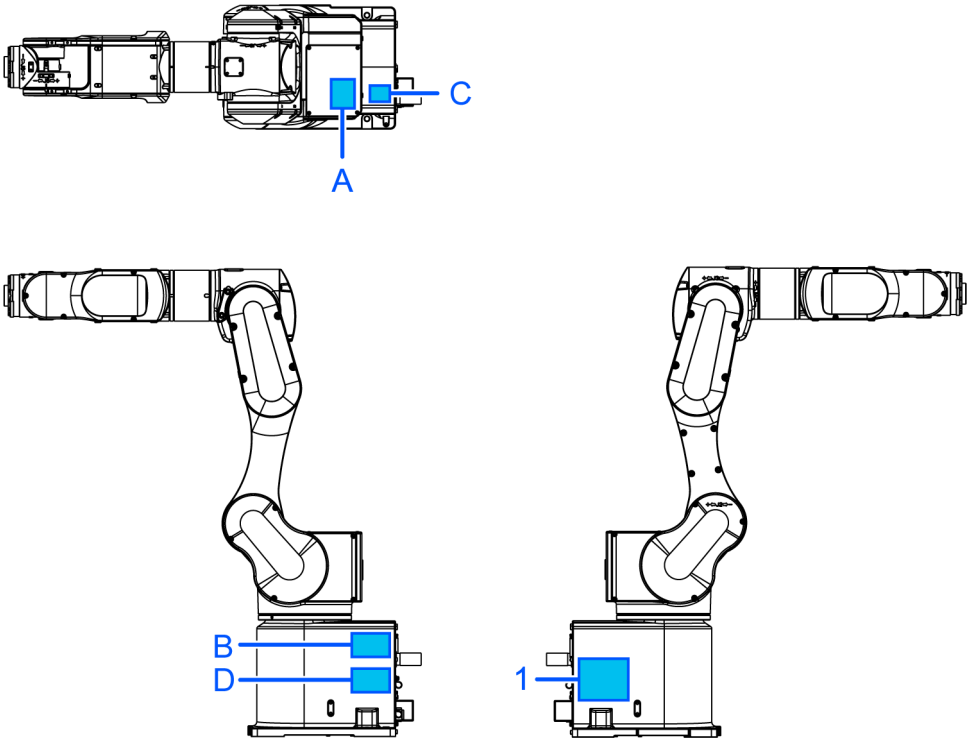
3.1.8 Warning Labels

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

Location	Warning Label	NOTE
A		HOT Be careful not to burn yourself.
B		When releasing the brakes, be careful of the arm falling due to its own weight.
C		Do not connect the following devices to the TP port that has this label attached to it. The different signal arrangement could cause a breakdown in the device. Dummy plug (optional device) Operation Pendant OP500 Operator Pendant OP500RC Jog Pad JP500 Teaching Pendant TP-3 ** Operator Panel OP1
D		Touching any internal electrified parts while the power is turned on may cause an electric shock. Make sure to always turn the power off when performing maintenance and repairing parts. Do not open the cover for 300 seconds after turning off the power. Residual voltage may cause an electric shock.

Location	Label	NOTE
1	-	The product name, model name, serial number, information of supported laws and regulations, product specifications, manufacturer, importer, date of manufacture, country of manufacture, etc. are listed. For details, see the label affixed to the product.

Location of Labels



3.1.9 Responses for Emergencies or Malfunctions

3.1.9.1 When a Collision with the Manipulator Occurs

When the Manipulator collides with a mechanical stop or peripheral device etc., discontinue use and contact the supplier.

Also, if the Manipulator collides with a mechanical stop or peripheral device etc., the following problems may occur.

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

3.1.9.2 Entanglement with the Manipulator

When the operator is caught between the Manipulator and a mechanical part such as a base table, press the emergency stop switch to release the brake on the arm, and then move the arm manually.

⚠ WARNING

- To secure a method to release the brakes in an emergency situation, make sure to prepare a PC that has the Epson RC+ installed or a teach pendant when using the Manipulator.
- When performing work close to the robot, a supervisor other than the operator must be present.
- In an emergency situation such as when you cannot /do not want to turn ON the power and need to escape, remove the robot from the base table before escaping. For details on the base table and mounting conditions, refer to the following.
  Installation
  When using the wall mounting and ceiling mounting models, be careful not to drop the manipulator.

How to release a brake

For details, refer to the following section.

How to Move Arms with the Electromagnetic Brake

3.2 Specifications

3.2.1 Model Number

VT 6 - B 90 1 □ □-□
[a] [b] [c] [d] [e]

- a: Arm length
  - 90: 910 mm
- b: Brake
  - 1: Brakes on all joints
- c: Environment
  - S: Standard
  - C: Cleanroom
- d: Mounting type
  - □: Table top mounting
  - R: Ceiling mounting*
  - W: Wall mounting*
- e: Power supply
  - □: AC specification

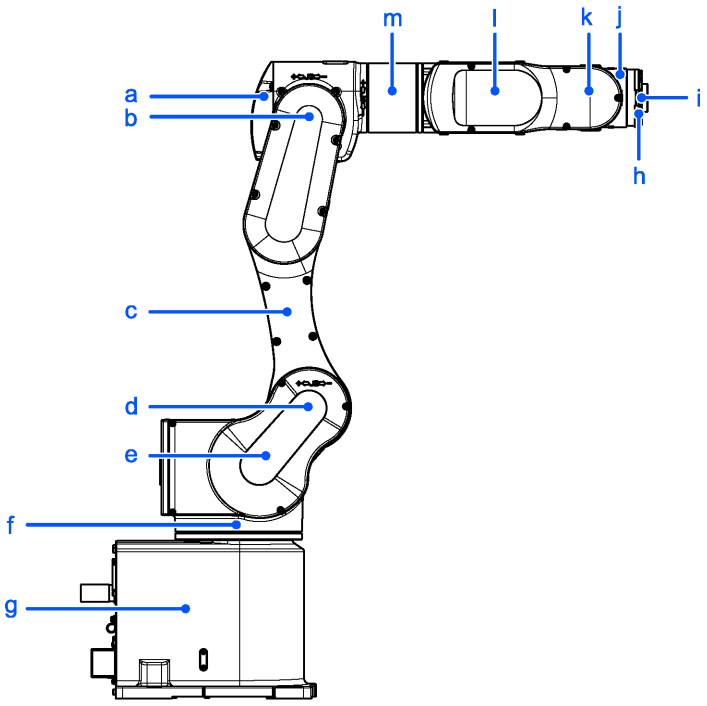
* Manipulators are set to "Table Top mounting" at shipment. To use the Manipulators as "Ceiling mounting", you need to change the model settings. For details on how to change the model settings, refer to the following sections.

Changing the Robot
You can also refer to "Epson RC+ User's Guide - Robot Configuration".

For details on the specification, refer to the following.

Appendix A: Specifications Table

3.2.2 Part Names

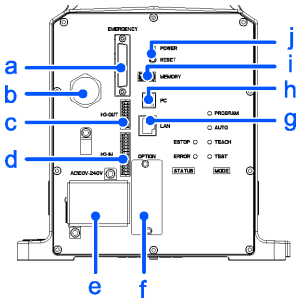


Symbol	Description
a	Arm #3
b	Joint #3
c	Arm #2
d	Joint #2
e	Arm #1 (Lower Arm)
f	Joint #1
g	Base
h	Joint #6
i	Arm #6
j	Arm #5
k	Joint #5
l	Arm #4
m	Joint #4

KEY POINTS

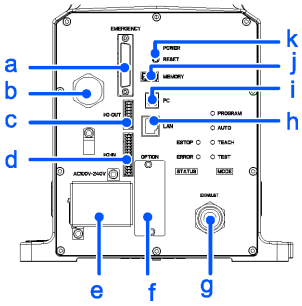
When the LED lamp is lighting or the Controller power is on, the current is being applied to the Manipulator. (The LED lamp may not be seen depending on the Manipulator's posture. Be thoroughly careful.
Performing any work procedure with the power turned on is extremely dangerous and may result in electric shock and/or malfunction of the robot system. Before starting any maintenance work, be sure to turn off the Manipulator.

Standard model



Symbol	Description
a	EMERGENCY connector
b	TP Port
c	I/O (Output) Connector
d	I/O (Input) Connector
e	Power Cover (Power connector inside)
f	Option Cover (Option connector inside)
g	LAN (Ethernet Communication) Port
h	Development PC Connection Port
i	Memory port
j	Reset Switch

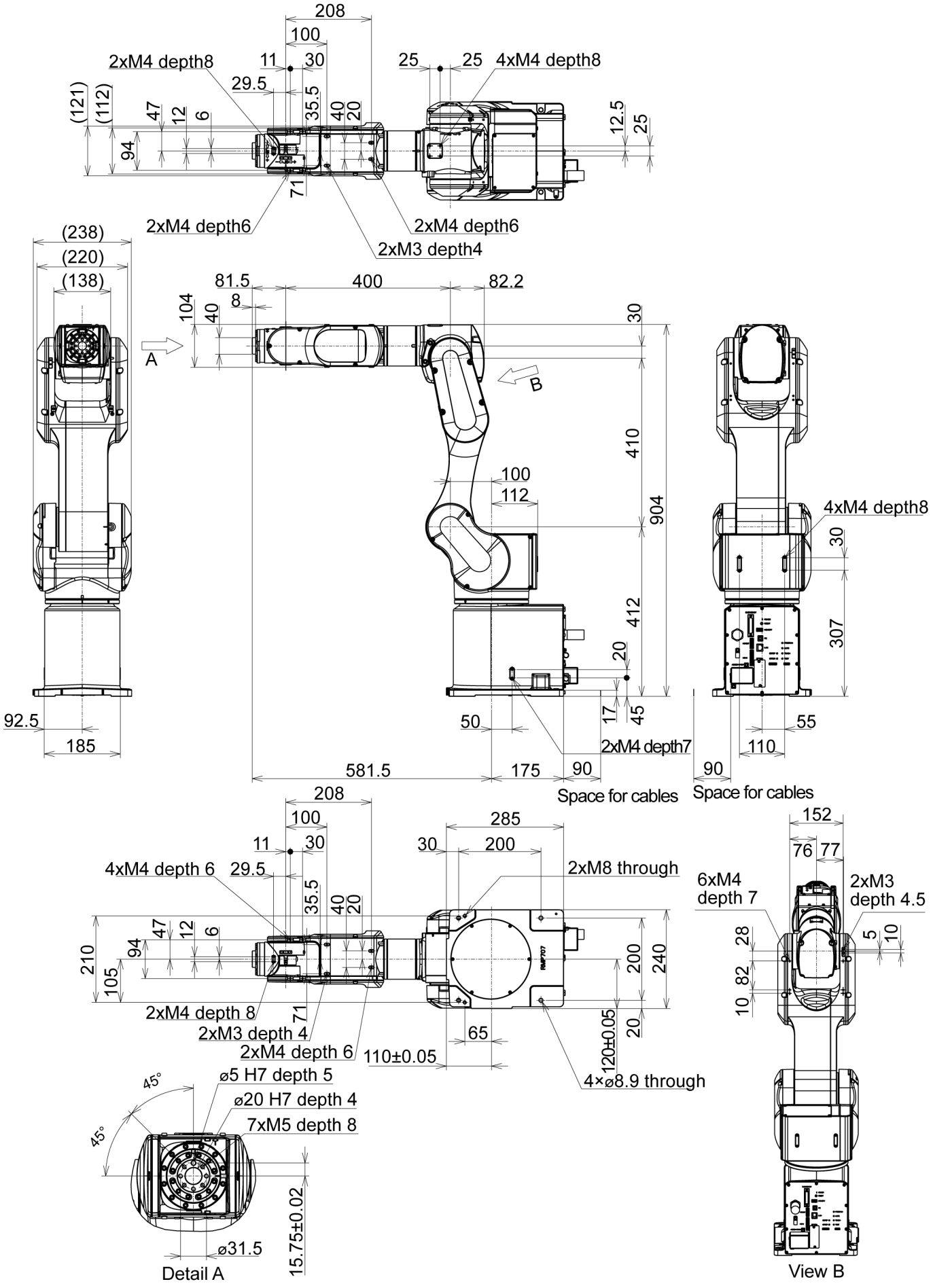
Cleanroom model



Symbol	Description
a	EMERGENCY connector
b	TP Port
c	I/O (Output) Connector
d	I/O (Input) Connector
e	Power Cover (Power connector inside)
f	Option Cover (Option connector inside)
g	Exhaust port Fitting for φ12 mm pneumatic tube

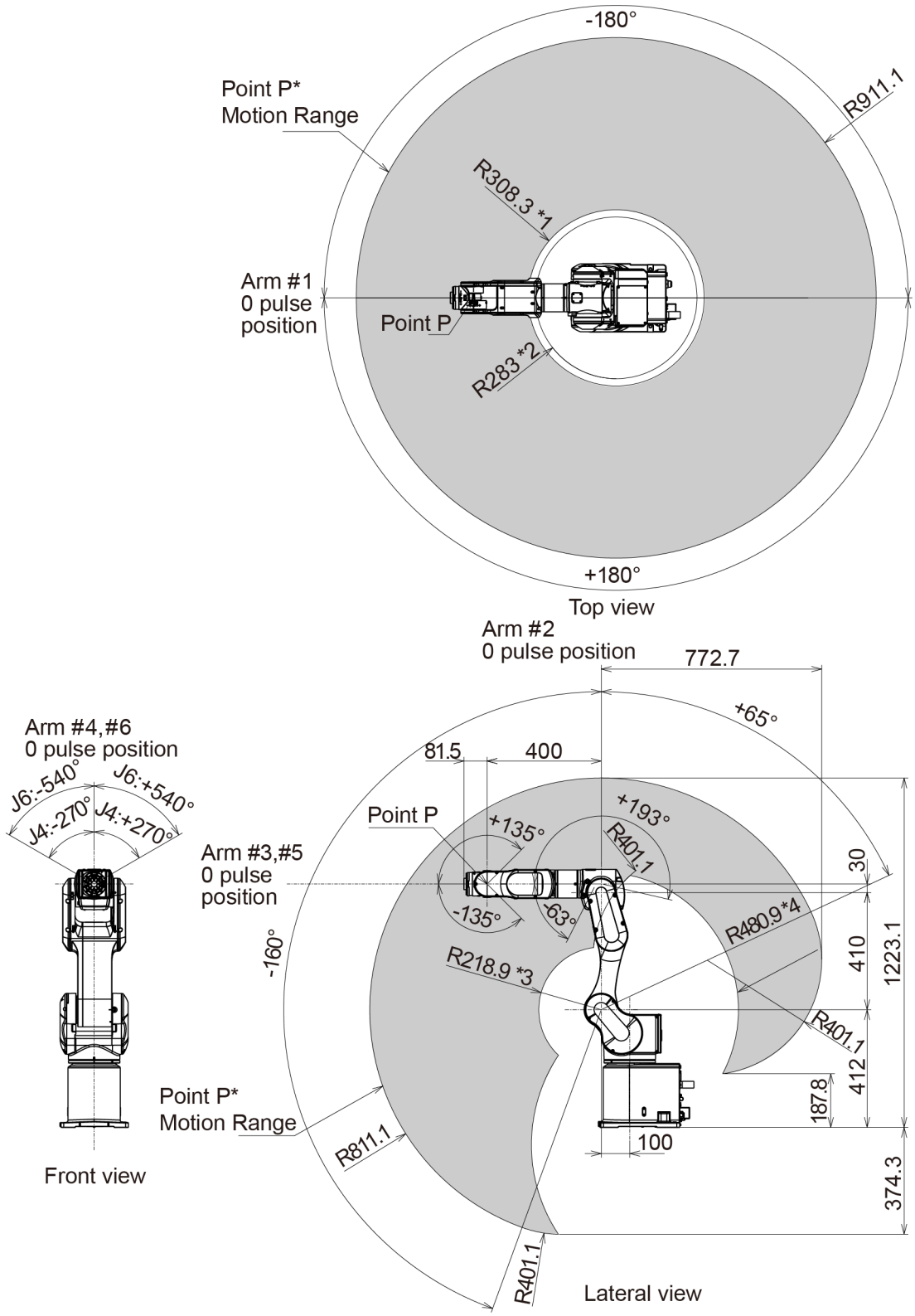
Symbol	Description
h	LAN (Ethernet Communication) Port
i	Development PC Connection Port
j	Memory port
k	Reset Switch

3.2.3 Outer Dimensions


208
100
2xM4 depth8
11
30
25
25
4xM4 depth8
29.5
35.5
40
20
(121)
(112)
47
12
6
94
12.5
25
71
2xM4 depth6
2xM4 depth6
2xM3 depth4
(238)
(220)
(138)
81.5
400
82.2
104
40
8
30
A
B
410
100
112
904
412
20
17
45
92.5
185
50
55
2xM4 depth7
110
581.5
175
90
90
Space for cables
Space for cables
4xM4 depth8
30
307
208
100
285
11
30
30
200
4xM4 depth 6
29.5
2xM8 through
35.5
40
20
47
12
6
94
210
105
200
240
2xM4 depth 8
71
2xM3 depth 4
2xM4 depth 6
110±0.05
65
120±0.05
20
4×ø8.9 through
45°
45°
ø5 H7 depth 5
ø20 H7 depth 4
7xM5 depth 8
ø31.5
15.75±0.02
Detail A
152
76
77
6xM4
depth 7
2xM3
depth 4.5
28
5
10
10
82
View B

[Unit: mm]

3.2.4 Standard Work Envelope



(deg.=°)

*P point: Intersection of the rotation centers for Joints #4, #5, and #6

*1 : P point from top with Joint #3 declining -63° (Joint #1 center – P point center)

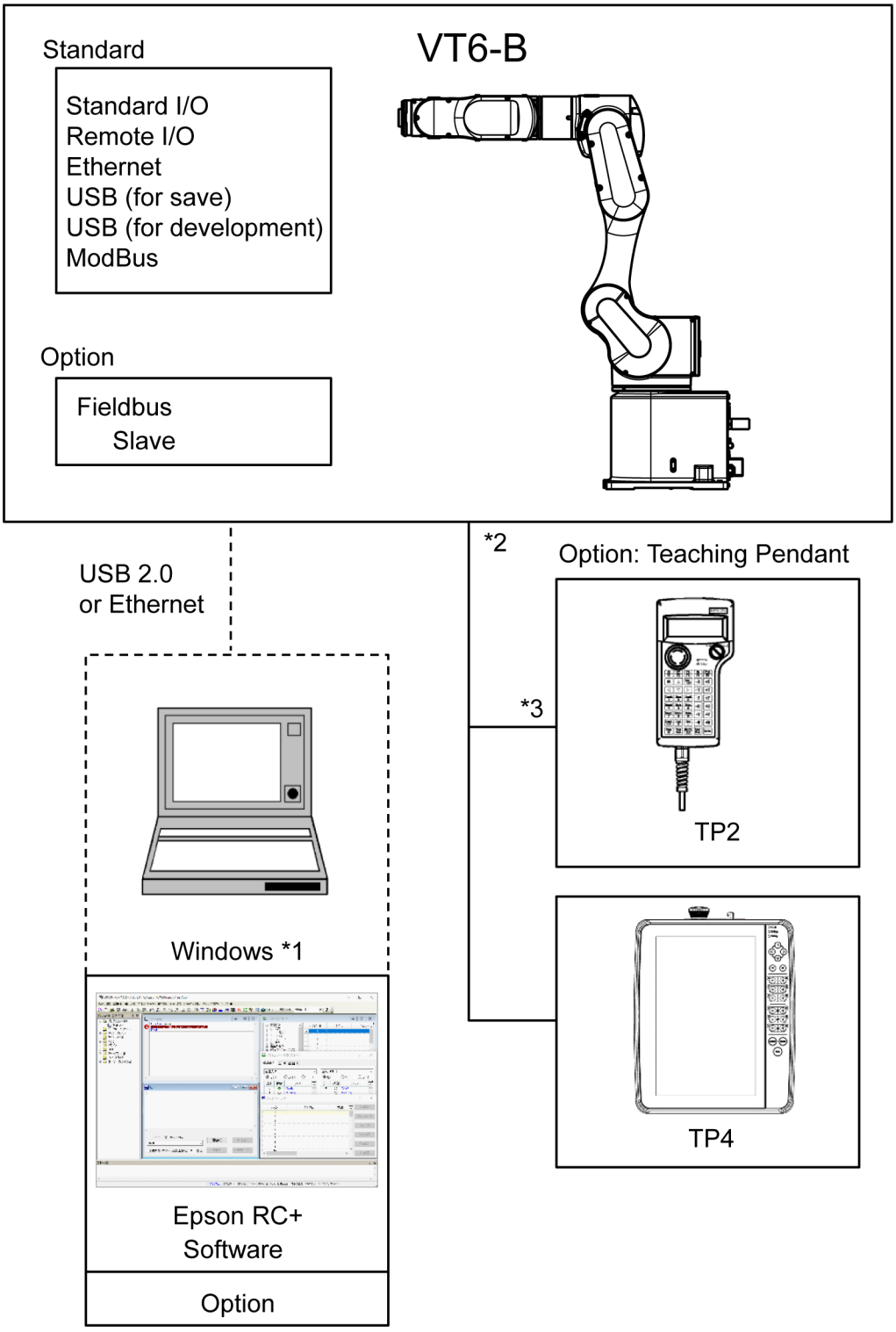
*2 : P point from top with Joint #3 tilting up +193° (Joint #1 center – P point center)

*3 : P point from lateral with Joint #3 declining -63° (Joint #2 center – P point center)
*4 : P point from lateral with Joint #3 tilting up +193° (Joint #2 center – P point center)

⚠ CAUTION

- Pay attention to the arm pose of the basic arms (Arms #1, #2, and #3) when operating the Manipulator. Arm #5 moves keeping a constant angle regardless of the arm pose. Depending on the arm pose of the basic arms, the wrist may collide with the Manipulator. The collision may cause equipment damage to and/or malfunction of the Manipulator.

3.2.5 System Configuration Example



*1 For system requirements, refer to the following manual:
"Epson RC+ User's Guide"
*2 One of the Teach Pendants is available.
*3 When connecting to VT-B series Manipulators, a dedicated conversion cable is required.

3.2.6 Specifications Table

For the specifications tables of each model, refer to the following section.

Appendix A: Specifications Table

3.2.7 How to Set the Model

The Manipulator model for your system has been set before shipment from the factory.
It is normally not required to change the model when you receive your system.

⚠ CAUTION

- When you need to change the setting of the Manipulator model, be sure to set the Manipulator model properly. Improper setting of the Manipulator model may result in abnormal or no operation of the Manipulator and/or cause safety problems.

KEY POINTS

If the custom specifications number (MT***) or (X***) is described on the face plate (S/N label), the Manipulator has custom specifications. (Depending on the date of shipment, a label with only the custom specification number may be sealed)
The custom specifications may require a different configuration procedure. Check the custom specifications number and contact the supplier.

The Manipulator model can be set from the software.
Refer to the following manual.
"Epson RC+ User's Guide - Robot Configuration"

3.2.8 Safety Functions

3.2.8.1 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 Function

- Safe Torque OFF (STO)
  - A state where the robot is stopped when a signal from the robot controller is input, which causes the relay to open and shut off the power supply to the motor.
  - This will make the robot controller enter the safety mode.
  - STO is operated indirectly from an emergency stop or protective stop. It cannot be operated directly.
- Emergency Stop
  - This function puts the robot in an emergency stop state when the emergency stop switch on the EMERGENCY Connector is pressed.
  - After the signal is input, the STO is executed, and the robot controller enters the emergency stop state after the motor is stopped.
  - The robot controller’s emergency stop circuit is as described below.
    - EMERGENCY Connector
    - This is an emergency stop switch (E-Stop, TP) attached to Teach Pendant.

- Safeguard (SG)/Safeguard (Protective Stop)
  - This function puts the robot in a protective stop when a signal is input from peripheral safety devices on the EMERGENCY Connector.
  - After a signal is input, the protective stop is executed, and the robot enters the protective stop state after the motor is stopped.
  - The robot controller's safeguard (SG) circuit is as described below.
    - EMERGENCY Connector

3.2.8.2 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

Safety Functions	Enable Mode	Stop Category	SFF	PFHd 10^{-7}	Response Time (ms)
Emergency Stop E.Stop, TP	ALL	1	95%	1.1	1300
Safeguard (SG)/Safeguard (Protective Stop)	AUTO	1	93%	1.9	750

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

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

3.3 Environment and Installation

Unpacking and transportation of the Manipulators and related equipment shall be performed by personnel who has taken robot system training held by Epson and suppliers. Also, the laws and regulations of the installation country must be followed.

3.3.1 Environment

To ensure that the robot system operates and maintains maximum performance and to ensure its safe use, the robot system should be installed in an environment that meets the following requirements.

Item	Conditions
Ambient temperature *	5 to 40°C
Ambient relative humidity	10 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
Altitude	1000 m or less

Item	Conditions
Environment	■ Install indoors. ■ Keep away from direct sunlight. ■ Keep away from dust, oily smoke, salinity, metal powder, and other contaminants. ■ Keep away from flammable or corrosive liquids and gases. ■ Keep away from water. ■ Keep away from shocks or vibrations. ■ Keep away from sources of electric noise. ■ Keep away from strong electric or magnetic fields ■ Keep away from explosive areas. ■ Keep away from large quantities of radiation.

* When used in a low-temperature environment near the minimum temperature specified in the product specifications, or when the unit is idle for a long period of time during holidays or at night, a collision detection error or similar error may occur immediately after the start of operation due to high resistance in the drive unit. In such cases, warm-up operation for about 10 minutes is recommended.

⚠ WARNING

Use a circuit breaker on the power cable of the Manipulator.
If a circuit breaker is not used, it may cause an electric shock and circuit breakdown caused by short circuit.

⚠ CAUTION

- When cleaning the Manipulator, do not rub it strongly with alcohol or benzene. It may lose luster on the coated face.
- This product should be used in an overvoltage category 2, pollution degree 2 environment.

KEY POINTS

The Manipulator is not suitable for use in harsh environments such as application work. If the Manipulator will be used in a location that does not meet the above requirements, please contact the supplier.

3.3.2 Base table

A base table for anchoring the Manipulator is not supplied. The base table must be fabricated or obtained by the customer.

The shape and size of the base table vary depending on the application of the robot system. As a reference when designing the base table, the requirements from the Manipulator side are shown here.

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

The following are the torque and reaction force produced by the movement of the Manipulator.

	VT6-B901*	
Max. torque on the horizontal plate	360	N·m
Max. Reaction fore on the horizontal direction	670	N
Maximum reaction force in vertical direction	670	N

⚠ CAUTION

If vibration occurs, improve rigidity of the base table or lower the speed or acceleration and deceleration settings. If it is used when the vibration is strong, it may cause the connected parts to get loose and apply excessive load to mechanical parts, potentially shortening the lifespan.

The threaded holes required for mounting the Manipulator base are M8. Use mounting bolts conforming to the strength equivalent to ISO898-1 property class 10.9 or 12.9. For dimensions, refer to the following.

Manipulator Mounting Dimensions

The plate for the Manipulator mounting face should be at least 20 mm thick and made of steel for reducing vibrations. The surface roughness should be 25 µm or less.

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

The Manipulator's installation surface should have a flatness of 0.5 mm or less and an inclination of 0.5° or less. If the installation surface does not have the proper flatness, the base of the Manipulator may be damaged or the robot may be unable to operate at maximum performance.

When mounting the Manipulator on a mobile platform, be sure to use a mobile platform in low acceleration. When the mobile platform is used in high acceleration, it may cause the Manipulator to make a safety stop.

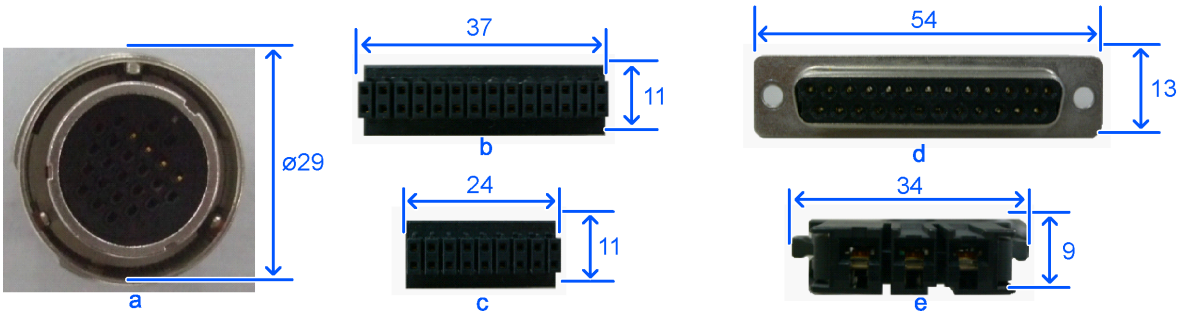
Be sure to design the installation position of the Manipulator so that the center of gravity is always within the mobile platform when the Manipulator grasps a workpiece by using a tool. For operation pose, create an operation program so that the center of gravity of the Manipulator is always within the mobile platform. If the center of gravity is not within the mobile platform, the Manipulator may fall over.

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

If passing cables through the holes in the base table, refer to the connector dimensions in the figures below.

KEY POINTS

Adjust the holes of the base table with the shell size to be used.



Symbol	Description
a	TP connector
b	I/O (Input) Connector
c	I/O (Output) Connector
d	EMERGENCY Connector
e	AC power connector

⚠ WARNING

To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to the following:

Safeguard (Safeguard Interlock)

3.3.3 Manipulator Mounting Dimensions

Mounting Area

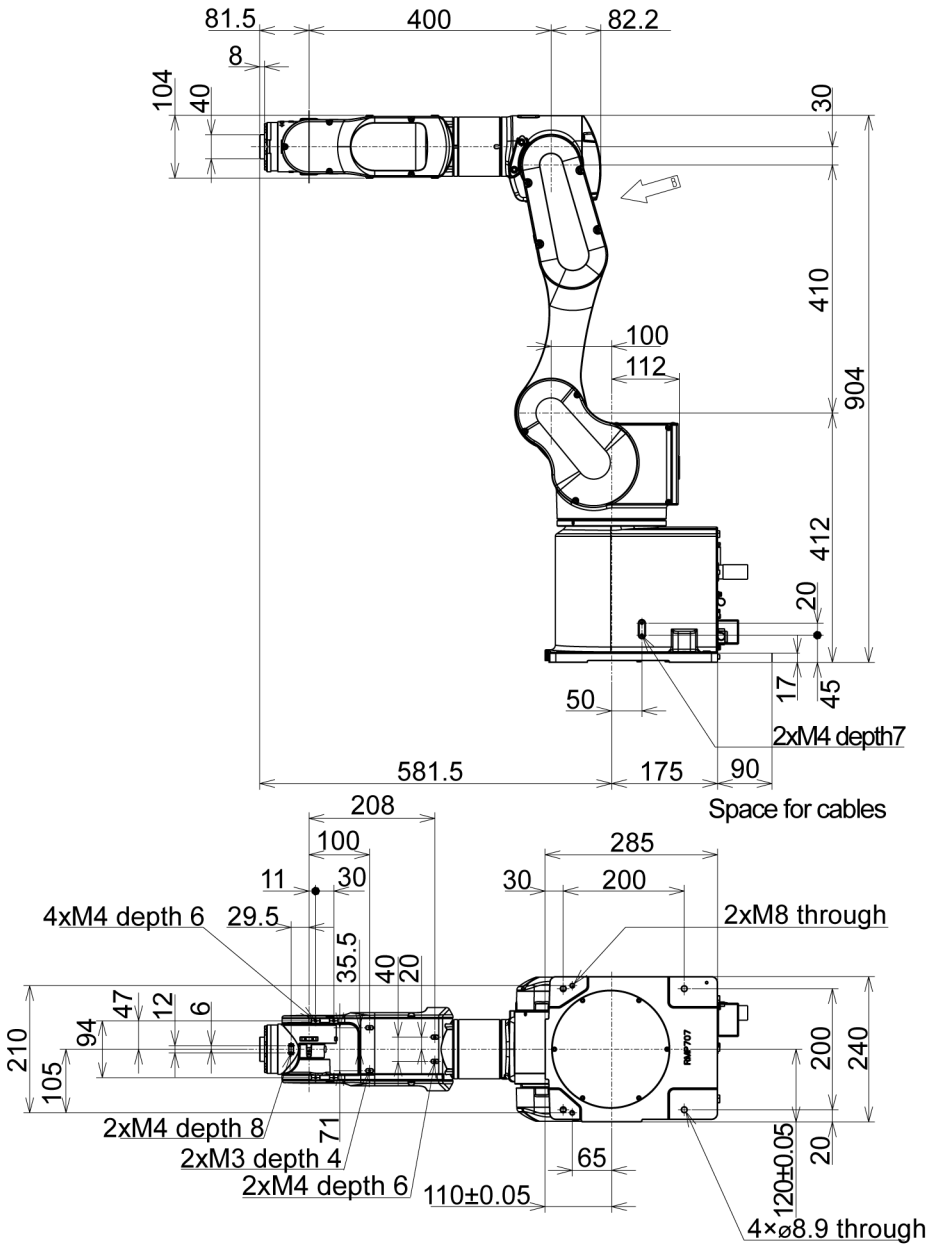
Besides the area required for installation of the Manipulator, peripheral equipment, and other devices, the following space should be provided.

- Space for teaching
- Space for maintenance and inspection
  (Ensure a space to open the covers and plates for maintenance)
- Space for cables

KEY POINTS

The minimum bend radius of the power cable is 90 mm. When installing the cables, be sure to maintain sufficient distance from obstacles. Also, leave enough space for other cables so that they are not forced to bend at extreme angles.

Ensure that the distance to the safeguard from the maximum motion range is more than 100 mm.



[Unit: mm]

3.3.4 Unpacking and Transportation

Use a cart or a similar equipment to transport the Manipulator in the same condition as it was delivered. Observe the following when unpacking the Manipulator.
Unpacking, and transportation shall be performed by personnel who has taken robot system training held by Epson and the suppliers and should conform to all national and local codes.

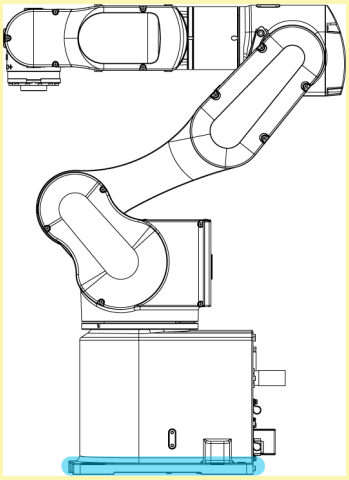
⚠ WARNING

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

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

⚠ CAUTION

- Use a cart or the like to transport the Manipulator in the same status as it was delivered.
- When removing the fixing bolts securing the Manipulator to the transportation pallet and the packing box or the anchor bolts, support the Manipulator to prevent it from falling. Removing the fixing bolts or anchor bolts without supporting the Manipulator may cause it to fall, catching your hands or feet. Also, when installing and transporting the Manipulator, make sure it does not fall until all of the bolts are fixed.
- The Manipulator should be transported by two or more people or secured to transporting equipment. Also, do not hold the bottom of the base (the shaded area in the figure). Holding these parts by hand is extremely hazardous and may cause your hands and fingers to get caught.



VT6-B901**
Approximately 43 kg: 94.8 lbs.

- When transporting the Manipulator, avoid excessive vibration or shock. Excessive vibration or shock may cause equipment damage and/or malfunction of the Manipulator.
- 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.

3.3.5 Installation

Installation shall be made by personnel who has taken robot system training held by Epson and suppliers and should conform to all national and local codes.

⚠ WARNING

- To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to the following:

  Safeguard (Safeguard Interlock)

- Install the Manipulator in a location with sufficient space so that a tool or a workpiece does not touch the wall or a safeguard when the Manipulator extends its arm fully while holding a workpiece. Installing the Manipulator in a location with insufficient space is extremely hazardous and may result in serious bodily injury

and/or severe equipment damage to the robot system as a tool or a workpiece may collide with a wall or a safeguard.

- Anchor the Manipulator before turning on the power or operating it. Turning on the power 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 to operators and/or severe equipment damage.
- Before installing and 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 to operators and/or severe equipment damage.
- This Manipulator is not a collaborative robot. Be sure to perform risk assessment and take safety measures such as safeguard and emergency stop switch. Operating the Manipulator without taking safety measures is extremely hazardous, may result in serious bodily injury and/or severe equipment damage.
- When installing the Manipulator, do not remove the supports until all of the fixing bolts are fixed. If the support is removed without the bolts being properly secured, the manipulator may fall or tip over, which is extremely dangerous. Be especially careful for specifications such as wall mounting and ceiling mounting.
- When mounting to a wall or ceiling, there is a possibility of the Manipulator falling and tipping over. Be sure to use a work table that is appropriate for installing and be careful of the Manipulator falling and tipping over.

⚠ CAUTION

- The Manipulator must be installed to avoid interference with buildings, structures, and other machines and equipment. Without doing so, it may collide with peripheral devices or become pinch points.
- Resonance (resonating sound or minute vibrations) may occur during Manipulator operation depending on the rigidity of the base table. If resonance occurs, improve the rigidity of the base table or change the speed or acceleration and deceleration settings of the Manipulator.
- When mounting the Manipulator on the mobile platform, the Manipulator may fall over. Be careful of the following items and take measures to prevent the Manipulator from falling.
  - Rigidity of the connection between mobile platform and the Manipulator
  - Acceleration of the mobile platform and the Manipulator
  - Motion range of the Manipulator
- Be sure to design the installation position of the Manipulator so that the center of gravity is always within the mobile platform when the Manipulator grasps a workpiece by using a tool. For operation pose, create an operation program so that the center of gravity of the Manipulator is always within the mobile platform. If the center of gravity is not within the mobile platform, the Manipulator may fall over.
- The Manipulator should be installed and transported by two or more people. The Manipulator’s weight is as follows: Be careful not to pinch or injure your hands, feet, or other body part due to dropping the Manipulator.

  VT6-B901**
  Approximately 43 kg: 94.8 lbs.

Fixing bolt

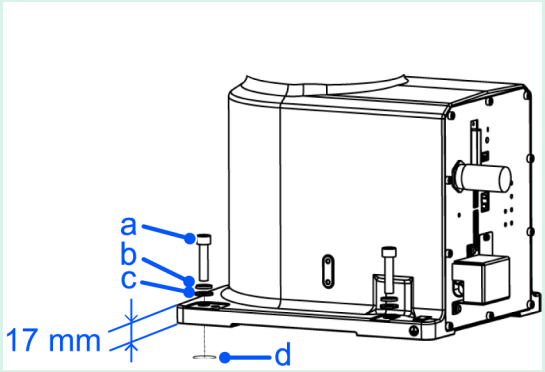
For dimensions, refer to the following.

Manipulator Mounting Dimensions

KEY POINTS

There are four threaded holes for the Manipulator base.
The mounting bolts are M8 size. Use mounting bolts conforming to the strength of ISO898-1 property class 10.9 or 12.9.

Tightening Torque:
32.0 ± 1.6 N·m (314 ±16 kgf·cm)



Symbol	Description
a	4-M8X35
b	Spring washer
c	Plain washer
d	Threaded hole (18 mm or more depth)

Cleanroom Specifications

When using the Manipulator in the clean room, follow the steps below before the installation.

1. Unpack the Manipulator outside of the cleanroom.
2. Secure the Manipulator to transporting equipment (or a pallet) with bolts so that the Manipulator does not fall down.
3. Wipe off any dust on the Manipulator using a lint-free cloth that was dipped in ethyl alcohol or distilled water.
4. Carry the Manipulator into the cleanroom.
5. Secure the Manipulator to the base table.

3.3.6 Power supply

WARNING

There is no power switch on the Manipulator. Right after inserting the power plug to power, the Robot System turns ON. Be ware of electric shock when inserting a power plug.

3.3.6.1 Power Supply Specifications

Item	Specifications
Rated Voltage	100 to 240 VAC (Input voltage should be within ±10 of the rated voltage.)

Item	Specifications
Phase	Single phase
Frequency	50 / 60 Hz
Momentary Power Interrupt	Less than 10 msec.
Rated capacity	1,200VA
Short-circuit current rating	5 kA
Maximum Load Current	12.0A (In case of 100V)
Inrush Current (When AC power is turned ON)	Approx. 60A (2 ms)
Leakage current	Less than 3.5 mA
Grounding	D ground (grounding resistance of 100 Ω or less).
Pollution level	2
Overvoltage category	2

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

3.3.6.2 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 the connector of a Power cable to the Manipulator, insert until it clicks into place.

The specification for the power supply connection side is is as shown in the table below.

AC specification

Item	Specifications
AC power wire (2 cables)	Black/White
Protective ground wire	Green/Yellow
Cable length	5 m
Terminal	M4 round terminal

The power cables can be secured using the cable clamp which is located in the rear side of the Manipulator.
(Only for Standard model, Cleanroom model)

3.3.6.3 Breaker

AC power line

Use the table below as a guide when selecting the rated current of the breaker or circuit protector.

VT6-B	Power supply	Rated current
AC specification	100VAC	20 A
	200VAC	10 A

Circuit breaker:
Install a circuit breaker (double-pole interruption type).

Circuit protector:
Install a circuit protector or a circuit breaker with an over current protection function.
Select a circuit protector that can withstand inrush current. For details, refer to the following.
Power Supply Specifications

3.3.7 Connecting the Cables

⚠ WARNING

- To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the power cable to a power receptacle. DO NOT connect it directly to a factory power source.
- 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.
- Ground the Manipulator by connecting to the Power cable. Ensure that the Power cable and ground wire are connected correctly. If the ground wire is connected improperly to ground, it may result in a fire or electric shock.

⚠ CAUTION

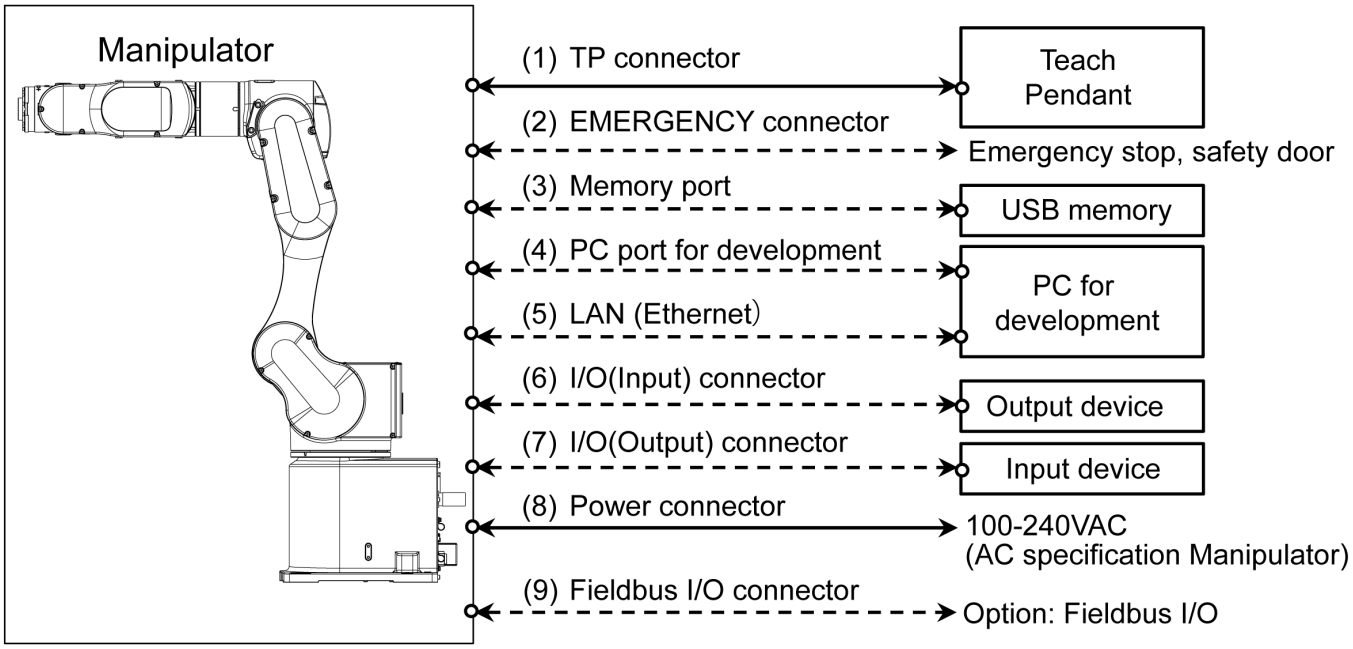
- Check that the serial number matches for each device. Improper connection between the Manipulator and the Controller may not only lead to malfunction of the robot system but also safety problems.
- Before connecting the connector, check that the pins are not bent. Connecting with pins bent may damage the connector and result in malfunction of the robot system.

3.3.7.1 Connection Example

o Detachable connector

——— Supplied cable

- - - - - Not supplied cable (Prepare by yourself)



1. TP connector
   Connect the Teach Pendant (option).
   For details, refer to the following.
   TP Port

2. EMERGENCY connector
   Connects the emergency stop switch and the safeguard switch.
   For safety reasons, connect the proper switches for these input devices. For details, refer to the following.
   EMERGENCY connector

3. Memory Port
   Connect to USB memory. For details, refer to the following.
   Memory Port

4. PC port for development
   Connects the PC for development For details, refer to the following.
   Development PC Connection Port

5. LAN (Ethernet Communication)
   Connect the EtherNet cable. For details, refer to the following.
   LAN (Ethernet Communication) Port

6. I/O (Input) connector
   This input connector is for the user's output device. When there is an output device, use this connector. For details, refer to the following.
   Standard I/O Connector

7. I/O (Output) Connector
   This output connector is for the user's input device. When there is an input device, use this connector. For details, refer to the following.
   Standard I/O Connector

8. Power connector
   Connector for supplying AC power source (AC specification Manipulator).

9. Fieldbus I/O connector
   EMC measures should be implemented for the Fieldbus I/O cables as needed. For details, refer to the following section.
   Key Points for Noise Reduction

When the Manipulator is a model with cleanroom specifications, an exhaust system must be connected. For details on the exhaust system, refer to the following.
Appendix A: Specifications Table

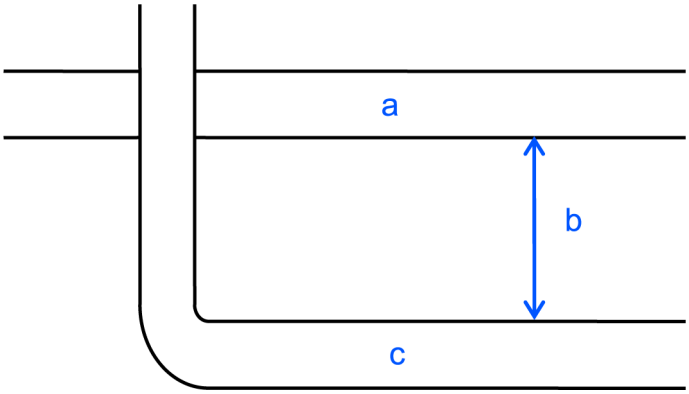
3.3.7.2 Key Points for Noise Reduction

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 Manipulator frame is important not only for the purpose of preventing an electric shock, but also to reduce the effects of electrical disturbances from the surrounding area. The ground wire (green/yellow) of the Manipulator's power cable must be connected to the ground terminal of the power distribution system. For details about the plug and the Manipulator's AC power cable, refer to the following.
  Power supply

- Power should be supplied as far as possible away from power lines connected to equipment which may be a source of noise.

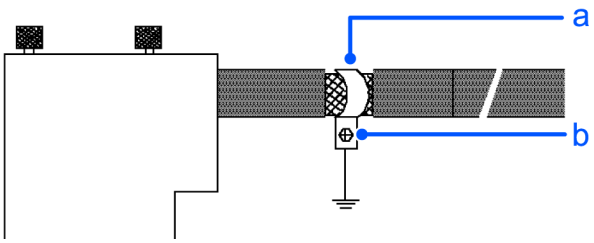
- AC and DC lines should be housed in different ducts and as far apart as possible. For example, AC motor power lines and Manipulator power lines should be as far away as possible from I/O cables for devices such as sensors and valves, and both should not be bundled together with cable ties. If the lines 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

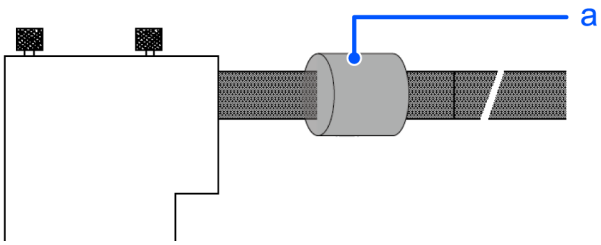
- Keep wiring to I/O connectors and EMERGENCY connectors as short as possible. Be sure to use shielded wires, and clamp the shield inside the connector. Also, keep as far away as possible from noise sources in the surrounding area.

- When using inductive load components such as relays and solenoid valves for Manipulator 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.
- Communication cables such as USB, Ethernet, and fieldbus are susceptible to noise. Therefore, 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

3.3.8 Relocation and Storage

3.3.8.1 Safety Information for Relocation and Storage

Observe the following when relocating, storing, and transporting the Manipulators.

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

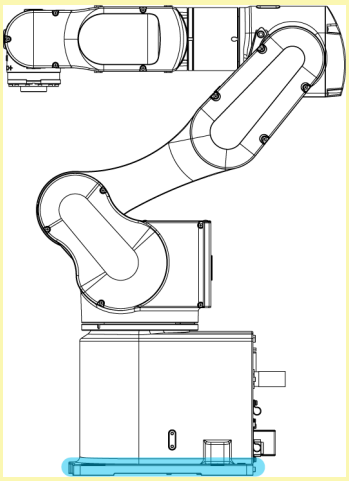
⚠ WARNING

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

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

⚠ CAUTION

- When removing the fixing bolts, support the Manipulator to prevent it from falling. Removing the fixing bolts without supporting the Manipulator may cause it to fall, catching your hands or feet.
- The Manipulator should be transported by two or more people or secured to transporting equipment. Also, do not hold the bottom of the base (the shaded area in the figure). Holding these parts by hand is extremely hazardous and may cause your hands and fingers to get caught.



VT6-B901**: Approx. 43 kg: 94.8 lbs.

- When transporting the Manipulator, avoid excessive vibration or shock.
  Excessive vibration or shock may cause equipment damage and/or malfunction of the Manipulator.
- 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.

Be sure to transport and store the robot system in an environment that meets the following conditions:

Item	Conditions
Ambient temperature *	-20 to 60°
Ambient relative humidity	10 to 90% (with no condensation)

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

When the Manipulator is used for a robot system again after a long-term storage, perform a test run to verify that it works properly, and then operate it thoroughly.

When condensation occurs on the Manipulator during transportation or storage, turn ON the power only after the condensation dries.

3.3.8.2 Relocation

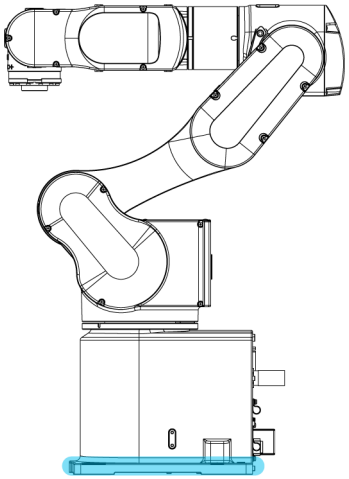
Follow the procedures described below when relocating the Manipulator.

⚠ CAUTION

- Install or relocate the Manipulator with two or more people. The Manipulator's weight is as follows: Be careful not to pinch or injure your hands, feet, or other body part due to dropping the Manipulator.

  Approximately 43 kg: 94.8 lbs.

1. Position the Manipulator as shown in the figure.
   Do not hold the bottom of the base (the shaded area in the figure). Holding these parts by hand is extremely hazardous and may cause your hands and fingers caught.



   Recommended
   Joint #2 +55°
   Joint #3 -55°
   Weight of the Manipulator VT6-B901**
   Approximately 43 kg: 94.8 lbs.

2. Turn OFF the power on all devices.

KEY POINTS

Remove the mechanical stops if using them to limit the motion range. For details on the motion range, refer to the following section.
Setting the Work Envelope by Mechanical Stops

3. Unscrew the anchor bolts. Then, remove the Manipulator from the base table.

4. Then, secure the Manipulator to the delivery equipment or have at least 2 people to transport the Manipulator.

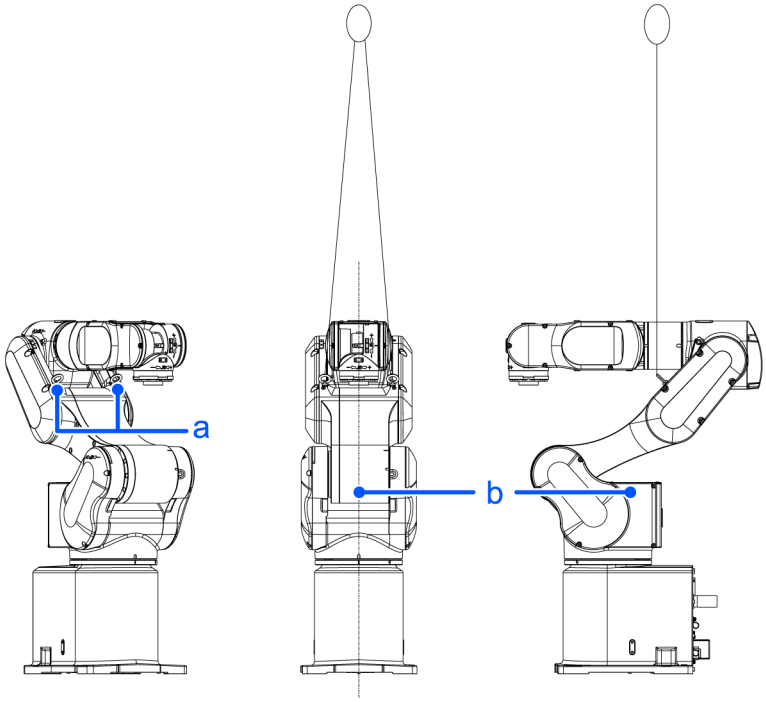
Using eyebolts

Check that the eyebolts are securely fastened before transporting the Manipulator. After transporting the Manipulator, remove the eyebolts and keep them for future use.

The eyebolts and wire must be strong enough to withstand the weight (See the figures below).

If you use the eyebolts to lift up the Manipulator, make sure to put hands on it to keep the balance. The Manipulator may fall if the balance is lost and this is extremely hazardous.

To prevent damage on the covers and arms, it is recommended to protect the contacting parts of the wire and arm with a cloth.



Symbol	Description
a	Threaded holes for eyebolts: 2×M6 depth 13
b	Center of gravity

Weight of the Manipulator VT6-B901**
Approximately 43 kg: 94.8 lbs.

⚠ CAUTION

- Remove the eyebolts from the Manipulator after transportation/relocation is completed.
  If the Manipulator is operated with the eyebolts left on it, the arm may collide with the eyebolts and it may cause equipment damage to and/or malfunction of the Manipulator.

Transportation and installation of the Manipulator and related equipment should be performed by people who have received installation training provided by Epson and the suppliers. Also, the laws and regulations of the installation country must be followed.

⚠ WARNING

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

3.3.9 Checking the Basic Orientation

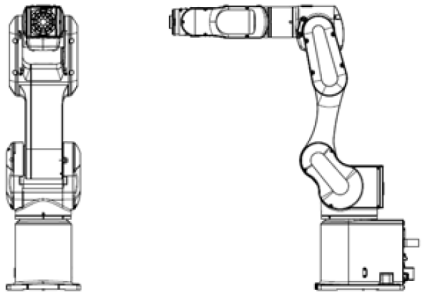
After installing the Manipulator and setup the operating environment, check if it moves to the basic position properly.

Follow the steps below to set the basic orientation of the Manipulator shown below as the origin position.

1. Start Epson RC+.
   Double click the [Epson RC+] icon on the desktop.
2. Open the command window.
   Epson RC+ menu-[Tools]-[Command Window]
3. Execute the following command in [Command Window].

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

If the Manipulator cannot be in the basic orientation shown below, please contact the supplier.



3.4 Setting the Hand

3.4.1 Installing the Hand

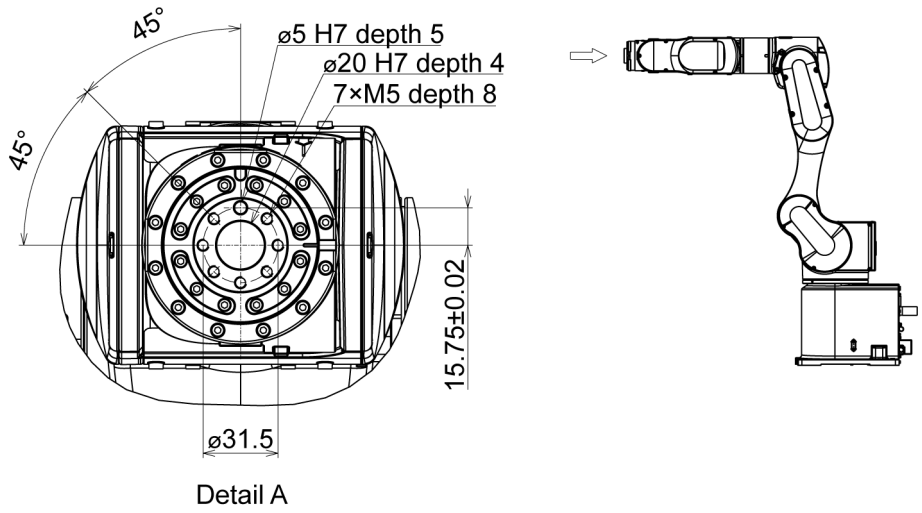
Create the hand for your Manipulator. For details on installing the hand, refer to the following manual.
“Epson RC+ 8.0 Hand Function”
The flange dimensions at the end of Arm #6 is as below.

⚠ CAUTION

- If you use a hand equipped with a zipper, make sure to connect wires and/or use pneumatic tubes so that the gripper does not release the workpiece when the power to the robot system is turned OFF. Improper connection of the wires and/or pneumatic tubes may damage the robot system and/or workpiece as the workpiece is released when the Emergency Stop switch is pressed. I/O outputs are configured at the factory so that they are automatically shut off (0) by power disconnection, the Emergency Stop switch, or the safety features of the robot system.

  However, the I/O set in the hand function does not turn off (0) when the Reset command is executed or in emergency stop.

Wrist flange



Arm #6

Attach the hand to the end of the Arm #6 using the M5 bolts.

Layout

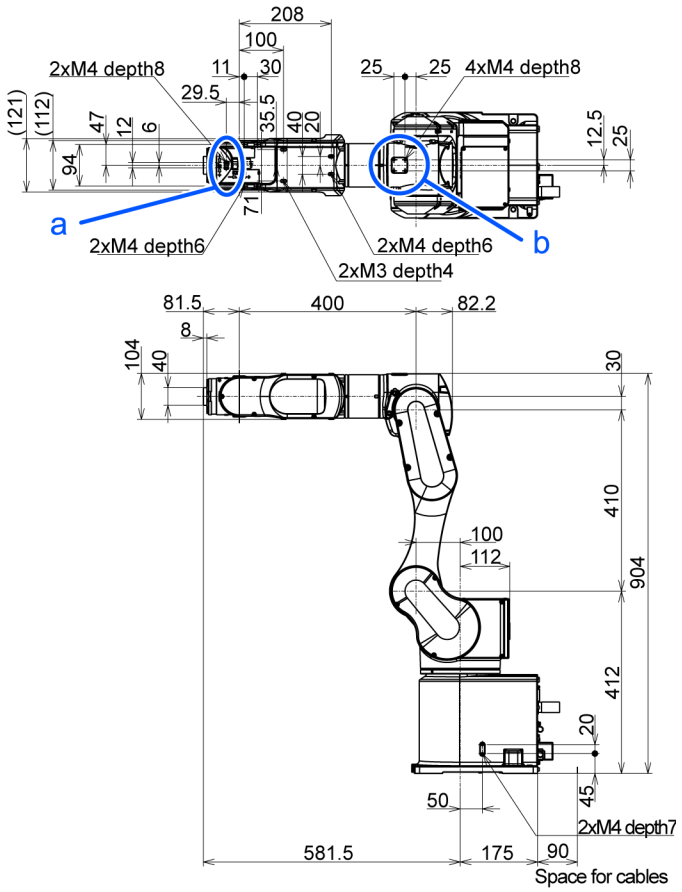
When attaching and operating a hand, the hand may come into contact with the Manipulator body due to the outer diameter of the hand, the size of the workpiece, or the position of the arm. Carefully consider the interference area of the hand when designing the system layout.

3.4.2 Attaching Cameras and Air Valves

Decks are equipped to Arms #4 and #5 to enable the easy installation of air valve.

To mount the camera, the camera plate unit is necessary. We provide the optional “Camera Plate Unit”. For details, refer to the following.

Options



Symbol	Description
a	Arm #5 deck
b	Arm #3 deck

3.4.3 Weight and Inertia Settings

The WEIGHT and INERTIA (inertia moment and eccentricity) commands are for setting the load parameters of the Manipulator. These settings optimize the Manipulator motion.

WEIGHT Setting

The WEIGHT command is for setting the load weight. The more the load weight increases, the more the speed and acceleration/deceleration are reduced.

INERTIA Setting

The INERTIA command is for setting the inertia moment and the eccentricity of the load. The more the inertia moment increases, the more the acceleration and deceleration of the Arm #6 are reduced. The more the eccentricity increases, the more the acceleration and deceleration for the Manipulator movement are reduced.

To ensure optimum Manipulator performance, make sure that the load (weight of the hand and workpiece) and moment of inertia of the load are within the maximum rating for the Manipulator, and that Arm #6 does not become eccentric. However, if the load or the inertia moment exceeds the ratings or if the load becomes eccentric, follow the explanation described below.

- **Weight Setting**
- **INERTIA Setting**

Setting parameters makes the operation of the Manipulator optimal, reduces vibration to shorten the operating time, and improves the capacity for larger loads. This also works to curb any persistent vibration that may occur when the hand and workpiece have a large moment of inertia.

You can also perform settings using the "Weight, Inertia, and Eccentricity/Offset Measurement Utility."

Details are described in the following manuals.
"Epson RC+ User's Guide - Weight, Inertia, and Eccentricity/Offset Measurement Utility"

The allowable load for VT6-B series Manipulators is up to 6 kg.

Due to the limitations of the moment and moment of inertia shown in the table below, the load (hand + workpiece) should also meet these conditions.

Allowable Load

Joint	Allowable moment	(GD2/4) Moment of inertia
Joint #4	12.0 N·m (1.22 kgf·m)	0.3 $kg \cdot m^2$
Joint #5	12.0 N·m (1.22 kgf·m)	0.3 $kg \cdot m^2$
Joint #6	7.0 N·m (0.71 kgf·m)	0.1 $kg \cdot m^2$

Moment

The moment indicates amount of torque applied on the joint in order to support the gravity on the load hand + workpiece). The moment increases as weight of the load and amount of eccentricity increase. As this also increases the load applied on the joint, make sure to keep the moment within the allowable value.

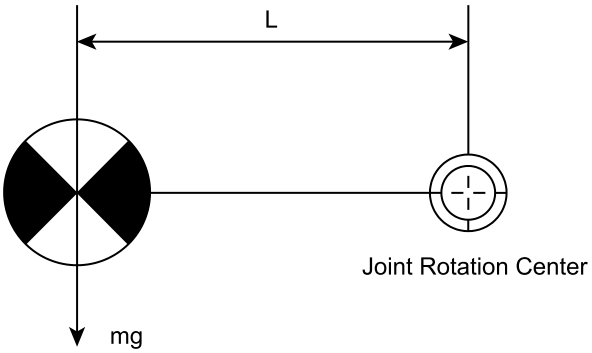
Moment of inertia

The moment of inertia indicates how difficult the load (hand + workpiece) to rotate when the Manipulator joint starts to rotate (amount of inertia). The moment of inertia increases as weight of the load and amount of eccentricity increase. As this also increases the load applied on the joint, make sure to keep the moment within the allowable value.

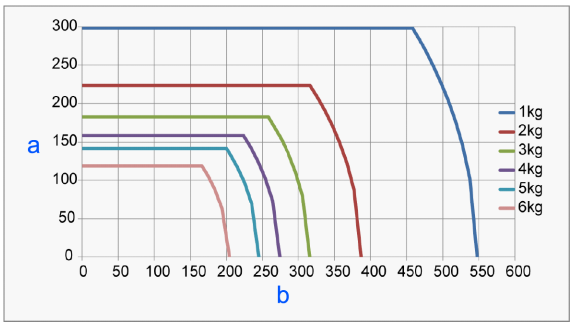
The moment M (Nm) and moment of inertia I (kgm^2) when the volume of the load (hand + workpiece) is small can be obtained by the following formula.

$M\ (N \cdot m) = m(kg) \times L\ (m) \times g\ (m/s^2)$
$I\ (kgm^2) = m(kg) \times L^2\ (m^2)$

m: Weight of load (kg)
L: Eccentricity of load (m)
g: Gravitational acceleration (m/s^2)



The diagram below shows the distribution of the maximum load center of gravity position when the load (hand + workpiece) volume is small. Design the hand so that the center of gravity is within the allowable moment. If the volume of the load is large, calculate the moment and inertia moment by referring to the following section.



Symbol	Description
a	Arm #6 Load center of gravity position from rotation center [mm]
b	Arm #5 Load center position from rotation center [mm]

Max. Eccentricity of Load (Distance between the joint rotation center and the load's center of gravity)

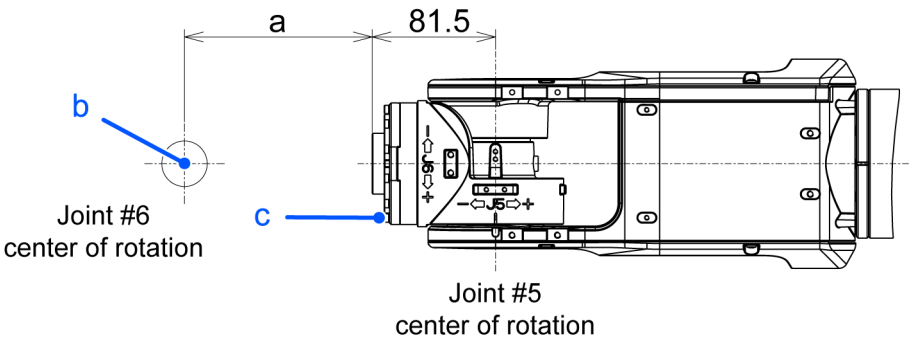
Joint	1 kg	2 kg	3 kg	4 kg	5 kg	6 kg
#4	548 mm	387 mm	316 mm	274 mm	245 mm	204 mm
#5	548 mm	387 mm	316 mm	274 mm	245 mm	204 mm
#6	300 mm	224 mm	183 mm	158 mm	141 mm	119 mm

When calculating the critical dimension of the load using the allowable moment and inertia moment, the calculated value represents a distance from the Arm #5 rotation center, not the distance from the flange. To calculate the distance from the flange to the load's center of gravity, subtract the distance from the center of the Arm #5 rotation center to the flange (=81.5 mm) as shown in the example below.

Example: Calculation of the critical dimension of the load (a) when the load is 6 kg.

- Center of gravity by the allowable moment control: 12.0 N·m/(6 kg×9.8 m/s^2) = 0.204 m = 204 mm
- Center of gravity by the allowable inertia moment control: (0.3 kgm^2/6 kg)1/2 = 0.223 m = 223 mm
- Due to the allowable moment control, center of gravity for the load limit is 204 mm from the Arm #5 rotation center.
- Distance from the flange to the center of gravity for the load limit a = 204 mm - 81.5 mm = 122.5 mm

Critical Dimension of Load



[Unit: mm]

3.4.3.1 Weight Setting

⚠ CAUTION

- Set the total weight of the hand and the workpiece smaller than the maximum payload. The VT6-B series are not designed to work with a load exceeding the allowable value.
  Always set the Weight parameters of the WEIGHT command according to the load. Setting a value smaller than the actual weight may cause errors or impact that not only impair full functionality but also shorten the life of the mechanical components.

The acceptable weight capacity (hand + workpiece) for VT6-B series is as follows:

Rated	Maximum
3 kg	6 kg

Change the setting of the Weight parameter according to the load. After changing the Weight parameter setting, the maximum acceleration/deceleration and speed of the robot system is set automatically.

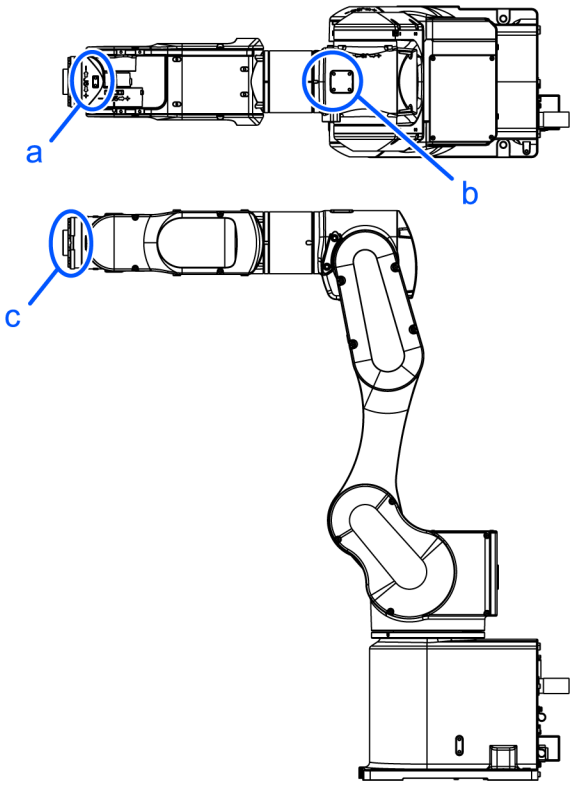
Setting method of Weight parameters

Epson RC+

Select [Tools]-[Robot Manager]-[Weight] panel and set the value in [Weight:]. You may also execute the Weight command from [Command Window].

Load on the Manipulator

Mounting location of the load



Symbol	Description
a	Arm #5 deck
b	Arm #3 deck
c	Load on the fore end of Arm #6

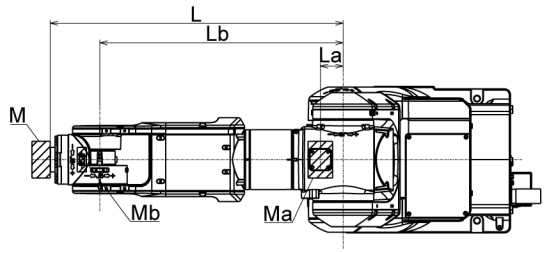
When you attach the equipment to the decks on the upper arm, convert its weight into equivalent weight assuming that the equipment is attached to the end of Arm #6. Then, this equivalent weight added to the load will be a Weight parameter.

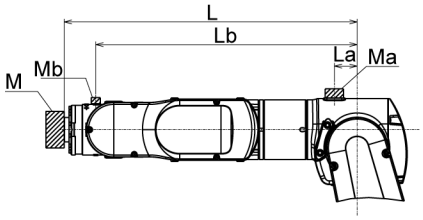
Calculate the Weight parameter by using the formula below and enter the value.

Weight Parameter Formula

Weight Parameter=M_w+ W_a + W_b

- M_w: Payload on the fore end of Arm #6 (kg)
- W_a: Equivalent weight of Arm #4 deck (kg)
- W_b: Equivalent weight of Arm #5 deck (kg)
- $W_a=M_a (L_a)^2/ (L)^2$
- $W_b=M_b (L_b)^2/ (L)^2$
- M_a: Weight of the air valve on Arm #3 deck (kg)
- M_b: Weight of the camera on Arm #5 deck (kg)
- L: Length of the upper arm (481.5 mm)
- L_a: Distance between Joint #4 and the center of gravity of the air valve on Arm #3 deck (mm)
- L_b: Distance between the Joint #3 and the center of gravity of the camera on Arm #5 deck (mm)





[Example]

When the following load is attached to the VT6-B901S* (VT6-B) with a payload M_w = 5 kg attached to the tip of Arm #6 (L = 481.5 mm from the Joint #3):

- Load on Arm #4 deck is 1.5 kg (M_a). The deck is 37.5 mm (La) away from the Joint #3.
- Load on Arm #5 deck is 1.0 kg (M_b). The deck is 400 mm (Lb) away from the Joint #3.

W_a=1.5 × 37.5^2/481.5^2=0.009 → 0.0 (round down)

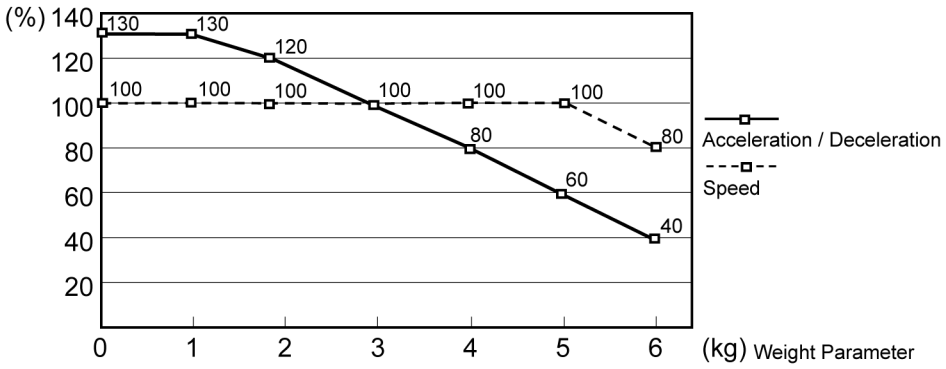
W_b=1.0 × 390^2/481.5^2=0.65 → 0.7 (round up)

M_w+W_a+W_b=5+0.01+0.0=5.7

The Weight parameter is “5.7”.

Automatic speed setting by Weight parameter

The percentages on the graph are the ratios when the acceleration and speed are set to 100% when the weight parameter value is set to the rated value (3 kg).



KEY POINTS

Maximum AccelS setting value varies depending on Weight setting value. For details, refer to the following.
Appendix A: Specifications Table

3.4.3.2 INERTIA Setting

Moment of Inertia and the INERTIA Setting

The moment of inertia is a quantity that expresses how hard it is for an object to turn, and it is expressed in terms of values for the moment of inertia, inertia, or GD2. When a hand or other object is attached to the Arm #6 for operation, the moment of inertia of the load must be taken into consideration.

⚠ CAUTION

- The moment of inertia of the load (hand + workpiece) must be 0.1 kgm^2or less. The VT6-B series Manipulators are not designed to work with a moment of inertia exceeding 0.1 kgm^2. Always set the value corresponding to the moment of inertia. Setting a parameter value that is smaller than the actual moment of inertia may cause errors or impact, may prevent the Manipulator from working at full functionality, and may shorten the lifespan of mechanical parts.

The allowable moment of inertia of a load for VT6-B series Manipulators is 0.03 kgm2 at the default rating and 0.1 kgm2 at the maximum. Change the setting of the moment of inertia according to the inertia moment of the load using the INERTIA command. After the setting is changed, the maximum acceleration/deceleration of Arm #6 that corresponds to the "Inertia" value is corrected automatically.

Moment of Inertia of Load Attached to Arm #6

The moment of inertia of the load (hand + workpiece) attached to Arm #6 can be set by the "Inertia" parameter in the Inertia command.

Epson RC+

Go to [Tools] - [Robot Manager] - [Inertia] panel, and enter the value in [Inertia]. This can also be set using the Inertia statement in [Command Window].

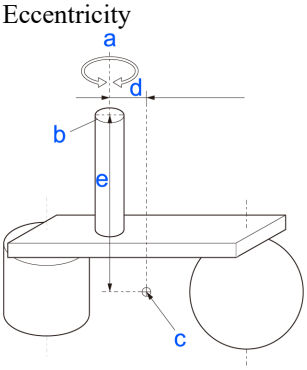
Eccentricity and INERTIA Setting

⚠ CAUTION

- The eccentricity of the load (hand + workpiece) must be 300 mm or less. The VT6-B series Manipulators are not designed to work with eccentricities exceeding 300 mm. Always set the value based on the eccentricity. Setting the eccentricity parameter to a value smaller than the actual eccentricity may cause errors or impact that not only impair full functionality but also shorten the life of the mechanical components.

The allowable eccentricity of load for VT6-B series Manipulators is 50 mm at the default rating and 300 mm at the maximum. Change the setting of the inertia moment according to the inertia moment of the load using the INERTIA command. After the setting is changed, the maximum acceleration/deceleration of the Manipulator that corresponds to the "Eccentricity" is corrected automatically.

Eccentricity



Symbol	Description
a	Rotation axis
b	Flange
c	Load center of gravity position
d	Eccentricity (300 mm or less)
e	Eccentricity (300 mm or less)

Eccentricity of Load Attached to Arm #6

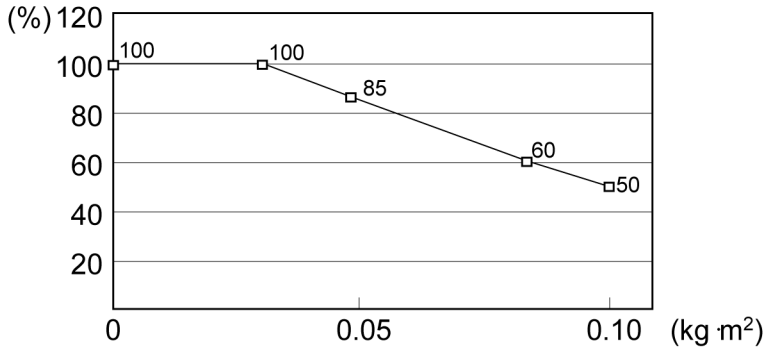
The eccentricity of the load (hand + workpiece) attached to the Arm #6 can be set by the "Eccentricity" parameter in the Inertia statement.
Enter the larger value of either "d" or "e" in the figure above to [Eccentricity].

Epson RC+

Go to [Tools] - [Robot Manager] - [Inertia] panel, and enter the value in [Eccentricity]. This can also be set using the Inertia statement in [Command Window].

Automatic Acceleration/Deceleration Correction at INERTIA Setting

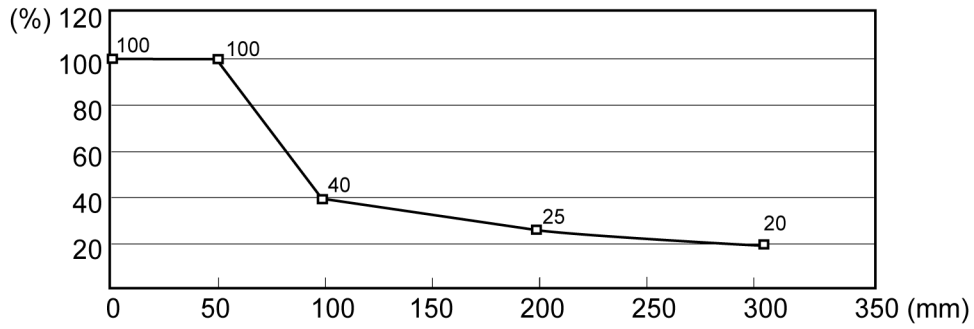
The percentages on the graph are ratios based on 100% as the acceleration/deceleration at the rated (0.03 kg·m2) setting.



Moment of inertia Parameter (kg m2)	Automatic Acceleration/Deceleration Correction at INERTIA (Moment of inertia) Setting (%)
0	100
0.03	100
0.05	85
0.08	60
0.1	50

Automatic correction by eccentricity setting

The percentages on the graph are ratios based on 100% as the acceleration/deceleration at the rated (50 mm) setting.

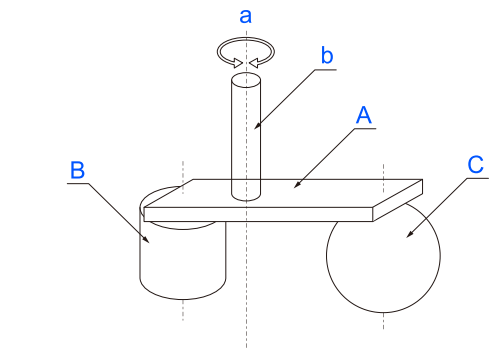


Eccentricity quantity parameter (mm)	Automatic Acceleration/Deceleration Correction at Inertia Setting (%)
0	100
50	100
100	40

Eccentricity quantity parameter (mm)	Automatic Acceleration/Deceleration Correction at Inertia Setting (%)
200	25
300	20

Calculating the Moment of Inertia

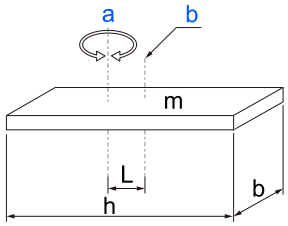
An example of calculating the moment of inertia of a load (hand holding a workpiece) is shown below.
The moment of inertia of the entire load is calculated by the sum of (A), (B), and (C).



Whole moment of inertia = Moment of inertia of end effector (A) + Moment of inertia of work piece (B) + Moment of inertia of work piece (C)

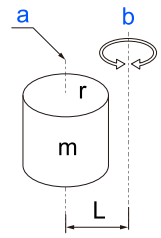
The methods for calculating the moment of inertia for (A), (B), and (C) are shown below. Use the moment of inertia of these basic shapes as a reference to find the moment of inertia of the entire load.

(A) Moment of inertia of a rectangular parallelepiped



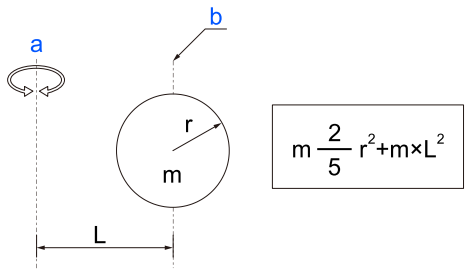
$$m\frac{b^2+h^2}{12}+m\times L^2$$

(B) Moment of inertia of a cylinder



$$m\frac{r^2}{2}+m\times L^2$$

(C) Moment of inertia of a sphere



3.4.4 Safety Information for Auto Acceleration

The speed and acceleration/deceleration of the Manipulator are automatically optimized according to the values of WEIGHT and INERTIA and the Manipulator's postures.

WEIGHT Setting

The speed and acceleration/deceleration of the Manipulator are controlled according to the load weight set by the WEIGHT command. The more the load weight increases, the more the speed and acceleration/deceleration are reduced to prevent residual vibration.

INERTIA Setting

The acceleration/deceleration of Arm #6 are controlled according to the moment of inertia set by the INERTIA command. The acceleration/deceleration of the whole Manipulator are controlled according to the eccentricity set by the INERTIA command. The more the inertia moment and eccentricity of the load increase, the more the acceleration/ deceleration are reduced.

Auto Acceleration/Deceleration According to the Manipulator's Posture

The acceleration/deceleration are controlled according to the Manipulator's posture. When the Manipulator extends its arms or when the movement of the Manipulator produces vibration frequently, the acceleration/deceleration are reduced.

Set appropriate values for WEIGHT and INERTIA so that the Manipulator operation is optimized.

3.5 Work Envelope

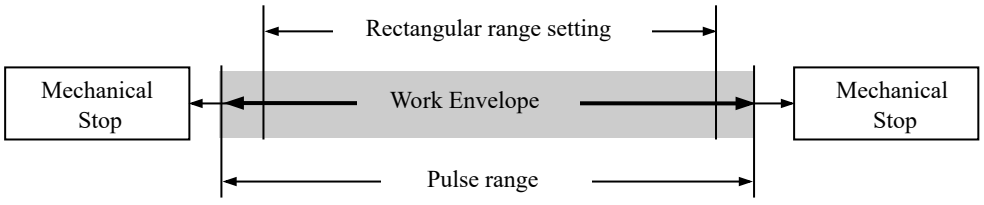
> ⚠ CAUTION
>
> - When restricting the work envelope for safety reasons, be sure to make settings using both the pulse range and mechanical stop. Failure to do so may cause serious safety problems.

The work envelope is preset at the factory as explained in the following section. This is the maximum work envelope of the Manipulator.

Standard Work Envelope

The work envelope can be set by one of the following three methods.

1. Setting by pulse range (for all joints)
2. Setting by mechanical stops
3. Setting the Rectangular Range in the XY Coordinate System of the Manipulator



To limit the work envelope for layout efficiency or safety reasons, make the settings as explained in the following sections.

Work Envelope Setting by Pulse Range (for All Joints)
Setting the Work Envelope by Mechanical Stops
Restriction of Manipulator Operation by Joint Angle Combination

3.5.1 Work Envelope Setting by Pulse Range (for All Joints)

Pulses are the basic unit of Manipulator motion. The motion range (work envelope) of the Manipulator is set by the pulse lower limit value and pulse upper limit value (pulse range) for each joint. Pulse values are read from the encoder output of the servomotor.
Be sure to set the pulse range within the mechanical stop range.

KEY POINTS

Once the Manipulator receives a motion command, it checks whether the target position specified by the command is within the pulse range before operating. If the target position is outside of the pulse range that was set, an error occurs and the Manipulator does not move.

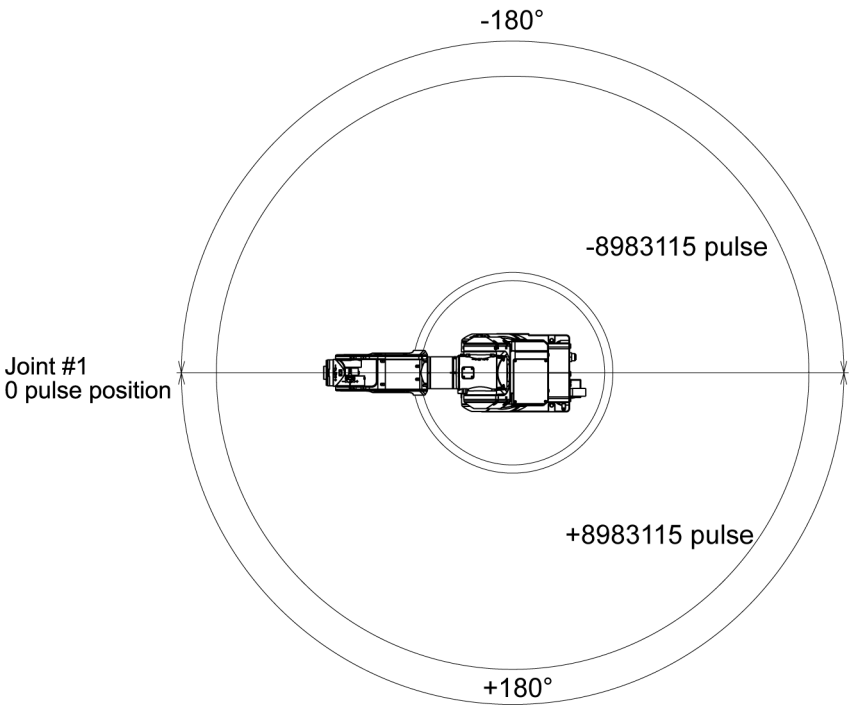
Epson RC+

Go to [Tools] - [Robot Manager] - [Range] panel, and make the setting. (This can also be set using the Range command in the [Command Window].)

(deg.=°)

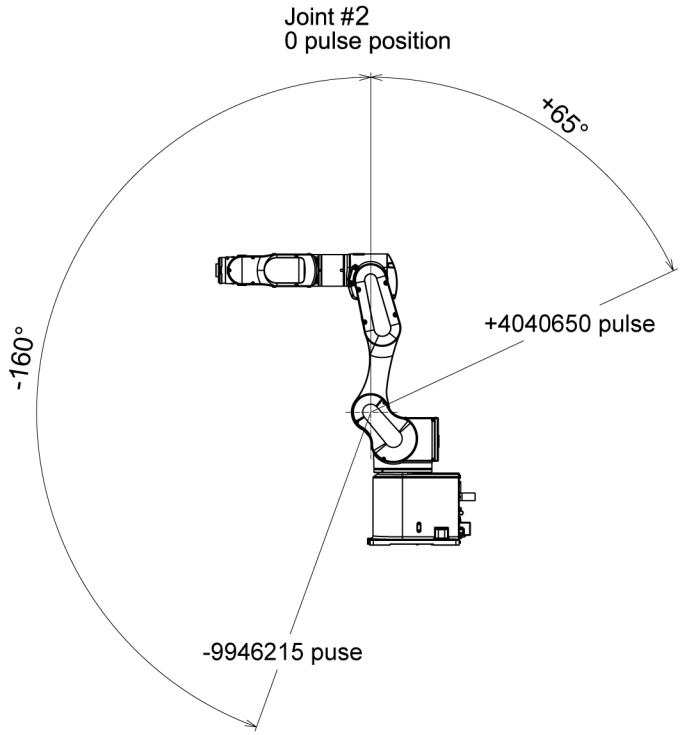
3.5.1.1 Joint #1 Maximum Pulse Range

With the 0 pulse as a starting point, the counterclockwise pulse value is defined as positive (+), and the clockwise pulse value is defined as negative (-).



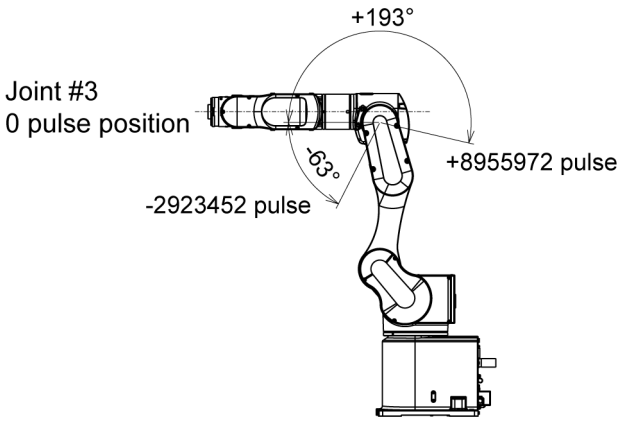
3.5.1.2 Joint #2 Maximum Pulse Range

With the 0 pulse as a starting point, the clockwise pulse value is defined as positive (+), and the counterclockwise pulse value is defined as negative (-).



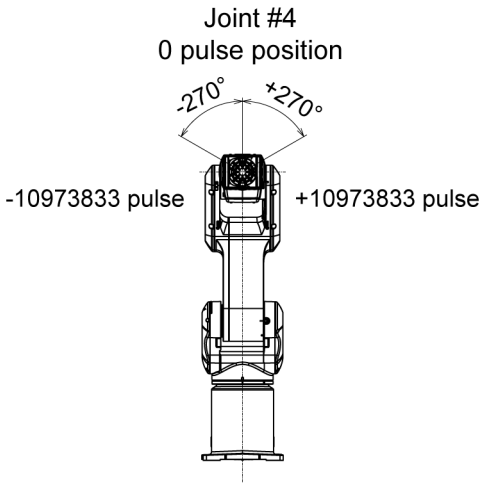
3.5.1.3 Joint #3 Maximum Pulse Range

With the 0 pulse as a starting point, the clockwise pulse value is defined as positive (+), and the counterclockwise pulse value is defined as negative (-).



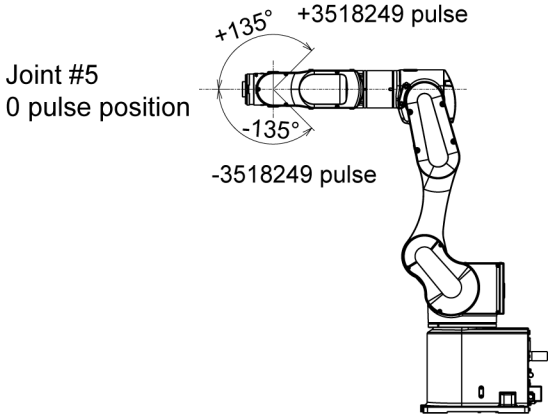
3.5.1.4 Joint #4 Maximum Pulse Range

From the angle of arm end, with the 0 pulse as a starting point, the clockwise pulse value is defined as positive (+), and the counterclockwise pulse value is defined as negative (-).



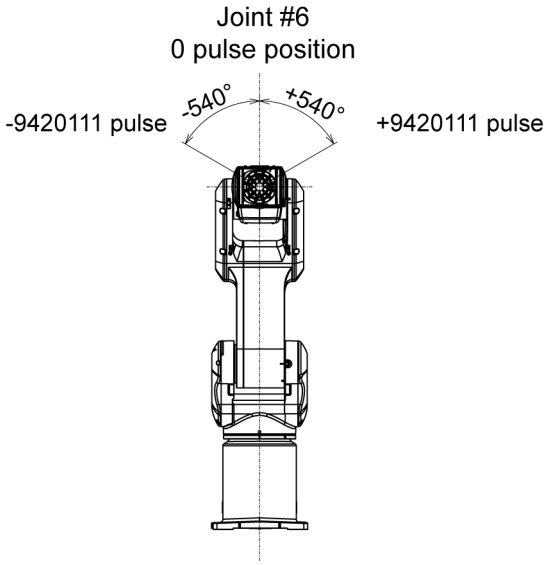
3.5.1.5 Joint #5 Maximum Pulse Range

With the 0 pulse as a starting point, the clockwise pulse value is defined as positive (+), and the counterclockwise pulse value is defined as negative (-).



3.5.1.6 Joint #6 Maximum Pulse Range

From the end of the arm's angle, with the 0 pulse as a starting point, the clockwise pulse value is defined as positive (+), and the counterclockwise pulse value is defined as negative (-).



3.5.2 Setting the Work Envelope by Mechanical Stops

Using the variable mechanical stops physically limits the absolute area that the Manipulator can move.

Before starting any work, be sure to turn off the Manipulator.

Use bolts conforming to the specified length and surface processing (ex: nickel plating) with high corrosion resistance.

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

For details on the pulse range setting, refer to the following section.
Work Envelope Setting by Pulse Range (for All Joints)

Be sure to set the pulse range inside the positions of the mechanical stop range.

Make sure to check that the mechanical stop's position and the pulse range setting is correct before use.

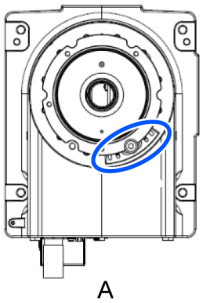
KEY POINTS

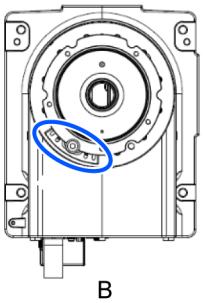
For details on the variable mechanical stop, contact the supplier.

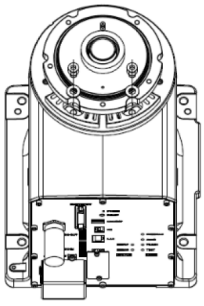
3.5.2.1 Setting the Joint #1 Work Envelope

Install variable mechanical stop (J1) in the threaded holes corresponding to the angles to be set.

- Hexagon socket head cap bolt: M8 × 10 (1 bolt)
- Hexagon socket head cap bolt + washer: M8 × 10 (1) ＋ Plain washer for M8 (small washer) (1)
- Strength: ISO 898-1 property class: 10.9 or 12.9
- Tightening torque: 32.0 ± 1.6 Nm (326 ± 16 kgf cm)


A


B



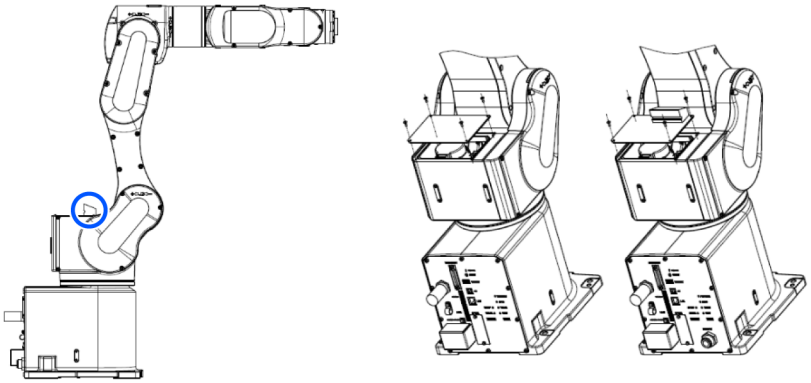
		A	B
Angle (°)	±180	-64 ,(+180)	-124 to +164
Pulse	±8983115	-3193997 to +8983115	- 6188368 to +8184616
Variable Mechanical Stop (J1)	Not applied (standard)	Applied	Applied

3.5.2.2 Setting the Joint #2 Work Envelope

Install the variable mechanical stop (J2) by taking off the upper cover of Arm #1.

- Cross Recessed Binding Head Machine Screw: M4 × 16 (1 bolt)

- Tightening torque: 0.6 ± 0.1 N·m (6.1 ± 1.0 kgf·cm)



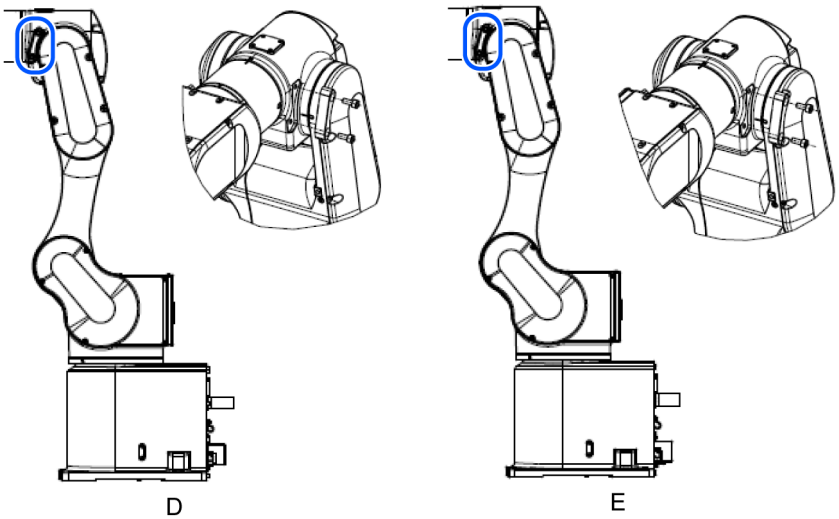
C

		C
Angle (°)	-160, +65	-160 to +57
Pulse	-9946215 to +4040650	-9946215 to +3543339
Variable Mechanical Stop (J2)	Not applied (standard)	Applied

3.5.2.3 Setting the Joint #3 Work Envelope

Remove the mechanical stop of Arm #3 and install the variable mechanical stop (J3).

- Hexagon socket head cap bolt: M6 × 15 × 2 bolts
- Strength: ISO 898-1 property class: 10.9 or 12.9
- Tightening torque: 13.0 ± 0.65N·m (133 ± 6.6 kgf cm)



D E

	D	E
Angle (°)	-63 to +193	-57 to +187
Pulse	-2923452 to +8955972	-2645028 to +8677548
Variable Mechanical Stop (J3)	Not applied (standard)	Applied

3.5.3 Restriction of Manipulator Operation by Joint Angle Combination

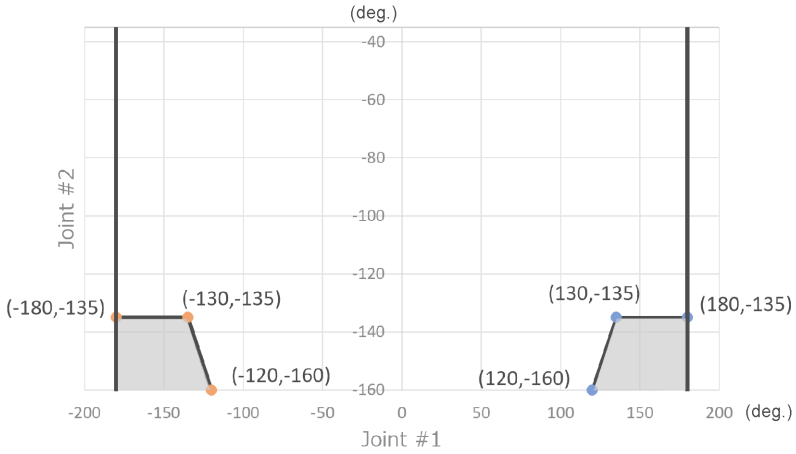
To prevent the arms of the Manipulator from interfering each other, the Manipulator operation is restricted in the specified motion range according to the angle combination of the Joint #1, #2, and #3.

The Manipulator operation is restricted and the Manipulator stops when the joint angles are within the colored areas in the following figure. In addition, the determination of whether it is inside or outside of the colored area may differ depending on a position due to calculation error on the boundary line as shown below.

The restriction to Manipulator operation is enabled:
During CP motion command execution
When you attempt to execute the motion command for moving the Manipulator to a target point (or pose) in the specified motion range (colored area).

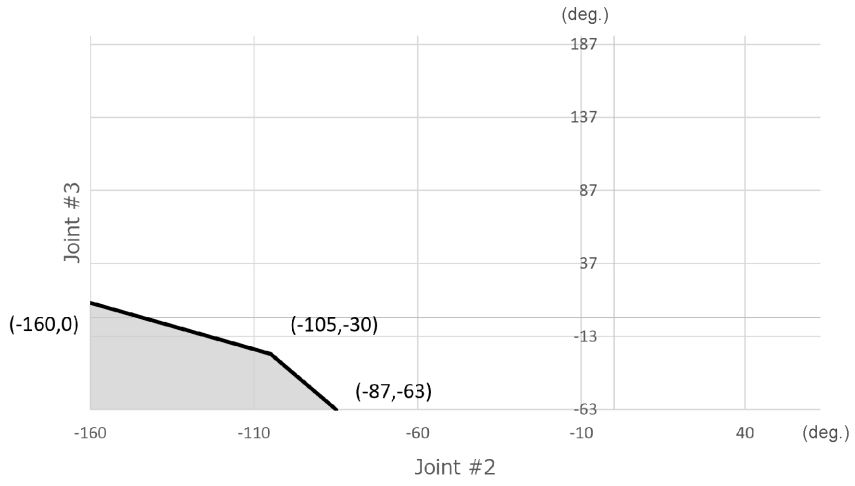
The restriction to the Manipulator operation is disabled:
The Arms of the Manipulator momentarily go through the specified motion range during the PTP motion command execution even though the joint angles of the Arms are in the colored areas of the figures above.

Combination of Joint #1 and #2

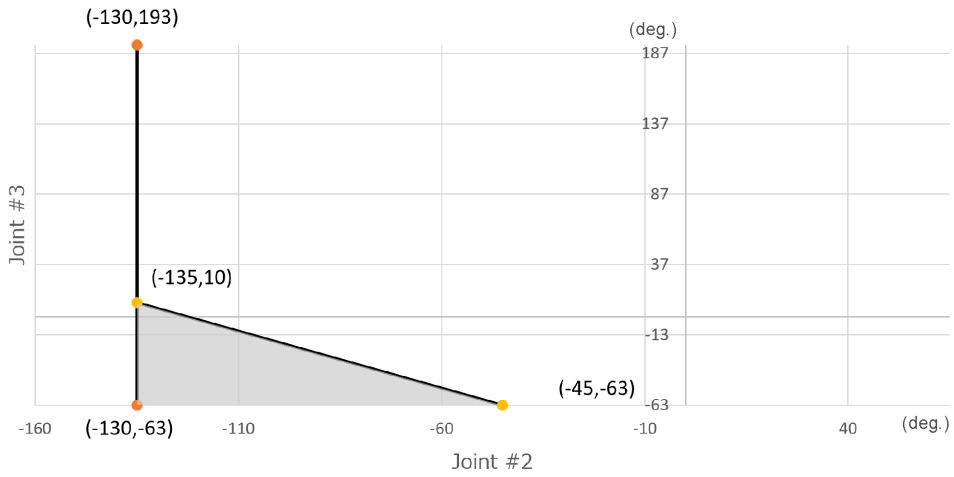


Combination of Joint #2 and #3

- -130 deg. ≤ J1 ≤ 130 deg.



- J1 ≤ -130 deg. or 130 deg. ≤ J1

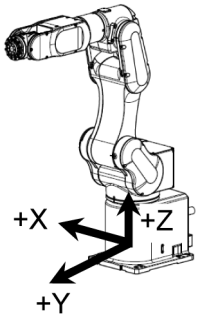
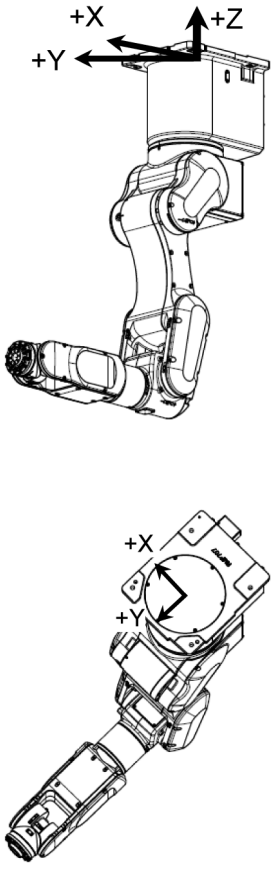
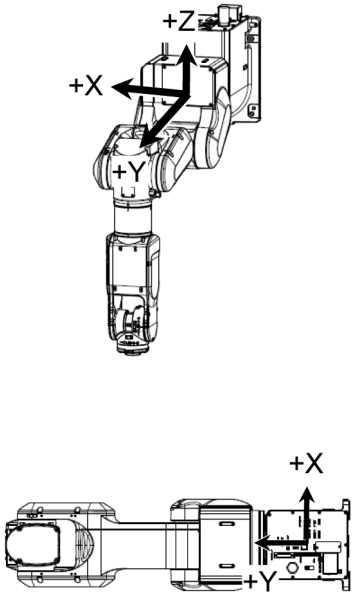


(deg.=°)

3.5.4 Coordinate System

The origin point is where the Manipulator's installation face intersects with the rotation axis of Joint #1.

For details on the coordinate system, refer to the following.
"Epson RC+ User's Guide"

Table top mounting	Ceiling mounting *	Wall mounting*
		

3.5.5 Changing the Robot

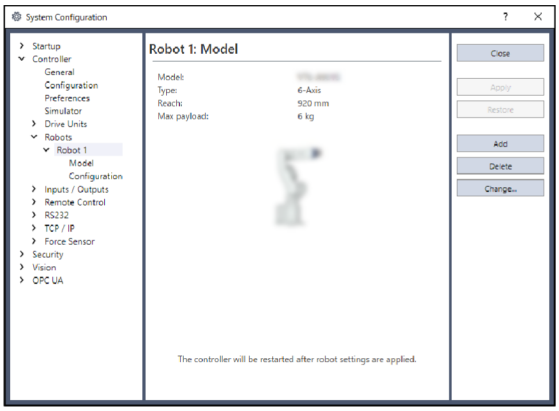
This section describes how to change the Manipulator model on Epson RC+.

⚠ CAUTION

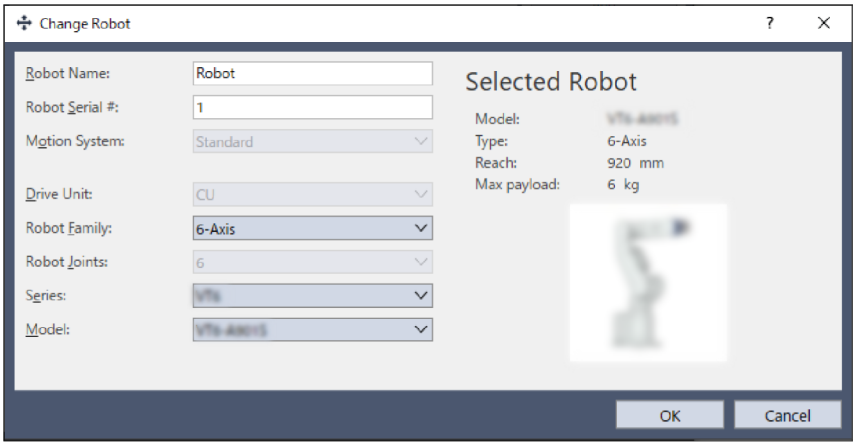
Changing the Manipulator should be done with great caution. It initializes the robot calibration parameters (Hofs, CalPls), additional axis information, and PG parameter data. Before changing the robot, make sure to save the calibration data by following the procedure below.

1. Select the Epson RC+ menu-[Setup]-[System Configuration].
2. Select [Robots]-[Robot**]-[Calibration] from the tree list. Then, click [Save].

1. Select the Epson RC+ menu-[Setup]-[System Configuration].
2. Select [Robots]-[Robot**] from the tree list.



3. Click the [Change] button. The following dialog box will be displayed.



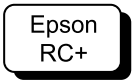
4. Input the robot name and serial number printed on the name plate of the robot. Any serial number can be entered. However, enter the number printed on the Manipulator.
5. Select the robot type in the [Robot Family] box.
6. Select the series name of the Manipulator in the [Series] box.
7. Select the robot model in the [Model] box. Available robots will be displayed according to the format of the currently installed motor driver. When [Dry run] is used, all the Manipulators of the series selected in Step 6 will be displayed.
8. Click the [OK] button. The Controller is restarted.

3.5.6 Setting the Rectangular Range in the XY Coordinate System of the Manipulator

The Cartesian (rectangular) range in the XY coordinate system of the Manipulator is specified by the limited Manipulator operation area and the XYLIM setting. The limited Manipulator operation area is defined so that the hand does not interfere with the rear side of the Manipulator. The XYLIM setting enables you to determine the upper and lower limits of the X and Y coordinates.

These settings are software-based limit, and so it does not change the maximum physical range. The maximum physical range is based on the position of the mechanical stops. The maximum range is based on the position of the mechanical stops.

These settings are disabled during a joint jogging operation. Therefore, be careful not to allow the hand to collide with the Manipulator or peripheral equipment.



Go to [Tools] - [Robot Manager] - [Range] panel, and make the setting. You may also execute the Weight command from [Command Window].

3.6 Operation Mode & LED

3.6.1 Overview of Operation Modes

The robot system has three modes.

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

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

AUTO mode
This mode enables automatic operation (program execution) of the robot system for manufacturing operation, and also programming, debugging, adjusting, and conducting maintenance of the robot system.

This mode cannot operate the Manipulators or run programs with the safeguard open.

TEST mode
In this mode, program verification is performed with the enable switch held down and the safeguard open.

It is a low-speed program verification function (T1: Manual deceleration mode) as defined in the safety standard.

This mode can operate the specified Function with multi-task / single-task, multi-Manipulator / single-Manipulator at low speed.

3.6.2 Switching Operation Modes

Operation is switched between TEACH mode and AUTO mode by the mode selector key switch on the Teach Pendant.

TEACH mode
When the mode selector key switch is switched to "Teach," operation is set to TEACH mode.

Switching to TEACH mode during program execution aborts program execution.

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

AUTO mode

Switch the mode selector key switch to "Auto," and turn on the latch release input signal to set to AUTO mode.

TEST mode

When the mode selector key switch is switched to "Teach," operation is set to TEACH mode.

Push [F1] key-[Test Mode] in [Jog & Teach] screen of TEACH mode. The mode will be changed to TEST.

3.6.3 Program Mode (AUTO)

3.6.3.1 What is Program Mode (AUTO)?

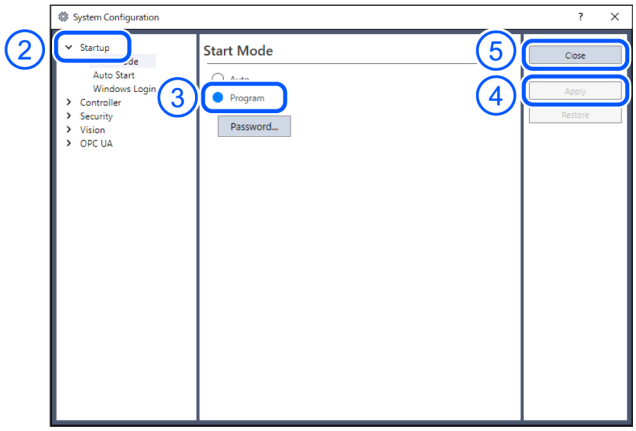
Program mode is for programming, debugging, adjusting, and conducting maintenance on the robot system.

Follow the procedures below to switch to the Program mode.

3.6.3.2 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].
3. Select [Start mode]-[Program] button.
4. Click the [Apply] button.
5. Click the [Close] button.

3.6.4 Automatic Operation Mode (AUTO)

3.6.4.1 What is Automatic Operation Mode (AUTO)?

Automatic operation mode is for automatic operation of the robot system.

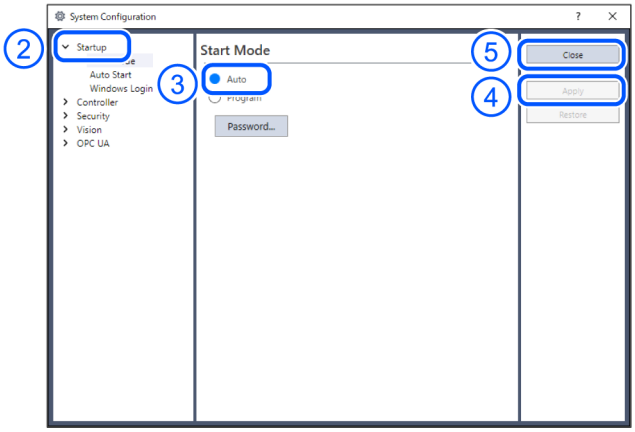
There are two ways to enter automatic operation mode.

- A: Set the Epson RC+ start mode to “operator mode” and start the Epson RC+.
  Reference: **Settings from Epson RC+**
- B: Turn Epson RC+ offline.
  Programs can be executed and stopped by the control device specified from Epson RC+.
  Reference: **Control Device Settings**

3.6.4.2 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.

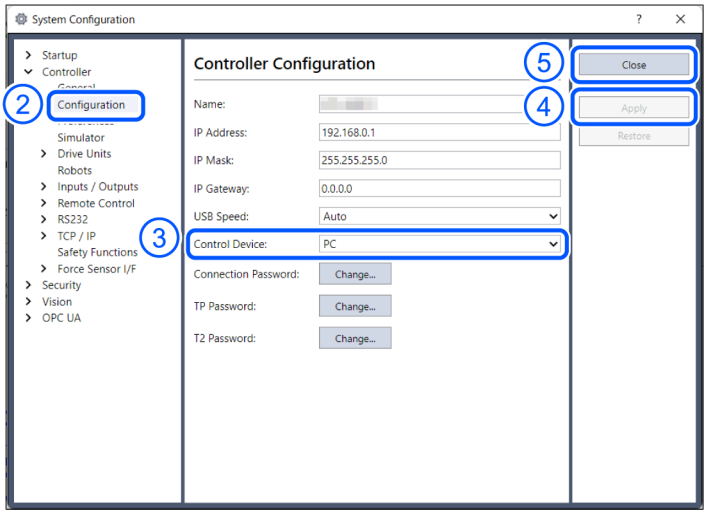


2. Select [Startup].
3. Select [Start Mode]-[Auto] button.
4. Click the [Apply] button.
5. Click the [Close] button.

3.6.4.3 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.

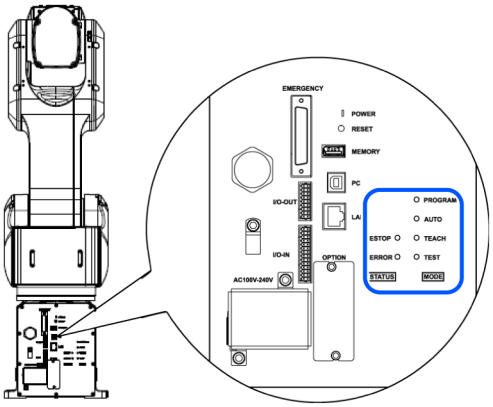


2. Select [Controller] - [Configuration].
3. Select [Control Device] to select the control device from the following two types.
   - PC
   - Remote I/O
4. Click the [Apply] button.
5. Click the [Close] button.

3.6.5 LED

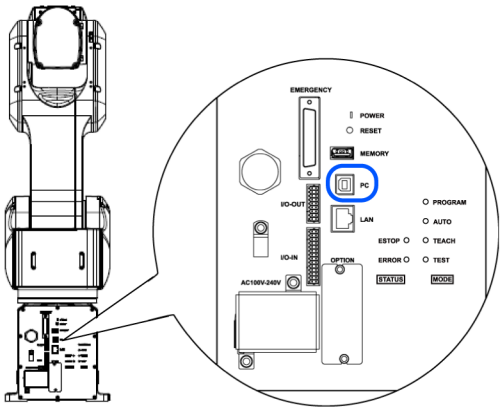
Six LEDs are located on the Manipulator.

LEDs (ERROR, E-STOP, TEACH, TEST, AUTO, PROGRAM) turn ON according to the Controller status (error, Emergency Stop, TEACH mode, Auto mode, Program mode).



Controller status	LED display
Saving the Controller state to the USB memory device	TEST, TEACH, AUTO, and PROGRAM blink
Start up (Required time is different depending on the connection status of the device.)	1. TEST, TEACH, AUTO, and PROGRAM blink (for 15 seconds) 2. All turn OFF (10 seconds) 3. All turn ON (to 10 seconds) 4. All turn OFF (10 to 30 seconds) 5. Either of TEACH, AUTO, or PROGRAM turns ON
Complete Controller status storage to USB memory	TEACH, AUTO, PROGRAM turn ON (for 2 seconds). ERROR turns OFF even if an error occurs.
Failed to save Controller state to the USB memory device	ERROR, TEACH, AUTO, PROGRAM turn ON (for 2 seconds).
Error state	ERROR turns ON
Warning state	ERROR blinks
Emergency stop state	E-STOP turns ON
TEACH mode	TEACH blinks
Auto mode (AUTO mode)	AUTO blinks
Program mode (AUTO mode)	PROGRAM blinks
Power supply drop	TEACH, AUTO turn ON
TEST mode	TEST blinks

3.7 Development PC Connection Port



KEY POINTS

- For other details on the connection between the development PC and the Manipulator, refer to the following.
  "Epson RC+ User's Guide - [PC and Controller Communications] (Setup Menu)"
- Be sure to install the Epson RC+ to the development PC first, then connect the development PC and Manipulator with the USB cable.
  If the Manipulator and the development PC are connected without installing the Epson RC+ to the development PC, [Add New Hardware Wizard] appears. If this wizard appears, click the [Cancel] button.

3.7.1 What is Development PC Connection USB Port?

Connect the Manipulator and development PC with a USB cable to enable development of the robot system and setting of the Manipulator 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 Manipulator are turned on. However, the Manipulator stops when the USB cable is removed while the Manipulator and the development PC are connected.

3.7.2 Notes

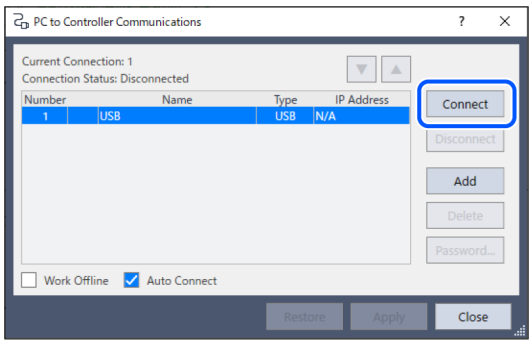
Pay attention to the following points when connecting the development PC and the Manipulator.

- Connect the development PC and the Manipulator using a USB cable with a length of 5 meters or less, 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 Manipulator are connected, do not connect or disconnect other USB devices from the development PC. This could cause the Manipulator to disconnect.

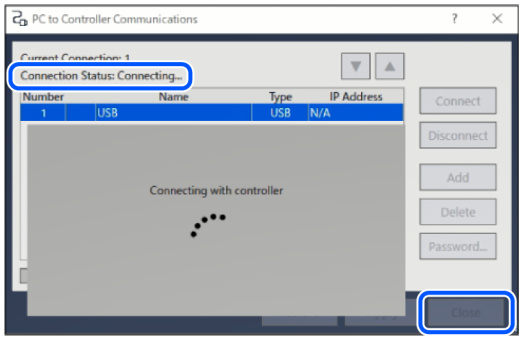
3.7.3 Software Setup and Connection Check

This section explains the procedure for connecting the development PC and the Manipulator.

1. Make sure that the Epson RC+ software is installed on the development PC connected to the Manipulator.
   If it is not installed, refer to the following to install.
   "Epson RC+ User's Guide"
2. Connect the development PC and the Manipulator by a USB cable.
3. Turn ON the Manipulator.
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.



6. Select the “No.1 USB” and click the [Connect] button.
7. After connection of the development PC and the Manipulator is completed, "Connected" is displayed in [Connection Status]. Make sure that “Connected” is displayed and click the [Close] button to close the [PC to Controller Communications] dialog.



Connection of the development PC and the Manipulator is completed. The robot system can now be used from Epson RC+.

3.7.4 Disconnection of Development PC and Manipulator

This section explains the procedure for disconnecting the development PC and the Manipulator.

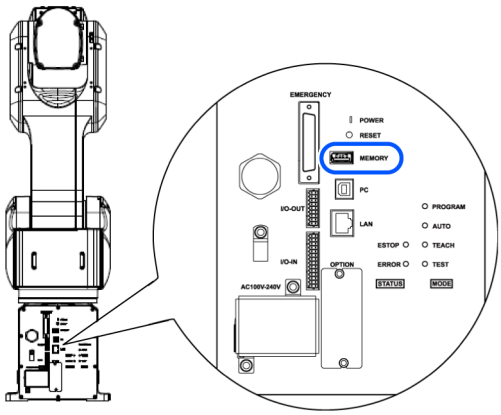
1. From the Epson RC+ menu, select [Setup] - [PC to Controller Communications] to display the [PC to Controller Communications] dialog box.
2. Click the [Disconnect] button. After the [Disconnect] button is clicked, the Manipulator and the development PC are disconnected, and the USB cable can be removed.

KEY POINTS

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

3.8 Memory Port

Connect a commercial USB memory to the Manipulator memory port to use the Controller status storage function to the USB memory.



3.8.1 What is Controller Status Storage Function?

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

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

It cannot execute status storage to USB memory when operating the Manipulator.

3.8.2 Before Using Controller Status Storage Function

3.8.2.1 Notes

⚠ CAUTION

Regardless of the Manipulator status, the Controller Backup function can be executed at any time after the Manipulator 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 Manipulator and communication with Epson RC+. Other than only when it is necessary, do not execute this function when operating the Manipulator.

- 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 Manipulator. Operation is not guaranteed when there is a cable or hub between the Manipulator 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 Manipulator.

3.8.2.2 Supported USB Memory Devices

Use a USB memory device that meets the following conditions:

- USB 2.0 supported
- No security features
  USB memory devices that require password entry cannot be used.
- No installation of a driver or software is necessary for Windows 8, Windows 10, Windows 11, or Linux
  (For supported operating systems for the Epson RC+, refer to Epson RC+ User's Guide.)
- FAT32 format
- 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.

3.8.3 Using the Controller Backup Function

3.8.3.1 Executing Controller Backup

⚠ CAUTION

Regardless of the Manipulator status, the Controller Backup function can be executed at any time after the Manipulator 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 Manipulator and communication with Epson RC+. Other than only when it is necessary, do not execute the backup function when operating the Manipulator.

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

1. Insert the USB memory device into the memory port.
   When the data transfer starts, the LED of TEACH, AUTO, and PROGRAM starts blinking.
   (The data transfer time varies according to the size of the project.)
2. When the Manipulator status storage is completed successfully, the LED of TEACH, AUTO, and PROGRAM are turned ON for two seconds. The LED of ERROR turns OFF even in the error status.
   If it ends in failure, the LED of ERROR, TEACH, AUTO, and PROGRAM are turned ON for two seconds.
3. Remove the USB memory from the Manipulator.

KEY POINTS

- It is recommended that the USB memory device include an LED that enables the user to check the status change.

- 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.

3.8.3.2 Load Data with Epson RC+

The following shows the procedure to load the data stored in the USB memory by Epson RC+ and display the Controller status. For details on the procedure, refer to the following manual.
"Epson RC+ User's Guide - [Controller] Command (Tools Menu)"

3.8.3.3 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-mails.
2. Make sure the USB memory has the following folders.
   "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.

3.8.4 Details of Saved Data

The following files are created by the Controller status storage function.

File Name	Outline	
Backup.txt	Information file for restoration	This file contains the information required when restoring the Manipulator.
CurrentMnp01.PRM	Robot parameter	Information such as ToolSet is saved here.
CurrentStatus.txt	Status saving data	The program status and I/O status are saved here.
ErrorHistory.csv	Error history	
InitFileSrc.txt	Default	Various settings of the Controller are saved here.
MCSys01.MCD	Robot settings	Information on connected Manipulator 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.

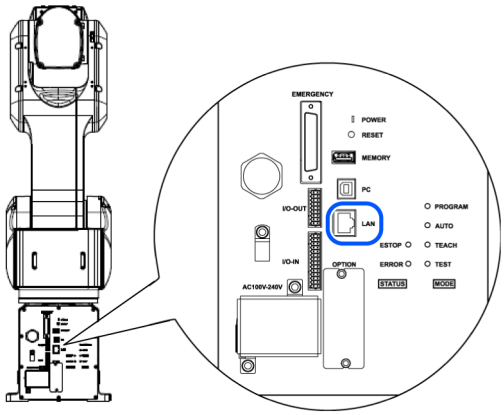
File Name	Outline	
GlobalPreserves.dat	Backup variables	The values of the backup variables (Global Preserve variables) are saved here.
WorkQueues.dat	Work queue information	Queue information from the work queue is saved here.
MCSRAM.bin MCSYSTEMIO.bin MCTABLE.bin MDATA.bin SERVOSRAM.bin VXDWORK.bin	Internal information of Manipulator	
All files related to project except project name.obj *1	Project related files	If the check box is checked off in [Include project files when status exported] in the Epson RC+ menu - [Setup]-[System Configuration]-[Controller]-[Preferences] screen, it will be saved. Program files are included.

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

3.9 LAN (Ethernet Communication) Port

KEY POINTS

- For other details on the connection between the development PC and the Manipulator, refer to the following.
  "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.
  - "Epson RC+ Help"
  - “User’s Guide -TCP/IP Communication”



3.9.1 What is a LAN (Ethernet Communication) Port?

- **Connecting to the development PC**
  This port can be used to connect the Manipulator to the development PC. This enables the same operations as when connecting the Manipulator and development PC by the dedicated development PC connection port.
  Development PC Connection Port

- **Connection with other Manipulator, Controller, or PC**
  By creating robot application software, Ethernet (TCP/IP) communication between multiple Controllers is possible.

3.9.2 IP Addresses

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

- F/W: Ver.7.4.58.x

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 therefore, a password is required to authenticate the connection.
Note that password authentication is not performed for a USB connection.

KEY POINTS

For details on the password settings, refer to the following.
"Epson RC+ User's Guide - Setting Password for PC Ethernet Controller Connection"

Use the private IP addresses in the following ranges:

Private Address List
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 Manipulator 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.

3.9.3 Changing Manipulator IP Address

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

In this section, the procedure to change the IP address when connecting the Manipulator’s development PC connection port and the development PC by the USB cable is indicated.

1. Connect the development PC by a USB cable. Connect the development PC and Manipulator.
   Reference: **Development PC Connection Port**
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 Manipulator is automatically restarted. When the Manipulator restart dialog box no longer appears, setting of the IP address is complete.

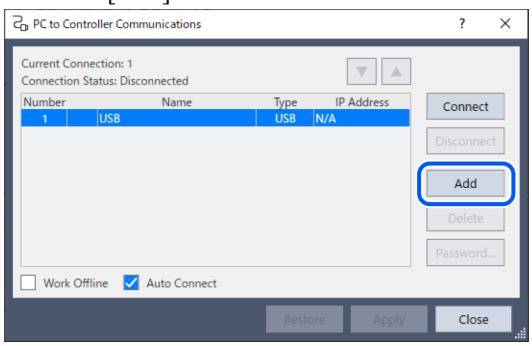
KEY POINTS

When the Manipulator and the development PC are connected via the Ethernet, the Manipulator IP address can also be changed. However, if you are connected via Ethernet, the manipulator and development PC will not be automatically reconnected after restarting the manipulator.

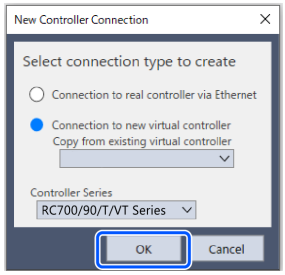
3.9.4 Ethernet Connection of Development PC and Manipulator

This section describes Ethernet connection of the development PC and Manipulator.

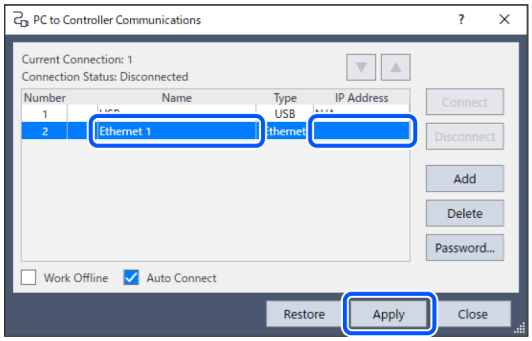
1. Connect an Ethernet cable to the development PC and Manipulator.
2. Turn ON the Manipulator.
3. Start the Epson RC+ software.
4. From the Epson RC+ menu, select [Setup] - [PC to Controller Communications] to display the [PC to Controller Communications] dialog.
5. Click the [Add] button.



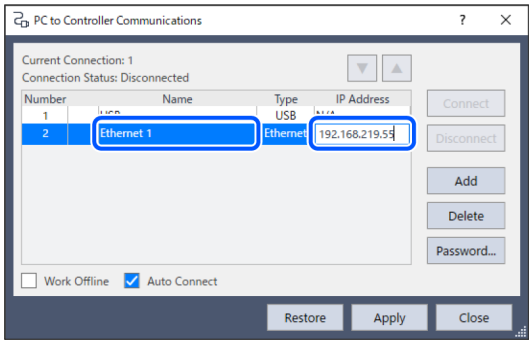
6. Perform the following settings and then click the [OK] button.
   Connection method: Connection to Controller via Ethernet
   Controller series: RC700/90/T/VT series



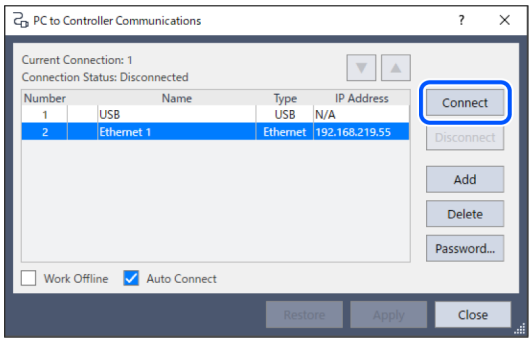
7. “No. 2” is added. Make the following settings, and click the [Apply] button.
   Name: Valid value for identifying the Manipulator to be connected
   IP Address: IP address of the Manipulator to be connected



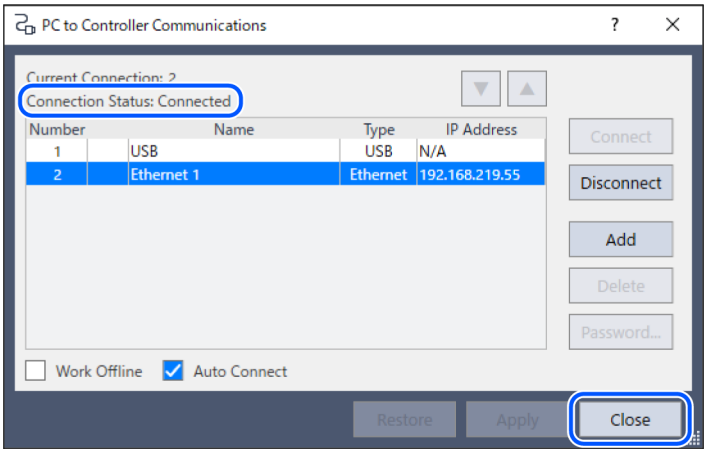
8. The [Name] and [IP Address] set in Step 7 are displayed.



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



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



Connection of the development PC and the Manipulator is completed. The robot system can now be used from Epson RC+ over an Ethernet connection.

3.9.5 Disconnection of Development PC and Manipulator with Ethernet

This section explains the procedure for disconnecting the development PC and the Manipulator.

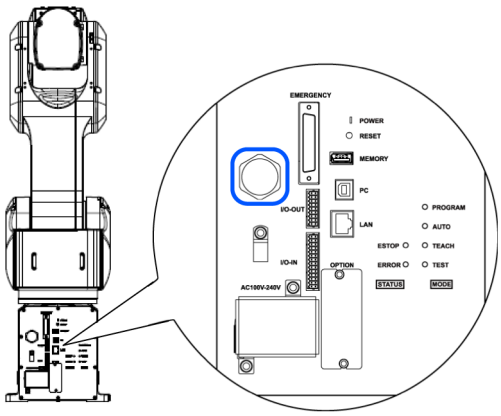
1. From the Epson RC+ menu, select [Setup] - [PC to Controller Communications] to display the [PC to Controller Communications] dialog box.
2. Click the [Disconnect] button.
   After the [Disconnect] button is clicked, the Manipulator and the development PC are disconnected, and the Ethernet cable can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

KEY POINTS

The Manipulator stops when the Ethernet cable is removed while the Manipulator and the development PC are connected. Click the [Disconnect] button in the [PC to Controller Communications] dialog box before removing the Ethernet cable.

3.10 TP Port

3.10.1 What is a TP Port?



This port is used to connect a Teach Pendant (TP2, TP4).
A dedicated conversion cable(*) is necessary when connecting TP2 to VT-B series Manipulator. Contact the supplier of your region if you only need the conversion cable.
(* TP Exchange Cable: R12NZ900L6)

KEY POINTS

- If nothing is connected to the TP port, the Manipulator enters an emergency stop state. When not connecting a Teach Pendant, connect the TP bypass plug.
- Store the removed TP in place so that it can be distinguished from the TP connected to the Controller.
- Do not connect the devices except TP bypass plug, TP2 and TP4 to the TP port. The different signal arrangement could cause a breakdown in the device.

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

3.10.2 Connecting a Teach Pendant

The Teach Pendants come with a dedicated cable. Connect the connector of this cable to the TP port.

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

- Plug the Teach Pendant connector into the Manipulator, and turn on the Manipulator.
- With the Manipulator turned on, plug in the Teach Pendant connector.

⚠ WARNING

- 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.

KEY POINTS

- The Teach Pendant can be connected and disconnected while the Manipulator power is turned on.
- When the Teach Pendant connector is disconnected from the Manipulator while the Teach Pendant mode selector key switch 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."
- To switch mode from TEACH to AUTO, a latch release is required.
- 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 Manipulator and the disconnected Teach Pendant in separate locations.

For more information on Teach Pendants, refer to the following manuals.
"Robot Controller Option Teach Pendant TP2"
"Robot Controller Option Teach Pendant TP4"

3.11 Options

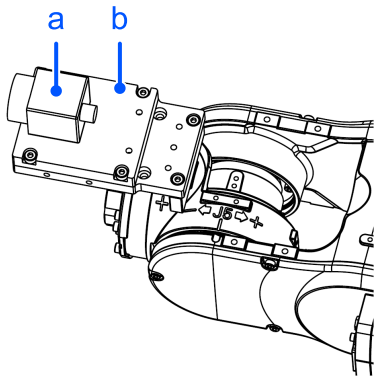
The VT6-B series Manipulator has the following options.

- **Camera Plate Unit**
- **Variable Mechanical Stop**
- **External Wiring Kit**

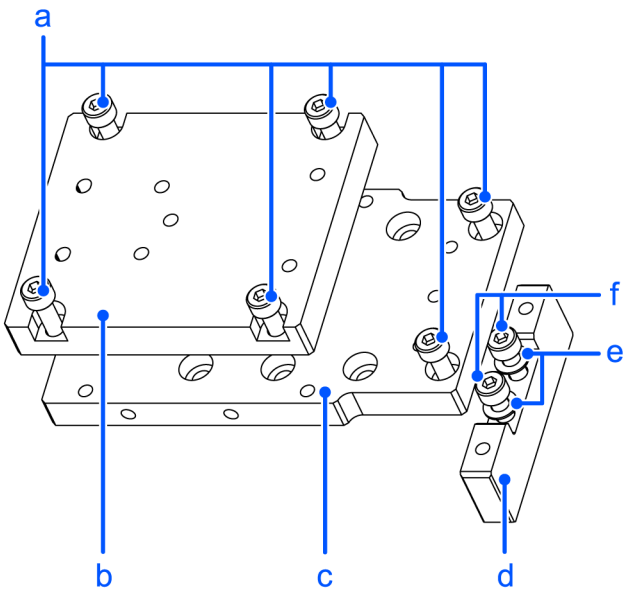
3.11.1 Camera Plate Unit

To mount a camera to the VT-B series Manipulator, you need to mount the camera plate unit first.

Appearance of arm end with camera



Symbol	Description
a	Camera
b	Camera Plate Unit



Parts Included		Qty.
a	Hexagon socket head cap bolt M4×12	6
b	Camera adapter plate	1
c	Camera mid plate	1
d	Camera base plate	1
e	Plain washer for M4 (small washer)	2
f	Hexagon socket head cap bolt M4×20	2

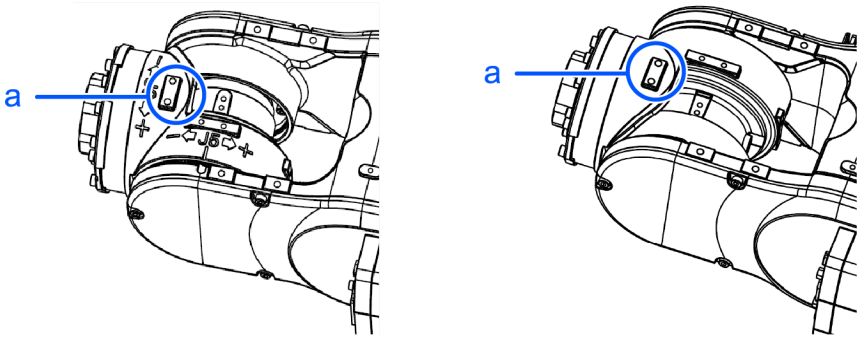
Installation

KEY POINTS

For details of tightening the hexagon socket head cap bolt, refer to the following section.

Tightening the Hexagon Socket Head Cap Bolts

1. Mount the camera base plate to the Manipulator.
   2×M4×20+Plain washer for M4 (small washer)



Symbol	Description
a	Mounting holes for the camera base plate

2. Mount the camera mid plate to the base plate.
   2×M4×12

> **KEY POINTS**
>
> The motion range and dimension of the Manipulator with the camera installed may vary depending on the mounting hole of camera mid plate. The details are described in the table below.

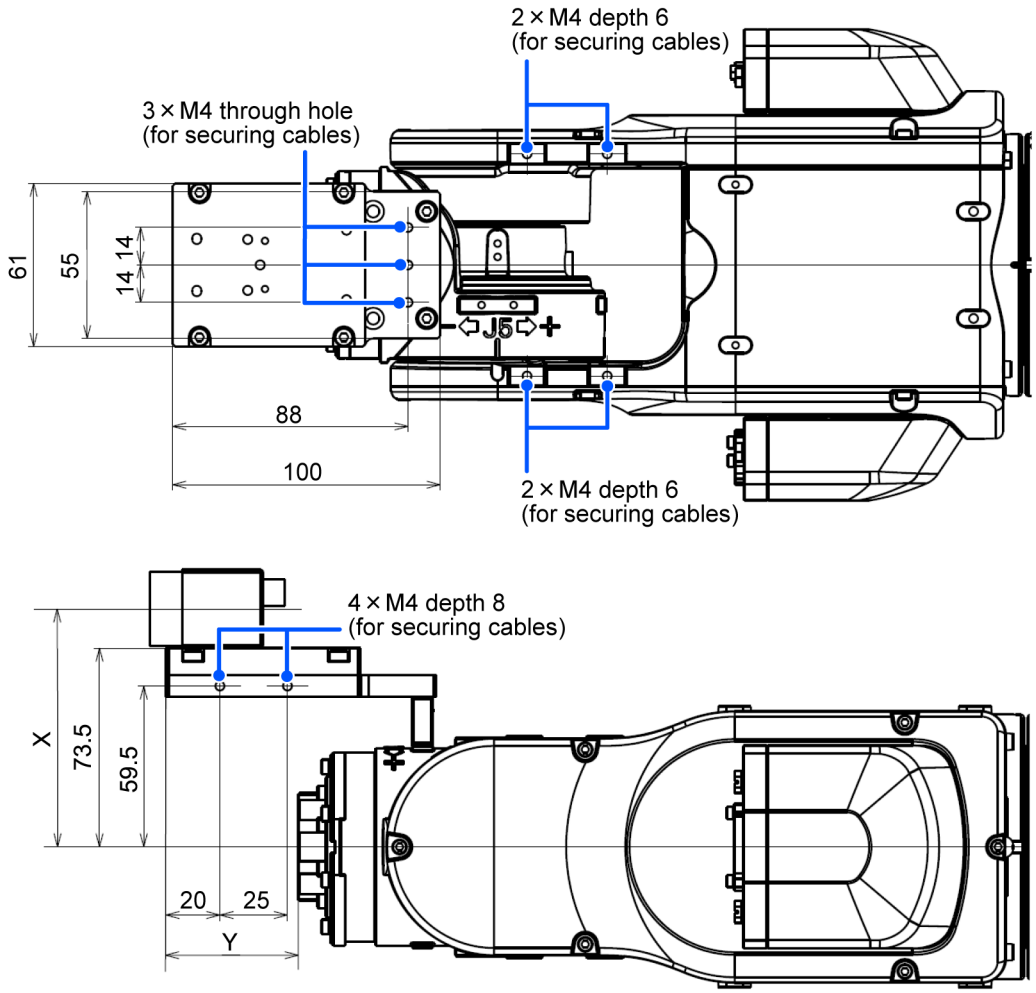
3. Mount the camera to the camera adapter plate.

> **KEY POINTS**
>
> According to the camera, the available mounting hole of adapter plate will be different. The details are described below.

4. Mount the camera adapter plate and camera to the camera mid plate.
   4×M4×12
5. Secure the cables at the position where they do not interfere with the Manipulator motion.

> **KEY POINTS**
>
> When securing the cables, check if the cables bend radius is big enough and the cables are not rubbing against each other while the Manipulator moves. Otherwise, the cables will be disconnected.

Dimension of the camera plate unit

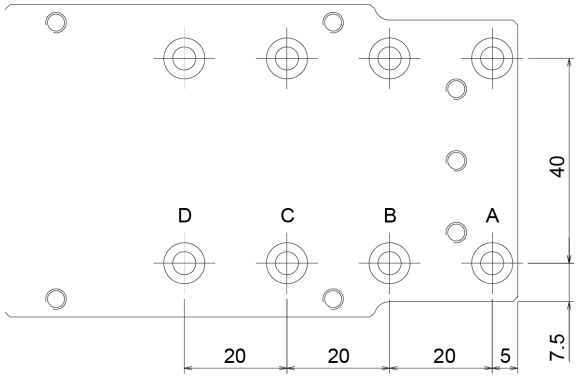


Dimensions X and Y will change depending on the position of camera mid plate and camera size. Refer to the table below for the values.

Camera mid plate

The camera mid plate uses the mounting holes A to D.

By using the different mounting holes, it can be mounted to the camera base plate in the different four positions.

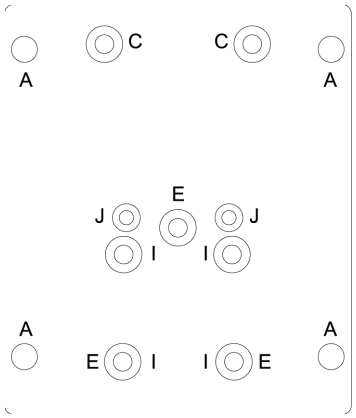


Camera adapter plate

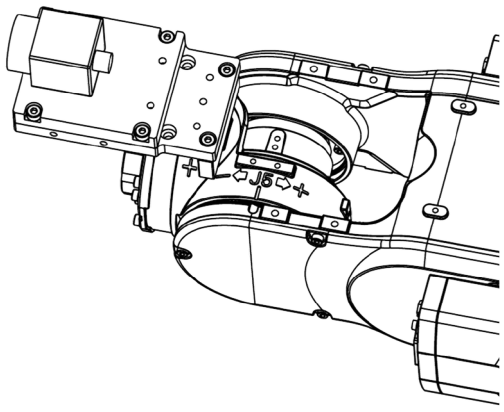
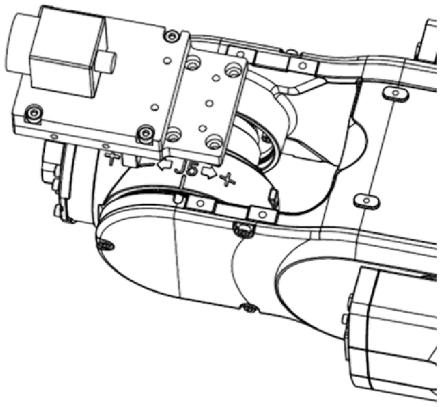
Each camera uses the different mounting holes.

- USB camera: J (2)

- GigE camera: E (3)



Mounting example

Using the mounting hole A	Using the mounting hole C
	

E.g.) Camera: XC-ES30

Camera and Joint #5 motion range (reference values)

The Joint #5 motion range varies depending on the mounting position of camera mid plate and the camera you are using.

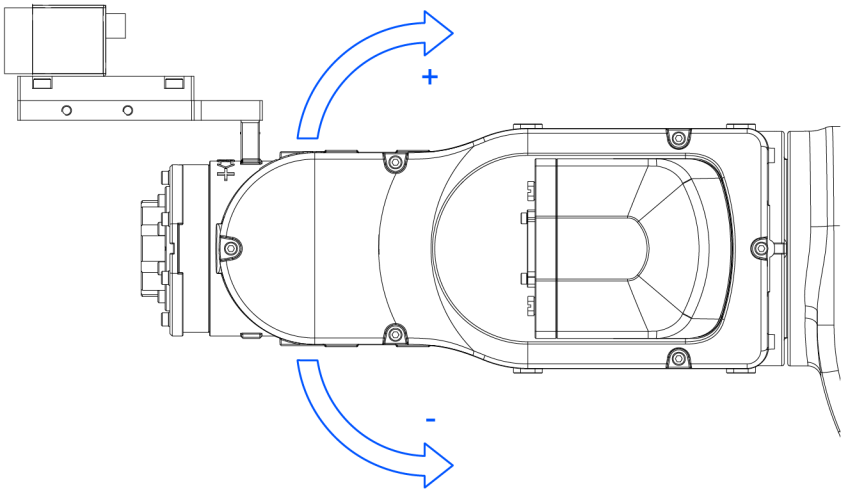
The table below shows the motion range (reference values) based on the available cameras for this option and the mounting positions of the camera mid plate. The values in the table may vary depending on how to secure the cables.

By changing the Y position, you can extend the distance from the hand mounting surface to the camera. Also, you can attach the larger end effector. However, be careful about the Joint #5 motion range that will be limited in this case.

USB Camera, GigE Camera	A	B	C	D	X
VT6-B series (Top surface mounting)	-135°～+60°	-135°～+50°	-135°～+40°	-135°～+35°	88 mm
VT6-B series (Bottom surface mounting)	-60°～+135°	-50°～+135°	-40°～+135°	-35°～+135°	88 mm

Y	A	B	C	D
VT6-B series	43 mm	23 mm	3 mm	-17 mm

Direction of the Joint #5 motion



3.11.2 Variable Mechanical Stop

This option is used to mechanically limit the motion range of the Manipulator.

For installation and angle restriction measures, refer to the following.
Setting the Work Envelope by Mechanical Stops

KEY POINTS

For details on tightening the hexagon socket head cap bolt, refer to the following section.
Tightening the Hexagon Socket Head Cap Bolts

Standard mounting products will be reused as the fixing bolts for J2 and J3. Make sure not to lose them once they are removed.

****Variable Mechanical Stop (J1)**

Parts Included	Qty.
Variable Mechanical Stop (J1)	1
Hexagon socket head cap bolt M8×10	1
Plain washer M8	2

****Variable Mechanical Stop (J2)**

Parts Included	Qty.
Variable Mechanical Stop (J2)	1

****Variable Mechanical Stop (J3)**

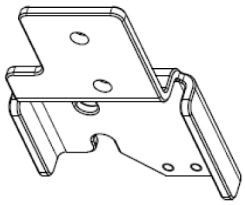
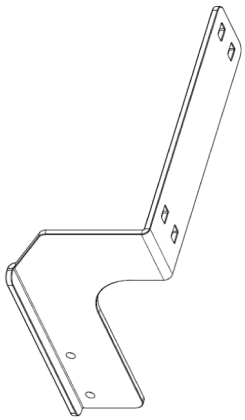
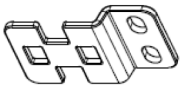
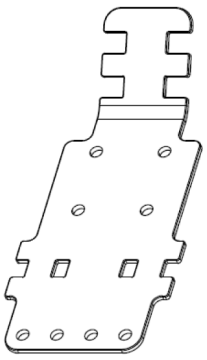
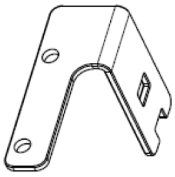
Parts Included	Qty.
Variable Mechanical Stop (J3)	1

3.11.3 External Wiring Kit

Using the external wiring kit, you can fix the wirings and pneumatic tubes for the hand along with the Manipulator. The external wiring kit can be used to select the cable fixing plate, according to your Manipulator’s operation condition.

For details of tightening the hexagon socket head cap bolt, refer to the following section.

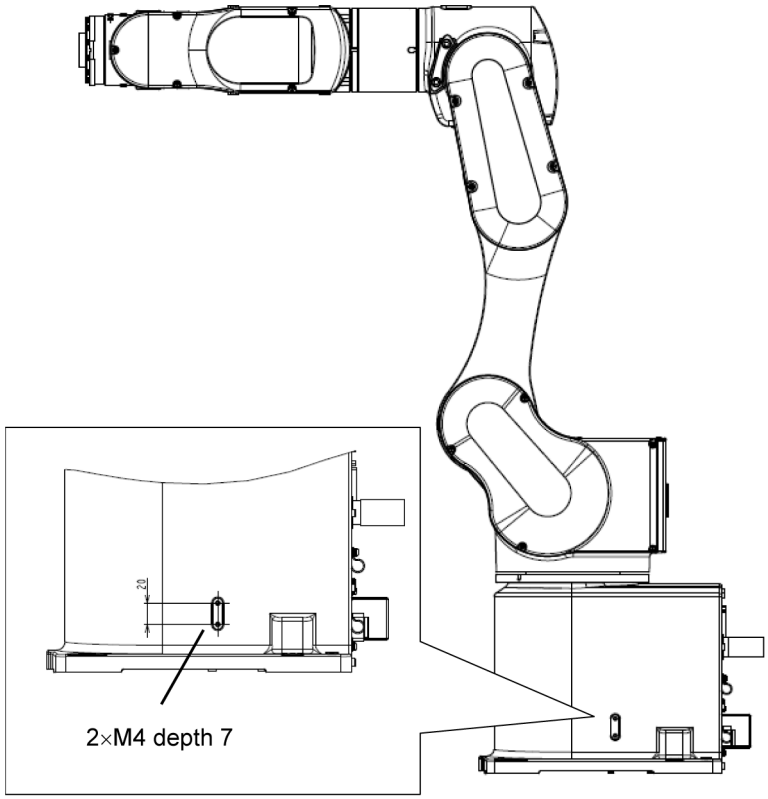
Tightening the Hexagon Socket Head Cap Bolts

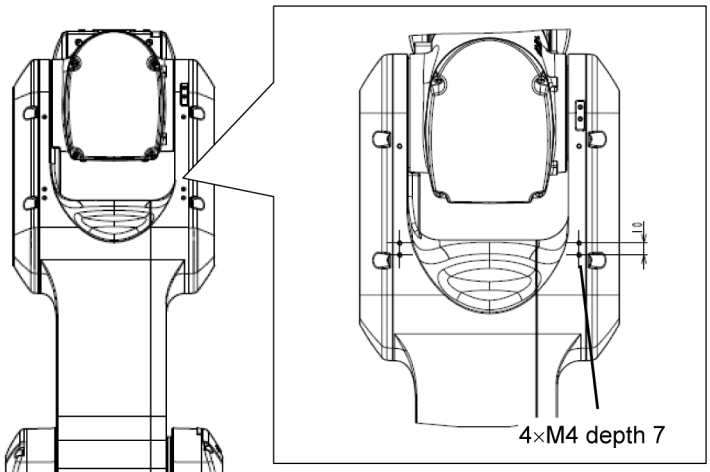
Parts Included		Qty.
Cable fixing plate	For the Base 	1
	For Arm #1 	1
	For Arm #2 	1
	For Arm #3 	1
	For Arm #4 	1
Wire tie		8
Cable protection sheet		7
Hexagon spacer		4

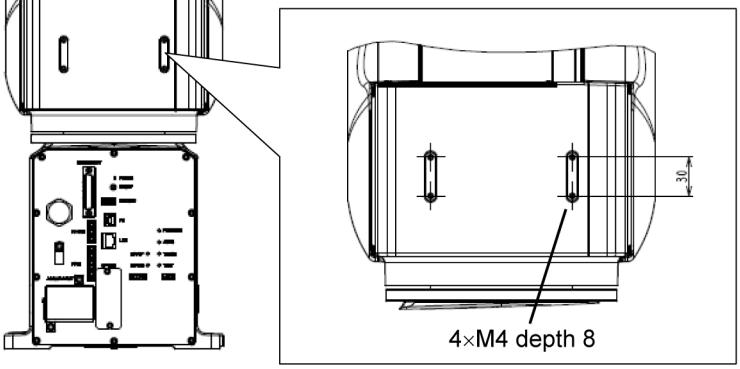
Parts Included	Qty.
Hexagon socket head cap bolt M4×8	12

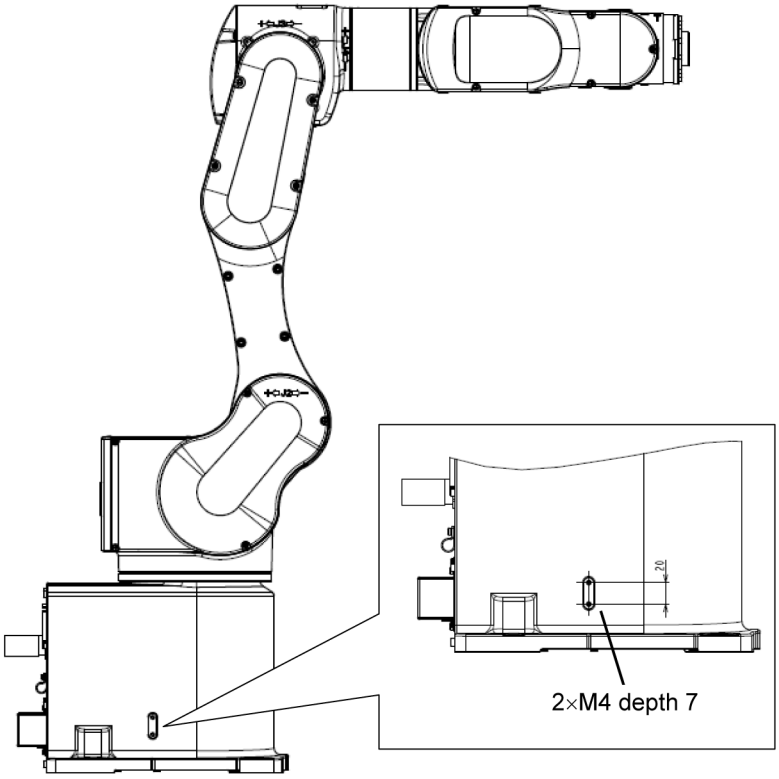
Location for cable fixing plates

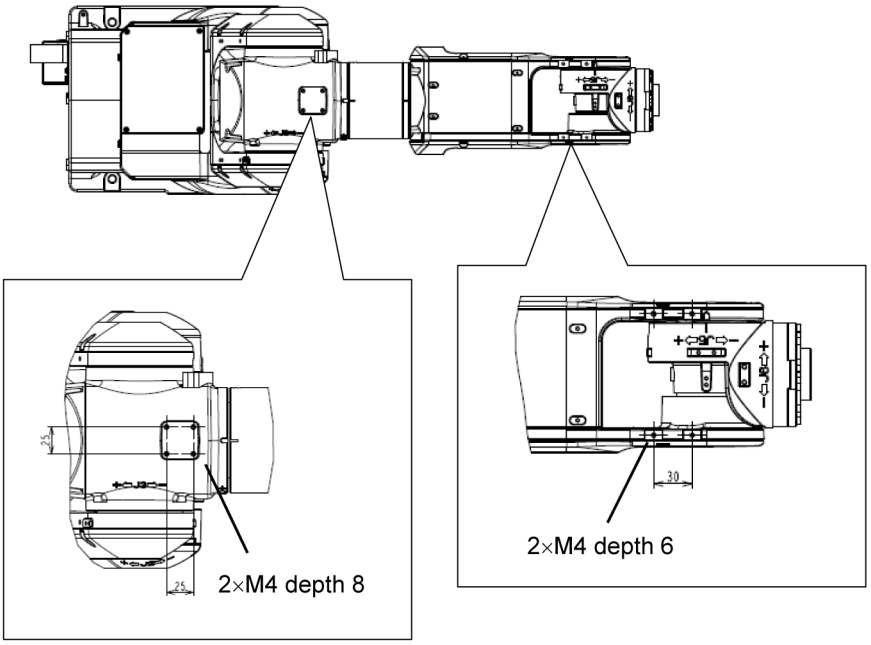
There are two mounting positions for the base on both sides. Use each cable fixing plate to select the location suitable for the cable routing according to your Manipulator's operation condition.




10
4×M4 depth 7


30
4×M4 depth 8

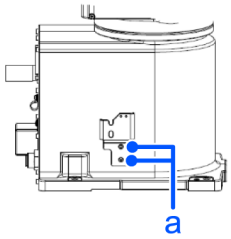

20
2×M4 depth 7



How to mount the cable fixing plates

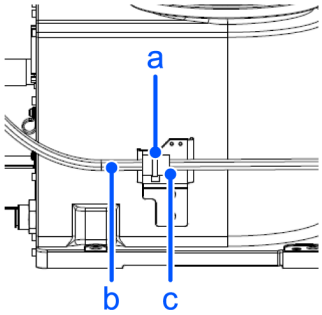
For the Base

1. Mount the cable fixing plate on your Manipulator.



Hexagon socket head cap bolt (a) 2-M 4×8

2. Put the wire tie (a) through the cutout and the slotted hole for fixing the cables on the cable fixing plate. Then, bind the cables (b) with the cable tie over the cable protection sheet (c).

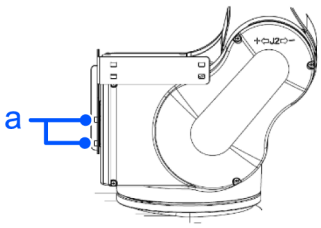


KEY POINTS

When binding the cables, be sure to make extra length so that the cables will not be tight while each joint operates and the bending radius is within the specifications of the cable.

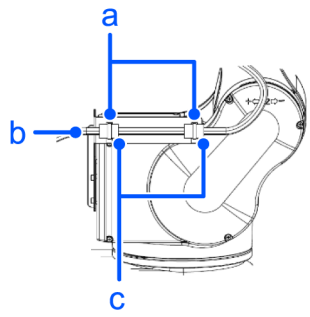
Plate for Arm #1

1. Mount the cable fixing plate on your Manipulator.



Hexagon socket head cap bolt (a): 2-M4× 8
Tightening torque: 4.0 ± 0.2 N·m

2. Put the cable tie (a) through the slotted holes (2×2 locations) for fixing cables on the cable fixing plate. Then, bind the cables (b) with the cable tie over the cable protection sheet (c).



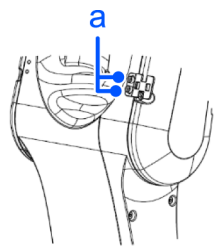
KEY POINTS

When binding the cables, be sure to make extra length so that the cables will not be tight while each joint operates and the bending radius is within the specifications of the cable.

Plate for Arm #2

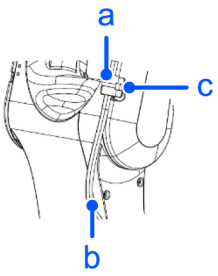
Installation

1. Mount the cable fixing plate on your Manipulator.



Hexagon socket head cap bolt (a): 2-M4× 8
Tightening torque: 4.0 ± 0.2 N·m

2. Put the cable tie (a) through the two slotted holes for fixing the cables on the cable fixing plate. Then, bind the cables (b) with the cable tie over the cable protection sheet (c).

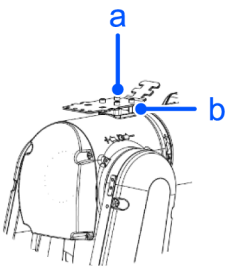


KEY POINTS

When binding the cables, be sure to make extra length so that the cables will not be tight while each joint operates and the bending radius is within the specifications of the cable.

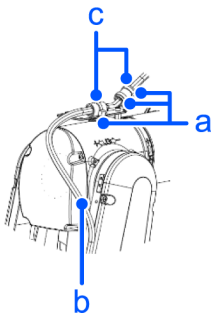
Plate for Arm #3

1. Mount the cable fixing plate and the hexagon spacer (b) on your Manipulator.



Hexagon socket head cap bolt (a): 2-M 4×8
Tightening torque: 4.0 ± 0.2 N·m

2. Put the cable tie (a) through the cutout for fixing the cables on the cable fixing plate. Then, bind the cables (b) with the cable tie over the cable protection sheet (c). After binding the cables, use the cutout on the front to bind the cables (b) with the cable tie (a) over the cable protection sheet (c).

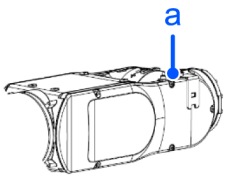


KEY POINTS

When binding the cables, be sure to make extra length so that the cables will not be tight while each joint operates and the bending radius is within the specifications of the cable.

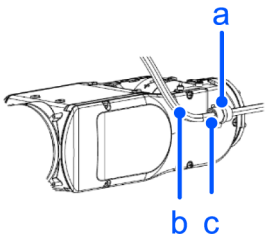
Plate for Arm #4

1. Mount the cable fixing plate on your Manipulator.



Hexagon socket head cap bolt (a): 2-M 4×8
Tightening torque: 4.0 ± 0.2 N·m

2. Put the cable tie (a) through the two cutouts for fixing cables on the cable fixing plate. Then, bind the cables (b) with the cable tie over the cable protection sheet (c).



KEY POINTS

When binding the cables, be sure to make extra length so that the cables will not be tight while each joint operates and the bending radius is within the specifications of the cable.

3.12 EMERGENCY connector

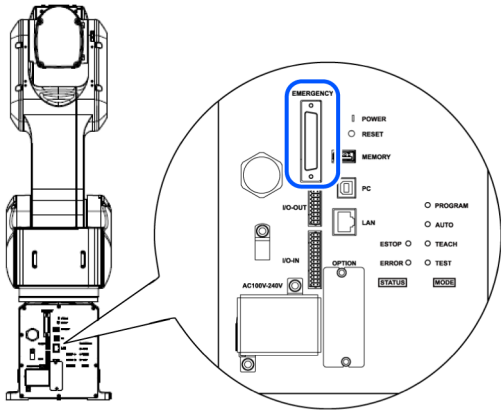
CAUTION

- 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 options are added, or parts are replaced for maintenance.
- 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.

KEY POINTS

For details on safety items related to this section, refer to the following.
"Epson RC+ User's Guide - Safety"
Read together with this manual to ensure safety.

Connect a safeguard switch or Emergency Stop switch to the EMERGENCY connector for safety.
When nothing is connected to the EMERGENCY connector, the robot system does not operate normally.



3.12.1 Connection Between the Safeguard Switch and the Latch Release Switch

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

Connector Name	Type
EMERGENCY connector (Manipulator side)	D-Sub 25 pin female (cable side) D-Sub 25 pin male (board side)

* The E-STOP BOX, EMERGENCY connector cable, terminal block, and EMERGENCY connector kit are available as options.

3.12.1.1 Safeguard Switch

⚠ WARNING

The interlock of the safeguard must be functioning when the robot system is operated. Do not operate the system under the condition that the switch cannot be turned ON/OFF (e.g. The tape is put around the switch.).

In order to maintain a safe working zone, a safeguard must be set up around the Manipulator and have an interlock switch at the entrance of the working zone. The “safeguard” that is described in this manual is one of the safeguards and an interlock of the safeguard is called the safeguard switch.

Make sure to connect the safeguard switch to the safeguard input terminal on the EMERGENCY connector. The safeguard switch has safety features such as temporary hold-up of the program or the operation-prohibited status that are activated whenever the Safeguard is opened.

Observe the following in designing the safeguard switch and the safeguard.

- For the Safeguard switch, select a switch that opens as the safeguard opens, and not by the spring of the switch itself.
- Two safeguard inputs are available. If the signals at the two inputs differ by two seconds or more, the system recognizes it to be an error caused by some kind of abnormality in the input circuit. Therefore, safeguard switches with two contacts should be used, and each contact should be connected to the two safeguard inputs.
- Make sure to design the safeguard to prevent the door from closing accidentally.

3.12.1.2 Latch Release Switch

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

Latch release open: The safeguard open state and TEACH mode state are latched.
Latch release closed: 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.

3.12.1.3 Checking the switch function

After the safeguard switch and latch release switch is connected to the EMERGENCY connector, be sure to use the following procedure to check the function of the switch to ensure safety before operating the Manipulator.

1. While the safeguard is open, turn on the power to start up the Manipulator.
2. Make sure that "Safety" is displayed on the status bar on the screen.
3. Close the safeguard and turn on the switch connected to the latch release input.

Make sure that "Safety" no longer appears on the status bar.

KEY POINTS

Controller activation may fail when the safeguard switch is input during the initialization immediately after turning ON the controller. In this case, delay the input timing of the safeguard switch.

The information that the safeguard is open can be latched by software based on the latch release input condition. To cancel the latched condition, close the safeguard, and then close the safeguard latch release input.
Latch release input open : The latch release switch latches the condition that the safeguard is open.
Latch release input closed : The latch release switch does not latch the condition that the safeguard is open.

KEY POINTS

The latch release input also serves as a latch release input to confirm the change from the TEACH mode. In order to change from the TEACH mode, turn the mode selector key switch on the Teach Pendant to “Auto”. Then, close the latch release input.

3.12.2 Connecting an Emergency Stop Switch

3.12.2.1 Emergency Stop Switch

When adding an external Emergency Stop switch in addition to the Emergency Stop on the Teach Pendant, be sure to connect the Emergency Stop switch to the Emergency Stop input terminal on the EMERGENCY connector.

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

Two circuits are available for the emergency stop input. If the signals at the two circuits differ by two seconds or more, the system recognizes it as a critical error that was caused by some kind of abnormality in the emergency stop circuit.
Therefore, make sure that the Emergency Stop switch has double contacts and refer to the following for details.
Circuit Diagram and Wiring Example

Give the emergency stop function to all the equipment which have executable token.

3.12.2.2 Emergency Stop Switch Function Check

After the emergency stop switch is connected to the EMERGENCY 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, turn on the manipulator and start it up.
2. Make sure that E-STOP LED of the Manipulator is on.
3. Make sure that “EStop” is displayed on the status bar on the main window.
4. Release the emergency stop switch.
5. Execute the RESET command.
6. Make sure that E-STOP LED is turned OFF and that “EStop” is dimmed on the main window status bar.

3.12.2.3 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

3.12.3 Signal Arrangement

The EMERGENCY connector (D-Sub 25 pin male) signal arrangement are as follows:

Pin Number	Signal Name	Function	Pin Number	Signal Name	Function
1	ESW11	Emergency Stop switch contact (1)*\ 3	14	ESW21	Emergency Stop switch contact (2)*\ 3
2	ESW12	Emergency Stop switch contact (1)*\ 3	15	ESW22	Emergency Stop switch contact (2)*\ 3
3	ESTOP1+	Emergency Stop circuit 1+\ *4	16	ESTOP2+	Emergency Stop circuit 2+\ *4
4	ESTOP1-	Emergency Stop circuit 1- *\ 4	17	ESTOP2-	Emergency Stop circuit 2- *\ 4

Pin Number	Signal Name	Function	Pin Number	Signal Name	Function
5	Not used	*1	18	SDLATCH1	Safeguard latch release
6	Not used	*1	19	SDLATCH2	Safeguard latch release
7	SD11	Safety input 1 *\ 2	20	SD21	Safety input 2 *\ 2
8	SD12	Safety input 1 *\ 2	21	SD22	Safety input 2 *\ 2
9	24V	24V output	22	24V	24V output
10	24V	24V output	23	24V	24V output
11	24VGND	24V GND output	24	24VGND	24V GND output
12	24VGND	24V GND output	25	24VGND	24V GND output
13	Not used	*1			

*1 Do not connect anything to these pins.
*2 An error occurs if the timing of the input of safeguard input 1 and safeguard input 2 differ by two seconds or more. Connect a switch having two identical contacts.
*3 An error occurs if the timing of the input of the emergency stop switch input 1 and emergency stop switch input 2 differ by two seconds or more. Connect a switch having two identical contacts.
*4 Do not apply reverse voltage to the emergency stop input circuit.

Circuit	Voltage	Pin
Emergency stop switch output rated load	+30 V 0.3 A or under	1-2, 14-15 pin
Safeguard input voltage range Safeguard input current	+24V ±10% 10 mA / +24V input	7-8, 20-21 pin
Latch release input voltage range Latch release input current	+24V±10% 10 mA / +24V input	18-19 pin

⚠ CAUTION

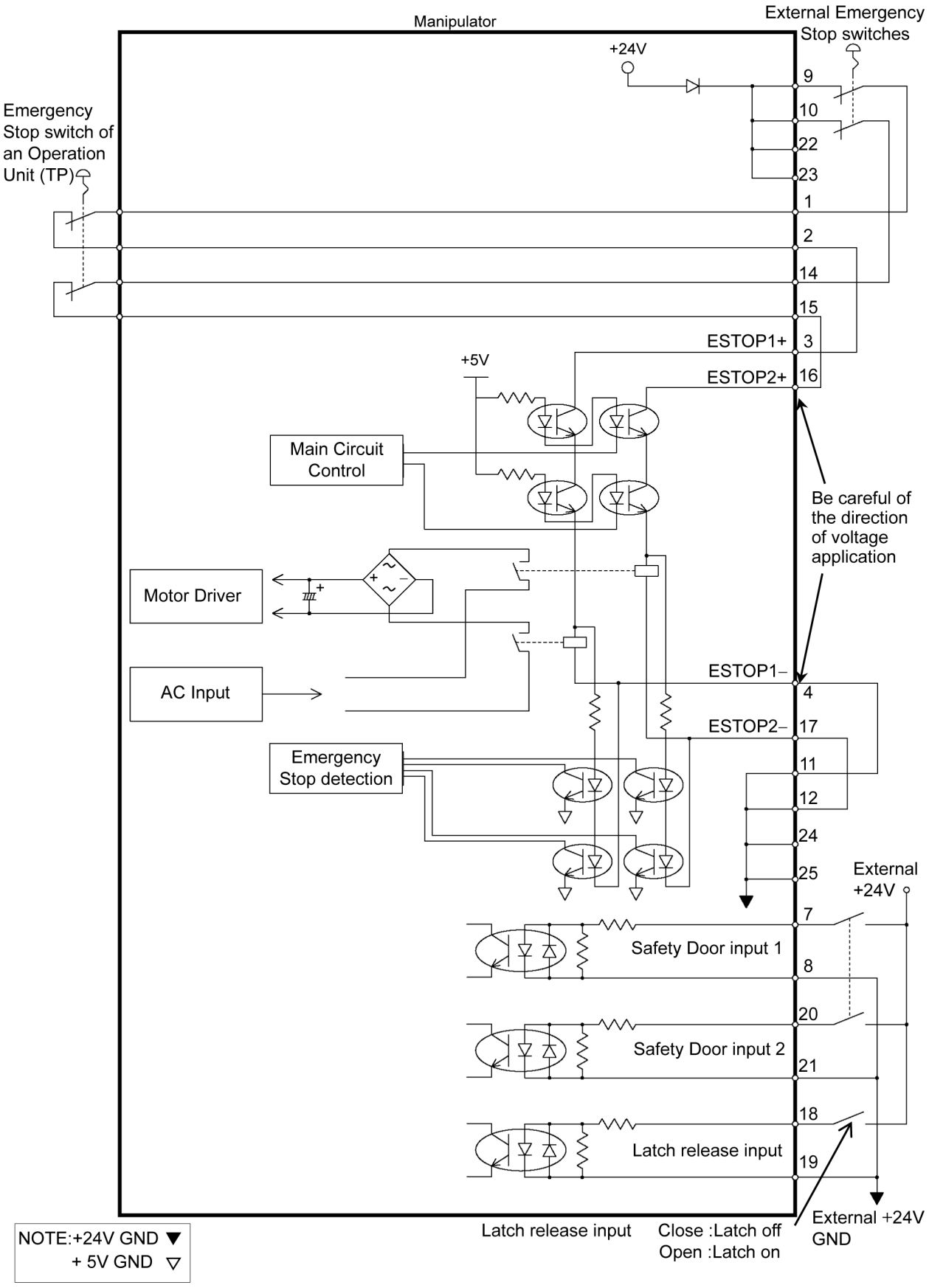
- The 24 V output is for emergency stop. Do not use it for other purposes. Doing so may result in system breakdown.
- Do not apply reverse voltage to the emergency stop circuit. Doing so may result in system breakdown.

KEY POINTS

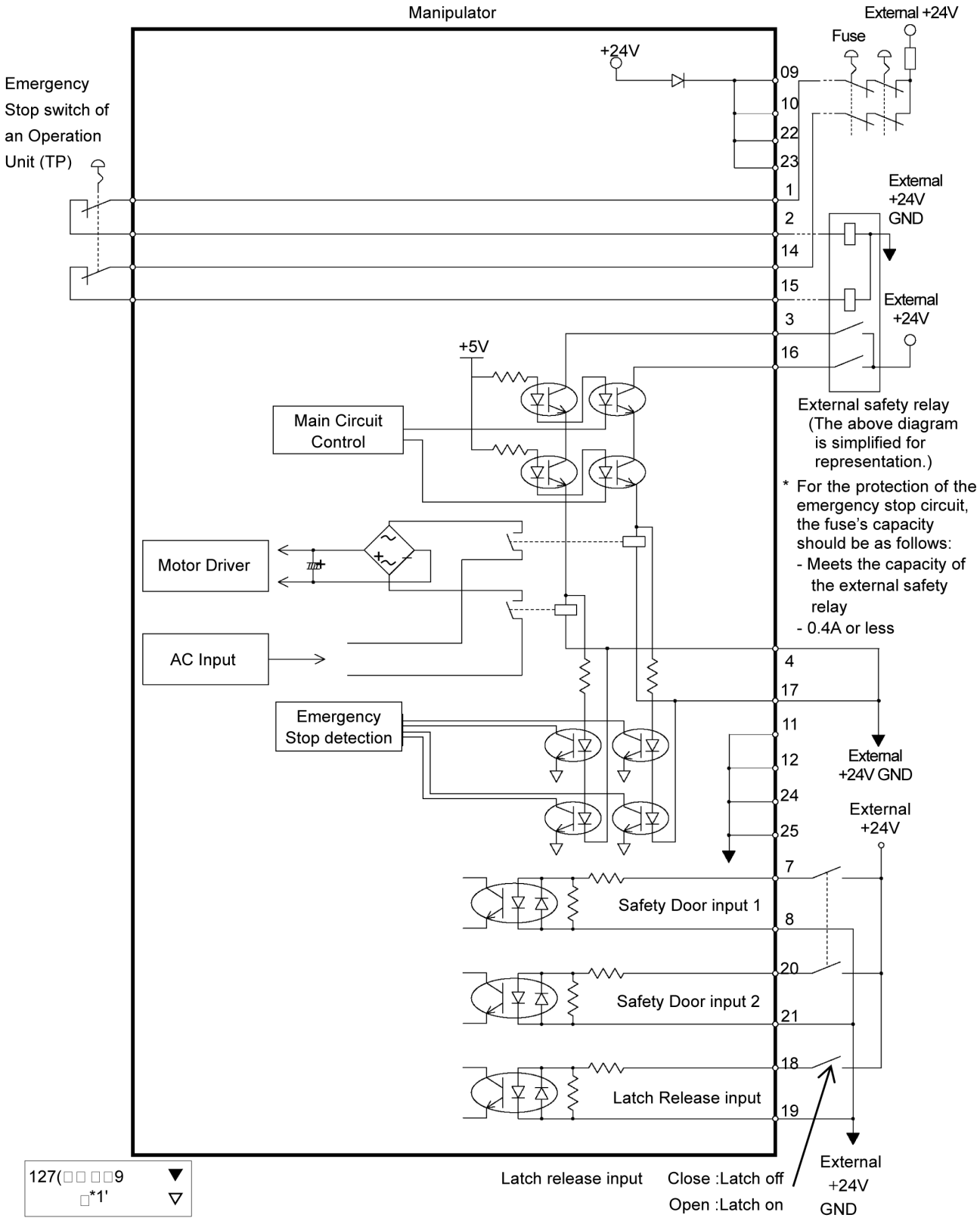
The total electrical resistance of the emergency stop switches and their circuit should not exceed 1 Ω.

3.12.4 Circuit Diagram and Wiring Example

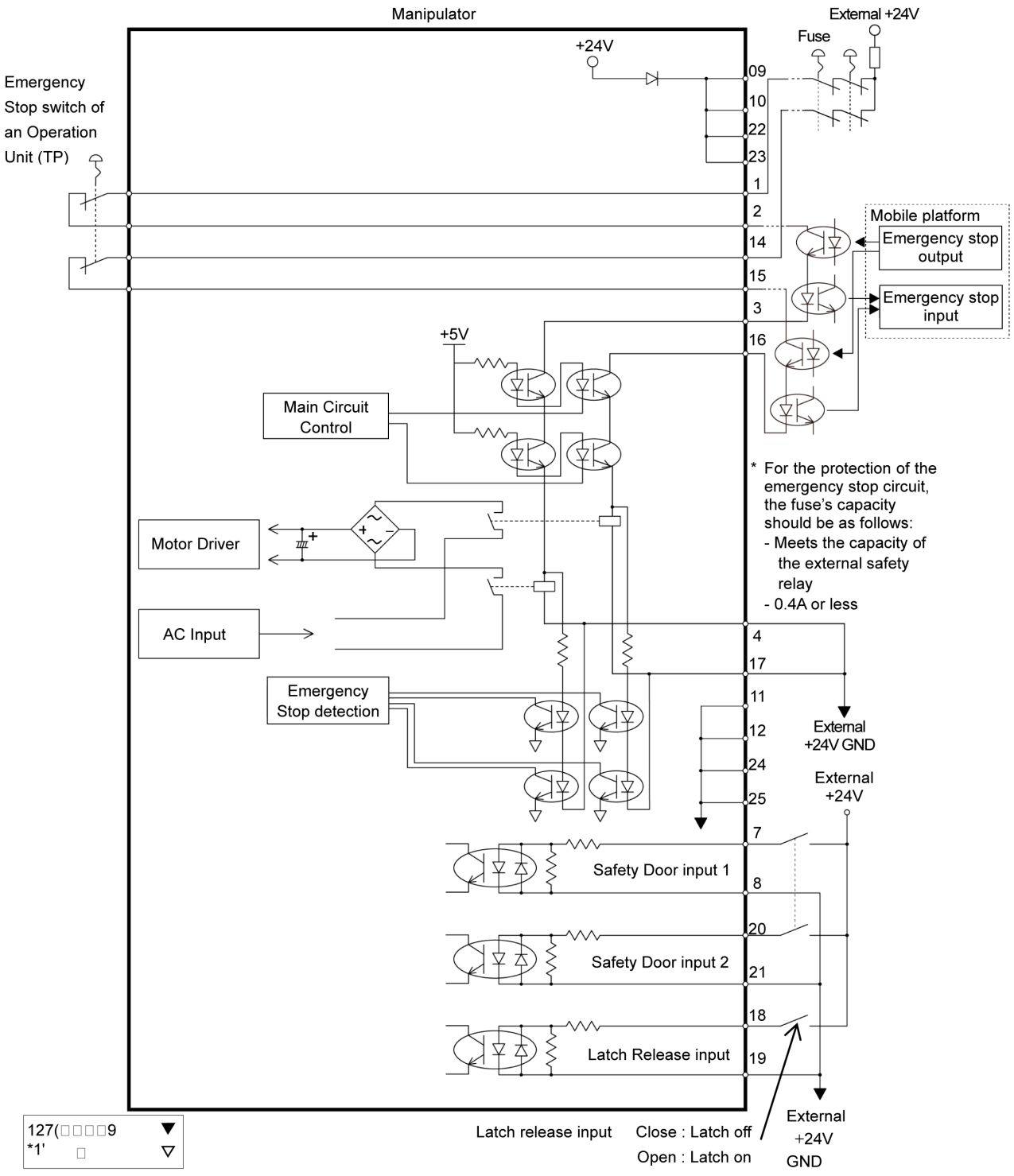
3.12.4.1 Example 1: When External Emergency Stop Switch is Connected



3.12.4.2 Example 2: When External Safety Relay is Connected



3.12.4.3 Example 3: Connection Example of Mobile Platform and Emergency Stop



3.13 Standard I/O Connector

> ⚠ CAUTION
>
> Be careful not to exceed rated current range or rated current which are defined in the manual.
> If it exceeds the rated current range, the Manipulator may not operate at all.

Standard I/O Connector is a connector mounted on the rear side of the Manipulator for connecting the user's input/output equipment to the system.

Connector Name	Point	Bit number
I/O (Input) Connector	24	0-23
I/O (Output) Connector	16	0-15

When wiring, refer to the following section to prevent noise.
Key Points for Noise Reduction

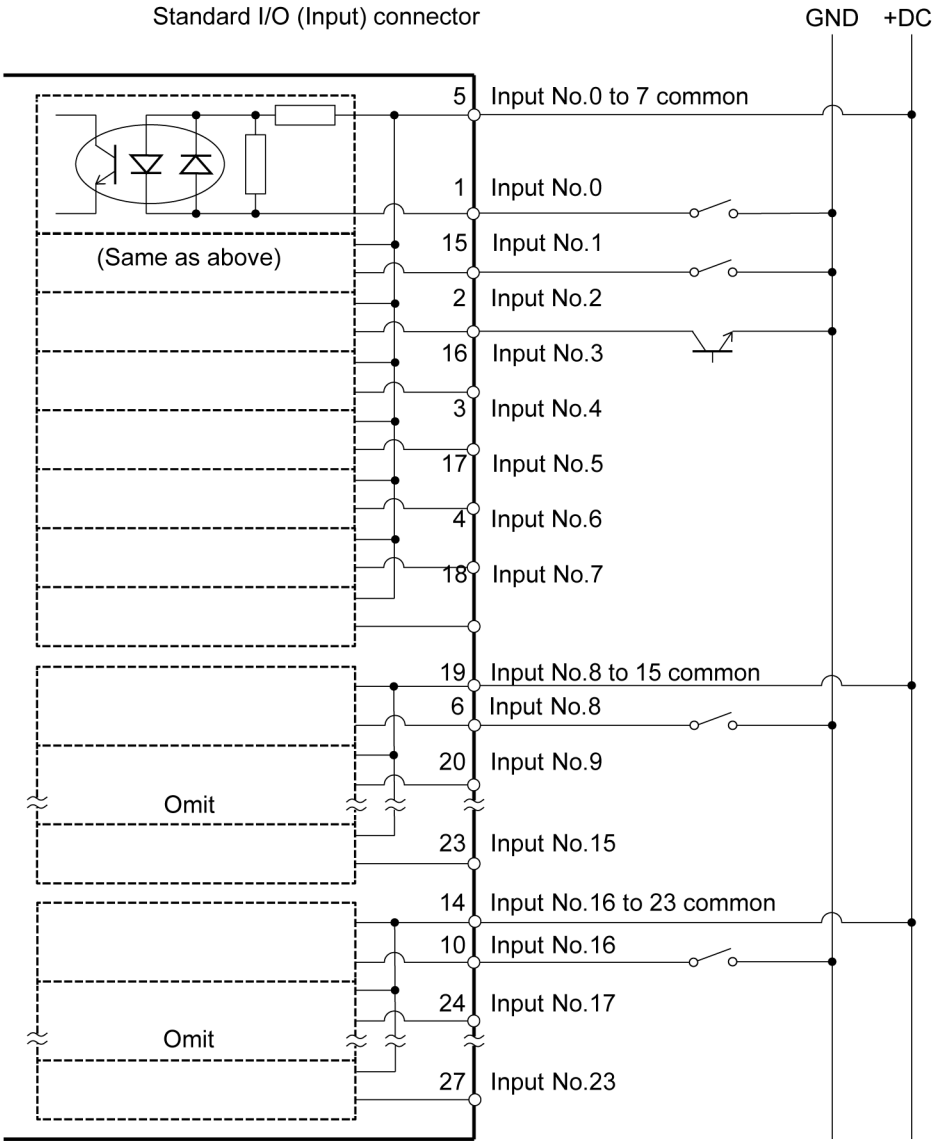
By default, remote functions are assigned to the I/O of input bit numbers 0 to 7 and output bit numbers 0 to 8.
For details, refer to the following.
I/O Remote Settings

3.13.1 Input Circuit

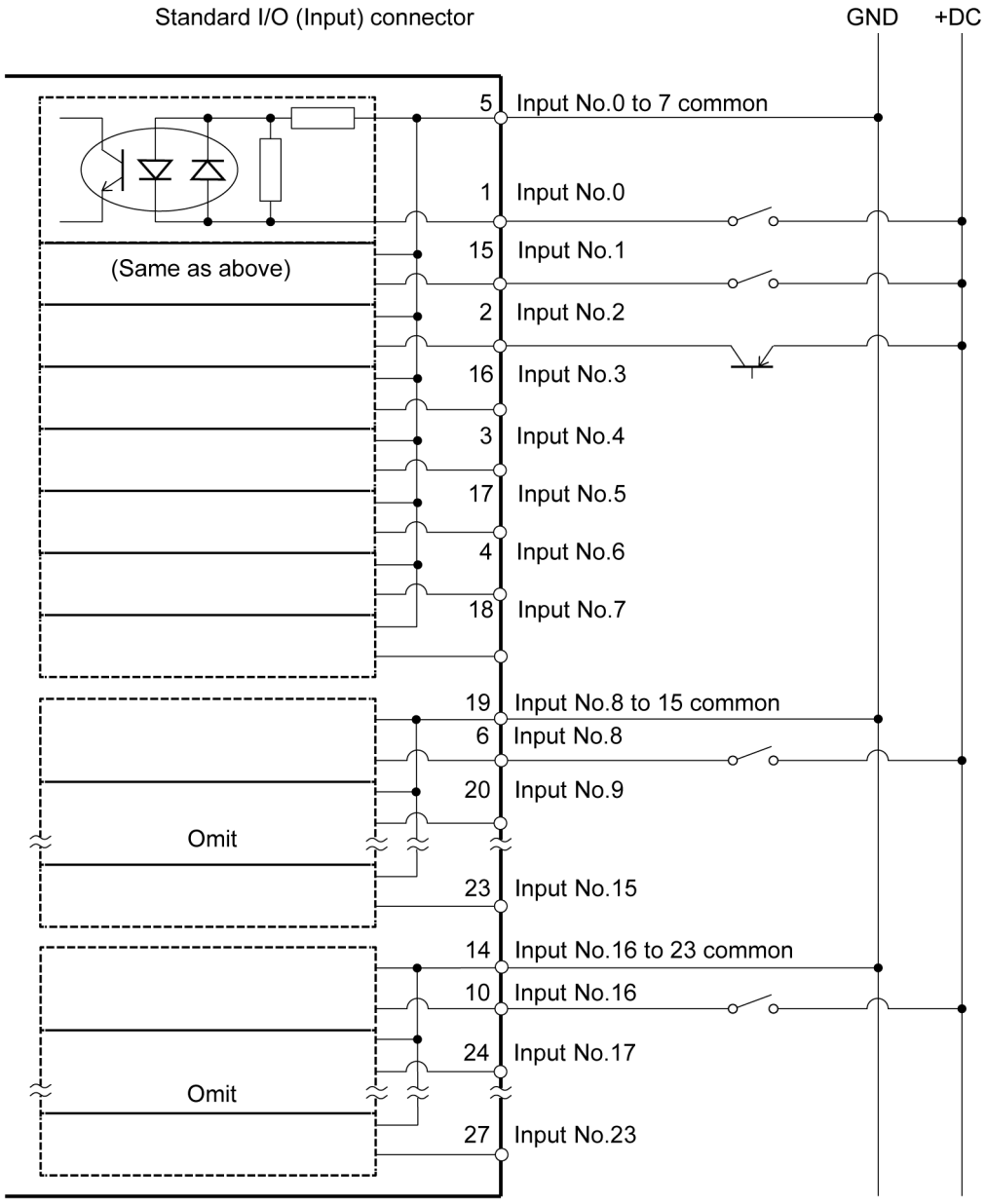
Input Voltage Range:+ 12 to 24 V ±10%
ON Voltage: + 10.8 V (MIN.)
OFF Voltage: + 5 V (MAX.)
Input Current: 10 mA / + 24V input

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

Input Circuit Diagram and Wiring Example 1



Input Circuit Diagram and Wiring Example 2



Pin Arrangements of Input Circuit

Pin Number	Signal Name	Pin Number	Signal Name
1	Input No. 0 (Start)	15	Input No. 1 (SelProg1)
2	Input No. 2 (SelProg2)	16	Input No. 3 (SelProg4)
3	Input No. 4 (Stop)	17	Input No. 5 (Pause)
4	Input No. 6 (Continue)	18	Input No. 7 (Reset)
5	Input common No. 0 to 7	19	Input common No. 8 to 15
6	Input No. 8	20	Input No. 9
7	Input No. 10	21	Input No. 11
8	Input No. 12	22	Input No. 13
9	Input No. 14	23	Input No. 15

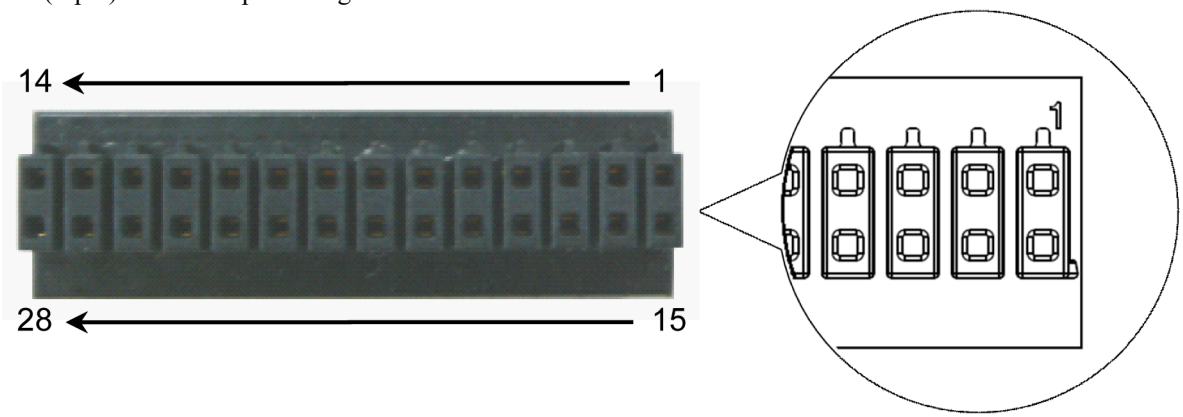
Pin Number	Signal Name	Pin Number	Signal Name
10	Input No. 16	24	Input No. 17
11	Input No. 18	25	Input No. 19
12	Input No. 20	26	Input No. 21
13	Input No. 22	27	Input No. 23
14	Input common No. 16 to 23	28	Not used

By default, the remote functions shown in parentheses ( ) are assigned to the I/O of inputs 0 to 7.
For details, refer to the following section.
I/O Remote Settings

Connector Name	Connector model
I/O (Input) Connector	DMC 0,5/14-G1-2,54 P20THR R72 (Board side) DFMC 0,5/14-ST-2,54 (Cable side) (PHOENIX CONTACT)

* I/O connector is included with shipment.

I/O (Input) Connector pin arrangement



3.13.2 Output Circuit

Rated output voltage: +12 V to 24 V ± 10 %
Maximum output current: 100 mA per output
Output device: PhotoMOS relay
ON resistance: Less than 0.7 Ω

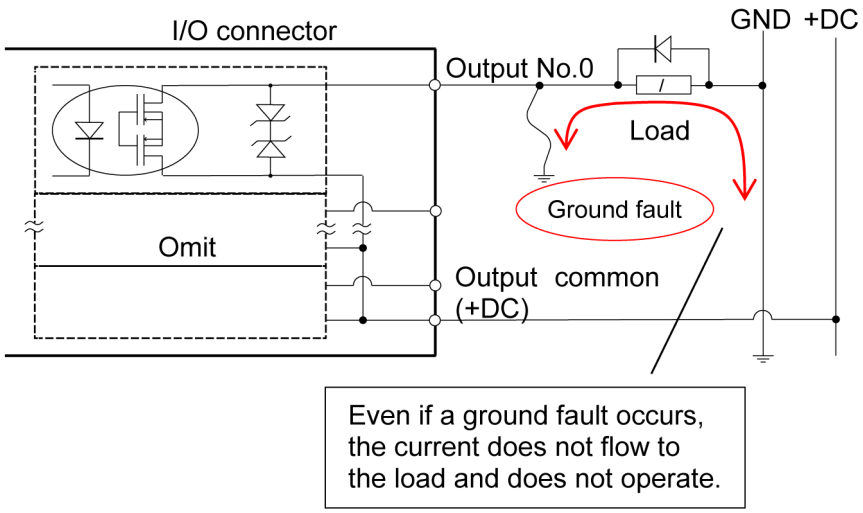
The output circuit uses a non-polarized PhotoMOS relay, which allows the following two types of wiring.

⚠ CAUTION

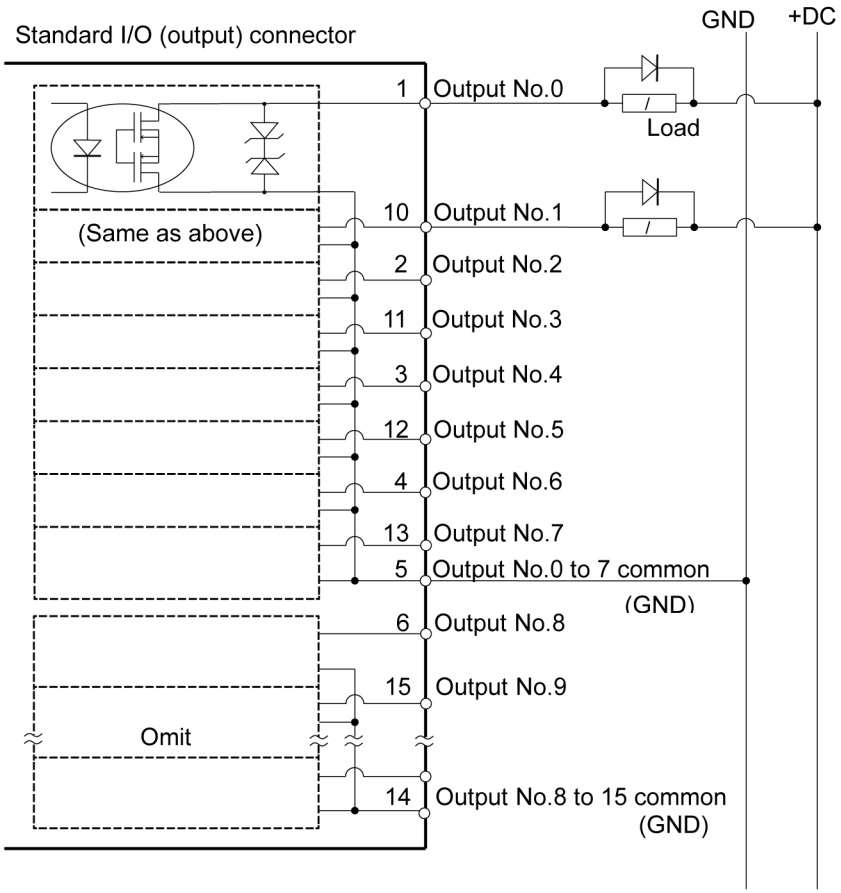
- The output circuit does not have a built-in protection circuit for short-circuit or reverse-connection. Be careful that wiring mistakes do not occur. If the wiring is performed incorrectly, components on the board may be damaged and the robot system may not function properly.

- 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.

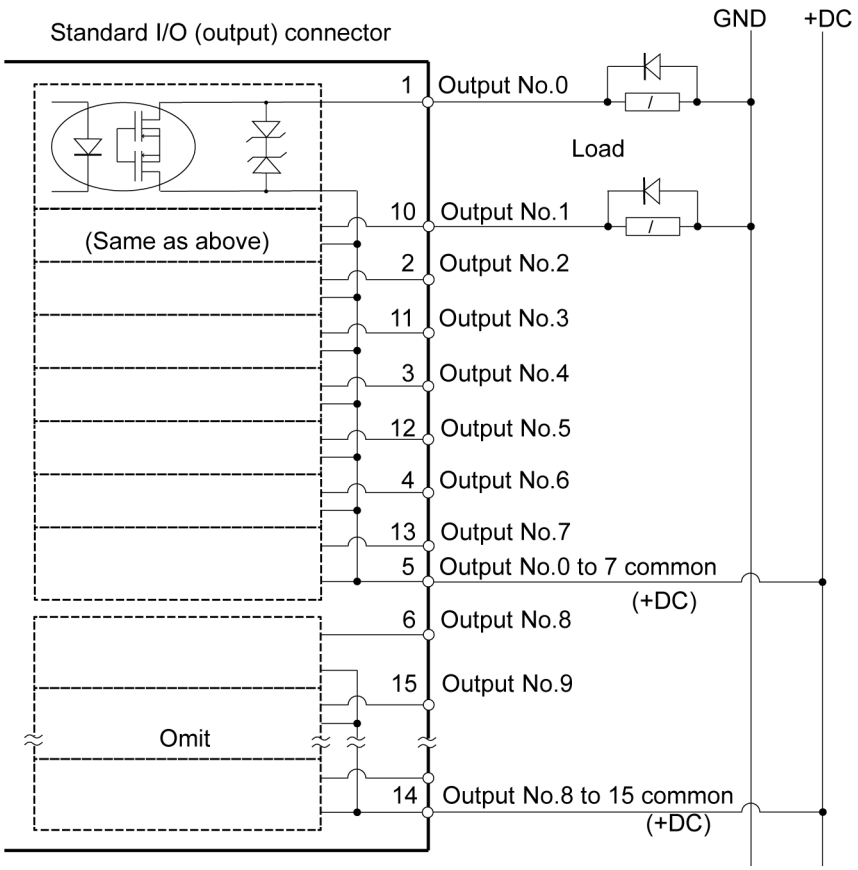
Plus common (PNP) connection



Outputs Circuit Diagram and Wiring Example 1: Sink type (NPN)



Outputs Circuit Diagram and Wiring Example 2: Source type (PNP)



Pin Number	Signal Name	Pin Number	Signal Name
1	Output No. 0 (Ready)	10	Output No. 1 (Running)
2	Output No. 2 (Paused)	11	Output No. 3 (Error)
3	Output No. 4	12	Output No. 5 (SafeguardOn)
4	Output No. 6 (SError)	13	Output No. 7 (Warning)
5	Output common No. 0 to 7	14	Output common No. 8 to 15
6	Output No. 8 (EStopOff)	15	Output No. 9
7	Output No. 10	16	Output No. 11
8	Output No. 12	17	Output No. 13
9	Output No. 14	18	Output No. 15

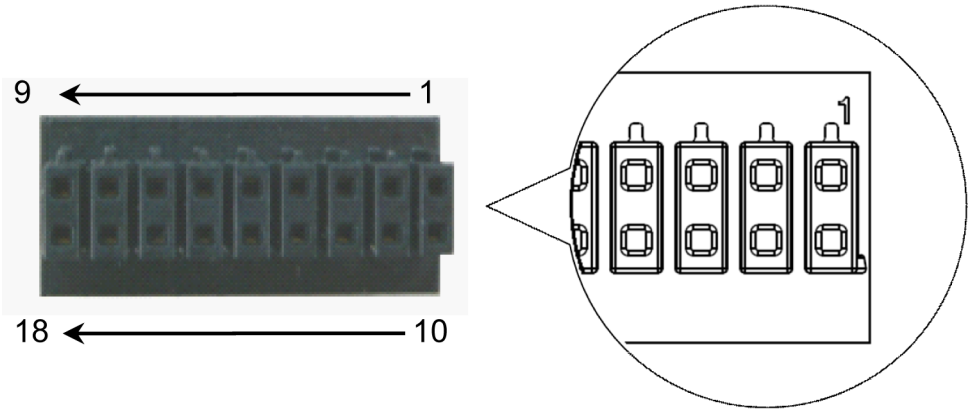
By default, the remote functions shown in parentheses ( ) are assigned to the I/O of outputs 0 to 8.
For details, refer to the following section.

I/O Remote Settings

Connector Name	Connector model
I/O (Output) Connector	DMC 0,5/9-G1-2,54 P20THR R44 (Board side) DFMC 0,5/9-ST-2,54 (Cable side) (PHOENIX CONTACT)

* I/O connector is included with shipment.

I/O (Output) Connector pin arrangement



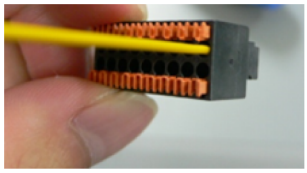
3.13.3 How to Make the I/O Cable

The following section describes the procedure to make the I/O cable that is needed to connect the user's input/output devices.

3.13.3.1 I/O Cable Connection Method

1. Prepare the I/O connector and cable which are included with shipment.
   Adaption cable
   Wire capacity: 0.14 to 0.5 mm2
   Wire type: single wire, stranded wire, stranded wire with rod terminal

2. Push the edge of the cable into the wire insertion slot.



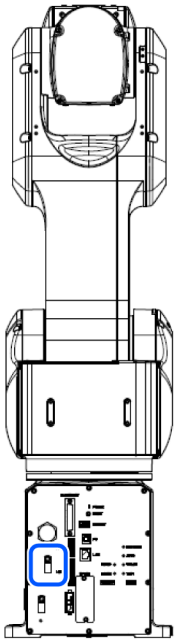
For single wire and stranded wire, peel off the covering of the cable.

KEY POINTS

- When using a stranded wire or slimmer single wire, insert it while pushing the orange colored open button.
- Be careful of the orange colored push pins because they come off easily.
- There is a cable check hole above the open button. You can check cables using a tester.

3.13.3.2 How to Fix the I/O Cable

The I/O cables can be fixed by using a cable clamp on the rear side of the Manipulator.



KEY POINTS

It becomes difficult to disconnect the wiring of I/O cables when the fixing cables are fixed with an I/O cable clamp.

3.14 I/O Remote Settings

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

By assigning remote functions to Standard I/O and Fieldbus 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.
For details on how to change the settings, refer to the following sections.
"Epson RC+ User's Guide - Remote Control"

The I/O numbers where remote functions are assigned can be changed by the user.
For details on how to change the settings, refer to the following sections.
"Epson RC+ User's Guide - Remote Control"

For details on I/O wiring, refer to the following section.
Standard I/O Connector
Fieldbus I/O

For details on connecting with external devices, refer to the following section.
"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.
- Assign remote functions to inputs/outputs correctly and wire correctly when setting up remote I/O signals.
- Be sure to check the correspondence between the functions and wiring before supplying power.
- When checking the operation, prepare for configuration or wiring errors. If the Manipulator performs an abnormal operation due to a setting or wiring error, do not hesitate to immediately stop the Manipulator 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"

3.14.1 I/O Signal Functions

By default, remote functions are assigned to the I/O of input numbers 0 to 8 and output numbers 0 to 7.
To change the function arrangements from the default settings, the settings must be made using Epson RC+.
A Fieldbus I/O board is required to output all functions.

3.14.1.1 Inputs

Remote input enables external operation of Manipulators 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) (*13)	Ready output ON Error output OFF EStopOn output OFF SafeguardOn output OFF EStopOff output ON Pause input OFF Stop input OFF
SelProg1	1	Specify the main function number to execute (*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 (*3)	Running output ON
Continue	6	Continue paused task	Paused output ON Pause input OFF Stop input OFF
Reset	7	Release emergency stop and error (*4)	Ready output ON
Shutdown	Not set	Terminates the system	
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 preferences settings Stop or pause all tasks and commands (*12)	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 the robot number to execute the command (*5)	

Function Name	Default	Description	Input Acceptance Condition (*\ 1)
SetMotorsOn	Not set	Turn ON the robot motor (*5) (*6)	Ready output ON EStopOn output OFF SafeguardOn output OFF EStopOff output ON SetMotorOff input OFF
SetMotorsOff	Not set	Turn OFF the robot motor (*5)	Ready output ON
SetPowerHigh	Not set	Set the robot power mode to High (*5)	Ready output ON EStopOn output OFF SafeguardOn output OFF EStopOff output ON SetPowerLow input OFF
SetPowerLow	Not set	Set the robot power mode to Low (*5)	Ready output ON
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
MCal	Not set	Execute MCal (*5) (*7)	Ready output ON Error output OFF EStopOn output OFF SafeguardOn output OFF EStopOff output ON MotorsOn output ON Pause input OFF Stop input OFF

Function Name	Default	Description	Input Acceptance Condition (*\ 1)
Recover	Not set	After the safeguard is closed, perform the recovery operation to the position when the safeguard is open.	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		
ResetAlarm	Not set	Cancel the alarm (*\ 11)	
SelAlarm1 SelAlarm2 SelAlarm4 SelAlarm8	Not set	Specify the alarm number to cancel (*10)	
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.	
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		

(*1) “AutoMode output ON” is not described because it is an input acceptance condition that is common to all remote input
(*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

Function Name	SelProg1	SelProg2	SelProg4	SelProg8	SelProg16	SelProg32
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) "NoPause task" and "NoEmgAbort task" do not pause. For details, refer to Epson RC+ Help or “Pause” in SPEL+ Language Reference.
(*4) This turns off I/O outputs and initializes robot parameters. For details, refer to Epson RC+ Help or “Reset” in SPEL+ Language Reference.
(*5) The values specified by the 5 bits “SelRobot1, 2, 4, 8, 16” are the robot numbers.

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
13	1	0	1	1	0
14	0	1	1	1	0
15	1	1	1	1	0
16	0	0	0	0	1

0=OFF, 1=ON
(*6) This also initializes robot parameters. For details, refer to Epson RC+ Help or “Motor” in SPEL+ Language Reference.
(*7) For details, refer to Epson RC+ Help or “MCal” in SPEL+ Language Reference.
(*8) 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.
(*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) The values specified by the 4 bits “SelAlarm1, 2, 4, 8” are the the alarm numbers.

Alarm Number	Target	SelAlarm1	SelAlarm2	SelAlarm4	SelAlarm8
1	Controller battery	1	0	0	0
2	Battery of the robot connected to CU	0	1	0	0
3	Grease of the robot connected to CU	1	1	0	0

Alarm Number	Target	SelAlarm1	SelAlarm2	SelAlarm4	SelAlarm8
4	-	0	0	1	0
5	-	1	0	1	0
6	-	0	1	1	0
7	-	1	1	1	0
8	-	0	0	0	1
9	-	1	0	0	1

0=OFF, 1=ON
Grease is applied to the following target location. 6-Axis Robots: Bevel gear at Joint #6
SCARA Robots, RS Series: Ball screw spline unit of Joint #3

(*11) The specified alarm can be canceled by selecting the conditions using SelAlarm1-SelAlarm8 and setting this signal.
(*12) This performs all tasks and commands, robot power modes, and PowerHigh command operations according to the set values in the Controller preferences.

- Preferences (1): "Low power at ForcePowerLow signal OFF"
- Preferences (2): "Pause tasks at ForcePowerLow signal change"

For details on Controller preferences, refer to the following.
“Epson RC+ User's Guide -[System Configuration] (Setup menu) [Setup]-[System Configuration]-[Controller]-[Preferences]”

Preferences (1)	Preferences (2)	ForcePowerLow Signal Change	All tasks and commands	Robot power mode	PowerHigh Commands
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
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

(*13) Do not execute 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.

3.14.1.2 Outputs

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

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.

This signal is not a safety signal. Do not use it for safety-related functions.

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. (*13)
EStopOn	Not set	OFF except in emergency stop state ON in emergency stop state OFF in Controller power off state (*11)
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. (*13)
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. (*13)
EStopOff	8	ON except in an emergency stop state OFF in emergency stop state OFF in Controller power off state
MotorsOn	Not set	ON when the robot motor is on (*5)
AtHome	Not set	ON when robots are in the home position (*5)
PowerHigh	Not set	ON when the robot is in the High power mode (*5)
MCalReqd	Not set	ON when the robot has not performed Mcal (*5)
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 that is being executed or was last executed (*1)

Function Name	Default	Description
AutoMode	Not set	ON when remote input can be accepted (*2)
TeachMode	Not set	ON when in TEACH mode
TestMode	Not set	ON when in TEST mode
EnableOn	Not set	ON when enable switch is on
ErrorCode1 . . . ErrorCode8192	Not set	Output the error number
InsideBox1 . . . InsideBox15	Not set	ON when robot is inside the entry detection area (*3)
InsidePlane1 . . . InsidePlane15	Not set	ON when robot is inside the entry detection area (*4)
Alarm	Not set	On when at least one of the alarm is occurring (*9)
Alarm1	Not set	Turns ON when a battery alarm of the Controller is on. (*12)
Alarm2	Not set	Turns ON when a battery alarm of the Manipulator connected to CU is on. (*12)
Alarm3	Not set	Turns ON when a grease alarm of the Manipulator connected to CU is on. (*10) (*12)
Alarm4	Not set	Reserved
Alarm5	Not set	Reserved
Alarm6	Not set	Reserved
Alarm7	Not set	Reserved
Alarm8	Not set	Reserved
Alarm9	Not set	Reserved
PositionX	Not set	Outputs the current X coordinate in the world coordinate system. (*6) (*7)
PositionY	Not set	Outputs the current Y coordinate in the world coordinate system. (*6) (*7)
PositionZ	Not set	Outputs the current Z coordinate in the world coordinate system. (*6) (*7)
PositionU	Not set	Outputs the current U coordinate in the world coordinate system. (*6) (*7)
PositionV	Not set	Outputs the current V coordinate in the world coordinate system. (*6) (*7)

Function Name	Default	Description
PositionW	Not set	Outputs the current W coordinate in the world coordinate system. (*6) (*7)
Torque1	Not set	Outputs the current torque value of Joint #1. (*6) (*7)
Torque2	Not set	Outputs the current torque value of Joint #2. (*6) (*7)
Torque3	Not set	Outputs the current torque value of Joint #3. (*6) (*7)
Torque4	Not set	Outputs the current torque value of Joint #4. (*6) (*7)
Torque5	Not set	Outputs the current torque value of Joint #5. (*6) (*7)
Torque6	Not set	Outputs the current torque value of Joint #6. (*6) (*7)
CPU	Not set	Outputs the CPU load ratio of the user program. (*8)
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 force control function (*5)
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	

(*1) “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
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

(*2) 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

(*3) For details, refer to the following.

- “Help”
- "Epson RC+ Language Reference - Box"

(*4) For details, refer to the following.

- “Help”
- "Epson RC+ Language Reference - Plane"

(*5) 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: All robots are selected	1~ 16: Robot number is selected
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

(*6) 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.

(*\ 7) This is output in the Real format.

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

(*9) This is turned on when any one of the controller alarm information or robot alarm information has occurred.

(*10) For details about the target that requires grease up, refer to the service manual.

(*11) 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.

(*12) The controller alarm and the output timing differed because the battery alarm and grease alarm is monitored every five minutes. It may be output up to 5 minutes after the controller alarm occurs.

“Alarm” will be on when the battery alarm or grease alarm of the Controller or Manipulator occurs when the “Robot maintenance” is enabled. For details on Robot maintenance, refer to the “Alarm” section of the maintenance manual.

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

Output Function Name	Error Number
Error	1000 to 8000s

Output Function Name	Error Number
SError	9000s
Warning	410 to 900s

For details on status numbers/error numbers, refer to the following manual.
“Status Code / Error Code List”

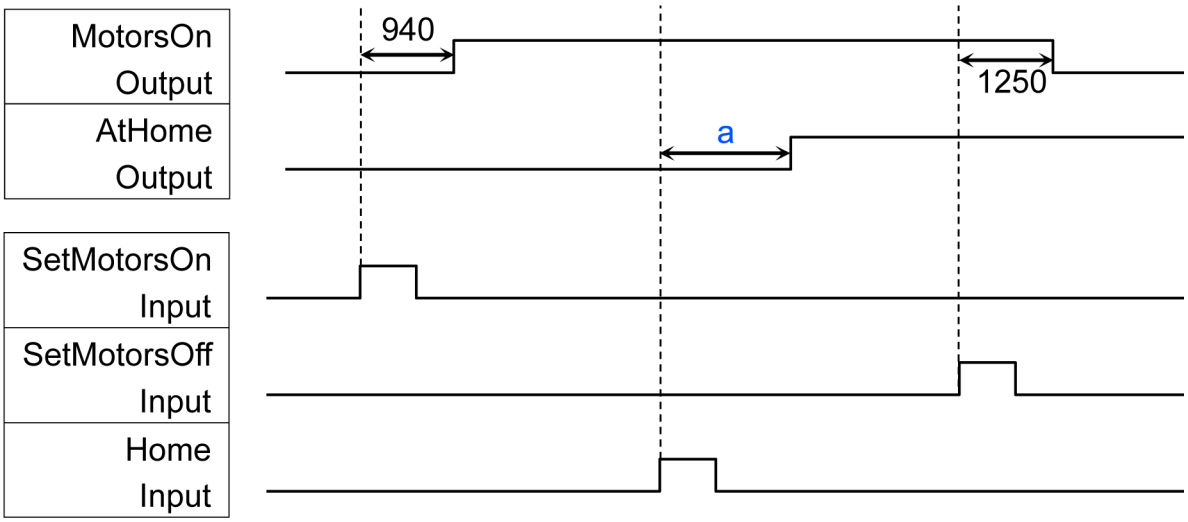
3.14.2 Timing Charts

3.14.2.1 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 Manipulator'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 ms, and input with chattering should be avoided.

3.14.2.2 Timing for Operation Execution Sequence

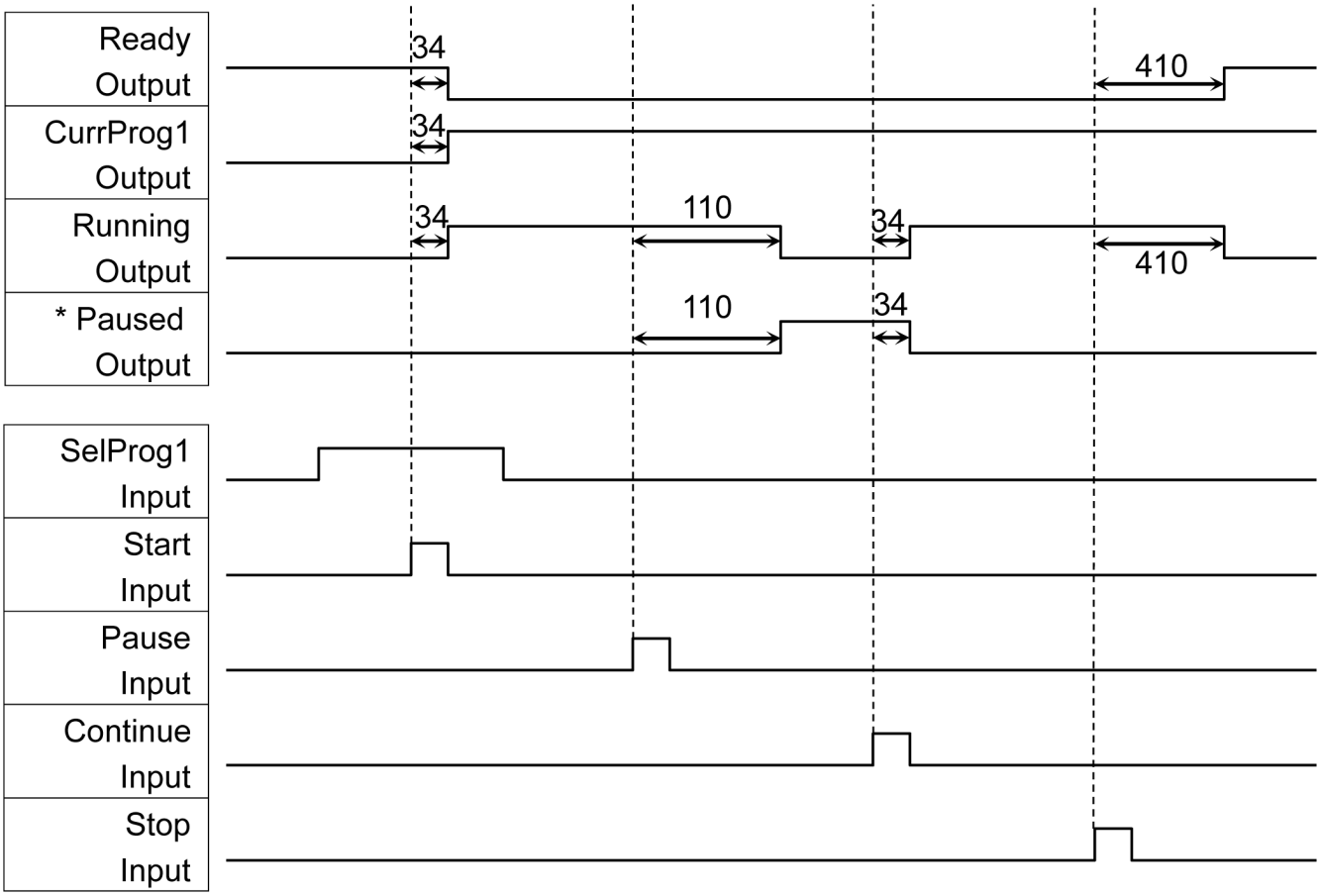
[Unit: ms]



Symbol	Description
a	Due to the Home operation command

3.14.2.3 Timing for Program Execution Sequence

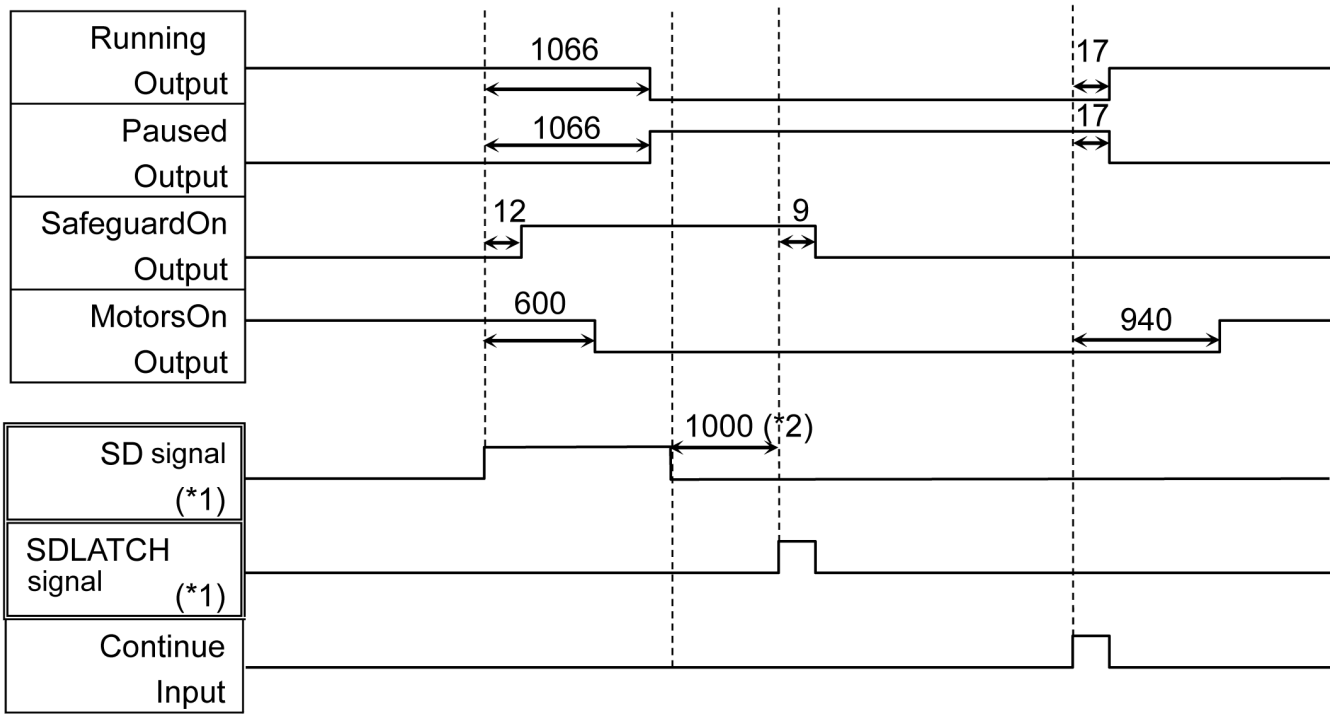
[Unit: ms]



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

3.14.2.4 Timing for Safeguard Input Sequence

[Unit: ms]

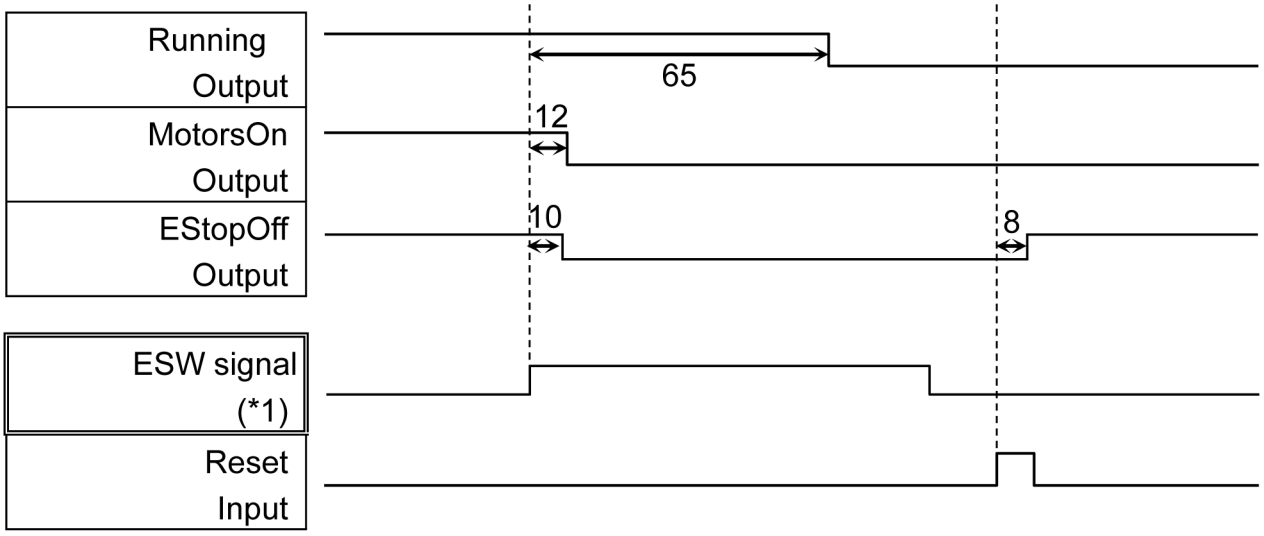


(*1) This is a logical symbol that is used to describe the timing of the controller's internal processing.
For more information on the input signal names and operation conditions, refer to the following.
Signal Arrangement

(*2) When the input interval of the SD signal and the SDLATCH signal is short, error 9626 may occur due to chattering.

3.14.2.5 Timing forf Emergency Stop Sequence

[Unit: ms]

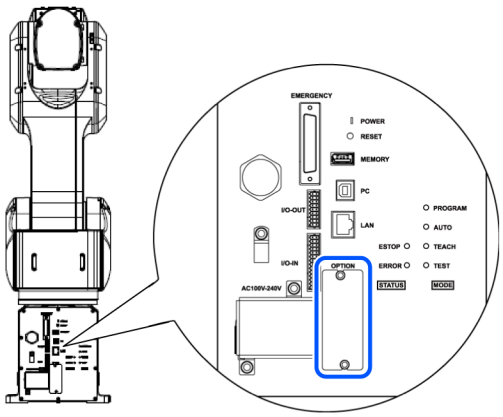


(*1) This is the logical signal that indicates the timing of Controller internal processing.
For more information on the input signal names and operation conditions, refer to the following section.
Signal Arrangement

3.15 SD Card Slot

⚠ CAUTION

- Do not use any SD card other than the included one. When using an SD card other than the included one, the system may not operate properly.
- SD card is only available for robot system.
  SD card is written only for robot system. It cannot be used for reading/writing data.
  If you write data on SD card, the robot system may not operate properly.
- Replacement of the SD card should be performed by a person who has taken proper training.
  For details, refer to the following section.
  “Safety Manual - Training”



SD card slot is a slot for inserting an SD card.
A firmware to operate the Manipulator is written on the SD card.
For details, refer to the following section.
“Service Manual”

3.16 Fieldbus I/O

Fieldbus I/O supports the following modules.

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

For details, refer to the following section.
"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.
“Service Manual”

3.17 Restrictions

For VT-B series Manipulator, there are commands with restrictions and commands that may cause an error when executed.
However, an error does not occur when building a program.
Also, some functions have restrictions.

3.17.1 Commands that Cannot Be Used

The following commands and functions cannot be used.

AbortMotion
: Aborts a motion command and puts the running task in error status

Toff
: Turns off the execution line display on the LCD.

Ton
: Turns on the execution line display on the LCD

ShutDown
: Shuts down Epson RC+ and shuts down or restarts Windows.

WindowsStatus
: Returns the Windows startup status.

3.17.2 Commands that will Cause Motion Error If Specifying RS-232C

The following commands will cause a motion error if RS-232 C port of the Controller is specified.

Input #
: Allows string or numeric data to be received from a file, communications port, or database and stored in variables.

Print #
: Outputs data to the specified file, communications port, database, or device.

Line Input #
: Reads data of one line from a file, communication port, database, or the device.

Lof
: Checks whether the specified RS-232 or TCP/IP port has any lines of data in its buffer.

Read
: Reads characters from a file or communication port.

ReadBin
: Reads binary data from a file or communication port.

Write
: Writes characters to a file or communication port without adding an end of line terminator.

WriteBin
: Writes binary data to a file or communications port.

3.17.3 Commands that will Cause an Error

3.17.3.1 Conveyor Tracking Commands

A motion error will occur if a command or function that is dedicated to conveyor tracking is executed.

Cnv_AbortTrack
: Aborts motion command to a conveyor queue point.

Cnv_Accel Function
: Returns acceleration and deceleration setting value for the conveyor

Cnv_Accel
: Sets acceleration and deceleration setting value for the conveyor

Cnv_AccelLim
: Sets limit of acceleration and deceleration after the conveyor has been tracked

Cnv_AccelLim Function
Returns limit of acceleration and deceleration after the conveyor has been tracked
Cnv_Adjust
Sets whether to retrieve the tracking delay offset of the conveyor
Cnv_AdjustClear
Clears the tracking delay offset of the conveyor
Cnv_AdjustGet Function
Returns the tracking delay offset of the conveyor
Cnv_AdjustSet
Sets the tracking delay offset of the conveyor
Cnv_Downstream Function
Returns the downstream limit for the conveyor
Cnv_Downstream
Sets the downstream limit for the specified conveyor
Cnv_Fine Function
Returns the current Cnv_Fine setting
Cnv_Fine
Sets the value of Cnv_Fine for one conveyor
Cnv_Flag Function
Returns the tracking state for the tracking abort line
Cnv_Mode Function
Returns the setting mode value of the conveyor
Cnv_Mode
Sets the setting mode value of the conveyor
Cnv_Name$ Function
Returns the name of the specified conveyor
Cnv_Number
Returns the number of a conveyor specified by name
Cnv_OffsetAngle Function
Returns the offset value of the conveyor queue data
Cnv_OffsetAngle
Sets the offset value for the conveyor queue data
Cnv_Point Function
Returns a robot point in the specified conveyor's coordinate system derived from sensor coordinates
Cnv_PosErr Function
Returns deviation in current tracking position compared to tracking target
Cnv_PosErrOffset
Sets an offset value to correct the deviation in current tracking position compared to tracking target
Cnv_Pulse Function
Returns the current position of a conveyor in pulses
Cnv_QueAdd
Adds a robot point to a conveyor queue
Cnv_QueGet Function
Returns a point from the specified conveyor's queue
Cnv_QueLen Function
Returns the number of items in the specified conveyor's queue
Cnv_QueList
Displays a list of items in the specified conveyor's queue
Cnv_QueMove
Moves data from upstream conveyor queue to downstream conveyor queue.
Cnv_QueReject
Sets and displays the queue reject distance for a conveyor
Cnv_QueReject Function
Returns the current part reject distance for a conveyor
Cnv_QueRemove
Removes items from a conveyor queue
Cnv_QueUserData Function
Returns the user data value associated with an item in a conveyor queue
Cnv_QueUserData
Sets and displays user data associated with a queue entry
Cnv_RobotConveyor Function

Returns the conveyor being tracked by a robot

Cnv_Speed Function
Returns the current speed of a conveyor

Cnv_Trigger
Latches current conveyor position for the next Cnv_QueAdd statement

Cnv_Upstream Function
Returns the upstream limit for the specified conveyor

Cnv_Upstream
Sets the upstream limit for the specified conveyor

3.17.3.2 PG Commands

A motion error will occur when a command dedicated to PG is executed.

PG_FastStop
Immediately stops the pulse output axes that is spinning continuously

PG_LSpeed
Sets the pulse speed of the time when the pulse output axis starts accelerating and finishes decelerating

PG_Scan
Starts the continuous spinning motion of the pulse output axis

PG_SlowStop
Slowly stops the pulse output axis spinning continuously

3.17.3.3 R-I/O Commands

A motion error will occur if a command or function dedicated to the R-I/O command is executed.

LatchEnable
Enable/Disable the latch function for the robot position by the R-I/O input

LatchState Function
Returns the latch state of the robot position using the R-I/O

LatchPos Function
Returns the robot position that is latched using the R-I/O input signal

SetLatch
Sets the latch function of the robot position using the R-I/O input

3.17.3.4 Force Sensing Commands

A motion error will occur if a command or function dedicated to force sensing is executed.

Force_Calibrate
Sets zero offsets for all axes for the current force sensor

Force_ClearTrigge
Clears all trigger conditions for the current force sensor

Force_GetForce Function
Returns the force for a specified axis

Force_GetForces
Returns the force and torque for all force sensor axes in an array

Force_Sensor Function
Returns the force sensor to be used for the current task

Force_Sensor
Sets the force sensor to be used for the current task

Force_SetTrigger
Sets the force trigger for the Till command

3.17.3.5 Robot Control Commands

ROTOK Function
Returns whether an ROT modifier parameter can be added when issuing a move command to a target coordinate
DiffToolOrientation Function
Returns the angle between the coordinate axes of Tool coordinate systems.

* When COORD_ALL is specified, an error will occur. When a command other than COORD_ALL is specified, the operation will be executed.

DiffPoint Function
Returns the difference between two specified points

3.17.3.6 Other (FineDist)

The FineDist command cannot be used. The robot determines the position based on the set value of Fine even if FineDist is used.

Fine
Sets the positioning error limits of the target position. (Unit: pulse)
FineDist
Sets the positioning error limits of the target position. (Unit: mm)

3.17.3.7 Other (HealthCalcPeriod)

The HealthCalcPeriod command cannot be used.
The period in which the maintenance information calculates the “remaining months” is one day. (This cannot be changed.)

HealthCalcPeriod
Sets the calculation period of maintenance
HealthCalcPeriod Function
Returns the calculation period of maintenance

3.17.3.8 Other (ChDisk)

A USB option cannot be specified to the ChDisk command.

3.17.4 Function Restrictions

The following functions cannot be used partially.

3.17.4.1 Loop Processing

If the created robot control program consists of multi-tasking and also have tasks with infinite loop, the system may become unstable and the connection with Epson RC+ may be disconnected.

The Controller detects infinite loop tasks. If the possibilities to affect the system are detected, the following error occurs and stops the program.
If the error occurs, modify the program and make sure not to set infinite loop.
Error code: 2556
Error message: An excessive loop was detected. Reduce the number of looped tasks or reset Wait

Do not perform any processing such as infinite loop or any other similar processing as much as possible.

Execute Wait command or a similar command in the loop processing and avoid occupying the CPU when performing calculation that requires loop or waiting for I/O signals.
It is not a problem if it is used in a loop that requires Wait commands such as the Wait command, robot motion command, Print command, and Wait Net command.

KEY POINTS

Infinite loop is performed in the following case:
When commands are created only with command without Wait in the loop such as operation instruction, assignment command, and I/O check command

Example 1: When turning the output port “2” on when input port “0” is on
Example of a program that may cause an error

```
Do
   If Sw(0) = On Then
       On(2)
       Exit Do
   EndIf
Loop
```

Correction example

```
Wait Sw(0) = On
On(2)
```

Example 2: When performing a large amount of calculations in a loop structure
Example of a program that may cause an error

```
For i = 0 To 10000
    For j = 0 To 10000
        a = a + 1
    Next
Next
```

Correction example

```
For i = 0 To 10000
    For j = 0 To 10000
        a = a + 1
    Next
    Wait 0.01     ' Execute Wait to avoid occupying the CPU
Next
```

3.17.4.2 Camera Searching by CV1/CV2

You may not be able to use Camera searching in VT series Manipulator if CV1/CV2 is used and the following two conditions are met.

- When connecting PC and VT series Manipulator with a USB
- When the configuration of a default gateway of VT series Manipulator is None or “0.0.0.0”

Type the IP address for CV1/ CV2 manually when you cannot use Camera searching.
For more details of Camera searching, refer to the following.
“Vision Guide 8.0 Hardware & Setup - Setup - CV1/CV2 Camera Configuration”

3.17.4.3 Restoring the Controller Settings Backup Data

Controller settings backup data that was acquired by the virtual controller cannot be restored to the VT-B series Manipulator.

KEY POINTS

Controller settings backup data that was acquired from an actual controller can be restored.

3.18 Error Code Table

For details on the error code, refer to the following.
“Status Code / Error Code List”

4. Periodic Inspection

Accurate inspection work is necessary to prevent breakdowns and ensure safety. This section explains the inspection schedule and what should be inspected.

Perform inspections according to the predetermined schedule.

4.1 VT6-B Manipulator Periodic Inspection

Accurate inspection work is necessary to prevent breakdowns and ensure safety. This section explains the inspection schedule and what should be inspected.

Perform inspections according to the predetermined schedule.

4.1.1 Inspection

4.1.1.1 Inspection Schedule

Inspection items are divided into five stages (daily, 1-month, 3-month, 6-month, and 12-month), with additional items added at each stage. However, if the Manipulator is powered and operated for more than 250 hours in a month, add inspection items every 250, 750, 1500, and 3000 hours.

	Inspection Item					
	Daily Inspection	1-month Inspection	3-month Inspection	6-month Inspection	12-month Inspection	Overhaul (Parts Replacement)
1 months (250 hours)	Perform daily	✓				
2 months (500 hours)		✓				
3 months (750 hours)		✓	✓			
4 months (1,000 hours)		✓				
5 months (1,250 hours)		✓				
6 months (1,500 hours)		✓	✓	✓		
7 months (1,750 hours)		✓				
8 months (2,000 hours)		✓				
9 months (2,250 hours)		✓	✓			
10 months (2,500 hours)		✓				
11 months (2,750 hours)		✓				
12 months (3,000 hours)		✓	✓	✓	✓	
13 months (3,250 hours)		✓				
⋮	⋮	⋮	⋮	⋮	⋮	⋮

	Inspection Item					
	Daily Inspection	1-month Inspection	3-month Inspection	6-month Inspection	12-month Inspection	Overhaul (Parts Replacement)
(20,000 hours)						✓

4.1.1.2 Inspection Details

Inspection items

Inspection Item	Inspection Location	Daily Inspection	1-month Inspection	3-month Inspection	6-month Inspection	12-month Inspection
Check for loose or rattling bolts	Hand installation bolts	✓	✓	✓	✓	✓
	Manipulator installation bolts	✓	✓	✓	✓	✓
Check for loose connectors	External side of Manipulator (connector plate, etc.)	✓	✓	✓	✓	✓
Inspection for flaws Clean off adhering debris, etc.	Entire Manipulator	✓	✓	✓	✓	✓
	External cables		✓	✓	✓	✓
Correct deformations and misalignments	Safeguard etc.	✓	✓	✓	✓	✓
Check brake operation	Brake for Joint #1 to #6	✓	✓	✓	✓	✓
Check for abnormal operation noise and vibration	Entire Manipulator	✓	✓	✓	✓	✓
Checking the the power supply for operation	Controller	-	-	-	-	✓
Checking emergency stop and safeguard operation	Emergency Stop switch	-	-	-	-	✓
	Safeguard	-	-	-	-	✓
Checking the Enable switch	Enable switch	-	-	-	-	✓

Inspection methods

Inspection Item	Inspection Method
Check for loose or rattling bolts	Using an Allen wrench or similar tool, check that the hand mounting bolts and Manipulator installation bolts are not loose. If the bolts are loose, refer to the following section, and retighten to the proper torque. **Tightening the Hexagon Socket Head Cap Bolts**
Check for loose connectors	Check that no connectors are loose. If a connector is loose, reattach it so that it will not come off.

Inspection Item	Inspection Method
Inspection for flaws Clean off adhering debris, etc.	Check the appearance of the Manipulator, and clean off any dust or other foreign substances adhering to it. Check the appearance of the cables for any flaws, and make sure it is not disconnected.
Correct deformations and misalignments	Before operating the robot system, make sure that no one is inside the safeguarded area. If it is misaligned, correct it to the original position.
Check brake operation	With the motor turned off, check that the arm does not drop. If the arm drops while the motor is turned off and the brake is not released, contact the supplier. If the arm drops while the motor is turned off and the brake is not released, contact the supplier.
Check for abnormal operation noise and vibration	Check for any abnormal noise and vibration during operation. If you notice anything unusual, contact the supplier.
Checking the the power supply for operation	Turn OFF and ON the power supply, and check that it starts without any error.
Check the operation of the emergency stop switch	Operate the emergency stop switch with the motor energized, check that the LED lamp near the Joint #1 light is off and the ESTOP LED on the Controller is on. If Epson RC+ is connected, make sure to check whether “EStop” is displayed in red on the status bar.
Check the operation of the safeguard	Operate the safeguard with the motor energized, and check that the LED lamp near Joint #1 is off. If Epson RC+ is connected, make sure to check whether “Safety” is displayed in blue on the status bar.
Checking the Enable switch	When the motor is turned on in teach mode, grip or release the enable switch to check if the motor is turned off. Check whether the indicating lamp on the Manipulator is turned off.

4.1.2 Overhaul (Parts Replacement)

Overhaul (replacement) shall be performed by personnel who has taken a proper training.

For details, refer to the following manual.
“Safety Manual - Role and Training for Safety Managers”

4.1.3 Tightening the Hexagon Socket Head Cap Bolts

Hexagon socket head cap bolts (referred to as "bolts" below) are used in locations where mechanical strength is required.
During assembly, these bolts are tightened at the tightening torques shown in the following table.
Unless otherwise specified, when retightening these bolts in the work procedures described in this manual, use a torque wrench or similar tool to obtain the tightening torques in the following table.

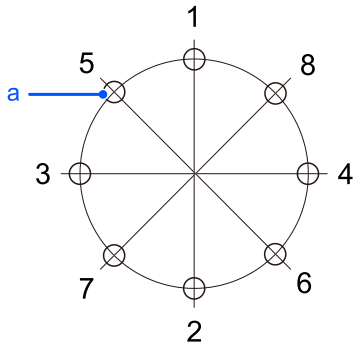
Bolt	Tightening Torque
M3	2.0 ± 0.1 N·m (21 ± 1 kgf·cm)
M4	4.0 ± 0.2 N·m(41 ± 2 kgf·cm)

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

For set screw, refer to the following table.

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

Bolts arranged in a circular pattern should be secured in place by tightening in criss-cross order as shown in the figure.



Symbol	Description
a	Threaded holes

When securing the bolts, do not tighten the bolts all at once, but tighten them in two or three separate rounds with an Allen wrench, and then use a torque wrench or similar tool to secure them at the tightening torques shown in the table above.

5. Appendix

This section provides detailed technical data such as the specifications, stopping time, and stopping distance for each model.

5.1 Appendix A: Specifications Table

5.1.1 VT6-B Specifications Table

Item				Specifications		
				VT6-B901*	VT6-B901*R	VT6-B901*W
Machinery name				Industrial robot		
Product series				VT-B		
Model				**Model Number**		
Model Name				VT6-B		
Mounting type *\ 1				Table top mounting	Ceiling mounting	Wall mounting
Arm length			P: From J1 to the center of J5	911.1 mm		
Maximum reach			From J1 to J6 flange surface	992.6 mm		
Manipulator weight	AC		Standard model Cleanroom model	43 kg: 94.8 lbs. (weight of cables not included)		
Drive system			All joints	AC servo motor		
Maximum operating speed * 2	Joint #1			166.3°/s		
	Joint #2			123°/s		
	Joint #3			141.2°/s		
	Joint #4	AC	Standard model Cleanroom model	268.7°/s		
	Joint #5			296.8°/s		
	Joint #6	AC	Standard model Cleanroom model	293.2°/s		
Maximum synthetic speed				4549 mm/s		
Repeatability			Joint #1 to #6	±0.03 mm		
Maximum motion range			Joint #1	±180°		±30
			Joint #2	-160° to +65°		
			Joint #3	-63° to +193°		
			Joint #4	±270°		
			Joint #5	±135°		
			Joint #6	±540°		

Item			Specifications		
			VT6-B901*	VT6-B901*R	VT6-B901*W
Max. pulse range (pulse)		Joint #1	±8983115		
		Joint #2	-9946215 to 4040650		
		Joint #3	-2923452 to +8955972		
		Joint #4	±10973833		
		Joint #5	±3518249		
		Joint #6	±9420111		
Resolution		Joint #1	0.0000200°/pulse		
		Joint #2	0.0000161°/pulse		
		Joint #3	0.0000215°/pulse		
		Joint #4	0.0000246°/pulse		
		Joint #5	0.0000384°/pulse		
		Joint #6	0.0000573°/pulse		
Motor rated capacity	Joint #1		283 W		
	Joint #2		283 W		
	Joint #3		283 W		
	Joint #4		100 W		
	Joint #5		100 W		
	Joint #6		100 W		
Payload (load) *3	Rated		3 kg		
	Maximum		6 kg		
Allowable moment	Joint #4		12 N·m (1.22 kgf·m)		
	Joint #5		12 N·m (1.22 kgf·m)		
	Joint #6		7 N·m (0.71 kgf·m)		
Allowable moment of inertia ($GD^2/4$) *4	Joint #4		0.3 kg·m²		
	Joint #5		0.3 kg·m²		
	Joint #6		0.1 kg·m²		
Environmental requirements *5	Ambient temperature		5 to 40°C		
	Ambient relative humidity		10 to 80% RH (with no condensation)		
	Vibration		4.9 m/s² (0.5 G) or less		
Transportation and Storage	Temperature		-20 to +60°C		
	Humidity		10 to 90% (with no condensation)		

Item				Specifications		
				VT6-B901*	VT6-B901*R	VT6-B901*W
Noise level *6				L_{aeq} = 65 dB(A) or less		
Environmental Specifications				Standard, Cleanroom: *7		
Setting value range	Speed			1 ~ (5) ~ 100		
	Accel *8			1 ~ (5) ~ 120		
	SpeedS			0.1 ~ (50) ~ 2000		
	AccelS *9			0.1 ~ (200) ~ 10000		
	Fine			0 ~ (10000) ~ 65535		
	Weight			0 ~ (3) ~ 6		
	Inertia			0 ~ (0.03) ~ 0.1		
Motion Control	Development Environment			Epson RC+		
	Programming Language			SPEL+ (multitasking robot language)		
	Joint control			Standard 6 joints simultaneous control Digital AC servo control		
	Operation method			PTP (Point-To-Point) method CP (Continuous Path) method		
	Speed control			In PTP control: Programmable in the range of 1 to 100% IN CP control: Programmable when actual speed is specified		
	Acceleration/Deceleration Control			In PTP control: Programmable from 1 to 100% and auto acceleration IN CP control: Programmable when actual speed is specified		
External interface	EMERGENCY			Emergency Stop: Redundant (Category 3/PLd) Safeguard: Redundant (Category 3/PLd)		
	I/O	Standard I/O (Rear side of Manipulator)		Input: 24 points output: 16-point non-polar, sink/source-compatible		
			Remote I/O (Remote functions are applied to Standard I/O)	Input: 8 points Program, 3 points Start, Stop, Pause, Continue, Reset Output: 8 points Ready, Running, Paused, Error, SafeguardOn, SError, Warning, EStopOff		
	Field bus Slave (Option)			Enable to add only one module		
	TP Connection Port			Supported for teach pendant (Option: TP2, TP3, TP4)		
	Development PC Connection USB Port			USB TypeB		
	Memory Port			USB TypeA		
	Ethernet Port			Supported for 10/100 Mbps		

Item		Specifications		
		VT6-B901*	VT6-B901*R	VT6-B901*W
	Reset Switch		Enable to use for resetting of system	
Display	Mode Display LED	TEACH, AUTO, PROGRAM, TestMode, Error, E-STOP		
Controller Status Save		Storage to USB memory Save to PC (Epson RC+)		

*1: Mounting types other than “Table Top mounting”, “Ceiling mounting”, and “Wall mounting” are out of specification.

*2: When PTP commands are used

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

*4: When the center of gravity of the load is aligned with the center position of each arm
When the center of gravity is away from the center of each arm, set the eccentricity using the INERTIA command.

*5: For details on the environmental conditions, refer to the following.
Environment
When used in a low-temperature environment near the minimum temperature specified in the product specifications, or when the unit is idle for a long period of time during holidays or at night, a collision detection error or similar error may occur immediately after the start of operation due to high resistance in the drive unit. In such cases, warm-up operation for about 10 minutes is recommended.

*6: The conditions at measurement are as follows.

- Operating conditions of the Manipulator:
  Under rated load, all arms simultaneous motion, maximum speed, and maximum acceleration/deceleration
  VT6L: Duty 50%
- Measurement location
  1000 mm away from the rear side of the Manipulator

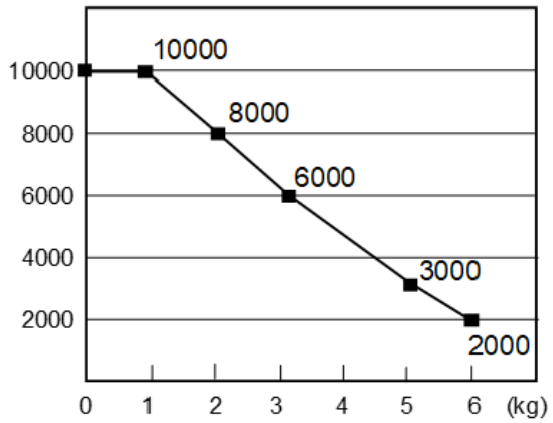
*7: Manipulators with cleanroom specifications discharge the exhaust inside of the base and inside of the arm cover section together. Consequently, if there is a gap in the base section, the arm tip section will not be sufficiently negatively pressurized, which may result in dust generation.

- Cleanliness
  ISO Class 4 (ISO14644-1)
- Exhaust port:
  Fitting for ø12 mm pneumatic tube
  60 L/min during suction
- Application exhaust tube:
  Polyurethane tube outer diameter ø12 mm (inner diameter ø8 mm)

*8: The Accel setting of "100" is the optimum setting that balances acceleration/deceleration and vibration during positioning. The Accel setting can be set higher than 100 but may result in shortening the lifespan if it is continuously used with a large value. Therefore, it is recommended to limit setting such high values for motions that are absolutely necessary.

*9: The upper limit of AccelS varies depending on the load. For details, refer to the following figure. Setting the value which exceeds the maximum AccelS causes an error. Check the setting value.

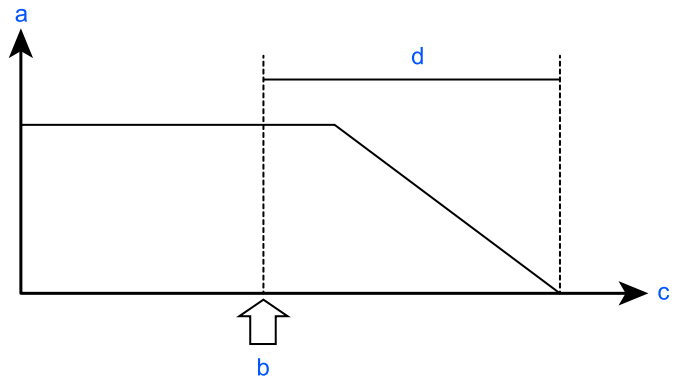
Maximum AccelS setting value


10000
8000
6000
4000
2000
10000
8000
6000
3000
2000
0
1
2
3
4
5
6
(kg)

5.2 Appendix B: Stopping Time and Stopping Distance at Emergency Stop

The stopping time and stopping distance at an emergency stop are shown in the graphs for each model.

The stopping time is the length of time corresponding to the "Stopping time" in the figure below. Be sure to confirm that a safe environment is provided where the robot will be installed and operated.



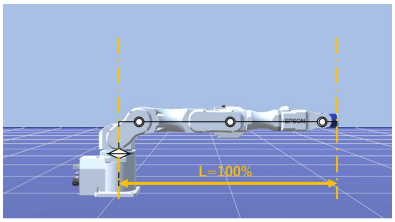
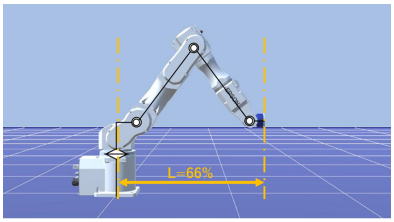
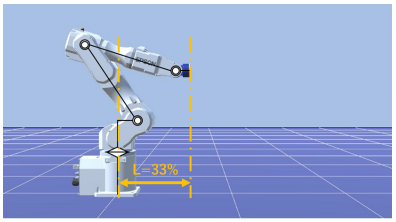
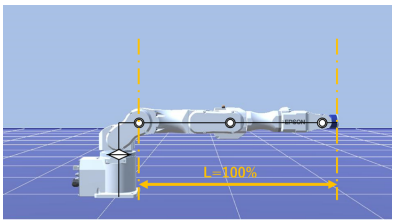
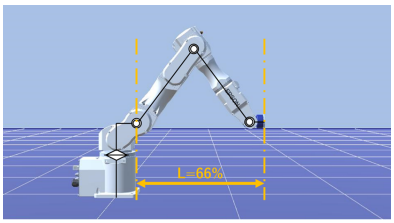
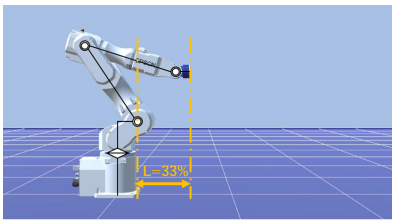
Symbol	Description
a	Motor speed
b	Emergency stop or safeguard open
c	Time
d	Stopping time

Conditions

The stopping time and stopping distance depend on the parameters (setting values) that were set for the robot. These graphs show the times and distances for the following parameters.
These conditions are based on the ISO 10218-1:2011 Annex B.

- Accel: 100, 100
- Speed: 100 %, 66 %, 33 % Settings
- Weight: 100 %, 66 %, 33 % of the maximum payload, rated payload
- Arm elongation rate: 100 %, 66 %, 33 % *1
- Other settings: Default
- Operation: Singular axis motion of a Go command
- Input timing of the Stop signal: Input with maximum speed. In this motion, it is the center of the motion range.

*1 The arm elongation rate The arm elongation rate L is as described in the figure below. The graphs indicate the results where the stopping time and the stopping distance in the longest among the arm elongation rates.

Axis	θ = 100%	θ = 66%	θ = 33%
J1			
J2			

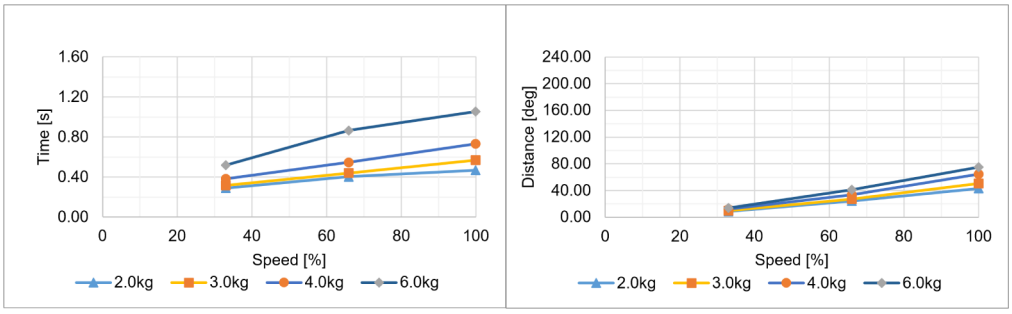
Explanation of legend

The graphs are displayed for each Weight setting value (at 100%, approx. 66%, and approx. 33% of the maximum payload, and at the rated payload).

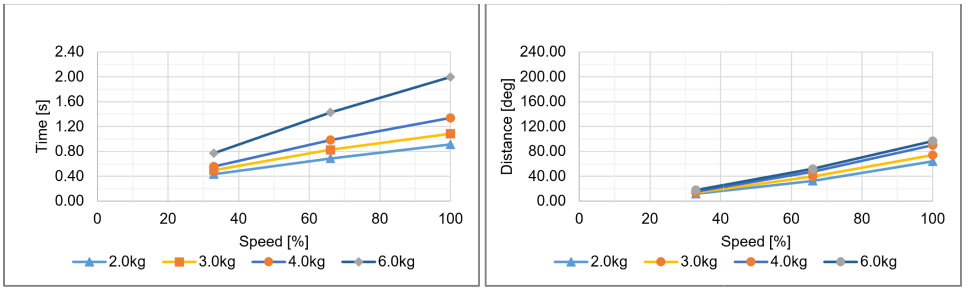
- Horizontal axis: Arm speed (Speed setting value)
- Vertical axis: Stopping time and stopping distance at each arm speed
- Time (sec): Stopping time (sec)
- Distance (deg): stopping distance (degree)

5.2.1 VT6-B Stopping Time and Stopping Distance at Emergency Stop

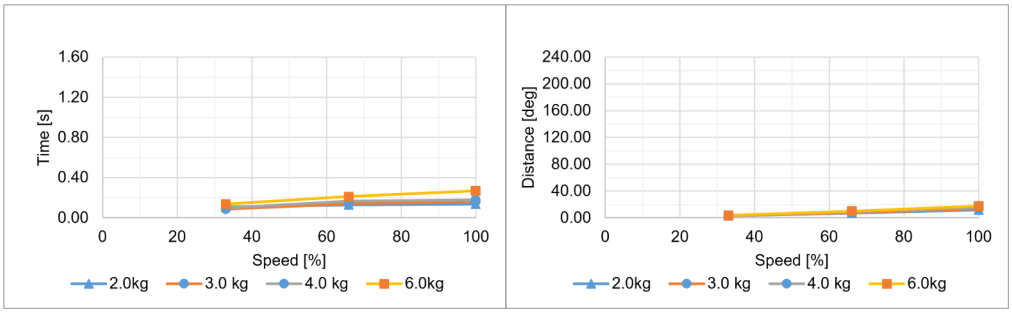
VT6-B901**: J1 (Table top mounting, Ceiling mounting)



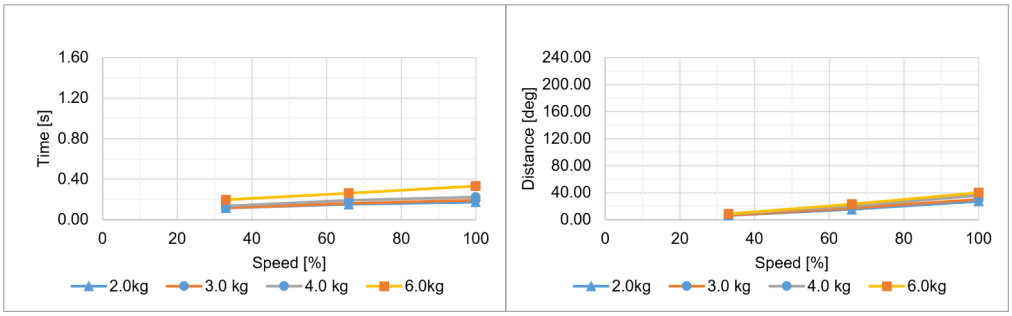
VT6-B901**: J2 (Table top mounting, Ceiling mounting, Wall mounting)



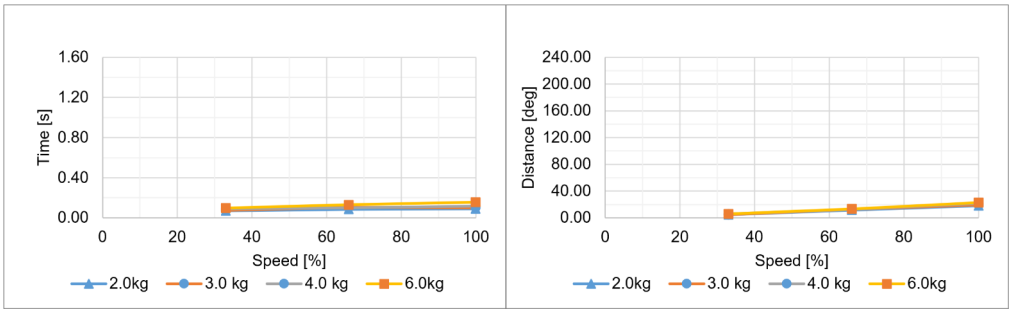
VT6-B901**: J3 (Table top mounting, Ceiling mounting, Wall mounting)



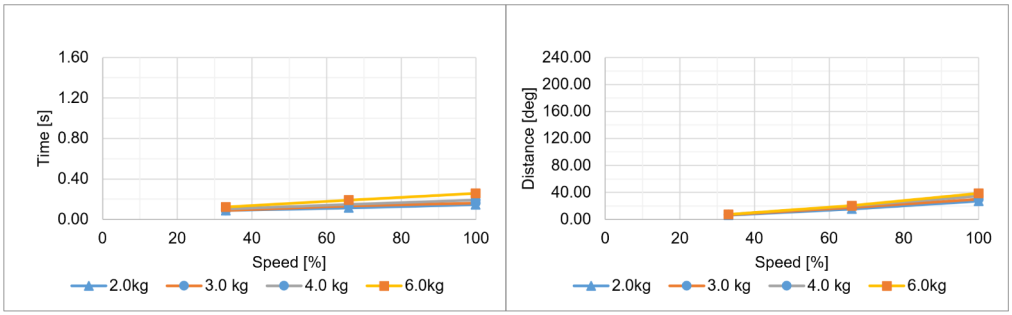
VT6-B901**: J4 (Table top mounting, Ceiling mounting, Wall mounting)



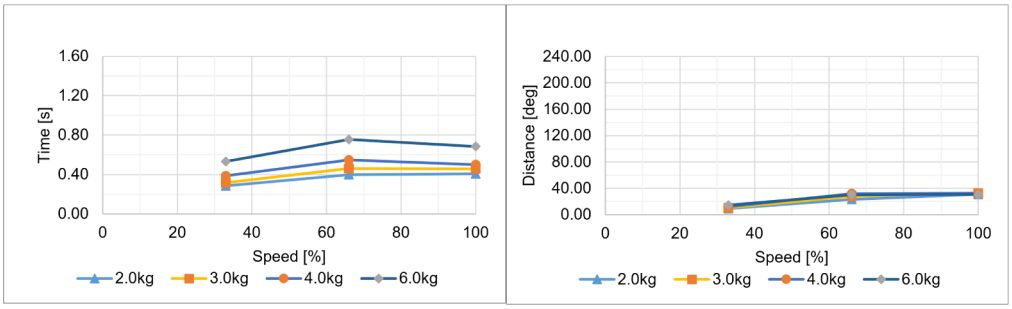
VT6-B901**: J5 (Table top mounting, Ceiling mounting, Wall mounting)



VT6-B901**: J6 (Table top mounting, Ceiling mounting, Wall mounting)



VT6-B901**: J1 (Wall mounting)



5.2.2 Supplementary Information regarding the Stopping Time and Stopping Distance at Emergency Stop

The stopping time and stopping distance described in Appendix B was measured by the motion determined by us based on the ISO 10218-1.
Therefore, it does not guarantee the maximum value of the stopping time and stopping distance in the customer's environment.
The stopping time and stopping distance differs depending on the robot's model, motion, and input timing of the stop signal.
Make sure to always measure the stopping time and stopping distance that matches the customer's environment.

KEY POINTS

The following are included in the robot's motion and parameter.

- The motion's starting point, target point, and relay point
- Motion commands (Go, Move, Jump commands etc.)
- Weight and Inertia Settings
- Motion speed, acceleration, deceleration, and one where the motion timing changes
  Also, refer to the following description.

Weight and Inertia Settings
Safety Information for Auto Acceleration

5.2.2.1 How to check the stopping time and stopping distance in the customer's environment

Measure the stopping time and stopping distance of the actual motion with the following method.

1. Create a motion program in the customer's environment.
2. After the motion to check the stopping time and stopping distance starts, input the stop signal at your own timing.
3. Record the time and distance from when the stop signal was input until the robot stopped.
4. Check the maximum stopping time and stopping distance by repeating 1 through 3 mentioned above.

- How to input the stop signal: Operate the stop switch manually or input the stop signal with the safety PLC.
- How to measure the stopping distance: The angle could also be measured with the Where or RealPos command.
- How to measure the stopping time: Measure with a stop watch or the Tmr function.

⚠ CAUTION

The stopping time and stopping distance changes depending on the timing the stop signal is input.

In order to prevent collision with people or objects, perform a risk assessment based on the maximum stopping time and stopping distance and perform an equipment design.

Therefore, make sure to measure the maximum value by changing the timing of the stop signal input during the actual motion and measure repeatedly.

5.2.2.2 Commands that can be useful when measuring stopping time and stopping distance

Commands	Functions
Where	Returns the data of the robot’s current position
RealPos	Returns the current position of the specified robot Unlike the motion target position of the CurPos, this obtains the position of the actual robot from the encoder in real time.
PAgl	Returns by calculating the Joint position from the specified coordinate value. P1 = RealPos 'Obtain the current position Joint1 = PAgl (P1, 1) 'Request the J1 angle from the current position
SF_RealSpeedS	Display the current speed from the limited speed position in mm/s.
Tmr	The Tmr function returns the elapsed time from when the timer starts in seconds.
Xqt	Runs the program specified with the function name and complete the task. The function used to measure the stopping time and stopping distance should be used to run tasks that were launched by attaching the NoEmgAbort options. You can run a task that does not stop with the emergency stop and safeguard open.

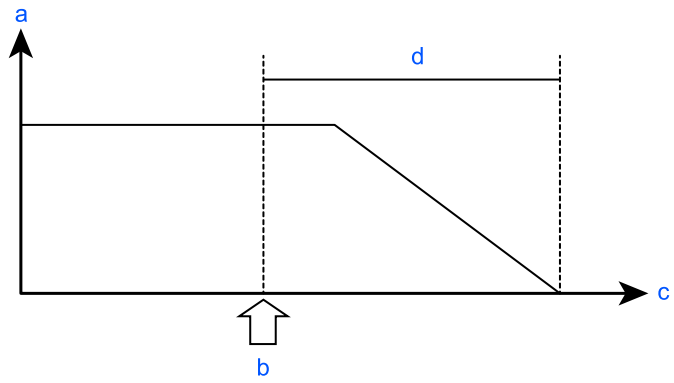
For more information, refer to the following manual.

"Epson RC+ SPEL+ Language Reference"

5.3 Appendix C: Stopping Time and Stopping Distance when the Safeguard is Open

The stopping time and stopping distance when the safeguard is opened are shown in the graphs for each model.

The stopping time is the length of time corresponding to the "Stopping time" in the figure below. Be sure to confirm that a safe environment is provided where the robot will be installed and operated.



Symbol	Description
a	Motor speed
b	Emergency stop or safeguard open
c	Time
d	Stopping time

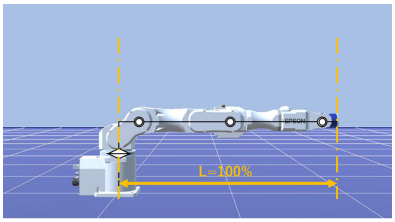
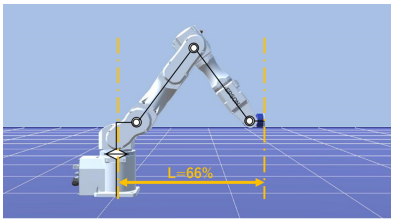
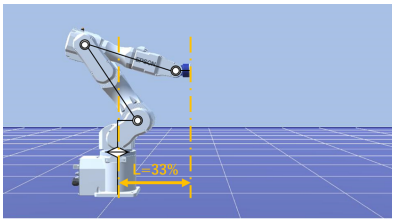
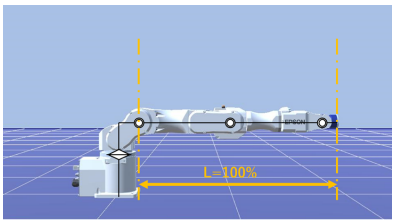
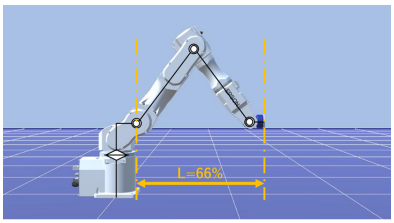
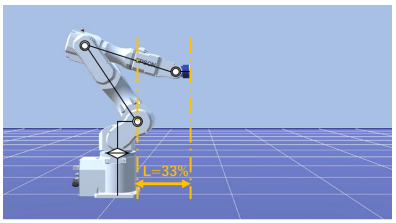
Conditions

The stopping time and stopping distance depend on the parameters (setting values) that were set for the robot. These graphs show the times and distances for the following parameters.

These conditions are based on the ISO 10218-1:2011 Annex B.

- Accel: 100, 100
- Speed: 100 %, 66 %, 33 % Settings
- Weight: 100 %, 66 %, 33 % of the maximum payload, rated payload
- Arm elongation rate: 100 %, 66 %, 33 % *1
- Other settings: Default
- Operation: Singular axis motion of a Go command
- Input timing of the Stop signal: Input with maximum speed. In this motion, it is the center of the motion range.

*1 The arm elongation rate The arm elongation rate L is as described in the figure below. The graphs indicate the results where the stopping time and the stopping distance in the longest among the arm elongation rates.

Axis	θ = 100%	θ = 66%	θ = 33%
J1			
J2			

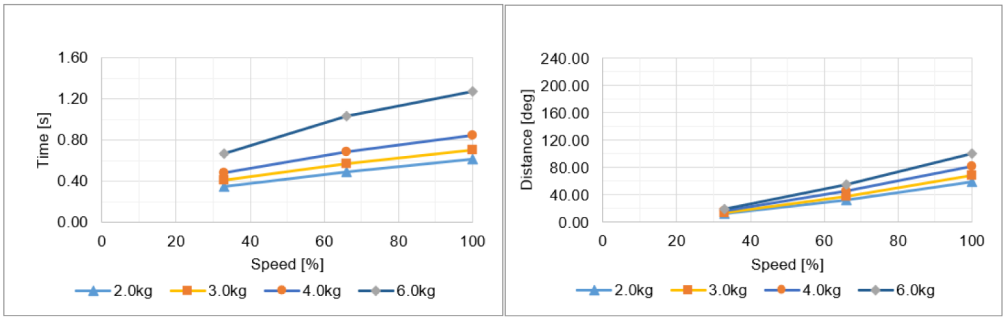
Explanation of legend

The graphs are displayed for each Weight setting value (at 100%, approx. 66%, and approx. 33% of the maximum payload, and at the rated payload).

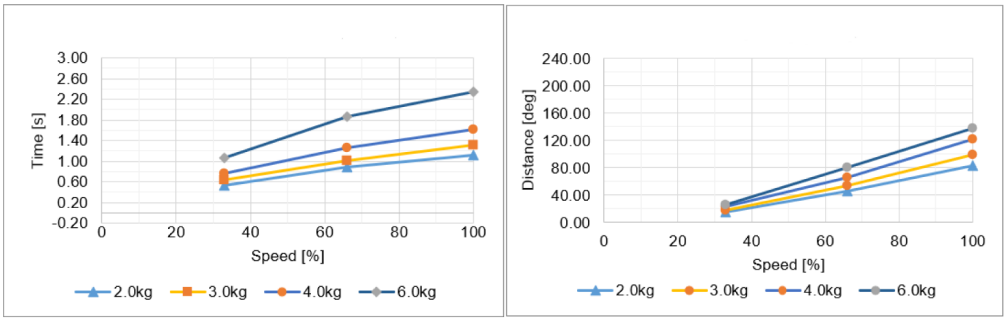
- Horizontal axis: Arm speed (Speed setting value)
- Vertical axis: Stopping time and stopping distance at each arm speed
- Time (sec): Stopping time (sec)
- Distance (deg): stopping distance (degree)

5.3.1 Supplementary Information regarding the Stopping Time and Stopping Distance of VT6-B

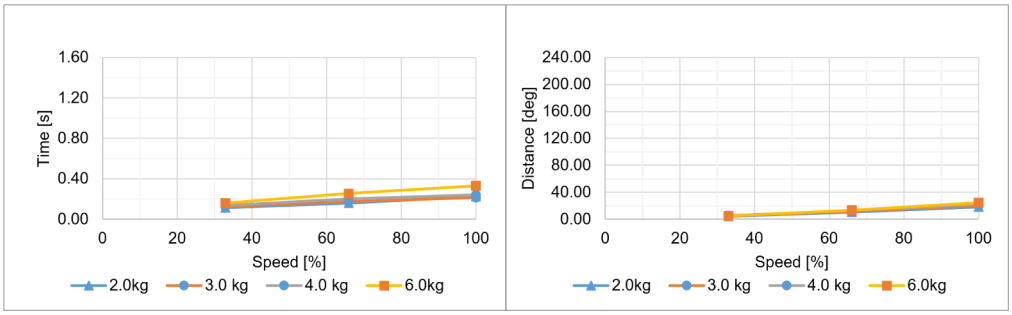
VT6-B901**: J1 (Table top mounting, Ceiling mounting)



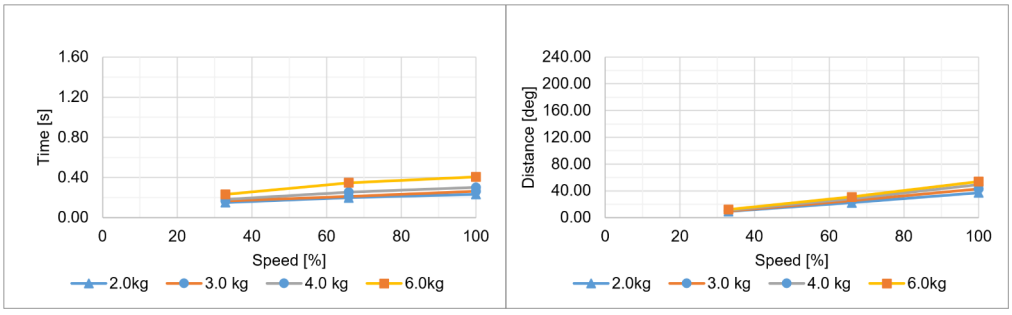
VT6-B901**: J2 (Table top mounting, Ceiling mounting, Wall mounting)



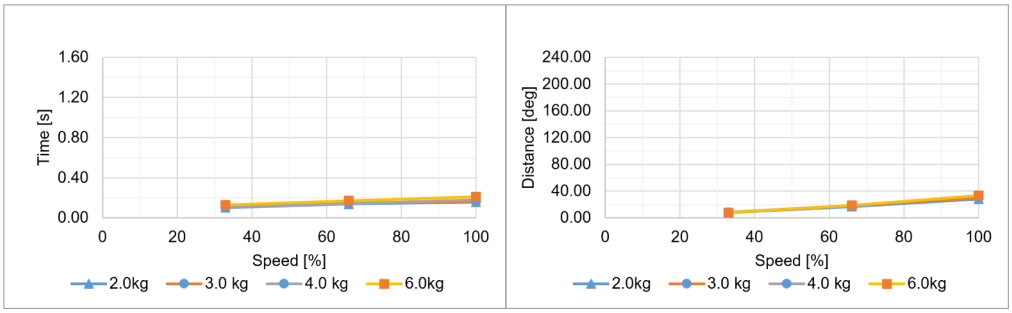
VT6-B901**: J3 (Table top mounting, Ceiling mounting, Wall mounting)



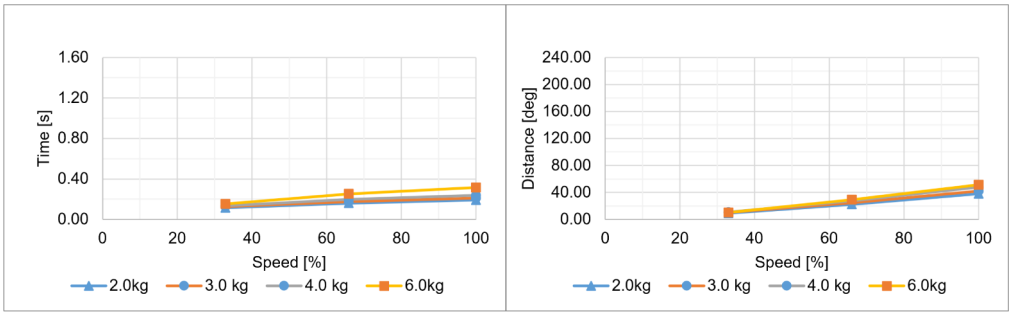
VT6-B901**: J4 (Table top mounting, Ceiling mounting, Wall mounting)



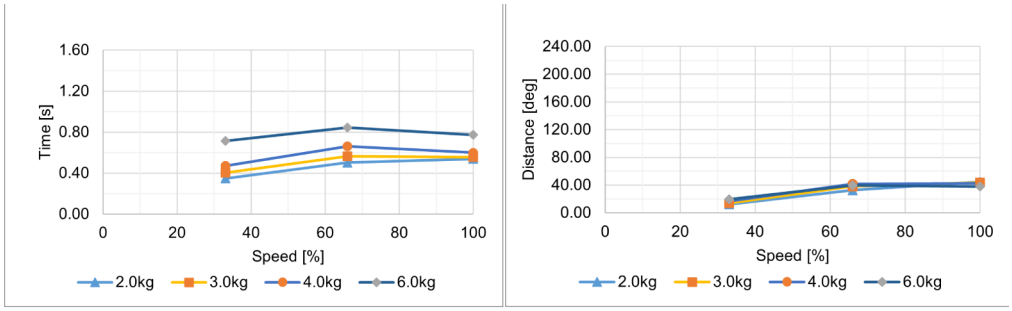
VT6-B901**: J5 (Table top mounting, Ceiling mounting, Wall mounting)



VT6-B901**: J6 (Table top mounting, Ceiling mounting, Wall mounting)



VT6-B901**: J1 (Wall mounting)



5.3.2 Supplementary Information regarding the Stopping Time and Stopping Distance when the Safeguard is Open

The stopping time and stopping distance described in Appendix. C was measured by the motion determined by Epson based on the ISO 10218-1.

Therefore, it does not guarantee the maximum value of the stopping time and stopping distance in the customer's environment. The stopping time and stopping distance differs depending on the robot's model, motion, and input timing of the stop signal. Make sure to always measure the stopping time and stopping distance that matches the customer's environment.

The following are included in the robot's motion and parameter.

- The motion's starting point, target point, and relay point
- Motion commands (Go, Move, Jump commands etc.)
- Weight and Inertia Settings
- Motion speed, acceleration, deceleration, and one where the motion timing changes

Also, refer to the following description.

Weight and Inertia Settings
Safety Information for Auto Acceleration

5.3.2.1 How to check the stopping time and stopping distance in the customer's environment

Measure the stopping time and stopping distance of the actual motion with the following method.

1. Create a motion program in the customer's environment.
2. After the motion to check the stopping time and stopping distance starts, input the stop signal at your own timing.
3. Record the time and distance from when the stop signal was input until the robot stopped.
4. Check the maximum stopping time and stopping distance by repeating 1 through 3 mentioned above.

- How to input the stop signal: Operate the stop switch/safeguard manually or input the stop signal with the safety PLC.
- How to measure the stopping distance: The angle could also be measured with the Where or RealPos command.
- How to measure the stopping time: Measure with a stop watch or with the Tmr function.

⚠ CAUTION

The stopping time and stopping distance changes depending on the timing the stop signal is input.

In order to prevent collision with people or objects, perform a risk assessment based on the maximum stopping time and stopping distance and perform an equipment design.

Therefore, make sure to measure the maximum value by changing the timing of the stop signal input during the actual motion and measure repeatedly.

5.3.2.2 Commands that can be useful when measuring stopping time and stopping distance

Commands	Functions
Where	Returns the data of the robot’s current position
RealPos	Returns the current position of the specified robot Unlike the motion target position of the CurPos, this obtains the position of the actual robot from the encoder in real time.
PAgl	Returns by calculating the Joint position from the specified coordinate value. P1 = RealPos 'Obtain the current position Joint1 = PAgl (P1, 1) ‘ Request the J1 angle from the current position
Tmr	The Tmr function returns the elapsed time from when the timer starts in seconds.
Xqt	Runs the program specified with the function name and complete the task. The function used to measure the stopping time and stopping distance should be used to run tasks that were launched by attaching the NoEmgAbort options. You can run a task that does not stop with the emergency stop and safeguard open.

For more information, refer to the following manual.

"Epson RC+ SPEL+ Language Reference"