

Mitsubishi Electric Industrial Robot

Hello ASSISTA
Quick Set-up Guide

RV-5AS-D

SAFETY PRECAUTIONS

Read the separate Safety Manual and following precautions thoroughly before using this product. Take precautions as necessary.

BASIC PRECAUTIONS AND IMPORTANT POINTS WHEN USING COLLABORATIVE ROBOTS

Collaborative robots have a variety of safety functions, so unlike conventional industrial robots, they can work in the same space as humans without being separated by a machine guard.

Even though collaborative robots are equipped with safety functions, it does not guarantee that they will not cause injury. To prevent injury, customers who use robots, machine manufacturers who construct robot systems, and system builders such as system integrators must select and use functions correctly. Peripherals must be designed, manufactured, set, programmed, maintained, and inspected appropriately. Before working with collaborative robots, conduct risk assessments, check that no risk is present, and ensure all required documentation is in order.

It is vitally important that all the points mentioned above are fully understood in order to work with collaborative robots safely and without incident. When using collaborative robots, always keep in mind that they may move unexpectedly.

INTRODUCTION

Thank you for purchasing Mitsubishi Electric MELFA industrial robots.

Before operating this robot, make sure to read and fully understand the contents of this manual.

To operate this robot safely, make sure to read this manual and the Safety Manual included with the robot controller. Keep the manuals in a safe place so that they can be read whenever necessary.

Applicable products

This manual is for the following products.




Robot:

- RV-5AS-D

Robot controller:

- CR800-05VD

Symbols

 DANGER	Incorrect handling may result in imminent danger, leading to death or serious injury.
 WARNING	Incorrect handling may lead to death or serious injury.
 CAUTION	Incorrect handling may lead to injury or property damage.

- No part of this document may be reproduced by any means or in any form, without prior consent from Mitsubishi Electric.
- The contents of this document are subject to change without notice.
- We make every effort to ensure that the information in this document is as accurate as possible. Please contact us if you find any incorrect, questionable, or missing information.

Copyright(C)2020-2022 MITSUBISHI ELECTRIC CORPORATION

ABOUT THIS MANUAL

This manual explains the robot setup procedure and the steps required for pick-and-place operations.

It also explains how to setup the Easy-setup kit (option).

The manual consists of the following parts:

- Part 1 SETUP

This part explains how to unpack, install, wire, and operate the robot.

- Part 2 OPERATION

This part explains how to create and run programs using RT VisualBox.

- Part 3 VISION SENSOR

This part explains how to create and run vision sensor programs using RT VisualBox.

MANUALS INCLUDED WITH THIS PRODUCT

Manual name	Description	Manual No.
Collaborative Robot Safety Manual	To ensure the safety of robot users, this manual provides information on common precautions and safety measures that should be taken when handling the robot or creating and designing robot systems. Read this manual first.	BFP-A3733
Hello ASSISTA Quick Set-up Guide (This manual)	Describes procedures including unpacking, installation, programming using RT VisualBox, and operation of the robot.	BFP-A3715
Standard Specifications	Provides information on standard product specifications, options, and maintenance parts. It also provides information on safety and technical precautions when introducing the robot into a new environment.	BFP-A3727
Robot Arm Setup and Maintenance	Explains pre-operation requirements for the robot (unpacking, transportation, installation, and operation checks) and how to carry out maintenance and inspection.	BFP-A3729
Controller Setup and Maintenance	Explains the steps that must be taken before using the robot controller (unpacking, transportation, and installation). It also contains information on maintenance and inspection.	BFP-A3731
Collaborative Robot: Detailed explanations of functions and operations	Provides information on functions specific to collaborative robots.	BFP-A3735
Detailed explanations of functions and operations* ¹	Provides information on functions and operation methods, how to use MELFA-BASIC VI commands in programs, how to connect external input/output devices, and how to set parameters. The FR series is used as an example for explanation purposes. For information on unsupported functions, refer to the separate Instruction Manual "Collaborative Robot: Detailed explanations of functions and operations".	BFP-A3478
Troubleshooting* ¹	Provides information on the causes and solutions to errors that may occur while operating the robot.	BFP-A3480
Tracking Function* ¹	Provides information on the specifications, functions, and usage of the conveyor tracking function.	BFP-A3520
GOT Direct Connection Extended Function* ¹	Describes the data configuration of the memory between the GOT and the robot, monitoring, and operating procedures.	BFP-A3546
Ethernet Function* ¹	Explains how to communicate with a computer over Ethernet using TCP/IP protocols.	BFP-A3379

*1 Instances where the CR800-D controller is mentioned also refer to the CR800-05VD.

CONTENTS

SAFETY PRECAUTIONS	1
BASIC PRECAUTIONS AND IMPORTANT POINTS WHEN USING COLLABORATIVE ROBOTS.....	1
INTRODUCTION.....	1
ABOUT THIS MANUAL.....	2
MANUALS INCLUDED WITH THIS PRODUCT	2

PART 1 SETUP

CHAPTER 1 STEPS FROM UNPACKING THE ROBOT TO INSTALLING THE ROBOT 7

1.1 Unpacking the Robot	7
1.2 Unpacking the Robot Controller	10
1.3 Unpacking the Easy-setup Kit	11
1.4 Checking the Accessories	13
Products included with the robot controller	13
1.5 Equipment Supplied by Customer.....	14
Minimum equipment required (robot + hand)	14
Parts required when using a vision sensor	16
1.6 Equipment Fabricated by Customer	17
1.7 Transporting the robot	18
1.8 Installing the robot	19
1.9 Installing the Robot Controller.....	19
1.10 Installing the Easy-setup Kit	20
Earth leakage breaker / Safety extension unit power supply box	20
EMG / Mode selector switch box.....	20
1.11 Installing the Safety Extension Unit	21

CHAPTER 2 CONNECTING THE ROBOT CONTROLLER, ROBOT, AND PERIPHERALS 22

2.1 Connecting the Power Supply and Grounding Wire to the Safety Extension Unit.....	22
2.2 Connecting the Robot Controller and the Earth leakage Breaker / Safety Extension Unit Power Supply Box	23
2.3 Connecting the Robot Controller and the Safety Extension Unit.....	25
2.4 Connecting the EMG / Mode Selector Switch Box to the Robot Controller.....	26
2.5 Connecting the Robot Controller to the Robot.....	27
2.6 Connecting the Grounding Wire to the Robot	30

CHAPTER 3 OPERATING THE ROBOT 31

3.1 Powering on the Robot, Robot Controller, and Peripherals	31
3.2 Checking the Robot Status with the Status Indicator LED	32
3.3 Moving the Robot by Hand.....	33

CHAPTER 4 CONNECTING THE ROBOT, HAND, AND VISION SENSOR 35

4.1 Connecting the Hand to the Robot	35
4.2 Mounting the Vision Sensor on the Robot	41

PART 2 OPERATION

CHAPTER 5	INSTALLING RT VisualBox ON A COMPUTER	48
5.1	Equipment Required to Install RT VisualBox	48
5.2	Recommended Operating Environment	48
5.3	Points to Check Before Installing RT VisualBox	49
5.4	Starting the Installation Wizard	51
CHAPTER 6	CONNECTING THE COMPUTER TO THE ROBOT CONTROLLER	53
CHAPTER 7	SETTING UP RT VisualBox FOR THE FIRST TIME	55
7.1	Starting RT VisualBox	55
7.2	Interface Overview	63
	Main screen	63
	Program block panel	64
CHAPTER 8	CREATING A PROGRAM WITH RT VisualBox	65
8.1	Creating a program	65
8.2	Deleting Unnecessary Blocks	67
CHAPTER 9	TEACHING POSITIONS TO THE ROBOT	68
CHAPTER 10	SAVING THE PROJECT	82
CHAPTER 11	SETTING A LOW-SPEED SPACE IN THE COLLABORATION AREA	83
CHAPTER 12	CHECKING THE ROBOT MOVEMENT IN STEP OPERATION	89
CHAPTER 13	RUNNING THE PROGRAM	92
CHAPTER 14	STOPPING THE PROGRAM AND EXITING RT VisualBox	93

PART 3 VISION SENSOR

CHAPTER 15	INCORPORATING A VISION SENSOR	97
15.1	Applications	97
15.2	Supported Vision Sensors	97
15.3	Configuring the Vision Sensor Connection Settings	98
15.4	Configuring the Workpiece Transfer Settings	100
	Registering workpiece transfer settings	100
15.5	CREATING A PROGRAM WITH RT VisualBox	107
15.6	CHECKING THE ROBOT MOVEMENT IN STEP OPERATION	108
15.7	RUNNING THE PROGRAM	109
	REVISIONS	111
	TRADEMARKS	112

PART 1 SETUP

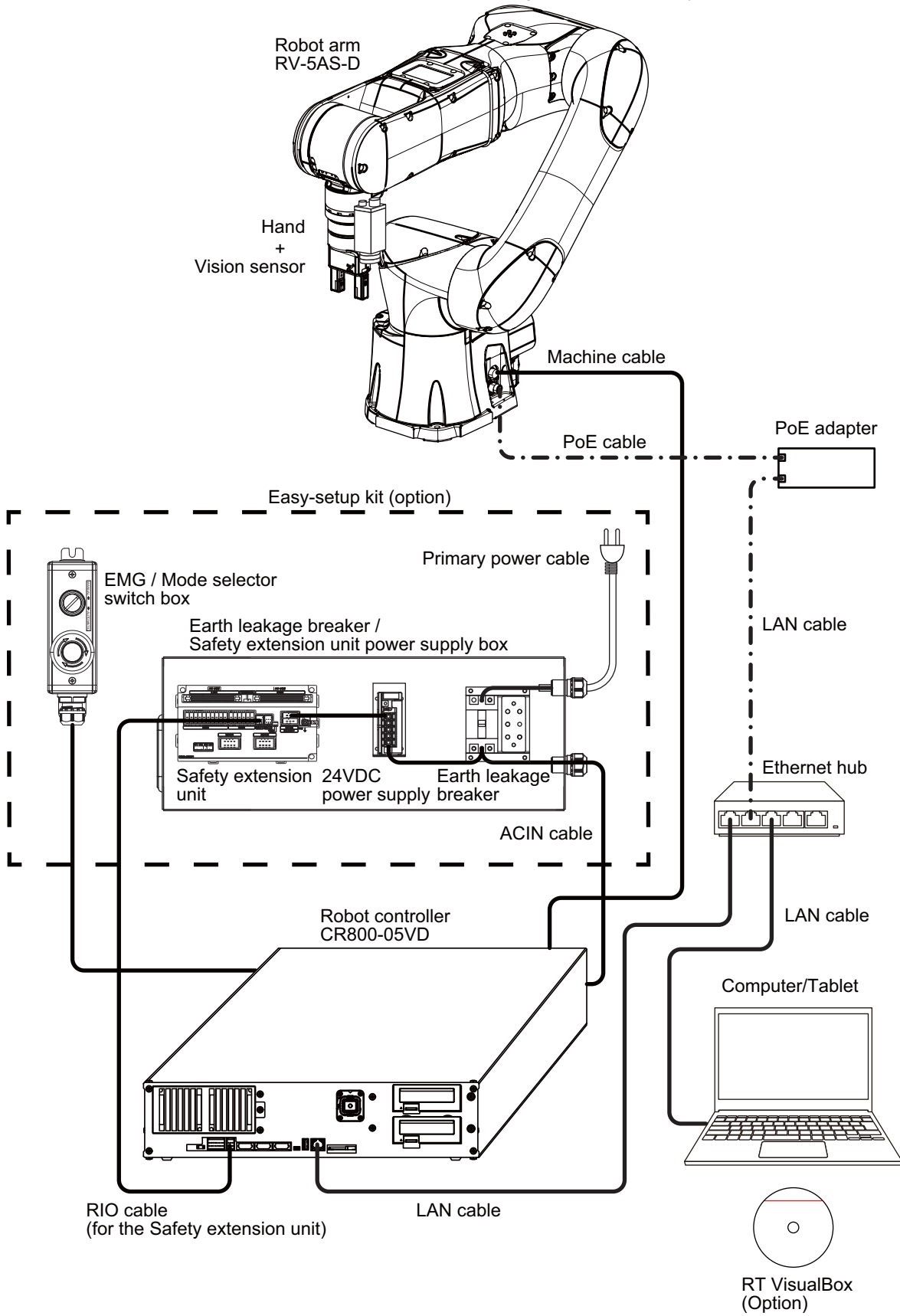
1 STEPS FROM UNPACKING THE ROBOT TO INSTALLING THE ROBOT

2 CONNECTING THE ROBOT CONTROLLER, ROBOT, AND PERIPHERALS

3 OPERATING THE ROBOT

4 CONNECTING THE ROBOT, HAND, AND VISION SENSOR

Part 1 "SETUP" explains what equipment is required for the system below and how to connect the equipment.
 Select the name of a piece of equipment in the figure below to display additional information on that item.



[-] : Included with the Easy-setup kit

- - - : Connect when using a vision sensor

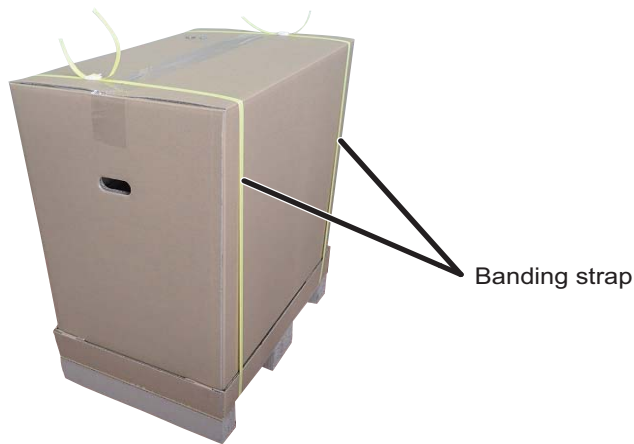
1 STEPS FROM UNPACKING THE ROBOT TO INSTALLING THE ROBOT

1.1 Unpacking the Robot

⚠ CAUTION

Unpack the robot on a flat surface near to where it is to be installed.
Unpacking the robot on an unstable surface may cause the robot to tip over.

1. Cut the banding straps with scissors, then open the box.



2. Pull the box up and remove it.



3. Remove the left and right inserts.



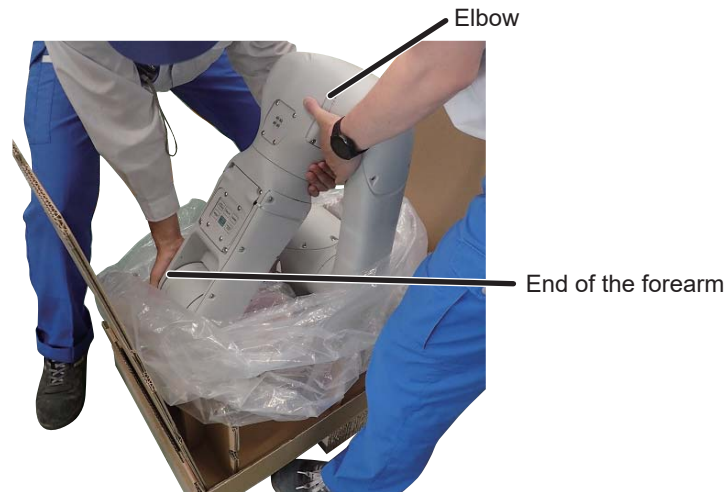
4. Remove the top inserts.



5. Open the plastic bag covering the robot.



6. Remove the robot from the box. When lifting the robot, one person should hold the end of the forearm and elbow, while another person holds the area under the elbow.



Weight: Approx. 32kg

CAUTION

- Place the robot on a flat surface. Fix the robot in place or have somebody support it during installation. External forces may cause the robot to fall if the robot is not fixed in place or supported during installation. Remove the support bracket for the mechanical interface once the robot has been installed.



- The support bracket and packaging are required when relocating the robot. Keep them in a safe place.

1.2 Unpacking the Robot Controller

1. Open the box.



2. Pull up the handles of the inner box, then take out the robot controller.



Weight: Approx. 12.5 kg

3. Remove accessory A.



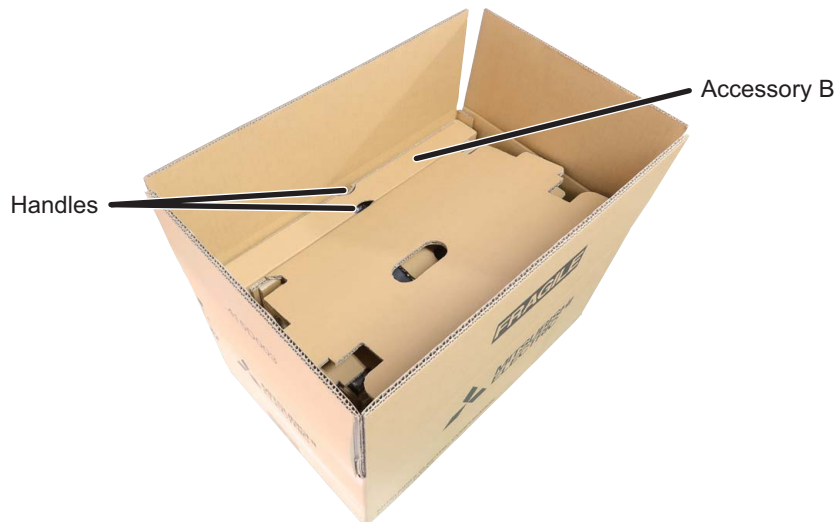
1.3 Unpacking the Easy-setup Kit

The Easy-setup kit is an option.
Continue to section 1.4 if you are not using the Easy-setup kit.

1. Open the box.



2. Remove accessory B using the finger holes.



3. Remove the Easy-setup Kit using the finger holes.



4. Remove the EMG / Mode selector switch box.

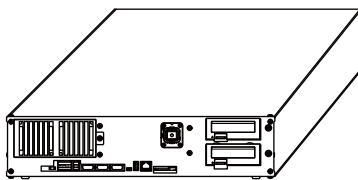
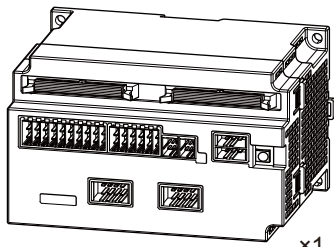
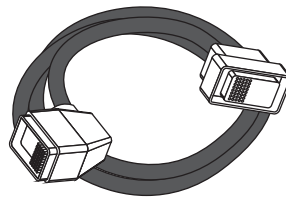

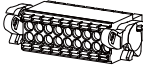
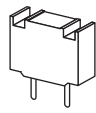
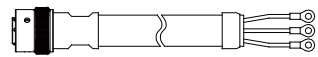



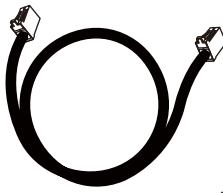
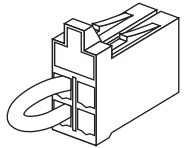
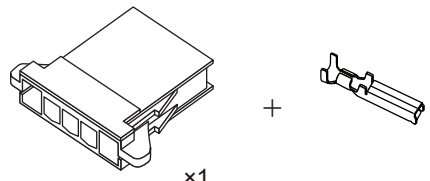
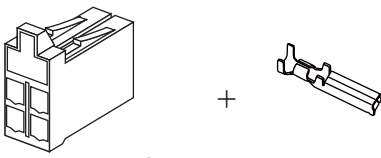
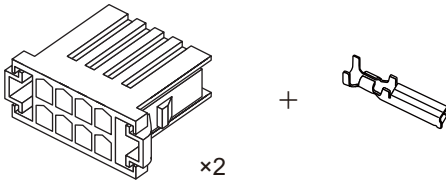
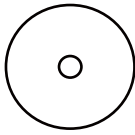
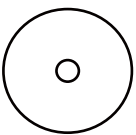


5. Remove the Earth leakage breaker / Safety extension unit power supply box.



1.4 Checking the Accessories

Products included with the robot controller

			
Robot controller x1	Safety extension unit x1	Machine cable x1	
			
CNUSR11 connector*1 x1	CNUSR12 connector x1	Fuse (1.6 A) x1	
			
ACIN cable x1	Robot installation screw (M8x35) x4	Spring washer for robot installation screws x4	
			
		Plain washer for robot installation screws x4	
		 DCIN connector set*2	
RIO cable (1m) x1	Terminator cap x1		
 SDI connector set*2		 SDO connector set*2	
 Robot Safety Option Instruction Manual (CD-ROM) x1		 RV-5AS-D Series Instruction Manual (CD-ROM) x1	
Accessory A			

*1 This connector is not required when using the Easy-setup kit as the kit includes a pre-wired connector.

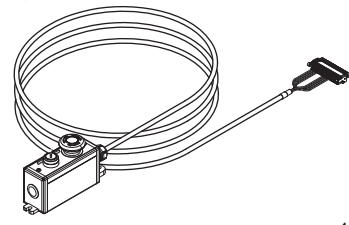
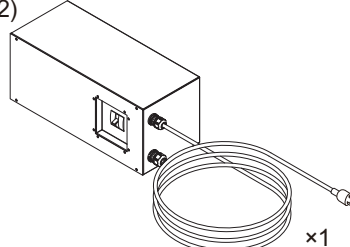
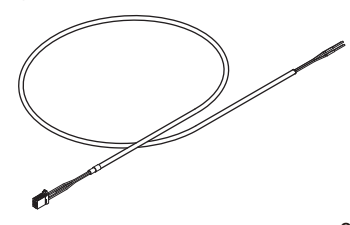
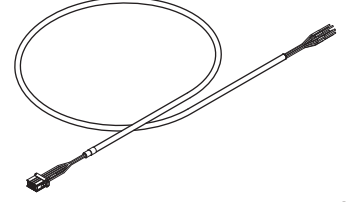
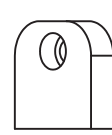

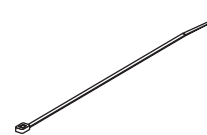


*2 The connector sets are not required when using the Easy-setup kit as the kit includes cables with pre-installed connectors.

1.5 Equipment Supplied by Customer

All of the products manufactured by MELFA robot partner companies can be supplied by Mitsubishi Electric (hands, fingers, suction pads, vision sensors, installation stands, etc.). For further information, refer to the MELFA ASSISTA catalog.

Minimum equipment required (robot + hand)

Parts included in the Easy-setup kit

<p>A-1)</p>  <p>x1</p> <p>EMG / Mode selector switch box</p>	<p>A-2)</p>  <p>x1</p> <p>Earth leakage breaker / Safety extension unit power supply box*1</p>	<p>A-3)</p>  <p>x8</p> <p>SDI cable</p>
<p>A-4)</p>  <p>x2</p> <p>SDO cable</p>	<p>A-5)</p>  <p>x1</p> <p>Support bracket</p>	<p>A-6)</p>  <p>x1</p> <p>Mode selector switch key</p>
<p>A-7)</p>  <p>x2</p> <p>Cable tie</p>	<p>A-8)</p>  <p>x3</p> <p>Safety extension unit fixing screw (M5 x 15)</p>	<p>A-9)</p>  <p>x2</p> <p>EMG / Mode selector switch box fixing screw (M5 x 8)</p>

Accessory B

*1 The plug type will differ depending on the country the product is intended for.

Parts included with the hand

Recommended hands for this product are shown below.



Co-act EGP-C40 N-N-Assista
(Manufactured by SCHUNK)



HRC-03-099455
(Manufactured by Zimmer Group)



KIT-ASSISTA-G
(Manufactured by GIMATIC)



ROB-SET ECBPM ASSISTA
(Manufactured by SCHMALZ)

In this Instruction Manual, the Zimmer HRC-03-099455 will be used for explanation purposes.

- | | | | | |
|--|-------------------------------|----------------------------------|-------------------------------|---------------------------------------|
| B-1) <input type="checkbox"/> | B-2) <input type="checkbox"/> | B-3) <input type="checkbox"/> | B-4) <input type="checkbox"/> | B-5) <input type="checkbox"/> |
| | | | | |
| Hand
(HRC-03-099455
manufactured by
Zimmer Group) | Finger | Finger
installation
screw | Hand bracket | Hand bracket
installation
screw |
| B-6) <input type="checkbox"/> | B-7) <input type="checkbox"/> | B-8) <input type="checkbox"/> | B-9) <input type="checkbox"/> | B-10) <input type="checkbox"/> |
| | | | | |
| Hand bracket
positioning pin | Adapter plate | Adapter plate
positioning pin | Hand installation screw | Hand positioning pin |

Parts

- | | | | | |
|--|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| C-1) <input type="checkbox"/> | C-2) <input type="checkbox"/> | C-3) <input type="checkbox"/> | C-4) <input type="checkbox"/> | C-5) <input type="checkbox"/> |
| | | | | |
| Installation screw
for the
grounding
wire (M4 x 10) | Spring washer | Plain washer | Grounding wire
(#11 AWG) | Grounding wire
(#14 AWG) |
| C-6) <input type="checkbox"/> | | | | |
| | | | | |
| Ethernet hub
(100BASE-TX) | | | | |

Tools

- | | | |
|-------------------------------|-------------------------------|--|
| D-1) <input type="checkbox"/> | D-2) <input type="checkbox"/> | D-3) <input type="checkbox"/> |
| | | |
| Scissors | Hexagon wrench | Phillips-head screwdriver
(length: 18 cm or longer) |

Parts required when using a vision sensor

The following parts are required in addition to the robot and hand.

Parts included with the vision sensor

In this Instruction Manual, the Mitsubishi Electric VS80M-202 will be used for explanation purposes.

E-1)	<input type="checkbox"/>	E-2)	<input type="checkbox"/>
	x1		x4
Vision sensor (VS80M-202 manufactured by Mitsubishi Electric)		Vision sensor installation screw (M3 x 6)	

Parts included with the vision sensor mounting bracket

F-1)	<input type="checkbox"/>	F-2)	<input type="checkbox"/>	F-3)	<input type="checkbox"/>	F-4)	<input type="checkbox"/>
	x1		x2		x2		x2
Vision sensor mounting bracket*1 (1F-ASSISTA-2DVSFLG manufactured by Mitsubishi Electric)		Vision sensor mounting bracket installation screw (M4 x 12)		Vision sensor positioning pin		Cable tie	

*1 The Cognex BKT-IS8K-01 cannot be used with the Vision sensor installation kit.

Devices

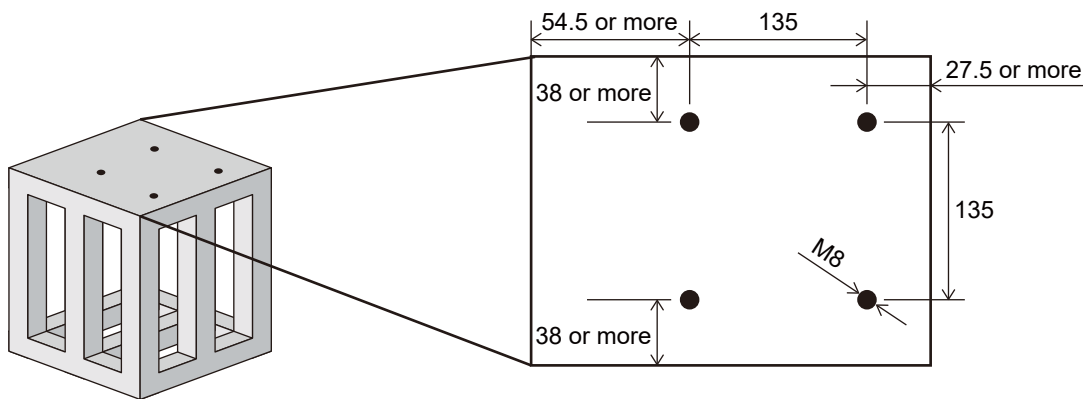
G-1)	<input type="checkbox"/>	G-2)	<input type="checkbox"/>	G-3)	<input type="checkbox"/>
	x1		x1		x1
PoE adapter (CPS-AC-POE1A-JP manufactured by Cognex)		Ethernet hub (100BASE-TX)		C-mount lens (8 mm)	

Parts

H-1)	<input type="checkbox"/>	H-2)	<input type="checkbox"/>
	x2		x1
Ethernet cable (100 BASE-TX)		PoE Ethernet cable (CCB-84901-2001-□ manufactured by Cognex)*1	

*1 indicates the length of the cable.

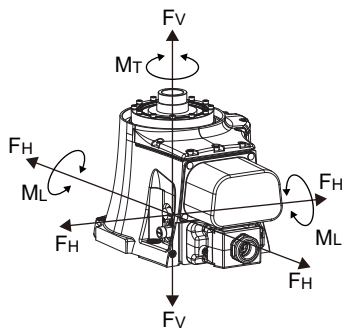
1.6 Equipment Fabricated by Customer



Installation stand
(Surface roughness: 6.3 Ra)

Installation dimensions

The installation stand is subject to the following reaction forces generated by the movement of the robot. The installation stand must have sufficient strength and rigidity to withstand these forces.



Item	Value
Tilt moment (M_L)	325N·m
Torsional moment (M_T)	275N·m
Horizontal direction translation force (F_H)	700N
Vertical direction translation force (F_V)	1010N

Point

A range of accessories developed by MELFA robot partner companies are available (hands, fingers, suction pads, vision sensors, mobile platforms, etc.).

For further information, refer to the MELFA ASSISTA catalog.

- Hand



Co-act EGP-C40
N-N-Assista
(Manufactured by
SCHUNK)



HRC-03-099455
(Manufactured by
Zimmer Group)



KIT-ASSISTA-G
(Manufactured by
GIMATIC)



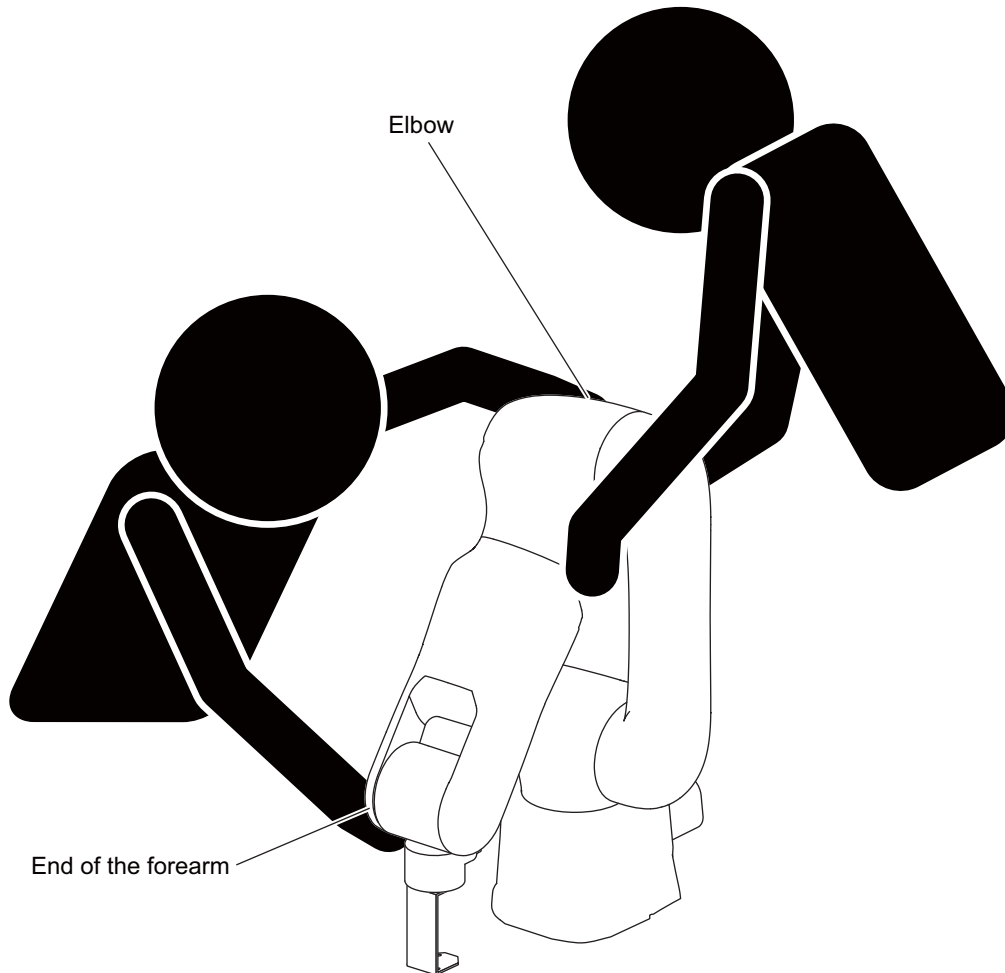
ROB-SET
ECBPM ASSISTA
(Manufactured by
SCHMALZ)

1.7 Transporting the robot

CAUTION

- To prevent accidents, do not transport the robot by holding the cover.
- Minimize the transportation distance of the robot.

1. Move the unpacked robot to where it will be installed. When transporting the robot, one person should hold the end of the forearm and elbow, while another person holds the area under the elbow.



Weight: Approx. 32kg

2. Place the robot in the position it will be installed in.

CAUTION

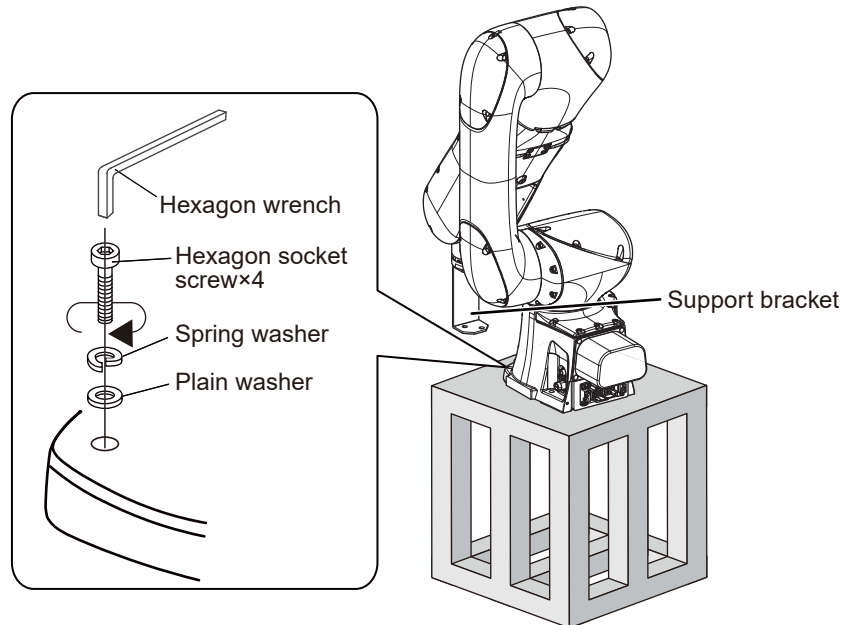
Fix the robot in place or have somebody support it during installation. External forces may cause the robot to fall if the robot is not fixed in place or supported during installation.

1.8 Installing the robot

The following equipment is required.

Item number	Item	Quantity
D-2)	Hexagon wrench/driver	1
Accessory A	Robot installation screw	4
Accessory A	Spring washer for robot installation screws	4
Accessory A	Plain washer for robot installation screws	4
-	Installation stand	1

1. Install the robot on to the level surface of the installation stand (surface roughness: 6.3 Ra). Fix the robot to the stand with the four installation screws. (Recommended tightening torque: 26.5 N•m)



2. Remove the support bracket attached to the mechanical interface.


CAUTION

The support bracket and packaging are required when relocating the robot. Keep them in a safe place.

1.9 Installing the Robot Controller

Install the robot controller on a level surface.

For information on the installation dimensions of the robot controller, refer to the section "Outside dimensions/Installation dimensions" in the following manual:

 RV-5AS-D Standard Specifications (BFP-A3727): Outside dimensions/Installation dimensions

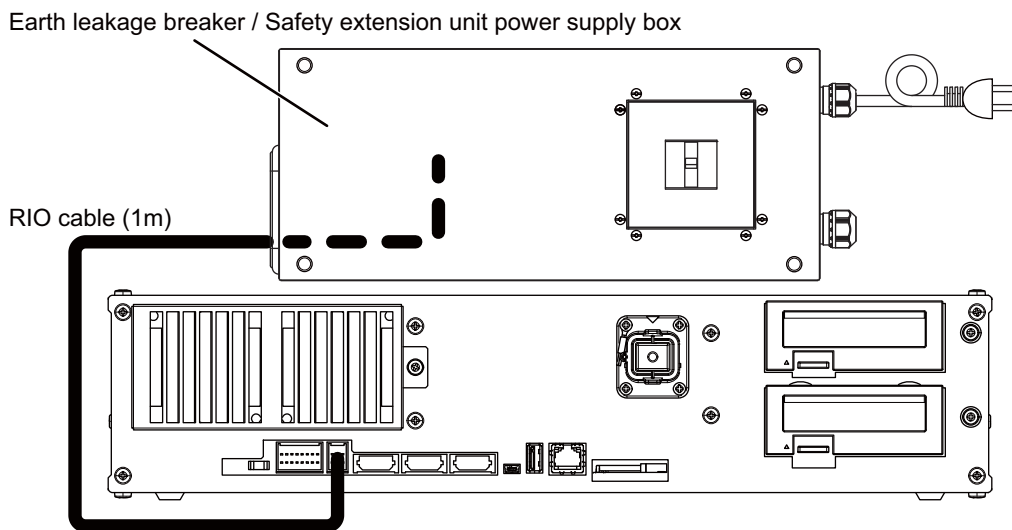
1.10 Installing the Easy-setup Kit

The following equipment is required.

Item number	Item	Quantity	Item number	Item	Quantity
A-1)	EMG / Mode selector switch box	1	A-9)	EMG / Mode selector switch box fixing screw (M5 × 8)	2
A-2)	Earth leakage breaker / Safety extension unit power supply box	1	D-3)	Phillips-head screwdriver (length: 18 cm or longer)	1
A-5)	Support bracket	1	Accessory A	RIO cable	1
A-6)	Mode selector switch key	1	-	-	-

Earth leakage breaker / Safety extension unit power supply box

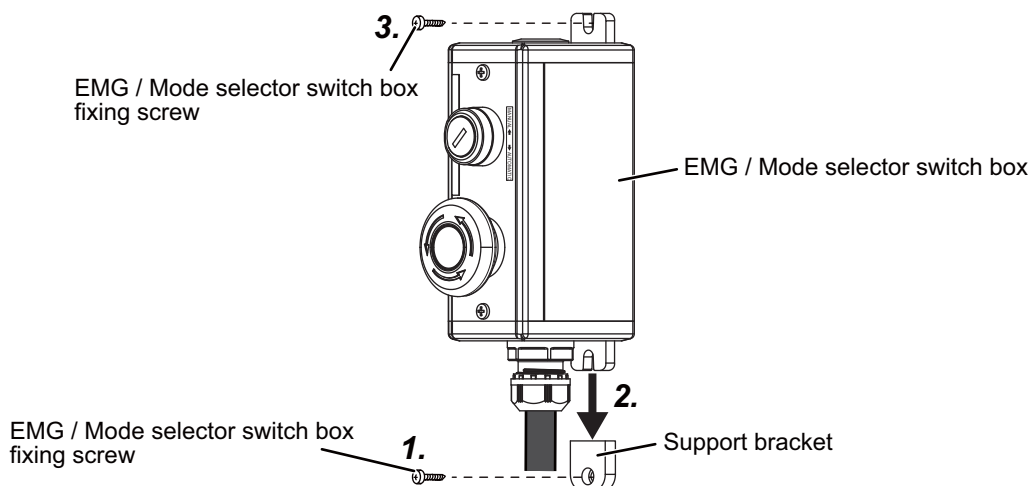
Position the Earth leakage breaker / Safety extension unit power supply box so that it is within reach of the RIO cable (1m).



EMG / Mode selector switch box

Position the EMG / Mode selector switch box in an easily accessible place that is within 3m of the robot controller.

Follow the steps below if you would like to fix the EMG / Mode selector switch box in place.



1. Fix the support bracket (included with the Easy-setup kit) in place using a fixing screw.
2. Slot the lower tab on the EMG / Mode selector switch box into the support bracket.
3. Fix the other side of the EMG / Mode selector switch box in place using a fixing screw.

1.11 Installing the Safety Extension Unit

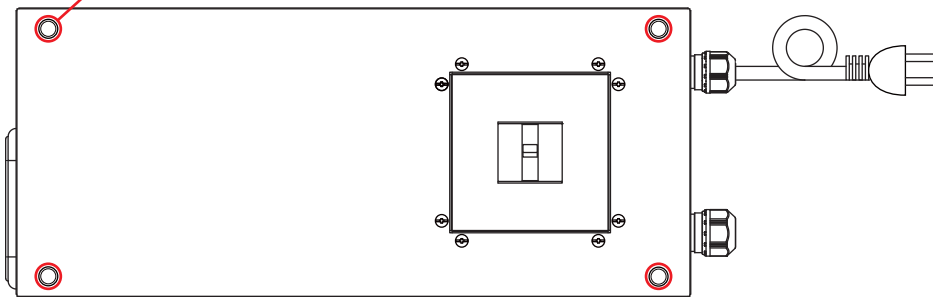
The following equipment is required.

Item number	Item	Quantity
A-2)	Earth leakage breaker / Safety extension unit power supply box	1
A-8)	Safety extension unit fixing screw (M5 × 15)	3
D-3)	Phillips-head screwdriver (length: 18 cm or longer)	1

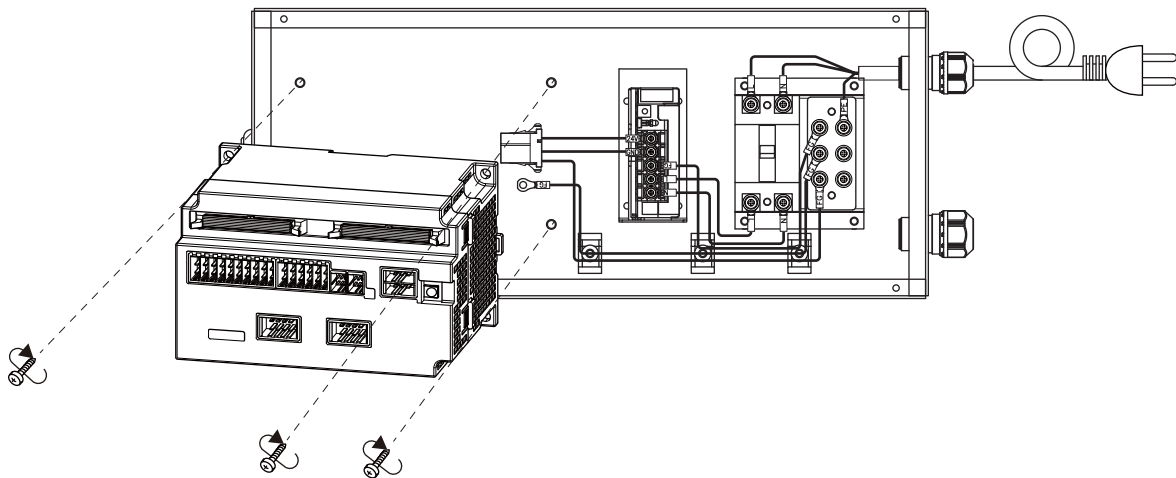
Install the Safety extension unit in the Earth leakage breaker / Safety extension unit power supply box.

1. Remove the fixing screws on the front cover of the Earth leakage breaker / safety extension unit power supply box (four places).

Fixing screws for the front cover of the Earth leakage breaker / Safety extension unit power supply box (four places)



2. Fix the Safety extension unit in place using the fixing screws (three places).

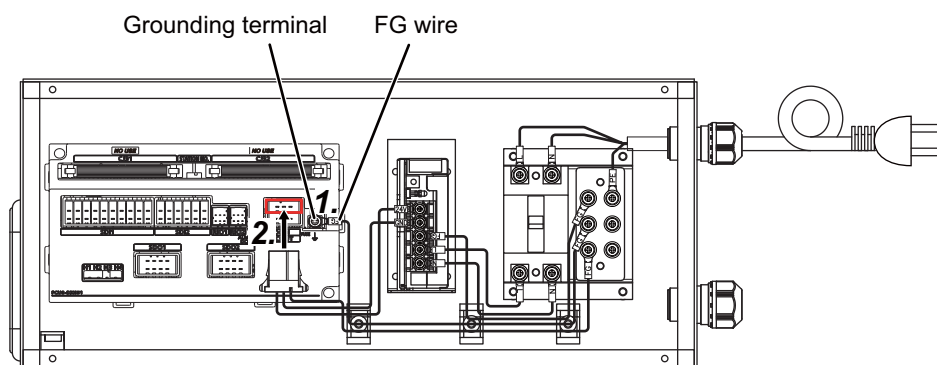


2 CONNECTING THE ROBOT CONTROLLER, ROBOT, AND PERIPHERALS

2.1 Connecting the Power Supply and Grounding Wire to the Safety Extension Unit

The following equipment is required.

Item number	Item	Quantity
A-2)	Earth leakage breaker / Safety extension unit power supply box	1
D-3)	Phillips-head screwdriver (length: 18 cm or longer)	1

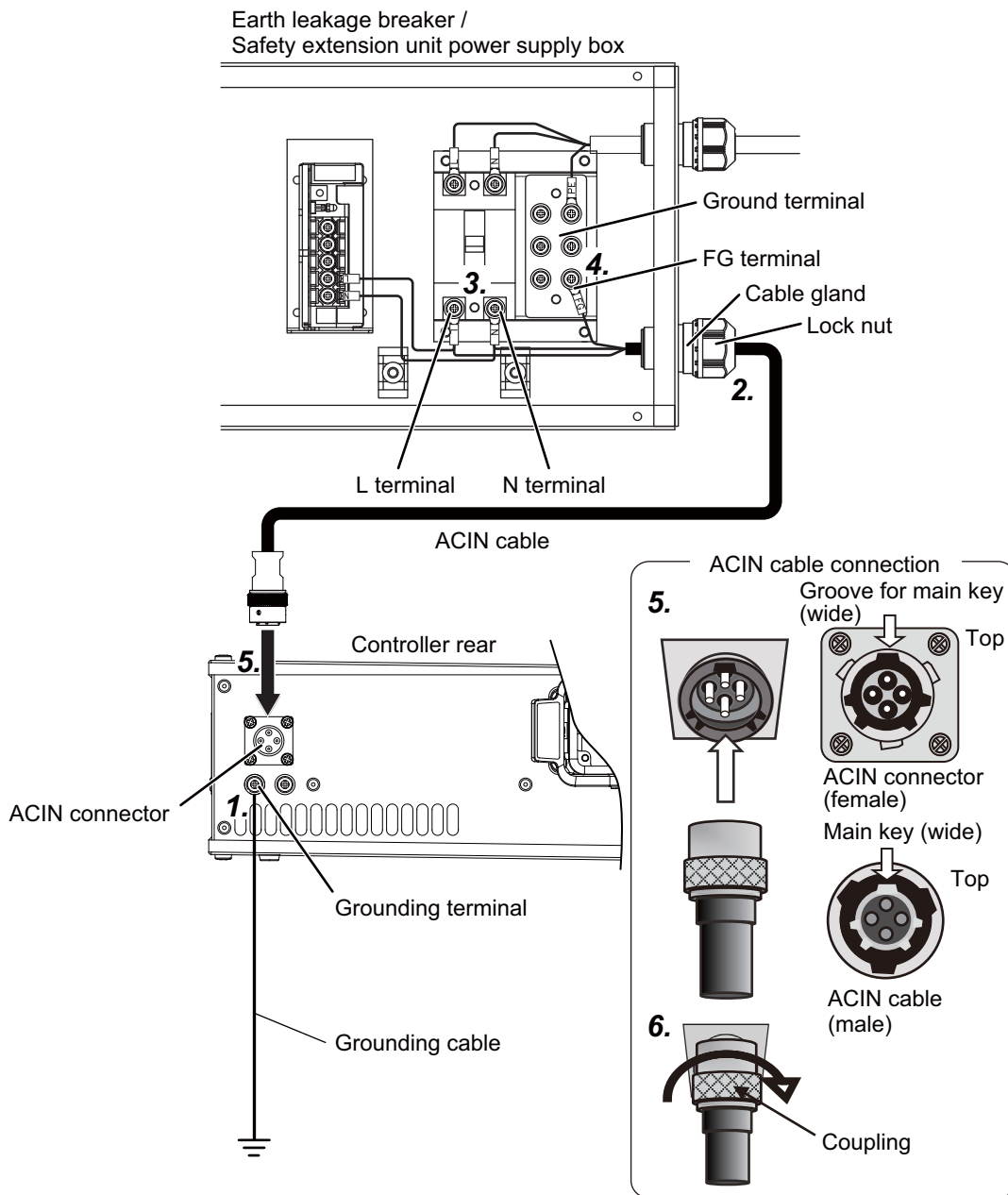


1. Connect the FG wire to the ground terminal of the Safety extension unit.
2. Connect the DCIN cable to the DCIN socket of the Safety extension unit.

2.2 Connecting the Robot Controller and the Earth leakage Breaker / Safety Extension Unit Power Supply Box

The following equipment is required.

Item number	Item	Quantity
A-2)	Earth leakage breaker / Safety extension unit power supply box	1
C-5)	Grounding wire (#14 AWG)	1
D-3)	Phillips-head screwdriver (length: 18 cm or longer)	1
Accessory A	ACIN cable	1



1. Connect the grounding wire to the ground terminal of the robot controller. (Tightening torque: 2 to 3 N·m)
2. Pull the ACIN cable through the cable gland on the Earth leakage breaker / Safety extension unit power supply box. Turn the lock nut counter-clockwise to loosen the cable gland and let the ACIN cable pass through.

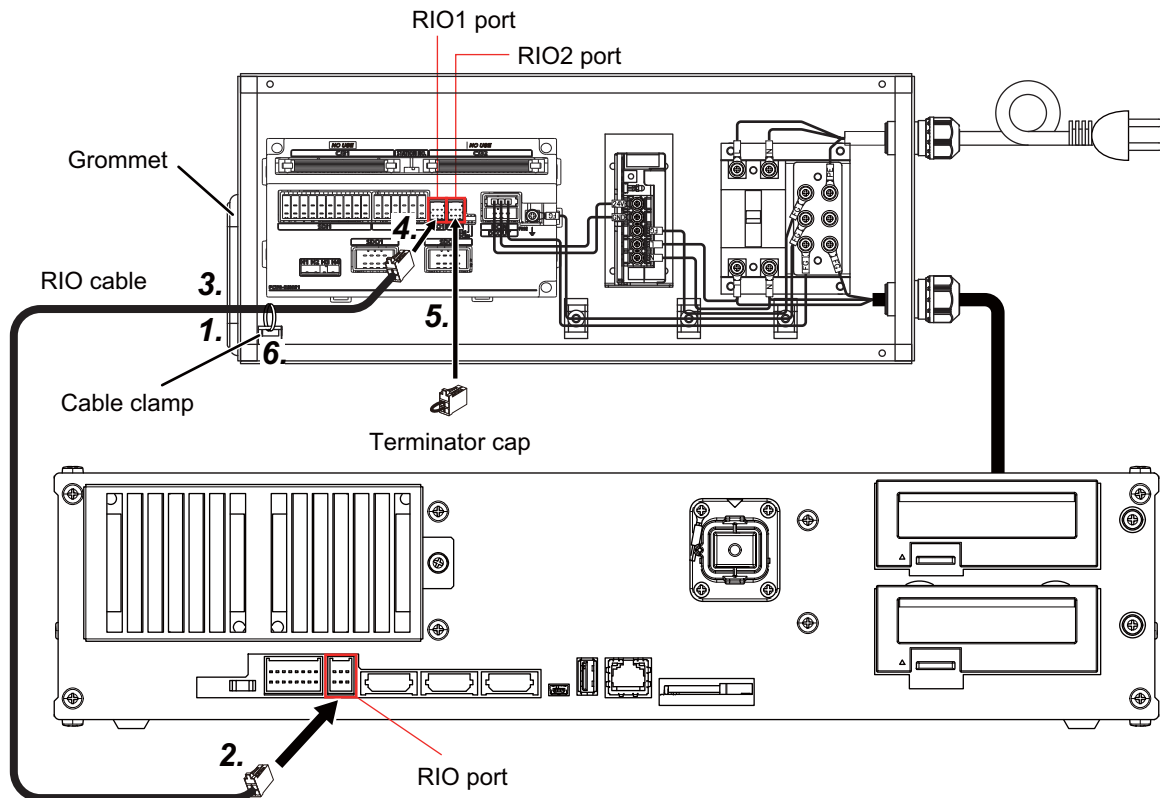
- 3.** Connect the L and N wires of the ACIN cable to the L and N terminals of the earth leakage breaker. Ensure that the flat side of each ring terminal is facing down so that they sit on top of the ring terminals that are already connected to the earth leakage breaker. (Tightening torque: 2 to 3 N·m)
- 4.** Connect the FG wire of the ACIN cable to the FG terminal on the Ground terminal block.
- 5.** Turn the lock nut clockwise to tighten the cable gland and fix the ACIN cable in place.
Hold the cable gland from inside the Earth leakage breaker / Safety extension unit power supply box and turn the lock nut.
- 6.** Connect the ACIN cable to the ACIN socket of the robot controller.
Face the main key on the ACIN cable plug upward. (Refer to the "ACIN cable connection" illustration.)
Align the main key of the ACIN cable plug with the grooves on the ACIN socket. Push the plug into the socket as far as it will go.
The plug may be damaged if it is not correctly aligned with the socket.
- 7.** Tighten the coupling on the ACIN cable, turning it clockwise until it locks.

2.3 Connecting the Robot Controller and the Safety Extension Unit

The following equipment is required.

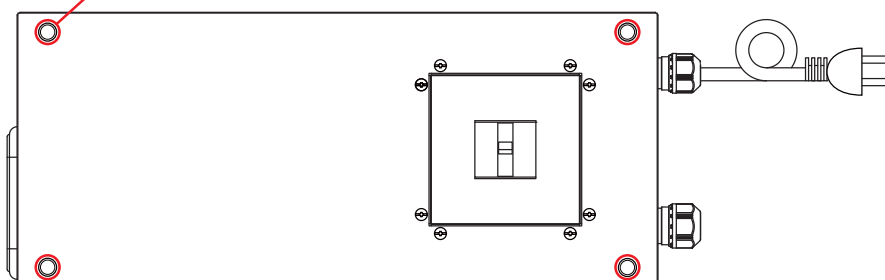
Item number	Item	Quantity
A-2)	Earth leakage breaker / Safety extension unit power supply box	1
A-7)	Cable tie	1
Accessory A	RIO cable	1
Accessory A	Terminator cap	1

2



1. Cut an opening in the grommet to allow the cable through.
2. Connect the RIO cable to the RIO port of the robot controller.
3. Pull the RIO cable through the grommet into the Earth leakage breaker / Safety extension unit power supply box.
4. Connect the RIO cable to the RIO1 socket of the safety extension unit.
5. Connect the terminator cap to the RIO2 socket of the Safety extension unit.
6. Secure the RIO cable to the cable clamp with a cable tie.
7. Reattach the front cover of the Earth leakage breaker / Safety extension unit power supply box.

Fixing screws for the front cover of the Earth leakage breaker / Safety extension unit power supply box (four places)

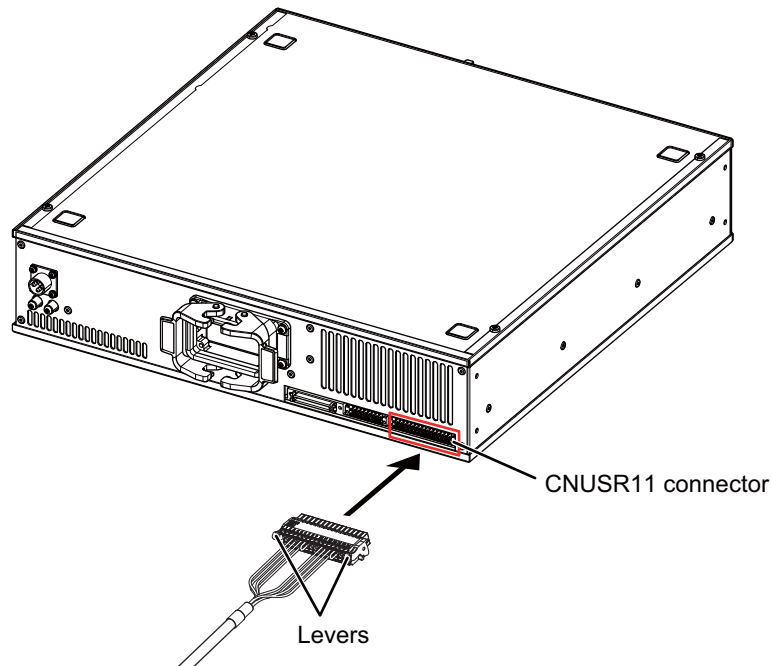


2.4 Connecting the EMG / Mode Selector Switch Box to the Robot Controller

The following equipment is required.

Item number	Item	Quantity
A-1)	EMG / Mode selector switch box	1

1. Connect CNUSR11 connector of the EMG / Mode selector switch box to the CNUSR11 port on the robot controller. Check that the levers on both sides of the CNUSR11 connector are up.



2.5 Connecting the Robot Controller to the Robot

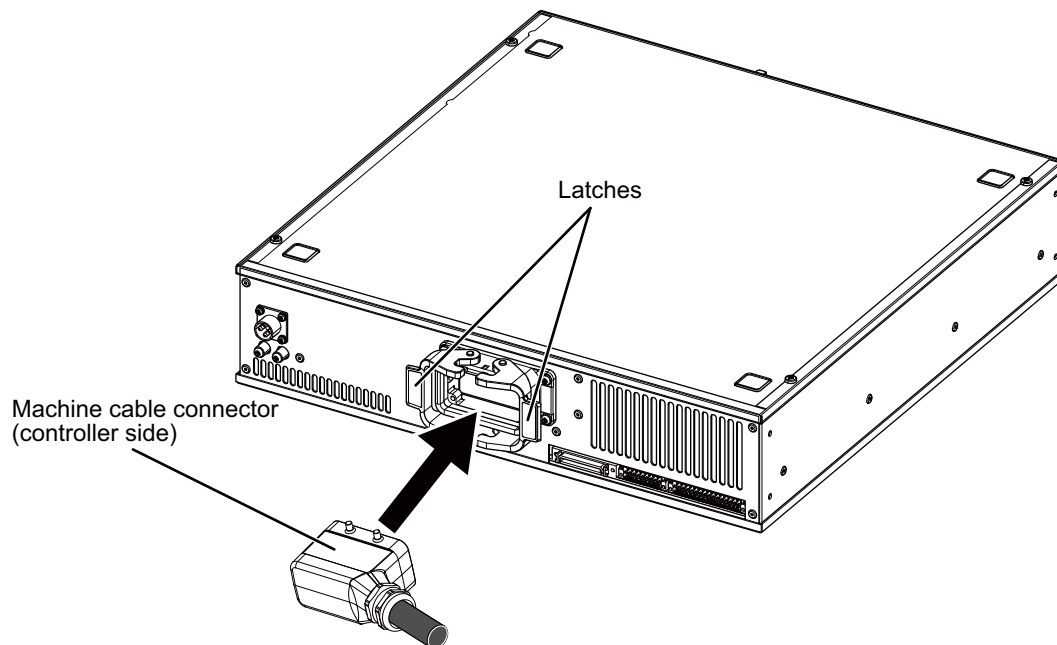
CAUTION

- When connecting the machine cable to the controller, ensure the connector is parallel with the socket. Applying too much pressure to one side of the connector may damage the pins or result in a bad connection.
- Forcibly pulling or excessively bending the cable may cause it to fray or result in damage to the connector.
- Connect the machine cable in an environment that is free from dust and oil mist.

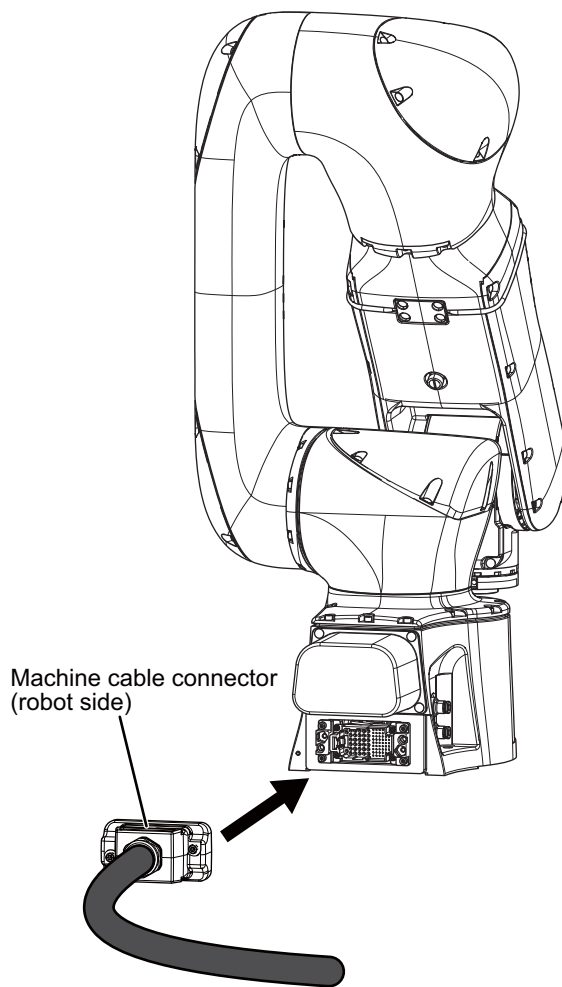
The following equipment is required.

Item number	Item	Quantity
Accessory A	Machine cable	1

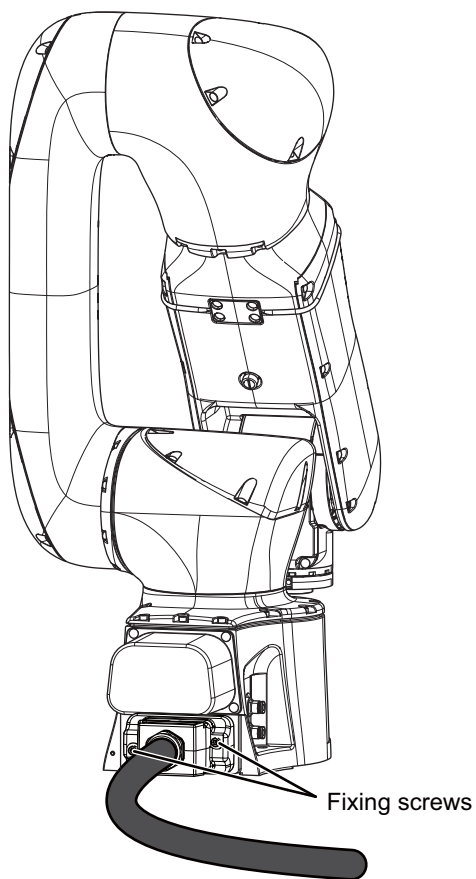
1. Connect the machine cable connector (controller side) to the robot controller. Close the latches to lock the connector in place.



2. Connect the robot side of the machine cable to the robot.



3. Tighten the two fixing screws to lock the connector in place. (Recommended tightening torque: 4.0 N·m)

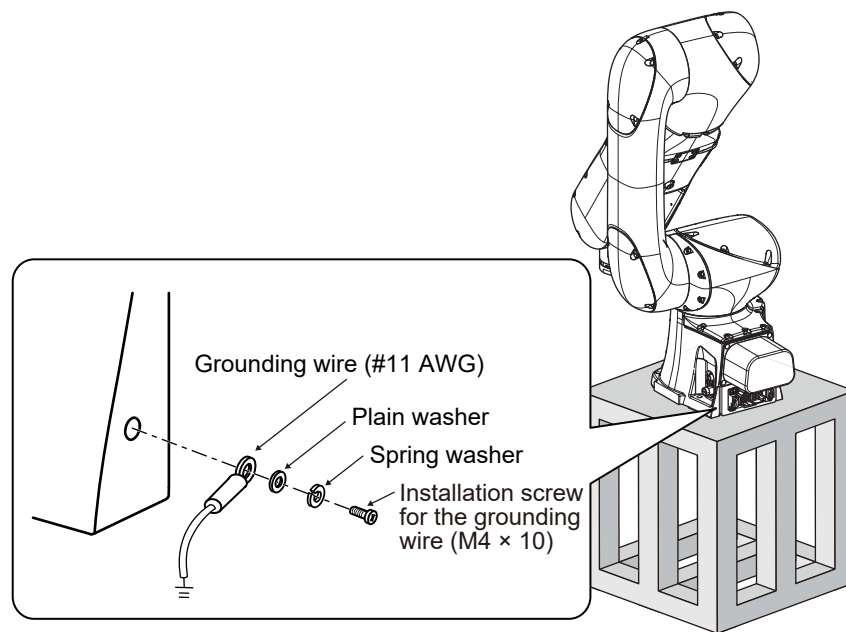


2.6 Connecting the Grounding Wire to the Robot

The following equipment is required.

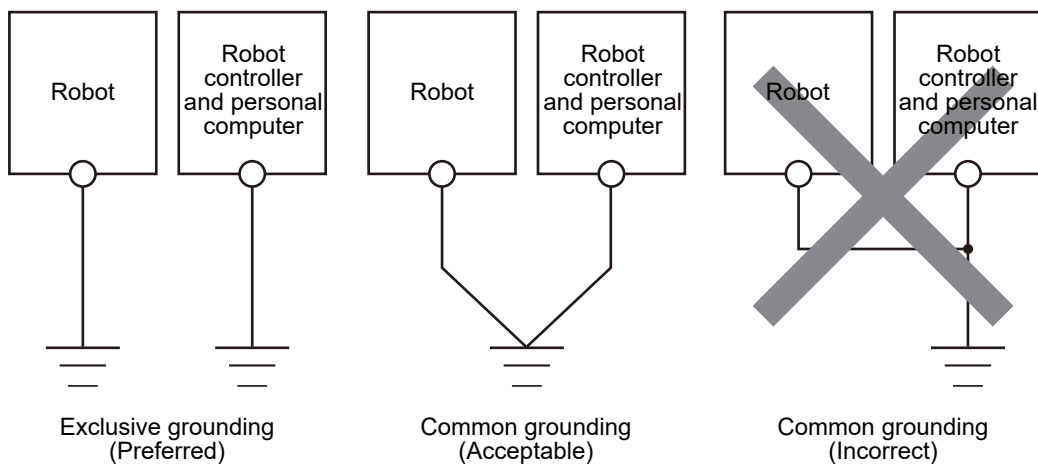
Item number	Item	Quantity
C-1)	Installation screw for the grounding wire (M4 × 10)	1
C-2)	Spring washer	1
C-3)	Plain washer	1
C-4)	Grounding wire (#11 AWG)	1
D-3)	Phillips-head screwdriver (length: 18 cm or longer)	1

Connect the grounding wire to the ground terminal on the robot.



Point

- Ground the robot using the Exclusive grounding method shown below.



- Ground the robot with a ground resistance of 100 ohms or less.

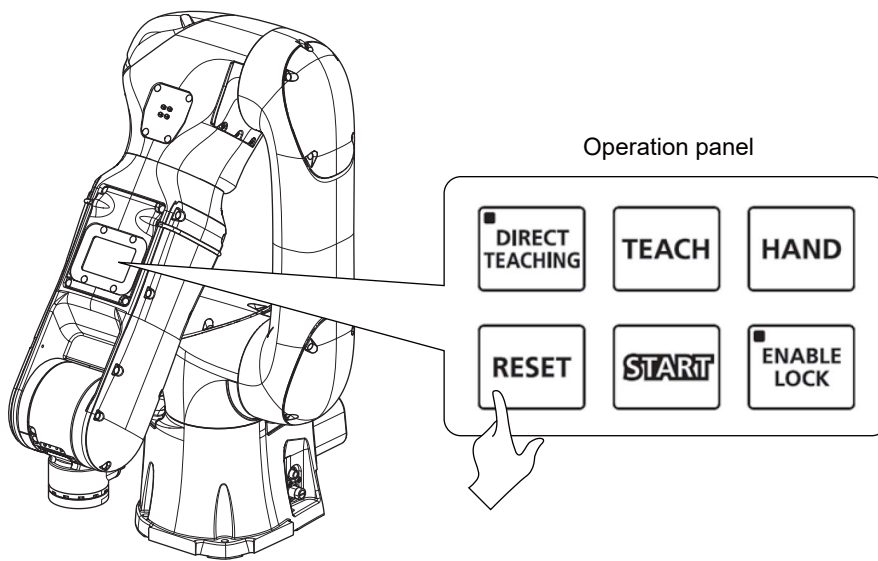
3 OPERATING THE ROBOT

3.1 Powering on the Robot, Robot Controller, and Peripherals

Precautions

The operations performed in this chapter will cause the robot to move. Check that there are no obstacles, such as tools, within the operating range of the robot before turning the power on.

1. Power on the power of the Earth leakage breaker / Safety extension unit power supply box.
If the controller software version is C2d or later, error C0330 will occur upon power on. Press the [RESET] button on the robot arm operation panel to clear the error.

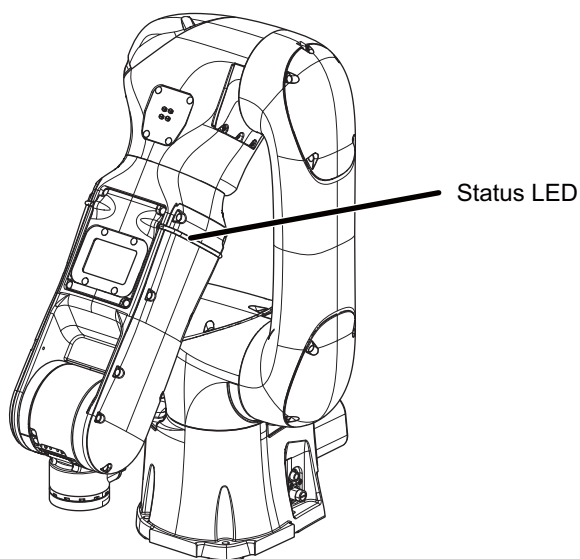


Point

- If you are not using the Easy-setup kit, power on the Safety extension unit, then the robot controller. If the Safety extension unit is not powered on first, an error will occur.
- When the controller software version is C2d or later, error C0330 (Undefined hand condition) will occur upon power on if the hand conditions (weight, size, and center of gravity) have not been set. Error C0330 occurs at every power on until the hand conditions are set. Set the hand conditions in the procedure described later. For details, refer to the following page:
☞ Page 55 SETTING UP RT VisualBox FOR THE FIRST TIME

3.2 Checking the Robot Status with the Status Indicator LED

Check that the Status indicator LED is has turned blue.



For information on the Status indicator LED, refer to the section "Status indicator LED" in the following manual:

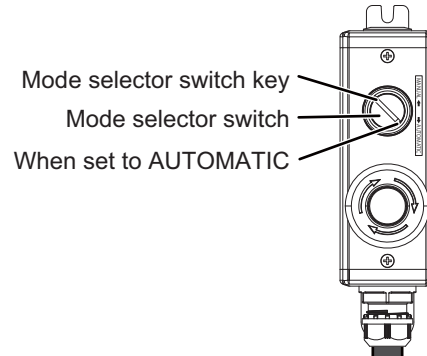
 RV-5AS-D Standard Specifications (BFP-A3727)

3.3 Moving the Robot by Hand

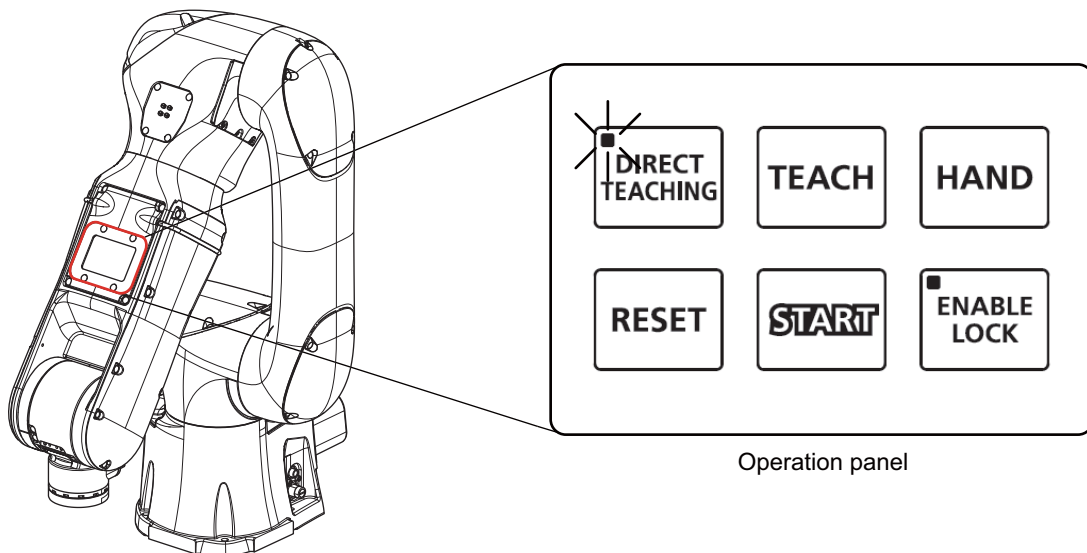
This section explains how to use the direct teaching function to move the robot arm into a position that allows for the hand to be attached.

If an error occurs while moving the robot arm, press the [RESET] button on the robot arm operation panel to reset the error.

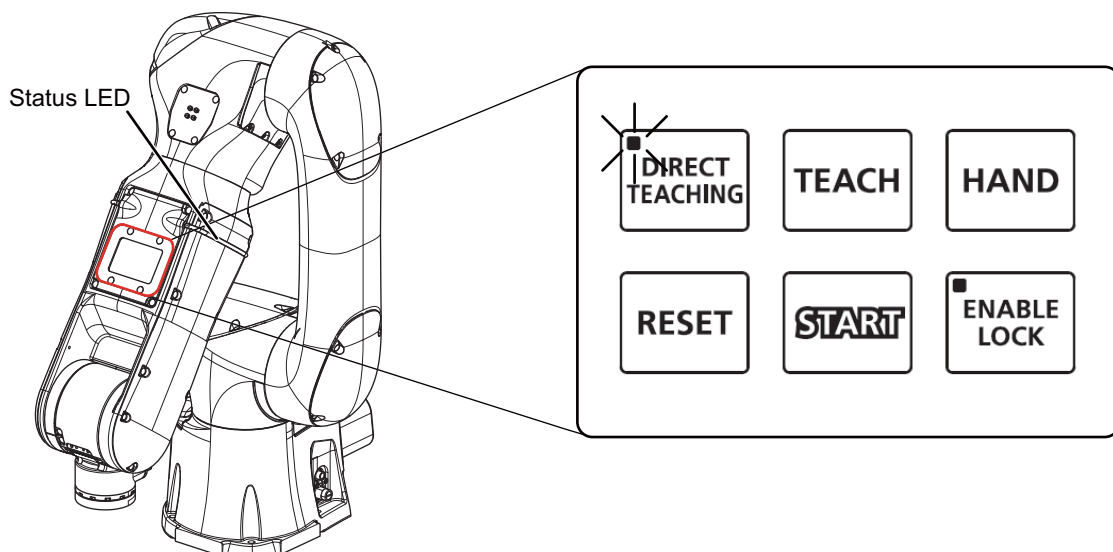
1. Set the mode selector switch to AUTOMATIC mode, then remove the mode selector switch key.



2. Hold down the [DIRECT TEACHING] button on the robot arm operation panel for 2+ seconds. Release the button after the LED has stopped flashing.



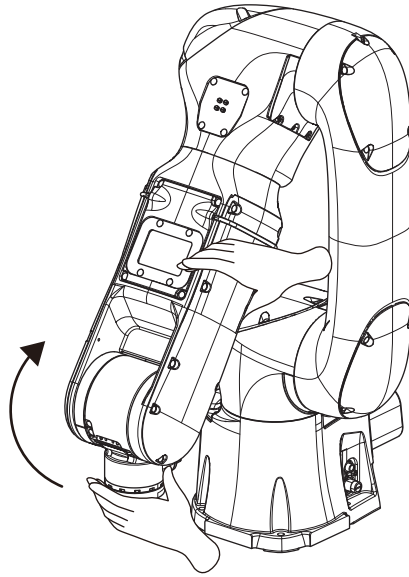
3. Check that the [DIRECT TEACHING] button LED is on or the Status indicator LED is flashing green.



Point 

Press any button on the robot arm operation panel once you have finished teaching the robot.

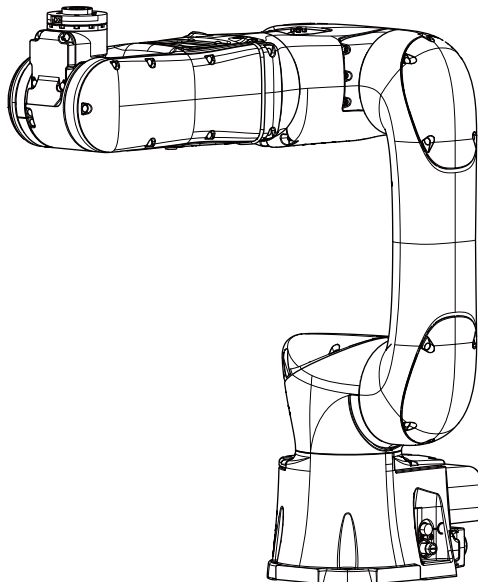
4. Hold the robot arm by hand, and face the hand installation surface upward.



Point 


If an excessive amount of force is applied to the robot arm when teaching the robot directly, an error will occur. Press the [RESET] button on the robot arm operation panel to reset the error. Reduce the amount of force that is applied to the arm when teaching the robot directly.

5. Move the robot arm into the posture shown below, then hold down the [DIRECT TEACHING] button on the robot arm operation panel for 2+ seconds.



6. Check that the [DIRECT TEACHING] button LED turns off or the Status indicator LED has changed from green to blue.
7. Power off the power of the Earth leakage breaker / Safety extension unit power supply box.

For further information on direct teaching, refer to the section "Direct teaching" in the following manual:

 Collaborative Robot: Detailed explanations of functions and operations (BFP-A3735)

4 CONNECTING THE ROBOT, HAND, AND VISION SENSOR

4.1 Connecting the Hand to the Robot

In this Instruction Manual, the Zimmer HRC-03-099455 will be used for explanation purposes.

The steps are mostly the same for other hands, however they may differ in some instances.

For lists of the items required to use recommended hands and information on hand installation, refer to the following document:

📖RV-5AS-D Standard Specifications (BFP-A3727): Connections of recommended hands, recommended vision sensors and the force sensor

The following equipment is required.

Item number	Item	Quantity	Item number	Item	Quantity
B-1)	Hand (HRC-03-099455 manufactured by Zimmer Group)	1	B-7)	Adapter plate	1
B-2)	Finger	1	B-8)	Adapter plate positioning pin	1
B-3)	Finger installation screw	4	B-9)	Hand installation screw	2
B-4)	Hand bracket	1	B-10)	Hand positioning pin	1
B-5)	Hand bracket installation screw	4	D-1)	Scissors	1
B-6)	Hand bracket positioning pin	1	D-2)	Hexagon wrench/driver	1

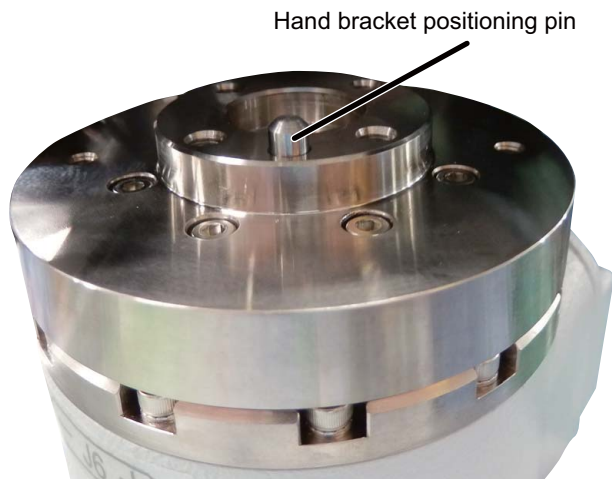
1. Ensure that the robot and peripheral devices are powered off. Check that the Status indicator LED is has turned off.

2. Remove the hand cover screws (two places), then remove the cover.

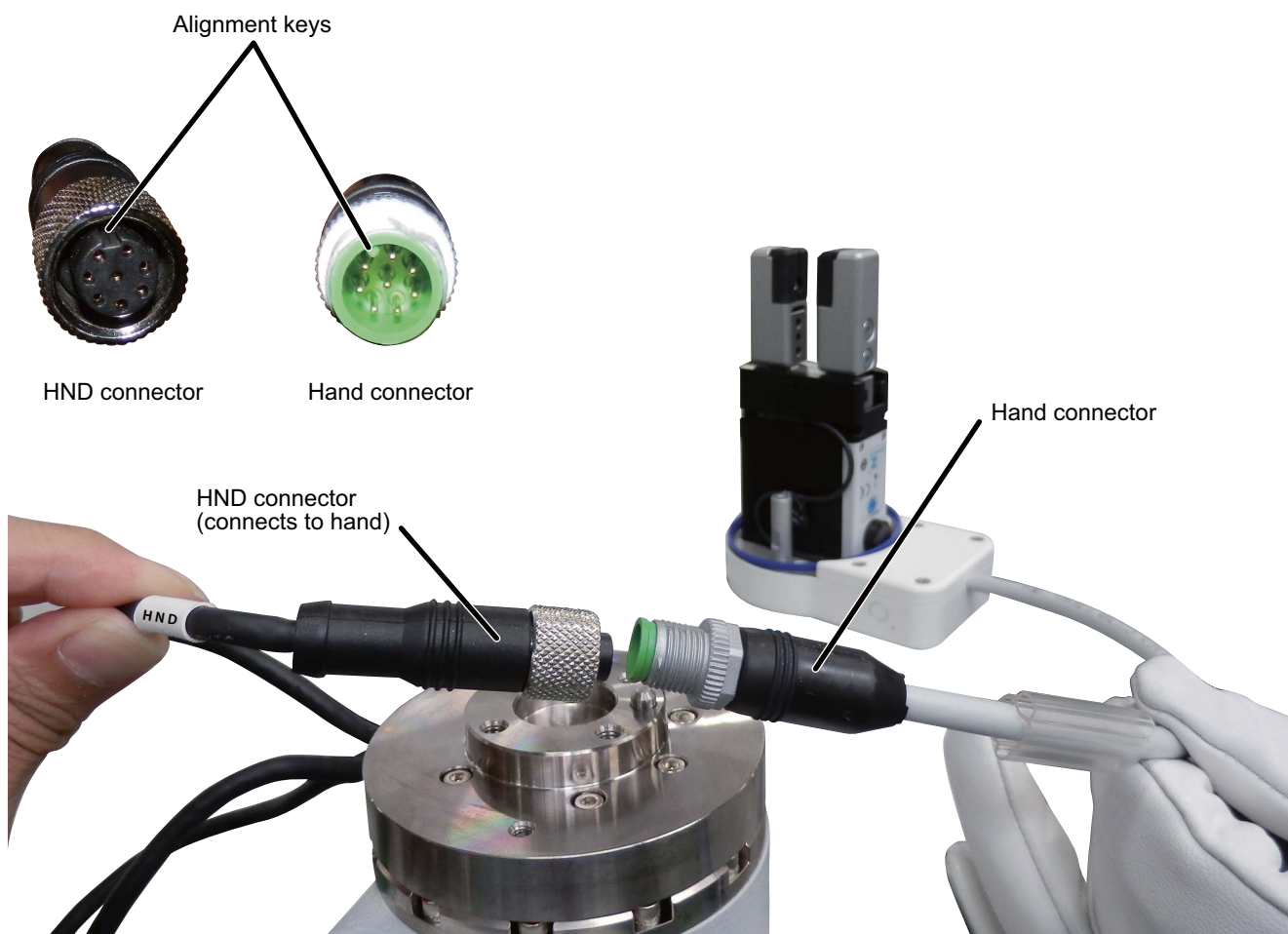
Remove the cover with the hand in the closed position.



- 3.** Insert the hand bracket positioning pin into the alignment hole on the robot flange. Push the pin in until it reaches the bottom of the alignment hole.



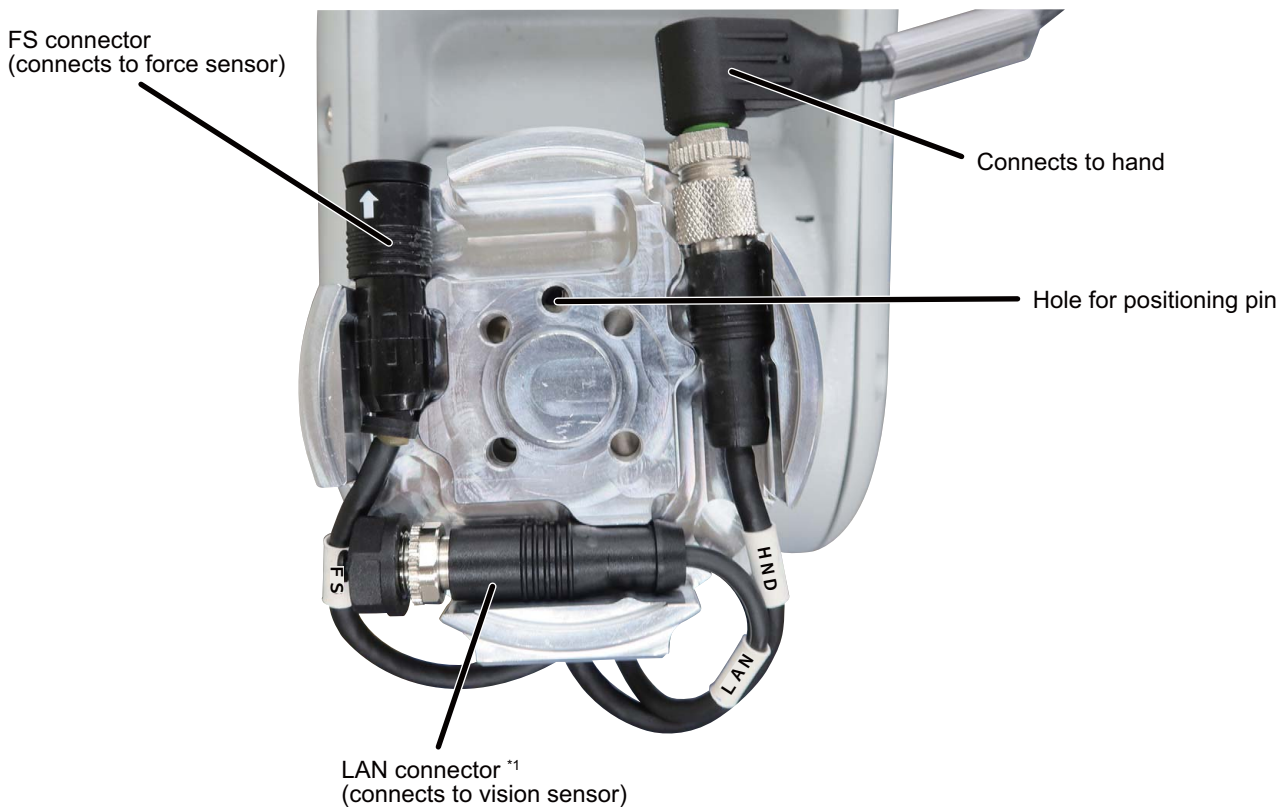
- 4.** Connect the hand connector to the HND connector. Lineup the keys of both connectors before connecting them. Then, tighten the coupling by turning it clockwise. Make sure the hand does not fall.



5. Conceal the connectors in the hand bracket.
Conceal the connectors as shown in the image below.




Hand bracket

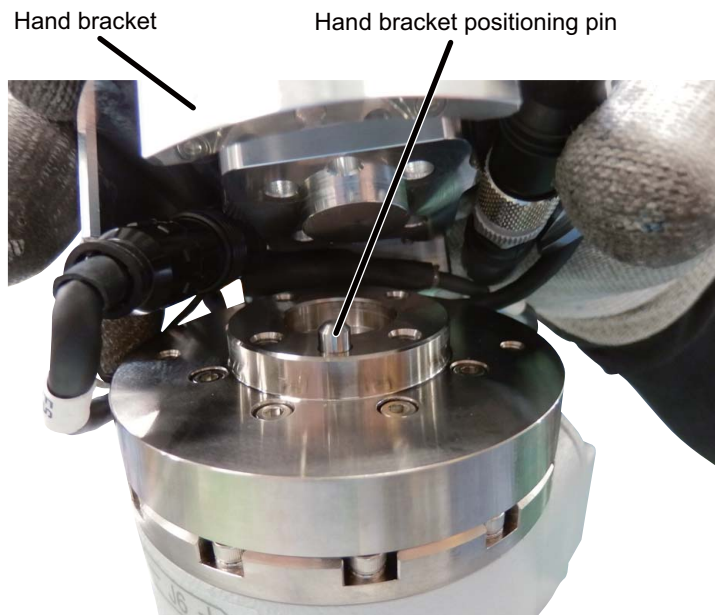


*1 When using a vision sensor, do not conceal the LAN connector in the hand bracket.

Point 

Refer to the following page for information on how to install a vision sensor:
 Page 41 Mounting the Vision Sensor on the Robot

- 6.** Install the hand bracket onto the robot flange. Line up the hole on the bracket with the positioning pin on the robot flange. Be careful not to pinch the cables between the hand bracket and robot flange.

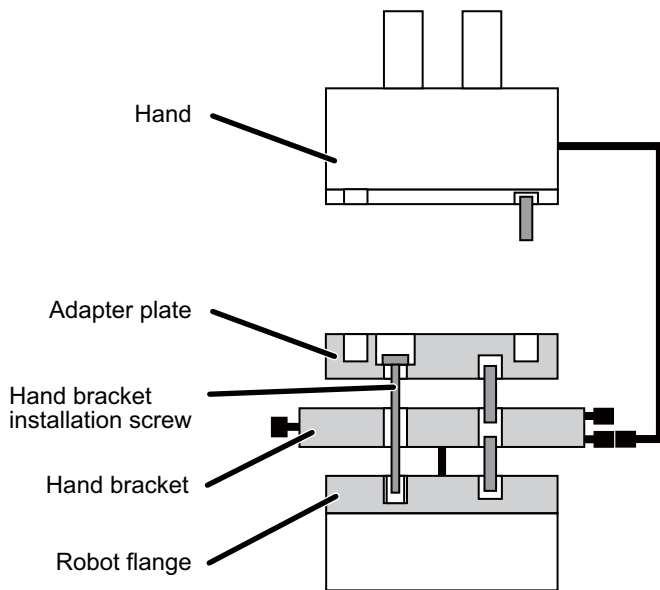
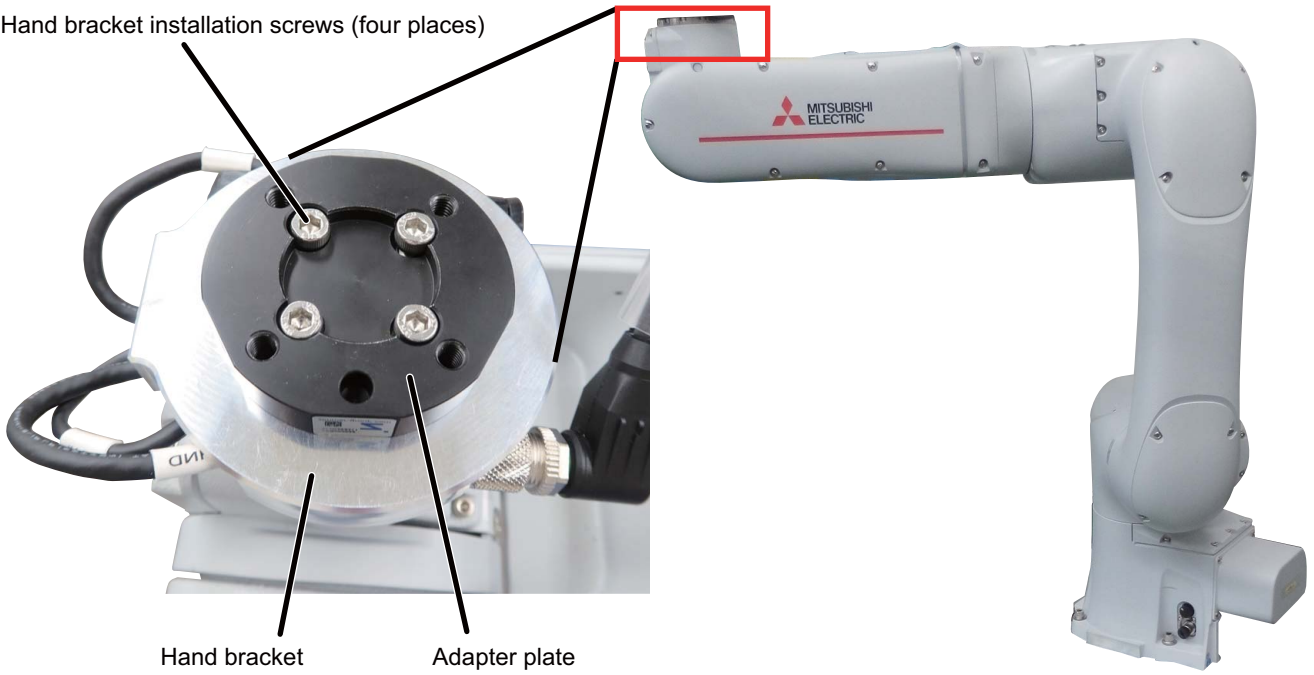


- 7.** Insert the adapter plate positioning pin into the alignment hole on the hand bracket.

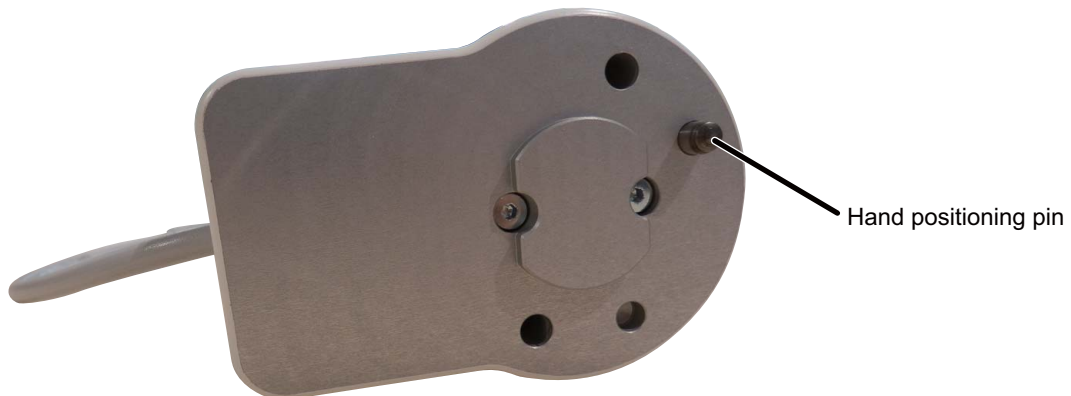


8. Fix the hand bracket and adapter plate to the robot flange. Fix both the hand bracket and the adapter plate to the flange using the hand bracket installation screws (four places).

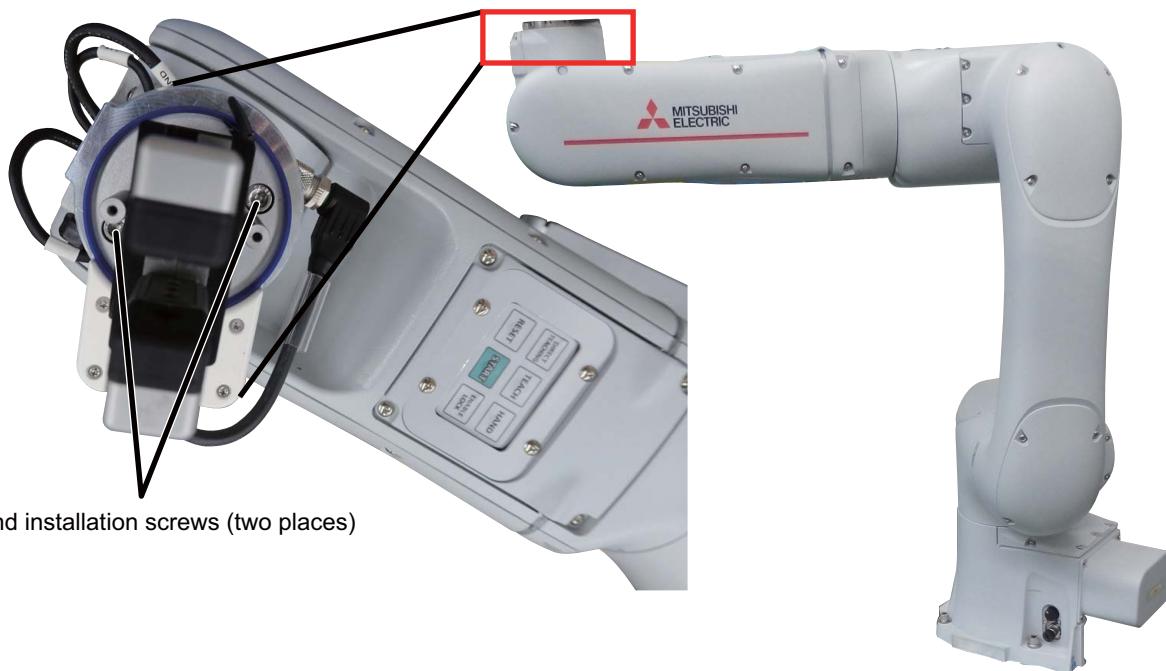
Hand bracket installation screws (four places)



9. Insert the hand positioning pin into the alignment hole on the hand.



10. Fix the hand to the adapter plate. Fix the hand to the adapter plate using the hand installation screws (two places).



11. Reinstall the hand cover that was removed in step 3.



4.2 Mounting the Vision Sensor on the Robot

The following equipment is required.

Item number	Item	Quantity	Item number	Item	Quantity
D-1)	Scissors	1	F-4)	Cable tie	2
D-2)	Hexagon wrench/driver	1	G-1)	PoE adapter (CPS-AC-POE1A-JP manufactured by COGNEX)	1
E-1)	Vision sensor (VS80M-202 manufactured by Mitsubishi Electric)	1	G-2)	Ethernet hub (100BASE-TX)	1
E-2)	Vision sensor installation screw (M3 × 6)	4	G-3)	C-mount lens (8 mm)	1
F-1)	Vision sensor mounting bracket (1F- ASSISTA-2DVSFLG manufactured by Mitsubishi Electric)	1	H-1)	Ethernet cable (100 BASE-TX)	1
F-2)	Vision sensor mounting bracket installation screw (M4 × 12)	2	H-2)	PoE Ethernet cable (CCB-84901-2001-# manufactured by Cognex)	1
F-3)	Vision sensor positioning pin	2	-	-	-

1. Ensure that the robot and peripheral devices are powered off. Check that the Status indicator LED is has turned off. Turn the C-mount lens clockwise to attach it to the vision sensor.



2. Attach the vision sensor to the bracket using the vision sensor mounting bracket installation screws (four places).

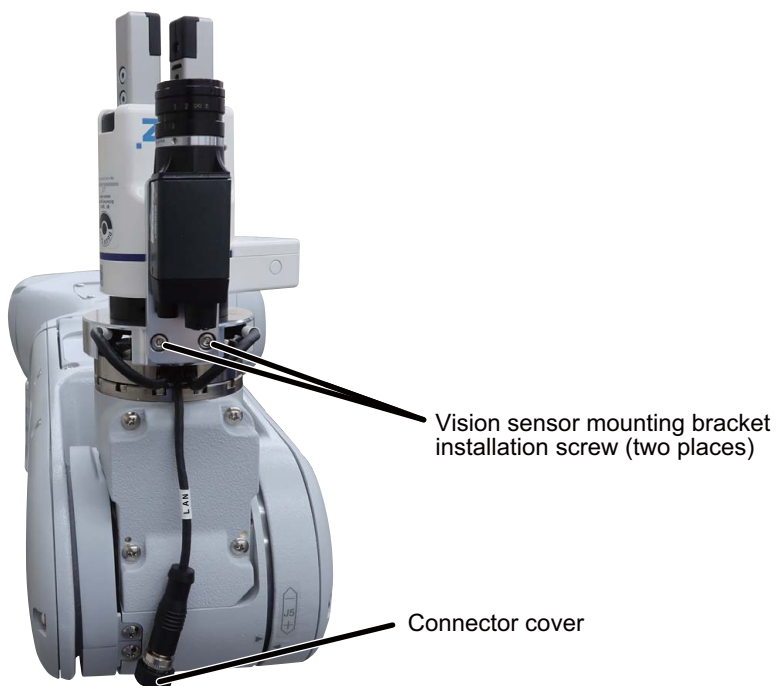
Vision sensor mounting bracket installation screws (four places)



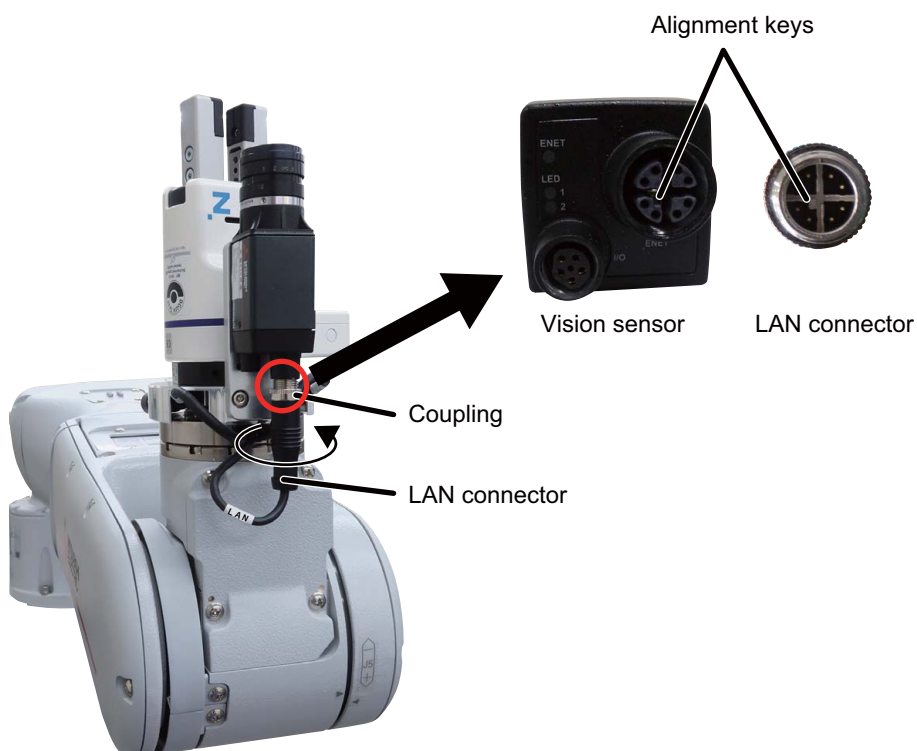
3. Insert the vision sensor positioning pins into the alignment holes on the vision sensor mounting bracket.



4. Fix the vision sensor to the hand bracket using the vision sensor mounting bracket installation screws (two places).



5. Remove the cover from the LAN connector. Line up the both the LAN connector and vision sensor connector before connecting them. Then, tighten the LAN connector coupling by turning it clockwise. Keep the LAN connector cover in a safe place.

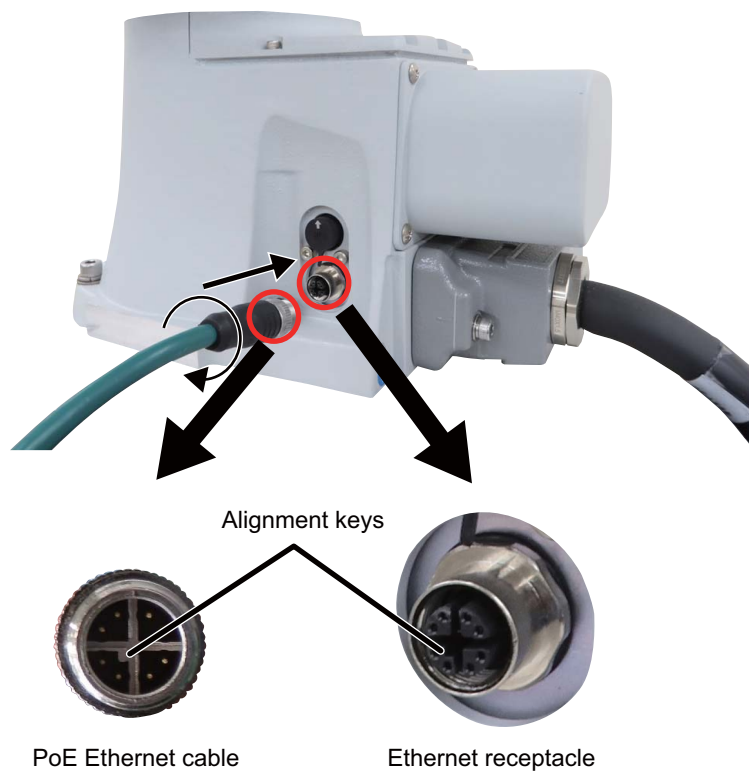


- 6.** Secure the LAN cable to the LAN connector, and the HND cable to the LAN cable using cable ties. Use another cable tie to secure the FS cable in place.

Ensure that the LAN cable does not come into contact with the robot arm.



- 7.** Connect the PoE Ethernet cable to the Ethernet receptacle on the robot. Line up the keys of both the PoE Ethernet cable connector and the Ethernet receptacle before connecting them. Then, tighten the PoE Ethernet cable coupling by turning it clockwise.



8. Connect the other end of the PoE Ethernet cable to the PoE adapter OUT port.



9. Connect the Ethernet hub using an Ethernet cable via the PoE adapter IN port.



10. Connect the power cable to the PoE adapter.

PART 2 OPERATION

5 INSTALLING RT VisualBox ON A COMPUTER

6 CONNECTING THE COMPUTER TO THE ROBOT CONTROLLER

7 SETTING UP RT VisualBox FOR THE FIRST TIME

8 CREATING A PROGRAM WITH RT VisualBox

9 TEACHING POSITIONS TO THE ROBOT

10 SAVING THE PROJECT

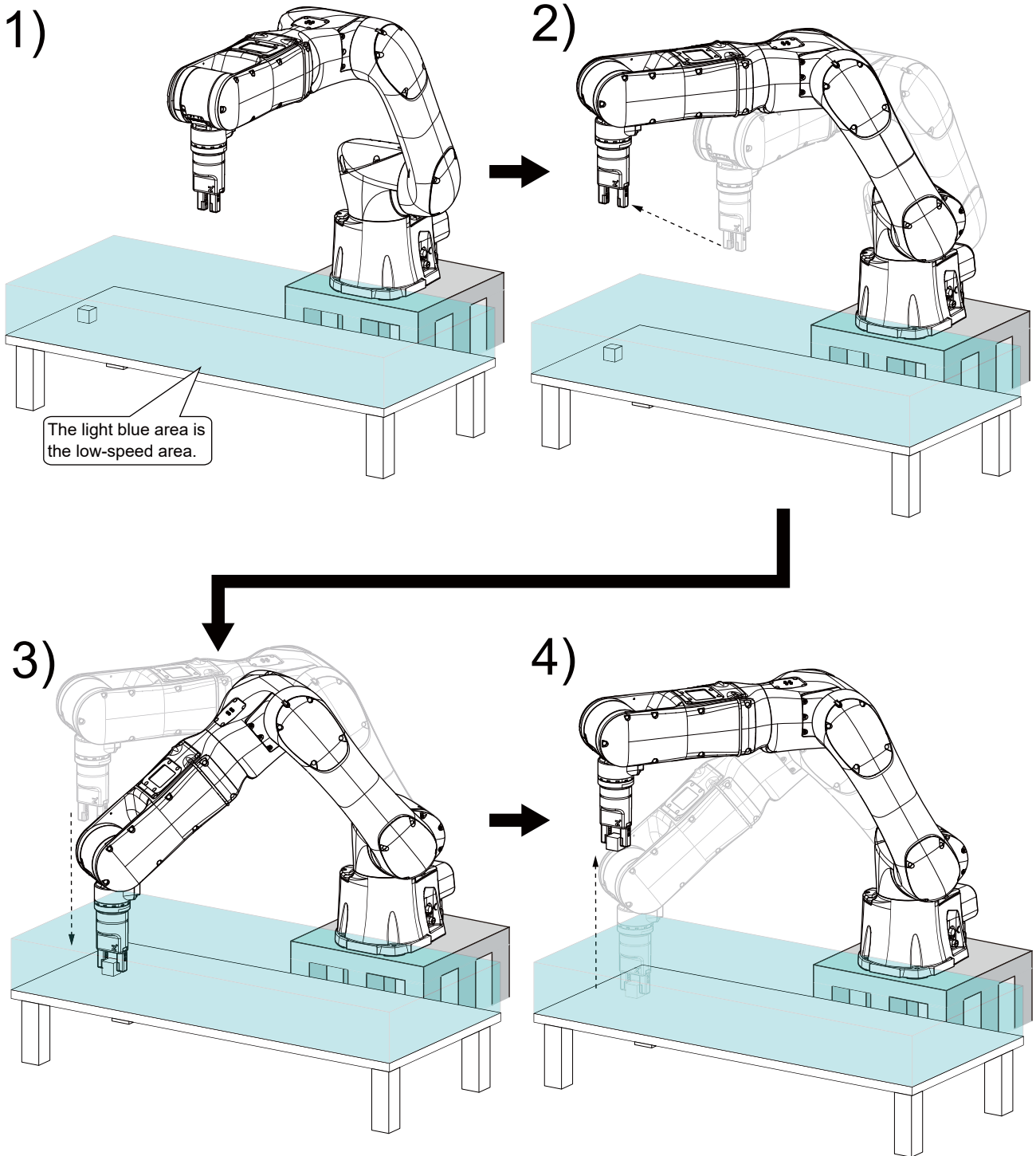
11 SETTING A LOW-SPEED SPACE IN THE COLLABORATION AREA

12 CHECKING THE ROBOT MOVEMENT IN STEP OPERATION

13 RUNNING THE PROGRAM

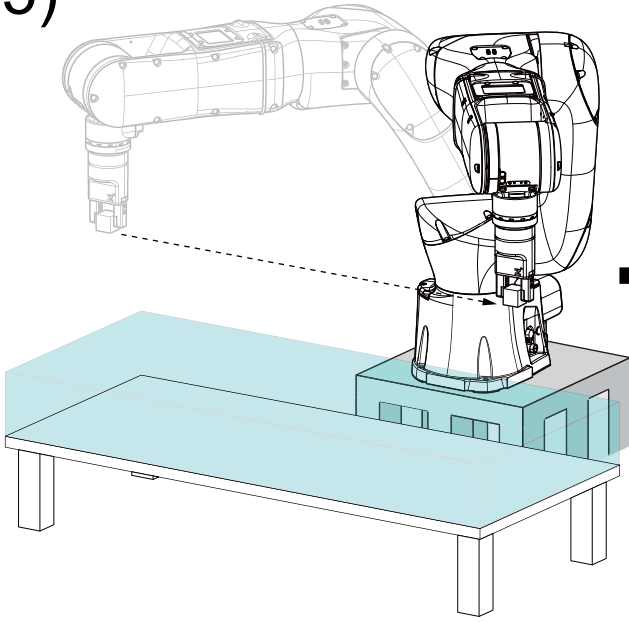
14 STOPPING THE PROGRAM AND EXITING RT VisualBox

This part explains how to connect a robot to RT VisualBox, how to create a program, and how to use that program to operate the robot. The hand and workpiece platform used in this section are examples. Select a hand and a workpiece platform that are suitable for the system you want to create. The program that will be created in this part of the manual will instruct the robot to operate in the manner shown in the figures below. The light blue area in the figures below indicates a low-speed space. The low-speed space is a space in the collaboration area where it is necessary to reduce the possibility of harm to people. For an explanation of technical terms, refer to the section "Terms" in the following manual: [Collaborative Robot: Detailed explanations of functions and operations \(BFP-A3735\)](#)

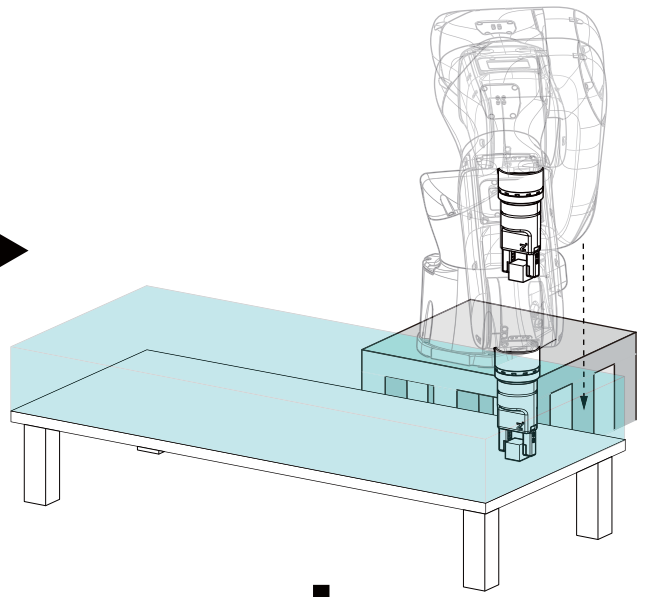


Continue to step 5.
(On the next page)

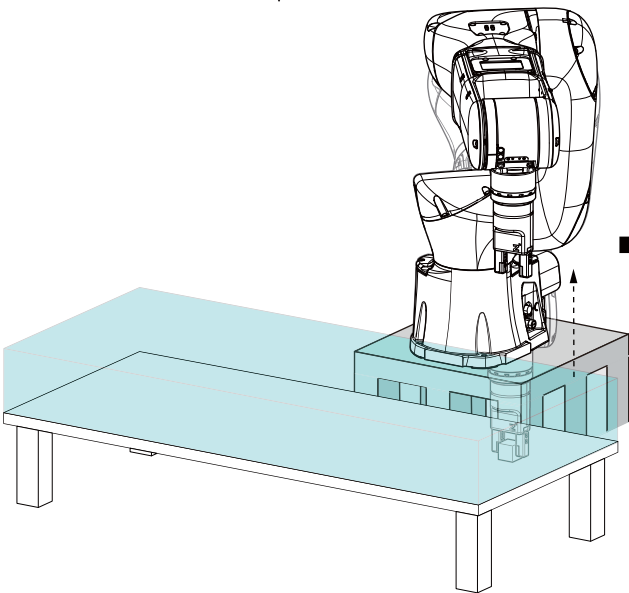
5)



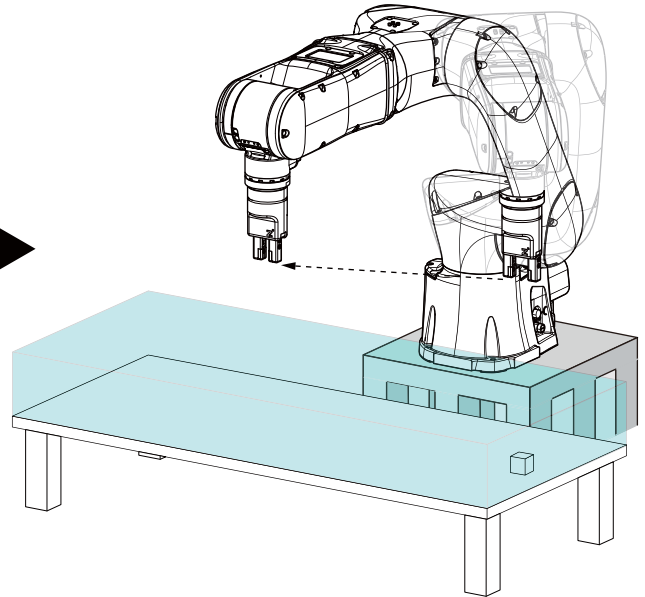
6)



7)



8)



Go back to step 1.

5 INSTALLING RT VisualBox ON A COMPUTER

Precautions

If RT VisualBox has already been installed on the computer, uninstall it before installing the latest version of RT VisualBox. When installing RT VisualBox, log in as a user with administrator rights. The system will not let you install the software if you log in as a user who does not have administrator rights.

Close all running applications before installation. If you install RT VisualBox while other applications are running, it may not work properly.

Only one robot controller can be connected to RT VisualBox. It is not possible to connect multiple robot controllers to RT VisualBox at the same time.

RT VisualBox, RT ToolBox2, and RT ToolBox3 cannot be run alongside each other.

5.1 Equipment Required to Install RT VisualBox

- Computer/Tablet
- LAN cable (10Base-T or 100Base-TX)
- RT VisualBox installer CD-ROM
- License Certificate (The Product Name and Product ID are printed on this certificate.)

5.2 Recommended Operating Environment

	System requirements
CPU / Graphics	Intel® Core™ i3; 2 GHz or more / Graphics card with 1 GB or more of VRAM
Memory	64-bit OS: 2 GB or more
Storage	5 GB or more
Virtual memory	512 MB or more
Display	1280 × 1024 or more recommended, 1024 × 768 minimum required
Disk drive	CD-ROM
Input interface	Touchscreen or mouse and keyboard
Communication functions/ports	Either USB 2.0 or LAN (100Base-TX or 10Base-T)
Operating system	Windows 10 Home (64 bit) ^{*1} , Windows 10 Pro (64 bit) ^{*1} , Windows 10 Enterprise (64 bit) ^{*1}

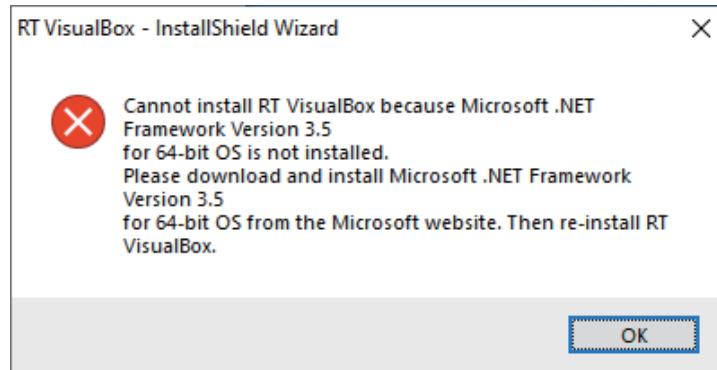
*1 Before installing RT VisualBox, enable ".NET Framework 3.5 (includes .NET 2.0 and 3.0)".

For details on how to check the current settings and how to enable Windows features, refer to the following page:

 Page 49 Points to Check Before Installing RT VisualBox

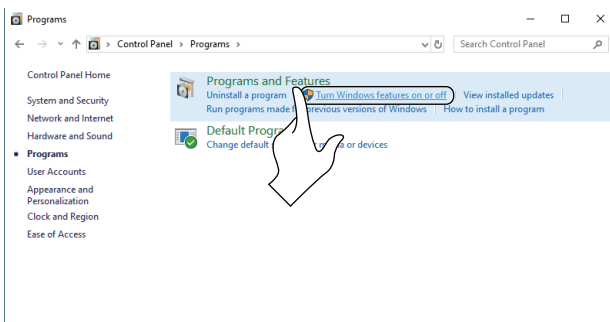
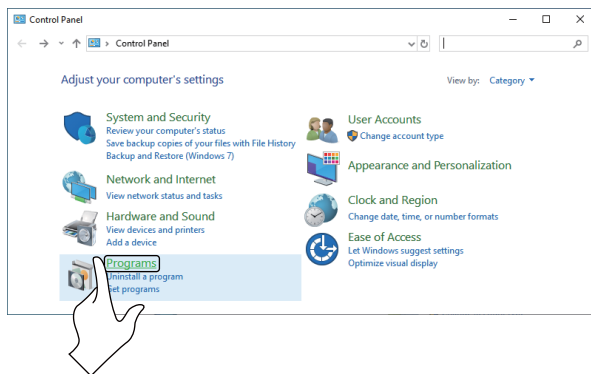
5.3 Points to Check Before Installing RT VisualBox

Before installing RT VisualBox on a computer, enable ".NET Framework 3.5 (includes .NET 2.0 and 3.0)" on the computer. Attempting to install RT VisualBox without enabling ".NET Framework 3.5 (includes .NET 2.0 and 3.0)" will display the following message and stop the installation.

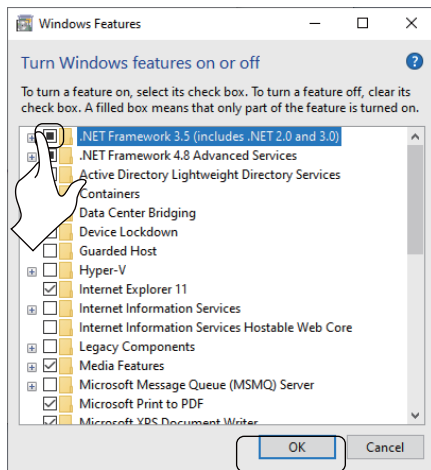


If this message appears, install RT VisualBox again after enabling ".NET Framework 3.5 (includes .NET 2.0 and 3.0)" by following the steps below.

Operating procedure

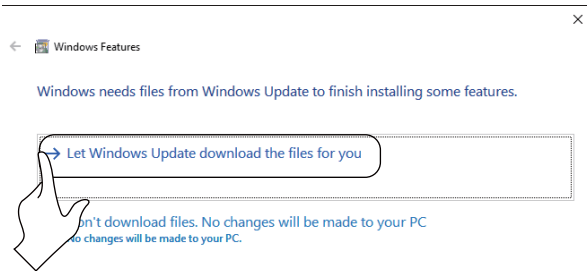


1. Configure the settings to connect the computer to the Internet.
2. From the Control Panel, tap/click [Programs].
3. Tap/click [Turn Windows features on or off].

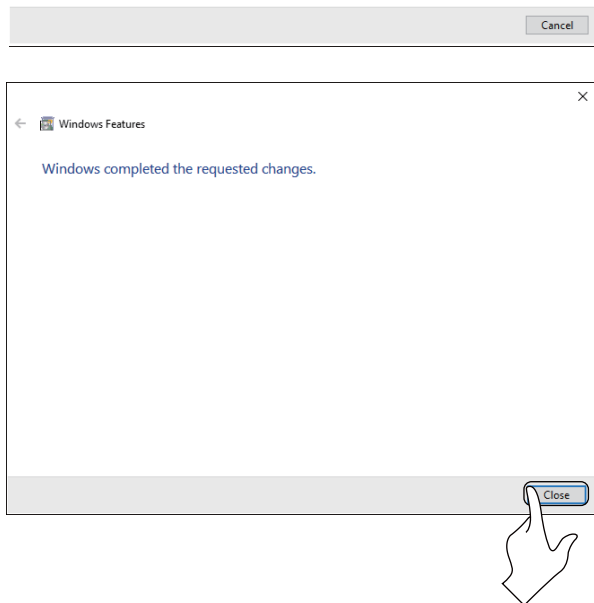


4. Select the ".NET Framework 3.5 (includes .NET 2.0 and 3.0)" check box in the Turn Windows Features On or Off window, then tap/click the [OK] button. If ".NET Framework 3.5 (includes .NET 2.0 and 3.0)" check box is already selected, refer to the following page:

➔ Page 51 Starting the Installation Wizard



5. Tap/click [Download files from Windows Update].

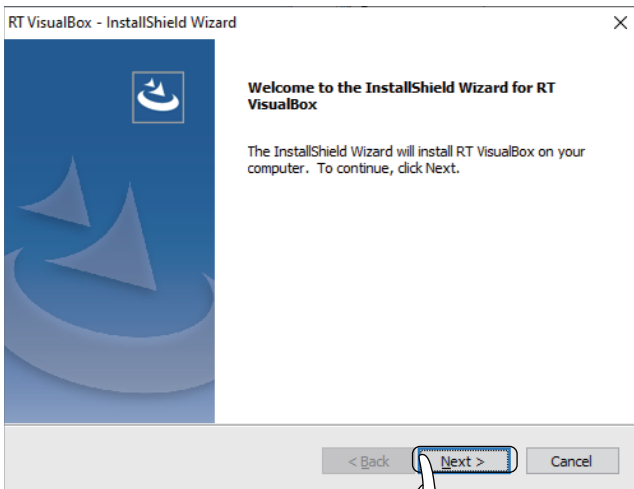


6. The window on the left will appear when the settings have been configured.

7. Tap/click the [Close] button to close the window.

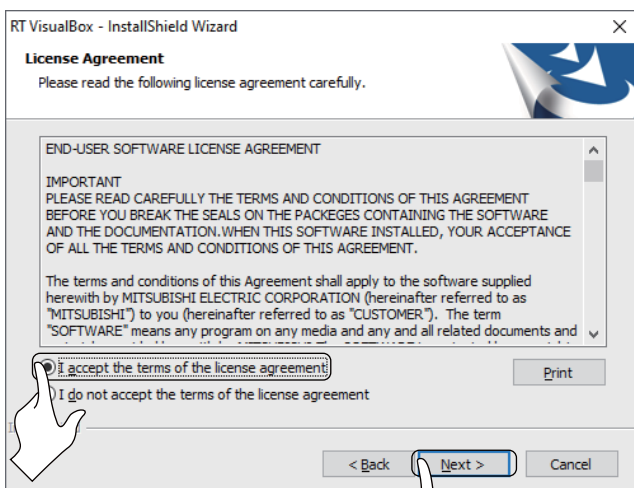
5.4 Starting the Installation Wizard

Operating procedure

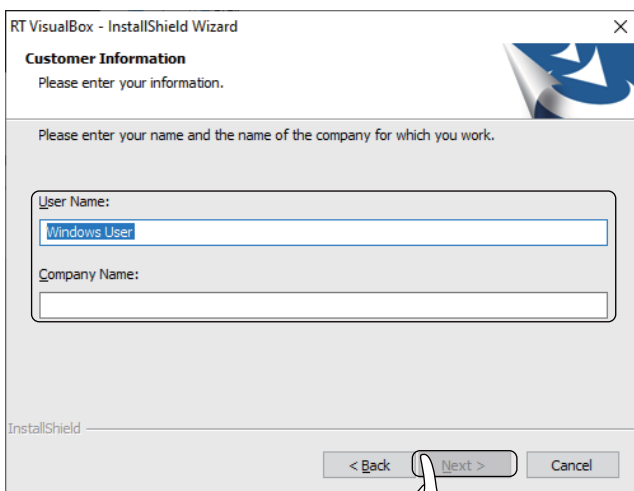


1. Insert the CD-ROM into the computer's CD-ROM drive. The Setup screen will appear automatically. If the Setup screen does not appear, use Explorer to find "Setup.exe" in the CD-ROM drive and run "Setup.exe".

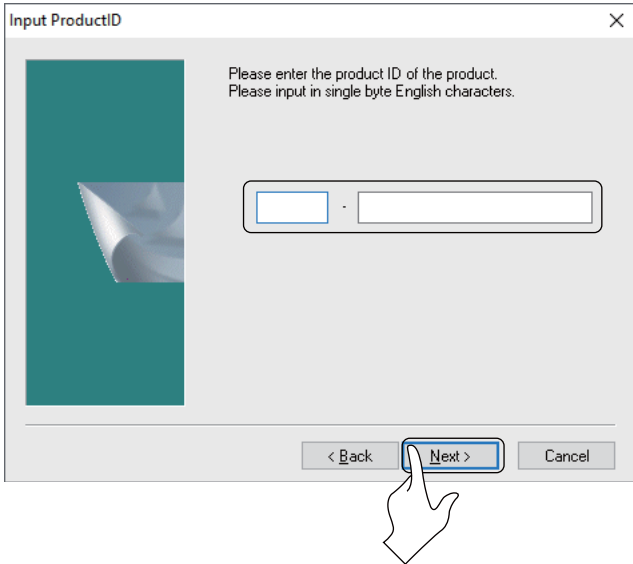
2. Tap/click the [Next] button.



3. Read the License Agreement, select "I accept the terms of the license agreement", then tap/click the [Next] button.



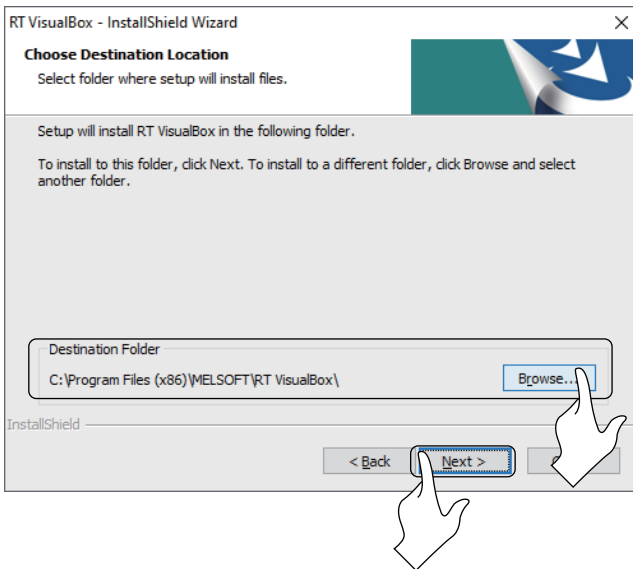
4. Enter a User Name and Company Name in the Customer Information window, then tap/click the [Next] button.



5. Enter the Product ID, and tap/click the [Next] button. (The product ID is indicated on the License Certificate.)

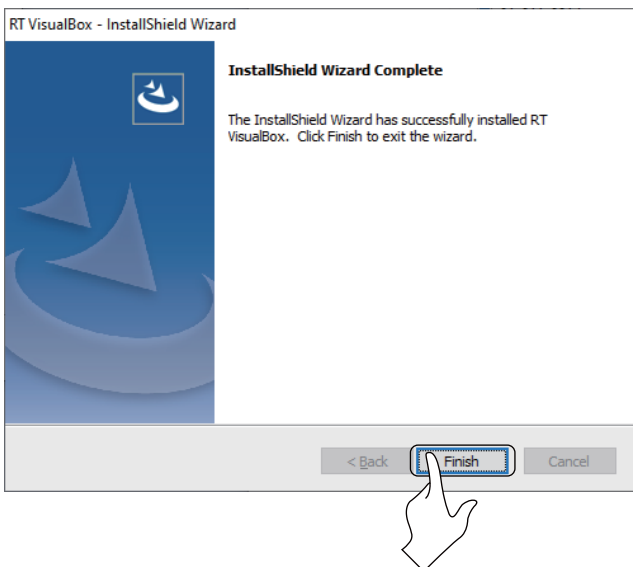
Point

- If a product ID is not entered, the trial version of this software will be installed. It is not possible to connect with the robot when using the trial version of this software.
- Uninstall the trial version before installing a fully licensed version of this software.



6. Check the destination folder, and tap/click the [Next] button. The installation will start.

To change the destination folder, tap/click the [Browse] button to specify a folder.



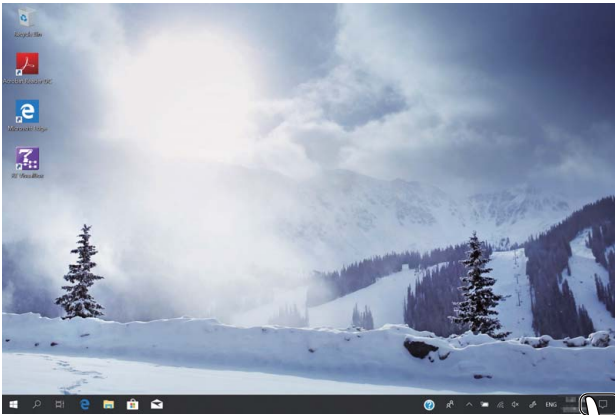
7. The window shown on the left will appear once the installation has finished. Tap/click the [Finish] button to complete the installation process. Start RT VisualBox to check that it is operating correctly.

A message requesting a reboot of the computer may appear after the installation. Reboot the computer as directed on screen.

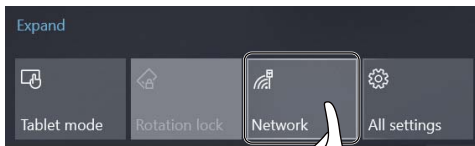
6 CONNECTING THE COMPUTER TO THE ROBOT CONTROLLER

Check the network status of the computer, then connect the computer to the robot controller with a LAN cable.
If the computer is connected via Wi-Fi, turn off Wi-Fi.
To turn off Wi-Fi, follow the steps below.

Operating procedure



1. Tap/click the icon in the lower-right corner of the Windows Desktop screen.



2. Tap/click [Network].



3. Tap/click the Wi-Fi icon.



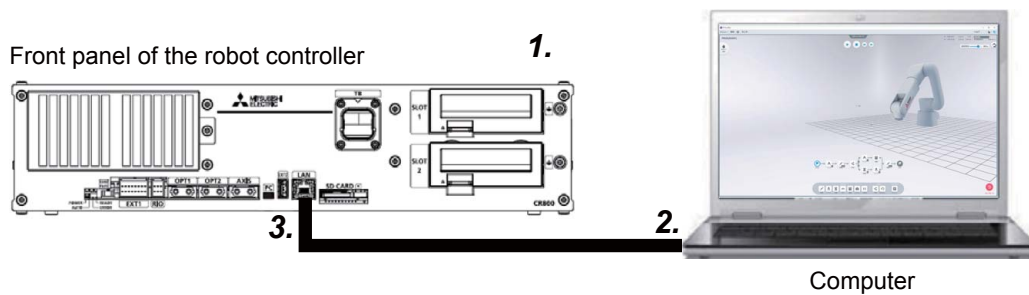
4. Check that "Wi-Fi Turned off" appears and the Wi-Fi icon turns gray (originally blue).

The following steps show how to connect the computer to the robot controller with a LAN cable.

Operating procedure

For further information on the Safety extension unit, refer to the following page:

☞ Page 25 Connecting the Robot Controller and the Safety Extension Unit



1. Power on the Safety extension unit, then the robot controller.
2. Connect the LAN cable to the computer.
3. Connect the LAN cable to the "LAN" port (for Ethernet) on the front of the robot controller.

To connect the computer to the robot controller with a USB cable, refer to the section "Connecting the robot to the computer" in the following manual:

☞ RT VisualBox Instruction Manual (BFP-A3696)

Precautions

Do not disconnect the LAN cable during communication with the robot controller. If the cable is disconnected during communication, data will not be acquired properly and the operation of the robot controller or computer may be affected. Only disconnect the cable while in Offline mode or after exiting RT VisualBox.

7 SETTING UP RT VisualBox FOR THE FIRST TIME

7.1 Starting RT VisualBox

Connect the robot to RT VisualBox, and configure the settings before creating a program.

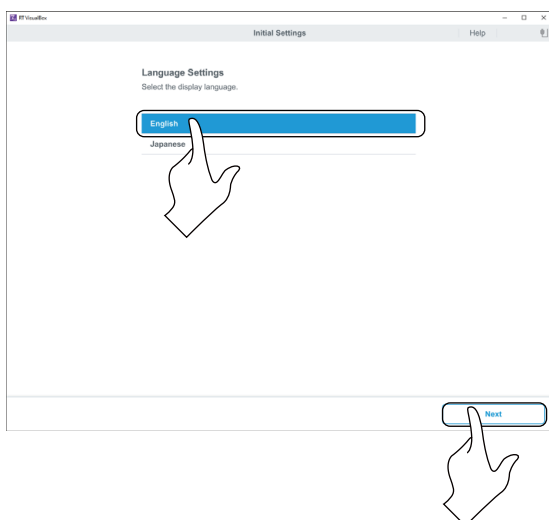
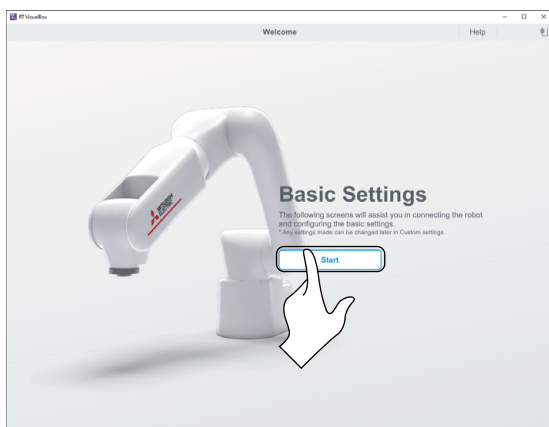
Precautions

Ensure that the following settings are configured correctly.

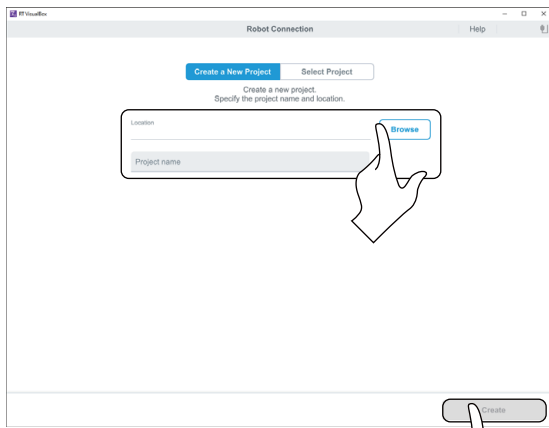
- Hand size, weight, and center of gravity (refer to step 13)
- Workpiece size, weight, and center of gravity (refer to step 14)
- Workpiece grasp position (refer to step 15)

If the settings for the hand are not configured correctly, the arm may rise or fall when direct teaching is turned on. Furthermore, the safety functions may not work properly. Ensure that the correct values are set.

Operating procedure

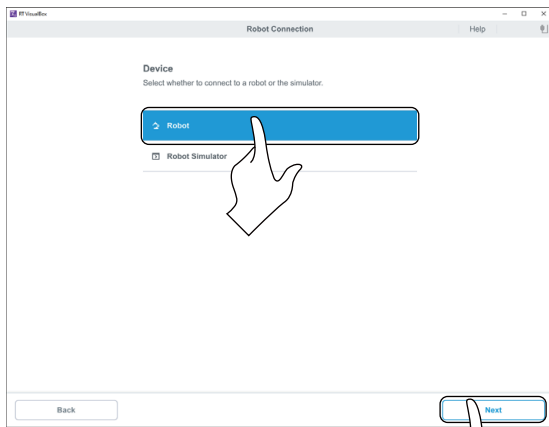


1. A shortcut will be created on the desktop after RT VisualBox has been installed. Double-tap/click this shortcut to start RT VisualBox.
2. The screen on the left only appears when RT VisualBox starts for the first time. Tap/click the [Start] button.
3. Select [English] in the Language Settings screen, then tap/click the [Next] button.

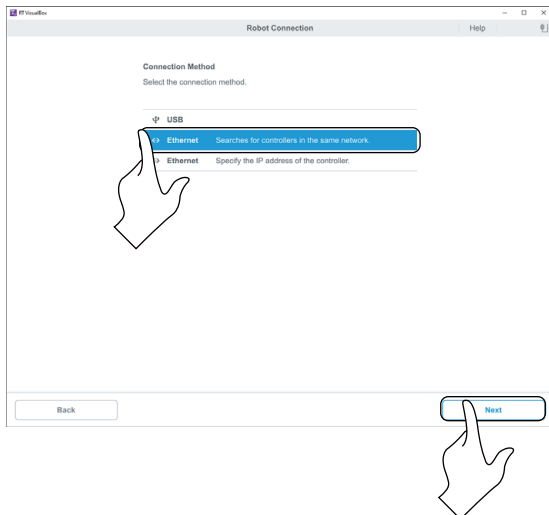


4. Select [Create a New Project].

Select where to save the project and enter a project name, then tap/click the [Create] button.



5. Select [Robot], then tap/click the [Next] button. It is not possible to connect with the robot when using the trial version of this software.

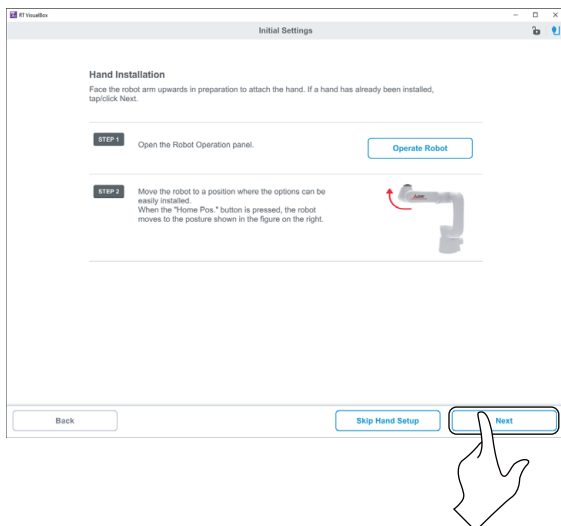
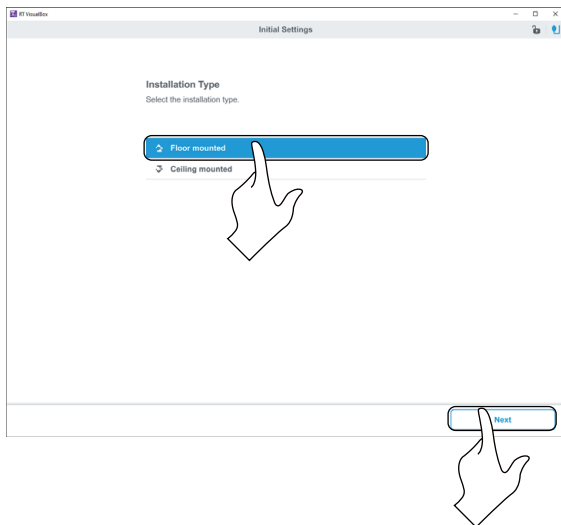
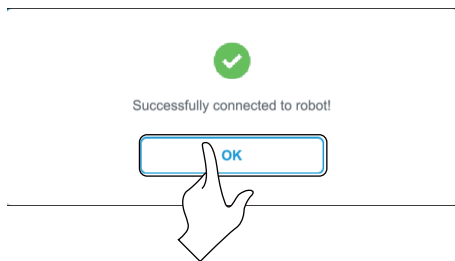
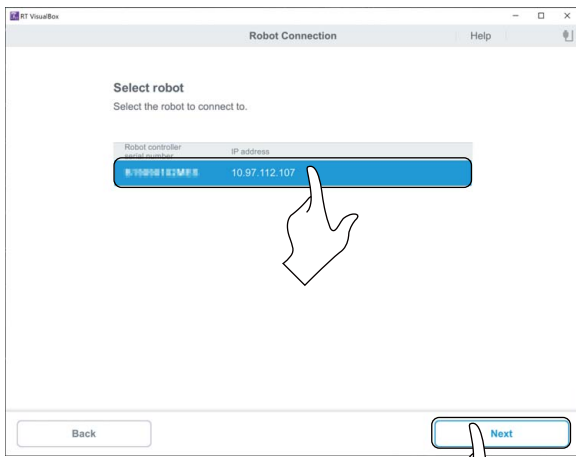


6. Select [Search for controllers on the same network] in the Connection Method screen, then tap/click the [Next] button.

The page may be blocked by a firewall depending on the settings of your computer.

If the software is being blocked by a firewall, refer to the following page:

 Page 61 If blocked by a firewall



7. In the Robot Selection screen, select the robot you want to use, then tap/click the [Next] button.

If the desired robot is not listed or cannot be connected, refer to the following page:

👉 Page 62 If the robot cannot be connected to RT VisualBox

8. The dialog box on the left will appear once the robot has been successfully connected.

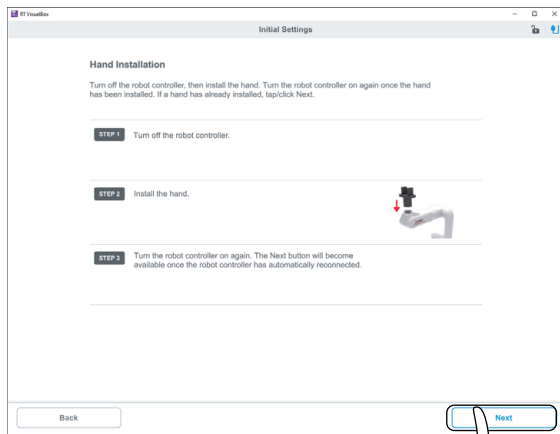
Tap/click the [OK] button to close the dialog box.

9. Select [Floor mounted] as the installation type, then click the [Next] button.


10. Check that the posture of the robot is the same as that displayed on the left of the Hand Installation screen, then tap/click the [Next] button.

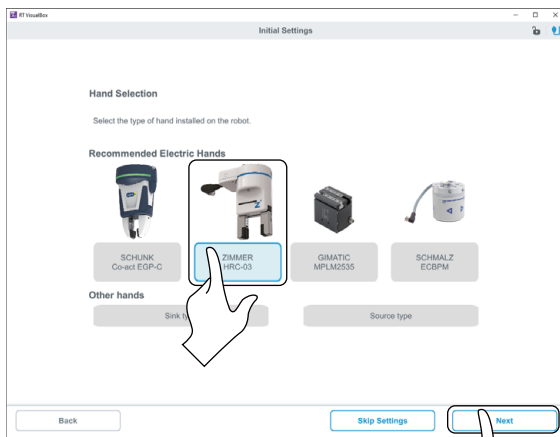
If the posture of the robot differs from that displayed on the screen, refer to the following page:

👉 Page 33 Moving the Robot by Hand

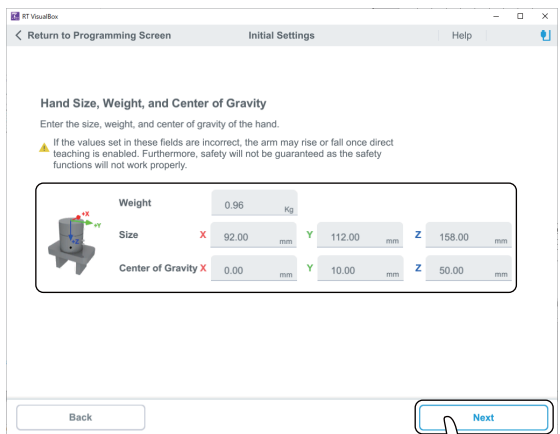


11. The steps in the Hand Installation screen can be skipped because the hand has already been installed. Tap/click the [Next] button.

If a hand has not been installed, refer to the following page:
 Page 35 CONNECTING THE ROBOT, HAND, AND VISION SENSOR



12. Select [ZIMMER HRC-03] in the Hand Selection screen, then tap/click the [Next] button.



13. In the Hand Size, Weight, and Center of Gravity screen, enter the following values, then tap/click the [Next] button.

When installing a hand only:

- Weight: 0.96 kg

- Size:

X: 92.00 mm

Y: 112.00 mm

Z: 158.00 mm

- Center of gravity:

X: 0.00 mm

Y: 10.00 mm

Z: 50.00 mm

When installing a hand and vision sensor:

- Weight: 1.15 kg

- Size:

X: 131.00 mm

Y: 112.00 mm

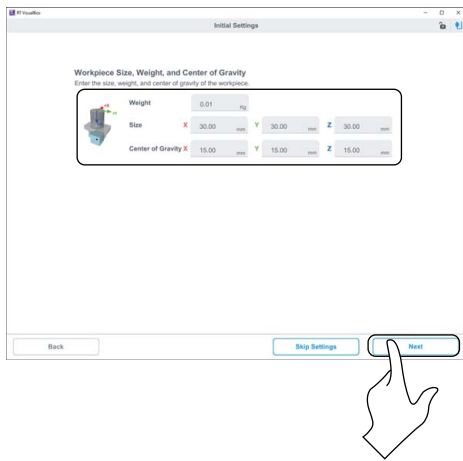
Z: 158.00 mm

- Center of gravity:

X: 12.00 mm

Y: 8.60 mm

Z: 51.00 mm



14. In the Workpiece Size, Weight, and Center of Gravity screen, enter the following values, then tap/click the [Next] button.

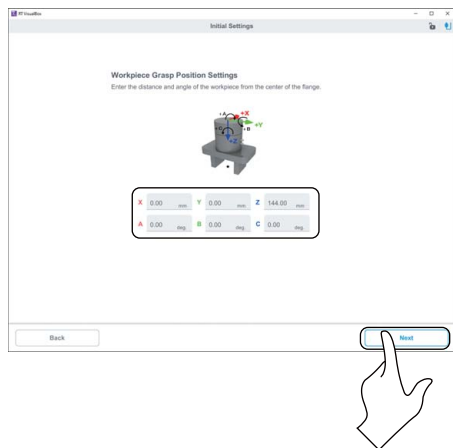
A 30 mm × 30 mm × 30 mm wooden block with a weight of 0.012 kg is used as a workpiece in this example.

Enter the size, weight, and center of gravity of the workpiece.

- Weight: 0.01 kg
- Size:
 - X: 30.00 mm
 - Y: 30.00 mm
 - Z: 30.00 mm
- Center of gravity:
 - X: 15.00 mm
 - Y: 15.00 mm
 - Z: 15.00 mm

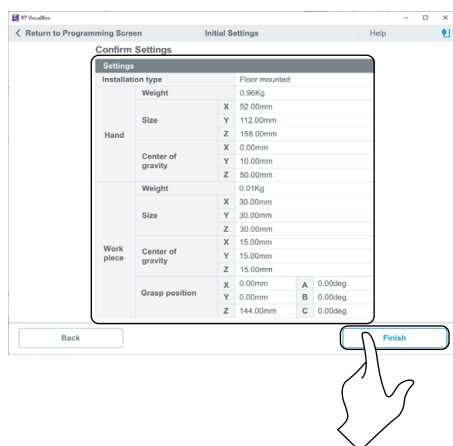
Point

Use a workpiece that is suitable for the size of the hand you are using. Set the values according to the properties of the workpiece.



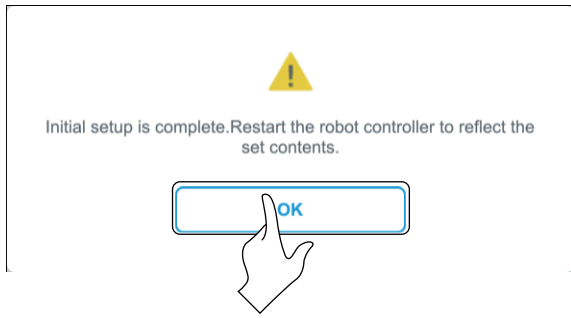
15. In the Work Gripping Position Setting screen, enter the following values, then tap/click the [Next] button.

- X, Y, and Z components of the grasp position:
 - X: 0.00 mm
 - Y: 0.00 mm
 - Z: 144.00 mm
- A, B, and C components of the grasp position:
 - A: 0.00 deg.
 - B: 0.00 deg.
 - C: 0.00 deg.



16. The values set in the steps above will be displayed in a table in the Confirm Settings screen. If all the settings are correct, tap/click the [Finish] button.

If the settings are incorrect, tap/click the [Back] button and make corrections in the applicable setting screen.



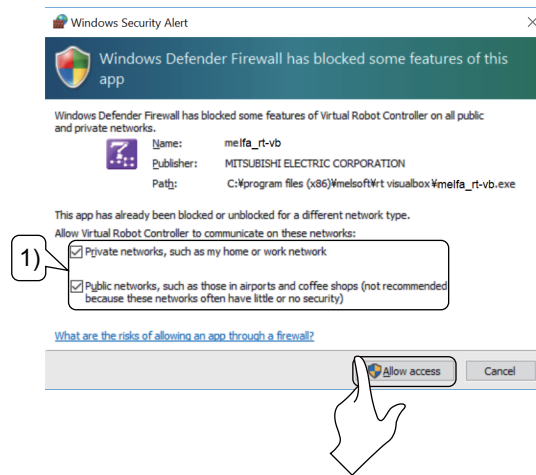
17. The dialog box on the left will appear once the settings have been configured.

Tap/click the [OK] button to restart the robot controller.

The program will return to the main screen once the robot controller restarts.

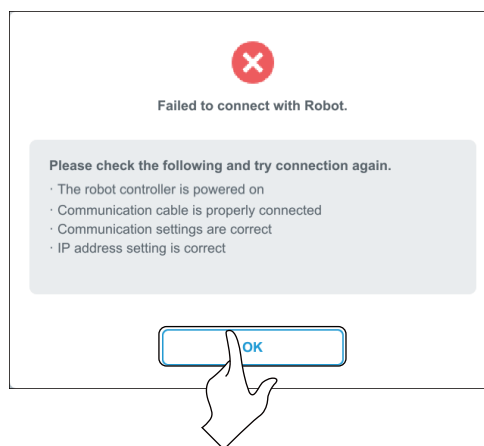
If blocked by a firewall

1. If the following window appears, select the two check boxes indicated by number 1, then tap/click the [Allow access] button.



2. Tap/click the [OK] button to display the screen shown in the following step:

☞ Starting RT VisualBox(Step 6)



If the robot cannot be connected to RT VisualBox

If the robot does not appear in the Robot Selection screen or cannot be connected, do the following:

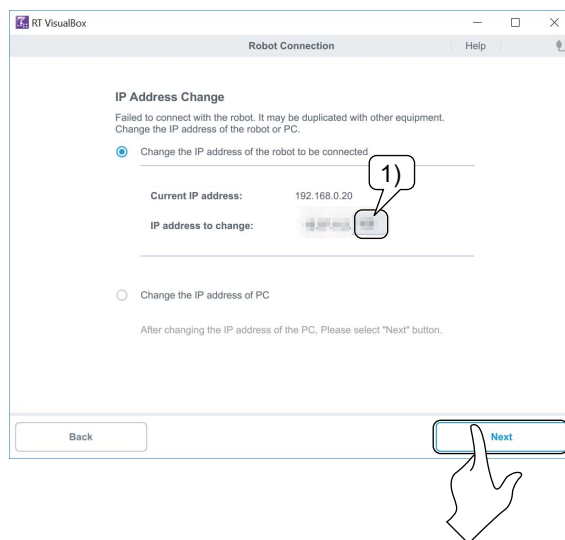
■The robot or the robot controller is not turned on

Check if the robot and robot controller are turned on. Turn on the robot and robot controller.

☞ Page 53 CONNECTING THE COMPUTER TO THE ROBOT CONTROLLER

■The IP address of the computer or robot is set incorrectly

The following screen will appear when the robot is connected to a computer on a network.

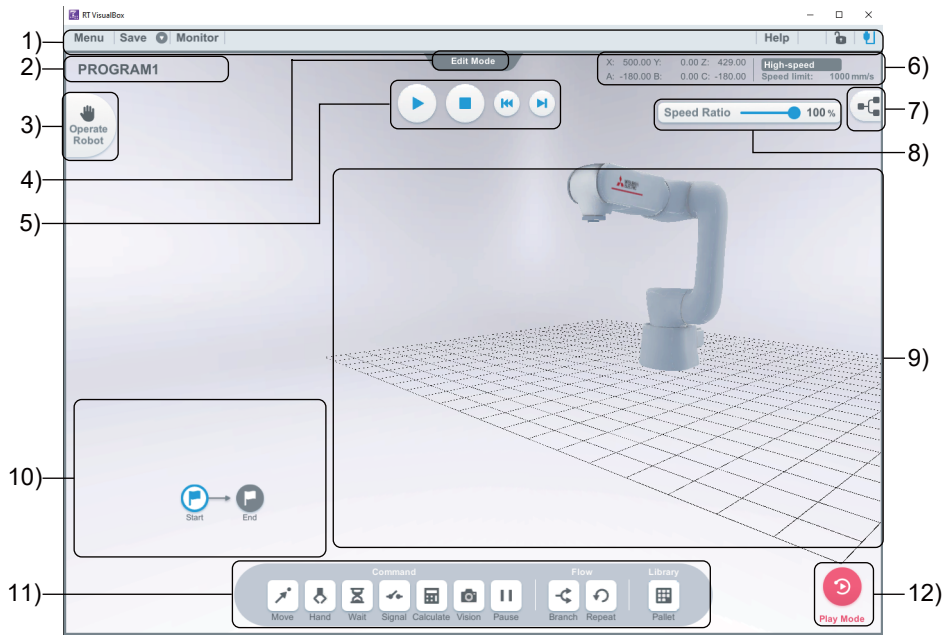




- 1.** A free IP address on the network that the computer is currently connected to will be displayed in the Recommended IP address field in the Change IP Address screen. The software will select an IP address with digits (indicated by "1") that avoid creating a duplicated address on the network.
- 2.** If you are satisfied with the IP address, tap/click the [Next] button. If you would like to change the address, enter an address which is not being used on the network using the digits from 1 to 254.
- 3.** Return to the following step once the settings have been configured.

☞ Starting RT VisualBox(Step 8)

7.2 Interface Overview

Main screen



No.	Name	Use
1)	Menu bar	Contains various menus and indicates the connection status of the robot controller.
2)	Program name	Displays the name of the program.
3)	Operate Robot button	Displays a panel used for operating the robot.
4)	Display mode	Displays the current display mode. <ul style="list-style-type: none"> • Edit mode: Program creation mode • Play mode: Program execution mode
5)	Program execution buttons	Start, stop, reset the program and perform step operation.
6)	Robot status	Displays the robot's current position, safe speed mode, and speed limit. "Current position" refers to the current position of the tip of the hand. For further information, refer to the following page: Page 55 Starting RT VisualBox(Steps 13 and 15)
7)	Programming/3D view button	 Enables programming mode.
		 Enables 3D mode.
8)	Speed slider-bar	Sets the robot's operation speed.
9)	3D area	Displays a 3D model of the robot and positions that have been taught to it.
10)	Programming area	The area used to create a program by placing and arranging program blocks.
11)	Program block panel	Used to select program blocks when creating a program. (Displayed in Edit mode) For further information on the program block panel, refer to the following page: Page 64 Program block panel
12)	Mode button	Switches between Edit mode and Play mode.

Program block panel

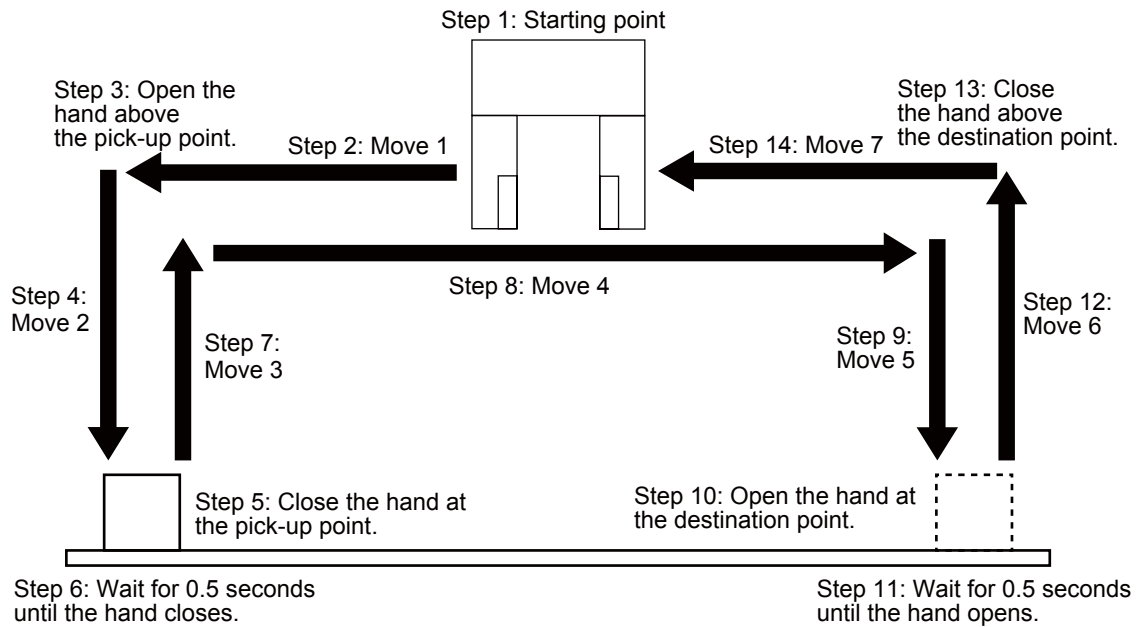


Block name	Description
Move	Moves the robot (Tap/click to configure settings).
Hand	Opens/closes the hand (Tap/click to configure settings).
Wait	Instructs the robot to wait (Tap/click to configure settings).
Signal	Outputs signals (Tap/click to configure settings).
Calculate	Performs calculations (Tap/click to configure settings).
Vision	Identifies the workpiece (Tap/click to configure settings). (This block becomes available when a robot is connected to the software.)
Pause	Pauses the operation.
Branch	Branches conditions (Tap/click to configure settings).
Repeat	Repeats the operation (Tap/click to configure settings).
Pallet	Used to set up palletizing operations (Tap/click to configure settings).

8 CREATING A PROGRAM WITH RT VisualBox

8.1 Creating a program

This section explains how to edit and create a robot program.
The figure below shows an overview of the program.



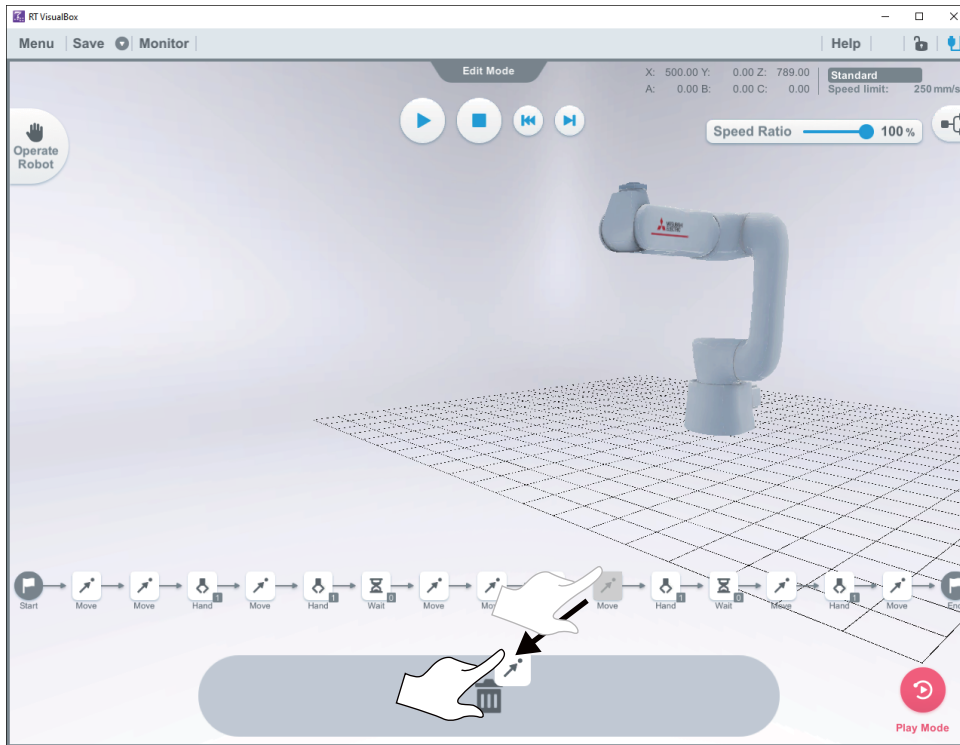
Operating procedure



1. Drag and drop a [Move] block to the area between Start and End to set a start position.

8.2 Deleting Unnecessary Blocks

Select a program block in the program and drag the block downwards. A trash can will appear. To delete the block, move it to the trash can and release it.



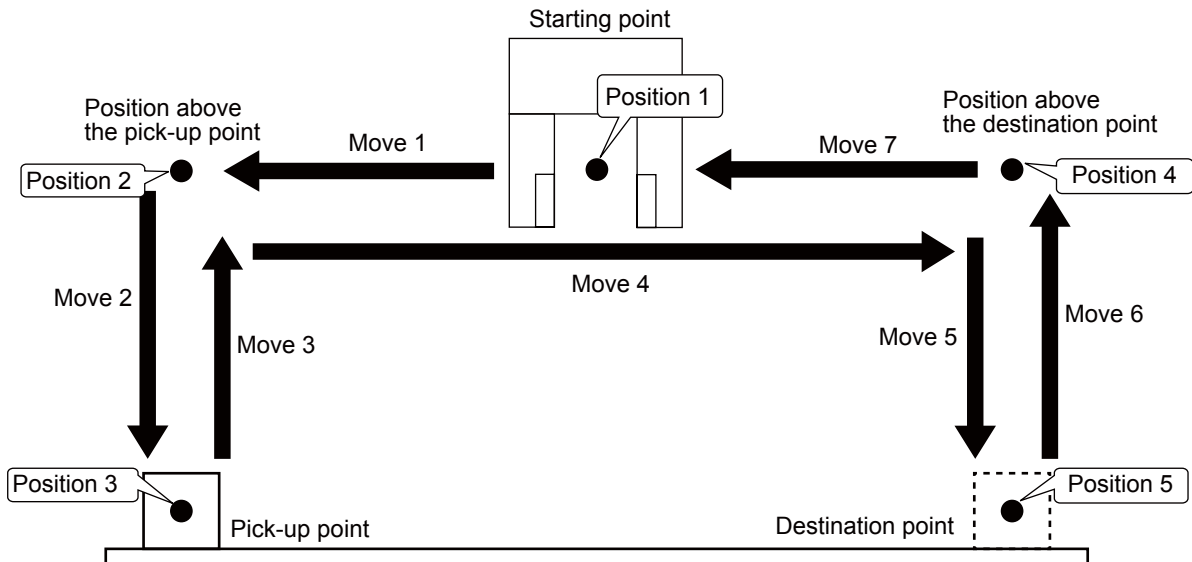
9

TEACHING POSITIONS TO THE ROBOT

This section explains how to teach positions to the robot using either RT VisualBox or by moving the arm directly with your hands.

In this chapter, a 30 mm × 30 mm × 30 mm wooden block is placed at the pick-up point.

Use a workpiece that is suitable for the size of the hand you are using.

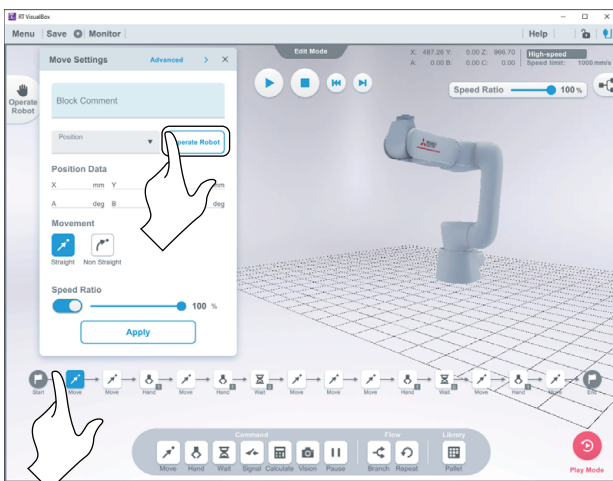


CAUTION

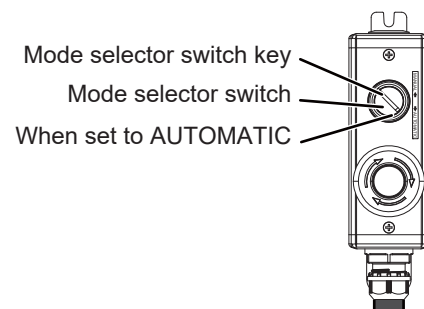
- Place an emergency stop switch in an easily accessible place near the robot. Connect the emergency stop switch to the external emergency stop input terminals of the robot controller.
- If the settings for the hand are not configured correctly, the arm may rise or fall when direct teaching is turned on. Furthermore, the safety functions may not work properly. Ensure the settings are correct.
- The robot arm may continue to move under its own inertia in direct teaching mode. Do not release your hands from the robot arm until it has stopped moving.
- Workpiece settings are not enabled during direct teaching. The robot arm may fall depending on the weight of the workpiece. Do not release your hands from the robot arm until it stops completely.
- If using one of the hand settings from HADDAT1 to HADDAT8 set in RT ToolBox3, be aware that the hand setting in the controller will be reset to HNDDAT0 if the controller's power is cycled. In this case, the arm may rise or fall as the correct hand settings will no longer be set.
- The STR error may occur when the robot is being operated. If this error occurs, press the [RESET] button on the robot arm operation panel, or tap/click the [Reset] button in the error dialog box in RT VisualBox.

Teaching the 1st movement "position 1" (starting point)

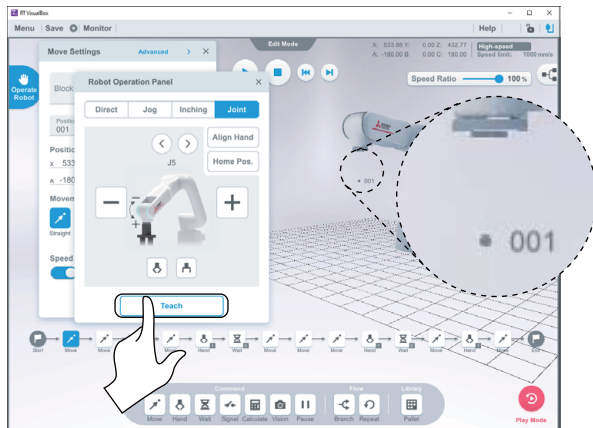
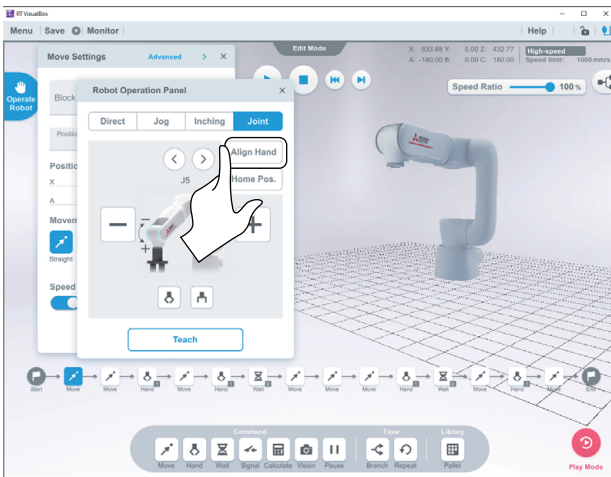
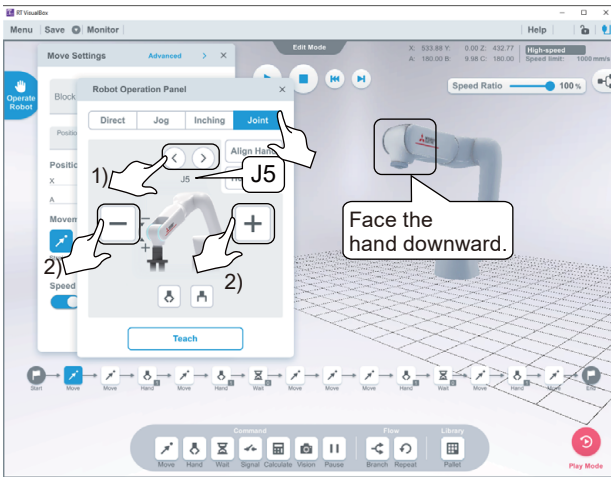
Operating procedure



1. Set the robot controller mode selector switch to AUTOMATIC mode, then remove the mode selector switch key.



2. Tap/click the [Move] block to the right of Start to display the Move Setting window.
3. Tap/click the [Operate Robot] button.



4. Use the Robot Operation panel to move the robot and face the hand downward.

Move axis J5 using the controls in the [Joint] tab in the Robot Operation panel.

1) Tap/click the button indicated by number 1 until "J5" appears.

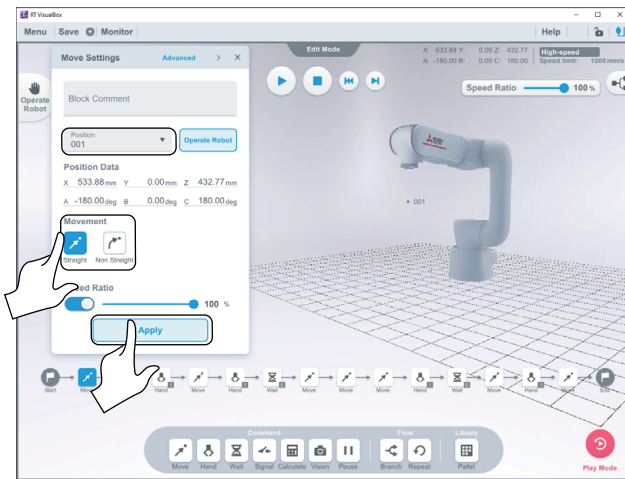
2) Tap/click the button indicated by number 2 until axis J5 is roughly facing downward. (Move axis J5 so that the robot's posture is the same as that displayed in the window on the left.)

5. Tap/click the [Align Hand] button to face the hand straight down.

6. Tap/click the [Teach] button once. This will set the current position of the robot to position 1 which is shown in the program overview figure at the beginning of this chapter.

7. The number "001" will appear near the flange. The number indicates the taught position.

Tap/click the [x] button in the top right of the Robot Operation panel to close the panel.



8. In the Move Settings window, check that [Position] and [Movement] are set as follows:

- Position: 001
- Movement: Straight

Ensure that the settings are correct, then tap/click the [Apply] button.

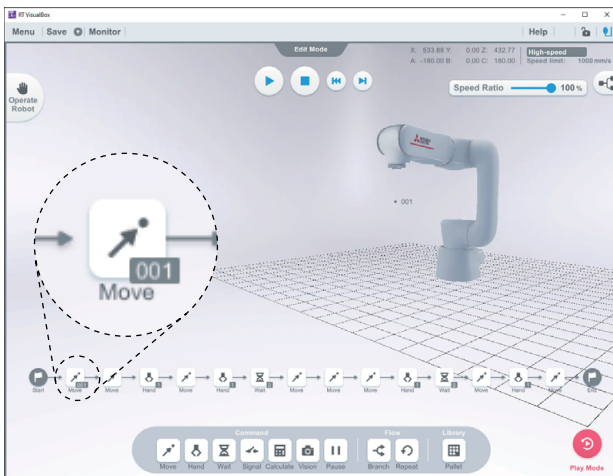
Point

The robot arm moves differently depending on the Movement settings which are explained as follows:

Selecting [Non Straight] will move the robot arm faster than when [Straight] is selected. When [Non Straight] is selected, the robot arm moves to the destination while following a shallow curve. Select [Non Straight] if the robot can move without interfering with surrounding objects.

Selecting [Straight] will move the robot arm to the destination rectilinearly.

Select [Straight] if the robot arm needs to move up and down vertically above the pick-up point or the destination point in order to prevent the hand from interfering with the workpiece or the robot from interfering with surrounding objects.



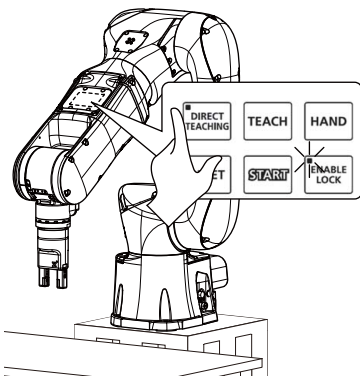
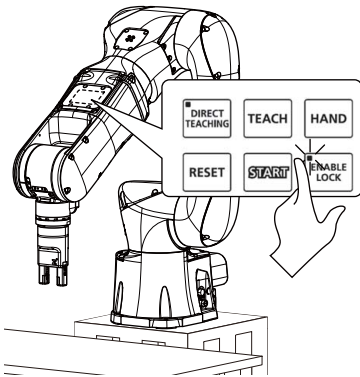
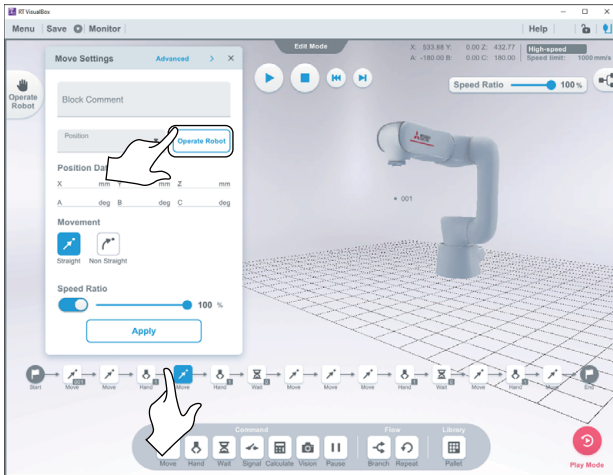
9. Once the settings have been configured, the number "001" will appear in the bottom right of the [Move] block.

Teaching the 3rd movement "position 2" (pick-up point)

⚠ CAUTION

- Do not operate the robot using any method other than the robot arm operation panel when teaching the robot directly.

Operating procedure



1. Tap/click the [Move] block shown in the screen shown on the left to display the Move Setting window.

2. Press the [ENABLE LOCK] button on the robot arm operation panel.

The LED at the top-left of the [ENABLE LOCK] button will turn on.

Operating the robot will only be possible using the robot arm operation panel once [ENABLE LOCK] has been turned on.

Point

Turning on [ENABLE LOCK] acquires the robot operation rights, rendering operation from other peripherals ineffective.

For further information on operation rights, refer to the section "Operation rights" in the following manual:

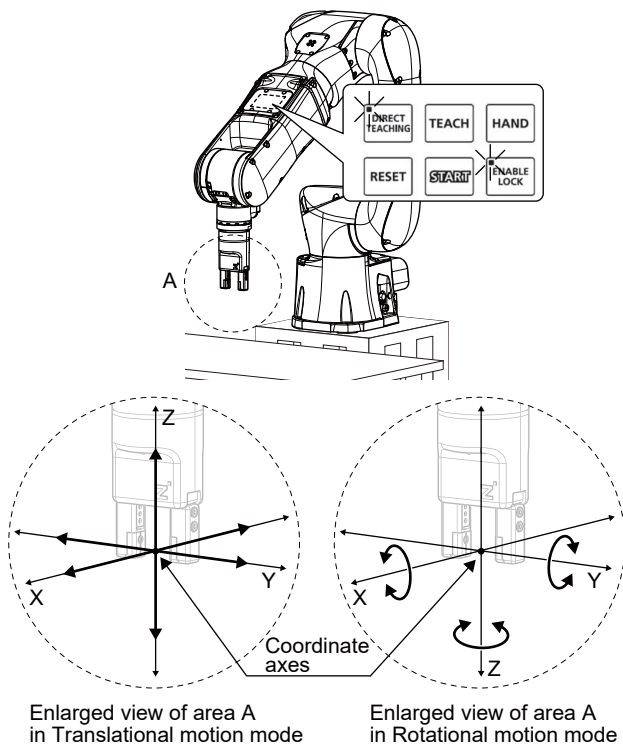
RT VisualBox Instruction Manual (BFP-A3696)

3. Hold down the [DIRECT TEACHING] button on the robot arm operation panel for 2+ seconds.

Point

Direct teaching is automatically turned off under the following conditions:

- The robot arm is not moved for a certain period of time (the initial value is 60 seconds) after direct teaching is turned on.
- The [Jog], [Inching] or [Joint] tab is selected in the Robot Operation panel.
- An error occurs.
- Communication with RT VisualBox is lost for 30 seconds.



- The LED at the top-left of the [DIRECT TEACHING] button on the robot arm operation panel will turn on. The Status indicator LED will flash green.

Point

Pressing the [DIRECT TEACHING] button once while direct teaching is turned on allows you to move the robot arm in Translational mode. Pressing it again switches to Rotational mode.

In this situation, the LED at the top-left of the button will flash. (The LED flashes quickly in Translational mode and slowly in Rotational mode.)

The mode switches in the following order each time the [DIRECT TEACHING] button is pressed: Free → Translational → Rotational → Free

Pressing the [Free] button in the [Direct] tab in the Robot Operation window also allows you to switch the mode in the following order:

Free → Translational → Rotation → Free

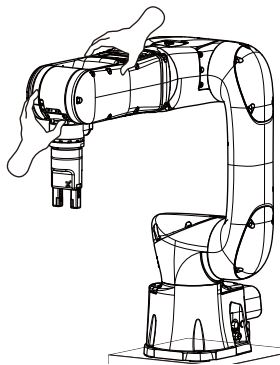
Translational: The robot moves in the coordinate (Cartesian) axes.

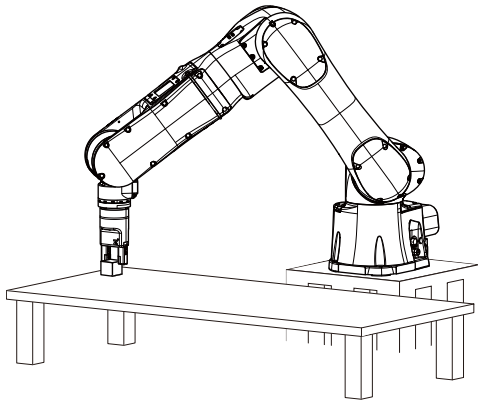
Rotational: The robot moves in the rotational direction of the coordinate (Cartesian) axes.

For further information on translational and rotational motion, refer to the following manual:

Collaborative Robot: Detailed explanations of functions and operations (BFP-A3735), Direct teaching modes

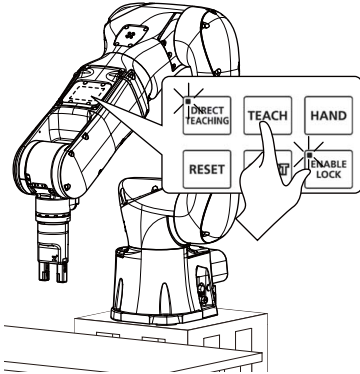
- Hold the robot arm directly with your hands, and move it to the desired position/posture.



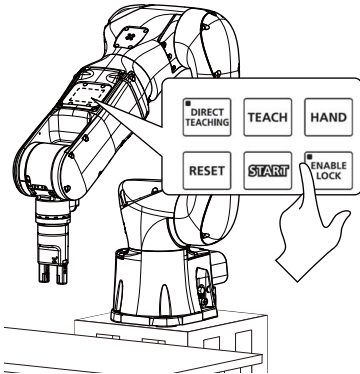


6. Move the robot arm so that the robot's posture is almost the same as that illustrated on the left.

Adjust the posture of the robot so that the arm is in a position to grasp the workpiece at the pick-up point.



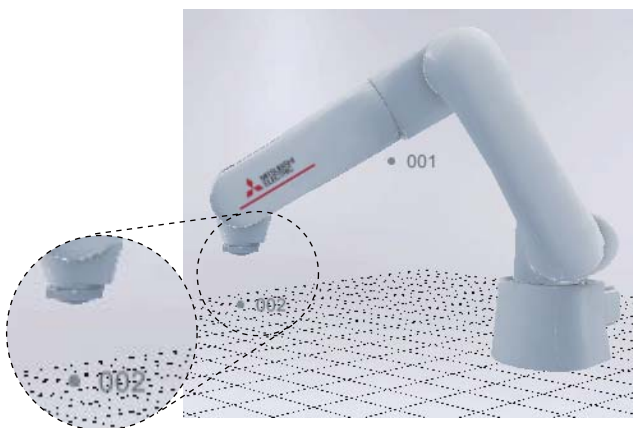
7. Press the [TEACH] button on the robot arm operation panel.



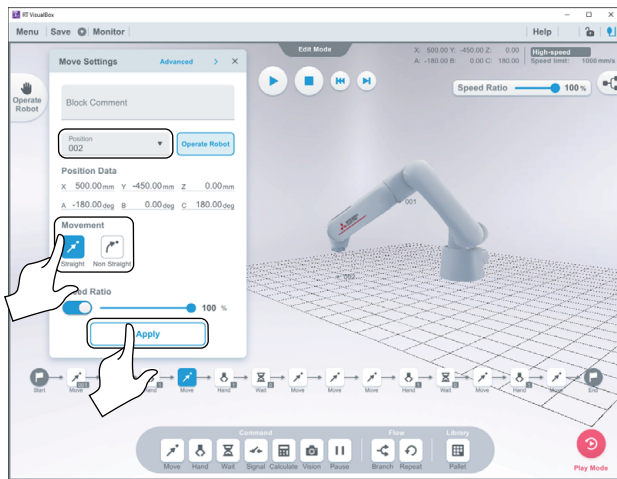
8. Press the [ENABLE LOCK] button on the robot arm operation panel.

The LED at the top-left of the [ENABLE LOCK] button will turn off.

Turning off [ENABLE LOCK] allows peripherals and the robot arm operation panel to acquire the robot operation rights.



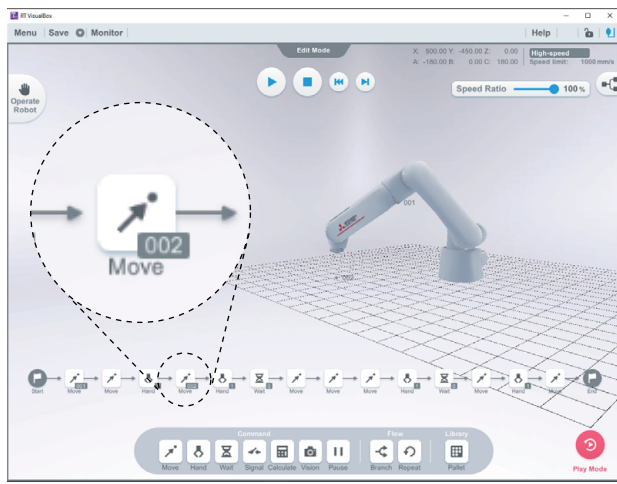
9. The number "002" will appear near the flange in RT VisualBox.



10. In the Move Settings window, check that [Position] and [Movement] are set as follows:

- Position: 002
- Moving Method: Straight

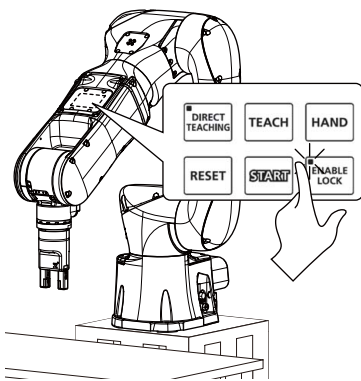
Ensure that the settings are correct, then tap/click the [Apply] button.



11. Once the settings have been configured, the number "002" will appear in the bottom right of the [Move] block.

Teaching the 2nd movement "position 3" (the position above the pick-up point)

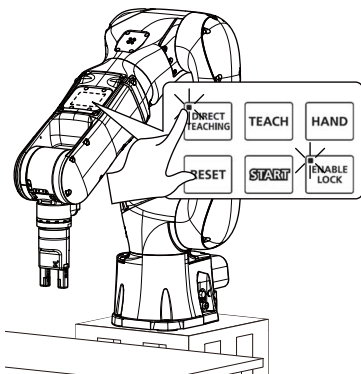
Operating procedure



1. Press the [ENABLE LOCK] button on the robot arm operation panel.

The LED at the top-left of the [ENABLE LOCK] button will turn on.

Operating the robot will only be possible using the robot arm operation panel once [ENABLE LOCK] has been turned on.

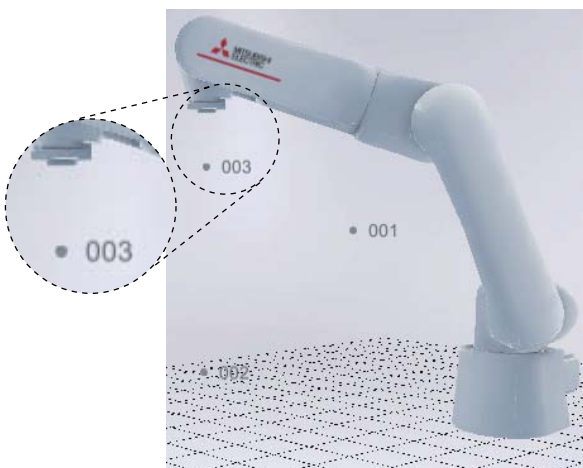
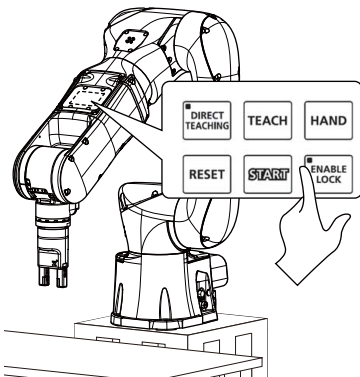
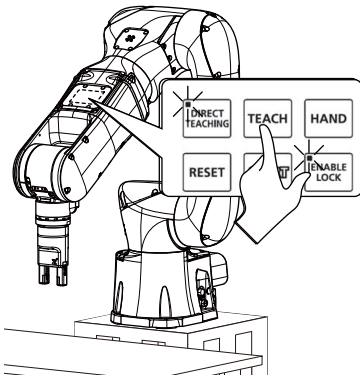
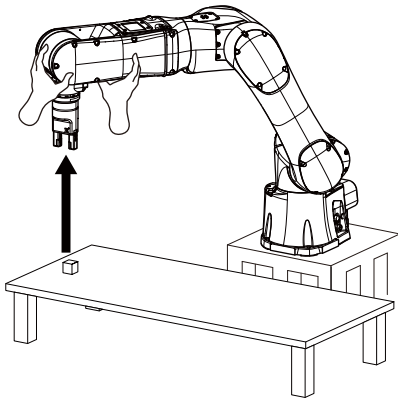


2. Hold down the [DIRECT TEACHING] button on the robot arm operation panel for 2+ seconds.

The LED at the top-left of the [DIRECT TEACHING] button will turn on.

3. Press the [DIRECT TEACHING] button once. (Do not press and hold the button.)

The LED at the top-left of the button will flash.



4. Move the robot arm to the position above the pick-up point. The position above the pick-up point is located directly above position 2 (pick-up point) which is shown in the program overview figure at the beginning of this chapter.

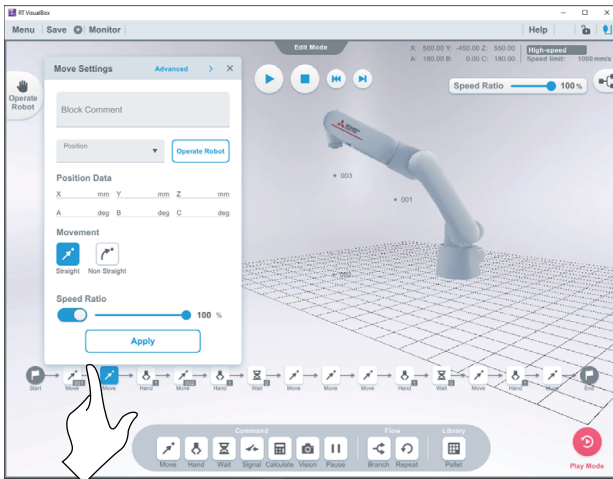
5. Press the [TEACH] button on the robot arm operation panel or tap/click the [Teach] button in the Robot Operation panel in RT VisualBox.

6. Press the [ENABLE LOCK] button on the robot arm operation panel.

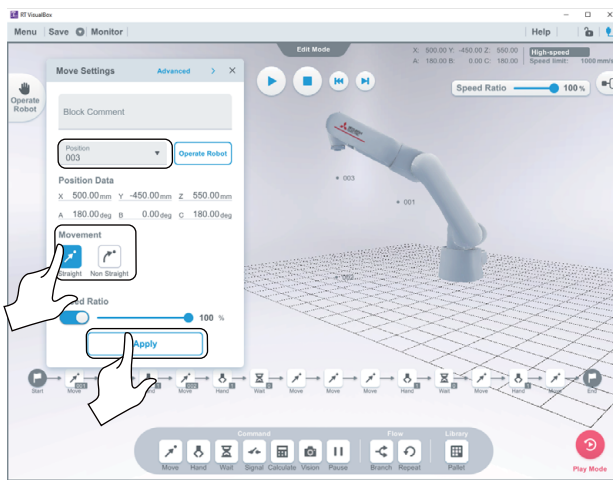
The LED at the top-left of the [ENABLE LOCK] button will turn off.

Turning off [ENABLE LOCK] allows peripherals and the robot arm operation panel to acquire the robot operation rights.

7. The number "003" will appear near the flange in RT VisualBox.



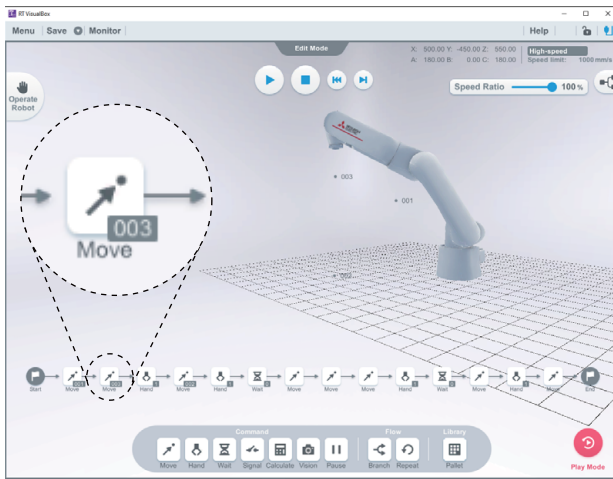
8. Tap/click the [Move] block shown in the screen shown on the left to display the Move Settings window.



9. In the Move Settings window, check that [Position] and [Movement] are set as follows:

- Position: 003
- Movement: Straight

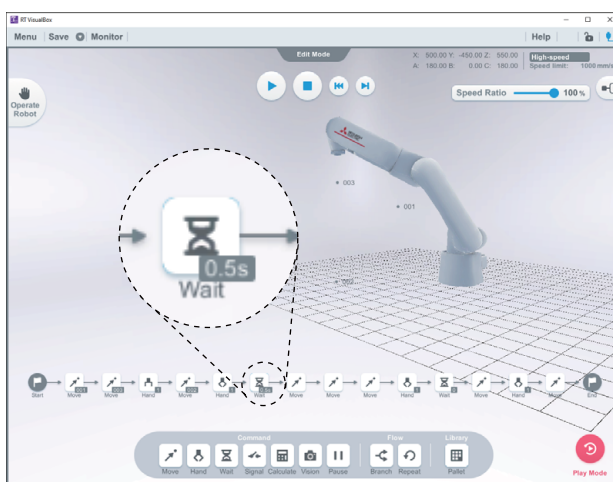
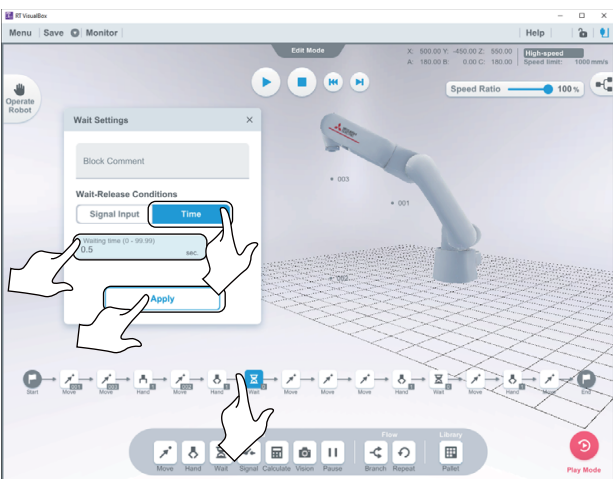
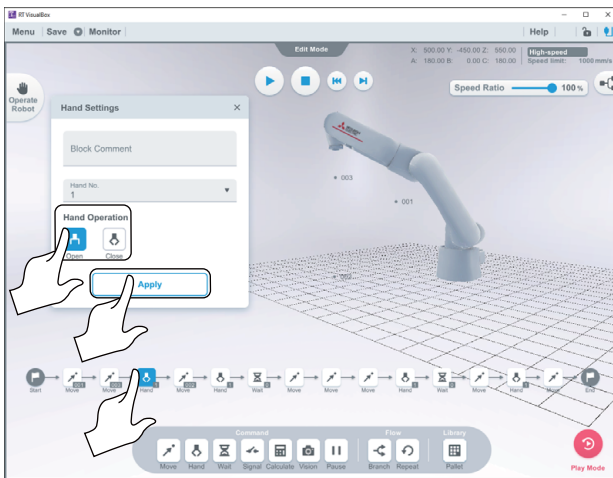
Ensure that the settings are correct, then tap/click the [Apply] button.



10. Once the settings have been configured, the number "003" will appear in the bottom right of the [Move] block.

Opening the hand and setting the standby time

Operating procedure

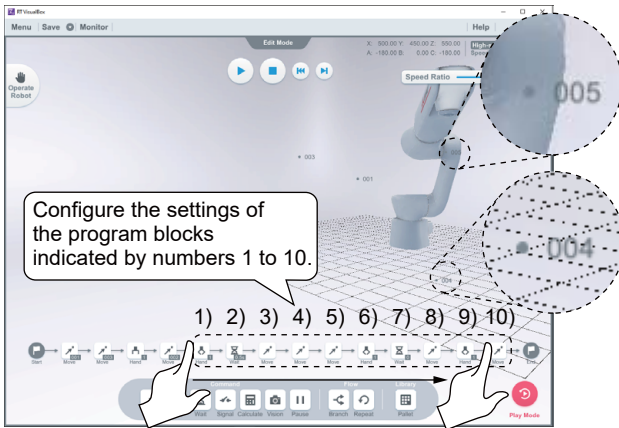


1. Tap/click the [Hand] block shown on the screen shown on the left to display the Hand Settings window.
2. In the Hand Settings window, set [Hand Operation] to [Open], then tap/click the [Apply] button.
3. Tap/click the [Wait] block shown on the screen shown on the left to display the Wait Settings window.
4. Tap/click [Time] under [Wait-Release Conditions].
5. Enter 0.5 in the Waiting Time field, then tap/click the [Apply] button.
6. "0.5s" will appear in the bottom right of the [Wait] block.

Teaching the 4th movement "position 5" (the position above the destination point) and the 5th movement "position 4" (destination point)

This section explains how to teach the 4th and 5th movements. It also explains standby times and the settings used for opening and closing the hand which were not mentioned in the previous section.

Operating procedure



1. Refer to the screen on the left to set positions and configure the settings of each block.

The following information shows the settings of the positions described in the program overview at the beginning of this chapter.

Refer to the following pages for how to set [Move] blocks.

☞ Teaching the 3rd movement "position 2" (pick-up point)
Teaching the 2nd movement "position 3" (the position above the pick-up point)

- 004: 5th movement (destination point)
- 005: 4th movement (the position above the destination point)

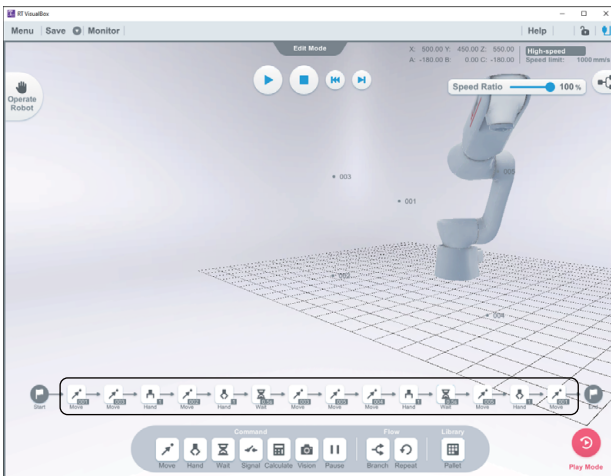
Information on the settings of each block is provided below. Refer to the following page for how to set [Hand] and [Wait] blocks.

☞ Opening the hand and setting the standby time

- 1) Hand Operation: Close
- 2) Wait-Release Conditions: Time
Waiting Time: 0.5s
- 3) Position: 003
Movement: Straight
- 4) Position: 005
Movement: Straight
- 5) Position: 004
Movement: Straight
- 6) Hand Operation: Open
- 7) Wait-Release Conditions: Time
Waiting Time: 0.5s
- 8) Position: 005
Movement: Straight
- 9) Hand Operation: Close
- 10) Position: 001
Movement: Straight

Point

Depending on where the starting point is, an error may occur or the robot may move unexpectedly while the robot moves from position 5 to position 1. To avoid this situation, create a via point between positions 5 and 1 by placing a [Move] block between the blocks of steps 8 and 10.



- Once the settings of [Move] blocks have been configured, a position number will appear in the bottom right of the [Move] block.

Using values to teach the 2nd movement "position 3" (the position above the pick-up point) and the 4th movement "position 5" (the position above the destination point)

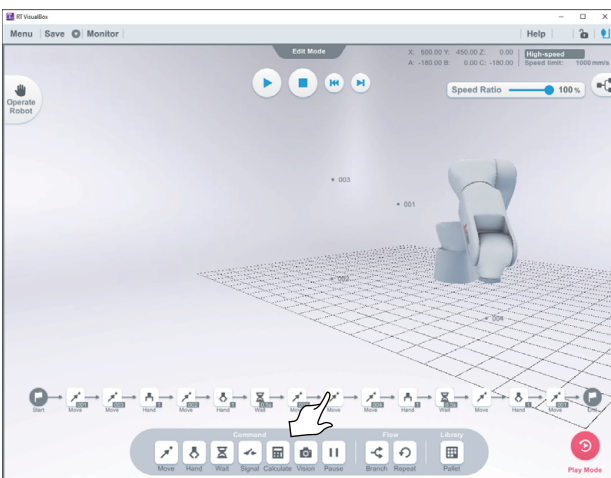
It is possible to use values to teach the 2nd movement "position 3" (the position above the pick-up point) and the 4th movement "position 5" (the position above the destination point).

Below is an example of how to teach the 4th movement "position 5" (the position above the destination point) using values.

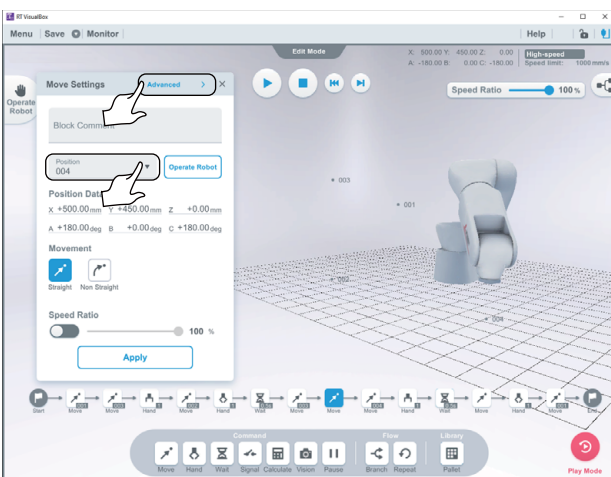
⚠ CAUTION

- Check that the robot does not collide with any obstacles after this setting has been changed.

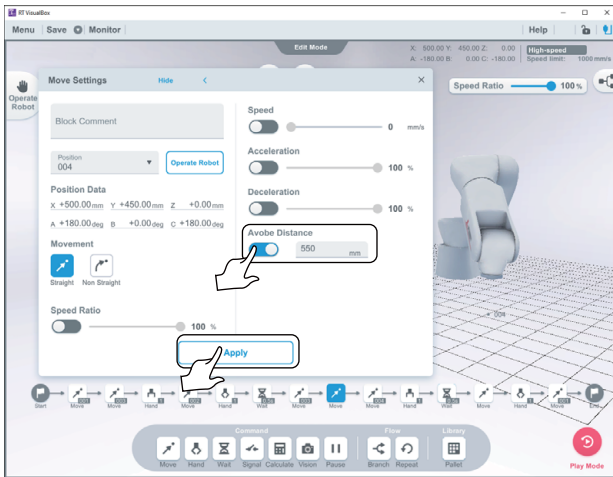
Operating procedure



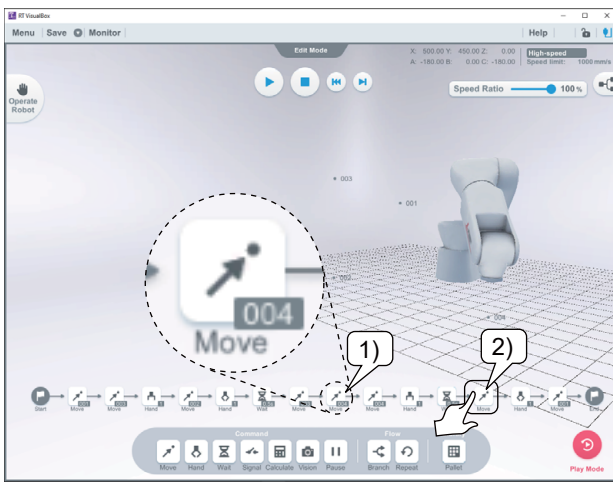
- Tap/click the [Move] block shown in the screen shown on the left.



- Select [Position 004] in the Move Settings window.
- Tap/click [Advanced].



4. Tap/click the [Distance above a position] switch, then enter the distance for the 4th movement "position 5" (the position above the destination point).
5. Then, tap/click the [Apply] button.



6. Once the settings have been configured, the number "004" will appear in the bottom right of the [Move] block (indicated by "1").
7. Configure the same settings for the [Move] block indicated by "2".

Deleting taught positions

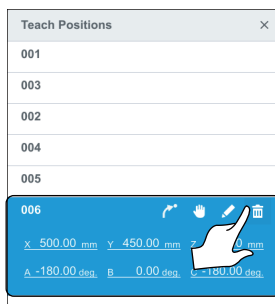
This section explains how to delete unnecessary positions.

9

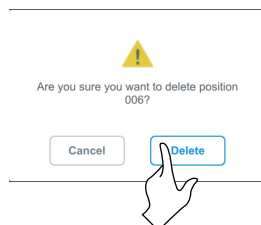
Operating procedure



1. Tap/click [Monitor] and select [Position List]. The Position List window will appear.



2. Select a position number you want to delete, then tap/click the delete icon.



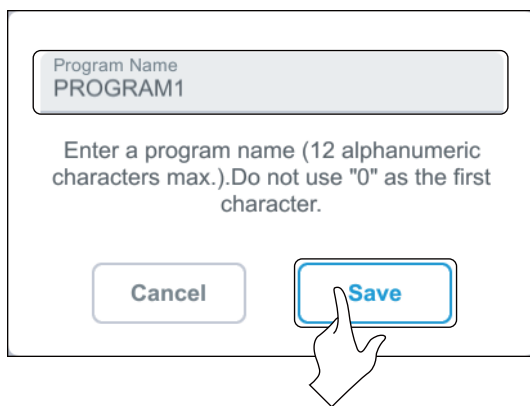
3. To delete the position number, tap/click the [Delete] button in the dialog box shown on the left.

10 SAVING THE PROJECT

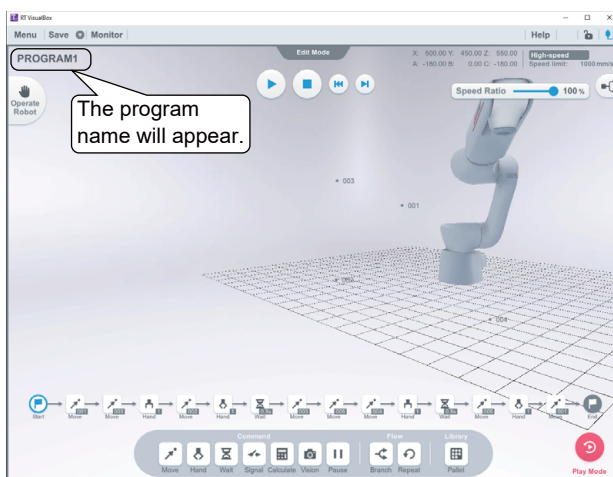
Operating procedure



1. Tap/click the button to the right of [Save] (indicated by "1").
2. Select [Save As].



3. Enter a name in the Program Name field.
For this example project, tap/click the [Save] button to save the project with the displayed default name.



4. After saving the project, the program name will appear in the upper-left corner of the screen.
The data will be saved in the robot controller.

Point

Programs containing errors cannot be saved. Check the properties of each block to see if all settings (such as position settings) have been configured. Blocks with errors highlight in blue. Review the settings of the blocks.

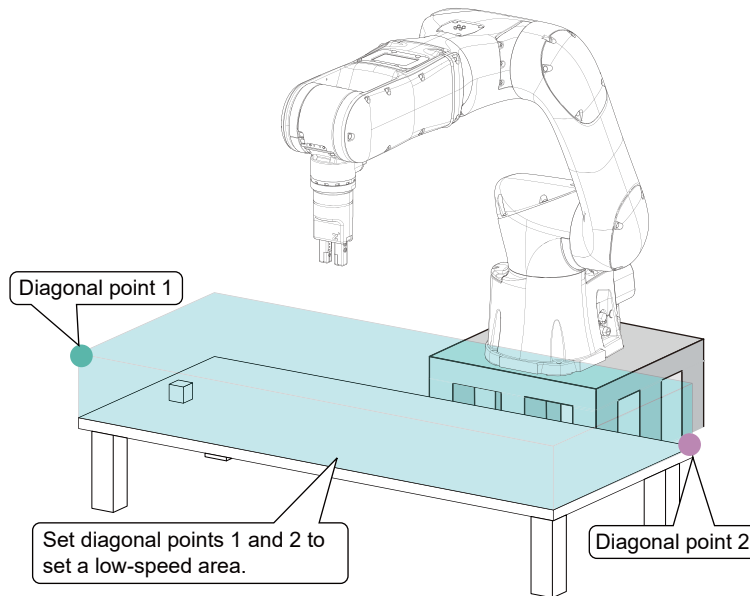
11 SETTING A LOW-SPEED SPACE IN THE COLLABORATION AREA

The low-speed space is a space in the collaboration area where it is necessary to reduce the possibility of harm to people. For an explanation of technical terms, refer to the section "Terms" in the following manual:

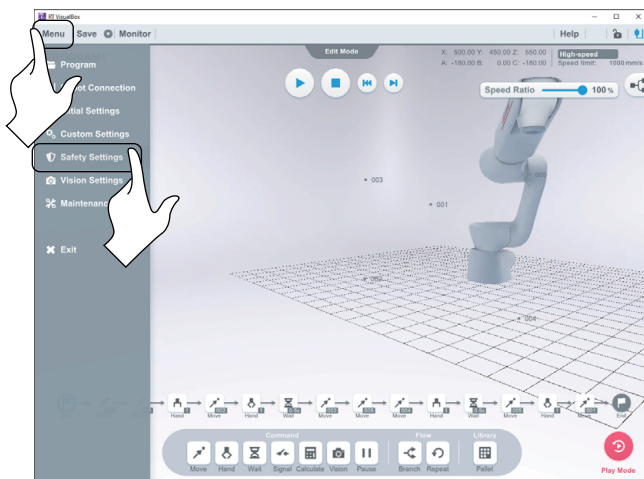
📖 Collaborative Robot: Detailed explanations of functions and operations (BFP-A3735)

Up to three low-speed spaces can be set.

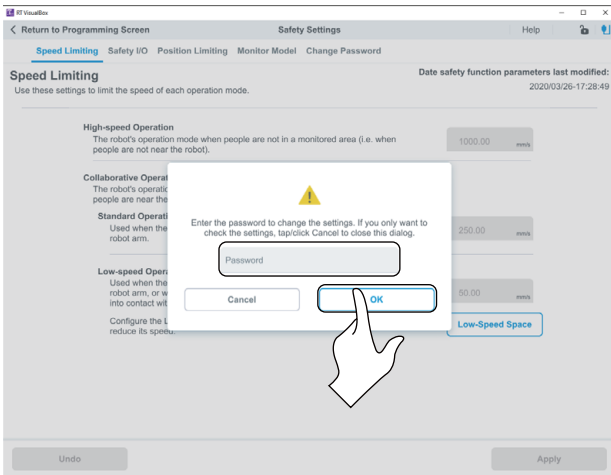
The following steps show how to set low-speed spaces.



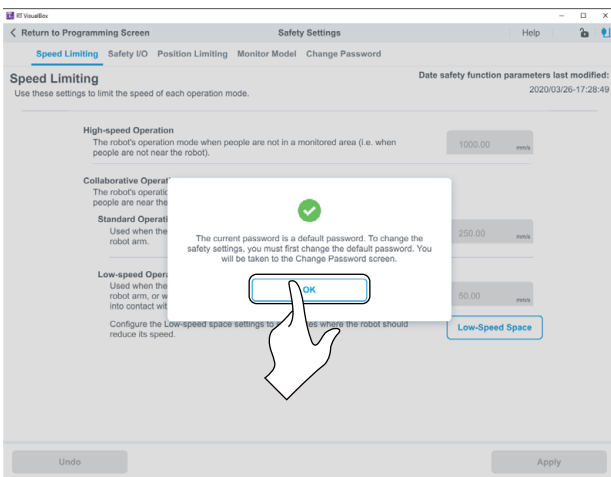
Operating procedure



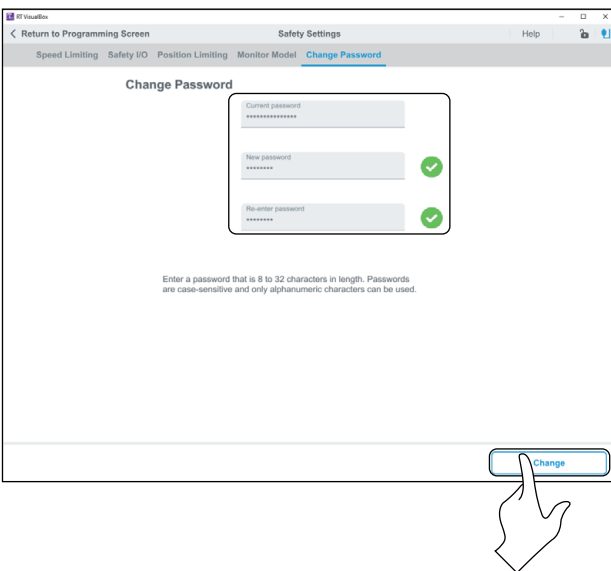
1. Tap/click [Menu] to display the menu.
2. Tap/click [Safety Settings].



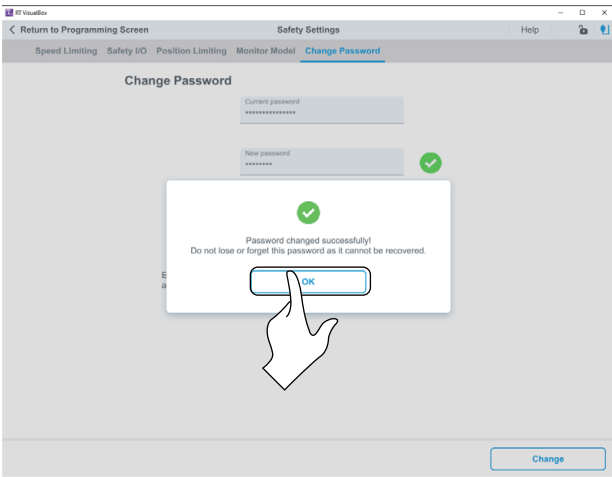
3. The dialog box on the left will appear when configuring the safety settings for the first time.
The default password is "MELFASafetyPSWD".
4. Enter the password, then tap/click the [OK] button.



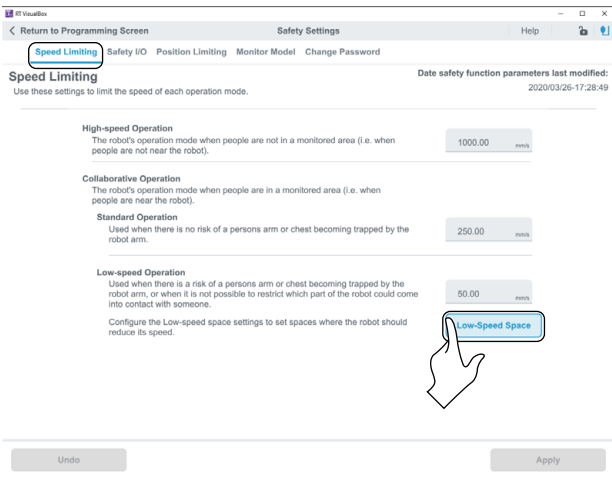
5. The safety settings cannot be changed without changing the default password. When the default password is entered, the Change Password screen will appear.



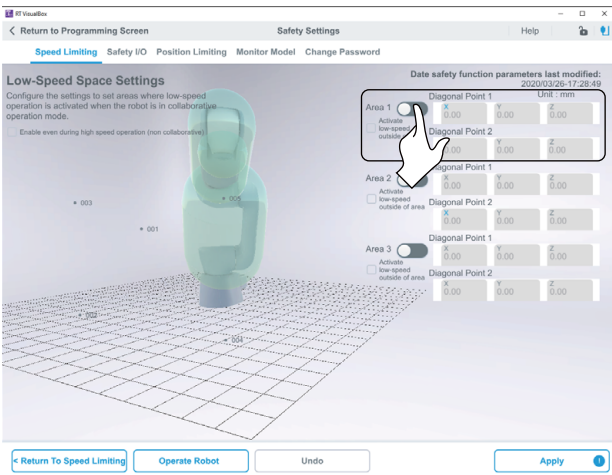
6. Change the password.
The password must be 8 to 32 characters long. Passwords are case-sensitive and only single-byte alphanumeric characters (0 to 9 and A to Z) can be used.
7. Enter the same password twice, then tap/click the [Change] button.



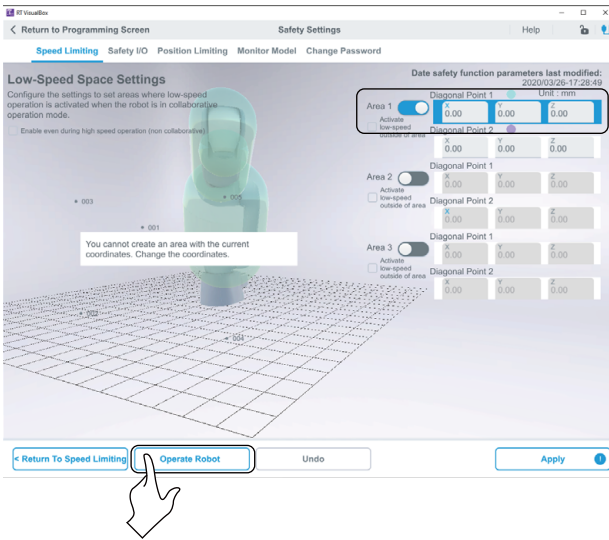
- 8. The dialog box on the left will appear once the password has been successfully changed. Tap/click the [OK] button to close the dialog box.



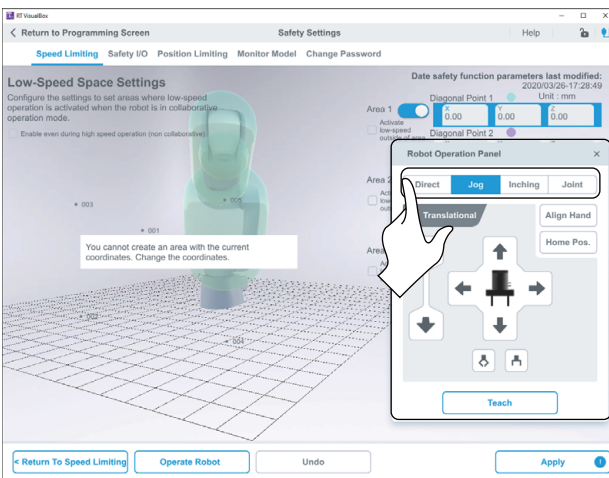
- 9. Tap/click [Speed Limiting] tab, then the [Low-Speed Space] button.



- 10. The Low-Speed Space Settings screen will appear. Tap/click the button to the right of Area1 to set a low-speed space. Specify two diagonal points to set an area.



11. Tap/click the [Operate Robot] button to set Diagonal Point 1.

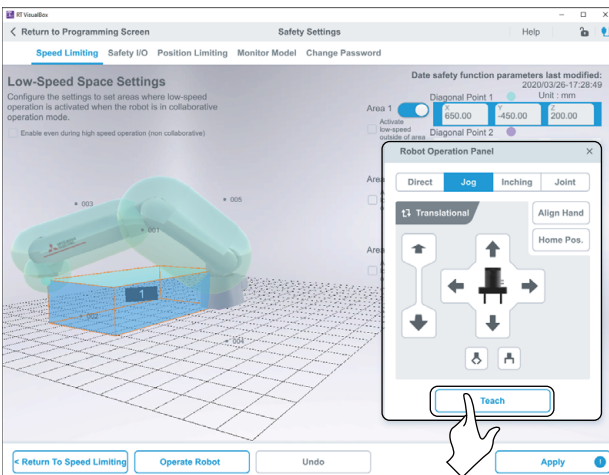


12. Set Diagonal Point 1 using one of the following modes: Direct, Jog, Inching, and Joint.

Point

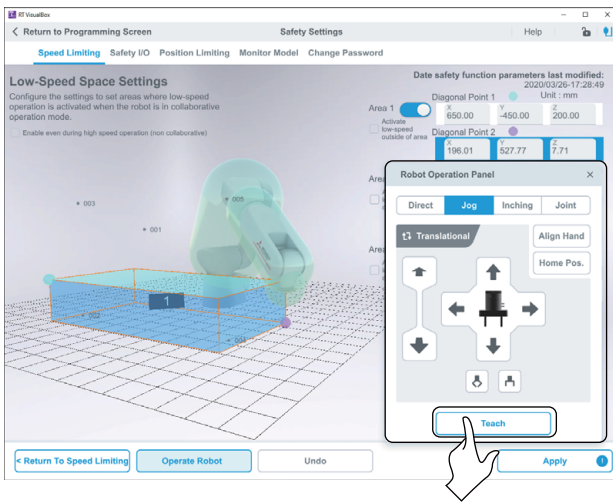
Note that the physical robot will move when setting diagonal points using the Robot Operation window. To set a low-speed space below the top surface of the workbench, do either of the following:

- Move the workbench beforehand to a place where it will not interfere with the robot.
- Enter coordinate values in the fields shown in step 16.



13. Move the robot to roughly where you want Diagonal Point 1 to be, then tap/click the [Teach] button in the Robot Operation panel.

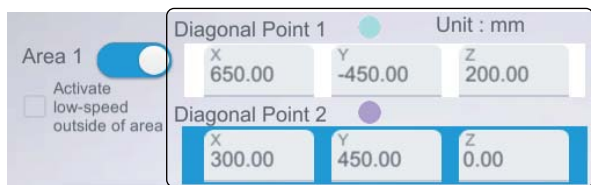
Values will be entered in the fields of Diagonal Point 1. Then, the fields of Diagonal Point 2 will be selected.



14. After values have been entered in the fields of Diagonal Point 2, a light-blue cuboid will appear that corresponds to the values that have been set.

The area within this cuboid will be a low-speed space.

15. Use the 3D view to move around the robot and check that the space in which the robot will work with humans is set as a low-speed space.

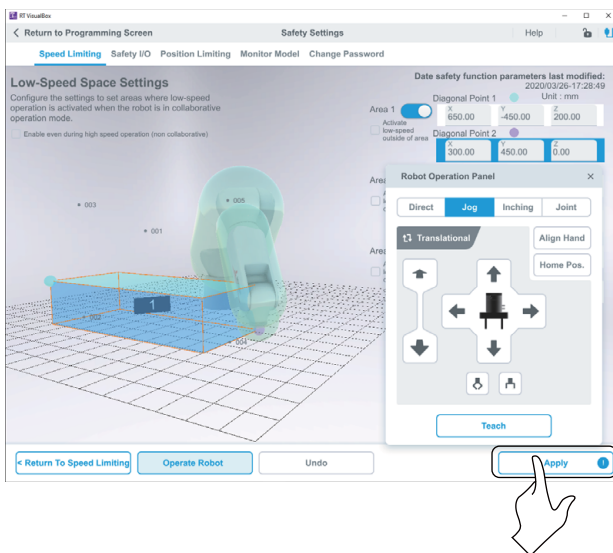


16. To set the space more precisely, directly modify the values in the Diagonal Point 1 and Diagonal Point 2 fields.

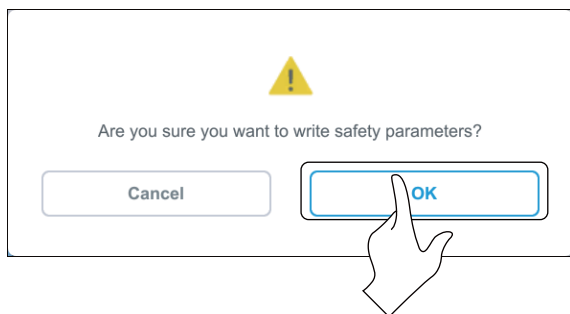
The values in the screen on the left are examples.

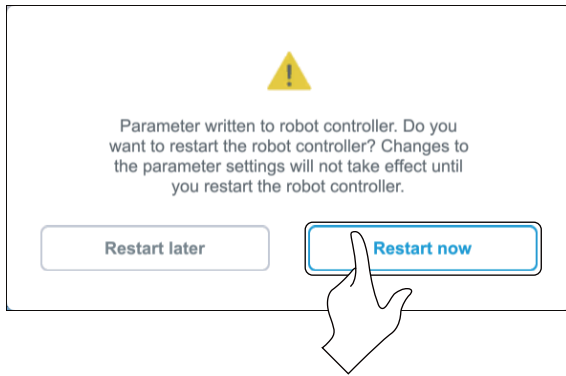
Set values specific to your needs.

17. Tap/click the [Apply] button.



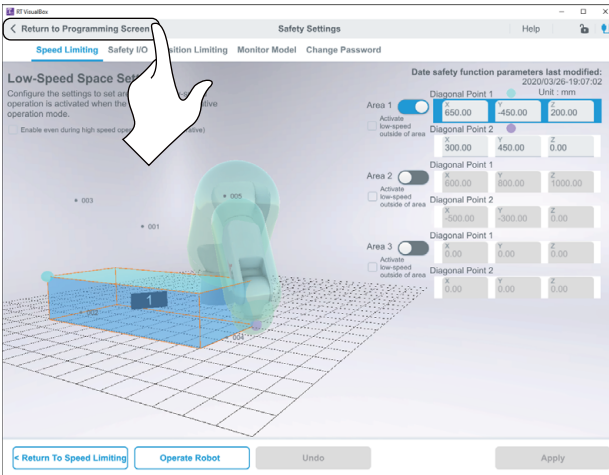
18. Tap/click the [OK] button.





19. Tap/click the [Restart now] button.

If the robot controller restarts successfully, the Low-Speed Space Settings screen will appear.

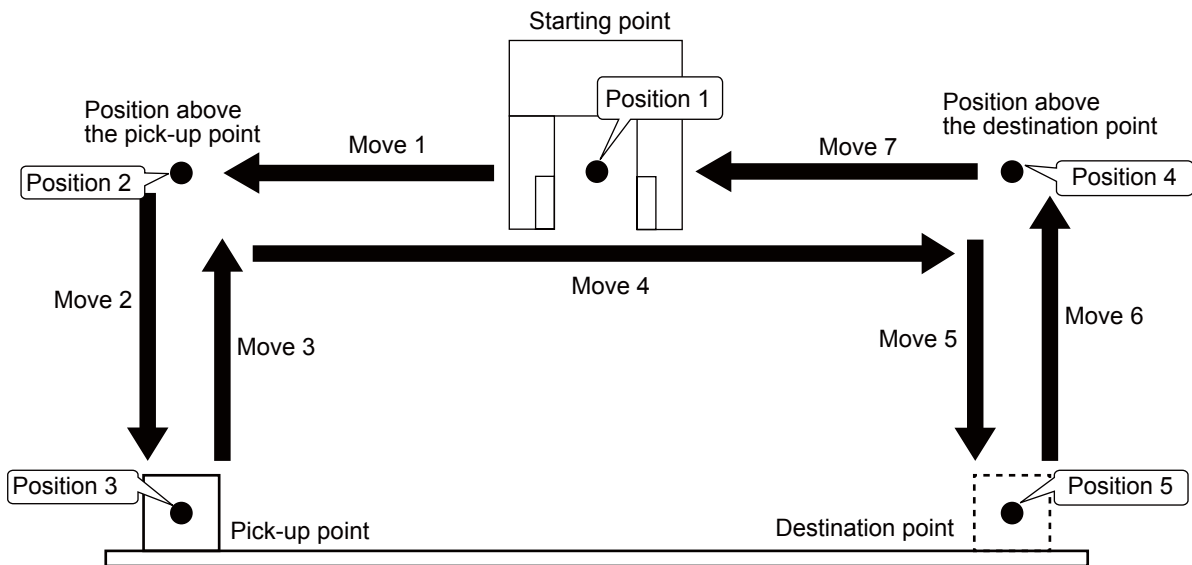


20. Tap/click [Return to Programming Screen]. The main screen will appear.

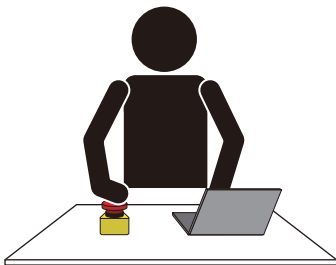
12 CHECKING THE ROBOT MOVEMENT IN STEP OPERATION

Check that there are no obstacles, such as tools, within the operating range of the robot before performing step operation. Screenshots from RT VisualBox are used to explain the following operation. Note that the robot will move during step operation.

When setting the workpiece down before using step operation, make sure that the workpiece is left in the same position and orientation that it was in when the teaching positions were taught.



⚠ CAUTION



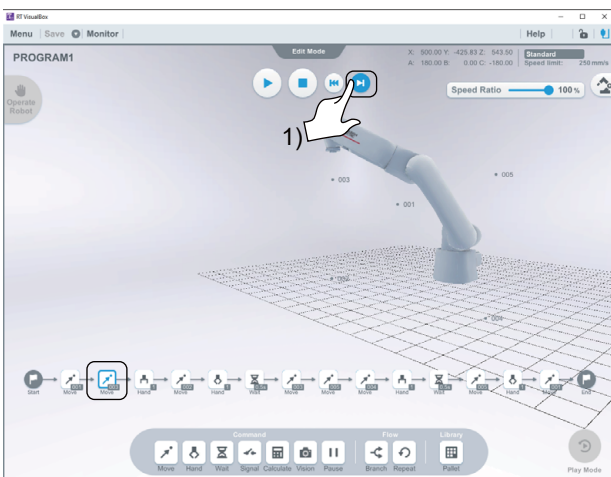
Before performing step operation, be sure to place an emergency stop switch nearby so that the robot can be stopped immediately.

The robot may move faster than expected during step operation.

To slow down the robot, set Speed Ratio to less than 100%.

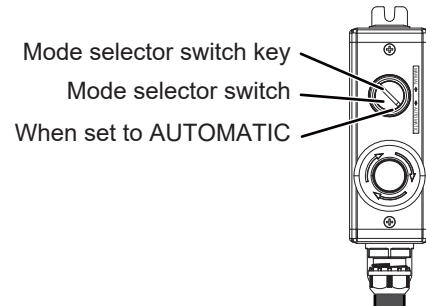
Operating procedure

Start with the Speed Ratio at 10% when checking the robot's movement for the first time, then gradually increase the Speed Ratio as required.



1. Check that the settings are as follows:

- The robot controller mode selector switch is set to AUTOMATIC mode and the mode selector switch key has been removed.



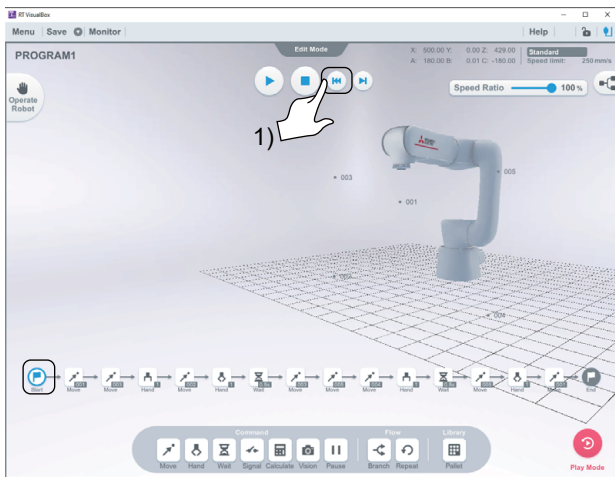
- RT VisualBox is in Edit mode.

2. Tap/click the [Step forward] button (indicated by "1") to perform the next step from the current position in the program. Tap/click the [Stop] button (indicated by "2") to stop the robot.

3. Tap/click the [Step forward] button. The block that is currently being performed will highlight in blue.

The blue highlight will disappear once the current step is complete.

Tapping/clicking the [Step forward] button again will highlight the next block in blue.



4. Run the program to END using step operation to check that the settings of all the blocks are configured correctly.

Tapping/clicking the [Reset] button (indicated by "1") will highlight [Start] in blue.

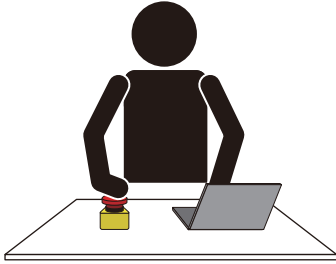
13 RUNNING THE PROGRAM

Execute one cycle of the program or run the program repeatedly.

Screenshots from RT VisualBox are used to explain the following operation. Note that the robot will move while the program runs.

When setting the workpiece down before running the program, ensure that the workpiece is left at the taught pick-up point.

⚠ CAUTION



Before running the program, be sure to place an emergency stop switch nearby so that the robot can be stopped immediately.

The robot may move faster than expected while the program runs.

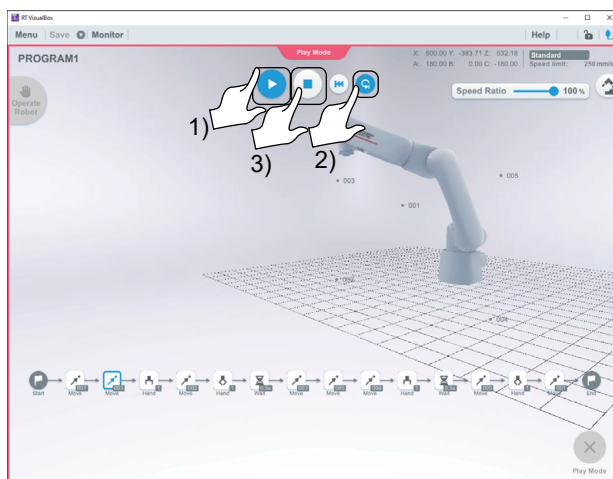
To slow down the robot, set the Speed Ratio to less than 100%.

Operating procedure

Start with the Speed Ratio at 10% when checking the robot's movement for the first time, then gradually increase the Speed Ratio as required.



1. Tap/click the [Play Mode] button in the lower-right corner of the screen to switch the mode from Edit Mode to Play Mode.



2. Tap/click the [Play] button (indicated by "1") to start the robot.
3. Tap/click the [End] button (indicated by "2") during robot operation. The robot will stop after one cycle of the program.

Tapping/clicking the [Stop] button (indicated by "3") during robot operation will stop the robot. Tapping/clicking the [Play] button will restart the robot from where it has stopped.

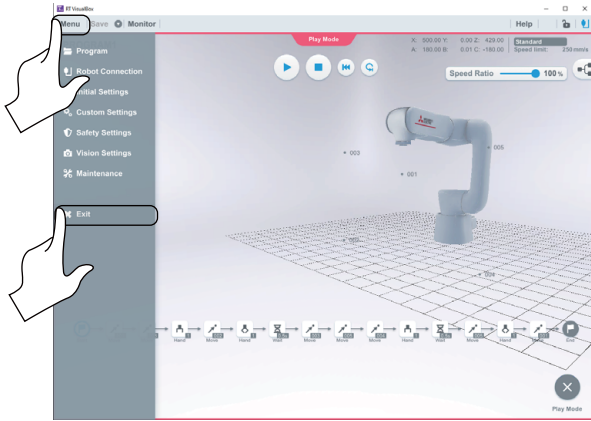
Point

The operation will repeat continuously until the [End] button is tapped/clicked.

Do not use a workpiece when repeatedly running the program created in this section.

14 STOPPING THE PROGRAM AND EXITING RT VisualBox

Operating procedure



1. To exit RT VisualBox, tap/click [Menu] to display the menu.
2. Tap/click [Exit].

MEMO

PART 3

VISION SENSOR

15 INCORPORATING A VISION SENSOR

This part explains how to incorporate a vision sensor into the system. Using a vision sensor allows the robot to utilize image data so that it can automatically adjust its grasp position.

15 INCORPORATING A VISION SENSOR

15.1 Applications

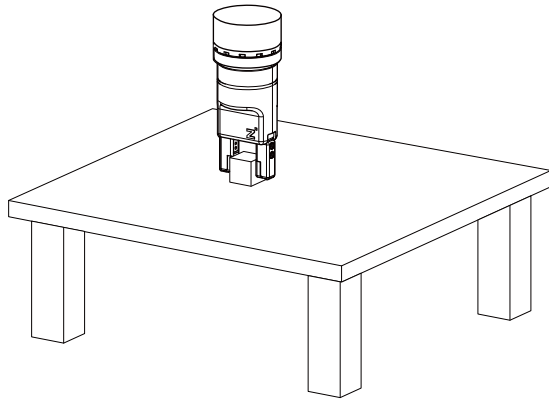
When picking and placing workpieces, there are times when workpieces cannot be grasped properly if they are not in a fixed position.

However, by using a vision sensor the robot is able to utilize image data to automatically adjust its grasp position.

This allows the robot to transport multiple workpieces consecutively.

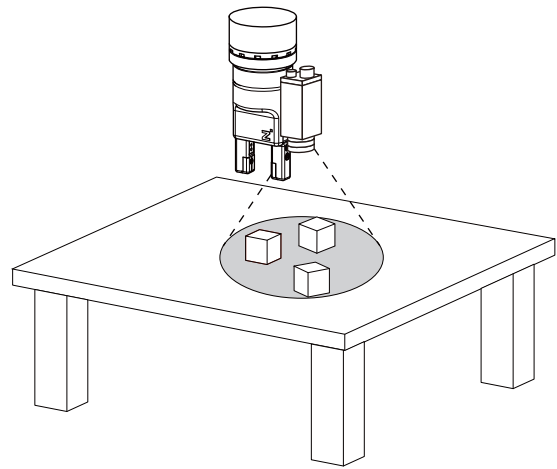
●Without a vision sensor

The robot can only move to a taught position.



●With a vision sensor

The vision sensor can identify workpieces within its field of view (FOV), so even if the position of workpiece is different to the taught pick-up point, the robot can automatically adjust its grasp position accordingly.



15

15.2 Supported Vision Sensors

RT VisualBox supports the following vision sensors. (As of April 2020)

	Description
Model	VS80M-202, VS80M-202-R (Manufactured by Mitsubishi Electric) ^{*1*2} In-Sight 8402M-363-50, In-Sight 8402M-373-50 (Manufactured by Cognex) ^{*2}
Installation type	Installed on the robot hand bracket.

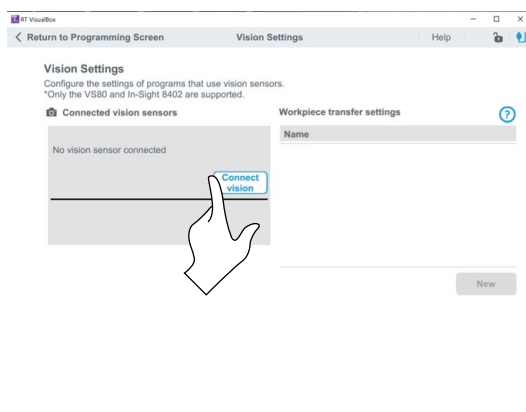
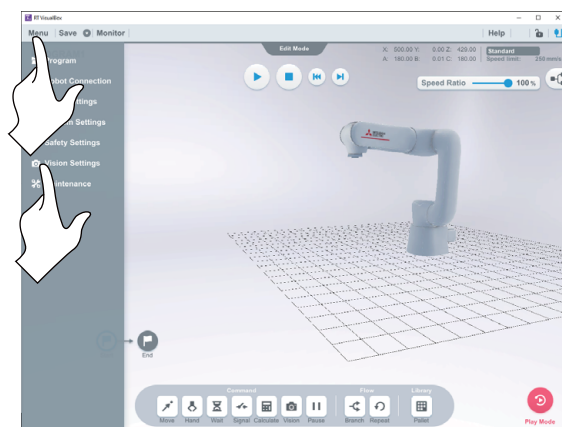
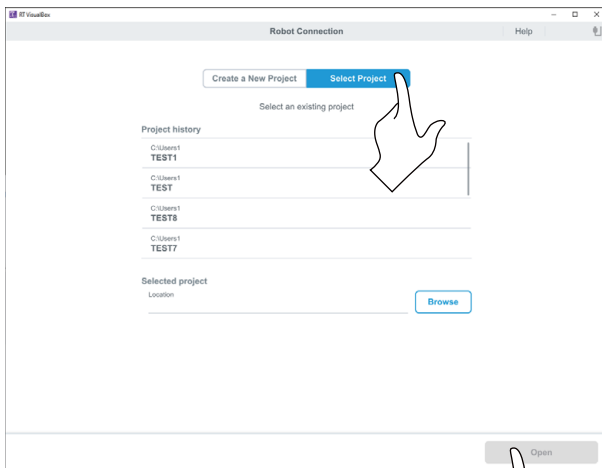
*1 Only available in Japan.

*2 Meets PoE Class 2 standards (6.49 W max.).

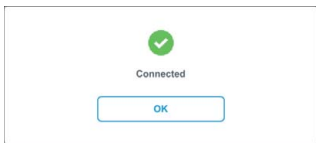
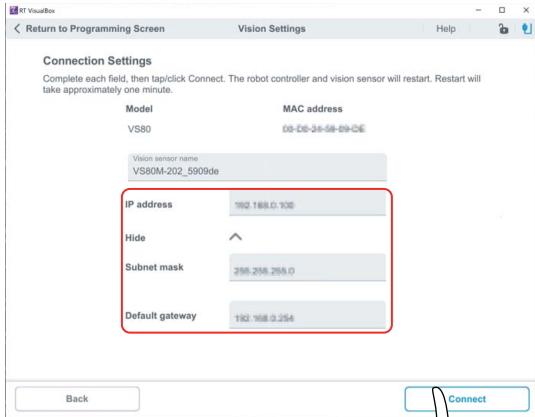
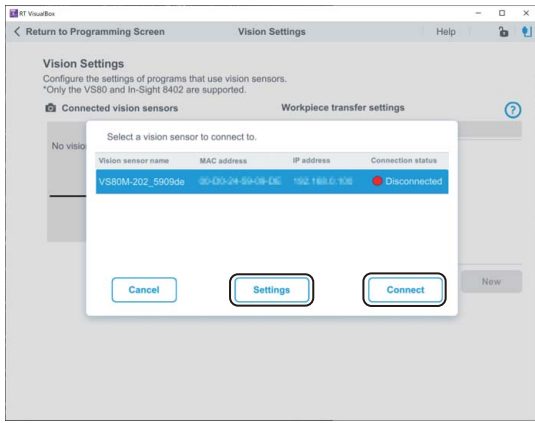
PoE is technology that allows an Ethernet cable to send both data and power to devices.

15.3 Configuring the Vision Sensor Connection Settings

Operating procedure



1. Connect the computer and robot controller to an Ethernet hub.
2. Start RT VisualBox, then tap/click [Select Project].
3. Select the project that was created in chapter 10, then tap/click [Open].
4. Tap/click the [Menu] tab on the menu bar.
5. Tap/click [Vision Settings] to display the Vision Settings screen.
6. Tap/click [Connect Vision].



7. When connecting a vision sensor for the first time or if the connection fails, tap/click the [Set] button.

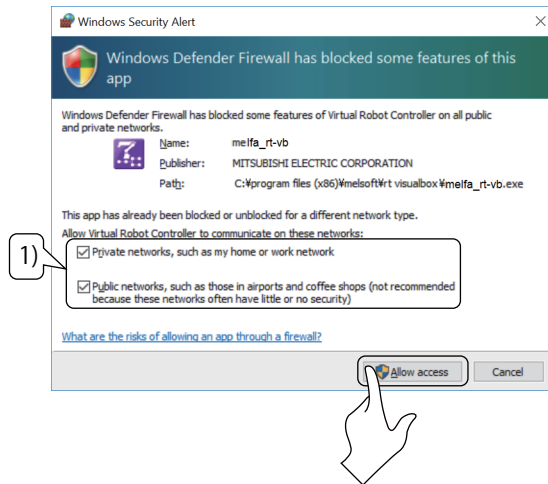
For all other situations, select the vision sensor you want to connect and tap/click the [Connect] button.

8. If settings need to be configured, enter the network settings then tap/click the [Connect] button. Once the settings have been configured, the robot controller and vision sensor will automatically restart.

9. Please wait while a connection between the computer and vision sensor is established.

If blocked by a firewall

1. If the following window appears, select the two check boxes indicated by number 1, then tap/click the [Allow access] button.



2. Tap/click the [OK] button.

15.4 Configuring the Workpiece Transfer Settings

In this section we will configure the workpiece transfer program used for the vision sensor.

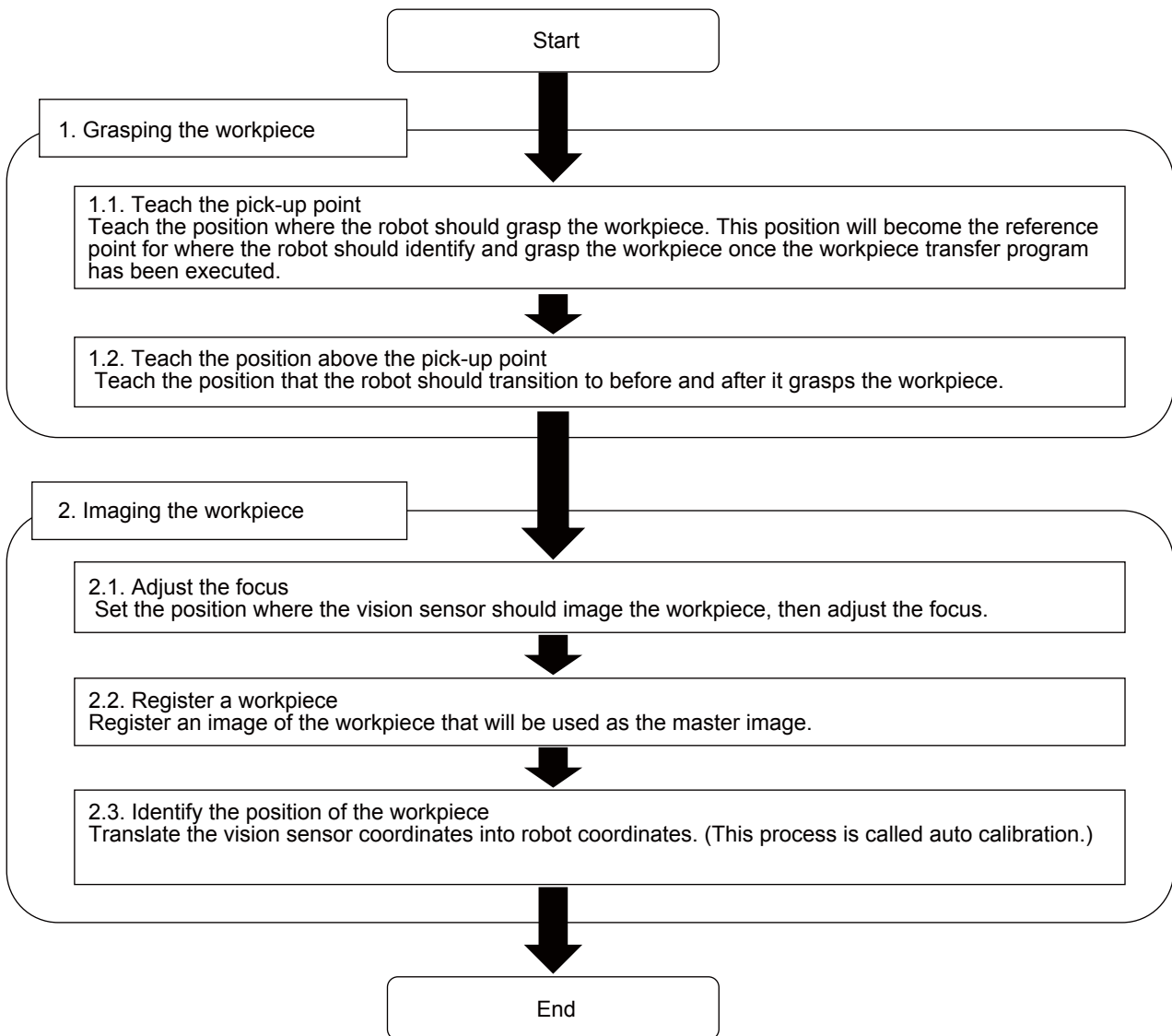
If the robot attempts to pick up a workpiece from a position specified by the Move block, it may not be able to grasp the workpiece properly if the workpiece has deviated from that position. However, once these settings have been configured, the robot will be able to utilize vision sensor image data to automatically adjust its grasp position.

Refer to the following page for further information on the Move block.

Page 68

Registering workpiece transfer settings

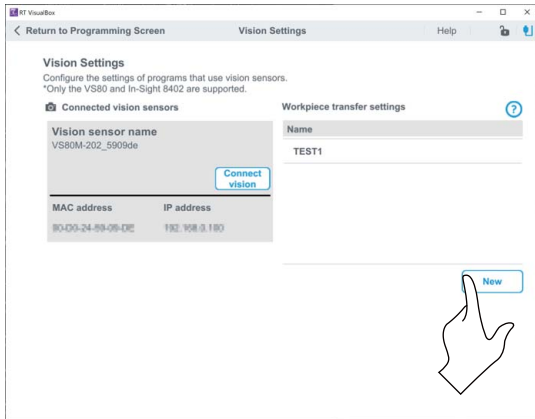
Follow the process below to configure the workpiece transfer settings. Configure these settings while the vision is connected to the computer and robot.



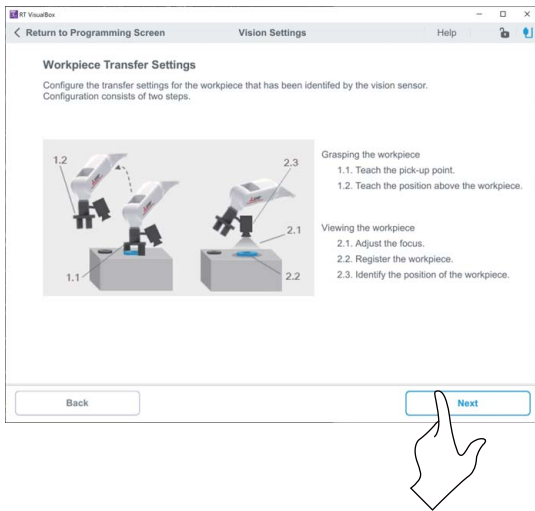
CAUTION

Ensure that the vision sensor connection cable does not come into contact with the robot arm while the robot is operating.

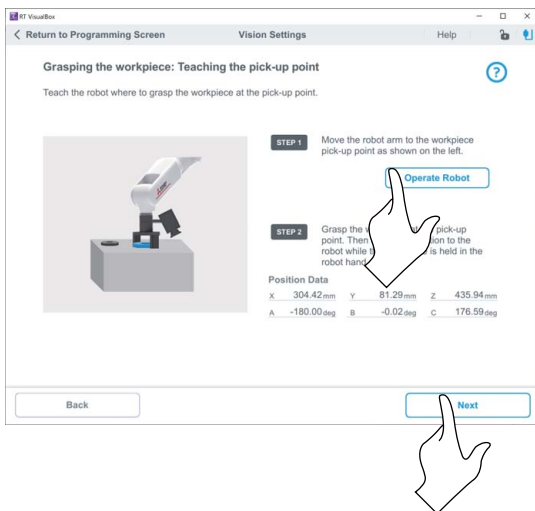
Operating procedure



1. Tap/click [New] under [Workpiece transfer settings].

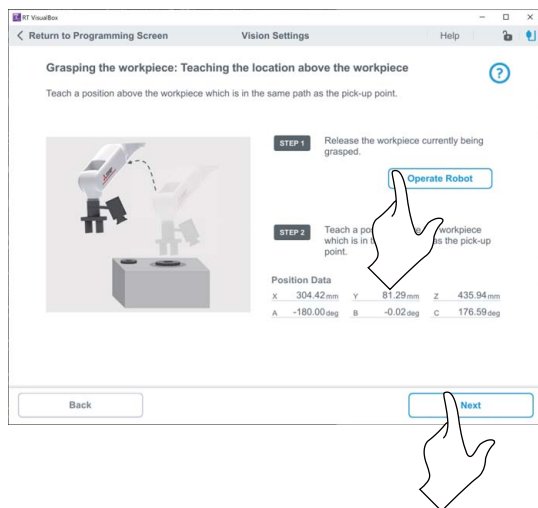


2. An illustration of the workpiece transfer process will appear. Tap/click [Next].



Teach the position where the robot should grasp the workpiece. This position will become the reference point used for adjusting the robot's grasp position during operation of the program that was created with the workpiece transfer settings.

3. Tap/click [Operate Robot] and move the robot to the position where it will grasp the workpiece.
4. Grasp the workpiece and then tap/click [Teach] in the Robot Operation panel.
5. Check that the current position appears in the Position Data fields, then tap/click [Next].



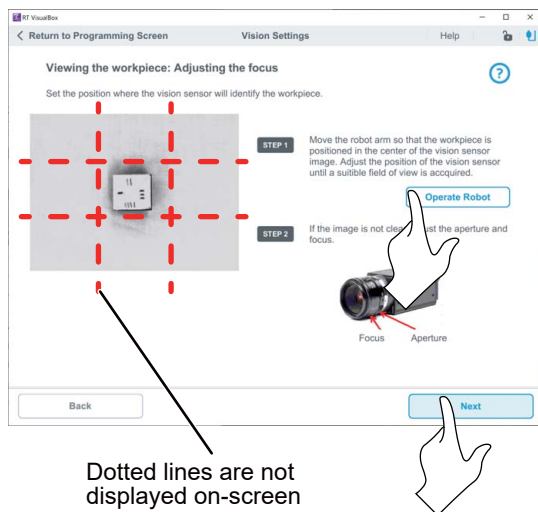
Teach the position above the pick-up point.

6. Tap/click [Operate Robot] and release the workpiece.
7. Move the robot arm to a position above the workpiece, then tap/click the [Teach] button in the Robot Operation panel. This position will become the via point.
8. Check that the current position appears in the Position Data fields, then tap/click [Next].

This position will be the position the robot diverts to before and after it grasps the workpiece. If a position far away from the workpiece is taught, there is a possibility that the robot will collide with other objects. It may also become impossible for the robot to grasp the workpiece.

⚠ CAUTION

After releasing the workpiece in Step 6, do not move the workpiece until it has been registered as instructed in Step 17. Doing so may lower recognition accuracy.



Move the robot arm to a position where the vision sensor can identify the workpiece.

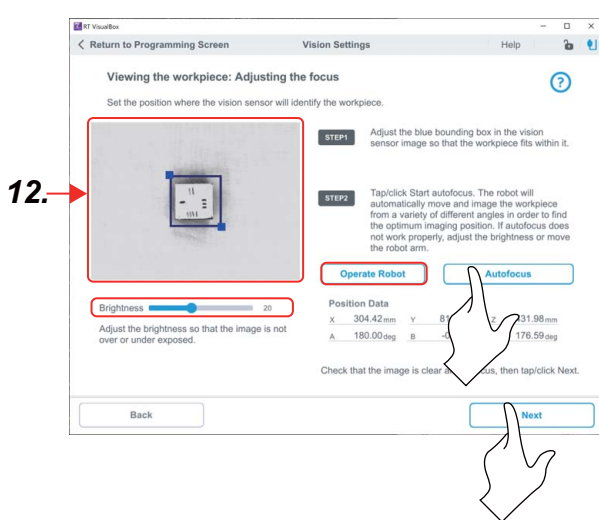
9. Tap/click the [Operate Robot] button. While looking at the image displayed by the vision sensor, move the robot so that the workpiece is in the center of the image and fits within the frame.
10. If the image is not clear, adjust the aperture and focus of the vision sensor.
11. After making the necessary adjustments, tap/click [Next].

Point

- Ensure that the workpiece is positioned within the red dotted lines as the robot will move during autocalibration.
- Placing the workpiece on a plain surface will make registering a workpiece easier.

⚠ CAUTION

At this stage, the vision sensor's FOV has been determined. If the workpiece pick-up point will change during automatic operation, ensure that the vision sensor's FOV is large enough to encompass all the pick-up points.



Use autofocus to have the robot move to an optimal focal position.

12. Adjust the blue bounding box in the vision sensor image so that the workpiece fits within it.

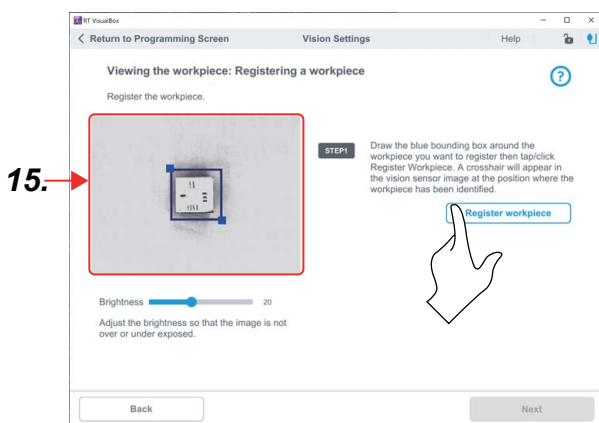
13. Tap/click the [Autofocus] button.

14. If autofocus is successful, the robot stops and the position data is updated. Tap/click [Next].

If autofocus fails, adjust the brightness or tap/click [Operate Robot] to change the robot position.

⚠ CAUTION

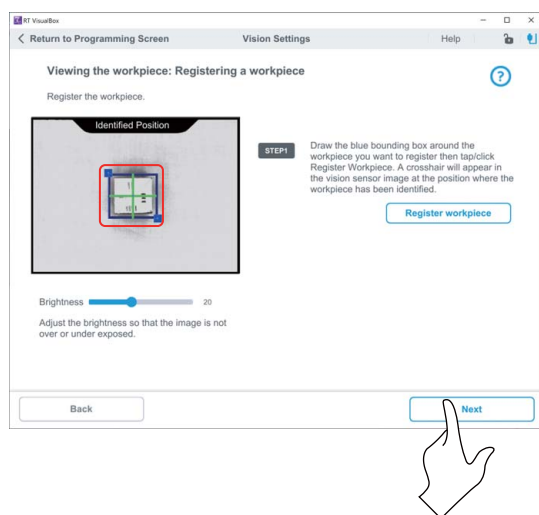
The robot moves during autofocus. Be sure to place an emergency stop switch nearby so that the robot can be stopped immediately.



Register the workpiece.

15. Adjust the blue bounding box in the vision sensor image so that the workpiece fits within it.

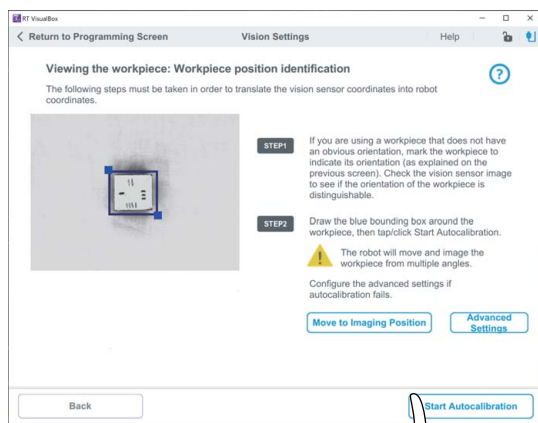
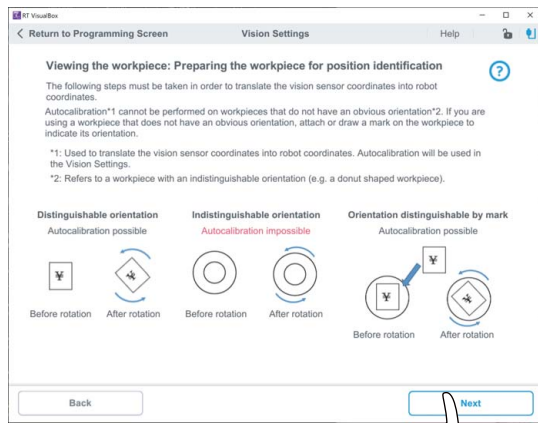
16. Tap/click [Register workpiece].



17. A crosshair will appear in the center of the workpiece. Tap/click [Next].

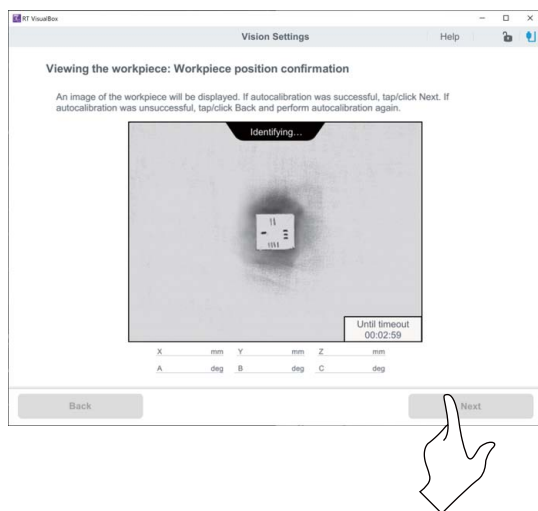
⚠ CAUTION

- This registered image will become the master image. Adjust the brightness to achieve the greatest possible clarity.
- Only one type of workpiece can be registered per set of workpiece transfer settings. To register a different type of workpiece, create a new set of workpiece transfer settings.



⚠ CAUTION

The robot operates during autocalibration. Be sure to place an emergency stop switch nearby so that the robot can be stopped immediately.



18. Precautions regarding workpiece orientation that should be noted when using autocalibration will appear. Follow the on-screen instructions and check if autocalibration is possible with the workpiece you are using.

Tap/click [Next].

Point

Autocalibration is a function that translates the vision sensor coordinates into robot coordinates. It allows the robot to distinguish its position in relation to positions in the image captured by the vision sensor.

Execute autocalibration.

During autocalibration, the robot will move 100 mm in the forward, back, left, and right directions.

19. Draw a mark indicating the orientation of the workpiece if the workpiece does not have a feature that helps determine its orientation.

20. Draw the blue bounding box around the workpiece, then tap/click [Start Autocalibration].

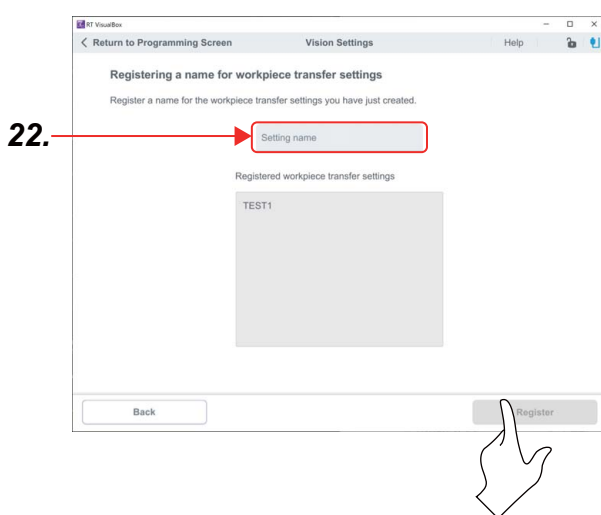
21. Check the autocalibration result.

During autocalibration, an image will be displayed every time an image is captured.

If autocalibration is successful, the robot stops and the workpiece position data is updated. Tap/click [Next].

If autocalibration fails, return to step 19. Refer to the following page and restart autocalibration.

📖 Page 105 If autocalibration fails



Decide on a name for the workpiece transfer settings.

22. Enter a name.

23. Tap/click the [Register] button.

If autocalibration fails

If autocalibration fails, tap/click [Move to Imaging Position] and check the points below after the robot has moved back to the position it was in before autocalibration.

No.	Possible cause	Solution
1	Are you trying to perform autocalibration on a workpiece that has an indistinguishable orientation?	Refer to the following manual: ☞ Page 105 Solution to No.1
2	Is the workpiece within the vision sensor's FOV during calibration?	Refer to the following manual: ☞ Page 105 Solution to No.2
3	Has error L2602 (destination point out of robot's operating range) occurred?	Refer to the following manual: ☞ Page 106 Solution to No.3
4	Has the robot arm come into contact with a surrounding object or become entangled with a cable during calibration?	Refer to the following manual: ☞ Page 106 Solution to No.4
5	Did the software time-out before calibration finished?	Refer to the following manual: ☞ Page 106 Solution to No.5
6	Was the workpiece within the blue bounding box before calibration started?	Refer to the following manual: ☞ Page 106 Solution to No.6
7	Is the allowable error during calibration too small?	Refer to the following manual: ☞ Page 106 Solution to No.7

15

■Solution to No.1

Go back to Step 19 and make sure that a mark has been put on the workpiece to indicate its orientation. Then perform auto calibration again.

■Solution to No.2

There are three solutions to this problem.

- Place the workpiece in the center of the vision sensor's FOV, then start autocalibration. If the workpiece is not placed in the center of the vision sensor's FOV, it may leave the vision sensor's FOV altogether while the robot arm is moving during calibration.
- Go to [Advanced Settings] and adjust the values of each movement stated below so that the workpiece is within the vision sensor's FOV.
 - Rotational movement
 - Movement in the X axis
 - Movement in the Y axis
- If non of the steps above resolve the problem, re-teach the pick-up point and try autocalibration again. Move the vision sensor back from the workpiece so that the workpiece occupies less space within the vision sensor's FOV.

■Solution to No.3

There are two solutions to this problem.

1. Go to [Advanced Settings] and adjust the values of each movement stated below to change the distance the arm is allowed to move during calibration.

- Rotational movement
- Movement in the X axis
- Movement in the Y axis

Inverting the direction of rotation is acceptable when adjusting the values for rotational movement.

2. If the above step does not resolve the problem, change the posture of the robot and configure the vision sensor settings from the start again.

■Solution to No.4

There are two solutions to this problem.

1. Go to [Advanced Settings] and adjust the values of each movement stated below. Change the distance the arm is allowed to move so that it does not interfere with surrounding objects or become entangled in cables, etc.

- Rotational movement

In order to improve accuracy, ensure that rotational movement increases in progressively larger degrees of movement as stated below:

1st rotation < 2nd rotation < 3rd rotation ≤ 4th rotation

2. Go to [Advanced Settings] and adjust the values of each movement stated below. Change the distance the arm is allowed to move so that it does not interfere with surrounding objects or become entangled in cables, etc.

- Movement in the X axis
- Movement in the Y axis

■Solution to No.5

There are two solutions to this problem.

1. The speed of the movement may be too slow. Increase the speed of the movement or increase the Time out time in [Advanced Settings].

2. The robot may have stopped due to the position limiting settings. Go to [Advanced Settings] and adjust the values of each movement stated below to change how much the robot moves during calibration.

- Rotational movement
- Movement in the X axis
- Movement in the Y axis

■Solution to No.6

Draw the blue bounding box around the workpiece, then start auto calibration.

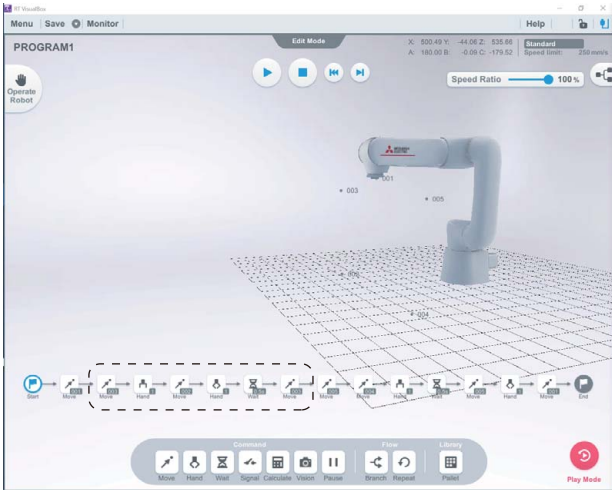
■Solution to No.7

Go to [Advanced Settings] and increase the permissible error in 0.01 increments, then perform autocalibration. "Permissible error" refers to the amount of error that is permissible between the resultant position and the target position.

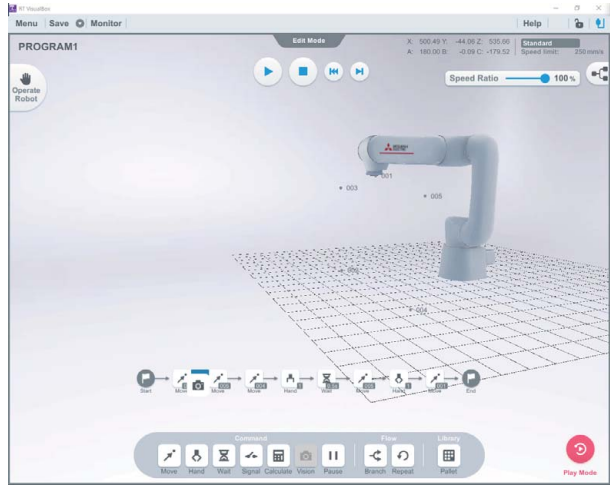
15.5 CREATING A PROGRAM WITH RT VisualBox

This chapter explains how to create and edit robot programs that incorporate a vision sensor. This program will be created based on the program created in part 2.

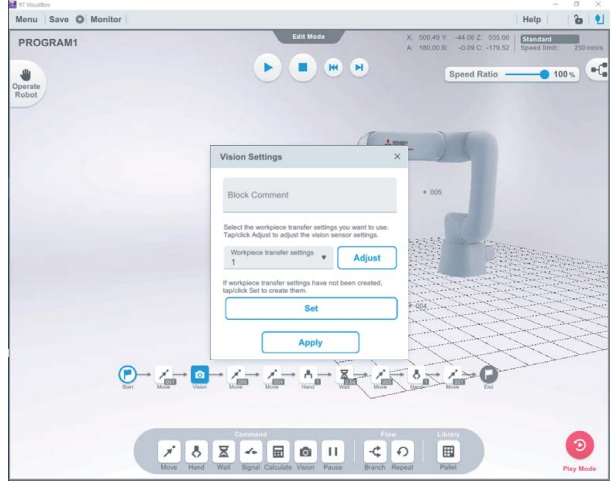
Operating procedure



1. Drag the program blocks within the dotted lines downwards and drop them into the trash can.



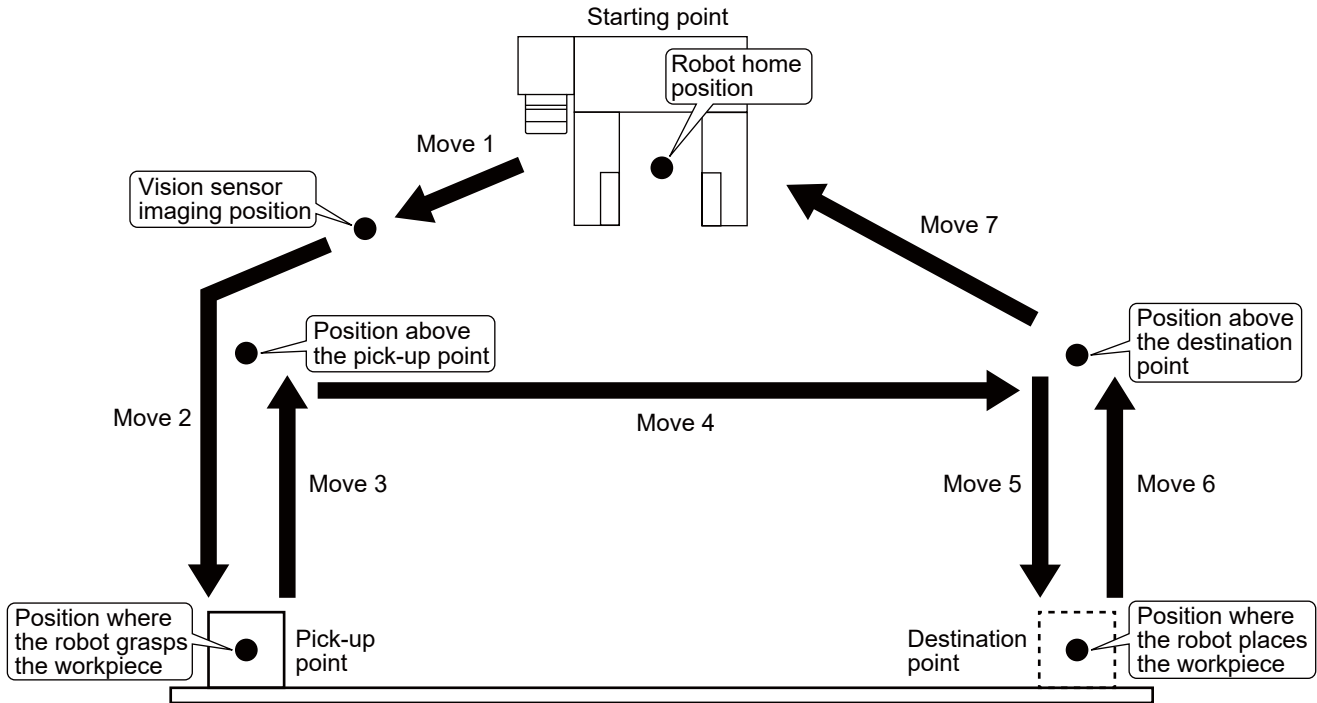
2. Drag and drop a [Vision] block in place of the program blocks that were deleted in step 1.



- 3. Tap/click the [Vision] block placed in the program in step 2.
- 4. Select the workpiece transfer settings you would like to use from the drop down list.
- 5. Then, tap/click the [Apply] button.

15.6 CHECKING THE ROBOT MOVEMENT IN STEP OPERATION

Check that there are no obstacles, such as tools, within the operating range of the robot before performing step operation. The robot will operate as illustrated in the figure below.



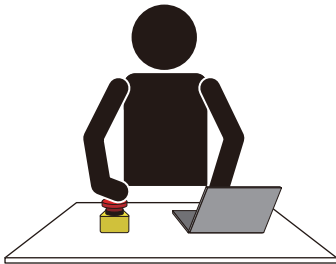
Point

If the vision sensor cannot identify the workpiece when it is at the imaging position, the [Vision] block program will not be executed. The [Vision] block will be white. The [Move] block in the next step of the program will highlight in blue. The program will then stop. Tapping/clicking the [Step forward] button will move the robot to the position above the destination point.

If the workpiece can be identified, the value "1" will be stored in "M_VSFoundNum". If the workpiece cannot be identified, the value "0" will be stored in "M_VSFoundNum". When setting identification conditions, set them in the variable "M_VSFoundNum" found in the [Branch] block. Also create the operations that will occur depending on whether the sensor was able to identify the workpiece. For further information, refer to the section "Branch block" in the following manual.

📖 RT VisualBox Instruction Manual (BFP-A3696)

⚠️ CAUTION



Before performing step operation, be sure to place an emergency stop switch nearby so that the robot can be stopped immediately.
 The robot may move faster than expected during step operation.
 To reduce the speed of the robot, set the Speed Ratio to less than 100%.

For further information on operation steps, refer to the following page:

📖 Page 89 CHECKING THE ROBOT MOVEMENT IN STEP OPERATION

15.7 RUNNING THE PROGRAM

Execute one cycle of the program or run the program continuously.

Take the following precautions when running the program continuously.

- Ensure that there are no workpieces at the destination point as the fingers of the robot hand will interfere with the workpieces.
- When transferring multiple workpieces, ensure that there is ample space for the fingers of the robot hand to access each workpiece.

For further information, refer to the following page:

 Page 92 RUNNING THE PROGRAM

REVISIONS

*The manual number is on the bottom left of the back cover.

Revision date	*Manual No.	Description
April 2020	BFP-A3715	First edition
July 2020	BFP-A3715-A	Revised the guidelines for unpacking the robot.
October 2020	BFP-A3715-B	<ul style="list-style-type: none">• Revised information on the parts included in the Easy-setup kit.• Added Rotational mode to direct teaching.• Revised the weight of recommended hands.• Added information on the trial version of RT VisualBox.
February 2022	BFP-A3715-C	<ul style="list-style-type: none">• Software version C2d supported. Revised "3.1 Powering on the Robot, Robot Controller, and Peripherals".

This manual confers no industrial property rights or any rights of any other kind, nor does it confer any patent licenses. Mitsubishi Electric Corporation cannot be held responsible for any problems involving industrial property rights which may occur as a result of using the contents noted in this manual.

© 2020-2022 MITSUBISHI ELECTRIC CORPORATION

TRADEMARKS

Ethernet is a registered trademark of Fuji Xerox Co., Ltd. in Japan.

Microsoft and Windows are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

Adobe and Adobe Reader are registered trademarks of Adobe Systems Incorporated.

Unicode is either a registered trademark or a trademark of Unicode, Inc. in the United States and other countries.

The company names, system names, and product names mentioned in this manual are either registered trademarks or trademarks of their respective companies.

In some cases, trademark symbols such as [™] or [®] are omitted in this manual.

BFP-A3715-C(2202)MEE

MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE : TOKYO BUILDING, 2-7-3 MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
NAGOYA WORKS : 1-14 , YADA-MINAMI 5-CHOME , HIGASHI-KU, NAGOYA , JAPAN

Authorised representative:

Mitsubishi Electric Europe B.V. FA - European Business Group
Mitsubishi-Electric-Platz 1, D-40882 Ratingen, Germany
Tel: +49(0)2102-4860

Specifications subject to change without notice.