EPSON

Epson RC+ 8.0
Hand Function

Original instructions

Rev.2
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1. FOREWORD

1.1 Introduction

Thank you for purchasing this Epson robot system. This manual provides the information necessary for correctly using the robot system.
Before using the system, please read this manual and related manuals to ensure correct use.
After reading this manual, store it in an easily accessible location for future reference.

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

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

1.2 Trademarks

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

1.3 Notation

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

1.4 Terms of Use

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The information in this document is subject to change without notice.
Please contact us if you find any errors in this document or if you have any questions about the information in this document.

1.5 Manufacturer

SEIKO EPSON CORPORATION

1.6 Contact Information

Contact information details are listed in the "Supplier" section in the following manual.
Note that the contact information may vary depending on your region.
"Safety Manual - Contact Information"

The Safety Manual is also available at the following site.
URL: https://download.epson.biz/robots/

2. Overview

2.1 Hand

Various peripheral equipment (End Effector or EOAT (End Of Arm Tooling)) can be attached to the end of the Epson robot manipulator.
For the Epson RC+, a hand is a collective term used to describe grippers, electric screwdrivers, and other end effectors attached to the end of the manipulator.
Epson RC+ provides functions that allow for easier control of frequently used hands.
Hands compatible with Epson RC+ hand functions are described below.
Hand type

KEY POINTS

I/O control-driven hands not compatible with hand functions can still be controlled using SPEL+ commands (I/O control on and off commands).

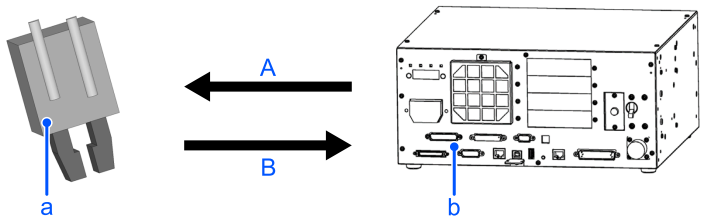
2.2 Definition of Terms

The terms used in this manual, and their definitions, are described in the table below.

Term	Meaning
Hand	A general term for a device attached to the end of the manipulator to perform an action
End effector*1	A general term for a device attached to the end of the manipulator (ISO standard)
EOAT*1	End Of Arm Tooling A general term for a device attached to the end of the manipulator
Gripper	A general term for hand tools used to grip a workpiece Grippers are primarily comprised of vacuum-type and chuck-type grippers.
Electric screwdriver	An electric device used to tighten screws (The hand function is intended for use with end of arm tooling that can be attached to the end of the manipulator and support I/O control.)
Dispenser	A device used to apply adhesives and grease
Welding torch	A device used for welding
Pneumatic	Compressed air. Supplies air pressure as a source of power to operate a device.
Vacuum (state)	A state of lower air pressure than atmospheric pressure
Vacuum generator	A device that generates a vacuum state Ejectors, vacuum pumps, etc.
Ejector	A device that generates a vacuum from the air flow obtained from pneumatic
Vacuum pump	A pump used to generate a vacuum by discharging gas from a container
Vacuum break (function)	A function used to actively return a vacuum state back to atmospheric pressure conditions by feeding pneumatic into the part in a vacuum state

Term	Meaning
Input*2	A signal sent from the hand to the controller
Output*2	A signal sent from the controller to the hand
Single function (hand)	A hand consisting of two states - “open, close”, or “suction, release” (The Epson RC+ Hand function defines an I/O connection as a connection with a maximum of two input or output bits each.)
Advanced (hand)	Other than single function hands ■ These hands have I/O connections and the input or output bits, or both have three or more bits ■ These hands use communications rather than I/O connection signals
Suction (hand)	The operation of sucking up a workpiece using a vacuum This can also be used to describe the types of hands that use suction
Chuck (hand)	The operation of clamping on a workpiece to grip it This can also be used to describe the types of hand that use clamping The chuck hands consist of two types that grip the workpiece from outside of it (external grip type) and grip the workpiece from inside of it (internal grip type).
Fingers	The moving part at the end of a chuck-type hand
Valve	A solenoid valve used to control pneumatic The Epson RC+ Hand function supports both single solenoid and double solenoid valves.
Single acting (Type)	Chuck hands that operate using pneumatic pressure to open or close the hand, and then using a spring action to perform the opposite action The fingers are either always open or closed when pneumatic is not being supplied.
Double acting (Type)	Chuck hands that use pneumatic pressure to both open and close the hand
Sensor	A sensor used to acquire the finger position of a chuck hand This may also be called an auto switch, a sensor switch, a proximity sensor, or other names depending on the manufacturer. The Epson RC+ Hand function supports two wire and three wire (NPN/PNP) sensors.
Plus common	A connection method that connects a common I/O terminal to a positive power supply voltage (+24V) Source common When connecting the I/O output terminal for the controller as a plus common connection, the controller functions as a PNP-type switch (transistor) internally. When connecting the I/O input terminal for the controller as a plus common connection, it uses an NPN-type sensor (transistor).
Minus common	A connection method that connects a common I/O terminal to a negative power supply voltage (GND) Sink common When connecting the I/O output terminal for the controller as a minus common connection, the controller functions as an NPN-type switch (transistor) internally. When connecting the I/O input terminal for the controller as a minus common connection, it uses a PNP-type sensor (transistor).

*1: For the Epson RC+, this is referred to as the “hand”.
*2: “Input” and “output” signals described in this manual always refer to the direction of the signal as viewed from the controller.



Symbol	Description
a	Hand
b	Controller
A	Output (Action command, etc.)
B	Input (Workpiece detection signal, etc.)

2.3 Related Manuals

In addition to this manual, refer to the following manuals when using hand functions.

- **Epson RC+ User's Guide**
  This manual describes how to operate the robot control system.
- **SPEL+ Language Reference**
  This manual provides information on SPEL+ Language commands.
- **Manipulator Manual**
  These provide a detailed description of various robot-related topics.
- **Controller Manual**
  This manual provides information on I/O connector specifications.

3. Safety

Please read this manual thoroughly before use to use correctly.
After reading, keep this manual handy for easy access at all times, and refer to confirm unclear points.

3.1 Conventions

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

⚠ WARNING

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

⚠ WARNING

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

⚠ CAUTION

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

3.2 Safety Precautions

⚠ WARNING

- Do not use this product for the purpose of ensuring safety.
- Only use this product under the operating conditions described in this manual. The use of this product in environments that do not met the recommended operating conditions may reduce the lifespan of the product, and cause serious safety concerns.

⚠ CAUTION

- Thoroughly read the manuals prepared by the robot hand manufacturer to operate the hand in the correct manner.
- Users are expected to prepare their own robot hand and hand peripheral equipment.
- When attaching a chuck to the hand, ensure that the wiring and air piping are configured so that the workpiece is not released when the power is turned off. Failing to configure the wiring and air piping for the chuck to clamp the workpiece when the power is turned off will result in the robot releasing the workpiece when the power is cut, potentially damaging the robot system and the workpiece.
- Epson robot controller settings include the following.
  - Turn the output port off with Reset
  - Turn the output port off with Emergency Stop

  Output ports selected or configured by the hand functions described in this manual are not affected by these settings to prevent the workpiece accidentally being released. Output from the output port selected by the hand function is maintained even when the Emergency Stop button is pressed, or the Reset command is executed. For more information, refer to the following.

  "Epson RC+ 8.0 User's Guide - [System Configuration] Command (Setup Menu) - [Setup]-[System Configuration]-[Controller]-[Preferences] Page"
- An end effector must be designed and developed to meet the requirements stipulated in ISO 10218-2 (JIS B8433). The following is a partial excerpt from ISO 10218-2 (Section 5.3.10).

  a. A loss or fluctuation in energy supply (for example, power, hydro-pneumatic, vacuum source) must not result in a hazardous load discharge.

  b. The static and dynamic force resulting from the load and the end effector combined must be kept within the load capacity and dynamic response range of the robot.

  c. The mounting flange and accessory components must be properly connected

  d. Any removable tools must be securely mounted during use.

  e. If the removal of a removable tool could potentially cause a hazardous condition, said tools must only be removed in a designated location or specific controlled conditions

  f. The end effector must be capable of withstanding the forces expected to be applied to the end effector for the intended lifespan of the product

3.3 Robot Safety

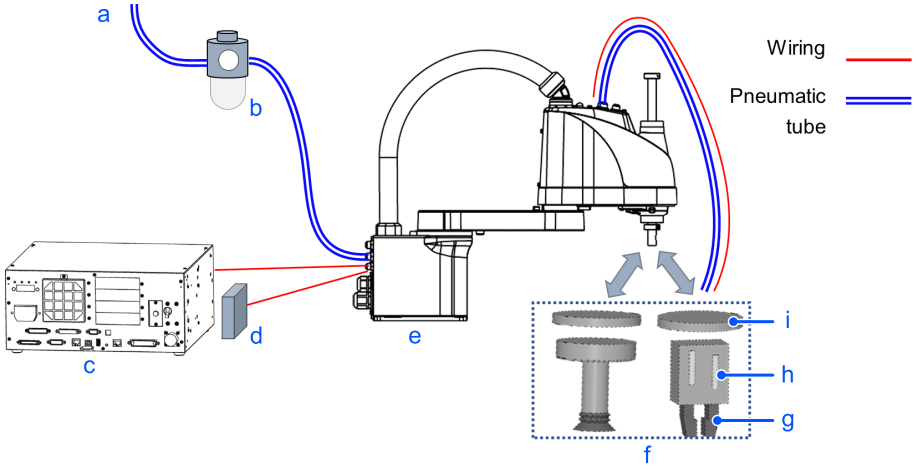
Safety is the most important consideration when operating the robot and other automatic devices. The controller and Epson RC+ include a broad range of safety functions. Such safety functions include the emergency stop and safeguard input functions. Use these safety functions when designing the robot cell.
For more on safety information and guidelines refer to the following manuals.
"Safety Manual"
"Safety in the Manipulator Manuals"

4. Hand Types and How to Mount Them

4.1 Items to be prepared by the customer

The general peripheral equipments indicated in the diagram below shall be prepared by the customer as required.

Outline view of mounting a robot hand



Symbol	Item
a	Compressed air
b	Regulator
c	Controller
d	External power supply
e	Manipulator
f	Hand
g	Finger, Vacuum pad
h	Unit
i	Tool adapter

KEY POINTS

While not noted in the diagram, the valve and vacuum generator may be installed near the user wiring or piping connectors at the rear or top side of the manipulator.

4.1.1 Hand unit, fingers, vacuum pad

Use the hand, fingers, vacuum pad, and other equipment best suited to the shape and material of the workpiece in use

4.1.2 Tool adapter

An adapter used to mount the hand to the robot

Robot Flange Dimensions and Tool Adapter

4.1.3 Pneumatic generator

Compressor, etc.
This is required when using a pneumatic chuck hand, and an ejector to use a suction hand.

4.1.4 Regulator, mist separator, filter, etc.

This includes regulators used to adjust the pressure of the compressed air, and filters for removing dust and moisture from the compressed air

4.1.5 Valve

These is used to turn the supply of compressed air to the hand on and off
A solenoid valve (single solenoid, double solenoid) is suitable.

4.1.6 Vacuum generator (ejectors, vacuum pumps, etc.)

When using a suction hand: Vacuum generator
Epson RC+ Hand function supports the vacuum break function provided with many vacuum generators.

4.1.7 24V DC external power supply

A 24V DC power supply for supplying power to the sensors, valves, and other devices installed to the hand.

KEY POINTS

A T series manipulator can supply 24V DC power from the hand I/O connector. Do not exceed the following allowable current levels during use.

- T3: 500 [mA] or less
- T6: 700 [mA] or less

For more information, refer to the following.

"T Series Manual - Hand I/O Connector"

"T-B Series Manual - Hand I/O Connector"

⚠ WARNING

Always make sure that the plug for the external power source is pulled out of the socket when wiring and connecting the 24V DC external power source. Performing work while the power source is conducting electricity may cause electric shock or a malfunction.

⚠ CAUTION

Read the manual provided with the external power source thoroughly when using an external power source.

4.1.8 Electric wires, tubes, connectors

Electric wires, tubes for compressed air, connectors best suited to the hand or valve in use
Some manipulators allow users to wire and connect their own wiring and piping internally.

For more information about manipulator wiring and piping, refer to the following manuals.
"Manipulator Manuals"

4.2 Hand type

Hands compatible with Epson RC+ hand functions are indicated in the table below.

Hand type	Mechanism	Power source	Connection method	I/O points (When viewed from the controller)
Grippers	Chuck	Pneumatic	I/O connection	Output: two points or less AND Input: two points or less
		Electric		
	Suction	Pneumatic		
		Electric		
Electric screwdrivers	-	Electric	I/O connection	Output: six points or less AND Input: one point or less

KEY POINTS

In addition to the types of robot hands described above, I/O control-driven hands not compatible with hand functions can still be controlled using SPEL+ commands (I/O control on and off commands).

For more information, refer to the following manual.

"SPEL+ Language Reference"

However, other types of robot hands cannot be controlled by operations performed from the [Hands] screen and the [Jog & Teach] screen described in this manual.

4.2.1 Gripper

In Hand Functuin of Epson RC+, gripper is the collective term used to describe hands that grip a workpiece.
Grippers primarily consist of the following two types.

- Chuck hands
- Suction hands

4.2.1.1 Chuck hands

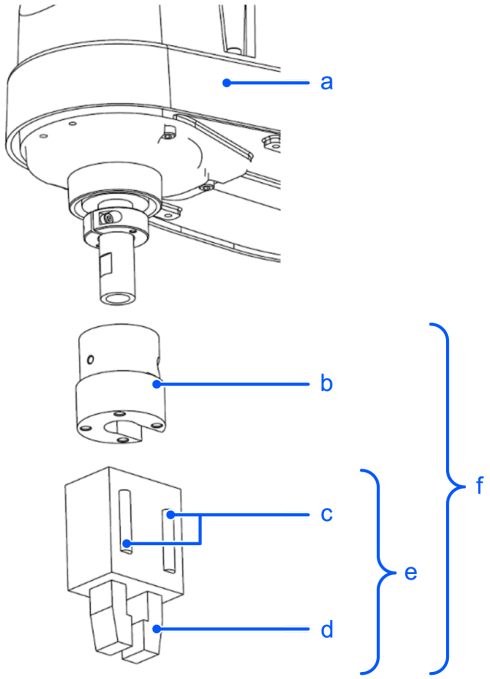
This type of robot hand is controlled with compressed air or electric power.
It grips onto a workpiece by opening and closing the finger parts. A sensor can be attached to some chuck hands to detect whether the fingers are in an open or closed state. Prepare a tool adapter that matches the shape of the hand and robot to attach this tool to the robot.
Robot Flange Dimensions and Tool Adapter

Item	Type
Power source	Pneumatic Electric
Chuck configuration	Single acting system Double acting system

Item	Type
Number of fingers	Two (Operated on a single system) Three (Operated on a single system)
Gripping direction	External grip (grasp the workpiece from outside) Internal grip (grasp the workpiece from inside)
Sensor	None One Two

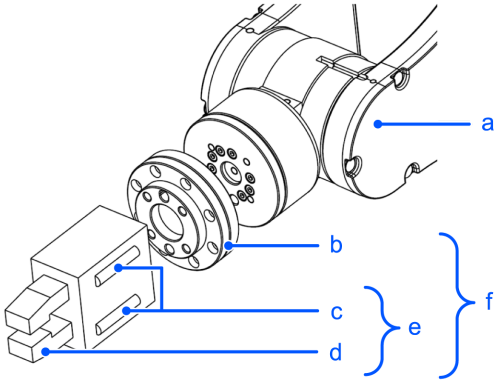
Outline diagram for mounting a chuck hand

SCARA robot



Symbol	Item
a	SCARA robot (LS, G, GX, T, RS series)
b	Tool adapter
c	Sensor (option)
d	Fingers
e	Chuck hand
f	Items to be prepared by the customer

6-axis robot



Symbol	Item
a	6-Axis robot (C, VT, N series)
b	Tool adapter
c	Sensor (option)
d	Fingers
e	Chuck hand
f	Items to be prepared by the customer

KEY POINTS

The illustrations of hand unit, fingers, and tool adapter do not represent a particular manufacturer product.

4.2.1.2 Suction hands

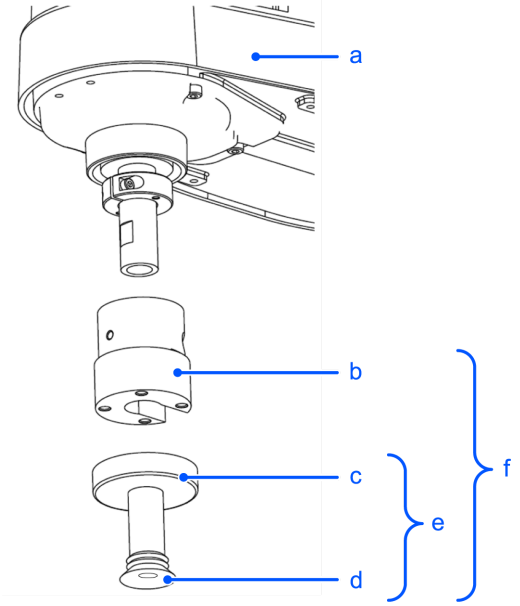
This type of robot hand uses compressed air or an electric pump to create a vacuum and pick up a workpiece using suction. These hands may only use one vacuum pad, or multiple vacuum pads connected on a single pneumatic circuit. When using a vacuum generator alongside a vacuum break function as a set, the vacuum break function can be used to quickly release the workpiece.
Prepare a tool adapter that matches the shape of the hand and robot to attach this tool to the robot.
Robot Flange Dimensions and Tool Adapter

With the Epson RC+ Hand function, when you select a suction hand with two outputs, the second bit will be a vacuum break bit.

Item	Type
Power source	Pneumatic (vacuum) Electric
Number of pads	One Multiple
Vacuum break function	None Available
Sensor	None One Two

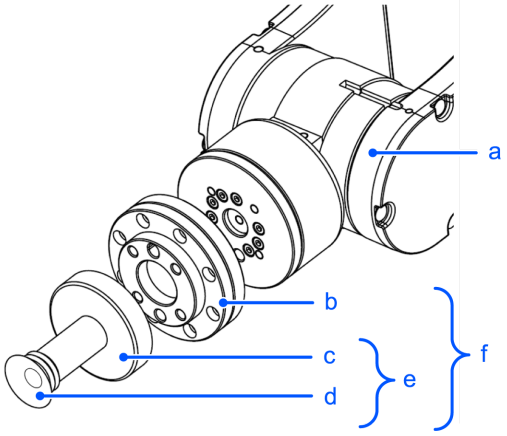
Outline diagram for mounting a suction hand

SCARA robot



Symbol	Item
a	SCARA robot (LS, G, GX, T, RS series)
b	Tool adapter
c	Hand unit
d	Vacuum pad
e	Vacuum hand
f	Items to be prepared by the customer

6-axis robot



Symbol	Item
a	6-Axis robot (C, VT, N series)
b	Tool adapter
c	Hand unit
d	Vacuum pad

e	Vacuum hand
f	Items to be prepared by the customer

KEY POINTS

The illustrations of hand unit, fingers, and tool adapter do not represent a particular manufacturer product.

4.2.2 Electric screwdriver

This is a screwdriver used to tighten and loosen screws.
You can control the screwdriver by issuing control signals from an external device.

4.3 System Configuration Example

4.3.1 I/O Port Pin Assignments

The I/O terminal for the hand can be connected to the I/O port corresponding to the robot controller indicated in the table below.

Controller	Available I/O port	Output polarity	Remarks
RC700 series	Standard I/O	NPN and PNP	-
	Extended I/O	NPN or PNP	Can be connected when installing an extended I/O board (option)
RC700DU series	Standard I/O	NPN and PNP	-
RC800 series	Standard I/O	NPN and PNP	-
	Extended I/O	NPN or PNP	Can be connected when installing an extended I/O board (option)
RC90 series	Standard I/O	NPN and PNP	-
	Extended I/O	NPN or PNP	Can be connected when installing an extended I/O board (option)
T series	Standard I/O	NPN and PNP	-
	Hand I/O	NPN and PNP	24V DC power can also be supplied

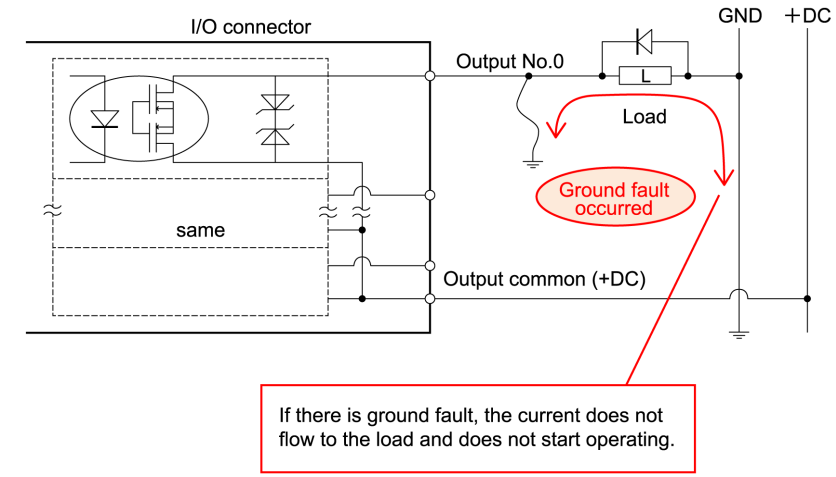
Controller	Available I/O port	Output polarity	Remarks
VT series	Standard I/O	NPN and PNP	-

⚠ CAUTION

- The following I/O port has two types of connection: a plus common and a minus common connection.
  - Extended I/O board (option) output

  These are factory settings. Users cannot change the output polarity. Check that the I/O output type matches the external connection device before wiring. Wiring the wrong output type will damage the circuit board components and prevent the robot system from functioning properly.
  For details, refer to the following manuals.
  "RC700 Series Manual - Functions - Expansion I/O Board"
  "RC700-D Manual - Functions - Expansion I/O Board"
  "RC700-E Manual - Expansion I/O Boards"
  "RC800-A Manual - Expansion I/O Boards"
  "RC90 Series Manual - Functions - Expansion I/O Board"
- When wiring the I/O port, take sufficient safety precautions to prevent excess current to ensure that connections are suitable for user's operating environment.
- Use Plus Common (PNP) to prevent the load from operating unintentionally if the wiring between the controller and the load is grounded fault. This conforms to European Machinery Directives.

Plus Common (PNP) connection



KEY POINTS

A nonpolar PhotoMOS relay is used for the following controllers, and the output circuit of the manipulator. Either plus common (PNP) or minus common (NPN) wiring can be used.

- RC700 series
- RC800 series
- RC90 series
- T series
- VT series

4.3.1.1 RC700 series, RC800 series, RC90 series, VT (Protection model) series Standard I/O Pin Assignments

Pin Number	Signal Name	Pin Number	Signal Name	Pin Number	Signal Name
1	Input common No.0 to 7	18	Input common No.8 to 15	34	Input common No.16 to 23
2	Input No.0	19	Input No.8	35	Input No.16
3	Input No.1	20	Input No.9	36	Input No.17
4	Input No.2	21	Input No.10	37	Input No.18
5	Input No.3	22	Input No.11	38	Input No.19
6	Input No.4	23	Input No.12	39	Input No.20
7	Input No.5	24	Input No.13	40	Input No.21
8	Input No.6	25	Input No.14	41	Input No.22
9	Input No.7	26	Input No.15	42	Input No.23
10	Output No.0	27	Output No.6	43	Output No.11
11	Output No.1	28	Output No.7	44	Output No.12
12	Output No.2	29	Output No.8	45	Output No.13
13	Output No.3	30	Output No.9	46	Output No.14
14	Output No.4	31	Output No.10	47	Output No.15
15	Output No.5	32	Not Used	48	Not Used
16	Not Used	33	Output common No.8 to 15	49	Not Used
17	Output common No.0 to 7	-	-	50	Not Used

4.3.1.2 T series Pin Assignments

Input port

Pin Number	Signal Name	Pin Number	Signal Name
1	Input No.0	15	Input No.1
2	Input No.2	16	Input No.3
3	Input No.4	17	Input No.5
4	Input No.6	18	Input No.7
5	Input common No.0 to 7	19	Input common No.8 to 15
6	Input No.8	20	Input No.9
7	Input No.10	21	Input No.11
8	Input No.12	22	Input No.13

Pin Number	Signal Name	Pin Number	Signal Name
9	Input No.14	23	Input No.15
10	Input No.16	24	Input No.17
11	Not Used	25	Not Used
12	Not Used	26	Not Used
13	Not Used	27	Not Used
14	Input common No.16 to 17	28	Not Used

Output port

Pin Number	Signal Name	Pin Number	Signal Name
1	Output No.0	10	Output No.1
2	Output No.2	11	Output No.3
3	Output No.4	12	Output No.5
4	Output No.6	13	Output No.7
5	Output common No.0 to 7	14	Output common No.8 to 11
6	Output No.8	15	Output No.9
7	Output No.10	16	Output No.11
8	Not Used	17	Not Used
9	Not Used	18	Not Used

Hand I/O port

Pin Number	Signal Name	Pin Number	Signal Name
1	Input No.18	9	Input No.19
2	Input No.20	10	Input No.21
3	Input No.22	11	Input No.23
4	Input common No.18 to 23	12	Not Used
5	+24V	13	GND
6	Output No.12	14	Output No.13
7	Output No.14	15	Output No.15
8	Output common No.12 to 15		

4.3.1.3 VT series (Standard model, cleanroom model) Pin Assignments

Input port

Pin Number	Signal Name	Pin Number	Signal Name
1	Input No.0	15	Input No.1
2	Input No.2	16	Input No.3

Pin Number	Signal Name	Pin Number	Signal Name
3	Input No.4	17	Input No.5
4	Input No.6	18	Input No.7
5	Input common No.0 to 7	19	Input common No.8 to 15
6	Input No.8	20	Input No.9
7	Input No.10	21	Input No.11
8	Input No.12	22	Input No.13
9	Input No.14	23	Input No.15
10	Input No.16	24	Input No.17
11	Input No.18	25	Input No.19
12	Input No.20	26	Input No.21
13	Input No.22	27	Input No.23
14	Input common No.16 to 23	28	Not Used

Output port

Pin Number	Signal Name	Pin Number	Signal Name
1	Output No.0	10	Output No.1
2	Output No.2	11	Output No.3
3	Output No.4	12	Output No.5
4	Output No.6	13	Output No.7
5	Output common No.0 to 7	14	Output common No.8 to 15
6	Output No.8	15	Output No.9
7	Output No.10	16	Output No.11
8	Output No.12	17	Output No.13
9	Output No.14	18	Output No.15

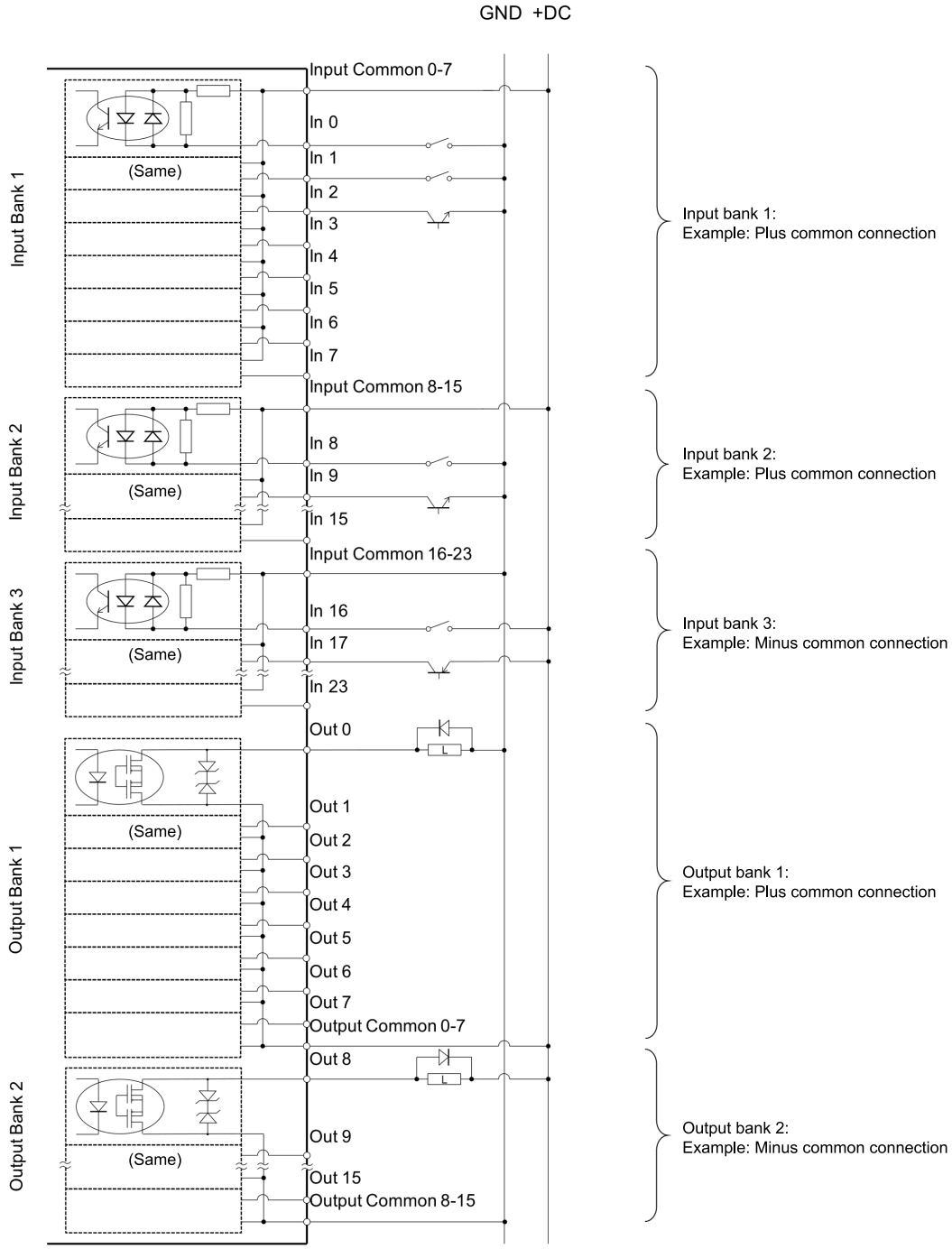
For more information, refer to the following manuals.
"RC700 Series Manual - Functions - I/O Connector - Expansion I/O Board"
"RC700-D Manual - Functions - I/O Connector - Expansion I/O Board"
"RC700-E Manual - I/O Connector, Expansion I/O Boards"
"RC800-A Manual - I/O Connector, Expansion I/O Boards"
"RC90 Series Manual - Functions - I/O Connector - Expansion I/O Board"
"T Series Manual - T3 T6 Manipulator - Standard I/O Connector - Hand I/O Connector"
"T-B Series Manual - T3-B T6-B Manipulator - Standard I/O Connector - Hand I/O Connector"
"VT Series Manual - VT6L Manipulator - Standard I/O Connector"

4.3.2 Typical Connection Example

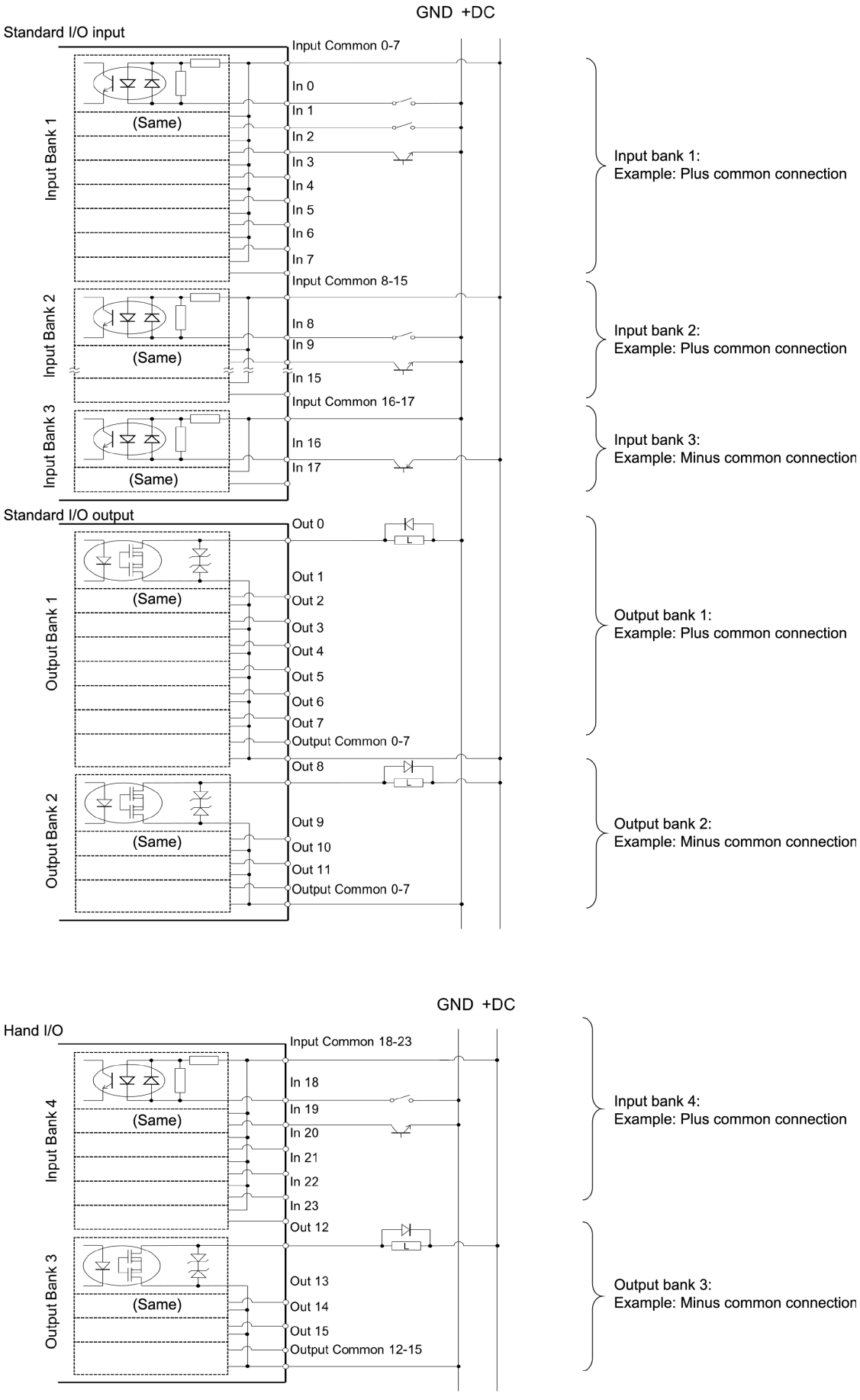
An I/O port consists of several I/O banks. A standard I/O port has three input banks, and two output banks. They each have up to eight I/O terminals, and one common terminal. Plus common and minus common connections can be used separately for

each bank.
The illustration shows how to connect a typical I/O port. Both plus common and minus common connections are connected in tandem for illustrative purposes.
The T series splits input bank 3 and output bank 2 into two halves of each, and the bit number of the latter half is connected to the hand I/O.

4.3.2.1 RC700 series, RC800 series, RC90 series, VT (Protection model) series Typical Application



4.3.2.2 T series Typical Application



4.3.3 Wiring Example

4.3.3.1 Connecting to a standard I/O on the controller

Select the controller and I/O relationship to connect from a combination of (a) to (d) in the table below.
Connect the sensors and valves written on the right side of the diagram to the standard I/O input and output port for each.

		Output from the controller	
		Plus common	Minus common
Input to the controller	Plus common	Circuit diagram example (a)	Circuit diagram example (b)
	Minus common	Circuit diagram example (c)	Circuit diagram example (d)

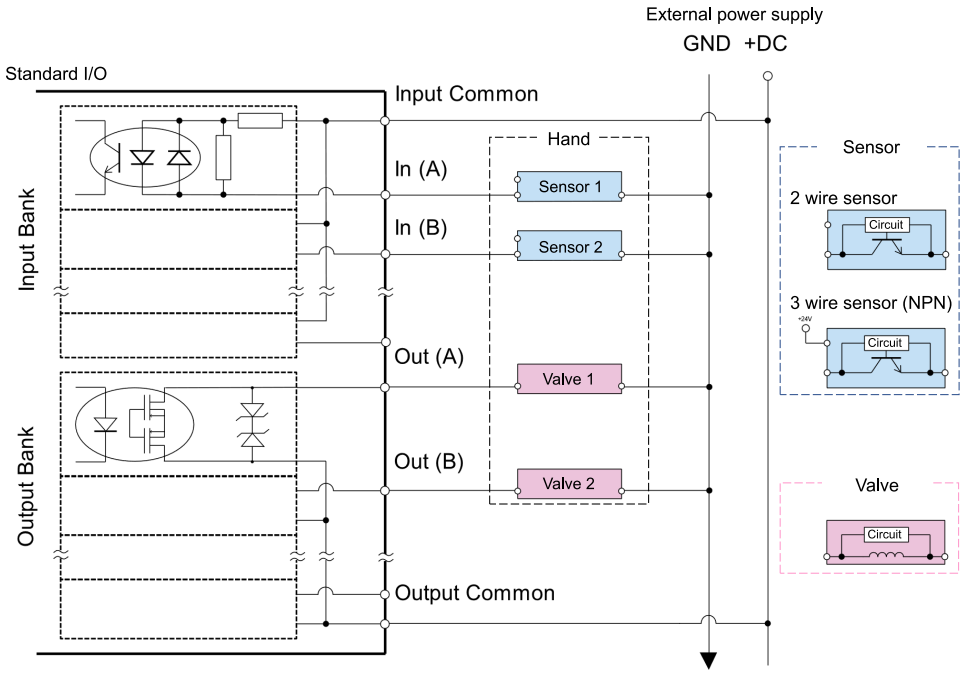
KEY POINTS

- Epson RC+ assigns input bits 0 to 7, and output bits 0 to 8, to the remote function used to control the robot controller via a PLC or other external device (remote I/O) by default. When using these bit numbers with the hand function, refer to the following manual and change the bit number assigned to the remote function accordingly.

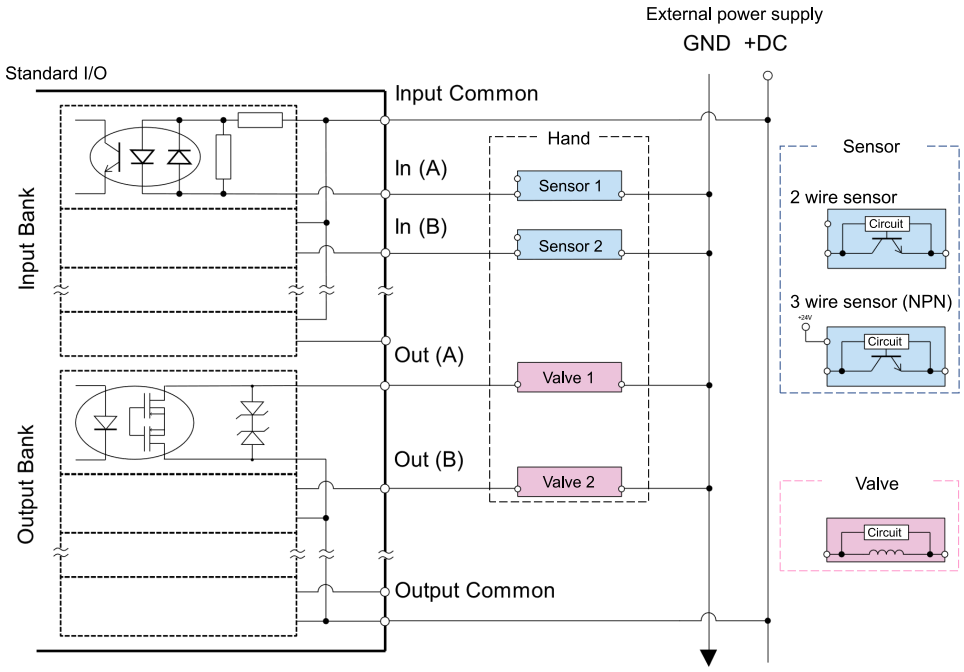
  "Epson RC+ User's Guide - Remote Control, Remote I/O"

- The following example describes a hand set to “Output: 2, Input: 2”. Note that sensor 2 and valve 2 do not need to be wired if there are fewer I/O points from the hand than used in this example. The input side does not need to be wired when using a hand without a sensor.

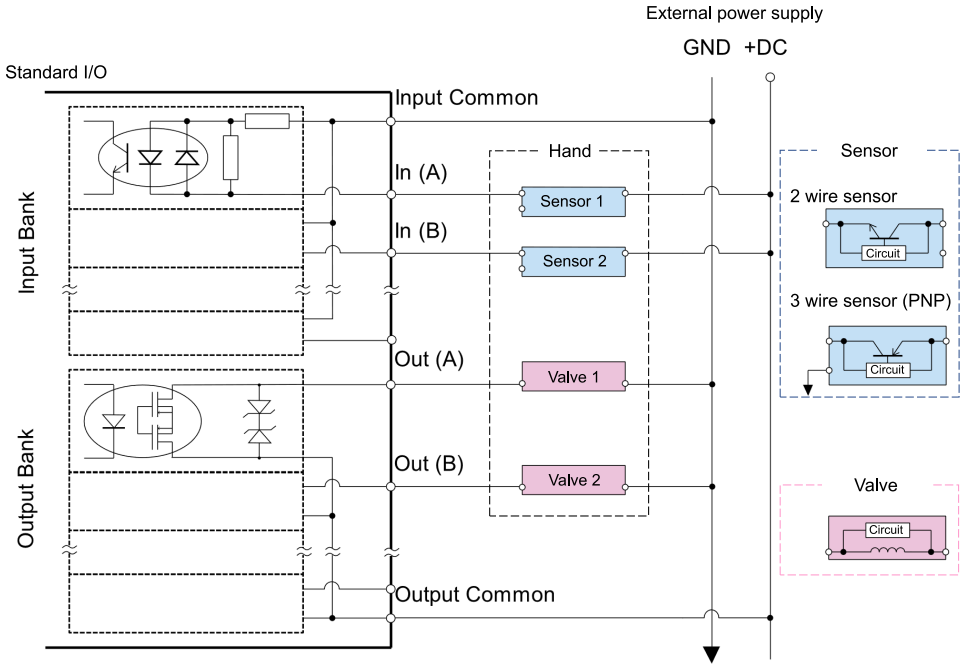
- Circuit diagram example (a) Input: Plus common, Output: Plus common



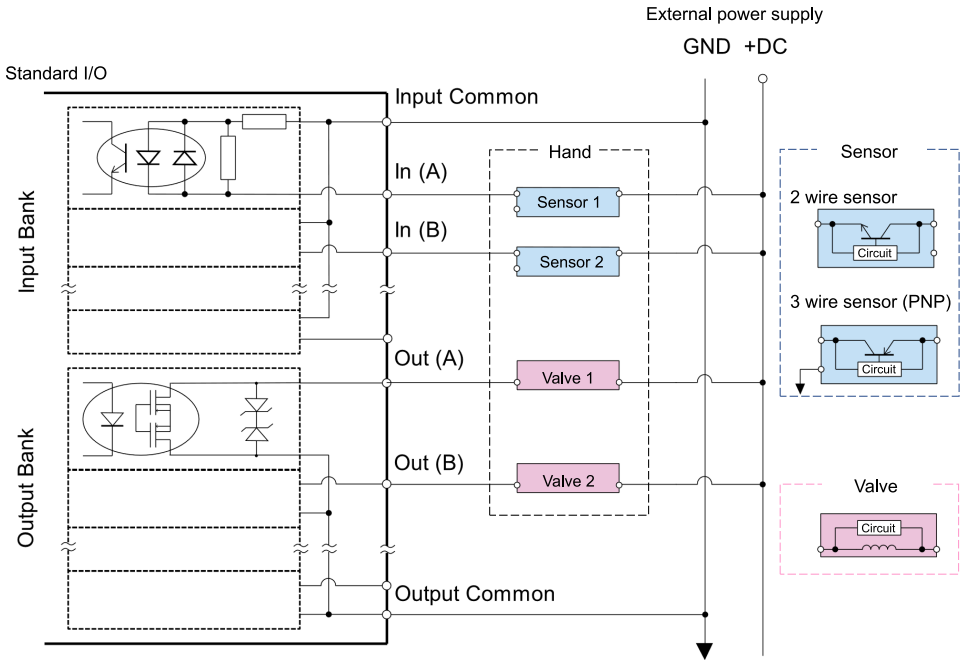
- Circuit diagram example (b) Input: Plus common, Output: Minus common



- Circuit diagram example (c) Input: Minus common, Output: Plus common



- Circuit diagram example (d) Input: Minus common, Output: Minus common



4.3.3.2 Connecting to a T series hand I/O

A T series robot can supply 24V DC power from the hand I/O connector. An external power source is not required to control the hand while remaining within the allowable current range described below.

- T3: 500 [mA] or less
- T6: 700 [mA] or less

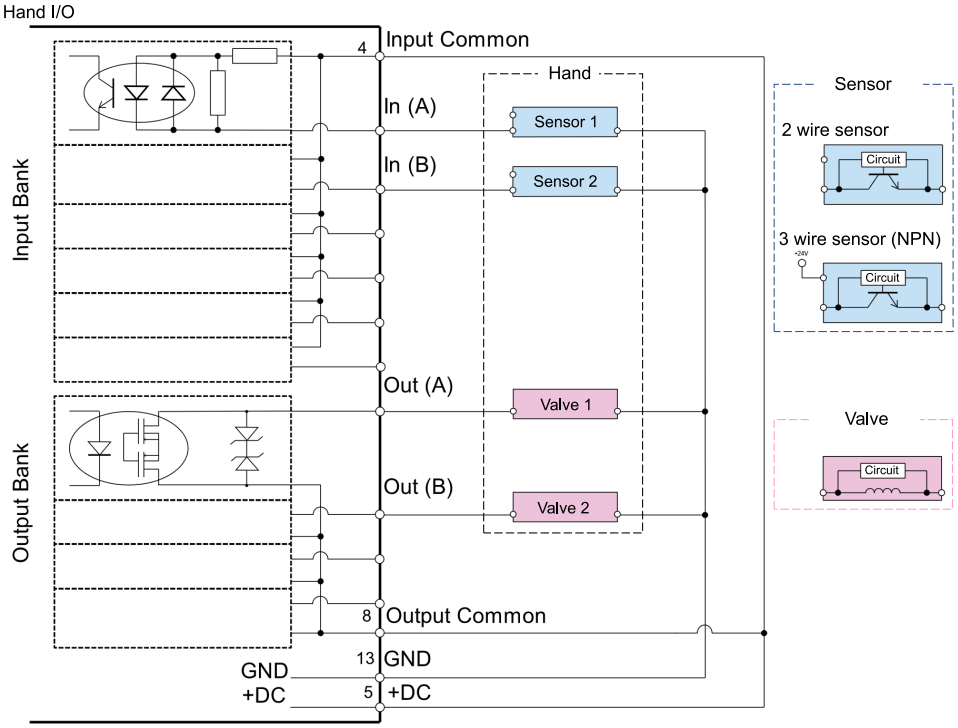
KEY POINTS

Prepare a separate external power source when connecting a robot hand, such as an electric hand, that will exceed the above current value.

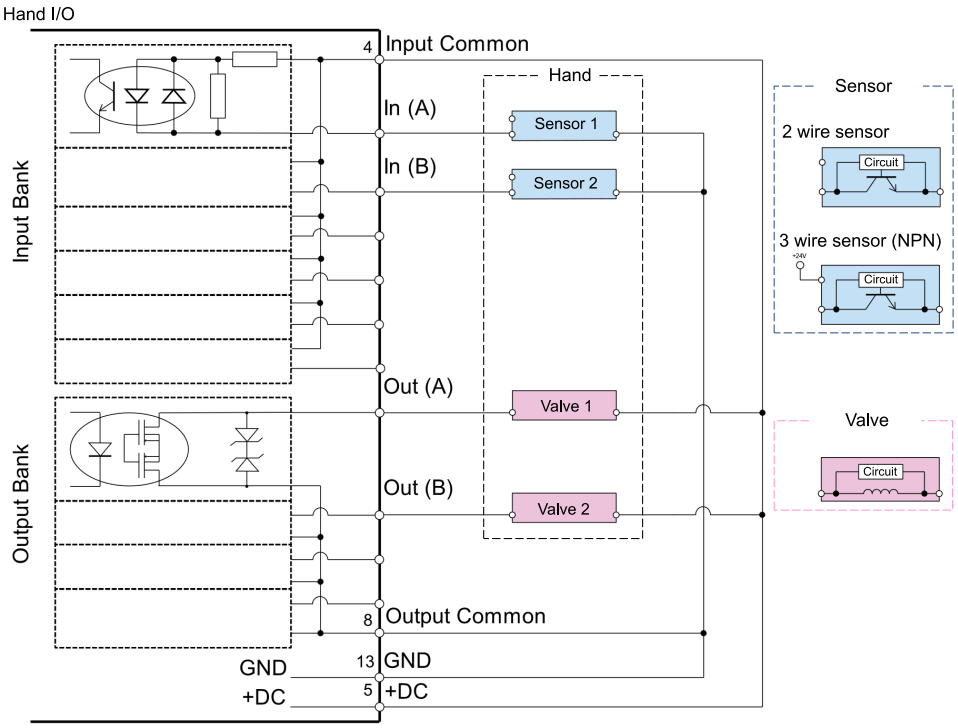
In this case, use the same wiring arrangement as a standard I/O described below.

"Connecting to a standard I/O on the controller"

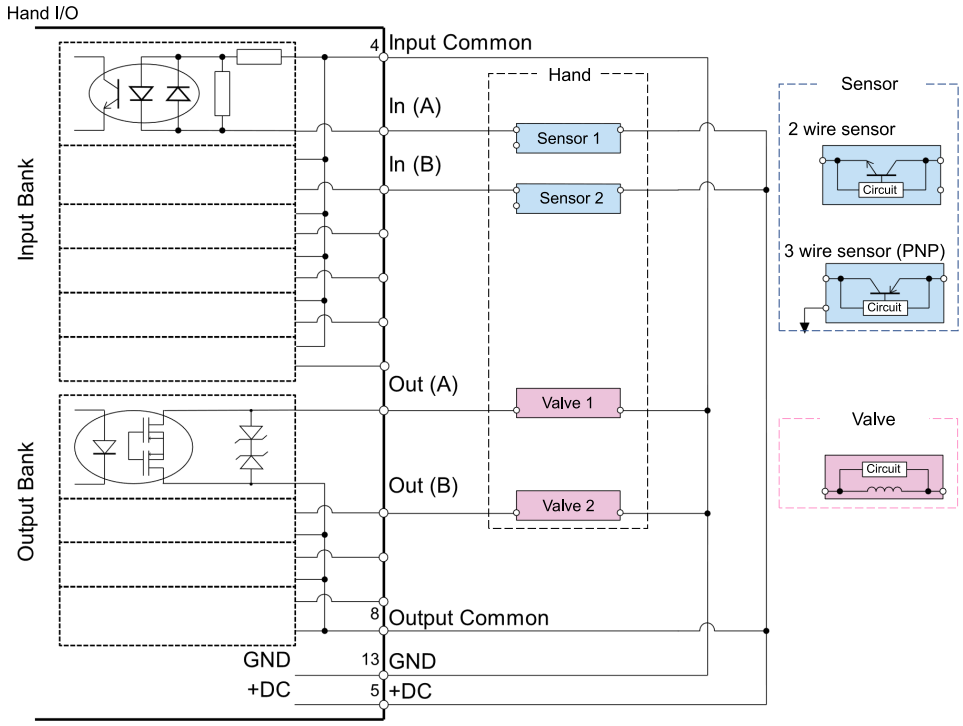
- Circuit diagram example (a) Input: Plus common, Output: Plus common



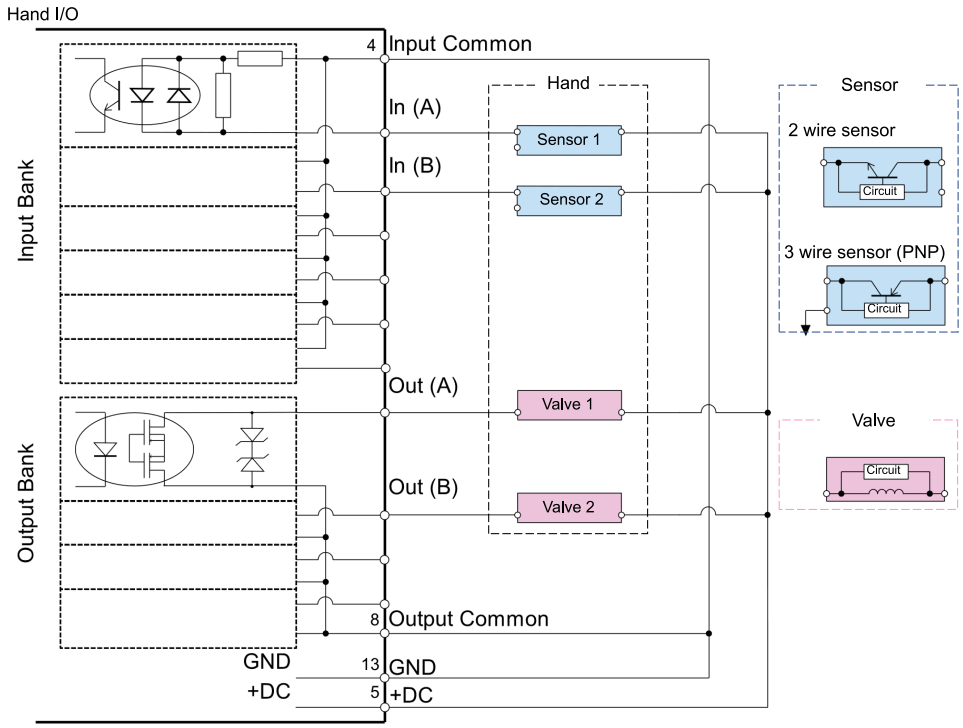
- Circuit diagram example (b) Input: Plus common, Output: Minus common



- Circuit diagram example (c) Input: Minus common, Output: Plus common



- Circuit diagram example (d) Input: Minus common, Output: Minus common



4.3.3.3 Connecting to an optional extended I/O board

Use the same wiring arrangement as a standard I/O described below.
"Connecting to a standard I/O on the controller"
Note that extended boards have two different polarity types, plus common (PNP) and minus common (NPN). Make sure that the polarity is correct when connecting.

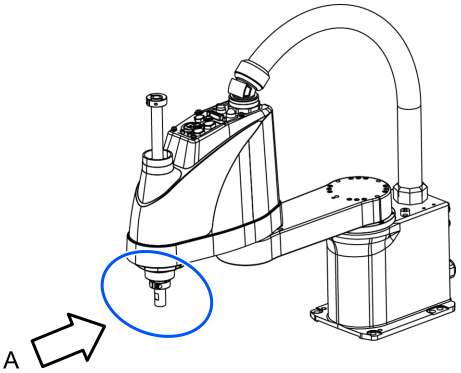
4.4 Robot Flange Dimensions and Tool Adapter

4.4.1 For SCARA Robots

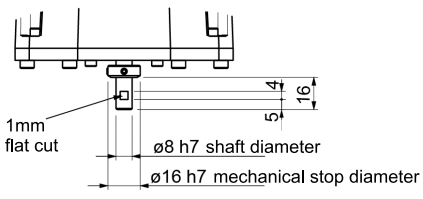
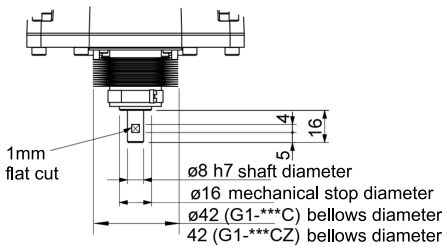
On a SCARA robot (LS series, G series, GX series, T series, and RS series), attach the hand to the end of the shaft.
The four shaft sizes are indicated in the table below.

Outer diameter of the shaft [mm]	LS series	G series	GX series	T series	RS series
⌀8	-	G1	-	-	-
⌀16	LS3	G3	GX4	T3	RS3 RS4
⌀20	LS6	G6	GX8	T6	-
⌀25	LS10 LS20	G10 G20	-	-	-

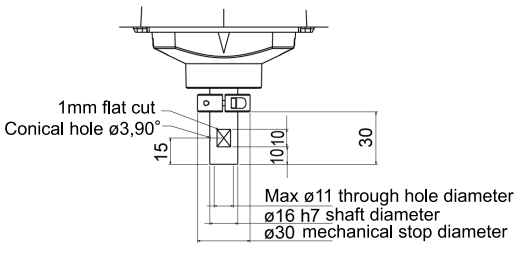
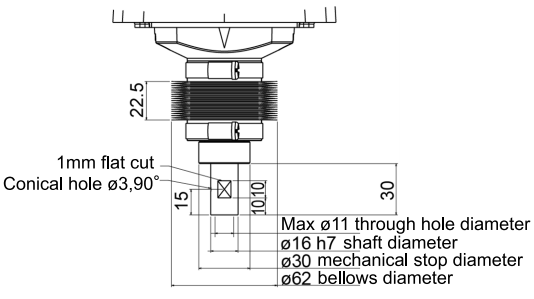
The following illustrations show the end of the SCARA robot shaft viewed from the direction of arrow (A).



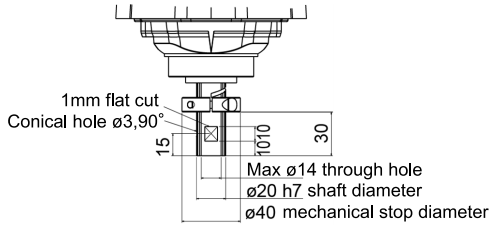
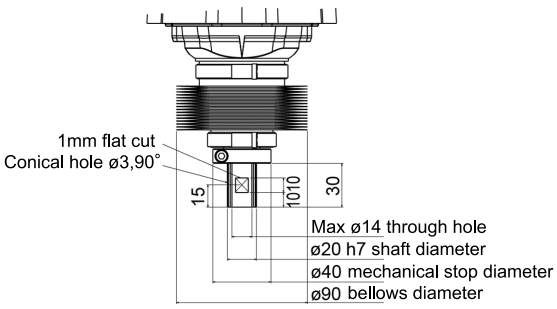
Models with a shaft outer diameter of ⌀8: G1 series

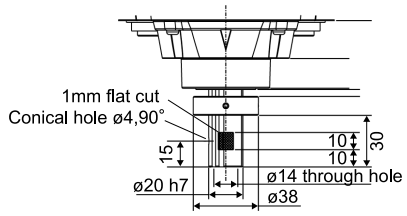
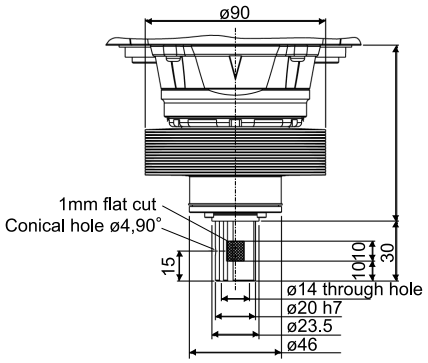
Standard model	Cleanroom model
	

Models with a shaft outer diameter of ⌀16: LS3, G3, GX4, T3, RS3, RS4

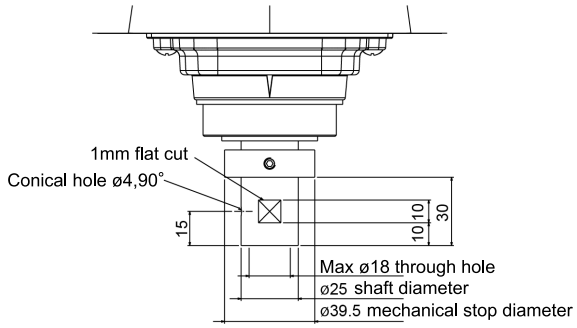
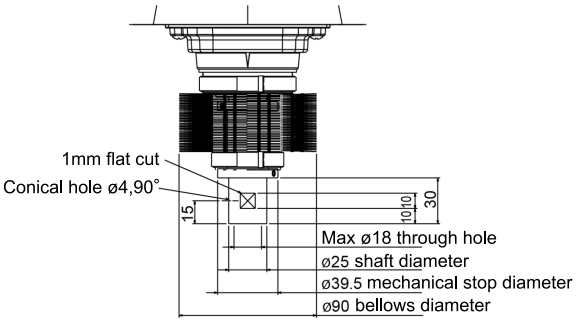
Standard model	Cleanroom model
	

Models with a shaft outer diameter of ⌀20: LS6, G6, GX8, T6

Standard model	Cleanroom model
	

GX8 Standard model	GX8 Cleanroom model
	

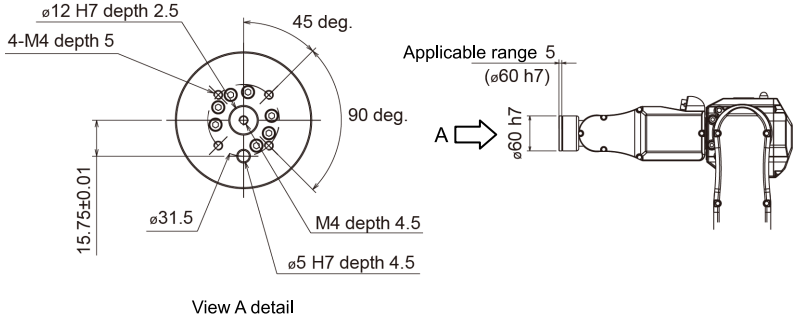
Models with a shaft outer diameter of ⌀25: LS10, LS20, G10, G20

Standard model	Cleanroom model
	

4.4.2 For 6-axis Robots

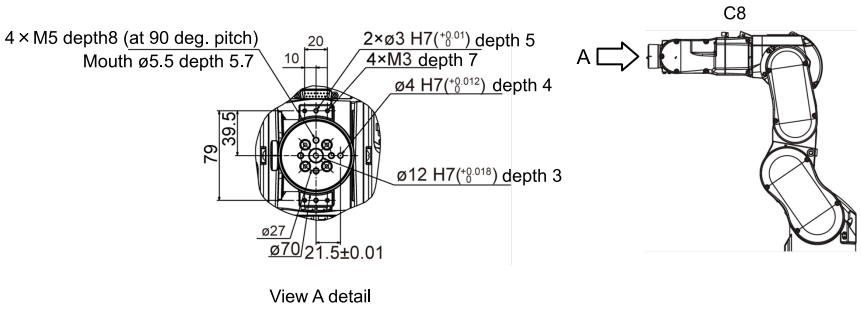
On a 6-axis robot (C series, VT series, N series), the hand is attached to the flange face. The dimensions of the flange face are as follows.

C4 series

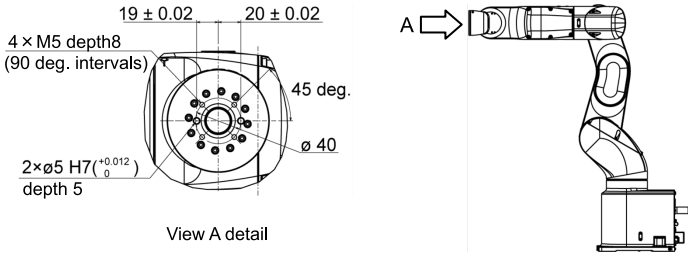


View A detail

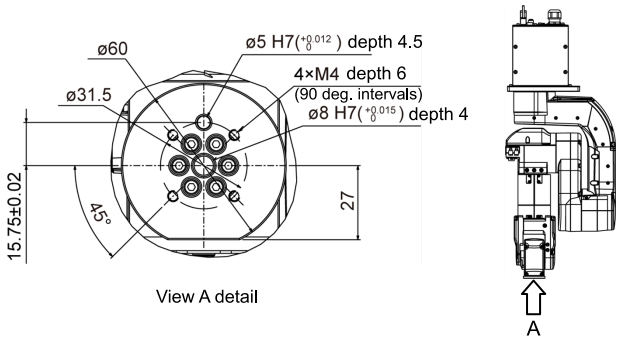
C8, C12 series



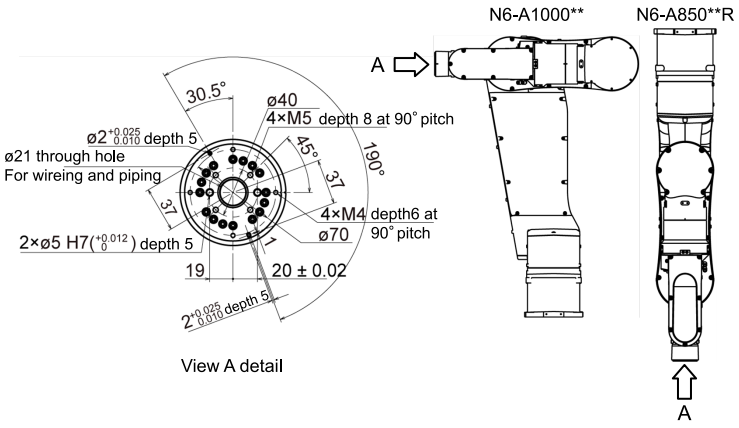
VT series



N2 series



N6 series

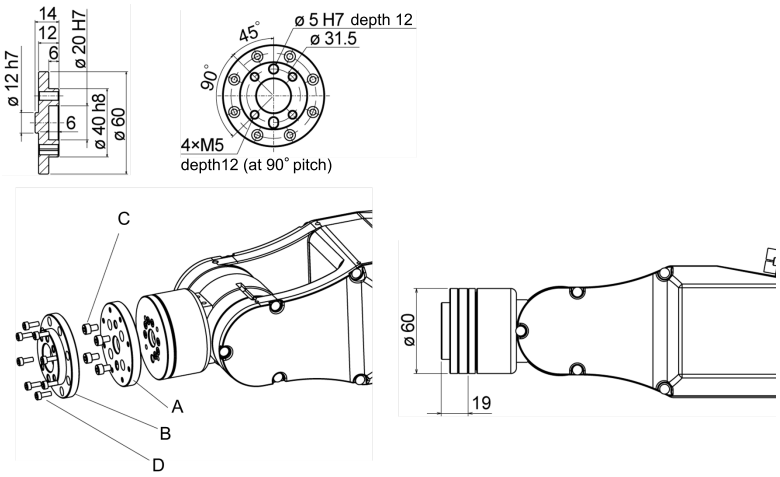


4.4.3 Tool Adapter

A plate is available for mounting a hand with dimensions designed for use with an ISO flange to the SCARA robot and the 6-axis robot. (Sold separately: Option)
For more information, refer to the following. Alternatively, inquire with your distributor.
Option

The flange face dimensions when mounting a tool adapter to each manipulator are outlined below.

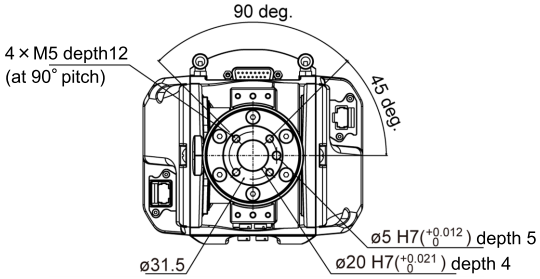
Attaching a PS-compatible plate to a C4 series device



Symbol	Description
A	PS compatible plate 1
B	PS compatible plate 2
C	Hexagon socket head screw 4-M4×6
D	Hexagon socket head screw 8-M3×8

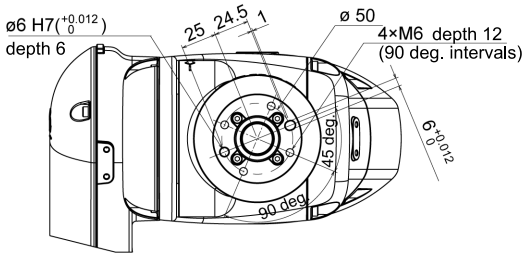
Each dimension and tolerance complies with ISO9409-1-31.5-4-M5.

Attaching a tool adapter (ISO flange) to a C8 or C12 series device



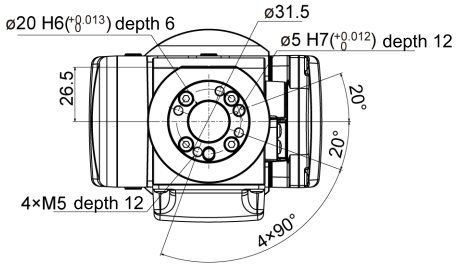
Each dimension and tolerance complies with ISO9409-1-31.5-4-M5.

Attaching a tool adapter (ISO flange) to a VT6 series device



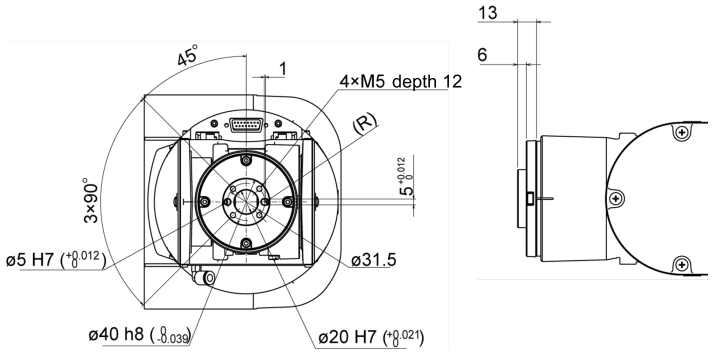
Each dimension and tolerance complies with ISO9409-1-50-4-M6.

Attaching a tool adapter (ISO flange) to a N2 series device



Each dimension and tolerance complies with ISO9409-1-31.5-4-M5.

Attaching a tool adapter (ISO flange) to a N6 series device

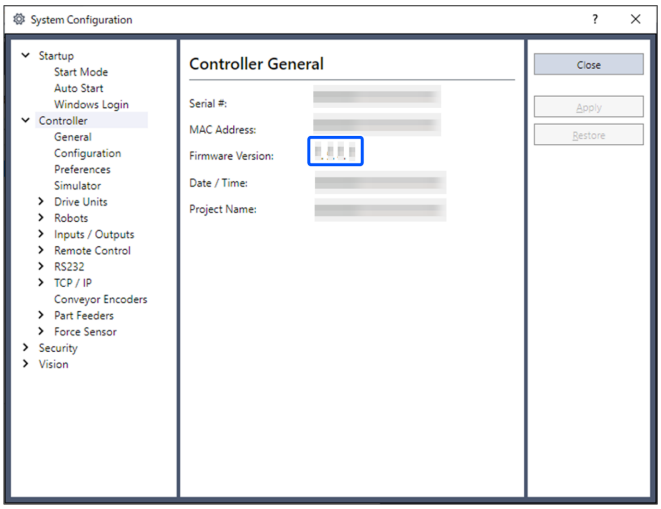


Each dimension and tolerance complies with ISO9409-1-31.5-4-M5.

5. Verifying the Firmware Version

5.1 Version check for controller firmware:

Start Epson RC+ 8.0 and select Epson RC+ 8.0 menu-[Setup]-[System Configuration] to open the [System Configuration] dialog. Select [Controller] to open a dialog that contains connected controller firmware version.



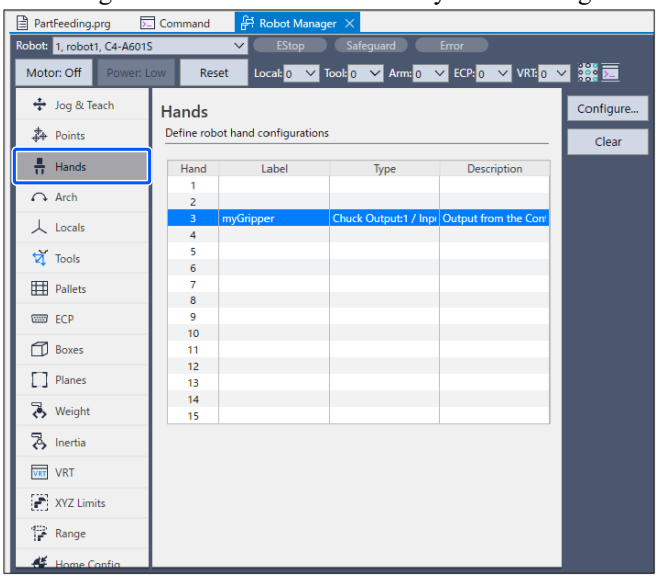
If the software version installed is older than the software versions described below, update the software while referring to the corresponding manual.

Controller	Firmware version	Reference manuals
RC90 series	Ver. 7.5.4.x or later	RC90 Series Maintenance Manual - Firmware Update
RC700 series		RC700 Series Maintenance Manual - Firmware Update
		RC700-D Manual - Installation - Firmware Update
		RC700-E Manual - Appendix - Appendix B:Troubleshooting - Upgrading Firmware
RC800 series	Ver. 8.0.0.x or later	RC800-A Manual - Appendix - Appendix C:Troubleshooting - Upgrading Firmware
VT series	Ver.7.5.54x or later	T series MAINTENANCE MANUAL - Firmware Update
T-B series	Ver.7.5.54x or later	T-B series MAINTENANCE MANUAL - Firmware Update

6. Software Screen Configuration

6.1 Epson RC+ GUI (Hand Tab)

In the Epson RC+ menu, select the [Tools] - [Robot Manager] - [Hands] tab to display the [Hands] screen. Hands 1 to 15 registered to the robot selected in [Robot:] on the upper left of the screen will appear.
Following below shows a robot with only one hand registered.



Items shown in the [Hands] screen are described in the table below.

Hand

Hand number
A maximum of 15 hands can be set to each of the robots 1 to 4.

Label

The label given to the hand number

Type

Hand type

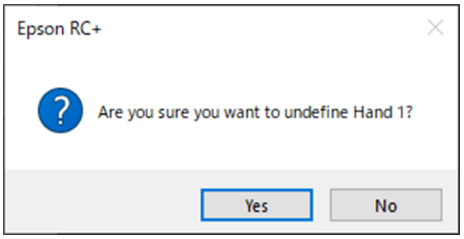
Description Hand description

[Configure...] button

Select a hand and click this button to display the [Configure Robot Hand*] screen. (* indicates the hand number. The number from 1 to 15 is allocated.)
You can register a new hand, or modify or delete hand details here.

[Clear (C)] button

Select a registered hand and click this button to display a confirmation window for deleting the hand.

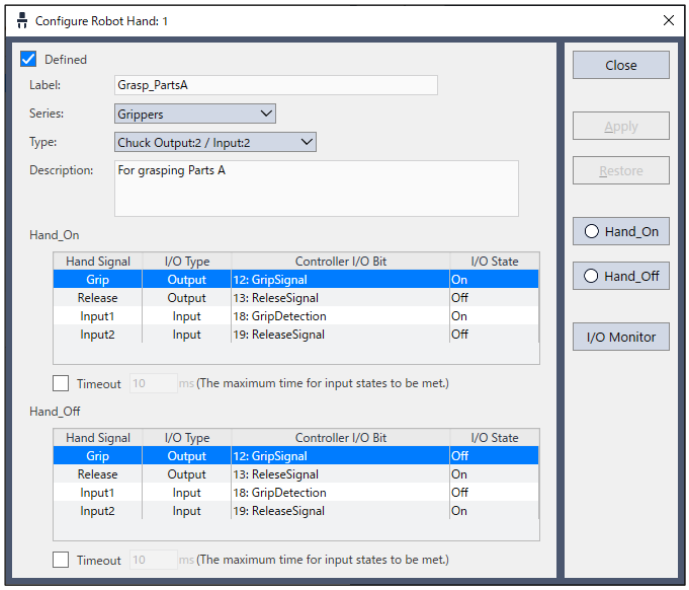


Click the [Yes] button to delete the registered hand information.

6.2 Configure Robot Hand Screen

You can set the following properties on the [Configure Robot Hand: *] screen.

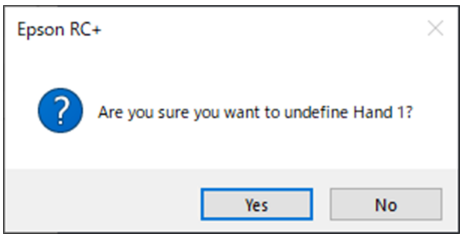
- The type of hand attached
- The number of output bits/input bits
- Operations of two hand motion commands (Hand_On statement, Hand_Off statement)



[Defined] check box

Select this check box to register the hand.

Deselect this check box and click the [Apply] button to display a confirmation window for deleting the hand.



Click the [Yes] button to delete the registered hand information.

If this check box is not selected: Only the following buttons will be available.

- [Close] button
- [I/O Monitor] button

Label (option)

This is the label given to the hand number.

Labels can be set using up to 31 one-byte characters, or 15 two-byte characters.

Accepted characters include alphanumeric characters, Japanese/Chinese characters, and underscores (_). Numbers and underscores cannot be used for the initial character.

An error will occur when attempting to specify a label that already exists (when the same label is being used for another hand).

Series

Select the hand series (type).

- Grippers
- Screwdrivers

Type

Select the hand type, and the number of input and output bits from the following.

If “Grippers” is selected in the [Series] field:

Choices	Type	Number of bits as seen from the controller	
		Output to the hand	Input from the hand
Chuck (Output:1 / Input:0)	Chuck	1	0
Chuck (Output:1 / Input:1)	Chuck	1	1
Chuck (Output:1 / Input:2)	Chuck	1	2
Chuck (Output:2 / Input:0)	Chuck	2	0
Chuck (Output:2 / Input:1)	Chuck	2	1
Chuck (Output:2 / Input:2)	Chuck	2	2
Suction (Output:1 / Input:0)	Vacuum	1	0
Suction (Output:1 / Input:1)	Vacuum	1	1
Suction (Output:1 / Input:2)	Vacuum	1	2
Suction (Output:2 / Input:0)	Vacuum	2 *	0
Suction (Output:2 / Input:1)	Vacuum	2 *	1
Suction (Output:2 / Input:2)	Vacuum	2 *	2

*If you select a suction hand with two outputs, the second output point to the hand will be set as the vacuum break bit.

If “Screwdrivers” is selected in the [Series] field:
Always select “Electric screwdriver”.

Description (option)
Leave a description of the hand in this field. Comments can be up to 255 one-byte, or 127 two-byte characters in length.

Hand_On definition area, Hand_Off definition area
Refer to Hand_On, Hand_Off Definition Area

[Close] button
This closes the [Configure Robot Hand*] screen.

[Apply] button
This saves the current settings.
This button will be unavailable until you make any changes after displaying the [Configure Robot Hand*] screen.

[Restore] button
This restores the previous settings.
This button will be unavailable until you make any changes after displaying the [Configure Robot Hand*] screen.

[Hand_On] button
Click this button to immediately execute the Hand_On command.
This will also acquire the return value for the Hand_On function. If “True”, the LED to the left of the button will light up.

Button display	Meaning
	This button is unavailable when hand information has not been set, or until clicking the [Apply] button when making changes.

Button display	Meaning
	The hand has been set properly, and the return value for the Hand_On function is “True”
	The hand has been set properly, and the return value for the Hand_On function is “False”

[Hand_Off] button

Click this button to immediately execute the Hand_Off command.

This will also acquire the return value for the Hand_Off function. If “True”, the LED to the left of the button will light up.

Button display	Meaning
	This button is unavailable when hand information has not been set, or until clicking the [Apply] button when making changes.
	The hand has been set properly, and the return value for the Hand_Off function is “True”
	The hand has been set properly, and the return value for the Hand_Off function is “False”

[I/O Monitor] button

This displays the I/O Monitor screen.

For more information, refer to the following manual.

"Epson RC+ User's Guide - [I/O Monitor] Command (Tools Menu)"

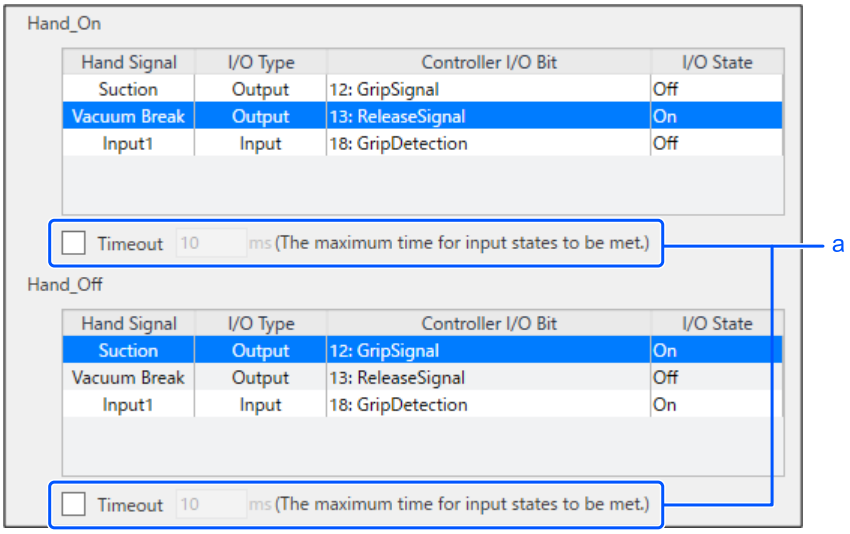
KEY POINTS

Register the hand settings in the [Configure Robot Hand *] screen, and then click the [Hand_On] and [Hand_Off] button in the screen to immediately check the motion of the hand. Alternatively, you can also check hand motion by selecting a registered hand from the list of hands, and then clicking the [Configure...] button.

6.2.0.1 Hand_On, Hand_Off definition area

In this area you can check how each Hand_On and Hand_Off command functions, and define the I/O input status acquired with Hand_On and Hand_Off functions.

The contents can be configured are the same for Hand_On and Hand_Off.



a: Timeout and delay settings

Hand Signal

This is the name of the hand signal. This is set automatically as follows based on the hand type selected in the Type field. The signal name cannot be changed.

Unless specified otherwise, outputs described here are level outputs.

Hand type	Signal name	Meaning	Input/Output
Chuck	Grip	Grip	Output
	Release	Release	Output
	Input1	Input 1	Input
	Input2	Input 2	Input
Vacuum	Suction	Vacuum	Output
	Vacuum Break	Vacuum break	Pulse output*
	Input1	Input 1	Input
	Input2	Input 2	Input

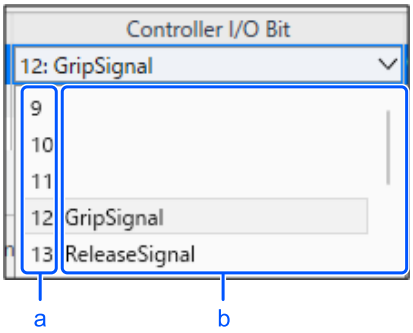
*When selecting a vacuum-type hand with two outputs, the second output point will be set for the vacuum break. This bit makes the following pulse output when the Hand_Off command is executed. When detecting that the workpiece vacuum detection signal is off, this bit will be automatically restored to its original output state.

I/O Type

This shows the I/O type (Input/Output). This cannot be changed.

Controller I/O Bit

Select the bit number (a) for the I/O being controlled from the pull-down menu. The I/O label name (b) will also appear for bit numbers that have been assigned an I/O label.



To assign an I/O label: refer to the following manual.
"Epson RC+ User's Guide - [I/O Label Editor] Command Command (Tools Menu)"

I/O State

Output bit: Specify whether to turn the bit selected as the I/O bit for the controller on or off.
Input bit: Specify whether the bit “On” selected as the I/O bit for the controller indicates that an operation is successful. Or the bit “Off” selected as the I/O bit for the controller indicates that an operation is successful.

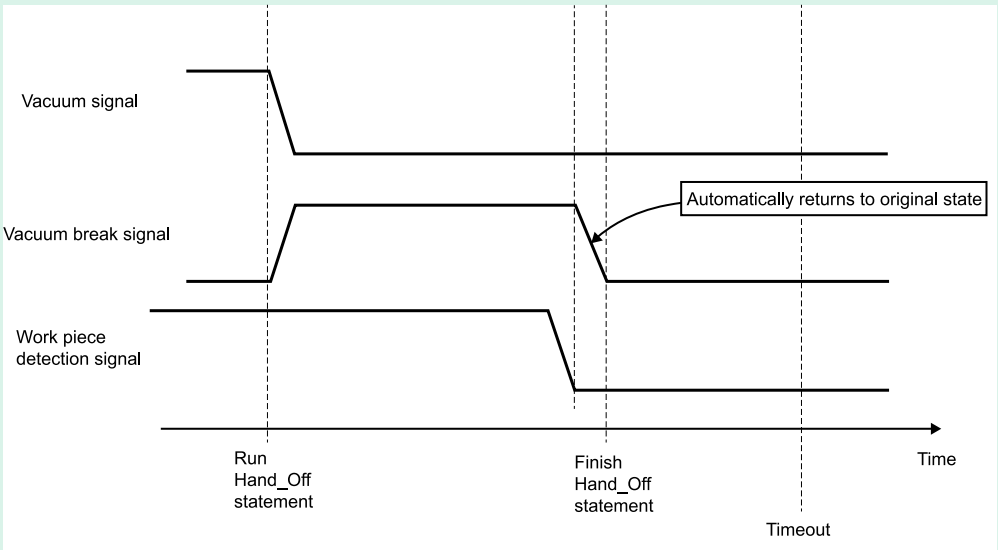
Timeout/Delay

Set the time of delay before the Hand_On command or the Hand_Off command times out, or before the next command is executed. This will appear differently depending on the type of hand set.
A: If the hand has an input: Timeout
B: If the hand does not have an input: Delay time
C: When using an electric screwdriver: Not shown (setting unavailable)

For details, refer to the following topic.
Timeout and Delay

KEY POINTS

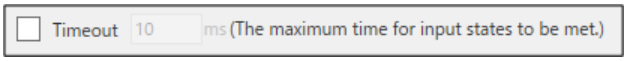
Note that a vacuum break may not occur if the vacuum break pulse output is too short. To ensure that a vacuum break occurs, enable the timeout setting for the Hand_Off command, and set a sufficiently long timeout duration.



6.2.0.2 Timeout and Delay

6.2.0.2.1 A: Hands with an input

If a hand with one or two input points from the hand is selected in the [Type] field on the [Configure Robot Hand *] screen, you can enable or disable the timeout function, and specify the timeout (Unit: [ms]).



[Timeout] check box

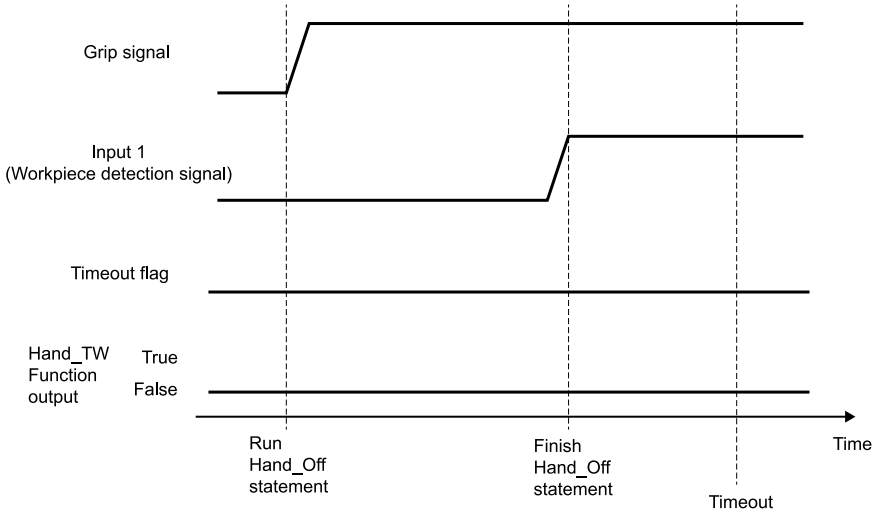
When this check box is selected, the timeout setting is enabled.

- When enabled:
  The controller will wait until a motion successful input signal is received from the hand after the Hand_On or Hand_Off command is executed. However, if the time specified as the timeout duration elapses the command will time out, and the next command will be executed. You can acquire the timeout status with the Hand_TW function.
- When disabled:
  When the Hand_On command or the Hand_Off command is executed, the controller will proceed to the next command immediately.

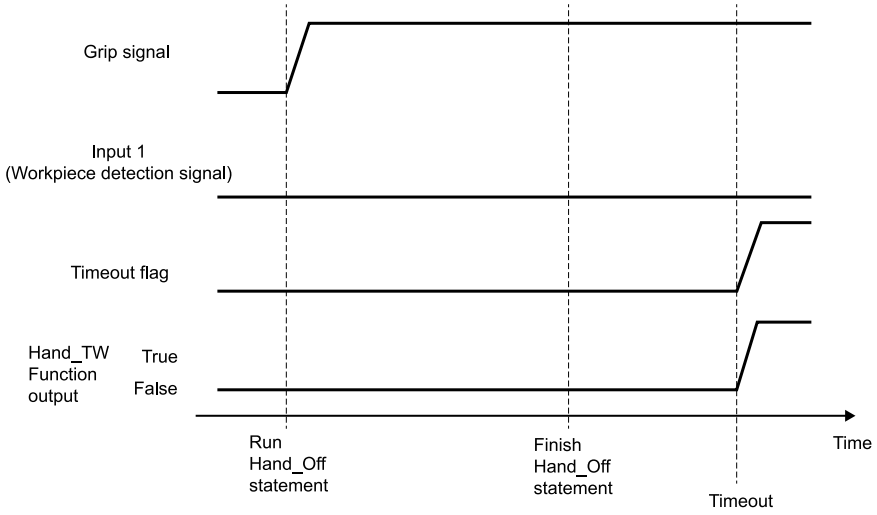
Timeout

Specify the duration used to determine a timeout.
Specification range: 10 [ms] ~ 10000 [ms]
Specification value: Integer values only

If the input signal from the hand enters the motion success state within the timeout duration:



If the input signal from the hand does not enter the motion success state within the timeout duration:



6.2.0.2.2 B: Hands without an input

If a hand without an input point from the hand is selected in the [Type] field on the [Configure Robot Hand *] screen, you can set whether there is a delay (standby time) before the next command is issued, and the delay duration (Unit: [ms]).

[Delay] check box

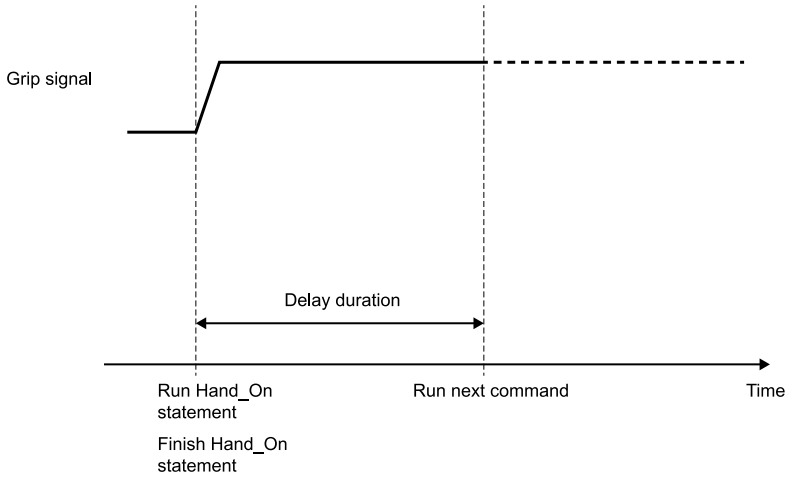
When this check box is selected, the delay setting is enabled.

- When enabled:
  When the Hand_On command or the Hand_Off command is executed, the controller will wait for the period specified in the [Delay] field before proceeding to the next command.
- When disabled:
  When the Hand_On command or the Hand_Off command is executed, the controller will proceed to the next command immediately.

Delay

Specify the standby duration before the controller proceeds to the next command.
Specification range: 10 [ms] ~ 10000 [ms]
Specification value: Integer values only

When a delay is set:



6.2.0.2.3 C: Electric screwdriver

The timeout and delay duration cannot be set when “Screwdrivers” (electric screwdriver) is selected in the [Series] field of the [Configure Robot Hand *] screen. When this is selected, the controller will immediately proceed to the next command after the Hand_On command or the Hand_Off command is executed.
The [Timeout] and [Delay] options will not be shown when electric screwdriver is selected.

6.2.0.3 Check Grip Status

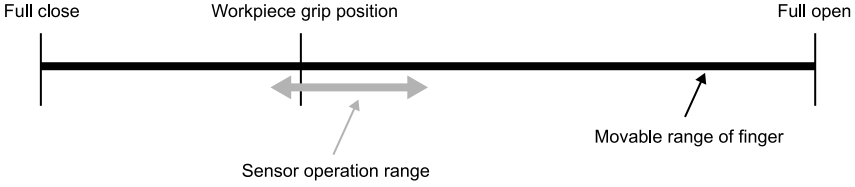
A sensor mounted on the chuck hand, or a pressure sensor attached to the vacuum generator can be used to detect whether the workpiece is being gripped. You can specify the input bit indicating the grip state, and the release state on the Configure Robot Hand screen according to these sensor specifications.
If the sensor input detects the grip state, the Hand_On function will return a “True” value. Conversely, if the release state is detected, the Hand_Off function will return a “True” value. Otherwise these functions will return a “False” value.

6.2.0.3.1 For a hand without a sensor (chuck / suction)

Provided that Hand_On/Hand_Off commands are output as configured on the Configure Robot Hand screen, the workpiece grip and release function is working properly.

6.2.0.3.2 For a chuck hand with a single sensor

The following diagram depicts a schematic view of the movable range of the chuck hand fingers. Assume that the finger position when gripping the workpiece (workpiece grip position) is located between the fully open and fully closed positions.



In this case, set the Hand_On, Hand_Off definition area as follows to detect whether the workpiece is being gripped. (When the sensor is connected to I/O bit 18)

Hand_On

Hand Signal	I/O Type	Controller I/O Bit	I/O State
(Omitted)			
Input1	Input	18: (Grip detection)	On

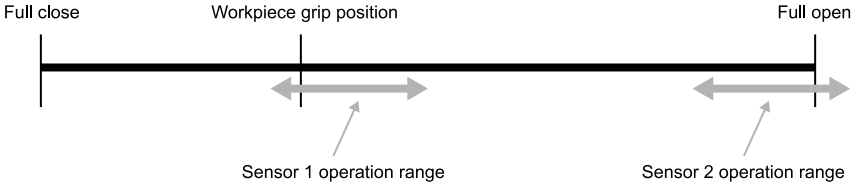
Hand_Off

Hand Signal	I/O Type	Controller I/O Bit	I/O State
(Omitted)			
Input1	Input	18: (Grip detection)	Off

6.2.0.3.3 For a chuck hand with two sensors

The following diagram depicts a schematic view of the movable range of the chuck hand fingers. Assume that the finger position when gripping the workpiece (workpiece grip position) is located between the fully open and fully closed positions. In this case, set the Hand_On, Hand_Off definition area as follows to detect whether the workpiece is being gripped (when the sensors are connected to I/O bits 18 and 19).

Example 1: When the sensors are attached near the workpiece grip position, and near the fully open position



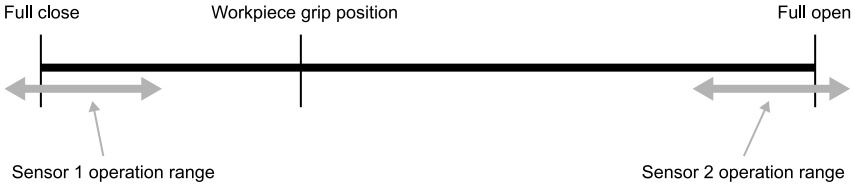
Hand_On

Hand Signal	I/O Type	Controller I/O Bit	I/O State
(Omitted)			
Input1	Input	18: (Sensor 1: Grip detection)	On
Input2	Input	19: (Sensor 2: Full open detection)	Off

Hand_Off

Hand Signal	I/O Type	Controller I/O Bit	I/O State
(Omitted)			
Input1	Input	18: (Sensor 1: Grip detection)	Off
Input2	Input	19: (Sensor 2: Full open detection)	On

Example 2: When the sensors are attached near the fully open position, and near the fully closed position



Hand_On

Hand Signal	I/O Type	Controller I/O Bit	I/O State
(Omitted)			
Input1	Input	18: (Sensor 1: Full close detection)	Off
Input2	Input	19: (Sensor 2: Full open detection)	Off

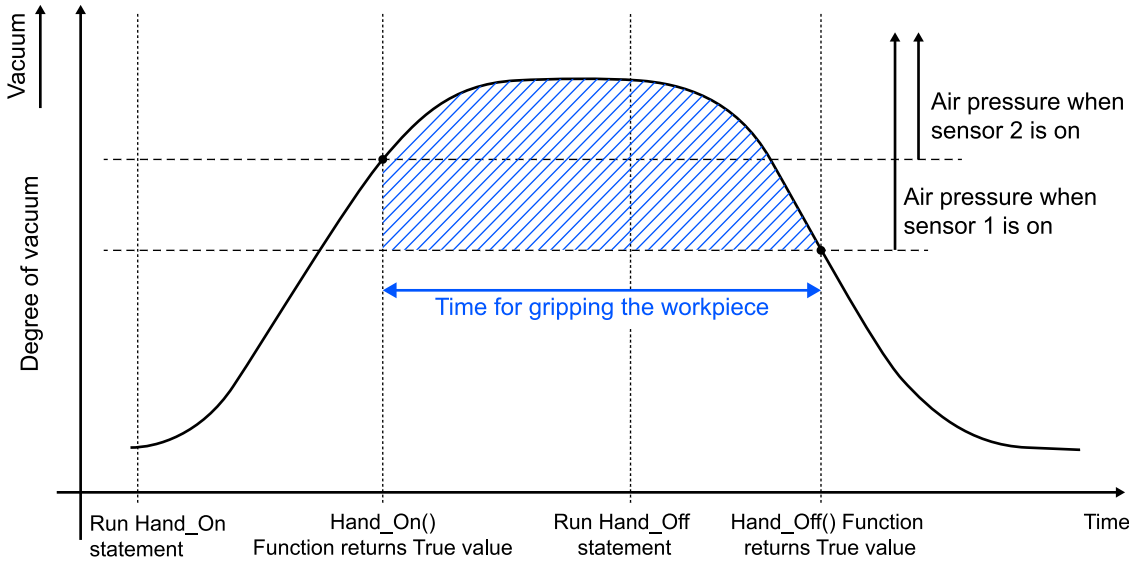
Hand_Off

Hand Signal	I/O Type	Controller I/O Bit	I/O State
(Omitted)			

Hand Signal	I/O Type	Controller I/O Bit	I/O State
Input1	Input	18: (Sensor 1: Full close detection)	Off
Input2	Input	19: (Sensor 2: Full open detection)	On

6.2.0.3.4 For a suction hand

The following diagram depicts a schematic view of pneumatic pressure within the suction hand. Executing the Hand_On command gradually shifts the hand to a vacuum state, and executing the Hand_Off command returns it to atmospheric pressure. If one or two* sensors are built into the vacuum generator, set the Hand_On, Hand_Off definition area as follows to detect whether the workpiece is being gripped. (When the sensors are connected to I/O bits 18 and 19)
*For a vacuum generator capable of setting two air pressure values that act as sensor triggers taking into account hysteresis (displacement)



Hand_On

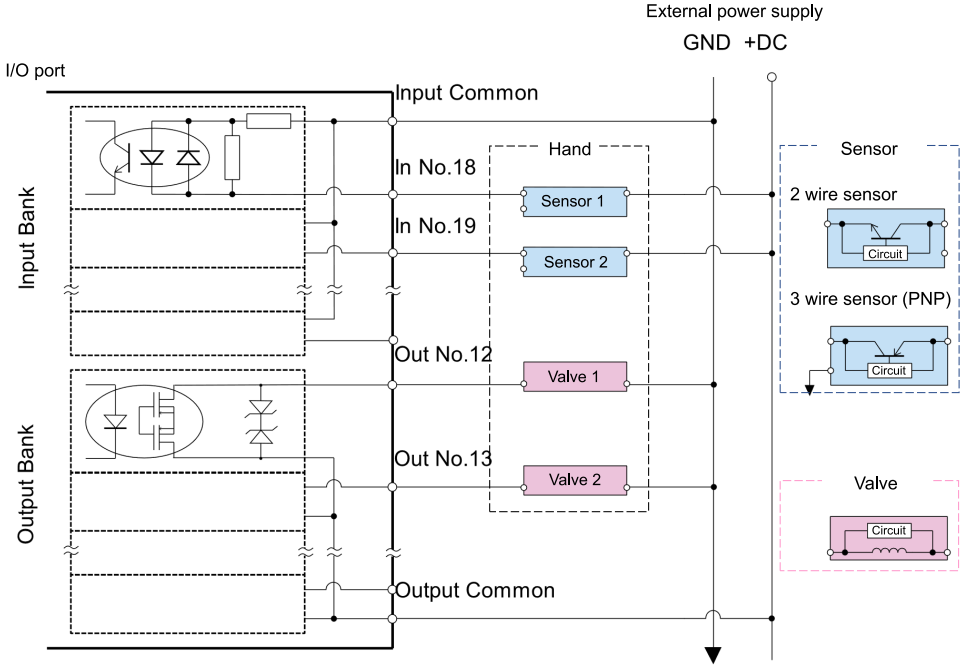
Hand Signal	I/O Type	Controller I/O Bit	I/O State
(Omitted)			
Input1	Input	18: (Sensor 1, hysteresis)	On
Input2	Input	19: (Sensor 2, setting)	On

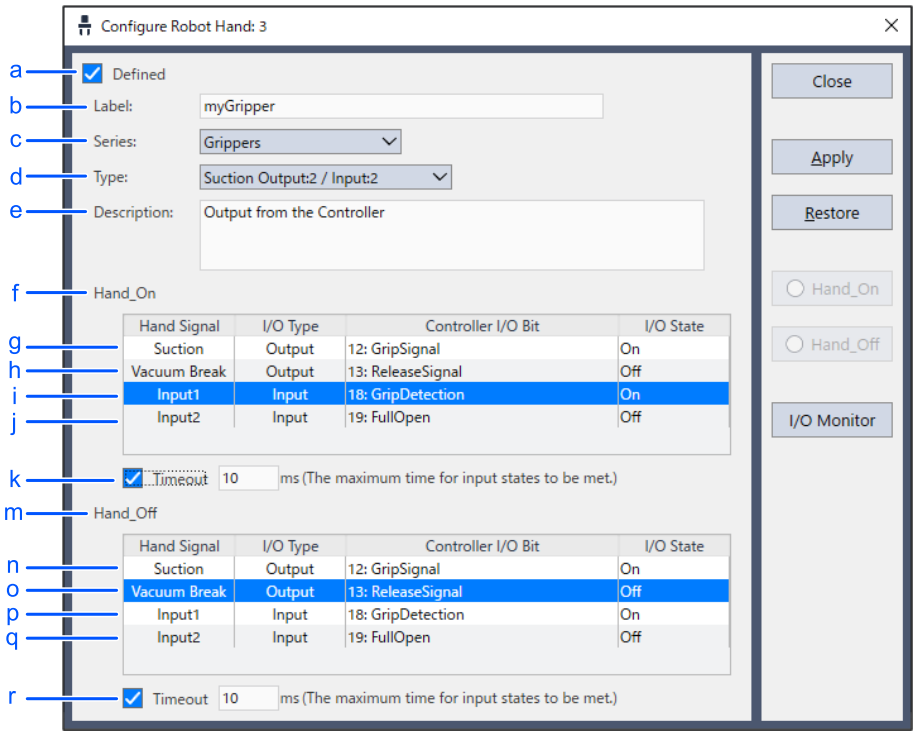
Hand_Off

Hand Signal	I/O Type	Controller I/O Bit	I/O State
(Omitted)			
Input1	Input	18: (Sensor 1, hysteresis)	Off
Input2	Input	19: (Sensor 2, setting)	Off

6.2.0.4 Example of Hand Configuration

The following example describes settings when connecting a chuck hand with two output points and two input points.



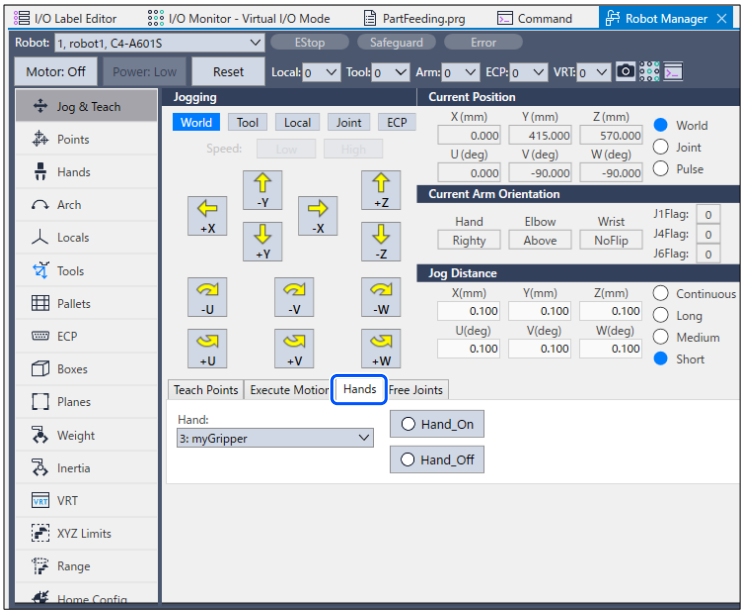


Symbol	Description	
a	Select the [Defined] check box	
b	Label	Enter a name
c	Series	Select Grippers
d	Type	Chuck (Select Output:2/Input: 2)
e	Description	Enter a description (option)
f	Hand_On (grip motion command) definition	

Symbol		Description	
	g	Motion command: Turns output bit 12 (grip signal) on	
	h	Motion command: Turns output bit 13 (release signal) off	
	i	Motion complete condition: Standby until input bit 18 (grip detection signal) is on	
	j	Motion complete condition: Standby until input bit 19 (full open detection signal) is off	
k		Timeout	Place a check in the [Timeout] check box The controller proceeds to the next command regardless of input signal once the timeout duration input here has elapsed
m		Hand_Off (release motion command) definition	
	n	Motion command: Turns output bit 12 (grip signal) Off	
	o	Motion command: Turns output bit 13 (release signal) On	
	p	Motion complete condition: Standby until input bit 18 (grip detection signal) is Off	
	q	Motion complete condition: Standby until input bit 19 (full open detection signal) is On	
r		Timeout	Place a check in the [Timeout] check box The controller proceeds to the next command regardless of input signal once the timeout duration input here has elapsed

6.3 Epson RC+ GUI (Jog & Teach Tab)

In the Epson RC+ menu, select the [Tools] - [Robot Manager] - [Jog & Teach] tab to open the [Jogging] screen.
Registered hands will appear in the [Hands] tab at the bottom of the screen. Select this tab to control the hands. The [Hands] tab will not appear when no hands are registered.



Hands

Select the hand to operate. Hands registered to the robot selected in [Robot:] on the upper left of the screen will appear in the pull-down menu.

[Hand_On] button

Click this button to immediately execute the Hand_On command for the hand selected in [Hands].
This will also acquire the return value for the Hand_On function. If “True”, the LED to the left of the button will light up.

Button display	Meaning
Hand_On(N)	When the return value for the Hand_On function is “True”
Hand_On(N)	When the return value for the Hand_On function is “False”

[Hand_Off] button

Click this button to immediately execute the Hand_Off command for the hand selected in [Hands].
This will also acquire the return value for the Hand_Off function. If “True”, the LED to the left of the button will light up.

Button display	Meaning
Hand_Off(F)	When the return value for the Hand_Off function is “True”
Hand_Off(F)	When the return value for the Hand_Off function is “False”

KEY POINTS

Selecting the Hands tab is useful for controlling the hand without switching screens during a jog motion

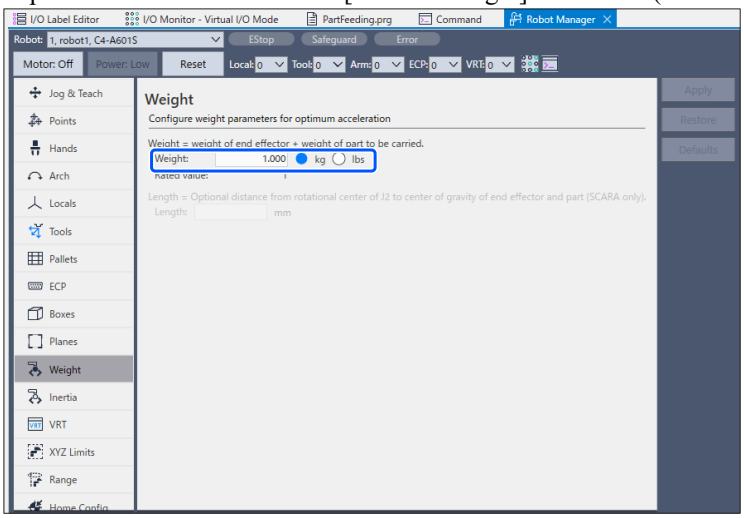
6.4 Other Settings

6.4.1 Weight Settings

Set the weight of the hand. Set the correct total weight of the attached hand (including the tool adapter and other peripherals) and the workpiece. There are two methods for configuring settings.

6.4.1.1 Configuration method 1: Setting the weight in the settings screen

For more information, refer to the following manual.
"Epson RC+ 8.0 User's Guide - [Robot Manager] Command (Tools Menu) - [Tools]-[Robot Manager]-[Weight] Page"



The [Length] does not normally need to be changed.

6.4.1.2 Configuration method 2: Setting the weight using SPEL+ commands

For more information, refer to the following manual.
"SPEL+ Language Reference - Weight Statement, Weight Function"

6.4.1.3 Example settings

This section describes the procedure used to set the Weight value using configuration methods 1 and 2 under the following conditions.

Component	Weight [kg]
Hand unit	1.0
Tool adapter	0.2
Workpiece	0.5
Wiring, piping, etc.	(This can be ignored)
Total	1.7

- Configuration method 1: In the [Weight] panel, enter “1.7” in the [Weight] field, and then select the [kg] button.
- Configuration method 2: Enter and execute the following command in the command window.

```
> Weight 1.7
```

⚠ CAUTION

- The combined weight of the hand and the workpiece must be equal to or less than the maximum transportable weight. For more information about the maximum transportable weight, refer to the manipulator manual. Make sure to set the Weight setting according to the load. Setting the weight setting to a lower value than the actual weight may cause errors or excess vibration, and prevent the robot from functioning properly, and reduce the lifespan of each component.
- Once set, weight settings are kept even when the power is turned off.

KEY POINTS

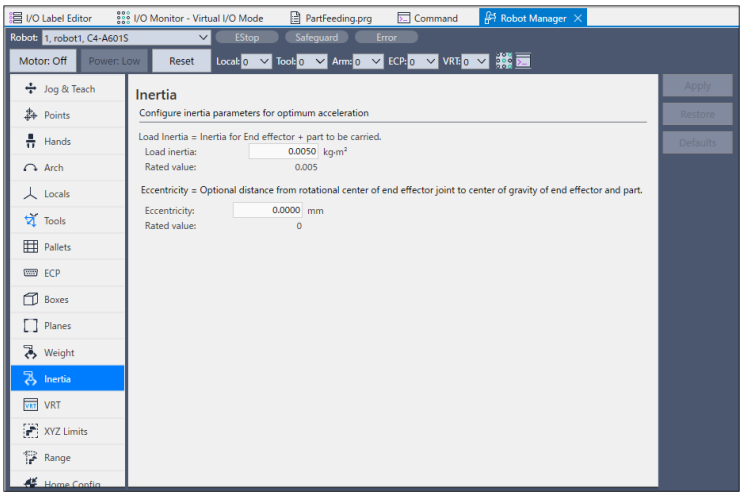
You can also execute the Weight command by running it in a SPEL+ program. However, as the Weight setting is stored to the internal controller storage media (compact flash / SD card), frequently executing this command within the program (particularly when on a loop) will adversely affect the life of the storage media. It is recommended that limit using this command as much as possible.

6.4.2 Inertia Settings and Eccentricity Settings

6.4.2.1 Moment (of inertia) and inertia settings

The moment of inertia is an amount that indicates the difficulty in getting a physical object to turn. This is expressed as values such as the moment of inertia, inertia, or GD2. When moving a hand attached to a shaft or flange, ensure that the total moment of inertia of the hand (including the tool adapter and other peripherals) and the workpiece does not exceed the maximum allowable value for the manipulator. There are two methods for configuring settings. Set this in conjunction with the eccentricity described in the next section.

Configuration method 1: Configuring settings in the settings screen
For more information, refer to the following manual.
"Epson RC+ 8.0 User's Guide - [Robot Manager] Command (Tools Menu) - [Tools]-[Robot Manager]-[Eccentricity] Page"



Configuration method 2: Configuring settings using SPEL+ commands.

```
> Inertia 0. 01
```

For more information, refer to the following manual.
"SPEL+ Language Reference - Inertia Statement, Inertia Function"

⚠ CAUTION

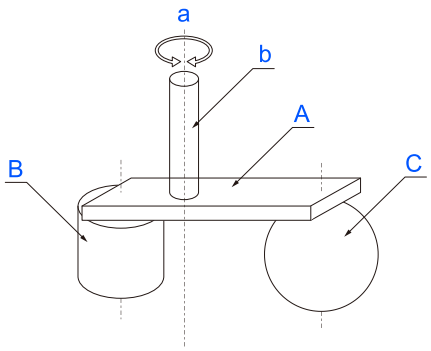
Always set the eccentric quantity parameter according to the eccentric quantity. Setting a value that is smaller than the actual eccentric quantity may cause errors, excessive shock, insufficient function of the Manipulator, and/or shorten the life cycle of parts/mechanisms.

KEY POINTS

You can also execute the Inertia command by running it in a SPEL+ program. However, as the Inertia setting is stored to the internal controller storage media (compact flash / SD card), frequently executing this command within the program (particularly when on a loop) will adversely affect the life of the storage media. It is recommended that limit using this command as much as possible.

6.4.2.2 How to calculate the moment of inertia

The following example shows how to calculate the moment of inertia for the load (the total of the hand and workpiece, including the tool adapter and other peripherals).
The moment of inertia for the total load is found by calculating the sum of components (A) to (C).

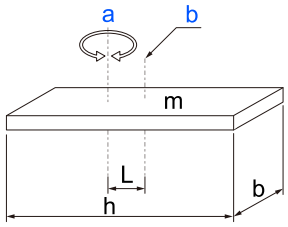


Whole moment of inertia = Moment of inertia of end effector (A) + Moment of inertia of work piece (B) + Moment of inertia of work piece (C)

Symbol	Item
a	Rotation center
b	Shaft
A	Hand
B	Workpiece
C	Workpiece

The methods for calculating the moment of inertia for (A), (B), and (C) are shown below. Calculate the total moment of inertia using the basic formulas.

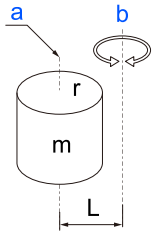
(A) Moment of inertia of a rectangular parallelepiped



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

Symbol	Item
a	Rotation center
b	Rectangular parallelepiped’s center of gravity
m	Weight

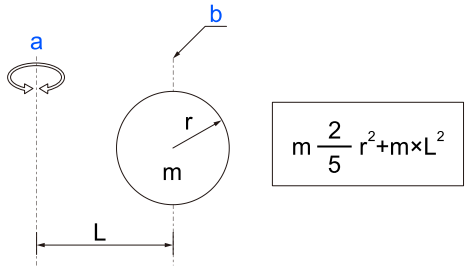
(B) Moment of inertia of a cylinder



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

Symbol	Item
a	Cylinder’s center of gravity
b	Rotation center
m	Weight

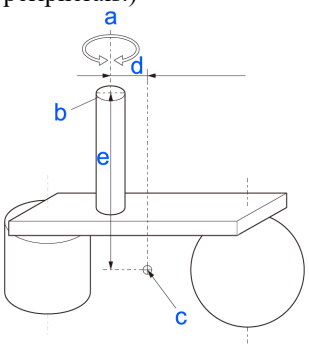
(C) Moment of inertia of a sphere



Symbol	Item
a	Rotation center
b	Sphere’s center of gravity
m	Weight

6.4.2.3 How to calculate eccentricity

Set the following value as the eccentricity of the load (the total of the hand and workpiece, including the tool adapter and other peripherals.)



Symbol	Item
a	Rotation center
b	Attachment face
c	Position of center of gravity of load
d	▪ For a SCARA robot: The displacement of the center of gravity of the entire load from the shaft axis (“d” in the diagram above) ▪ For a 6-axis robot: The displacement of the center of gravity of the entire load from the flange (the largest of “d” or “e” in the diagram above)
e	

6.4.3 Tool Settings

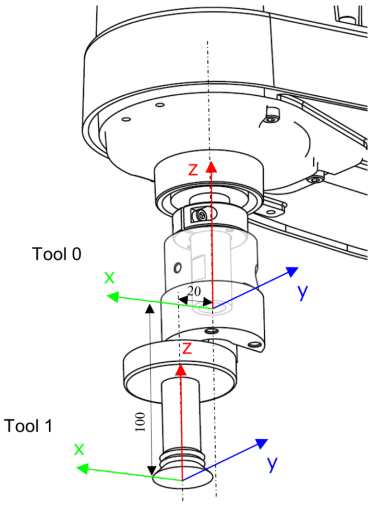
Set Tool coordinate systems for the attached hand as follows to move the robot as intended when jogging. This is particularly useful in reducing the risk of collision when controlling the hand in the vicinity of the workpiece and other obstacles.

Of the Tool coordinate systems, the Tool 0 coordinate system is preset to the tip of the shaft (for a SCARA robot), or the center of the flange face (for a 6-axis robot), and cannot be changed. 15 Tool coordinate systems (Tool 1 to Tool 15) can be set by the user.

6.4.3.1 Example 1: For a SCARA robot, set the vacuum pad surface part of a suction hand to the Tool 1 coordinate system

If the center of the vacuum pad of a mounted hand is offset from the center of axis at the base of the shaft as described below:
x axis direction: 20mm
z axis direction: -100mm

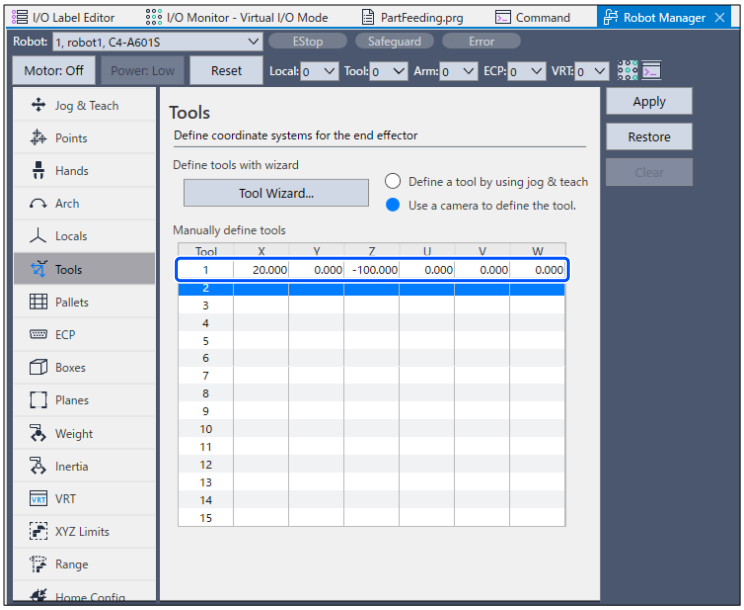
Set the Tool 1 coordinate system as follows.



Tool 1: Offset amount from Tool 0

x	y	z	u	v	w
20	0	-100	0	0	0

Epson RC+ 8.0 User's Guide - [Robot Manager] Command (Tools Menu) - [Tools]-[Robot Manager] - [Tools] Page

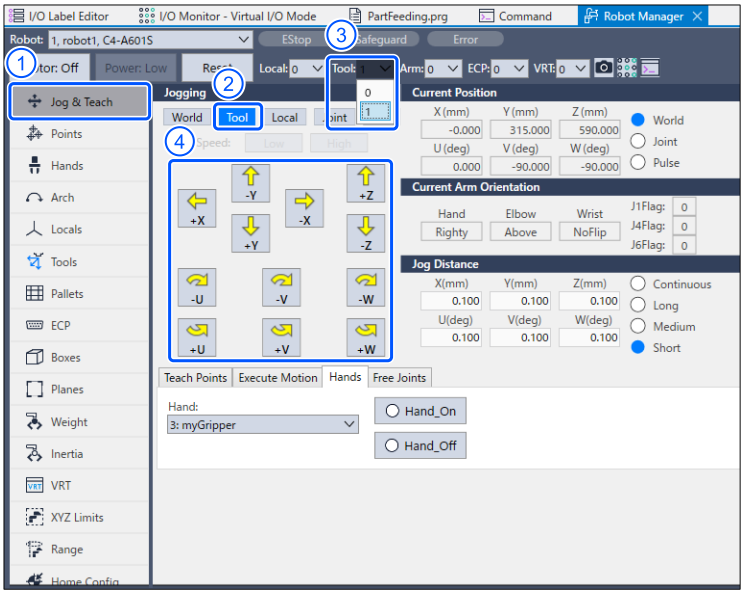


To perform a jog motion in the specified tool coordinate system:

1. Open the [Jog & Teach] screen.
2. Set the [Mode] to Tool.

3. In the [Tool:] field, select the tool coordinate system set above (in this example, 1).
4. Click jog buttons.

This will move the robot based on the coordinate axis specified by the Tool 1 coordinate system.

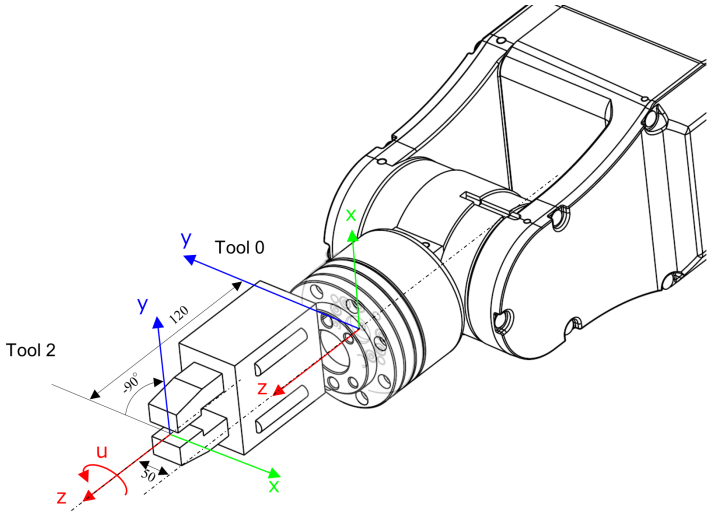


6.4.3.2 Example 2: Setting the finger tip (gripping point) of the chuck hand on a 6-axis robot to the Tool 2 coordinate system

Offset the gripping point of the attached hand from the center of the flange surface as follows:

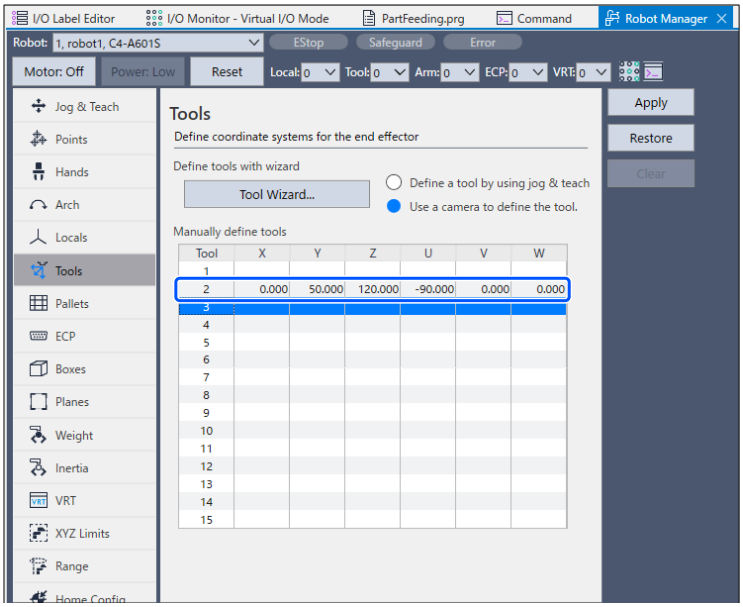
- Y-axis direction: 50mm
- Z-axis direction: 120mm
  If, in addition to this, the hand is attached with a 90 degree rotation around the Z-axis:

Set the Tool 2 coordinate system as follows.



Tool 2: Offset amount from Tool 0

x	y	z	u	v	w
0	50	120	-90	0	0



Select the tool coordinate system set in the [Jog & Teach] screen in the same way as example 1 to move the hand based on this coordinate axis.

KEY POINTS

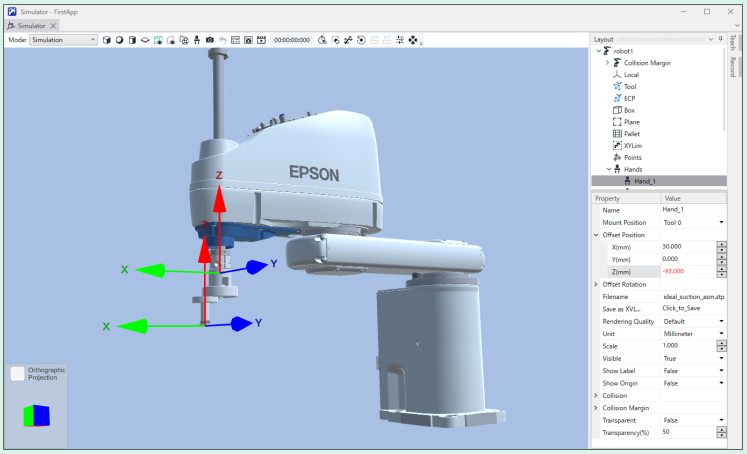
- While an offset has been added in the X-axis and Y-axis direction to provide an example, it is recommended that the center of gravity for the whole hand matches the center of the shaft axis (on a SCARA robot) or the center of the flange surface (J6 axis) as closely as possible. If an offset occurs, refer to the following to set the correct degree of eccentricity.

  "Inertia Settings and Eccentricity Settings"

- The Tool 0 coordinate system is set to the tip of the shaft (for a SCARA robot), or the center of the flange face (for a 6-axis robot). This cannot be changed.
- You can use CAD data on the hand and tool adapter to display the hand and the tool coordinate system on the simulator screen using the Epson RC+ simulator function.

  For more information, refer to the following manual.

  "Epson RC+ 8.0 User's Guide - Simulator"



7. SPEL+ Command Reference

7.1 SPEL+ Command Reference

KEY POINTS

SPEL+ has the Hand commands and the Hand functions to set and retrieve the arm position of robots. Note that the use of that commands and functions are different from the SPEL+ commands and the SPEL+ functions of hands in this chapter.

Command, Function	Description	
Hand_On Statement	Gripper	Executes grasping operation of a hand
	Electric screwdriver	Executes screw tightening operation of a hand
Hand_On Function	Gripper	When a hand is in the grasping status, returns “True”
	Electric screwdriver	When a hand is in the completed screw tightening status, returns “True”
Hand_Off Statement	Gripper	Executes releasing operation of a hand
	Electric screwdriver	Executes screw loosening operation of a hand
Hand_Off Function	Gripper	When a hand is in the releasing status, returns “True”
	Electric screwdriver	When a hand is in the completed screw loosening status, returns “True”
Hand_TW Function	If the Hand_On command and the Hand_Off command is timed out, returns “True”	
Hand_Def Function	If a hand is defined, returns “True”	
Hand_Type Function	Returns the type number of a hand	
Hand_Label$ Function	Returns the label of a hand	
Hand_Number Function	Returns the hand number	

7.2 Hand_On Statement

For grippers: Executes the gripping motion.
For electric screwdrivers: Executes the screw tightening motion.

Syntax

Hand_On { Hand Number | Hand Label }

Parameters

Hand Number Specify the number 1 to 15 of the hand to operate.
Hand Label Specify the label of the hand to operate.

Description

This sets the output bit specified in the [I/O Type] field to the state specified in the [I/O] State field for the hand specified based on the Hand_On definition. If the timeout setting has been enabled, the Hand_On command will continue to wait for the input bit to satisfy the specified condition until the timeout time [ms] passes. For example, if the Hand_On is defined as follows, the Hand_On command will act in the following way.
Refer to:**Hand_On, Hand_Off definition area**

Hand_On

Hand Signal	I/O Type	Controller I/O Bit	I/O State
Grip	Output	12: GripSignal	On
Release	Output	13: ReleaseSignal	Off
Input1	Input	18: GripDetection	On
Input2	Input	19: FullyOpened	Off

Executing the Hand_On command will:

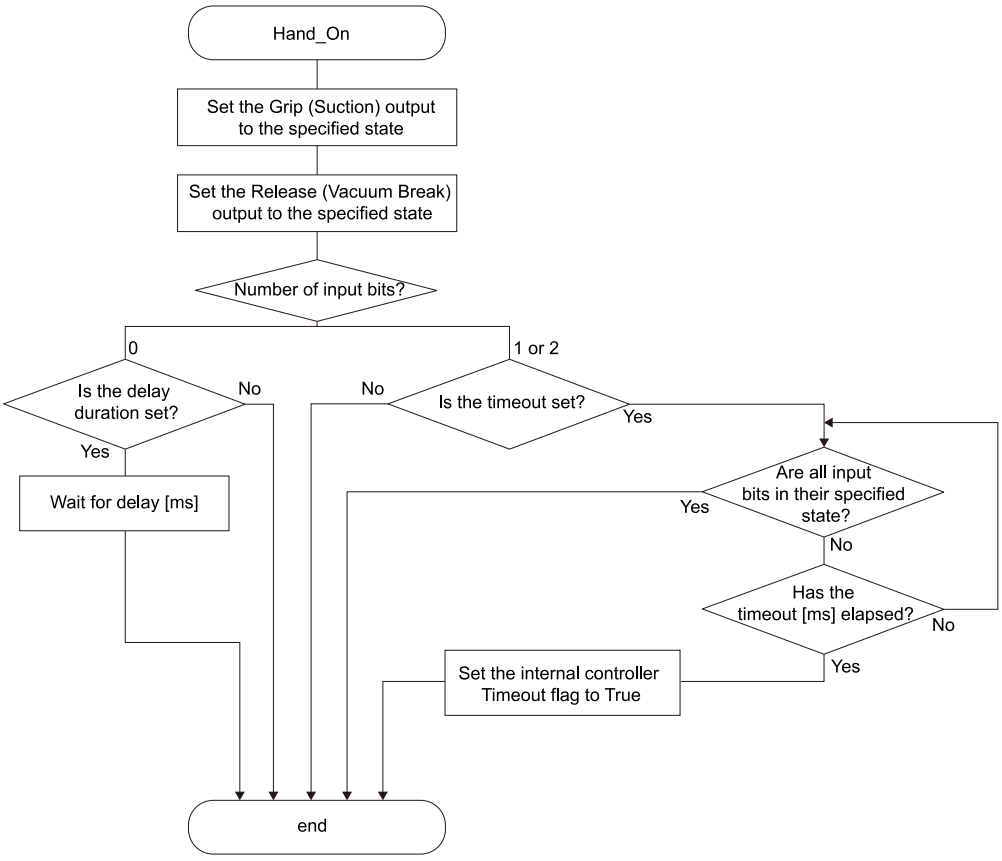
- Turn I/O output bit 12 on.
- Turn I/O output bit 13 off.

How timeout and delays work

State	Description
When no timeout or delay setting is set	The controller will immediately proceed to the next command when the Hand_On command is executed.
When a timeout is set	The Hand_On command will continue to wait for the input bit to satisfy the specified condition until the timeout time [ms] passes. If the input bit value meets the specified condition before the specified timeout elapses, the next command will be executed.
When a delay is set	The Hand_On command will wait from the output bit operation until the delay set elapses before moving onto the next command.

For more information, refer to the following.

Configure Robot Hand Screen



Note

Emergency stop and reset output
Output from the output port selected by the hand function is maintained even when the Emergency Stop button is pressed, or the Reset command is executed.

See Also

Hand_Off, Hand_On Function, Hand_Off Function, Hand_TW Function, Hand_Def Function, Hand_Type Function, Hand_Label$ Function, Hand_Number Function

Hand_On Example

```
' Put Hand 1 registered to Robot 1 in a grip state

Robot 1
Tool 1

Jump P1
Hand_On 1
```

7.3 Hand_On Function

For grippers : Determines whether the hand is in the grip state.
For electric screwdrivers : Determines whether the hand has finished screw tightening.

Syntax

Hand_On ({ Hand Number | Hand Label })

Parameters

Hand Number Specify the number 1 to 15 of the hand to operate.
Hand Label Specify the label of the hand to operate.

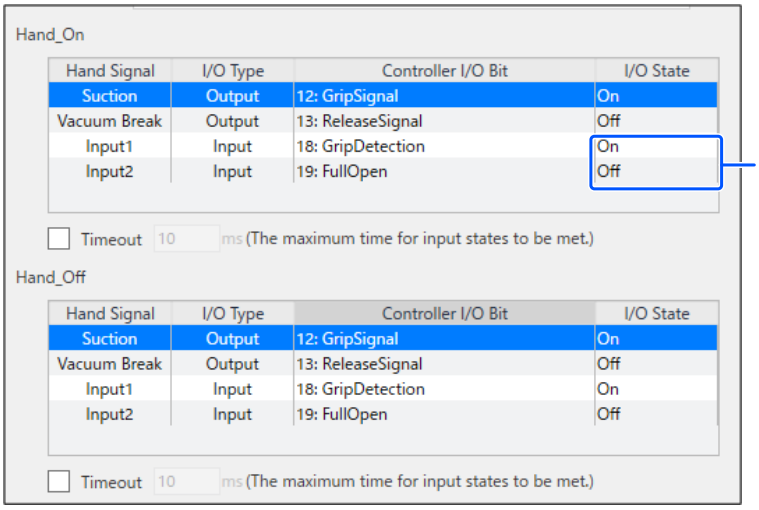
Return Values

For grippers : If the hand is in the gripped state, returns “True”. If not, returns “False”.
For electric screwdrivers : If screw tightening is complete, returns “True”. If not, returns “False”.

Description

This function acquires the following information.
For grippers : Whether the hand is in a grip state
For electric screwdrivers : Whether the hand has finished screw tightening.

Once the gripping operation has been performed with the Hand_On command, use the Hand_On() function to acquire operation results and determine whether the workpiece has been gripped properly, or whether screw tightening is complete. The gripped state refers to a state in which the input bit specified in the Hand_On definition area is in the specified I/O state.



a:Gripped state/Conditions are met

Note

If one input bit has been set, combine this function with the following commands to change the robot motion based on whether the hand enters the gripped state.
Find command, Sense command, Till command, Trap command, Wait command

See Also

! ... \parallel processing, Hand_On, Hand_Off, Hand_Off Function, Hand_TW Function, Hand_Def Function, Hand_Type Function, Hand_Label$ Function, Hand_Number Function

Hand_On Function Example

```
' If the hand is in the grip state, “Gripping” will appear in the Run window

If Hand_On(1) = True Then
        Print "Gripping"
Endif
```

7.4 Hand_Off Statement

For grippers : Executes the release motion.
For electric screwdrivers : Loosens the screw.

Syntax

Hand_Off { Hand Number | Hand Label }

Parameters

Hand Number Specify the number 1 to 15 of the hand to operate.
Hand Label Specify the label of the hand to operate.

Description

This sets the output bit specified in the [I/O Type] field to the state specified in the [I/O State] field for the hand specified based on the Hand_Off definition (Hand_On, Hand_Off Definition Area). If the timeout setting has been enabled, the Hand_On command will continue to wait for the input bit to satisfy the specified condition until the timeout time [ms] passes.
For example, if Hand_Off is defined as follows, the Hand_Off command will act in the following way.

Hand_Off

Hand Signal	I/O Type	Controller I/O Bit	I/O State
Grip	Output	12: GripSignal	Off
Release	Output	13: ReleaseSignal	On
Input1	Input	18: GripDetection	Off
Input2	Input	19: FullyOpened	On

Executing the Hand_Off command will:

- Turn I/O output bit 12 off.
- Turn I/O output bit 13 on.

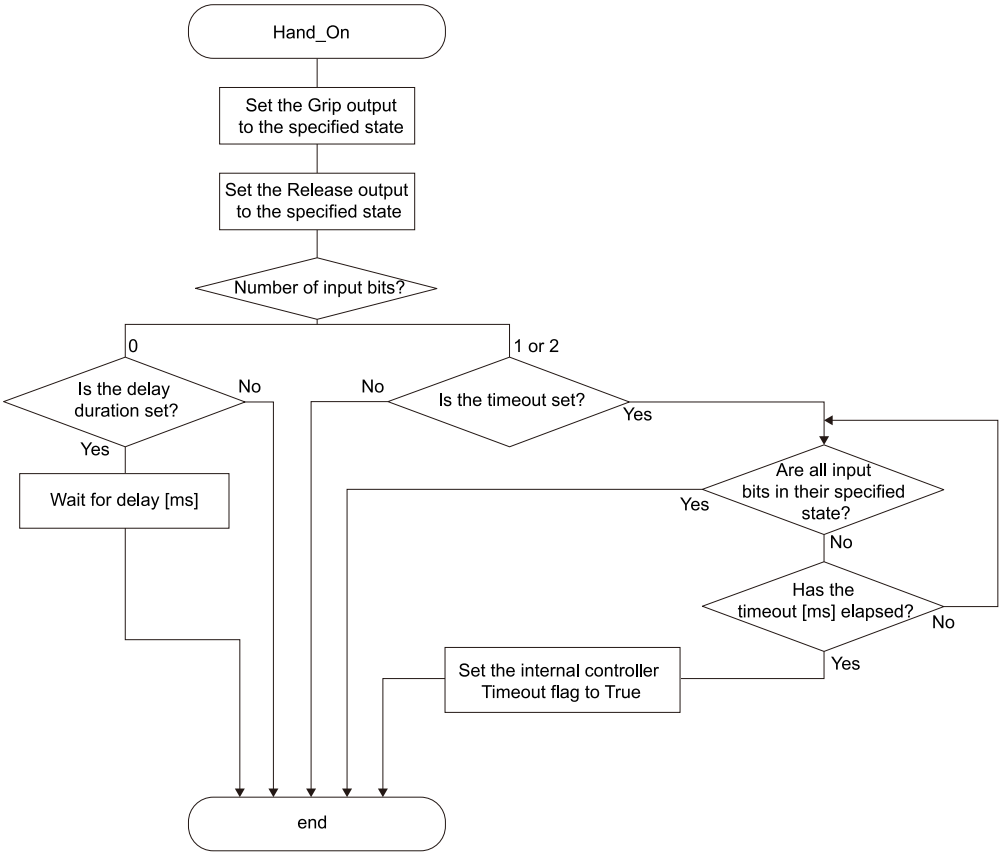
How timeout and delays work

State	Description
When no timeout or delay setting is set	The controller will immediately proceed to the next command when the Hand_Off command is executed. However, if a suction hand on output 2 is selected, the command will standby for 10 ms to ensure that the vacuum break pulse signal is output. Reference: Flowchart
When a timeout is set	The Hand_Off command will continue to wait for the input bit to satisfy the specified condition until the timeout time [ms] passes. If the input bit value meets the specified condition before the specified timeout elapses, the next command will be executed.
When a delay is set:	The Hand_Off command will wait from the output bit operation until the delay set elapses before moving onto the next command.

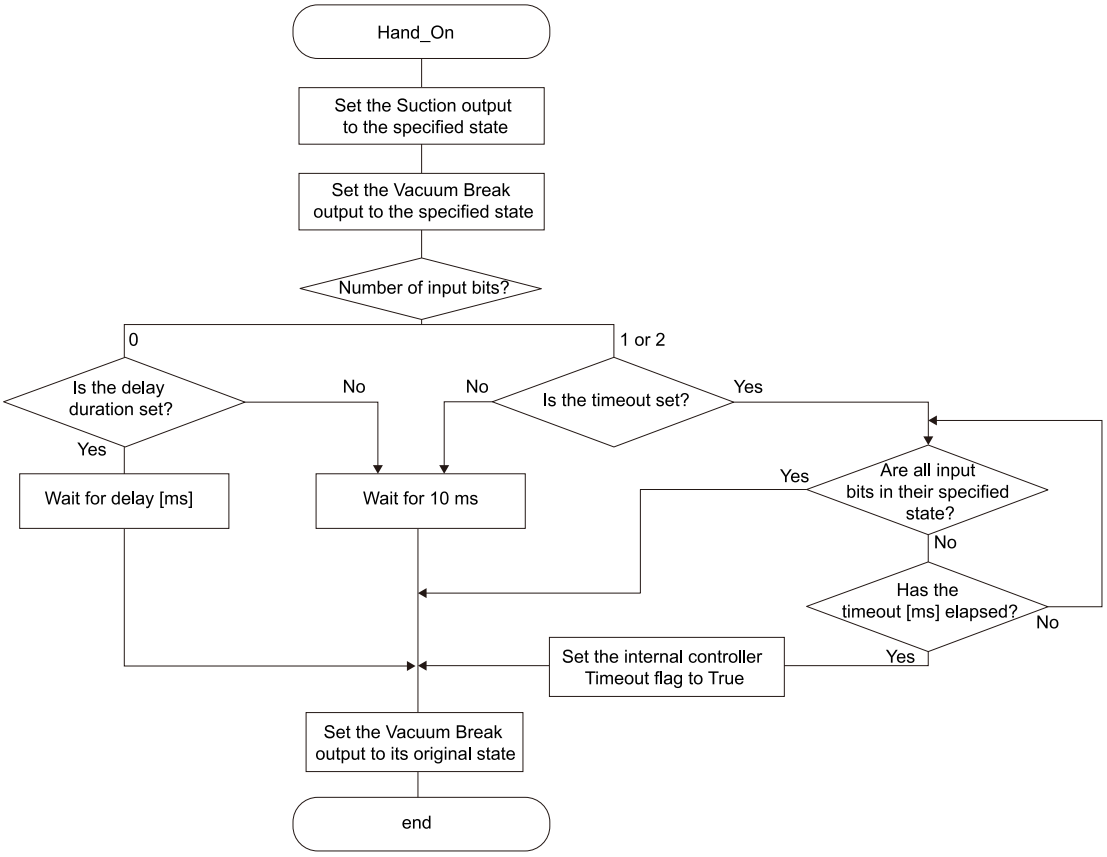
For more information, refer to the following.

Configure Robot Hand Screen

(A) When using a chuck hand, or a suction hand (output 1)



(B) When using a suction hand (output 2...with vacuum break function)



Note

Emergency stop and reset output

Output from the output port selected by the hand function is maintained even when the Emergency Stop button is pressed, or the Reset command is executed.

See Also

Hand_On, Hand_On Function, Hand_Off Function, Hand_TW Function, Hand_Def Function, Hand_Type Function, Hand_Label$ Function, Hand_Number Function

Hand_Off Example

```
' Open and close Hand 1 registered to Robot 1.
' When executing a Jump command to move Robot 1 from Home to P1,
' the Hand_Off command is executed when the robot has moved up
' to half of the total travel distance.
' When P1 is reached, the workpiece is gripped with the Hand_On command.
' (Use Hand_Off during motion to reduce takt times)

Robot 1
Tool 1

Go Home
Jump P1 ! D50; Hand_Off 1 !
Hand_On 1
```

7.5 Hand_Off Function

For grippers : Determines whether the hand is in the release state.
For electric screwdrivers : Determines whether the hand has finished screw loosening.

Syntax

Hand_Off ({ Hand Number | Hand Label })

Parameters

Hand Number Specify the number 1 to 15 of the hand to operate.
Hand Label Specify the label of the hand to operate.

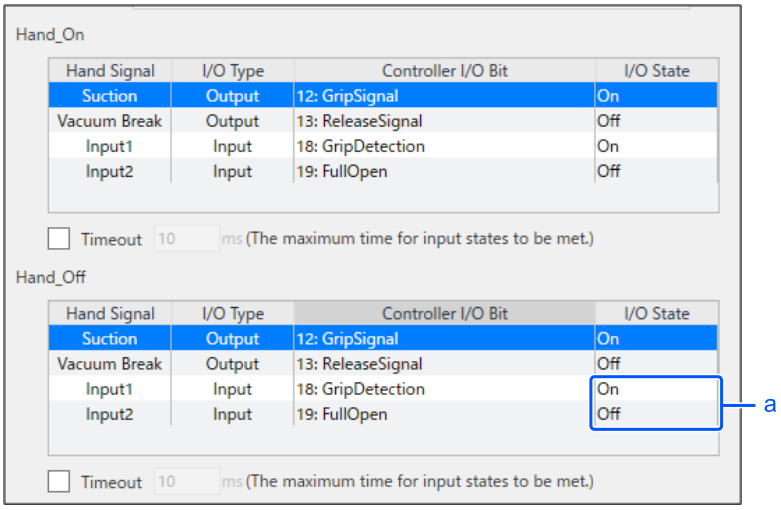
Return Values

For grippers : If the hand is in the released state, returns “True”. If not, returns “False”.
For electric screwdrivers : If screw loosening is complete, returns “True”. If not, returns “False”.

Description

This function acquires the following information.
For grippers : Whether the hand is in a release state
For electric screwdrivers : Whether the hand has finished screw loosening.

Once the release operation has been performed with the Hand_Off command, use the Hand_Off() function to acquire operation results and determine whether the workpiece has been released properly, or whether screw loosening is complete.
The released state refers to a state in which the input bit specified in the Hand_Off definition area is in the specified I/O state.



a:Released state/Conditions are met

Note

If one input bit has been set, combine this function with the following commands to change the robot motion based on whether the hand enters the released state.
Find command, Sense command, Till command, Trap command, Wait command

See Also

! ... \parallel processing, Hand_On, Hand_Off, Hand_On Function, Hand_TW Function, Hand_Def Function, Hand_Type Function, Hand_Label$ Function, Hand_Number Function

Hand_Off Function Example

```
' When setting an electric screwdriver to hand 1,
' and operating the hand in combination with a force sensor

Robot 1
Tool 1

Hand_Off 1
Bmove XY(-10, 0, 0, 0, 0, 0) FC1 Till Hand_Off(1) = True
```

7.6 Hand_TW Function

Acquires the timeout results of the Hand_On command or Hand_Off command executed immediately beforehand.

Syntax

Hand_TW

Parameters

None

Return Values

If a timeout occurred with the Hand_On command or Hand_Off command executed immediately beforehand, returns “True”. If not, returns “False”.

Description

If the timeout setting is enabled, and the Hand_On command or Hand_Off command do not complete within the timeout duration set, this function will return “True”. For more information, see Hand_On and the flowchart depicted in the command reference for the Hand_On command. If the “Set the internal controller timeout flag to True” described in the same flowchart has passed, executing the Hand_TW function will return “True”.

See Also
Hand_On, Hand_Off, Wait, TW Function

Hand_TW Function Example

```
' Display a "Grip Failed" message in the Run window if a timeout is triggered
' when executing the Hand_On command

Hand_On 1
If Hand_TW = True Then
        Print "Grip failed"
Endif
```

7.7 Hand_Def Function

Acquires whether the hand has been defined.

Syntax
Hand_Def ({Hand Number | Hand Label})

Parameters
Hand Number Specify the number 1 to 15 of the hand to operate.
Hand Label Specify the label of the hand to operate.

Return Values
If the hand has been defined, returns "True". If not, returns "False".

See Also
Hand_Type Function, Hand_Label$ Function, Hand_Number Function

Hand_Def Function Example

```
' Display the label for hand 1 if set, display "Hand 1 is not defined"
' in the Run window if not set

If Hand_Def(1) = True Then
        Print Hand_Label$(1)
Else
        Print "Hand 1 is not defined"
Endif
```

7.8 Hand_Type Function

Acquires the type number for the hand.

Syntax
Hand_Type(Hand Number | Hand Label)

Parameters
Hand Number Specify the number 1 to 15 of the hand to operate.
Hand Label Specify the label of the hand to operate.

Return Values
Hand type number (integer, decimal)

Please see the following.

Configure Robot Hand Screen

Constant	Value	Description
HAND_TYPE_CHUCK_OUT1_IN0	&H111101	Chuck (Output:1 / Input:0)
HAND_TYPE_CHUCK_OUT1_IN1	&H111111	Chuck (Output:1 / Input:1)
HAND_TYPE_CHUCK_OUT1_IN2	&H111121	Chuck (Output:1 / Input:2)
HAND_TYPE_CHUCK_OUT2_IN0	&H111102	Chuck (Output:2 / Input:0)
HAND_TYPE_CHUCK_OUT2_IN1	&H111112	Chuck (Output:2 / Input:1)
HAND_TYPE_CHUCK_OUT2_IN2	&H111122	Chuck (Output:2 / Input:2)
HAND_TYPE_SUCTION_OUT1_IN0	&H111201	Suction (Output:1 / Input:0)
HAND_TYPE_SUCTION_OUT1_IN1	&H111211	Suction (Output:1 / Input:1)
HAND_TYPE_SUCTION_OUT1_IN2	&H111221	Suction (Output:1 / Input:2)
HAND_TYPE_SUCTION_OUT2_IN0	&H111202	Suction (Output:2 / Input:0)
HAND_TYPE_SUCTION_OUT2_IN1	&H111212	Suction (Output:2 / Input:1)
HAND_TYPE_SUCTION_OUT2_IN2	&H111222	Suction (Output:2 / Input:2)
HAND_TYPE_SCREWDRIVER_TYPE1	&H211017	Screwdriver

KEY POINTS

Use the Hex$ function to convert the hand type number acquired with the Hand_Type function (decimal) to a hexadecimal number.

Example:

```
> print Hex$(Hand_Type(1))
111122
```

See Also

Hand_On, Hand_Off, Hand_On Function, Hand_Off Function, Hand_TW Function, Hand_Def Function, Hand_Type Function, Hand_Label$ Function, Hand_Number Function, Hex$ Function

Hand_Type Function Example

```
' Compare the type number for hand 1 with the Define string and confirm whether
they match

If Hand_Type(1) <> HAND_TYPE_SUCTION_OUT2_IN1 Then
        Print "Hand1 is not a suction out2 in1."
EndIf
```

7.9 Hand_Label$ Function

Acquires the label set for the hand.

Syntax
Hand_Label$(Hand Number)

Parameters
Hand Number Specify the number 1 to 15 of the hand to operate.

Return Values
The label set for the hand (character string)

Description
This function displays the hand label specified in the Configure Robot Hand screen. If a label has not been assigned, this will appear “ “ (blank).

See Also
Hand_Number Function

Hand_Label$ Function Example

```
Print Hand_Label$(1)          ' Display the hand 1 label
```

7.10 Hand_Number Function

Acquires the hand number associated with the hand label.

Syntax
Hand_Number(Hand Label)

Parameters
Hand Label Specify the hand label set. (Up to 31 one-byte characters in length)

Return Values
Hand number (integer)

Description
This function displays the hand number associated with the hand label specified in the Configure Robot Hand screen. If a hand with the label specified cannot be found, an error message will appear: “Error 2555: Undefined label set. Please specify a defined label”.

Note
Hands that have not been assigned a label
A hand label does not need to be assigned when configuring hand settings. As such, you can register multiple hands without a label name.
Enter in the following to return the lowest hand number among hands without a label.

```
> print Hand_Number("")
```

We recommend assigning a hand label to each hand registered due to the difficulty of identifying unlabeled hands within a program.

See Also
Hand_Label$ Function

Hand_Number Function Example

```
String HandName$
```

```
Print Hand_Number(Hand1)                ' Display the hand 1 number
Print Hand_Number("Hand1")

HandName$ = "Hand1"
Print Hand_Number(HandName$)
```

8. SPEL+ Command Examples

8.1 Command Examples

8.1.1 Example 1: Transporting a single workpiece using a single robot with a single function hand

```
Function main
        Tool 1

        Motor On
        Hand_Off 1      'Set to release state
        Go P0           'Move to initial position

        Do
                Go P1   'Pick up position
                Hand_On 1       'Vacuum
                If Hand_TW = True Then
                        ' Write operations when in an error
                EndIf

                Go P2   'Place position
                Hand_Off 1      'Release
                If Hand_TW = True Then
                        ' Write operations when in an error
                EndIf
        Loop
Fend
```

8.1.2 Example 2: Transporting two workpieces at once using a single robot with two single function hands

```
Function main
        Tool 1

        Motor On
        Hand_Off 1      'Set to release state
        Hand_Off 2
        Go P0           'Move to initial position

        Do
                Tool 1  'Tool 1
                Go P1   'Pick up position
                Hand_On 1       'Hand 1 vacuum
                If Hand_TW = True Then
                        ' Write operations when in an error
                EndIf

                Tool 2  'Tool 2
                Go P2   'Pick up position
                Hand_On 2       'Hand 2 vacuum
                If Hand_TW = True Then
                        ' Write operations when in an error
                EndIf

                Tool 1  'Tool 1
                Go P3   'Place position
                Hand_Off 1      'Hand 1 release
                If Hand_TW = True Then
                        ' Write operations when in an error
                EndIf

                Tool 2  'Tool 2
```

```
                Go P4   'Place position
                Hand_Off 2      'Hand 2 release
                If Hand_TW = True Then
                        ' Write operations when in an error
                EndIf
        Loop
Fend
```

8.1.3 Example 3: Transporting a single workpiece using two robots each with a single function hand

```
Function main
        Xqt RB1 'Robot 1 transportation
        Xqt RB2 'Robot 2 transportation
Fend

Function RB1
        Robot 1
        Tool 1
        Motor On
        MemOff RB1End
        Hand_Off 1      'Set to release state
        Go P0

        Do
                Wait MemSw(RB2End) = On 'Await robot 2 transportation
'complete
                MemOff RB1End

                Go P1   'Pick up position
                Hand_On 1       'Vacuum
                If Hand_TW = True Then
                        ' Write operations when in an error
                EndIf

                Go P2   'Place position
                Hand_Off 1      'Release
                If Hand_TW = True Then
                        ' Write operations when in an error
                EndIf

                Go P0
                MemOn RB1End
                Wait 0.2
        Loop
Fend

Function RB2
        Robot 2
        Tool 1
        Motor On
        MemOff RB2End
        Hand_Off 1      'Set to release state
        Go P0

        MemOn RB2End    'Start from robot 1 transportation

        Do
                Wait MemSw(RB1End) = On 'Await robot 1 transportation ' complete
                MemOff RB2End

                Go P1   'Pick up position
                Hand_On 1       'Vacuum
                If Hand_TW = True Then
```

```
                        ' Write operations when in an error
                EndIf

                Go P2   'Place position
                Hand_Off 1      'Release
                If Hand_TW = True Then
                        ' Write operations when in an error
                EndIf

                Go P0
                MemOn RB2End
                Wait 0.2
        Loop
Fend
```

8.1.4 Example 4: Transporting a single workpiece and tightening screws using a single robot, and a single function hand with an electric screwdriver using a tool changer

```
Function main
        Tool 1

        Motor On
        Hand_Off 1      'Set to release state
        Go P0

        Do
                Tool 1
                Go P1
                Hand_On 1
                If Hand_TW = True Then
                        ' Write operations when in an error
                EndIf

                Go P2
                Hand_Off 1
                If Hand_TW = True Then
                        ' Write operations when in an error
                EndIf

                Go P3
                Tool 0
                Go P4

                Tool 2
                Go P5
                Hand_On 2
                BMove XY(-10, 0, 0, 0, 0, 0) FC1 Till Hand_On(2) = True
                Hand_Off 2
                BMove XY(10, 0, 0, 0, 0, 0) FC1 Till Hand_Off(2) = True
                Hand_On 2
                BMove XY(-10, 0, 0, 0, 0, 0) FC1 Till Hand_On(2) = True

                Go P4
                Tool 0
                Go P3
        Loop
Fend
```

8.2 List of Conditions for Using SPEL+ Commands

Command window
Available for use in the command window.
Program
Can be used as a statement in a SPEL+ program
Function
Can be used as a function

Command		Command window		Program	Function
		RC+	TP3 / TP4		
H	Hand_On	✓	✓	✓	✓
	Hand_Off	✓	✓	✓	✓
	Hand_TW	✓	✓	✓	✓
	Hand_Def	✓	✓	✓	✓
	Hand_Type	✓	✓	✓	✓
	Hand_Label$	✓	✓	✓	✓
	Hand_Number	✓	✓	✓	✓

9. Troubleshooting

9.1 FAQ

Frequently asked questions and Response.

9.1.1 Selecting a hand and hand peripheral equipment

Do you have a recommended hand or hand peripheral equipment?

Epson does not recommend specific manufacturers, or specific hand products or hand peripheral equipment.

Can I use an electric servo hand, or a hand capable of precise finger space control?

The Epson RC+ Hand function does not support these hands.
However, these hands can be controlled in combination with I/O control commands, such as the On command and the Off command.
Please inquire with your distributor for more information.

I use a T series robot. Should I use the hand I/O or the standard I/O?

On a T series robot, the hand can be controlled through either the hand I/O or the standard I/O. These share the same electrical specifications for each I/O bit.

I/O port	Output	Input	24V DC output
Hand I/O	4	6	Available*
Standard I/O	12	18	None

*Allowable output current from the hand I/O

- T3: 500 [mA] or less
- T6: 700 [mA] or less

Use an I/O port suitable for your operating environment considering the wiring and piping arrangements necessary, and your power supply capacity.

Is a tool adapter required?

Please prepare an adapter (tool adapter) to attach the hand.
For 6-axis robots, there are tool adapters available to convert the flange face of the manipulator to an ISO flange (option add-on sold separately).
Refer to the following, or inquire with your distributor.
Option

9.1.2 Installing, setup

Where can I configure hand settings?

Configure hand settings in the [Hands] panel.
The [Hands] panel can be accessed from the Epson RC+ menu by selecting the [Tools] - [Robot Manager] - [Hands] tab.

An error message “Error 2612: Incorrect hand settings detected.” appears when clicking the [Apply] button in the Hands screen.

- If a gripper is selected:
  Failing to specify all [Controller I/O Bits] for [Hand_On] and [Hand_Off] on the [Configure Robot Hand *] screen will cause error 2612 to occur.
  If there are unused I/O bits, change the [Type] settings to match the actual number of I/O bits in use.

- If an electric screwdriver is selected:
  Bits other than the Start bit and the Complete bit can also be set to “Unused”.

The [Hand_On] and [Hand_Off] buttons on the [Configure Robot Hand*] screen are grayed out.
Click the[Apply] button to apply settings and make the [Hand_On] and [Hand_Off] buttons available.

The hand does not move even when clicking the [Hand_On] and [Hand_Off] buttons on the [Configure Robot Hand*] screen.
Check the following.

1. Is the wiring correct? When you use a model with valve or sensor which has LED for checking the operation, do the LED light up correctly?
2. Is compressed air being supplied? If a slight click sound is heard from the valve when you clicked the buttons, compressed air may not be supplied correctly even when the valve is functioning.
3. Is I/O outputting how it has been set? You can check the controller I/O state in the [I/O Monitor].

What happens if the wrong weight setting is set?
If a smaller value than the total actual weight of the hand and the workpiece is set:
Excessive force will be applied to the manipulator, which may cause a malfunction.

If a larger value than the total actual weight of the hand and the workpiece is set:
Particularly in the case of 6-axis robots, the wrong gravity correction setting will be applied, which may cause a malfunction.
Please set the weight as accurately as possible.

What happens if the wrong inertia setting is set?
If a smaller value than the actual total moment of inertia of the hand and the workpiece is set:
Excessive force will be applied to the manipulator, which may cause a malfunction.

If a larger value than the actual total moment of inertia of the hand and the workpiece is set:
This will not cause an immediate malfunction. However, this will reduce motion speeds, limiting performance.

9.1.3 Operation

The [Hands] tab does not appear at the bottom of the [Jog & Teach] screen.
Please register a hand.
The [Hands] tab will not appear in the [Jog & Teach] screen if a hand has not been registered.

The hand does not move even when clicking the [Hand_On] and [Hand_Off] buttons on the [Jog & Teach] screen.
Please see the following.
"FAQ" - "Installing, setup" - "The hand does not move even when clicking the [Hand_On] and [Hand_Off] buttons on the [Configure Robot Hand*] screen."

The hand moves in the opposite direction when clicking the [Hand_On] and [Hand_Off] buttons.

1. When using a double solenoid valve, switch the wiring of the two solenoid valves. Alternatively, switch the piping between the valves and the hand.
2. Set the On/Off settings for the input bit set for [Hand_On] or [Hand_Off] in the [Hands] screen in reverse.
   For more information, refer to the following.
   Configure Robot Hand Screen

When selecting a suction hand with two outputs:
Even though the second output for [Hand_Off] is set to “On”, it is “Off” after the Hand_Off command is executed.

When selecting a suction hand with two output points, the second output is assigned to the vacuum break signal.
To prevent the continued blowout of destructing air after a vacuum break, the vacuum break signal is automatically set to turn off if the input from the hand (workpiece detection signal) turns off.
This is functioning as intended and is not a sign of a malfunction.

I want to copy hand settings to a PC, or another controller.

There is no way to export individual hand setting configurations.

What are some basic SPEL program functions?

Turn hand 1 into the grip state (close, vacuum):

```
Hand_On 1
```

Turn hand 1 into the release state (open, vacuum break):

```
Hand_Off 1
```

Check whether hand 1 is in the grip state:

```
If Hand_On (1) = True Then
  ' Process when gripping
Else
  ' Process when not gripping
Endif
```

For more information, refer to the following.
Command Examples

9.2 SPEL+ Error Messages

Refer to the following manual.
"Status Code/Error Code List"

10. Option

10.1 ISO flange compatible tool adapter

There are tool adapters available to convert the flange shape of the SCARA robot and the 6-axis robot to an ISO flange (in compliance with ISO9409-1). Please inquire with your distributor for more information.

Also, refer to the following manuals.

- "Manipulator manuals": These provide a detailed description of various robot-related topics.
- **Robot Flange Dimensions and Tool Adapter**

SCARA robot:

Applicable manipulator	Name	Diameter of ball screw [mm]	ISO flange
LS3, G3, GX4, T3, RS3, RS4	ISO Tool Adapter for SCARA D16	⌀16	Position 2, 4
LS6, G6, T6, GX8	ISO Tool Adapter for SCARA D20	⌀20	Position 2, 4
LS10, LS20, G10, G20	ISO Tool Adapter for SCARA D25	⌀25	Position 4

6-Axis robot:

Applicable manipulator	Name	ISO flange
C4 series	PS compatible plate (tool adapter)	Position 2
C8/C12 series	Tool adapter (ISO flange)	Position 2
VT6 series	Tool adapter (ISO flange)	Position 4
N2 series	Tool adapter (ISO flange)	Position 2
N6 series	Tool adapter (ISO flange)	Position 2

Each dimention and tolerance conforms to -31.5-4-M5 (No. 2) and -50-4M6 (No. 4) of ISO9409-1.
Position 2: PCD ⌀31.5, M5×4
Position 4: PCD ⌀50, M6×4